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## GROUND INVESTIGATION REPORT

Starlings, Milton Road, Harwich, Essex

Tendring District Council

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## Contents:-

### Executive Summary

<b>1. Introduction .....</b>	<b>3</b>
<b>2. Site Location and Description .....</b>	<b>3</b>
<b>3. Proposed Development.....</b>	<b>4</b>
<b>4. Review of RJL Phase One Desk Study Report, ref. 60275 (Nov 2019).....</b>	<b>4</b>
<b>5. Factual Ground Investigation Information.....</b>	<b>4</b>
5.1. Fieldwork.....	4
5.1.1. Windowless Sampling .....	5
5.1.2. Trial Pitting .....	6
5.1.3. Gas Monitoring .....	6
5.2. Laboratory Testing.....	6
5.2.1. Geo-Environmental Testing .....	6
5.2.2. Geotechnical Testing .....	6
5.3. Ground Conditions .....	7
5.3.1. Made Ground.....	7
5.3.2. Head Deposits .....	8
5.3.3. Thames Group.....	9
5.3.4. Groundwater .....	10
5.3.5. Ground Gases.....	10
<b>6. Geo-Environmental Assessment .....</b>	<b>11</b>
6.1. Soil Analysis.....	11
6.1.1. Reference Criteria .....	11
6.1.2. Discussion of Analytical Results – Soils .....	12
6.2. Risk Assessment.....	13
6.2.1. Soil Contamination and End Users.....	14
6.2.1. Soil Contamination and Controlled Waters.....	14
6.2.2. Soil Contamination and Construction Workers, Maintenance Workers and the Public .....	14
6.2.3. Soil Contamination and Flora .....	15
6.2.4. Soil Contamination and Structures and Services .....	15
6.2.5. Ground Gas Contamination .....	16
6.2.6. Conceptual Model.....	16
6.2.7. Summary .....	17
6.3. Waste .....	18
6.4. General Comments / Discovery Strategy .....	18
<b>7. Geotechnical Assessment .....</b>	<b>18</b>

7.1. Structural Foundations .....	19
7.1.1. Shallow Foundations.....	19
7.2. Ground Floor Construction .....	20
7.3. Groundworks.....	20
7.4. Concrete Grade .....	21
7.5. External Works.....	21
7.5.1. Drainage.....	21
7.5.2. Pavement Design .....	21

## Appendix

- Appendix A: Figures & drawings
- Appendix B: Exploratory hole logs & data plots
- Appendix C: Results of Chemical Analyses
- Appendix D: Geotechnical Test Results
- Appendix E: Gas monitoring results & calibration certificates
- Appendix F: Limitations of use

## List of Tables

	<b>Page No.</b>
Table 1: Summary of Groundwater Levels	10
Table 2: Gas Monitoring Results on 13/01/2020	10
Table 3: Results of Chemical Analyses - Soil	12
Table 4: Revised Conceptual Model	17
Table 5: Net Safe Bearing Pressures	19

### EXECUTIVE SUMMARY

<b>Purpose:</b>	To undertake an intrusive ground investigation to establish the prevailing ground conditions, recover soil samples, assess the contamination status of the site and install monitoring standpipes in order that an assessment of the gas regime beneath the site may be made.
<b>Site Status:</b>	At the time of investigation, the site comprised a vacant parcel of land cleared of structures, although floor slabs and a single storey height brick wall remained.
<b>Fieldwork:</b>	The fieldwork comprised the formation of 6no. trial pits, 5no. windowless sampler boreholes, the installation, soil sampling and subsequent monitoring of 3no. gas standpipes.
<b>Ground Conditions:</b>	The encountered ground conditions comprised the following sequence: <ul style="list-style-type: none"> <li>• Made Ground – max. proven depth of 1.90m below ground level (bgl);</li> <li>• Head Deposits – max. proven depth of 3.60m bgl;</li> <li>• Thames Group – base unproven in this investigation at 5.00m bgl;</li> <li>• Groundwater – encountered between 1.30m bgl and 2.70m bgl.</li> </ul>
<b>Soil Contamination:</b>	Concentrations of contaminants in soils were recorded to be below their threshold criteria for the protection of human health in a commercial setting, although microscopic asbestos cement fragments were recorded. Given the proposed hardstanding intended to cover the site remediation was not considered to be required.
<b>Gassing Regime:</b>	Gas monitoring to date has recorded to the following: <ul style="list-style-type: none"> <li>• Max. CO<sub>2</sub> concentrations of 1.9% by volume (v/v)</li> <li>• Max. CH<sub>4</sub> concentrations of 1.2% v/v</li> <li>• Min. O<sub>2</sub> concentrations of 10.5% v/v</li> <li>• Max. VOC concentrations of 0.0ppm</li> <li>• Peak flow rates of 0.0l/hr</li> </ul> <p>The monitoring programme is ongoing and the CS-2 classification should be reviewed and if necessary revised following completion of the monitoring regime.</p>
<b>Structural Foundations:</b>	Shallow mass concrete foundations were considered appropriate for the majority of the site. Safe bearing pressures of between 50kN/m <sup>2</sup> and 70kN/m <sup>2</sup> have been determined for strip footings at 1.50m bgl and 2.00m bgl, respectively.
<b>Ground Floor Construction:</b>	Fully suspended floor slabs with a subfloor void appropriate to high-volume change potential soils will be required.
<b>Concrete Grade:</b>	A design sulphate class of DS-3 is considered appropriate for use on site, with an aggressive chemical environment for concrete (ACEC) classification of AC-3 recommended.
<b>Pavement Design:</b>	A design CBR value of 1% is recommended where the sub-base comprises the made ground with a design CBR value of 3% where the subbase comprises the Head Deposits. In-situ CBR tests are recommended to confirm these values.

**Drainage:**

Given the predominantly cohesive nature of the prevailing natural ground conditions, infiltration drainage is considered unlikely to be suitable at the site.

## **1. Introduction**

Richard Jackson Ltd received an instruction to undertake ground investigation works in connection with the proposed redevelopment of Starlings, Milton Road, Harwich, Essex.

The works were instructed by the Client, Tendring District Council and were carried out in accordance with our fee proposal of 28<sup>th</sup> October 2019, reference 60275/RPL.

Richard Jackson Ltd (RJL) have previously prepared a phase one desk study report that covers the site, reference 60275 dated November 2019. This is briefly reviewed in this report.

The intrusive investigation, on which this report is based, comprised the formation of 5no. windowless sampler (WLS) boreholes and 6no. trial pits. In-situ testing and soil sampling were also undertaken. Semi-permanent monitoring standpipes were installed in 3no. WLS boreholes and gas monitoring is on-going.

This report assesses the findings of the intrusive investigation and gives recommendations for use in the design and construction of the proposed scheme.

Chemical analyses have been undertaken in order that the contamination status of the site may be determined and the need for further investigation or remediation assessed.

This report shall be read in conjunction with the limitations of use provided in Appendix F.

## **2. Site Location and Description**

The site was located to the northwest of Milton Road, Dovercourt, Harwich, Essex, CO12 3EQ. The approximate Ordnance Survey grid reference for the centre of the site was TM 257 316. A site location plan is presented as Figure 1 in Appendix A.

The site was irregular in shape with maximum approximate dimensions of 40m northwest to southeast by 60m northeast to southwest.

At the time of investigation, the site comprised a vacant parcel of land which had been cleared of structures, although concrete floor slabs and a single storey brick wall were noted to remain. Debris, rubbish and unmanaged vegetation were also present at the site.

A detailed site description is presented as Section 3 of the RJL Phase One Desk Study Report reference 60275, dated November 2019.

### **3. Proposed Development**

The proposed scheme is to comprise redevelopment of the subject site to provide surface car parking together with the construction of a public toilet and small areas set to soft landscaping.

An indicative proposed development plan is presented in Appendix A.

### **4. Review of RJL Phase One Desk Study Report, ref. 60275 (Nov 2019)**

RJL prepared a phase one desk study report for the subject site and an adjacent two-storey car park, 'Milton Road Car Park'. The findings of the report, specific to the subject site, are summarised as follows.

The site was recorded to have been developed throughout the studied historical period (1870-2019), with various phases of redevelopment recorded including a garage from the 1950s. Off-site mixed residential and industrial development was also recorded.

The Thames Group, an unproductive stratum, was recorded as the geology to exist beneath the site.

Made Ground, the sites former use as a garage and fly tipped asbestos containing materials were identified as potential on-site sources of contamination. Off-site, made ground, infilled brickfields, industrial development and a landfill were identified as potential sources of contamination.

A moderate/low risk from soil contamination was considered to be presented to the identified sensitive receptors together with a high risk considered to be presented from ground gases.

It was recommended that intrusive ground investigations were undertaken at the site to confirm the prevailing ground conditions, establish the presence and extent of made ground and to assess the contamination status of the site. The installation and subsequent monitoring of standpipes was also recommended to assess the potential gassing regime beneath the site. Given the observed fly tipping, asbestos testing of recovered soil samples was also recommended.

### **5. Factual Ground Investigation Information**

The findings of the factual ground investigation are provided in the following sections.

#### **5.1. Fieldwork**

The fieldwork on which the report is based was undertaken on 4<sup>th</sup> & 5<sup>th</sup> December 2019 and comprised the following:

- The excavation of 6no. trial pits – (TP01 – TP06);



- The formation of 5no. small diameter windowless sampler boreholes (WLS) – (WS01 – WS05);
- The installation of 3no. semi-permanent monitoring standpipes in WLS Boreholes (WS03-WS05);
- A single gas monitoring visit undertaken on 13<sup>th</sup> January 2010. A further 5no. visits are scheduled.

An exploratory hole location plan is presented as Figure 2 in Appendix A.

Exploratory hole logs are presented in Appendix B and give descriptions and depths of strata encountered, together with details of samples taken, in-situ tests, well installations and other relevant information.

Soil samples were recovered from throughout the depth of exploratory holes for chemical analyses, geotechnical testing and record keeping purposes. Samples recovered for chemical analyses were stored in air tight plastic containers and amber glass jars.

All samples recovered for chemical analysis were transported to the analytical laboratory, DETS Ltd, in cool boxes under chain of custody protocols.

Where applicable, investigative techniques, sampling, logging of soils and in-situ testing complied with the requirements of British Standard BS5930:2015- 'Code of Practice for Site Investigations'.

#### **5.1.1. Windowless Sampling**

The windowless sampling (WLS) utilised a track-mounted hydraulic power-pack and percussive hammer to drive a series of small diameter windowless tubes into the ground.

The WLS boreholes were formed to depths of between 4.00m below ground level (bgl) (WS01) and 5.00m bgl (WS02 - WS04).

WLS boreholes were positioned to provide a representative site coverage whilst targeting potential source of contamination identified in the phase one desk study.

In-situ standard penetration tests (SPTs) were undertaken throughout the depth of the WLS boreholes to provide an indication of the soil density / stiffness. The number of blows required to advance a 60° cone over the final 300mm of a 450mm total drive was recorded as the 'N' value these values were presented on the borehole logs.

Where cohesive soils were encountered, both a hand shear vane and pocket penetrometer were used to assess the undrained shear strength of the encountered soils. The results of these tests are recorded as the 'IVN' and 'PP' values respectively and are presented on the logs in Appendix B.

A photo-ionisation detector (PID) was used to screen recovered soil samples for the presence of volatile organic compounds (VOCs). Results of this screening are included on the WLS borehole records.

On completion of 3no. of the WLS boreholes, semi-permanent 50mm diameter HDPE gas and groundwater monitoring standpipes were installed to a maximum depth of 5.00m bgl (WS03-WS05).

### **5.1.2. Trial Pitting**

A mechanical excavator was used to form 6no. trial pits (TP01 – TP06) to depths of between 1.60m bgl (TP05) and 2.80m bgl (TP01). Trial pits were positioned to provide a representative coverage of the site.

Where cohesive soils were encountered, both a hand shear vane and pocket penetrometer were used to assess the undrained shear strength of the encountered soils. The results of these tests are recorded as the 'IVN' and 'PP' values respectively and are presented on the trial pit logs in Appendix B.

A photo-ionisation detector (PID) was used to screen recovered soil samples for the presence of volatile organic compounds (VOCs). Results of this screening are included on the WLS borehole records.

### **5.1.3. Gas Monitoring**

The installed standpipes have been monitored on a single occasion (13/01/2020) since installation for the presence of methane, carbon-dioxide and oxygen using an infra-red portable gas analyser. Gas flow, atmospheric pressure, and standing water levels (SWLs) were also monitored during each visit.

A photo-ionisation detector (PID) was used during the monitoring visit to assess the installations for the presence of volatile organic compounds (VOCs).

Measurements to the base of the standpipes were also made to confirm the depth of the installation.

## **5.2. Laboratory Testing**

### **5.2.1. Geo-Environmental Testing**

Chemical analyses were undertaken on a number of soil samples recovered from the site. Details of chemical analyses undertaken are provided in Section 6. Results of chemical analyses are presented in full in Appendix C.

### **5.2.2. Geotechnical Testing**

Disturbed and undisturbed soil samples recovered from the exploratory holes were sent to a UKAS accredited soil testing laboratory Soil Property Testing (SPT) Ltd. The following tests were carried out in accordance with BS EN ISO: 17892-2:2014 & BS1377:1990:

- 12no. water content determinations;
- 6no. atterberg limit tests (four-point liquid limit cone method);
- 2no. particle size distribution (PSD) determinations;
- 8no. pH value and sulphate content (2:1 water soil extract) determinations\*;

*\*These tests were undertaken by the UKAS and MCerts accredited laboratory DETS Ltd*

The results of these tests are presented in Appendices C and D.

### **5.3. Ground Conditions**

The British Geological Survey (BGS) 1:50,000 scale series online mapping of the area, indicates the Thames Group to exist beneath the site. The deposits encountered in this investigation comprised the following sequence:

- Made Ground
- Head Deposits
- Thames Group

#### **5.3.1. Made Ground**

Concrete was encountered from ground level to 0.30m bgl in TP03.

Made ground was encountered beneath the concrete on TP03 and from ground level in the remaining 10no. exploratory holes. The depth of the made ground, ranged from 0.40m bgl (WS03 & WS04) to 1.90m bgl (WS01 & TP03). It should be noted that the base of the Made Ground remained unproven in TP05 which was terminated at its target depth of 1.50m bgl.

The made ground was encountered as a variable material, typically sand to cobbles sized fragments of red brick, concrete, ash and cinder block, together with a gravelly sand containing brick, ash, chalk, wire and ceramic fragments, and a silty sandy clay with gravel of brick and concrete.

Concrete was encountered within the made ground from 0.85m to 1.05m bgl in TP01 and from 1.00m to 1.10m bgl in WS02. A void was encountered immediately beneath the concrete on WS02 to a depth of 1.30m bgl.

A suspected hydrocarbon odour and black staining was recorded in the made ground soils in TP03 from 1.40m bgl with the presence of suspected oil tank pipe work from 1.70m bgl also noted.

Headspace screening using the PID was undertaken on a number of samples of made ground, full results of which are presented on the exploratory hole logs. Generally, headspace VOC concentrations were recorded to be 0.0ppm,

although in TP03 VOC concentrations ranged from 0.0ppm (0.30m bgl) to 12.7ppm (1.50m bgl) were also recorded.

### 5.3.2. Head Deposits

Soils interpreted to represent the Head Deposits were encountered beneath the Made Ground in 9no. of the 11no. of the exploratory holes, being absent in TP05 and WS05. The base of the Head Deposits, where proven, ranged from 1.10m bgl (WS03) to 3.60m bgl (WS04). The base of the Head Deposits was not proven in TP02, TP03 or TP06 at 1.90m bgl, 2.50m bgl and 2.60m bgl respectively.

The Head Deposits were typically encountered as a soft to firm brown mottled orange clay with sandy pockets and gravel of flint. The Head Deposits were recorded as a clayey silty sand in TP04 from 1.30m to 2.00m bgl and in TP06 from 0.70m to 2.60m bgl. A saturated sand was recorded in WS02 from 2.00m to 2.50m bgl.

Black mottling and an organic odour were recorded in the Thames Group in WS03 from 0.40m bgl. A strong suspected hydrocarbon odour was recorded in the Head Deposits in TP01 from 1.80m bgl.

Headspace screening using the PID was undertaken on a number of samples of the Head Deposits, full results of which are presented on the exploratory hole logs. Recorded headspace VOC concentrations were generally 0.0ppm, although concentrations of 99.70ppm and 349ppm were recorded in TP01 at 1.80m bgl and 2.20m bgl, respectively.

SPTs were undertaken throughout the depth of the Head Deposits in WLS boreholes. The results of these tests ranged from N=2 (WS04 at 1.00m bgl) to N=9 (WS02 at 2.00m bgl). Full results are provided on the WLS logs presented in Appendix B and summarised on the 'N' Value -vs- Depth Plot presented in Appendix B.

Hand shear vane and pocket penetrometer tests were also undertaken throughout the depth of the Head Deposits. The results of these tests ranged from 18kN/m<sup>2</sup> (WS04 at 1.90m bgl) to 85kN/m<sup>2</sup> (WS01 at 2.90m bgl). Full results are provided on the exploratory hole logs and summarised on the 'undrained shear strength -vs- depth plots presented in Appendix B.

Water content determinations were undertaken on 7no. samples of the Head Deposits, the results of which ranged from 9.3% (TP06 at 1.60m bgl) to 45.8% (WS04 at 3.40m bgl).

Atterberg limit tests were undertaken on 4no. samples of the Head Deposits. Full results of these tests are provided in Appendix D and can be summarised as follows:

- Liquid Limits of between 23% (TP06 at 1.60m bgl) and 36% (WS02 at 1.40m bgl);
- Plastic Limits of between 13% (TP06 at 1.60m bgl) and 18% (WS02 at 1.40m bgl);

- Plasticity Indices of between 8% (WS04 at 1.70m bgl) and 18% (WS02 at 1.40m bgl).

Modified plasticity indices of between 8% (WS04 at 1.70m bgl) and 18% (WS02 at 1.40m bgl) were calculated on the basis of the following relationship:

- Modified plasticity index = (% samples passing 0.425mm sieve x plasticity index) / 100

The results of the atterberg limit tests indicated the Head Deposits to be of low to intermediate plasticity and of low volume change potential.

