

# SUMMERHILL FARM, POVERTY LANE, MAGHULL

## Phase II Geo-Environmental Assessment

Persimmon Homes (Lancashire) Ltd and Countryside Properties  
(UK) Ltd

JULY 2017

## CONTACTS



**JONNY AYKROYD**  
Principal Consultant

**dd** +44 (0)161 245 8725

**m** +44 (0)7557 135 667

**e** [jonny.aykroyd@arcadis.com](mailto:jonny.aykroyd@arcadis.com)

**Arcadis.**

Three Piccadilly Place  
Manchester M1 3BN  
United Kingdom

# Summerhill Farm, Poverty Lane, Maghull

## Phase II Geo-Environmental Assessment

Author Luke Truman

Checker Jonny Aykroyd

Approver Matt Gardner

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This report dated 21 July 2017 has been prepared for Persimmon Homes (Lancashire) Ltd and Countryside Properties (UK) Ltd (jointly, the "Client") in accordance with the terms and conditions of appointment dated 22 March 2017 (the "Appointment") between the Client and **Arcadis (UK) Limited** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

# CONTENTS

|          |                                                             |          |
|----------|-------------------------------------------------------------|----------|
| <b>1</b> | <b>INTRODUCTION .....</b>                                   | <b>1</b> |
| 1.1      | Appointment.....                                            | 1        |
| 1.2      | Project Background.....                                     | 1        |
| 1.3      | Project Objectives .....                                    | 1        |
| 1.4      | Scope of Work.....                                          | 2        |
| 1.5      | Reliability / Limitations of Information .....              | 2        |
| <b>2</b> | <b>ENVIRONMENTAL SETTING .....</b>                          | <b>3</b> |
| 2.1      | Site Location .....                                         | 3        |
| 2.2      | Geological Setting .....                                    | 3        |
| 2.3      | Hydrogeological Setting .....                               | 4        |
| 2.3.1    | Groundwater Flow .....                                      | 4        |
| 2.3.2    | Aquifer Classification .....                                | 4        |
| 2.3.3    | Groundwater Abstraction and Source Protection Zones .....   | 4        |
| 2.4      | Hydrological Setting.....                                   | 4        |
| <b>3</b> | <b>INTRUSIVE INVESTIGATION METHODOLOGY.....</b>             | <b>5</b> |
| 3.1      | Setting Out & Utility Clearance .....                       | 5        |
| 3.2      | Windowless Sample Boreholes .....                           | 5        |
| 3.3      | Trial Pits.....                                             | 5        |
| 3.4      | In-situ Testing .....                                       | 5        |
| 3.5      | Soil Sampling .....                                         | 5        |
| 3.6      | Environmental Laboratory Analysis .....                     | 6        |
| 3.7      | Geotechnical Laboratory Analysis .....                      | 6        |
| 3.8      | Monitoring Well Installations.....                          | 6        |
| 3.9      | Ground Gas Monitoring .....                                 | 7        |
| 3.10     | Waste Disposal .....                                        | 7        |
| 3.11     | Surveying .....                                             | 8        |
| <b>4</b> | <b>GROUND CONDITIONS.....</b>                               | <b>9</b> |
| 4.1      | Stratigraphy.....                                           | 9        |
| 4.2      | Topsoil .....                                               | 9        |
| 4.3      | Made Ground.....                                            | 9        |
| 4.4      | Shirdley Hill Sand .....                                    | 9        |
| 4.5      | Glacial Till.....                                           | 10       |
| 4.6      | Field Screening and Visual and Olfactory Observations ..... | 11       |

|           |                                               |           |
|-----------|-----------------------------------------------|-----------|
| 4.7       | Groundwater .....                             | 11        |
| <b>5</b>  | <b>GEOTECHNICAL APPRAISAL.....</b>            | <b>13</b> |
| 5.1       | Proposed Development.....                     | 13        |
| 5.2       | Site Preparation & Topsoil Strip .....        | 13        |
| 5.3       | Foundations & Floor Slabs .....               | 13        |
| 5.4       | Pavement and Road Design .....                | 14        |
| 5.5       | Excavations and Groundwater .....             | 15        |
| 5.6       | Concrete Classification.....                  | 15        |
| 5.7       | Soakaway Drainage .....                       | 15        |
| <b>7</b>  | <b>CONTAMINATION ASSESSMENT .....</b>         | <b>16</b> |
| 7.1       | Methodology .....                             | 16        |
| 7.2       | Chemical Soil Analyses .....                  | 16        |
| 7.2.1     | Human Health GQRA .....                       | 17        |
| 7.2.2     | Controlled Water .....                        | 17        |
| 7.2.3     | GQRA Conclusion .....                         | 17        |
| 7.1       | Preliminary Waste Soil Characterisation ..... | 17        |
| <b>8</b>  | <b>GROUND GAS ASSESSMENT.....</b>             | <b>18</b> |
| 8.1       | Methodology .....                             | 18        |
| 8.2       | Ground Gas Conceptual Model.....              | 18        |
| 8.3       | Ground Gas Monitoring .....                   | 18        |
| 8.4       | Assessment and Recommendations.....           | 19        |
| <b>9</b>  | <b>RECOMMENDATIONS FOR FURTHER WORK.....</b>  | <b>21</b> |
| 9.1       | Foundation Zoning .....                       | 21        |
| 9.2       | Made Ground/Infilled Ponds.....               | 21        |
| <b>10</b> | <b>STUDY REFERENCES .....</b>                 | <b>22</b> |

## FIGURES

|                 |                                                                                                  |
|-----------------|--------------------------------------------------------------------------------------------------|
| <b>Figure 1</b> | Exploratory Location plan                                                                        |
| <b>Figure 2</b> | Depth to Competent Strata (Glacial Till $C_u > 50\text{kPa}$ ) / Glacial Till Elevation Contours |
| <b>Figure 3</b> | Thickness of Shirdley Hill Sand                                                                  |
| <b>Figure 4</b> | SPT N Values vs Depth Plot                                                                       |
| <b>Figure 5</b> | $C_u$ Values vs Depth Plot                                                                       |

# DATA TABLES

|                |                                       |
|----------------|---------------------------------------|
| <b>Table 1</b> | Ground and Groundwater Elevations     |
| <b>Table 2</b> | PAH Concentrations in Soil (mg/kg)    |
| <b>Table 3</b> | Metals Concentrations in Soil (mg/kg) |
| <b>Table 4</b> | Inorganics in Soil                    |
| <b>Table 5</b> | Ground Gas Monitoring                 |

# APPENDICES

## APPENDIX A

Legislative Context and Regulatory Guidance

## APPENDIX B

Study Limitations

## APPENDIX C

Borehole / Trial Pit Records

## APPENDIX D

Geotechnical Laboratory Reports

## APPENDIX E

Chemical Laboratory Reports

## APPENDIX F

Derivation Method of Generic Assessment Criteria

# 1 INTRODUCTION

## 1.1 Appointment

Arcadis (UK) Limited (Arcadis) was commissioned by Persimmon Homes (Lancashire) Ltd and Countryside Properties (UK) Ltd (jointly, the 'client') to undertake a Phase II Geo-Environmental Assessment of land at Summerhill Farm, Poverty Lane, Maghull, L31 3DS (the 'site').

All works were undertaken in line with UK Regulations and Legislation presented in Appendix A, and as per the scope of works agreed between Arcadis and the client.

## 1.2 Project Background

This assessment focuses on approximately 30 hectares of farmland around Summerhill farm, north of Poverty Lane and south of Whinney Brook; and has been designed to support the redevelopment of the area into residential end use.

Arcadis were previously commissioned by the Client to produce a Phase 1 Desk Study for the subject site and wider strategic housing development site (i.e. including additional land to the north and west), the full reference of which is as follows:

- Arcadis – Phase I Geo-Environmental Assessment, Persimmon Homes / Countryside Properties, Summerhill Farm, Poverty Lane, Maghull, L31 3DS – Report Ref. 36708100, February 2017.

The outcome of the Phase 1 assessment was that in the context of the historical land-use (and lack of significant previous development), the geo-environmental risks were generally considered to be low but locally elevated, particularly in relation to the potential for localised Made Ground deposits (e.g. infilled ponds) and from hazardous ground gas in these areas and areas where potentially organic alluvial soils may be present (e.g. adjacent to the watercourse).

This assessment therefore aims to interrogate the Preliminary Risk Assessment (presented in the Phase I report) and refine the Conceptual Site Model (CSM) to confirm the low geo-environmental risk via a broad sweep of soil sampling and testing including targeting of the areas of potential elevated risk.

## 1.3 Project Objectives

The overall objective of this set of works was to address the following areas/elements of potential concern about the site and address the foreseeable planning conditions associated with residential development of the site:

- Establishment of site's baseline ground conditions including the soils capability to support shallow foundations and its environmental quality for re-use.
- Geotechnical issues which may arise due to the presence of the shallow Shirdley Hill Sand (potential for running sand conditions), potentially soft alluvial deposits in proximity to Whinney Brook and any Made Ground anticipated to be present around areas of infilled ponds, ditches etc.
- Potential ground contamination issues related to any historical or current on- and off-site land-uses.
- Potential hazardous ground gas emissions (associated with potential Made Ground deposits).

To address these points, it was therefore necessary to conduct a site investigation to:

- Confirm the geological and hydrogeological conditions beneath the site;
- Collect sufficient geotechnical information to allow for the production of a geotechnical appraisal geared towards high-density residential development; and
- Investigate, quantify, and risk assess the level of any ground contamination present relative to the proposed site development.

## 1.4 Scope of Work

To achieve the above objectives, the following scope of work was undertaken:

- Utility / service clearance of the exploratory hole locations;
- Progression of 13no boreholes to depths of 5m bgl or drill refusal;
- Progression of 20no trial pits to depths of up to 4m bgl or excavation refusal/collapse;
- Geotechnical and environmental soil sampling;
- In-situ Standard Penetration Testing (SPT) of the ground at 1m depth intervals in boreholes;
- Installation of a maximum of 8 dual-purpose groundwater and ground gas monitoring wells in drilled boreholes;
- Geotechnical laboratory testing of recovered soil samples;
- Chemical laboratory testing of recovered soil samples;
- Ground gas and groundwater elevation monitoring (6 visits) via installed monitoring wells; and,
- Provision of an interpretative Phase II Geo-Environmental Assessment report.

The site layout and exploratory locations are presented on Figure 1.

## 1.5 Reliability / Limitations of Information

Arcadis warrants that the services performed were conducted in a competent and professional manner in accordance with sound consulting practices and procedures.

Arcadis cannot warrant the actual property conditions described in this report beyond matters amenable to confirmation within the limits of this report.

The reader is referred to the Study Limitations, presented as Appendix B.

## 2 Environmental Setting

This information is presented as background information and was originally provided in the Phase I report.

### 2.1 Site Location

The centre of the Site is located at National Grid Reference: 339140, 401957. The Site elevation ranges from approximately 19m Above Ordnance Datum (AOD) in the southwest to 26m AOD in the northeast.

### 2.2 Geological Setting

The regional geological information pertaining to the Site was gained from a review of the BGS 1:50,000 scale maps (no. 83 Formby, solid and drift editions, and no. 84 Wigan, solid and drift editions). This was supplemented with archive borehole records available through the BGS GeoIndex website.

| Geological Formation           | Published Information                                                                                                                                                                                                                                                                                                                                                             | Borehole Record Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Made Ground and Topsoil</b> | The available BGS mapping does not show the presence of Made Ground underlying the Site, however Made Ground may be present in developed areas of the site.                                                                                                                                                                                                                       | <p>Borehole record SD30SE8 located in the centre of the site records a unit named 'soil' (presumably topsoil) to a depth of approximately 0.5m below ground level (bgl).</p> <p>Borehole record SD30SE29 located in the northwest of the site records 'soil' to a depth of approximately 0.6m below ground level (bgl).</p> <p>No other indication of Made Ground is given within available on-site borehole records.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Superficial Geology</b>     | <p>The majority of the Site is underlain by the Shirdley Hill Sand of Quaternary age, described as fine grained aeolian (windblown) sands with peat layers present towards the base. This is underlain by Glacial Till of Quaternary age, comprising clay, sand and gravel.</p> <p>The northwest corner of the Site is underlain directly by the older Glacial Till deposits.</p> | <p>Borehole record SD30SE8 located in the centre of the Site records sand to approximately 0.9m bgl, underlain by clay to approximately 11.6 m bgl followed by a sand layer to approximately 12.5m bgl.</p> <p>Borehole record SD30SE29 located in the northwest of the Site records black and white sand to approximately 1.5m bgl, underlain by predominantly clay to approximately 8.8m bgl. This is followed by sand and gravel to approximately 13.5m bgl. Superficial deposits have been classified as Glacial Till and Glacial Outwash.</p> <p>Borehole record SD30SE100, located on the south-eastern site boundary indicates superficial geology to comprise Glacial Till to a depth of 14.5m bgl. This log also provides cohesion values which indicate Stiff soils to 2m bgl underlain by Firm soils to 7m bgl in turn underlain by Very Stiff soils.</p> |
| <b>Bedrock Geology</b>         | Bedrock geology is recorded to be the Sherwood Sandstone Group, deposited in the Permian and Triassic periods, and comprising Sandstones with subordinate siltstone and mudstone.                                                                                                                                                                                                 | <p>Borehole record SD30SE8 located in the centre of the Site records bedrock at approximately 12.5m bgl.</p> <p>Borehole record SD30SE29 located in the northwest of the Site records bedrock, interpreted as Bunter Sandstone to be present</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Geological Formation | Published Information | Borehole Record Information                                                                                                                                                                                                                                                         |
|----------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                       | <p>from approximately 13.5m bgl. The unit is proven to a depth of approximately 15m bgl.</p> <p>Borehole record SD30SE100, located on the south-eastern site boundary records weathered red sandstone to be present from 14.5m bgl. The unit is proven to a depth of 16.3m bgl.</p> |

## 2.3 Hydrogeological Setting

### 2.3.1 Groundwater Flow

The Hydrogeological Map of Clwyd and Cheshire Basin (Sheet 19) infers a general groundwater flow direction to the northwest in the bedrock sandstone, with groundwater anticipated at approximately 8m AOD (i.e. ~12m bgl).

A site-specific depth to water was not recorded within the available BGS borehole logs in either the superficial or bedrock deposits.

### 2.3.2 Aquifer Classification

The superficial deposit of Shirdley Hill Sand is designated as a Secondary (A) Aquifer, while the bedrock Sherwood Sandstone Group is classified as a Principal Aquifer. Whilst only the uppermost drift unit is mapped, the Glacial Till is generally designated as either Unproductive Strata or Secondary (Undifferentiated) Aquifer.

Principal Aquifers are described as layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and are of local and/or regional importance. They may support water supply and/or river base flow on a strategic scale. Secondary (A) Aquifers are permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. Unproductive Strata are drift deposits with low permeability that have negligible significance for water supply or river base flow.

### 2.3.3 Groundwater Abstraction and Source Protection Zones

There are no active groundwater abstraction licences in place at the Site.

There are two active groundwater abstraction licences in place within 2km of the site, both for potable water abstractions. The nearest is located approximately 520m southeast of the site and is licenced to United Utilities Water Limited for direct public potable water supply.

The site is located within a Groundwater Source Protection Zone (SPZ). The site is within SPZ 3 (Total Catchment area) related to the aforementioned potable water abstraction licenced to United Utilities Water Ltd.

## 2.4 Hydrological Setting

### 2.4.1 Surface Water Features

Whinney Brook is the most pertinent surface water feature to this investigation, originating at the northern boundary on School Lane, flowing to the south along the eastern boundary of Ashworth Farm and then southwest across the site, exiting the site on the northwest boundary.

### 2.4.2 Flooding

A review of data supplied within the Groundsure report indicates that the area surrounding Whinney Brook is classified as being at high risk of flooding from rivers or sea (Flood Zone 3; greater than 1 in 30 chance). The remainder of the site is classified as having a very low risk of flooding from rivers or sea (being in Flood Zone 1; less than 1 in 1000 chance). It is understood that a Flood Risk Assessment is being undertaken by others.

### 3 Intrusive Investigation Methodology

The intrusive works were completed between the 30<sup>th</sup> May and 2<sup>nd</sup> June 2017 and comprised:

- Progression of 13no boreholes to a maximum depth of 5.45m bgl with subsequent installation of groundwater / ground gas monitoring wells in seven of the locations; and,
- Progression of 20no trial pits with excavation depths ranging from 2.0m – 3.5m bgl.

The environmental monitoring works were completed between 21<sup>st</sup> June 2017 and 28<sup>th</sup> September 2017 and comprised:

- 6no separate monitoring events to gauge the hazardous ground gas regime and groundwater elevations.

#### 3.1 Setting Out & Utility Clearance

Prior to carrying out intrusive works, Utility Service Plans were obtained for the subject site in order to inform the intrusive investigation of the location of below ground utilities.

Exploratory hole locations were distributed to provide a relatively even coverage across the site area, and were set out using GPS. Locations were modified slightly on site from there originally planned positions to fall within the tractor tracks and therefore minimize crop damage. Actual positions were subsequently recorded using handheld GPS.

Utility service clearance involved inspection of the public utility plans and cross checking against the planned exploratory holes together with the utilisation of a Cable Avoidance Tool (CAT) to check for any unrecorded services detectable with the device.

Prior to drilling, utility clearance pits were excavated to a depth of 1.2m bgl, using hand tools.

#### 3.2 Windowless Sample Boreholes

The windowless sample boreholes were drilled by Arcadis approved sub-contractor, Paul Blackledge Drilling Ltd, under the supervision and direction of a suitably qualified and experienced Arcadis geo-environmental engineer.

Boreholes were progressed using a percussive drilling technique with a windowless sampling drilling rig to enable in-situ testing, the collection of soil samples, and subsequent installation of dual-purpose monitoring wells.

#### 3.3 Trial Pits

Trial pits were excavated by a JCB 3CX backhoe excavator, under the supervision and direction of a suitably qualified and experienced Arcadis geo-environmental engineer.

Trial pits were progressed to dimensions of 1m width by 3m length, to a maximum depth of 4m to enable the collection of soil samples. All locations were backfilled with arisings in reverse order of initial extraction.

#### 3.4 In-situ Testing

In-situ strength tests comprising Standard Penetration Tests (SPT's) were undertaken in the boreholes at 1m intervals and at the final depth.

Hand Shear Vane (HSV) tests were conducted in accordance with standard procedures at intervals throughout the depth of trial pits where cohesive material was encountered.

#### 3.5 Soil Sampling

Soil arisings were logged in accordance with British Standard BS5930:2015.

Soil samples comprising disturbed (glass jar, tub and bulk bag) and undisturbed samples were collected from the exploratory holes at distinct changes in lithology and across a range of depths/strata across the site

in order to be tested for a range of chemical parameters, as well as any soils exhibiting palpable visual and/or olfactory signs of contamination.

Soil samples were selected for laboratory analysis by an Arcadis consultant based on a review of the site findings.

Samples selected for chemical analysis were transferred to laboratory prepared glass jars and/or plastic tubs and stored in pre-chilled cool boxes prior to dispatch to the laboratory.

### 3.6 Environmental Laboratory Analysis

Samples collected for chemical analysis purposes were exported to ALS Environmental, an Arcadis approved supplier and United Kingdom Accreditation Service (UKAS) laboratory.

Soil samples were tested for one or more of the following range of analyses:

- Metals and Semi Metals: As, Cd, Cr, CrVI, Cu, Ni, Pb, Hg, Se, and Zn;
- Non-metallic Inorganics: pH and water soluble sulphate (SO<sub>4</sub>);
- Poly Aromatic Hydrocarbons (PAHs – 16no); and
- Total Cyanide

The rationale for chemical testing of soil samples is presented in the table below:

| Chemical Analysis                                               | Sample Quantity / Location  | Purpose                                                                             |
|-----------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------|
| <b>Poly-Aromatic Hydrocarbons (16 compounds)</b>                | 15 samples, shallow soils   | General contaminant screening and to inform preliminary waste classification        |
| <b>Metals (As, Cd, Cr(III), Cr(VI), Cu, Pb, Hg, Ni, Se, Zn)</b> | 15 samples, shallow soils   |                                                                                     |
| <b>Total Cyanide</b>                                            | 15 samples, shallow soils   |                                                                                     |
| <b>pH</b>                                                       | 43 samples, range of depths |                                                                                     |
| <b>pH</b>                                                       | 43 samples, range of depths | Assessment of chemical aggressivity / sulphate attack on buried concrete structures |
| <b>Water Soluble Sulphate (SO<sub>4</sub>)</b>                  | 17 samples, range of depths |                                                                                     |

### 3.7 Geotechnical Laboratory Analysis

Soil samples were submitted for geotechnical laboratory analysis at Professional Soils Laboratory Ltd (PSL), Doncaster.

In order to obtain geotechnical parameters for the proposed development soil samples were tested for one or more of the following:

- Moisture content;
- Atterberg limits; and,
- Particle Size Distribution (PSD).

### 3.8 Monitoring Well Installations

Permanent 50mm diameter dual-purpose (soil gas and groundwater) monitoring wells were installed in boreholes WS101, WS102, WS104, WS108, WS105, WS115 and WS114; the details of which are shown on the borehole logs presented in Appendix C.

The screened sections of the wells were surrounded by a gravel filter pack. Between the top of the monitoring wells screened sections and ground level the wells comprised plain well pipe and a bentonite seal. All monitoring wells were finished at the ground surface with a well cap and flush mounted cover. A gas tap was fitted to each well to enable bulk ground gas monitoring.

The following table provides details of the installations:

| Location ID | Depth to Base (mbgl) | Response Zone (mbgl) | Lithology Surrounding Response Zone |
|-------------|----------------------|----------------------|-------------------------------------|
| WS101       | 4.0                  | 1.0 – 4.0            | Glacial Till                        |
| WS102       | 3.0                  | 1.0 – 3.0            | Shirdley Hill Sand<br>Glacial Till  |
| WS104       | 4.0                  | 1.0 – 4.0            | Shirdley Hill Sand<br>Glacial Till  |
| WS105       | 5.0                  | 1.0 – 5.0            | Shirdley Hill Sand<br>Glacial Till  |
| WS108       | 3.5                  | 0.5 – 3.5            | Glacial Till                        |
| WS114       | 5.0                  | 1.0 – 5.0            | Glacial Till                        |
| WS115       | 5.0                  | 1.0 – 5.0            | Glacial Till                        |

### 3.9 Ground Gas Monitoring

Bulk ground gas monitoring was undertaken using a GA2000 landfill gas analyser. 6no separate visits were undertaken in order to capture differing periods of atmospheric pressure. Parameters recorded were gas flow, atmospheric pressure, difference pressure, oxygen, methane, low explosion limit, hydrogen sulphide, carbon monoxide and carbon dioxide. Depth to groundwater was also recorded using an interface probe. The gas tap was opened, allowing gas to pass through the gas analyser. The flow rate and concentration of ground gases was recorded at regular intervals, including the peak flow and concentration and the steady-state conditions.

### 3.10 Waste Disposal

Soil arisings from excavations and boreholes were used to backfill these locations.

Plastics waste produced during the works was disposed of by Arcadis under appropriate waste transfer documentation and in accordance with the appropriate waste regulations.

### **3.11 Surveying**

A topographic survey of the exploratory locations was not undertaken by Arcadis, however topographical data of the site was provided by the client and this was utilised to gauge approximate surface elevations of exploratory locations.

## 4 Ground Conditions

### 4.1 Stratigraphy

The ground encountered during the site investigation largely confirmed the anticipated geology and in general comprised a thin layer of topsoil overlying superficial deposits including Shirdley Hill Sand which in turn overlies Glacial Till.

Borehole and trial pit logs are presented in Appendix C. The following table summarises the stratigraphy encountered:

| Lithology                                               | General Description                                                                                                                          | Locations<br>Soil Type<br>Observed                                     | Depth Range<br>of Horizon<br>Base (mbgl) | Horizon<br>Thickness<br>Range (m) |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------|-----------------------------------|
| <b>Topsoil</b>                                          | Dark brown gravelly SAND.<br>Topsoil in some locations contained an element of clay material                                                 | All locations                                                          | 0.2 – 0.6                                | 0.2 – 0.6                         |
| <b>Made Ground</b>                                      | Re-worked sandy gravelly CLAY transferred from another part of site assumed to act as infill and land gradation material for a historic pond | TP115                                                                  | 0.9                                      | 0.4                               |
| <b>Shirdley Hill Sand<br/>(Superficial<br/>Deposit)</b> | Orangish brown SAND occasionally containing elements of silt, gravel, and/or clay.                                                           | All locations,<br>excluding<br>WS107, TP106,<br>TP110, TP114,<br>TP119 | 0.5 – 2.9                                | 0.3 – 1.6                         |
| <b>Glacial Till<br/>(Superficial<br/>Deposit)</b>       | Firm to stiff brown sandy gravelly CLAY frequently containing cobbles and rarely elements of silt.                                           | All locations                                                          | >5.45                                    | >4.95                             |

### 4.2 Topsoil

Topsoil was encountered in all of the exploratory holes to a maximum depth of 0.6mbgl.

The material generally comprised dark brown gravelly SAND (locally clayey gravelly SAND).

### 4.3 Made Ground

Made Ground was only encountered in TP115 to a depth of 0.9mbgl and was assessed as being re-worked sandy gravelly CLAY; potentially transferred from another part of site and assumed to act as infill and land gradation material for a historic pond.

### 4.4 Shirdley Hill Sand

Shirdley Hill Sand was encountered in all locations, excluding WS107, TP106, TP110, TP114, TP119, to depths of between 0.5 and 2.9mbgl.

The greatest thickness of sand below the topsoil layer was observed in the south-west, where surface elevation is generally higher, with thickness ranging between 1 and 2.5 metres, and reducing to <1 metre approximately 200m from the south-west site boundary. Figure 3 presents a graphical representation of the variation in sand thickness described here.

SPTs undertaken in the Shirdley Hill Sand recorded N-values of between 1 and 11 indicating that the sand is generally loose; consistent with its provenance and deposition as wind-blown sand/dunes. Figure 4 shows the general and relatively conservative trend between SPT N-Values and depth which includes the N-Values achieved in the sand.

Particle Size Distribution (PSD) tests undertaken on 5no samples of Shirdley Hill Sand from locations TP102, TP103, TP105, TP112, and TP119 indicated the following:

| Soil Fraction | Range of Values (%) |
|---------------|---------------------|
| Cobbles       | 0                   |
| Gravel        | 0 – 4               |
| Sand          | 80 – 99             |
| Silt/Clay     | 1 – 16              |

The PSD results indicate that the sand also contains elements of silt/clay and gravel at maximum proportions of 4% and 16% respectively.

13no samples of Glacial Till were submitted for chemical analysis for pH with values ranging from 6.29 to 8.60. 6no samples were submitted for water soluble sulphate with values ranging between <4 and 18.2mg/l.

## 4.5 Glacial Till

Glacial Till was encountered in all locations beneath the Shirdley Hill Sand or locally where absent directly beneath Topsoil to a maximum recorded depth of 5.45mbgl (base not proven). The stratum generally comprised firm to stiff brown sandy gravelly CLAY frequently containing cobbles and rarely elements of silt.

SPTs undertaken in the Glacial Till recorded N-values of between 4 and 31 indicating a soft to very stiff consistency of the material. Figure 4 shows the general and relatively conservative trend between SPT N-Values and depth which includes the N-Values achieved in the sand.

Geotechnical Classification tests undertaken on 49no samples of Glacial Till indicated the following:

| Soil Classification Test | Range of Values (%) |
|--------------------------|---------------------|
| Natural Moisture Content | 13 – 22             |
| Liquid Limit             | 22 – 40             |
| Plastic Limit            | 11 – 19             |
| Plasticity Index         | 10 – 22             |
| Fraction <0.425mm        | 94 – 100            |

The classification test results indicate the material to be overall of low plasticity and the material has an overall modified Plasticity Index (PI') range of <20% and thus has a low potential for volume change (shrink/swell).

22no samples of Glacial Till were submitted for chemical analysis for pH with values ranging from 7.60 to 8.79. 10no samples were submitted for water soluble sulphate with values ranging between <4 and 33.3mg/l.

## 4.6 Field Screening and Visual and Olfactory Observations

Examination of soil arisings and monitoring of groundwater (utilising the oil-water interface probe) revealed no evidence of separate phase liquids e.g. fuel, oil.

All soil samples were visually inspected during the intrusive investigations. The arisings were noted to be natural in colour and with no olfactory evidence of any contamination impact.

## 4.7 Groundwater

Groundwater strikes recorded during borehole drilling and trial pit excavation were as follows:

| Location ID | Groundwater Strike<br>(m bgl) | Lithology  |
|-------------|-------------------------------|------------|
| TP101       | 1.6                           | Sand       |
| TP103       | 1                             | Sand       |
| TP104       | 1.7                           | Sand       |
| TP105       | 1.45                          | Sand       |
| TP108       | 2.2                           | Sandy Clay |
| TP109       | 1.7                           | Sandy Clay |
| TP110       | 2.1                           | Sandy Clay |
| TP111       | 1.4                           | Sandy Clay |
| TP112       | 1.6                           | Sand       |
| TP115       | 1.3                           | Peat       |
| TP116       | 1.6                           | Sandy Clay |
| TP119       | 1.4                           | Sandy Clay |
| WS101       | 1.5                           | Sand       |
| WS102       | 3.5                           | Sand       |
| WS104       | 5.4                           | Clay       |
| WS106       | 2.9                           | Sand       |
| WS109       | 2                             | Sand       |
| WS110       | 3.6                           | Sandy Clay |

The above indicates that the groundwater of the Secondary (A) Aquifer within the superficial deposits sits on average between 1 and 2m bgl; primarily in the Shirdley Hill Sand and on top of the Glacial Till.

Groundwater depths/levels were recorded during the post-SI monitoring of the newly installed gas and groundwater monitoring wells.

Rest groundwater levels recorded on 21<sup>st</sup> June 2017 and were found to be resting between 0.8 and 2.26m bgl; thus indicating that the groundwater strikes observed during drilling were generally representative of rest groundwater levels.

Groundwater elevations above ordnance datum (AOD) ranged from 21.03m AOD (WS104) to 18.78m AOD (WS115), indicating a north-westerly groundwater flow direction toward Whinney Brook.

Details of resting groundwater levels gauged in monitoring wells are presented in Table 1 of the 'Data Tables'.

It should be appreciated that ground and groundwater conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

It should also be noted that groundwater levels may be affected by seasonal variations such as rainfall and that no account can be taken of such variations in this report.

## 5 Geotechnical Appraisal

### 5.1 Proposed Development

The site is proposed to be developed for private housing comprising circa 800 units of different styles with associated private gardens, driveways and hardstanding for car parking and access.

Detailed designs have not been made available to inform this appraisal and we have assumed that the elevation of development will be similar to existing ground levels and therefore significant re-profiling of the current surface will not be undertaken.

### 5.2 Site Preparation & Topsoil Strip

Prior to redevelopment, site wide stripping of the Topsoil should be undertaken. This material should be stockpiled and protected from inclement weather for future use in gardens and landscaping.

Any excavated soils destined for reuse should be protected from inclement weather to minimise any changes in moisture content.

### 5.3 Foundations & Floor Slabs

The site geology generally comprised a layer of topsoil proven to a maximum depth of 0.6m bgl, overlying Shirdley Hill Sand to maximum depths of 2.9m bgl and Glacial Till to >5.45m bgl. Bedrock was not encountered during this investigation as it's anticipated depth exceeded the scope of drilling.

Made Ground was present in a single location (TP115, between 0.5 and 0.9m bgl) and comprised site-derived re-worked clay.

The Shirdley Hill Sand is present above the Glacial Till in the majority of locations, however the horizon's thickness varies across site. As shown on Figure 3, the greatest thickness of sand below the topsoil layer was observed in the south-west, where surface elevation is generally higher, with thickness ranging between 1 and 2.5 metres, and reducing to <1 metre approximately 200 metres north-east from the south-western boundary. Dark blackish brown organic plastic pseudo fibrous PEAT was encountered in approximately half of trial pit TP115 at depths of between 1.2 and 2.2m bgl. Peat soils were not encountered within any other exploratory holes and therefore the deposit is considered to be localised in extent within the Shirdley Hill Sand.

The Standard Penetration Test (SPT) data indicate that the Shirdley Hill Sand is generally loose; consistent with its provenance and deposition as wind-blown sand/dunes. Furthermore, PSD gradings of five samples indicated that the sand also contains minor constituents of silt/clay and gravel at maximum proportions of 4% and 16% respectively. SPTs undertaken in the Glacial Till recorded N-values of between 4 and 31 indicating a soft to very stiff consistency of the material. The SPT N Values generally increase with increasing depth (as shown on Figure 4), however there is significance variance in the N Values at all depths; particularly at depths less than 2.5mbgl.

The stiffness of the shallow (1-3m bgl) Glacial Till soils was found to be both laterally and vertically variable across site. Undrained Shear Strength (Cu) values are plotted against depth on Figure 5 which includes both recorded and estimated Cu values from Hand Shear Vane (HSV) tool and SPT N Values respectively. With respect to the N values, the cohesion/shear strength of the strata has been estimated based on the relationship between shear strength (c), plasticity index and SPT N value (after Stroud, 1975) whereby  $c = f_1 N$ . An upper bound plasticity index of around 20% has been used to determine coefficient  $f_1 = 5$ .

The HSV results generally yielded higher Cu values than the estimations from the SPT N values. Based on the field observations (i.e. how the material behaves under thumb and finger pressure) the N values are considered conservative.

Figure 2 presents an interpolated ground model based on exploratory hole (point) data of the minimum depths from the existing ground surface at which the Glacial Till attains an estimated undrained shear

strength ( $C_u$ ) of 50kPa; at which depths traditional spread/strip foundations could be designed upon an allowable net bearing pressure of 100kPa. Strip foundations are therefore likely to be feasible for the north-eastern two thirds of the site (orange colours on Figure 2) however the depth to competent strata across the southwest third of the site precludes the use of conventional strip foundations; largely due to the thickness of the overlying Shirdley Hill Sand.

Natural drainage is governed by the subsurface gradient and topography of the (less permeable) Glacial Till which (as indicated by the interpolated contours on Figure 2) decreases in elevation from east to west and which directs shallow groundwater to towards Whinney Brook and the western corner of the site. The Shirdley Hill Sand attains a thickness of approximately 1.5 to 2.0m in the south-western third of the site and given the loose density of the stratum combined with the potential for shallow groundwater, there is significant potential for running sands conditions to develop in any open excavations. On this basis, the construction of deep strip foundations (e.g. trench fill) is unlikely to be feasible through the Shirdley Hill Sand formation.

Ground improvement by vibro-treatment methods (such as vibro stone columns) could be utilised to improve the load-bearing and settlement characteristics of the Shirdley Hill Sand beneath plots in the south-western third of the site where the depth to competent Glacial Till strata precludes the use of conventional strip foundations (either due to construction cost or the practicalities of dewatering, shoring up and constructing trench fill foundations through the sand). Treatment would be required to extend the full thickness of the Made Ground to the underlying competent Glacial Till. Following vibro-treatment, suitably-reinforced spread foundations based upon a net allowable bearing pressure of about 125kPa could be formed on the treated ground at depths of around 1mbgl.

If ground improvement by vibro treatment is to be considered further, consultation with a reputable ground-improvement specialist is recommended. Ideally the specialist will have local knowledge and have experience of working on similar developments with similar ground conditions.

Due consideration should also be given to the following limitations:

- NHBC standards require that vibro-treatment beneath structures extends through the full thickness of Made Ground to the underlying (competent) Glacial deposits.
- Consideration should be given to the impact during construction, in terms of noise/vibration etc. upon nearby structures, services and developments.
- There are distance limitations of vibro-treatment adjacent to existing structures/services; these are understood to be in the order of 2-6m and therefore are unlikely to affect existing structures surrounding the site.

With respect to floor slabs, the subgrade materials are not considered to be sensitive to change of volume on change of moisture content (low shrink/swell potential) and therefore construction of ground-bearing floor slabs is considered a feasible option.

## 5.4 Pavement and Road Design

In consideration of the ground conditions encountered, it is likely that the road pavement sub-grade exposed at formation levels will comprise cohesive Glacial Till (sandy clay) or Shirdley Hill Sand.

Cohesive sub-grades are potentially moisture sensitive and therefore susceptible to softening when exposed to inclement weather.

Pavement and road design should be based upon a suitable (equilibrium) CBR value. Reference has been made to Table 5.1 'Equilibrium Subgrade CBR Estimation' in IAN 73/06 (Highways Agency, 2009) and from this it is recommended that new road pavement and road construction design should be based upon (an estimated) CBR value of:

- 3% for clay sub-grades (consistent with the material exhibiting a Plasticity Index of ~10-20%); and
- 5% for sand sub-grades.

However, the design value will need to be reviewed and confirmed by suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.

Notwithstanding this, the formation at all levels should be proof-rolled prior to pavement construction, and any soft zones thus revealed should be excavated out, with the resulting excavation in-filled with appropriately graded engineered granular fill.

## **5.5 Excavations and Groundwater**

Shallow excavations conducted during the works were generally noted to be damp and unstable in the south-west of site, particularly within the sands, and becoming drier and more stable to the north-east where the elevation of Glacial Till was higher. Typically, excavations within the sands could not extend below approximately 2m bgl due to the un-supported walls collapsing.

Therefore, ground excavations at the site should be feasible using an appropriate scale of hydraulic plant, and when conducted within sands, will require adequate lateral support to ensure their stability.

Based on the available data, it is considered likely that groundwater (from the Secondary (A) Aquifer) will be encountered in shallow excavations <2m bgl. Additionally, the flow and quantity may increase during periods of wet weather (particularly in the south-west of site) due to the high porosity and permeability of the sands and gradient of the Glacial Till. In this scenario, appropriate groundwater control/dewatering provisions will be required to keep excavations dry.

## **5.6 Concrete Classification**

Design/mix of buried concrete should be undertaken in accordance with BRE (2005).

A review of the available soil chemical results indicates that sulphate and pH results fall within "Design Sulphate Class" DS-1, and the "Aggressive Chemical Environment for Concrete" (ACEC) class for the site is considered to be AC-1. Design/mix of buried concrete should be undertaken in accordance with these classifications.

## **5.7 Soakaway Drainage**

The Glacial Till will not support infiltration drainage due to its inherent low permeability.

The Shirdley Hill Sand comprises relatively clean, fine to medium sand and therefore would support infiltration locally (e.g. roof drainage), however as outlined in previous sections, the sand deposit is generally at higher elevation (against gravity drainage) and the clay sub-surface elevation dips to the west. As a result, the natural drainage of the site (via perched groundwater flow) is to the west and therefore it is understood (anecdotally) that the sand deposit tends to act like a large sump and the western areas can become saturated.

The combination of the sand being at higher elevation together with the location of the sand relative to the natural site drainage direction and proximity to Whinney Brook dictates that large scale/strategic soakaways are unlikely to be feasible at this site.

## 7 Contamination Assessment

### 7.1 Methodology

In line with CLR11 (DEFRA & EA, 2004), a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the measured concentrations of contaminants from the chemical analysis.

