

SITE INVESTIGATION, LAND QUALITY RISK ASSESSMENT & OUTLINE GEOTECHNICAL ASSESSMENT

**Proposed Development
Of a Care Home
Yapton Road, Middleton-on-Sea**

Prepared for: Frontier Estates Ltd

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SLR



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1.0 INTRODUCTION

1.1 Background

In February 2019, SLR Consulting Limited (SLR) was appointed by Frontier Estates Limited (the Client) to provide consultancy services to support a planning application for the construction of a care home with associated car parking and soft landscaping at the Former Yapton Road Poultry Farm, Yapton Road, Middleton-on-Sea, West Sussex, PO22 6DY (the site).

A site location plan is provided in **Drawing 1**, while the current layout is illustrated in **Drawing 2**.

Building upon SLR's Preliminary Land Quality Risk Assessment (PLQRA) dated May 2019, SLR has carried out a ground investigation and this report provides the factual results alongside an assessment of the land quality risks and consideration of the ground conditions in the form of an outline geotechnical assessment.

The report has been completed by SLR Consulting's Land Quality and Remediation team based at Treewood House, Rowden Lane, Bradford on Avon, Wiltshire, BA15 2AU (Tel: 01225 309400).

1.2 Proposed Development

A planning application will be made for Frontier Estates Limited and will seek to demolish the existing buildings and redevelop the site into a care home, which will comprise:

- ◆ en-suite bedrooms, along with internal communal and operational areas;
- ◆ Car parking and cycle storage, and
- ◆ Managed landscaped gardens.

Indicative site layout plans are provided in **Appendix 01**.

1.3 Objectives

SLR's PLQRA report presented basic site information and detailed desk study information. The information therein was used to develop a preliminary conceptual model of potential risks to human and environmental receptors. The conceptual model examined the potential for contaminant-pathway-receptor linkages. The risks associated with the potential linkages were discussed and SLR recommended an intrusive investigation to provide the scheme's environmental consultant and (foundation) designers with information regarding the chemistry of the Made Ground and outline geotechnical properties.

This report presents the findings of the voluntary ground investigation. The information obtained has been used to further develop the conceptual model, and to provide information about foundation options. The risks associated with the potential linkages are discussed as is the need for further assessment.

Overall, this "precautionary" approach is designed to give confidence to future residents, those lending to Frontier and the local authority that the development site, in the words of the National Planning Policy Framework 2019, is:

...suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation.

It is also our objective to show that Frontier's redevelopment will leave the site / land in a condition where it is not capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

The secondary objective of this LQRA is to establish if there is any evidence of significant subsurface contamination from past or present activities on or adjacent to the site which could give rise to abnormal development costs i.e. expenditure on remedial works to deal with unacceptable risks to the environment or proposed residents, employees, visitors and contractors.

1.4 Scope of Work

As part of the evaluation of the site and in accordance with current best practice, SLR's PLQRA used the information collected from the desk-based research and site walkover:

- ✦ to identify the likely contaminant sources, receptors and pathways present at the site;
- ✦ to develop a conceptual model; and
- ✦ to identify potential pollutant linkages which required inspection.

When considering the potential pollutant linkages (PPL), their significance and acceptability, SLR was aware that:

- ✦ The site was open land until the 1960s, when it was redeveloped into a poultry farm. Various stages of construction and demolition of barns has occurred;
- ✦ Stockpiles of mixed soil and construction demolition rubble have been identified in the north of the site. Fragments of fibre cement sheet have been identified which might contain asbestos. This assessment assumes **these will be removed from site** prior to the commencement of groundworks.
- ✦ The site is underlain by River Terrace Deposits (sand and gravel) which are further underlain by the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formations.
- ✦ The site is reported to be in an area which does not require radon protection measures;
- ✦ The River Terrace Deposits are designated as secondary (A) aquifer. Groundwater is anticipated to be present at c.2-3m depth;
- ✦ The Chalk Aquifer is designated as a principal aquifer;
- ✦ The site is not in the vicinity of a groundwater Source Protection Zone;
- ✦ The site is not listed as being within a Zone 2/3 flood plain;
- ✦ there is a negligible too low to very low risk from ground stability hazards on site, including from ground dissolution features;
- ✦ On-site potentially contaminative land uses are limited **to the demolition of buildings** (possibly containing ACM) associated with the poultry farm;
- ✦ A **leaking sewer** has been revealed on-site which may be discharging to groundwater;
- ✦ A vehicle repair garage has been identified off-site that could pose a potential source of contamination.

Given the proposed use as a care home with managed gardens the most likely / significant PPL appear to be:

- ❖ **PPL 1a:** Potential harm to human health from exposure to contaminants entering water supply pipework
- ❖ **PPL 1b:** Potential harm to human health from exposure to contaminants in Made Ground
- ❖ **PPL 1c:** Potential damage to future buildings from exposure to aggressive ground and differential settlement
- ❖ **PPL 1d:** Potential pollution of Controlled Waters (groundwater) by contaminants in Made Ground
- ❖ **PPL 2&b:** Potential pollution of Controlled Waters (groundwater & surface water) by contaminants from leaking sewer
- ❖ **PPL 3a:** Potential harm to human health from inhalation of vapours from possible off-site contamination.
- ❖ **PPL 3b:** Potential pollution of Controlled Waters (groundwater) by contaminants migrating from an off-site source.
- ❖ **PPL 4a-c:** Potential Harm to Human and Plant Health from Potential Contaminants in Imported / Site-Won Landscaping Soils
- ❖ **PPL 5:** Potential Risks to Health or the Environment from Unidentified Sources.

Table 1-1
 PPL Requiring Further Investigation & Action Taken

Source / Area of Concern	PPL	Description of PPL	SLR's PLQRA Recommendation	Action Taken
Source 1 – Made Ground associated with the demolition of multiple on-site structures such as poultry sheds and barns.	PPL 1a	<i>Potential harm to human health from exposure to contaminants entering water supply pipework</i>	Shallow intrusive investigation along proposed water supply route or precautionary installation of barrier supply pipe.	At the time of investigation, the proposed route of the water supply pipework was not known. As such, Source 1 relevant to water pipes has not been investigated. Once the route of the pipe is known the developer will only commit to testing if Made Ground or organic contamination is suspected along the proposed route.
	PPL 1b	<i>Potential harm to human health from exposure to contaminants in Made Ground.</i>	Shallow intrusive investigation and screening to take account of the chemistry of soils within areas of possible soft landscaping and beneath the building footprint.	Source 1 relevant to potential harm for human health has been investigated by visual / olfactory observation within the trial pits and boreholes, along with chemical analysis of soil samples. The results have been subject to a Generic Quantitative Risk Assessment (GQRA) – see Section 7.2.
	PPL 1c	<i>Potential damage to future buildings from exposure to aggressive ground</i>	Intrusive investigation to provide information regarding aggressive ground conditions.	Source 1 relevant to foundations has been investigated by trial pits and boreholes located close to and within the footprint of the proposed building. Soil samples have been tested for aggressive compounds – see Section 7.3