### **5.3.3. Thames Group**

Soils interpreted to represent the Thames Group were encountered beneath the Made Ground in WS05 and beneath the Head Deposits in TP01, TP04 and WS01-WS05. The base of the Thames Group remained unproven in this investigation at a maximum depth of 5.00m bgl.

The Thames Group was typically encountered as a firm becoming stiff with depth, grey mottled brown clay. Weak mudstone fragments were encountered in WS05 from 3.70m bgl and ironstone nodules were recorded from 4.50m bgl on WS01.

Headspace screening using the PID was undertaken on a number of samples of the Thames Group, full results of which are presented on the exploratory hole logs. Recorded headspace VOC concentrations in the Thames Group were recorded to be 0.0ppm.

SPTs were undertaken throughout the depth of the Thames Group in WLS boreholes. The results of these tests ranged from N=7 (WS03 at 1.00m bgl) to N=23 (WS01 at 5.00m bgl). Full results are provided on the WLS logs presented in Appendix B and summarised on the 'N' Value -vs- Depth Plot presented in Appendix B.

Hand shear vane and pocket penetrometer tests were also undertaken throughout the depth of the Thames Group. The results of these tests ranged from 30kN/m<sup>2</sup> (WS01 at 3.50m bgl) to 135kN/m<sup>2</sup> (WS01 at 4.60m bgl). Full results are provided on the exploratory hole logs and summarised on the 'undrained shear strength -vs- depth plots presented in Appendix B.

Water content determinations were undertaken on 5no. samples of the Thames Group, the results of which ranged from 37.7% (WS02 at 2.60m bgl) to 46.8% (WS05 at 3.30m bgl).

Atterberg limit tests were undertaken on 2no. samples of the Thames Group. Full results of these tests are provided in Appendix D and can be summarised as follows:

- Liquid Limits of between 75% (WS05 at 1.80m bgl) and 84% (WS03 at 2.30m bgl);

- Plastic Limits of between 25% (WS05 at 1.80m bgl) and 30% (WS03 at 2.30m bgl);
- Plasticity Indices of between 50% (WS05 at 1.80m bgl) and 54% (WS03 at 2.30m bgl).

The results of the atterberg limit tests indicated the Thames Group to be of very high plasticity and of high-volume change potential.

#### 5.3.4. Groundwater

Groundwater was encountered in a number of the exploratory holes during formation and subsequent monitoring. Table 1, provides a summary of the groundwater data and includes strike depth, observed rises in groundwater during borehole formation and standing water levels (SWLs) recorded during monitoring.

Table 1: Summary of Groundwater Levels

Exploratory Hole	Strike Depth (m bgl)	Stratum	SWL during monitoring on 13.01.20 (m bgl)
TP03	1.70	Made Ground	n/a
WS02	1.30	Made Ground	n/a
	2.00	Head Deposits	n/a
WS03	Not encountered		1.39
WS04	2.70	Head Deposits	1.82
WS05	Not encountered		2.10

#### 5.3.5. Ground Gases

Table 2 provides a summary of the gas monitoring results to date. Full results are presented in Appendix E along with the calibration certificates for the gas analyser and PID used at the site.

Table 2: Gas Monitoring Results on 13/01/2020

Borehole	Peak CH <sub>4</sub> (% v/v)	Peak CO <sub>2</sub> (% v/v)	Min. O <sub>2</sub> (% v/v)	Peak VOCs (ppm)	Peak Flow Rate (l/hr)
WS03	0.0	1.7	10.5	0.0	0.0
WS04	0.0	1.9	16.2	0.0	0.0
WS05	1.2	1.2	19.8	0.0	0.0

The results of the remaining 5no. monitoring visits will be presented under separate cover on completion of the monitoring regime.

## 6. Geo-Environmental Assessment

The purpose of this section is to provide an assessment of the contamination status of the site.

The analysis was undertaken by Concept Life Science (CLS) Ltd., a UKAS and MCerts accredited laboratory.

### 6.1. Soil Analysis

A broad suite of analyses was scheduled, including metals, asbestos and hydrocarbons. 5no. samples of soil have been analysed for a broad suite of contaminants as follows:

Arsenic	pH
Cadmium	Total Cyanide
Chromium	Water Soluble Sulphate
Copper	Total Phenols
Nickel	BTEX Compounds
Lead	Total Sulphur
Mercury	Speciated Polyaromatic Hydrocarbons (PAH)
Selenium	Organic Matter Content
Zinc	Total Petroleum Hydrocarbons (TPH)

Analysis for the presence of a range of Volatile Organic Compounds (VOC) was undertaken on 4no. soil samples.

A further 2no. samples were analysed for TPH Criteria Works Group (CWG) methodology. Asbestos screening was undertaken by the analytical laboratory on 5no. samples of soil.

#### 6.1.1. Reference Criteria

Screening values have been adopted for the site to reflect site-specific parameters, such as, intended end use and the Soil Organic Matter (SOM). Screening values have been developed on the basis of current guidance as given in The Land Quality Management / Chartered Institute of Environmental Health document, 'The LQM / CIEH S4ULS for human health assessment', (2015) publication no. S4UL3379.

It is understood that the site is to be developed for commercial purposes with limited areas of soft landscaping. Therefore, screening values specific to a commercial end use been adopted for the site.

A SOM of 1% has been adopted for organic chemicals for the purposes of the initial assessment on the basis of laboratory analysis. A SOM of 6% has been adopted for inorganic chemicals as detailed in 'The LQM / CIEH S4ULS for human health assessment', (2015).

In the absence of published S4UL for lead, the DEFRA Category 4 Screening Level (C4SL) for lead has been adopted.

Full details of the reference criteria used to derive the screening values, including the adopted values, are provided in Appendix C and summarised below.

The adopted screening values are also summarised in the following section.

### 6.1.2. Discussion of Analytical Results – Soils

Results of the chemical analyses undertaken on soils are presented in Appendix C and summarised in Table 3.

Table 3: Results of Chemical Analyses - Soils

Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
Arsenic	5	640	4 - 14	0
Cadmium	5	190	<0.2 - 0.5	0
Chromium	5	8,600	10 - 16	0
Copper	5	68,000	7 - 78	0
Nickel	5	980	7 - 21	0
Lead	5	2,300	13 - 354	0
Selenium	5	12,000	<3	0
Mercury	5	1,100	<1	0
Zinc	5	730,000	26 - 230	0
Benzo(a)pyrene	5	35	<0.1 - 0.65	0
Dibenz(a,h)anthracene	5	3.5	<0.1	0
Naphthalene	5	190	<0.1 - 0.12	0
Total Phenols	5	760	<2	0
TPH Aromatic C <sub>5</sub> -C <sub>7</sub>	7	26,000	<0.01	0
TPH Aromatic C <sub>7</sub> -C <sub>8</sub>	7	56,000	<0.05	0
TPH Aromatic C <sub>8</sub> -C <sub>10</sub>	7	3,500	<2 - 7	0
TPH Aromatic C <sub>10</sub> -C <sub>12</sub>	7	16,000	<2 - 14	0
TPH Aromatic C <sub>12</sub> -C <sub>16</sub>	7	36,000	<2 - 20	0
TPH Aromatic C <sub>16</sub> -C <sub>21</sub>	7	28,000	<3 - 10	0
TPH Aromatic C <sub>21</sub> -C <sub>35</sub>	7	28,000	<10	0
TPH Aliphatic C <sub>5</sub> -C <sub>6</sub>	7	3,200	<0.01	0



Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
TPH Aliphatic C <sub>6</sub> -C <sub>8</sub>	7	7,800	<0.05	0
TPH Aliphatic C <sub>8</sub> -C <sub>10</sub>	7	2,000	<2 – 9	0
TPH Aliphatic C <sub>10</sub> -C <sub>12</sub>	7	9,700	<2 – 30	0
TPH Aliphatic C <sub>12</sub> -C <sub>16</sub>	7	59,000	<3 – 50	0
TPH Aliphatic C <sub>16</sub> -C <sub>35</sub>	7	1,600,000	<10 - 4	0
Benzene	7	27	<0.002 – 0.007	0
Toluene	7	56,000	<0.005	0
Ethylbenzene	7	5,700	<0.002 – 0.059	0
M & P xylene	7	5,900	<0.002 – 0.749	0
O xylene	7	6,600	<0.002 – 0.108	0
Vinyl Chloride	4	0.059	<0.005	0
1,2 – Dichloroethane	4	0.67	<0.005	0
Trichloroethene	4	1.2	<0.005	0
1,1,1 – Trichloroethane	4	660	<0.005	0
Tetrachloroethene	4	19	<0.005	0
Chlorobenzene	4	56	<0.005	0
Hexachlorobutadiene	4	31	<0.005	0

Asbestos was detected in 1no. of the 5no. samples which underwent asbestos screening. Chrysotile in microscopic cement fragments was recorded in the made ground in WS05 from 0.40-0.50m bgl.

From the above it is evident that none of the soil samples analysed presented elevated concentrations of the contaminants screened for when compared to their tier one screening values for the protection of human health in a commercial setting.

## 6.2. Risk Assessment

As detailed in the preceding sections, concentrations of contaminants in soil samples analysed have been recorded to be below their tier one screening values for the protection of human health in a commercial setting.

### **6.2.1. Soil Contamination and End Users**

Considering initially end users of the site, exposure to contaminants would be primarily through direct contact, ingestion or inhalation of contaminated soils where soil is exposed such as in landscaped areas.

There is considered to be a significantly reduced risk beneath buildings or in paved areas as in such areas there is a restricted pathway by which the pollutant linkage may be completed.

Microscopic asbestos cement fragments were encountered WS05 which could be considered to pose a risk to end users of the site. However, the proposed end use of the site will comprise predominantly hardstanding cover which is considered to mitigate the risk posed by asbestos present in made ground beneath the site.

On the basis of the results to date and the above summary, remediation is not considered to be necessary as no soil contamination has been encountered which would pose an on-going risk to the site's future end users.

### **6.2.1. Soil Contamination and Controlled Waters**

Soil concentrations of TPH and BTEX compounds were recorded above their method detection limits (MDL) albeit still at relatively low concentrations respectively, in samples which were recorded to have suspected hydrocarbon odours. These impacted soils may be considered to pose a risk to controlled waters beneath the site.

Groundwater was encountered in discrete perched pockets within the made ground and Head deposits beneath the site. It should be noted that the prevailing soils beneath the site are designated as an unproductive stratum and although groundwater was encountered in a number of locations, it is considered that unlikely to be in hydraulic continuity with the wider controlled waters environment due to the potential cohesive nature of the nature soils beneath the site and in the surrounding area. The encountered groundwater is therefore considered to be of low sensitivity and to have minimal resource value.

On the basis of the above, remediation in respect to the TPH and BTEX impacted soils is not considered to be necessary for the protection of controlled waters, however, from a future land liability perspective groundwater monitoring and analysis may be prudent to confirm this.

### **6.2.2. Soil Contamination and Construction Workers, Maintenance Workers and the Public**

Risks to site workers and site neighbours during redevelopment arise primarily through dermal contact, ingestion and inhalation of contaminants. It is considered that the degree of contamination observed poses a moderate risk to site workers and the general public.

In order to reduce the risk to site workers during redevelopment, appropriate safety measures should be adopted on site.

Workers should avoid contact with the soils by the use of protective boots, overalls and gloves, and should wash before eating, drinking and using the toilet.

To prevent the inhalation of contaminants by site workers and the wind-blown transfer of contaminants off site, the generation of dust should be avoided; this can be achieved by spraying the materials with water if necessary. Measures should be taken to ensure that contaminated materials are not accidentally transferred off site, for example on vehicle tyres.

Given the recorded concentrations of carbon-dioxide and methane to date, of up to 1.9% and 1.2% by volume (% v/v), respectively, together with the depleted oxygen concentrations as low as 10.5% v/v, excavations should be checked for toxic, anoxic or explosive conditions prior to entry by site workers.

Reference should be made to CIRIA Report No.132 'A Guide for Safe Working on Contaminated Sites' (1996), and Health and Safety Guidance Document, 'Protection of Workers and the General Public during the Development of Contaminated Land' (1991).

### **6.2.3. Soil Contamination and Flora**

Concentrations of the phytotoxic contaminants, zinc, copper and nickel have been compared to the threshold values presented in Table 1 of British Standard BS3882: 'Specification for Topsoil and Requirements for Use' (2007), in order that this risk to flora may be assessed. It should be appreciated that this specification is only applicable to topsoil materials which are being placed. Topsoil which is to remain in-situ is not required to comply with the specifications of BS3882.

The screening values for phytotoxic contaminants are pH dependent and the following values have been adopted on the basis of a pH greater than 7.

- Threshold Value for Zinc –300mg/kg
- Threshold Value for Copper –200mg/kg
- Threshold Value for Nickel –110mg/kg

Concentrations of the phytotoxic contaminants are all below the threshold values and thus the analysed samples are not considered to pose a risk to flora.

### **6.2.4. Soil Contamination and Structures and Services**

The recorded concentrations of some TPH and BTEX compounds are considered to pose a risk to water supply services. It would be prudent to contact the water supply company to see if barrier pipes should be installed within the proposed scheme.

### 6.2.5. Ground Gas Contamination

Gas monitoring to date has recorded maximum carbon-dioxide and methane concentrations of 1.9% and 1.2% by volume (%v/v) respectively. No VOC concentrations or flow rates have been detected.

Depleted oxygen concentrations as low as 10.5%v/v have been recorded.

Carbon-dioxide is a heavier gas than air, which affects the respiratory and central nervous systems. It can cause unconsciousness at concentrations of 5% by volume and death at concentrations of 10% to 15% by volume. Methane is a flammable asphyxiant gas, which is within explosive limits of 5% to 10% by volume in air.

Table 8.5 of CIRIA Report 665 (2007) provides information on current UK practice with respect to gas control measures based upon a Gas Screening Value (GSV).

A GSV is obtained by multiplying the maximum concentration of gas by the maximum flow rate. As no flow rates have been detected at the site, the minimum detection limit of the analyser of 0.1l/hr has been adopted. The following GSV have therefore been calculated:

- Carbon Dioxide – 0.0019l/hr;
- Methane – 0.0012l/hr

For the purposes of characterising the site, the more conservative GSV for Carbon Dioxide has been adopted.

The calculated GSV typically corresponds to a characteristic situation 1 (CS-1), however, where methane concentrations exceed 1% v/v it is recommended that a CS-2 classification is adopted and this is recommended for the site based on this initial data.

A CS-2 classification requires the adoption of protective measures to mitigate the risk posed by ground gases. Reference should be made to British Standard 8485 'Code of Practice for the Design of Protective Measures for Methane and Carbon-dioxide Ground Gases for New Buildings' (2015), to determine which protective measures are appropriate for adoption in the proposed scheme.

It should be noted that gas monitoring is on-going and the above will be reviewed on completion of the full monitoring regime.

### 6.2.6. Conceptual Model

On the basis of the findings detailed in Section 6.1 together with the above discussion, the preliminary conceptual model presented in our phase one desk study report has been revised and is presented as Table 4.

Table 4: Revised Conceptual Model

Contaminant	Source(s)	Pathway(s)	Receptor(s)	Comment
Asbestos	Fly Tipped Material & Made Ground	Direct Contact, Ingestion, Inhalation	Site Workers & General Public	Soils to be covered by hardstanding. Fly tipped asbestos at the site should be removed by an appropriately qualified contractor. Refer to Section 6.2.2.
BTEX & TPH	Made Ground, Garage	Leaching & Migration	Controlled Waters	Consider groundwater monitoring and analysis as parts of sites future management.
		Direct Contact, Ingestion, Inhalation	Site Workers & General Public	Refer to Section 6.2.2.
		Direct Contact	Water Supply Services	Refer to Section 6.2.5.
Ground Gases (CO <sub>2</sub> & CH <sub>4</sub> )	Made Ground, Infilled Brickfield	Inhalation, Accumulation, Explosion	End Users & General Public	On-going gas monitoring regime should be completed & the requirements for has mitigation measures should be revised following completion.
			Site Workers	Refer to Section 6.2.6

### 6.2.7. Summary

On the basis of the above it is considered that the site may be developed for its intended commercial end use, subject to the completion of the following tasks:

- Installation of hardstanding;
- Consideration to groundwater sampling and analysis as part of the sites ongoing management;
- Completion of the on-going gas monitoring programme and installation or appropriate gas mitigation measures, if required.

The above conclusions are subject to regulatory approval.

### **6.3. Waste**

Reference should be made to the EU Waste Framework Directive, Revised Directive 2008/98/EC and 'The definition of Waste: Development Industry Code of Practice (CoP) Version 2' published by CL:AIRE (2011) to establish whether soils generated from on-site works are classified as waste.

Waste will likely be generated from excavation works. There may be limited opportunities for re-use of materials on site, subject to compliance with the CoP.

The groundworks contractor should classify the waste in accordance with the document entitled, 'Guidance on the classification and assessment of waste (1<sup>st</sup> Edition 2015), Technical Guidance WM3', to determine whether the soils to be disposed of off-site are considered to be hazardous or not.

There is likely to be some waste to be disposed of off-site. Waste removed from the site, for disposal, must be classified according to the analytical methods and criteria recommended by the Landfill (England and Wales) (Amendment) Regulations 2004 and 2005. The regulations set new acceptance criteria for wastes to be disposed of at landfill sites with effect from 16th July 2005.

Results of solid soil analysis are included in Appendix C and should be forwarded to the receiver/hauler to assist in the off-site disposal of waste soils.

Full and detailed records should be kept of all waste soils removed from site for future reference purposes.

### **6.4. General Comments / Discovery Strategy**

As with any sampling exercise, the sampling process is representative and it is possible that areas of contamination may be found during the redevelopment of the site. Excavations on site should be supervised and any areas of suspected contamination should be assessed by a competent professional and subject to further analysis is necessary.

It should be noted that all remediation proposals are subject to the approval of the Local Authority. It would be prudent to involve the regulatory bodies early in the development of the proposed scheme and before construction commences in order that all requirements are met.

## **7. Geotechnical Assessment**

We understand that the proposed development scheme will include a predominantly hardstanding car park area, with a public toilet which has been assumed to be a single storey structure.