The GQRA comprises the comparison of the laboratory measured concentrations with Generic Assessment Criteria (GAC) which have been derived in-house by Arcadis using the relevant EA and associated guidance (refer to Appendix F for the GAC derivation methodology):

- EA Science Reports SC050021/SR2, SC050021/SR3 and SC050021/SR7;
- EA Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination;
- EA Groundwater protection: policy and practice (GP3);
- Related Toxicity and Soil Guideline Value Reports; and,
- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination

The GAC are risk-based and designed to protect the most sensitive human health or environmental receptors associated with the Site. The process is designed to highlight potentially significant impacts that warrant further investigation or assessment.

The GAC are all based on Health Criteria that represent minimal or tolerable levels of risks to health as described in the Environment Agency's SR2 guidance, ensuring that the resulting assessment criteria are 'suitable for use' under planning.

The development proposals comprise the construction and subsequent use of the site as low density residential. We have therefore undertaken a GQRA on the basis that the development site falls under the "Low Density Residential" GAC risk parameters.

The primary target Human Health receptor at the site is considered to be future residents via inhalation and ingestion pathways, and the primary Controlled Water receptor is considered to be surface water (Whinney Brook) via surface run-off and percolation/lateral migration within the superficial deposits in a westerly flow direction.

The Glacial Till is recorded as being a Secondary (undifferentiated) Aquifer. The groundwater encountered on site is understood to be perched water, with actual groundwater confined in the bedrock aquifer by the overlying low-permeable Glacial Till; the thickness of which is estimated at an average of 9 metres (based on historic borehole records). Given the depth to the actual groundwater table and the significant thickness of the overlying Glacial Till the aquifer is not considered to be a plausible receptor.

### 7.2 Chemical Soil Analyses

The results of the soil laboratory analysis are presented in Tables 2 to 4 of the 'Data Tables'.

In order to confirm the chemical suitability of the shallow soils for re-use, 15no samples were analysed for:

- Metals and semi-metals;
- Total cyanide;
- PAHs; and
- pH (plus an additional 34no samples).

pH values ranged from 6.24 in location TP108 at 0-0.3m bgl to 8.79 in location WS110 at 5-5.45m bgl indicating near-neutral to mildly alkaline conditions. pH for the samples of Glacial Till tended toward the higher end of this range.

### **7.2.1 Human Health GQRA**

None of the concentrations of metals or PAHs exceeded their defined GAC.

All of the concentrations of total cyanide were recorded below the laboratory method detection limit and therefore are not considered to pose a significant risk.

### **7.2.2 Controlled Water**

None of the concentrations of metals exceeded their defined GAC protective of Surface Water.

Measured PAH concentrations are low (i.e. they are below the Low Density Residential Human Health GAC) however a number of PAH concentrations exceeded the Surface Water GAC.

These contaminants are generally considered to be of limited leaching potential due to their low solubility and mobility characteristics and therefore are not considered to pose a significant risk to Whinney Brook.

### **7.2.3 GQRA Conclusion**

The levels of contamination measured in the shallow soils are considered very low (typical of Greenfield/arable farmland), and as such, the overall risk to Human Health and Controlled Waters receptors is considered negligible. The shallow site soils (Topsoil and underlying subsoils) are considered chemically suitable for re-use in the development.

## **7.1 Preliminary Waste Soil Characterisation**

On the basis of the current information it is likely that the majority of materials derived from site would be classifiable as "Inert" natural soils for re-use or landfill disposal. Any Made Ground (reworked, uncontaminated natural soils) would also likely be classified as Inert.

Any peat soils or contaminated soils requiring offsite disposal would be classified as either Non-Hazardous or Hazardous waste and would be subject to appropriate characterisation and classification.

Note that an appropriate waste characterisation can only be undertaken on the material due to be disposed of via further chemical testing which should be completed immediately prior to disposal. For Inert Waste disposal (and in the highly unlikely event of Hazardous Waste disposal), allowance will need to be made for adequate Waste Acceptance Criteria (WAC) testing with appropriate consideration of the additional time and cost associated with this.

In all cases where soils require off-site disposal, the materials need to be managed under the appropriate legislation and consideration given to any remedial techniques that could be used to improve the soil.

## 8 Ground Gas Assessment

### 8.1 Methodology

Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide within ground gas) is provided in two key documents:

- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2015); and
- Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).

The assessment presented herein is primarily based on the British Standard document.

Hazardous ground gases can be considered as a type of land contamination, and qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be provided, based upon the qualitative risk model and gas monitoring results.

Based on the measured flow rates and measured hazardous gas concentrations, individual “hazardous gas flow rates” ( $Q_{hg}$ ) can be derived for each monitoring point, from which the “site characteristic hazardous gas flow rate” ( $Q_{hgs}$ ), and then the “Characteristic Situation” can be determined.

BS8485 provides guidance on the level of required gas protection based upon the characteristic situation and the type of development (e.g. non-managed property such as private housing, public buildings, commercial buildings or industrial buildings).

### 8.2 Ground Gas Conceptual Model

The development will comprise residential end-use with gardens. The sensitivity of development with respect to ground gas is considered high on the basis that private ownership with no building management and include private housing therefore the development falls in to Building Type A as defined in BS8485.

On the basis of the investigation findings, potential sources of ground gas generation are considered to be limited to Made Ground and any naturally occurring organic material/sediments which may give rise to the generation of hazardous ground gas.

The overall risk is considered “moderate” and a programme of gas monitoring, comprising 6no visits over a period of 3 months, has been initiated to quantify the ground gas regime and allow a risk assessment to be completed.

### 8.3 Ground Gas Monitoring

Standpipes installed during the intrusive works have been monitored on 2no occasions to date on 21<sup>st</sup> June 2017 and 17<sup>th</sup> July 2017.

The gas monitoring records are presented in Table 5 of the ‘Data Tables’.

The data collected have been compiled to complete a preliminary gas risk assessment for the site. A summary of the results together with the calculated hazardous gas flow rates is presented in the following table:

| Monitoring Point | Max Flow (l/hr)<br>* | Max CH <sub>4</sub><br>(%v/v) | Max CO <sub>2</sub><br>(%v/v) | Max CH <sub>4</sub><br>Q <sub>hg</sub><br>(l/hr) | Max CO <sub>2</sub><br>Q <sub>hg</sub><br>(l/hr) |
|------------------|----------------------|-------------------------------|-------------------------------|--------------------------------------------------|--------------------------------------------------|
| WS101            | 0.1                  | 0.1                           | 2.4                           | 0.0001                                           | 0.0024                                           |
| WS102            | -10.9                | 0.1                           | 1                             | -0.0109                                          | 0.0001                                           |
| WS104            | 0.2                  | <0.1                          | 1.7                           | 0.0002                                           | 0.0017                                           |
| WS105            | <0.1                 | <0.1                          | 3.1                           | <0.0001                                          | 0.0031                                           |
| WS108            | -0.7                 | <0.1                          | 2.3                           | -0.0007                                          | 0.0023                                           |
| WS114            | <0.1                 | <0.1                          | 1.3                           | <0.0001                                          | 0.0013                                           |
| WS115            | <0.1                 | <0.1                          | 1.9                           | <0.0001                                          | 0.0019                                           |

\* Where flow <0.1l/r and/or gas concentration <0.1% were recorded, a value of 0.1 has been assumed in order to calculate the borehole hazardous gas flow rate (Q<sub>hg</sub>).

## 8.4 Assessment and Recommendations

The table below is reproduced from BS8485 and presents the relationship between the adopted Gas Screening Value (GSV) for site and Characteristic Situation (CS) allocation.

| Characteristic Situation | Hazard Potential | Site Characteristic GSV<br>(l/hr) | Additional Factors                                    |
|--------------------------|------------------|-----------------------------------|-------------------------------------------------------|
| 1                        | Very Low         | <0.07                             | Typically <1% CH <sub>4</sub> and <5% CO <sub>2</sub> |
| 2                        | Low              | 0.07 to <0.7                      | Typical measured flow rate <70l/h                     |
| 3                        | Moderate         | 0.7 to <3.5                       | -                                                     |
| 4                        | Moderate to High | 3.5 to <15                        | -                                                     |
| 5                        | High             | 15 to <70                         | -                                                     |
| 6                        | Very High        | >70                               | -                                                     |

The maximum results for all locations are presented below, and have been compared with the criteria outlined above:

- Maximum flow = 0.2 l/hr
- Maximum Methane = 0.1 %v/v
- Maximum Carbon Dioxide = 3.1 %v/v
- Maximum Q<sub>hg</sub> = 0.0031 l/hr (CO<sub>2</sub>)

The preliminary monitoring dataset indicates the site to fall into Characteristic Situation 1 (CS1) indicative of 'very low' gas risk.

Summerhill Farm, Poverty Lane, Maghull

In this scenario no gas protection measures will be required for the proposed buildings; however the conclusion is subject to further monitoring and the final assessment which will be presented in an addendum letter report.

## **9 Recommendations for Further Work**

### **9.1 Foundation Zoning**

There is significant variance in the strength of the shallow Glacial Till soils and therefore the appraisal of foundation depths and bearing pressures discussed in this report are relatively conservative and could be refined further through additional intrusive investigations which would aim to increase the confidence and resolution of the strength data for the shallow soils.

Supplementary geotechnical investigations may comprise 2 days of Cone Penetration Testing (CPT) which will allow for approximately 40 to 50no positions across the site to depths of 5m bgl. The CPT produces a continuous soil type/strength profile from ground level to the final depth of the test and will therefore determine more detailed geotechnical engineering properties of the shallow soils and will also vastly increase the number of test positions across the site; thereby allowing better zoning of the site in terms of foundations depths and bearing capacities as necessary. It would be beneficial to undertake this work following the crop harvest in order to provide unrestricted access to test positions across the site and increase the efficiency of the investigations (i.e. allow for more test positions per day).

### **9.2 Made Ground/Infilled Ponds**

The desk study identified the potential for historical in-filled ponds, however to date only one location (a trial pit) was found to contain peat soil overlain by re-worked site-derived sand/clay material. Other window sample locations and initial ground gas readings do not appear to indicate conditions associated with such features however there are a number of locations which still could potentially be infilled ponds and therefore it would be prudent to undertake one additional day of drilling (windowless sampling) and further trial pitting to investigate/delineate potential features and allow for any additional ground gas monitoring locations as required.

## 10 Study References

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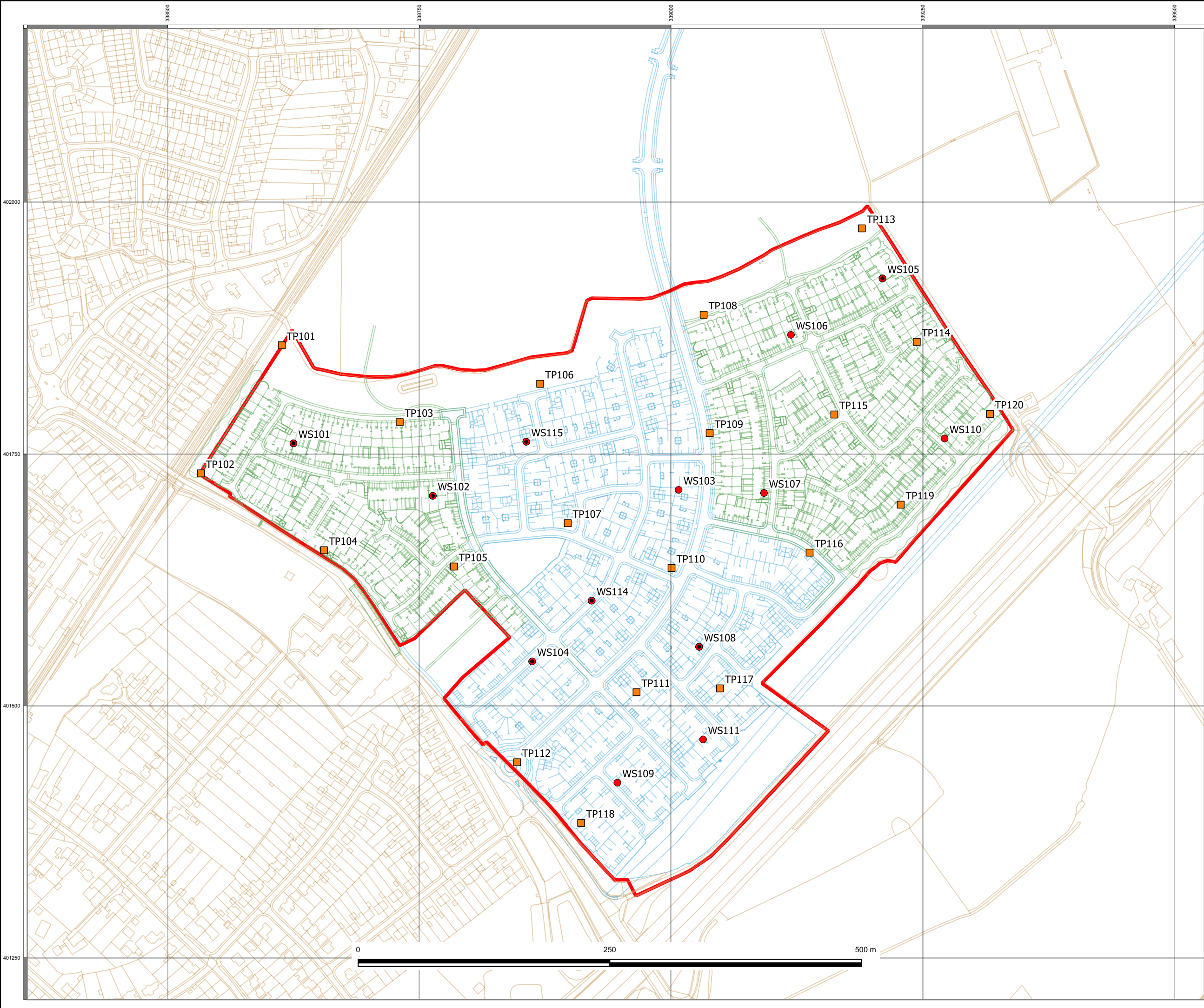
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Highways Agency (HA), 2009. Interim Advice Note 73/06: Design guidance for road pavement foundations (draft HD 25) (Revision 1 (2009)).

Stroud M A, 1975. The Standard Penetration test in insensitive clays and soft rocks, Proceedings of the European Symposium on Penetration Testing, 2, 367-375, 1975.

# FIGURES



### Legend

**Exploratory Locations**

- Trial Pit
- Borehole
- Monitoring Point
- OS Map
- Planning Layout (Persimmon)
- Planning Layout (Countryside)
- Site Boundary

**Notes:**

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

**Title:**  
Exploratory Location Plan

**Site:**  
Summerhill Farm, Maghull

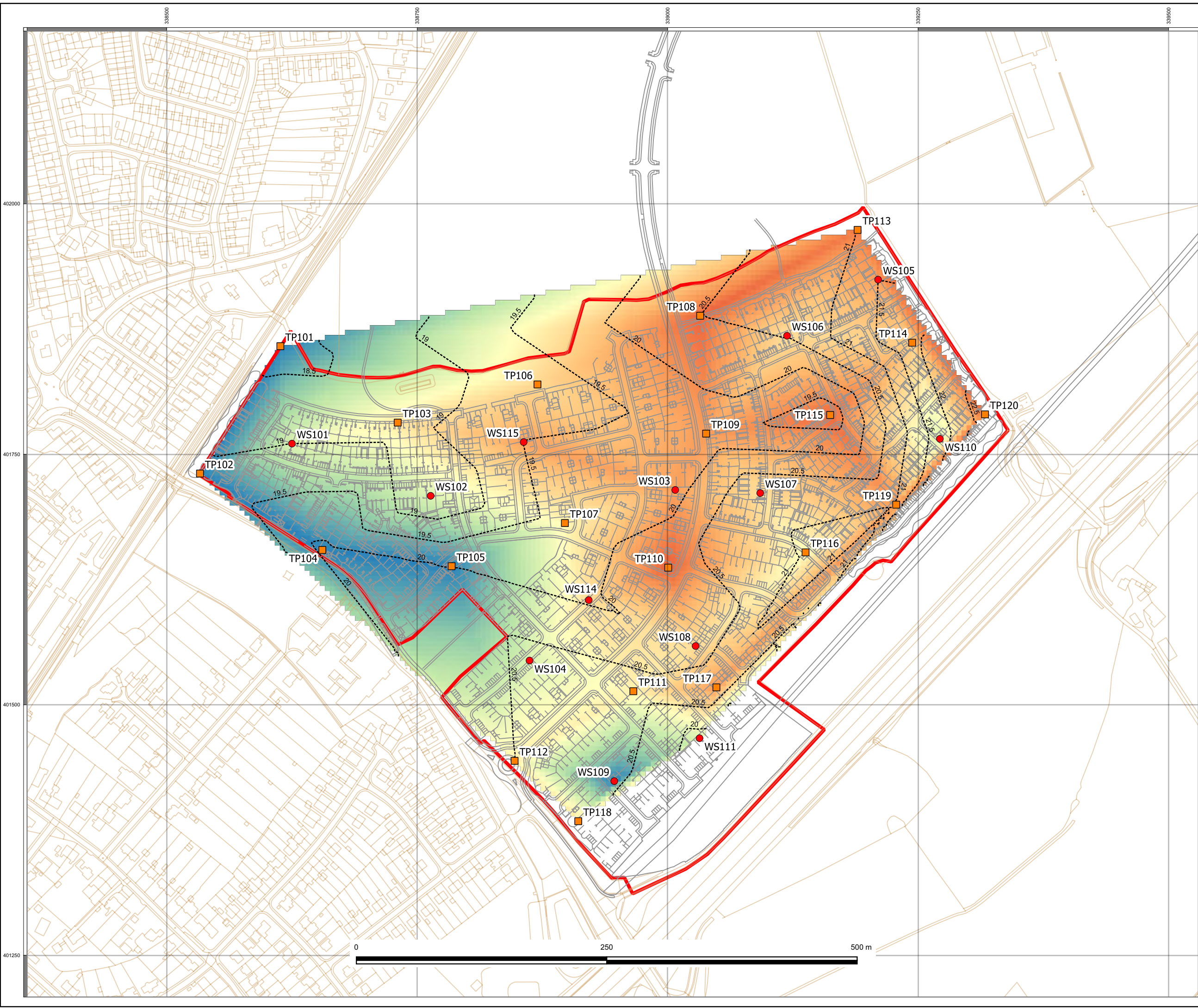
**Client:**  
Persimmon Homes / Countryside Properties

|                                     |                        |
|-------------------------------------|------------------------|
| <p><b>Project:</b><br/>37158100</p> | <p><b>Figure 1</b></p> |
|-------------------------------------|------------------------|

Date: 06/07/2017  
Drawn By: LT  
DRG No: 37158100\_01  
Scale at A3 Page Size: 1:3,500



Design & Consultancy  
for natural and  
built assets



Legend

Exploratory Locations

- Trial Pit
- Borehole

----- Glacial Till Contours (m AOD)

Depth to Glacial Till Cu>50kPa

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5

Notes:

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

Title:  
Depth to Competent Strata  
(Glacial Till Cu>50kPa)

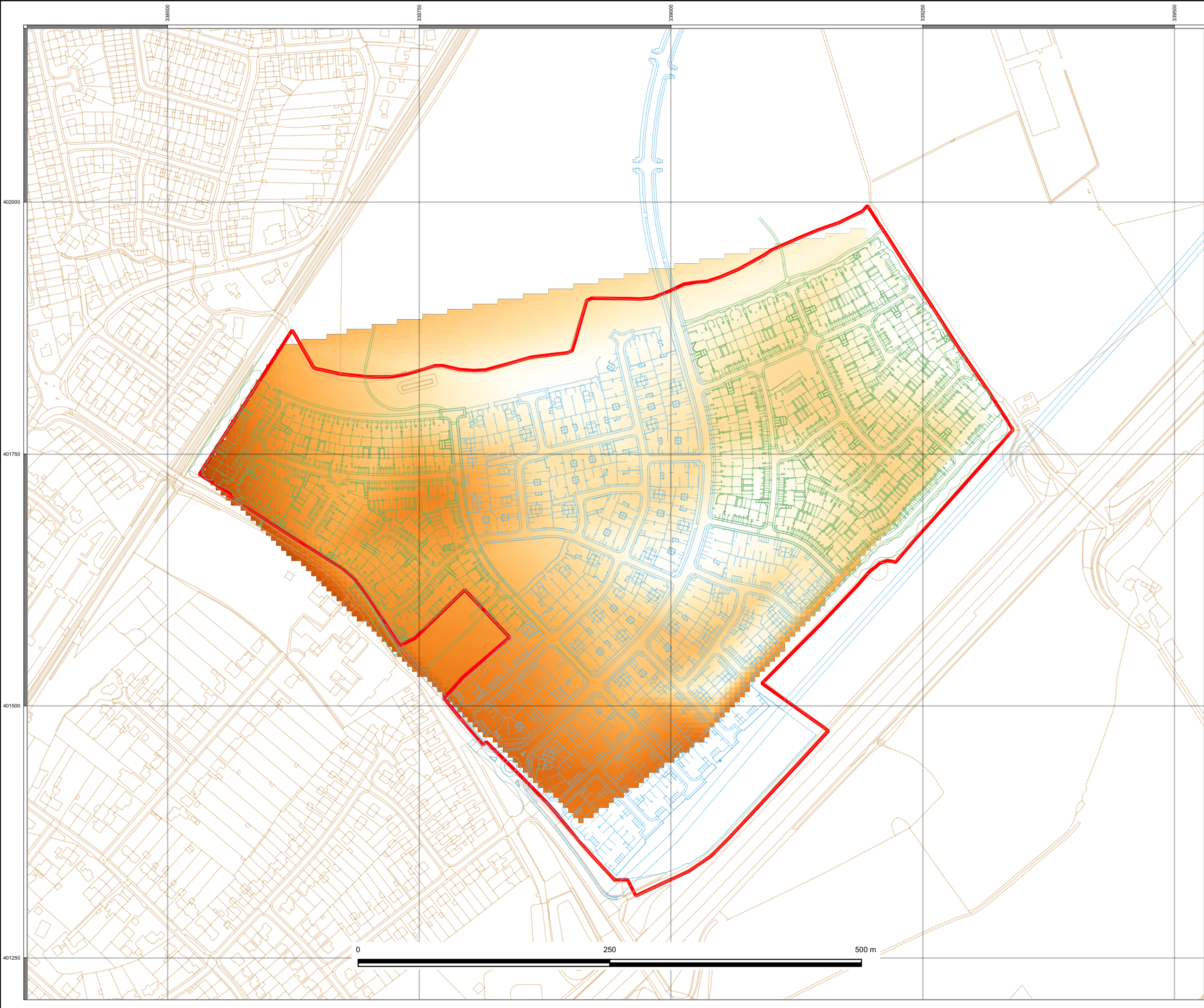
Site:  
Summerhill Farm, Maghull

Client:  
Persimmon Homes / Countryside Properties

Project:  
37158100

Figure 2

Date: 06/07/2017  
Drawn By: LT  
DRG No: 37158100\_02  
Scale at A3 Page Size: 1:3,500



**Legend**

Shirdley Hill Sand Thickness (m)

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

**Title:**  
Thickness of Shirdley Hill Sand

**Site:**  
Summerhill Farm, Maghull

**Client:**  
Persimmon Homes / Countryside Properties

**Project:**  
37158100

Figure 3

Date: 06/07/2017  
Drawn By: LT  
DRG No: 37158100\_03  
Scale at A3 Page Size: 1:3,500

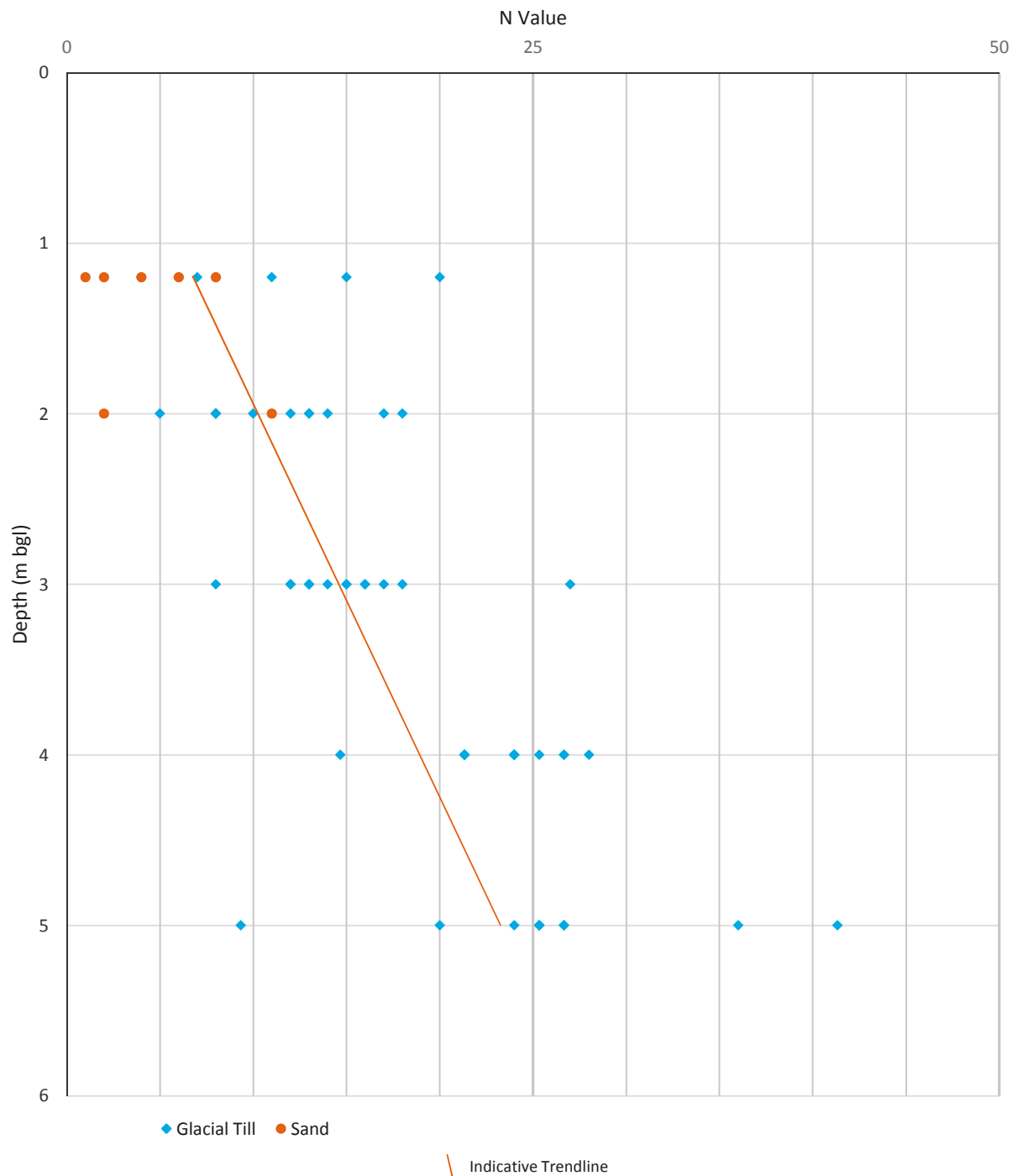
**Project Name :** SUMMERHILL FARM, MAGHULL

**Job Number :** 37158100

**Client :** PERSIMMON HOMES & COUNTRYSIDE PROPERTIES

## SPT N Values vs. Depth

Strata: Shirdley Hill Sand & Glacial Till



**Figure 4**

Drawn By: LT

Date: JUNE 2017

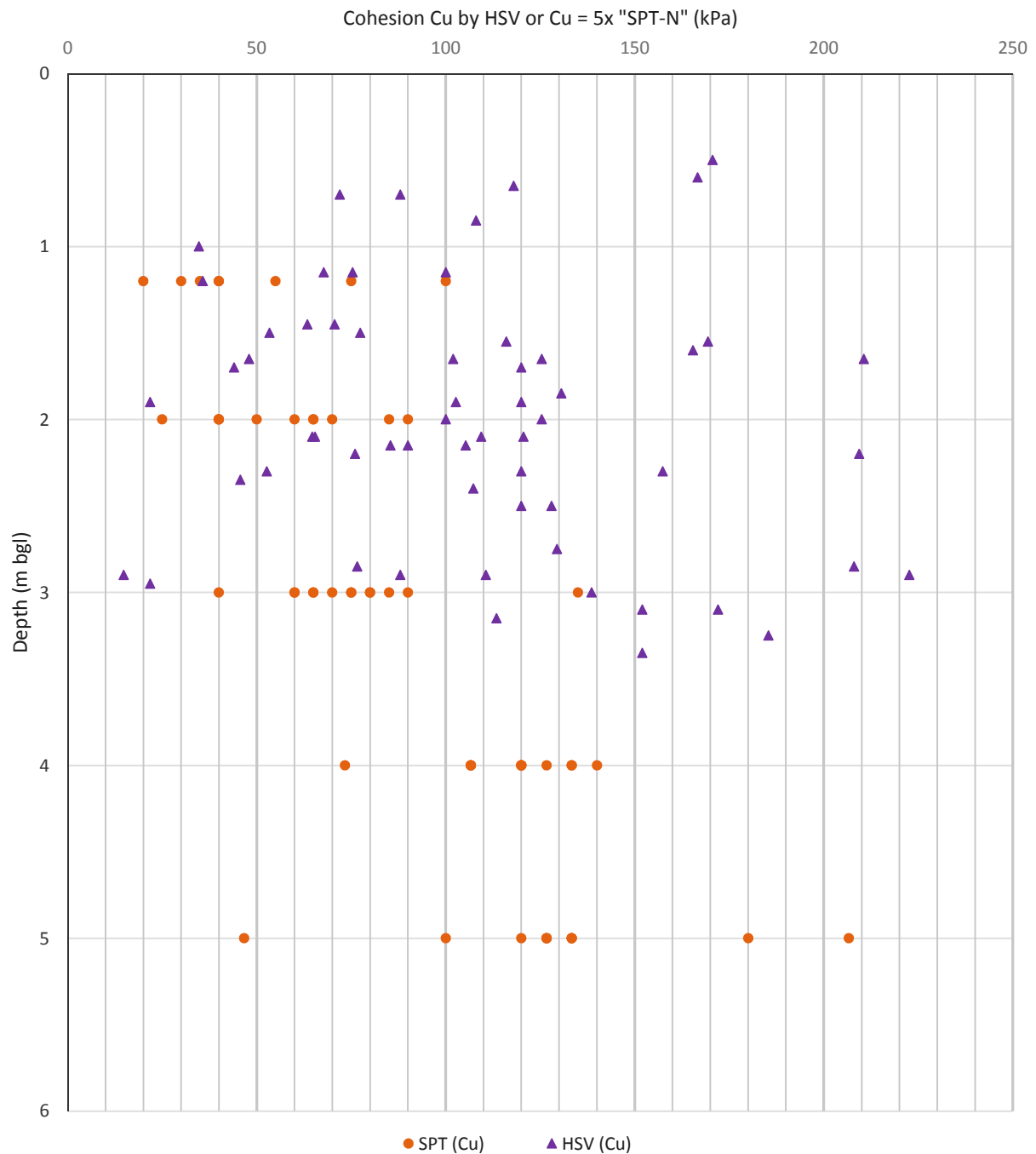
**Project Name :** SUMEMRHILL FARM, MAGHULL

**Job Number :** 37158100

**Client :** PERSIMMON HOMES & COUNTRYSIDE PROPERTIES

## Cu Values vs. Depth

Strata: Glacial Till



**Figure 5**

Drawn By: LT

Date: JUNE 2017

# TABLES

## Data Tables

### Notes and Abbreviations

|                |                                                                                                                                                                                                           |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ---            | Concentration is less than the method detection limit, therefore it is assumed that there is no significant risk                                                                                          |
|                | No laboratory analysis conducted                                                                                                                                                                          |
| GAC            | Generic Assessment Criteria                                                                                                                                                                               |
| m bgl          | Metres Below Ground Level                                                                                                                                                                                 |
| m AOD          | Metres Above Ordnance Datum                                                                                                                                                                               |
| na             | Not applicable / no GAC derived                                                                                                                                                                           |
| -              | No groundwater present in monitoring well                                                                                                                                                                 |
| #              | No GAC for individual TPH fractions given that the compliance criteria is for sum TPH                                                                                                                     |
| GG             | Ground gas installation point, not intended for groundwater monitoring                                                                                                                                    |
| NR             | No appropriate inhalation reference dose identified during review of toxicological data                                                                                                                   |
| ND             | Results of modelling indicates pathway not considered to present a significant risk                                                                                                                       |
| NVP            | Contaminant has only a low vapour pressure in soil                                                                                                                                                        |
| >SOL           | Target acceptable risk not exceeded at theoretical solubility concentration                                                                                                                               |
| TPH            | Total Petroleum Hydrocarbons                                                                                                                                                                              |
| PAH            | Polycyclic Aromatic Hydrocarbon                                                                                                                                                                           |
| VOC            | Volatile Organic Compound                                                                                                                                                                                 |
| MTBE           | Methyl Tert-Butyl Ether                                                                                                                                                                                   |
| <b>1.23</b>    | Concentration exceeds GAC for water resource receptor only                                                                                                                                                |
| <b>1.23</b>    | Concentration exceeds GAC for human health receptor + water resource receptor                                                                                                                             |
| <i>Italics</i> | Target exceeds theoretical soil saturation limit. Concentrations above the soil saturation limit may indicate the presence of separate phase in soil, but does not necessarily present a significant risk |

**TABLE 1**  
**Ground and Groundwater Elevation**

| Monitoring Well | Ground Elevation m AOD | MW Installation Depth | Product Depth m bgl | Product Thickness mm | Groundwater Depth m bgl | Depth to Base of MW m bgl | Groundwater Elevation m AOD |
|-----------------|------------------------|-----------------------|---------------------|----------------------|-------------------------|---------------------------|-----------------------------|
| Monitoring      | Event I                |                       |                     |                      |                         |                           |                             |
| Date            | 21 June 2017           |                       |                     |                      |                         |                           |                             |
| WS101           | 20.600                 | 4.000                 | -                   | -                    | 1.330                   | 3.700                     | 19.270                      |
| WS102           | 20.400                 | 3.000                 | -                   | -                    | 0.800                   | 2.960                     | 19.600                      |
| WS104           | 22.500                 | 4.000                 | -                   | -                    | 1.470                   | 3.020                     | 21.030                      |
| WS105           | 22.000                 | 5.000                 | -                   | -                    | 1.520                   | 4.780                     | 20.480                      |
| WS108           | 21.500                 | 3.500                 | -                   | -                    | 2.260                   | 3.570                     | 19.240                      |
| WS114           | 21.050                 | 5.000                 | -                   | -                    | 1.380                   | 4.890                     | 19.670                      |
| WS115           | 20.410                 | 5.000                 | -                   | -                    | 1.630                   | 4.520                     | 18.780                      |

**TABLE 1**  
**Ground and Groundwater Elevation**

| Monitoring Well | Ground Elevation m AOD | MW Installation Depth | Product Depth m bgl | Product Thickness mm | Groundwater Depth m bgl | Depth to Base of MW m bgl | Groundwater Elevation m AOD |
|-----------------|------------------------|-----------------------|---------------------|----------------------|-------------------------|---------------------------|-----------------------------|
| Monitoring      | Event II               |                       |                     |                      |                         |                           |                             |
| Date            | 17 June 2017           |                       |                     |                      |                         |                           |                             |
| WS101           | 20.600                 | 4.000                 | -                   | -                    | 1.650                   | 3.710                     | 18.950                      |
| WS102           | 20.400                 | 3.000                 | -                   | -                    | 0.970                   | 2.920                     | 19.430                      |
| WS104           | 22.500                 | 4.000                 | -                   | -                    | 1.510                   | 2.940                     | 20.990                      |
| WS105           | 22.000                 | 5.000                 | -                   | -                    | 2.070                   | 4.770                     | 19.930                      |
| WS108           | 21.500                 | 3.500                 | -                   | -                    | 1.870                   | 3.550                     | 19.630                      |
| WS114           | 21.050                 | 5.000                 | -                   | -                    | 1.560                   | 4.820                     | 19.490                      |
| WS115           | 20.410                 | 5.000                 | -                   | -                    | 2.170                   | 4.470                     | 18.240                      |

**TABLE 2**  
**PAH Concentrations in Soil (mg/kg)**

| Sample Identity        | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP101      | TP104      | TP105      | TP106      | TP107      | TP 108     | TP 109     | TP 110     |
|------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl  |                                         | Human Health                          | Water<br>Resource | 0.00-0.50  | 0.80-1.00  | 0.00-0.50  | 0.00-0.50  | 0.00-0.40  | 0.00-0.30  | 0.40-0.60  | 0.00-0.50  |
| Sample Date            |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 01/06/2017 | 01/06/2017 | 01/06/2017 |
| Naphthalene            | 28.1                                    | 1.81                                  | 0.018             | 0.0257     | ---        | ---        | 0.0505     | 0.0601     | 0.0442     | ---        | 0.0448     |
| Acenaphthylene         | 72.7                                    | 44                                    | na                | ---        | ---        | ---        | ---        | 0.0144     | ---        | ---        | ---        |
| Acenaphthene           | 15.6                                    | 360                                   | na                | 0.0388     | ---        | ---        | 0.0939     | 0.0857     | 0.0403     | ---        | 0.0426     |
| Fluorene               | 12                                      | 536                                   | na                | 0.0291     | ---        | ---        | 0.0565     | 0.0534     | 0.0234     | ---        | 0.0374     |
| Phenanthrene           | 4.83                                    | 1090                                  | na                | 0.332      | ---        | 0.0947     | 0.613      | 0.867      | 0.27       | ---        | 0.498      |
| Anthracene             | 0.706                                   | 1280                                  | na                | 0.0579     | ---        | 0.0202     | 0.105      | 0.184      | 0.046      | ---        | 0.0988     |
| Fluoranthene           | 6.46                                    | 353                                   | na                | 0.507      | ---        | 0.206      | 1.09       | 1.88       | 0.381      | ---        | 0.698      |
| Pyrene                 | 0.75                                    | 1850                                  | na                | 0.497      | ---        | 0.199      | 1.02       | 1.75       | 0.35       | ---        | 0.655      |
| Benz(a)anthracene      | 0.582                                   | 2.86                                  | na                | 0.251      | ---        | 0.111      | 0.472      | 0.824      | 0.216      | ---        | 0.413      |
| Chrysene               | 0.15                                    | 82.3                                  | na                | 0.302      | ---        | 0.104      | 0.533      | 0.807      | 0.207      | ---        | 0.382      |
| Benzo(b)fluoranthene   | 0.413                                   | 11.8                                  | 0.032             | 0.443      | ---        | 0.154      | 0.813      | 1.5        | 0.321      | ---        | 0.552      |
| Benzo(k)fluoranthene   | 0.234                                   | 13                                    | 0.049             | 0.139      | ---        | 0.0539     | 0.265      | 0.614      | 0.108      | ---        | 0.232      |
| Benzo(a)pyrene         | 0.31                                    | 5                                     | 0.065             | 0.265      | ---        | 0.0958     | 0.517      | 1.09       | 0.234      | ---        | 0.435      |
| Indeno(1,2,3-cd)pyrene | 0.0209                                  | 11.2                                  | 0.0018            | 0.15       | ---        | 0.0562     | 0.285      | 0.585      | 0.129      | ---        | 0.247      |
| Dibenzo(a,h)anthracene | 0.00134                                 | 1.12                                  | na                | 0.0485     | ---        | ---        | 0.0953     | 0.17       | 0.0451     | ---        | 0.0872     |
| Benzo(g,h,i)perylene   | 0.00634                                 | 3680                                  | 0.0084            | 0.199      | ---        | 0.0804     | 0.381      | 0.788      | 0.168      | ---        | 0.321      |
| <b>TOTAL PAH</b>       |                                         |                                       |                   | 3.285      | ---        | 1.175      | 6.390      | 11.273     | 2.583      | ---        | 4.744      |

