



PHASE I AND II GEO-ENVIRONMENTAL ASSESSMENT

14 FITZALAN ROAD, ARUNDEL
WEST SUSSEX, BN18 9JS

REC REFERENCE: 1CO102284P2R0

REPORT PREPARED FOR: RENAISSANCE GROUP OF COMPANIES

DATE: OCTOBER 2016



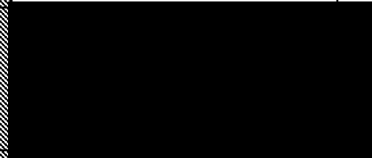
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QUALITY ASSURANCE

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EXECUTIVE SUMMARY

Site Address	14 Fitzalan Road, Arundel, BN18 9LS	
Grid Reference	501932, 106897	
Site Area	0.27ha	
Current Site Use	A site walkover was carried out on 27th September 2016. The site is located on the north-eastern edge of Fitzalan Road, and is currently occupied by Blastreat Limited, an industrial and architectural blast cleaning and finishing company. The site topography is generally flat, roughly rectangular in shape and measures approximately 0.22 hectares in size. It comprises multiple large warehouse structures housing several spray and heat treatment rooms on the west and east. An inverted, roughly L-shaped hard standing area runs in a north-south direction across the site. Other features within the site include; an administrative office attached to the northern end of the large warehouse, an electricity substation on the northwest corner, a diesel tank with a 1m high bund wall on the northeast and drums of wastes, gas tanks and chemical storage near the southern boundary. Both untreated and finished metal products are noted on the surface of the hardstanding. Access is via Fitzalan Road onto the hard standing area to the north and a smaller access off the eastern boundary onto Fitzalan Road to the east.	
Proposed Use	REC Ltd understands that Renaissance Group of Companies Ltd is proposing to redevelop the site into retirement apartments. It is believed that the proposed development is not planned to include a basement. The proposed site development plan has yet to be finalised and as such this report represents an initial intrusive assessment in order to determine the primary contaminated land and geotechnical liability risks. The scope of works was provided by the Client's Engineer, Rushby Brewster, prior to commencement of works in order to provide an initial assessment prior to purchase of the site by the Client.	
Site Investigation Findings	Made Ground	Made Ground was encountered within all exploratory hole and typically comprised reinforced concrete or paving bricks overlying sandy GRAVEL / CLAY of varying proportions. Sand is fine to coarse. Gravel is angular to sub-rounded, fine to coarse flint, brick, concrete, asphalt, charcoal, ash, chalk and rare glass/ceramics. Cobbles are sub-rounded flints, bricks, concretes and white chalk relics. A maximum thickness of 0.90m bgl was encountered within WS101 and WS104.
	Raised Marine Deposits	Raised Marine Deposits (Alluvium) was encountered within all exploratory holes and typically comprised soft dark grey orangeish brown silty slightly gravelly CLAY with low cobble content. Gravel is angular to sub-rounded fine to medium flint. Cobbles are sub-rounded flint. This stratum was noted to change at depth to slightly silty organic CLAY. Organic material was noted to comprise amorphous organic products, with an organic odour throughout.
	Groundwater	No groundwater was encountered within any of the exploratory holes during the site investigation. However groundwater was encountered within the two monitoring wells (WS101 and WS103) during the return visits at depths ranging between 1.08 and 1.39mbgl.





Site History	From the earliest available maps, the site is shown as Swallow Brewery until circa 1970 when the site became a joinery which is unchanged to the present day.
Ground Gases	Based on the gas monitoring undertaken to date, the ground gas regime for the site can be classified as Characteristic Situation 1 and as such no gas protection measures are required. However, this is based on a very limited scope of works.
Radon	The site is situated in an area where less than 1% of properties are above the radon action level and therefore no radon protective measures are necessary.
Coal Mining / Ground Workings	A review of available records did not identify any historic or active coal mining activity within 1km of the site boundary. However, there are two records of offsite underground non-coal mining; sporadic chalk extraction, at 119m northwest and 580m south reported to be restricted in extent due to localised difficult ground conditions. There are five records of historic ground workings within 250m relating to unspecified wharfs and pits with the closest located 35m northwest of the site. There is also one single record of current ground working relating to sand and gravel extraction at Arundel Station Gravel Pit located 692m south of the site.
Revised Conceptual Site Model (CSM)	The Phase II Site Investigation has not identified any potentially harmful contaminants on site based on the limited scope of works provided by the Client's Engineer. As such we would recommend that additional works are undertaken as detailed on the page overleaf in order to expand the data set and to provide a more robust report.
Preliminary Geotechnical Assessment	Foundation Conditions and Bearing Capacity It is recommended that the site is cleared and any vegetation below areas of proposed development are stripped in accordance with Series 200 of the Specification for Highway Works. Redundant services should be sealed off, grubbed out and replaced with suitable compacted engineered fill. It is considered that the Made Ground and Alluvial Clays identified on site are not suitable as founding material due to their inherent variability and the general decrease in strength with depth identified. As such, it is likely that a piled foundation solution will be adopted for the proposed scheme. It is therefore recommended that boreholes are advanced in order to obtain information on deeper and more competent ground conditions. Given that the proposed development is likely to be piled a suspended floor slab will therefore be incorporated into the scheme. Ventilation of the under floor void will be required however, to address potential condensation issues. It is recommended that advice should be sought from a suitably qualified structural engineer with regard to the design and construction of the floor slab. Concrete design should use the classification of DS-3 / AC2 as a worst case scenario. Pavements and Construction Atterberg Limit determinations identified underlying natural deposits to be of medium volume change potential with a Plasticity Index of circa 34% to 39%. Such a Plasticity Index is indicative of a design CBR value of 3-4%, assuming a high water table in average construction conditions in accordance with <i>Design Manual for Roads and Bridges Volume 7: Pavement Design and Maintenance</i>.





Conclusions and Recommendations

The findings of this report have not identified any significant contamination issues pertaining to the proposed scheme. This is most likely attributable to the site being covered in concrete hardstanding which has severed the pathway between the various on-site sources and receptors. In addition, given the relatively fine grained and impermeable nature of the underlying soils, lateral and vertical migration is therefore likely to have been minimised.

However, this is based on a very limited data set and as such we would recommend that the following supplementary works are undertaken in order to provide a more robust report:

- ▶ Additional window sampling locations with extra land gas and groundwater points installed in order to expand the chemical analysis data set and to establish whether a vapour risk is present through VOC analysis;
- ▶ Additional land gas and groundwater monitoring visits undertaken to confirm whether gas protection measure are required;
- ▶ Groundwater sampling and analysis to determine whether an off-site risk is present from nearby historical uses. This will be important given that a piled foundation solution and deep bore soakaways are likely to be adopted for the scheme;
- ▶ Deeper boreholes into the underlying CHALK in order to establish whether deep bore soakaways could be utilised and in order to obtain information for outline pile design given the relatively poor strength of the natural Alluvial soils encountered; and
- ▶ Additional sampling and chemical analysis undertaken in the area of the fuel tank situated in the northeast corner of the site, primarily beneath the existing bund once it has been removed.



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Appendix IV Exploratory Hole Logs

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Appendix VI Geotechnical Testing Results

Appendix VII Historic Maps

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1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants Ltd (REC) has been commissioned by Renaissance Group of Companies Ltd, ('the Client'), to undertake a Phase I & II Geo-Environmental Site Assessment at 14 Fitzalan Road, Arundel, BN18 9JS. A site location plan (ref. 1CO102284-001) is presented within Appendix III.

The purpose of this report is to support the initial planning application process, inform the client of any likely constraints, and provide an assessment of potential contamination and geotechnical aspects relating to the scheme. The scope of works was provided by the Client's Engineer, Rushby Brewster, prior to commencement of works in order to provide an initial assessment prior to purchase of the site. As such the exploratory hole grid spacing achieved was limited to the scope provided.

1.2 Proposed Development

REC Ltd understands that Renaissance Group of Companies Ltd is proposing to redevelop the site into retirement apartments. It is believed that the proposed development is not planned to include a basement. The proposed site development plan has yet to be finalised and as such this report represents an initial intrusive assessment in order to determine the primary contaminated land and geotechnical liability risks.

1.3 Objectives

The objectives of the geo-environmental investigation are to:

- ❖ Undertake a site walkover survey to evaluate the current state of the site with respect to future works and to identify any current areas of potential environmental concern;
- ❖ Review historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Phase 1 Desk Study in line with Environment Agency (EA) document Model Procedures for the Management of Contaminated Land (Contaminated Land Report 11 (CLR11));
- ❖ Undertake a preliminary stage of intrusive works including sampling and analysis to provide an overview of environmental issues identified;
- ❖ Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- ❖ Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs; and,
- ❖ Provide recommendations regarding future works, if required.

1.4 Sources of Information

Background information was sought from the following sources:

- ❖ Groundsure Database Search: GS-3293449 and GS-3293448;
- ❖ Historical mapping dated 1876 to 2014;





- ❖ Online planning records held by Arun District Council;
- ❖ Environment Agency Groundwater Vulnerability Map (www.environment-agency.gov.uk/wiyby);
- ❖ Radon: Guidance on protective measures for new buildings (BRE Document BR 211, 2015) and HPA Indicative Radon Atlas for England and Wales);
- ❖ BRE Document BR211 Radon: Guidance on protective measures for new buildings (2007); and,
- ❖ British Geological Survey Online Mapping (<http://www.bgs.ac.uk>)

1.5 Risk Classification

REC has utilised the available data to classify the site on the basis of its likely contaminated land liability and potential for geotechnical constraints in relation to the property development. The risk classification definitions are summarised below:

Risk	Definition
Low	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property.
Low-Moderate	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of a future redevelopment of the site etc.
Moderate	Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the site will likely require further site investigation.
Moderate-High	Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment including intrusive ground investigations.
High	Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine to level of risk and associated liability.

1.6 Limitations

The limitations of this report are presented in Appendix I.

1.7 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC. A charge may be levied against such approval.





2.0 SITE SETTING

2.1 Site Details

Site Address	14 Fitzalan Road, Arundel, West Sussex, BN18 9JS
National Grid Reference	501932, 106897
Site Area	0.27 ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location plan (ref. 1CO102284-001) is presented in Appendix III.

2.2 Current Site Use

2.2.1 Site Description

A site walkover was carried out on 27th September 2016. The site is located on the north-eastern edge of Fitzalan Road, and is currently occupied by Blastreat Limited, an industrial and architectural blast cleaning and finishing company. The site topography is generally flat, roughly rectangular in shape and measures approximately 0.27 hectares in size. It comprises multiple large warehouse structures housing several spray and heat treatment rooms on the west and east. An inverted, roughly L-shaped hard standing area runs in north-south direction across the site. Other features within the site include; an administrative office attached to the northern end of the large warehouse, an electricity substation on the northwest corner, a diesel tank with a 1m high bund wall on the northeast and drums of wastes, gas tanks and chemical storage near the southern boundary. Both untreated and finished metal products are noted on the surface of the hard standing which covers the entirety of the site, except for where there are buildings present.