Source / Area of Concern	PPL	Description of PPL	SLR's PLORA Recommendation	Action Taken
	PPL 1d	<i>Potential pollution of Controlled Waters (groundwater) by contaminants in Made Ground.</i>	Intrusive investigation and environmental screening of soil samples to take account of soil chemistry, and collection of groundwater samples to assess groundwater chemistry.	Source 1 relevant to risk to Controlled Waters has been investigated by the collection of groundwater samples, along with chemical analysis and Generic Quantitative Risk Assessment (GQRA) – See Section 7.4 .
Source 2 – Possible leaking sewer <i>Note: Anecdotal information indicates that the sewer crossing the south of the site may be leaking.</i>	PPL2a	<i>Potential pollution of Controlled Waters (groundwater) by contaminants from leaking sewer.</i>	Collection of groundwater sample from historic well located adjacent to possible location of leaking sewer, as well as collection of additional groundwater samples to assess groundwater chemistry.	Source 2 has been investigated by the collection of groundwater samples and analysis for ammoniacal nitrogen and Generic Quantitative Risk Assessment (GQRA) – see Section 7.5 .
	PPL 2b	<i>Potential Pollution of Controlled Waters (surface water) by contaminants from leaking sewer.</i>		
Source 3 – Off-site vehicle repair garage to the east. <i>Note: No spills or pollution incidents have been recorded from the adjacent properties</i>	PPL 3a	<i>Potential harm to human health from inhalation vapours from a possible off-site source</i>	Intrusive investigation comprising the monitoring of groundwater and retrieval of groundwater samples to assess groundwater chemistry. Analysis to include petroleum hydrocarbons.	Source 3 has been investigated by the investigation of soil samples, collection of groundwater samples and analysis for evidence of petroleum hydrocarbons migrating onto site – see Section 7.6 .
	PPL 3b	<i>Potential pollution of Controlled Waters (groundwater) by contaminants migrating from off-site source</i>		
Source 4 – Contaminants within (yet to be) imported / site-won soils to be used in landscaped areas (subsoil & topsoil).	PPL 4a-c	<i>Potential Harm to Human and Plant Health from Potential Contaminants in Imported / Site-Won Landscaping Soils</i>	Site-won / imported topsoil is to be tested for compliance with BS 3882:2015, and compost tested against BSI PAS100.	-

Source / Area of Concern	PPL	Description of PPL	SLR's PLORA Recommendation	Action Taken
<i>Note: It is possible that site-won soil will need to be supplemented with imported material in order to create the areas of soft landscaping planned.</i>				
Source 5 - Unidentified Contaminant Sources <i>Although unlikely, the possibility of unidentified contaminant sources should be anticipated.</i>	PPL 5	<i>Potential Risks to Health or the Environment from Unidentified Sources</i>	Shallow intrusive investigation and screening to take account of the chemistry of soils.	Source 5 has been investigated by the collecting soil samples around site, followed by a generic quantitative risk assessment. No unexpected contaminants identified to date.

1.4.1 Scope of Field Work

The fieldworks are detailed in **Section 2**, but briefly the tasks undertaken by SLR, after consideration of the findings of PLQRA, comprised;

- ✧ health and safety planning and project management;
- ✧ procuring utility plans;
- ✧ clearance of all excavation locations with reference to underground service plans and use of a Cable Avoidance Tool (CAT);
- ✧ Excavation of nine trial pits excavated to between 3.10 and 3.20 meters below ground level (m BGL) (TP01-TP09);
- ✧ Drilling of four boreholes progressed to between 5.00 and 5.20m BGL using dynamic sampling techniques (WS01-WS04), including the installation of groundwater monitoring wells;
- ✧ Field screening tests and collection of soil samples and logging of soil arisings from all locations to BS5930¹;
- ✧ geotechnical and environmental laboratory analysis of soil samples.

¹ British Standards Institution (2015). BS5930 BSI Standards Publication Code of Practice for Ground Investigations

2.0 Record of Site Activities

2.1 Utility Clearance

Utility plans were obtained in advance of the fieldwork. A site-specific utilities clearance was undertaken at all proposed locations by a specialist utilities clearance company (Service Location Ltd.). This included tracing of services using a cable avoidance tool (CAT) & Genny, and a ground penetrating radar (GPR) survey.

Each location was also cleared by SLR's on site engineer using a CAT and Genny. The location of underground and above ground utilities, in combination with visible obstructions shaped the final locations of SLRs exploratory hole locations.

2.2 Exploratory Holes

The nine trial pits (TP01 –TP09) were excavated using a JCB 3CX Eco on the 29th & 30th May 2019 to a maximum depth of 3.20mbgl. “

The four boreholes (WS01-WS04) we progressed via dynamic sampling techniques, utilising a Premier PP1110 tracked dynamic sampling rig on 1st May 2019. Boreholes were progressed to a maximum depth of 5.20m BGL. A hand pit was excavated to 1.20m BGL at each borehole location to ensure clearance from buried utilities.

Exploratory hole locations are shown in relation to the existing site layout on **Drawing 3**. Exploratory hole locations were selected to enable an assessment of the soil chemistry to give overall site coverage and assess ground conditions in the vicinity of demolished / current agricultural buildings (Source 1). WS02 & WS04 were also progressed in the eastern part of the site to allow an assessment to be made on whether contaminants may have migrated onto site from the adjacent off-site vehicle repair garage.

Soil samples were collected during the excavation for environmental testing and small and bulk disturbed samples were obtained for initial geotechnical testing and assessment. Field screening of all samples for hydrocarbon vapours using a MiniRAE Lite Photo Ionisation Detector (PID) calibrated with isobutylene.

In order to assess groundwater conditions at the site, monitoring standpipes were installed in each of the four boreholes. Each borehole was constructed with a 50mm diameter slotted well screen from 0.50m BGL to the base (response zone), with the screen being surrounded with gravel filter pack. The wells were completed with 50mm plain well casing, sealed with bentonite clay. The remainder of the annulus was backfilled and completed with flush sealed covers, secured in concrete. The plain well casing and bentonite seal prevents surface water run-off or near surface water, contamination or air from the atmosphere from directly entering the response zone of the standpipe. The standpipes were constructed of HDPE (high density polyethylene) and finished with plastic end caps.

The response zones for the wells are screened into the River Terrace Deposits, spanning the water table and area of groundwater fluctuation, to enable the wells to be monitored for the presence of floating non-aqueous phase liquid (NAPL).

Ground conditions at all exploratory hole locations were logged to EN ISO 14688 (BS5930+A2) by SLR. The trial pit and borehole locations are presented in **Appendix 02**.

2.3 Laboratory Analysis - Environmental

All soil samples were stored in cool boxes and transported by courier under chain of custody to Jones Environmental Laboratories.

2.3.1 Soil Samples

Fourteen selected shallow soil samples were analysed for pH, metals, polycyclic aromatic hydrocarbons (PAH) and asbestos screening. Following initial screening, asbestos was identified within seven, so quantification via a combination of detailed gravimetric analysis and Phase Contrast Optical Microscopy (PCOM).

In addition to the above analysis, seven samples were tested for total petroleum hydrocarbons by criteria working group (TPH CWG).

The results are discussed in **Section 7.2 and 7.6**. Copies of the test certificates are contained in **Appendix 03** and collated within a generic quantitative risk assessment in **Appendix 04**.

2.3.2 Groundwater Samples

Four groundwater samples were retrieved from WS01, WS02, WS03 and MW01 using low flow techniques.

Samples were analysed for dissolved metals, TPH CWG including BTEX, nitrate and ammoniacal nitrogen. Two samples were also scheduled for PAHs.

The results are discussed in **Section 7.4**. Copies of the test certificates are contained in **Appendix 03** and collated within a generic quantitative risk assessment in **Appendix 05**.

2.4 Laboratory Analysis - Geotechnical

Disturbed samples recovered from the boreholes were submitted to Geolabs Limited for analysis. The laboratory analysis included:

- ✦ water content;
- ✦ Atterberg Limits 4-point liquid and plastic limit;
- ✦ particle size distribution (PSD) by wet sieve and pipette sedimentation method;
- ✦ pH; and
- ✦ water soluble sulphate content by 2:1 aqueous extract.

At the time of this report the geotechnical testing was not complete. Following completion of the test results an updated report including an interpretation of the results and outline geotechnical assessment will be issued.

3.0 Record of Physical Conditions

3.1 Geology

Ground conditions were proven during the site investigation as comprising topsoil underlain by a variably clayey sandy gravelly silt of the River Terrace Deposits. Thin localised layers of Made Ground were noted across the site, likely to be present as a result of construction and demolition of agricultural buildings.

