



Your Environment

PHASE 2: SITE INVESTIGATION REPORT HOLLYTREE FARM, HALL GATE ROAD, SUTTON ST EDMUND, SPALDING, PE12 0LN

For Trundley Design

Your Environment

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1.0 Introduction

YourEnvironment (YE) was instructed by Trundley Design (Quote No: Q4910.1, Dated: August 16th 2018) to conduct a Site Investigation (SI) at a site known as Holly Tree Farm, Hall Gate Road, Sutton St Edmund, Spalding, PE12 0LN.

The purpose of this report is to satisfy a specific planning condition which has been attached to the proposed redevelopment of the site by South Holland District Council, reference H19-0652-17, condition 11.

We are content that as a result of the actual site investigation works and subsequent soil testing undertaken, as outlined within this report, we have comprehensively characterised the ground conditions and consequently the potential for contamination to exist on site. These works and ensuing assessment have been detailed in this report.

The information contained in this report is intended for the use of the named client (or their approved contractors). Should any part of this report be relied on by a third party, that party does so wholly at its own risk and YE disclaims any liability to such parties. Should the purposes for which the report is used, or the proposed use of the site change, this report may no longer be valid and further use of, or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. YE should in all such altered circumstances be commissioned to review and update this report accordingly.

2.0 Proposed Development

We understand current plans for the redevelopment of the site include:

- Conversion of agricultural storage building into dwelling.

The proposed redevelopment plans for the site, at the time of issuing this report can be reviewed within **Appendix A**.

3.0 Site Information

3.1 Geology

The relevant British Geological Survey (BGS) online mapping information indicates that the superficial ground deposits underlying the study site are comprised of Barroway Drove Beds (sand and silt). Underlying the superficial drift deposit is bedrock composed of the Claygate Member (clay, silt and sand).

3.2 Hydrogeology

The Environment Agency designate aquifers in accordance with the Water Framework Directive. These designations reflect not only the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetlands ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

As a result of the superficial geology on site, the aquifer is designated as being Secondary (Undifferentiated). This is defined as layers that cannot be attributed to a category A or B rock type. These layers could have previously been described as a minor or a non-aquifer due to their variable characteristics.

The resulting aquifer of the bedrock geology on site is designated as being Unproductive. This is defined as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

3.3 Site Characteristics

Access

The site was accessible from Hall Gate Road, via large wood gate which would provide vehicular access for both large and small plant machines.

Topography

Both on and off site the ground was relatively flat without buildings, stables, barn etc along with tended gardens.

Vegetation

The site was bordered by vegetation in all aspects, with hedgerows, shrubs and large sized trees along most of the site boundaries. The area to be developed was predominantly non-vegetated with small weeds in areas of undisturbed soft gardens and with some hardstanding.

Buildings and Structures / Floor Covering

There were several structures located on site, the main structures are farm buildings such as stables and outbuildings, built on hardstanding with large tended gardens. Also noted, were overhead services and telegraph/electricity poles on the site. In addition, two above tanks were noted, which were observed for the attenuation of rainwater. The buildings were being utilised as storage at the time of walkover, by way of materials and small plant equipment.

Surface Permeability / Ground Covering

It was estimated that approximately 40% of the site was impermeable concrete, with 60% comprising soft landscaping and topsoil running parallel with the site boundaries.

Drainage Features

Ground drainage features were observed during the walkover. In addition, a pond was noted in the western paddock adjacent to the site. The drainage features observed were noted to be aligned towards the pond. In view of this and geometric shape of the pond it is possible that this represents designed attenuation.

Other Services

The site has access to all services.

Surrounds

The site neighbour's residential property with respective gardens to the north and east. Farmland and fields to the south and west.

4.0 Preliminary Conceptual Site Model

This presented Conceptual Site Model has been re-issued from the earlier Phase 1: Desktop Study & Preliminary Risk Assessment completed, using information regarding the possible **sources** of contamination on site, the **pathway** in which the contamination can migrate and a vulnerable **receptor** to the contamination, all of which need to be present for there to be a risk. Given the proposed end use of the site as being residential the generic land use of 'residential with homegrown produce' has been applied. Consequently, the following Source - Pathway - Receptor relationships have been identified.

