# Phase II Geoenvironmental Site Assessment
Wrexham Road
Holt

Reference:14-608-R2-1
Date: April 2021

# PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Land off Wrexham Road
Holt
LL13 9YU

Prepared for:
**Mrs V and Mr A Pridding**

**Report Ref: 14-608-R2-1**
**Date Issued: 30th April 2021**

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# EXECUTIVE SUMMARY

| | | |
|---|---|---|
| **Site Address** | Land off Wrexham Road, Holt, LL13 9YU | |
| **Grid Reference** | E 340580, N 353380 | |
| **Site Area** | 1.76 Ha | |
| **Proposed Development** | E3P understands that the land adjacent Sycamore House, Wrexham Road is a draft allocation site for Wrexham's Local Development Plan and J10 Planning are working on behalf of Mrs V and Mr A Pridding to obtain outline permission for a residential development comprising circa 39 houses with associated adopted estate roads and utility infrastructure. | |
| **Current Site Use** | The site is an irregularly shaped parcel of land located north east of Wrexham, in Holt. The site is located within 500 m of the River Dee and is currently used as an agricultural field for grazing cattle. A barn and yard are present in the north east of the site, used for storage of tractors, vehicles, and agricultural equipment. Hay is stored to the east of the barn. | |
| **Site History** | The site originally appeared to comprise agricultural land associated with the Sycamore House to the north. Orchards were present in the north west and north east until circa 1970. The north east of the site was used for informal storage until the construction of a barn and more permanent yard circa 2012. | |
| **Environmental Setting** | **Drift Geology** | Till (Devensian – Diamicton) across the site. Potentially River Terrace Deposits (Sand and Gravel) are indicated immediately south of the site and may extend beneath. |
| | **Bedrock Geology** | Chester Formation (SANDSTONE) |
| | **Faults** | A fault is present within 500 m of site. |
| | **Hydrogeology** | Secondary undifferentiated strata (drift) overlying a Principal productive aquifer (solid). There is one groundwater abstraction point within 250 m of site (245 m east). |
| | **Hydrology** | The nearest surface water course is located 223 m east of the site and is a tributary of the River Dee. |
| | **Flood Risk** | Unaffected by flooding from rivers. |
| **Natural Landform and Geomorphology** | The subject site is underlain by Glacial Till – these are deposits laid down by the deposition of melting ice shelf in the most recent glaciation. The underlying rock formations are associated with the Chester Sandstone Formation.<br><br>It is likely that the site groundwater will run eastwards towards the River Dee. The site will be within the River Catchment of the River Dee so it may be worth assessing recent hydrographs in order to discern whether the site is going to more liable to flooding with climate change.<br><br>Lidar data does not appear to indicate any artificial level changes on the site itself, however, the A534 roadway cutting to the south is visible. | |
| **Utility Locations** | Overhead BT is present in the west of the site. Utility connections are available throughout Wrexham Road to the north. | |
| **Landfill Sites and Ground Gases** | There are no current or historical landfill sites within 250 m of the site. | |
| **Radon** | Unaffected – no special precautions required. | |

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| **Coal Mining/Land Stability** | The site is not located in a Coal Mining Reporting Area or Development High Risk Area, therefore no further assessment is required. |
| **Brine Workings** | The site is not located within an area deemed to be at risk from ground instability arising from historic brine pumping activities and/or salt extraction |
| **Hazardous Installations** | No hazardous installations that could potentially prejudice the proposed construction of highly sensitive residential dwellings have been identified within influencing distance of the subject site. |

## GROUND INVESTIGATION

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| **Ground Investigation Works** | E3P has completed an intrusive ground investigation comprising:<br><br>- 17 x mechanically excavated trial pits,<br>- 4 x BRE365 soakaways,<br>- 5 x window sample boreholes,<br>- Construction of environmental monitoring installations. |
| **Ground Conditions** | **Made Ground – 0.00 m bgl to 0.60 m bgl**<br><br>Localised Made Ground deposits comprise reworked topsoil of dark brown silty clayey fine to coarse sand with rootlets and rare brick gravel to 0.60 m bgl.<br><br>Dark brown sandy gravel was identified in TP116 to 0.40 m bgl with gravel of brick, mudstone and concrete and occasional concrete boulders. |
| | **Topsoil – 0.00 m bgl to 0.80 m bgl**<br><br>Topsoil was encountered in the majority of exploratory hole locations to a maximum depth of 0.80 m bgl in WS103.<br><br>Topsoil comprised dark brown clayey fine to medium SAND with rootlets. |
| | **DRIFT – 0.05 m bgl to >5.45 m bgl**<br><br>Drift deposits were encountered within all exploratory locations to depths in excess of 5.45 m bgl.<br><br>The drift deposits are varied, generally comprising medium dense brown slightly gravelly fine to coarse SAND and medium dense brown clayey GRAVEL with gravel of mudstone.<br><br>The granular drift deposits are generally underlain by firm medium strength to very stiff very high strength, reddish brown gravelly CLAY with gravel of mudstone. |
| | **SOLID**<br><br>The solid bedrock geology was not encountered during the ground investigation. There are no BGS boreholes in the vicinity of the site. |
| | **GROUNDWATER –** Groundwater was encountered as slow and rapid seepages between 0.30 m and 4.00 m bgl during the site investigation. |

## CONTAMINATED LAND ASSESSMENT

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| **Human Health** | The Tier I assessment has identified elevated concentrations of non-volatile PAHs and TPH C16-C35 in the shallow Made Ground in TP116 located in the north east sector.<br><br>The identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds and heavy end TPH C16-C35 compounds can be mitigated through the installation of a suitable cover system where Made Ground remains.<br><br>E.coli has been detected (160 MPN/g) in TP116 at 0.1 m bgl adjacent an area of manure storage. The presence of E.coli indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens. It is therefore recommended that the impacted soils in this part of the site are segregated and placed in an area of no future sensitivity.<br><br>The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.<br><br>Chemical analysis of the topsoil and natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.<br><br>However, soils in the vicinity of TP116 are not recommended for reuse due to the presence of E.Coli. It is recommended these materials are removed and placed in an area of low sensitivity, and future groundworkers on-site have the appropriate Personal Protective Equipment whilst handling soils on-site. |
| **Controlled Waters** | No significant sources of mobile contamination have been identified. Marginally elevated concentrations of selenium and zinc have been identified. The inorganic compounds are generally of low solubility and mobility and appear to be associated with the localised Made Ground in the north east sector. E. coli has also been detected in soils in TP116 which may leach and effect drinking water or run off into nearby watercourses.<br><br>The site is underlain by a mixed geology. The granular deposits will afford less protection to the underlying Principal aquifer in the bedrock, however, cohesive soils will afford some protection.<br><br>The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the underlying aquifer.<br><br>There is considered to be no unacceptable level of risk to controlled waters. |
| **Ground Gas** | Ground gas monitoring suggests that the site can be classified as Green (equivalent CS1), and it is considered that gas protection measures will not be required. |
| **Potable Water Infrastructure** | Barrier pipes unlikely to be required. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation. |

## GEOTECHNICAL ASSESSMENT

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| **Underground Obstructions** | Obstructions will be present beneath the existing structures in the north east.<br><br>During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed plots. |
| **Allowable Bearing Pressure** | The natural gravelly SAND has been assessed as being medium dense with a net ABP of 76-208 kN/m$^2$ between 1.00 m to 5.45 m bgl. However, it should be noted that the presence of shallow groundwater may significantly reduce the ABP of the underlying sands.<br><br>The natural cohesive soils are firm medium strength to very stiff very high strength with a net ABP of 87-439 kN/m$^2$ between 1.00 m and 5.45 m bgl. |
| **Foundation Options** | Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying medium dense SAND and firm medium strength to very stiff very high strength CLAY.<br><br>Where proposed levels remain similar, it is likely that plots could be constructed using strip or trench fill foundations bearing on the underlying firm to very stiff clays or medium dense sands, subject to the required bearing stratum being present at a shallow depth and the absence of tree influence.<br><br>Where the suitable founding stratum is greater than 2.50 m bgl or collapsible soils preclude the adoption of trenched foundations, an engineered foundation solution will be required.<br><br>Foundation depths within the conjectured influence of former, existing or proposed trees will need to be deepened to ensure that structural loading bears within the underlying target founding stratum, which cannot be subject to volumetric instability associated with fluctuation in moisture content. |
| **Building Floor Slabs** | Ground-bearing floor slabs are unlikely to be viable given the shallow cohesive soils. |
| **Heave Precautions** | The Clay soils are classified as Low to Medium Volume Change Potential and where present at a shallow depth within the conjectured zone of potential tree influence, heave precautions will be required within the construction of a shallow foundation and to the underside of floor residential floor slabs. |
| **Soakaway Drainage** | The soakaway tests showed poor soakage potential and considering the high groundwater table, it is considered that soakaway drainage may not be suitable for the proposed development. |
| **Sulphate Assessment** | Concrete classification will be DS1 AC1s. |
| **CBR Design %** | Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions.<br><br>Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade. |
| **Cut/Fill** | Development levels unknown at this time; however an element of cut-and-fill works will be required to prepare the development platform. |

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| **Civil Engineering Excavations** | Shallow bedrock has not been encountered.<br><br>Made Ground present in the north east sector is likely to be loosely compacted and possibly prone to collapse. Granular drift deposits were noted to be unstable and prone to collapse.<br><br>Perched groundwater may also require localised pumping in excavations. |
| **Waste Characterisation** | Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: *Waste Classification – Guidance on the classification and assessment of waste*. |

## RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- Plot-specific foundation schedule (upon receipt of the final development levels).
- Arboricultural survey.
- Remediation and enabling works strategy.

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## DRAWING LIST

14-608-001 - Site Location Plan
14-608-002 - Proposed Development Layout Plan
14-608-003 - Historical Features Plan
14-608-004 - Site Features Plan
14-608-005 - Exploratory Hole Location Plan
14-608-006 - Depth of Made Ground Plan
14-608-007 - Depth of Topsoil Plan
14-608-008 - Depth to Founding Strata Plan
14-608-010 - Conceptual Site Model
14-608-015 - Concept Foundation Zoning Plan
14-608-018 - Contamination Exceedances Plan

# 1. INTRODUCTION

## 1.1. BACKGROUND

E3P has been commissioned by J10 Planning on behalf of the Mrs V and Mr A Pridding to undertake a detailed Phase II Geoenvironmental Site Assessment for a parcel of land to the south of Wrexham Road in Holt.

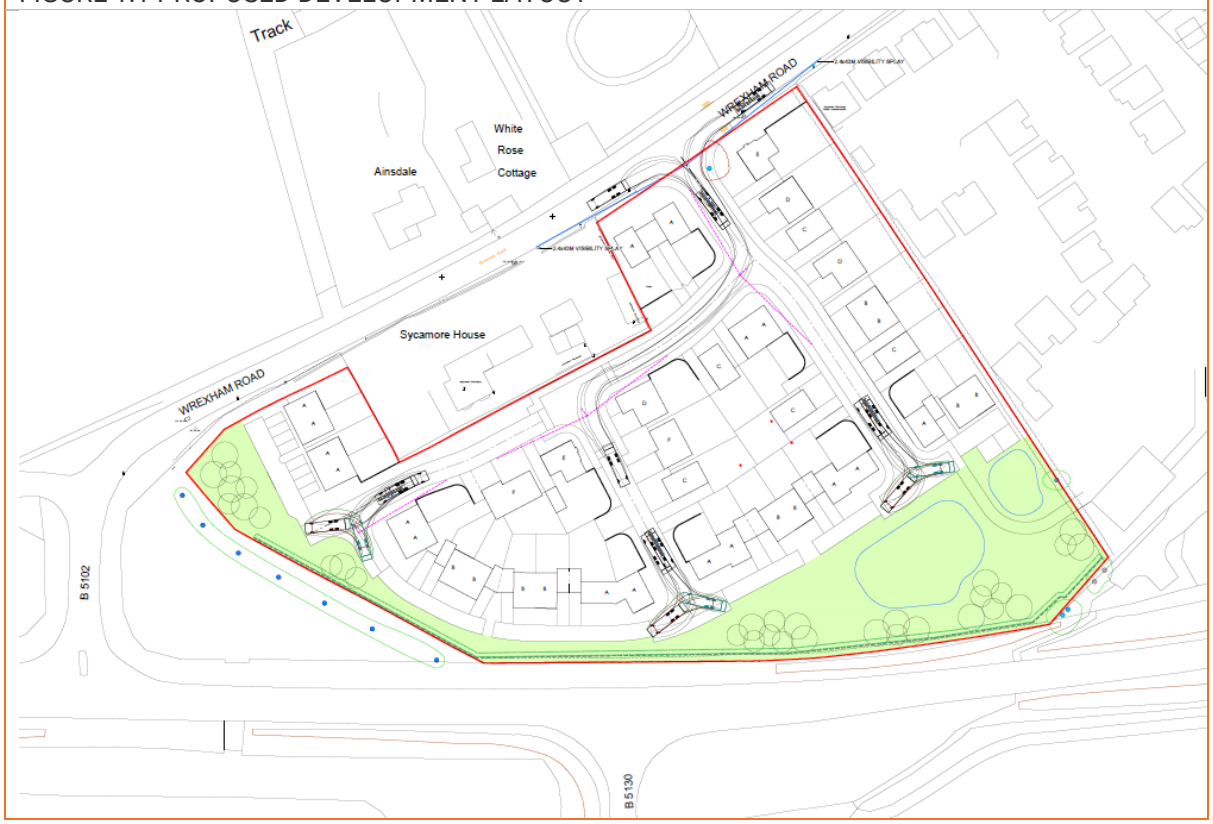
This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed development for a proposed low-rise residential development.

## 1.2. PROPOSED DEVELOPMENT

E3P understands that the land adjacent Sycamore House, Wrexham Road is a draft allocation site for Wrexham's Local Development Plan and J10 Planning are working on behalf of Mrs V and Mr A Pridding to obtain outline permission for a residential development comprising of 39 new houses with associated adopted estate roads and utility infrastructure.

An extract from the proposed development plan is presented as Figure 1.1.

FIGURE 1.1 PROPOSED DEVELOPMENT LAYOUT




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## 1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:

- Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available in order to complete a desk study in line with Environment Agency (EA) document *Land Contamination: Risk Management (LCRM) (2019).*
- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- Provide recommendations regarding future works required.

## 1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- Design of suitable intrusive ground investigation;
- 5 no. Window sample probeholes with environmental monitoring installations;
- 17 no. Mechanically excavated trial pits;
- 4 no. BRE365 soakaway tests;
- In-situ geotechnical testing;
- Chemical and geotechnical laboratory analysis;
- Groundwater monitoring and sampling;
- Ground gas monitoring;
- Contamination risk assessment and conceptual site model;
- Geotechnical assessment and interpretation; and
- Factual and interpretive reporting.

## 1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.

## 1.6. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.



# 2. GROUND INVESTIGATION

## 2.1. E3P PHASE 1 GEO-ENVIRONMENTAL SITE ASSESSMENT (REF: 14-608-R1-1, DATED FEBRUARY 2021)

The pertinent points from the previously completed E3P desk study summarised below:

- The north east of the site is being used as an agricultural storage area and includes a barn and storage of tractors and vehicles. The barn is of post 2000 construction. The remainder of the site comprises trimmed, mixed grass. There are hedgerows surrounding the site and some mature trees in the north east and west of site.
- The site appears to be generally topographically level, with a slight dip in the south east.
- No retaining structures have been observed on site.
- No above-ground storage tanks (ASTs) or underground storage tanks (USTs) were observed at the site. Given the agricultural nature of the site, it is possible that unrecorded fuel storage or septic tanks may have existed on-site at some point in the past.
- There is no equipment identified that may contain PCBs within the site boundary.
- Manure storage on-site may present a source of harmful bacterial on-site. No other potentially hazardous waste streams are likely to be generated at the site.
- The Envirocheck report indicates that the site is not located within a groundwater source protection zone. There is a groundwater abstraction point within 250 m of site.
- A number of historically infilled field boundaries are present within the site boundary, which are potential sources of alluvial deposits, silts and possible organic peat deposits in addition to potential depths of Made Ground.
- The site is located within a currently defined Zone 1, considered to be at little or no risk of fluvial or coastal or tidal flooding. However, the land immediately south of the site is classified as Flood Zone 2 and the River Dee it is found 323 m to the east of site.

## 2.2. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources identified within the previous site investigations. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed on the 28th January 2021. The works are summarised in Table 2.1.

## 2.3. LIMITATIONS OF THE INVESTIGATION

Due to extremely wet weather and boggy ground conditions at the time of the intrusive ground investigation, the window sample rig could not access the south east sector of the site. Coverage was obtained by completing trial pits with the excavator in this area.

## 2.4. SCOPE OF INVESTIGATION

TABLE 2.1 SUMMARY OF FIELDWORK

| POTENTIAL SOURCE/RATIONALE | LOCATION HOLE | TYPE | MAXIMUM DEPTH (m bgl) | MONITORING WELLS RESPONSE ZONE (m bgl) |
|---|---|---|---|---|
| General Ground Conditions | WS101 | Window Sample Probehole | 5.16 | 0.5–2.0 |
| | WS102 | | 5.45 | 0.5–2.0 |
| | WS103 | | 5.45 | 0.5–2.5 |
| | WS104 | | 5.45 | 0.5–2.5 |
| | WS105 | | 5.45 | 0.5–2.5 |
| General Ground Conditions / Permeability Characteristics | TP101/SA101-TP104/SA104 | Mechanically Excavated Trial Pit / Soakaway | 1.90 | N/A |
| General Ground Conditions | TP105-TP115 | Mechanically Excavated Trial Pit | 4.00 | N/A |
| Storage Area/Barn | TP116-TP117 | Mechanically Excavated Trial Pit | 2.50 | N/A |

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources. BRE365 soakaway tests were completed in selected trial pit locations to investigate the permeability characterises of the underlying drift deposits.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

The sampling locations are illustrated in Drawing 14-608-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater recovered for chemical analysis.

## 2.5. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube.

The results are shown in the probehole logs in Appendix V and presented in Table 3.4 and discussed in Section 5.

## 2.6. PERMEABILITY TESTS

Four BRE365 soakaway tests were undertaken within trial pits TP101/SA101 to TP104/SA104 in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development.



The results are presented in Table 3.7 and the test certificates are included within Appendix IX.

## 2.7. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analysis comprising:

- Metals.
- pH, total sulphate, water-soluble sulphate (2:1 extract).
- Sulphide.
- Cyanide.
- Phenols.
- Total and speciated polycyclic aromatic hydrocarbons (PAHs).
- Asbestos identification.
- Banded total petroleum hydrocarbon (TPH).
- E. coli.

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 4.

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

- Atterberg limits determinations;
- Moisture content;
- Particle size distribution; and
- Dry density/moisture content relationship.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 5.

# 3. GROUND AND GROUNDWATER CONDITIONS

## 3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 3.1.

TABLE 3.1 SUMMARY OF STRATA

| HOLE | DEPTH TO STRATUM (m bgl) | | | | | |
|---|---|---|---|---|---|---|
| | MADE GROUND | TOPSOIL | SAND | GRAVEL | FIRM CLAY | STIFF CLAY |
| TP101 | – | 0.00–0.40 | 0.40–1.00 | – | 1.00–1.90 | – |
| TP102 | – | 0.00–0.60 | – | 0.70–1.50 | 0.60–0.70 | – |
| TP103 | – | 0.00–0.40 | – | – | 0.40–1.50 | – |
| TP104 | – | 0.00–0.05 | 0.05–1.40 | – | – | – |
| TP105 | – | 0.00–0.60 | – | 0.60–2.00 | – | – |
| TP106 | – | 0.00–0.60 | – | 0.60–1.90 | – | – |
| TP107 | – | 0.00–0.40 | – | 0.40–1.80 | 1.80–2.20 | – |
| TP108 | – | 0.00–0.60 | 0.60–2.00 | – | – | 2.00–4.00 |
| TP109 | – | 0.00–0.60 | 0.60–1.00 | – | 1.00–2.40 | – |
| TP110 | 0.00–0.30 | – | – | 0.30–1.00 | – | 1.00–2.00 |
| TP111 | – | 0.00–0.40 | 0.40–0.60 | 0.60–0.80 | – | 0.80–2.00 |
| TP112 | – | 0.00–0.60 | 0.60–1.00 | 1.00–1.20 | – | 1.20–2.00 |
| TP113 | – | 0.00–0.40 | – | 0.40–1.20 | 1.20–2.00 | – |
| TP114 | – | 0.00–0.60 | 0.60–1.20 | – | – | 1.20–2.40 |
| TP115 | 0.00–0.40 | – | – | 0.40–1.20 | – | 1.20–2.50 |
| TP116 | 0.00–0.40 | – | – | 0.40–2.40 | – | – |
| TP117 | – | 0.00–0.10 | 0.10–1.50 | – | – | 1.50–2.50 |
| WS101 | 0.00–0.20 | – | 1.20–2.30<br>3.00–5.16 | – | – | 0.20–1.20<br>2.30–3.00 |
| WS102 | 0.00–0.60 | – | 1.00–2.30<br>3.00–4.00 | 0.60–0.80 | 0.80–1.00 | 2.30–3.00<br>4.00–5.45 |
| WS103 | – | 0.00–0.80 | 0.80–5.45 | – | – | – |
| WS104 | – | 0.00–0.50 | 0.50–2.50 | – | – | 2.50–5.45 |
| WS105 | – | 0.00–0.10 | 1.00–5.45 | – | 0.10–1.00 | – |

## 3.2. MADE GROUND

Localised Made Ground deposits comprise reworked topsoil of dark brown silty clayey fine to coarse sand with rootlets and rare brick gravel to a maximum depth of 0.60 m bgl (WS102).

Dark brown sandy gravel was identified in TP116 (located in the yard area) from ground level to 0.40 m bgl with gravel of brick, mudstone and concrete and occasional concrete boulders.

A Depth of Made Ground Plan is presented as Drawing 14-608-006 in Appendix III.

## 3.3. TOPSOIL

Topsoil was encountered in the majority of exploratory hole locations to a maximum depth of 0.80 m bgl in WS103.

Topsoil comprised dark brown clayey fine to medium SAND with rootlets.

A Depth of Topsoil Plan is presented as Drawing 14-608-007 in Appendix III

## 3.4. DRIFT DEPOSITS

Drift deposits were encountered within all exploratory locations beneath the topsoil or Made Ground to depths in excess of 5.45 m bgl.

The drift deposits are varied, generally comprising of the following sequence:

- Medium dense brown slightly gravelly fine to coarse SAND and medium dense brown clayey GRAVEL with gravel of mudstone; over,
- Firm medium strength to very stiff very high strength, reddish brown gravelly CLAY with gravel of mudstone.

## 3.5. SOLID GEOLOGY

The solid bedrock geology was not encountered during the ground investigation.

There are no BGS boreholes in the vicinity of the site to reliably infer the likely depth to rockhead.

## 3.6. GROUNDWATER

The depth of the groundwater strikes are shown on the exploratory hole records in Appendix V and are summarised in Table 3.2.

TABLE 3.2 SUMMARY GROUNDWATER STRIKES

| LOCATION | DEPTH TO STRIKE (m) | NOTES |
|---|---|---|
| TP101 | 1.50 | Slow ingress |
| TP102 | 0.30 | Rapid ingress |
| TP103 | 1.00 | Slow ingress |
| TP105 | 1.80 | Rapid ingress |
| TP107 | 0.30 | Slow ingress |
| TP107 | 2.00 | Slow ingress |
| TP108 | 2.00 | Rapid ingress |
| TP109 | 1.20 | Rapid ingress |
| TP110 | 0.60 | Rapid ingress |
| TP111 | 1.00 | Rapid ingress |

| LOCATION | DEPTH TO STRIKE (m) | NOTES |
|---|---|---|
| TP113 | 0.70 | Rapid ingress |
| TP115 | 0.90 | Rapid ingress |
| TP116 | 1.20 | Rapid ingress |
| TP117 | 1.50 | Slow ingress |
| WS101 | 4.00 | Slow ingress |
| WS104 | 2.70 | Slow ingress |

Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free-phase hydrocarbon product, if present. These results are summarised in Table 4.7.