Reference should be made to the excavation records, **Appendix 02**. For full details of the strata encountered by this investigation, but in summary the encountered geological horizons are described below:

Topsoil: Topsoil was encountered between 0.0-0.25mbgl and comprised a sandy gravelly silt with roots and rootlets. This stratum was encountered in all exploratory holes with the exception of TP8.

Made Ground: Made Ground was encountered between 0.15-0.45m BGL within TP6, TP7, TP8 & TP9. Made Ground does not appear to be constrained to one particular area of the site and is likely to be localised to areas where construction/demolition of agricultural buildings has occurred. Made Ground encountered comprised silty slightly gravelly sand with anthropogenic inclusions including brick and charcoal. Made Ground within TP9 identified a pocket of material found to contain multiple fragments of fibre cement sheet (found to contain asbestos). Further information provided in **Section 7.2** of this report.

Superficial Geology - River Terrace Deposits: River Terrace Deposits were found in all exploratory holes from 0.15 - >5.20m BGL. The superficial deposits primarily comprised variably clayey sandy gravelly silt. Bands of variably silty sand were encountered within all locations within the exception of TP01, TP02 and TP09.

Solid Geology – Chalk: The Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated) was encountered within all boreholes, and within TP08 and TPO9 in the south of the site. The chalk was found to be deeper within the north of the site; recorded at 4.10m BGL within WS01, rising to 2.80m BGL within WS03.

3.2 Groundwater

Groundwater was encountered within all boreholes hole locations. Although arisings were logged as damp, no water strikes were recorded within the trial pits. The groundwater strikes are presented on the Logs in **Appendix 02** and summarised in Table 3-1, below.

Table 3-1
Groundwater Monitoring Results Summary

BH/TP	Strata	Initial Water Strike (m BGL)	Water Level (after Zennings) (m BGL)	Water Level at first monitoring round 07/05/2019 (m BGL)	Water Level (mAOD)
WS01	RTD	3.20	1.55	1.55	3.25
WS02	RTD	2.51	1.85	1.85	3.16
WS03	RTD	3.11	1.53	1.53	3.28
WS04		3.40	Not recorded	Not installed	
MW01	?	-	-	1.62	-

Groundwater was generally encountered in the chalk formation, confined by the overlying cohesive River Terrace Deposits. Groundwater has been found to be flowing to the north east, toward the Ryebank Rye.

The site is not listed as being within a groundwater Source Protection Zone.

4.0 Record of Chemical Conditions

4.1 Visual Observations

Made Ground was encountered only in TP6, TP7, TP8 and TP9 to a maximum depth of 0.45m BGL. Anthropogenic material comprised localised areas of brick and fibre cement sheet. Metal was also noted within the hand pit in WS04. Evidence of ash was noted within the topsoil, possibly evidence as a result of small-scale bonfires.

No hydrocarbon or sulphurous odours were noted during the site investigation, and all samples retained for laboratory analysis were screened for organic vapours using a MiniRAE Lite PID calibrated to isobutylene.

Visual and olfactory evidence of hydrocarbon contamination was not encountered within any of the exploratory holes Table 4-1 below summarises the evidence of contamination encountered.

Table 4-1
Visual/olfactory Evidence of Contamination - Soil

Hole	Depth Encountered (m BGL)	Headspace Test Result (ppm)	Strata	Notes
TP01	0.00-0.25	<0.1	Topsoil	Ash noted
TP06	0.15-0.45	<0.1	Made Ground	Brick fragments and rare charcoal
TP07	0.00-0.30	<1	Made Ground	Brick fragments, concrete, brick tiles
TP08	0.00-0.20	<0.1	Made Ground	Rare brick
TP09	0.10-0.40	<0.1	Made Ground	Rare charcoal gravel and brick. Abundant fibre cement sheets (asbestos)
WS04	0.00-0.20	<0.1	Made Ground	Brick and occasional metal debris. Ash and charcoal noted.

4.2 Soil Chemistry

During the site investigation, fourteen soil samples were collected and scheduled for contaminants detailed in **Section 2.3**. Full chemical analysis certificates are provided as **Appendix 03**, and the results are summarised in the context of a GQRA within **Appendix 04**.

The data trends are summarised below:

- ✦ The concentrations of metals exceed the limit of detection (LOD) in the majority of samples tested, although concentrations are low.
- ✦ PAHs were not typically encountered within the River Terrace Deposits; however PAHs were encountered within the topsoil/Made Ground. Significantly elevated PAHs were encountered where ash/charcoal was noted (to a maximum total concentration of 918 mg/kg) within the trial pit and

borehole logs. The PAH profile indicates the ash/charcoal is likely to be the source of the elevated PAHs (see **Section 7.2** for more detail);

- TPH was recorded in excess of the LOD within two of the seven samples analysed; in TP06 @ 0.20m BGL C5-C35 recorded a 130 mg/kg and WS04 @ 0.25m BGL recorded at 719 mg/kg. Both samples detected the majority of hydrocarbons in the aromatic EC16-EC35 band, indicating a waste oil source;

Asbestos was identified within seven of the fourteen samples tested. Table 4-2 below summarises the asbestos identified from the samples analysed:

Table 4-2
Summary of Soil Data -- Asbestos

BH/TP	Depth (m BGL)	Visible Asbestos		Asbestos in Soil Result	
		Type	Description	Type	Quantity (% wt/wt)
TP04	0.20	NAD	-	Chrysotile fibre bundles	0.001
TP06	0.20	NAD	-	Chrysotile fibre bundles	<0.001
TP07	0.20	NAD	-	NAD	-
TP09	0.30m	Asbestos cement sheet	Multiple cement sheet fragments. Good condition, limited weathering. Sheet in sample weighs 23.5grams (2.2% of sample).	Chrysotile fibre bundles	0.001
WS01	0.20	Asbestos cement sheet	Single cement sheet fragment. Good condition, weighs 48.6 grams (4.1% of sample)	Chrysotile fibre bundles	<0.001
WS02	0.25	NAD	-	Chrysotile fibre bundles	<0.001
WS04	0.25	NAD	-	Chrysotile fibre bundles	<0.001

NAD=No asbestos detected. Asbestos quantified using detailed gravimetric analysis and phase contract optical microscopy.

Based on the above, the following conclusions have been drawn with respect to the assessment of contaminants:

- Concentrations of metals encountered were generally low;
- Elevated levels of PAHs have been identified within the topsoil and Made Ground, possibly associated with the presence of ash/charcoal; and
- Asbestos is present locally within the Made Ground.

4.3 Groundwater Chemistry

During the site investigation, four groundwater samples were collected from WS01, WS02, WS03 and MW101. Samples were scheduled for contaminants detailed in **Section 2.3**. Full chemical analysis certificates are provided as **Appendix 03**, and the results are summarised in the context of a GQRA within **Appendix 05**.

The data trends are summarised below:

- ✦ Low concentrations of total dissolved chromium and dissolved nickel were identified within all samples above the LOD. Dissolved arsenic was recorded within WS01 at a concentration of 0.019 mg/l.
- ✦ No petroleum hydrocarbons were recorded within samples above the LOD, with the exception of the sample collected from MW01, where aromatic EC16-EC21 was recorded at a concentration of 0.01 mg/l;
- ✦ Nitrate was recorded within all samples above the LOD, with the highest being recorded within WS01 at 190 mg/l;
- ✦ Ammoniacal nitrogen was recorded above the LOD within three of the four samples, significantly elevated within WS01 (1.31 mg/l) and MW01 (1.92 mg/l);
- ✦ Low concentrations of PAHs were recorded within both samples collected.

5.0 Waste Assessment

5.1 Background

Wastes are listed in the List of Waste Regulations (LoW 2005 – which transpose the European Waste Catalogue (EWC) into domestic legislation) and are grouped according to generic industry, process or waste type. Wastes within the LoW are either Hazardous or Non-Hazardous. Some of these wastes are Hazardous without further assessment (absolute entries) or are ‘mirror’ entries that require further assessment of the hazardous properties in order to determine the potential for hazardous waste.