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site possibly containing elevated metals, other inorganics such as TPH, PAH, phenols, VOC and SVOCs.	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Low Likelihood	Moderate/ Low	A moderate to low risk is assessed due to the limited potentially contaminative land uses on site, with particular reference to the past agricultural nature of the barn. Contact is likely between future residential occupiers/visitors and contaminants in the shallow soil in garden areas of the site, soil/dust tracked back into the house, from ingestion of home grown produce and from vapour intrusion.
		Construction Workers	Medium	Likely	Moderate	Construction workers are likely to come into direct contact with soils during groundworks. Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from contact with soils and shallow/perched groundwater.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Medium	Low Likelihood	Low/ Moderate	A low to moderate risk is assessed due to the limited potentially contaminative sources on site and the presence of a Secondary (Undifferentiated) Aquifer within the superficial deposits and an Unproductive Aquifer within the bedrock underlying the site. There are no active surface, potable or groundwater abstraction licences within 2000m. In addition, the nearest surface water feature is 1m south, which we consider to be a drain. The study site is not located within a source protection zone.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Likely	Moderate	Hydrocarbons, especially aromatics are known to permeate plastic pipes. Provision of water supply pipes and connectors formed from proprietary "barrier pipe" materials (eg polyethylene-aluminium-polyethylene) may be required by the water supply company.
	Uptake	Plant and Wildlife	Mild	Low Likelihood	Moderate	A moderate risk is assessed as there are indicated areas of soft landscaping on the proposed site plans.
On Site: Asbestos at/near ground surface in	Inhalation of fibres in airborne dust	Future end users and site visitors	High	Low Likelihood	Low	Likelihood is considered to be low as although the site walkover did not identify any potential asbestos containing materials (ACMs), the agricultural history of the site creates potential for asbestos

Made Ground soils.						contamination. Therefore, asbestos should be tested for in the upper Made Ground.
		Construction Workers	High	Low Likelihood	Low	Despite the lack of identified ACMs observed during the walkover, safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from asbestos in soils.
On Site: Ground Gases (CH ₄ , CO ₂) from on site Made Ground.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	A low risk is given due to the lack of landfill and infilled land within proximity to the barn. We consider the pond to still be present on site. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation, and a limited thickness is present.
Off Site: Historical land uses and activities, Made Ground/infilled material possibly containing elevated metals, other inorganics, TPH, PAH, PCBs, phenols, VOC and SVOCs.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Mild	Low Likelihood	Low	Given the variable permeability of the underlying geology and hydrogeology, there is a moderate risk for the leaching of contaminants. However, due to the lack of potentially contaminative land uses within proximity to the site, we consider the risk to be low.
	Inhalation of vapours	Future end users and site visitors	Medium	Low Likelihood	Low	A low level of risk is assessed due to the limited potentially contaminative land uses/activities within proximity to the site that could pose a potential risk to the site.
Off Site: Ground Gases (CH ₄ , CO ₂ , H ₂ S) from off site Made Ground historical land uses/activities.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	The lack of potentially contaminative land uses/activities and infilled land proximal to the site create a low potential for ground gas generation. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation.

Table 1: Preliminary Conceptual Site Model

5.0 Fieldworks

5.1 Site Investigation

All SI works were completed on August 29th 2018 under the supervision of a Geo-Environmental Engineer from YE. In summary the investigation included:

- Two (2no.) hand excavated trial pits (TP01-TP02) were completed to a maximum depth of 1.00 metre below ground level (mbgl).
- The trial pits were logged with any groundwater conditions noted and representative soil samples removed in accordance with current guidelines.
- Soil samples were removed from shallow sub surface locations of 0.15, 0.30, 0.70 and 1.00mbgl. Samples were subsequently placed in suitable containers including 1kg tubs and 250ml glass jars and placed in cool boxes with cool packs prior to storage within our *in-house* laboratory fridges and then subsequent forwarding to our designated laboratory for analysis.
- The trial pits were backfilled after excavation.