## 3.7. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has not been identified during the site investigation.

## 3.8. SOIL CONSISTENCY

Undrained shear strength values were measured using field hand shear vane tests. Results of the tests are presented in Table 3.3, which indicate the clay soils to vary between firm and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 3.3 SUMMARY OF HAND SHEAR VANE TESTS

| LOCATION | DEPTH | SHEAR STRENGTH (kPA) | CALCULATED ALLOWABLE BEARING PRESSURE ($kN/m^2$) |
|---|---|---|---|
| TP107 | 1.8 | 94 | 222 |
| TP107 | 2.2 | 69 | 161 |
| TP108 | 2.0 | 89 | 209 |
| TP108 | 2.4 | 80 | 188 |
| TP108 | 2.8 | 93 | 218 |
| TP108 | 3.2 | 93 | 218 |
| TP110 | 1.0 | 140 | 328 |
| TP110 | 1.4 | 172 | 404 |
| TP111 | 1.4 | 173 | 406 |
| TP111 | 1.8 | 150 | 351 |
| TP112 | 1.8 | 187 | 439 |
| TP114 | 2.0 | 187 | 439 |
| TP117 | 2.0 | 135 | 318 |

**Notes**
ABP Calculated using Stroud and Butler et al 1974.

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 3.4.

TABLE 3.4 STANDARD/CONE PENETRATION TEST RESULTS

| BOREHOLES | DEPTH (m bgl) | MATERIAL FIELD DESCRIPTION | CPT/SPT "N" VALUE | CORRECTED "N" VALUE $(N_1)_{60}$ | TERZAGHI & PECK RELATIVE DENSITY (SANDS) | EUROCODE SOIL STRENGTH | CONSISTENCY (BS 5930) | TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH ($kN/m^2$) | ALLOWABLE BEARING PRESSURE ($kN/m^2$)* |
|---|---|---|---|---|---|---|---|---|---|
| **WS101** | 1.00 | Gravelly SAND | 14 | 14.11 | Medium Dense | N/A | N/A | N/A | 141.14 |
| **WS101** | 2.00 | Gravelly SAND | 11 | 10.05 | Medium Dense | N/A | N/A | N/A | 100.49 |
| **WS101** | 3.00 | Gravelly SAND | 23 | 20.00 | Medium Dense | N/A | N/A | N/A | 200.02 |
| **WS101** | 4.00 | Clayey SAND | 22 | 18.59 | Medium Dense | N/A | N/A | N/A | 185.87 |
| **WS101** | 5.00 | Clayey SAND | 50 | 41.48 | Dense | N/A | N/A | N/A | 414.81 |
| **WS102** | 1.00 | Slightly gravelly SAND | 11 | 11.09 | Medium Dense | N/A | N/A | N/A | 110.90 |
| **WS102** | 2.00 | Slightly gravelly SAND | 15 | 13.70 | Medium Dense | N/A | N/A | N/A | 137.03 |
| **WS102** | 2.00 | CLAY | 15 | 13.70 | N/A | Medium strength | Stiff | 68.52 | 140.87 |
| **WS102** | 3.00 | Slightly gravelly SAND | 15 | 13.04 | Medium Dense | N/A | N/A | N/A | 130.45 |
| **WS102** | 4.00 | CLAY | 31 | 26.19 | N/A | High strength | Very Stiff | 130.95 | 269.24 |
| **WS102** | 5.00 | CLAY | 20 | 16.59 | N/A | High strength | Very Stiff | 82.96 | 170.57 |
| **WS103** | 1.00 | Gravelly very clayey SAND | 14 | 14.11 | Medium Dense | N/A | N/A | N/A | 141.14 |
| **WS103** | 2.00 | Gravelly very clayey SAND | 12 | 10.96 | Medium Dense | N/A | N/A | N/A | 109.62 |
| **WS103** | 3.00 | Gravelly very clayey SAND | 11 | 9.57 | Loose | N/A | N/A | N/A | 95.66 |



| BOREHOLES | DEPTH (m bgl) | MATERIAL FIELD DESCRIPTION | CPT/SPT "N" VALUE | CORRECTED "N" VALUE $(N_1)_{60}$ | TERZAGHI & PECK RELATIVE DENSITY (SANDS) | EUROCODE SOIL STRENGTH | CONSISTENCY (BS 5930) | TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH ($kN/m^2$) | ALLOWABLE BEARING PRESSURE ($kN/m^2$)* |
|---|---|---|---|---|---|---|---|---|---|
| **WS103** | 4.00 | Gravelly very clayey SAND | 9 | 7.60 | Loose | N/A | N/A | N/A | 76.04 |
| **WS103** | 5.00 | Gravelly very clayey SAND | 17 | 14.10 | Medium Dense | N/A | N/A | N/A | 141.04 |
| **WS104** | 1.00 | Gravelly very clayey SAND | 10 | 10.08 | Medium Dense | N/A | N/A | N/A | 100.81 |
| **WS104** | 2.00 | Gravelly very clayey SAND | 14 | 12.79 | Medium Dense | N/A | N/A | N/A | 127.90 |
| **WS104** | 3.00 | Slightly sandy CLAY | 11 | 9.57 | N/A | Medium strength | Stiff | 47.83 | 98.34 |
| **WS104** | 4.00 | Slightly sandy CLAY | 10 | 8.45 | N/A | Medium strength | Stiff | 42.24 | 86.85 |
| **WS104** | 5.00 | Slightly sandy CLAY | 17 | 14.10 | N/A | Medium strength | Stiff | 70.52 | 144.98 |
| **WS105** | 1.00 | Clayey SAND | 13 | 13.11 | Medium Dense | N/A | N/A | N/A | 131.06 |
| **WS105** | 2.00 | Clayey SAND | 17 | 15.53 | Medium Dense | N/A | N/A | N/A | 155.30 |
| **WS105** | 3.00 | Clayey SAND | 15 | 13.04 | Medium Dense | N/A | N/A | N/A | 130.45 |
| **WS105** | 4.00 | Clayey SAND | 17 | 14.36 | Medium Dense | N/A | N/A | N/A | 143.62 |
| **WS105** | 5.00 | Clayey SAND | 25 | 20.74 | Medium Dense | N/A | N/A | N/A | 207.41 |



**Notes**
* The Allowable Bearing Pressure (ABP) should be considered indicative.
The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).
Allowable bearing pressure on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.

## 3.9. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to unstable in granular drift deposits, with frequent side wall collapse.

The Made Ground and natural strata was excavated with relative ease.

## 3.10. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions.

The results are included in Table 3.5. The full results can be found in Appendix VIII.

TABLE 3.5 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

| LOCATION | DEPTH (m) | SOIL FRACTION (%) | | | |
|---|---|---|---|---|---|
| | | COBBLES | GRAVEL | SAND | SILT/CLAY |
| TP114 | 1.00 (Natural) | 0 | 35 | 57 | 8 |

## 3.11. SOIL DENSITY/MOISTURE CONTENT RELATIONSHIP

Dry density / moisture content relationship analysis has been conducted on soils using via utilising proctor compaction tests utilising a 2.5 kg rammer. The results of the tests have been summarised in Table 3.6.

The full test results can be found in Appendix VIII.

TABLE 3.6 SUMMARY DRY DENSITY AND MOISTURE CONTENT

| LOCATION | LABORATORY DESCRIPTION | TOP DEPTH (m) | METHOD OF COMPACTION | INITIAL MOISTURE CONTENT (%) | OPTIMUM MOISTURE CONTENT (%) | MATERIAL RETAINED ON 37.5 mm SIEVE (%) | MAX DRY DENSITY (mg/m³) | MATERIAL RETAINED ON 20.0 mm TEST SIEVE (%) |
|---|---|---|---|---|---|---|---|---|
| TP102 | Brown mottled grey sandy very silty CLAY. | 2.00 | 2.5 kg | 28 | 22 | 0 | 1.63 | 0 |
| TP114 | Brown slightly clayey silty very gravelly SAND. | 1.00 | 2.5 kg | 11 | 11 | 0 | 1.95 | 3 |

The proctor compaction tests have indicated that the materials on site are variable with the material in TP102 being wet of the optimum. It should be noted that if this material is excavated for use in a cut/fill operation careful consideration should be taken in the stabilisation of this material.

Engineering of this type of material will need to be completed during dry weather periods only.

## 3.12. SOIL INFILTRATION

In-situ BRE 365 Soakaway tests were undertaken over a 48-hour period within trial pits completed as TP101/SA101 – TP104/SA104.

The results are presented in Table 3.7 and the test certificates are included within Appendix IX.

TABLE 3.7 BRE365 SOAKAWAY TESTING RESULTS

| LOCATION | DEPTH (m) | MATERIAL | TEST NO. | SOIL INFILTRATION RATE (m/s) |
|---|---|---|---|---|
| SA101 | 1.90 | SAND and gravelly sandy CLAY | Test No.1 | N/A |
| SA102 | 1.50 | Sandy clayey GRAVEL | Test No.1 | N/A |
| SA103 | 1.50 | Sandy gravelly CLAY | Test No.1 | N/A |
| SA104 | 1.40 | Gravelly SAND | Test No.1 | 7.98E-07 |

Soil infiltration was taken over the wetted area from between 75 % and 25 % of the effective depth.

Tests completed in SA101, SA102 and SA103 did not reach 75 % or 25 % effective storage depth and therefore failed.

The time to fall 25 % was extrapolated for SA104 to calculate an infiltration rate. The rate suggests poor soakage potential.

Therefore, considering the poor soakage potential and high groundwater table, it is considered that soakaway drainage may not be suitable for the proposed development. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

## 3.13. SOIL PLASTICITY

The Atterberg limits determinations, summarised in Table 3.8, show the clay to be of low to moderate plasticity.

TABLE 3.8 SUMMARY OF PLASTICITY INDEX TEST RESULTS

| LOCATION | DEPTH (m) | NATURAL MOISTURE CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | PASSING 425 µm SIEVE (%) | MODIFIED PLASTICITY INDEX | NHBC VOLUME CHANGE POTENTIAL |
|---|---|---|---|---|---|---|---|---|
| TP102 | 2.00 | 28 | 25 | 53 | 28 | 100 | 28.00 | Medium |
| TP110 | 1.00 | 21 | 23 | 47 | 24 | 97 | 23.28 | Medium |
| TP112 | 1.50 | 21 | 21 | 40 | 19 | 94 | 17.86 | Low |
| WS102 | 2.00 | 27 | 24 | 51 | 27 | 96 | 25.92 | Medium |
| WS105 | 1.00 | 19 | 19 | 39 | 20 | 98 | 19.60 | Low |

The results of the Atterberg limits testing confirmed that the soils would be deemed to be "Low to Medium Volume Change Potential" in accordance with the classification system utilised by the LABC/NHBC industry guidance.

## 3.14. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 3.9), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

TABLE 3.9 SUMMARY OF pH AND SULPHATE DATA

| LOCATION | DEPTH (m) | $SO_4$ IN 2:1 WATER/SOIL (g/l) | pH VALUE | CLASSIFICATION |
|---|---|---|---|---|
| TP106 | 0.10 | 0.0050 | 6.6 | DS-1, AC-1s |
| TP109 | 0.10 | 0.0039 | 6.8 | DS-1, AC-1s |
| TP112 | 0.10 | 0.0047 | 7.1 | DS-1, AC-1s |
| TP116 | 0.10 | 0.4200 | 8.3 | DS-1, AC-1s |

# 4. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

## 4.1. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

The results of this comparison have been summarised within Table 4.1.

TABLE 4.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A RESIDENTIAL END USE

| DETERMINANT | UNIT | GAC | N | MC | LOC. OF EX | PATH-WAY | ASSESSMENT |
|---|---|---|---|---|---|---|---|
| Arsenic | mg/kg | 37 | 6 | 8.3 | - | 1 | No Further Action |
| Cadmium | mg/kg | 17 | 6 | 0.5 | - | 1 | No Further Action |
| Chromium (VI) | mg/kg | 6.1 | 6 | <4.0 | - | 1 | No Further Action |
| Lead | mg/kg | 200 | 6 | 170 | - | 1 | No Further Action |
| Mercury | mg/kg | 1.2 | 6 | 0.5 | - | 3 | No Further Action |
| Nickel | mg/kg | 180 | 6 | 19 | - | 1 | No Further Action |
| Selenium | mg/kg | 250 | 6 | <1.0 | - | 1 | No Further Action |
| Copper | mg/kg | 2400 | 6 | 38 | - | 1 | No Further Action |
| Zinc | mg/kg | 3700 | 6 | 130 | - | 1 | No Further Action |
| Cyanide – Total | mg/kg | 791 | 6 | <1.0 | - | 1 | No Further Action |
| Phenols – Total | mg/kg | 210 | 4 | <1.0 | - | 1 | No Further Action |
| Asbestos | Fibres | NFD | 4 | NAD | - | 3 | No Further Action |
| Naphthalene | mg/kg | 2.3 | 6 | <0.05 | - | 4 | No Further Action |
| Acenaphthylene | mg/kg | 170 | 6 | <0.05 | - | 2 | No Further Action |
| Acenaphthene | mg/kg | 210 | 6 | 4.6 | - | 1 | No Further Action |
| Fluorene | mg/kg | 170 | 6 | 3.1 | - | 1 | No Further Action |
| Phenanthrene | mg/kg | 95 | 6 | 38 | - | 2 | No Further Action |
| Anthracene | mg/kg | 2400 | 6 | 9.1 | - | 2 | No Further Action |
| Fluoranthene | mg/kg | 280 | 6 | 29 | - | 2 | No Further Action |
| Pyrene | mg/kg | 620 | 6 | 24 | - | 2 | No Further Action |
| Benzo(a)Anthracene | mg/kg | 7.2 | 6 | 8.8 | TP116 0.10 m | 2 | Further Action |
| Chrysene | mg/kg | 15 | 6 | 6.5 | - | 2 | No Further Action |
| Benzo(b)Fluoranthene | mg/kg | 2.6 | 6 | 8.5 | TP116 0.10 m | 2 | Further Action |
| Benzo(k)Fluoranthene | mg/kg | 77 | 6 | 2.8 | - | 2 | No Further Action |
| Benzo(a)Pyrene | mg/kg | 2.2 | 6 | 7.7 | TP116 0.10 m | 2 | No Further Action |
| Indeno(123-cd)Pyrene | mg/kg | 27 | 6 | 3.2 | - | 2 | No Further Action |
| Dibenzo(a,h)Anthracene | mg/kg | 0.24 | 6 | 0.98 | TP116 0.10 m | 2 | Further Action |
| Benzo(ghi)Perylene | mg/kg | 320 | 6 | 4.1 | - | 2 | No Further Action |
| TPH C5-C6 (aliphatic)* | mg/kg | 42 | 6 | <1.0 | - | 4 | No Further Action |
| TPH C6-C8 (aliphatic)* | mg/kg | 100 | 6 | <0.1 | - | 4 | No Further Action |
| TPH C8-C10 (aliphatic)* | mg/kg | 27 | 6 | <0.1 | - | 4 | No Further Action |
| TPH C10-C12 (aromatic)* | mg/kg | 74 | 6 | <2.0 | - | 4 | No Further Action |
| TPH C12-C16 (aromatic)* | mg/kg | 140 | 6 | 65 | - | 4 | No Further Action |
| TPH C16-C21 (aromatic)* | mg/kg | 260 | 6 | 290 | TP116 0.10 m | 1 | Further Action |
| TPH C21-C35 (aromatic)* | mg/kg | 1100 | 6 | 1900 | TP116 0.10 m | 1 | Further Action |

**Notes**
PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; NFD = no fibres detected.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 4.1, the results of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants in the Made Ground at 0.10 m bgl in TP116:

- Benzo(b)Fluoranthene;
- Benzo(a)Anthracene;
- Benzo(a)Pyrene
- Dibenzo(a,h)Anthracene.
- Hydrocarbon Fractions C16-C35 (aromatic).

No asbestos was detected in the soils submitted for analysis.

Analysis for E.coli has been completed in a sample from TP116 at 0.10 m bgl. The testing has identified a value of 160 MPN/g, (most probable number per gram) associated with nearby storage of manure. The presence of E.coli indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens. It is therefore recommended that the impacted soils in this part of the site are segregated and placed in an area of no future sensitivity.

In relation to these exceedances, the following can be determined:

- The main exposure pathways based on the Tier I exceedances are:
  - Soil ingestion; and
  - Dermal contact and ingestion.
- The exceedances for all determinands are associated with shallow Made Ground deposits (0.10 m) in TP116.

## HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds and heavy end TPH C16-C35 compounds can be mitigated through the installation of a suitable cover system where Made Ground remains.

The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.

Chemical analysis of the natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.

Chemical testing completed to date suggests that the topsoil is likely to be suitable for re-use in the garden cover system, however further samples will be required to confirm this. However, soils in the vicinity of TP116 are not recommended for reuse due to the presence of E.Coli. It is recommended these materials are removed and placed in an area of low sensitivity, and future groundworkers on-site have the appropriate Personal Protective Equipment whilst handling soils on-site.

## 4.2. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 4.2.

TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

| DISCUSSION | | SENSITIVITY RATING |
|---|---|---|
| **Contaminant Source** | | |
| **Made Ground**<br>Limited thicknesses of Made Ground are present in the north east sector in the location of the yard and existing barn. Chemical analysis has identified elevated PAH and heavy end TPH compounds in the shallow Made Ground. E. coli has also been detected in soils in TP116 which may leach and effect drinking water or run off into nearby watercourses. | | **Medium** |
| **Pathway** | | |
| **Vertical Migration**<br>Due to the majority of the site being underlain by granular drift deposits, vertical migration of contaminants is considered possible as a result of the high permeability of the drift deposits. However, underlying clay deposits will offer some protection to the underlying aquifer. | | **Medium** |
| **Lateral migration**<br>Lateral migration of contaminants is considered possible due to the presence of granular drift deposits across the site. However, there are no surface water courses within 50 m and thus no viable receptors. | | **Low/Medium** |
| **Receptor** | | |
| **Aquifer Classification in Superficial Drift Deposits** | Secondary Undifferentiated | **Low** |
| **Aquifer Classification in Bedrock** | Principal aquifer | **High** |
| **Groundwater Source Protection Zone or Drinking Water Safeguard Zone** | The site is not affected. | **Low** |
| **Distance to the Closest Groundwater Abstraction Point** | The closest groundwater abstraction is operating at Bellis Bros Ltd, located 245 m north of site for agricultural use and spray irrigation. | **Medium** |
| **Is the Site Located Within 50 m of a Surface Watercourse?** | The site is not located within 50 m of a Surface Watercourse. | **Low** |
| The ICSM developed within the context of the site setting has viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying Principal aquifer. | | |

To ensure a robust appraisal of the identified risk to controlled waters, E3P has identified the sources of potential contamination that represent a risk to controlled waters from the initial CSM, we have then assessed the availability of ground investigation data in the form of analysis of the solid phase (soil) and dissolved phase within the perched groundwater or aquifer. The results of this assessment are presented in Table 4.3.

TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

| CONTAMINANT | ASSESSMENT RATING | DISCUSSION |
|---|---|---|
| **BTEX > 1 mg/kg** | The soil data analysis has not identified any detectable concentrations of VOCs above 1mg/kg or TPH C5 to C6 that might otherwise be indicative of VOC impact. | None |
| **Total VOC > 1 mg/kg** | | |
| **Total SVOC > 1 mg/kg** | No SVOC analysis has been completed due to the absence of a viable source. Naphthalene concentrations are less than the LOD. | None |
| **C5-C10 > 5 mg/kg** | All concentrations are below the laboratory LOD. | None |
| **C10-C12 > 10 mg/kg** | All concentrations are below the laboratory LOD. | None |
| **C12-C16 > 50 mg/kg** | A concentration of 65 mg/kg has been identified in the shallow Made Ground in TP116. | **Further discussion** |
| **Phenols > 2 mg/kg** | All concentrations are below the laboratory LOD. | None |
| **Naphthalene > 2 mg/kg** | Concentrations of naphthalene are less than the LOD. | None |
| **Total PAH > 10 mg/kg** | Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected in the shallow Made Ground in TP116. | **Further discussion** |
| **PCB > 1 mg/kg** | No potential sources of PCB have been identified | None |
| **Heavy metals > 500 mg/kg** | Concentrations of heavy metals above 500 mg/kg have not been recorded. | None |

The Tier I assessment has included a comparison of leachate analysis from samples of the natural drift and Made Ground and groundwater samples to drinking water standards in the first instance due to the presence of a principal aquifer and environmental quality standards (EQS) in the absence of DWS standards.

These are presented in Table 4.4.

TABLE 4.4 COMPARISON OF GROUNDWATER AND LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

| DETERMINAND | UNIT | EQS [1, 2, 3] AA | DWS [3,4,5] | NO. OF GW SAMPLES | MAX CONC. IN GROUNDWATER | LOCATION OF EXCEEDANCE | NO. OF LEACHATE SAMPLES | MAX CONC. IN LEACHATE | LOCATION OF EXCEEDANCE | ASSESSMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | µg/l | 50 | 10 | 2 | 2.16 | - | 2 | 5.9 | - | No Further Action |
| Cadmium | µg/l | 0.08-0.25 | 5 | 2 | 0.14 | - | 2 | <0.08 | - | No Further Action |
| Chromium (VI) | µg/l | 3.4 | – | 2 | - | - | 2 | <5.0 | - | No Further Action |
| Chromium (III) | µg/l | 4.7 | 50 | 2 | 6.4 | - | 2 | 2.5 | - | No Further Action |
| Copper | µg/l | 1 | 2000 | 2 | 11 | - | 2 | 11 | - | No Further Action |
| Total Cyanide | µg/l | 1 | 50 | 2 | 4.2 | - | 2 | <1.0 | - | No Further Action |
| Lead | µg/l | 1.2 | 10 | 2 | 0.5 | - | 2 | 7.6 | - | No Further Action |
| Mercury | µg/l | – | 1.0 | 2 | <0.05 | - | 2 | <0.5 | - | No Further Action |
| Nickel | µg/l | 4 | 20 | 2 | 17 | - | 2 | 3.5 | - | No Further Action |
| Selenium | µg/l | – | 10 | 2 | 11 | WS102 | 2 | <4.0 | - | Further Action |
| Zinc | µg/l | 10.9 | – | 2 | 22 | WS102 | 2 | 11 | TP116 0.1 m | Further Action |
| pH | 6–9 | | | 2 | 7.2-7.3 | - | 2 | 7.2-7.8 | - | No Further Action |
| Naphthalene | µg/l | 2 | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Anthracene | µg/l | 0.1 | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Benzo[b]fluoranthene | µg/l | 0.00017* | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Benzo[k]fluoranthene | µg/l | 0.00017* | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Benzo(a)pyrene | µg/l | 0.00017* | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Indeno(123-cd)pyrene | µg/l | 0.00017* | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Fluoranthene | µg/l | 0.0063 | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |
| Benzo(ghi)perylene | µg/l | 1.7–4 | 10* | 2 | <0.01 | - | 2 | <0.01 | - | No Further Action |

| DETERMINAND | UNIT | EQS [1, 2, 3] AA | DWS [3,4,5] | NO. OF GW SAMPLES | MAX CONC. IN GROUNDWATER | LOCATION OF EXCEEDANCE | NO. OF LEACHATE SAMPLES | MAX CONC. IN LEACHATE | LOCATION OF EXCEEDANCE | ASSESSMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| TPH C5-C6 (benzene) | µg/l | 10 | 1 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C6-C8 (toluene) | µg/l | 74 | 700 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C8-C10 (ethyl benzene) | µg/l | 20 | 300 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C10-C12 (xylene) | µg/l | 30 | 500 | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C10-C12 (xylene) | µg/l | 30 | 500 | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C12-C16 | µg/l | 2 | 90[5] | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C16-C35 | µg/l | 50# | 90[5] | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C5-C6 | µg/l | – | 15000 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C6-C8 | µg/l | – | 15000 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C8-C10 | µg/l | – | 300 | 2 | <1.0 | - | 2 | <1.0 | - | No Further Action |
| TPH C10-C12 | µg/l | – | 300 | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C12-C16 | µg/l | – | 300 | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C16-C21 | µg/l | – | 300** | 2 | <10 | - | 2 | <10 | - | No Further Action |
| TPH C21-C35 | µg/l | – | 300** | 2 | <10 | - | 2 | <10 | - | No Further Action |
| Tetrachloroethylene | µg/l | 0.4 | 10 | 2 | <1.0 | - | 0 | - | - | No Further Action |
| Trichloroethylene | µg/l | 10 | 10 | 2 | <1.0 | - | 0 | - | - | No Further Action |
| Trichlorobenzene | µg/l | 0.4 | – | 2 | <1.0 | - | 0 | - | - | No Further Action |
| Trichloromethane | µg/l | 2.5 | – | 2 | <1.0 | - | 0 | - | - | No Further Action |
| Dichloromethane | µg/l | 20 | 200 | 2 | <1.0 | - | 0 | - | - | No Further Action |
| Carbon Tetrachloride | µg/l | 12 | 3 | 2 | <1.0 | - | 0 | - | - | No Further Action |

| DETERMINAND | UNIT | EQS [1, 2, 3] AA | DWS [3,4,5] | NO. OF GW SAMPLES | MAX CONC. IN GROUNDWATER | LOCATION OF EXCEEDANCE | NO. OF LEACHATE SAMPLES | MAX CONC. IN LEACHATE | LOCATION OF EXCEEDANCE | ASSESSMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| **Vinyl Chloride** | µg/l | – | 0.3 | 2 | <1.0 | - | 0 | - | - | No Further Action |

**Notes**

# Solubility <0.01µg/l
AA – Annual Average
MAC- Maximum Admissible Concentration
* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water
** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)

### 4.2.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the DWS values for the following inorganic compounds:

- Selenium

This comparison indicates that the data exceeds the EQS values for the following inorganic compounds:

- Zinc

### 4.2.2. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

No DWS is available for Zinc, therefore to be conservative, the value has been compared to the EQS standard. The exceedance in the leachate sample from TP116 is marginal of 11 ug/l compared to the standard of 10.9 ug/l.