Waste soil has “mirror” entries on the LoW and as such the first phase of the waste classification process is that of determining if the waste is hazardous or not, i.e. the hazard assessment.

Certain contaminants such as asbestos or diesel have prescribed concentration thresholds that if breached will render the material hazardous waste. Thus, in the first instance the concentrations of plausible contaminants within the soil should be identified. Results of this assessment should help to determine the likely fate of the soil and whether or not the soil is hazardous or non-hazardous.

Dependent on the results of the hazard assessment advice can be given as to the likely options available for a given waste and any further testing or assessment that may be required.

Subject to passing further WAC testing and after pre-treatment/off site treatment, hazardous wastes are likely to require landfilling. Non-hazardous waste may be suitable for re-use rather than landfilling; however this would be based on compliance with the appropriate code of practice or environmental permit of the receiving site.

It should be noted that where waste is classified as “non-hazardous”, in order to dispose of this material at a licensed inert landfill facility, it should pass a suitable inert waste WAC test.

5.2 Step 1 – LoW Code

The first decision in the waste assessment is to determine the LoW Code for the waste soil and whether that material is Hazardous, Non-Hazardous or a mirror entry which is potentially Hazardous or Non Hazardous depending on the presence of certain contaminant. Based upon observations made during the initial site investigation the following two LoW codes for the material are judged to be applicable:

- ✦ 17 05 03 – soils and stones containing hazardous substances; or
- ✦ 17 05 04 – soils and stones other than those mentioned in 17 05 03.

The purpose of the remainder of the assessment is to determine if the soil material is either Hazardous or Non-Hazardous waste and therefore which of the above is applicable.

5.3 Step 2 – Hazard Assessment

The second stage of the assessment is to determine the nature of the soil material, based on the composition or properties. In this case we can determine the composition of the soil material from laboratory analysis.

The contaminants present above laboratory detection limits were assessed in terms of the hazard phrases present. The HazWasteOnline model was used to undertake the initial Hazard Assessment screen, the purpose of which is to establish whether the sampled soils should be considered as either Hazardous or Non-Hazardous

waste. This classification process is in line with the Environment Agency's technical guidance WM3 "Guidance on the classification and assessment of waste", 1st edition 2015 Version 1.1. The model output sheets are attached in **Appendix 06** for reference.

Based on the results of the Hazard Assessment, indicative List of Waste (LoW) coding for all the soil analysed, all are likely to be classified as '17 05 04, soil and stones other than those mentioned in 17 05 03', i.e. non-hazardous waste.

5.4 Step 3 – Asbestos Waste

The presence of asbestos containing materials (ACM) with the shallow soil does pose a potential issue with regards to waste classification.

Materials, including waste soils and construction waste, become hazardous waste if the asbestos content exceeds the 0.1% carcinogenic threshold on a weight for weight (w/w) basis. In practice whether the asbestos content is above or below 0.1% is difficult to prove and depends on whether asbestos containing materials (ACMs) and/or loose asbestos fibres are present. Under current legislation (WM3) SLR's interpretation of whether the presence of asbestos renders waste soils or aggregate hazardous is as follows:

1. If no visible asbestos is present and asbestos fibre content is below 0.1% - the material is non-hazardous waste.
2. If no visible asbestos is present and asbestos fibre content is above 0.1% - the material is hazardous waste.
3. If visible asbestos is present and asbestos fibre content is above 0.1% - the material is hazardous waste.
4. If visible asbestos is present and asbestos fibre content is below 0.1% - the parent material is non-hazardous BUT the asbestos is hazardous waste. In this case the material should be given two EWC codes and will be treated as though all the material is hazardous waste until the visible asbestos has been removed.

The above effectively means that if asbestos is visibly present then it will require disposal to a hazardous treatment centre. Alternatively, the shallow topsoil/Made Ground could be segregated and pre treated (i.e. removing visible asbestos through grading and hand picking). The soil fraction would then be classified as non-hazardous waste, and the asbestos fragments as hazardous.

6.0 Outline Geotechnical Assessment

In broad terms, this section seeks to support the NPPF by ensuring the site is suitable for its new use *taking account of ground conditions and land instability*. This section relates to PPL2c which deals with the physical ground conditions by way of an outline geotechnical assessment; the land's chemical qualities are assessed in **Section 7**.

6.1 Limitations

The comments and recommendations contained below are based on the observed ground conditions from the recent ground investigation; once geotechnical testing results are available further assessment will be undertaken. Extrapolation between, and to, other parts of the site is not considered possible given the nature of the information gathered and the geological setting as interpreted. No responsibility is accepted for geological and geotechnical conditions which vary from those on which this report is based. It should be noted that the solutions are discussed in principle only and must be subject to a more complete assessment at the detailed design stage of the project.

6.2 Foundation Recommendations

The ground investigation intersected a thin veneer of topsoil and localised Made Ground in several areas comprising sandy silt to silty sand with variable clay and gravel content (brick, charcoal and asbestos containing material) to a maximum depth of 0.45mbgl. Superficial slightly gravelly clayey silt and sand deposits were encountered underlying the topsoil and Made Ground, extending past the base of all excavations. The silt and sand deposits were generally described as soft to firm slightly gravelly clayey sandy silt with frequent beds of silty sandy and occasionally increasing gravelly content with increasing depth. Gravel comprised chalk and flint.

Groundwater seepages were recorded in several trial pit excavations between 2.1mbgl and 2.6mbgl. Installation of groundwater monitoring wells within the four boreholes recorded groundwater levels between 1.53mbgl and 1.85mbgl (3.28mAOD and 3.16mAOD). Groundwater was generally encountered within the chalk bedrock, rising following water strike indicating it is confined by the overlying cohesive River Terrace Deposits.

The proposed development will comprise a two-storey residential care home, possibly with a basement, and including landscaped gardens, parking and service areas.

6.2.1 Shrinkage and Swelling of Soils

An Arboricultural Impact Assessment Survey conducted in January 2017² identified a number of trees onsite and offsite along the eastern and southern site boundaries. Species including Oak, Hazel, Hawthorn, Cherry, Maple, Birch, Bay Laurel and Ash in good to poor form were recorded.

The Tree Survey identified a number of high water demand trees including Oak offsite and Hawthorn onsite plus several moderate water demand trees onsite including Bay Laurel, Ash and Cherry. The proposed building lies within the zone of influence of a number of trees. These factors need to be considered within the foundation design, for which the worst-case scenario will be taken i.e. highest water uptake.

Whilst there may not be an explicit requirement for the proposed development to adhere to NHBC guidelines³, in the context of building near trees, this is considered to provide a best practice approach.

²PJC Consultancy Limited (January 2017). Ref: 3822/16-02 r2. Arboricultural Impact Assessment – Poultry Farm, Yapton Road, Middleton-on-Sea, West Sussex PO22 6HS

³ NHBC Standards 2017, Part 4 Foundations

In accordance with NHBC guidance the modified plasticity index will be determined from the geotechnical testing results of cohesive superficial samples. The volume change potential of the soils will be determined and used to assess the required depth of foundations. Reference has been made to the NHBC guidance and the Tree Survey to determine the possible worst case of required depth of foundations, assuming a high volume change potential soil.

The Oak recorded offsite is approximately 10m from the proposed structure and was recorded as 11m tall. Foundations installed within 10m of a high water demand tree species, such as Oak, should be constructed to a depth of 1.8m. The 7m tall Bay Laurel tree recorded in the south-eastern corner of the Site is a moderate water demand species and is located approximately 2m south of the proposed structure. Foundations within 2m of such a tree should be constructed to 1.95m. This is considered to be a worst case, along the southern boundary.