Access is via Fitzalan Road onto the hard standing area to the north and a smaller access off the eastern boundary onto Fitzalan Road to the east.

2.2.2 Hazardous Materials Storage

During the site walkover, a raised diesel storage tank with a 1m high bund wall was noted on the northeast corner of the site. The tank appeared to be in good condition, with no significant spillages noted within the area. No other visual evidence of Underground Storage Tanks (USTs) or further Above Ground Storage Tanks (ASTs) were observed.

2.2.3 Polychlorinated Biphenyls (PCBs)

An electricity substation with transformers was noted on the northwest corner of the site. The condition was visually inspected and deemed to be satisfactory. As the substation is owned and operated by UKPN, responsibility for any contamination, if present, should reside with them.

2.2.4 Asbestos Containing Materials (ACMs)

No potential ACMs were observed at the site, however the building is likely to contain asbestos and it is recommended that a full R&D asbestos survey should be carried out prior to demolition.





2.2.5 Waste Storage

Drums filled with industrial solid wastes and chemicals were noted next to the southern boundary and adjacent to the northern boundary. A skip filled with suspected non-hazardous wastes comprising bubble wraps, broken wooden pallets and food packaging was also noted adjacent to the north boundary.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Fitzalan Road with residential dwellings and River Arun beyond.
East	Fitzalan Road with commercial outlets and Queen Street beyond.
South	Residential dwellings and Queens Lane beyond.
West	Residential Dwelling (Greenhurst).



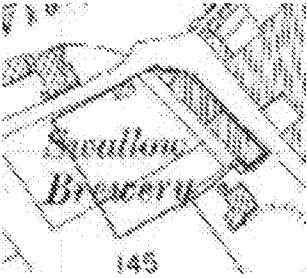
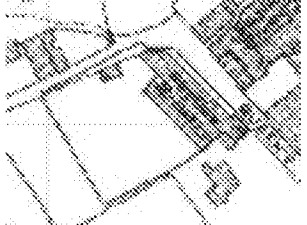
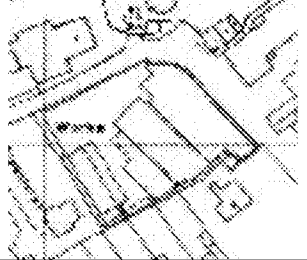
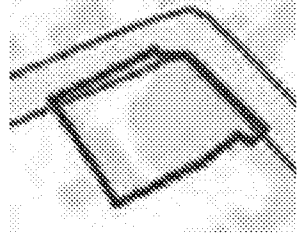


3.0 SITE HISTORY

3.1 On-Site Historical Development

A review of historical mapping pertinent to the site is summarised in Table 3.1 below:

Table 3.1 Summary of Historical Land Uses

Dates	Historical Land Use	Historical Map Image
1878 -1897 (1:2,500)	The site is labelled 'Swallow Brewery' with building footprints along the eastern and on the north boundary. An unnamed road is shown adjacent to the north and east site boundaries, River Arun is shown about 52m north and an allotment garden is shown about 50m southwest of the site. Other features include; Timber Yard 125m northwest, wharf 40m north, areas of cuttings 120m west and 110m east-northeast and a number of interconnected drains.	
1912 - 1937 (1:2,500)	A building footprint adjacent to the east boundary is labelled 'Swallow Brewery' and the rest is shown as an open field. Swallow Brewery is shown immediately beyond the road off east boundary. Timber yard to the northwest is renamed 'Saw Mills' while area of cutting to the west is no longer shown.	
1970 - 1972 (1:2,500)	The site is labelled 'Joinery Works' with additional structures adjacent to the original one to the east and adjacent to the west boundary. Swallow Brewery, Timber Yard and Wharf are no longer shown in the surrounding area. Garages are shown east, northeast and north with closest 30m east. Other features include, a Coal Yard is shown 100m west, a Depot 25m northwest, Works 120m northwest and an Allotment Garden 100m southwest of the site.	
1978 - 1994 (1:2,500)	The site is labelled 'Works' with no modification to the building layout. In the surrounding area, a road adjacent to the north and east boundaries is named 'Fitzalan Road'. The number garages reduced, coal yard and depot no longer shown on the map.	
2002 - Present (1:10,000)	The site has no designation and the layout has remained unchanged till date. In the surrounding area, garages and works are no longer shown. From the earliest map, the wider area continued to witness changes in land use.	





3.2 Off-Site Historical Development

A review of potentially contaminative land uses identified on historical Ordnance Survey maps within influencing distance of the site are summarised in Table 3.2 below:

Table 3.2 Summary of Potentially Contaminative Off-Site Historical Land Uses

Surrounding Feature	Dates	Distance	Direction
General historic development	1897 to present Surrounding area fully urbanised by 1994	Adjacent to the site	All Directions
Electricity Substations	1970 to 1999	7m – 192m	North and West
Brewery	1876 to 1938	8m & 9m	Northeast
Ship Yard	1876	73m	Northwest
Police Station	1974	104m & 263m	Southeast & Northwest
Boat House	1896	132m	Northeast
Sawmills	1938	143m	West
Works	1970 - 1994	~150m	North West
Historical Tanks	1972 & 1978	100m & 127m	East & West
Historical Garages	1970 - 1991	8m – 403m	Northeast, East & West
Infilled land (Unspecified Wharfs, Unspecified Pits, Fish Ponds, Pond Grave Yard and Cuttings)	1876 to 1976	35m – 495m	Northwest, West & North

3.3 Planning History

REC has undertaken a review of online planning records held by the Arun District Council and there are two planning application records relating this site. They are:

- ❖ Application for a proposed first floor toilet made in 1977; and,
- ❖ Application for addition of external fire escape made in 1996.

In both cases no environmentally pertinent information has been obtained.





4.0 GEO-ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

A review of the online British Geological Survey (BGS) mapping for the site indicates that the site is underlain by the following geological sequence:

Geological Unit	Classification	Description	Aquifer Classification
Superficial Deposit	Raised Marine Deposits	Clay, Silt, Sand and Gravel	Secondary A
Bedrock	Spetisbury Chalk Member	Chalk	Principal

The British Geological Survey (BGS) online geological mapping records indicate the site is underlain by superficial Raised Marine Deposits; comprising clay, silt sand and gravel. The superficial deposits are underlain by the Spetisbury Chalk Member. Although, no records of artificial deposits are recorded, localised occurrences of Made Ground cannot be ruled out, especially considering the site historical uses.

A historical borehole (TQ00NW2) located adjacent to the site confirmed the underlying geology as Drift Deposits (Raised Marine Deposits) over Upper Chalk (Spetisbury Chalk Member). The top of the chalk geology was encountered at a depth of circa 9.00mbgl.

The data search report identifies two historic groundwater abstraction licences located 859m north for general use and potable water supply. Both results are in relation to the same extraction point for Southern Water Services Ltd.

The data search indicates that the site is not within a groundwater Source Protection Zone (SPZ). However, the site is underlain by a Secondary A aquifer which is assumed to have high leaching potential in absence of soil information for urban areas.

4.2 Geotechnical Data

Geotechnical Data presented within the Groundsure Report identifies the following ground conditions:

Hazard	Designation
Shrink-Swell Clay	Negligible
Landslides	Very Low
Ground Dissolution	Very Low
Compressible Ground	Negligible
Collapsible Deposits	Very Low
Running Sand	Very Low





4.3 Coal Mining & Ground Workings

A review of available records did not identify any historic or active coal mining activity within 1km of the site boundary. However, there are two records of offsite underground non-coal mining; sporadic chalk extraction, at 119m northwest and 580m south reported to be restricted in extent due to localised difficult ground conditions. There are five records of historic ground workings within 250m of the site, relating to unspecified wharfs and pits, with the closest located 35m northwest of the site. There is also a single record of current ground working relating to sand and gravel extraction at Arundel Station Gravel Pit located 692m south of the site.

There are no records of any other mining and or ground working related activities within or at close proximity to the site.

4.4 Railways and Tunnels

A review of available data indicated no record of historical or active railways or tunnel features within a 250m of the site.

4.5 Hydrology

The River Arun is the nearest recorded major surface water feature located 58m northwest of the site. It is understood that this River is tidal and protected by flood defences. There are drains and culverts located at close proximity to the site and within the surrounding areas which are interconnected to River Arun.

There are no surface water abstraction licences within 1.0km radius of the site.

The data search indicates that there are fifty eight records of Environmental Agency Zone 2, and forty eight records of Zone 3 floodplain flooding within 250m of the site. These records include four Zone 2 and two Zone 3 onsite. In addition, there are also ten records indicating risk of flooding from rivers and seas and the ratings indicate that it is low onsite and ranges from very low to high in the surrounding areas. There are five records of flood defences located from 35m to 241m from the site. However, the overall Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating is **Low**. The search also indicates that site lies within 50m of a groundwater flooding susceptible area relating to shallow unconsolidated sedimentary aquifers.

4.6 Radon Risk Potential

BRE211 Radon: Guidance on protective measures for new buildings (2007 Edition) indicates that the site lies within an area where less than 1% of properties are above the action level and thus no radon protective measures are required in the construction of new dwellings.

4.7 Industrial Land Uses

According to historical mapping, the site is shown as a Brewery from 1878 until 1937 and then a Joinery Works from an open space with a pub on the western boundary. After 1970, the site is shown as a Joinery Works with the later layout modification and addition of an electricity substation along the north western boundary.

The data search identifies eighteen records of current industrial land uses within 250m of the site and their details are presented in the table below:





Feature	Distance (m)	Direction	Category
Electrical Substations	20 - 193	N, NW & SW	Electrical features
Texaco	25	SE	Fuel Service Station
Telephone Exchange	50	SW	Telecommunication feature
Wake Marine Ltd	83	N	Distribution and Haulage
Slipway	90	NW	Moorings and Unloading Facilities
John Wilkes	100	W	Arms and Ammunitions
Craig Whitsey Gunmakers Ltd	102	W	Arms and Ammunitions
Ship's Cat	102	W	Pest and Vermin Control
Designscene Business Centre	105	N	Business Parks and Industrial Estates
Arun Microelectronics Ltd	109	W	Measurement and Inspection Equipment
Industrial Estate	118	W	Business Parks and Industrial Estates
Enterprise Garage	131	W	Vehicle Repairs, Testing and Servicing
Arundel Technologies Ltd	133	N	Medals, Trophies, Ceremonial and Religious Goods
Landing Stage	141	NE	Moorings and Unloading Facilities
Arundel Photographic	153	N	Photographic and Optical Equipment
Gennor UK Ltd	159	NW	Paints, Varnishes and Lacquers
Independent Digital Services	168	N	Electrical Equipment Repair and Servicing
Nineveh Shipyard	173	NW	Marine Equipment including Boats and Ships
The Waterside Tea Garden & Bistro	176	NE	Boat Hiring Services
Jam Gallery	181	N	Jewellery, Gems, Clocks and Watches
Warehouse	206	W	Container and Storage
Walking Stick Shop	210	NW	Disability and Mobility Equipment
Worldwide Digital Media	214	NW	Published Goods
Fireplace Specialist Ltd	214	NW	Published Goods

Based on their distance from the site and the nature of activities involved, all the above named current industrial land uses are not likely to pose any significant contamination source, with the exception of Texaco Services Station.