Proposed development plans indicated that the new toilet building will be situated in the north of the site. It is understood that levels at the site are to be raised and as such the depths quoted below are based on existing site ground levels.

The recommendations provided within this section are based upon the above information and our understanding of the proposed scheme as detailed in Section 3, together with the proposed development plans included in Appendix A.

## **7.1. Structural Foundations**

### **7.1.1. Shallow Foundations**

Conventional mass concrete foundations, bearing on to either the Head Deposits or the Thames Group are considered appropriate for adoption across the site.

Net safe bearing pressures have been determined for the site on, based on conventional strip footings. The net safe bearing pressures is the permissible increase in vertical stress at the level of the underside of the foundation, above existing overburden pressure which may be calculated on the basis of a soil bulk density of 20kN/m<sup>3</sup>.

Groundwater was encountered in a number of exploratory holes during formation and subsequent monitoring. For the purposes of estimating net safe bearing pressures, we have taken a conservative approach to the depth to groundwater beneath the site and assumed that the water table is at 1.95m bgl.

Table 5 provides a summary of the calculated net safe bearing pressures at a range of depths bgl. The assumed shear strength of the soil has been inferred from the 'undrained shear strength -vs- depth plot presented in Appendix B together with the soil descriptions provided by the site engineer. The undrained shear strengths have also been derived from SPT 'N' Values using the correlations provided in Stroud and Butler's paper (1975). Elastic theory has been used to derive the stress distribution beneath the foundations.

*Table 5: Net Safe Bearing Pressures*

<b>Foundation</b>	<b>Depth, bgl (m)</b>	<b>Nett Safe Bearing Pressure (kN/m<sup>2</sup>)</b>
0.60m wide strip footing	1.50	50
	2.00	70

At the above net safe bearing pressures, total drained settlements have been calculated to be within tolerable limits.

The total drained settlements have been calculated using modulus of elasticity values,  $E_v'$ . In cohesive soils, the  $E_v'$  values are based on the relationship;  $E_v' = 130 \times C_u$ , after Stroud and Butler (1975).

Settlement in cohesive soils typically comprises a small amount of immediate settlement as loads are applied and a larger proportion of consolidation settlement which will occur over a longer period of time.

All surface materials and made ground should be penetrated and foundations extended at least 150mm into undisturbed natural soils. The formation

should be inspected by a competent engineer prior to concreting. If very soft or loose pockets are encountered, these should be excavated until a firm to stiff or medium dense to dense deposit suitable for bearing is encountered.

It should be noted that both the Head Deposits and Thames Group are shrinkable materials and therefore, where influenced by trees, hedgerows or other vegetation, foundations will need to be designed in accordance with NHBC Standards Chapter 4.2 'Building near Trees' (2016). The Head Deposits should be considered to have a low-volume change potential whilst the Thames Group should be considered to have a high-volume change potential.

Where foundations exceed a depth of 1.5m due to the influence of trees, anti-heave precautions should be adopted.

Foundations should be excavated beyond the depth of any significant roots encountered in the excavations. Reference should be made to NHBC standards when considering any new areas of planting.

Shallow groundwater may be encountered in the made ground or granular pockets of the Thames Group and therefore, groundwater control measures may be required to control groundwater ingress.

## **7.2. Ground Floor Construction**

Fully suspended ground floor slabs are recommended for adoption on site and should incorporate a sub floor void appropriate to high-volume change potential.

## **7.3. Groundworks**

The stability of made ground or disturbed ground must not be relied upon in unsupported excavations.

Safe working conditions must be provided at all times where operatives are required to work in excavations.

Heavy plant and stockpiles of materials should not be permitted close to the edges of open excavations.

Based on observations made during fieldwork, groundwater ingress from the made ground of Head Deposits could be encountered in excavations for structures or services and the requirement for groundwater control measures should be considered.

Further reference should be made to CIRIA Report No. 97, 'Trenching Practice' (1997).

Where operatives are required to work in excavations, the excavations should be monitored for the presence of carbon-dioxide, methane and oxygen prior to being entered. Monitoring should also be undertaken throughout the duration of the works in excavations to ensure safe working conditions are maintained.



#### **7.4. Concrete Grade**

Sulphate content and pH value determinations were carried out by the analytical laboratory on a total of 8no. samples.

Values of water-soluble sulphate ranged from 23mg/l SO<sub>4</sub> to 1760mg/l SO<sub>4</sub>, pH values ranged from 7.8 to 8.6 and the concentrations of total sulphur ranged from <0.02% to 0.65%.

The above results have been compared to current guidance provided within BRE Special Digest 1, third edition 'Concrete in Aggressive Ground' (2005). Given the observed extent of made ground at the site, the methodology provided within Section C5.1.3 has been used to determine the required concrete grade.

The following representative values have been adopted for the shallow soils at the site:

- Water Soluble Sulphate – 1,029mg/l SO<sub>4</sub>;
- pH Value – 7.8;
- Total Potential Sulphate – 1.11%.

In accordance with BRE SD1 (2005) and on the basis of the above results and an assumption of mobile groundwater, the following classifications are recommended for shallow buried concrete at the site.

- Design Sulphate Class – DS-3;
- Aggressive Chemical Environment for Concrete (ACEC) – AC-3.

#### **7.5. External Works**

##### **7.5.1. Drainage**

Infiltration testing was outside the scope of this investigation. Given the predominantly cohesive nature of the underlying natural soils, it is considered that infiltration drainage at the site is unlikely to be a viable option. Alternative methods of surface water disposal should be investigated.

##### **7.5.2. Pavement Design**

The investigation identified the likely subgrade for pavement design to comprise either Made Ground or the Head Deposits.

Given the variable nature of the made ground, a conservative design CBR value of 1% should be adopted for preliminary design purposes in areas where made ground is present at subgrade level.

Reference has been made to the 'Design Guidance for Road Pavement Foundations', Interim Advice Note 73106, Revision 1 (2009), when considering the CBR value appropriate for use where the Head Deposits exists at subgrade level.

Interim advice note 73106, Revision 1 (2009) provides recommendations for design CBR values on the basis of soil plasticity. The recorded plasticity index of the Head Deposits ranged from 8% to 18%. Therefore, a CBR value of 3% is recommended for the preliminary design of thin road pavements where the Head Deposits are present at formation level. Thin pavement construction is defined as a depth to subgrade of 300mm.

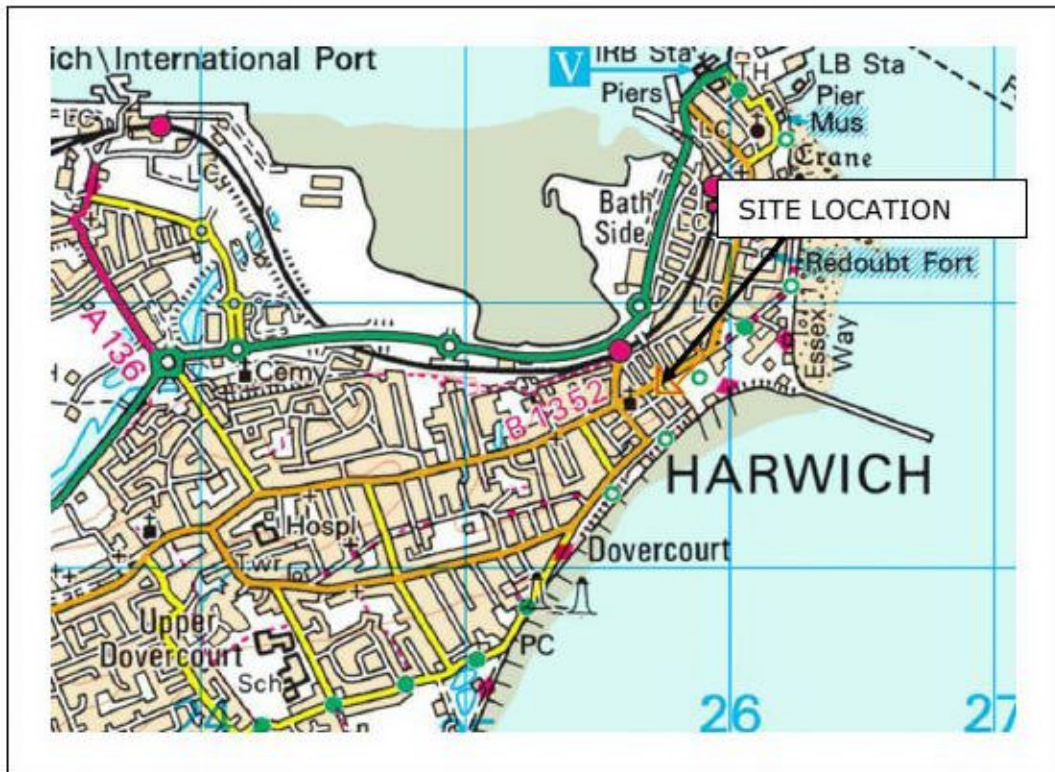
In-situ CBR tests should be carried out prior to road pavement construction to confirm the CBR values. In-situ tests should be undertaken once final levels for road construction have been determined.

It should be noted that in some locations the Thames Group is classified as a frost susceptible material on the basis of a recorded plasticity index below 15%. All due care and attention should be taken in respect of this.

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## **Appendix A**

Figures & Drawings



REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, © CROWN COPYRIGHT RICHARD JACKSON LTD – ACC No. 100002572

**Richard Jackson**  
Engineering Consultants  
consulting civil & structural engineers  
847 The Crescent, Colchester, CO4 9YQ

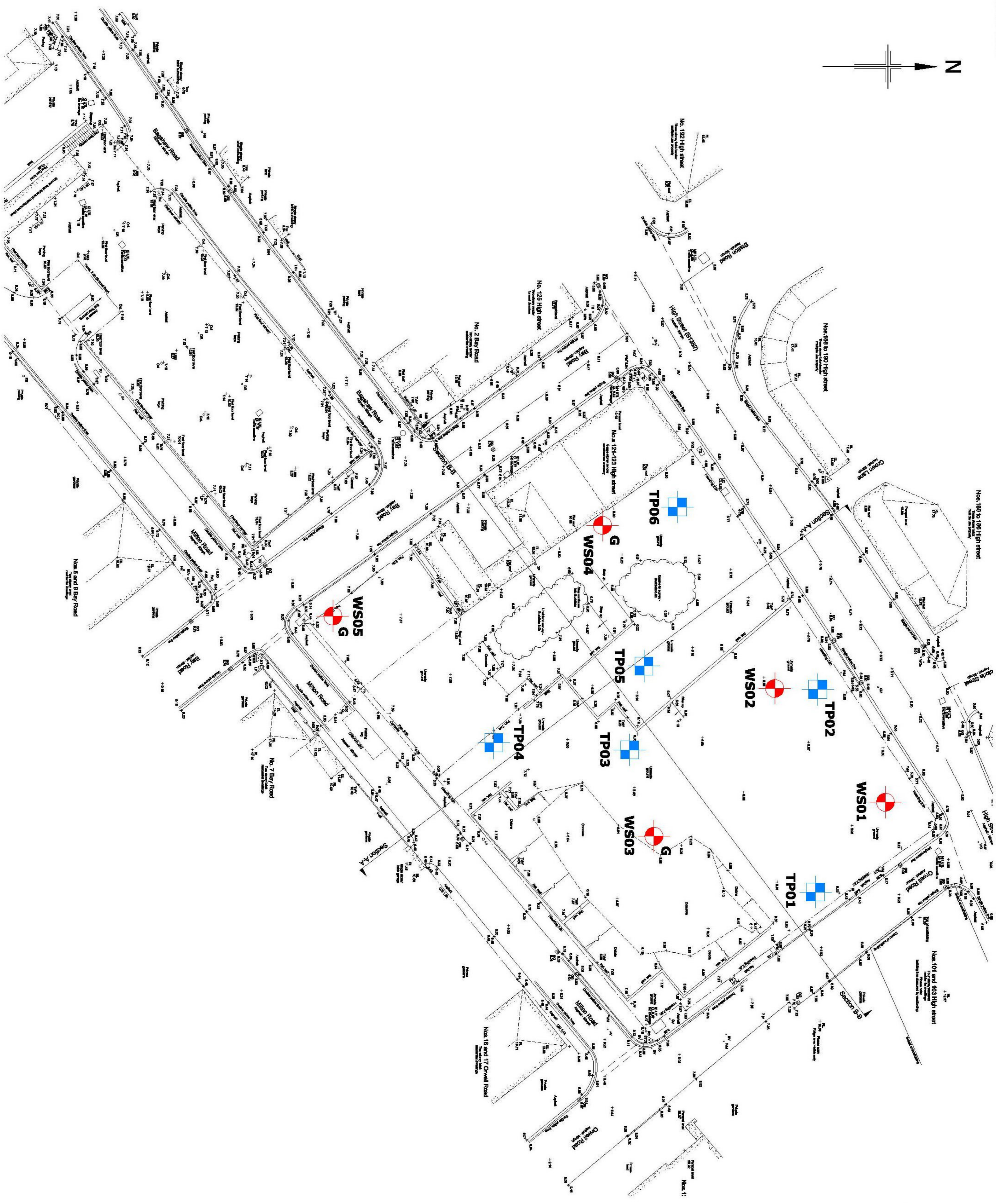
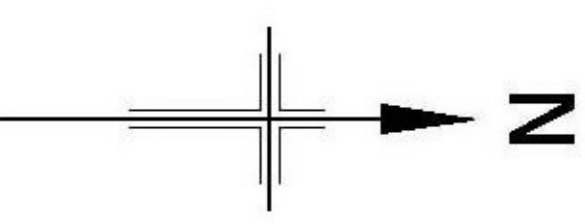
Starlings & Milton Road, Harwich,  
Essex, CO12 3EQ

FIGURE 1

**SITE LOCATION PLAN**

SCALE: N.T.S.

JOB NO: 60275



- KEY**
- : WINDLESS SAMPLER BOREHOLE
  - : TRIAL PIT
  - : MONITORING WELL INSTALLED

REV	DATE	DESCRIPTION	DRAWN	CHECK

**REVISIONS**

The drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.



**Project**  
 STARLINGS  
 MILTON ROAD  
 HARWICH

**Title**  
 EXPLORATORY HOLE LOCATION  
 PLAN

**Client**  
 TENDRING DISTRICT COUNCIL

Scale	1:200 @ A1	Drawn	J.BAKER	Date	DEC 2019
3rd Manager	R.LAYCOCK	Checked	K.KORRELY	Approved	K.KORRELY



107 The Colchester Customer Centre, Essex CO1 1PQ  
 1000 High Street, Tendring District Council, Harwich, Essex, SA1 1LW  
 4 The Old Church, St. Matthews Road, Harwich, Essex, SA1 1LW  
 The Windmill, South Hill, Harwich, Essex, SA1 1LW

Drawing No. **60275/G/FIG02**

- Drawing Status**
- INFORMATION
  - APPROVAL
  - CONSTRUCTION
  - AS CONSTRUCTED
  - TENDER
  - COSTING
  - AS CONSTRUCTED

## **Appendix B**

Exploratory hole logs and data plots



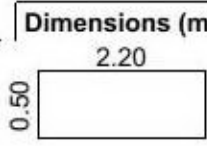
<b>Project Name:</b> Starlings	<b>Project No.:</b> 60275	<b>Co-ords:</b> Orientation:	<b>Dimensions (m)</b> 1.90 0.50	<b>Date:</b> 05/12/2019
<b>Location:</b> Milton Road, Dovercourt	<b>Level (m, aOD):</b>	<b>Depth (m):</b> 2.80		<b>Scale:</b> 1:20
<b>Client:</b> Tendring District Council				<b>Logged:</b> KO

Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.30	ES1	PID=0.0		0.20	[Pattern]	Red brick recovered as medium SAND to COBBLE sized fragments. MADE GROUND		
	0.30	PID					0.85	Clinker and ash recovered as fine SAND to coarse GRAVEL sized fragments. MADE GROUND	
	1.20	D2	PID=0.0		1.05	[Pattern]	CONCRETE		
	1.20	PID					1.40	Brown gravelly medium to coarse SAND. Gravel is fine brick ash and chalk. MADE GROUND	
	1.60	PP	PP=85		1.40	[Pattern]	Firm grey with reddish orange veins slightly sandy very silty CLAY. HEAD DEPOSITS		
	1.70	D3	PID=0.0		1.70		[Pattern]	...black staining and a strong hydrocarbon odour from 1.80m	
	1.70	PID						1.80	
	1.80	ES4	PID=99.7		1.80				
	1.80	PID						2.10	
	2.10	PP	PP=20		2.20				
	2.20	D5	PID=349.0		2.20				
	2.20	PID				2.70			
	2.75	IVN	67		2.80		Firm brown CLAY. THAMES GROUP		
							End of Pit at 2.800m		

<b>Groundwater:</b> Groundwater not encountered	<b>Key</b>			
<b>Stability:</b> Dry & Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
<b>Remarks:</b>	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
		Groundwater strike		Standing water level



<b>Project Name:</b> Starlings	<b>Project No.:</b> 60275	<b>Co-ords:</b> Orientation:	<b>Date:</b> 05/12/2019
<b>Location:</b> Milton Road, Dovercourt		<b>Level (m, aOD):</b>	<b>Scale:</b> 1:20
<b>Client:</b> Tendring District Council		<b>Depth (m):</b> 1.90	<b>Logged:</b> KO



Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description
	Depth	Type	Results				
					0.15 0.20		Red brick recovered as medium SAND to COBBLE sized fragments. <b>MADE GROUND</b>
	0.40 0.40	ES1 PID	PID=0.0				Clinker recovered as fine to coarse GRAVEL with sand sized ash. <b>MADE GROUND</b>
	1.50 1.50 1.60 1.80	D2 PID PP PP	PID=0.0 PP=45 PP=55		1.40   1.90		Firm grey with rare reddish orange veins slightly sandy very silty CLAY. <b>HEAD DEPOSITS</b>  ...becoming slightly silty at 1.70m  End of Pit at 1.900m

<b>Groundwater:</b> Groundwater not encountered	<b>Key</b>			
<b>Stability:</b> Dry & Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
<b>Remarks:</b>	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
		Groundwater strike		Standing water level