The depth of foundation will vary dependent on the proximity to trees and tree species and reference should be made to the NHBC guidelines during detailed design. Given the general absence of trees for the north-western area of the Site it may be feasible to construct foundations at various depths based on the zone of influence of trees. Foundation design will need to take into account the proposed planting as well as species removed.

6.2.2 Foundation Options

Foundation solutions have been considered taking into account ground conditions, proximity of high and moderate water demand tree species and location of the proposed structure within the Site. Limited Made Ground and topsoil was encountered during the investigation and as such foundations installed into the superficial deposits are considered during this assessment.

The foundation design takes into consideration a worst-case scenario. This uses the poorest ground conditions within the footprint of the proposed development with the highest load. This allows for some variation in ground conditions as well as considering a maximum load.

As discussed in **Section 6.2.1**, above, the depth of foundation will be determined by the proximity to and water demand of the tree species and the volume change potential, determined by laboratory testing. Where high or moderate water demand tree species are sufficiently distant from the proposed structure, traditional shallow strip foundations may be appropriate. Trench fill foundations are recommended where foundations deeper than 1.5mbgl are required.

Calculations have been carried out to determine the bearing capacity for ground conditions comprising soft to firm sandy silts primarily. Traditional shallow strip foundations installed within the superficial River Terrace Deposits provide a bearing capacity in excess of 175kPa. This is considered to be adequate for the proposed development, however no loading information regarding the proposed development has been provided.

Foundations will need to be installed deeper in close proximity to trees, the bearing capacity increases with depth. Recommended protection measures are outlined in the NHBC Guidance³.

The risk of excessive differential settlement impacting the proposed structure is considered to be moderately low. Foundations will be constructed into the underlying River Terrace Deposits which primarily consist of slightly gravelly sandy clayey silts. As such settlement will likely occur in the months to years following construction, and total settlement is anticipated to be within acceptable limits, estimated to be <25mm.

There is potential for limited areas of softer material within the silts which may not be considered suitable for strip foundations. It is recommended that prior to construction foundation excavations are proof rolled with a Wacker plate to highlight any soft areas. These should then be removed and backfilled with suitable granular material to ensure the structure remains stable.

6.3 Temporary Works and Basal Heave

Excavations were stable during the ground investigation however the presence of groundwater seepages and granular horizons within the River Terrace Deposit could lead to instabilities. If instabilities occur during excavations temporary shoring is recommended.

Monitoring wells installed within WS01 to WS03 recorded groundwater levels between 1.53mbgl and 1.85mbgl. During excavation slight groundwater seepages were recorded and so the shallow groundwater recorded during the monitoring visit may potentially be associated with the lower principal aquifer within the underlying chalk bedrock. Given its largely cohesive nature, the overlying superficial deposit may be confining the groundwater and as such the potential for basal heave within excavations should be considered.

6.3.1 Groundwater Control

Groundwater will need to be taken into consideration during construction. Groundwater seepages within the River Terrace Deposits were encountered between 2.1mbgl and 2.6mbgl, associated with more granular horizons. Given the depth potential for a basement within the proposed structure and depth of shallow strip and trench-fill foundations dewatering will likely be required, however traditional sump pumping from within the excavations may not be an efficient or cost-effective option. It is recommended that construction occurs whilst the water table is at its lowest, in the summer months.

An alternative foundation solution may be required if groundwater within shallow foundation excavations is higher than currently recorded and cannot be managed efficiently.

Wellpointing may be suitable for reducing the head of water during temporary works for the basement excavation however further information is needed to calculate the hydrostatic uplift force present beneath the Site. Further investigation will likely include drilling into the chalk aquifer and groundwater monitoring.

For all excavations during construction it is recommended that earthworks and groundwater control solutions are designed by a competent specialist contractor.

6.4 General

In addition to the above, it is recommended that all design and construction works be carried out on site in accordance with recognised engineering codes of practice including BS 8004 (1986: Code of Practice for Foundations) and BS 6031 (2009: Code of Practice for Earthworks).

7.0 Land Quality Risk Assessment

In broad terms, this section seeks to support the NPPF by ensuring the site is suitable for its new use *taking account of ground conditions and land instability*. The previous section dealt with the suitability of the physical ground conditions, and the subsections below assess the land's chemical quality by assessing the PPL set out in **Section 1.4** of this report – which were drawn from SLR's PLQRA report.

7.1 PPL1a

Potential Harm to Human Health from Exposure to Contaminants Entering Water Supply Pipework

This PPL (Potential Harm to Human Health from Exposure to Contaminants Entering Water Supply Pipework) concerns ground conditions along the route of all proposed water supply pipes. At the time of investigation the proposed route of the water supply pipework was not known. As such, Source 1 relevant to water pipes has not been investigated. Once the route of the pipe is known the developer will only commit to testing if Made Ground or organic contamination is suspected along the route of the water supply pipework. Alternatively the developer may elect to install barrier pipe as a precautionary measure.

7.2 PPL1b

Potential Harm to Human Health from Exposure to Contaminants in Made Ground

This PPL concerns the chemistry of the soils in the proposed landscaped areas. The contaminants of concern associated with the shallow soils are heavy metals, PAHs and asbestos.

7.2.1 Approach & Assessment Criteria

Chemical analysis have been screened against generic assessment criteria (GAC) protective of human health. The GAC have been developed as a guide for regulators and developers; if the concentrations recorded on site are lower than the GAC it is generally accepted that the contaminants in question are present at acceptable concentrations which aren't capable of putting human health at significant risk - as long as the humans make normal use of the site. An exceedance of these values indicates to an assessor that soil contaminant concentrations need to be considered further. GACs combine both authoritative science and policy judgements.

The GAC and S4ULs / C4SLs used have been derived using the CLEA model according to several typical land uses:

- ✦ Residential (with and without vegetable growth);
- ✦ Allotments;
- ✦ Commercial/Industrial;
- ✦ Public Open Space residential (POS1);
- ✦ Public Open space park (POS2).

The proposed development at the site is considered a residential land use. The proposed site layout in **Appendix 01** indicates the site will comprise a care home building, with associated soft landscaping and car parking. The generic land use most appropriate to the majority of the site is therefore residential without plant uptake. The ingestion pathways concerning vegetables are not assessed here as any crops grown in the raised planters for resident's use will be nourished by imported soil / compost.

The selected GAC for the site for an initial screen are the LQM/CIEH S4ULs. These provide screening criteria derived using the most recent toxicological data, whilst still modelling "minimal risk". The selected criteria are designed to be protective of small children who are assumed to live on site and play in the garden – as such it

will be overly protective of the elderly residents of this care home and the workers (the CLEA model would anticipate those adult receptors to have a far lower exposure to soil based and soil-derived contaminants). The S4ULs are therefore considered conservative. It should be noted that no S4UL is available for lead. As such SLR has adopted the C4SL as an initial screening criteria.

Where contaminants are sensitive to soil organic matter (SOM), 1% values have been adopted as a conservative measure. When assessing PAHs, chemical analysis results have been compared with GAC derived using the Toxicological Equivalency Factor (TEF), rather than the Surrogate Marker (SM) method.

No GAC are available in the UK for asbestos in soils, therefore asbestos has been assessed separately, as detailed in **Section 7.2.4**.

The results for the chemistry of the Made Ground are presented in **Appendix 04**. The table compares the laboratory results to the generic human health assessment criteria⁴ (GAC) (NB: the cells shaded red represent concentrations in excess of the criteria, while those in green indicate a concentration above the limit of detection (LOD)).

The individual sample results for each contaminant were compared to generic assessment criteria. The GAC and their sources are detailed in **Appendix 04** and the full laboratory results are provided in **Appendix 03**.

7.2.2 Heavy Metals

Testing comprised the analysis of fourteen shallow samples (nine topsoil/ Made Ground, six natural ground) from twelve locations.

No metals were revealed in excess of the adopted GAC. The risk to the proposed redevelopment from metals is therefore considered very low.