4.8 Sensitive Land Uses

The following sensitive land uses have been identified within close proximity to the site:

- 11no. records of Sites of Special Scientific Interest (SSSI) relating to Arundel Park and the closest is located 460m northwest;
- 2no. records for both South Down National Parks (NP) and Environmentally Sensitive Areas (ESA) within 2km radius and the closest is located 60m northeast; and,
- 38no. unnamed Ancient and Semi-Natural woodlands are recorded within 2km from the site and the nearest is located 342m to the north.

4.9 Site Sensitivity Assessment

Based on the site's proximity to residential dwellings and potential presence of Made Ground from onsite historic site use, the site is considered to be within a **low to medium** sensitivity setting in respect of human health.

With regards to controlled waters, the site is considered to be at a **medium** sensitivity setting for the following rationale:

- The superficial geology is designated Secondary 'A' Aquifer while the bedrock geology is designated a Principal Aquifer with high to very high permeability;
- The site is occupied by active businesses and is surrounded by residential dwellings;
- There is an electricity substation within the site boundary;
- The site is located near designated Environmentally Sensitive Sites;
- The River Arun is located 58m north west

4.10 Geotechnical Assessment

The following potential geotechnical constraints have been identified:

- Due to the site's proximity to the River Arun, it is anticipated that shallow groundwater level will pose a great risk foundation design and any excavation work; and,
- There is a potential for groundwater flooding to occur at the surface of the site.





5.0 REGULATORY INFORMATION

5.1 Contaminated Land Officer

The Pollution Officer Arun District Council has been contacted in view of any contamination concerns at the site via email. As at the time of writing this report, no official response has been received from either the Contaminated Land Officer, or the Council.

5.2 Landfill Sites and Waste Treatment Sites

A review of available information has identified three records of Environmental Agency historic landfill located at Fagins Den, Penfold Works and Canada Road all for inert, commercial and household wastes located 421m west, 685m southwest and 749m west, respectively. Records indicate that all three licences were issued 01/01/1976 and have not been surrendered.

There are no waste treatment sites within 1km radius of the site.

5.3 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table only includes records not otherwise detailed in the report.

Table 5.1 Summary of Regulatory Activities

Activity	0-249m	250-500m	Details
Fuel Stations Entries	1	0	Texaco Arundel Service Station located 25m to the southeast. This fuel station is now obsolete.
Records of Part 2A and Part B Activities and Enforcements	1	0	A single Part A activity for petrol vapour recovery process at Castle Service Station located 46m east of the site.
Licensed Discharge Consents	4	8	There are four discharge consents within 250m radius of the site comprising two sewage and two miscellaneous discharges at Town Quay Pumping Station at (72m north and 83m north) and Fitzalan Swimming Pool at (151m east). One of the Fitzalan Swimming Pool consents has been revoked while the rest remain undefined. Eight discharge consents are outside 250m radius which relate to 5 sewage and 3 miscellaneous discharges from Portreves Acre, Swimming Poll, Surrey Wharf Wastewater PS, 50 Fitzalan Road, Fitzalan Road Pumping Station and Arundel Relief Road. Three of the consents have been revoked while the rest remain undefined.
Environmental Agency Recorded Pollution Incidents	2	1	There are two records of oils and fuel pollution incidents dated 16/06/2001 and 22/08/2003. There are no recorded risks to air, land and water with only a minor risk to water 22/08/2003. There is one contaminated water incident on 10/10/2001 which had no risk to land and air but minor impact to water.
Authorised industrial processes (IPC/IPPC/LAPPC)	0	0	N/A
Licensed radioactive substances	0	0	N/A





Activity	0-249m	250-500m	Details
Planning Hazardous Substance Consents and Enforcements	0	0	N/A
Control of Major Accident Hazard (COMAH) sites	0	0	N/A
Notification of Installations Handling Hazardous Substances (NIHHS) sites	0	0	N/A
Contaminated Land Register Entries and Notices	0	0	N/A





6.0 INITIAL CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with CLR11 - Model Procedures for the Management of Land Contamination (Environment Agency, 2004) and BS 10175:2011+A1:2013 - Investigation of Potentially Contaminated Land. Code of Practice, a preliminary Conceptual Site Model (CSM) has been developed to identify potential contamination sources, migration pathways, and significant receptors within the site.

6.2 Contaminant Sources

6.2.1 On-site Potential Sources

Potential sources of contamination identified on site include;

- Made Ground associated with historical development of the site;
- Historical site use (Brewery and Joinery works);
- Potential contamination from onsite fuel storage;
- Current site use as a metal works polishing, spraying and finishing company;
- Electricity Substation in the northwest corner of the site; and
- Organic Rich Alluvial Soils.

6.2.2 Off-site Potential Sources

Potential sources of contamination identified off site include:

- Swallow Brewery located **adjacent** on the eastern boundary;
- Electricity Substations with the closest located **7m** north; and,
- Numerous garages with the closest located **8m** northeast;
- Potentially infilled grounds comprising Unspecified Wharfs/Pits Fish Ponds, Grave Yard and Cuttings and the closest located **35m** northwest;
- Allotment Garden **60m** west of the site boundary;
- Coal Yard **100m** to the west;
- Unspecified Tank/Tanks with the closest located **100m** east; and
- An infilled pond approximately **240m** southwest of the site.

6.3 Potential Pathways

Receptors may be potentially at risk from the identified potential sources of contamination via the following pathways:

- Migration of mobile contaminants on or off site via services, sewers and manmade conduits;
- Migration of gases through permeable strata within the Raised Marine Deposits;
- Direct contact, ingestion and inhalation of contaminants on site;





- Migration of contaminated dusts during earthworks;
- Migration of mobile contaminants into surface waters via groundwater;
- Migration of hazardous gases via permeable strata; and,
- Uptake of toxins/phytotoxins by plants.

6.4 Potential Receptors

The following potential receptors have been identified:

- Future site users (i.e. female residential child);
- Neighbouring residents (female child); and,
- Controlled waters (Principal Aquifer – Bedrock, River Arun – Primary River).

Construction workers are not considered to be a plausible receptor as exposure will be managed through the use of appropriate PPE and hygienic working practices, as required under HSE/ CDM regulations. Furthermore potential exposure to possible contaminants is not expected to be over prolonged work duration thereby limiting any impact to ground workers.

6.5 Preliminary Risk Assessment

CIRIA 552: Contaminated Land Risk Assessment 'A Guide to Good Practice' provides guidance on risk assessment taking into account factors such as severity of the potential harm that may arise from a successful pollutant linkage, potential magnitude of the hazard, and the sensitivity of the target receptor. Risk assessment is initially assessed by determining the severity of the potential hazard, which takes into account receptor sensitivity and the magnitude of the potential impact as detailed in Tables 6.1 & 6.2 below:

6.2.1 Severity

Table 6.1 Receptor sensitivity

Category	Human sensitivity	Environmental sensitivity
Very Low	Ground workers	Non-sensitive water course
Low	Commercial / Industrial	Secondary Aquifer
Moderate	Residential without plant uptake	Principal Aquifer / Sensitive Watercourse
High	Residential with plant uptake	Groundwater Source Protection Zone

Table 6.2 Magnitude of Impact

Category	Example
No impact	No identified or potential pollutants present
Slight impact	Minor leaks and spills from fuel infrastructure, inert landfills
Moderate impact	Major leaks and spills from fuel infrastructure
Gross impact	Heavily contaminated industrial sites, hazardous landfills





Severity is subsequently assessed considering the potential receptor and magnitude of impact as outlined within Table 6.3 below:

Table 6.3 Determination of level of severity for potential hazards

	Receptor Sensitivity			
	Very Low	Low	Moderate	High
No Impact	Minor	Minor	Minor	Minor
Slight Impact	Minor	Minor	Minor	Mild
Moderate Impact	Minor	Minor	Mild	Medium
Gross Impact	Minor	Mild	Medium	Severe

6.2.2 Likelihood

The likelihood of an event is assessed while considering the potential for presence of a contaminant, presence of receptor, and the substantiality of the pollutant pathway. Likelihood is broken down into four separate categories within the CSM as shown in Table 6.4 below:

Table 6.4 Definitions of likelihood categories

Category	Definition
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.
Low Likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
High Likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.

6.2.3 Risk Rating

Table 6.5 demonstrates the methodology used to provide an overall risk rating within the preliminary CSM with respect to any potential sources of contamination that may affect the site. An overall risk rating is assigned to each potential contaminant considering the assessed likelihood and severity as determined using the methodologies within Tables 6.1 to 6.4.

Table 6.5 Level of risk rating for hazard definition

Likelihood	Severity			
	Minor	Mild	Medium	Severe
Unlikely	Very Low	Very Low	Low	Low / Moderate
Low Likelihood	Very Low	Low	Low / Moderate	Moderate
Likely	Low	Low / Moderate	Moderate	High
High Likelihood	Low / Moderate	Moderate	High	Very High





6.6 Conceptual Site Model

A site specific CSM has therefore been created using the above information and is provided on the following page.





Table 6.6 Initial Conceptual Site Model (CSM)

Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood	Severity	Overall Risk Rating	Active / Inactive
On-Site							
Made Ground associated with historical development	Heavy Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion of soils Dermal contact with soils	Future Site Users	High Likelihood	Medium	High	Potentially Active – further investigation recommended for risks to future site users
		Vertical and lateral migration	Controlled Waters	Low Likelihood	Medium	Low / Moderate	
	Asbestos Fibres In Soil	Inhalation of airborne fibres	Future Site Users	High Likelihood	Severe	Very High	
	Polycyclic Aromatic Hydrocarbons (PAHs) and Total Petroleum Hydrocarbons (TPHs)	Ingestion of soils Dermal contact with soils Inhalation of vapours	Future Site Users	Likely	Severe	High	
		Vertical and lateral migration	Controlled Waters	Likely	Medium	Moderate	
	Ground gas generation (CH ₄ and CO ₂)	Inhalation of ground gases	Future Site Users	Likely	Severe	High	
Historical site use (Swallow Brewery, Joinery Works and metal polishing/coating)	Total Petroleum Hydrocarbons (TPHs)	Inhalation of vapours Ingestion of soils Dermal contact with soils	Future Site Users	Likely	Medium	Moderate	Potentially Active – further investigation recommended for risks to future site users
		Vertical and lateral migration	Controlled Waters	Likely	Medium	Moderate	
	Polycyclic Aromatic Hydrocarbons (PAHs)	Ingestion of soils Dermal contact with soils	Future Site Users	Likely	Medium	Moderate	
	Volatile Organic Compounds (VOCs)	Inhalation of vapours	Future Site Users	Low Likelihood	Medium	Low / Moderate	
		Vertical and lateral migration	Controlled Waters	Low Likelihood	Medium	Low / Moderate	
Fuel storage adjacent to the north boundary	Total Petroleum Hydrocarbons (TPHs)	Inhalation of vapours Ingestion of soils Dermal contact with soils	Future Site Users	Likely	Medium	Moderate	Potentially Active – further investigation recommended for risks to future site users
		Vertical and lateral migration	Controlled Waters	Likely	Medium	Moderate	
	Polycyclic Aromatic Hydrocarbons (PAHs)	Ingestion of soils Dermal contact with soils	Future Site Users	Likely	Medium	Moderate	
Electricity substation in the northwest corner	Polychlorinated Biphenyls (PCBs)	Lateral and vertical migration onto site	Future Site Users	Unlikely	Medium	Low	Inactive – PCB has very low mobility and is unlikely to migrate to