<b>Project Name:</b> Starlings	<b>Project No.:</b> 60275	<b>Co-ords:</b> Orientation:	<b>Dimensions (m)</b> 2.10 0.50	<b>Date:</b> 05/12/2019
<b>Location:</b> Milton Road, Dovercourt	<b>Level (m, aOD):</b>	<b>Depth (m):</b> 2.50		<b>Scale:</b> 1:20
<b>Client:</b> Tendring District Council				<b>Logged:</b> KO

Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description
	Depth	Type	Results				
					0.15		CONCRETE
	0.30 0.30	D1 PID	PID=0.0				Brown slightly clayey gravelly medium to coarse SAND. Gravel is subangular to subrounded fine to coarse brick ash concrete ceramic and rare wire fragments. MADE GROUND
	0.90	PP	PP=10		0.80		Soft greyish brown occasionally mottled orange slightly silty slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded medium to coarse brick and occasional concrete. MADE GROUND
	1.20 1.30 1.30	PP D2 PID	PP=15 PID=0.0		1.40		Stiff grey stained black silty CLAY with sand lenses and a strong suspected hydrocarbon odour. MADE GROUND
▼	1.50 1.50 1.60	ES3 PID PP	PID=12.7 PP=85		1.90		...suspected oil tank pipework at 1.70m in southern end of pit with a strong suspected hydrocarbon odour
	2.00 2.00 2.20	D4 PID PP	PID=8.8 PP=75		2.50		Firm pale grey occasionally mottled orange brown slightly silty sandy CLAY with sand lenses. HEAD DEPOSITS ...rare sand lenses from 2.20m
	2.50	PP	PP=60		2.50		End of Pit at 2.500m

<b>Groundwater:</b> Groundwater struck at 1.70m	<b>Key</b>			
<b>Stability:</b> Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
<b>Remarks:</b>	▼	Groundwater strike	▼	Standing water level



Project Name: Starlings	Project No. 60275	Co-ords:	Dimensions (m) 1.90	Date
		Orientation:		05/12/2019
Location: Milton Road, Dovercourt			Level (m, aOD):	Scale 1:20
Client: Tendring District Council			Depth (m): 2.50	Logged KO

Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.50 0.50	D1 PID	PID=0.0		0.70		Blackish brown gravelly cobbly medium SAND. Gravel is fine ash and brick and medium to coarse brick and concrete. Cobbles are brick and concrete. MADE GROUND
	0.80	PP	PP=25				Soft brown mottled orange brown slightly gravelly sandy CLAY with rare cobbles. Gravel is fine brick and medium to coarse tile. Cobbles are brick. MADE GROUND
	1.00 1.00	D2 PID	PID=0.0		1.30		...becoming silty at 1.20m
	1.40 1.40	D3 PID	PID=0.0				Orange clayey very silty fine to medium SAND. HEAD DEPOSITS
	2.10	IVN	65		2.00		Firm orange brown CLAY. THAMES GROUP
	2.40 2.40	D4 PID	PID=0.0		2.50		End of Pit at 2.500m

Groundwater: Groundwater not encountered	<b>Key</b>			
Stability: Dry & Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
Remarks:	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
		Groundwater strike		Standing water level



<b>Project Name:</b> Starlings	<b>Project No.:</b> 60275	<b>Co-ords:</b> Orientation:	<b>Dimensions (m)</b> 1.90	<b>Date:</b> 05/12/2019
<b>Location:</b> Milton Road, Dovercourt		<b>Level (m, aOD):</b>	0.50	<b>Scale:</b> 1:20
<b>Client:</b> Tendring District Council		<b>Depth (m):</b> 1.60		<b>Logged:</b> KO

Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.40 0.40	D1 PID	PID=0.0				Brown gravelly medium SAND with frequent roots. Gravel is fine to medium ash brick and ceramic with slate fragments. MADE GROUND
	1.00 1.00	D2 PID	PID=0.0		1.10		<p>...frequent coarse gravel and cobbles of concrete and brick from 0.70m</p> <p>...slightly clayey from 0.80m</p>
	1.30 1.40 1.40	PP D3 PID	PP=40 PID=0.0		1.60		Firm brown slightly sandy gravelly CLAY. Gravel is medium to coarse brick and rare fine ash. MADE GROUND
	End of Pit at 1.600m						

<b>Groundwater:</b> Groundwater not encountered	<b>Key</b>			
<b>Stability:</b> Dry & Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
<b>Remarks:</b>	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
		Groundwater strike		Standing water level



<b>Project Name:</b> Starlings	<b>Project No.:</b> 60275	<b>Co-ords:</b> Orientation:	<b>Dimensions (m)</b> 2.00 0.50	<b>Date:</b> 05/12/2019
<b>Location:</b> Milton Road, Dovercourt		<b>Level (m, aOD):</b>		<b>Scale:</b> 1:20
<b>Client:</b> Tendring District Council		<b>Depth (m):</b> 2.60		<b>Logged:</b> KO

Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description
	Depth	Type	Results				
							Fine to coarse GRAVEL and COBBLES of red brick and cinder block with occasional concrete cobbles. MADE GROUND
	0.80 0.80	D1 PID	PID=0.0		0.70		Pale brown clayey silty fine to medium SAND. HEAD DEPOSITS
	1.60 1.60	D2 PID	PID=0.0				...friable clay pockets from 1.40m
	2.40 2.40	D3 PID	PID=0.0		2.60		End of Pit at 2.600m

<b>Groundwater:</b> Groundwater not encountered	<b>Key</b>			
<b>Stability:</b> Dry & Stable	<b>D</b>	Disturbed	<b>IVN</b>	Hand Vane
<b>Remarks:</b>	<b>B</b>	Bulk	<b>PID</b>	PID Reading
	<b>ES</b>	Environmental	<b>PP</b>	Pocket Penetrometer
		Groundwater strike		Standing water level



**Project Name:** Starlings

**Dates**  
04/12/2019

**Project no.**  
60275

Hole Type  
**WLS**

**Location:** Milton Road, Dovercourt

**Co-ordinates:**

Scale  
**1:30**

**Client:** Tendring District Council

**Ground Level (m):**

Logged By  
**KO**

Well	Water		Samples & In-situ Tests					Level (m)	Depth (m)	Legend	Stratum Description	Scale
	Depth	Level	Casing	SWL	Depth	Type	Results					
[Pattern]					0.30 0.30 - 0.40	PID ES1	PID=0.0		0.50	[Pattern]	Reddish brown slightly clayey gravelly medium SAND. Gravel is subrounded fine to medium brick concrete and flint.	[Scale]
								0.70	[Pattern]	MADE GROUND		
								1.00	[Pattern]	Red brick COBBLES.		
			1.00		1.00	C	N=3 (1,2/1,1,1,0)		1.00	[Pattern]	Firm to stiff greyish brown slightly sandy gravelly CLAY. Gravel is subangular to rounded medium to coarse concrete brick and flint.	
					1.40 1.40 - 1.50	PID D2	PID=0.0		1.30	[Pattern]	MADE GROUND	
									1.90	[Pattern]	Yellowish brown slightly cobbly medium to coarse SAND. Cobbles are brick.	
			1.00		2.00 2.10 - 2.20	C D3	N=5 (1,1/1,1,1,2)		1.90	[Pattern]	MADE GROUND	
									2.50	[Pattern]	Stiff brown slightly sandy slightly gravelly CLAY with roots. Gravel is fine ash and brick and occasional subrounded medium to coarse flint.	
									2.90	[Pattern]	MADE GROUND	
			1.00		2.90 3.00 3.10 - 3.20 3.20	IVN C D4 PID	85 N=10 (1,2/2,2,3,3) PID=0.0		3.00	[Pattern]	Firm greyish brown mottled pale orange sandy CLAY with rare gravel of angular to subrounded fine to medium chert and quartzite and rare recently active roots.	
									3.50	[Pattern]	HEAD DEPOSITS	
									3.60	[Pattern]	...very silty from 2.70m to 2.80m	
									3.90	[Pattern]	...sand lens at 2.80m	
			1.00		3.90 4.00 4.20 - 4.30	IVN C D5	30 95 (2,3/3,4,4,5)		3.90	[Pattern]	...becoming stiff at 2.90m	
									4.00	[Pattern]	Stiff pale grey occasionally mottled brown silty CLAY.	
								4.20	[Pattern]	THAMES GROUP		
								4.60	[Pattern]	...IVN at 3.80m = Failed		
								4.90	[Pattern]	...occasionally mottled reddish orange from 4.00m		
								5.00	[Pattern]	...ironstone nodules from 4.50m		
		1.00		4.90 5.00	PP C	75 N=23 (3,3/5,6,6,6)		5.00	[Pattern]	End of Borehole at 5.000m		

**Groundwater:** Groundwater not encountered

**Groundwater Key**

	Groundwater
	Strike
	Standing water level

**Sample Type Key**

<b>D</b>	Disturbed
<b>B</b>	Bulk
<b>U</b>	Undisturbed
<b>ES</b>	Environmental

**Test Type Key**

<b>IVN</b>	Hand vane
<b>S/C</b>	SPT / CPT
<b>PP</b>	Pocket penetrometer
<b>PID</b>	PID Reading

**Remarks:**



**Project Name:** Starlings

**Dates**  
04/12/2019

**Project no.**  
60275

Hole Type  
**WLS**

**Location:** Milton Road, Dovercourt

**Co-ordinates:**

Scale  
**1:30**

**Client:** Tendring District Council

**Ground Level (m):**

Logged By  
**KO**

Well	Water		Samples & In-situ Tests				Level (m)	Depth (m)	Legend	Stratum Description	Scale
	Depth	Level	Casing	SWL	Depth	Type					
					0.40	PID	PID=0.0	0.10		Red brick recovered as a subangular medium to coarse GRAVEL.	
					0.40 - 0.50	ES1		0.20		MADE GROUND	
					1.00	C	N=1 (1,1/1,0,0,0)	1.00		Firm to stiff greyish brown very sandy gravelly CLAY. Gravel is subrounded to subangular medium brick and concrete.	1
	1.30		1.00		1.40 - 1.50	D2		1.10		MADE GROUND	
					1.50	PID	PID=0.0	1.30		Concrete recovered as coarse GRAVEL and COBBLES.	
					1.60	IVN	30			CONCRETE	
					1.90	IVN	69	2.00		VOID	2
	2.00		1.00		2.00	C	N=9 (1,1/1,2,3,3)			Soft brown sandy CLAY with occasional very clayey sand pockets.	
					2.60	PID	PID=0.0	2.50		HEAD DEPOSITS ...becoming firm at 1.90m	
					2.60 - 2.70	D3				Saturated greyish brown medium to coarse SAND.	
					2.90	IVN	60			HEAD DEPOSITS	
			1.00		3.00	C	N=11 (1,2/2,3,3,3)			Firm pale grey mottled brown and orange brown silty CLAY.	3
					3.20 - 3.30	D4				THAMES GROUP	
					3.30	PID	PID=0.0			...IVN at 2.50m = Failed ...becoming stiff at 3.00m	
					3.60	IVN	78				
					3.90	IVN	94	4.00			4
			1.00		4.00	C	N=13 (2,2/3,3,3,4)			End of Borehole at 4.000m	

**Groundwater:** Groundwater struck at 1.30m & 2.00m.

**Groundwater Key**

	Groundwater
	Strike
	Standing water level

**Sample Type Key**

<b>D</b>	Disturbed
<b>B</b>	Bulk
<b>U</b>	Undisturbed
<b>ES</b>	Environmental

**Test Type Key**

<b>IVN</b>	Hand vane
<b>S/C</b>	SPT / CPT
<b>PP</b>	Pocket penetrometer
<b>PID</b>	PID Reading

**Remarks:**

**Project Name:** Starlings

**Dates**  
 04/12/2019

**Project no.**  
 60275

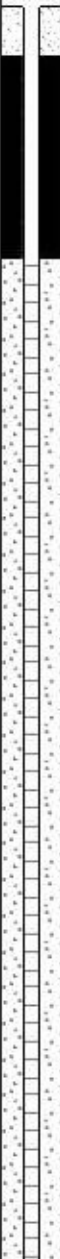

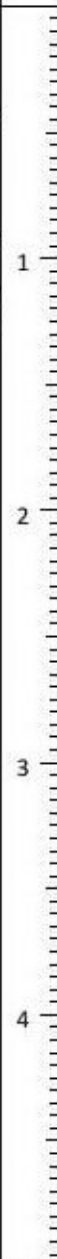
 Hole Type  
**WLS**
**Location:** Milton Road, Dovercourt

**Co-ordinates:**


 Scale  
**1:30**
**Client:** Tendring District Council


**Ground Level (m):**

 Logged By  
**KO**

Well	Water		Samples & In-situ Tests				Level (m)	Depth (m)	Legend	Stratum Description	Scale
	Depth	Level	Casing	SWL	Depth	Type					
					0.50	PID	PID=0.0		0.40	 Brown mottled red and whitish grey sandy subrounded to subangular fine to coarse brick and concrete GRAVEL. <b>MADE GROUND</b>	
					0.50 - 0.60	ES1	22				
					0.60	IVN			0.90	<b>HEAD DEPOSITS</b>	
			1.00		1.00	C	N=7		1.10	Grey very clayey slightly silty medium SAND with a slight organic odour. <b>HEAD DEPOSITS</b>	
					1.20	PID	(1,1/1,2,2,2)			Firm grey mottled orange brown CLAY with occasional sandy pockets. <b>THAMES GROUP</b>	
					1.20 - 1.30	D2	PID=0.0			<i>...becoming stiff at 1.80m</i>	
					1.60	IVN	68			<i>...no sandy pockets from 2.00m</i>	
			1.00		1.90	IVN	89			<i>...rare silt partings and decayed roots from 2.30m</i>	
					2.00	C	N=9				
					2.30	PID	(1,1/1,2,3,3)				
					2.30 - 2.40	D3	PID=0.0				
					2.50	IVN	90				
					2.80	IVN	98				
			1.00		3.00	C	N=10				
					3.30	PID	(2,2/2,3,2,3)				
				3.30 - 3.40	D4	PID=0.0					
				3.60	IVN	93					
				3.80	PP	110					
		1.00		4.00	C	N=11			<i>...IVN at 3.90m = Failed</i>		
				4.10 - 4.20	D5	(2,2/2,2,3,4)					
				4.70	PP	120					
		1.00		5.00	C	N=12			<i>...iron staining from 4.90m</i> End of Borehole at 5.000m		
						(3,2/3,3,3,3)					

**Groundwater:** Groundwater not encountered

**Groundwater Key**
 Groundwater Strike

 Standing water level

**Sample Type Key**
**D** Disturbed

**B** Bulk

**U** Undisturbed

**ES** Environmental

**Test Type Key**
**IVN** Hand vane

**S/C** SPT / CPT

**PP** Pocket penetrometer

**PID** PID Reading

**Remarks:**



**Project Name:** Starlings

**Dates**  
04/12/2019

**Project no.**  
60275

Hole Type  
**WLS**

**Location:** Milton Road, Dovercourt

**Co-ordinates:**

Scale  
**1:30**

**Client:** Tendring District Council

**Ground Level (m):**

Logged By  
**KO**

Well	Water		Samples & In-situ Tests				Level (m)	Depth (m)	Legend	Stratum Description	Scale
	Depth	Level	Casing	SWL	Depth	Type					
					0.20	PID	PID=0.0	0.40		Red brick recovered as coarse SAND to medium GRAVEL sized fragments. MADE GROUND	
					0.20 - 0.30	ES1					
					0.50	IVN	20	1.00		Very soft to soft brown slightly sandy very silty CLAY with occasional recently active roots. HEAD DEPOSITS	
					0.80	IVN	38				
					0.90	PID	PID=0.0				
					0.90 - 1.00	D2	N=2				
					1.00	C	(0,1,0,1,0,1)	1.00			
					1.60	IVN	19				
					1.70 - 1.80	D3					
					1.90	IVN	18				
		1.95			2.00	C	N=6 (1,1/1,2,1,2)	1.00		...orange fine to medium sand lens from 1.95m	
					2.50	IVN	61				
					2.50 - 2.60	D4					
					2.80	IVN	20				
					3.00	C	N=8 (1,1/1,2,2,3)	1.00		...becoming soft at 2.80m ...dark blackish brown speckling at 2.90m	
				3.40	PID	PID=0.0					
				3.40 - 3.50	D5						
				3.60	IVN	47					
				3.90	IVN	90	1.00		Firm brown slightly sandy CLAY. THAMES GROUP ...becoming stiff at 3.90m		
				4.00	C	N=10 (1,2/2,2,3,3)					
				4.20	PID	PID=0.0					
				4.20 - 4.30	D6						
				4.70	IVN	84	5.00		End of Borehole at 5.000m		

**Groundwater:** Groundwater struck at 1.95m

**Groundwater Key**

	Groundwater Strike
	Standing water level

**Sample Type Key**

<b>D</b>	Disturbed
<b>B</b>	Bulk
<b>U</b>	Undisturbed
<b>ES</b>	Environmental

**Test Type Key**

<b>IVN</b>	Hand vane
<b>S/C</b>	SPT / CPT
<b>PP</b>	Pocket penetrometer
<b>PID</b>	PID Reading