The positions of exploratory holes in relation to the existing site layout can be reviewed within **Appendix B**, with exploratory trial pit logs located in **Appendix C**.

6.0 Geology & Ground Conditions

The following ground conditions were encountered during the SI;

Top Soil - Encountered in TP01 to depth of 0.30mbgl and comprised of a brown slightly clayey, slightly gravelly SILT. Gravel is occasional and mixed lithology is fine. Rootlets noted.

Made Ground - Encountered in TP01 to depth of 0.70mbgl and generally comprised of a greyish brown, sandy, gravelly SILT. Gravel is occasional, brick is fine to medium, and of mixed lithology. Rootlets noted.

Barroway Drove Beds - Natural soils that we assume to belong to the underlying Barroway Drove Beds were identified within TP01 and TP02 and was a brown slightly gravelly CLAY/SILT with occasional gravels and fine of mixed lithology or a brown very silty CLAY. Rootlets noted.

7.0 Groundwater Conditions

Groundwater was not encountered in any of the trial pits during investigative works undertaken.

It should be noted that groundwater levels are dependent upon seasonal variations and can change after periods of prolonged rainfall or drought.

8.0 Visual and Olfactory Observations

With the exception of general anthropogenic material identified, no visual and/or olfactory evidence of potential contamination was noted within any soils encountered during the drilling of exploratory holes.

9.0 Contamination

9.1 Soil Testing

A total of four (4no.) samples have been analysed by The Environmental Laboratory Limited in a UKAS and MCERTS accredited laboratory-testing facility in accordance with laboratory protocol.

The testing completed comprised of a focused suite comprised of heavy metals, speciated Total Petroleum Hydrocarbons (TPH CWG Aromatic/aliphatic split) and speciated Polycyclic Aromatic Hydrocarbons (PAH) including the more carcinogenic benzo(a)pyrene (BaP) and naphthalene, phenols, cyanide, BTEX & MTBE, sVOCs & VOCs, OPPs & OCPS, soil organic matter (SOM) content, pH and sulphates.

Samples taken from the Made Ground were additionally screened for asbestos.

The results of this laboratory testing have been compared to the Soil Guideline Values (SGVs) as well as the CIEH 'LQM' guideline values for inorganic and organic contaminants in soils. The proposed development of the site is intended to comprise of residential and therefore screening has been made against a land use of 'residential with homegrown produce'.

9.2 Selection of Screening Criteria

The on site receptors for the study site are considered to be:

- Construction workers (during redevelopment of the site only);
- Future maintenance workers (following redevelopment);
- Future end users and site visitors (following redevelopment); and
- Trespassers (during redevelopment).

The off-site receptors for the site are considered to be:

- Residents/visitors to the nearby residential dwellings and workers/visitors to the nearby commercial buildings in the immediate vicinity of the site.

Risks to construction workers during the redevelopment process will be mitigated by adhering to appropriate health and safety legislation, and the wearing of appropriate personal protective equipment (PPE). During redevelopment, the site will be securely fenced to prevent trespassers from accessing the site, and good site management practices will be implemented to mitigate exposure to off site receptors.

The potential pathways for contaminants within the soil to human health receptors following redevelopment are considered to be:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;

- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside.

The potential pathways for contaminants within the soil to off-site human health receptors following redevelopment are considered to be:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;
- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside if contamination within soil is able to migrate across the site boundary within.

In the first instance, the results of this laboratory testing have been compared to generic assessment criteria (GAC) for the residential with homegrown produce land use scenario. These incorporate the following pathways:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;
- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside.

Given that these incorporate a number of pathways that will not be relevant to the site following redevelopment, this is a highly conservative approach and exceedances will be discussed in this light.