**TABLE 2**  
**PAH Concentrations in Soil (mg/kg)**

| Sample Identity        | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP112      | TP 113     | TP114      | TP116      | TP120      | WS 104     | WS 109     |
|------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl  |                                         | Human Health                          | Water<br>Resource | 0.00-0.40  | 0.70-0.90  | 0.00-0.40  | 0.60-0.85  | 0.00-0.40  | 0.60-      | 0.00-0.60  |
| Sample Date            |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 31/05/2017 | 01/06/2017 | 31/05/2017 | 31/05/2017 | 31/05/2017 | 01/06/2017 | 01/06/2017 |
| Naphthalene            | 28.1                                    | 1.81                                  | 0.018             | 0.0184     | ---        | 0.012      | ---        | 0.0118     | ---        | ---        |
| Acenaphthylene         | 72.7                                    | 44                                    | na                | ---        | ---        | ---        | ---        | ---        | ---        | ---        |
| Acenaphthene           | 15.6                                    | 360                                   | na                | ---        | ---        | 0.0241     | ---        | 0.0148     | ---        | ---        |
| Fluorene               | 12                                      | 536                                   | na                | ---        | ---        | 0.0166     | ---        | 0.012      | ---        | ---        |
| Phenanthrene           | 4.83                                    | 1090                                  | na                | 0.0967     | ---        | 0.292      | ---        | 0.145      | ---        | 0.066      |
| Anthracene             | 0.706                                   | 1280                                  | na                | ---        | ---        | 0.0473     | ---        | 0.0249     | ---        | ---        |
| Fluoranthene           | 6.46                                    | 353                                   | na                | 0.17       | ---        | 0.373      | ---        | 0.172      | ---        | 0.103      |
| Pyrene                 | 0.75                                    | 1850                                  | na                | 0.167      | ---        | 0.358      | ---        | 0.164      | ---        | 0.1        |
| Benz(a)anthracene      | 0.582                                   | 2.86                                  | na                | 0.0923     | ---        | 0.203      | ---        | 0.0861     | ---        | 0.0694     |
| Chrysene               | 0.15                                    | 82.3                                  | na                | 0.099      | ---        | 0.231      | ---        | 0.0906     | ---        | 0.0676     |
| Benzo(b)fluoranthene   | 0.413                                   | 11.8                                  | 0.032             | 0.166      | ---        | 0.282      | ---        | 0.116      | ---        | 0.0979     |
| Benzo(k)fluoranthene   | 0.234                                   | 13                                    | 0.049             | 0.0556     | ---        | 0.0805     | ---        | 0.0393     | ---        | 0.0409     |
| Benzo(a)pyrene         | 0.31                                    | 5                                     | 0.065             | 0.096      | ---        | 0.184      | ---        | 0.0797     | ---        | 0.0671     |
| Indeno(1,2,3-cd)pyrene | 0.0209                                  | 11.2                                  | 0.0018            | 0.0572     | ---        | 0.0975     | ---        | 0.0465     | ---        | 0.0453     |
| Dibenzo(a,h)anthracene | 0.00134                                 | 1.12                                  | na                | ---        | ---        | 0.0322     | ---        | ---        | ---        | ---        |
| Benzo(g,h,i)perylene   | 0.00634                                 | 3680                                  | 0.0084            | 0.0801     | ---        | 0.133      | ---        | 0.0639     | ---        | 0.0602     |
| <b>TOTAL PAH</b>       |                                         |                                       |                   | 1.098      | ---        | 2.366      | ---        | 1.067      | ---        | 0.717      |

**TABLE 3**  
**Metals Concentrations in Soil (mg/kg)**

| Sample Identity        | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP101      | TP104      | TP105      | TP106      | TP107      | TP 108     | TP 109     | TP 110     |
|------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl  |                                         | Human Health                          | Water<br>Resource | 0.00-0.50  | 0.80-1.00  | 0.00-0.50  | 0.00-0.50  | 0.00-0.40  | 0.00-0.30  | 0.40-0.60  | 0.00-0.50  |
| Sample Date            |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 01/06/2017 | 01/06/2017 | 01/06/2017 |
| Arsenic                | NVP                                     | 37                                    | na                | 7.51       | 1.02       | 11         | 9.87       | 13.3       | 10.9       | 2.43       | 13.4       |
| Cadmium                | NVP                                     | 26                                    | na                | 0.166      | 0.0221     | 0.266      | 0.235      | 0.325      | ---        | ---        | ---        |
| Chromium (as III)      | NVP                                     | 159,000                               | na                | 9.31       | 6.2        | 10.9       | 22.8       | 18.8       | 10.2       | 13.6       | 16.1       |
| Chromium (as VI)       | NVP                                     | 21                                    | na                | ---        | ---        | ---        | ---        | ---        | ---        | ---        | ---        |
| Copper                 | NVP                                     | 3,690                                 | na                | 32.9       | 4.15       | 28.5       | 34.2       | 45.3       | 34.9       | 9.13       | 47.7       |
| Lead                   | NVP                                     | 200                                   | na                | 61.7       | 4.27       | 49.8       | 56.5       | 83.5       | 85.4       | 4.63       | 96.3       |
| Mercury (as inorganic) | NVP                                     | 170                                   | na                | 0.353      | ---        | ---        | ---        | 0.227      | 0.288      | ---        | 0.272      |
| Nickel                 | NVP                                     | 130                                   | na                | 12.1       | 3.49       | 10.9       | 21.2       | 20.7       | 15         | 12.5       | 23.1       |
| Selenium               | NVP                                     | 350                                   | na                | ---        | ---        | ---        | ---        | ---        | ---        | ---        | ---        |
| Zinc                   | NVP                                     | 10,500                                | na                | 45.6       | 6.19       | 36.7       | 54.6       | 68.4       | 52.9       | 16.8       | 72.9       |

**TABLE 3**  
**Metals Concentrations in Soil (mg/kg)**

| Sample Identity        | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP112      | TP 113     | TP114      | TP116      | TP120      | WS 104     | WS 109     |
|------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl  |                                         | Human Health                          | Water<br>Resource | 0.00-0.40  | 0.70-0.90  | 0.00-0.40  | 0.60-0.85  | 0.00-0.40  | 0.60-      | 0.00-0.60  |
| Sample Date            |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 31/05/2017 | 01/06/2017 | 31/05/2017 | 31/05/2017 | 31/05/2017 | 01/06/2017 | 01/06/2017 |
| Arsenic                | NVP                                     | 37                                    | na                | 7.9        | 9.18       | 12.1       | 3.57       | 4.47       | 1.04       | 6.29       |
| Cadmium                | NVP                                     | 26                                    | na                | 0.0666     | 0.173      | 0.248      | 0.0412     | 0.13       | ---        | ---        |
| Chromium (as III)      | NVP                                     | 159,000                               | na                | 8.9        | 42.3       | 15.1       | 12.6       | 7.67       | 4.15       | 6.93       |
| Chromium (as VI)       | NVP                                     | 21                                    | na                | ---        | ---        | ---        | ---        | ---        | ---        | ---        |
| Copper                 | NVP                                     | 3,690                                 | na                | 32.7       | 23.2       | 29.6       | 5.22       | 13.7       | 4.15       | 22.8       |
| Lead                   | NVP                                     | 200                                   | na                | 62.9       | 11.4       | 45.3       | 4.69       | 22.9       | 3.98       | 52.8       |
| Mercury (as inorganic) | NVP                                     | 170                                   | na                | 0.168      | ---        | ---        | ---        | ---        | ---        | ---        |
| Nickel                 | NVP                                     | 130                                   | na                | 14.7       | 40.1       | 15.7       | 9.59       | 6.36       | 4.74       | 9.65       |
| Selenium               | NVP                                     | 350                                   | na                | ---        | ---        | ---        | ---        | ---        | ---        | ---        |
| Zinc                   | NVP                                     | 10,500                                | na                | 47.2       | 56         | 40.8       | 13.1       | 19.7       | 6.8        | 33.5       |

**TABLE 4**  
**Inorganics in Soil**

| Sample Identity                                 | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP101      | TP102      | TP104      | TP105      | TP106      | TP106      | TP120      |
|-------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                           |                                         | Human Health                          | Water<br>Resource | 0.00-0.50  | 1.20-1.40  | 0.80-1.00  | 0.00-0.50  | 0.00-0.50  | 1.90-2.10  | 0.00-0.40  |
| Sample Date                                     |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 30/05/2017 | 31/05/2017 |
| Water Soluble Sulphate as SO4 2:1 Extract (g/l) | na                                      | na                                    | na                | ---        |            |            |            | ---        |            |            |
| pH (units)                                      | na                                      | na                                    | na                | 7.23       | 6.42       | 6.96       | 6.91       | 7.3        | 8.2        | 6.58       |
| Cyanide, Total (mg/kg)                          | na                                      | na                                    | na                | ---        |            | ---        | ---        | ---        | ---        |            |

| Sample Identity                                 | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP107      | TP 108     | TP 108     | TP 109     | TP 110     | TP112      | WS 104     |
|-------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                           |                                         | Human Health                          | Water<br>Resource | 0.00-0.40  | 0.00-0.30  | 2.20-2.50  | 0.40-0.60  | 0.00-0.50  | 0.00-0.40  | 0.60-      |
| Sample Date                                     |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 30/05/2017 | 01/06/2017 | 01/06/2017 | 01/06/2017 | 01/06/2017 | 31/05/2017 | 01/06/2017 |
| Water Soluble Sulphate as SO4 2:1 Extract (g/l) | na                                      | na                                    | na                | 0.0182     |            |            |            |            |            |            |
| pH (units)                                      | na                                      | na                                    | na                | 7.25       | 6.24       | 8.6        | 8          | 6.51       | 6.71       | 7.06       |
| Cyanide, Total (mg/kg)                          | na                                      | na                                    | na                | ---        | ---        | ---        |            | ---        | ---        | ---        |

| Sample Identity                                 | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | TP112      | TP 113     | TP114      | TP 115     | TP116      | TP117      | WS106      |
|-------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                           |                                         | Human Health                          | Water<br>Resource | 2.00-2.20  | 0.70-0.90  | 0.00-0.40  | 1.50-1.70  | 0.60-0.85  | 1.00-1.30  | 3.00-3.45  |
| Sample Date                                     |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 31/05/2017 | 01/06/2017 | 31/05/2017 | 01/06/2017 | 31/05/2017 | 31/05/2017 | 02/06/2017 |
| Water Soluble Sulphate as SO4 2:1 Extract (g/l) | na                                      | na                                    | na                | ---        | 0.103      |            |            | ---        |            |            |
| pH (units)                                      | na                                      | na                                    | na                | 7.18       | 7.6        | 6.97       | 6.42       | 7.06       | 8.21       | 8.35       |
| Cyanide, Total (mg/kg)                          | na                                      | na                                    | na                | ---        |            | ---        | ---        |            |            |            |

**TABLE 4**
**Inorganics in Soil**

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | WS101      | WS101      | WS102      | WS103      | WS103      | WS109      | WS110      |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource | 1.20-1.65  | 3.00-3.45  | 1.20-1.65  | 2.00-2.45  | 4.00-4.45  | 2.00-2.45  | 3.00-3.45  |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                | ---        |            |            | 0.0295     | 0.0333     |            |            |
| pH (units)                                                  | na                                      | na                                    | na                | 7.08       | 8.29       | 7.83       | 8.32       | 8.37       | 8.24       | 8.33       |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |            |            |            |            |            |            |            |

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | WS104      | WS104      | WS105      | WS105      | WS106      | WS114      | WS115      |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource | 1.50-      | 4.00-4.45  | 3.00-3.45  | 5.00-5.45  | 1.20-1.65  | 5.00-5.45  | 2.00-2.45  |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                | ---        |            |            | 0.0303     | 0.0269     |            |            |
| pH (units)                                                  | na                                      | na                                    | na                | 7.28       | 8.42       | 8.57       | 8.59       | 8.43       |            |            |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |            |            |            |            |            |            |            |

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | WS107      | WS107      | WS108      | WS108      | WS 109     |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource | 3.00-3.45  | 5.00-5.45  | 2.00-2.45  | 4.00-4.45  | 0.00-0.60  |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 | 01/06/2017 |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                |            | 0.0286     | 0.024      |            |            |
| pH (units)                                                  | na                                      | na                                    | na                | 8.24       | 8.38       | 8.25       | 8.49       | 6.29       |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |            |            |            |            | ---        |

**TABLE 4**
**Inorganics in Soil**

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | WS110      | WS111      | WS111      | WS114      |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|------------|------------|------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource | 5.00-5.45  | 1.20-1.65  | 3.00-3.45  | 3.00-3.45  |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 02/06/2017 | 02/06/2017 | 02/06/2017 | 02/06/2017 |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                | 0.0255     |            |            | 0.0148     |
| pH (units)                                                  | na                                      | na                                    | na                | 8.79       | 6.92       | 8.7        | 8.27       |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |            |            |            |            |

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   | WS115      |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource | 4.00-4.45  |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  | 02/06/2017 |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                | 0.0159     |
| pH (units)                                                  | na                                      | na                                    | na                | 8.35       |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |            |

| Sample Identity                                             | Theoretical<br>Soil Saturation<br>Limit | GAC                                   |                   |
|-------------------------------------------------------------|-----------------------------------------|---------------------------------------|-------------------|
| Sample Depth<br>m bgl                                       |                                         | Human Health                          | Water<br>Resource |
| Sample Date                                                 |                                         | Combined<br>Inhalation /<br>Ingestion | Surface<br>Water  |
| Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l) | na                                      | na                                    | na                |
| pH (units)                                                  | na                                      | na                                    | na                |
| Cyanide, Total (mg/kg)                                      | na                                      | na                                    | na                |

**Table 5**
**Ground Gas Monitoring**

| Date                                           |                 | 21 June 2017      |         |         |         |         |         |         |
|------------------------------------------------|-----------------|-------------------|---------|---------|---------|---------|---------|---------|
| Monitoring Point                               |                 | WS101             | WS102   | WS104   | WS105   | WS108   | WS114   | WS115   |
| Weather                                        |                 | Bright, warm, dry |         |         |         |         |         |         |
| Atmospheric Conditions (Steady/Rising/Falling) |                 | Steady            |         |         |         |         |         |         |
| Atmospheric Pressure                           | (mb)            | 1013              | 1013    | 1013    | 1013    | 1013    | 1013    | 1013    |
| Gas Flow Rate                                  | Peak (l/hr)     | 0.1               | <0.1    | 0.1     | <0.1    | <0.1    | <0.1    | <0.1    |
|                                                | Steady (l/hr)   | <0.1              | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    |
| Methane (CH <sub>4</sub> )                     | Peak (% v/v)    | <0.1              | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    |
|                                                | Steady (% v/v)  | <0.1              | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    |
| Carbon Dioxide (CO <sub>2</sub> )              | Peak (% v/v)    | 2.4               | 0.1     | 1.7     | 3.1     | 2.3     | 1.3     | 1.9     |
|                                                | Steady (% v/v)  | 2.4               | 0.1     | 1.7     | 3.1     | 2.3     | 1.3     | 1.9     |
| Oxygen                                         | Minimum (% v/v) | 19.0              | 20.2    | 19.9    | 18.2    | 19.0    | 19.8    | 19.0    |
|                                                | Steady (% v/v)  | 19.1              | 20.2    | 19.9    | 18.2    | 19.0    | 20.0    | 19.0    |
| Hydrogen Sulphide                              | ppm             | <1                | <1      | <1      | <1      | <1      | <1      | <1      |
| Carbon Monoxide                                | ppm             | 1                 | 2       | <1      | <1      | <1      | <1      | <1      |
| Q <sub>hg</sub> CH <sub>4</sub>                | (l/hr)          | 0.0001            | <0.0001 | 0.0001  | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Q <sub>hg</sub> CO <sub>2</sub>                | (l/hr)          | 0.0024            | 0.0001  | 0.0017  | 0.0031  | 0.0023  | 0.0013  | 0.0019  |
| Depth to Water                                 | m bgl           | 1.330             | 0.800   | 1.470   | 1.520   | 2.260   | 1.380   | 1.63    |
| Depth to Base of well                          | m bgl           | 3.700             | 2.960   | 3.020   | 4.780   | 3.570   | 4.890   | 4.52    |
| Well Screening                                 | m bgl           | 1-4               | 1-3     | 1-4     | 1-5     | 0.5-3.5 | 1-5     | 1-5     |
| Screened Geology                               |                 | Natural           | Natural | Natural | Natural | Natural | Natural | Natural |

**Table 5**
**Ground Gas Monitoring**

| Date                                           |                 | 17 July 2017      |         |         |         |         |         |         |
|------------------------------------------------|-----------------|-------------------|---------|---------|---------|---------|---------|---------|
| Monitoring Point                               |                 | WS101             | WS102   | WS104   | WS105   | WS108   | WS114   | WS115   |
| Weather                                        |                 | Bright, warm, dry |         |         |         |         |         |         |
| Atmospheric Conditions (Steady/Rising/Falling) |                 | Steady            |         |         |         |         |         |         |
| Atmospheric Pressure                           | (mb)            | 1027              | 1027    | 1027    | 1027    | 1027    | 1027    | 1027    |
| Gas Flow Rate                                  | Peak (l/hr)     | <0.1              | -10.9   | 0.2     | <0.1    | -0.7    | <0.1    | <0.1    |
|                                                | Steady (l/hr)   | <0.1              | -8.2    | <0.1    | <0.1    | -0.6    | <0.1    | <0.1    |
| Methane (CH <sub>4</sub> )                     | Peak (% v/v)    | 0.1               | 0.1     | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    |
|                                                | Steady (% v/v)  | 0.1               | 0.1     | <0.1    | <0.1    | <0.1    | <0.1    | <0.1    |
| Carbon Dioxide (CO <sub>2</sub> )              | Peak (% v/v)    | 1.4               | 1.0     | 0.3     | 2.3     | 2.3     | 0.7     | 1.2     |
|                                                | Steady (% v/v)  | 1.4               | 1.0     | 0.3     | 2.3     | 2.3     | 0.7     | 1.2     |
| Oxygen                                         | Minimum (% v/v) | 19.1              | 18.7    | 19.6    | 18.9    | 17.9    | 19.3    | 19.3    |
|                                                | Steady (% v/v)  | 19.1              | 18.8    | 19.6    | 18.9    | 17.9    | 19.3    | 19.3    |
| Hydrogen Sulphide                              | ppm             | <1                | <1      | <1      | <1      | <1      | <1      | <1      |
| Carbon Monoxide                                | ppm             | <1                | 6       | 6       | 2       | 4       | <1      | 1       |
| Q <sub>hg</sub> CH <sub>4</sub>                | (l/hr)          | 0.0001            | -0.0109 | 0.0002  | <0.0001 | -0.0007 | <0.0001 | <0.0001 |
| Q <sub>hg</sub> CO <sub>2</sub>                | (l/hr)          | 0.0014            | -0.1090 | 0.0006  | 0.0023  | -0.0161 | 0.0007  | 0.0012  |
| Depth to Water                                 | m bgl           | 1.650             | 0.970   | 1.510   | 2.070   | 1.870   | 1.560   | 2.17    |
| Depth to Base of well                          | m bgl           | 3.710             | 2.920   | 2.940   | 4.770   | 3.550   | 4.820   | 4.47    |
| Well Screening                                 | m bgl           | 1-4               | 1-3     | 1-4     | 1-5     | 0.5-3.5 | 1-5     | 1-5     |
| Screened Geology                               |                 | Natural           | Natural | Natural | Natural | Natural | Natural | Natural |

**Notes:**

- Parameter not measured
- mb Millibar
- % v/v Percentage Volume by Volume
- l/hr Litres per hour
- ppm Parts Per Million
- Q<sub>hg</sub> Borehole Hazardous Gas Flow Rate
- m bgl Metres below ground level
- nr Not recorded

Summerhill Farm, Poverty Lane, Maghull

## **APPENDIX A**

### **Legislative Context and Regulatory Guidance**

Land contamination is generally dealt with by the following types of regulation:

- Acts of Parliament to investigate and remedy harm caused by land contamination;
- Conditions placed upon Planning Permissions for the redevelopment of land; and,
- Acts of Parliament and Regulations for the control of waste.

In England land contamination is identified and dealt with through Acts / Regulations including:

- The Contaminated Land (England) (Amended) Regulations (2012);
- Part IIA of the Environmental Protection Act (1990);
- The Environment Act 1995;
- The Town and Country Planning Act (1990);
- The Environmental Permitting (England and Wales) (Amended) Regulations (2011);
- The Water Resources Act (1991);
- The Water Act (2003); and
- The Environmental Damage (Prevention and Remediation) Regulations 2009.

### **Part IIA of the Environmental Protection Act 1990**

Part IIA of the Environmental Protection Act 1990 (which was inserted by Section 57 of the Environment Act 1995) created a regime for the identification and remediation of contaminated land. Section 78A (2) of the Environmental Protection Act 1990 defines contaminated land for the purposes of Part IIA as:

*'any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that;*

*(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or*

*(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused.'*<sup>1</sup>

Harm is defined under section 78A of the Environmental Protection Act as meaning 'harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property'. Types of harm are related to specific receptors in order to determine whether they can be regarded as "significant", as defined in the DEFRA (2012)<sup>2</sup> statutory guidance.

Part IIA sets the definition of contaminated land within the context of the 'suitable for use' approach. The 'suitable for use' approach underlies these objectives, and is based on the principles of risk assessment, including the concept of the 'pollutant linkage'.

In the event that there are unacceptable levels of risk posed by a site, a remediation notice can be served under the contaminated land regime introduced under Part IIA of the Environmental Protection Act 1990.

### **Regulation of Development on Land Affected by Contamination**

Management of risks from contamination in development of land is also regulated in the England under the Town and Country Planning Act 1990. Land contamination is a material planning consideration within this planning regime.

The Local Planning Authority may impose conditions on the development during planning that include preliminary risk assessment, site investigation, risk assessment and remediation. The Environment Agency may use its role as a statutory consultee to provide the Local Planning Authority with advice.

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<sup>1</sup> Definition amended by the Water Act 2003, and came into force on 6<sup>th</sup> April 2012

<sup>2</sup> Contaminated Land Statutory Guidance. DEFRA 2012, which came into force on 6<sup>th</sup> April 2012

Assessment of risk is again based on the pollutant linkage concept. The aim of risk management in the development should be to render the land suitable for the proposed use and, therefore, to prevent consideration of the site under Part IIA.

The National Planning Policy Framework (NPPF) (2012) provides high level guidance on the relationship between development and the management of risks from land contamination caused by historical use. The interpretation of the NPPF is left to local decision-makers, but with the expectation that good practice developed using the pre-existing Planning Policy Statements will be maintained. The Building Regulations 2000, made under the Building Act 1984, also require measures to be taken to protect new buildings and their occupants from the effects of contamination. Guidance on the requirements is provided in Approved Document C - Site preparation and resistance to contaminants and moisture, published by ODPM in 2004.

### **Voluntary Remediation Action**

Voluntary remediation action on contamination resulting from historical activities can often anticipate future remediation requirements, such as through the Planning regime, and is encouraged, especially where the site is not being assessed under Part IIA.

### **Environmental Damage**

The Environmental Damage (Prevention and Remediation) Regulations 2009 came into force on 1<sup>st</sup> March 2009 to implement EC Directive 2004/35 on environmental liability with regard to the prevention and remedying of environmental damage.

These Regulations do not apply retrospectively; environmental damage that took place before the Regulations came into force (1<sup>st</sup> March 2009), or damage that takes place (or is likely to take place) after that date but is caused by an incident, event or emission that occurred before that date are exempt from the requirements of the Regulations.

The Regulation is concerned with preventing environmental damage. It requires that all operators of activities that cause an imminent threat of environmental damage to take all reasonably practical steps to prevent the damage. Where damage has already been caused, the operator must take all reasonably practical steps to prevent further damage from occurring.

### **Non-Statutory Regulatory Technical Guidance Documents**

The non-statutory regulatory technical guidance for England on the assessment of land contamination, primarily released as part of the Contaminated Land Exposure Assessment (CLEA) methodology (DEFRA and EA) has recently been updated. The following documents currently present guiding principles in investigating and assessing potentially contaminated land, which are generally adopted in considering sites within any of the legal frameworks discussed above, or when considering voluntary remediation action:

- Investigation of potentially contaminated sites – Code of Practice (British Standard 10175: 2011).
- Contaminated Land Report CLR11 Model Procedures for the Management of Land Contamination. (DEFRA and EA, 2004).
- Human health toxicological assessment of contaminants in soil Environment Agency Science Report SC050021/SR2 (EA, 2009).
- Updated technical background to the CLEA model Environment Agency Science Report SC050021/SR3 (EA, 2009).
- Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values Environment Agency Science Report SC050021/SR7 (EA, 2008).
- An ecological risk assessment framework for contaminants in soil. Environment Agency Science Report SC070009/SR1 and related reports S2a-e.
- Groundwater Protection: Policy and Practice, Environment Agency GP3 Parts 1-4.

Summerhill Farm, Poverty Lane, Maghull

- Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (EA of England and Wales, 2006) developed in consultation with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Heritage and Environment Service.
- Assessing risks posed by hazardous ground gases to buildings Report C665 (CIRIA, 2007).
- BS 8485:2007 Code of practice for the characterization and remediation from ground gas in affected developments (British Standards Institution, 2007).
- Risk Based Corrective Action (RBCA) Methodology (ASTM designation E1739-95, E2081-00).
- DoE Industry Profiles.

Summerhill Farm, Poverty Lane, Maghull

## **APPENDIX B**

### **Study Limitations**

**IMPORTANT:** This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Arcadis UK Ltd (Arcadis), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with **Persimmon Homes / Countryside Properties** (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.
2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.
3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.
4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis have no obligation to advise the Client or any other party of such changes or their repercussions.
5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.
6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties.
7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.
8. This report refers, within the limitations stated, to the condition of the Site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.
9. The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.
10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the site have not been investigated.
11. If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.
12. Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issue

**APPENDIX C**  
**Borehole / Trial Pit Records**

|                                |                                             |                                     |                                                   |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 20.60          | Hole Diameter (mm): 83                            | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338625<br>Northing: 401761 | Well Diameter (mm): 50<br>Filter Material: Gravel | Logged by:<br>JA  |
| Project: 37158100              | Date: 01/06/2017                            | Method:                             |                                                   | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|----------------|
| TOPSOIL: Dark brown medium SAND.                                                                                                           |    |                  |                 |                |                     |              |              |                           |                 |                |
| Very loose light brown medium SAND. (Shirdley Hill Sand Formation)                                                                         |    | 0.40             | 20.20           | J              | 0.50                |              |              |                           |                 |                |
|                                                                                                                                            |                                                                                     |                  |                 | SPT            | 1.20-1.65           |              |              | N=1<br>(1,1/1,0,0<br>,0)  |                 |                |
| Firm light grey slightly sandy SILT/CLAY. Sand is fine to coarse. (Glacial Till)                                                           |    | 1.60             | 19.00           | D              | 1.70                |              |              |                           |                 |                |
|                                                                                                                                            |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=8<br>(1,1/2,2,2<br>,2)  |                 |                |
| Firm becoming stiff reddish brown slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of mixed lithologies. (Glacial Till) |  | 2.20             | 18.40           | D              | 2.50                |              |              |                           |                 |                |
|                                                                                                                                            |                                                                                     |                  |                 | SPT            | 3.00-3.45           |              |              | N=15<br>(2,3/3,3,4<br>,5) |                 |                |
| Lenses of sand apparent between 3.50m - 3.60m bgl.                                                                                         |  |                  |                 | SPT            | 4.00-4.45           |              |              | N=18<br>(4,4/3,5,5<br>,5) |                 |                |
|                                                                                                                                            |                                                                                     |                  |                 | SPT            | 5.00-5.45           |              |              | N=19<br>(3,3/4,5,5<br>,5) |                 |                |
| End of Borehole at 5.45 m                                                                                                                  |                                                                                     | 5.45             | 15.15           |                |                     |              |              |                           |                 |                |

|      |                      |     |                           |
|------|----------------------|-----|---------------------------|
| Key: |                      |     |                           |
| D    | Disturbed Sample     | PPT | Pocket Penetrometer Test  |
| B    | Bulk Sample          | PID | Photoionisation Detector  |
| U    | Undisturbed Sample   | SPT | Standard Penetration Test |
| J    | Jar Sample           |     | (Uncorrected)             |
| ▽    | Water Strike         |     |                           |
| ▼    | Standing Water Level |     |                           |

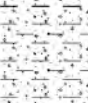
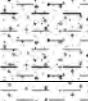
Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                                   |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 20.40          | Hole Diameter (mm): 83                            | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338763<br>Northing: 401709 | Well Diameter (mm): 50<br>Filter Material: Gravel | Logged by:<br>JA  |
| Project: 37158100              | Date: 01/06/2017                            | Method:                             |                                                   | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                                      | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value        | Well<br>Details | Water<br>Level |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|-----------------------|-----------------|----------------|
| TOPSOIL: Dark brown SAND.                                                                                                                                                        |   |                  |                 | J              | 0.20                |              |              |                       |                 |                |
| Light brown medium SAND. (Shirdley Hill Sand Formation)                                                                                                                          |   | 0.40             | 20.00           |                |                     |              |              |                       |                 |                |
| Soft to firm greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |   | 0.80             | 19.60           | D              | 1.00                |              |              | N=7<br>(1,1/1,2,2,2)  |                 | 1              |
| Firm becoming stiff brown slightly gravelly CLAY. Gravel is angular to rounded fine of mixed lithologies. (Glacial Till)                                                         |   | 1.90             | 18.50           | D              | 1.80                |              |              | N=8<br>(1,2/2,2,2,2)  |                 | 2              |
| Medium dense brown gravelly medium SAND. Gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)                                                  |   | 3.00             | 17.40           | SPT            | 3.00-3.45           |              |              | N=27<br>(3,5/6,7,7,7) |                 | 3              |
| Stiff brown slightly sandy slightly gravelly CLAY. Sand is medium to coarse, Gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)              |  | 3.90             | 16.50           | SPT            | 4.00-4.45           |              |              | N=18<br>(4,4/4,4,5,5) |                 | 4              |
| No recovery.                                                                                                                                                                     |                                                                                    | 4.00             | 16.40           | SPT            | 4.00-4.45           |              |              | N=18<br>(4,4/4,4,5,5) |                 | 4              |
|                                                                                                                                                                                  |                                                                                    |                  |                 | SPT            | 5.00-5.45           |              |              | N=7<br>(1,1/1,2,2,2)  |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                                                        |                                                                                    | 5.45             | 14.95           |                |                     |              |              |                       |                 |                |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| U | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J | Jar Sample           |     |                                         |
| ▽ | Water Strike         |     |                                         |
| ▽ | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                         |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 20.84          | Hole Diameter (mm): 83                  | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339008<br>Northing: 401715 | Well Diameter (mm):<br>Filter Material: | Logged by:<br>OC  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                         | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                   | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of flint.                                        |    |                  |                 |                |                     |              |              |                           |                 |                |
| Light brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of flint. (Shirdley Hill Sand Formation)                 |    | 0.40             | 20.44           | J              | 0.70-0.80           |              |              |                           |                 |                |
| Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse, gravel is subangular to subrounded fine to medium of flint. (Glacial Till)         |    | 1.00             | 19.84           | SPT            | 1.20-1.65           |              |              | N=11<br>(2,2/2,3,3<br>,3) |                 | 1              |
| Firm to stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse, gravel is subangular to subrounded fine to medium of flint. (Glacial Till) |    | 1.40             | 19.44           | D              | 1.70-1.90           |              |              |                           |                 |                |
|                                                                                                                                                               |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=12<br>(2,3/3,3,3<br>,3) |                 | 2              |
|                                                                                                                                                               |                                                                                     |                  |                 | D              | 2.50-2.70           |              |              |                           |                 |                |
| Firm to stiff orangish brown slightly gravelly CLAY. Gravel is rounded to subrounded medium to coarse of flint and chalk. (Glacial Till)                      |    | 3.00             | 17.84           | SPT            | 3.00-3.45           |              |              | N=13<br>(2,3/3,3,3<br>,4) |                 | 3              |
|                                                                                                                                                               |                                                                                     |                  |                 | D              | 3.40-3.60           |              |              |                           |                 |                |
| No recovery.                                                                                                                                                  |                                                                                     | 3.75             | 17.09           |                |                     |              |              |                           |                 |                |
| Stiff slightly silty slightly gravelly CLAY. Gravel is rounded to subrounded fine to coarse of flint and chalk. (Glacial Till)                                |   | 4.00             | 16.84           | SPT            | 4.00-4.45           |              |              | N=16<br>(4,4/4,4,4<br>,4) |                 | 4              |
|                                                                                                                                                               |                                                                                     |                  |                 | D              | 4.30-4.60           |              |              |                           |                 |                |
| Medium dense orange medium SAND. (Glacial Till)                                                                                                               |  | 4.95             | 15.89           | SPT            | 5.00-5.45           |              |              | N=20<br>(4,5/5,5,5<br>,5) |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                                     |                                                                                     | 5.45             | 15.39           |                |                     |              |              |                           |                 |                |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J                                                                                   | Jar Sample           |     |                                         |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                                   |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 22.50          | Hole Diameter (mm): 83                            | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338862<br>Northing: 401544 | Well Diameter (mm): 50<br>Filter Material: Gravel | Logged by:<br>JA  |
| Project: 37158100              | Date: 01/06/2017                            | Method:                             |                                                   | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                   | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|---------------------------------------------------------------------------------------|
| TOPSOIL: Dark brown fine to medium SAND.                                                                                                                      |   |                  |                 | J              | 0.20                |              |              |                           |                 |                                                                                       |
| Loose light yellowish brown medium SAND.<br>(Shirdley Hill Sand Formation)                                                                                    |   | 0.50             | 22.00           | J              | 0.60                |              |              |                           |                 |                                                                                       |
|                                                                                                                                                               |                                                                                    |                  |                 | SPT            | 1.20-1.65           |              |              | N=6<br>(1,1/1,1,2<br>,2)  |                 | 1                                                                                     |
|                                                                                                                                                               |                                                                                    |                  |                 | D              | 1.50                |              |              |                           |                 |                                                                                       |
|                                                                                                                                                               |                                                                                    | 1.80             | 20.70           |                |                     |              |              |                           |                 |                                                                                       |
| Soft to firm becoming stiff (at 3.0m) brown<br>slightly gravelly CLAY. Gravel is angular to<br>rounded fine to coarse of mixed lithologies.<br>(Glacial Till) |  |                  |                 | SPT            | 2.00-2.45           |              |              | N=5<br>(0,0/1,1,1<br>,2)  |                 | 2                                                                                     |
|                                                                                                                                                               |                                                                                    |                  |                 | D              | 2.20                |              |              |                           |                 |                                                                                       |
|                                                                                                                                                               |                                                                                    |                  |                 | SPT            | 3.00-3.45           |              |              | N=15<br>(2,3/3,3,4<br>,5) |                 | 3                                                                                     |
|                                                                                                                                                               |                                                                                    |                  |                 | D              | 3.50                |              |              |                           |                 |                                                                                       |
|                                                                                                                                                               |                                                                                    |                  |                 | SPT            | 4.00-4.45           |              |              | N=20<br>(4,5/5,5,5<br>,5) |                 | 4                                                                                     |
|                                                                                                                                                               |                                                                                    |                  |                 | D              | 4.50                |              |              |                           |                 |                                                                                       |
|                                                                                                                                                               |                                                                                    |                  |                 | SPT            | 5.00-5.45           |              |              | N=19<br>(2,2/4,5,5<br>,5) |                 | 5                                                                                     |
| End of Borehole at 5.45 m                                                                                                                                     |                                                                                    | 5.45             | 17.05           |                |                     |              |              |                           |                 |  |

Key:

|                                                                                     |                      |     |                           |
|-------------------------------------------------------------------------------------|----------------------|-----|---------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test  |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector  |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test |
| J                                                                                   | Jar Sample           |     | (Uncorrected)             |
|  | Water Strike         |     |                           |
|  | Standing Water Level |     |                           |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                                   |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 22.00          | Hole Diameter (mm): 83                            | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339210<br>Northing: 401924 | Well Diameter (mm): 50<br>Filter Material: Gravel | Logged by:<br>JA  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                                   | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                     | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly silty slightly<br>gravelly medium SAND. Gravel is subangular to<br>subrounded fine to medium of mixed lithologies. |    |                  |                 | J              | 0.30                |              |              |                           |                 |                |
| Stiff brown silty slightly sandy CLAY. Sand is<br>fine. (Glacial Till)                                                                          |   | 0.50             | 21.50           | D              | 0.50                |              |              |                           |                 |                |
|                                                                                                                                                 |                                                                                     |                  |                 | SPT            | 1.20-1.65           |              |              | N=15<br>(3,3/4,3,4<br>,4) |                 | 1              |
|                                                                                                                                                 |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=18<br>(2,4/4,5,4<br>,5) |                 | 2              |
|                                                                                                                                                 |                                                                                     |                  |                 | SPT            | 3.00-3.45           |              |              | N=17<br>(2,3/4,4,4<br>,5) |                 | 3              |
|                                                                                                                                                 |                                                                                     |                  |                 | SPT            | 4.00-4.45           |              |              | N=16<br>(2,3/4,4,4<br>,4) |                 | 4              |
| Stiff to very stiff brown silty very sandy CLAY.<br>Sand is fine. (Glacial Till)                                                                |  | 4.25             | 17.75           |                |                     |              |              |                           |                 |                |
| Brown slightly clayey silty fine SAND (compact).<br>(Glacial Till)                                                                              |  | 4.30             | 17.70           |                |                     |              |              |                           |                 |                |
|                                                                                                                                                 |                                                                                     | 4.40             | 17.60           |                |                     |              |              |                           |                 |                |
| Stiff to very stiff brown silty slightly sandy<br>CLAY. Sand is fine. (Glacial Till)                                                            |  | 4.60             | 17.40           |                |                     |              |              |                           |                 |                |
|                                                                                                                                                 |                                                                                     | 4.75             | 17.25           |                |                     |              |              |                           |                 |                |
| Brown slightly clayey silty fine SAND (compact).<br>(Glacial Till)                                                                              |  |                  |                 | SPT            | 5.00-5.45           |              |              | N=27<br>(2,4/5,6,8<br>,8) |                 | 5              |
| Very stiff brown silty very sandy CLAY. Sand is<br>fine. (Glacial Till)                                                                         |  |                  |                 |                |                     |              |              |                           |                 |                |
| End of Borehole at 5.45 m                                                                                                                       |                                                                                     | 5.45             | 16.55           |                |                     |              |              |                           |                 |                |