The selenium exceedance in the groundwater sample from WS102 is also very marginal of 11 ug/l compared to the standard of 10 ug/l.

The inorganic compounds are generally of low solubility and mobility and appear to be associated with the localised Made Ground in the north east sector.

The site is underlain by a mixed geology. The granular deposits will afford less protection to the underlying Principal aquifer in the bedrock, however underlying cohesive soils will afford some protection.

As the site is currently open, agricultural land, with little hardstanding surface cover, rainfall is not being intercepted and subsequently infiltrates freely into the underlying Made Ground, potentially mobilising the identified contaminants.

The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate and reduce the risk further to the underlying aquifer.

Based on the above, there is considered to be no unacceptable level of risk to the controlled water receptors.

## 4.3. GROUND GAS

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 – *Assessing risks posed by hazardous ground gases to buildings* (2007). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

### 4.3.1. INVESTIGATION RATIONALE

The ICSM has identified that the underlying localised Made Ground may represent a potential source of ground gas generation. Based on the identification of these sources, E3P has determined that the site represents a low ground gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, the gas assessment requires that nine visits are required over six months, with at least two sets of readings at low or falling atmospheric pressure as set out within CIRIA 665 Tables 5.5a and 5.5b.

The spacing requirements for monitoring wells are detailed within CIRIA 665 Table 4.2, which indicates that for low gas hazard sites (Made Ground with limited degradable material, organic clay of limited thickness) and a high sensitivity development, nominal well spacing should be between 25 m and 50 m.

TABLE 4.5 GROUND GAS MONITORING LOCATION RATIONALE

| LOCATION | GROUND GAS SOURCE | DEPTH OF MONITORING WELL (m) |
|---|---|---|
| **WS101** | Natural Drift Deposits | 0.5–2.0 |
| **WS102** | Natural Drift Deposits / Localised Made Ground | 0.5–2.0 |
| **WS103** | Natural Drift Deposits | 0.5–2.5 |
| **WS104** | Natural Drift Deposits | 0.5–2.5 |
| **WS105** | Natural Drift Deposits | 0.5–2.5 |

### 4.3.2. MONITORING METHODOLOGY

Concentrations of methane ($CH_4$), carbon dioxide ($CO_2$) and oxygen ($O_2$) were measured using a calibrated infra-red gas analyser (GFM435) with gas flow rates were measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 60 seconds at each location, at which point the maximum concentration of $CH_4$ and $CO_2$, together with the lowest concentration of $O_2$ were recorded. The results of the ground gas monitoring are presented in Table 8.9.

CIRIA C665 and NHBC Report No 10627-R01 provide assessments for carbon dioxide and methane based upon gas screening values (GSVs) utilising flow rates and concentrations. The site-based GSVs for steady state methane and carbon dioxide are based upon the following equation:

$$GSV = \frac{concentration\ (by\ vol)}{100} \times flowrate\ (1\ /\ hr)$$

The GSVs within CIRIA C665 are based upon all buildings other than standard residential houses. The NHBC GSVs are based upon standard residential houses with precast concrete floors (block and beam). The CIRIA 665 report author (Steve Wilson) since provided further clarification regarding which guidance should be adopted for residential houses that have suspended cast in-situ concrete floor slab: for the avoidance of doubt, it was confirmed that the GSVs within the CIRIA 665 guidance should be adopted. The thresholds for GSVs based upon NHBC and CIRIA guidance are provided within Table 4.6.

TABLE 4.6 RESIDENTIAL THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH CIRIA C665 AND NHBS REPORT NO 10627-R01 – RESIDENTIAL END USE

| CIRIA – NO SUBFLOOR VOID | | NHBC – SUBFLOOR VOID | | |
|---|---|---|---|---|
| **CLASSIFICATION** | **GSV (METHANE AND CARBON DIOXIDE)** | **CLASSIFICATION** | **GSV (METHANE)** | **GSV (CARBON DIOXIDE)** |
| **CS1** | < 0.07 | Green | < 0.13 | < 0.76 |
| **CS2** | < 0.70 | Amber 1 | < 0.63 | < 1.60 |
| **CS3** | < 3.5 | Amber 2 | < 1.60 | < 3.10 |
| **CS4** | < 15 | Red | > 1.60 | > 3.10 |
| **CS5** | < 70 | N/A | N/A | N/A |
| **CS6** | > 70 | N/A | N/A | N/A |

### 4.3.3. SUMMARY OF MONTIORING RESULTS

Table 4.7 presents of the ground gas and groundwater monitoring results to date.

TABLE 4.7 SUMMARY OF GROUND GAS MONITORING RESULTS

| WELL | DATE | $CH_4$ INITIAL (%V/V) | $CH_4$ STEADY (%V/V) | $CH_4$ GSV (l/hr) | $CO_2$ INITIAL (%V/V) | $CO_2$ STEADY (%V/V) | $CO_2$ GSV (l/hr) | $O_2$ (%V/V) | ATMOS (mb) | ATMOS. DYNAMIC | FLOW (l/hr) | RESPONSE ZONE (m bgl) | DEPTH TO BASE (m bgl) | DEPTH TO WATER (m bgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS101 | 16/2/21 | 0.1 | 0.1 | 0.00010 | 2.3 | 2.3 | 0.00230 | 13.4 | 1000 | Falling | 0.10 | 0.5–2.0 | 1.45 | 1.25 |
| | 25/2/21 | 0.1 | 0.1 | 0.00085 | 2.5 | 2.5 | 0.02125 | 16.0 | 1022 | Rising | 0.85 | | 1.47 | 1.17 |
| | 10/3/21 | 0.1 | 0.1 | 0.00052 | 2.4 | 2.4 | 0.01248 | 16.8 | 1009 | Rising | 0.52 | | 1.46 | 1.20 |
| | 23/3/21 | 0.1 | 0.1 | 0.00079 | 5.5 | 5.5 | 0.04345 | 13.7 | 1015 | Steady | 0.79 | | 1.45 | 1.33 |
| | 9/4/21 | 0.1 | 0.1 | 0.00026 | 5.1 | 5.1 | 0.01326 | 14.2 | 1019 | Low | 0.26 | | 1.45 | 1.38 |
| | 23/4/21 | 0.1 | 0.1 | 0.00026 | 5.5 | 5.5 | 0.01430 | 16.6 | 1025 | Rising | 0.26 | | 1.45 | 1.44 |
| WS102 | 16/2/21 | 0.2 | 0.1 | 0.00020 | 2.9 | 2.9 | -0.00290 | 11.7 | 998 | Falling | -0.10 | 0.5–2.0 | 1.40 | **0.40** |
| | 25/2/21 | 0.1 | 0.1 | -0.00396 | 0.9 | 0.9 | -0.03564 | 19.3 | 1022 | Rising | -3.96 | | 1.40 | **0.48** |
| | 10/3/21 | 0.1 | 0.1 | -0.0023 | 1.4 | 1.4 | -0.03220 | 18.9 | 1009 | Rising | -2.3 | | 1.40 | **0.45** |
| | 23/3/21 | 0.1 | 0.1 | 0.00079 | 0.4 | 0.4 | 0.00316 | 19.8 | 1015 | Steady | 0.79 | | 1.38 | 0.75 |
| | 9/4/21 | 0.1 | 0.1 | 0.00052 | 0.6 | 0.6 | 0.00312 | 19.6 | 1019 | Low | 0.52 | | 1.39 | 0.80 |
| | 23/4/21 | Could Not Locate. | | | | | | | | | | | - | - |
| WS103 | 16/2/21 | Could Not Locate. | | | | | | | | | | 0.5–2.5 | - | - |
| | 25/2/21 | | | | | | | | | | | | - | - |
| | 10/3/21 | | | | | | | | | | | | - | - |
| | 23/3/21 | 0.1 | 0.1 | 0.00079 | 1.4 | 1.4 | 0.01106 | 18.9 | 1015 | Steady | 0.79 | | 1.40 | 1.13 |
| | 9/4/21 | 0.1 | 0.1 | 0.00026 | 1.3 | 1.3 | 0.00338 | 19.0 | 1019 | Low | 0.26 | | 1.40 | 1.20 |
| | 23/4/21 | 0.1 | 0.1 | 0.00052 | 1.2 | 1.2 | 0.00624 | 19.2 | 1025 | Rising | 0.52 | | 1.40 | 1.30 |
| WS104 | 16/2/21 | 0.2 | 0.1 | -0.0002 | 3.5 | 3.5 | 0.00350 | 16.3 | 998 | Falling | 0.10 | | 1.05 | 0.82 |

| WELL | DATE | $CH_4$ INITIAL (%V/V) | $CH_4$ STEADY (%V/V) | $CH_4$ GSV (l/hr) | $CO_2$ INITIAL (%V/V) | $CO_2$ STEADY (%V/V) | $CO_2$ GSV (l/hr) | $O_2$ (%V/V) | ATMOS (mb) | ATMOS. DYNAMIC | FLOW (l/hr) | RESPONSE ZONE (m bgl) | DEPTH TO BASE (m bgl) | DEPTH TO WATER (m bgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25/2/21 | 0.1 | 0.1 | 0.00052 | 2.2 | 2.2 | 0.01144 | 17.9 | 1022 | Rising | 0.52 | 0.5–2.5 | 1.09 | 0.70 |
| | 10/3/21 | 0.1 | 0.1 | 0.00026 | 2.6 | 2.6 | 0.00676 | 17.3 | 1009 | Rising | 0.26 | | 1.08 | 0.74 |
| | 23/3/21 | 0.1 | 0.1 | -0.00085 | 3.4 | 3.4 | -0.02890 | 17.6 | 1015 | Steady | -0.85 | | 1.09 | Dry |
| | 9/4/21 | 0.1 | 0.1 | -0.00026 | 3.1 | 3.1 | -0.00806 | 18.0 | 1019 | Low | -0.26 | | 1.08 | 1.07 |
| | 23/4/21 | 0.1 | 0.1 | 0.00013 | 2.9 | 2.9 | 0.00377 | 17.9 | 1025 | Rising | 0.13 | | 1.08 | Dry |
| WS105 | 16/2/21 | 0.2 | 0.2 | 0.00020 | 1.2 | 1.2 | 0.00120 | 13.4 | 998 | Falling | 0.10 | 0.5–2.5 | 1.50 | 0.90 |
| | 25/2/21 | 0.1 | 0.1 | 0.00026 | 1.4 | 1.4 | 0.00364 | 16.8 | 1022 | Rising | 0.26 | | 1.42 | 0.74 |
| | 10/3/21 | 0.1 | 0.1 | 0.00052 | 1.4 | 1.4 | 0.00728 | 16.6 | 1009 | Rising | 0.52 | | 1.43 | 0.78 |
| | 23/3/21 | 0.1 | 0.1 | 0.00085 | 2.6 | 2.6 | 0.02210 | 17.3 | 1015 | Steady | 0.85 | | 1.40 | 1.03 |
| | 9/4/21 | 0.1 | 0.1 | 0.00052 | 2.2 | 2.2 | 0.01144 | 17.9 | 1019 | Low | 0.52 | | 1.41 | 1.09 |
| | 23/4/21 | 0.1 | 0.1 | 0.00026 | 2.3 | 2.3 | 0.00598 | 17.5 | 1025 | Rising | 0.26 | | 1.40 | 1.22 |

**NOTES**

| NHBC Traffic Light System | | Typical Max CH4 Concentration | GSV CH4 | Typical Max CO2 Concentration | GSV CO2 |
|---|---|---|---|---|---|
| | Amber 1 | 1 | 0.16-0.63 | 5 | 0.78-1.56 |
| | Amber 2 | 5 | 0.63-1.56 | 10 | 1.56-3.13 |
| | Red | 20 | 1.56+ | 30 | 3.13+ |

Values in **BOLD** exceed Amber 1 Thresholds
Values in BLUE denote water above monitoring well

### 4.3.4. SOURCES OF GROUND GAS

The Phase I report and subsequent ground investigation has identified the following potential sources of ground gas:

- Made Ground deposits.

### 4.3.5. GROUNDWATER

During the monitoring, groundwater levels were observed between 0.40 m and 1.44 m bgl.

### 4.3.6. GAS FLOW

During the monitoring a positive flow was noted in each of the monitoring wells, ranging from 0.1 to 0.85 l/hr.

The measure of positive flow is considered to be the result of groundwater fluctuations and flooding of the well causing compression – as opposed to gas generation – as the highest flows are recorded during periods of high groundwater levels.

Negative flows are indicative of back pressure from wind being greater than the active flow from the wells. Negative flows were recorded in WS102 and WS104.

### 4.3.7. GAS CONCENTRATIONS

Methane has been recorded at a maximum concentration of 0.2 % v/v in WS102, WS104 and WS105.

Carbon dioxide concentrations were recorded within the monitoring wells at concentrations ranging from 0.4 % v/v to 5.5 % v/v (WS101).

### 4.3.8. GAS ASSESSMENT

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 4.8.

TABLE 4.8 GAS RISK PROFILE AND LOCATION

| LOCATION | MAX $CH_4$ (% v/v) | GSV (l/hr) | MAX $CO_2$ (% v/v) | GSV (l/hr) | CLASSIFICATION |
|---|---|---|---|---|---|
| WS101 | 0.1 | 0.00085 | 5.5 | 0.04345 | Green* |
| WS102 | 0.2 | 0.00396 | 2.9 | 0.03564 | Green |
| WS103 | 0.1 | 0.00079 | 1.4 | 0.01106 | Green |
| WS104 | 0.2 | 0.00052 | 3.5 | 0.02890 | Green |
| WS105 | 0.2 | 0.00026 | 1.6 | 0.02210 | Green |

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Ground gas monitoring suggests that the site can be predominantly classified as Green (equivalent CS1), and it is considered that gas protection measures will not be required.

*Guidance suggests that where CO2 exceeds 5%, consideration for increasing the classification to Amber 1/CS2 is recommended. Elevated CO2 (>5% v/v) has been detected in WS101 during three of the six monitoring visits. WS101 is located in the barn / yard area which is understood to have been used for storage prior to redevelopment. No potential gas sources were noted in this part of the site other than minimal thicknesses of Made Ground, and no degrading organics were noted in the recovered soils. Total organic content of the underling natural sources is also recorded to be low (0.7%). It is therefore considered that in the absence of a credible source, the risk remains low and the site as a whole should be classified as Green/CS1 with no gas protection measures required.

At the time of remediation/enabling works, it may be prudent to undertake a watching brief/visual inspection of the soils to identify any areas of potentially infilled or organic Made Ground.

## 4.4. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "*Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites*"

TABLE 4.9 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

| **Contaminant Group** | **PE-threshold (mg/kg)** | **Concentrations at Current pipeline depth (mg/kg)** |
|---|---|---|
| **Total VOC** | 0.5 | <1.0 |
| **Total BTEX And MTBE** | 0.1 | N/A |
| **Total SVOCs (Excluding PAH and those substances marked with an *)** | 2 | N/A |
| **EC5-EC10 Aliphatic and Aromatic Hydrocarbons** | 2 | <1.0 |
| **EC10-EC16- Aliphatic and Aromatic Hydrocarbons** | 10 | **13** |
| **EC16-EC40 Aliphatic and Aromatic Hydrocarbons** | 500 | 106 |
| **Phenols (From SVOC Analysis)*** | 2 | N/A |
| **Cresols and Chlorinated Phenols (From SVOC Analysis)** | 2 | N/A |
| **Ethers*** | 0.5 | N/A |
| **Nitrobenzene*** | 0.5 | N/A |
| **Ketones*** | 0.5 | N/A |
| **Aldehydes*** | 0.5 | N/A |
| **Amines** | Fail | N/A |
| **Other Consideration** | | |
| **Are there any exceedances of the PE threshold outside of the pipeline depth?** | Yes – TP116 at 0.10 m bgl. | |
| **Is free product present in soil and groundwater?** | None. | |

| | |
|---|---|
| **Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?** | No – heavy end hydrocarbon impact and low solubility PAH has been identified within localised Made Ground. |
| **Will soils impacted with above determinands likely be utilised elsewhere on site?** | Currently unknown. |
| **Will soils be imported to site as part of any future earth works** | Currently unknown. The importation of materials may affect the WIR Risk Assessment which should be updated after completion. |

**Notes -** Pipe line depth normally between 0.75m–1.35m

Based on the assessment of current site conditions, barrier pipes are unlikely to be required.

## 4.5. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 4.10 has been prepared for the site.

TABLE 4.10 CONCEPTUAL MODEL

| POLLUTANT LINKAGE | CONTAMINANT (SOURCE) | PATHWAY | RECEPTOR | PROBABILITY | CURRENT RISK | RESIDUAL RISK AFTER MITIGATION |
|---|---|---|---|---|---|---|
| PL1<br>PL2 | Non-volatile PAH, TPH C16-C35 (Made Ground) | Dermal contact.<br>Dermal contact and ingestion. | Future site users.<br>Off-site receptors. | Likely | Moderate | LOW |
| **Assessment:**<br>Elevated non-volatile PAH and heavy end TPH identified in the shallow localised Made Ground in TP116 at 0.10 m bgl.<br><br>**Recommendation:**<br>Cover system to garden and landscaped areas where Made Ground remains will prevent exposure to future site users. Construction works completed with PPE and provision of welfare. | | | | | | |
| PL3 | ACM in Made Ground | Inhalation of dust. | Future site users.<br>Buildings.<br>Off-site land users. | Low likelihood | Low | LOW |
| **Assessment:**<br>Asbestos has not been identified in the soils submitted for analysis.<br><br>**Recommendation:**<br>If asbestos is identified in the soils during site enabling works, these will require placement in accordance with the asbestos CSM. Given the age of the existing barn on site (post 2000), it is very unlikely that asbestos will be present and therefore a pre-demolition survey may not be required | | | | | | |

| POLLUTANT LINKAGE | CONTAMINANT (SOURCE) | PATHWAY | RECEPTOR | PROBABILITY | CURRENT RISK | RESIDUAL RISK AFTER MITIGATION |
|---|---|---|---|---|---|---|
| PL4 | Volatile Contaminants such as hydrocarbons, (Localised Made Ground) | Inhalation of vapours.<br><br>Migration through permeable strata and preferential pathways. | Future site users.<br><br>Off-site receptors. | Unlikely | Low | LOW |
| **Assessment:**<br>Leakages/spillages of volatile contamination are considered possible in the north east sector, however no volatile hydrocarbons have been identified in the soils analysed.<br><br>**Recommendation:**<br>A watching brief should be completed during remediation in the north east sector to confirm the absence of any potentially volatile contaminants. | | | | | | |
| PL4 | Methane, carbon dioxide (Localised Made Ground, potentially infilled features on and within 250 m of the site) | Inhalation of gas.<br><br>Migration through permeable strata and preferential pathways.<br><br>Explosion in confined spaces. | Future site users.<br><br>Buildings.<br><br>Off-site land users. | Low likelihood | Low | LOW |
| **Assessment:**<br>Ground gas monitoring suggests that the site can be classified as Green (equivalent CS1), and it is considered that gas protection measures will not be required.<br><br>**Recommendation:**<br>N/A | | | | | | |

| POLLUTANT LINKAGE | CONTAMINANT (SOURCE) | PATHWAY | RECEPTOR | PROBABILITY | CURRENT RISK | RESIDUAL RISK AFTER MITIGATION |
|---|---|---|---|---|---|---|
| PL5 | Mobile contaminants such as metals, E.coli (Localised Made Ground) | Surface runoff.<br><br>Migration through permeable strata and preferential pathways.<br><br>Perched waters migration. | Groundwater (principal aquifer). | Low Likelihood | Low | LOW |

**Assessment:**
No significant sources of mobile contamination have been identified. Marginally elevated concentrations of selenium and zinc have been identified. The inorganic compounds are generally of low solubility and mobility and appear to be associated with the localised Made Ground in the north east sector. E. coli has also been detected in soils in TP116 which may leach and effect drinking water or run off into nearby watercourses.

The site is underlain by a mixed geology. The granular deposits will afford less protection to the underlying Principal aquifer in the bedrock, however cohesive soils will afford some protection.

The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the underlying aquifer.

**Recommendation:**
There is considered to be no unacceptable level of risk to controlled waters.

| | | | | | | |
|---|---|---|---|---|---|---|
| **PL6** | Sulphate (potential ash within Made Ground) | Sulphate attack on concrete. | Building structure. | Low Likelihood | Low | **LOW** |
| **Assessment:**<br>Chemical analysis confirms that the soils meet class DS-1, AC-1s.<br><br>**Recommendation:**<br>Concrete should be designed in accordance with the chemical testing results. | | | | | | |
| **PL7** | Organic contaminants such as hydrocarbons (Made Ground) | Ingestion of tainted water supply. | Future site users.<br><br>Water pipes. | Low Likelihood | Low | **LOW** |
| **Assessment:**<br>Current indications suggest that barrier pipe will not be required for the proposed development.<br><br>**Recommendation:**<br>A pipeline risk assessment should be completed following a process of remediation and enabling works. | | | | | | |
| **PL8** | Phytotoxic contaminants (Made Ground) | Direct Contact (plant uptake). | Flora. | Likely | Low | **LOW** |
| **Assessment:**<br>Phytotoxic contaminants inhibit plant growth. The screening values for phytotoxic contaminants are pH dependent and the following values have been adopted on the basis of an average pH between 6 and 7 – Zinc 200 mg/kg, Copper 135 mg/kg and Nickel 75 mg/kg. Concentrations of the phytotoxic contaminants in the topsoil samples tested are all below the threshold values, except in TP105 (marginally elevated copper) in the west of the site. The overall risk to flora is considered low.<br><br>**Recommendation:**<br>The topsoils on site are considered suitable or re-use in the growing medium/as topsoil on site. | | | | | | |

**Notes:**
Main exposure pathways: PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants;

# 5. GEOTECHNICAL ASSESSMENT

## 5.1. PROPOSED DEVELOPMENT

E3P understands that the land adjacent Sycamore House, Wrexham Road is a draft allocation site for Wrexham's Local Development Plan and J10 Planning are working on behalf of Mrs V and Mr A Pridding to obtain outline permission for a residential development comprising a minimum of 35 houses with associated adopted estate roads and utility infrastructure.

## 5.2. SUMMARY OF GROUND CONDITIONS

**Made Ground**

- Localised Made Ground deposits comprise reworked topsoil of dark brown silty clayey fine to coarse sand with rootlets and rare brick gravel to 0.60 m bgl.
- Dark brown sandy gravel was identified in TP116 to 0.40 m bgl with gravel of brick, mudstone and concrete and occasional concrete boulders.

**Topsoil**

- Topsoil was encountered in the majority of exploratory hole locations to a maximum depth of 0.80 m bgl in WS103.
- Topsoil comprised dark brown clayey fine to medium SAND with rootlets.

**Drift Deposits**

- Drift deposits were encountered within all exploratory locations to depths in excess of 5.45 m bgl.
- The drift deposits are varied, generally comprising medium dense brown slightly gravelly fine to coarse SAND and medium dense brown clayey GRAVEL with gravel of mudstone.
- The granular drift deposits are generally underlain by firm medium strength to very stiff very high strength, reddish brown gravelly CLAY with gravel of mudstone.

**Solid Geology**

- The solid bedrock geology was not encountered during the ground investigation. There are no BGS boreholes in the vicinity of the site.