Contaminants have been screened against revised LQM/CIEH S4UL criteria¹ where available. These GAC have been designed for use under planning, using Health Criteria Values based on minimal risk, and updated exposure parameters. The S4UL are intended to replace the previous LQM/CIEH GAC. The S4UL are based on the assumption of a sandy loam soil the 1% soil organic matter (SOM) criteria have been used, where available and appropriate, in the first instance. All soil samples were analysed for %SOM, the range was from 1.3-8%, and so this conservative approach is considered appropriate for initial screening.

Where no S4UL are available, the EIC/ AGS/ CL:AIRE/ GAC² have been used. The toxicological criteria within these are also based on minimal risk. It is recognised that these criteria have not recently been updated, and in particular, do not incorporate the slightly higher inhalation rates that have been used within the S4UL. However, given that they incorporate additional pathways, they are considered suitable for an initial screen. The EIC/ AGS/ CL:AIRE/ GAC are also based on a sandy loam soil and the 1% SOM criteria have been used in the first instance.

There is neither an S4UL nor a EIC/ AGS/ CL:AIRE/ GAC available for lead. In the absence of a GAC based on minimal risk, the C4SL for lead has been used. It is recognised that this is based on a “low level of toxicological concern” rather than on a minimal risk level. However, it is considered appropriate for use under planning, especially for a site where there will effectively be no pathways for inorganic metals following redevelopment.

All the GAC are based on a sandy loam soil. This is considered appropriate for use for initial screening. Although it is apparent from the laboratory soil descriptions, that the Made

¹ Nathanail et al. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, 2015. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3495

² CL:AIRE (2010) The EIC/AGS/CL:AIRE Generic Assessment Criteria for Human Health Risk Assessment

Ground, by its very nature is heterogeneous, and often has a significant sand/gravel component, especially at shallow depths, it is noted that many of the soil descriptions have a significant clay component at increasing depth.

All of the GAC assume unsaturated soils. However, the use of the GAC are considered to be conservative, because they assume a certain air-filled porosity and water-filled porosity.

The GAC also assume that no free phase product is present, and are not intended for use in this instance. No free product was observed within soils during the site investigation.

9.3 Soil Testing Results & Screening

All metals, PAHs, and TPH CWG analytes are presented in the following tables, concentrations shown are in mg/kg. Other potential contaminants of concern are only shown where there is at least one result exceeding the limit of detection. All of the soil contamination laboratory analytical results are presented within **Appendix D**.

Metals and Metalloids

Determinant	Min	Max	GAC	Number of exceedances
Arsenic	9	14	37*	0
Cadmium	<0.5	0.5	11*	0
Chromium (III)	21	30	910*	0
Chromium (VI)	<0.8	0.8	6*	0
Copper	14	38	2400*	0
Lead	17	173	200*	0
Mercury	<0.5	<0.5	40* ^a	0
Nickel	17	24	180* ^b	0
Selenium	<1	<1	250*	0
Zinc	78	250	3700*	0
Total Phenols	<6	<6	420*	0
Total Cyanide	<1	<1	140*	0

Table 2: Metalloids Soil Exceedances (all concentrations in mg/kg)

*LQM/CIEH GAC for Residential with Homegrown Produce land use scenario based on a sandy loam soil and 1% SOM.

- a) Based on the inorganic mercury GAC as the conceptual site model does not suggest that other forms of mercury are likely to be present on site.
- b) LQM issued an update to the nickel S4ULs in August 2015 and this has been taken into account.

➤ There were no exceedances for the metalloids screened.