## Key:

|                                                                                     |                      |     |                                            |
|-------------------------------------------------------------------------------------|----------------------|-----|--------------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                   |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                   |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test<br>(Uncorrected) |
| J                                                                                   | Jar Sample           |     |                                            |
|  | Water Strike         |     |                                            |
|  | Standing Water Level |     |                                            |

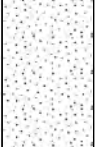
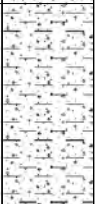
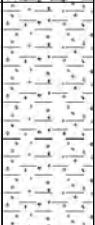
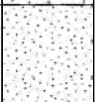
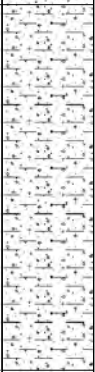
Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                         |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 21.42          | Hole Diameter (mm): 83                  | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339119<br>Northing: 401868 | Well Diameter (mm):<br>Filter Material: | Logged by:<br>JA  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                         | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                                       | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly silty slightly<br>gravelly medium SAND. Gravel is subangular to<br>subrounded fine to medium of mixed lithologies.                                   |    | 0.30             | 21.12           | J              | 0.40                |              |              |                           |                 |                |
| Yellowish brown fine to medium SAND (loose).<br>(Shirdley Hill Sand Formation)                                                                                                    |    | 0.90             | 20.52           |                |                     |              |              |                           |                 |                |
| Soft to firm brown mottled yellow sandy slightly<br>gravelly CLAY. Sand is fine to medium, gravel is<br>angular to rounded fine to coarse of mixed<br>lithologies. (Glacial Till) |    | 1.70             | 19.72           | SPT            | 1.20-1.65           |              |              | N=6<br>(1,1/1,1,2<br>,2)  |                 | 1              |
| Firm brown slightly gravelly CLAY. Gravel is<br>angular to rounded fine to coarse of mixed<br>lithologies. (Glacial Till)                                                         |   | 2.60             | 18.82           | SPT            | 2.00-2.45           |              |              | N=13<br>(1,2/3,3,3<br>,4) |                 | 2              |
| Brown medium SAND (compact). (Glacial Till)                                                                                                                                       |  | 3.00             | 18.42           | SPT            | 3.00-3.45           |              |              | N=13<br>(2,2/3,4,3<br>,3) |                 | 3              |
| Firm to stiff brown very sandy slightly gravelly<br>CLAY. Gravel is angular to rounded fine to coarse<br>of mixed lithologies. (Glacial Till)                                     |  | 4.00             |                 | SPT            | 4.00-4.45           |              |              | N=11<br>(2,2/2,3,3<br>,3) |                 | 4              |
| End of Borehole at 4.45 m                                                                                                                                                         |                                                                                     | 4.45             | 16.97           |                |                     |              |              |                           |                 |                |
|                                                                                                                                                                                   |                                                                                     |                  |                 |                |                     |              |              |                           |                 | 5              |

Key:

|   |                      |     |                           |
|---|----------------------|-----|---------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test  |
| B | Bulk Sample          | PID | Photoionisation Detector  |
| U | Undisturbed Sample   | SPT | Standard Penetration Test |
| J | Jar Sample           |     | (Uncorrected)             |
| ▽ | Water Strike         |     |                           |
| ▼ | Standing Water Level |     |                           |

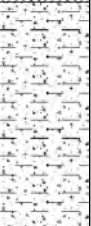
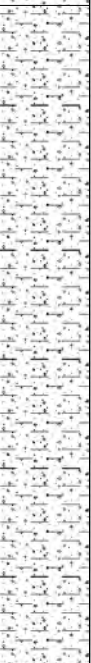
Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                         |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 21.51          | Hole Diameter (mm): 83                  | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339092<br>Northing: 401711 | Well Diameter (mm):<br>Filter Material: | Logged by:<br>OC  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                         | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                 | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value            | Well<br>Details | Water<br>Level |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|---------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly gravelly medium SAND. Gravel is subangular to subrounded fine to medium of flint.                                              |    |                  |                 | J              | 0.20-0.30           |              |              |                           |                 |                |
| Firm brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of flint and chalk. (Glacial Till)      |    | 0.60             | 20.91           | SPT            | 1.20-1.65           |              |              | N=8<br>(2,2/2,2,2<br>,2)  |                 | 1              |
| Stiff brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)                                  |   | 1.50             | 20.01           | D              | 1.40-1.60           |              |              |                           |                 |                |
|                                                                                                                                                             |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=14<br>(3,3/3,3,4<br>,4) |                 | 2              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 2.50-2.70           |              |              |                           |                 |                |
| Firm to stiff slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till) |  | 2.80             | 18.71           | SPT            | 3.00-3.45           |              |              | N=12<br>(3,3/3,3,3<br>,3) |                 | 3              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 3.60-3.80           |              |              |                           |                 |                |
|                                                                                                                                                             |                                                                                     |                  |                 | SPT            | 4.00-4.45           |              |              | N=20<br>(3,4/5,5,5<br>,5) |                 | 4              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 4.40-4.60           |              |              |                           |                 |                |
|                                                                                                                                                             |                                                                                     |                  |                 | SPT            | 5.00-5.45           |              |              | N=20<br>(3,5/5,5,5<br>,5) |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                                   |                                                                                     | 5.45             | 16.06           |                |                     |              |              |                           |                 |                |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J                                                                                   | Jar Sample           |     |                                         |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

Site:  
Poverty Lane, Maghull

Location:  
Poverty Lane, Maghull, L31 3DS

Ground Level (mAOD): 21.50

Hole Diameter (mm): 83

Scale  
1:30

Client:  
Persimmon Homes Ltd

Easting: 339028

Well Diameter (mm): 50

Logged by:  
OC

Northing: 401559

Filter Material: Gravel

Project: 37158100

Date: 02/06/2017

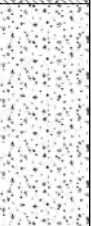
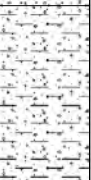
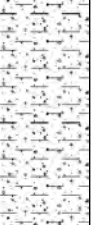
Method:

Checked by:  
JA

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                         | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value        | Well<br>Details | Water<br>Level |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|-----------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine of flint.                                        |    |                  |                 | J              | 0.20-0.30           |              |              |                       |                 |                |
| Brown slightly gravelly fine to medium SAND (loose). Gravel is subangular to subrounded fine of flint. (Shirdley Hill Sand Formation)               |    | 0.50             | 21.00           |                |                     |              |              |                       |                 |                |
|                                                                                                                                                     |                                                                                     |                  |                 | SPT            | 1.20-1.65           |              |              | N=4<br>(1,1/1,1,1,1)  |                 | 1              |
| Firm slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till)  |    | 1.40             | 20.10           | D              | 1.50-1.70           |              |              |                       |                 |                |
|                                                                                                                                                     |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=10<br>(2,2/2,2,3,3) |                 | 2              |
| No recovery.                                                                                                                                        |                                                                                     | 2.10             | 19.40           |                |                     |              |              |                       |                 |                |
|                                                                                                                                                     |                                                                                     |                  |                 | SPT            | 3.00-3.45           |              |              | N=16<br>(4,4/4,4,4,4) |                 | 3              |
| Stiff slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till) |  | 3.00             | 18.50           | D              | 3.40-3.80           |              |              |                       |                 |                |
|                                                                                                                                                     |                                                                                     |                  |                 | SPT            | 4.00-4.45           |              |              | N=19<br>(4,4/4,5,5,5) |                 | 4              |
| Stiff slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till)                |  | 4.20             | 17.30           |                |                     |              |              |                       |                 |                |
|                                                                                                                                                     |                                                                                     | 4.30             | 17.20           | D              | 4.50-4.70           |              |              |                       |                 |                |
| Stiff slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till) |  |                  |                 | SPT            | 5.00-5.45           |              |              | N=20<br>(5,5/5,5,5,5) |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                           |                                                                                     | 5.45             | 16.05           |                |                     |              |              |                       |                 |                |

## Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J                                                                                   | Jar Sample           |     |                                         |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                         |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 22.88          | Hole Diameter (mm): 83                  | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338947<br>Northing: 401424 | Well Diameter (mm):<br>Filter Material: | Logged by:<br>LT  |
| Project: 37158100              | Date: 01/06/2017                            | Method:                             |                                         | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                          | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value           | Well<br>Details | Water<br>Level |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|--------------------------|-----------------|----------------|
| TOPSOIL: Dark brown fine to medium SAND.                                                                                                                             |   |                  |                 | J              | 0.00-0.60           |              |              |                          |                 |                |
| Very loose to loose light yellowish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                        |   | 0.60             | 22.28           |                |                     |              |              |                          |                 |                |
|                                                                                                                                                                      |                                                                                    |                  |                 | SPT            | 1.20-1.65           |              |              | N=8<br>(1,1/1,1,3<br>,3) |                 | 1              |
|                                                                                                                                                                      |                                                                                    |                  |                 | D              | 1.65                |              |              |                          |                 |                |
|                                                                                                                                                                      |                                                                                    |                  |                 | SPT            | 2.00-2.45           |              |              | N=2<br>(0,0/0,0,1<br>,1) |                 | 2              |
| Firm to stiff dark brown slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 2.20             | 20.68           |                |                     |              |              |                          |                 |                |
|                                                                                                                                                                      |                                                                                    |                  |                 | D              | 2.45                |              |              |                          |                 |                |
|                                                                                                                                                                      |                                                                                    |                  |                 | SPT            | 3.00-3.45           |              |              | N=8<br>(2,2/2,2,2<br>,2) |                 | 3              |
| End of Borehole at 3.75 m                                                                                                                                            |                                                                                    | 3.75             | 19.13           |                |                     |              |              |                          |                 | 4              |
|                                                                                                                                                                      |                                                                                    |                  |                 |                |                     |              |              |                          |                 | 5              |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| U | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J | Jar Sample           |     |                                         |
| ▽ | Water Strike         |     |                                         |
| ▼ | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                         |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 22.75          | Hole Diameter (mm): 83                  | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339272<br>Northing: 401766 | Well Diameter (mm):<br>Filter Material: | Logged by:<br>OC  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                         | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                 | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value        | Well<br>Details | Water<br>Level |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|-----------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly gravelly medium SAND. Gravel is subangular to subrounded fine to medium of flint.                                              |    |                  |                 | J              | 0.20-0.30           |              |              |                       |                 |                |
| Light brown slightly gravelly medium SAND. Gravel is subangular to subrounded fine to medium of flint. (Shirdley Hill Sand Formation)                       |    | 0.40             | 22.35           |                |                     |              |              |                       |                 |                |
| Firm locally stiff brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded of flint and chalk. (Glacial Till)       |    | 1.00             | 21.75           | SPT            | 1.20-1.65           |              |              | N=8<br>(1,2/2,2,2,2)  |                 | 1              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 1.40-1.60           |              |              |                       |                 |                |
|                                                                                                                                                             |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=8<br>(2,2/2,2,2,2)  |                 | 2              |
| No recovery.                                                                                                                                                |                                                                                     | 2.30             | 20.45           |                |                     |              |              |                       |                 |                |
| Stiff brown slightly gravelly CLAY. Gravel is subangular to subrounded of flint and chalk. (Glacial Till)                                                   |  | 2.60             | 20.15           | D              | 2.60-2.80           |              |              |                       |                 |                |
| Firm to stiff slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till) |  | 3.00             | 19.75           | SPT            | 3.00-3.45           |              |              | N=12<br>(3,3/3,3,3,3) |                 | 3              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 3.30-3.50           |              |              |                       |                 |                |
| Sample liner saturated from 3.60m bgl onwards. Assumed water strike.                                                                                        |                                                                                     |                  |                 | SPT            | 4.00-4.45           |              |              | N=16<br>(3,3/3,4,4,5) |                 | 4              |
|                                                                                                                                                             |                                                                                     |                  |                 | D              | 4.60-4.80           |              |              |                       |                 |                |
|                                                                                                                                                             |                                                                                     |                  |                 | SPT            | 5.00-5.45           |              |              | N=19<br>(4,4/4,5,5,5) |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                                   |                                                                                     | 5.45             | 17.30           |                |                     |              |              |                       |                 |                |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| U | Undisturbed Sample   | SPT | Standard Penetration Test (Uncorrected) |
| J | Jar Sample           |     |                                         |
| ▽ | Water Strike         |     |                                         |
| ▼ | Standing Water Level |     |                                         |

Remarks: HP = Hand PitPD = Percussive Drill

|               |                         |              |
|---------------|-------------------------|--------------|
| STRATA RECORD | IN SITU TESTS / SAMPLES | Sheet 1 of 1 |
|---------------|-------------------------|--------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|---------------------------------------------|
| <b>Key:</b><br>D Disturbed Sample      PPT Pocket Penetrometer Test<br>B Bulk Sample          PID Photoionisation Detector<br>U Undisturbed Sample    SPT Standard Penetration Test<br>J Jar Sample<br> Water Strike<br> Standing Water Level |  |  |  | Remarks: HP = Hand PitPD = Percussive Drill |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|---------------------------------------------|



# ARCADIS

Design & Consultancy  
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2 Craven Court, Newmarket, Suffolk CB8 7FA  
Tel: +44(0)1638 674767  
Fax: +44(0)1638 668191

Borehole  
Number  
**WS114**

Site:  
Poverty Lane, Maghull

Location:  
Poverty Lane, Maghull, L31 3DS

Ground Level (mAOD): 21.05

Hole Diameter (mm): 83

Scale  
1:30

Client:  
Persimmon Homes Ltd

Easting: 338921

Well Diameter (mm): 50

Logged by:  
OC

Northing: 401605

Filter Material: Gravel

Project: 37158100

Date: 02/06/2017

Method:

Checked by:  
JA

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                 | Legend | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value                     | Well<br>Details | Water<br>Level |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------|-----------------|----------------|---------------------|--------------|--------------|------------------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly gravelly medium SAND. Gravel is subangular to subrounded fine of flint.                                                        |        |                  |                 |                |                     |              |              |                                    |                 |                |
| Light brown slightly gravelly medium SAND (loose). Gravel is subangular to subrounded fine of flint. (Shirdley Hill Sand Formation)                         |        | 0.40             | 20.65           |                |                     |              |              |                                    |                 |                |
| Soft brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint. (Glacial Till)                          |        | 1.10             | 19.95           |                |                     |              |              |                                    |                 |                |
| Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till)        |        | 1.30             | 19.75           |                |                     |              |              | 4 /225mm<br>(1,1/1 for<br>75mm2,1) |                 |                |
| Lenses of sand apparent between 1.60m - 1.80m bgl. 20% recovery of the sample liner.                                                                        |        |                  |                 |                |                     |              |              |                                    |                 |                |
| Stiff brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till)               |        | 2.20             | 18.85           |                |                     |              |              | N=13<br>(1,1/2,3,4<br>,4)          |                 |                |
| Stiff to very stiff brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till) |        | 2.65             | 18.40           |                |                     |              |              |                                    |                 |                |
| Stiff brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till)               |        | 3.70             | 17.35           |                |                     |              |              |                                    |                 |                |
| No recovery.                                                                                                                                                |        | 4.00             | 17.05           |                |                     |              |              | N=21<br>(1,3/3,6,6<br>,6)          |                 |                |
| Stiff orangish brown slightly sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till)      |        | 4.30             | 16.75           |                |                     |              |              |                                    |                 |                |
| Stiff brown sandy slightly gravelly CLAY. Sand is medium, gravel is subangular to subrounded fine of flint and chalk. (Glacial Till)                        |        | 4.70             | 16.35           |                |                     |              |              |                                    |                 |                |
| Orange medium sand lenses visible between 4.70m - 5.00m bgl.                                                                                                |        |                  |                 |                |                     |              |              | N=15<br>(1,3/4,3,4<br>,4)          |                 |                |
| End of Borehole at 5.45 m                                                                                                                                   |        | 5.45             | 15.60           |                |                     |              |              |                                    |                 |                |

### Key:

D Disturbed Sample PPT Pocket Penetrometer Test  
B Bulk Sample PID Photoionisation Detector  
U Undisturbed Sample SPT Standard Penetration Test  
J Jar Sample (Uncorrected)  
▽ Water Strike  
▼ Standing Water Level

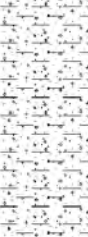
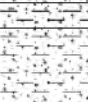
Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                     |                                                   |                   |
|--------------------------------|---------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD): 20.41          | Hole Diameter (mm): 83                            | Scale<br>1:30     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338856<br>Northing: 401762 | Well Diameter (mm): 50<br>Filter Material: Gravel | Logged by:<br>JA  |
| Project: 37158100              | Date: 02/06/2017                            | Method:                             |                                                   | Checked by:<br>JA |

## STRATA RECORD

## IN SITU TESTS / SAMPLES

Sheet 1 of 1

| Description                                                                                                                                                                                | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD) | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | SPT N<br>Value             | Well<br>Details | Water<br>Level |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-----------------|----------------|---------------------|--------------|--------------|----------------------------|-----------------|----------------|
| TOPSOIL: Dark brown slightly silty slightly<br>gravelly medium SAND. Gravel is subangular to<br>subrounded fine to medium of mixed lithologies.                                            |    |                  |                 |                |                     |              |              |                            |                 |                |
| Brown medium SAND. (Shirdley Hill Sand Formation)                                                                                                                                          |    | 0.40             | 20.01           |                |                     |              |              |                            |                 |                |
| Stiff brown slightly sandy slightly gravelly<br>CLAY. Sand is medium to coarse, Gravel is<br>subangular to subrounded fine to medium of mixed<br>lithologies. (Glacial Till)               |   | 0.90             | 19.51           | SPT            | 1.20-1.65           |              |              | N=20<br>(2,3/4,5,5<br>,6)  |                 | 1              |
|                                                                                                                                                                                            |                                                                                     |                  |                 | D              | 1.40                |              |              |                            |                 |                |
|                                                                                                                                                                                            |                                                                                     |                  |                 | SPT            | 2.00-2.45           |              |              | N=17<br>(2,4/4,3,5<br>,5)  |                 | 2              |
| Firm to stiff brown slightly sandy slightly<br>gravelly CLAY. Sand is medium to coarse, Gravel<br>is subangular to subrounded fine to medium of<br>mixed lithologies. (Glacial Till)       |  | 2.50             | 17.91           | SPT            | 3.00-3.45           |              |              | N=16<br>(2,4/4,4,4<br>,4)  |                 | 3              |
| Stiff to very stiff brown very sandy slightly<br>gravelly CLAY. Sand is medium to coarse, Gravel<br>is subangular to subrounded fine to medium of<br>mixed lithologies. (Glacial Till)     |  | 3.50             | 16.91           |                |                     |              |              |                            |                 |                |
|                                                                                                                                                                                            |                                                                                     | 3.60             | 16.81           | SPT            | 4.00-4.45           |              |              | N=18<br>(2,3/4,4,5<br>,5)  |                 | 4              |
| Stiff to very stiff brown slightly sandy slightly<br>gravelly CLAY. Sand is medium to coarse, Gravel<br>is subangular to subrounded fine to medium of<br>mixed lithologies. (Glacial Till) |  |                  |                 | SPT            | 5.00-5.45           |              |              | N=31<br>(2,5/6,7,7<br>,11) |                 | 5              |
| End of Borehole at 5.45 m                                                                                                                                                                  |                                                                                     | 5.45             | 14.96           |                |                     |              |              |                            |                 |                |

|                                                                                     |                      |     |                           |
|-------------------------------------------------------------------------------------|----------------------|-----|---------------------------|
| Key:                                                                                |                      |     |                           |
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test  |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector  |
| U                                                                                   | Undisturbed Sample   | SPT | Standard Penetration Test |
| J                                                                                   | Jar Sample           |     | (Uncorrected)             |
|  | Water Strike         |     |                           |
|  | Standing Water Level |     |                           |

Remarks: HP = Hand PitPD = Percussive Drill

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>19.90                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338613<br>Northing: 401858                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                 |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                   | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly clayey slightly gravelly fine to medium SAND with frequent rootlets, gravel is subangular fine to medium rare mixed lithologies. |   | 0.60             | 19.30                   | J<br>D         | 0.00-0.50              |              |              |              |
| Light orangish brown fine to medium SAND.<br>(Shirdley Hill Sand Formation)                                                                                   |   | 1.60             | 18.30                   | D<br>J         | 1.20-1.60<br>1.40-1.60 |              |              | ▽            |
| Firm to stiff brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine of mixed lithologies. (Glacial Till)               |  | 2.50             | 17.40                   | D              | 2.20-2.50              |              | 46           |              |
| End of Trial Pit at 2.50 m                                                                                                                                    |                                                                                    |                  |                         |                |                        |              |              |              |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ■ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.6m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>22.00                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338533<br>Northing: 401731                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

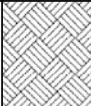
| STRATA RECORD                                                                                                                                                   |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                     | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND with frequent rootlets. Gravel is rare subangular medium mixed lithologies.                           |    |                  |                         | D              | 0.00-0.50           |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                         |    | 0.70             | 21.30                   | B              | 0.70-1.20           |              |              | 1            |
|                                                                                                                                                                 |                                                                                     |                  |                         | D              | 1.00-1.40           |              |              |              |
|                                                                                                                                                                 |                                                                                     |                  |                         | J              | 1.20-1.40           |              |              |              |
| Light orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                        |   | 1.40             | 20.60                   |                |                     |              |              | 2            |
|                                                                                                                                                                 |                                                                                     |                  |                         | J              | 2.70-2.90           |              |              |              |
| Firm to stiff light brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine to medium of mixed lithologies. (Glacial Till) |  | 2.90             | 19.10                   | D              | 2.90-3.00           |              | 22           | 3            |
| End of Trial Pit at 3.00 m                                                                                                                                      |                                                                                     | 3.00             | 19.00                   |                |                     |              |              | 4            |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit generally stable with collapse of lower horizons containing sand.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>19.80                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338731<br>Northing: 401782                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                             |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                               | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly clayey slightly gravelly fine to medium SAND with frequent rootlets. Gravel is subangular fine to medium rare mixed lithologies.                                             |   | 0.35             | 19.45                   |                |                        |              |              |              |
| Light orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                                                  |   |                  |                         | D<br>B<br>J    | 0.50-1.00<br>0.70-1.00 |              |              |              |
| Firm to stiff brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine of mixed lithologies. Occasional pockets of blueish grey medium to coarse sand. (Glacial Till) |  | 1.00             | 18.80                   |                |                        |              |              | ▽ 1          |
|                                                                                                                                                                                                           |                                                                                    |                  |                         | J<br>D         | 2.10-2.30              |              | 90           | 2            |
| End of Trial Pit at 2.30 m                                                                                                                                                                                |                                                                                    | 2.30             | 17.50                   |                |                        |              |              | 3            |
|                                                                                                                                                                                                           |                                                                                    |                  |                         |                |                        |              |              | 4            |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ■ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.0m bgl.  
Remarks: Trial pit stable.Land drain ecoutered in excavation.

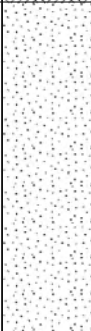
|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>22.10                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338655<br>Northing: 401655                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                  | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown fine to medium SAND with frequent rootlets.                                                                                              |    |                  |                         | D              | 0.00-0.50           |              |              |              |
| Orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                           |   | 0.80             | 21.30                   | J              | 0.80-1.00           |              |              | 1            |
|                                                                                                                                                              |                                                                                     |                  |                         | D              | 1.00-1.40           |              |              |              |
| Very stiff light brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine to medium of mixed lithologies. (Glacial Till) |  | 2.00             | 20.10                   |                |                     |              |              | 2            |
|                                                                                                                                                              |                                                                                     |                  |                         | J              | 2.90-3.00           |              | 15           | 3            |
| End of Trial Pit at 3.00 m                                                                                                                                   |                                                                                     | 3.00             | 19.10                   |                |                     |              |              | 4            |

Key:  
D Disturbed Sample      PPT Pocket Penetrometer Test  
B Bulk Sample            PID Photoionisation Detector  
J Jar Sample                SPT Standard Penetration Test  
 Water Strike                (Uncorrected)  
 Standing Water Level

Groundwater: Groundwater encountered at 1.7m bgl.  
Remarks: Trial pit unstable due to shallow sands collapsing.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.60                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338784<br>Northing: 401638                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                  | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown fine to medium SAND with frequent rootlets.                                                                                              |   | 0.50             | 21.10                   | J              | 0.00-0.50              |              |              |              |
| Orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                           |   | 1.60             | 20.00                   | B<br>J<br>D    | 1.10-1.60<br>1.40-1.60 |              |              | ▽            |
| Very stiff light brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine to medium of mixed lithologies. (Glacial Till) |  | 2.30             | 19.30                   | D              | 2.20-2.30              |              | 22           |              |
| End of Trial Pit at 2.30 m                                                                                                                                   |                                                                                    |                  |                         |                |                        |              |              |              |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ▼ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.4m bgl.  
Remarks: Trial pit unstable due to shallow sands collapsing. Shallow ground water increased the instability of the trial pit.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>19.85                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338870<br>Northing: 401820                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                             |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                               | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly clayey fine to medium SAND with frequent rootlets.                                                                                                                           |   |                  |                         | J              | 0.00-0.50           |              |              |              |
| Firm to stiff brownish grey slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular fine of mixed lithologies. Occasional pockets of blueish grey medium to coarse sand. (Glacial Till) |  | 0.60             | 19.25                   | D              | 0.60-1.00           |              |              | 1            |
|                                                                                                                                                                                                           |                                                                                    |                  |                         | D              | 1.70-2.10           |              |              |              |
|                                                                                                                                                                                                           |                                                                                    |                  |                         | J              | 1.90-2.10           |              | 103          | 2            |
| End of Trial Pit at 2.10 m                                                                                                                                                                                |                                                                                    | 2.10             | 17.75                   |                |                     |              |              |              |
|                                                                                                                                                                                                           |                                                                                    |                  |                         |                |                     |              |              | 3            |
|                                                                                                                                                                                                           |                                                                                    |                  |                         |                |                     |              |              | 4            |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>20.62                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338897<br>Northing: 401682                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 30/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                                                |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                                                  | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Light brown clayey fine to medium SAND.                                                                                                                                                                             |   |                  |                         | J              | 0.00-0.40           |              |              |              |
| Light orangish brown fine to medium SAND.<br>(Shirdley Hill Sand Formation)                                                                                                                                                  |   | 0.40             | 20.22                   | D              | 0.50-0.90           |              |              |              |
|                                                                                                                                                                                                                              |                                                                                    |                  |                         | J              | 0.70-0.90           |              |              |              |
| Firm becoming very stiff brownish grey slightly<br>sandy slightly gravelly CLAY. Sand is fine, gravel<br>is subangular to subrounded fine of mixed<br>lithologies. Rare cobble of sandstone and<br>limestone. (Glacial Till) |  | 0.90             | 19.72                   |                |                     |              |              | 1            |
|                                                                                                                                                                                                                              |                                                                                    |                  |                         | D              | 2.20-2.50           |              | 107          | 2            |
| End of Trial Pit at 2.50 m                                                                                                                                                                                                   |                                                                                    | 2.50             | 18.12                   |                |                     |              |              | 3            |
|                                                                                                                                                                                                                              |                                                                                    |                  |                         |                |                     |              |              | 4            |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.00                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339032<br>Northing: 401888                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 01/06/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                         |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                           | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine of mixed lithologies. Frequent rootlets present.                                                   |    | 0.30             | 20.70                   | J              | 0.00-0.30           |              |              |              |
| Light orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                                              |    | 0.50             | 20.50                   | D              | 0.30-0.50           |              |              |              |
| Firm to stiff brown slightly sandy slightly gravelly slightly cobbly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse, cobble is subrounded of mixed lithologies. (Glacial Till) |   | 2.20             | 18.80                   | B              | 1.50-1.80           |              | 118          |              |
| Soft brown slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till)                                                |  | 2.80             | 18.20                   |                | 2.20-2.80           |              |              | ▽            |
| Firm to stiff brown slightly sandy slightly gravelly slightly cobbly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse, cobble is subrounded of mixed lithologies. (Glacial Till) |  | 3.00             | 18.00                   |                |                     |              | 223          |              |
| End of Trial Pit at 3.00 m                                                                                                                                                                            |                                                                                     |                  |                         |                |                     |              |              |              |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ■ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 2.2m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>20.70                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339038<br>Northing: 401771                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 01/06/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                         |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                           | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly clayey slightly gravelly fine to medium SAND with frequent rootlets. Gravel is subangular to subrounded fine to medium rare mixed lithologies.                           |   | 0.40             | 20.30                   | J              | 0.40-0.60              |              |              |              |
| Light orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                                              |   |                  |                         |                |                        |              |              |              |
| Firm brown sandy slightly gravelly slightly cobbly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse, cobble is subrounded of mixed lithologies. (Glacial Till)                   |   | 1.00             | 19.70                   | J<br>B         | 1.00-1.20<br>1.00-1.50 |              | 75           | 1            |
|                                                                                                                                                                                                       |                                                                                    |                  |                         | D              | 1.50-1.80              |              | 102          | ▽            |
| Firm to stiff brown slightly sandy slightly gravelly slightly cobbly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse, cobble is subrounded of mixed lithologies. (Glacial Till) |  | 1.80             | 18.90                   |                |                        |              |              | 2            |
|                                                                                                                                                                                                       |                                                                                    |                  |                         | D              | 3.10-3.40              |              | 185          | 3            |
| End of Trial Pit at 3.40 m                                                                                                                                                                            |                                                                                    | 3.40             | 17.30                   |                |                        |              |              | 4            |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ■ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.7m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>20.80                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339001<br>Northing: 401637                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 01/06/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

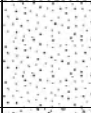
| STRATA RECORD                                                                                                                                                                                                     |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                                       | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND.                                                                                                                                                                   |    |                  |                         | J              | 0.00-0.50              |              |              |              |
| Firm to stiff brown slightly sandy slightly<br>gravelly slightly cobbly CLAY. Sand is fine,<br>gravel is subangular to subrounded fine to coarse,<br>cobble is subrounded of mixed lithologies.<br>(Glacial Till) |   | 0.50             | 20.30                   | D              | 0.50-0.70              |              | 167          |              |
|                                                                                                                                                                                                                   |                                                                                     |                  |                         | D              | 1.40-1.70              |              | 211          |              |
| Soft brown slightly sandy slightly gravelly<br>slightly cobbly CLAY. Sand is fine, gravel is<br>subangular to subrounded fine to coarse, cobble is<br>subrounded of mixed lithologies. (Glacial Till)             |  | 2.00             | 18.80                   | B<br>J         | 2.70-3.00<br>2.80-3.00 |              | 77           |              |
| End of Trial Pit at 3.00 m                                                                                                                                                                                        |                                                                                     | 3.00             | 17.80                   |                |                        |              |              |              |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 2.1m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.83                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338966<br>Northing: 401514                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

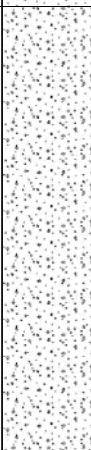
| STRATA RECORD                                                                                                                                                             |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                        |              |              | Sheet 1 of 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                               | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)    | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND with frequent rootlets.                                                                                                    |   | 0.30             | 21.53                   | D              | 0.00-0.30              |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                   |   | 0.65             | 21.18                   | J              | 0.40-0.60              |              |              |              |
| Soft brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)          |   | 1.80             | 20.03                   | D<br>J         | 0.80-1.10<br>0.90-1.10 |              | 36           | 1<br>▽       |
| Firm orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 2.40             | 19.43                   |                |                        |              | 53           | 2            |
| End of Trial Pit at 2.40 m                                                                                                                                                |                                                                                    |                  |                         |                |                        |              |              | 3<br>4       |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ■ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.4m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>22.70                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338847<br>Northing: 401444                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                     |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                       | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND with frequent rootlets.                                                                                            |    |                  |                         | J<br>D         | 0.00-0.40           |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                           |    | 0.40             | 22.30                   | B              | 0.40-0.70           |              |              |              |
| Light yellowish brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded medium of mixed lithologies. (Shirdley Hill Sand Formation)       |   | 0.70             | 22.00                   | D              | 1.00-1.40           |              |              | 1            |
| Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)  |  | 2.20             | 20.50                   | J              | 2.00-2.20           |              | 157          | 2            |
| Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 2.40             | 20.30                   |                |                     |              |              |              |
| End of Trial Pit at 2.50 m                                                                                                                                        |                                                                                     | 2.50             | 20.20                   |                |                     |              |              |              |
|                                                                                                                                                                   |                                                                                     |                  |                         |                |                     |              | 139          | 3            |
|                                                                                                                                                                   |                                                                                     |                  |                         |                |                     |              |              | 4            |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.6m bgl.  
Remarks: Trial pit unstable due to shallow sands collapsing. Land drain encountered in excavation.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.70                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339190<br>Northing: 401974                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 01/06/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                                                      |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                                        | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine of mixed lithologies. Frequent rootlets present.                                                |   | 0.40             | 21.30                   |                |                     |              |              |              |
| Light orangish brown slightly gravelly fine to medium SAND. Gravel is subrounded medium to coarse of mixed lithologies. (Shirdley Hill Sand Formation)                                             |   | 0.70             | 21.00                   | J              | 0.60-0.70           |              |              |              |
| Firm to stiff brown slightly sandy slightly gravelly slightly cobbly CLAY. Sand is fine, gravel is subrounded to rounded fine to medium, cobble is subrounded of mixed lithologies. (Glacial Till) |  |                  |                         |                |                     |              | 108          |              |
|                                                                                                                                                                                                    |                                                                                    |                  |                         | D              | 1.70-2.00           |              | 131          |              |
|                                                                                                                                                                                                    |                                                                                    |                  |                         | D              | 2.70-3.00           |              | 208          |              |
| End of Trial Pit at 3.00 m                                                                                                                                                                         |                                                                                    | 3.00             | 18.70                   |                |                     |              |              |              |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>22.30                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339244<br>Northing: 401861                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

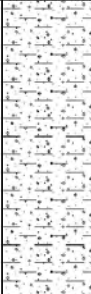
| STRATA RECORD                                                                                                                                                            |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                            |              |              | Sheet 1 of 1 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|----------------------------|--------------|--------------|--------------|
| Description                                                                                                                                                              | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m)        | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND.                                                                                                                          |   | 0.40             | 21.90                   | J<br>B         | 0.00-0.40                  |              |              |              |
| Firm to stiff brown slightly sandy slightly<br>gravelly CLAY. Sand is fine, gravel is subangular<br>to subrounded fine to coarse of mixed lithologies.<br>(Glacial Till) |  | 2.00             | 20.30                   | J<br>D         | 0.40-0.60<br><br>1.60-1.80 |              | 120          |              |
| End of Trial Pit at 2.00 m                                                                                                                                               |                                                                                    |                  |                         |                |                            |              |              |              |

Key:

|                                                                                     |                      |     |                                            |
|-------------------------------------------------------------------------------------|----------------------|-----|--------------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                   |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                   |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test<br>(Uncorrected) |
|  | Water Strike         |     |                                            |
|  | Standing Water Level |     |                                            |

Groundwater: No ground water encountered.  
Remarks: Trial pit stable.Very stiff clay preventing excavation  
beyond 2.0m bgl.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>20.40                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339162<br>Northing: 401789                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 01/06/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

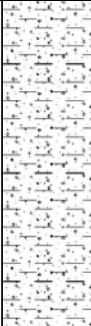
| STRATA RECORD                                                                                                                                                                |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                                  | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine of mixed lithologies. Frequent rootlets present.                          |    |                  |                         | J              | 0.00-0.50           |              |              |              |
| MADE GROUND: Firm to stiff brown slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till) |    | 0.50             | 19.90                   |                |                     |              | 72           |              |
| Light brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                              |    | 0.90             | 19.50                   |                |                     |              |              | 1            |
| Dark blackish brown organic plastic pseudo fibrous PEAT. (50% of trial pit, other 50% soft to firm CLAY). (Shirdley Hill Sand / Glacial Till)                                |   | 1.20             | 19.20                   | J<br>D         | 1.50-1.70           |              | 125          | ▽            |
| Firm to stiff brown slightly sandy slightly gravelly CLAY. Sand is fine, gravel is subangular to subrounded fine to coarse of mixed lithologies. (Glacial Till)              |  | 2.20             | 18.20                   | D              | 2.90-3.20           |              | 152          | 3            |
| End of Trial Pit at 3.20 m                                                                                                                                                   |                                                                                     | 3.20             | 17.20                   |                |                     |              |              | 4            |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ▼ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.3m bgl.  
Remarks: Trial pit generally stable with collapse of zones containing peat.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.90                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339138<br>Northing: 401652                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                             |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                               | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND with frequent rootlets.                                                                                                    |   |                  |                         | J              | 0.00-0.40           |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                   |   | 0.40             | 21.50                   | D              | 0.40-0.85           |              |              |              |
|                                                                                                                                                                           |                                                                                    |                  |                         | J              | 0.60-0.85           |              |              |              |
| Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till)  |   | 0.85             | 21.05                   | D              | 0.85-1.10           |              | 35           | 1            |
| Firm to stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 1.50             | 20.40                   |                |                     |              |              | ▽            |
|                                                                                                                                                                           |                                                                                    |                  |                         | D              | 2.40-2.60           |              | 120          | 2            |
| End of Trial Pit at 2.60 m                                                                                                                                                |                                                                                    | 2.60             | 19.30                   |                |                     |              |              | 3            |
|                                                                                                                                                                           |                                                                                    |                  |                         |                |                     |              |              | 4            |

Key:

|   |                      |     |                                         |
|---|----------------------|-----|-----------------------------------------|
| D | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B | Bulk Sample          | PID | Photoionisation Detector                |
| J | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
| ▽ | Water Strike         |     |                                         |
| ▼ | Standing Water Level |     |                                         |

Groundwater: Groundwater encountered at 1.6m bgl.  
Remarks: Trial pit stable.

|                                |                                             |                                                              |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>21.57                                | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 339049<br>Northing: 401517                          |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe ExcavatorBackfilled with arisings |                                                                                                                       | Checked By:<br>JA |

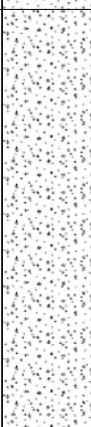
| STRATA RECORD                                                                                                                                                             |                                                                                    |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                               | Legend                                                                             | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND with frequent rootlets.                                                                                                    |   |                  |                         | B              | 0.00-0.45           |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                   |   | 0.45             | 21.12                   | J              | 0.45-0.60           |              |              |              |
| Firm to stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 0.60             | 20.97                   | D              | 0.60-0.90           |              |              |              |
|                                                                                                                                                                           |                                                                                    |                  |                         | J              | 1.00-1.30           |              | 100          | 1            |
|                                                                                                                                                                           |                                                                                    |                  |                         | D              | 1.90-2.20           |              | 105          | 2            |
| End of Trial Pit at 2.20 m                                                                                                                                                |                                                                                    | 2.20             | 19.37                   |                |                     |              |              |              |
|                                                                                                                                                                           |                                                                                    |                  |                         |                |                     |              |              | 3            |
|                                                                                                                                                                           |                                                                                    |                  |                         |                |                     |              |              | 4            |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit stable.