**Remarks:**





**Project Name:** Starlings

**Dates**  
04/12/2019

**Project no.**  
60275

Hole Type  
**WLS**

**Location:** Milton Road, Dovercourt

**Co-ordinates:**

Scale  
**1:30**

**Client:** Tendring District Council

**Ground Level (m):**

Logged By  
**KO**

Well	Water		Samples & In-situ Tests				Level (m)	Depth (m)	Legend	Stratum Description	Scale
	Depth	Level	Casing	SWL	Depth	Type					
					0.40 - 0.50	ES1	PID=0.0			Dark grey mottled black sandy clayey GRAVEL of subrounded to subangular fine to coarse brick ash clinker concrete and flint. MADE GROUND	
					0.50	PID					
			1.00		1.00	C	N=4 (0,1/1,1,1,1)		0.90	Firm grey sandy silty gravelly CLAY. Gravel is fine ash and brick. MADE GROUND	
					1.60	IVN	76		1.40	Firm brown occasionally mottled grey and orange slightly silty CLAY with rare recently active roots and fine chert gravel. THAMES GROUP	
			1.00		1.80 - 1.90	D2	68				
					1.90	IVN	PID=0.0				
					1.90	PID	N=6				
					2.00	C	(1,1/1,1,2,2)				
					2.20	PID	PID=0.0			...rare silt partings from 2.20m	
					2.20 - 2.30	D3	58				
					2.50	IVN	103				
			1.00		2.80	IVN	N=8 (1,1/1,2,2,3)				
					3.00	C	PID=0.0				
					3.30	PID	53				
					3.30 - 3.40	D4					
				3.50	IVN						
		1.00		4.00	C	N=14 (2,2/3,3,4,4)		3.70	Firm pale grey mottled orange brown with frequent iron staining CLAY with frequent weak mudstone fragments and ironstone nodules. THAMES GROUP		
				4.20 - 4.30	D5				...becoming stiff at 4.50m		
				4.70	IVN	88					
								5.00	End of Borehole at 5.000m		

**Groundwater:** Groundwater not encountered

**Groundwater Key**

	Groundwater Strike
	Standing water level

**Sample Type Key**

<b>D</b>	Disturbed
<b>B</b>	Bulk
<b>U</b>	Undisturbed
<b>ES</b>	Environmental

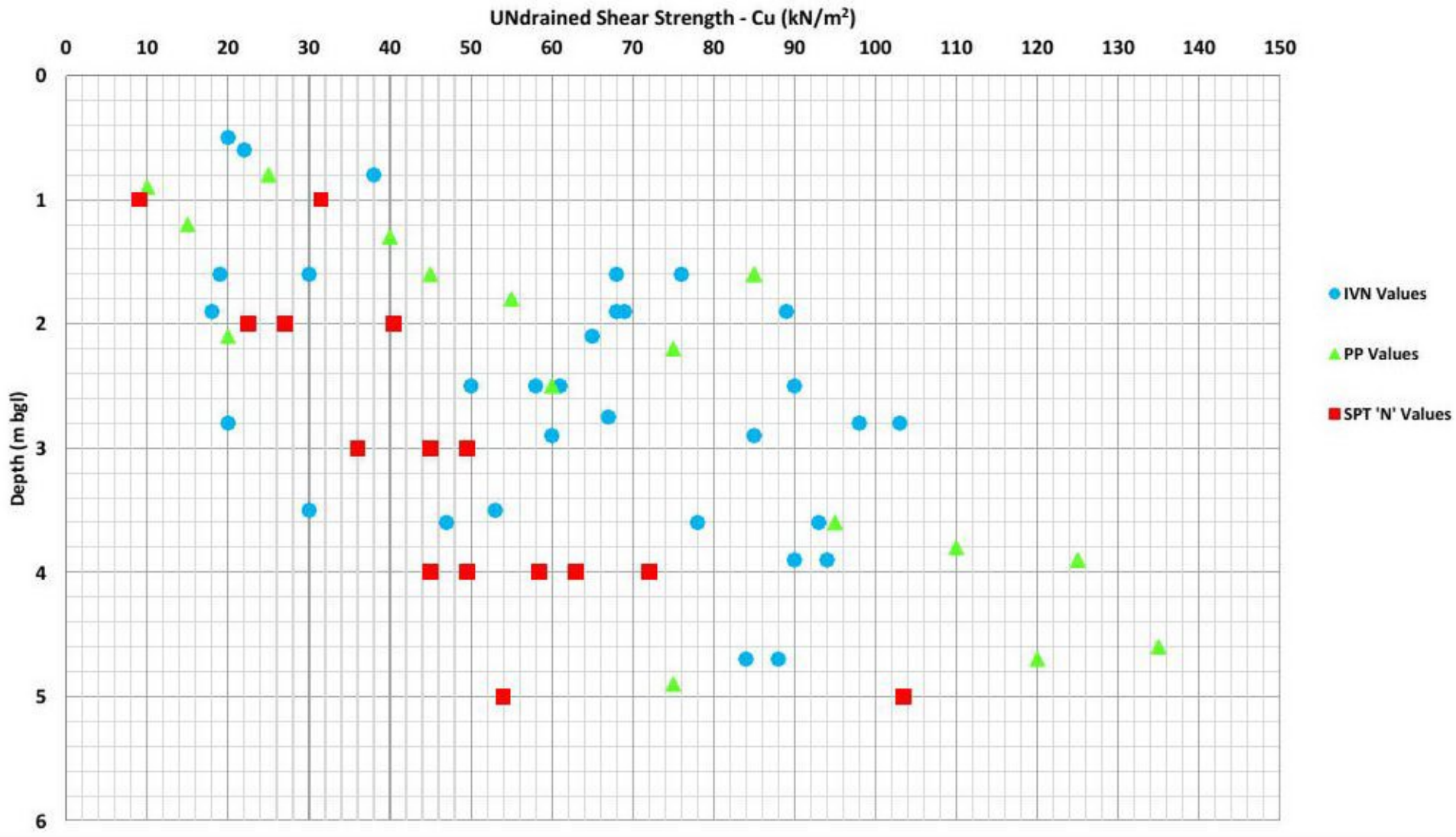
**Test Type Key**

<b>IVN</b>	Hand vane
<b>S/C</b>	SPT / CPT
<b>PP</b>	Pocket penetrometer
<b>PID</b>	PID Reading

**Remarks:**

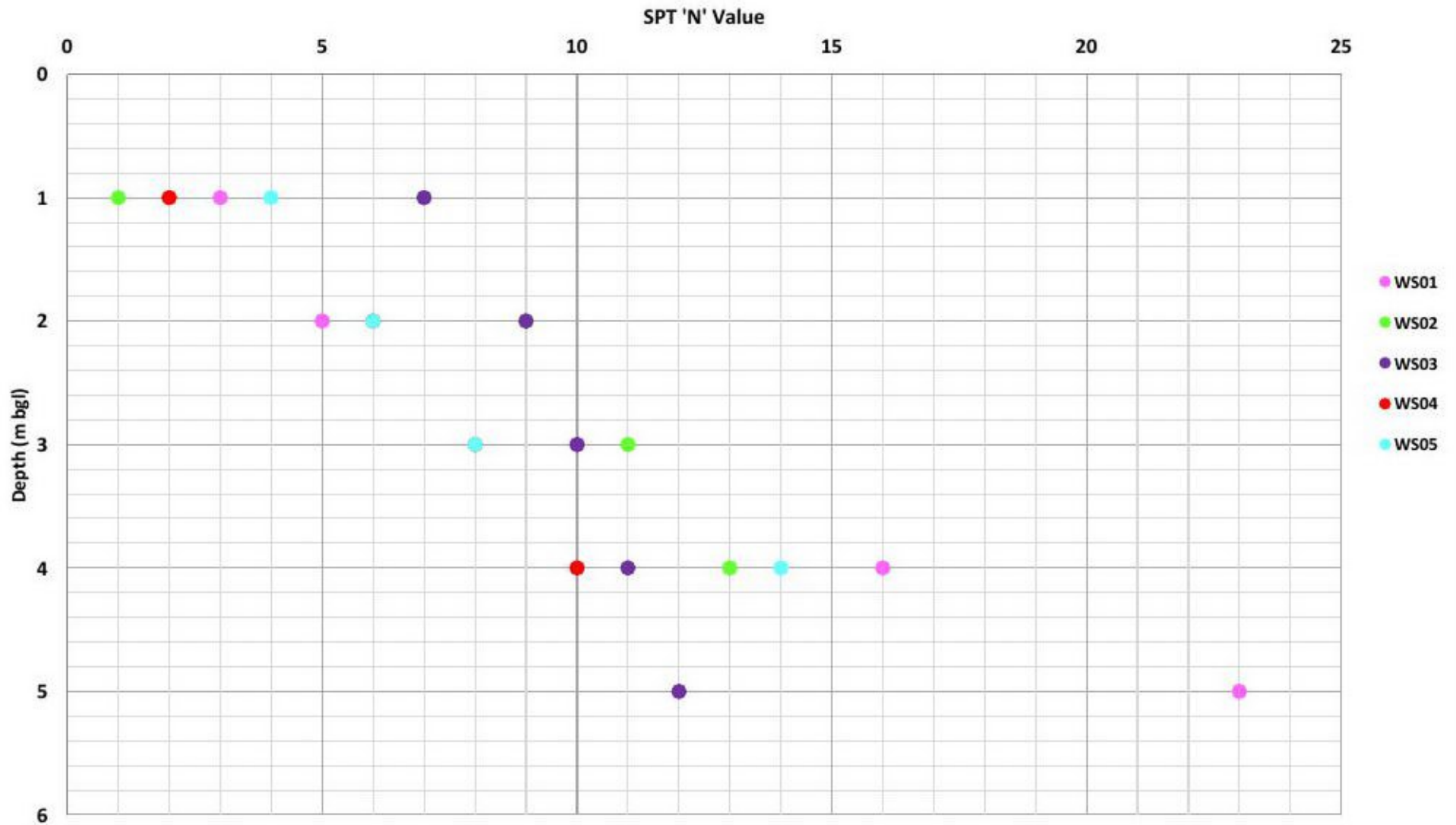
# 60275 - Starlings, Milton Road, Harwich

## Undrained Shear Strength (Cu) -vs- Depth Profile



# 60275 - Starlings, Milton Road, Harwich

## SPT 'N' Value -vs- Depth Profile



## **Appendix C**

### Results of Chemical Analyses

**60275 – Starlings, Milton Road, Harwich, Essex**

**Geo-environmental Assessment**  
**Reference Criteria**

**Soils**

In 2014 Land Quality Management Ltd (LQM) and the Chartered Institute of Environmental Health (CIEH) published 'Suitable 4 Use Levels' (S4ULs) for human health risk assessment. The S4ULs have been derived in accordance with UK legislation, national and Environment Agency policy using a modified version of the Contaminated Land Exposure Assessment (CLEA) software. The S4ULs are based on minimal or tolerable risk as described in SR2 (Environment Agency, 2009a).

The S4ULs are intended to replace the 2<sup>nd</sup> edition of the LQM/CIEH Generic Assessment Criteria (GAC).

The S4ULs have also been used to replace the Environment Agency Soil Guideline Values (SGVs), which were defined in 2009 alongside updates to the CLEA methodology and software.

The parameters detailed in the LQM/CIEH S4ULs publication have been adapted using the CLEA software to reflect site specific conditions, including the Soil Organic Matter (SOM), where these are significantly different from the values used to derive the SGV.

It is understood the site is to be developed to provide a surface car park with localised areas of soft landscaping, therefore S4ULs for commercial use been adopted for this site.

A SOM of 1% has been adopted for organic chemicals for the purposes of the initial assessment on the basis of laboratory analysis. A SOM of 6% has been adopted for inorganic chemical as detailed in 'The LQM / CIEH S4ULs for human health assessment', (2015).

Only the three most hazardous PAH's, benzo(a)pyrene, dibenz(a,h)anthracene and naphthalene have been considered on this occasion.

In the absence an S4UL for lead the Category 4 Screening Level (C4SL) for lead has been adopted. In March 2014 DEFRA published C4SLs for six contaminants including lead. The C4SLs are based on a unique toxicological benchmark, 'Low Level of Toxicological Concern' rather than the 'minimal or tolerable level of risk' which forms the basis for the S4ULs.

A summary of the tier one screening values for human health is given in the Table, below.

Contaminant	Origin of Screening Value	Screening Value (mg/kg)
Arsenic	S4UL <sup>1</sup>	640
Cadmium	S4UL <sup>1</sup>	190
Chromium	S4UL <sup>1</sup>	8,600
Copper	S4UL <sup>1</sup>	68,000
Nickel	S4UL <sup>1</sup>	980
Lead	C4SL <sup>2</sup>	2,300
Selenium	S4UL <sup>1</sup>	12,000
Mercury	S4UL <sup>1</sup>	1,100
Zinc	S4UL <sup>1</sup>	730,000
Benzo(a)pyrene	S4UL <sup>3</sup>	35
Dibenz(a,h)anthracene	S4UL <sup>3</sup>	3.5
Naphthalene	S4UL <sup>3</sup>	190
Total Phenols	S4UL <sup>3</sup>	760
TPH Aromatic C <sub>5</sub> -C <sub>7</sub>	S4UL <sup>3</sup>	26,000*
TPH Aromatic C <sub>7</sub> -C <sub>8</sub>	S4UL <sup>3</sup>	56,000*
TPH Aromatic C <sub>8</sub> -C <sub>10</sub>	S4UL <sup>3</sup>	3,500*
TPH Aromatic C <sub>10</sub> -C <sub>12</sub>	S4UL <sup>3</sup>	16,000*
TPH Aromatic C <sub>12</sub> -C <sub>16</sub>	S4UL <sup>3</sup>	36,000*
TPH Aromatic C <sub>16</sub> -C <sub>21</sub>	S4UL <sup>3</sup>	28,000
TPH Aromatic C <sub>21</sub> -C <sub>35</sub>	S4UL <sup>3</sup>	28,000
TPH Aliphatic C <sub>5</sub> -C <sub>6</sub>	S4UL <sup>3</sup>	3,200*
TPH Aliphatic C <sub>6</sub> -C <sub>8</sub>	S4UL <sup>3</sup>	7,800*
TPH Aliphatic C <sub>8</sub> -C <sub>10</sub>	S4UL <sup>3</sup>	2,000*
TPH Aliphatic C <sub>10</sub> -C <sub>12</sub>	S4UL <sup>3</sup>	9,700*
TPH Aliphatic C <sub>12</sub> -C <sub>16</sub>	S4UL <sup>3</sup>	59,000*
TPH Aliphatic C <sub>16</sub> -C <sub>35</sub>	S4UL <sup>3</sup>	1,600,000
Benzene	S4UL <sup>3</sup>	27
Toluene	S4UL <sup>3</sup>	56,000*
Ethylbenzene	S4UL <sup>3</sup>	5,700*
M & P Xylene	S4UL <sup>3</sup>	65,900*
O Xylene	S4UL <sup>3</sup>	6,600*
Vinyl Chloride	S4UL <sup>3</sup>	0.059

Contaminant	Origin of Screening Value	Screening Value (mg/kg)
1,2 - Dichloroethane	S4UL <sup>3</sup>	0.67
Trichloroethene	S4UL <sup>3</sup>	1.2
1,1,1 - Trichloroethane	S4UL <sup>3</sup>	660
Tetrachloroethene	S4UL <sup>3</sup>	19
Chlorobenze	S4UL <sup>3</sup>	56
Hexachlorobutadine	S4UL <sup>3</sup>	31

<sup>1</sup> Value derived for site specific conditions use using CLEA software, S4UL parameters, at an SOM of 6% for commercial use

<sup>2</sup> Category 4 Screening Level adopted based on DEFRA (2014)

<sup>3</sup> Value derived for site specific conditions use using CLEA software, S4UL parameters, at an SOM of 1% for commercial use

\*Although soils up to this value may not be harmful to human health, it should be noted that soils would be saturated at this value and remediation may still be necessary. Results will therefore be reviewed on a case by case basis.



Kay O'Reilly  
Richard Jackson Ltd  
847 The Crescent  
Colchester  
Essex  
CO4 9YQ

**DETS Ltd**  
Unit 1  
Rose Lane Industrial Estate  
Rose Lane  
Lenham Heath  
Kent  
ME17 2JN

## **DETS Report No: 19-17098**

**Site Reference:** Starlings

**Project / Job Ref:** 60275

**Order No:** None Supplied

**Sample Receipt Date:** 09/12/2019

**Sample Scheduled Date:** 09/12/2019

**Report Issue Number:** 1

**Reporting Date:** 13/12/2019

**Authorised by:**

[REDACTED]

Dave Ashworth  
Technical Manager

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<b>Soil Analysis Certificate</b>						
<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	04/12/19	04/12/19	04/12/19	04/12/19	04/12/19
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	WS01 ES1	WS02 ES1	WS03 ES1	WS04 ES1	WS05 ES1
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	0.30 - 0.40	0.40 - 0.50	0.50 - 0.60	0.20 - 0.30	0.40 - 0.50
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451477	451478	451479	451480	451481

Determinand	Unit	RL	Accreditation					
Asbestos Screen <sup>(S)</sup>	N/a	N/a	ISO17025	Not Detected	Not Detected		Not Detected	Detected
Sample Matrix <sup>(S)</sup>	Material Type	N/a	NONE					Chrysotile in microscopic cement
Asbestos Type <sup>(S)</sup>	PLM Result	N/a	ISO17025					Chrysotile
pH	pH Units	N/a	MCERTS	7.9	8.4	7.8	8.5	8.6
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO <sub>4</sub>	mg/kg	< 200	NONE					
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE					
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	1760	299	45	23	289
W/S Sulphate as SO <sub>4</sub> (2:1)	q/l	< 0.01	MCERTS	1.76	0.30	0.04	0.02	0.29
Total Sulphur	%	< 0.02	NONE	0.65	0.03	0.04	< 0.02	0.09
Organic Matter	%	< 0.1	MCERTS	1.1	0.3	0.8	0.3	1.6
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE					
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	9	7	4	6	14
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	0.5
Chromium (Cr)	mg/kg	< 2	MCERTS	12	10	11	11	16
Copper (Cu)	mg/kg	< 4	MCERTS	12	11	7	7	78
Lead (Pb)	mg/kg	< 3	MCERTS	227	55	13	35	354
W/S Magnesium	mg/l	< 0.1	NONE					
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	7	9	9	9	21
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	67	26	31	31	230
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C  
Subcontracted analysis (S)

<b>Soil Analysis Certificate</b>				
<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	05/12/19	05/12/19	05/12/19
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied	None Supplied
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	TP03 ES3	WS04 D2	TP02 D2
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied	None Supplied
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	1.50	0.90 - 1.00	1.50
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451483	451484	451485