Organics

Determinant	Min	Max	GAC	Number of exceedances
Naphthalene	<0.1	<0.1	2.3*	0
Acenaphthylene	<0.1	0.2	170*	0
Acenaphthene	<0.1	<0.1	210*	0
Fluorene	<0.1	<0.1	170*	0
Phenanthrene	<0.1	0.6	95*	0
Anthracene	<0.1	0.1	2400*	0
Fluoranthene	<0.1	1.8	280*	0
Pyrene	<0.1	1.7	620*	0
Benzo(a)anthracene	<0.1	1.2	7.2*	0
Chrysene	<0.1	1.1	15*	0
Benzo(b)fluoranthene	<0.1	1.2	2.6*	0
Benzo(k)fluoranthene	<0.1	1.6	77*	0
Benzo(a)pyrene	<0.1	1	2.2*	0
Indeno(1,2,3-cd)pyrene	<0.1	1	27*	0
Dibenzo(a,h)anthracene	<0.1	0.2	0.24*	0
Benzo(g,h,i)perylene	<0.1	1	320*	0

Table 3: PAH Soil Exceedances (all concentrations in mg/kg)

- There were no exceedances noted from the screening undertaken on PAH congeners.

Determinant	Min	Max	GAC	Number of exceedances
Aliphatic >C5 - C6	< 0.01	< 0.01	42*	0
Aliphatic >C6 - C8	< 0.01	< 0.01	100*	0
Aliphatic >C8 - C10	< 1	< 1	27*	0
Aliphatic >C10 - C12	< 1	< 1	130*	0
Aliphatic >C12 - C16	< 1	< 1	1100*	0
Aliphatic >C16 - C21	< 1	< 1	65000*	0
Aliphatic >C21 - C34	< 1	1.8	65000*	0
Aromatic >C5 - C7	< 0.01	< 0.01	70*	0
Aromatic >C8 - C10	< 1	< 1	34*	0
Aromatic >C10 - C12	< 1	< 1	74*	0
Aromatic >C12 - C16	< 1	< 1	140*	0
Aromatic >C16 - C21	< 1	11.7	260*	0
Aromatic >C21 - C35	1	39.7	1100*	0
Aromatic >C35 - C40	< 1	1.7	1100*	0

Table 4: TPH CWG Aliphatic/Aromatic Soil Exceedances (all concentrations in mg/kg)

* LQM/CIEH GAC Residential with Homegrown Produce land use scenario based on a sandy loam soil and 1% SOM. It is noted that the LQM/CIEH S4UL guidance recommends an additive approach for the TPH fraction, so that a hazard index approach is used. Based on a preliminary conservative comparison of maximum concentrations to S4ULs, no forward modelling is necessary to prove that this would still result in no exceedances at the site.

➤ There were no exceedances for TPH CWG congeners within the samples tested.

Determinant	Min	Max	GAC	Number of exceedances
Benzene	< 10	< 10	87*	0
Toluene	< 10	< 10	130000*	0
Ethylbenzene	< 10	< 10	47000*	0
p & m-xylene	< 10	< 10	56000*	0
o-xylene	< 10	< 10	60000*	0
MTBE	< 10	< 10		0

Table 5: BTEX and MTBE Soil Exceedances (all concentrations in ug/kg)

Determinant	Min	Max	GAC	Number of exceedances
Aldrin	170	170	5700*	0
Dieldrin	470	470	970*	0
p, p-DDE	100	100	-	0
p, p-DDD	38	38	-	0
p, p-DDT	140	140	-	0
Sum of DDT congeners	278	278	-	0

Table 6: Organo Chlorine Pesticide Soil Exceedances (All concentrations in ug/kg)

*LQM/CIEH GAC for Residential with Homegrown Produce land use scenario based on a sandy loam soil and 1% SOM.

➤ There were no exceedances for the OCPs Aldrin and Dieldrin, for which LQM/CIEH GACs are available. No UK GACs are available for the DDT congeners p, p-DDE, p,p-DDD and p,p-DDT, however the concentrations recorded are not considered to be significant (for example, New Zealand has a Residential with Homegrown Produce GAC for sum of DDT congeners, derived using broadly similar exposure pathways and risk assumptions to those used in the UK, of 45,000 ug/kg, compared with 278 ug/kg recorded in the sample analysed).

No detectable concentrations of Organo Phosphorous Pesticides were recorded.

Detectable trace concentrations of a number of SVOC compounds were recorded, up to a maximum of 0.20 mg/kg for aniline. These may be breakdown products of the OCPs recorded however they are not considered to be significant.