|                                |                                             |                                                               |                                                                                                                       |                   |
|--------------------------------|---------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Site:<br>Poverty Lane, Maghull | Location:<br>Poverty Lane, Maghull, L31 3DS | Ground Level (mAOD):<br>22.70                                 | Trial pit width (m): 1.00<br>Trial pit length (m): 3.00<br>Support Method: None<br>Pit Stability: Refer to 'remarks'. | Scale<br>1:25     |
| Client:<br>Persimmon Homes Ltd |                                             | Easting: 338911<br>Northing: 401384                           |                                                                                                                       | Logged By:<br>LT  |
| Project No: 37158100           | Date: 31/05/2017                            | Excavation Method: Backhoe Excavator Backfilled with arisings |                                                                                                                       | Checked By:<br>JA |

| STRATA RECORD                                                                                                                                                            |                                                                                     |                  | IN SITU TESTS / SAMPLES |                |                     |              |              | Sheet 1 of 1 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------|----------------|---------------------|--------------|--------------|--------------|
| Description                                                                                                                                                              | Legend                                                                              | Depth<br>(m bgl) | Level<br>(mAOD)         | Sample<br>Type | Sample<br>Depth (m) | PID<br>(ppm) | PPT<br>(kPa) | Water Level  |
| TOPSOIL: Dark brown clayey fine to medium SAND with frequent rootlets.                                                                                                   |    |                  |                         |                |                     |              |              |              |
| Dark orangish brown fine to medium SAND. (Shirdley Hill Sand Formation)                                                                                                  |    | 0.40             | 22.30                   | J<br>D         | 0.40-0.60           |              |              |              |
| Light yellowish brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded medium of mixed lithologies. (Shirdley Hill Sand Formation)              |   | 0.60             | 22.10                   |                |                     |              |              |              |
| Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is subangular to subrounded fine to medium of mixed lithologies. (Glacial Till) |  | 2.00             | 20.70                   | D              | 2.00-2.20           |              | 65           |              |
| End of Trial Pit at 2.20 m                                                                                                                                               |                                                                                     | 2.20             | 20.50                   | J              | 2.20                |              |              |              |

Key:

|                                                                                     |                      |     |                                         |
|-------------------------------------------------------------------------------------|----------------------|-----|-----------------------------------------|
| D                                                                                   | Disturbed Sample     | PPT | Pocket Penetrometer Test                |
| B                                                                                   | Bulk Sample          | PID | Photoionisation Detector                |
| J                                                                                   | Jar Sample           | SPT | Standard Penetration Test (Uncorrected) |
|  | Water Strike         |     |                                         |
|  | Standing Water Level |     |                                         |

Groundwater: No ground water encountered.  
Remarks: Trial pit unstable due to shallow sands collapsing.

|               |                         |              |
|---------------|-------------------------|--------------|
| STRATA RECORD | IN SITU TESTS / SAMPLES | Sheet 1 of 1 |
|---------------|-------------------------|--------------|

|                                                                                                                                                                                                                                                                            |                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <p>Key:</p> <p>D Disturbed Sample      PPT Pocket Penetrometer Test</p> <p>B Bulk Sample          PID Photoionisation Detector</p> <p>J Jar Sample            SPT Standard Penetration Test</p> <p>☒ Water Strike          (Uncorrected)</p> <p>▼ Standing Water Level</p> | <p>Groundwater: No ground water encountered.</p> <p>Remarks: Trial pit stable.</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|



Summerhill Farm, Poverty Lane, Maghull

## **APPENDIX D**

### **Geotechnical Laboratory Reports**



# LABORATORY REPORT



4043

**Contract Number: PSL17/2666**

Report Date: 25 June 2017  
Client's Reference: 37258100  
Client Name: Arcadis EC Harris  
1 Whitehall Riverside  
Leeds  
LS1 4BN

**For the attention of: Jonny Aykroyd**

Contract Title: Maghull East, Poverty Lane  
Date Received: 6/6/2017  
Date Commenced: 6/6/2017  
Date Completed: 25/6/2017

**Notes: Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson  
(Director)

A Watkins  
(Director)

R Berriman  
(Quality Manager)

L Knight  
(Senior Technician)

S Eyre  
(Senior Technician)

A Fry  
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,  
Doncaster DN4 0AR  
tel: +44 (0)844 815 6641  
fax: +44 (0)844 815 6642  
e-mail: [rgunson@prosoils.co.uk](mailto:rgunson@prosoils.co.uk)  
[awatkins@prosoils.co.uk](mailto:awatkins@prosoils.co.uk)

Page 1 of

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample                               |
|-------------|---------------|-------------|-------------|--------------|-----------------------------------------------------|
| TP101       | 3             | D           | 2.20        | 2.50         | Brown slightly gravelly very sandy CLAY.            |
| TP102       | 2             | B           | 0.70        | 1.20         | Dark brown slightly silty SAND.                     |
| TP102       | 4             | D           | 2.90        | 3.00         | Brown slightly gravelly very sandy CLAY.            |
| TP103       | 2             | B           | 0.50        | 1.00         | Brown silty SAND.                                   |
| TP105       | 1             | B           | 1.10        | 1.60         | Brown slightly silty SAND.                          |
| TP105       | 3             | D           | 2.20        | 2.30         | Brown slightly gravelly very sandy CLAY.            |
| TP106       | 1             | D           | 0.60        | 1.00         | Brown slightly gravelly very sandy CLAY.            |
| TP108       | 2             | D           | 1.50        | 1.80         | Brown very sandy CLAY.                              |
| TP109       | 2             | D           | 1.50        | 1.80         | Brown slightly gravelly very sandy CLAY.            |
| TP110       | 1             | D           | 0.50        | 0.70         | Brown slightly gravelly sandy CLAY.                 |
| TP110       | 2             | D           | 1.40        | 1.70         | Brown slightly gravelly sandy CLAY.                 |
| TP112       | 2             | B           | 0.40        | 0.70         | Brown slightly silty SAND.                          |
| TP113       | 1             | D           | 1.70        | 2.00         | Brown slightly gravelly very sandy CLAY.            |
| TP113       | 2             | D           | 2.70        | 3.00         | Brown slightly gravelly very sandy CLAY.            |
| TP114       | 2             | D           | 0.40        | 0.60         | Brown slightly gravelly very sandy CLAY.            |
| TP114       | 3             | D           | 1.60        | 1.80         | Brown slightly gravelly very sandy CLAY.            |
| TP115       | 1             | D           | 1.50        | 1.70         | Black slightly gravelly sandy slightly clayey PEAT. |
| TP115       | 2             | D           | 2.90        | 3.20         | Brown slightly gravelly very sandy CLAY.            |
| TP116       | 2             | D           | 0.85        | 1.10         | Brown slightly gravelly very sandy CLAY.            |



Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample                                       |
|-------------|---------------|-------------|-------------|--------------|-------------------------------------------------------------|
| TP116       | 3             | D           | 2.40        | 2.60         | Brown slightly gravelly very sandy CLAY.                    |
| TP117       | 2             | D           | 0.60        | 0.90         | Brown slightly gravelly very sandy CLAY.                    |
| TP117       | 3             | D           | 1.90        | 2.20         | Brown slightly gravelly sandy CLAY.                         |
| TP119       | 2             | B           | 0.40        | 1.10         | Brown slightly gravelly very silty SAND.                    |
| TP119       | 3             | D           | 2.20        | 2.40         | Brown very sandy CLAY.                                      |
| TP120       | 2             | D           | 0.60        | 0.80         | Brown slightly gravelly sandy CLAY.                         |
| WS101       | 2             | D           | 1.70        |              | Greyish brown slightly gravelly very sandy very silty CLAY. |
| WS101       | 4             | D           | 2.50        |              | Brown slightly gravelly very sandy CLAY.                    |
| WS101       | 6             | SPT         | 4.00        | 4.45         | Brown slightly gravelly very sandy CLAY.                    |
| WS102       | 1             | D           | 1.00        |              | Brown slightly gravelly very sandy CLAY.                    |
| WS102       | 4             | SPT         | 2.00        | 2.45         | Brown slightly gravelly very sandy CLAY.                    |
| WS103       | 2             | D           | 1.70        | 1.90         | Brown slightly gravelly very sandy CLAY.                    |
| WS103       | 6             | D           | 3.40        | 3.60         | Brown slightly gravelly very sandy CLAY.                    |
| WS104       | 1             | D           | 2.20        |              | Brown slightly gravelly very sandy CLAY.                    |
| WS104       | 1             | D           | 4.50        |              | Brown slightly gravelly very sandy CLAY.                    |
| WS105       | 1             | SPT         | 1.20        | 1.65         | Brown slightly gravelly sandy CLAY.                         |
| WS105       | 4             | SPT         | 4.00        | 4.45         | Brown slightly gravelly very sandy CLAY.                    |
| WS106       | 1             | SPT         | 1.20        | 1.65         | Brown very sandy CLAY.                                      |
| WS106       | 3             | SPT         | 2.00        | 2.45         | Brown slightly gravelly very sandy CLAY.                    |



Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample                        |
|-------------|---------------|-------------|-------------|--------------|----------------------------------------------|
| WS107       | 3             | SPT         | 2.00        | 2.45         | Brown slightly gravelly very sandy CLAY.     |
| WS107       | 4             | D           | 2.50        | 2.70         | Brown very sandy CLAY.                       |
| WS108       | 2             | D           | 1.50        | 1.70         | Brown slightly gravelly very sandy CLAY.     |
| WS108       | 3             | SPT         | 3.00        | 3.45         | Brown very sandy CLAY.                       |
| WS109       | 1             | D           | 1.65        |              | Brown silty SAND.                            |
| WS110       | 2             | D           | 1.40        | 1.60         | Brown slightly gravelly sandy CLAY.          |
| WS110       | 6             | SPT         | 4.00        | 4.45         | Brown slightly gravelly very sandy CLAY.     |
| WS111       | 1             | D           | 1.80        | 2.00         | Brown slightly gravelly slightly silty SAND. |
| WS111       | 2             | S           | 2.00        | 2.45         | Brown slightly gravelly very sandy CLAY.     |
| WS114       | 1             | S           | 1.20        | 1.65         | Brown slightly gravelly very sandy CLAY.     |
| WS114       | 4             | D           | 2.40        | 2.60         | Brown slightly gravelly very sandy CLAY.     |
| WS115       | 1             | SPT         | 1.20        | 1.65         | Brown slightly gravelly sandy CLAY.          |
| WS115       | 3             | SPT         | 3.00        | 3.45         | Brown slightly gravelly very sandy CLAY.     |
|             |               |             |             |              |                                              |
|             |               |             |             |              |                                              |
|             |               |             |             |              |                                              |
|             |               |             |             |              |                                              |
|             |               |             |             |              |                                              |
|             |               |             |             |              |                                              |



Maghull East, Poverty Lane

|                     |
|---------------------|
| <b>Contract No:</b> |
| <b>PSL17/2666</b>   |
| <b>Client Ref:</b>  |
| <b>37258100</b>     |

# SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content %<br>Clause 3.2 | Linear Shrinkage %<br>Clause 6.5 | Particle Density Mg/m <sup>3</sup><br>Clause 8.2 | Liquid Limit %<br>Clause 4.3/4 | Plastic Limit %<br>Clause 5.3 | Plasticity Index %<br>Clause 5.4 | Passing .425mm % | Remarks                     |
|-------------|---------------|-------------|-------------|--------------|----------------------------------|----------------------------------|--------------------------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------|-----------------------------|
| TP101       | 3             | D           | 2.20        | 2.50         | 17                               |                                  |                                                  | 26                             | 14                            | 12                               | 94               | Low plasticity CL.          |
| TP102       | 4             | D           | 2.90        | 3.00         | 21                               |                                  |                                                  | 28                             | 15                            | 13                               | 96               | Low plasticity CL.          |
| TP105       | 3             | D           | 2.20        | 2.30         | 17                               |                                  |                                                  | 22                             | 12                            | 10                               | 95               | Low plasticity CL.          |
| TP106       | 1             | D           | 0.60        | 1.00         | 18                               |                                  |                                                  | 30                             | 17                            | 13                               | 94               | Low plasticity CL.          |
| TP108       | 2             | D           | 1.50        | 1.80         | 16                               |                                  |                                                  | 34                             | 18                            | 16                               | 100              | Low plasticity CL.          |
| TP109       | 2             | D           | 1.50        | 1.80         | 16                               |                                  |                                                  | 25                             | 13                            | 12                               | 98               | Low plasticity CL.          |
| TP110       | 1             | D           | 0.50        | 0.70         | 18                               |                                  |                                                  | 40                             | 18                            | 22                               | 96               | Intermediate plasticity CI. |
| TP110       | 2             | D           | 1.40        | 1.70         | 15                               |                                  |                                                  | 36                             | 18                            | 18                               | 97               | Intermediate plasticity CI. |
| TP113       | 1             | D           | 1.70        | 2.00         | 14                               |                                  |                                                  | 32                             | 13                            | 19                               | 94               | Low plasticity CL.          |
| TP113       | 2             | D           | 2.70        | 3.00         | 13                               |                                  |                                                  | 29                             | 15                            | 14                               | 95               | Low plasticity CL.          |
| TP114       | 2             | D           | 0.40        | 0.60         | 15                               |                                  |                                                  | 34                             | 17                            | 17                               | 94               | Low plasticity CL.          |
| TP114       | 3             | D           | 1.60        | 1.80         | 15                               |                                  |                                                  | 31                             | 18                            | 13                               | 94               | Low plasticity CL.          |
| TP115       | 1             | D           | 1.50        | 1.70         | 126                              |                                  |                                                  |                                | NP                            |                                  |                  |                             |
| TP115       | 2             | D           | 2.90        | 3.20         | 15                               |                                  |                                                  | 30                             | 17                            | 13                               | 94               | Low plasticity CL.          |
| TP116       | 2             | D           | 0.85        | 1.10         | 22                               |                                  |                                                  | 32                             | 14                            | 18                               | 97               | Low plasticity CL.          |
| TP116       | 3             | D           | 2.40        | 2.60         | 17                               |                                  |                                                  | 35                             | 16                            | 19                               | 97               | Intermediate plasticity CI. |
| TP117       | 2             | D           | 0.60        | 0.90         | 16                               |                                  |                                                  | 34                             | 16                            | 18                               | 97               | Low plasticity CL.          |
| TP117       | 3             | D           | 1.90        | 2.20         | 18                               |                                  |                                                  | 38                             | 18                            | 20                               | 97               | Intermediate plasticity CI. |
| TP119       | 3             | D           | 2.20        | 2.40         | 15                               |                                  |                                                  | 35                             | 17                            | 18                               | 100              | Intermediate plasticity CI. |

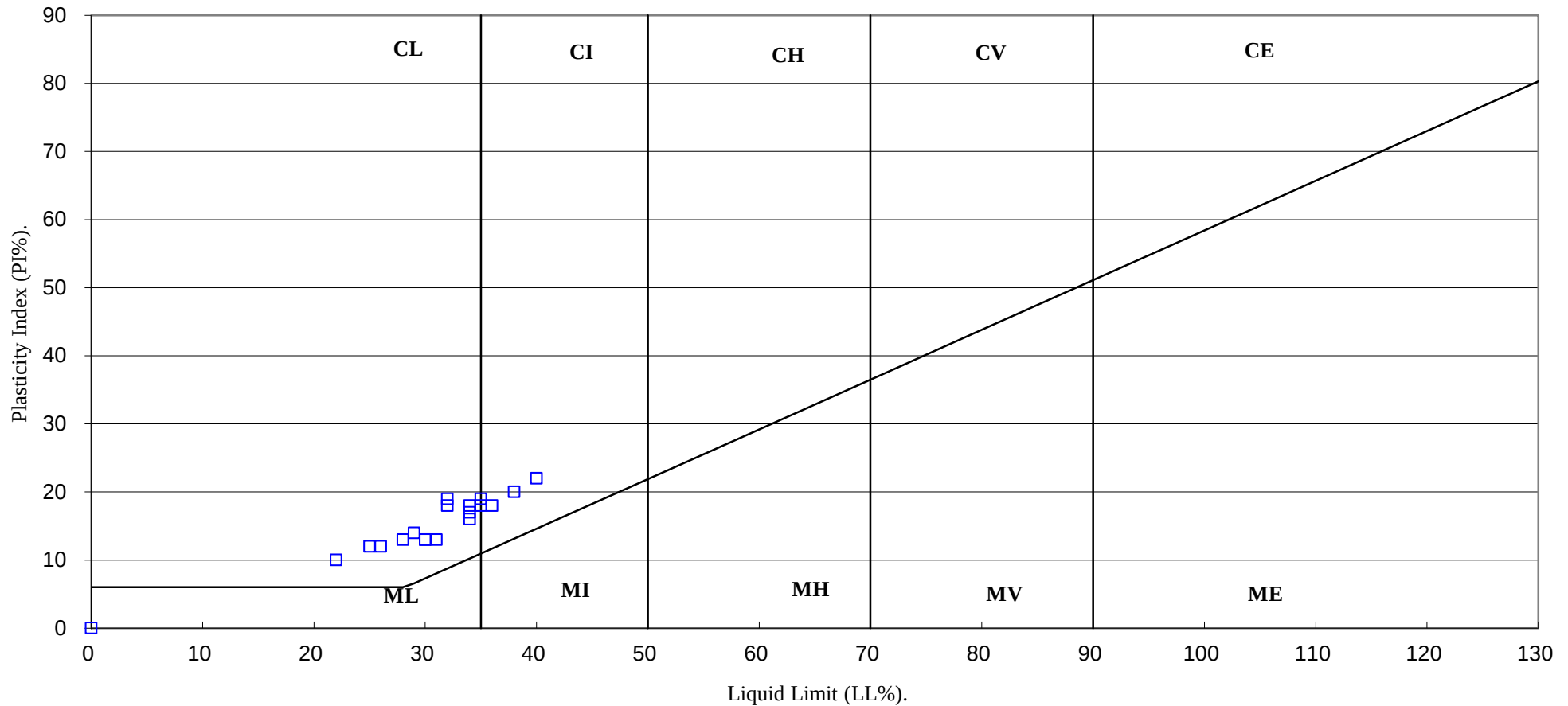
SYMBOLS : NP : Non Plastic

\* : Liquid Limit and Plastic Limit Wet Sieved.

|                                                                                     |                                                                                     |                                   |  |              |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------|--|--------------|
|  |  | <p>Maghull East, Poverty Lane</p> |  | Contract No: |
|                                                                                     |                                                                                     |                                   |  | PSL17/2666   |
|                                                                                     |                                                                                     |                                   |  | Client Ref:  |
|                                                                                     |                                                                                     |                                   |  | 37258100     |

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



**PSL**  
Professional Soils Laboratory

Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

| Hole Number | Sample Number | Sample Type | Top Depth<br>m | Base Depth<br>m | Moisture Content<br>%<br>Clause 3.2 | Linear Shrinkage<br>%<br>Clause 6.5 | Particle Density<br>Mg/m <sup>3</sup><br>Clause 8.2 | Liquid Limit<br>%<br>Clause 4.3/4 | Plastic Limit<br>%<br>Clause 5.3 | Plasticity Index<br>%<br>Clause 5.4 | Passing .425mm<br>% | Remarks                     |
|-------------|---------------|-------------|----------------|-----------------|-------------------------------------|-------------------------------------|-----------------------------------------------------|-----------------------------------|----------------------------------|-------------------------------------|---------------------|-----------------------------|
| TP120       | 2             | D           | 0.60           | 0.80            | 19                                  |                                     |                                                     | 36                                | 16                               | 20                                  | 96                  | Intermediate plasticity CI. |
| WS101       | 2             | D           | 1.70           |                 | 16                                  |                                     |                                                     | 22                                | 11                               | 11                                  | 96                  | Low plasticity CL.          |
| WS101       | 4             | D           | 2.50           |                 | 19                                  |                                     |                                                     | 33                                | 16                               | 17                                  | 96                  | Low plasticity CL.          |
| WS101       | 6             | SPT         | 4.00           | 4.45            | 16                                  |                                     |                                                     | 29                                | 14                               | 15                                  | 96                  | Low plasticity CL.          |
| WS102       | 1             | D           | 1.00           |                 | 19                                  |                                     |                                                     | 26                                | 15                               | 11                                  | 98                  | Low plasticity CL.          |
| WS102       | 4             | SPT         | 2.00           | 2.45            | 13                                  |                                     |                                                     | 30                                | 14                               | 16                                  | 96                  | Low plasticity CL.          |
| WS103       | 2             | D           | 1.70           | 1.90            | 17                                  |                                     |                                                     | 33                                | 18                               | 15                                  | 98                  | Low plasticity CL.          |
| WS103       | 6             | D           | 3.40           | 3.60            | 14                                  |                                     |                                                     | 27                                | 13                               | 14                                  | 96                  | Low plasticity CL.          |
| WS104       | 1             | D           | 2.20           |                 | 18                                  |                                     |                                                     | 32                                | 15                               | 17                                  | 97                  | Low plasticity CL.          |
| WS104       | 1             | D           | 4.50           |                 | 15                                  |                                     |                                                     | 34                                | 16                               | 18                                  | 96                  | Low plasticity CL.          |
| WS105       | 1             | SPT         | 1.20           | 1.65            | 13                                  |                                     |                                                     | 37                                | 19                               | 18                                  | 93                  | Intermediate plasticity CI. |
| WS105       | 4             | SPT         | 4.00           | 4.45            | 14                                  |                                     |                                                     | 31                                | 14                               | 17                                  | 98                  | Low plasticity CL.          |
| WS106       | 1             | SPT         | 1.20           | 1.65            | 22                                  |                                     |                                                     | 33                                | 17                               | 16                                  | 100                 | Low plasticity CL.          |
| WS106       | 3             | SPT         | 2.00           | 2.45            | 16                                  |                                     |                                                     | 35                                | 16                               | 19                                  | 97                  | Intermediate plasticity CI. |
| WS107       | 3             | SPT         | 2.00           | 2.45            | 18                                  |                                     |                                                     | 33                                | 16                               | 17                                  | 98                  | Low plasticity CL.          |
| WS107       | 4             | D           | 2.50           | 2.70            | 17                                  |                                     |                                                     | 31                                | 16                               | 15                                  | 100                 | Low plasticity CL.          |
| WS108       | 2             | D           | 1.50           | 1.70            | 16                                  |                                     |                                                     | 31                                | 15                               | 16                                  | 96                  | Low plasticity CL.          |
| WS108       | 3             | SPT         | 3.00           | 3.45            | 15                                  |                                     |                                                     | 28                                | 14                               | 14                                  | 100                 | Low plasticity CL.          |
| WS109       | 1             | D           | 1.65           |                 | 17                                  |                                     |                                                     |                                   | NP                               |                                     |                     |                             |

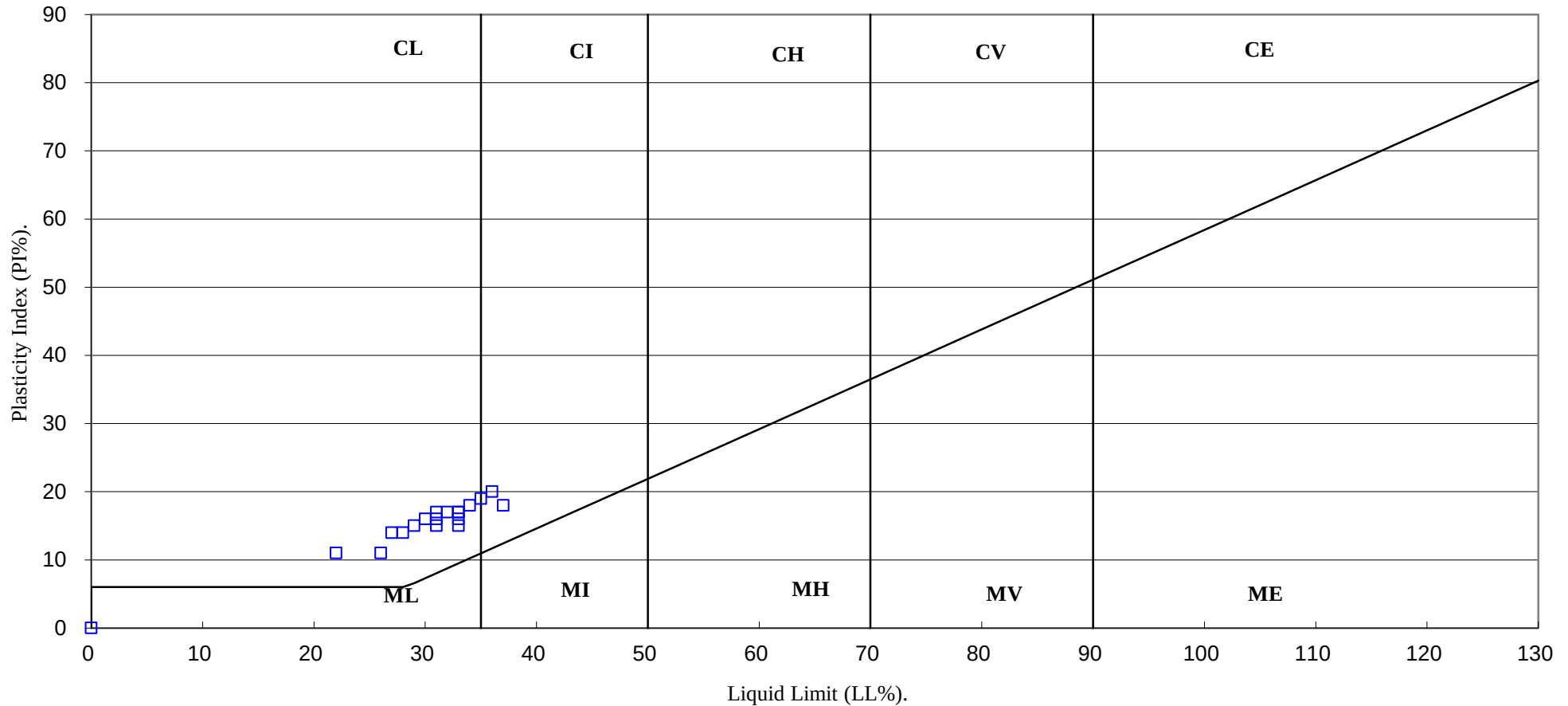
SYMBOLS : NP : Non Plastic

\* : Liquid Limit and Plastic Limit Wet Sieved.

|                                                                                     |                                                                                     |                                   |  |              |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------|--|--------------|
|  |  | <p>Maghull East, Poverty Lane</p> |  | Contract No: |
|                                                                                     |                                                                                     |                                   |  | PSL17/2666   |
|                                                                                     |                                                                                     |                                   |  | Client Ref:  |
|                                                                                     |                                                                                     |                                   |  | 37258100     |

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



**PSL**  
Professional Soils Laboratory

Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content %<br>Clause 3.2 | Linear Shrinkage %<br>Clause 6.5 | Particle Density Mg/m <sup>3</sup><br>Clause 8.2 | Liquid Limit %<br>Clause 4.3/4 | Plastic Limit %<br>Clause 5.3 | Plasticity Index %<br>Clause 5.4 | Passing .425mm % | Remarks                     |
|-------------|---------------|-------------|-------------|--------------|----------------------------------|----------------------------------|--------------------------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------|-----------------------------|
| WS110       | 2             | D           | 1.40        | 1.60         | 18                               |                                  |                                                  | 37                             | 17                            | 20                               | 97               | Intermediate plasticity CI. |
| WS110       | 6             | SPT         | 4.00        | 4.45         | 14                               |                                  |                                                  | 29                             | 15                            | 14                               | 97               | Low plasticity CL.          |
| WS111       | 1             | D           | 1.80        | 2.00         | 21                               |                                  |                                                  |                                | NP                            |                                  |                  |                             |
| WS111       | 2             | S           | 2.00        | 2.45         | 21                               |                                  |                                                  | 34                             | 17                            | 17                               | 96               | Low plasticity CL.          |
| WS114       | 1             | S           | 1.20        | 1.65         | 18                               |                                  |                                                  | 33                             | 16                            | 17                               | 96               | Low plasticity CL.          |
| WS114       | 4             | D           | 2.40        | 2.60         | 14                               |                                  |                                                  | 32                             | 18                            | 14                               | 96               | Low plasticity CL.          |
| WS115       | 1             | SPT         | 1.20        | 1.65         | 16                               |                                  |                                                  | 40                             | 18                            | 22                               | 97               | Intermediate plasticity CI. |
| WS115       | 3             | SPT         | 3.00        | 3.45         | 13                               |                                  |                                                  | 30                             | 15                            | 15                               | 98               | Low plasticity CL.          |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |
|             |               |             |             |              |                                  |                                  |                                                  |                                |                               |                                  |                  |                             |

SYMBOLS : NP : Non Plastic

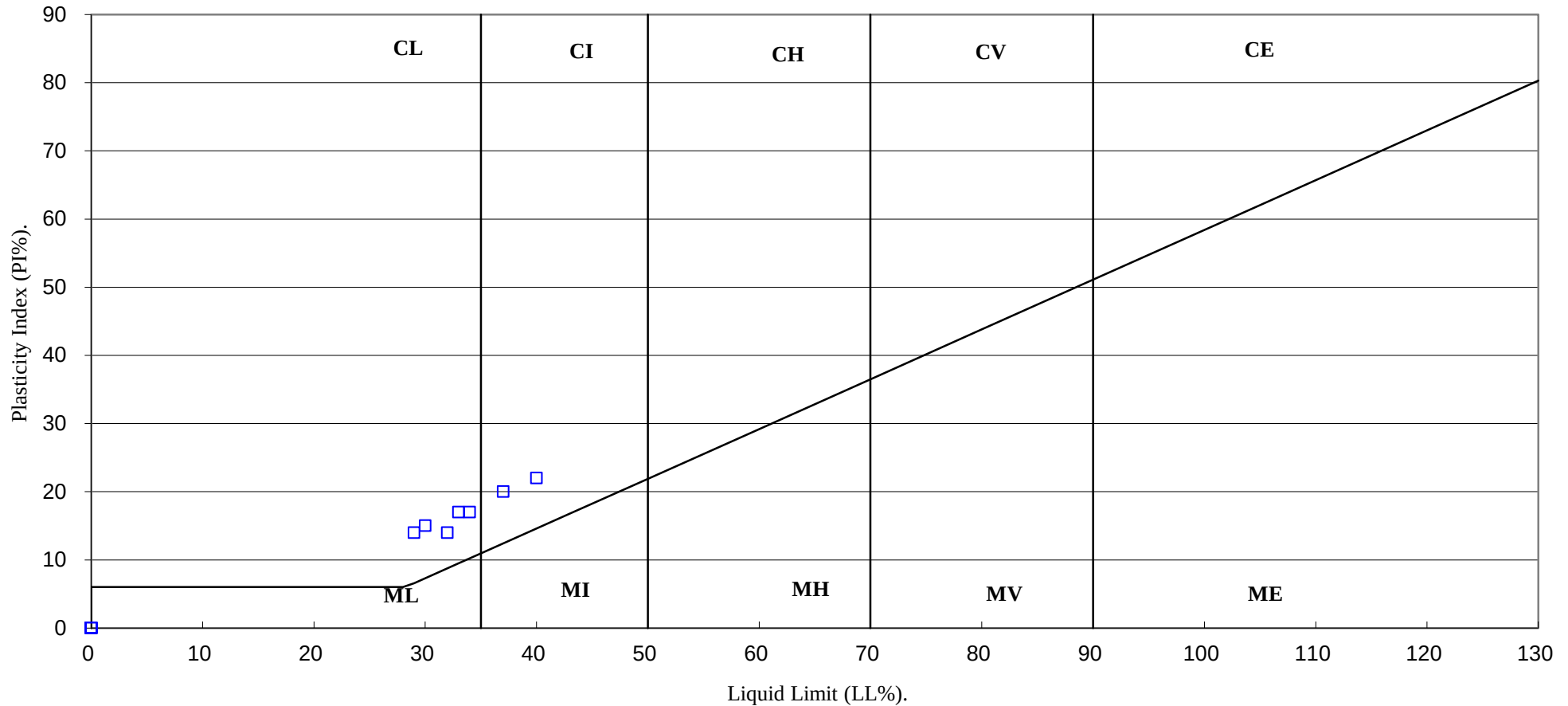
\* : Liquid Limit and Plastic Limit Wet Sieved.

|                                                                                     |                                                                                     |              |  |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------|--|
|  |  | Contract No: |  |
|                                                                                     |                                                                                     | PSL17/2666   |  |
|                                                                                     |                                                                                     | Client Ref:  |  |
|                                                                                     |                                                                                     | 37258100     |  |

Maghull East, Poverty Lane

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



**PSL**  
Professional Soils Laboratory

Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# PARTICLE SIZE DISTRIBUTION TEST

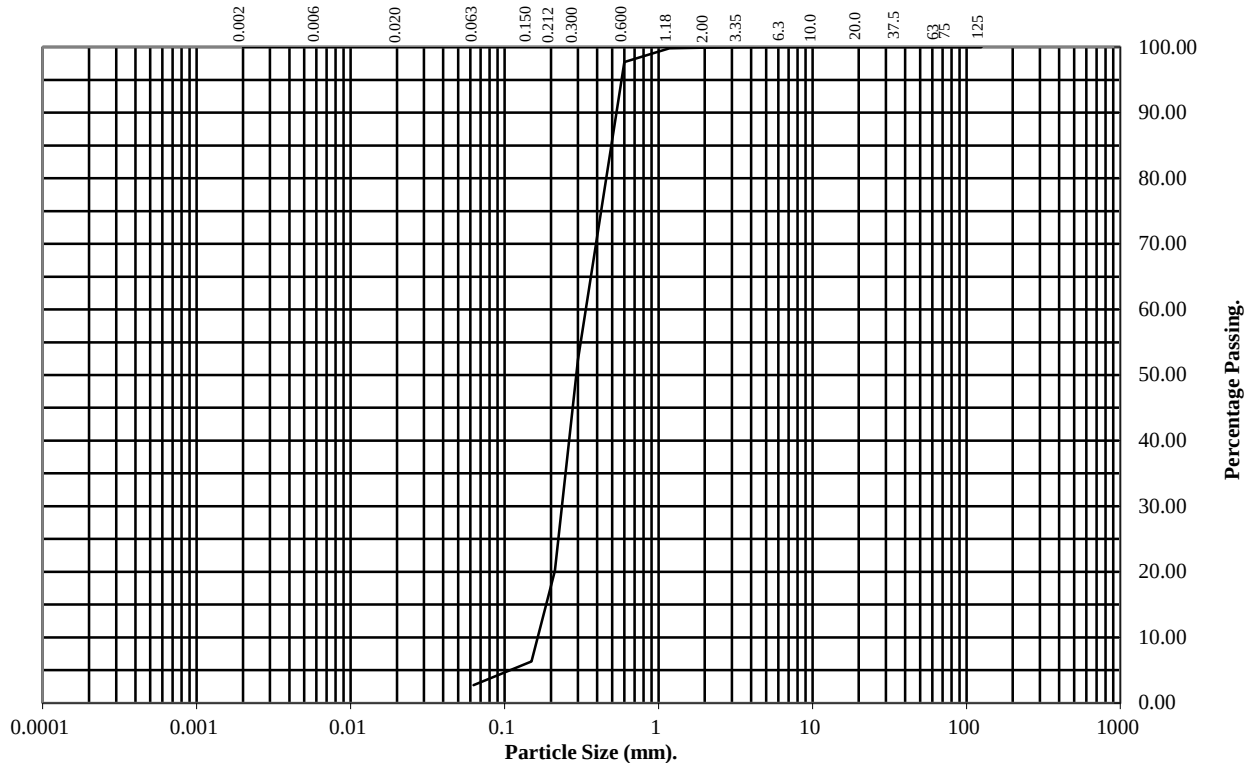
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP102 Top Depth (m): 0.70

Sample Number: 2 Base Depth(m): 1.20

Sample Type: B



| BS Test Sieve | Percentage Passing |
|---------------|--------------------|
| 125           | 100                |
| 75            | 100                |
| 63            | 100                |
| 37.5          | 100                |
| 20            | 100                |
| 10            | 100                |
| 6.3           | 100                |
| 3.35          | 100                |
| 2             | 100                |
| 1.18          | 100                |
| 0.6           | 98                 |
| 0.3           | 52                 |
| 0.212         | 20                 |
| 0.15          | 6                  |
| 0.063         | 3                  |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles       | 0                |
| Gravel        | 0                |
| Sand          | 97               |
| Silt/Clay     | 3                |

## Remarks:

See Summary of Soil Descriptions



Maghull East, Poverty Lane

|                     |
|---------------------|
| <b>Contract No:</b> |
| <b>PSL17/2666</b>   |
| <b>Client Ref:</b>  |
| <b>37258100</b>     |

# PARTICLE SIZE DISTRIBUTION TEST

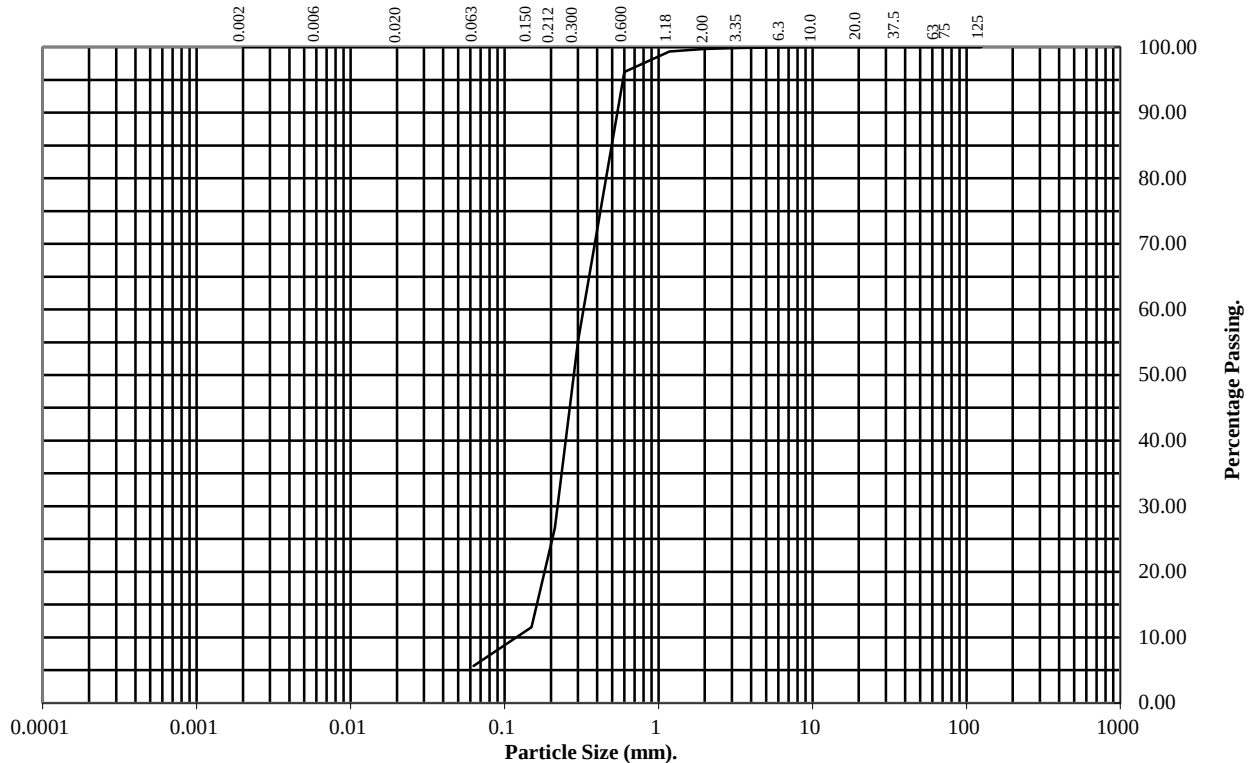
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP103 Top Depth (m): 0.50