**Groundwater**

- Groundwater was encountered as slow and rapid ingress between 0.30 m and 4.00 m bgl. The high water table will preclude the use of infiltration drainage systems.

## 5.3. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW)*. This should include the following:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- Demolition of all existing buildings and removal of all hardstanding.
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- Buried structures and old foundations should be excavated from below the proposed development footprint with the resulting void backfilled.

## 5.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 5.1.

TABLE 5.1 SUMMARY OF ABP

| **GRANULAR SOILS** | | | |
|---|---|---|---|
| **Description** | **Depth (Range m bgl)** | **Relative Density** | **Allowable Bearing Pressure ($kN/m^2$)** |
| **Gravelly SAND** | 1.00–5.45 | Medium Dense | 76–208 |
| **COHESIVE SOILS** | | | |
| **Description** | **Depth (range m bgl)** | **Undrained Shear Strength (Cu) ($kN/m^2$)** | **Allowable Bearing Pressure ($kN/m^2$)** |
| **Firm medium strength to very stiff very high strength CLAY** | 1.00–5.45 | 42–187 | 87–439 |

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying medium dense SAND and firm medium strength to very stiff very high strength CLAY. It should be noted that the presence of shallow groundwater may significantly reduce the ABP of the underlying granular strata.

Where proposed levels remain similar, it is likely that plots could be constructed using strip or trench fill foundations bearing on the underlying firm to very stiff clays or medium dense sands and gravels, subject to the required bearing stratum being present at a shallow depth and the absence of tree influence.

Where the suitable founding stratum is greater than 2.50 m bgl, an engineered foundation solution will be required.

To determine if VSC is viable at the subject site, E3P has completed a Ground Improvement Design Risk Matrix that is summarised in Table 5.2.

TABLE 5.2 GROUND IMPROVEMENT DESIGN RISK MATRIX

| RISK ITEM | COMMENT | PASS/FAIL |
|---|---|---|
| **Soft clays with an undrained shear strength less than 30 kN/m$^2$** | CLAY soils are generally firm to stiff with Cu > 60 kN. | **PASS** |
| **Ground with peat layers close to foundation level or the base of the stone column, or where intermediate layers of peat are thicker than 200 mm, either as a single layer or the sum of the thicknesses of individual layers throughout the length of the stone column** | None identified. | **PASS** |
| **Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading** | Made Ground beneath the north-eastern sector will require removal and processing to render the site suitable for VSC. The existing buildings substructure will also require excavation and processing into a graded aggregate suitable for vibro treatment. | **PASS – on completion of enabling works** |
| **Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation** | None identified. | **PASS** |
| **Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing** | None identified. | **PASS** |
| **Fill, containing degradable material where organic material forms more than 15% of fill by volume** | None identified. | **PASS** |
| **Clays with a plasticity index greater than 40%** | None identified. | **PASS** |
| **Highly sensitive soils liable to collapse or remoulding** | None identified. | **PASS** |
| **Cohesive soils with trees in influencing distance** | Plots where tree influence has been modelled and will either be subject to a piled or mass trench-fill solution. | **PASS** |
| **Overall Risk Rating and Suitability for Vibratory Ground Improvement** | | **PASS** |

Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It is recommended that at working drawing stage a foundation schedule is prepared for the development, taking account of the physical change of natural clay soils and the current/proposed locations of trees.

At this time it is not possible to accurately define the foundation types due to the absence of a detailed tree survey and final development levels; however, based on our extensive experience of similar sites, we would anticipate that the final foundation solution would be a combination of the following:

- Shallow strip foundations bearing on medium dense SAND and GRAVEL and firm to very stiff gravelly CLAY at circa 10 m bgl;
- Trench fill to support reinforced strip foundations in areas of variable ground and/or potential tree influence;
- Ground improvement using Vibro Stone Columns (VSC) to support a shallow strip foundation where strip/trench foundations are unsuitable due to sidewall instability; and/or,
- Driven piles.

A summary of anticipated foundations is presented in Table 5.3.

TABLE 5.3 ANTICIPATED FOUNDATIONS

| LOCATION | ANTICIPATED FOUNDING STRATA DEPTH (m bgl) | GROUND WATER (m bgl) | TARGET STRATUM | TREES | FOUNDATION TYPE | TYPE OF CONCRETE |
|---|---|---|---|---|---|---|
| WS101 | 1.55 | 4.00 | MD SAND | Y | Trench Fill | DS-1 AC-1s |
| WS102 | 1.35 | - | MD SAND | N | Strip | DS-1 AC-1s |
| WS103 | 1.15 | - | MD SAND | N | Strip | DS-1 AC-1s |
| WS104 | 0.95 | 2.70 | MD SAND | N | Strip | DS-1 AC-1s |
| WS105 | 0.90 | - | Firm CLAY | N | Strip | DS-1 AC-1s |
| TP101 | 1.45 | 1.50 | Firm CLAY | N | Strip | DS-1 AC-1s |
| TP102 | >1.50 | 0.30 | TBC | N | Trench Fill/VSC/Pile | DS-1 AC-1s |
| TP103 | 0.90 | 1.00 | Firm CLAY | N | Strip | DS-1 AC-1s |
| TP104 | 0.95 | - | MD SAND | N | Strip | DS-1 AC-1s |
| TP105 | 0.95 | 1.80 | GRAVEL | N | Strip | DS-1 AC-1s |
| TP106 | 0.95 | - | GRAVEL | N | Strip | DS-1 AC-1s |
| TP107 | 2.25 | 0.30 | Firm CLAY | N | Trench Fill | DS-1 AC-1s |
| TP108 | 2.45 | 2.00 | Stiff CLAY | N | Trench Fill | DS-1 AC-1s |
| TP109 | 1.45 | 1.20 | Firm CLAY | N | Strip | DS-1 AC-1s |

| LOCATION | ANTICIPATED FOUNDING STRATA DEPTH (m bgl) | GROUND WATER (m bgl) | TARGET STRATUM | TREES | FOUNDATION TYPE | TYPE OF CONCRETE |
|---|---|---|---|---|---|---|
| TP110 | 1.45 | 0.60 | Stiff CLAY | N | Strip | DS-1 AC-1s |
| TP111 | 1.25 | 1.00 | Stiff CLAY | N | Strip | DS-1 AC-1s |
| TP112 | 1.65 | - | Stiff CLAY | Y | Trench Fill | DS-1 AC-1s |
| TP113 | 1.65 | 0.70 | Stiff CLAY | N | Trench Fill | DS-1 AC-1s |
| TP114 | 1.65 | - | Stiff CLAY | N | Trench Fill | DS-1 AC-1s |
| TP115 | 1.65 | 0.90 | Stiff CLAY | N | Trench Fill | DS-1 AC-1s |
| TP116 | >2.50 | 1.20 | Stiff CLAY | N | VSC/Pile | DS-1 AC-1s |
| TP117 | 0.95 | 1.50 | Stiff CLAY | N | Strip | DS-1 AC-1s |

## 5.5. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

Where a cast in-situ suspended slab is utilised with no subfloor void, appropriate compressible material (heave precautions) will be required in the construction of the substructure.

## 5.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils, which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectured zones of influence.

As the clay is deemed to be moderate plasticity, heave precautions are required to the internal face of the external load-bearing walls (outside or within tree influence).

If a ground beam is to be constructed within the zone of tree influence, heave precautions are required to the underside of this and edge beams.

If the ground floor slab is to be constructed with a beam and block floor, a minimum subfloor void of 200 mm is required within any structures located in the zone of conjectured tree influence.

If the ground floor slab is constructed with a cast in-situ suspended floor slab, then heave precautions that can tolerate 50 mm of clay swelling are required within any part of the floor slab to be located within the zone of influence of a tree.

A summary of heave precautions is presented in Table 5.4.

TABLE 5.4 SUMMARY OF HEAVE PRECAUTIONS

| | | MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS | | MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS |
|---|---|---|---|---|
| **Plasticity Index of Soil** | **Required Foundation Depth (m)** | **Thickness of Void Former Against Side of Foundation or Ground Beam (mm)** | **Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)** | **Void Dimension (mm)** |
| **High Plasticity (> 40)** | > 2.5 | Engineer Design | | Engineer Design |
| | 2.0–2.5 | 35 | 150 | 300 |
| | 1.5–2.0 | 25 | 75 | |
| **Moderate Plasticity (20–40)** | > 2.5 | Engineer Design | | Engineer Design |
| | 2.0–2.5 | 25 | 100 | 250 |
| | 1.5–2.0 | 25 | 50 | |
| **Low Plasticity (< 20)** | 2.0–2.5 | N/A | 50 | 200 |
| | > 2.0 | No Special Precautions | | |

## 5.7. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works (Series 600-Earthworks) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

## 5.8. DRAINAGE

The soakaway tests showed poor soakage potential and considering the high groundwater table, it is considered that soakaway drainage may not be suitable for the proposed development.

## 5.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

## 5.10. EXCAVATIONS

Trial pits were generally unstable in granular drift deposits.

Site observations indicated that excavations should be feasible in the near surface with normal plant, however, due to the likelihood of trench collapse, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.

TABLE 5.5 CIVIL ENGINEERING EXCAVATION RISK MATRIX

| RISK ITEM | PRESENT | COMMENT |
|---|---|---|
| **Running Sands** | No | No running sand has been identified, however due to the high groundwater table running sands are considered possible. |
| **Minor Water Ingress** | Yes | Water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure.<br><br>Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed. |
| **Shallow Bedrock** | No. | Shallow bedrock has not been identified. |

## 5.11. CONSTRUCTION ACTIVITY AND INSPECTION

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

- Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.
- Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.
- The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).

## 5.12. GEOTECHNICAL RISK REGISTER

| POTENTIAL ABNORMAL CONSTRAINT | LOCATION ON SITE | ESTIMATED AREA OF SITE AT RISK (%) | ASSESSMENT AND MITIGATION |
|---|---|---|---|
| **Remediation of contaminated soils** | On site | 10 | The risk to chronic human health associated with the elevated concentrations of non-volatile PAH and heavy end TPH compounds can be mitigated through the installation of a suitable cover system in affected gardens, landscaping and public open space where Made Ground is present to remove any potential for direct exposure to impacted soils. |
| **Bedrock** | N/A | N/A | No shallow bedrock has been identified. |
| **Obstructions** | NE | 10 | The site has been subject to limited historical development. No obstructions were encountered during site investigation, however, obstructions may be present in the location of the exiting barn in the north east. |
| **Trench collapse** | On site | 100 | The exploratory holes within the granular drift deposits and the Made Ground were found to be unstable/collapsing in trial pits. Allowances for trench support required. |
| **Mature trees** | NE Western boundary | TBC | Arboriculture survey required to determine areas of potential tree influence. |
| **Volume change potential clay** | On site | TBC | The clay is low to medium volume change potential, therefore heave precautions are required. |
| **Running sands** | N/A | N/A | Data searches indicate low risk. |
| **Ground dissolution** | N/A | N/A | Data searches indicate no hazard. |
| **Concrete design** | N/A | - | The soils meet classification DS-1 AC-1s. |
| **Low-permeability ground** | On site | 100 | The soakaway tests showed poor soakage potential and considering the high groundwater table, it is considered that soakaway drainage may not be suitable for the proposed development. |

| POTENTIAL ABNORMAL CONSTRAINT | LOCATION ON SITE | ESTIMATED AREA OF SITE AT RISK (%) | ASSESSMENT AND MITIGATION |
|---|---|---|---|
| **Services/sensitive structures** | North | TBC | Services are present along Wrexham Road to the north. Piling may not be possible within close proximity to any sensitive infrastructure. |
| **Abnormal foundation solutions** | TBC | TBC | Depending on development levels an abnormal foundation solution (MTF, VSC, Pile) may be required in areas of tree influence, deeper Made Ground or where the ABP is reduced in saturated natural granular drift deposits. |
| **Areas not investigated** | NE | 10 | A watching brief should be completed during remediation in the north east sector to confirm the absence of any potentially volatile contaminants. |

## 5.13. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Plot-specific foundation schedule (upon receipt of the final development levels).
- Arboricultural survey.
- Remediation and enabling works strategy.

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1. CONTAMINATED LAND ASSESSMENT

| | |
|---|---|
| **Human Health** | The Tier I assessment has identified elevated concentrations of non-volatile PAHs and TPH C16-C35 in the shallow Made Ground in TP116 located in the north east sector.<br><br>The identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds and heavy end TPH C16-C35 compounds can be mitigated through the installation of a suitable cover system where Made Ground remains.<br><br>E.coli has been detected (160 MPN/g) in TP116 at 0.1 m bgl adjacent an area of manure storage. The presence of E.coli indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens. It is therefore recommended that the impacted soils in this part of the site are segregated and placed in an area of no future sensitivity.<br><br>The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.<br><br>Chemical analysis of the topsoil and natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.<br><br>However, soils in the vicinity of TP116 are not recommended for reuse due to the presence of E.Coli. It is recommended these materials are removed and placed in an area of low sensitivity, and future groundworkers on-site have the appropriate Personal Protective Equipment whilst handling soils on-site. |
| **Controlled Waters** | No significant sources of mobile contamination have been identified. Marginally elevated concentrations of selenium and zinc have been identified. The inorganic compounds are generally of low solubility and mobility and appear to be associated with the localised Made Ground in the north east sector. E. coli has also been detected in soils in TP116 which may leach and effect drinking water or run off into nearby watercourses.<br><br>The site is underlain by a mixed geology. The granular deposits will afford less protection to the underlying Principal aquifer in the bedrock, however, cohesive soils will afford some protection.<br><br>The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the underlying aquifer.<br><br>There is considered to be no unacceptable level of risk to controlled waters. |

| | |
|---|---|
| **Ground Gas** | Ground gas monitoring suggests that the site can be classified as Green (equivalent CS1), and it is considered that gas protection measures will not be required. |

## 6.2. GEOTECHNICAL ASSESSMENT

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying medium dense SAND and firm medium strength to very stiff very high strength CLAY. However, it should be noted that the presence of shallow groundwater may significantly reduce the ABP of the underlying sands.

Where proposed levels remain similar, it is likely that plots could be constructed using strip or trench fill foundations bearing on the underlying firm to very stiff clays or medium dense sands and gravels, subject to the required bearing stratum being present at a shallow depth and the absence of tree influence.

Where the suitable founding stratum is greater than 2.50 m bgl, or where significant trench collapse is anticipated an engineered foundation solution will be required.

Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

BRE365 Soakaway testing has indicated the site to be unfavourable for infiltration drainage systems due to a highwater table and generally poor infiltration rates.

Concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s.

# END OF REPORT

# APPENDIX I
# LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

# APPENDIX II
# GLOSSARY

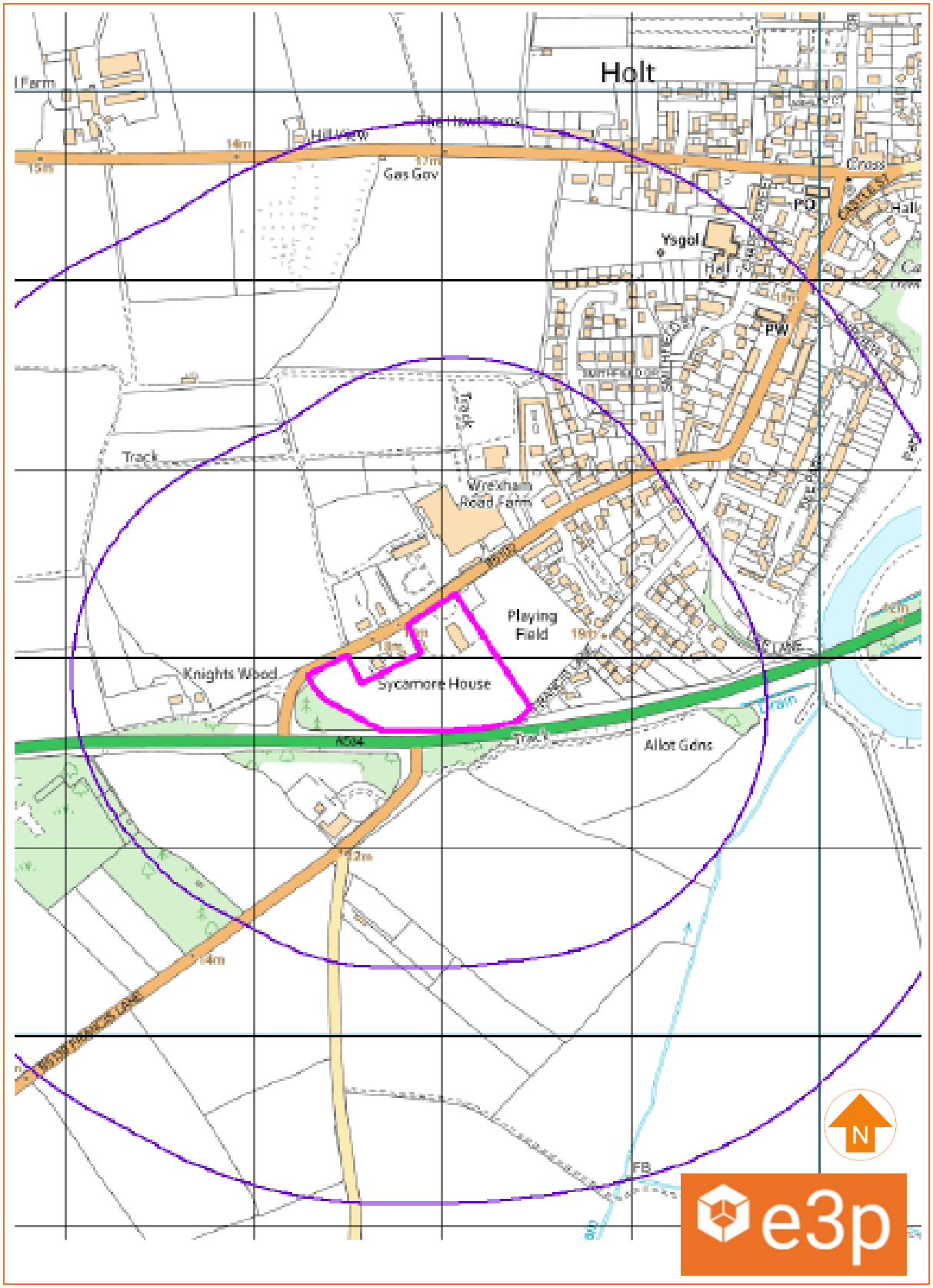
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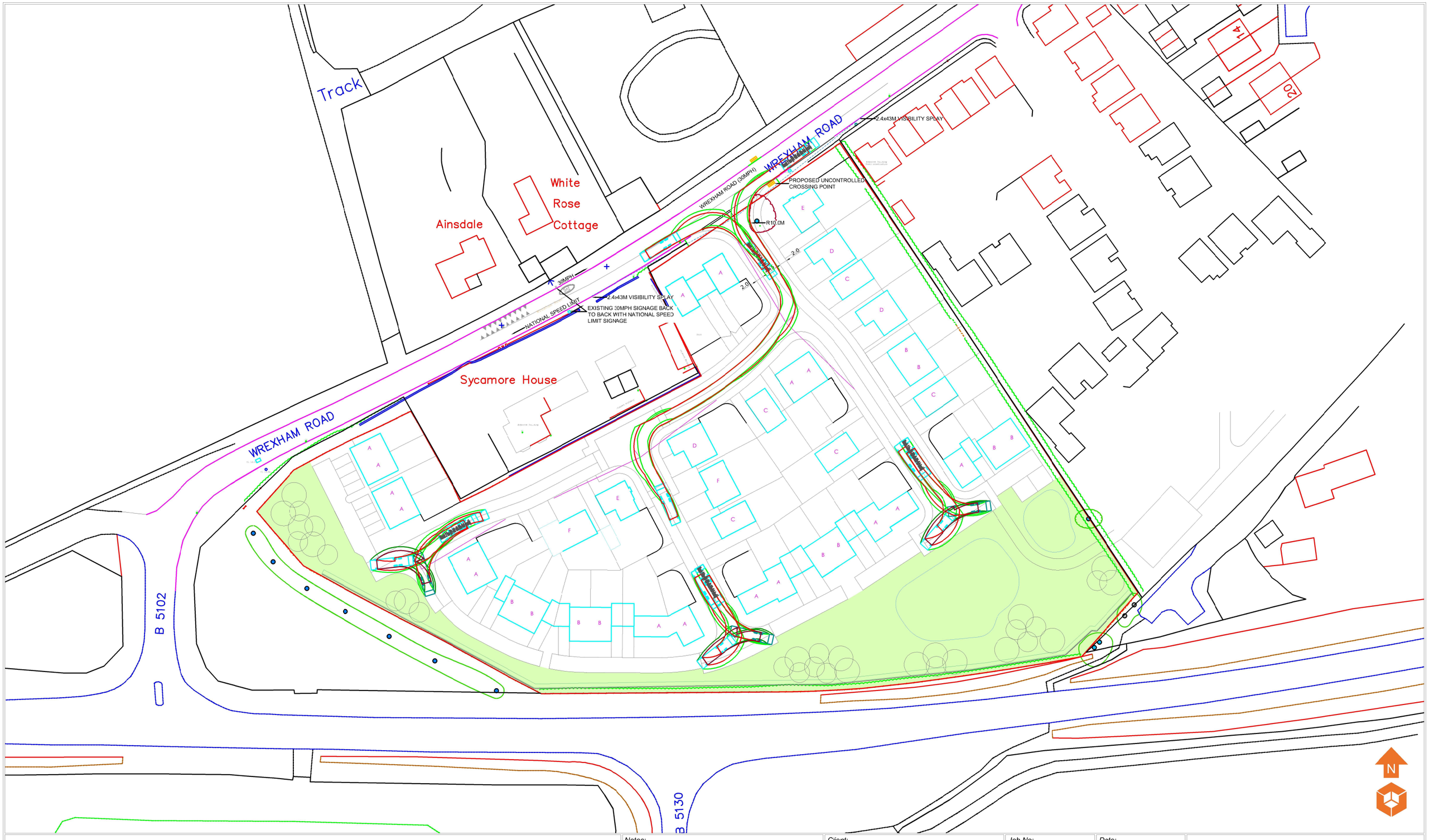
| | | | |
|---|---|---|---|
| **ACM** | Asbestos-containing material | **MMP** | Materials management plan |
| **ADS** | Acoustic design statement | **ND** | Not detected |
| **AST** | Above-ground storage tank | **NDP** | Nuclear density probe |
| **BGS** | British Geological Survey | **NMP** | Noise management plan |
| **BSI** | British Standards Institute | **NPSE** | Noise policy statement for England |
| **BTEX** | Benzene, toluene, ethylbenzene, xylenes | **NR** | Not recorded |
| **CA** | Coal Authority | **PAH** | Polycyclic aromatic hydrocarbon |
| **CBR** | California bearing ratio | **PCB** | Polychlorinated biphenyl |
| **CIEH** | Chartered Institute of Environmental Health | **PI** | Plasticity index |
| **CIRIA** | Construction Industry Research Association | **PID** | Photo ionisation detector |
| **CLEA** | Contaminated land exposure assessment | **POS** | Public open space |
| **CML** | Council of Mortgage Lenders | **PPE** | Personnel protective equipment |
| **CoC** | Contaminants of concern | **ProPG** | Professional practice guidance |
| **CSM** | Conceptual site model | **QA** | Quality assurance |
| **DNAPL** | Dense non-aqueous phase liquid (chlorinated solvents, PCB) | **SGV** | Soil guideline value |
| **DWS** | Drinking water standard | **SPH** | Separate-phase hydrocarbon |
| **EA** | Environment Agency | **SPT** | Standard penetration test |
| **EQS** | Environmental quality standard | **SVOC** | Semi-volatile organic compound |
| **FFL** | Finished floor level | **TPH** | Total and speciated petroleum hydrocarbon |
| **GAC** | General assessment criteria | **TPH CWG** | Total Petroleum Hydrocarbon (Criteria Working Group) |
| **GL** | Ground level | **UKWIR** | United Kingdom Water Infrastructure Risk |
| **GSV** | Gas screening value | **UST** | Underground storage tank |
| **HCV** | Health criteria value | **VCC** | Vibro-concrete column |
| **ICSM** | Initial conceptual site model | **VOC** | Volatile organic compound |
| **LEL** | Lower explosive limit | **VRSC** | Vibro-replacement stone columns |
| **LMRL** | Lower method reporting limit | **VSC** | Vibro-stone columns |
| **LNAPL** | Light non-aqueous phase liquid (petrol, diesel, kerosene) | **WHO** | World Health Organisation |
| **MCV** | Moisture condition value | **WRAP** | Waste and Resources Action Programme |

| | | | |
|---|---|---|---|
| **MIBK** | Methyl isobutyl ketone | **WTE** | Water table elevation |
| **m** | Metres | **ppm** | Parts per million |
| **km** | Kilometres | **mg/m$^3$** | Milligram per metre cubed |
| **% v/v** | Percent volume in air | **m bgl bgl** | Metres below ground level |
| **mb** | Millibars (atmospheric pressure) | **m bcl** | Metre below cover level |
| **l/hr** | Litres per hour | **mAOD** | Metres above ordnance datum (sea level) |
| **µg/l** | Micrograms per litre (parts per billion) | **kN/m$^2$** | Kilonewtons per metre squared |
| **ppb** | Parts per billion | **µm** | Micrometre |
| **mg/kg** | Milligrams per kilogram (parts per million) | **SSRT** | Site Specific Remediation Target |
| **PSD** | Particle Size Distribution | **DD** | Dry Density |
| **CL:AIRE** | Contaminated Land: Applications in Real Environments | **Mc** | Moisture Content |
| **ρ** | Bulk Density | **GPR** | Ground Penetrating Radar |
| **NDP** | Nuclear Density Probe | **FFL** | Finished Floor Level |
| **LEL** | Lower Explosive Limit | **UKWIR** | UK Water Industry Research |
| **CIRIA** | Construction Industry Research and Information Association | **LOD** | Limit of Detection |