No asbestos was detected in any of the samples tested.

The soil contamination laboratory certificates can be reviewed within **Appendix D**.

10.0 Site Investigation Findings

10.1 Risks to Human Health

With the exception of the limited depth of Made Ground identified, no other visual and/or olfactory evidence of potential contamination was noted within any soils encountered during the SI works undertaken.

All the samples returned concentrations below the available SGVs and LQM guidance values for each determinant which were adopted as Generic Assessment Criteria (GAC) within YE's risk assessment for the site.

A review of the borehole logs indicate that natural soils are present across the site below approximately GL - 0.70mbgl, it would therefore be reasonable to conclude that any forms of contamination would cease at these depths.

We consider the contamination to these areas to be relatively minimal judging by the lack of exceedances identified in the laboratory results of the soil samples tested from the trial pits.

10.2 Risks to Plants and Wildlife

A low risk has been attributed given the concentrations of phytotoxic contaminants below elevated concentrations often below the limit of detection returned and the lack of soft landscaping areas within the proposed redevelopment plans.

10.3 Risks to Site Workers

Basic, general good precautions should be taken to minimise exposure of site workers during ground works through the implementation of site safety procedures and the use of suitable personal protective equipment (PPE). Such precautions should include, but not be limited to:

- Personal hygiene, washing and changing procedures;
- Availability of site welfare;
- Provision of PPE appropriate to the task; and
- Safety briefings and tool box talks.

All site works will be undertaken in accordance with the guidelines prepared by the Health and Safety Executive (1991) and all work will be carried out in accordance with the Principal Contractor's Health and Safety Plan.

11.0 Updated Conceptual Site Model and Risk Assessment

The Conceptual Site Model has been re-formulated based upon the results from the SI in accordance with BS10175:2015. It aims to provide information regarding the sources of contamination and the pathways in which contamination can migrate to a vulnerable receptor, all of which need to be present for there to be a risk. This is in relation to the proposed end use being classified as 'Residential with Homegrown Produce'. The assessment of the off site sources has been formulated based on information available from Groundsure and DEFRA databases. The following linkages have been identified:

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site possibly containing elevated metals, other inorganics such as TPH, PAH, phenols, VOC and SVOCs.	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Low Likelihood	Low	Contact is likely between future residential occupiers/visitors and contaminants in the shallow soil in garden areas of the site, soil/dust tracked back into the house, from ingestion of home grown produce and from vapour intrusion. However a low risk is assessed due to the returned laboratory results that show there to be no exceeded contaminants.
		Construction Workers	Medium	Low Likelihood	Low	Construction workers are likely to come into direct contact with soils during groundworks. Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from contact with soils and shallow/perched groundwater.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Medium	Low Likelihood	Low	A low risk is assessed due to the returned soil laboratory results that show the soils to not have elevated levels of contaminants. Furthermore, as the site has a low water table, the risk to controlled waters from Made Ground above is low.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Low Likelihood	Low	Hydrocarbons, especially aromatics are known to permeate plastic pipes. Provision of water supply pipes and connectors formed from proprietary "barrier pipe" materials (eg polyethylene-aluminium-polyethylene) may be required by the water supply company, however this is unlikely given the low concentrations of hydrocarbons recorded.
	Uptake	Plant and Wildlife	Mild	Low Likelihood	Low	A low risk is assessed due to the returned laboratory results that show no elevated levels of phytotoxic contaminants.
On Site: Asbestos at/near ground surface in	Inhalation of fibres in airborne dust	Future end users and site visitors	High	Low Likelihood	Low	The results of screening indicate that no asbestos was present in the soils sampled suggesting an absence across the site. However, it cannot be guaranteed that asbestos is not present within the soils across the remainder of the site. Consequently, a watching brief should be adopted