Sample Number: 2 Base Depth(m): 1.00

Sample Type: B



| BS Test Sieve | Percentage Passing |
|---------------|--------------------|
| 125           | 100                |
| 75            | 100                |
| 63            | 100                |
| 37.5          | 100                |
| 20            | 100                |
| 10            | 100                |
| 6.3           | 100                |
| 3.35          | 100                |
| 2             | 100                |
| 1.18          | 99                 |
| 0.6           | 96                 |
| 0.3           | 55                 |
| 0.212         | 27                 |
| 0.15          | 12                 |
| 0.063         | 6                  |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles       | 0                |
| Gravel        | 0                |
| Sand          | 94               |
| Silt/Clay     | 6                |

## Remarks:

See Summary of Soil Descriptions



Maghull East, Poverty Lane

|              |
|--------------|
| Contract No: |
| PSL17/2666   |
| Client Ref:  |
| 37258100     |

# PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

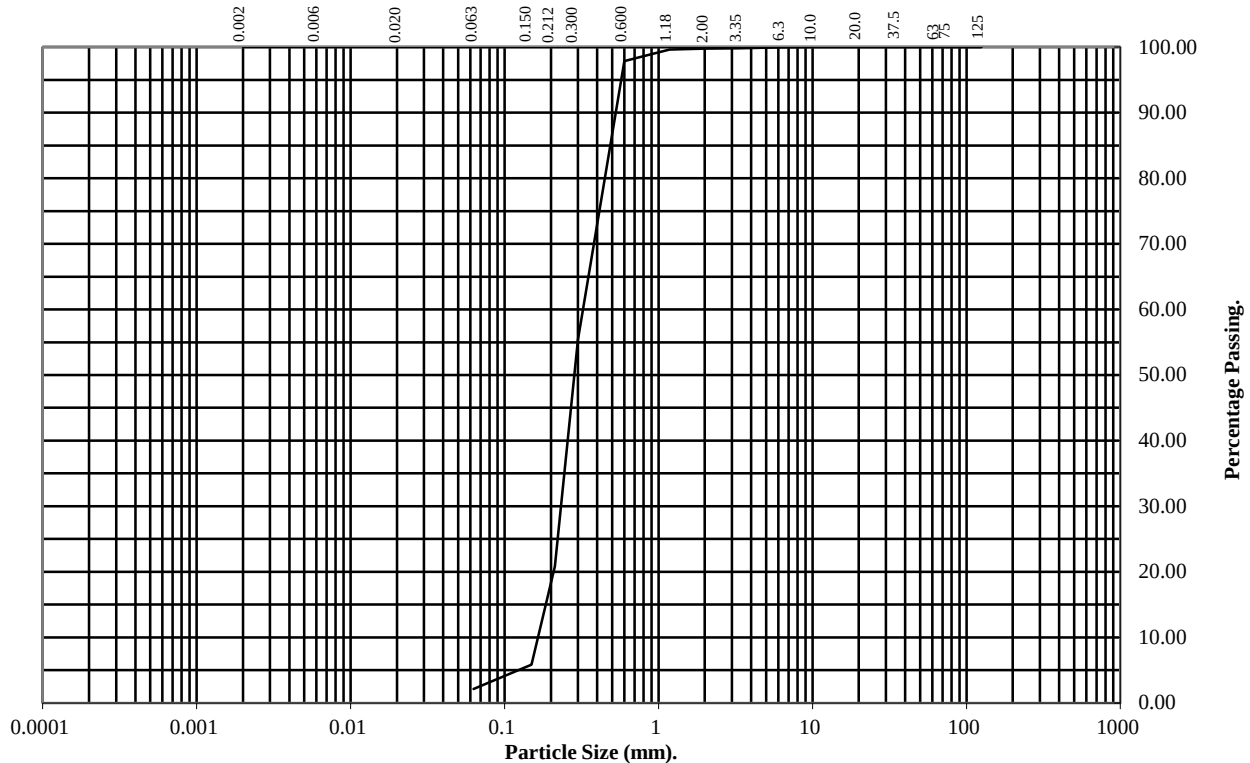
Hole Number: TP105

Top Depth (m): 1.10

Sample Number: 1

Base Depth(m): 1.60

Sample Type: B



| BS Test Sieve | Percentage Passing |
|---------------|--------------------|
| 125           | 100                |
| 75            | 100                |
| 63            | 100                |
| 37.5          | 100                |
| 20            | 100                |
| 10            | 100                |
| 6.3           | 100                |
| 3.35          | 100                |
| 2             | 100                |
| 1.18          | 100                |
| 0.6           | 98                 |
| 0.3           | 55                 |
| 0.212         | 21                 |
| 0.15          | 6                  |
| 0.063         | 2                  |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles       | 0                |
| Gravel        | 0                |
| Sand          | 98               |
| Silt/Clay     | 2                |

## Remarks:

See Summary of Soil Descriptions



Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# PARTICLE SIZE DISTRIBUTION TEST

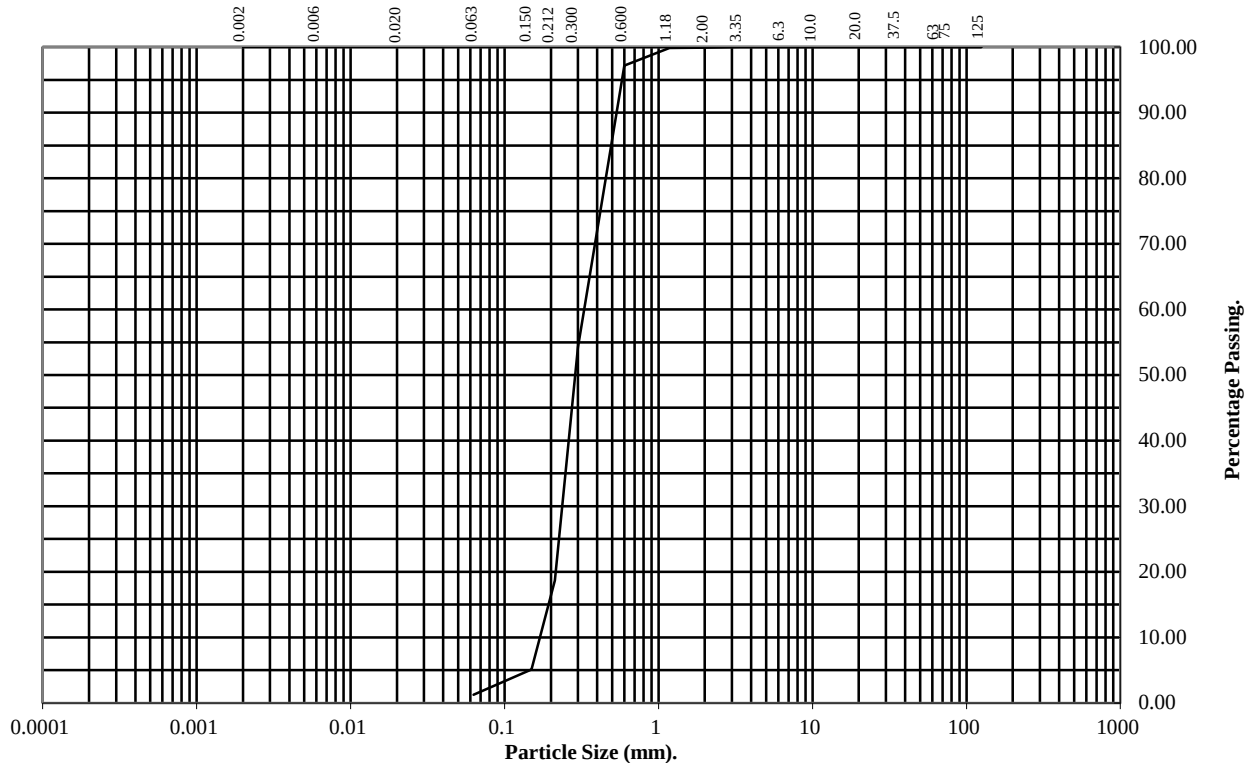
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP112 Top Depth (m): 0.40

Sample Number: 2 Base Depth(m): 0.70

Sample Type: B



| BS Test Sieve | Percentage Passing |
|---------------|--------------------|
| 125           | 100                |
| 75            | 100                |
| 63            | 100                |
| 37.5          | 100                |
| 20            | 100                |
| 10            | 100                |
| 6.3           | 100                |
| 3.35          | 100                |
| 2             | 100                |
| 1.18          | 100                |
| 0.6           | 97                 |
| 0.3           | 54                 |
| 0.212         | 19                 |
| 0.15          | 5                  |
| 0.063         | 1                  |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles       | 0                |
| Gravel        | 0                |
| Sand          | 99               |
| Silt/Clay     | 1                |

## Remarks:

See Summary of Soil Descriptions



Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

# PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

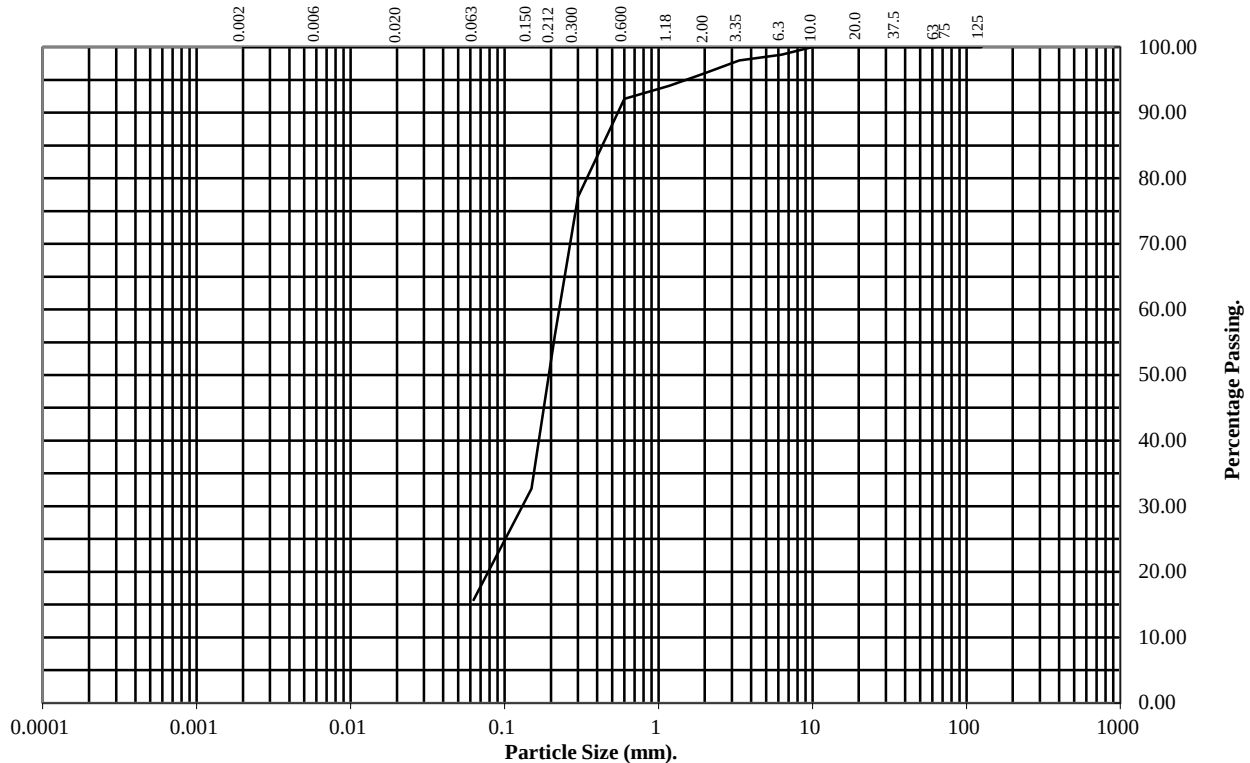
Hole Number: TP119

Top Depth (m): 0.40

Sample Number: 2

Base Depth(m): 1.10

Sample Type: B



| BS Test Sieve | Percentage Passing |
|---------------|--------------------|
| 125           | 100                |
| 75            | 100                |
| 63            | 100                |
| 37.5          | 100                |
| 20            | 100                |
| 10            | 100                |
| 6.3           | 99                 |
| 3.35          | 98                 |
| 2             | 96                 |
| 1.18          | 94                 |
| 0.6           | 92                 |
| 0.3           | 77                 |
| 0.212         | 56                 |
| 0.15          | 33                 |
| 0.063         | 16                 |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles       | 0                |
| Gravel        | 4                |
| Sand          | 80               |
| Silt/Clay     | 16               |

## Remarks:

See Summary of Soil Descriptions



Maghull East, Poverty Lane

Contract No:

PSL17/2666

Client Ref:

37258100

Summerhill Farm, Poverty Lane, Maghull

## **APPENDIX E**

### **Chemical Laboratory Reports**



Unit 7-8 Hawarden Business Park  
Manor Road (off Manor Lane)  
Hawarden  
Deeside  
CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

ARCADIS UK Ltd  
2 Craven Court  
Willie Snaith Road  
Newmarket  
Suffolk  
CB8 7FA

**Attention:** Tom Costema

## CERTIFICATE OF ANALYSIS

**Date:** 14 June 2017  
**Customer:** H\_ARCADIS\_NMK  
**Sample Delivery Group (SDG):** 170602-122  
**Your Reference:** Maghull  
**Location:** Maghull, Liverpool.  
**Report No:** 412359

We received 14 samples on Thursday June 01, 2017 and 7 of these samples were scheduled for analysis which was completed on Wednesday June 14, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

**Sonia McWhan**

Operations Manager





## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170602-122  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412359  
**Superseded Report:**

### Received Sample Overview

| Lab Sample No(s) | Customer Sample Ref. | AGS Ref. | Depth (m)   | Sampled Date |
|------------------|----------------------|----------|-------------|--------------|
| 15623059         | TP101                |          | 0.00 - 0.50 | 30/05/2017   |
| 15623060         | TP101                |          | 1.40 - 1.60 | 30/05/2017   |
| 15623061         | TP102                |          | 1.20 - 1.40 | 30/05/2017   |
| 15623062         | TP102                |          | 2.70 - 2.90 | 30/05/2017   |
| 15623063         | TP103                |          | 0.70 - 1.00 | 30/05/2017   |
| 15623065         | TP103                |          | 2.10 - 2.30 | 30/05/2017   |
| 15623066         | TP104                |          | 0.80 - 1.00 | 30/05/2017   |
| 15623067         | TP104                |          | 2.90 - 3.00 | 30/05/2017   |
| 15623068         | TP105                |          | 0.00 - 0.50 | 30/05/2017   |
| 15623069         | TP105                |          | 1.40 - 1.60 | 30/05/2017   |
| 15623070         | TP106                |          | 0.00 - 0.50 | 30/05/2017   |
| 15623071         | TP106                |          | 1.90 - 2.10 | 30/05/2017   |
| 15623072         | TP107                |          | 0.00 - 0.40 | 30/05/2017   |
| 15623073         | TP107                |          | 0.70 - 0.90 | 30/05/2017   |

#### Maximum Sample/Coolbox Temperature (°C) :

**17.6**

#### ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

**Only received samples which have had analysis scheduled will be shown on the following pages.**



# CERTIFICATE OF ANALYSIS

**SDG:** 170602-122  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412359  
**Superseded Report:**

## Results Legend



Test



No Determination Possible

## Sample Types -

S - Soil/Solid  
 UNS - Unspecified Solid  
 GW - Ground Water  
 SW - Surface Water  
 LE - Land Leachate  
 PL - Prepared Leachate  
 PR - Process Water  
 SA - Saline Water  
 TE - Trade Effluent  
 TS - Treated Sewage  
 US - Untreated Sewage  
 RE - Recreational Water  
 DW - Drinking Water Non-regulatory  
 UNL - Unspecified Liquid  
 SL - Sludge  
 G - Gas  
 OTH - Other

|                                     | Lab Sample No(s)          |                     | 15623059                | 15623061                | 15623066                | 15623068                | 15623070                | 15623071                | 15623072                |
|-------------------------------------|---------------------------|---------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                     | Customer Sample Reference |                     | TP101                   | TP102                   | TP104                   | TP105                   | TP106                   | TP106                   | TP107                   |
|                                     | AGS Reference             |                     |                         |                         |                         |                         |                         |                         |                         |
|                                     | Depth (m)                 |                     | 0.00 - 0.50             | 1.20 - 1.40             | 0.80 - 1.00             | 0.00 - 0.50             | 0.00 - 0.50             | 1.90 - 2.10             | 0.00 - 0.40             |
|                                     | Container                 |                     | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) |
|                                     | Sample Type               |                     | S                       | S                       | S                       | S                       | S                       | S                       | S                       |
| Anions by Kone (soil)               | All                       | NDPs: 0<br>Tests: 2 |                         | X                       |                         |                         |                         | X                       |                         |
| Cyanide Comp/Free/Total/Thiocyanate | All                       | NDPs: 0<br>Tests: 5 | X                       |                         | X                       | X                       | X                       |                         | X                       |
| Hexavalent Chromium (s)             | All                       | NDPs: 0<br>Tests: 5 | X                       |                         | X                       | X                       | X                       |                         | X                       |
| Metals in solid samples by OES      | All                       | NDPs: 0<br>Tests: 5 | X                       |                         | X                       | X                       | X                       |                         | X                       |
| PAH by GCMS                         | All                       | NDPs: 0<br>Tests: 5 | X                       |                         | X                       | X                       | X                       |                         | X                       |
| pH                                  | All                       | NDPs: 0<br>Tests: 7 | X                       | X                       | X                       | X                       | X                       | X                       | X                       |
| Sample description                  | All                       | NDPs: 0<br>Tests: 7 | X                       | X                       | X                       | X                       | X                       | X                       | X                       |



## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170602-122  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412359  
**Superseded Report:**

### Sample Descriptions

#### Grain Sizes

|                  |          |             |                 |               |             |               |            |                    |       |
|------------------|----------|-------------|-----------------|---------------|-------------|---------------|------------|--------------------|-------|
| <b>very fine</b> | <0.063mm | <b>fine</b> | 0.063mm - 0.1mm | <b>medium</b> | 0.1mm - 2mm | <b>coarse</b> | 2mm - 10mm | <b>very coarse</b> | >10mm |
|------------------|----------|-------------|-----------------|---------------|-------------|---------------|------------|--------------------|-------|

| Lab Sample No(s) | Customer Sample Ref. | Depth (m)   | Colour      | Description | Inclusions | Inclusions 2 |
|------------------|----------------------|-------------|-------------|-------------|------------|--------------|
| 15623059         | TP101                | 0.00 - 0.50 | Dark Brown  | Loamy Sand  | Stones     | Vegetation   |
| 15623061         | TP102                | 1.20 - 1.40 | Dark Brown  | Sand        | Stones     | Vegetation   |
| 15623066         | TP104                | 0.80 - 1.00 | Dark Brown  | Loamy Sand  | Vegetation | Stones       |
| 15623068         | TP105                | 0.00 - 0.50 | Dark Brown  | Loamy Sand  | Vegetation | Stones       |
| 15623070         | TP106                | 0.00 - 0.50 | Dark Brown  | Sandy Loam  | Vegetation | Stones       |
| 15623071         | TP106                | 1.90 - 2.10 | Light Brown | Sand        | Vegetation | Stones       |
| 15623072         | TP107                | 0.00 - 0.40 | Dark Brown  | Loamy Sand  | Vegetation | Stones       |

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.









## CERTIFICATE OF ANALYSIS

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**SDG:** 170602-122  
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**Report Number:** 412359  
**Superseded Report:**

### Table of Results - Appendix

| Method No | Reference                                         | Description                                                                                                                             | Wet/Dry Sample <sup>1</sup> | Surrogate Corrected |
|-----------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------|
| PM001     |                                                   | Preparation of Samples for Metals Analysis                                                                                              |                             |                     |
| PM024     | Modified BS 1377                                  | Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material                                   |                             |                     |
| TM133     | BS 1377: Part 3 1990;BS 6068-2.5                  | Determination of pH in Soil and Water using the GLpH pH Meter                                                                           |                             |                     |
| TM151     | Method 3500D, AWWA/APHA, 20th Ed., 1999           | Determination of Hexavalent Chromium using Kone analyser                                                                                |                             |                     |
| TM153     | Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999  | Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser |                             |                     |
| TM181     | US EPA Method 6010B                               | Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES                                                                        |                             |                     |
| TM218     | Determination of PAH by GCMS Microwave extraction | The determination of PAH in soil samples by microwave extraction and GC-MS                                                              |                             |                     |
| TM243     |                                                   | Mixed Anions In Soils By Kone                                                                                                           |                             |                     |

<sup>1</sup> Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



## CERTIFICATE OF ANALYSIS

SDG: 170602-122  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412359  
Superseded Report:

## Test Completion Dates

| Lab Sample No(s)                    | 15623059       | 15623061       | 15623066       | 15623068       | 15623070       | 15623071       | 15623072       |
|-------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.                | TP101          | TP102          | TP104          | TP105          | TP106          | TP106          | TP107          |
| AGS Ref.                            |                |                |                |                |                |                |                |
| Depth                               | 0.00 - 0.50    | 1.20 - 1.40    | 0.80 - 1.00    | 0.00 - 0.50    | 0.00 - 0.50    | 1.90 - 2.10    | 0.00 - 0.40    |
| Type                                | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil)               |                | 13-Jun-2017    |                |                |                | 13-Jun-2017    |                |
| Cyanide Comp/Free/Total/Thiocyanate | 13-Jun-2017    |                | 13-Jun-2017    | 13-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| Hexavalent Chromium (s)             | 12-Jun-2017    |                | 12-Jun-2017    | 09-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| Metals in solid samples by OES      | 14-Jun-2017    |                | 14-Jun-2017    | 13-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| PAH by GCMS                         | 12-Jun-2017    |                | 12-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    |                | 09-Jun-2017    |
| pH                                  | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    |
| Sample description                  | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    |



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170602-122  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412359  
Superseded Report:

## ASSOCIATED AQC DATA

### Anions by Kone (soil)

| Component                                 | Method Code | QC 1565        |
|-------------------------------------------|-------------|----------------|
| Chloride (soluble)                        | TM243       | 89.30 : 110.70 |
| Water Soluble Sulphate as SO4 2:1 Extract | TM243       | 70.45 : 129.55 |

### Cyanide Comp/Free/Total/Thiocyanate

| Component     | Method Code | QC 1571                         | QC 1577                         |
|---------------|-------------|---------------------------------|---------------------------------|
| Free Cyanide  | TM153       | <b>101.0</b><br>84.60 : 110.40  | <b>104.0</b><br>84.60 : 110.40  |
| Thiocyanate   | TM153       | <b>91.02</b><br>83.02 : 103.47  | <b>95.21</b><br>83.02 : 103.47  |
| Total Cyanide | TM153       | <b>104.29</b><br>87.53 : 111.13 | <b>107.86</b><br>87.53 : 111.13 |

### Hexavalent Chromium (s)

| Component           | Method Code | QC 1595                       | QC 1572                       |
|---------------------|-------------|-------------------------------|-------------------------------|
| Hexavalent Chromium | TM151       | <b>98.0</b><br>90.20 : 107.00 | <b>98.0</b><br>90.20 : 107.00 |

### Metals in solid samples by OES

| Component | Method Code | QC 1539                         | QC 1594                        | QC 1579                        |
|-----------|-------------|---------------------------------|--------------------------------|--------------------------------|
| Aluminium | TM181       | <b>94.81</b><br>80.01 : 112.97  | <b>86.67</b><br>80.01 : 119.99 | <b>87.41</b><br>80.01 : 119.99 |
| Antimony  | TM181       | <b>97.68</b><br>84.48 : 118.55  | <b>88.03</b><br>88.00 : 113.03 | <b>96.14</b><br>88.00 : 113.03 |
| Arsenic   | TM181       | <b>100.0</b><br>87.69 : 109.58  | <b>88.43</b><br>82.63 : 117.37 | <b>95.12</b><br>82.63 : 117.37 |
| Barium    | TM181       | <b>92.19</b><br>81.38 : 110.22  | <b>87.5</b><br>79.45 : 120.55  | <b>91.41</b><br>79.45 : 120.55 |
| Beryllium | TM181       | <b>95.55</b><br>85.83 : 108.41  | <b>91.44</b><br>82.93 : 117.07 | <b>93.15</b><br>82.93 : 117.07 |
| Boron     | TM181       | <b>97.18</b><br>83.88 : 109.63  | <b>85.31</b><br>69.98 : 130.02 | <b>88.98</b><br>69.98 : 130.02 |
| Cadmium   | TM181       | <b>97.87</b><br>88.34 : 110.05  | <b>97.34</b><br>81.95 : 118.05 | <b>98.94</b><br>81.95 : 118.05 |
| Chromium  | TM181       | <b>105.06</b><br>81.29 : 118.71 | <b>96.2</b><br>81.29 : 118.71  | <b>98.1</b><br>81.29 : 118.71  |
| Cobalt    | TM181       | <b>96.55</b><br>87.71 : 110.26  | <b>90.6</b><br>83.86 : 116.14  | <b>97.18</b><br>83.86 : 116.14 |
| Copper    | TM181       | <b>96.07</b><br>85.64 : 106.59  | <b>87.05</b><br>78.57 : 121.43 | <b>89.67</b><br>78.57 : 121.43 |
| Iron      | TM181       | <b>100.0</b><br>81.99 : 118.01  | <b>91.67</b><br>83.21 : 116.79 | <b>95.14</b><br>83.21 : 116.79 |
| Lead      | TM181       | <b>94.47</b><br>86.25 : 109.61  | <b>89.15</b><br>85.12 : 107.33 | <b>94.04</b><br>85.12 : 107.33 |



# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170602-122  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412359  
**Superseded Report:**

## Metals in solid samples by OES

|            |       | QC 1539                         | QC 1594                        | QC 1579                        |
|------------|-------|---------------------------------|--------------------------------|--------------------------------|
| Manganese  | TM181 | <b>90.51</b><br>82.29 : 105.35  | <b>87.68</b><br>82.91 : 117.09 | <b>91.72</b><br>82.91 : 117.09 |
| Mercury    | TM181 | <b>101.57</b><br>87.62 : 110.64 | <b>91.37</b><br>81.99 : 118.01 | <b>98.43</b><br>81.99 : 118.01 |
| Molybdenum | TM181 | <b>98.84</b><br>86.47 : 109.19  | <b>89.96</b><br>81.45 : 118.55 | <b>96.14</b><br>81.45 : 118.55 |
| Nickel     | TM181 | <b>96.5</b><br>87.43 : 110.63   | <b>89.74</b><br>79.64 : 120.36 | <b>96.97</b><br>79.64 : 120.36 |
| Phosphorus | TM181 | <b>90.87</b><br>77.53 : 107.97  |                                | <b>92.37</b><br>81.03 : 118.97 |
| Selenium   | TM181 | <b>97.63</b><br>86.31 : 108.23  | <b>85.16</b><br>83.31 : 116.69 | <b>94.66</b><br>83.31 : 116.69 |
| Strontium  | TM181 | <b>96.83</b><br>86.88 : 109.57  | <b>92.6</b><br>83.64 : 116.36  | <b>94.08</b><br>83.64 : 116.36 |
| Thallium   | TM181 | <b>94.92</b><br>85.06 : 112.06  | <b>87.89</b><br>81.18 : 118.82 | <b>92.58</b><br>81.18 : 118.82 |
| Tin        | TM181 | <b>95.39</b><br>85.70 : 112.34  | <b>90.78</b><br>81.44 : 118.56 | <b>97.87</b><br>81.44 : 118.56 |
| Titanium   | TM181 | <b>97.69</b><br>80.40 : 114.25  | <b>92.31</b><br>71.02 : 128.98 | <b>88.46</b><br>71.02 : 128.98 |
| Vanadium   | TM181 | <b>96.63</b><br>84.96 : 106.52  | <b>89.57</b><br>84.93 : 104.46 | <b>89.88</b><br>84.93 : 104.46 |
| Zinc       | TM181 | <b>100.7</b><br>87.17 : 108.73  | <b>92.32</b><br>88.64 : 107.38 | <b>93.37</b><br>88.64 : 107.38 |

## PAH by GCMS

| Component             | Method Code | QC 1546                       |
|-----------------------|-------------|-------------------------------|
| Acenaphthene          | TM218       | <b>99.5</b><br>85.94 : 114.58 |
| Acenaphthylene        | TM218       | <b>95.0</b><br>80.81 : 110.43 |
| Anthracene            | TM218       | <b>96.0</b><br>83.86 : 112.99 |
| Benz(a)anthracene     | TM218       | <b>93.0</b><br>80.00 : 122.30 |
| Benzo(a)pyrene        | TM218       | <b>95.0</b><br>81.81 : 125.38 |
| Benzo(b)fluoranthene  | TM218       | <b>96.0</b><br>84.53 : 122.14 |
| Benzo(ghi)perylene    | TM218       | <b>94.0</b><br>77.49 : 119.12 |
| Benzo(k)fluoranthene  | TM218       | <b>97.0</b><br>83.50 : 116.50 |
| Chrysene              | TM218       | <b>97.0</b><br>80.95 : 114.55 |
| Dibenzo(ah)anthracene | TM218       | <b>97.0</b><br>77.15 : 122.45 |
| Fluoranthene          | TM218       | <b>94.5</b><br>75.95 : 111.95 |
| Fluorene              | TM218       | <b>99.5</b><br>86.00 : 115.54 |
| Indeno(123cd)pyrene   | TM218       | <b>96.5</b><br>77.85 : 121.35 |



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170602-122  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412359  
Superseded Report:

## PAH by GCMS

|              |       | QC 1546                        |
|--------------|-------|--------------------------------|
| Naphthalene  | TM218 | <b>105.5</b><br>82.88 : 115.56 |
| Phenanthrene | TM218 | <b>97.5</b><br>85.89 : 116.33  |
| Pyrene       | TM218 | <b>95.0</b><br>75.60 : 111.00  |

## pH

| Component | Method Code | QC 1599                        |
|-----------|-------------|--------------------------------|
| pH        | TM133       | <b>99.74</b><br>97.92 : 102.08 |

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis.

The figure detailed is the percentage recovery result for the AQC.

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control.



# CERTIFICATE OF ANALYSIS

|                  |                     |                          |          |                           |        |
|------------------|---------------------|--------------------------|----------|---------------------------|--------|
| <b>SDG:</b>      | 170602-122          | <b>Client Reference:</b> | Maghull  | <b>Report Number:</b>     | 412359 |
| <b>Location:</b> | Maghull, Liverpool. | <b>Order Number:</b>     | 37158100 | <b>Superseded Report:</b> |        |

## Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH<sub>4</sub> by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

## General

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

## Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

|   |                                                                 |
|---|-----------------------------------------------------------------|
| 1 | Container with Headspace provided for volatiles analysis        |
| 2 | Incorrect container received                                    |
| 3 | Deviation from method                                           |
| 4 | Holding time exceeded before sample received                    |
| 5 | Samples exceeded holding time before preservation was performed |
| § | Sampled on date not provided                                    |
| ◆ | Sample holding time exceeded in laboratory                      |
| @ | Sample holding time exceeded due to sampled on date             |
| & | Sample Holding Time exceeded - Late arrival of instructions.    |

## Asbestos

### Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

| Asbestos Type           | Common Name    |
|-------------------------|----------------|
| Chrysotile              | White Asbestos |
| Amosite                 | Brown Asbestos |
| Crocidolite             | Blue Asbestos  |
| Fibrous Actinolite      | -              |
| Fibrous Anorthophyllite | -              |
| Fibrous Tremolite       | -              |

### Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

**Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.**

**The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.**



Unit 7-8 Hawarden Business Park  
Manor Road (off Manor Lane)  
Hawarden  
Deeside  
CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

ARCADIS UK Ltd  
2 Craven Court  
Willie Snaith Road  
Newmarket  
Suffolk  
CB8 7FA

**Attention:** Tom Costema

## CERTIFICATE OF ANALYSIS

**Date:** 13 June 2017  
**Customer:** H\_ARCADIS\_NMK  
**Sample Delivery Group (SDG):** 170603-36  
**Your Reference:** Maghull  
**Location:** Maghull, Liverpool.  
**Report No:** 412192

We received 16 samples on Saturday June 03, 2017 and 6 of these samples were scheduled for analysis which was completed on Tuesday June 13, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

**Sonia McWhan**

Operations Manager





## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170603-36  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412192  
**Superseded Report:**

### Received Sample Overview

| Lab Sample No(s) | Customer Sample Ref. | AGS Ref. | Depth (m)   | Sampled Date |
|------------------|----------------------|----------|-------------|--------------|
| 15627014         | TP111                |          | 0.40 - 0.60 | 31/05/2017   |
| 15627018         | TP111                |          | 0.90 - 1.10 | 31/05/2017   |
| 15627022         | TP112                |          | 0.00 - 0.40 | 31/05/2017   |
| 15627023         | TP112                |          | 2.00 - 2.20 | 31/05/2017   |
| 15627025         | TP114                |          | 0.00 - 0.40 | 31/05/2017   |
| 15627026         | TP114                |          | 0.40 - 0.60 | 31/05/2017   |
| 15627027         | TP116                |          | 0.00 - 0.40 | 31/05/2017   |
| 15627028         | TP116                |          | 0.60 - 0.85 | 31/05/2017   |
| 15627029         | TP117                |          | 0.45 - 0.60 | 31/05/2017   |
| 15627030         | TP117                |          | 1.00 - 1.30 | 31/05/2017   |
| 15627031         | TP118                |          | 0.40 - 0.60 | 31/05/2017   |
| 15627032         | TP118                |          | 2.00 - 2.20 | 31/05/2017   |
| 15627033         | TP119                |          | 0.90 - 1.10 | 31/05/2017   |
| 15627034         | TP119                |          | 1.10 - 1.30 | 31/05/2017   |
| 15627035         | TP120                |          | 0.00 - 0.40 | 31/05/2017   |
| 15627037         | TP120                |          | 0.40 - 0.60 | 31/05/2017   |

#### Maximum Sample/Coolbox Temperature (°C) :

**18.8**

#### ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

**Only received samples which have had analysis scheduled will be shown on the following pages.**



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170603-36  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412192  
Superseded Report:

## Results Legend



Test


No Determination  
Possible

## Sample Types -

S - Soil/Solid  
UNS - Unspecified Solid  
GW - Ground Water  
SW - Surface Water  
LE - Land Leachate  
PL - Prepared Leachate  
PR - Process Water  
SA - Saline Water  
TE - Trade Effluent  
TS - Treated Sewage  
US - Untreated Sewage  
RE - Recreational Water  
DW - Drinking Water Non-regulatory  
UNL - Unspecified Liquid  
SL - Sludge  
G - Gas  
OTH - Other

|                                     | Lab Sample No(s)          |                     | 15627022                | 15627023                | 15627025                | 15627028                | 15627030                | 15627035                |
|-------------------------------------|---------------------------|---------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                     | Customer Sample Reference |                     | TP112                   | TP112                   | TP114                   | TP116                   | TP117                   | TP120                   |
|                                     | AGS Reference             |                     |                         |                         |                         |                         |                         |                         |
|                                     | Depth (m)                 |                     | 0.00 - 0.40             | 2.00 - 2.20             | 0.00 - 0.40             | 0.60 - 0.85             | 1.00 - 1.30             | 0.00 - 0.40             |
|                                     | Container                 |                     | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) | 250g Amber Jar (ALE210) |
|                                     | Sample Type               |                     | S                       | S                       | S                       | S                       | S                       | S                       |
| Anions by Kone (soil)               | All                       | NDPs: 0<br>Tests: 2 |                         | X                       |                         |                         | X                       |                         |
| Cyanide Comp/Free/Total/Thiocyanate | All                       | NDPs: 0<br>Tests: 4 | X                       |                         | X                       | X                       |                         | X                       |
| Hexavalent Chromium (s)             | All                       | NDPs: 0<br>Tests: 4 | X                       |                         | X                       | X                       |                         | X                       |
| Metals in solid samples by OES      | All                       | NDPs: 0<br>Tests: 4 | X                       |                         | X                       | X                       |                         | X                       |
| PAH by GCMS                         | All                       | NDPs: 0<br>Tests: 4 | X                       |                         | X                       | X                       |                         | X                       |
| pH                                  | All                       | NDPs: 0<br>Tests: 6 | X                       | X                       | X                       | X                       | X                       | X                       |
| Sample description                  | All                       | NDPs: 0<br>Tests: 6 | X                       | X                       | X                       | X                       | X                       | X                       |



## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170603-36  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412192  
**Superseded Report:**

### Sample Descriptions

#### Grain Sizes

|                  |          |             |                 |               |             |               |            |                    |       |
|------------------|----------|-------------|-----------------|---------------|-------------|---------------|------------|--------------------|-------|
| <b>very fine</b> | <0.063mm | <b>fine</b> | 0.063mm - 0.1mm | <b>medium</b> | 0.1mm - 2mm | <b>coarse</b> | 2mm - 10mm | <b>very coarse</b> | >10mm |
|------------------|----------|-------------|-----------------|---------------|-------------|---------------|------------|--------------------|-------|

| Lab Sample No(s) | Customer Sample Ref. | Depth (m)   | Colour      | Description     | Inclusions | Inclusions 2 |
|------------------|----------------------|-------------|-------------|-----------------|------------|--------------|
| 15627022         | TP112                | 0.00 - 0.40 | Dark Brown  | Sandy Silt Loam | Vegetation | None         |
| 15627023         | TP112                | 2.00 - 2.20 | Light Brown | Sand            | Stones     | None         |
| 15627025         | TP114                | 0.00 - 0.40 | Dark Brown  | Sandy Loam      | Vegetation | Stones       |
| 15627028         | TP116                | 0.60 - 0.85 | Dark Brown  | Sand            | Vegetation | Stones       |
| 15627030         | TP117                | 1.00 - 1.30 | Dark Brown  | Clay            | None       | None         |
| 15627035         | TP120                | 0.00 - 0.40 | Dark Brown  | Loamy Sand      | Vegetation | Stones       |

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.