# APPENDIX III
# DRAWINGS

## DRAWING 14-608-001 – SITE LOCATION PLAN






| | | | | |
|---|---|---|---|---|
| P1 | REVA | 19.04.2021 | EB | JS |
| Phase | Issue | Date | Drawn | Checked |

*Notes:*

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 19.04.2021

*Drawing No:* 002

*Scale:* NTS@ A3

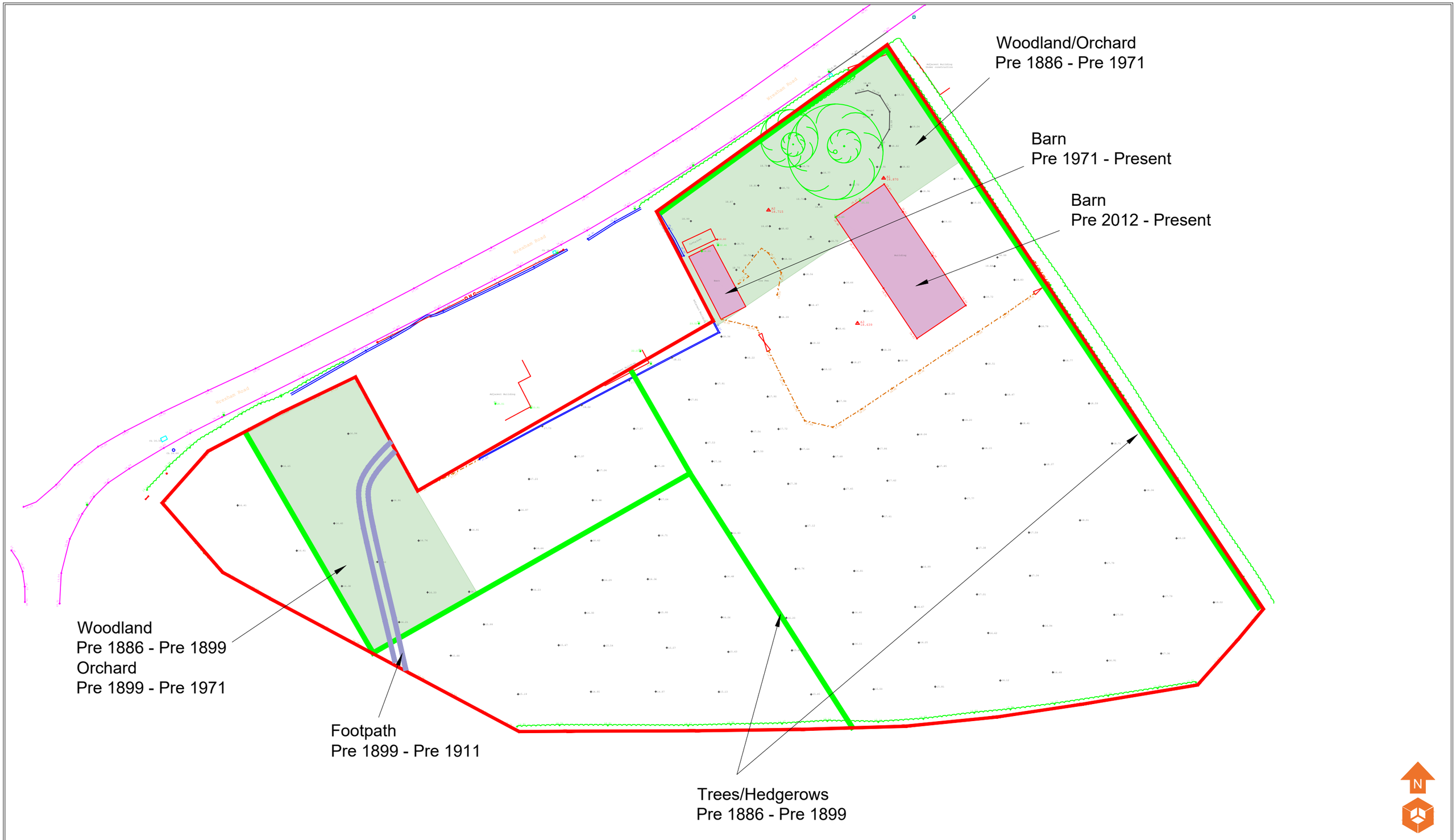
*Job Title:* Wrexham Road, Holt

*Drawing Title:* Proposed Development Plan


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*Historical Features*

- Former Woodland/Orchard
- Former Trees/Hedgerow
- Former Footpath
- Barn

*Notes:*

| | | | | |
|---|---|---|---|---|
| P1 | REVA | 12.02.2021 | CB | JS |
| Phase | Issue | Date | Drawn | Checked |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 12.02.2021

*Drawing No:* 003

*Scale:* 1:750 @ A3

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Historical Features Plan

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*Site Features*

- Grassland
- Gravel
- Mature Trees
- Barn
- Manure Storage

*Notes:*

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 12.02.2021

*Drawing No:* 004

*Scale:* 1:750 @ A3

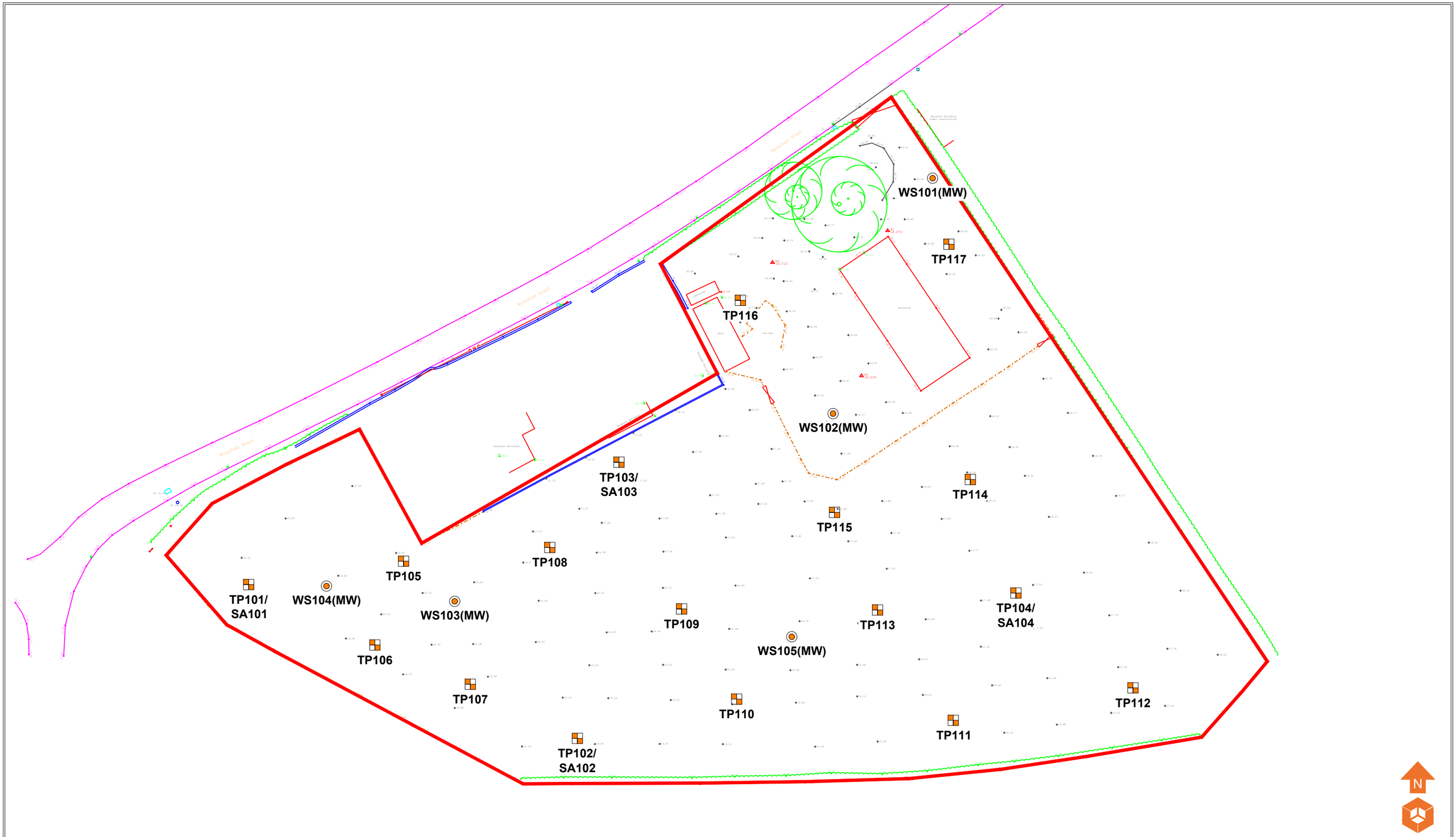
| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVA | 12.02.2021 | CB | JS |

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Site Features Plan

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*Location Symbols*

- WS101(MW) — Approximate Window Sample Probehole Location with Install
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location

*Notes:*

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVB | 11.03.2021 | HM | NS |
| P1 | REVA | 12.02.2021 | CB | JS |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 11.03.2021

*Drawing No:* 005

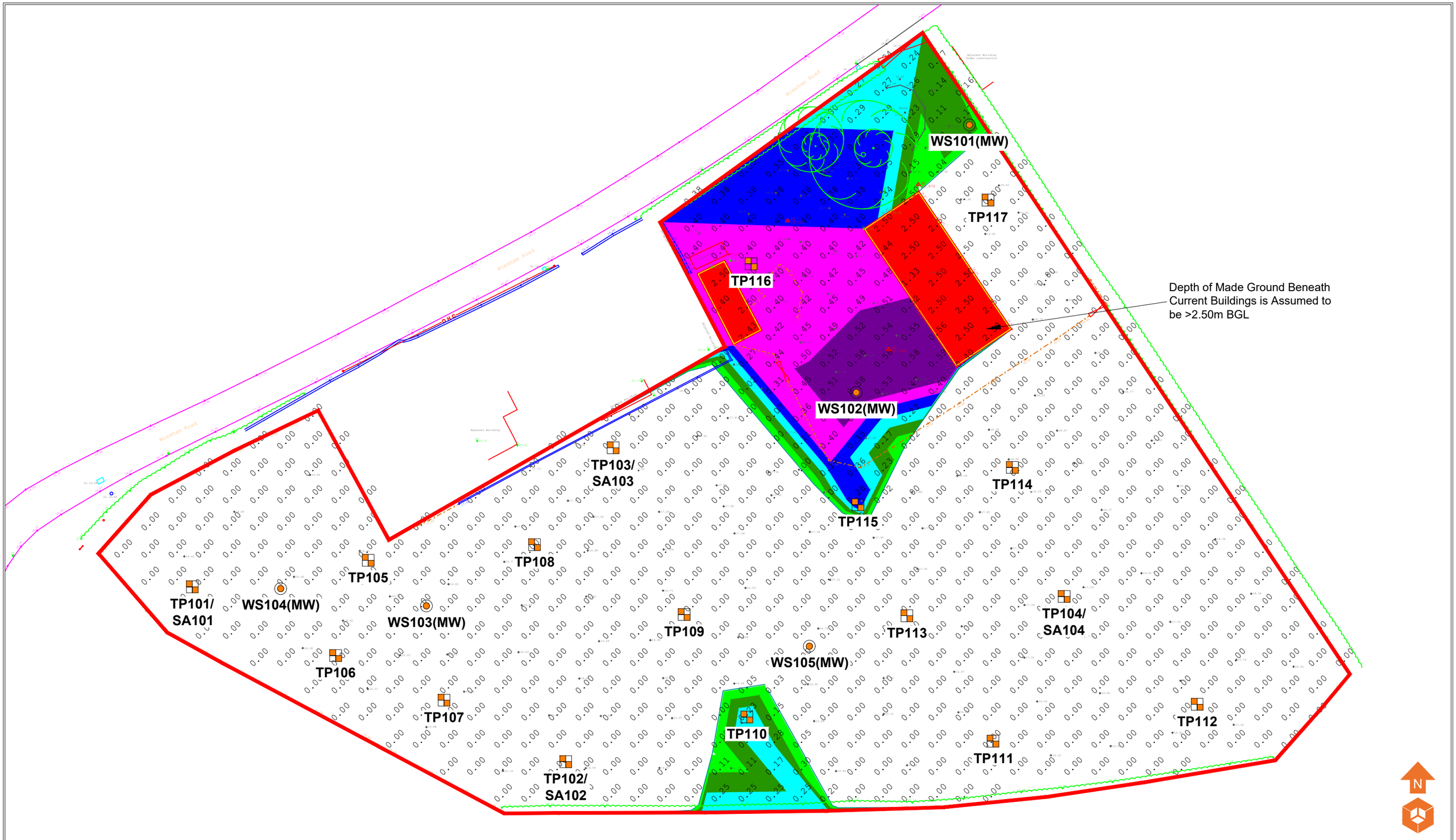
*Scale:* NTS

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Exploratory Hole Location Plan

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*Location Symbols*

- WS101(MW) — Approximate Window Sample Probehole Location with Install
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location

*Made Ground Depth (m)*

- Depth of Made Ground 0.00 - 0.09m
- Depth of Made Ground 0.10 - 0.19m
- Depth of Made Ground 0.20 - 0.29m
- Depth of Made Ground 0.30 - 0.39m
- Depth of Made Ground 0.40 - 0.49m
- Depth of Made Ground 0.50 - 0.59m
- Depth of Made Ground 0.60 - 0.69m
- Depth of Made Ground 0.70 - 0.79m
- Depth of Made Ground >0.80m

*Notes:*

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVC | 28.04.2021 | CB | JS |
| P1 | REVB | 11.03.2021 | HM | NS |
| P1 | REVA | 23.02.2021 | HM | JS |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 28.04.2021

*Drawing No:* 006

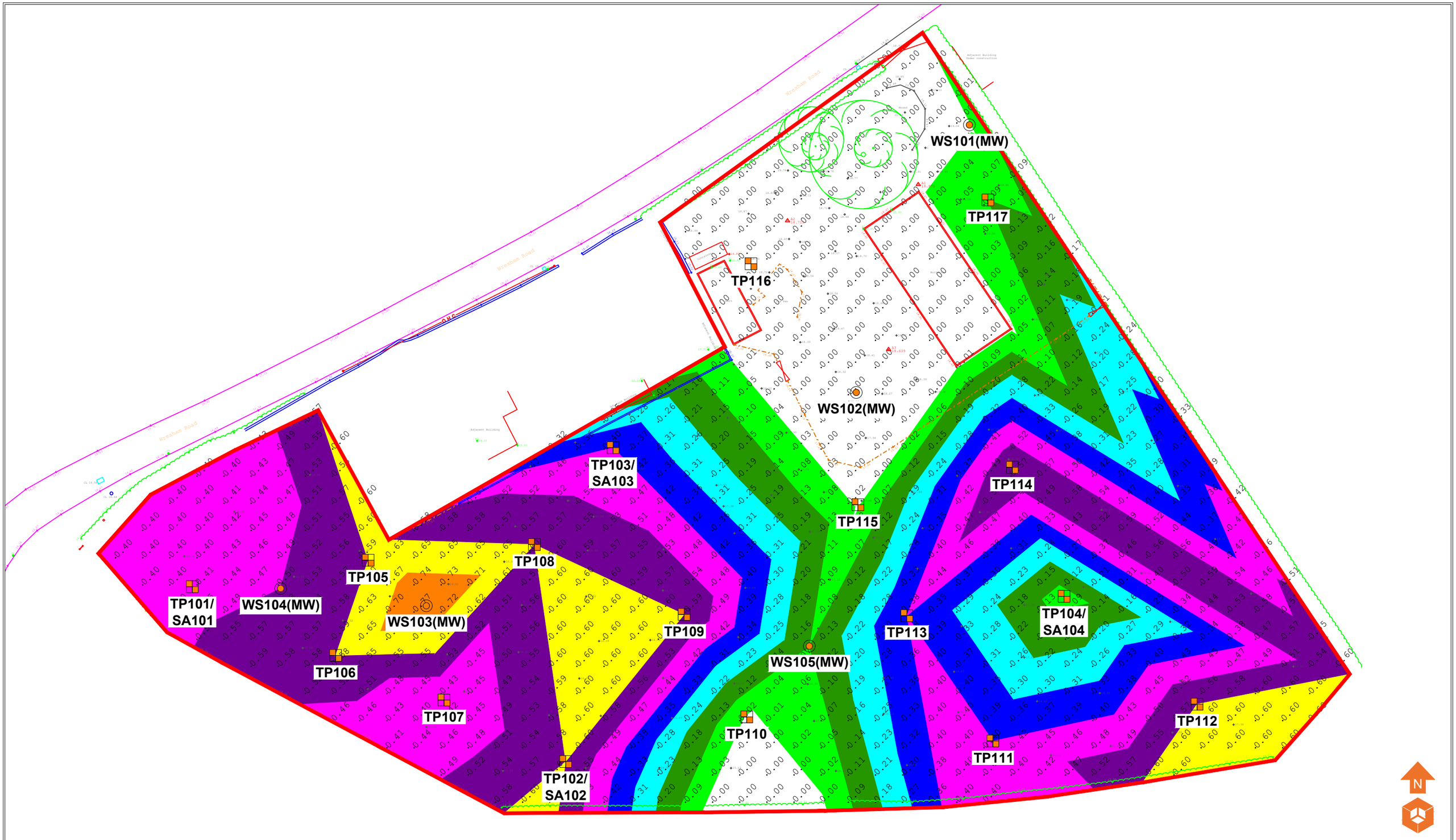
*Scale:* NTS

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Depth of Made Ground Plan

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*Location Symbols*

- WS101(MW) — Approximate Window Sample Probehole Location with Install
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location

*Made Ground Depth (m)*

- Depth of Made Ground 0.00 - 0.09m
- Depth of Made Ground 0.10 - 0.19m
- Depth of Made Ground 0.20 - 0.29m
- Depth of Made Ground 0.30 - 0.39m
- Depth of Made Ground 0.40 - 0.49m
- Depth of Made Ground 0.50 - 0.59m
- Depth of Made Ground 0.60 - 0.69m
- Depth of Made Ground 0.70 - 0.79m
- Depth of Made Ground >0.80m

*Notes:*

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 11.03.2021

*Drawing No:* 007

*Scale:* NTS

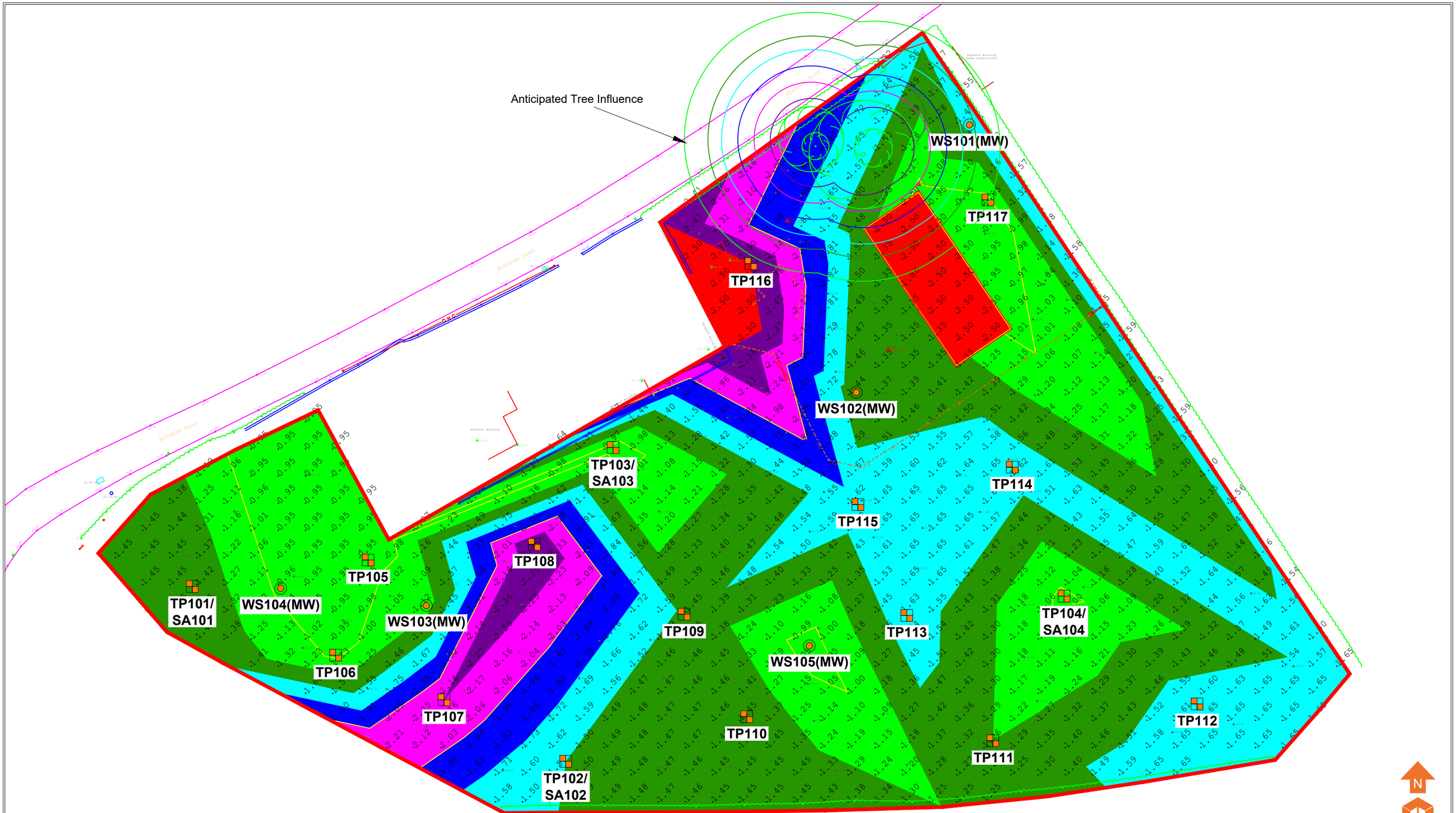
| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVB | 11.03.2021 | HM | NS |
| P1 | REVA | 23.02.2021 | HM | JS |

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Depth of Topsoil Plan

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*Location Symbols*

- Approximate Window Sample Probehole Location with Install
- Approximate Trial Pit Location
- Approximate Soakaway Test Location

*Shallow Spread Footings*

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

*Mass Trench Fill Footings*

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

*Engineered Footings*

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

*Notes:*

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVB | 11.03.2021 | HM | NS |
| P1 | REVA | 23.02.2021 | HM | JS |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 11.03.2021

*Drawing No:* 008

*Scale:* NTS

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Depth to Founding Strata Plan