Made Ground soils.						with regards to the site for the potential of finding any Asbestos Containing Materials (ACMs).
		Construction Workers	High	Low Likelihood	Low	Asbestos fibres have not been identified in the samples returned from laboratory analysis. However, safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from asbestos in soils.
On Site: Ground Gases (CH ₄ , CO ₂) from on site Made Ground.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	A low risk is given due to the lack of landfill and infilled land within proximity to the barn. We consider the pond to still be present on site. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation and the made ground is if very limited thickness.
Off Site: Historical land uses and activities, Made Ground/infilled material possibly containing elevated metals, other inorganics, TPH, PAH, PCBs, phenols, VOC and SVOCs.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Mild	Low Likelihood	Low	Given the variable permeability of the underlying geology and hydrogeology, there is a moderate risk for the leaching of contaminants. However, due to the lack of potentially contaminative land uses within proximity to the site, we consider the risk to be low.
	Inhalation of vapours	Future end users and site visitors	Medium	Low Likelihood	Low	A low level of risk is assessed due to the limited potentially contaminative land uses/activities within proximity to the site that could pose a potential risk to the site.
Off Site: Ground Gases (CH ₄ , CO ₂ , H ₂ S) from off site Made Ground historical land uses/activities.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	The lack of potentially contaminative land uses/activities and infilled land proximal to the site create a low potential for ground gas generation. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation.

Table 6: Updated Conceptual Site Model and Risk Assessment

12.0 Recommendations

The following recommendations are based on the results of chemical laboratory testing to date.

The following recommendations made do not constitute a formal remediation strategy and/or validation report. A remediation strategy should be agreed with the relevant local authority prior to such works commencing and/or the production of a validation report, if required as a result of imposition of planning conditions.

12.1 Watching Brief and Discovery Strategy

A watching brief should be maintained by the Main Contractor at all times during the groundworks stage. Should any unforeseen contamination, such as oils or soils/groundwater with an unusual colour or odour, be encountered during groundworks then the following procedure should be implemented:

- Work to cease in that area to prevent exposure to ground workers and potential contaminants being spread around;
- Notify a Geo-Environmental Consultant, to attend site and sample material;
- Notify the Environmental Health Department / Contaminated Land Officer(s) of South Holland District Council.

If the nature and extent of the contamination is unmanageable under the procedure set out above, then a suitable management, mitigation or remediation procedure will be agreed with the CLO. However, this is considered unlikely at this particular site.

12.2 Services

If new services will be installed as part of the redevelopment of the site we would recommend the local water company be contacted to determine their specification for the type of pipework which should be used on this site.

All services and in particular potable water supply pipework should comprise material of a specification acceptable to the responsible utility company.

Further information can be found within the published guidance for the '*Selection of Water Supply Pipes to be used in Brownfield Sites*', issued in January 2011 by the UK Water Industry Research (UKWIR), this supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note - '*Laying Pipes in Contaminated Land*' which has been withdrawn.

12.3 Surface Water

It should be noted that the Environment Agency does not recommend that soakaways be placed within Made Ground, potentially contaminative land or in ground previously identified as contaminated.

12.4 Management of Asbestos in Soil

Asbestos screening/identification analysis was completed on soil samples taken as part of the SI's completed, and no traces of asbestos was identified.

A watching brief should be maintained in accordance with the recommendations in Section 12.1. If additional areas of cemented asbestos are encountered, they can be managed in accordance with the above procedure. If further asbestos fibres are suspected, or friable Asbestos Containing Materials are encountered then works should stop, the area should be damped down and a specialist Asbestos Consultant contacted.

13.0 Limitations

This report has been prepared by YE with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources, together with a site walkover inspection of the site.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site. This report is an environmental stage 1 report and does not consider the geotechnical implications for the site, its redevelopment and proposed future use. Further advice should be sought on geotechnical investigation requirements for the proposed development.

The 'vicinity' of the site for the purposes of the report, is defined as locations situated within an approximate 250m radius of the site, although certain source of contamination and/or sensitive targets further than 250m of site have also been included.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not guarantee that the sites are free of hazardous, or potentially hazardous materials, or conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.