7.2.3 PAHs

Exceedances

Testing comprised the analysis of fourteen shallow samples (nine topsoil/ Made Ground, six natural ground) from twelve locations.

PAHs were recorded in excess of the adopted GAC in four locations; summarised below:

- ✧ TP01 @ 0.25m BGL – B(a)P (3.6 mg/kg), D(ah)A (0.43 mg/kg) & B(b)F (3.9 mg/l);
- ✧ TP07 @ 0.30m BGL – BaA (33 mg/kg), Chrys (34 mg/kg), BaP (41 mg/kg), DahA (3 mg/kg) & B(b)F (49 mg/kg);
- ✧ TP09 @ 0.30m BGL - BaA (86 mg/kg), Chrys (63 mg/kg), BaP (64 mg/kg), I(123cd)P (47 mg/kg) D(ah)A (7.3 mg/kg) & B(b)F (86 mg/kg);

⁴ The generic risk assessment criteria are drawn from several sources of guidance, some from non-statutory guidance and some informal. SLR uses a combination of assessment criteria that are currently available to assist in the screening of soil data prior to determining whether further action is required. The following assessment criteria have been used for the assessment of contaminant levels in soil:

- LQM/CIEH – Land Quality Management and the Chartered Institute of Environmental Health have published S4ULs derived following CLR technical guidance and using the Environment Agency's CLEA UK model; and
- SLR's own in-house screening criteria derived following CLR technical guidance using the CLEA UK model,
- CLAIRE / AGS / EIC – these institutions have published publicly available GACs derived following CLR technical guidance and using the Environment Agency's CLEA UK model; and
- Category 4 Screening Levels (Defra)

- WS04 @ 0.25m BGL – BaP (9.1 mg/kg), D(ah)A (1.5 mg/kg), B(b)F (11 mg/kg).

Given that the data set is relatively limited (nine samples from the shallow topsoil/Made Ground), there is insufficient data to justify the use of statistical analysis.

It should be noted that the adopted assessment criteria are protective of a female child, aged 0-6 occupying the site, and are therefore conservative. Nevertheless, some of the PAH exceedances are significant (up to 24 times the screening criteria). When assessed against a less sensitive receptor (elderly resident or on-site worker), exceedances of assessment criteria would still be present.

Source of PAHs

Where PAHs are identified, it is essential to understand the possible source to fully understand the risks posed. PAHs are formed as a result of the incomplete combustion of carbon, with man-made sources including motor vehicle engines & fuel, coal or wood fires, coal tar and creosote.

In order to assess the origin and significance of these detections SLR has produced a series of double ratio plots that involves plotting pairs of isomers to tentatively determine different PAH source profiles. The double ratio plots are included in **Appendix 07**. The double ratio plots indicate a combustion/pyrogenic signature from grass/wood/coal combustion and/or coal. This corresponds to the ash and charcoal identified within the shallow ground, likely to be present as a result of small bonfires.

7.2.4 Asbestos

Of the fourteen soil samples subject to asbestos analysis, seven identified asbestos fibre bundles, and two identified visible pieces of asbestos cement sheet. Within TP09, a layer of shallow Made Ground was identified which contained abundant asbestos cement sheet fragments. Where fibre bundles were identified, they were quantifiable in two locations ; TP04 @ 0.20m BGL (0.001%) and TP09 @ 0.30m (0.001%).

It should be noted that asbestos is likely to be present as a result of the construction/demolition of agricultural buildings, and is likely to be limited to the surface 500mm of ground.

The presence of asbestos within the Made Ground can pose a risk to human health in two principal areas, namely:

- 1) long term human health impacts (proposed end users of the site); and
- 2) short term human health impacts (ground workers during the construction phase of the redevelopment)

Long Term Human Health Impact

There is currently no GAC for asbestos in the UK, and where asbestos is identified, assessment is required on a site by site basis.

SLR has carried out an assessment of asbestos exposure using predictive exposure modelling, for asbestos free fibre within the soil, included as **Appendix 08**. SLR has calculated that at a free fibre concentration of 0.001%, the risk to the proposed end users of the site is very low.

The application of the free fibre criterion of 0.001 % for asbestos cement fragments in the ground however is not appropriate as this does not account for the significant difference in free fibre release from asbestos cement compared with unbound free fibres. For bound asbestos, SLR has therefore adopted 0.1%; a justification for which is provided in **Appendix 08**.

Visible asbestos cement sheet fragments in the locations of TP09 and WS01 have been identified at concentrations in excess of the 0.1% threshold. Action is therefore necessary in relation to asbestos.

Short Term Human Health Impact (Occupational Exposure)

The presence of asbestos within the ground can lead to groundworks which may disturb it to be classified under the Control of Asbestos Regulations (2012) (CAR 2012). Any earthworks/groundworks contractor should

therefore be provided with the results of this report and ensure the presence of asbestos is taken into account when carrying out work that may disturb the shallow ground.

7.3 PPL 1c

Potential Damage to Future Buildings from Aggressive Ground Conditions

Chemical analyses has been scheduled but as of yet the test results are not available. Once test results are received the chemical analyses will be discussed.

7.4 PPL 1d

Potential Harm to Controlled Waters from Contaminants in Made Ground

This PPL relates to potential impact from metals, PAHs & nitrate. Ammoniacal nitrogen is considered as part of PPL2, and petroleum hydrocarbons are considered as part of PPL3. Four groundwater samples were collected from WS01, WS02, WS03 and MW01

7.4.1 Approach and Assessment

Risks to groundwater and surface water from dissolved contaminants have been assessed by screening the results against generic water quality standards (WQS).

These criteria are protective of the environmental quality of surface waters (EQS) or of human health (via Drinking Water Standards). The screening criteria are drawn from the following list with criteria from the latter standards/guidance only being used where Environmental Quality Standards (EQS) and UK Drinking Water Standards are not available:

- Environmental Quality Standards (EQS) - The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010
- UK Drinking Water Standards (UK DWS) – are for the protection for human health and derive from either the Water Supply (Water Quality) Regulations 1989 or 2000.
- EU Drinking Water Standards (EU DWS) – are for the protection of human health and derive from the Council Directive 98/83/EC.
- World Health Organisation Guidelines (WHO Health) protect health and derive from the World Health Organisation Guidelines for Drinking Water Quality, 1984.

As an initial tier of generic screening, the lowest applicable WQS have been used to screen the laboratory results. Individual sample exceedances do not constitute an actual risk, but indicate that further consideration or assessment of the result should occur.

This could also include consideration of natural background concentrations within the strata under assessment.

The screening sheets are included in **Appendix 05**, with samples exceeding the GAC highlighted in red. The results of the water environment screening are discussed below.

Heavy Metals

Metals have not been identified in excess of the adopted WQS. The risk to the underlying aquifer from dissolved metals is therefore considered very low.

Nitrate

Nitrate has been revealed within all samples in excess of the LOD, and in excess of the WQS within two samples:

- ◆ WS01 (190 mg/l); and

✦ WS03 (66 mg/l)

The nitrate is likely to be present within the groundwater from the past use of the site as a poultry farm (as nitrate can leak from poultry manure). Given that the poultry farm is no longer operational, nitrate would degrade over time, and the risk is not considered significant.

PAHs

PAHs have been identified within the groundwater from the two samples analysed, with the following identified in excess of the WQS:

- ✦ WS02 – Fluoranthene at 0.000012 mg/l; and
- ✦ WS02 – Fluoranthene at 0.000052 mg/l; and

PAHs are typically large hydrocarbon molecules, with a relatively low solubility, and high carbon partition coefficient (K_{oc}). CLAIRE recently published guidance regarding risk assessment of petroleum hydrocarbon in groundwater⁵. The guidance states:

“...the heavier fractions (compounds >20 carbon atoms) are very unlikely to contain hydrocarbon compounds with appreciable aqueous solubility. These compounds are therefore unlikely to be of interest in a hydrogeological risk assessment, except in certain geological environmental environments such as karst, where suspected solid and/or LNPAL may potential be transported over significant distances”

Referencing the above, this effectively means due to their low mobility, PAHs typically do not pose a significant risk to groundwater, and the risk is considered very low.