Determinand	Unit	RL	Accreditation				
Asbestos Screen <sup>(S)</sup>	N/a	N/a	ISO17025	Not Detected			
Sample Matrix <sup>(S)</sup>	Material Type	N/a	NONE				
Asbestos Type <sup>(S)</sup>	PLM Result	N/a	ISO17025				
pH	pH Units	N/a	MCERTS		7.8	8.2	7.8
Total Cyanide	mg/kg	< 2	NONE				
Total Sulphate as SO <sub>4</sub>	mg/kg	< 200	NONE		298	776	2207
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE		0.03	0.08	0.22
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS		26	225	43
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS		0.03	0.22	0.04
Total Sulphur	%	< 0.02	NONE		< 0.02	0.03	0.08
Organic Matter	%	< 0.1	MCERTS				
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE		67.4	< 0.5	< 0.5
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE		6.74	< 0.05	< 0.05
W/S Chloride (2:1)	mg/kg	< 1	MCERTS		16	31	23
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS		8.2	15.5	11.7
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS		5	< 3	6
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS		2.4	< 1.5	2.8
Arsenic (As)	mg/kg	< 2	MCERTS				
Cadmium (Cd)	mg/kg	< 0.2	MCERTS				
Chromium (Cr)	mg/kg	< 2	MCERTS				
Copper (Cu)	mg/kg	< 4	MCERTS				
Lead (Pb)	mg/kg	< 3	MCERTS				
W/S Magnesium	mg/l	< 0.1	NONE		1.4	2.6	2.1
Mercury (Hg)	mg/kg	< 1	NONE				
Nickel (Ni)	mg/kg	< 3	MCERTS				
Selenium (Se)	mg/kg	< 3	NONE				
Zinc (Zn)	mg/kg	< 3	MCERTS				
Total Phenols (monohydric)	mg/kg	< 2	NONE				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C  
 Subcontracted analysis (S)



**DETS Ltd**  
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Soil Analysis Certificate - Speciated PAHs						
<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	04/12/19	04/12/19	04/12/19	04/12/19	04/12/19
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	WS01 ES1	WS02 ES1	WS03 ES1	WS04 ES1	WS05 ES1
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	0.30 - 0.40	0.40 - 0.50	0.50 - 0.60	0.20 - 0.30	0.40 - 0.50
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451477	451478	451479	451480	451481

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.12	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.13
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.26	< 0.1	< 0.1	0.13	0.31
Anthracene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	0.14
Fluoranthene	mg/kg	< 0.1	MCERTS	0.38	0.15	< 0.1	0.17	0.94
Pyrene	mg/kg	< 0.1	MCERTS	0.31	0.13	< 0.1	0.13	0.85
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.43	0.31	< 0.1	0.31	0.69
Chrysene	mg/kg	< 0.1	MCERTS	0.18	< 0.1	< 0.1	< 0.1	0.57
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.48	0.34	< 0.1	< 0.1	0.94
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.30
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.31	0.22	< 0.1	< 0.1	0.65
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.40	< 0.1	< 0.1	< 0.1	0.70
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.28	< 0.1	< 0.1	< 0.1	0.53
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	3.2	< 1.6	< 1.6	< 1.6	6.8

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**Soil Analysis Certificate - TPH CWG Banded**

<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	05/12/19	05/12/19			
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied			
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	TP01 E54	TP03 E53			
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied			
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	1.80	1.50			
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451482	451483			

Determinand	Unit	RL	Accreditation			
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	9	< 2	
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	30	< 2	
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	50	< 3	
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	4	< 3	
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	93	< 21	
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	7	< 2	
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	14	< 2	
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	20	< 2	
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	10	< 3	
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	
Aromatic (C5 - C35)	mg/kg	< 21	NONE	52	< 21	
Total >C5 - C35	mg/kg	< 42	NONE	145	< 42	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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**Soil Analysis Certificate - TPH LQM Banded**

<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	04/12/19	04/12/19	04/12/19	04/12/19	04/12/19
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	WS01 ES1	WS02 ES1	WS03 ES1	WS04 ES1	WS05 ES1
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	0.30 - 0.40	0.40 - 0.50	0.50 - 0.60	0.20 - 0.30	0.40 - 0.50
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451477	451478	451479	451480	451481

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C16 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Aliphatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
Aliphatic (C5 - C44)	mg/kg	< 30	NONE	< 30	< 30	< 30	< 30	< 30
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
Aromatic (>C5 - C44)	mg/kg	< 30	NONE	< 30	< 30	< 30	< 30	< 30
Total >C5 - C44	mg/kg	< 60	NONE	< 60	< 60	< 60	< 60	< 60

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - BTEX / MTBE						
<b>DETS Report No: 19-17098</b>	<b>Date Sampled</b>	04/12/19	04/12/19	04/12/19	04/12/19	04/12/19
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Site Reference: Starlings</b>	<b>TP / BH No</b>	WS01 ES1	WS02 ES1	WS03 ES1	WS04 ES1	WS05 ES1
<b>Project / Job Ref: 60275</b>	<b>Additional Refs</b>	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
<b>Order No: None Supplied</b>	<b>Depth (m)</b>	0.30 - 0.40	0.40 - 0.50	0.50 - 0.60	0.20 - 0.30	0.40 - 0.50
<b>Reporting Date: 13/12/2019</b>	<b>DETS Sample No</b>	451477	451478	451479	451480	451481

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	3
p & m-xylene	ug/kg	< 2	MCERTS	< 2	8	< 2	< 2	8
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C.



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Soil Analysis Certificate - BTEX / MTBE					
<b>DETS Report No:</b> 19-17098	<b>Date Sampled</b>	05/12/19	05/12/19		
<b>Richard Jackson Ltd</b>	<b>Time Sampled</b>	None Supplied	None Supplied		
<b>Site Reference:</b> Starlings	<b>TP / BH No</b>	TP01 ES4	TP03 ES3		
<b>Project / Job Ref:</b> 60275	<b>Additional Refs</b>	None Supplied	None Supplied		
<b>Order No:</b> None Supplied	<b>Depth (m)</b>	1.80	1.50		
<b>Reporting Date:</b> 13/12/2019	<b>DETS Sample No</b>	451482	451483		

Determinand	Unit	RL	Accreditation			
Benzene	ug/kg	< 2	MCERTS	7	< 2	
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	
Ethylbenzene	ug/kg	< 2	MCERTS	59	< 2	
p & m-xylene	ug/kg	< 2	MCERTS	749	< 2	
o-xylene	ug/kg	< 2	MCERTS	108	< 2	
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C.



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Soil Analysis Certificate - Volatile Organic Compounds (VOC)					
DETS Report No: 19-17098	Date Sampled	04/12/19	04/12/19	05/12/19	05/12/19
Richard Jackson Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Starlings	TP / BH No	WS03 ES1	WS05 ES1	TP01 ES4	TP03 ES3
Project / Job Ref: 60275	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.50 - 0.60	0.40 - 0.50	1.80	1.50
Reporting Date: 13/12/2019	DETS Sample No	451479	451481	451482	451483

Determinand	Unit	RL	Accreditation				
Dichlorodifluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Vinyl Chloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Chloromethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
Chloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Bromomethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
Trichlorofluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
trans-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
cis-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
2,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Chloroform	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Bromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1,1-Trichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1-Dichloropropene	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
Carbon Tetrachloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	7	< 2
1,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Trichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Bromodichloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Dibromomethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
TAME	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
cis-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
trans-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1,2-Trichloroethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
1,3-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Tetrachloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Dibromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2-Dibromoethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Chlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,1,1,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Ethyl Benzene	ug/kg	< 2	MCERTS	< 2	3	59	< 2
m,p-Xylene	ug/kg	< 2	MCERTS	< 2	8	749	< 2
o-Xylene	ug/kg	< 2	MCERTS	< 2	< 2	108	< 2
Styrene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
Bromoform	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
Isopropylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	12	< 5
1,1,2,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2,3-Trichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
n-Propylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	61	< 5
Bromobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
2-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,3,5-Trimethylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	375	< 5
4-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
tert-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2,4-Trimethylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	793	< 5
sec-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	21	< 5
p-Isopropyltoluene	ug/kg	< 5	MCERTS	< 5	< 5	30	< 5
1,3-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,4-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
n-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5
1,2-Dibromo-3-chloropropane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10
Hexachlorobutadiene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



**Soil Analysis Certificate - Sample Descriptions**

<b>DETS Report No:</b> 19-17098
<b>Richard Jackson Ltd</b>
<b>Site Reference:</b> Starlings
<b>Project / Job Ref:</b> 60275
<b>Order No:</b> None Supplied
<b>Reporting Date:</b> 13/12/2019

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
451477	WS01 ES1	None Supplied	0.30 - 0.40	13.1	Brown sandy gravel with stones and brick
451478	WS02 ES1	None Supplied	0.40 - 0.50	9.1	Brown clayey sand with stones and brick
451479	WS03 ES1	None Supplied	0.50 - 0.60	11.9	Brown clay
451480	WS04 ES1	None Supplied	0.20 - 0.30	11	Brown clayey sand
451481	WS05 ES1	None Supplied	0.40 - 0.50	9.8	Brown gravelly sand with stones and brick
451482	TP01 ES4	None Supplied	1.80	10.9	Brown clayey sand
451483	TP03 ES3	None Supplied	1.50	9.5	Brown clayey sand with stones
451484	WS04 D2	None Supplied	0.90 - 1.00	11.7	Brown clay
451485	TP02 D2	None Supplied	1.50	12.7	Brown clayey sand
451486	TP04 D4	None Supplied	2.40	19.3	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample <sup>US</sup>

Unsuitable Sample <sup>US</sup>

**Soil Analysis Certificate - Methodology & Miscellaneous Information**

**DETS Report No: 19-17098**

**Richard Jackson Ltd**

**Site Reference: Starlings**

**Project / Job Ref: 60275**

**Order No: None Supplied**

**Reporting Date: 13/12/2019**

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphénylcarbazine followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cydohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cydohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

**D Dried**  
**AR As Received**

**Appendix D**

Geotechnical test results



**TEST REPORT**  
ISSUED BY SOIL PROPERTY TESTING LTD  
DATE ISSUED: 18/12/2019



<b>Contract</b>	Starlings, Harwich	
<b>Serial No.</b>	36265	
<b>Client:</b>	Richard Jackson Limited  847 The Crescent Colchester Essex CO4 9YQ	<b>Soil Property Testing Ltd</b>  15, 16, 18 Halcyon Court, St Margaret's Way, Stukeley Meadows, Huntingdon, Cambridgeshire, PE29 6DG  [REDACTED]
<b>Samples Submitted By:</b>	Richard Jackson Limited	<b>Approved Signatories:</b>
<b>Samples Labelled:</b>	Starlings, Harwich	<input type="checkbox"/> <b>J.C. Garner B.Eng (Hons) FGS</b> Technical Director & Quality Manager <input type="checkbox"/> <b>S.P. Townend FGS</b> Chairman <input type="checkbox"/> <b>W. Johnstone</b> Materials Lab Manager <input checked="" type="checkbox"/> <b>D. Sabnis</b> Operations Manager  [REDACTED]
<b>Date Received:</b>	10/12/2019	<b>Samples Tested Between:</b> 10/12/2019 and 18/12/2019
<b>Remarks:</b>	For the attention of Kay O'Reilly Your Reference No: 60275	
<b>Notes:</b>	<ol style="list-style-type: none"><li>1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.</li><li>2 (a) UKAS - United Kingdom Accreditation Service. (b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.</li><li>3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.</li><li>4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.</li></ol>	



# TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD  
DATE ISSUED: 18/12/2019



0998

<b>Contract</b>		<b>Starlings, Harwich</b>															
<b>Serial No.</b>		<b>36265</b>						<b>Target Date</b>		<b>23/12/2019</b>							
<b>Scheduled By</b>		<b>Richard Jackson Limited</b>															
<b>SCHEDULE OF LABORATORY TESTS</b>																	
<b>Schedule Remarks</b>																	
Bore Hole No.	Type	Sample Ref.	Top Depth	<div style="display: flex; justify-content: space-between;"> <span>Water Content (BSFN)</span> <span>Liquid/Plastic Limits</span> <span>Wet Sieve Preparation</span> </div>												Sample Remarks	
				1	2	3	4	5	6	7	8	9	10	11	12		
TP04	D	3	1.50	1													
TP06	D	2	1.60	1	1	1											
WS01	D	3	2.10	1	1	1											
WS02	D	2	1.40	1	1												
WS02	D	3	2.60	1													
WS03	D	3	2.30	1	1												
WS04	D	3	1.70	1	1												
WS04	D	4	2.50	1													
WS04	D	5	3.40	1													
WS05	D	2	1.80	1	1												
WS05	D	3	2.20	1													
WS05	D	4	3.30	1													
<b>Totals</b>				<b>12</b>	<b>6</b>	<b>2</b>											<b>End of Schedule</b>



# TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD  
DATE ISSUED: 18/12/2019



0998

<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

## SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole /Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd 0.425mm (%)	Cor'd W/C <0.425mm	Curing Time (hrs)		
TP04	1.50	D	3	18.4									Yellowish brown slightly silty slightly clayey fine to medium SAND.	
TP06	1.60	D	2	9.3	23	13	10	-0.37	Wet Sieved	7 (M)	10.0*	73	Friable yellowish brown slightly gravelly sandy silty CLAY with occasional recently active roots. Gravel is fine to coarse angular to subangular brick, chert, concrete, and ceramic fragments.	CL
WS01	2.10 - 2.20	D	3	17.8	29	16	13	0.14	Wet Sieved	11 (M)	20.0*	75	Firm yellowish brown slightly gravelly sandy silty CLAY with occasional greyish brown mottling, and rare recently active roots. Gravel is fine to medium angular to subrounded chert, and quartzite, and rare brick.	CL
WS02	1.40 - 1.50	D	2	25.1	36	18	18	0.39	From Natural	0 (A)		100	Soft yellowish brown sandy silty CLAY. Sand is fine.	CI
WS02	2.60	D	3	37.7									Firm yellowish brown CLAY with rare bluish grey mottling.	
WS03	2.30	D	3	42.5	84	30	54	0.23	From Natural	0 (A)		24	Firm yellowish brown CLAY with rare bluish grey mottling, rare orange silt partings, and decayed roots.	CV
WS04	1.70 - 1.80	D	3	18.0	24	16	8	0.26	From Natural	0 (A)		26	Soft yellowish brown sandy silty CLAY with occasional recently active roots. Sand is fine to medium.	CL
WS04	2.50 - 2.60	D	4	38.2									Firm dark yellowish brown CLAY with rare recently active roots.	

Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS1377:Part 2:1990:3.2, 4.3  
 Type of Sample Key: U = Undisturbed, L = Liner, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter  
 Comments: \*Corrected water content assume material greater than 0.425mm is non-porous. See BS1377: Part 2: 1990 Clause 3 Note 1.

Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured



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0998

<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole /Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd 0.425mm (%)	Cor'd W/C <0.425mm	Curing Time (hrs)		
WS04	3.40 - 3.40	D	5	45.8									Soft dark yellowish brown CLAY with rare recently active roots.	
WS05	1.80 - 1.90	D	2	38.4	75	25	50	0.27	From Natural	<1% (A)		25	Soft olive yellow CLAY with occasional bluish grey and orange mottling, rare recently active roots, and fine chert gravel.	CV
WS05	2.20 - 2.30	D	3	43.2									Soft yellowish brown CLAY with rare orange silt partings.	
WS05	3.30 - 3.40	D	4	46.8									Soft yellowish brown CLAY with rare orange silt partings.	

Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS1377:Part 2:1990:3.2, 4.3  
 Type of Sample Key: U = Undisturbed, L = Liner, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter  
 Comments:  
 Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured



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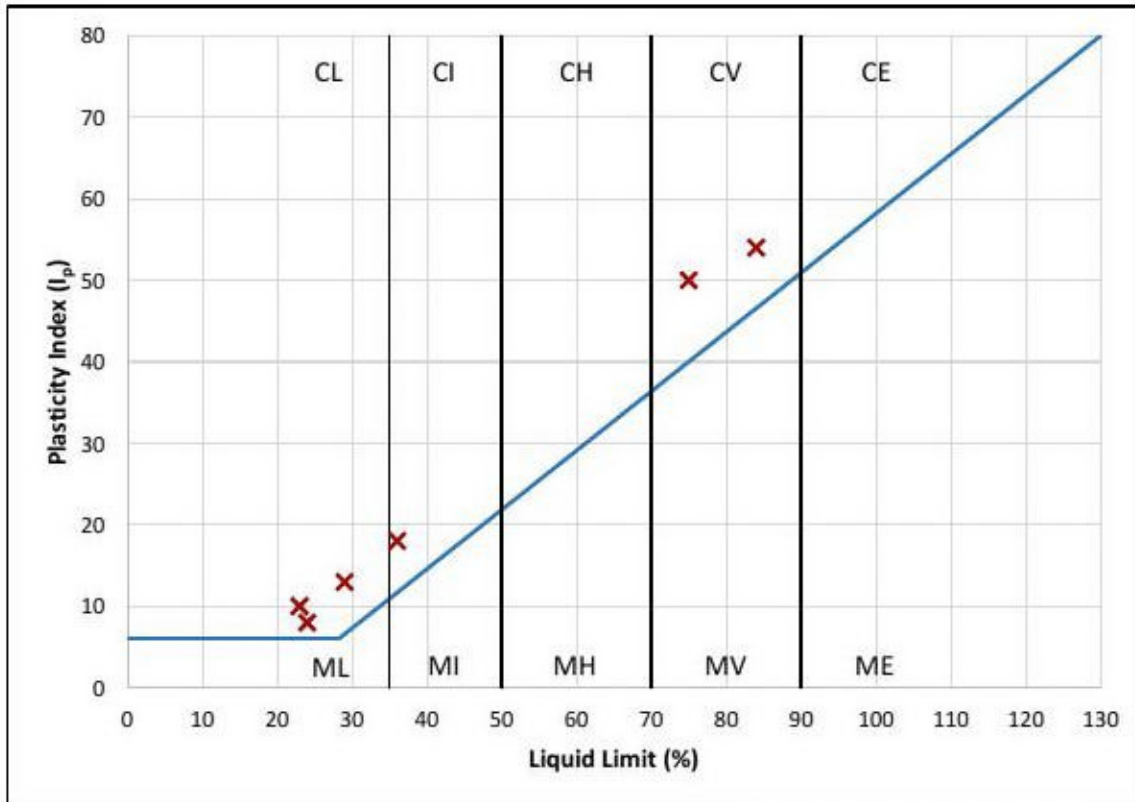