							the site.
Organic Rich Alluvial Soils	Ground gas generation (CH ₄ and CO ₂)	Inhalation of ground gases	Future Site Users	Likely	Severe	Moderate	Potentially Active – further investigation recommended for risks to future site users
Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood	Severity	Overall Risk Rating	Active / Inactive
Off-Site							
Allotment garden 60m to the west boundary	Heavy Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	Inactive – Given the distance to site and the general immobility of farming pesticides the linkage is considered to pose an insignificant risk to the future development of the site.
		Lateral and vertical migration	Controlled Waters	Unlikely	Medium	Low	
	Herbicides and Pesticides	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	
Swallow Brewery to the east of the site boundary	Ground gas generation (CH ₄ and CO ₂)	Lateral and vertical migration	Future Site Users	Unlikely	Severe	Low / Moderate	Potentially Active – further investigation recommended for risks to future site users.
Coal Yard 100m to the west	Total Petroleum Hydrocarbons (TPHs)	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	Inactive – considering the distance from site this is unlikely to pose significant to future use of the site
	Polycyclic Aromatic Hydrocarbons (PAHs)	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	
	Ground gas generation (CH ₄ and CO ₂)	Lateral and vertical migration	Future Site Users	Low Likelihood	Medium	Low / Moderate	Potentially Active – further investigation recommended for risks to future site users in relation to production of ground gases.



Offsite Tanks (closest located 100m east)	Total Petroleum Hydrocarbons (TPHs)	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	Inactive – considering the distance from site this is unlikely to pose significant to future use of the site
	Polycyclic Aromatic Hydrocarbons (PAHs)	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	
Garages in surrounding area (Closest located 8m northeast)	Total Petroleum Hydrocarbons (TPHs)	Lateral and vertical migration	Future Site Users	Likely	Severe	High	Potentially Active – further investigation recommended for risks to future site users
		Lateral and vertical migration	Controlled Waters	Likely	Severe	High	
Potential infilled grounds (closest located 35m northwest)	Potential ground gas generation (CH ₄ and CO ₂)	Lateral and vertical migration	Future Site Users	Low Likelihood	Severe	Moderate	Potentially Active – further investigation recommended for risks to future site users
Electricity substations (closest located 7m north)	PCBs	Lateral and vertical migration	Future Site Users	Unlikely	Medium	Low	Inactive – PCB's also have a very low mobility and are unlikely to migrate to the site.



7.0 SITE INVESTIGATION

7.1 Desk Study Information

Potential contamination sources have been identified from the desk study and these are listed in Table 7.1 below:

Table 7.1 Summary of Potential Contaminant Sources

Potential Source	Potential Contaminants	Potential Receptor
Made Ground associated with historical development	Metals, PAHs, TPHs, ground gases & asbestos	Future site users, controlled waters and buildings.
Historical Site Use	PAHs, TPHs and VOCs	Future site users and controlled waters
Fuel Storage	PAHs and TPHs	Future site users and controlled waters
Swallow Brewery off the east boundary	Ground gases	Future site users
Coal Yard 100m to the west	Ground gases	Future site users
Garages in the surrounding	TPHs	Future site users and controlled waters
Potentially infilled ground	Ground gases	Future site users

7.2 Site Investigation

A ground investigation was designed based on the findings of the desk study with exploratory holes advanced to target specific potential contaminant sources as summarised in Table 7.1 above. However, the works were limited to a single day of window sampling by the Client given that they would be undertaken prior to purchase.

In addition to the above, exploratory holes have also been advanced to provide information on baseline conditions across the site. The investigation has also been used to investigate the geotechnical information to assist in the design and construction of the proposed residential properties and associated infrastructure. An Exploratory Hole Location Plan (ref. 1CO102284-002) is presented in Appendix III.

Exploratory fieldwork was completed on the 29th September 2016 and a summary of works undertaken are presented in Table 7.2 below. A selection of site photographs are presented in Appendix VIII.

The ground conditions encountered, and details of monitoring well response zones are indicated on the logs, which are provided in Appendix IV.





Two initial return visits were undertaken to monitor installations for groundwater levels and ground gas concentrations, results are presented in Table 8.8.

Table 7.2 Summary of Fieldwork

Location Hole	Potential Source/Rationale	Type	Maximum Depth (m bgl)	Monitoring Wells Response Zone (m bgl)
WS101	To obtain information on baseline chemical and geotechnical conditions across the site.	Window Sample	5.00	1.00 – 4.50
WS102			4.00	N/A
WS103			5.00	1.00 – 5.00
WS104			5.00	N/A

Notes

m bgl – metres below ground level, N/A – Not applicable.

Soil samples obtained for chemical analysis were collected in appropriate sampling containers. All samples were subsequently stored in cooled boxes prior to submission to a UKAS accredited analytical laboratory. All samples were collected using appropriate PPE. A more detailed copy of REC sampling methodology, QA procedures and laboratory chain of custody forms can be provided upon request.

7.3 In-Situ Testing

7.3.1 Hand Shear Vanes

In-situ hand shear vane tests were carried out within the fine grained deposits at varying depths within each of the window sample locations. The results of the hand shear vane testing are presented on the exploratory hole logs included within Appendix IV.

7.3.2 Standard Penetration Tests

Standard Penetration Tests (SPTs) were carried out within each of the window sample locations, from a depth of 1.20m bgl and at every metre thereafter, where possible. The testing was carried out to provide validation of ground consistency and strength observations. The results of the in-situ SPT testing are presented in Section 8.1.4.

7.4 Laboratory Analysis

7.4.1 Soil Chemical Analysis

Selected soil samples were submitted to UKAS accredited Scientific Analysis Laboratories (SAL) Ltd of Braintree for a range of chemical analysis comprising, metals, pH, water soluble sulphate (2:1 extract), cyanide, phenols, total and speciated polycyclic aromatic hydrocarbons (PAHs), asbestos and banded total petroleum hydrocarbons (TPH). The results of the chemical analysis are included in Appendix V and discussed in Section 9.

7.4.2 Geotechnical Laboratory Analysis

Selected soil samples were submitted to UKAS accredited Professional Soil Laboratories (PSL) Ltd of Doncaster, where the following geotechnical analysis were undertaken:

- Atterberg Limits determinations; and,





➤ Moisture content;

The results of the geotechnical analysis are presented in Appendix VI and discussed in Sections 8 and 10.

7.5 Land Gas and Groundwater Monitoring

Two ground gas and groundwater monitoring wells were installed on site and two return monitoring visits were undertaken on 7th and 17th October 2016.

Concentrations of methane (CH₄), carbon dioxide (CO₂) and Oxygen (O₂) were measured using a gas analyser (GFM435), calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an internal flow pod. Gas measurements were recorded for a minimum of three minutes at each location, at which point the maximum concentration of CH₄ and CO₂ together with the lowest concentration of O₂ were recorded.

Groundwater level monitoring was undertaken using an electronic dip meter to record the depth to groundwater.

The results of ground gas and groundwater monitoring are presented within Table 8.8. Groundwater conditions are discussed within Section 8.2 and ground gas results are discussed in Section 9.3.





8.0 GROUND AND GROUNDWATER CONDITIONS

8.1 Ground Conditions

8.1.1 Summary of Ground Conditions

The ground investigation generally confirmed the published geology and identifies the strata set out in Table 8.1 below. Exploratory hole logs are included in Appendix IV.

Table 8.1 Summary of Strata

Stratum	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness(m)
Made Ground	Ground Level	Ground Level	0.90 (WS101 & WS104)
Alluvium	0.50	0.90	4.50 (WS103)NP

NP – Not proven

8.1.2 Made Ground

Made Ground was encountered within all exploratory hole and typically comprised reinforced concrete or paving bricks over sandy GRAVEL / CLAY of varying proportions. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse flint, brick, concrete, asphalt, charcoal, ash, chalk and rare glass/ceramics. Cobbles are sub-rounded flints, bricks, concretes and white chalk relics. A maximum thickness of 0.90m bgl was encountered within WS101 and WS104.

No visual or olfactory evidence of potential contamination was identified within this stratum during the works.

8.1.3 Solid Geology (Alluvium: Raised Marine Deposits)

Raised Marine Deposits (Alluvium) was encountered within all exploratory holes and typically comprised soft dark grey orangeish brown silty slightly gravelly CLAY with low cobble content. Gravel is angular to sub-rounded fine to medium flint. Cobbles are sub-rounded flint. The stratum was noted to change at depth to slightly silty organic CLAY. Organic material was noted to comprise amorphous products, with an organic odour throughout.

No visual or olfactory evidence of potential contamination was identified within this stratum during the works.

8.1.4 Standard Penetration Tests

Results of the Standard Penetration Tests, including undrained shear strengths derived from SPTs are included on Table 8.2 overleaf.





Table 8.2 Standard Penetration Test Results

Boreholes	Depth (m bgt)	Material Field Description	CPT/SPT "N" Value	Consistency/ Relative Density	Undrained shear strength (Cu)
WS101	1.00	Gravelly CLAY	0	Very soft	-
	2.00	CLAY	0	Very soft	-
	3.00	CLAY	0	Very soft	-
	4.00	CLAY	0	Very soft	-
	5.00	CLAY	0	Very soft	-
WS102	1.00	CLAY	2	Very soft	9
	2.00	CLAY	0	Very soft	-
	3.00	CLAY	0	Very soft	-
	4.00	CLAY	0	Very soft	-
	5.00	CLAY	0	Very soft	-
WS103	1.00	Gravelly CLAY	2	Very soft	9
	2.00	CLAY	0	Very soft	-
	3.00	CLAY	0	Very soft	-
	4.00	CLAY	0	Very soft	-
	5.00	CLAY	0	Very soft	-
WS104	1.00	CLAY	4	Very soft	18
	2.00	CLAY	0	Very soft	-
	3.00	CLAY	0	Very soft	-
	4.00	CLAY	0	Very soft	-
	5.00	CLAY	0	Very soft	-

8.1.5 Soil Plasticity

Atterberg Limit determination tests, summarised in Table 8.3 below, indicate the Alluvium deposits to be typically of medium volume change potential based on modified plasticity indices. Although it should be noted that they are close to the 40% threshold for high volume change potential indicated within NHBC Standards - Chapter 4.2 'Building near Trees'.