7.5 PPL 2a&b

Potential pollution of Controlled Waters (groundwater & surface water) by contaminants from leaking sewer

This PPOL relates to the risk to Controlled Waters from contaminants arising from a potential leaking sewer.

All groundwater samples were scheduled for ammoniacal nitrogen to assess any potential impact from a potential leaking sewer.

Results have been screened in accordance with the procedure set out in **Section 7.4**. The following exceedances of the WQS have been identified:

- ✦ WS01 at 1.31 mg/l
- ✦ MW01 at 1.92 mg/l

The above indicates that the sewer is likely to be leaking near MW01, and the elevated result from WS01 is likely to be attributed to the use of the site as a poultry farm. With regards to the sewer, it is recommended that this be repaired as soon as possible to stop the release of contaminants into the groundwater.

Once the sewer has been repaired, SLR do not consider further action is necessary, as groundwater is shallow and ammoniacal nitrogen will degrade readily, as reduction requires oxic conditions (likely to be present on-site).

7.6 PPL 3a&b

Potential harm to human health from inhalation of vapours from possible off-site contamination

Potential pollution of Controlled Waters (groundwater) by contaminants migrating from an off-site source.

⁵ CL:AIRE, 2017. Petroleum Hydrocarbon in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies. CL:AIRE, London. ISBN 978-1-905046-31-7.

These PPL relate to risk to human health and Controlled Waters from mobile contaminants migrating onto site from a vehicle repair garage located immediately east of the site. Following intrusive investigation and risk assessment, SLR do not consider Source 3 to pose a risk to the proposed redevelopment for the following reasons:

- ✦ No evidence of hydrocarbon impact has been noted within the soil or groundwater during the excavation of trial pits and drilling of boreholes. Field screening did not identify volatile contaminants within the soil;
- ✦ Groundwater samples analysed for TPH CWG did not identify petroleum hydrocarbons in excess of the LOD (with the exception of MW01, which identified heavy end hydrocarbons at the LOD of 0.01 mg/l);
- ✦ Groundwater has been found to be flowing to the north east i.e. away from the off-site source

The above indicates that it is unlikely that hydrocarbons have migrated onto the site, and are unlikely to do so in the future. The risk to the proposed redevelopment is therefore considered very low.

7.7 PPL 4a-c

Potential Harm to Human Health from Potential Contaminants in Imported Landscaping Soils – If Required

Any imported soil will need to meet the specification outlined in **Section 6.1** of the PLQRA. By working to the specification and ensuring compliance with the British Standards, Frontier Ltd should prevent PPL3 (a-c) from occurring. However, further chemical testing of any imported soil/material may be prudent to demonstrate that it does not pose a significant risk to human health.

Although the assessments reported above have demonstrated that the soils present on site are suitable for the proposed end-use of the site in terms of risk to human health and potential harm to landscape plants from phytotoxic elements, the work herein does not include an assessment regarding the suitability of the in-situ soils as a growing media (i.e. compliance with BS 3882:2015 topsoil criteria).

7.8 PPL 5

Potential Risks to Health or the Environment from Unidentified Sources

With the exception of buried asbestos (which requires further action), given the historic use of the site as a poultry farm, it is unlikely unexpected sources of contamination will be identified. Regardless, a watching brief should be maintained for any material exhibiting visual/olfactory evidence of contamination.

In practice, should the developer encounter potentially hazardous materials work should cease and the matter be referred to an appropriate environmental consultant, as specified in **Sections 6.2** and **6.3** of the PLQRA.

8.0 Conclusions and Recommendations

In broad terms, this report aims to support the NPPF by ensuring the site is suitable for its new use *taking account of ground conditions and land instability*.

The PLQRA identified that the most likely / significant PPL appeared to be:

- ✦ **PPL 1a:** Potential harm to human health from exposure to contaminants entering water supply pipework
- ✦ **PPL 1b:** Potential harm to human health from exposure to contaminants in Made Ground
- ✦ **PPL 1c:** Potential damage to future buildings from exposure to aggressive ground and differential settlement
- ✦ **PPL 1d:** Potential pollution of Controlled Waters (groundwater) by contaminants in Made Ground
- ✦ **PPL 2&b:** Potential pollution of Controlled Waters (groundwater & surface water) by contaminants from leaking sewer
- ✦ **PPL 3a:** Potential harm to human health from inhalation of vapours from possible off-site contamination.
- ✦ **PPL 3b:** Potential pollution of Controlled Waters (groundwater) by contaminants migrating from an off-site source.
- ✦ **PPL 4a-c:** Potential Harm to Human and Plant Health from Potential Contaminants in Imported / Site-Won Landscaping Soils
- ✦ **PPL 5:** Potential Risks to Health or the Environment from Unidentified Sources

8.1 Physical Ground Conditions

Nine trial pits were excavated to a maximum depth of 3.20mbgl, and four dynamic boreholes were drilled to a maximum depth of 5.20m BGL. The ground conditions across the site comprised topsoil overlying superficial River Terrace Deposits. The topsoil was found to contain occasional patches of ash/charcoal, and the Made Ground was found to contain occasional pockets of anthropogenic material including brick and fibre cement sheet fragments; found to contain asbestos.

Groundwater was encountered between 1.55-1.85m BGL (3.16-3.25m AOD) found to lie within the River Terrace Deposits

8.2 Preliminary Geotechnical Conclusions

Geotechnical laboratory testing results are not available currently and the following preliminary conclusions are based off observations only. Final geotechnical conclusions will be verified once testing results are analysed.

Geotechnical field observations found a thin layer of topsoil and Made Ground overlying natural River Terrace Deposits comprising slightly gravelly sandy silts with frequent granular horizons present. The underlying chalk bedrock geology was encountered, between 2.80m BGL in the south of the site and 4.10m BGL in the north of the site.

Information obtained across the Site the risk of differential settlement (PPL1c) is not considered to be a significant issue and shallow strip or trench-fill foundations are likely to be suitable for the proposed development. Where foundations fall within the zone of influence of existing / proposed trees, the depth of foundations may need to be increased. The proposed foundation design should consider the presence of silt susceptible to shrinking and swelling, shallow groundwater and earthwork stability.

If shallow groundwater is encountered during foundation excavation an alternative foundation solution may be required. Additional ground and groundwater data will be required to inform any new foundation solution.

In order to duly consider the potential of basal heave within the proposed basement excavation further information on the underlying groundwater conditions will be required.

8.3 Significance of Potential Pollutant Linkages

The assessed significance of each PPL is summarised below, along with recommendations for any further work (if required).

8.3.1 PPL 1a: Potential Harm to Human Health from Exposure to Contaminants Entering Water Supply Pipework

At the time of this investigation the proposed route of the water supply pipe was not known, as such PPL1a has not been assessed. However, by undertaking a targeted investigation along the route of the water supply pipe (once it is known) and working to the methodology set out in **Section 5.1** of the PLQRA, the developer will prevent PPL1a from occurring.

8.3.2 PPL 1b: Potential Harm to Human Health from Contaminants in Made Ground

Fourteen soil samples were recovered during the site investigation, and scheduled for a suite of contaminants comprising metals, PAH, TPH CWG including BTEX and asbestos. The data set was subject to a GQRA protective of residential land use.

It was found that the topsoil/Made Ground contains PAHs which might constitute a potential risk to the proposed end users of the site. Asbestos cement sheet fragments were also identified within shallow soils in TP09 and WS01 which may pose a potential risk.