0998

<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

## PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART

Plasticity				
Low	Medium	High	Very High	Extremely High



Plasticity Chart BS5930: 2015: Figure 8

High	NHBC Volume Change Potential
Medium	
Low	

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS1377: Part 2: 3.2, 4.3, 5.3, 5.4
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index





# TEST REPORT

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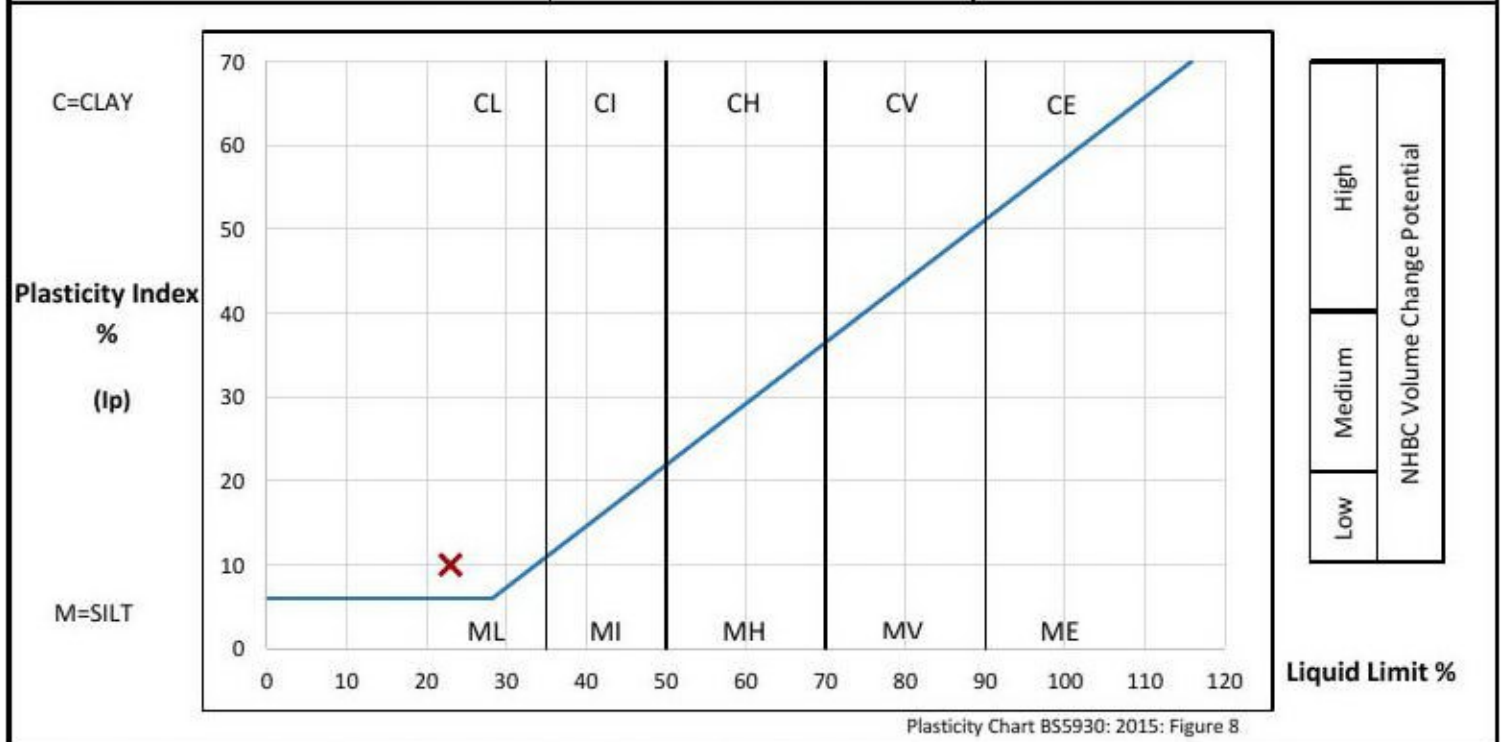


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
TP06	1.60	D	2	9.3	Friable yellowish brown slightly gravelly sandy silty CLAY with occasional recently active roots. Gravel is fine to coarse angular to subangular brick, chert, concrete, and ceramic fragments.	

<b>PREPARATION</b>			Liquid Limit	23 %	
Method of preparation			Wet sieved over 0.425mm sieve	Plastic Limit	13 %
Sample retained 0.425mm sieve	(Measured)	7 %	Plasticity Index	10 %	
Corrected water content for material passing 0.425mm			10.0 %	Liquidity Index	-0.37
Sample retained 2mm sieve	(Measured)	3 %	NHBC Modified (I'p)	9 %	
Curing time	73 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments: Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1  
 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index  
 Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)



# TEST REPORT

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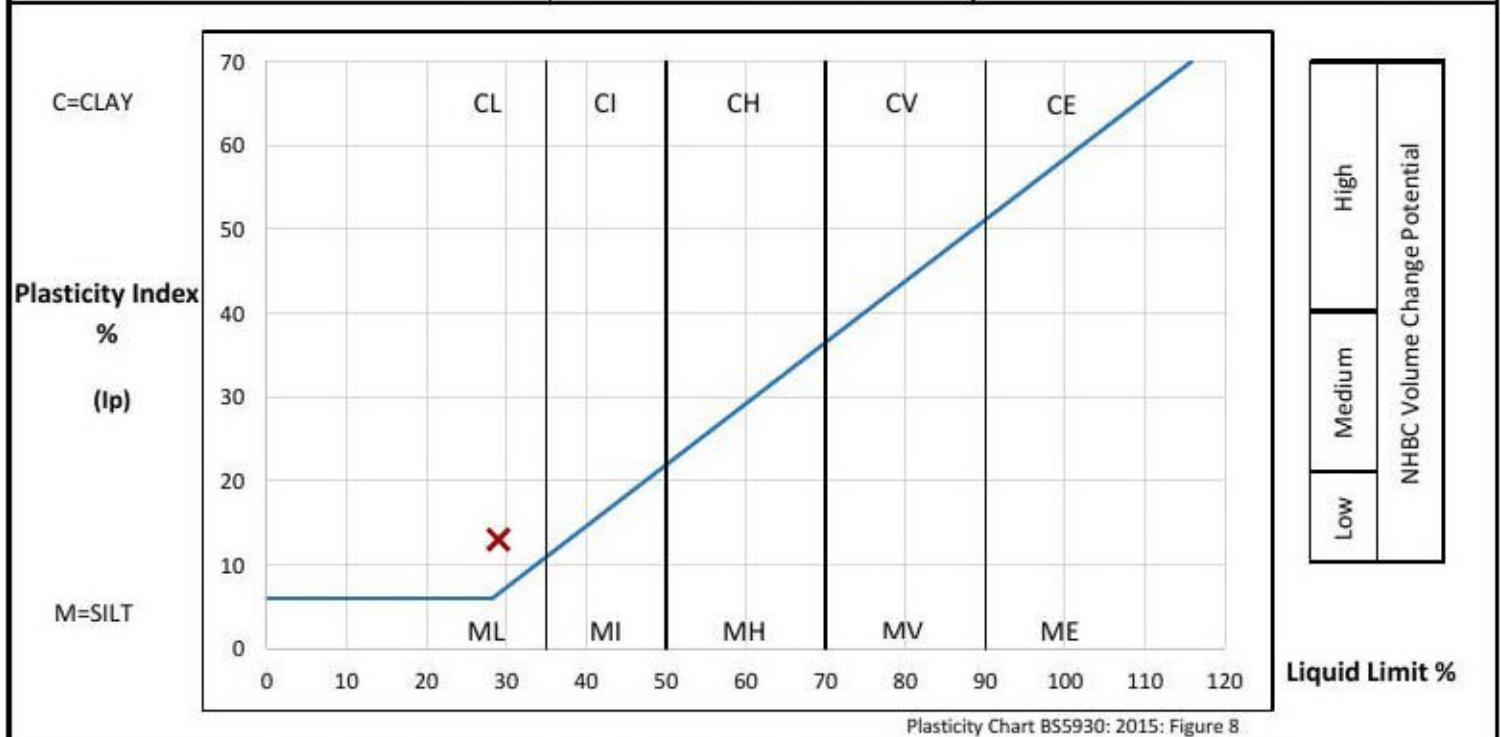


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
WS01	2.10 - 2.20	D	3	<b>17.8</b>	Firm yellowish brown slightly gravelly sandy silty CLAY with occasional greyish brown mottling, and rare recently active roots. Gravel is fine to medium angular to subrounded chert, and quartzite, and rare brick.	

<b>PREPARATION</b>			Liquid Limit	<b>29 %</b>	
Method of preparation			<b>Wet sieved over 0.425mm sieve</b>	Plastic Limit	<b>16 %</b>
Sample retained 0.425mm sieve	(Measured)	<b>11 %</b>	Plasticity Index	<b>13 %</b>	
Corrected water content for material passing 0.425mm			<b>20.0 %</b>	Liquidity Index	<b>0.14</b>
Sample retained 2mm sieve	(Measured)	<b>4 %</b>	NHBC Modified (I'p)	<b>12 %</b>	
Curing time	<b>75 hrs</b>	Clay Content	<b>Not analysed</b>	Derived Activity	<b>Not analysed</b>



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments: Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1  
 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index  
 Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)



# TEST REPORT

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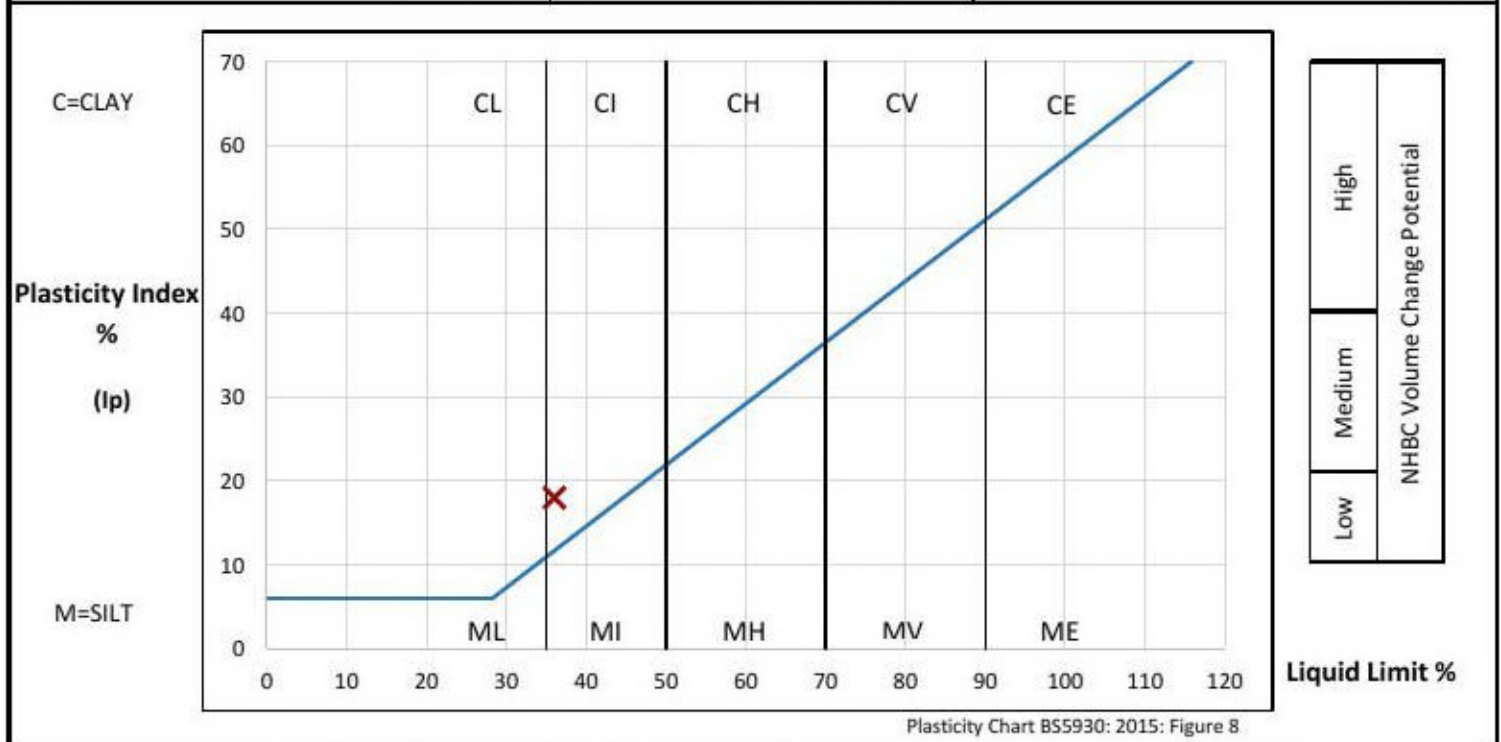


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
WS02	1.40 - 1.50	D	2	25.1	Soft yellowish brown sandy silty CLAY. Sand is fine.	

<b>PREPARATION</b>			Liquid Limit	36 %	
Method of preparation			From natural	Plastic Limit	18 %
Sample retained 0.425mm sieve	(Assumed)	0 %	Plasticity Index	18 %	
Corrected water content for material passing 0.425mm			Liquidity Index	0.39	
Sample retained 2mm sieve	(Assumed)	0 %	NHBC Modified (I'p)	n/a	
Curing time	100 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments:



# TEST REPORT

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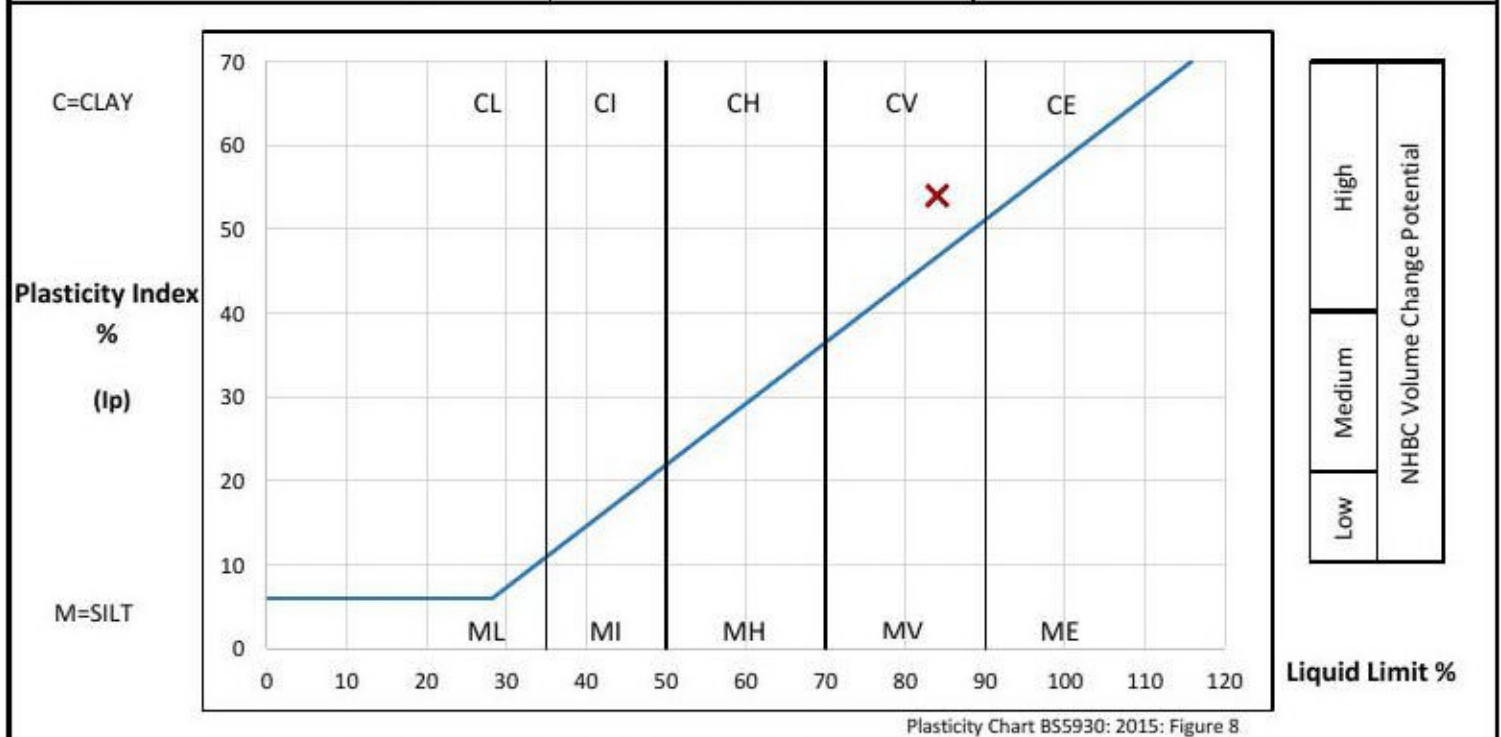


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
WS03	2.30	D	3	42.5	Firm yellowish brown CLAY with rare bluish grey mottling, rare orange silt partings, and decayed roots.	