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### Summary of Heave Precaution Requirements

| Volume Change Potential | Required Foundation Depth (m) | Minimum Void Dimensions for Foundations, Ground Beams & Suspended In-Situ Concrete Ground Floors | | Minimum Void Dimensions Under Pre-Cast Concrete & Suspended Timber Floors |
|---|---|---|---|---|
| | | Thickness of Void Former Against Side of Foundation or Ground Beam (mm) | Thickness of Void Former on Underside of Edge Beam & Floor Slab (mm) | Void Dimension (mm) |
| Low Volume Change Potential (<20%) | >2.0C | No Special Precautions | | 200 |
| | 2.00-2.30 | - | 50 | |
| Medium Volume Change Potential (20-40%) | 1.50-2.00 | 25 | 50 | 250 |
| | 2.00-2.30 | 25 | 100 | |
| | >2.5C | Engineer Design | | Engineer Design |
| High Volume Change Potential (>40%) | 1.50-2.00 | 25 | 75 | 300 |
| | 2.00-2.30 | 35 | 150 | |
| | >2.5C | Engineer Design | | Engineer Design |

### Minimum Width of Strip Footings

| Type of Ground (including Engineered Fill) | | Condition of Ground | Total Load of Load-Bearing Walling more than (kN/linear metre) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 20 | 30 | 40 | 50 | 60 | 70 |
| | | | Minimum Width of Strip Foundation (mm) | | | | | |
| Gravel | Sand | Medium Dense to Dense | 250 | 300 | 400 | 500 | 600 | 650 |
| Clay | Sandy Clay | Stiff | 250 | 300 | 400 | 500 | 600 | 650 |
| Clay | Sandy Clay | Firm | 300 | 350 | 400 | 500 | 750 | 850 |

### Items Considered

| | |
|---|---|
| Bearing Capacity | TBC |
| Trees | TBC |
| Historical | TBC |
| Groundwater Table | TBC |
| FFL | TBC |
| Contamination | TBC |
| Remediation | TBC |
| Volume Change Potential | TBC |
| Root Protection Areas | TBC |

### Residual Risks

| Foreseeable Risks That Cannot be Avoided | Applicable (Y/N) | Action to Reduce Risk | Justification for Design Decision |
|---|---|---|---|
| Deep Excavations | Y | Identify locations on drawing and depths on schedule | Lesser risk than other alternatives |
| Trench Collapse | Y | Risk highlighted on drawing | Lesser risk than other alternatives |
| Use of Working Platform for Pile/Vibro Operations | Y | Compliance with working platform directive required | Pile/Vibro foundation less risky than other alternatives |

*Anticipated Foundation Types*

- TS — Traditional Strip Foundations
  Minimum depth 450mm below proposed Final Finished Level
  Maximum safe bearing pressure limited to 100kN/m2
- MT — Mass Trench Fill Foundations
  Minimum depth 1,025mm below proposed Final Finished Level
  Maximum safe bearing pressure limited to 100kN/m2
- V — Vibro Stone Ground Compaction
  In accordance with NHBC Chapter 4.2
- P — Piled Foundations
  Achieve the maximum foundation depth exceeds 2.50m a pile/piled system will not have a tested (5) deep achieved any foundations may be adopted. Column or liner loads supported by ground beams.
- R — Raft Foundations
  Maximum safe bearing pressure limited to 100kN/m2 on spur engineered granular fill. Raft foundations to be designed to a structural engineer in accordance with C [illegible] of NHBC 2021. Raft foundations are considered suitable to be applied potential influence of clay based excavation in accordance with Section 4.2, sub section G FE
- TB — Traditional Strip / Trench Block Foundations
  Traditional strip foundations at 450mm below current level with toe in. Trench filled and subsequent backfill to development level.
- Colours on Plot Corners to be Used When Referring to Foundation Schedule.
  (Pending Final Layout & Levels)

*Depth to Target Founding Strata*

- Footings 0.75 - 0.90m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 0.90 - 1.25m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 1.25 - 1.50m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 1.50 - 1.75m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 1.75 - 2.00m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 2.00 - 2.25m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1
- Footings 2.25 - 2.50m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.1

*Engineered Foundation Solutions*

- Footings >2.50m Deep — From Final Finished Level, in accordance with NHBC Chapter 4.2
- Vibro
- Low Volume Change Potential Clay — Heave precautions required to underside of (usually floor slab (with no sub-floor void) within projected zone of tree influence. Heave precautions not required to foundation.

*Structural Design Risk Management*

Abnormal residual risks associated with the design outcomes on the drawing:

1. ****
2. ****

*Notes:*

*Client:* Mrs V & Mr A Pridding

*Job No:* 14-608

*Date:* 19.04.2021

*Drawing No:* 009

*Scale:* NTS@ A1

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVA | 19.04.2021 | EB | JS |

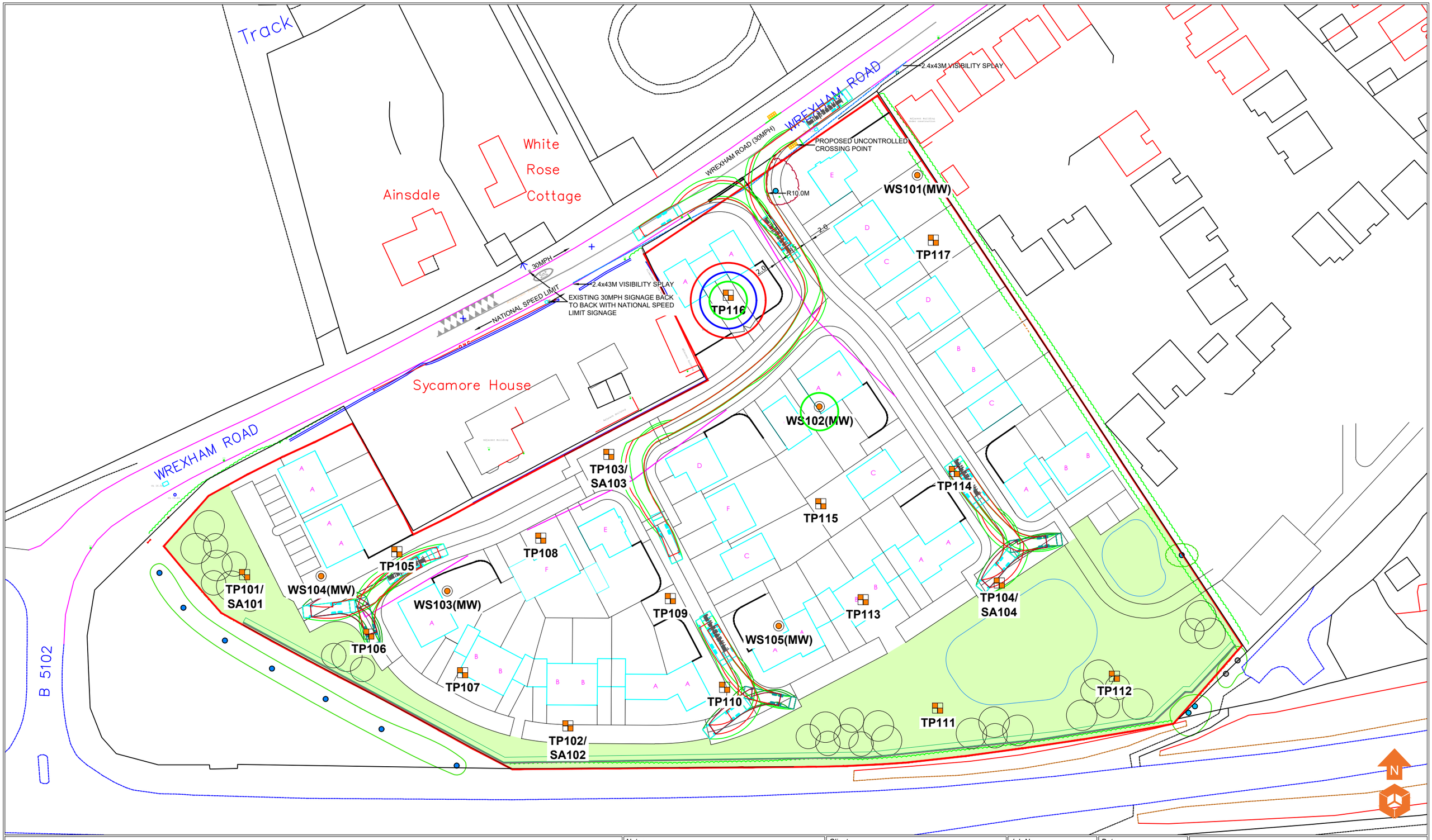
*Job Title:* Wrexham Road, Holt

*Drawing Title:* Concept Foundation Zoning Plan


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*Location Symbols*

- WS101(MW) — Approximate Window Sample Probehole Location with Install
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location

*Human Health Exceedances*

- TPH C16 - C35
- Non Volatile PAH

*Controlled Waters Exceedances*

- Heavy Metals

*Notes:*

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVC | 28.04.2021 | CB | JS |
| P1 | REVB | 26.04.2021 | HM | JS |
| P1 | REVA | 11.03.2021 | HM | NS |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 28.04.2021

*Drawing No:* 009

*Scale:* NTS

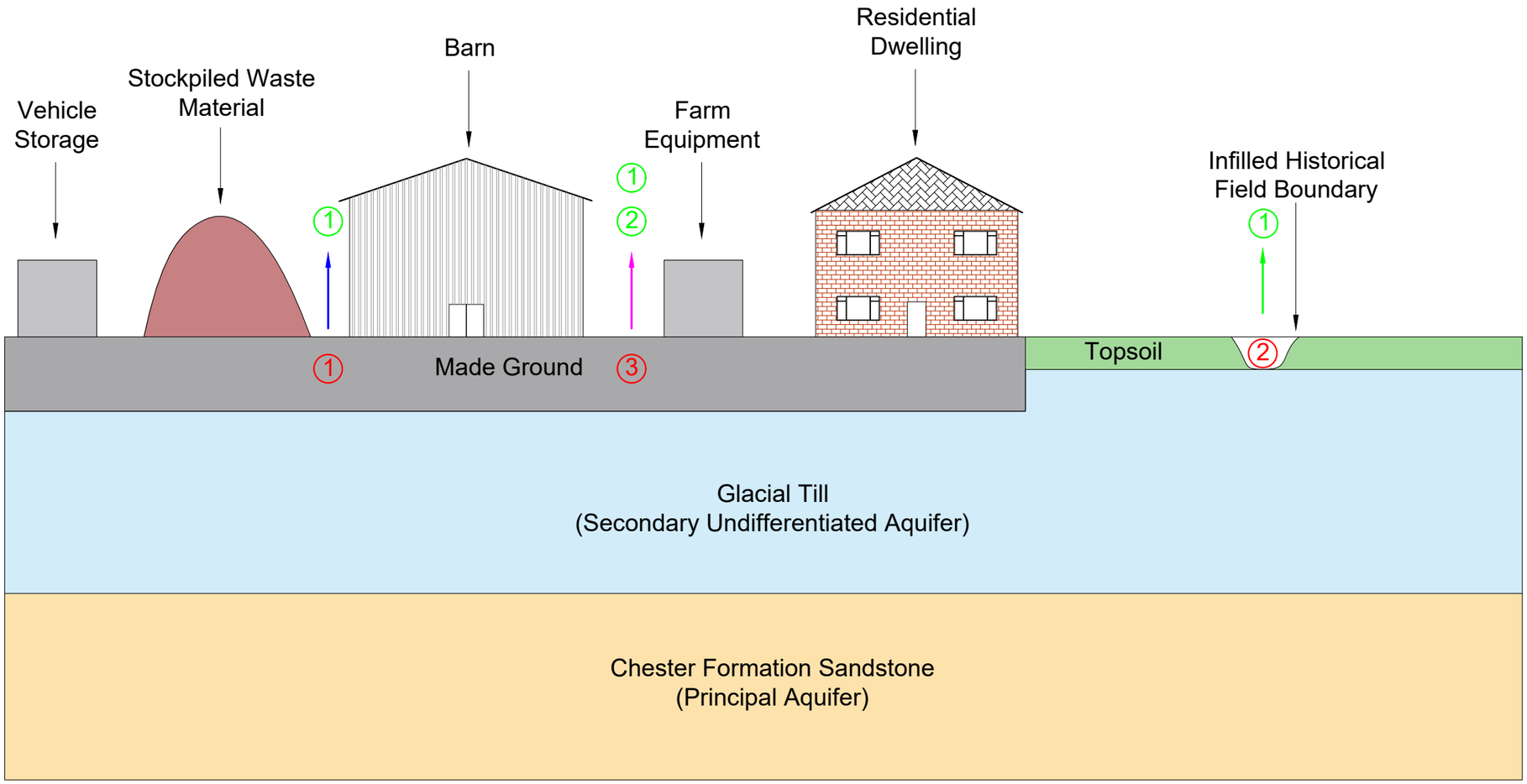
*Job Title:* Wrexham Road, Holt

*Drawing Title:* Contamination Issues Plan


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*Conceptual Site Model*

- Topsoil
- Made Ground
- Gravel/Concrete
- Glacial Till
- Chester Formation Sandstone

*Sources*

1. Non Volatile PAH, TPH C16 - C35
2. Hazardous Ground Gas
3. Organic Contaminants (Hydrocarbons)

*Receptors*

1. Future End Users
2. Water Pipes

*Pathways*

- Dermal Contact / Ingestion
- Inhalation / Accumulation
- Tainting of Water Supplies

*Notes:*

| Phase | Issue | Date | Drawn | Checked |
|---|---|---|---|---|
| P1 | REVB | 11.03.2021 | HM | NS |
| P1 | REVA | 24.02.2021 | CB | JS |

*Client:* Mrs V and Mr A Pridding

*Job No:* 14-608

*Date:* 11.03.2021

*Drawing No:* 010

*Scale:* NTS

*Job Title:* Wrexham Road, Holt

*Drawing Title:* Conceptual Site Model

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# APPENDIX IV
# PHOTOGRAPHS

| PLATE 1 | TP102/SA102 EXCAVATION |
|---|---|



| PLATE 2 | TP104/SA104 EXCAVATION |
|---|---|



| PLATE 3 | TP108 EXCAVATION |
|---|---|



PLATE 4 TP114 EXCAVATION



PLATE 5 TP116 EXCAVATION



| PLATE 6 | TP117 ARISINGS |
|---|---|



# APPENDIX V
# E3P EXPLORATORY HOLE LOGS

# Trial Pit Log

TrialPit No TP101/ SA101
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340485.00 - 353362.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 1.90 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | 0.40 | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 1.00 | | | Light brown fine to coarse SAND. |
| 1.50 | 1.50 | B | | 1.90 | | | Firm light grey slightly gravelly sandy CLAY. Gravel is fine to medium subrounded to rounded of mudstone. |
| | | | | | | | End of Pit at 1.90m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 101/ Soakaway 101



Trial Pit 101/ Soakaway 101 Spoil

Remarks: 1. Complete 2. Water strike encountered at 1.50m bgl. 3. Unstable from 0.60m bgl. 4. Clay is friable.

Stability: Unstable

# Trial Pit Log

TrialPit No TP102/ SA102
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340556.00 - 353336.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 1.50 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| 0.30 | | | | | | | Dark brown silty clayey fine to medium sand with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Firm light brown sandy gravelly CLAY. Gravel is fine to medium subrounded to rounded of mudstone. |
| | | | | 0.70 | | | Reddish brown slightly sandy clayey GRAVEL. Gravel is fine to medium subrounded to rounded of mudstone. |
| | | | | 1.50 | | | End of Pit at 1.50m |

## Trial Pit Photographs



Trial Pit 102/ Soakaway 102



Trial Pit 102/ Soakaway 102 Spoil

Remarks: 1. Complete 2. Rapid water strike encountered at 0.30m bgl. 3. Stable.

Stability: Stable

# Trial Pit Log

TrialPit No TP103/ SA103
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340563.00 - 353393.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 1.50 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | | | | Dark brown silty clayey fine to medium sand with frequent rootlets (Topsoil). |
| | | | | 0.40 | | | Firm orange brown sandy gravelly CLAY. Gravel is fine to medium subrounded to rounded of mudstone. |
| ▼ 1.00 | | | | | | | |
| | | | | 1.50 | | | End of Pit at 1.50m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 103/ Soakaway 103



Trial Pit 103/ Soakaway 103 Spoil

Remarks: 1. Complete 2. Water strike encountered at 1.00m bgl 3. Unstable past 0.40m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No TP104/ SA104
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340643.00 - 353358.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 1.40 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | 0.05 | | | Dark brown silty very clayey fine to medium SAND (Topsoil). Orange brown slightly gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of mudstone. |
| | | | | 1.40 | | | End of Pit at 1.40m |

1
2
3
4

## Trial Pit Photographs



Trial Pit 104/ Soakaway 104



Trial Pit 104/ Soakaway 104 Spoil

Remarks: 1. Complete 2. Unstable from 0.10m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP105
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340509.00 - 353371.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.00 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Orange brown clayey sandy GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | 1.00 | ES | | 1.00 | | | Grey brown very sandy clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| ▼ 1.80 | | | | 2.00 | | | End of Pit at 2.00m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Complete 2. Rapid water strike encountered at 1.80m bgl. 3. Unstable from 0.60m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP106
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340506.00 - 353351.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 1.90 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | 0.00 | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Grey brown sandy very clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 1.90 | | | End of Pit at 1.90m |

## Trial Pit Photographs



Trial Pit 106



Trial Pit 106 Spoil

Remarks: 1. Complete. 2. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP107
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340528.00 - 353344.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.20 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| 0.30 | | | | 0.40 | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.80 | | | Light brown clayey sandy GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | 1.80 | HVP | 94.34 | 1.80 | | | Grey brown clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| 2.00 | 2.00 | B | | | | | Firm medium strength to stiff high strength grey CLAY. |
| | 2.20 | HVP | 68.53 | 2.20 | | | End of Pit at 2.20m |

## Trial Pit Photographs



Trial Pit 107



Trial Pit 107 Spoil

Remarks: 1. Complete 2. Water strike encountered at 0.30m and 2.00m bgl. 3. Unstable from 0.70 m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP108
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340539.00 - 353374.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 3.80 x 1.30<br>Depth 4.00 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Grey brown very clayey gravelly fine to medium SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | 1.00 | ES | | | | | |
| ▼ 2.00 | 2.00 | HVP | 89 | 2.00 | | | Stiff high strength greyish brown slightly sandy CLAY. |
| | 2.40 | HVP | 80.1 | | | | |
| | 2.80 | HVP | 92.56 | | | | |
| | 3.00 | B | | | | | |
| | 3.20 | HVP | 92.56 | | | | |
| | | | | 4.00 | | | End of Pit at 4.00m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 108



Trial Pit 108 Spoil

Remarks: 1. Complete 2. Water strike encountered at 2.00m bgl. 3. Rapid water ingress 4. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

| | | | |
|---|---|---|---|
| | | | TrialPit No TP109 Sheet 1 of 1 |
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340573.00 - 353362.00 Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20 Depth 2.40 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | | | | Dark brown silty very clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Orange brown very clayey fine to medium SAND. |
| ▼ 1.20 | | | | 1.00 | | | Firm grey silty CLAY. |
| | | | | 2.40 | | | End of Pit at 2.40m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Complete 2. Rapid water strike encountered at 1.20 m bgl. 3. Rapid water ingress 4.Unstable from 0.30m bgl. 5. Clay is friable.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP110
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340594.00 - 353343.00 | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | Depth 2.00 | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | 0.30 | | | MADE GROUND: Dark brown silty very clayey fine to medium sand (Topsoil). |
| 0.60 | 1.00<br>1.00 | B<br>HVP | 139.73 | 1.00 | | | Orange brown slightly sandy GRAVEL. Gravel is fine to medium sub-rounded to rounded of mudstone. |
| | 1.40 | HVP | 171.77 | | | | Stiff high strength to very stiff very high strength reddish brown sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 2.00 | | | End of Pit at 2.00m |

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4

## Trial Pit Photographs



Trial Pit 110



Trial Pit 110 Spoil

Remarks: 1. Complete 2. Water strike encountered at 0.60m bgl. 3. Rapid water ingress. 4. Unstable from 0.30 m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP111
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340638.00 - 353341.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.00 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.40 | | | Dark brown silty clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Light greyish brown clayey fine to medium SAND. |
| | | | | 0.80 | | | Grey clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| ▼ 1.00 | | | | | | | Stiff high strength to very stiff very high strength red and grey mottled slightly sandy CLAY. |
| | 1.40 | HVP | 172.66 | | | | |
| | 1.80 | HVP | 149.52 | | | | |
| | | | | 2.00 | | | End of Pit at 2.00m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 111



Trial Pit 111 Spoil

Remarks: 1. Complete 2. Water strike encountered at 1.00m bgl 3. Rapid water ingress

Stability: Stable

# Trial Pit Log

TrialPit No: TP112
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340673.00 - 353343.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.00 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | | | | Dark brown silty very clayey fine to medium SAND with frequent rootlets (Topsoil). |
| | | | | 0.60 | | | Orange brown very clayey gravelly fine to medium SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 1.00 | | | Grey brown clayey sandy GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 1.20 | | | Very stiff very high strength reddish brown slightly gravelly sandy CLAY. Gravel is fine to medium subrounded to rounded of mudstone. |
| | 1.50 | B | | | | | |
| | 1.80 | HVP | 186.9 | | | | |
| | | | | 2.00 | | | End of Pit at 2.00m |

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4

## Trial Pit Photographs



Trial Pit 112



Trial Pit 112 Spoil

Remarks: 1. Complete. 2. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP113
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340614.00 - 353368.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): Depth 2.00 — 2.20 × 1.20 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.40 | | | Dark brown silty very clayey fine to medium SAND (topsoil). |
| ▼ 0.70 | | | | 1.20 | | | Orange brown sandy GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 2.00 | | | Firm to stiff reddish brown gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | | | | End of Pit at 2.00m |

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## Trial Pit Photographs



Trial Pit 113



Trial Pit 113 Spoil

Remarks: 1. Complete 2. Water strike encountered at 0.70m bgl. 3. Rapid water ingress. 4. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP114
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340630.00 - 353393.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.40 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.10 | ES | | | | | Dark brown silty very clayey fine to medium SAND (Topsoil). |
| | | | | 0.60 | | | |
| | 1.00 | B | | | | | Orange brown slightly clayey silty very gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 1.20 | | | |
| | 2.00 | HVP | 186.9 | | | | Very stiff very high strength reddish brown gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 2.40 | | | End of Pit at 2.40m |

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## Trial Pit Photographs



Trial Pit 114



Trial Pit 114 Spoil

Remarks: 1. Complete 2. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP115
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340597.00 - 353390.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.50 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | | | | MADE GROUND: Dark brown silty very clayey fine to medium sand with clay land drain (Topsoil). |
| | | | | 0.40 | | | Orange brown sandy very clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| 0.90 | | | | | | | |
| | | | | 1.20 | | | Stiff reddish brown gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | 2.50 | | | End of Pit at 2.50m |

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## Trial Pit Photographs



Trial Pit 115



Trial Pit 115 Spoil

Remarks: 1. Complete 2. Water strike encountered at 0.90m bgl. 3. Rapid water ingress. 4. Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP116
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340587.00 - 353430.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.40 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.40 | | | MADE GROUND: Dark brown sandy gravel with occasional boulders. Gravel is fine to medium angular to subangular of brick mudstone and concrete. Boulders are subangular to subrounded of concrete. |
| 1.20 | | | | 2.40 | | | Dark brown sandy clayey GRAVEL. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | | | | | | End of Pit at 2.40m |

## Trial Pit Photographs



Trial Pit 116



Trial Pit 116 Spoil

Remarks: 1. Complete 2. Water strike encountered at 1.20 m bgl. 3. Rapid water ingress 4.Unstable from 0.30m bgl.

Stability: Unstable

# Trial Pit Log

TrialPit No: TP117
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340628.00 - 353439.00<br>Level: | Date 28/01/2021 |
| Location: Holt, LL13 9YU | | Dimensions (m): 2.20 x 1.20<br>Depth 2.50 | Scale 1:30 |
| Client: Mrs V and Mr A Pridding | | | Logged I.McQuillan |

| Water Strike | Samples & In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.10 | | | Dark brown silty very clayey fine to medium SAND with occasional rootlets (Topsoil). |
| | | | | | | | Brown gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| ▼ 1.50 | | | | 1.50 | | | |
| | 2.00 | HVP | 135.28 | | | | Stiff high strength brown gravelly CLAY. Gravel is fine to medium angular to subangular of mudstone. |
| | | | | 2.50 | | | End of Pit at 2.50m |

1 2 3 4

## Trial Pit Photographs



Trial Pit 117



Trial Pit 117 Spoil

Remarks: 1. Complete 2. Water strike encountered at 1.50m bgl. 3. Unstable from 0.60m bgl.