Table 8.3 Summary of Atterberg Limits

Location	Depth (m)	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index	Volume Change Potential
WS101	1.90	33	65	27	38	100	38	Medium
WS102	1.30	35	67	28	39	100	39	Medium
WS103	1.90	32	59	25	34	98	33	Medium
WS104	1.30	33	62	26	36	100	36	Medium





8.1.6 pH and Sulphate

Chemical analyses for pH and water soluble sulphate (2:1 aqueous extract) contained in Appendix V (summarised below in Table 8.4), indicates that the near surface soils within both the Made Ground and the Alluvial deposits generally meet class DS-1 / AC-1s in accordance with BRE Special Digest 1 (2005). However, samples obtained from WS102 and WS104 indicated classifications of DS-2 / AC1s and DS-3 / AC2s respectively. As such it is recommended that a worst case is utilised in the design of shallow concrete structures.

Results are summarised in Table 8.4 below:

Table 8.4 Summary of pH and Sulphate Data

Location	Depth (m)	Water soluble SO ₄ (mg/l)	pH Value	Concrete Classification
WS101	0.50	300	8.5	DS-1 / AC1s
WS102	0.30	700	10.6	DS-2 / AC1s
WS103	0.20	150	8.3	DS-1 / AC1s
WS104	0.20	1600	8.6	DS-3 / AC2s
	0.50	370	8.4	DS-1 / AC1s

8.2 Groundwater Conditions

No groundwater was encountered within any of the exploratory holes during the site investigation. However groundwater was encountered within the two monitoring wells (WS101 and WS103) during the return visits at depths ranging between 1.08 and 1.39mbgl.

No visual or olfactory evidence of potential contamination within the groundwater was identified.

8.3 Ground Gas

Two gas monitoring installation wells were installed within WS101 and WS103 with response zones from 1.00m - 4.50m to 1.00 - 5.00mbgl. The results of the ground gas monitoring are presented in Table 8.6 overleaf.

8.4 Non-standard Permeability Testing

It was not possible to undertake non-standard permeability testing in the installations following the completion of works given the high groundwater monitored. However, given that ground conditions comprised Made Ground overlying predominantly fine grained and relatively impermeable soils it is not anticipated that shallow soakaways could feasibly be adopted. As such it is likely that deep borehole soakaways constructed within the underlying Chalk will be required will as the most likely option for disposal of surface water. However, additional ground investigation works will be required in order to assess this.





Table 8.6 Summary of ground gas and groundwater monitoring results

Date	Well	Flow (l/hr)		Low O ₂ %v/v	Concentration CH ₄		CH ₄ Qhg l/hr	Concentration CO ₂		CO ₂ Qhg l/hr	Atmospheric Pressure (mbar)	Response Zone (mbgl)	Depth to Water (mbgl)	Response zone flooded?
		Peak	Steady		Peak %v/v	Steady %v/v		Peak %v/v	Steady %v/v					
07/10/2016	WS101	<0.1	<0.1	19.0	<0.1	<0.1	<0.0001	0.9	0.9	0.0009	1020 (Steady)	1.00-4.37	1.21	No
07/10/2016	WS103	<0.1	<0.1	19.5	<0.1	<0.1	<0.0001	1.6	1.6	0.0016	1021 (Steady)	1.00-4.91	1.39	No
17/10/2016	WS101	<0.1	<0.1	21.0	<0.1	<0.1	<0.0001	<0.1	<0.1	<0.0001	1019 (Rising)	1.00-4.37	1.08	No
17/10/2016	WS103	<0.1	<0.1	19.3	<0.1	<0.1	<0.0001	1.4	1.4	0.0014	1019 (Rising)	1.00-4.90	1.28	No



9.0 TIER II GENERIC QUANTITATIVE CONTAMINATED LAND RISK ASSESSMENT

REC has undertaken a Tier II qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

9.1 Generic Assessment Criteria

At a Tier II stage, the long term (chronic) toxicity risk to human health is assessed by utilising appropriate and conservative generic assessment criteria (GAC) to determine whether there are actual or potential unacceptable risks at the site and if any viable pollutant linkages are present.

To undertake the Tier II assessment within the context of the development proposal, REC has determined that the most appropriate GAC values available will be those based upon a residential land use with the cultivation and ingestion of home-grown produce taken into account.

Utilising a truncated mean and discounting the highest and lowest SOM results, a value of 3.2% has been achieved. As such it is believed a SOM of 2.5% utilised within the Tier II assessment is most applicable.

The following assessment, summarised below and overleaf in Table 9.1, has primarily adopted the S4UL (Suitable for Use Levels reference values published by LQM/CIEH in 2015, the S4ULs). Currently, no published GAC value is available for cyanide and therefore REC has utilised the Environmental Agency Contaminated Land Exposure Assessment Tool (CLEA v1.06) to derive the relevant GAC for this proposed land use. Due to the absence of a published lead GAC for direct use within the planning regime, the 2014 Defra C4SL (Category 4 Screening Level) has been used as this value is considered to incorporate the latest toxicological, bio-accessibility and exposure modelling research to date.

Table 9.1 Summary of Toxicity Assessment for a Residential End Use with Plant Uptake (2.5% SOM)

Determinand	GAC (mg/kg)	GAC Source	n	[mc] (mg/kg)	Location / Strata	Primary Pathways	Assessment
Inorganics							
Arsenic	37	(i)	4	14	N/A	1	NFA
Barium	1200	(iv)	4	430		1	
Beryllium	1.7	(i)	4	0.9		1, 3	
Boron	290	(i)	4	<1		1, 2	
Cadmium	11	(i)	4	0.3		1, 2	
Chromium (III)	910	(i)	4	18		3	
Chromium (VI)	6	(i)	4	<1		1, 2, 3	
Copper	2400	(i)	4	59		1, 2	
Lead	200	(iii)	4	160		1, 2	
Mercury [Inorganic]	40	(i)	4	<1.0		1, 2	
Nickel	180	(i)	4	25		1	
Selenium	250	(i)	4	<3		1, 2	
Vanadium	410	(i)	4	34		1, 2	
Zinc	3700	(i)	4	400		1, 2	
Cyanide [Total]	3.4	(iv)	4	<1		1	
Asbestos	D.	(v)	4	ND	3		
Organics – PAHs and Phenol							
Phenols	550	(ii)	4	<1	N/A	2	NFA
Acenaphthene	510	(ii)	4	<0.1		2	
Acenaphthylene	420	(ii)	4	<0.1		2	





Determinand	GAC (mg/kg)	GAC Source	n	[mc] (mg/kg)	Location / Strata	Primary Pathways	Assessment
Anthracene	5400	(ii)	4	<0.1		2	
Benzo (a) anthracene	11	(ii)	4	<0.1		1	
Benzo (a) pyrene	2.7	(ii)	4	<0.1		1	
Benzo (b) fluoranthene	3.3	(ii)	4	<0.1		1	
Benzo (ghi) perylene	340	(ii)	4	<0.1		1	
Benzo (k) fluoranthene	93	(ii)	4	<0.1		1	
Chrysene	22	(ii)	4	0.1		1	
Dibenzo (a,h) anthracene	0.28	(ii)	4	<0.1		1	
Fluoranthene	560	(ii)	4	0.2		1, 2	
Fluorene	400	(ii)	4	<0.1		2	
Indeno (123-cd) pyrene	36	(ii)	4	<0.1		1	
Naphthalene	5.6	(ii)	4	<0.1		4	
Phenanthrene	220	(ii)	4	0.2		2	
Pyrene	1200	(ii)	4	0.1		1, 2	
Organics – TPH							
TPH C ₅ -C ₆	78	(ii)	4	<0.10	N/A	4	NFA
TPH C ₆ -C ₈	230	(ii)	4	<0.10		4	
TPH C ₈ -C ₁₀	65	(ii)	4	<0.10		4	
TPH C ₁₀ -C ₁₂	330	(ii)	4	<2		4	
TPH C ₁₂ -C ₁₆	2400	(ii)	4	<2		1, 2	
TPH C ₁₆ -C ₂₁	540	(ii)	4	4		1	
TPH C ₂₁ -C ₃₅	1500	(ii)	4	80		1	
Key for Table 9.1							
[mc]	Maximum Concentration Recorded						
D.	Fibres detected						
N.D.	No significant / trace presence of fibres detected (Limit of Detection = <0.001%)						
Primary Pathways							
1	Ingestion of soil and indoor dust and / or oral background exposure;						
2	Consumption of home-grown produce and attached soil;						
3	Inhalation of dust (background and indoor);						
4	Inhalation of vapour (background and indoor);						
Generic Assessment Criteria (GAC) Sources							
(i)	LQM/CIEH Suitable For Use Level (S4UL) (2015);						
(ii)	S4UL – Conservative Assessment Approach of 2.5% SOM;						
(iii)	Defra Category 4 Screening Level (2014);						
(iv)	CLEA 1.06 Derived Value;						
(v)	Control of Asbestos Regulations 2012 (CAR-SOIL, 2012).						

9.2 Human Health

A review of Tier II toxicity assessment results presented in Table 9.1 above shows that the tested soils did not exceed any Generic Assessment Criteria (GAC) values for any tested determinants. This is with respect to potential human health risk to future residential users, with private or communal gardens. However, it should be noted that this assessment has been made on a very limited data set based on a single day of window sampling specified by the Client. This is more pertinent in the area around the bunded fuel tank where only a single exploratory hole location was undertaken.

9.3 Controlled Waters

The site is considered to be a **medium** sensitivity setting with respect to controlled waters on the





basis that the site is underlain by both Secondary 'A' (Raised Marine Deposits) and Principal (Spetisbury Chalk Member) Aquifers. In addition, there are two historic groundwater and a single active potable water abstraction located within 1km of the site. Again, a network of surface water tributary lies within 250m of the site.

Given that no exceedances were identified in the soils analysed, no significant risk to controlled waters is present. However, this is based on a very limited data set.

9.4 Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published within BS 8485:2015.

Two monitoring visits have been completed over a period of two weeks between 7th October 2016 and 17th October 2016, with atmospheric pressure varying between 1019mbar and 1021mbar. A maximum concentration of 1.6% v/v carbon dioxide was recorded in WS103. Methane levels were all <0.1% v/v. All borehole flow rates were <0.1l/hr.

In accordance with the methodology outlined within BS8485:2015, REC have utilised the results of the ground gas monitoring surveys to calculate a tentative borehole hazardous gas flow rate (Qhg), previously known as a Gas Screening Value (GSV).

Table 9.2 Summary of Hazardous Gas Flow Rate

Flow rate (l/h)	Maximum CH ₄ (%)	Maximum CO ₂ (%)	CH ₄ Qhg (l/h)	CO ₂ Qhg Rate (l/h)	Implied CH ₄ CS	Implied CO ₂ CS
<0.1	<0.1	1.6	<0.0001	<0.0016	1	1

CS : Characteristic Situation

Qhg : Hazardous gas flow rate

The maximum implied characteristic situation for the site has therefore been calculated by combining the maximum observed flow rate and maximum observed concentrations during any monitoring event. This methodology provides a 'worst case scenario' in order to characterise the highest potential risk to human health from ground gas at the site.