<b>PREPARATION</b>			Liquid Limit	84 %	
Method of preparation		From natural	Plastic Limit	30 %	
Sample retained 0.425mm sieve	(Assumed)	0 %	Plasticity Index	54 %	
Corrected water content for material passing 0.425mm			Liquidity Index	0.23	
Sample retained 2mm sieve	(Assumed)	0 %	NHBC Modified (I'p)	n/a	
Curing time	24 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments:



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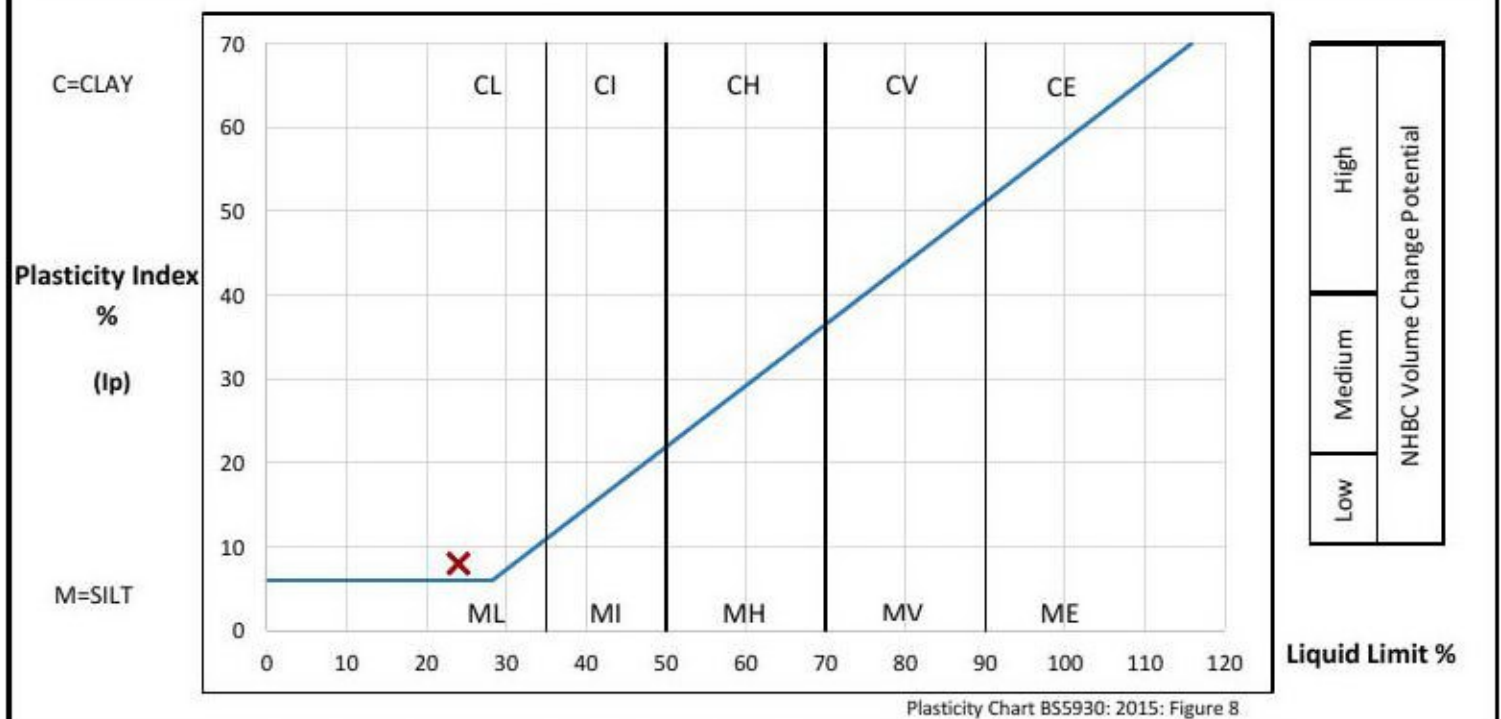


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
WS04	1.70 - 1.80	D	3	18.0	Soft yellowish brown sandy silty CLAY with occasional recently active roots. Sand is fine to medium.	

<b>PREPARATION</b>			Liquid Limit	24 %	
Method of preparation		From natural	Plastic Limit	16 %	
Sample retained 0.425mm sieve	(Assumed)	0 %	Plasticity Index	8 %	
Corrected water content for material passing 0.425mm			Liquidity Index	0.26	
Sample retained 2mm sieve	(Assumed)	0 %	NHBC Modified (I'p)	n/a	
Curing time	26 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments:



# TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD  
DATE ISSUED: 18/12/2019

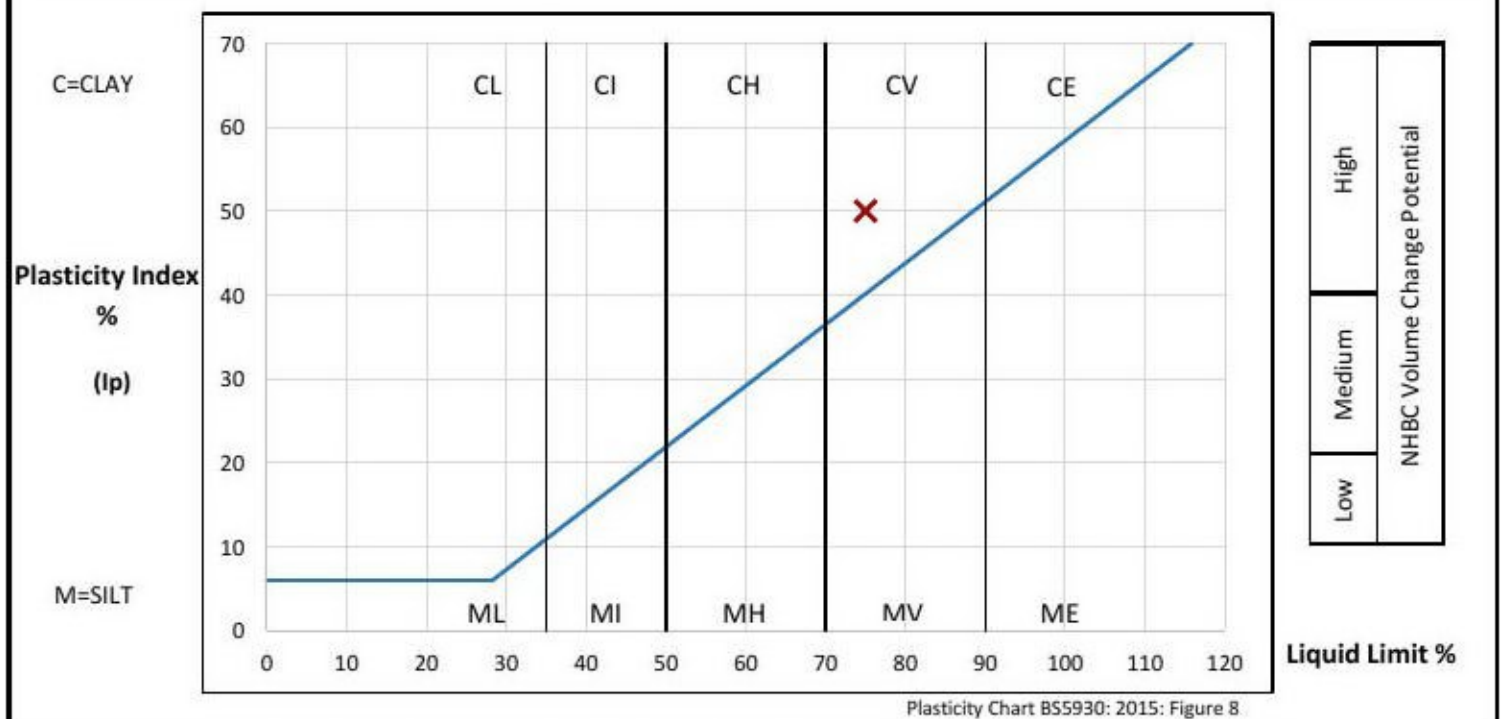


<b>Contract</b>	<b>Starlings, Harwich</b>
<b>Serial No.</b>	<b>36265</b>

### DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks
		Type	Reference			
WS05	1.80 - 1.90	D	2	38.4	Soft olive yellow CLAY with occasional bluish grey and orange mottling, rare recently active roots, and fine chert gravel.	

<b>PREPARATION</b>			Liquid Limit	75 %	
Method of preparation	From natural/gravel picked out by hand		Plastic Limit	25 %	
Sample retained 0.425mm sieve	(Assumed)	0 %	Plasticity Index	50 %	
Corrected water content for material passing 0.425mm			Liquidity Index	0.27	
Sample retained 2mm sieve	(Assumed)	<1 %	NHBC Modified (I'p)	n/a	
Curing time	25 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2  
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.3, 5.3, 5.4  
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter  
 Comments:

## **Appendix E**

Gas monitoring results & calibration certificates

**Ground Gas Monitoring**

**60275 – Starlings, Milton Road, Harwich**

Date: 13/01/2020      Weather: Cold, sunny, dry, windy  
 Instrument No: 10820 / MiniRAE 2000      Engineer: MB

Exploratory Hole	CO <sub>2</sub> Conc. (% by volume)		CH <sub>4</sub> Conc. (% by volume)		O <sub>2</sub> Conc. (% by volume)	Length of monitoring (mins)	VOC Conc. (ppm)	Flow Rate (l/hr)	Atmospheric Pressure (mb)	Standing Water Level (m bgl)	Depth to base (m bgl)	Time of Reading	Remarks
	P	S	P	S	S								
WS03	1.7	1.6	0.0	0.0	10.5	10	0.0	0.0	998	1.39	4.97	10:00	DP=0, LEL=0
WS04	1.9	1.9	0.0	0.0	16.2	08	0.0	0.0	1004	1.82	2.91	10:50	DP=0, LEL=0
WS05	1.2	0.7	1.2	0.0	19.7	10	0.0	0.0	1002	2.10	4.96	10:20	DP=0, LEL=0

P = Peak, S = Steady, DP = Differential Pressures, LEL = Lower Explosive Limit

Atmospheric Pressure 13/01/2020 (World Weather Online): 12am: 1020mb, 3am: 1017mb, 6am: 1016mb, 9am: 1013mb, 12pm: 1009mb, 3pm: 1004mb, 6pm: 999mb.



TEST DATE AND CONDITIONS			
Date	27/09/19		
Atmospheric Pressure	982	mB	
Ambient Temperature	21.5	°C	
EnviroNics Serial No.	5089		

**GFM430 Final Inspection & Calibration  
Check Certificate**

**GAS DATA LTD**

Unit 4, Fairfield Court  
Seven Stars Estate  
Wheler Rd  
Coventry  
CV3 4LJ



Customer	Richard Jackson Ltd
Certificate Number	121289
Order Number	323968

Serial Number	10820
Software Version	G430-00.0024/0013

Recalibration DUE Date
27/09/20

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	400	Accept > 200 cc/min	Pump Flow @ -200mB	250	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH <sub>4</sub>		CO <sub>2</sub>		O <sub>2</sub>	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
		60	60	40.7	40	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	5	5	5.1	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N <sub>2</sub>	0	0	0	0	0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Pressure Checks						
Atmospheric Pressure [AP] (mB)				Static Pressure [SP] (mB)		
Current Atmospheric Pressure (mB)	Instrument Atmospheric Pressure Reading (mB)			Applied Pressure (mB)	Instrument Pressure (mB)	
All Ports	Open Ports	981	Accept ±2.0	0.0mB	N/A	Accept ±0.0
AP Port (Internal)	+800 mB	800	Accept ±5.0	+50mB	N/A	Accept ±2.0
AP Port (Internal)	+1200mb	1200	Accept ±5.0	-100mB	N/A	Accept ±2.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-29.7	Accept $\pm 3.0$	-267	-263	Accept $\pm 50$
-3	-3	Accept $\pm 1.0$	-13	-13	Accept $\pm 6.0$
0	0	Accept $\pm 0.0$	0	0	Accept $\pm 0.5$
3	3	Accept $\pm 0.5$	13	13	Accept $\pm 3.0$
30	29.4	Accept $\pm 3.0$	276	270	Accept $\pm 50$
60	59.1	Accept $\pm 6.0$	816	809	Accept $\pm 130$
90	89.4	Accept $\pm 9.0$	1612	1620	Accept $\pm 250$

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading $^{\circ}\text{C}$	
Applied Temperature $^{\circ}\text{C}$		
-10	-10	Accept $\pm 2.0$
0	0	Accept $\pm 1.0$
30	30	Accept $\pm 1.0$
60	60	Accept $\pm 1.0$
100	100	Accept $\pm 1.0$

Technician:
<i>Jack Rutland</i>

Date Tested:
<b>30/09/19</b>

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to BS EN ISO9001:2015. Certificate NQA 8374. Valid until 21/03/2022

TEST DATE AND CONDITIONS	
Date	27.9.19
Atmospheric Pressure	982 mB
Ambient Temp	21.5 °C
Enviroics Serial No.	5089

**GAS DATA LTD**

Unit 4, Fairfield Court  
 Seven Stars Estate  
 Wheler Rd  
 Coventry  
 CV3 4LJ



**GFM430 -1 OUTWARD INSPECTION & QUALITY CHECK SHEET**

INSTRUMENT DETAILS			
SO Number	Instrument Type	Instrument Serial Number + SW Version	Job Number(s)
323 968	GFM430	10820 Q430-24/13	121289

Calibration Technician .. [Redacted] ..... Date 27.9.19.....  
 Inspection Technician .. [Redacted] ..... Date 30.9.19.....

INSTRUMENT CHECKS		Pass (P), Fail (F) or not applicable (NA)	INSTRUMENT PACKING LIST		Tick if included	
Function Tests	Dust Caps Fitted	P	Instrument		<input checked="" type="checkbox"/>	
	Keyboard Test (All Keys)	P	Leather Case		<input checked="" type="checkbox"/>	
	Backlight	P	Instrument Strap		<input checked="" type="checkbox"/>	
	Clock Set / Running	P	AC Battery Charger (UK)		<input checked="" type="checkbox"/>	
	Comms Test	P	AC Battery Charger (EURO)		<input checked="" type="checkbox"/>	
	Pump Flow Test (In & Out)	P	AC Battery Charger (US)		<input checked="" type="checkbox"/>	
	Overall Leak Test (30mB)	n/a	AC Battery Charger (AUS)		<input checked="" type="checkbox"/>	
	Battery Charge Test	P	Hard Carry Case		<input checked="" type="checkbox"/>	
	Service Date set to?	27.9.20	Gas Sample Tube - (new issue)		<input checked="" type="checkbox"/>	
Channel Test	Data Logging Enabled?	P	Flow Sample Tube - (new issue)		<input checked="" type="checkbox"/>	
	Verify CH4/LEL	P	Spares Pot		<input checked="" type="checkbox"/>	
	Verify CO2	P	Allen Key		<input checked="" type="checkbox"/>	
	Verify O2	P	Temperature Probe		<input checked="" type="checkbox"/>	
	Verify LEL	P	Vane Anemometer		<input checked="" type="checkbox"/>	
	Verify 1 <sup>st</sup> Option Gas	N/A	USB Cable		<input checked="" type="checkbox"/>	
	Verify 2 <sup>nd</sup> Option Gas	N/A	USB Memory stick		<input checked="" type="checkbox"/>	
	Verify 3 <sup>rd</sup> Option Gas	N/A	SiteMan Software		Ver 4.15 <input checked="" type="checkbox"/>	
	Verify 4 <sup>th</sup> Option Gas	N/A	Internal Filter Pack		Qty <input checked="" type="checkbox"/>	
	Verify Atmospheric pressure	P	External Filter Pack		Qty <input checked="" type="checkbox"/>	
	Verify static pressure	N/A	Field Guide		<input checked="" type="checkbox"/>	
	Verify differential pressure	P	Operation Manual (hard copy)		<input checked="" type="checkbox"/>	
	Verify flow	P	Extra Items:			
	Verify temperature probe input	P				
Verify vane anemometer input	P	Comments:				
DataBase Checks	Jobcard(s) completed and signed				P	
	Jobcard(s) booked off database				P	
	Calibration certificate completed				P	
	Complete & print QI record	n/a				
Label Checks	No. of Calibration label fitted	GDC   08727				
	Warranty label fitted	P				
H2S Range	H2S Range from Sales Order	N/A				ppm
	H2S Range from Cal Cert	N/A				ppm
	Over-range value correct?	N/A				





**CERTIFICATE OF CALIBRATION**  
MiniRAE 2000

**CALIBRATION CERTIFICATE NO:**

**66861**

ISSUED BY: SHAWCITY LIMITED  
DATE: 08/10/2019

APPROVED SIGNATORY



NAME: Dave Godfrey

CUSTOMER: Richard Jackson Ltd  
INSTRUMENT: MiniRAE 2000  
SERIAL NUMBER: 110-006049

CALIBRATION METHOD: CM03  
AMBIENT CONDITIONS: 20°C ± 2°C and 50% (± 20%) RH

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Prior to calibration the instrument was allowed to stabilise in the laboratory for at least 30 minutes.  
The instrument was calibrated by exposing the sensor to known values of gas concentrations.  
All gases were sampled through the complete probe and in line filter, where applicable.  
The reference value is that generated by the certified source and the indicated value is that measured by the instrument

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**CALIBRATION RESULTS**

GAS	LOT No	REF. VALUE	INDICATED VALUE
Isobutylene	WO216315-1	100 ppm	100 ppm

**COMMENTS:**

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ .  
This provides a level of confidence of uncertainty of approximately 95%.  
The uncertainty of measurement is ±2 %.  
The results indicate that the instrument conforms to the applicable parts of the published specification.

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**HEALTH & SAFETY, OCCUPATIONAL HYGIENE AND ENVIRONMENTAL MONITORING INSTR**

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## **Appendix F**

Limitations of use

### **Limitations of Use**

This report is based on the results of the exploratory boreholes, the laboratory testing carried out on samples recovered from those boreholes and on details of the scheme provided by the Client.

This report has been prepared for the benefit of Tendring District Council, and its contents should not be relied upon by others without the written authority of Richard Jackson Ltd. If any unauthorised third party makes use of this report they do so at their own risk and Richard Jackson Ltd owes them no duty of care or skill.

All information provided by others is taken as being in good faith as being accurate, but Richard Jackson Ltd cannot, and does not, accept any liability for the detailed accuracy, errors or omissions in such information.

Subsoils are by their nature hidden from view and no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may well be present beneath the site which was not evident from the investigations carried out.

Geological data, with the exception of geological maps held by Richard Jackson Ltd, Ordnance Survey maps and aerial photographs have not been inspected, nor has any other data relating to site conditions past or present, or any information regarding underground services, other than as indicated.

Groundwater levels can be subject to considerable seasonal variations, and the conditions encountered in the exploratory holes may not reflect long-term conditions.

There can be no guarantee that the samples analysed represent the highest concentrations of contamination present beneath the site. The chemical analysis results have been assessed to standards appropriate at the time of investigation.

Unless a greater period of retention of samples is agreed, it is our normal practice to discard all samples one month after submission of our final report.