Stability: Unstable

# Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340621E - 353456N | Hole Type WS |
| Location: Holt, LL13 9YU | | Level: | Scale 1:50 |
| Client: Mrs V and Mr A Pridding | | Dates: 28/01/2021 | Logged By I.McQuillan |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.20 | | | MADE GROUND: Dark brown clayey fine to coarse sand with occasional brick fragments (Topsoil). Firm brown sandy very gravelly CLAY. Gravel is fine to medium subrounded to rounded of mudstone. |
| | | 1.00 | SPT | N=14 (3,3/3,2,4,5) | 1.20 | | | Medium dense brown fine to coarse slightly clayey gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | 2.00 | SPT | N=11 (2,2/4,3,2,2) | 2.30 | | | Stiff medium strength brown CLAY. |
| | | 3.00 | SPT | N=23 (3,3/4,5,6,8) | 3.00 | | | Medium dense brown slightly clayey gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | 4.00 | 4.00 | SPT | N=22 (3,3/5,5,6,6) | 4.00 | | | Medium dense brown clayey fine to medium SAND. Gravel is fine to medium subangular to subrounded of mudstone. |
| | | 5.00 | SPT | 50 (10,10/50 for 10mm) | 5.16 | | | End of Borehole at 5.16m |

Remarks

1. Refused on cobble at 5.16m bgl. 2. Monitoring well installed. 3. Water strike encountered at 4.00m bgl.

# Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Wrexham Road | Project No. 14608 | Co-ords: | 340594E - 353409N | Hole Type WS |
| Location: | Holt, LL13 9YU | | Level: | | Scale 1:50 |
| Client: | Mrs V and Mr A Pridding | | Dates: | 28/01/2021 | Logged By I.McQuillan |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.60 | | | MADE GROUND: Dark brown silty clayey fine to medium sand with occasional rootlets and brick. |
| | | | | | 0.80 | | | Brown sandy GRAVEL. Gravel is fine to coarse subanulgar to subrounded of mudstone. |
| | | 1.00 | SPT | N=11 (2,2/2,3,3,3) | 1.00 | | | Firm brown CLAY. |
| | | 2.00 | D | | | | | Medium dense black slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse angular to subangular of mudstone. |
| | | 2.00 | SPT | N=15 (2,3/3,3,4,5) | | | | |
| | | | | | 2.30 | | | Stiff, medium strength brown CLAY. |
| | | 2.80 | PP | | | | | |
| | | 3.00 | SPT | N=15 (3,4/4,3,4,4) | 3.00 | | | Medium dense black slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse angular to subangular of mudstone. |
| | | 4.00 | SPT | N=31 (4,5/6,8,8,9) | 4.00 | | | Very stiff, high strength brown slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone. |
| | | 5.00 | SPT | N=20 (4,5/4,5,5,6) | | | | |
| | | | | | 5.45 | | | End of Borehole at 5.45m |

Remarks

1. Complete. 2. Monitoring well installed.

# Borehole Log

Borehole No. **WS103**

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Wrexham Road | Project No. 14608 | Co-ords: | 340522E - 353367N | Hole Type WS |
| Location: | Holt, LL13 9YU | | Level: | | Scale 1:50 |
| Client: | Mrs V and Mr A Pridding | | Dates: | 28/01/2021 | Logged By I.McQuillan |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.80 | | | Dark brown silty very clayey fine to medium SAND (Topsoil). |
| | | 1.00 | SPT | N=14 (3,3/2,4,4,4) | | | | Medium dense brown very clayey gravelly fine to medium SAND with occasional clay pockets. Gravel is fine to medium angular to subangular of mudstone. (Loose at circa 3.00m and 4.00m bgl). |
| | | 2.00<br>2.00 | D<br>SPT | N=12 (2,2/3,3,3,3) | | | | |
| | | 3.00<br>3.00 | D<br>SPT | N=11 (2,2/2,3,3,3) | | | | |
| | | 4.00<br>4.00 | D<br>SPT | N=9 (2,2/3,2,2,2) | | | | |
| | | 5.00 | SPT | N=17 (3,3/4,4,5,4) | | | | |
| | | | | | 5.45 | | | End of Borehole at 5.45m |

1 2 3 4 5 6 7 8 9 10

Remarks

1. Complete. 2. Monitoring well installed.

# Borehole Log

Borehole No. **WS104**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Wrexham Road | Project No. 14608 | Co-ords: 340502E - 353384N | Hole Type WS |
| Location: Holt, LL13 9YU | | Level: | Scale 1:50 |
| Client: Mrs V and Mr A Pridding | | Dates: 28/01/2021 | Logged By I.McQuillan |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.50 | | | Dark brown silty very clayey fine to medium SAND (Topsoil) with rootlets. |
| | | 1.00 | SPT | N=10 (3,2/3,2,3,2) | | | | Medium dense brown very clayey gravelly fine to medium SAND with occasional clay pockets. Gravel is fine to medium angular to subangular of mudstone. |
| | | 2.00 | SPT | N=14 (2,3/3,3,4,4) | | | | |
| | 2.70 | | | | 2.50 | | | Stiff medium strength brown slightly sandy CLAY. |
| | | 2.80 | PP | | | | | |
| | | 3.00 | SPT | N=11 (2,3/3,2,3,3) | | | | |
| | | 4.00 | D | | | | | |
| | | 4.00 | SPT | N=10 (3,2/2,3,3,2) | | | | |
| | | 5.00 | SPT | N=17 (3,3/4,4,5,4) | | | | |
| | | | | | 5.45 | | | End of Borehole at 5.45m |

Remarks

1. Complete. 2. Monitoring well installed. 3. Water strike encountered at 2.70m bgl.

# Borehole Log

Borehole No. **WS105**

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Wrexham Road | Project No. 14608 | Co-ords: | 340595E - 353362N | Hole Type WS |
| Location: | Holt, LL13 9YU | | Level: | | Scale 1:50 |
| Client: | Mrs V and Mr A Pridding | | Dates: | 28/01/2021 | Logged By I.McQuillan |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.10 | | | Dark brown silty very clayey fine to medium SAND (Topsoil) with rootlets. Firm brown CLAY. |
| | | 0.50 | PP | | | | | |
| | | 1.00 | D | | 1.00 | | | Medium dense brown clayey fine to medium SAND. |
| | | 1.00 | PP | | | | | |
| | | 1.00 | SPT | N=13 (4,2/3,3,3,4) | | | | |
| | | 2.00 | SPT | N=17 (4,4/4,4,4,5) | | | | |
| | | 3.00 | SPT | N=15 (3,3/4,4,3,4) | | | | |
| | | 4.00 | SPT | N=17 (5,5/4,4,4,5) | | | | |
| | | 5.00 | SPT | N=25 (5,5/5,6,7,7) | | | | |
| | | | | | 5.45 | | | End of Borehole at 5.45m |

Remarks

1. Complete. 2. Monitoring well installed.

# APPENDIX VI
# CHEMICAL TESTING RESULTS

**Isabella McQuillan**
e3p
Taylor Road
Urmston
Manchester
M41 7JQ

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

# Analytical Report Number : 21-54165

Replaces Analytical Report Number: 21-54165, issue no. 1
Client references/information amended.

| | | | |
|---|---|---|---|
| **Project / Site name:** | Wrexham Road, Holt | **Samples received on:** | 29/01/2021 |
| **Your job number:** | 14-608 | **Samples instructed on/ Analysis started on:** | 29/01/2021 |
| **Your order number:** | 14-508-IM-D | **Analysis completed by:** | 08/02/2021 |
| **Report Issue Number:** | 2 | **Report issued on:** | 08/03/2021 |
| **Samples Analysed:** | 2 leachate samples - 6 soil samples | | |

**Signed:**

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**
**Your Order No: 14-508-IM-D**

| Lab Sample Number | | | | 1754363 | 1754364 | 1754365 | 1754366 | 1754367 |
|---|---|---|---|---|---|---|---|---|
| **Sample Reference** | | | | TP105 | TP106 | TP108 | TP109 | TP112 |
| **Sample Number** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Depth (m)** | | | | 1.00 | 0.10 | 1.00 | 0.10 | 0.10 |
| **Date Sampled** | | | | 28/01/2021 | 28/01/2021 | 28/01/2021 | 28/01/2021 | 28/01/2021 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 12 | 18 | 10 | 17 | 14 |
| Total mass of sample received | kg | 0.001 | NONE | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Asbestos in Soil | Type | N/A | ISO 17025 | - | Not-detected | - | Not-detected | Not-detected |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | - | 6.6 | - | 6.8 | 7.1 |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1 | < 1 | < 1 | < 1 | < 1 |
| Total Sulphate as SO4 | mg/kg | 50 | MCERTS | - | 560 | - | 590 | 570 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | g/l | MCERTS | MCERTS | - | 0.005 | - | 0.0039 | 0.0047 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | mg/kg | 2.5 | | - | 10 | - | 7.7 | 9.4 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | mg/l | 1.25 | MCERTS | - | 5 | - | 3.9 | 4.7 |
| Sulphide | mg/kg | 1 | MCERTS | - | 3.3 | - | 5 | < 1.0 |
| Total Sulphur | mg/kg | 50 | MCERTS | - | 460 | - | 460 | 510 |
| Total Organic Carbon (TOC) | % | 0.1 | MCERTS | < 0.1 | - | < 0.1 | - | 2.1 |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | - | < 1.0 | - | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.95 | < 0.05 | 0.35 | 0.33 |
| Pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.89 | < 0.05 | 0.33 | 0.32 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.56 | < 0.05 | 0.24 | 0.23 |
| Chrysene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.56 | < 0.05 | 0.19 | 0.23 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.68 | < 0.05 | 0.21 | 0.2 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.24 | < 0.05 | 0.12 | 0.13 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.56 | < 0.05 | 0.22 | 0.21 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.29 | < 0.05 | < 0.05 | < 0.05 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.34 | < 0.05 | < 0.05 | < 0.05 |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | < 0.80 | 5.07 | < 0.80 | 1.66 | 1.65 |

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**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**
**Your Order No: 14-508-IM-D**

| Lab Sample Number | | | | 1754363 | 1754364 | 1754365 | 1754366 | 1754367 |
|---|---|---|---|---|---|---|---|---|
| **Sample Reference** | | | | TP105 | TP106 | TP108 | TP109 | TP112 |
| **Sample Number** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Depth (m)** | | | | 1.00 | 0.10 | 1.00 | 0.10 | 0.10 |
| **Date Sampled** | | | | 28/01/2021 | 28/01/2021 | 28/01/2021 | 28/01/2021 | 28/01/2021 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 4.6 | 6.9 | 6.4 | 7.1 | 8.3 |
| Barium (aqua regia extractable) | mg/kg | 1 | MCERTS | 17 | - | 26 | - | - |
| Beryllium (aqua regia extractable) | mg/kg | 0.06 | MCERTS | 0.28 | - | 0.41 | - | - |
| Boron (water soluble) | mg/kg | 0.2 | MCERTS | < 0.2 | - | < 0.2 | - | - |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | 0.4 | < 0.2 | 0.5 | 0.5 |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | - | 16 | - | 18 | 17 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 7.7 | 28 | 12 | 35 | 38 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 8.6 | 75 | 15 | 74 | 83 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | 0.5 | < 0.3 | 0.3 | 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | 16 | 19 | 18 | 17 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Vanadium (aqua regia extractable) | mg/kg | 1 | MCERTS | 13 | - | 17 | - | - |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 35 | 120 | 44 | 130 | 130 |
| **Petroleum Hydrocarbons** | | | | | | | | |
| TPH (C5 - C6) | mg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH (C6 - C8) | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| TPH (C8 - C10) | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| TPH (C10 - C12) | mg/kg | 2 | MCERTS | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| TPH (C12 - C16) | mg/kg | 4 | MCERTS | 13 | < 4.0 | < 4.0 | 13 | < 4.0 |
| TPH (C16 - C21) | mg/kg | 1 | MCERTS | 27 | 7.2 | < 1.0 | 23 | < 1.0 |
| TPH (C21 - C35) | mg/kg | 1 | MCERTS | 62 | 29 | < 1.0 | 56 | < 1.0 |
| TPH (C35 - C40) | mg/kg | 10 | MCERTS | 15 | < 10 | < 10 | 15 | < 10 |
| TPH Total C5 - C40 | mg/kg | 10 | MCERTS | 120 | 38 | < 10 | 110 | < 10 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**
**Your Order No: 14-508-IM-D**

| | | | | |
|---|---|---|---|---|
| **Lab Sample Number** | | | | 1754368 |
| **Sample Reference** | | | | TP116 |
| **Sample Number** | | | | None Supplied |
| **Depth (m)** | | | | 0.10 |
| **Date Sampled** | | | | 28/01/2021 |
| **Time Taken** | | | | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | |
| Stone Content | % | 0.1 | NONE | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 9 |
| Total mass of sample received | kg | 0.001 | NONE | 0.5 |
| Asbestos in Soil | Type | N/A | ISO 17025 | Not-detected |

**General Inorganics**

| | | | | |
|---|---|---|---|---|
| pH - Automated | pH Units | N/A | MCERTS | 8.3 |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1 |
| Total Sulphate as SO4 | mg/kg | 50 | MCERTS | 2400 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | g/l | MCERTS | MCERTS | 0.42 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | mg/kg | 2.5 | | 830 |
| Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction | mg/l | 1.25 | MCERTS | 415 |
| Sulphide | mg/kg | 1 | MCERTS | 21 |
| Total Sulphur | mg/kg | 50 | MCERTS | 1600 |
| Total Organic Carbon (TOC) | % | 0.1 | MCERTS | - |

**Total Phenols**

| | | | | |
|---|---|---|---|---|
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 1.0 |

**Speciated PAHs**

| | | | | |
|---|---|---|---|---|
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | 4.6 |
| Fluorene | mg/kg | 0.05 | MCERTS | 3.1 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | 38 |
| Anthracene | mg/kg | 0.05 | MCERTS | 9.1 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 29 |
| Pyrene | mg/kg | 0.05 | MCERTS | 24 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 8.8 |
| Chrysene | mg/kg | 0.05 | MCERTS | 6.5 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 8.5 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 2.8 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 7.7 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | 3.2 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | 0.98 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | 4.1 |

**Total PAH**

| | | | | |
|---|---|---|---|---|
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 150 |

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**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**
**Your Order No: 14-508-IM-D**

| Lab Sample Number | | | | 1754368 |
|---|---|---|---|---|
| Sample Reference | | | | TP116 |
| Sample Number | | | | None Supplied |
| Depth (m) | | | | 0.10 |
| Date Sampled | | | | 28/01/2021 |
| Time Taken | | | | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | |
| **Heavy Metals / Metalloids** | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 7.3 |
| Barium (aqua regia extractable) | mg/kg | 1 | MCERTS | - |
| Beryllium (aqua regia extractable) | mg/kg | 0.06 | MCERTS | - |
| Boron (water soluble) | mg/kg | 0.2 | MCERTS | - |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | 0.5 |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 17 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 24 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 170 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | 0.4 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 |
| Vanadium (aqua regia extractable) | mg/kg | 1 | MCERTS | - |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 120 |

**Petroleum Hydrocarbons**

| | | | | |
|---|---|---|---|---|
| TPH (C5 - C6) | mg/kg | 1 | NONE | < 1.0 |
| TPH (C6 - C8) | mg/kg | 0.1 | MCERTS | < 0.1 |
| TPH (C8 - C10) | mg/kg | 0.1 | MCERTS | < 0.1 |
| TPH (C10 - C12) | mg/kg | 2 | MCERTS | < 2.0 |
| TPH (C12 - C16) | mg/kg | 4 | MCERTS | 65 |
| TPH (C16 - C21) | mg/kg | 1 | MCERTS | 290 |
| TPH (C21 - C35) | mg/kg | 1 | MCERTS | 1900 |
| TPH (C35 - C40) | mg/kg | 10 | MCERTS | 760 |
| TPH Total C5 - C40 | mg/kg | 10 | MCERTS | 3000 |

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**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**

**Your Order No: 14-508-IM-D**

| Lab Sample Number | | | | 1754369 | 1754370 |
|---|---|---|---|---|---|
| Sample Reference | | | | TP108 | TP116 |
| Sample Number | | | | None Supplied | None Supplied |
| Depth (m) | | | | 1.00 | 0.10 |
| Date Sampled | | | | 28/01/2021 | 28/01/2021 |
| Time Taken | | | | None Supplied | None Supplied |
| **Analytical Parameter (Leachate Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| **General Inorganics** | | | | | |
| pH | pH Units | N/A | ISO 17025 | 7.2 | 7.8 |
| Total Cyanide (Low Level 1 µg/l) | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| **Total Phenols** | | | | | |
| Total Phenols (monohydric) | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | |
| Naphthalene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Acenaphthylene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Acenaphthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Fluorene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Phenanthrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(a)anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Chrysene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(b)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(k)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(a)pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Indeno(1,2,3-cd)pyrene | µg/l | 0.01 | NONE | < 0.01 | < 0.01 |
| Dibenz(a,h)anthracene | µg/l | 0.01 | NONE | < 0.01 | < 0.01 |
| Benzo(ghi)perylene | µg/l | 0.01 | NONE | < 0.01 | < 0.01 |
| **Total PAH** | | | | | |
| Total EPA-16 PAHs | µg/l | 0.2 | NONE | < 0.2 | < 0.2 |
| **Heavy Metals / Metalloids** | | | | | |
| Arsenic (dissolved) | µg/l | 1 | ISO 17025 | 5.9 | 4.8 |
| Cadmium (dissolved) | µg/l | 0.08 | ISO 17025 | < 0.08 | < 0.08 |
| Chromium (hexavalent) | µg/l | 5 | ISO 17025 | < 5.0 | < 5.0 |
| Chromium (dissolved) | µg/l | 0.4 | ISO 17025 | 2.5 | 1.2 |
| Copper (dissolved) | µg/l | 0.7 | ISO 17025 | 11 | 9.9 |
| Lead (dissolved) | µg/l | 1 | ISO 17025 | 7.4 | 7.6 |
| Mercury (dissolved) | µg/l | 0.5 | ISO 17025 | < 0.5 | < 0.5 |
| Nickel (dissolved) | µg/l | 0.3 | ISO 17025 | 3.5 | 3.2 |
| Selenium (dissolved) | µg/l | 4 | ISO 17025 | < 4.0 | < 4.0 |
| Zinc (dissolved) | µg/l | 0.4 | ISO 17025 | 8.1 | 11 |
| **Monoaromatics & Oxygenates** | | | | | |
| Benzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Toluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Ethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| p & m-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| o-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| MTBE (Methyl Tertiary Butyl Ether) | µg/l | 10 | NONE | < 10 | < 10 |

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**Analytical Report Number: 21-54165**
**Project / Site name: Wrexham Road, Holt**

**Your Order No: 14-508-IM-D**

| Lab Sample Number | | | | 1754369 | 1754370 |
|---|---|---|---|---|---|
| Sample Reference | | | | TP108 | TP116 |
| Sample Number | | | | None Supplied | None Supplied |
| Depth (m) | | | | 1.00 | 0.10 |
| Date Sampled | | | | 28/01/2021 | 28/01/2021 |
| Time Taken | | | | None Supplied | None Supplied |
| **Analytical Parameter (Leachate Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| **Petroleum Hydrocarbons** | | | | | |
| TPH1 (C10 - C40) | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C5 - C6 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C6 - C8 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C8 - C10 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic (C5 - C35) | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C5 - C7 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C7 - C8 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C8 - C10 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic (C5 - C35) | µg/l | 10 | NONE | < 10 | < 10 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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**Analytical Report Number : 21-54165**
**Project / Site name: Wrexham Road, Holt**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description * |
|---|---|---|---|---|
| 1754363 | TP105 | None Supplied | 1 | Light brown sand with gravel. |
| 1754364 | TP106 | None Supplied | 0.1 | Brown loam and sand with gravel and vegetation. |
| 1754365 | TP108 | None Supplied | 1 | Light brown sand. |
| 1754366 | TP109 | None Supplied | 0.1 | Brown loam and clay with gravel and vegetation. |
| 1754367 | TP112 | None Supplied | 0.1 | Brown loam and sand with vegetation and gravel. |
| 1754368 | TP116 | None Supplied | 0.1 | Brown clay and sand with gravel and vegetation. |

**Analytical Report Number : 21-54165**
**Project / Site name: Wrexham Road, Holt**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Sulphate, water soluble, in soil (16hr extraction) | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent). | In house method. | L038-PL | D | MCERTS |
| Metals in soil by ICP-OES | Determination of metals in soil by aqua-regia digestion followed by ICP-OES. | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L038-PL | D | MCERTS |
| BS EN 12457-1 (2:1) Leachate Prep | 2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis. | In-house method based on BSEN12457-1. | L043-PL | W | NONE |
| Asbestos identification in soil | Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques. | In house method based on HSG 248 | A001-PL | D | ISO 17025 |
| Metals by ICP-OES in leachate | Determination of metals in leachate by acidification followed by ICP-OES. | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L039-PL | W | ISO 17025 |
| Boron, water soluble, in soil | Determination of water soluble boron in soil by hot water extract followed by ICP-OES. | In-house method based on Second Site Properties version 3 | L038-PL | D | MCERTS |
| Hexavalent chromium in leachate | Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method | L080-PL | W | ISO 17025 |
| Hexavalent chromium in soil | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method | L080-PL | W | MCERTS |
| Moisture Content | Moisture content, determined gravimetrically. (30 oC) | In house method. | L019-UK/PL | W | NONE |
| Monohydric phenols in leachate - LOW LEVEL 1 ug/l | Determination of phenols in leachate by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar) | L080-PL | W | ISO 17025 |
| Monohydric phenols in soil | Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar) | L080-PL | W | MCERTS |
| Speciated EPA-16 PAHs in leachate | Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. | In-house method based on USEPA 8270 | L102B-PL | W | NONE |
| Speciated EPA-16 PAHs in soil | Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. | In-house method based on USEPA 8270 | L064-PL | D | MCERTS |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In house method. | L099-PL | D | MCERTS |
| pH at 20oC in leachate | Determination of pH in leachate by electrometric measurement. | In house method. | L005-PL | W | ISO 17025 |
| Sulphide in soil | Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode. | In-house method | L010-PL | D | MCERTS |
| Total sulphate (as SO4 in soil) | Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES. | In house method. | L038-PL | D | MCERTS |

**Analytical Report Number : 21-54165**
**Project / Site name: Wrexham Road, Holt**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Stones content of soil | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight. | In-house method based on British Standard Methods and MCERTS requirements. | L019-UK/PL | D | NONE |
| Total Sulphur in soil | Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES. | In house method. | L038-PL | D | MCERTS |
| TPH1 (Leachates) | Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS. | In-house method | L070-PL | W | NONE |
| TPHCWG (Leachates) | Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS. | In-house method | L070-PL | W | NONE |
| Total cyanide in soil | Determination of total cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| Total organic carbon (Automated) in soil | Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate. | In house method. | L009-PL | D | MCERTS |
| BTEX and MTBE in leachates (Monoaromatics) | Determination of BTEX and MTBE in leachates by headspace GC-MS. | In-house method based on USEPA8260 | L073B-PL | W | ISO 17025 |
| TPH in (Soil) | Determination of TPH bands by HS-GC-MS/GC-FID | In-house method, TPH with carbon banding and silica gel split/cleanup. | L076-PL | D | MCERTS |
| Total cyanide in leachate - 1µg/l | Determination of total cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L080-PL | W | ISO 17025 |
| D.O. for Gravimetric Quant if Screen/ID positive | Dependent option for Gravimetric Quant if Screen/ID positive scheduled. | In house asbestos methods A001 & A006. | A006-PL | D | NONE |
| Sulphate, water soluble, in soil (1hr extraction) | Sulphate, water soluble, in soil (1hr extraction) | In-house method | L038-PL | D | MCERTS |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

**Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.**

**Isabella McQuillan**
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[redacted]

[redacted]

# Analytical Report Number : 21-56334

| | | | |
|---|---|---|---|
| **Project / Site name:** | Wrexham Road, Holt | **Samples received on:** | 29/01/2021 |
| **Your job number:** | 14-608 | **Samples instructed on/ Analysis started on:** | 11/02/2021 |
| **Your order number:** | 14-608-IM-D | **Analysis completed by:** | 19/02/2021 |
| **Report Issue Number:** | 1 | **Report issued on:** | 19/02/2021 |
| **Samples Analysed:** | 1 soil sample | | |

[redacted]

**Signed:**

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 21-56334**
**Project / Site name: Wrexham Road, Holt**
**Your Order No: 14-608-IM-D**

| | | | | |
|---|---|---|---|---|
| **Lab Sample Number** | | | | 1767459 |
| **Sample Reference** | | | | TP116 |
| **Sample Number** | | | | None Supplied |
| **Depth (m)** | | | | 0.10 |
| **Date Sampled** | | | | 27/01/2021 |
| **Time Taken** | | | | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | |
| **Microbiological (Subcontracted)** | | | | |
| E. Coli | mpn/g | 1 | NONE | See Attached |

U/S = Unsuitable Sample  I/S = Insufficient Sample

**Analytical Report Number : 21-56334**
**Project / Site name: Wrexham Road, Holt**

**Water matrix abbreviations: Surface Water (SW)  Potable Water (PW)  Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| E. Coli in soil Subcon | E.Coli in Soil - Subcontracted Analysis | Subcontracted Analysis - See Attached Subcon Report. | | W | NONE |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis.  Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

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The results included within the report are representative of the samples submitted for analysis.