On the basis of measurements in Table 9.2, the site maximum site hazardous gas flow rate is considered to be <0.0016 L/h, which is the worst case for both methane and carbon dioxide. A maximum site hazardous gas flow rate of 0.0016 L/h lies well within the range of GSV values for CS1 (< 0.07 L/h). As such, the gas regime for the site can be classified as Characteristic Situation 1 (CS1) based on the limited monitoring visits undertaken.

It is therefore considered that no gas protection measures are required to be installed within the proposed development, based on the data available data. However, we would recommend that additional visits are undertaken in order to expand the data set and confirm this assessment.

9.5 Revised Conceptual Site Model

The Phase II Site Investigation has not identified any potentially harmful contaminants on site. However, this is based on a very limited data set.





10.0 GEOTECHNICAL ASSESSMENT

10.1 Proposed Development

REC Ltd understands that Renaissance Group of Companies Ltd is proposing to redevelop the site into retirement apartments without basements. The proposed site development plan has yet to be finalised.

10.2 Summary of Ground and Groundwater Conditions

Ground conditions identified at the site are summarised in Section 8.1.1 and typically comprises Made Ground, encountered within all exploratory locations, between depths of ground level to 0.90m bgl overlying typically soft CLAY alluvial soils.

No groundwater was encountered within any of the exploratory holes during the site investigation. However groundwater was encountered within the two monitoring wells (WS101 and WS103) during the return visits to depths ranging between 1.08 and 1.39mbgl.

10.3 Site Preparation

It is recommended that the site is cleared and any vegetation below areas of proposed development are stripped in accordance with Series 200 of the Specification for Highway Works. Redundant services should be sealed off, grubbed out and replaced with suitable compacted engineered fill.

10.4 Foundation Conditions and Bearing Capacity

It is considered that the Made Ground and Alluvial Clays identified on site are not suitable as founding material due to their inherent variability and poor strength which will give rise to unpredictable differential and total settlements. As such, it is likely that a piled foundation solution will be adopted for the proposed scheme. It is therefore recommended that boreholes are advanced in order to obtain information on deeper and more competent ground conditions.

10.5 Concrete Durability

Chemical analyses for pH and water soluble sulphate (2:1 aqueous extract) contained in Appendix V indicates that the near surface soils within both the Made Ground and the Alluvial deposits generally meet class DS-1 / AC-1s in accordance with BRE Special Digest 1 (2005). However, samples obtained from WS102 and WS104 indicated classifications of DS-2 / AC1s and DS-3 / AC2s respectively. As such it is recommended that a worst case is utilised in the design of shallow concrete structures. Further testing should be undertaken at depth to assess the concrete classification in accordance with BRE SD1 for the interactions with any proposed piled foundations

10.6 Excavations

It is recommended that where man entry into excavations deeper than 1.20m is required that either excavations are shored or that the sides of excavations are battered to a safe angle of repose.

Excavations should be protected during construction in order to avoid potentially excessive softening caused by wet weather or potential shrink and swell caused by periods of hot weather.





10.7 Floor Slabs

Given that the proposed development is likely to be piled a suspended floor slab will therefore be incorporated into the scheme. Ventilation of the under floor void will be required however, to address potential condensation issues.

It is recommended that advice should be sought from a suitably qualified structural engineer with regard to the design and construction of the floor slab.

10.8 Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- It is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and floor slabs;
- All excavations should be protected during construction in order to avoid potentially excessive softening caused by wet weather or potential shrink and swell caused by periods of hot weather; and,
- Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 utilised.

10.9 Pavements and Construction

Atterberg Limit determinations identified underlying natural deposits to be of medium volume change potential with a Plasticity Index of circa 34% to 39%. Such a Plasticity Index is indicative of a design CBR value of 3-4%, assuming a high water table in average construction conditions in accordance with *Design Manual for Roads and Bridges Volume 7: Pavement Design and Maintenance*.

As with good construction practice it is recommended that the formation level be inspected and that any areas of soft/loose deleterious strata are replaced with an appropriately compacted coarse grained medium. Likewise, any hard spots should also be removed to guard against reflective cracking in the pavement. Proof rolling/compaction of the formation level should be carried out prior to laying the new pavement.





11.0 CONCLUSIONS & RECOMMENDATIONS

The findings of this report have not identified any significant contamination issues pertaining to the proposed scheme. This is most likely attributable to the site being covered in concrete hardstanding which has severed the pathway between the various on-site sources and receptors. In addition, given the relatively fine grained and impermeable nature of the underlying soils, lateral and vertical migration is therefore likely to have been minimised.

However, this is based on a very limited data set and as such we would recommend that the following supplementary works are undertaken in order to provide a more robust report:

- Additional window sampling locations with extra land gas and groundwater points installed in order to expand the chemical analysis data set and to establish whether a vapour risk is present through VOC analysis;
- Additional land gas and groundwater monitoring visits undertaken to confirm whether gas protection measures are required;
- Groundwater sampling and analysis to determine whether a risk is present from historical uses. This will be important given that a piled foundation solution and deep bore soakaways are likely to be adopted for the scheme;
- Deeper boreholes into the underlying CHALK in order to establish whether deep bore soakaways could be utilised and in order to obtain information for outline pile design given the relatively poor strength of the natural Alluvial soils encountered; and
- Additional sampling and chemical analysis undertaken in the area of the fuel tank situated in the northeast corner of the site, primarily beneath the existing bund once it has been removed.

END OF REPORT





Phase I & II Geo-Environmental Assessment
14 Fitzalan Road
Arundel
October 2016
1CO102284P2R0

APPENDIX I LIMITATIONS

APPENDIX I LIMITATIONS





1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client as indicated in Section 1.2.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
11. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.





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APPENDIX II GLOSSARY

APPENDIX II

GLOSSARY





TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

UNITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m ³	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m ²	Kilo Newtons per metre squared
µm	Micro metre





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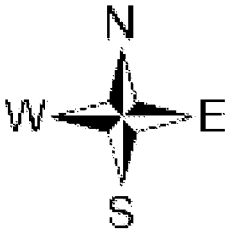
APPENDIX III DRAWINGS

APPENDIX III

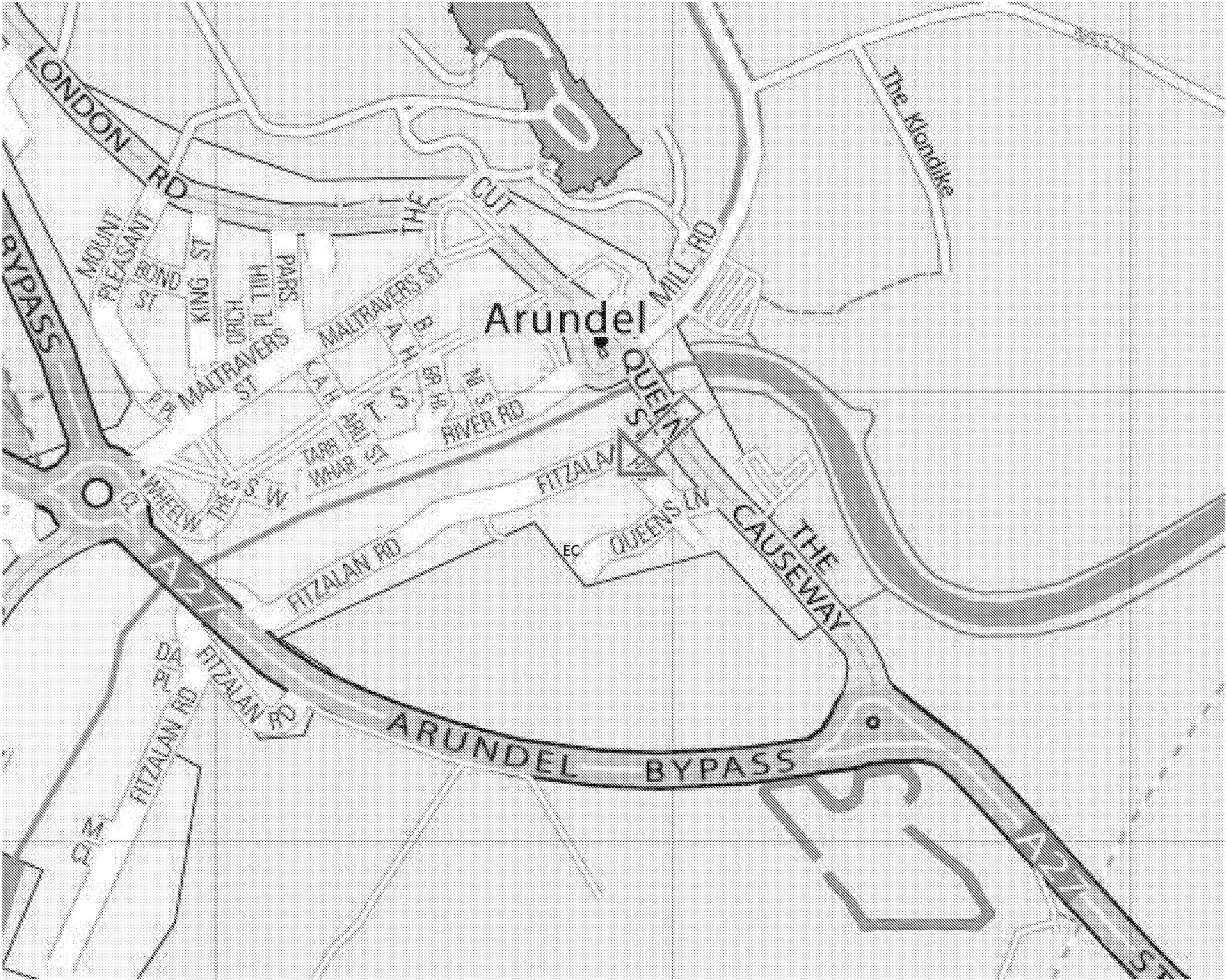
DRAWINGS



KEY:



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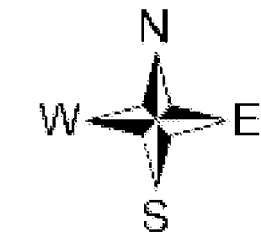
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Renaissance Group of
Companies