PAHs only pose a risk to proposed end land users when they are exposed to impacted soils (i.e. in proposed soft landscaped areas). Equally asbestos only poses a risk in soil when it is disturbed, thus giving the potential to release asbestos fibres into the atmosphere or allowing asbestos impacted soils to be tracked indoors.

Remediation in relation to this PPL is therefore necessary. Impacted soil from landscaped areas should be excavated and replaced with validated clean sub-soil/topsoil. Given the limited depth of impact (typically 300mm, maximum 500mm), and given the underlying natural strata is suitable for use, it is recommended that all the topsoil/Made Ground in proposed landscaped areas is removed.

To limit off-site disposal, it may be possible to re-use this material beneath the proposed building footprint as engineered fill, or beneath proposed hard landscaped areas (i.e. car parks).

Where shallow soils are destined for off-site disposal, the presence of visible asbestos cement sheet fragments may lead to the material being classified as hazardous waste. It may therefore be more cost effective to pre treat the material (via screening and hand-picking visible asbestos) prior to off-site disposal.

Given the presence of visible asbestos within the shallow ground, and quantifiable free fibre bundles within two samples, it is likely CAR 2012 will apply to works which disturb the Made Ground. Groundworks contractors should therefore be provided with this report and ensure the presence of asbestos is accounted for in their health and safety planning.

In addition to the removal of topsoil/Made Ground from proposed soft landscaped areas, the stockpiles of mixed demolition rubble/soil should be removed from site during groundworks. The presence of visible asbestos in these piles means it is unlikely this material could be re-used within the redevelopment.

The asbestos encountered above ground adjacent to the existing building on site can be mitigated by an asbestos hand pick by a suitable contractor to ensure that there is no risk to ground workers or potential end users.

8.3.3 PPL 1c: Potential Damage to Future Buildings from Exposure to Aggressive Ground

Awaiting laboratory testing results to determined potential for aggressive ground conditions.

8.3.4 PPL 1d: Potential Harm to Controlled Waters from Contaminants in Made Ground

Concentrations of metals or PAHs have not been identified within the groundwater that pose a significant risk to the underlying secondary A or principal aquifer. Nitrates have been encountered within two locations in excess of the adopted screening criteria (likely present as a result of the historic use of the site as a poultry farm, however given that these activities have stopped, nitrate in groundwater is likely to degrade over time, and the risk to Controlled Waters is considered to be low.

Referencing the above, no further assessment or mitigation measures are necessary in relation to this PPL is necessary.

8.3.5 PPL2a&b: Potential pollution of Controlled Waters (groundwater & surface water) by contaminants from leaking sewer

Contaminants have been identified within the shallow Groundwater that indicate a possible release from a broken sewer on-site (namely elevated ammoniacal nitrogen).

It is recommended that the sewer is fixed as soon as is reasonably practicable to cease ongoing release. Once this has occurred SLR do not consider further remediation is required, as the residual ammoniacal nitrogen will readily degrade.

8.3.6 PPL 3a&b: Potential harm to human health and Controlled Waters from contaminants from possible off-site source (vehicle repair garage)

This source related to an off-site vehicle repair garage occupying the land immediately to the east of the site. Investigation did not identify contaminants within the groundwater that are indicative of a release of hydrocarbons and off-site migration. It should also be noted that groundwater is flowing to the north east; away from the site.

As such, it is unlikely that contaminants are migrating onto site which may pose an unacceptable risk to human health or the wider environment, and no further investigation in relation to this is required at this time.

8.3.7 PPL 4a-c: Potential Harm to Human Health from Potential Contaminants in (yet to be) Imported Landscaping Soils

Any imported soil will need to meet the specification outlined in **Section 6.1** of the PLQRA. By working to the specification and ensuring compliance with the British Standards, Frontier should prevent PPL4(a-c) from occurring. However, further chemical testing of any imported soil/material may be prudent to demonstrate that it does not pose a significant risk to human health.

8.3.8 PPL 5: Potential Risks to Health or the Environment from Unidentified Sources

It is possible that unidentified sources of contamination may be revealed, not identified during investigation to date (i.e. buried caches of asbestos).

In practise, should the developer encounter potentially hazardous materials work should cease and the matter be referred to an appropriate environmental consultant, as specified in **Sections 6.2** and **6.3** of the PLQRA.

8.4 Overall

Building on the findings of SLR's Preliminary Land Quality Risk Assessment, Frontier Estates Ltd commissioned SLR to undertake a voluntary ground investigation to inform a Land Quality Risk Assessment and Outline Geotechnical Assessment.

This report has presented the findings of that voluntary ground investigation. The information obtained has also been used to provide information about foundation options.

Potential PPL's have been identified that require remediation/mitigation prior to occupation of the site. Nevertheless a well-managed construction process will leave the site / land in a condition where it is fit for its proposed use and not capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

In order to address the outstanding PPLs that pose a potential risk to human health, a remedial strategy for the site should be produced and submitted to the LPA prior to the commencement of construction.

DRAWINGS



LEGEND

 SITE LOCATION



FRONTIER



SLR

global environmental solutions

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YAPTON ROAD POULTRY FARM
MIDDLETON-ON-SEA

LAND QUALITY RISK ASSESSMENT

SITE LOCATION PLAN

DWG No. 1

Scale

1:10,000 @ A3

Date

MAY 2019

06594.00008.019.001.0_SITE_LOC_PLAN.dwg

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ARUN DISTRICT COUNCIL 148815747



TIN ROOF

POSSIBLE ASBESTOS ROOF

BRICK BASE COURSE

TIN ROOF

MW01

MANHOLE 3701

TYRES

POSSIBLE ASBESTOS
ROOF AND WALLS

SITE ACCESS

VEHICLE REPAIR GARAGE

SILVER BIRCH DRIVE

YAPTON ROAD

Middleton
Business Park

El Sub Sta

ANCTON

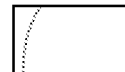
NOTES

1. DRAWING IS BASED ON EDMUND WILIAMS
SITE LOCATION/EXISTING DRAWING, DATED
FEB 2019.

LEGEND



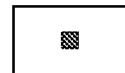
SITE BOUNDARY



DENSE VEGETATION



HISTORIC MONITORING
WELL IDENTIFIED DURING
WALKOVER



SOUTHERN WATER
MANHOLE, REF:3701



SMALL STOCKPILES
CONTAINING: SOIL, TIMBER,
DEMOLITION MATERIAL,
TYRES, CEMENT SHEETING
(POSSIBLY CONTAINING
ASBESTOS)

FRONTIER

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YAPTON ROAD POULTRY FARM
MIDDLETON-ON-SEA
LAND QUALITY RISK ASSESSMENT
SITE LAYOUT PLAN

DWG No. 2

Scale
1:10,000 @ A3

Date
MAY 2019

0 100 200 300 400m 600 800 1000
Metres 1:10,000

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ARUN DISTRICT COUNCIL 14881574

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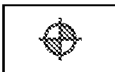
NOTES

1. DRAWING IS BASED ON EDMUND WILIAMS SITE LOCATION/EXISTING DRAWING, DATED FEB 2019.

LEGEND

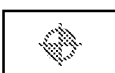
 SITE BOUNDARY

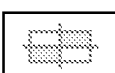
 DENSE VEGETATION

 HISTORIC MONITORING WELL IDENTIFIED DURING WALKOVER

 SOUTHERN WATER MANHOLE, REF:3701

 SMALL STOCKPILES CONTAINING: SOIL, TIMBER, DEMOLITION MATERIAL, TYRES, CEMENT SHEETTING (POSSIBLY CONTAINING ASBESTOS)

 BOREHOLE LOCATION

 TRIAL PIT LOCATION





SLR
global environmental solutions

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YAPTON ROAD POULTRY FARM
MIDDLETON-ON-SEA

LAND QUALITY RISK ASSESSMENT

EXPLORATORY HOLE LOCATION PLAN

DWG No. 3

Scale
1:10,000 @ A3

Date
MAY 2019

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