## CERTIFICATE OF ANALYSIS

**SDG:** 170603-36  
**Location:** Maghull, Liverpool.**Client Reference:** Maghull  
**Order Number:** 37158100**Report Number:** 412192  
**Superseded Report:**

## Table of Results - Appendix

| Method No | Reference                                         | Description                                                                                                                             | Wet/Dry Sample <sup>1</sup> | Surrogate Corrected |
|-----------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------|
| PM001     |                                                   | Preparation of Samples for Metals Analysis                                                                                              |                             |                     |
| PM024     | Modified BS 1377                                  | Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material                                   |                             |                     |
| TM133     | BS 1377: Part 3 1990;BS 6068-2.5                  | Determination of pH in Soil and Water using the GLpH pH Meter                                                                           |                             |                     |
| TM151     | Method 3500D, AWWA/APHA, 20th Ed., 1999           | Determination of Hexavalent Chromium using Kone analyser                                                                                |                             |                     |
| TM153     | Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999  | Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser |                             |                     |
| TM181     | US EPA Method 6010B                               | Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES                                                                        |                             |                     |
| TM218     | Determination of PAH by GCMS Microwave extraction | The determination of PAH in soil samples by microwave extraction and GC-MS                                                              |                             |                     |
| TM243     |                                                   | Mixed Anions In Soils By Kone                                                                                                           |                             |                     |

<sup>1</sup> Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



## CERTIFICATE OF ANALYSIS

SDG: 170603-36  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412192  
Superseded Report:

## Test Completion Dates

| Lab Sample No(s)                    | 15627022       | 15627023       | 15627025       | 15627028       | 15627030       | 15627035       |
|-------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.                | TP112          | TP112          | TP114          | TP116          | TP117          | TP120          |
| AGS Ref.                            |                |                |                |                |                |                |
| Depth                               | 0.00 - 0.40    | 2.00 - 2.20    | 0.00 - 0.40    | 0.60 - 0.85    | 1.00 - 1.30    | 0.00 - 0.40    |
| Type                                | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil)               |                | 12-Jun-2017    |                |                | 13-Jun-2017    |                |
| Cyanide Comp/Free/Total/Thiocyanate | 13-Jun-2017    |                | 13-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| Hexavalent Chromium (s)             | 13-Jun-2017    |                | 09-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| Metals in solid samples by OES      | 12-Jun-2017    |                | 13-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    |
| PAH by GCMS                         | 12-Jun-2017    |                | 09-Jun-2017    | 09-Jun-2017    |                | 09-Jun-2017    |
| pH                                  | 12-Jun-2017    | 12-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    |
| Sample description                  | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    |



## CERTIFICATE OF ANALYSIS

Validated

SDG: 170603-36  
Location: Maghull, Liverpool.Client Reference: Maghull  
Order Number: 37158100Report Number: 412192  
Superseded Report:

## ASSOCIATED AQC DATA

## Anions by Kone (soil)

| Component                                 | Method Code | QC 1560        | QC 1591        |
|-------------------------------------------|-------------|----------------|----------------|
| Chloride (soluble)                        | TM243       | 89.30 : 110.70 | 89.30 : 110.70 |
| Water Soluble Sulphate as SO4 2:1 Extract | TM243       | 70.45 : 129.55 | 70.45 : 129.55 |

## Cyanide Comp/Free/Total/Thiocyanate

| Component     | Method Code | QC 1565                         | QC 1571                         | QC 1577                         |
|---------------|-------------|---------------------------------|---------------------------------|---------------------------------|
| Free Cyanide  | TM153       | <b>98.5</b><br>84.60 : 110.40   | <b>101.0</b><br>84.60 : 110.40  | <b>104.0</b><br>84.60 : 110.40  |
| Thiocyanate   | TM153       | <b>91.62</b><br>83.02 : 103.47  | <b>91.02</b><br>83.02 : 103.47  | <b>95.21</b><br>83.02 : 103.47  |
| Total Cyanide | TM153       | <b>106.43</b><br>87.53 : 111.13 | <b>104.29</b><br>87.53 : 111.13 | <b>107.86</b><br>87.53 : 111.13 |

## Hexavalent Chromium (s)

| Component           | Method Code | QC 1595                       | QC 1572                       |
|---------------------|-------------|-------------------------------|-------------------------------|
| Hexavalent Chromium | TM151       | <b>98.0</b><br>90.20 : 107.00 | <b>98.0</b><br>90.20 : 107.00 |

## Metals in solid samples by OES

| Component | Method Code | QC 1521                         | QC 1539                         |
|-----------|-------------|---------------------------------|---------------------------------|
| Aluminium | TM181       | <b>96.3</b><br>80.01 : 119.99   | <b>94.81</b><br>80.01 : 112.97  |
| Antimony  | TM181       | <b>98.07</b><br>88.00 : 113.03  | <b>97.68</b><br>84.48 : 118.55  |
| Arsenic   | TM181       | <b>97.43</b><br>82.63 : 117.37  | <b>100.0</b><br>87.69 : 109.58  |
| Barium    | TM181       | <b>95.31</b><br>79.45 : 120.55  | <b>92.19</b><br>81.38 : 110.22  |
| Beryllium | TM181       | <b>100.0</b><br>82.93 : 117.07  | <b>95.55</b><br>85.83 : 108.41  |
| Boron     | TM181       | <b>99.72</b><br>69.98 : 130.02  | <b>97.18</b><br>83.88 : 109.63  |
| Cadmium   | TM181       | <b>106.38</b><br>81.95 : 118.05 | <b>97.87</b><br>88.34 : 110.05  |
| Chromium  | TM181       | <b>109.28</b><br>81.29 : 118.71 | <b>105.06</b><br>81.29 : 118.71 |
| Cobalt    | TM181       | <b>100.0</b><br>83.86 : 116.14  | <b>96.55</b><br>87.71 : 110.26  |
| Copper    | TM181       | <b>99.71</b><br>78.57 : 121.43  | <b>96.07</b><br>85.64 : 106.59  |
| Iron      | TM181       | <b>102.78</b><br>83.21 : 116.79 | <b>100.0</b><br>81.99 : 118.01  |
| Lead      | TM181       | <b>97.02</b><br>85.12 : 107.33  | <b>94.47</b><br>86.25 : 109.61  |



# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170603-36  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412192  
**Superseded Report:**

## Metals in solid samples by OES

|            |       | QC 1521                         | QC 1539                         |
|------------|-------|---------------------------------|---------------------------------|
| Manganese  | TM181 | <b>94.95</b><br>82.91 : 117.09  | <b>90.51</b><br>82.29 : 105.35  |
| Mercury    | TM181 | <b>100.78</b><br>81.99 : 118.01 | <b>101.57</b><br>87.62 : 110.64 |
| Molybdenum | TM181 | <b>98.84</b><br>81.45 : 118.55  | <b>98.84</b><br>86.47 : 109.19  |
| Nickel     | TM181 | <b>99.07</b><br>79.64 : 120.36  | <b>96.5</b><br>87.43 : 110.63   |
| Phosphorus | TM181 | <b>92.22</b><br>81.03 : 118.97  | <b>90.87</b><br>77.53 : 107.97  |
| Selenium   | TM181 | <b>97.63</b><br>83.31 : 116.69  | <b>97.63</b><br>86.31 : 108.23  |
| Strontium  | TM181 | <b>108.25</b><br>83.64 : 116.36 | <b>96.83</b><br>86.88 : 109.57  |
| Thallium   | TM181 | <b>96.09</b><br>81.18 : 118.82  | <b>94.92</b><br>85.06 : 112.06  |
| Tin        | TM181 | <b>100.35</b><br>81.44 : 118.56 | <b>95.39</b><br>85.70 : 112.34  |
| Titanium   | TM181 | <b>104.62</b><br>71.02 : 128.98 | <b>97.69</b><br>80.40 : 114.25  |
| Vanadium   | TM181 | <b>103.99</b><br>84.93 : 104.46 | <b>96.63</b><br>84.96 : 106.52  |
| Zinc       | TM181 | <b>100.35</b><br>88.64 : 107.38 | <b>100.7</b><br>87.17 : 108.73  |

## PAH by GCMS

| Component             | Method Code | QC 1546                       | QC 1567                        | QC 1542                        |
|-----------------------|-------------|-------------------------------|--------------------------------|--------------------------------|
| Acenaphthene          | TM218       | <b>99.5</b><br>85.94 : 114.58 | <b>104.5</b><br>79.20 : 110.98 | <b>107.5</b><br>86.71 : 113.69 |
| Acenaphthylene        | TM218       | <b>95.0</b><br>80.81 : 110.43 | <b>92.5</b><br>72.87 : 102.50  | <b>99.5</b><br>82.45 : 109.59  |
| Anthracene            | TM218       | <b>96.0</b><br>83.86 : 112.99 | <b>95.5</b><br>77.17 : 105.56  | <b>99.0</b><br>81.57 : 109.85  |
| Benz(a)anthracene     | TM218       | <b>93.0</b><br>80.00 : 122.30 | <b>110.0</b><br>80.20 : 118.53 | <b>98.5</b><br>80.40 : 121.27  |
| Benzo(a)pyrene        | TM218       | <b>95.0</b><br>81.81 : 125.38 | <b>110.0</b><br>83.44 : 122.62 | <b>99.5</b><br>82.28 : 120.13  |
| Benzo(b)fluoranthene  | TM218       | <b>96.0</b><br>84.53 : 122.14 | <b>109.5</b><br>79.54 : 122.43 | <b>107.5</b><br>82.24 : 121.86 |
| Benzo(ghi)perylene    | TM218       | <b>94.0</b><br>77.49 : 119.12 | <b>104.5</b><br>77.15 : 115.92 | <b>100.0</b><br>83.49 : 115.72 |
| Benzo(k)fluoranthene  | TM218       | <b>97.0</b><br>83.50 : 116.50 | <b>106.0</b><br>80.72 : 116.31 | <b>102.5</b><br>84.32 : 113.31 |
| Chrysene              | TM218       | <b>97.0</b><br>80.95 : 114.55 | <b>102.5</b><br>80.86 : 112.71 | <b>102.0</b><br>86.11 : 112.00 |
| Dibenzo(ah)anthracene | TM218       | <b>97.0</b><br>77.15 : 122.45 | <b>106.0</b><br>78.34 : 116.59 | <b>104.0</b><br>83.84 : 116.37 |
| Fluoranthene          | TM218       | <b>94.5</b><br>75.95 : 111.95 | <b>101.5</b><br>80.37 : 111.80 | <b>101.0</b><br>81.40 : 111.81 |
| Fluorene              | TM218       | <b>99.5</b><br>86.00 : 115.54 | <b>100.0</b><br>79.98 : 109.78 | <b>103.0</b><br>85.09 : 113.02 |
| Indeno(123cd)pyrene   | TM218       | <b>96.5</b><br>77.85 : 121.35 | <b>105.5</b><br>78.42 : 117.36 | <b>101.0</b><br>83.72 : 116.90 |



## CERTIFICATE OF ANALYSIS

**SDG:** 170603-36  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412192  
**Superseded Report:**

## PAH by GCMS

|              |       | QC 1546                        | QC 1567                        | QC 1542                        |
|--------------|-------|--------------------------------|--------------------------------|--------------------------------|
| Naphthalene  | TM218 | <b>105.5</b><br>82.88 : 115.56 | <b>102.5</b><br>74.42 : 111.97 | <b>105.5</b><br>84.24 : 113.39 |
| Phenanthrene | TM218 | <b>97.5</b><br>85.89 : 116.33  | <b>102.5</b><br>80.52 : 110.11 | <b>103.5</b><br>83.88 : 111.41 |
| Pyrene       | TM218 | <b>95.0</b><br>75.60 : 111.00  | <b>99.0</b><br>79.57 : 110.12  | <b>100.0</b><br>79.67 : 111.26 |

## pH

| Component | Method Code | QC 1599                        | QC 1502                        |
|-----------|-------------|--------------------------------|--------------------------------|
| pH        | TM133       | <b>99.74</b><br>97.92 : 102.08 | <b>99.87</b><br>97.92 : 102.08 |

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis.

The figure detailed is the percentage recovery result for the AQC.

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control.



# CERTIFICATE OF ANALYSIS

|                  |                     |                          |          |                           |        |
|------------------|---------------------|--------------------------|----------|---------------------------|--------|
| <b>SDG:</b>      | 170603-36           | <b>Client Reference:</b> | Maghull  | <b>Report Number:</b>     | 412192 |
| <b>Location:</b> | Maghull, Liverpool. | <b>Order Number:</b>     | 37158100 | <b>Superseded Report:</b> |        |

## Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH<sub>4</sub> by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

## General

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

## Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

|   |                                                                 |
|---|-----------------------------------------------------------------|
| 1 | Container with Headspace provided for volatiles analysis        |
| 2 | Incorrect container received                                    |
| 3 | Deviation from method                                           |
| 4 | Holding time exceeded before sample received                    |
| 5 | Samples exceeded holding time before preservation was performed |
| § | Sampled on date not provided                                    |
| ◆ | Sample holding time exceeded in laboratory                      |
| @ | Sample holding time exceeded due to sampled on date             |
| & | Sample Holding Time exceeded - Late arrival of instructions.    |

## Asbestos

### Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

| Asbestos Type           | Common Name    |
|-------------------------|----------------|
| Chrysotile              | White Asbestos |
| Amosite                 | Brown Asbestos |
| Crocidolite             | Blue Asbestos  |
| Fibrous Actinolite      | -              |
| Fibrous Anorthophyllite | -              |
| Fibrous Tremolite       | -              |

### Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

**Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.**

**The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.**



Unit 7-8 Hawarden Business Park

Manor Road (off Manor Lane)

Hawarden

Deeside

CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

ARCADIS UK Ltd  
2 Craven Court  
Willie Snaith Road  
Newmarket  
Suffolk  
CB8 7FA

**Attention:** Tom Costema

## CERTIFICATE OF ANALYSIS

**Date:** 13 June 2017  
**Customer:** H\_ARCADIS\_NMK  
**Sample Delivery Group (SDG):** 170605-39  
**Your Reference:** Maghull  
**Location:** Maghull, Liverpool.  
**Report No:** 412199

We received 15 samples on Saturday June 03, 2017 and 8 of these samples were scheduled for analysis which was completed on Tuesday June 13, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

**Sonia McWhan**

Operations Manager





## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170605-39  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412199  
**Superseded Report:**

### Received Sample Overview

| Lab Sample No(s) | Customer Sample Ref. | AGS Ref. | Depth (m)   | Sampled Date |
|------------------|----------------------|----------|-------------|--------------|
| 15632922         | TP 108               |          | 0.00 - 0.30 | 01/06/2017   |
| 15632923         | TP 108               |          | 2.20 - 2.50 | 01/06/2017   |
| 15632924         | TP 109               |          | 0.40 - 0.60 | 01/06/2017   |
| 15632925         | TP 109               |          | 1.00 - 1.20 | 01/06/2017   |
| 15632926         | TP 110               |          | 0.00 - 0.50 | 01/06/2017   |
| 15632927         | TP 110               |          | 2.80 - 3.00 | 01/06/2017   |
| 15632928         | TP 113               |          | 0.50 - 0.70 | 01/06/2017   |
| 15632929         | TP 113               |          | 0.70 - 0.90 | 01/06/2017   |
| 15632930         | TP 115               |          | 0.00 - 0.50 | 01/06/2017   |
| 15632931         | TP 115               |          | 1.50 - 1.70 | 01/06/2017   |
| 15632917         | WS 101               |          | 0.50        | 01/06/2017   |
| 15632918         | WS 102               |          | 0.20        | 01/06/2017   |
| 15632919         | WS 104               |          | 0.20        | 01/06/2017   |
| 15632920         | WS 104               |          | 0.60        | 01/06/2017   |
| 15632921         | WS 109               |          | 0.00 - 0.60 | 01/06/2017   |

#### Maximum Sample/Coolbox Temperature (°C) :

**21.4**

#### ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

**Only received samples which have had analysis scheduled will be shown on the following pages.**



# CERTIFICATE OF ANALYSIS

**SDG:** 170605-39  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412199  
**Superseded Report:**

## Results Legend



Test



No Determination Possible

## Sample Types -

S - Soil/Solid  
 UNS - Unspecified Solid  
 GW - Ground Water  
 SW - Surface Water  
 LE - Land Leachate  
 PL - Prepared Leachate  
 PR - Process Water  
 SA - Saline Water  
 TE - Trade Effluent  
 TS - Treated Sewage  
 US - Untreated Sewage  
 RE - Recreational Water  
 DW - Drinking Water Non-regulatory  
 UNL - Unspecified Liquid  
 SL - Sludge  
 G - Gas  
 OTH - Other

|                                     | Lab Sample No(s) |        | Customer Sample Reference |   | AGS Reference |  | Depth (m)   |  | Container               |   | Sample Type |  |
|-------------------------------------|------------------|--------|---------------------------|---|---------------|--|-------------|--|-------------------------|---|-------------|--|
|                                     | 15632921         | WS 109 |                           |   |               |  | 0.00 - 0.60 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632920         | WS 104 |                           |   |               |  | 0.60        |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632931         | TP 115 |                           |   |               |  | 1.50 - 1.70 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632929         | TP 113 |                           |   |               |  | 0.70 - 0.90 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632926         | TP 110 |                           |   |               |  | 0.00 - 0.50 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632924         | TP 109 |                           |   |               |  | 0.40 - 0.60 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632923         | TP 108 |                           |   |               |  | 2.20 - 2.50 |  | 250g Amber Jar (ALE210) | S |             |  |
|                                     | 15632922         | TP 108 |                           |   |               |  | 0.00 - 0.30 |  | 250g Amber Jar (ALE210) | S |             |  |
| Anions by Kone (soil)               | All              |        | NDPs: 0<br>Tests: 2       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   |               |  |             |  |                         |   |             |  |
| Cyanide Comp/Free/Total/Thiocyanate | All              |        | NDPs: 0<br>Tests: 6       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   |               |  |             |  |                         |   |             |  |
| Hexavalent Chromium (s)             | All              |        | NDPs: 0<br>Tests: 6       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   |               |  |             |  |                         |   |             |  |
| Metals in solid samples by OES      | All              |        | NDPs: 0<br>Tests: 6       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   |               |  |             |  |                         |   |             |  |
| PAH by GCMS                         | All              |        | NDPs: 0<br>Tests: 6       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   |               |  |             |  |                         |   |             |  |
| pH                                  | All              |        | NDPs: 0<br>Tests: 8       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
| Sample description                  | All              |        | NDPs: 0<br>Tests: 8       |   |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           | X |               |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |
|                                     |                  |        |                           |   | X             |  |             |  |                         |   |             |  |



## CERTIFICATE OF ANALYSIS

**SDG:** 170605-39  
**Location:** Maghull, Liverpool.**Client Reference:** Maghull  
**Order Number:** 37158100**Report Number:** 412199  
**Superseded Report:**

## Sample Descriptions

## Grain Sizes

|           |          |      |                 |        |             |        |            |             |       |
|-----------|----------|------|-----------------|--------|-------------|--------|------------|-------------|-------|
| very fine | <0.063mm | fine | 0.063mm - 0.1mm | medium | 0.1mm - 2mm | coarse | 2mm - 10mm | very coarse | >10mm |
|-----------|----------|------|-----------------|--------|-------------|--------|------------|-------------|-------|

| Lab Sample No(s) | Customer Sample Ref. | Depth (m)   | Colour      | Description | Inclusions | Inclusions 2 |
|------------------|----------------------|-------------|-------------|-------------|------------|--------------|
| 15632922         | TP 108               | 0.00 - 0.30 | Dark Brown  | Sand        | Vegetation | Stones       |
| 15632923         | TP 108               | 2.20 - 2.50 | Light Brown | Sand        | Stones     | None         |
| 15632924         | TP 109               | 0.40 - 0.60 | Dark Brown  | Sand        | Stones     | None         |
| 15632926         | TP 110               | 0.00 - 0.50 | Dark Brown  | Sand        | Stones     | Vegetation   |
| 15632929         | TP 113               | 0.70 - 0.90 | Dark Brown  | Clay Loam   | Stones     | None         |
| 15632931         | TP 115               | 1.50 - 1.70 | Dark Brown  | Sandy Clay  | Vegetation | Stones       |
| 15632920         | WS 104               | 0.60        | Light Brown | Sand        | None       | None         |
| 15632921         | WS 109               | 0.00 - 0.60 | Dark Brown  | Sand        | Stones     | Vegetation   |

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.









## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170605-39  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412199  
**Superseded Report:**

### Table of Results - Appendix

| Method No | Reference                                         | Description                                                                                                                             | Wet/Dry Sample <sup>1</sup> | Surrogate Corrected |
|-----------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------|
| PM001     |                                                   | Preparation of Samples for Metals Analysis                                                                                              |                             |                     |
| PM024     | Modified BS 1377                                  | Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material                                   |                             |                     |
| TM133     | BS 1377: Part 3 1990;BS 6068-2.5                  | Determination of pH in Soil and Water using the GLpH pH Meter                                                                           |                             |                     |
| TM151     | Method 3500D, AWWA/APHA, 20th Ed., 1999           | Determination of Hexavalent Chromium using Kone analyser                                                                                |                             |                     |
| TM153     | Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999  | Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser |                             |                     |
| TM181     | US EPA Method 6010B                               | Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES                                                                        |                             |                     |
| TM218     | Determination of PAH by GCMS Microwave extraction | The determination of PAH in soil samples by microwave extraction and GC-MS                                                              |                             |                     |
| TM243     |                                                   | Mixed Anions In Soils By Kone                                                                                                           |                             |                     |

<sup>1</sup> Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



## CERTIFICATE OF ANALYSIS

SDG: 170605-39  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412199  
Superseded Report:

## Test Completion Dates

| Lab Sample No(s)                    | 15632922       | 15632923       | 15632924       | 15632926       | 15632929       | 15632931       | 15632920       | 15632921       |
|-------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.                | TP 108         | TP 108         | TP 109         | TP 110         | TP 113         | TP 115         | WS 104         | WS 109         |
| AGS Ref.                            |                |                |                |                |                |                |                |                |
| Depth                               | 0.00 - 0.30    | 2.20 - 2.50    | 0.40 - 0.60    | 0.00 - 0.50    | 0.70 - 0.90    | 1.50 - 1.70    | 0.60           | 0.00 - 0.60    |
| Type                                | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil)               |                | 13-Jun-2017    |                |                |                | 13-Jun-2017    |                |                |
| Cyanide Comp/Free/Total/Thiocyanate | 13-Jun-2017    |                | 13-Jun-2017    | 13-Jun-2017    | 13-Jun-2017    |                | 13-Jun-2017    | 13-Jun-2017    |
| Hexavalent Chromium (s)             | 08-Jun-2017    |                | 08-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    |                | 08-Jun-2017    | 08-Jun-2017    |
| Metals in solid samples by OES      | 12-Jun-2017    |                | 12-Jun-2017    | 12-Jun-2017    | 13-Jun-2017    |                | 12-Jun-2017    | 12-Jun-2017    |
| PAH by GCMS                         | 12-Jun-2017    |                | 12-Jun-2017    | 12-Jun-2017    | 12-Jun-2017    |                | 12-Jun-2017    | 09-Jun-2017    |
| pH                                  | 09-Jun-2017    | 13-Jun-2017    | 12-Jun-2017    | 13-Jun-2017    | 12-Jun-2017    | 12-Jun-2017    | 09-Jun-2017    | 12-Jun-2017    |
| Sample description                  | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    | 06-Jun-2017    |



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170605-39  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412199  
Superseded Report:

## ASSOCIATED AQC DATA

### Anions by Kone (soil)

| Component                                 | Method Code | QC 1565        |
|-------------------------------------------|-------------|----------------|
| Chloride (soluble)                        | TM243       | 89.30 : 110.70 |
| Water Soluble Sulphate as SO4 2:1 Extract | TM243       | 70.45 : 129.55 |

### Cyanide Comp/Free/Total/Thiocyanate

| Component     | Method Code | QC 1565                         | QC 1571                         |
|---------------|-------------|---------------------------------|---------------------------------|
| Free Cyanide  | TM153       | <b>98.5</b><br>84.60 : 110.40   | <b>101.0</b><br>84.60 : 110.40  |
| Thiocyanate   | TM153       | <b>91.62</b><br>83.02 : 103.47  | <b>91.02</b><br>83.02 : 103.47  |
| Total Cyanide | TM153       | <b>106.43</b><br>87.53 : 111.13 | <b>104.29</b><br>87.53 : 111.13 |

### Hexavalent Chromium (s)

| Component           | Method Code | QC 1544                       |
|---------------------|-------------|-------------------------------|
| Hexavalent Chromium | TM151       | <b>96.0</b><br>90.20 : 107.00 |

### Metals in solid samples by OES

| Component | Method Code | QC 1581                         | QC 1583                         |
|-----------|-------------|---------------------------------|---------------------------------|
| Aluminium | TM181       | <b>94.07</b><br>80.01 : 112.97  | <b>100.74</b><br>80.01 : 119.99 |
| Antimony  | TM181       | <b>97.68</b><br>84.48 : 118.55  | <b>97.3</b><br>88.00 : 113.03   |
| Arsenic   | TM181       | <b>103.08</b><br>87.69 : 109.58 | <b>95.89</b><br>82.63 : 117.37  |
| Barium    | TM181       | <b>91.41</b><br>81.38 : 110.22  | <b>98.44</b><br>79.45 : 120.55  |
| Beryllium | TM181       | <b>94.52</b><br>85.83 : 108.41  | <b>96.58</b><br>82.93 : 117.07  |
| Boron     | TM181       | <b>96.89</b><br>83.88 : 109.63  | <b>96.33</b><br>69.98 : 130.02  |
| Cadmium   | TM181       | <b>95.74</b><br>88.34 : 110.05  | <b>103.19</b><br>81.95 : 118.05 |
| Chromium  | TM181       | <b>109.49</b><br>81.29 : 118.71 | <b>100.42</b><br>81.29 : 118.71 |
| Cobalt    | TM181       | <b>96.24</b><br>87.71 : 110.26  | <b>98.12</b><br>83.86 : 116.14  |
| Copper    | TM181       | <b>99.56</b><br>85.64 : 106.59  | <b>92.29</b><br>78.57 : 121.43  |
| Iron      | TM181       | <b>96.53</b><br>81.99 : 118.01  | <b>104.17</b><br>83.21 : 116.79 |
| Lead      | TM181       | <b>93.19</b><br>86.25 : 109.61  | <b>94.26</b><br>85.12 : 107.33  |



# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170605-39  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412199  
**Superseded Report:**

## Metals in solid samples by OES

|            |       | QC 1581                         | QC 1583                         |
|------------|-------|---------------------------------|---------------------------------|
| Manganese  | TM181 | <b>92.32</b><br>82.29 : 105.35  | <b>90.51</b><br>82.91 : 117.09  |
| Mercury    | TM181 | <b>104.31</b><br>87.62 : 110.64 | <b>99.61</b><br>81.99 : 118.01  |
| Molybdenum | TM181 | <b>100.77</b><br>86.47 : 109.19 | <b>98.46</b><br>81.45 : 118.55  |
| Nickel     | TM181 | <b>95.8</b><br>87.43 : 110.63   | <b>97.9</b><br>79.64 : 120.36   |
| Phosphorus | TM181 | <b>90.12</b><br>77.53 : 107.97  | <b>108.23</b><br>81.03 : 118.97 |
| Selenium   | TM181 | <b>99.41</b><br>86.31 : 108.23  | <b>95.55</b><br>83.31 : 116.69  |
| Strontium  | TM181 | <b>97.46</b><br>86.88 : 109.57  | <b>99.79</b><br>83.64 : 116.36  |
| Thallium   | TM181 | <b>99.61</b><br>85.06 : 112.06  | <b>94.53</b><br>81.18 : 118.82  |
| Tin        | TM181 | <b>93.62</b><br>85.70 : 112.34  | <b>100.0</b><br>81.44 : 118.56  |
| Titanium   | TM181 | <b>89.23</b><br>80.40 : 114.25  | <b>100.77</b><br>71.02 : 128.98 |
| Vanadium   | TM181 | <b>98.16</b><br>84.96 : 106.52  | <b>95.71</b><br>84.93 : 104.46  |
| Zinc       | TM181 | <b>99.3</b><br>87.17 : 108.73   | <b>97.21</b><br>88.64 : 107.38  |

## PAH by GCMS

| Component             | Method Code | QC 1542                        | QC 1505                        |
|-----------------------|-------------|--------------------------------|--------------------------------|
| Acenaphthene          | TM218       | <b>107.5</b><br>86.71 : 113.69 | <b>109.0</b><br>86.71 : 113.69 |
| Acenaphthylene        | TM218       | <b>99.5</b><br>82.45 : 109.59  | <b>106.0</b><br>82.45 : 109.59 |
| Anthracene            | TM218       | <b>99.0</b><br>81.57 : 109.85  | <b>104.5</b><br>81.57 : 109.85 |
| Benz(a)anthracene     | TM218       | <b>98.5</b><br>80.40 : 121.27  | <b>117.0</b><br>80.40 : 121.27 |
| Benzo(a)pyrene        | TM218       | <b>99.5</b><br>82.28 : 120.13  | <b>119.0</b><br>82.28 : 120.13 |
| Benzo(b)fluoranthene  | TM218       | <b>107.5</b><br>82.24 : 121.86 | <b>110.0</b><br>82.24 : 121.86 |
| Benzo(ghi)perylene    | TM218       | <b>100.0</b><br>83.49 : 115.72 | <b>115.5</b><br>83.49 : 115.72 |
| Benzo(k)fluoranthene  | TM218       | <b>102.5</b><br>84.32 : 113.31 | <b>111.5</b><br>84.32 : 113.31 |
| Chrysene              | TM218       | <b>102.0</b><br>86.11 : 112.00 | <b>108.0</b><br>86.11 : 112.00 |
| Dibenzo(ah)anthracene | TM218       | <b>104.0</b><br>83.84 : 116.37 | <b>116.0</b><br>83.84 : 116.37 |
| Fluoranthene          | TM218       | <b>101.0</b><br>81.40 : 111.81 | <b>107.5</b><br>81.40 : 111.81 |
| Fluorene              | TM218       | <b>103.0</b><br>85.09 : 113.02 | <b>110.5</b><br>85.09 : 113.02 |
| Indeno(123cd)pyrene   | TM218       | <b>101.0</b><br>83.72 : 116.90 | <b>116.5</b><br>83.72 : 116.90 |



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170605-39  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412199  
Superseded Report:

PAH by GCMS

|              |       | QC 1542                        | QC 1505                        |
|--------------|-------|--------------------------------|--------------------------------|
| Naphthalene  | TM218 | <b>105.5</b><br>84.24 : 113.39 | <b>109.5</b><br>84.24 : 113.39 |
| Phenanthrene | TM218 | <b>103.5</b><br>83.88 : 111.41 | <b>107.5</b><br>83.88 : 111.41 |
| Pyrene       | TM218 | <b>100.0</b><br>79.67 : 111.26 | <b>105.5</b><br>79.67 : 111.26 |

pH

| Component | Method Code | QC 1565                       | QC 1515                        | QC 1518                         | QC 1556                         |
|-----------|-------------|-------------------------------|--------------------------------|---------------------------------|---------------------------------|
| pH        | TM133       | <b>99.1</b><br>97.92 : 102.08 | <b>99.49</b><br>97.92 : 102.08 | <b>100.13</b><br>97.92 : 102.08 | <b>100.77</b><br>98.98 : 102.05 |

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis .

The figure detailed is the percentage recovery result for the AQC .

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control .



# CERTIFICATE OF ANALYSIS

|                  |                     |                          |          |                           |        |
|------------------|---------------------|--------------------------|----------|---------------------------|--------|
| <b>SDG:</b>      | 170605-39           | <b>Client Reference:</b> | Maghull  | <b>Report Number:</b>     | 412199 |
| <b>Location:</b> | Maghull, Liverpool. | <b>Order Number:</b>     | 37158100 | <b>Superseded Report:</b> |        |

## Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH<sub>4</sub> by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

## General

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

## Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

|   |                                                                 |
|---|-----------------------------------------------------------------|
| 1 | Container with Headspace provided for volatiles analysis        |
| 2 | Incorrect container received                                    |
| 3 | Deviation from method                                           |
| 4 | Holding time exceeded before sample received                    |
| 5 | Samples exceeded holding time before preservation was performed |
| § | Sampled on date not provided                                    |
| ◆ | Sample holding time exceeded in laboratory                      |
| @ | Sample holding time exceeded due to sampled on date             |
| & | Sample Holding Time exceeded - Late arrival of instructions.    |

## Asbestos

### Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

| Asbestos Type           | Common Name    |
|-------------------------|----------------|
| Chrysotile              | White Asbestos |
| Amosite                 | Brown Asbestos |
| Crocidolite             | Blue Asbestos  |
| Fibrous Actinolite      | -              |
| Fibrous Anorthophyllite | -              |
| Fibrous Tremolite       | -              |

### Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

**Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.**

**The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.**



Unit 7-8 Hawarden Business Park  
Manor Road (off Manor Lane)  
Hawarden  
Deeside  
CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

ARCADIS UK Ltd  
2 Craven Court  
Willie Snaith Road  
Newmarket  
Suffolk  
CB8 7FA

**Attention:** Tom Costema

## CERTIFICATE OF ANALYSIS

**Date:** 15 June 2017  
**Customer:** H\_ARCADIS\_NMK  
**Sample Delivery Group (SDG):** 170607-72  
**Your Reference:** Maghull  
**Location:** Maghull, Liverpool.  
**Report No:** 412603

We received 32 samples on Wednesday June 07, 2017 and 24 of these samples were scheduled for analysis which was completed on Thursday June 15, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

**Sonia McWhan**

Operations Manager





## CERTIFICATE OF ANALYSIS

Validated

SDG: 170607-72  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412603  
Superseded Report:

### Received Sample Overview

| Lab Sample No(s) | Customer Sample Ref. | AGS Ref. | Depth (m)   | Sampled Date |
|------------------|----------------------|----------|-------------|--------------|
| 15643167         | WS101                |          | 1.20 - 1.65 | 02/06/2017   |
| 15643166         | WS101                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643164         | WS102                |          | 1.20 - 1.65 | 02/06/2017   |
| 15643179         | WS103                |          | 0.70 - 0.80 | 02/06/2017   |
| 15643173         | WS103                |          | 2.00 - 2.45 | 02/06/2017   |
| 15643169         | WS103                |          | 4.00 - 4.45 | 02/06/2017   |
| 15643163         | WS104                |          | 1.50        | 02/06/2017   |
| 15643172         | WS104                |          | 4.00 - 4.45 | 02/06/2017   |
| 15643175         | WS105                |          | 0.30        | 02/06/2017   |
| 15643165         | WS105                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643168         | WS105                |          | 5.00 - 5.45 | 02/06/2017   |
| 15643178         | WS106                |          | 0.40        | 02/06/2017   |
| 15643156         | WS106                |          | 1.20 - 1.65 | 02/06/2017   |
| 15643155         | WS106                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643180         | WS107                |          | 0.30 - 0.40 | 02/06/2017   |
| 15643145         | WS107                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643146         | WS107                |          | 5.00 - 5.45 | 02/06/2017   |
| 15643177         | WS108                |          | 0.10 - 0.20 | 02/06/2017   |
| 15643148         | WS108                |          | 2.00 - 2.45 | 02/06/2017   |
| 15643144         | WS108                |          | 4.00 - 4.45 | 02/06/2017   |
| 15643151         | WS109                |          | 2.00 - 2.45 | 02/06/2017   |
| 15643174         | WS110                |          | 0.40 - 0.60 | 02/06/2017   |
| 15643158         | WS110                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643159         | WS110                |          | 5.00 - 5.45 | 02/06/2017   |
| 15643176         | WS111                |          | 0.50 - 0.60 | 02/06/2017   |
| 15643152         | WS111                |          | 1.20 - 1.65 | 02/06/2017   |
| 15643153         | WS111                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643181         | WS114                |          | 0.30        | 02/06/2017   |
| 15643162         | WS114                |          | 3.00 - 3.45 | 02/06/2017   |
| 15643147         | WS114                |          | 5.00 - 5.45 | 02/06/2017   |
| 15643149         | WS115                |          | 2.00 - 2.45 | 02/06/2017   |
| 15643160         | WS115                |          | 4.00 - 4.45 | 02/06/2017   |

#### Maximum Sample/Coolbox Temperature (°C) :

10.0

#### ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.



|          |       |  |             |                   |   |   |   |   |
|----------|-------|--|-------------|-------------------|---|---|---|---|
| 15643160 | WS115 |  | 4.00 - 4.45 | 400g Tub (ALE214) | S | X |   | X |
| 15643149 | WS115 |  | 2.00 - 2.45 | 400g Tub (ALE214) | S | X | X | X |
| 15643147 | WS114 |  | 5.00 - 5.45 | 400g Tub (ALE214) | S | X | X | X |
| 15643162 | WS114 |  | 3.00 - 3.45 | 400g Tub (ALE214) | S | X | X | X |
| 15643153 | WS111 |  | 3.00 - 3.45 | 400g Tub (ALE214) | S | X | X | X |
| 15643152 | WS111 |  | 1.20 - 1.65 | 400g Tub (ALE214) | S | X | X | X |
| 15643159 | WS110 |  | 5.00 - 5.45 | 400g Tub (ALE214) | S | X | X | X |



# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170607-72  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412603  
**Superseded Report:**

## Sample Descriptions

### Grain Sizes

|           |          |      |                 |        |             |        |            |             |       |
|-----------|----------|------|-----------------|--------|-------------|--------|------------|-------------|-------|
| very fine | <0.063mm | fine | 0.063mm - 0.1mm | medium | 0.1mm - 2mm | coarse | 2mm - 10mm | very coarse | >10mm |
|-----------|----------|------|-----------------|--------|-------------|--------|------------|-------------|-------|

| Lab Sample No(s) | Customer Sample Ref. | Depth (m)   | Colour      | Description | Inclusions | Inclusions 2 |
|------------------|----------------------|-------------|-------------|-------------|------------|--------------|
| 15643166         | WS101                | 3.00 - 3.45 | Light Brown | Silt Loam   | None       | None         |
| 15643167         | WS101                | 1.20 - 1.65 | Dark Brown  | Sand        | None       | None         |
| 15643164         | WS102                | 1.20 - 1.65 | Light Brown | Silt Loam   | None       | None         |
| 15643169         | WS103                | 4.00 - 4.45 | Dark Brown  | Clay        | None       | None         |
| 15643173         | WS103                | 2.00 - 2.45 | Dark Brown  | Clay        | None       | None         |
| 15643163         | WS104                | 1.50        | Beige       | Sand        | None       | None         |
| 15643172         | WS104                | 4.00 - 4.45 | Dark Brown  | Clay        | None       | None         |
| 15643165         | WS105                | 3.00 - 3.45 | Light Brown | Silt Loam   | None       | None         |
| 15643168         | WS105                | 5.00 - 5.45 | Dark Brown  | Clay        | Stones     | None         |
| 15643155         | WS106                | 3.00 - 3.45 | Dark Brown  | Clay        | Stones     | None         |
| 15643156         | WS106                | 1.20 - 1.65 | Dark Brown  | Clay        | Stones     | None         |
| 15643145         | WS107                | 3.00 - 3.45 | Dark Brown  | Clay        | Stones     | None         |
| 15643146         | WS107                | 5.00 - 5.45 | Dark Brown  | Clay        | None       | None         |
| 15643144         | WS108                | 4.00 - 4.45 | Dark Brown  | Clay        | Stones     | None         |
| 15643148         | WS108                | 2.00 - 2.45 | Dark Brown  | Clay        | None       | None         |
| 15643151         | WS109                | 2.00 - 2.45 | Light Brown | Loamy Sand  | Vegetation | None         |
| 15643158         | WS110                | 3.00 - 3.45 | Dark Brown  | Clay        | None       | None         |
| 15643159         | WS110                | 5.00 - 5.45 | Dark Brown  | Clay        | None       | None         |
| 15643152         | WS111                | 1.20 - 1.65 | Dark Brown  | Loamy Sand  | None       | None         |
| 15643153         | WS111                | 3.00 - 3.45 | Dark Brown  | Loamy Sand  | None       | None         |
| 15643147         | WS114                | 5.00 - 5.45 | Dark Brown  | Clay        | None       | None         |
| 15643162         | WS114                | 3.00 - 3.45 | Dark Brown  | Clay        | None       | None         |
| 15643149         | WS115                | 2.00 - 2.45 | Dark Brown  | Clay        | None       | None         |
| 15643160         | WS115                | 4.00 - 4.45 | Dark Brown  | Clay        | None       | None         |

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.