Job No:	1C0102284
Drawn By:	EC
Approved by:	RL

Notes:
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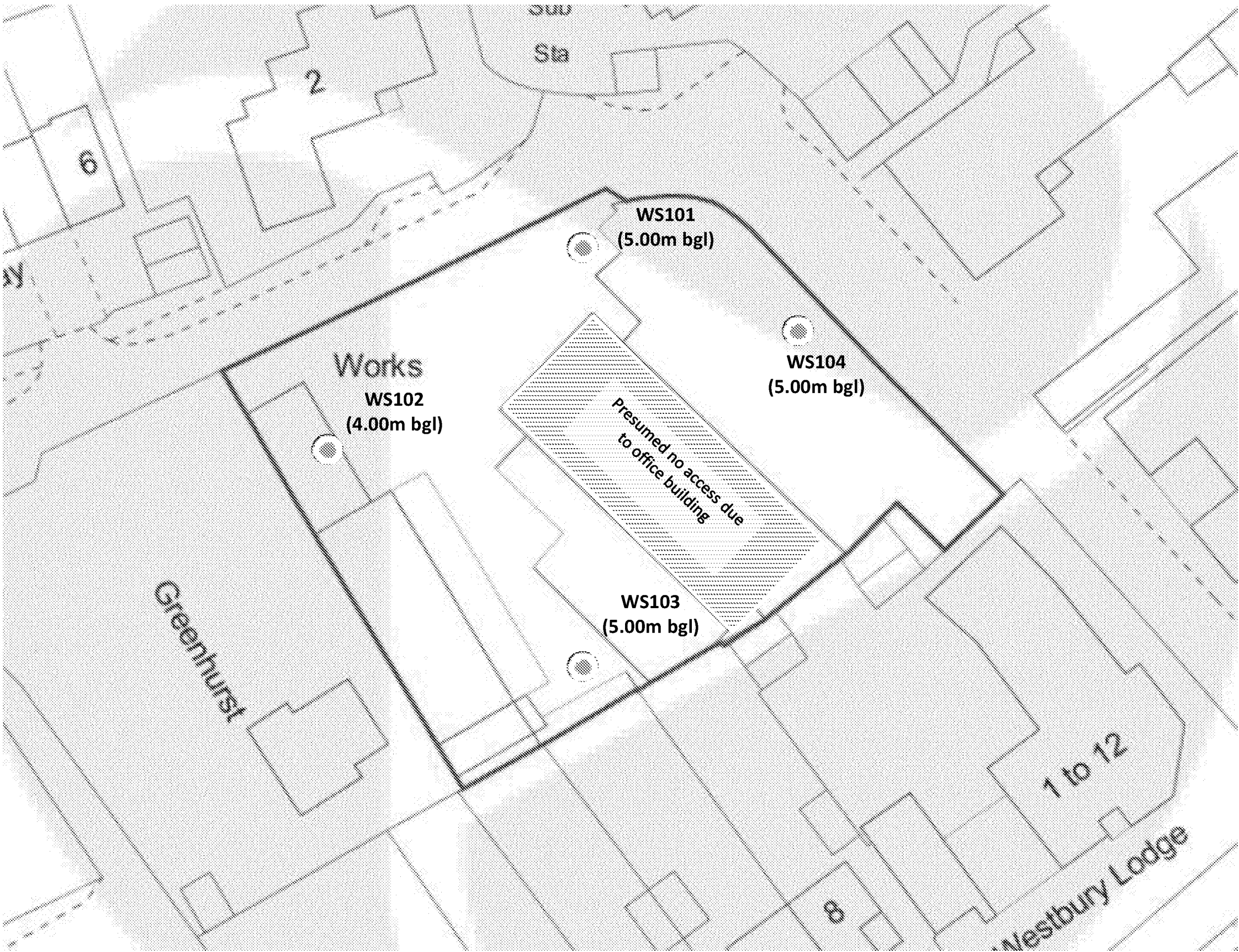
Drawing Title:
**1C0102284 –001 Site
Location Plan**

KEY:



 Window Sample Location

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Client:

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Companies

Job No:	1CO102284
Drawn By:	MN
Approved by:	RL

Notes:

Not to scale

Drawing Title:

**1CO102284 –002
Exploratory Hole Locations**



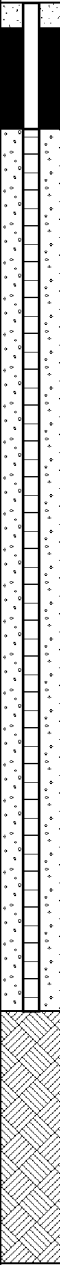
Phase I & II Geo-Environmental Assessment
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APPENDIX IV EXPLORATORY HOLE LOGS

APPENDIX IV EXPLORATORY HOLE LOGS



   		Borehole Log		Borehole No. WS101 Sheet 1 of 1	
Project Name: Arundel		Proj. ID: 1CO102284		Easting: Northing:	
Location: 14 Fitzalan Road, Arundel, West Sussex, BN18 9JS		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 5.00	
Client: Renaissance Group of Companies		Crew: Borehole Solutions Ltd		Start Date: 29/09/2016 End Date: 29/09/2016	
REC Engineer: MN					

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		Concrete with metal reinforcement [MADE GROUND]		
		0.30 - 0.40	ES		0.40		Brown sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse flint. Cobbles are subrounded flint. [MADE GROUND]		
		0.50 - 0.60	ES		0.90		Firm dark grey yellowish brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint, brick, chalk, ash and ceramics. Cobbles are subangular flint and brick. [MADE GROUND]		
		1.00 1.00 - 1.10	SPT ES	N=0 (0,0/0,0,0,0)	1.70		Soft orange brown mottled silty slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to medium flint. Cobbles are subrounded flints. [ALLUVIUM]	1	
		1.90 - 2.00 2.00 2.00	D SPT	HVP=36 N=0 (0,0/0,0,0,0)			Very soft dark greyish brown slightly silty organic CLAY. Amorphous organic material. Organic smell throughout. [ALLUVIUM]	2	
		2.90 - 3.00 3.00 3.00	D SPT	HVP=15 N=0 (0,0/0,0,0,0)				3	
		3.90 - 4.00 4.00 4.00	D SPT	HVP=5 N=0 (0,0/0,0,0,0)				4	
		4.90 - 5.00 5.00	D SPT	N=0 (0,0/0,0,0,0)	5.00			5	
							End of Borehole at 5.00m		
								6	

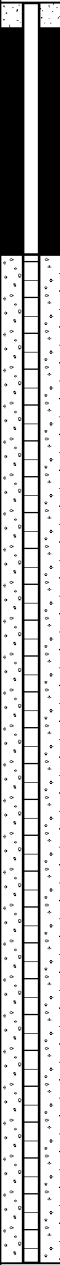
Remarks: GPR EM survey undertaken to clear location of services. Inspection pit hand excavated to 1.20mbgl. No groundwater encountered. Hole advanced to 5.00m bgl. 50mm internal diameter monitoring standpipe installed to 4.50m bgl and finished with a flush fitting cover.		 CONCEPT LIFE SCIENCES ANALYSIS AND INVESTIGATION
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   		Borehole Log			Borehole No. WS102 Sheet 1 of 1				
Project Name: Arundel		Proj. ID: 1CO102284		Easting: Northing:		Hole Type WS			
Location: 14 Fitzalan Road, Arundel, West Sussex, BN18 9JS		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 4.00		Scale: 1:30			
Client: Renaissance Group of Companies		Crew: Borehole Solutions Ltd		Start Date: 29/09/2016 End Date: 29/09/2016		REC Engineer: MN			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Concrete with metal reinforcement [MADE GROUND]	
		0.30 - 0.40	ES		0.50			Grey light brown sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint, brick, concrete, asphalt and rare glass. Cobbles are subangular flint, brick and concrete. [MADE GROUND]	
		0.60 - 0.70	ES					Soft to very soft dark grey silty CLAY. [ALLUVIUM]	1
		1.00	SPT	N=2 (1,1/1,1,0,0)					
		1.30 - 1.40	D		1.50				
		1.90 - 2.00	D					Very soft dark greyish brown slightly silty organic CLAY. Amorphous organic material. Organic smell throughout. [ALLUVIUM]	2
		2.00	SPT	HVP=21 N=0 (0,0/0,0,0,0)					
		2.90 - 3.00	D						3
		3.00	SPT	HVP=12 N=0 (0,0/0,0,0,0)					
		4.00	SPT	N=0 (0,0/0,0,0,0)	4.00			End of Borehole at 4.00m	4
								5	
								6	

Remarks:
 GPR EM survey undertaken to clear locations of services. Inspection pit hand excavated to 1.20mbgl. No groundwater encountered. Hole terminated at 4.00m bgl due to no sample recovery. Hole backfilled with arsising and reinstated with concrete .


CONCEPT LIFE SCIENCES
QUALITY AND SAFETY

   		Borehole Log		Borehole No. WS103 Sheet 1 of 1	
Project Name: Arundel		Proj. ID: 1CO102284		Easting: Northing:	
Location: 14 Fitzalan Road, Arundel, West Sussex, BN18 9JS		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 5.00	
Client: Renaissance Group of Companies		Crew: Borehole Solutions Ltd		Start Date: 29/09/2016 End Date: 29/09/2016	
REC Engineer: MN					

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20 - 0.30	ES		0.10		Concrete with metal reinforcement [MADE GROUND]		
		0.60 - 0.70	ES		0.50		Firm dark greyish brown mottled slightly silty slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to medium flint, brick, concrete, ash and clinker. Cobbles are subrounded flint, brick and concrete. [MADE GROUND]		
		1.00	SPT	N=2 (1,1/1,1,0,0)	1.10		Firm orangeisb brown mottled slightly silty slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to medium flint. Cobbles are subrounded flints. [ALLUVIUM]	1	
		1.50		HVP=73			Very soft to firm dark greyish brown slightly silty organic CLAY. Amorphous organic material. Organic smell throughout. [ALLUVIUM]		
		1.90 - 2.00	D						
		2.00		HVP=73					
		2.00	SPT	N=0 (1,1/0,0,0,0)				2	
			2.90 - 3.00	D					
		3.00		HVP=15					
		3.00	SPT	N=0 (0,0/0,0,0,0)				3	
		3.90 - 4.00	D						
	4.00	SPT	N=0 (0,0/0,0,0,0)				4		
		4.90 - 5.00	D						
	5.00	SPT	N=0 (0,0/0,0,0,0)	5.00			5		
End of Borehole at 5.00m								6	

Remarks: GPR EM survey undertaken to clear location of services. Inspection pit hand excavated to 1.20mbgl. No groundwater encountered. Hole advanced to 5.00m bgl. 50mm internal diameter monitoring standpipe installed to 5.00m bgl and finished with a flush fitting cover.		 CONCEPT LIFE SCIENCES ANALYSIS & INVESTIGATION
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October 2016
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APPENDIX V CHEMICAL TESTING RESULTS

APPENDIX V

CHEMICAL TESTING RESULTS

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Certificate of Analysis

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Report Number: 604613-1

Date of Report: 07-Oct-2016

Customer: Resource Environmental Consultants Ltd
UNIT 47
Basepoint Business Center
1 Winnall Valley Road
Winchester
Hampshire
SO23 0LD

Customer Contact: Miss Charlotte Toth

Customer Job Reference: 1CO102284

Customer Site Reference: 14 Fitzalan Road, Arundel

Date Job Received at SAL: 04-Oct-2016

Date Analysis Started: 04-Oct-2016

Date Analysis Completed: 07-Oct-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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Tests covered by this certificate were conducted in accordance with SAL SOPs

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



1549



Report checked
and authorised by :
Claire Brown Crociquia
Customer Service Manager