## CERTIFICATE OF ANALYSIS

Validated

**SDG:** 170607-72  
**Location:** Maghull, Liverpool.

**Client Reference:** Maghull  
**Order Number:** 37158100

**Report Number:** 412603  
**Superseded Report:**

### Table of Results - Appendix

| Method No | Reference                        | Description                                                                                              | Wet/Dry<br>Sample <sup>1</sup> | Surrogate<br>Corrected |
|-----------|----------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------|------------------------|
| PM024     | Modified BS 1377                 | Soil preparation including homogenisation, moisture screens of soils for<br>Asbestos Containing Material |                                |                        |
| TM133     | BS 1377: Part 3 1990;BS 6068-2.5 | Determination of pH in Soil and Water using the GLpH pH Meter                                            |                                |                        |
| TM243     |                                  | Mixed Anions In Soils By Kone                                                                            |                                |                        |

<sup>1</sup> Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



# CERTIFICATE OF ANALYSIS

Validated

SDG: 170607-72  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412603  
Superseded Report:

## Test Completion Dates

| Lab Sample No(s)      | 15643166       | 15643167       | 15643164       | 15643169       | 15643173       | 15643163       | 15643172       | 15643165       | 15643168       | 15643155       |
|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.  | WS101          | WS101          | WS102          | WS103          | WS103          | WS104          | WS104          | WS105          | WS105          | WS106          |
| AGS Ref.              |                |                |                |                |                |                |                |                |                |                |
| Depth                 | 3.00 - 3.45    | 1.20 - 1.65    | 1.20 - 1.65    | 4.00 - 4.45    | 2.00 - 2.45    | 1.50           | 4.00 - 4.45    | 3.00 - 3.45    | 5.00 - 5.45    | 3.00 - 3.45    |
| Type                  | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil) | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    |
| pH                    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    |
| Sample description    | 08-Jun-2017    | 09-Jun-2017    | 08-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 08-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    |

| Lab Sample No(s)      | 15643156       | 15643145       | 15643146       | 15643144       | 15643148       | 15643151       | 15643158       | 15643159       | 15643152       | 15643153       |
|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.  | WS106          | WS107          | WS107          | WS108          | WS108          | WS109          | WS110          | WS110          | WS111          | WS111          |
| AGS Ref.              |                |                |                |                |                |                |                |                |                |                |
| Depth                 | 1.20 - 1.65    | 3.00 - 3.45    | 5.00 - 5.45    | 4.00 - 4.45    | 2.00 - 2.45    | 2.00 - 2.45    | 3.00 - 3.45    | 5.00 - 5.45    | 1.20 - 1.65    | 3.00 - 3.45    |
| Type                  | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil) | 14-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 15-Jun-2017    |
| pH                    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    | 14-Jun-2017    |
| Sample description    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 08-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 08-Jun-2017    | 08-Jun-2017    |

| Lab Sample No(s)      | 15643147       | 15643162       | 15643149       | 15643160       |
|-----------------------|----------------|----------------|----------------|----------------|
| Customer Sample Ref.  | WS114          | WS114          | WS115          | WS115          |
| AGS Ref.              |                |                |                |                |
| Depth                 | 5.00 - 5.45    | 3.00 - 3.45    | 2.00 - 2.45    | 4.00 - 4.45    |
| Type                  | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) | Soil/Solid (S) |
| Anions by Kone (soil) | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    |
| pH                    | 15-Jun-2017    | 14-Jun-2017    | 15-Jun-2017    | 14-Jun-2017    |
| Sample description    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    | 09-Jun-2017    |



## CERTIFICATE OF ANALYSIS

Validated

SDG: 170607-72  
Location: Maghull, Liverpool.

Client Reference: Maghull  
Order Number: 37158100

Report Number: 412603  
Superseded Report:

## ASSOCIATED AQC DATA

### Anions by Kone (soil)

| Component                                 | Method Code | QC 1587                        | QC 1514                        | QC 1591        | QC 1513        |
|-------------------------------------------|-------------|--------------------------------|--------------------------------|----------------|----------------|
| Chloride (soluble)                        | TM243       | <b>70.48</b><br>89.30 : 110.70 | <b>68.57</b><br>89.30 : 110.70 | 89.30 : 110.70 | 89.30 : 110.70 |
| Water Soluble Sulphate as SO4 2:1 Extract | TM243       | <b>55.12</b><br>70.45 : 129.55 | <b>54.29</b><br>70.45 : 129.55 | 70.45 : 129.55 | 70.45 : 129.55 |

### pH

| Component | Method Code | QC 1510                        | QC 1514                        | QC 1596                        | QC 1511                         |
|-----------|-------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|
| pH        | TM133       | <b>99.49</b><br>98.98 : 101.28 | <b>99.74</b><br>98.98 : 101.28 | <b>99.87</b><br>98.98 : 102.05 | <b>100.13</b><br>98.98 : 102.05 |

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis.

The figure detailed is the percentage recovery result for the AQC.

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control.



# CERTIFICATE OF ANALYSIS

|                  |                     |                          |          |                           |        |
|------------------|---------------------|--------------------------|----------|---------------------------|--------|
| <b>SDG:</b>      | 170607-72           | <b>Client Reference:</b> | Maghull  | <b>Report Number:</b>     | 412603 |
| <b>Location:</b> | Maghull, Liverpool. | <b>Order Number:</b>     | 37158100 | <b>Superseded Report:</b> |        |

## Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH<sub>4</sub> by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

## General

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

## Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

|   |                                                                 |
|---|-----------------------------------------------------------------|
| 1 | Container with Headspace provided for volatiles analysis        |
| 2 | Incorrect container received                                    |
| 3 | Deviation from method                                           |
| 4 | Holding time exceeded before sample received                    |
| 5 | Samples exceeded holding time before preservation was performed |
| § | Sampled on date not provided                                    |
| ◆ | Sample holding time exceeded in laboratory                      |
| @ | Sample holding time exceeded due to sampled on date             |
| & | Sample Holding Time exceeded - Late arrival of instructions.    |

## Asbestos

### Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

| Asbestos Type           | Common Name    |
|-------------------------|----------------|
| Chrysotile              | White Asbestos |
| Amosite                 | Brown Asbestos |
| Crocidolite             | Blue Asbestos  |
| Fibrous Actinolite      | -              |
| Fibrous Anorthophyllite | -              |
| Fibrous Tremolite       | -              |

### Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

**Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.**

**The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.**

## **APPENDIX F**

### **Derivation Method of Generic Assessment Criteria**

| ARCADIS GENERIC ASSESSMENT CRITERIA FOR SOIL |                                                                                                                                                                                                                       |                                          |                     |          |                 |          |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------|----------|-----------------|----------|
| - RESIDENTIAL END USE -                      |                                                                                                                                                                                                                       |                                          |                     |          |                 |          |
| Compound                                     | Theoretical Soil Saturation Limit*                                                                                                                                                                                    | Human Health - Residential (Low Density) |                     |          | Water Resources |          |
|                                              |                                                                                                                                                                                                                       | Oral Pathways                            | Inhalation Pathways | Combined | Surface Waters  | Aquifers |
|                                              |                                                                                                                                                                                                                       | mg/kg                                    | mg/kg               | mg/kg    | mg/kg           | mg/kg    |
| Benzene                                      | 652                                                                                                                                                                                                                   | 0.483                                    | 0.0483              | 0.0439   | 0.019           | 0.0019   |
| Toluene                                      | 374                                                                                                                                                                                                                   | 764                                      | 85.4                | 76.8     | 0.16            | 2.3      |
| Ethylbenzene                                 | 201                                                                                                                                                                                                                   | 580                                      | 19.9                | 19.2     | 0.11            | 1.7      |
| Xylenes                                      | 216                                                                                                                                                                                                                   | 1060                                     | 6.52                | 6.48     | 0.17            | 2.9      |
| MTBE                                         | 1.11E+04                                                                                                                                                                                                              | 535                                      | 11.2                | 11       | 0.018           | 0.018    |
| ETBE                                         | 3500                                                                                                                                                                                                                  | 1.39                                     | 0.495               | 0.365    | 0.07            | 0.07     |
| TBA                                          | 2.35E+05                                                                                                                                                                                                              | 133                                      | 122                 | 63.7     | 0.014           | 0.014    |
| Aliphatic >C5-6                              | 375                                                                                                                                                                                                                   | 2.46E+04                                 | 8.53                | 8.53     | #               | #        |
| Aliphatic>C6-8                               | 112                                                                                                                                                                                                                   | 7.45E+04                                 | 11.5                | 11.5     | #               | #        |
| Aliphatic>C8-10                              | 36.5                                                                                                                                                                                                                  | 4390                                     | 1.48                | 1.48     | #               | #        |
| Aliphatic>C10-12                             | 18                                                                                                                                                                                                                    | 6030                                     | 5.81                | 5.8      | #               | #        |
| Aliphatic>C12-16                             | 7.57                                                                                                                                                                                                                  | 6360                                     | 26.5                | 26.4     | #               | #        |
| Aliphatic>C16-35                             | 652                                                                                                                                                                                                                   | 1.28E+05                                 | NR                  | 128000   | #               | #        |
| Aromatic >C5-C7 (as benzene)                 | 652                                                                                                                                                                                                                   | 0.483                                    | 0.0483              | 0.0439   | 0.019           | 0.0019   |
| Aromatic >C7-C8 (as toluene)                 | 374                                                                                                                                                                                                                   | 764                                      | 85.4                | 76.8     | 0.16            | 2.3      |
| Aromatic >C8-10                              | 224                                                                                                                                                                                                                   | 375                                      | 2.05                | 2.04     | #               | #        |
| Aromatic >C10-12                             | 130                                                                                                                                                                                                                   | 470                                      | 10.8                | 10.6     | #               | #        |
| Aromatic >C12-16                             | 57.2                                                                                                                                                                                                                  | 717                                      | 54.5                | 50.7     | #               | #        |
| Aromatic >C16-21                             | 16                                                                                                                                                                                                                    | 994                                      | NR                  | 994      | #               | #        |
| Aromatic >C21-35                             | 1.68                                                                                                                                                                                                                  | 1720                                     | NR                  | 1720     | #               | #        |
| TPH                                          | na                                                                                                                                                                                                                    | na                                       | na                  | na       | na              | na       |
| Naphthalene                                  | 28.1                                                                                                                                                                                                                  | 148                                      | 1.83                | 1.81     | 0.018           | 0.018    |
| Acenaphthylene                               | 72.7                                                                                                                                                                                                                  | 90.2                                     | 85.8                | 44       | -               | -        |
| Acenaphthene                                 | 15.6                                                                                                                                                                                                                  | 823                                      | 639                 | 360      | -               | -        |
| Fluorene                                     | 12                                                                                                                                                                                                                    | 938                                      | 1250                | 536      | -               | -        |
| Phenanthrene                                 | 4.83                                                                                                                                                                                                                  | 1350                                     | 5640                | 1090     | -               | -        |
| Anthracene                                   | 0.706                                                                                                                                                                                                                 | 1320                                     | 4.20E+04            | 1280     | -               | -        |
| Fluoranthene                                 | 6.46                                                                                                                                                                                                                  | 358                                      | 2.53E+04            | 353      | -               | -        |
| Pyrene                                       | 0.75                                                                                                                                                                                                                  | 2050                                     | 1.87E+04            | 1850     | -               | -        |
| Benzo(a)anthracene                           | 0.582                                                                                                                                                                                                                 | 21.9                                     | 3.29                | 2.86     | -               | -        |
| Chrysene                                     | 0.15                                                                                                                                                                                                                  | 206                                      | 137                 | 82.3     | -               | -        |
| Benzo(b)fluoranthene                         | 0.413                                                                                                                                                                                                                 | 22.7                                     | 24.5                | 11.8     | 0.032           | 0.026    |
| Benzo(k)fluoranthene                         | 0.234                                                                                                                                                                                                                 | 23.5                                     | 29.3                | 13       | 0.049           | 0.037    |
| Benzo(a)pyrene (C4SL)                        | 5.46                                                                                                                                                                                                                  |                                          | 5                   |          | 0.065           | 0.013    |
| Indeno(123cd)pyrene                          | 0.0209                                                                                                                                                                                                                | 22.3                                     | 22.6                | 11.2     | 0.0018          | 0.022    |
| Dibenzo(ah)anthracene                        | 0.00134                                                                                                                                                                                                               | 2.39                                     | 2.1                 | 1.12     | -               | -        |
| Benzo(ghi)perylene                           | 0.00634                                                                                                                                                                                                               | 3690                                     | 1.00E+06            | 3680     | 0.0084          | 0.105    |
| Dichloroethane (1,1)                         | 1580                                                                                                                                                                                                                  | 90.6                                     | 0.285               | 0.284    | 0.0042          | 0.0042   |
| Dichloroethane (1,2)                         | 2160                                                                                                                                                                                                                  | 0.0999                                   | 0.00138             | 0.00136  | 0.013           | 0.0038   |
| Trichloroethane (111)                        | 721                                                                                                                                                                                                                   | 1550                                     | 1.01                | 1.01     | 0.28            | 5.64     |
| Dichloroethene (1,1)                         | 1310                                                                                                                                                                                                                  | 85.1                                     | 0.039               | 0.039    | 0.37            | 0.019    |
| Dichloroethene (cis 1,2)                     | 1120                                                                                                                                                                                                                  | 7.12                                     | 0.0208              | 0.0207   | 0.041           | 0.041    |
| Dichloroethene (trans 1,2)                   | 2040                                                                                                                                                                                                                  | 25.1                                     | 0.313               | 0.309    | 0.041           | 0.041    |
| Trichloroethene                              | 724                                                                                                                                                                                                                   | 14                                       | 0.0166              | 0.0166   | 0.027           | 0.027    |
| Tetrachloroethene                            | 183                                                                                                                                                                                                                   | 56                                       | 0.176               | 0.175    | 0.041           | 0.041    |
| Chloroform (Trichloromethane)                | 2880                                                                                                                                                                                                                  | 8.42                                     | 0.114               | 0.112    | 0.0041          | 0.49     |
| Vinyl Chloride (chloroethene)                | 1180                                                                                                                                                                                                                  | 0.0119                                   | 0.000177            | 0.000174 | 0.0011          | 0.0011   |
| Chlorobenzene                                | 279                                                                                                                                                                                                                   | 78.6                                     | 0.0859              | 0.0858   | 0.37            | 0.37     |
| Phenol                                       | 2.02E+04                                                                                                                                                                                                              | 2010                                     | 278                 | 244      | 0.014           | 0.014    |
| Arsenic (C4SL)                               | NVP                                                                                                                                                                                                                   |                                          | 37                  |          |                 |          |
| Barium                                       | NVP                                                                                                                                                                                                                   | 880                                      | 8650                | 799      |                 |          |
| Boron                                        | NVP                                                                                                                                                                                                                   | 234                                      | 3.45E+05            | 234      |                 |          |
| Cadmium (C4SL)                               | NVP                                                                                                                                                                                                                   |                                          | 26                  |          |                 |          |
| Chromium (as VI) (C4SL)                      | NVP                                                                                                                                                                                                                   |                                          | 21                  |          |                 |          |
| Chromium (as III)                            | NVP                                                                                                                                                                                                                   | 1.59E+05                                 | NR                  | 1.59E+05 |                 |          |
| Copper                                       | NVP                                                                                                                                                                                                                   | 4770                                     | 1.63E+04            | 3690     |                 |          |
| Lead (C4SL)                                  | NVP                                                                                                                                                                                                                   |                                          | 200                 |          |                 |          |
| Mercury (inorganic - SGV)                    | NVP                                                                                                                                                                                                                   |                                          | 170                 |          |                 |          |
| Mercury (elemental)                          | 1.47                                                                                                                                                                                                                  | NR                                       | 0.0168              | 0.017    |                 |          |
| Mercury (methylated)                         | 36                                                                                                                                                                                                                    | 18.2                                     | 7.88                | 5.5      |                 |          |
| Molybdenum                                   | NVP                                                                                                                                                                                                                   | 107                                      | 2.07E+05            | 107      |                 |          |
| Nickel (SGV)                                 | NVP                                                                                                                                                                                                                   |                                          | 130                 |          |                 |          |
| Selenium (SGV)                               | NVP                                                                                                                                                                                                                   |                                          | 350                 |          |                 |          |
| Zinc                                         | NVP                                                                                                                                                                                                                   | 1.05E+04                                 | NR                  | 1.05E+04 |                 |          |
| Notes:                                       | Target exceeds theoretical soil saturation limit. Concentrations above the soil saturation limit may indicate the presence of separate phase in soil, but does not necessarily present a significant risk             |                                          |                     |          |                 |          |
| <i>Italics</i>                               | No appropriate reference dose identified during review of toxicological data                                                                                                                                          |                                          |                     |          |                 |          |
| NR                                           | No GAC for individual TPH fractions given that the compliance criteria is for sum TPH                                                                                                                                 |                                          |                     |          |                 |          |
| #                                            | Comprises multiple contaminants - no GAC derived                                                                                                                                                                      |                                          |                     |          |                 |          |
| na                                           | Contaminant has only a low vapour pressure in soil                                                                                                                                                                    |                                          |                     |          |                 |          |
| NVP                                          | No water quality standard identified as suitable for deriving generic assessment criteria                                                                                                                             |                                          |                     |          |                 |          |
| -                                            | Category Four Screening Level, adopted from The Companion Document to SP1010, DEFRA 2014                                                                                                                              |                                          |                     |          |                 |          |
| C4SL                                         | The theoretical soil saturation limit is higher where a soil organic matter content of 6% is assumed (vegetable ingestion pathways). This should be considered where appropriate in interpreting results of a generic |                                          |                     |          |                 |          |
| *                                            | quantitative assessment                                                                                                                                                                                               |                                          |                     |          |                 |          |
| Metals/inorganics                            | Inhalation exposure via dust inhalation only                                                                                                                                                                          |                                          |                     |          |                 |          |
|                                              | No GAC as potential for leaching commonly linked to the soil pH/cannot be readily modelled                                                                                                                            |                                          |                     |          |                 |          |

## SUMMARY

The purpose of this document is to describe the general principles adopted in the derivation of the Arcadis' Generic Assessment Criteria (GAC). The document and associated GAC underpins the generic quantitative risk assessments Arcadis undertakes for its clients and is not intended for any other use or use by others. Guidance has been provided by the EA to aid development of GAC which are appropriate for a typical England or Wales site, incorporating conservatism where warranted. Arcadis has used the EA guidance to develop in-house GAC to aid assessment of land contamination sites, and in particular to assess risks to human health receptors from chronic health effects and risks to water resource receptors. The GAC do not consider potential risks to ecological receptors, which may need to be assessed on specific sites. The following non-statutory technical guidance has been referred to in deriving the GAC.

- EA Science Reports SC050021/SR2, SC050021/SR3 and SC050021/SR7.
- Related Toxicity and Soil Guideline Value reports
- EA Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination
- EA. Groundwater protection: policy and practice (GP3)
- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination

The GAC used within this report have been derived for "commercial end use". Commercial end use assumes a pre-1970s commercial property is present at the site with some open areas uncovered by hardstanding. A neighbouring resident is assumed present, comprising a small terraced house without basement.

Arcadis has undertaken environmental works on hundreds of potentially contaminated sites across the UK. The typical shallow geology encountered comprises granular soils or made ground, with a low organic matter content. As such, Arcadis has taken the decision to derive in-house GAC for a *sand* rather than sandy loam soil-type used by the EA to derive Soil Guideline Values, with an organic matter content of 0.34% (fraction of organic carbon content 0.002, typical of many sites).

To derive Human Health GAC (HH-GAC), the following exposure pathways are considered active for potential soil or groundwater exposures:

| Site End-Use              | On-Site Pathways                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commercial/<br>Industrial | <ul style="list-style-type: none"><li>• Incidental ingestion of soil or dust</li><li>• Incidental dermal contact with soil or dust</li><li>• Inhalation of dusts inside or outside</li><li>• Inhalation of vapours outside from a soil or groundwater source</li><li>• Inhalation of vapours inside from a soil or groundwater source</li></ul>                          |
| Neighbouring<br>resident  | <p>Migration of impacted groundwater beneath neighbouring property, and subsequently:</p> <ul style="list-style-type: none"><li>• Inhalation of indoor air in an off-site property (originating from an on-site soil or groundwater source)</li><li>• Inhalation of outdoor air in an off-site garden (originating from an on-site soil or groundwater source)</li></ul> |

Two levels of water quality standard have been considered to enable Water Resource GAC (WR-GAC) to be developed depending on the environmental setting of a site. The WR-GAC have been derived based on adopted Environmental Quality Standards and Drinking Water Standards. No attenuation with transport off-site is assumed.

The following modelling tools have been utilised in the derivation of the GAC:

|                    |                                                       |
|--------------------|-------------------------------------------------------|
| HH-GAC (on-site):  | CLEA 1.06 and RBCA Toolkit v2.6                       |
| HH-GAC (off-site): | RBCA Toolkit v2.6 and Remedial Targets Worksheet v3.2 |
| WR-GAC:            | Remedial Targets Worksheet v3.2                       |

Example model inputs are presented in the following tables, alongside the CLEA modelling outputs.

|                   | Air-water partition co-efficient |                               | Diffusion co-efficient in air  |                               | Diffusion co-efficient in water |                               | Relative molecular mass |                               | Vapour pressure |                               | Water solubility   |                               | Koc             | Notes                         |
|-------------------|----------------------------------|-------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------------|-------------------------|-------------------------------|-----------------|-------------------------------|--------------------|-------------------------------|-----------------|-------------------------------|
|                   | cm <sup>3</sup> cm <sup>3</sup>  | Notes                         | m <sup>2</sup> s <sup>-1</sup> | Notes                         | m <sup>2</sup> s <sup>-1</sup>  | Notes                         | g mol <sup>-1</sup>     | Notes                         | Pa              | Notes                         | mg L <sup>-1</sup> | Notes                         | Log (dimension) |                               |
| Benzene           | 1.16E-01                         | Science Report – SC050021/SR7 | 8.77E-06                       | Science Report – SC050021/SR7 | 6.64E-10                        | Science Report – SC050021/SR7 | 78.11                   | Science Report – SC050021/SR7 | 6.24E+03        | Science Report – SC050021/SR7 | 1.78E+03           | Science Report – SC050021/SR7 | 1.83E+00        | Science Report – SC050021/SR7 |
| Toluene           | 1.15E-01                         | Science Report – SC050021/SR7 | 7.78E-06                       | Science Report – SC050021/SR7 | 5.88E-10                        | Science Report – SC050021/SR7 | 92.14                   | Science Report – SC050021/SR7 | 1.73E+03        | Science Report – SC050021/SR7 | 5.90E+02           | Science Report – SC050021/SR7 | 2.31E+00        | Science Report – SC050021/SR7 |
| Ethylbenzene      | 1.39E-01                         | Science Report – SC050021/SR7 | 7.04E-06                       | Science Report – SC050021/SR7 | 5.31E-10                        | Science Report – SC050021/SR7 | 106.17                  | Science Report – SC050021/SR7 | 5.53E+02        | Science Report – SC050021/SR7 | 1.80E+02           | Science Report – SC050021/SR7 | 2.65E+00        | Science Report – SC050021/SR7 |
| Sum xylenes       | 1.04E-01                         | Average for three xylenes     | 7.03E-06                       | Average for three xylenes     | 5.3E-10                         | Average for three xylenes     | 106.17                  | Average for three xylenes     | 4.52E+02        | Average for three xylenes     | 1.91E+02           | Average for three xylenes     | 2.66E+00        | Average for three xylenes     |
| MTBE              | 2.04E-02                         | Literature review             | 7.10E-06                       | Literature review             | 9.00E-10                        | Literature review             | 88.17                   | Literature review             | 3.45E+04        | Literature review             | 4.80E+04           | Literature review             | 1.08E+00        | Literature review             |
| Aliphatic >C5-6   | 3.40E+01                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 81                      | Literature review             | 3.60E+04        | Literature review             | 3.60E+01           | Literature review             | 2.90E+00        | Literature review             |
| Aliphatic >C6-8   | 5.10E+01                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 100                     | Literature review             | 6.40E+03        | Literature review             | 5.40E+00           | Literature review             | 3.60E+00        | Literature review             |
| Aliphatic >C8-10  | 8.20E+01                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 130                     | Literature review             | 6.40E+02        | Literature review             | 4.30E-01           | Literature review             | 4.51E+00        | Literature review             |
| Aliphatic >C10-12 | 1.30E+02                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 160                     | Literature review             | 6.50E+01        | Literature review             | 3.40E-02           | Literature review             | 5.40E+00        | Literature review             |
| Aliphatic >C12-16 | 5.40E+02                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 200                     | Literature review             | 4.80E+00        | Literature review             | 7.60E-04           | Literature review             | 6.70E+00        | Literature review             |
| Aliphatic >C16-35 | 6.40E+03                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 270                     | Literature review             | 7.70E-01        | Literature review             | 1.30E-06           | Literature review             | 9.00E+00        | Literature review             |
| Aromatic >C8-10   | 4.90E-01                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 120                     | Literature review             | 6.40E+02        | Literature review             | 6.50E+01           | Literature review             | 3.20E+00        | Literature review             |
| Aromatic >C10-12  | 1.40E-01                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 130                     | Literature review             | 6.40E+01        | Literature review             | 2.50E+01           | Literature review             | 3.40E+00        | Literature review             |
| Aromatic >C12-16  | 5.40E-02                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 150                     | Literature review             | 4.80E+00        | Literature review             | 5.80E+00           | Literature review             | 3.70E+00        | Literature review             |
| Aromatic >C16-21  | 1.30E-02                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 190                     | Literature review             | 7.70E-01        | Literature review             | 5.10E-01           | Literature review             | 4.20E+00        | Literature review             |
| Aromatic >C21-35  | 6.80E-04                         | TPHCWG                        | 1.00E-05                       | Literature review             | 0.000000001                     | Literature review             | 240                     | Literature review             | 4.40E-04        | Literature review             | 6.60E-03           | Literature review             | 5.11E+00        | Literature review             |

| Chemical Name     | Chemical Type | Oral HCV |                  |                     |               |                 |                     | Inhalation HCV |                  |                     |               |                 |                     | Combine oral and Inhalation AC | Oral MDI for adults |                           | Inhalation MDI for adults |                           |
|-------------------|---------------|----------|------------------|---------------------|---------------|-----------------|---------------------|----------------|------------------|---------------------|---------------|-----------------|---------------------|--------------------------------|---------------------|---------------------------|---------------------------|---------------------------|
|                   |               | Type     | µg kg-1 BW day-1 | Notes               | Oral exposure | Dermal exposure | Inhalation exposure | Type           | µg kg-1 BW day-1 | Notes               | Oral exposure | Dermal exposure | Inhalation exposure |                                | µg kg-1 BW day-1    | Notes                     | µg kg-1 BW day-1          | Notes                     |
| Benzene           | organic       | ID       | 2.90E-01         | UK TOX (March 2009) | Yes           | Yes             | No                  | ID             | 1.40E+00         | UK TOX (March 2009) | No            | No              | Yes                 | Yes                            | NR                  | NA                        | NR                        | NA                        |
| Toluene           | organic       | TDI      | 2.23E+02         | UK TOX (March 2009) | Yes           | Yes             | No                  | TDI            | 1.40E+03         | UK TOX (March 2009) | No            | No              | Yes                 | Yes                            | 1.00E+01            | UK TOX (March 2009)       | 5.20E+02                  | UK TOX (March 2009)       |
| Ethylbenzene      | organic       | TDI      | 1.00E+02         | UK TOX (March 2009) | Yes           | Yes             | No                  | TDI            | 2.20E+02         | UK TOX (March 2009) | No            | No              | Yes                 | Yes                            | 5.00E+00            | UK TOX (March 2009)       | 1.30E+02                  | UK TOX (March 2009)       |
| Sum xylenes       | organic       | TDI      | 1.80E+02         | UK TOX (March 2009) | Yes           | Yes             | No                  | TDI            | 6.00E+01         | UK TOX (March 2009) | No            | No              | Yes                 | Yes                            | 1.10E+01            | UK TOX (March 2009)       | 1.40E+02                  | UK TOX (March 2009)       |
| MTBE              | organic       | TDI      | 8.60E+02         | Literature review   | Yes           | Yes             | No                  | TDI            | 8.60E+02         | Literature review   | No            | No              | Yes                 | Yes                            | 3.00E+01            | EU Risk Assessment Report | 1.89E+02                  | EU Risk Assessment Report |
| Aliphatic >C5-6   | organic       | TDI      | 5.00E+03         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 5.26E+03         | TPHCWG              | No            | No              | Yes                 | Yes                            | 3.50E+05            | TDI x 70kg (MDI unknown)  | 3.68E+05                  | TDI x 70kg (MDI unknown)  |
| Aliphatic >C6-8   | organic       | TDI      | 5.00E+03         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 5.26E+03         | TPHCWG              | No            | No              | Yes                 | Yes                            | 3.50E+05            | TDI x 70kg (MDI unknown)  | 3.68E+05                  | TDI x 70kg (MDI unknown)  |
| Aliphatic >C8-10  | organic       | TDI      | 1.00E+02         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 2.70E+02         | TPHCWG              | No            | No              | Yes                 | Yes                            | 7.00E+03            | TDI x 70kg (MDI unknown)  | 1.89E+04                  | TDI x 70kg (MDI unknown)  |
| Aliphatic >C10-12 | organic       | TDI      | 1.00E+02         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 2.70E+02         | TPHCWG              | No            | No              | Yes                 | Yes                            | 7.00E+03            | TDI x 70kg (MDI unknown)  | 1.89E+04                  | TDI x 70kg (MDI unknown)  |
| Aliphatic >C12-16 | organic       | TDI      | 1.00E+02         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 2.70E+02         | TPHCWG              | No            | No              | Yes                 | Yes                            | 7.00E+03            | TDI x 70kg (MDI unknown)  | 1.89E+04                  | TDI x 70kg (MDI unknown)  |
| Aliphatic >C16-35 | organic       | TDI      | 2.00E+03         | TPHCWG              | Yes           | Yes             | No                  | NR             |                  |                     | NR            | NR              | NR                  | NR                             | 1.40E+05            | TDI x 70kg (MDI unknown)  |                           |                           |
| Aromatic >C8-10   | organic       | TDI      | 4.00E+01         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 5.50E+01         | TPHCWG              | No            | No              | Yes                 | Yes                            | 2.80E+03            | TDI x 70kg (MDI unknown)  | 3.85E+03                  | TDI x 70kg (MDI unknown)  |
| Aromatic >C10-12  | organic       | TDI      | 4.00E+01         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 5.50E+01         | TPHCWG              | No            | No              | Yes                 | Yes                            | 2.80E+03            | TDI x 70kg (MDI unknown)  | 3.85E+03                  | TDI x 70kg (MDI unknown)  |
| Aromatic >C12-16  | organic       | TDI      | 4.00E+01         | TPHCWG              | Yes           | Yes             | No                  | TDI            | 5.50E+01         | TPHCWG              | No            | No              | Yes                 | Yes                            | 2.80E+03            | TDI x 70kg (MDI unknown)  | 3.85E+03                  | TDI x 70kg (MDI unknown)  |
| Aromatic >C16-21  | organic       | TDI      | 3.00E+01         | TPHCWG              | Yes           | Yes             | No                  | NR             |                  |                     | NR            | NR              | NR                  | NR                             | 2.10E+03            | TDI x 70kg (MDI unknown)  |                           |                           |
| Aromatic >C21-35  | organic       | TDI      | 3.00E+01         | TPHCWG              | Yes           | Yes             | No                  | NR             |                  |                     | NR            | NR              | NR                  | NR                             | 2.10E+03            | TDI x 70kg (MDI unknown)  |                           |                           |

# PHYSICAL PROPERTIES

|                                                |                      | Commercial Land Use | Source                  |
|------------------------------------------------|----------------------|---------------------|-------------------------|
| Soil type                                      | na                   | Sand                | Professional experience |
| Porosity (total)                               | cm3 cm-3             | 0.54                | SC050021/SR3            |
| Porosity (air-filled)*                         | cm3 cm-3             | 0.30                | SC050021/SR3            |
| Porosity (water-filled)*                       | cm3 cm-3             | 0.24                | SC050021/SR3            |
| Capillary fringe porosity (air-filled)         | cm3 cm-3             | 0.01                | Literature value        |
| Capillary fringe porosity (water-filled)       | cm3 cm-3             | 0.53                | Literature value        |
| Thickness of capillary fringe                  | m                    | 0.1                 | Literature value        |
| Residual soil water content                    | cm3 cm-3             | 0.07                | SC050021/SR3            |
| Saturated hydraulic conductivity               | cm s-1               | 7.36E-03            | SC050021/SR3            |
| van Genuchten shape parameter                  | dimensionless        | 3.51E-01            | SC050021/SR3            |
| Bulk density                                   | g cm-3               | 1.18                | SC050021/SR3            |
| Soil organic matter content                    | %                    | 0.34                | Professional experience |
| Threshold value of wind speed at 10m           | m s-1                | 7.20                | SC050021/SR3            |
| Empirical function for dust model              | dimensionless        | 1.22                | SC050021/SR3            |
| Ambient soil temperature                       | K                    | 283                 | SC050021/SR3            |
| Mean annual windspeed (10m)                    | m s-1                | 5.00                | SC050021/SR3            |
| Air dispersion factor at 0.8m                  | g m-2 s-1 per kg m-3 | 68.0                | SC050021/SR3            |
| Air dispersion factor at 1.6m                  | g m-2 s-1 per kg m-3 | 120.0               | SC050021/SR3            |
| Fraction of site with hard or vegetative cover | m2 m-2               | 0.80                | SC050021/SR3            |
| Depth to groundwater (RBCA)                    | m                    | 1                   | Assumption              |
| Infiltration rate in vadose zone               | m day-1              | 6.80E-04            | Likely worst-case       |

|                                     |          |       |                         |
|-------------------------------------|----------|-------|-------------------------|
| Aquifer type**                      | na       | Sand  | Assumption              |
| Source width                        | m        | 40    | Likely worst-case       |
| Source length                       | m        | 40    | Likely worst-case       |
| Saturated aquifer thickness         | m        | 10    | Assumption              |
| Mixing zone depth                   | m        | 5.5   | Calculated in RTW       |
| Hydraulic conductivity              | m day-1  | 20    | Literature value        |
| Hydraulic gradient                  | m m-1    | 0.001 | Typical value for sand  |
| Aquifer soil organic matter content | %        | 0.34  | Professional experience |
| Effective Porosity (total)**        | cm3 cm-3 | 0.3   | Literature value        |
| Aquifer bulk density**              | g cm-3   | 1.18  | SC050021/SR3            |
| Distance to neighbouring resident** | m        | 5     | Likely worst-case       |

Notes:

\* Assumed to be present in foundation cracks when modelling in RBCA Toolkit

\*\* Only used to generate GAC for neighbouring residents through off-site migration of impact in groundwater

# BUILDING PROPERTIES

|                                    |        | Residential (neighbouring resident) | Commercial (on-site) | Source       |
|------------------------------------|--------|-------------------------------------|----------------------|--------------|
| Building footprint                 | m2     | 2.80E+01                            | 4.24E+02             | SC050021/SR3 |
| Living space air exchange rate     | hr-1   | 0.50                                | 1.00                 | SC050021/SR3 |
| Living space height (above ground) | m      | 4.8                                 | 9.6                  | SC050021/SR3 |
| Living space height (below ground) | m      | 0.0                                 | 0.0                  | SC050021/SR3 |
| Pressure difference                | Pa     | 3.1                                 | 4.4                  | SC050021/SR3 |
| Foundation thickness               | m      | 1.50E-01                            | 1.50E-01             | SC050021/SR3 |
| Floor crack area                   | cm2    | 4.23E+02                            | 1.65E+03             | SC050021/SR3 |
| Dust loading factor                | µg m-3 | 5.00E+01                            | 1.00E+02             | SC050021/SR3 |

# CLEA 1.06 EXPOSURE DATA

|                                                    |           | Age Class |     |      |      |      |      |                   |
|----------------------------------------------------|-----------|-----------|-----|------|------|------|------|-------------------|
|                                                    |           | Residents |     |      |      |      |      | Commercial Worker |
| Age class                                          | -         | 1         | 2   | 3    | 4    | 5    | 6    | 17                |
| Frequency of inhalation (dust and vapour indoors)  | days yr-1 | 365       | 365 | 365  | 365  | 365  | 365  | 230               |
| Frequency of inhalation (dust and vapour outdoors) | days yr-1 | 365       | 365 | 365  | 365  | 365  | 365  | 170               |
| Occupancy period (indoors)                         | hr day-1  | 23        | 23  | 23   | 23   | 19   | 19   | 8.3               |
| Occupancy period (outdoors)                        | hr day-1  | 1         | 1   | 1    | 1    | 1    | 1    | 0.7               |
| Body weight                                        | kg        | 5.6       | 9.8 | 12.7 | 15.1 | 16.9 | 19.7 | 70                |
| Body height                                        | m         | 0.7       | 0.8 | 0.9  | 0.9  | 1    | 1.1  | 1.6               |
| Inhalation rate*                                   | m3 day-1  | 5.4       | 8   | 8.9  | 10.1 | 10.1 | 10.1 | 14.8              |

\* Inhalation rate adopted from Category 4 Screening Levels

| RBCA Toolkit EXPOSURE DATA     |           | Age Class |      |
|--------------------------------|-----------|-----------|------|
|                                |           | 0-6       | 17   |
| Averaging time                 | yrs       | 6         | 49   |
| Body weight                    | kg        | 13.3      | 70   |
| Exposure duration              | yrs       | 6         | 49   |
| Averaging time (vapour flux)   | yrs       | 6         | 49   |
| Exposure frequency (indoors)*  | days yr-1 | 270.1     | 22.1 |
| Exposure frequency (outdoors)* | days yr-1 | 12.45     | 1.38 |

Notes:

Time-weighted average used for 0-6 year old female child

\* RBCA Toolkit compares an acceptable air concentration to a predicted air concentration. Only the exposure frequency can be modified (i.e. inhalation rate, time exposed cannot). As such, the TDSI (or ID) was converted to an acceptable indoor air concentration using the time-weighted properties for a 0-6 year old female child as defined in SR3. The exposure frequency was modified to account for the differing Category 4 Screening Level exposure scenarios for the remaining pathways, to be equivalent to modifying the inhalation rate and time exposed.

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**Arcadis (UK) Limited**

Three Piccadilly Place  
Manchester M1 3BN  
United Kingdom  
T: +44 (0)161 245 8700

**[arcadis.com](https://www.arcadis.com)**