Issued by :
Claire Brown Crociquia
Customer Service Manager

SAL Reference: 604613										
Project Site: 14 Fitzalan Road, Arundel										
Customer Reference: 1CO102284										
Soil					Analysed as Soil					
REC002S (SE)										
SAL Reference					604613 001		604613 002		604613 003	
Customer Sample Reference					WS101 @ 0.50-0.60m		WS102 @ 0.30-0.40m		WS103 @ 0.20-0.30m	
Date Sampled					29-SEP-2016		29-SEP-2016		29-SEP-2016	
Type					Clay		Sandy Soil		Clay	
Determinand	Method	Test Sample	LOD	Units						
Arsenic	T257	A40	2	mg/kg	11	10	14	7	6	
Barium	T257	A40	2	mg/kg	59	130	72	430	30	
Beryllium	T245	A40	0.5	mg/kg	0.6	<0.5	0.8	0.9	<0.5	
Boron (water-soluble)	T82	A40	1	mg/kg	<1	<1	<1	<1	<1	
Cadmium	T257	A40	0.1	mg/kg	0.1	0.3	0.1	<0.1	<0.1	
Chromium	T257	A40	0.5	mg/kg	12	9.5	18	17	4.6	
Copper	T257	A40	2	mg/kg	24	20	22	59	8	
Lead	T257	A40	2	mg/kg	160	51	77	110	18	
Mercury	T245	A40	1.0	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	
Nickel	T257	A40	0.5	mg/kg	13	11	16	25	8.9	
Selenium	T257	A40	3	mg/kg	<3	<3	<3	<3	<3	
Vanadium	T257	A40	0.1	mg/kg	25	18	34	17	6.5	
Zinc	T257	A40	2	mg/kg	59	100	91	400	35	
Asbestos ID	T27	A40			Asbestos not detected	Asbestos not detected	Asbestos not detected	Asbestos not detected	Asbestos not detected	
Chromium VI	T6	A40	1	mg/kg	<1	<1	<1	<1	<1	
pH	T7	A40			8.5	10.6	8.3	8.6	8.4	
Soil Organic Matter	T287	A40	0.1	%	3.6	2.4	3.6	21	2.1	
(Water Soluble) SO4 expressed as SO4	T242	A40	0.01	g/l	0.03	0.07	0.15	1.6	0.37	
SO4(Total)	T102	A40	0.02	%	0.06	0.25	0.08	0.48	0.12	
Cyanide(Total)	T921	AR	1	mg/kg	<1	<1	<1	<1	<1	
Phenols(Mono)	T921	AR	1	mg/kg	<1	<1	<1	<1	<1	
Moisture @105C	T162	AR	0.1	%	20	13	20	15	16	
Retained on 2mm	T2	A40	0.1	%	15.5	50.0	1.4	44.6	1.9	

SAL Reference: 604613													
Project Site: 14 Fitzalan Road, Arundel													
Customer Reference: 1CO102284													
Soil					Analysed as Soil								
Total and Speciated USEPA16 PAH (SE) (MCERTS)													
SAL Reference				604613 001		604613 002		604613 003		604613 004		604613 005	
Customer Sample Reference				WS101 @ 0.50-0.60m		WS102 @ 0.30-0.40m		WS103 @ 0.20-0.30m		WS104 @ 0.20-0.30m		WS104 @ 0.50-0.60m	
Date Sampled				29-SEP-2016		29-SEP-2016		29-SEP-2016		29-SEP-2016		29-SEP-2016	
Type				Clay		Sandy Soil		Clay		Sandy Soil		Clay	
Determinand	Method	Test Sample	LOD	Units									
Naphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	0.1	0.2	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Pyrene	T16	AR	0.1	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	T16	AR	0.1	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH(total)	T16	AR	0.1	mg/kg	0.2	0.3	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1

SAL Reference: 604613
Project Site: 14 Fitzalan Road, Arundel
Customer Reference: 1CO102284

Soil
 Suite C

Analysed as Soil

SAL Reference					604613 001	604613 002	604613 003	604613 004	604613 005
Customer Sample Reference					WS101 @ 0.50-0.60m	WS102 @ 0.30-0.40m	WS103 @ 0.20-0.30m	WS104 @ 0.20-0.30m	WS104 @ 0.50-0.60m
Date Sampled					29-SEP-2016	29-SEP-2016	29-SEP-2016	29-SEP-2016	29-SEP-2016
Type					Clay	Sandy Soil	Clay	Sandy Soil	Clay
Determinand	Method	Test Sample	LOD	Units					
TPH (C5-C6)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
TPH (C6-C8)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
TPH (C8-C10)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
TPH (C10-C12)	T219	AR	2	mg/kg	<2	<2	<2	<2	<2
TPH (C12-C16)	T219	AR	2	mg/kg	<2	<2	<2	<2	<2
TPH (C16-C21)	T219	AR	2	mg/kg	<2	<2	<2	4	<2
TPH (C21-C35)	T219	AR	2	mg/kg	10	20	80	10	<2

Index to symbols used in 604613-1

Value	Description
AR	As Received
A40	Assisted dried < 40C
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis except TPH Banded
Asbestos subcontracted to REC Limited
Retained on 2mm is removed before analysis

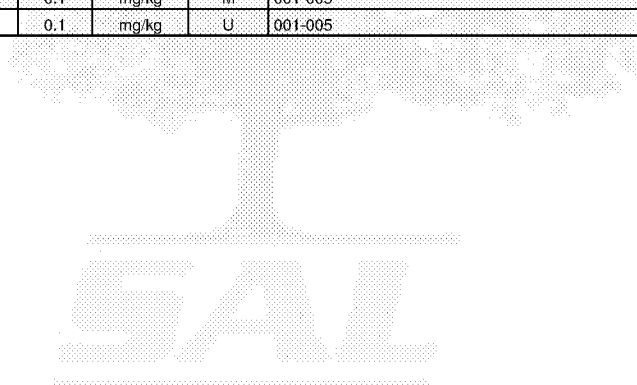
Method Index

Value	Description
T2	Grav.
T245	ICP/OES (Aqua Regia Extraction)
T82	ICP/OES (Sim)
T54	GC/MS (Headspace)
T102	ICP/OES (HCl extract)
T162	Grav (1 Dec) (105 C)
T16	GC/MS
T219	GC/FID (SE)
T921	Colorimetry (CF) (MCERT)
T257	ICP/OES (SIM) (Aqua Regia Extraction)
T27	PLM
T7	Probe
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T287	Calc TOC/0.58
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Arsenic	T257	A40	2	mg/kg	M	001-005
Barium	T257	A40	2	mg/kg	U	001-005
Beryllium	T245	A40	0.5	mg/kg	U	001-005
Boron (water-soluble)	T82	A40	1	mg/kg	N	001-005
Cadmium	T257	A40	0.1	mg/kg	M	001-005
Chromium	T257	A40	0.5	mg/kg	M	001-005
Copper	T257	A40	2	mg/kg	M	001-005
Lead	T257	A40	2	mg/kg	M	001-005

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Mercury	T245	A40	1.0	mg/kg	U	001-005
Nickel	T257	A40	0.5	mg/kg	M	001-005
Selenium	T257	A40	3	mg/kg	U	001-005
Vanadium	T257	A40	0.1	mg/kg	U	001-005
Zinc	T257	A40	2	mg/kg	M	001-005
Asbestos ID	T27	A40			SU	001-005
Chromium VI	T6	A40	1	mg/kg	N	001-005
pH	T7	A40			M	001-005
Soil Organic Matter	T287	A40	0.1	%	N	001-005
(Water Soluble) SO4 expressed as SO4	T242	A40	0.01	g/l	M	001-005
SO4(Total)	T102	A40	0.02	%	M	001-005
Cyanide(Total)	T921	AR	1	mg/kg	M	001-005
Phenols(Mono)	T921	AR	1	mg/kg	M	001-005
Moisture @105C	T162	AR	0.1	%	N	001-005
Retained on 2mm	T2	A40	0.1	%	N	001-005
TPH (C5-C6)	T54	AR	0.10	mg/kg	N	001-005
TPH (C6-C8)	T54	AR	0.10	mg/kg	N	001-005
TPH (C8-C10)	T54	AR	0.10	mg/kg	N	001-005
TPH (C10-C12)	T219	AR	2	mg/kg	U	001-005
TPH (C12-C16)	T219	AR	2	mg/kg	U	001-005
TPH (C16-C21)	T219	AR	2	mg/kg	U	001-005
TPH (C21-C35)	T219	AR	2	mg/kg	U	001-005
Naphthalene	T16	AR	0.1	mg/kg	U	001-005
Acenaphthylene	T16	AR	0.1	mg/kg	U	001-005
Acenaphthene	T16	AR	0.1	mg/kg	M	001-005
Fluorene	T16	AR	0.1	mg/kg	M	001-005
Phenanthrene	T16	AR	0.1	mg/kg	U	001-005
Anthracene	T16	AR	0.1	mg/kg	M	001-005
Fluoranthene	T16	AR	0.1	mg/kg	N	001-005
Pyrene	T16	AR	0.1	mg/kg	N	001-005
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	M	001-005
Chrysene	T16	AR	0.1	mg/kg	M	001-005
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	U	001-005
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	N	001-005
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	M	001-005
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	M	001-005
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	M	001-005
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	M	001-005
PAH(total)	T16	AR	0.1	mg/kg	U	001-005





Certificate of Analysis

Certificate Number 16-81579

21-Oct-16

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 16-81579

Client Reference PSL16/4657

Order No (not supplied)

Contract Title 14 Fitzalan Road, Arundel

Description 4 Soil samples.

Date Received 19-Oct-16

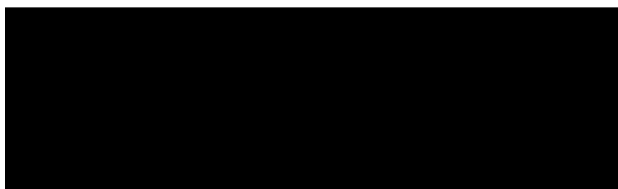
Date Started 19-Oct-16

Date Completed 21-Oct-16

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By



Rob Brown
Business Manager



Summary of Chemical Analysis Soil Samples

Our Ref 16-81579

Client Ref PSL16/4657

Contract Title 14 Fitzalan Road, Arundel

Lab No	1070106	1070107	1070108	1070109
Sample ID	WS101	WS102	WS103	WS104
Depth	1.90-2.00	1.30-1.40	1.90-2.00	1.30-1.40
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	n/s	n/s	n/s	n/s
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Inorganics							
pH	DETSC 2008#			8.1	8.0	8.2	8.4
Sulphate Aqueous Extract as SO ₄	DETSC 2076#	10	mg/l	19	150	22	12

Information in Support of the Analytical Results

Our Ref 16-81579
Client Ref PSL16/4657
Contract 14 Fitzalan Road, Arundel

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1070106	WS101 1.90-2.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1070107	WS102 1.30-1.40 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1070108	WS103 1.90-2.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1070109	WS104 1.30-1.40 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months



Phase I & II Geo-Environmental Assessment
14 Fitzalan Road
Arundel
October 2016
1CO102284P2R0

APPENDIX VI
GEOTECHNICAL TESTING RESULTS

APPENDIX VI REC GEOTECHNICAL TESTING RESULTS