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[redacted]

[redacted]

# Analytical Report Number : 21-57485

| | | | |
|---|---|---|---|
| **Project / Site name:** | Wrexham rd | **Samples received on:** | 17/02/2021 |
| **Your job number:** | | **Samples instructed on/ Analysis started on:** | 17/02/2021 |
| **Your order number:** | 14-608-IS-F | **Analysis completed by:** | 24/02/2021 |
| **Report Issue Number:** | 1 | **Report issued on:** | 24/02/2021 |
| **Samples Analysed:** | 2 water samples | | |

[redacted]

Karolina Marek
PL Head of Reporting Team
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

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soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 21-57485**
**Project / Site name: Wrexham rd**

**Your Order No: 14-608-IS-F**

| Lab Sample Number | | | | 1774076 | 1774077 |
|---|---|---|---|---|---|
| Sample Reference | | | | WS102 | WS103 |
| Sample Number | | | | None Supplied | None Supplied |
| Depth (m) | | | | None Supplied | None Supplied |
| Date Sampled | | | | 16/02/2021 | 16/02/2021 |
| Time Taken | | | | None Supplied | None Supplied |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| **General Inorganics** | | | | | |
| pH | pH Units | N/A | ISO 17025 | 7.2 | 7.3 |
| Total Cyanide (Low Level 1 µg/l) | µg/l | 1 | ISO 17025 | 4.2 | < 1.0 |
| Dissolved Organic Carbon (DOC) | mg/l | 0.1 | NONE | 28 | 9.69 |
| **Total Phenols** | | | | | |
| Total Phenols (monohydric) | µg/l | 1 | ISO 17025 | 4.2 | 4.8 |
| **Heavy Metals / Metalloids** | | | | | |
| Calcium (dissolved) | mg/l | 0.012 | ISO 17025 | 100 | 89 |
| Chromium (hexavalent) | µg/l | 5 | ISO 17025 | < 5.0 | < 5.0 |
| Arsenic (dissolved) | µg/l | 0.15 | ISO 17025 | 2.16 | 1.17 |
| Cadmium (dissolved) | µg/l | 0.02 | ISO 17025 | 0.14 | 0.08 |
| Chromium (dissolved) | µg/l | 0.2 | ISO 17025 | 6.4 | 4.1 |
| Copper (dissolved) | µg/l | 0.5 | ISO 17025 | 3.4 | 11 |
| Lead (dissolved) | µg/l | 0.2 | ISO 17025 | 0.5 | 0.2 |
| Manganese (dissolved) | µg/l | 0.05 | ISO 17025 | 5500 | 1400 |
| Mercury (dissolved) | µg/l | 0.05 | ISO 17025 | < 0.05 | < 0.05 |
| Nickel (dissolved) | µg/l | 0.5 | ISO 17025 | 17 | 11 |
| Selenium (dissolved) | µg/l | 0.6 | ISO 17025 | 11 | 3.3 |
| Zinc (dissolved) | µg/l | 0.5 | ISO 17025 | 22 | 5.4 |
| **Monoaromatics & Oxygenates** | | | | | |
| Benzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Toluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Ethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| p & m-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| o-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| MTBE (Methyl Tertiary Butyl Ether) | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| **Petroleum Hydrocarbons** | | | | | |
| TPH1 (C10 - C40) | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C5 - C6 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C6 - C8 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C8 - C10 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aliphatic (C5 - C35) | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C5 - C7 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C7 - C8 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C8 - C10 | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 |
| TPH-CWG - Aromatic (C5 - C35) | µg/l | 10 | NONE | < 10 | < 10 |

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**Analytical Report Number: 21-57485**
**Project / Site name: Wrexham rd**

**Your Order No: 14-608-IS-F**

| **Lab Sample Number** | | | | 1774076 | 1774077 |
|---|---|---|---|---|---|
| **Sample Reference** | | | | WS102 | WS103 |
| **Sample Number** | | | | None Supplied | None Supplied |
| **Depth (m)** | | | | None Supplied | None Supplied |
| **Date Sampled** | | | | 16/02/2021 | 16/02/2021 |
| **Time Taken** | | | | None Supplied | None Supplied |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| **VOCs** | | | | | |
| Chloromethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Chloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Bromomethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Vinyl Chloride | µg/l | 1 | NONE | < 1.0 | < 1.0 |
| Trichlorofluoromethane | µg/l | 1 | NONE | < 1.0 | < 1.0 |
| 1,1-Dichloroethene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Cis-1,2-dichloroethene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| MTBE (Methyl Tertiary Butyl Ether) | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1-Dichloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 2,2-Dichloropropane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Trichloromethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1,1-Trichloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2-Dichloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1-Dichloropropene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Trans-1,2-dichloroethene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Benzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Tetrachloromethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2-Dichloropropane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Trichloroethene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Dibromomethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Bromodichloromethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Cis-1,3-dichloropropene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Trans-1,3-dichloropropene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Toluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1,2-Trichloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,3-Dichloropropane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Dibromochloromethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Tetrachloroethene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2-Dibromoethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Chlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1,1,2-Tetrachloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Ethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| p & m-Xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Styrene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Tribromomethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| o-Xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,1,2,2-Tetrachloroethane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Isopropylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Bromobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| n-Propylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 2-Chlorotoluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 4-Chlorotoluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,3,5-Trimethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| tert-Butylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2,4-Trimethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| sec-Butylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,3-Dichlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |

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**Analytical Report Number: 21-57485**
**Project / Site name: Wrexham rd**

**Your Order No: 14-608-IS-F**

| **Lab Sample Number** | | | | 1774076 | 1774077 |
|---|---|---|---|---|---|
| **Sample Reference** | | | | WS102 | WS103 |
| **Sample Number** | | | | None Supplied | None Supplied |
| **Depth (m)** | | | | None Supplied | None Supplied |
| **Date Sampled** | | | | 16/02/2021 | 16/02/2021 |
| **Time Taken** | | | | None Supplied | None Supplied |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| p-Isopropyltoluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2-Dichlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,4-Dichlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Butylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2-Dibromo-3-chloropropane | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2,4-Trichlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| Hexachlorobutadiene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |
| 1,2,3-Trichlorobenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 |

**SVOCs**

| | | | | | |
|---|---|---|---|---|---|
| Aniline | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Phenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2-Chlorophenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Bis(2-chloroethyl)ether | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 1,3-Dichlorobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 1,2-Dichlorobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 1,4-Dichlorobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Bis(2-chloroisopropyl)ether | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2-Methylphenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Hexachloroethane | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Nitrobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 4-Methylphenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Isophorone | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2-Nitrophenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2,4-Dimethylphenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Bis(2-chloroethoxy)methane | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 1,2,4-Trichlorobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Naphthalene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| 2,4-Dichlorophenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 4-Chloroaniline | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Hexachlorobutadiene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 4-Chloro-3-methylphenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2,4,6-Trichlorophenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2,4,5-Trichlorophenol | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2-Methylnaphthalene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2-Chloronaphthalene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Dimethylphthalate | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 2,6-Dinitrotoluene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Acenaphthylene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Acenaphthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| 2,4-Dinitrotoluene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Dibenzofuran | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 4-Chlorophenyl phenyl ether | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Diethyl phthalate | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| 4-Nitroaniline | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Fluorene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Azobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Bromophenyl phenyl ether | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Hexachlorobenzene | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Phenanthrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Carbazole | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Dibutyl phthalate | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

**Analytical Report Number: 21-57485**
**Project / Site name: Wrexham rd**

**Your Order No: 14-608-IS-F**

| **Lab Sample Number** | | | | 1774076 | 1774077 |
|---|---|---|---|---|---|
| **Sample Reference** | | | | WS102 | WS103 |
| **Sample Number** | | | | None Supplied | None Supplied |
| **Depth (m)** | | | | None Supplied | None Supplied |
| **Date Sampled** | | | | 16/02/2021 | 16/02/2021 |
| **Time Taken** | | | | None Supplied | None Supplied |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | |
| Anthraquinone | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Butyl benzyl phthalate | µg/l | 0.05 | NONE | < 0.05 | < 0.05 |
| Benzo(a)anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Chrysene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(b)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(k)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(a)pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Indeno(1,2,3-cd)pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Dibenz(a,h)anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |
| Benzo(ghi)perylene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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The results included within the report relate only to the sample(s) submitted for testing.

**Analytical Report Number : 21-57485**
**Project / Site name: Wrexham rd**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Metals in water by ICP-OES (dissolved) | Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn). | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L039-PL | W | ISO 17025 |
| Metals in water by ICP-MS (dissolved) | Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW. | In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS. | L012-PL | W | ISO 17025 |
| Hexavalent chromium in water | Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW. | L080-PL | W | ISO 17025 |
| Monohydric phenols in water - LOW LEVEL 1 ug/l | Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar) | L080-PL | W | ISO 17025 |
| Semi-volatile organic compounds in water | Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS. | In-house method based on USEPA 8270 | L102B-PL | W | NONE |
| TPH1 (Waters) | Determination of dichloromethane extractable hydrocarbons in water by GC-MS. | In-house method | L070-PL | W | NONE |
| TPHCWG (Waters) | Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation. | In-house method | L070-PL | W | NONE |
| Volatile organic compounds in water | Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW | In-house method based on USEPA8260 | L073B-PL | W | ISO 17025 |
| Dissolved Organic Carbon in water | Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L037-PL | W | NONE |
| BTEX and MTBE in water (Monoaromatics) | Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW | In-house method based on USEPA8260 | L073B-PL | W | ISO 17025 |
| Low level total cyanide in water | Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | ISO 17025 |
| pH at 20oC in water (automated) | Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW | In house method. | L099-PL | W | ISO 17025 |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

Issue Date:
18/02/2021

# *Certificate of Analysis*



i2 Analytical UK Ltd
Unit 8
Delta Court
Second Avenue
Auckley
Doncaster

**Sample No:** 1296912 **Job No:** 21-02223

**Site name:** 21-56334

**Location:** Wrexham Road Holt TP116 @ 0.10

**Date taken:** 27/01/2021 **Time taken:** **Sampler:** XX

**Date received:** 17/02/2021 **Date Tested:** 17/02/2021

**Completed:** 18/02/2021 **Report date:** 18/02/2021 **Type:** WATER

**Order No:** 13393 **Your ref:** 1767459 **Deviating:** B

**Remarks:**

| Determination | Result | Units | Method |
|---|---|---|---|
| E. coli* | 160 | MPN/g | B2 |

1) * Tests marked with an * are not UKAS accredited and are not in the UKAS Accreditation Schedule for this laboratory
2) ** Indicates that analysis has been subcontracted to a UKAS testing laboratory
3) Detailed information on the methods of analysis are available from the laboratory
4) Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation
5) Time 00:00 indicates no sampling time provided
6) Sample integrity is only assured from the time of delivery to the laboratory
7) Results expressed as 0/100mls implies none found in the sample examined
8) Results shown on this report relate only to the sample identified by the laboratory sample number
9) Total bacterial counts reported as >300cfu are estimated counts only
10) Date of testing on multi sample reports will be the date of the first sample tested
11) Data supplied by the customer that may effect the validity of the result is assumed to be correct and is outside the control of the laboratory.These results apply to the sample as recieved.

Sample Deviating Due To:
A-No sample date, B-No sample time, C-Incorrect sample container,
D-Temperature of sample, E/F-Time between sampling & receipt/analysis exceeded.

Jonathan Usher
Technical Director

2450

Aqua House, Europa Way, Britannia Enterprise Park, Lichfield, Staffs. WS14 9TZ
Tel: 01543 261020, Fax: 01543 261021. Email: jusher@mercianscience.co.uk

# APPENDIX VII
# ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

| CONSTITUENT | ORIGIN OF RISK ASSESSMENT VALUE |
|---|---|
| Arsenic | 2014 LQM/CIEH S4ULs |
| Cadmium | 2014 LQM/CIEH S4ULs |
| Chromium | 2014 LQM/CIEH S4ULs |
| Lead | 2014 LQM/CIEH S4ULs |
| Mercury | 2014 LQM/CIEH S4ULs – methylmercury |
| Nickel | 2014 LQM/CIEH S4ULs |
| Selenium | 2014 LQM/CIEH S4ULs |
| Copper | 2014 LQM/CIEH S4ULs |
| Zinc | 2014 LQM/CIEH S4ULs |
| Cyanide – Total | 2014 LQM/CIEH S4ULs |
| Phenols – Total | 2014 LQM/CIEH S4ULs |
| Naphthalene | General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM. |
| Acenaphthylene | |
| Acenaphthene | |
| Fluorene | |
| Phenanthrene | |
| Anthracene | |
| Fluoranthene | |
| Pyrene | |
| Benzo(a)Anthracene | |
| Chrysene | |
| Benzo(b/k)Fluoranthene [iii] | |
| Benzo(a)Pyrene | |
| Indeno(123-cd)Pyrene | |
| Dibenzo(a,h)Anthracene | |
| Benzo(ghi)Perylene | |
| TPH $C_5$-$C_6$ (aliphatic) | |
| TPH $C_6$-$C_8$ (aliphatic) | |
| TPH $C_8$-$C_{10}$ (aliphatic) | |
| TPH $C_{10}$-$C_{12}$ (aliphatic) | |
| TPH $C_{12}$-$C_{16}$ (aromatic) | |
| TPH $C_{16}$-$C_{21}$ (aromatic) | |
| TPH $C_{21}$-$C_{35}$ (aromatic) | |

# APPENDIX VIII
# GEOTECHNICAL LAB CERTIFICATES

# LABORATORY REPORT

4043

**Contract Number: PSL21/0968**

Report Date: 26 February 2021

Client's Reference: 14608

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

**For the attention of: Izzy McQuillan/Jessica Sheridan**

Contract Title: Wrexham Road

Date Received: 2/2/2021
Date Commenced: 2/2/2021
Date Completed: 26/2/2021

**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:

| | | |
|---|---|---|
| A Watkins<br>(Director) | R Berriman<br>(Quality Manager) | S Royle<br>(Laboratory Manager) |
| [redacted] | | |
| L Knight<br>(Senior Technician) | S Eyre<br>(Senior Technician) | T Watkins<br>(Senior Technician) |



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

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample |
|---|---|---|---|---|---|
| TP102 | | B | 2.00 | | Brown mottled grey sandy very silty CLAY. |
| WS102 | | D | 2.00 | | Brown slightly gravelly sandy CLAY. |
| WS105 | | D | 1.00 | | Brown slightly gravelly sandy CLAY. |
| TP101 | | B | 1.50 | | Brown slightly clayey silty SAND. |
| TP110 | | B | 1.00 | | Brown slightly gravelly sandy CLAY. |
| TP112 | | B | 1.50 | | Brown slightly gravelly sandy CLAY. |
| TP114 | | B | 1.00 | | Brown very gravelly slightly clayey silty SAND. |
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# SUMMARY OF SOIL CLASSIFICATION TESTS

**(BS1377 : PART 2 : 1990)**

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % Clause 3.2 | Linear Shrinkage % Clause 6.5 | Particle Density $Mg/m^3$ Clause 8.2 | Liquid Limit % Clause 4.3/4 | Plastic Limit % Clause 5.3 | Plasticity Index % Clause 5.4 | Passing .425mm % | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP102 | | B | 2.00 | | 28 | | | 53 | 25 | 28 | 100 | High Plasticity CH |
| WS102 | | D | 2.00 | | 27 | | | 51 | 24 | 27 | 96 | High Plasticity CH |
| WS105 | | D | 1.00 | | 19 | | | 39 | 19 | 20 | 98 | Intermediate Plasticity CI |
| TP101 | | B | 1.50 | | 15 | | | | NP | | | |
| TP110 | | B | 1.00 | | 21 | | | 47 | 23 | 24 | 97 | Intermediate Plasticity CI |
| TP112 | | B | 1.50 | | 21 | | | 40 | 21 | 19 | 94 | Intermediate Plasticity CI |
| TP114 | | B | 1.00 | | | | | | | | | |
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**SYMBOLS :** **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

**Wrexham Road**

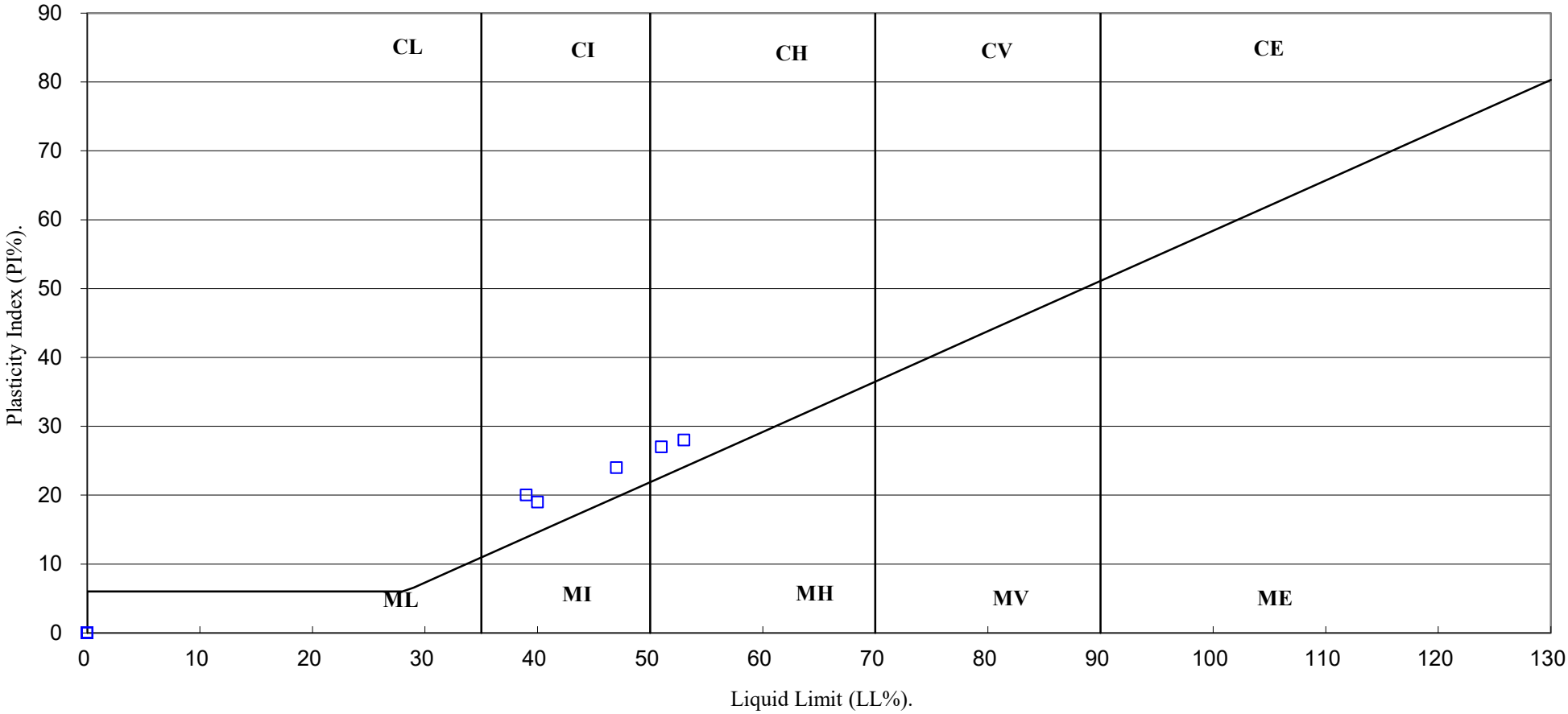
**Contract No:**

**PSL21/0968**

**Client Ref:**

**14608**

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.




| | | | |
|---|---|---|---|
| UKAS TESTING 4043 | PSL Professional Soils Laboratory | Wrexham Road | Contract No: PSL21/0968 Client Ref: 14608 |

# PARTICLE SIZE DISTRIBUTION TEST

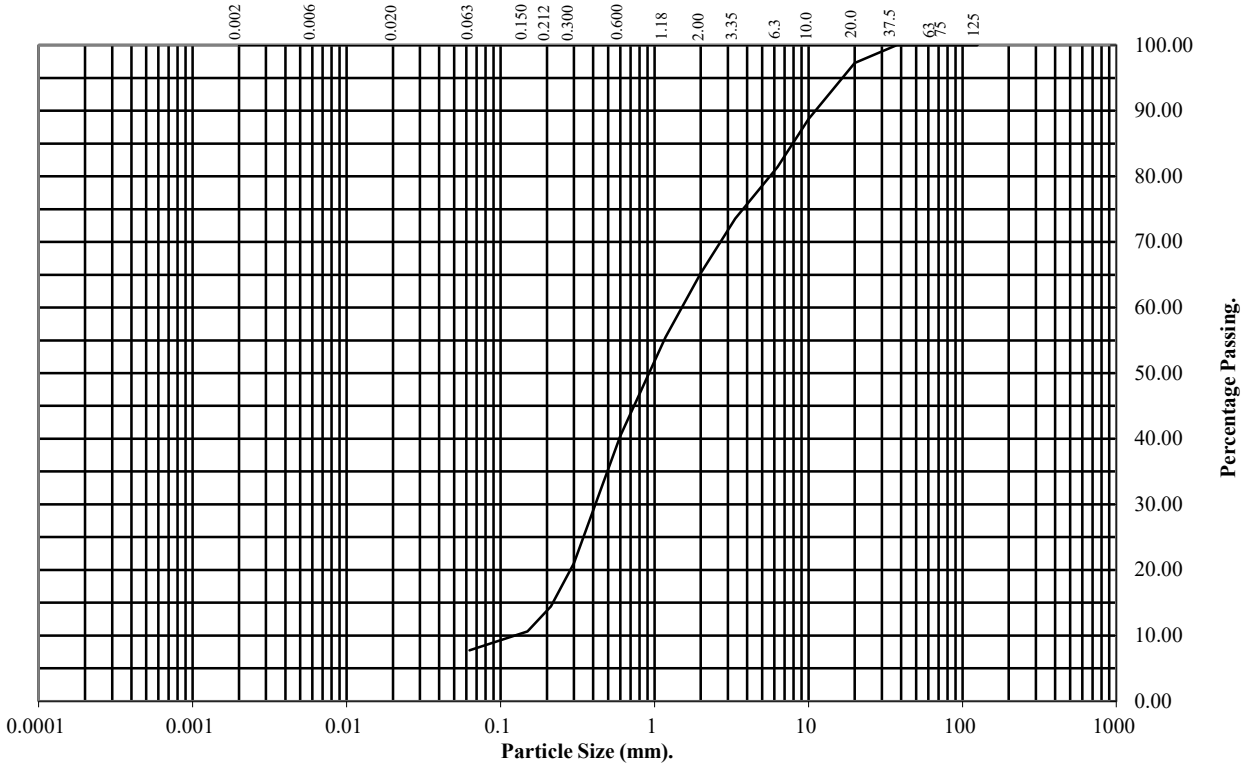
**BS1377 : Part 2 : 1990**

Wet Sieve, Clause 9.2

**Hole Number:** TP114 **Top Depth (m):** 1.00

**Sample Number:** **Base Depth(m):**

**Sample Type:** B




| BS Test Sieve (mm) | Percentage Passing |
|---|---|
| 125 | 100 |
| 75 | 100 |
| 63 | 100 |
| 37.5 | 100 |
| 20 | 97 |
| 10 | 89 |
| 6.3 | 81 |
| 3.35 | 74 |
| 2 | 65 |
| 1.18 | 55 |
| 0.6 | 40 |
| 0.3 | 21 |
| 0.212 | 14 |
| 0.15 | 11 |
| 0.063 | 8 |

| Soil Fraction | Total Percentage |
|---|---|
| Cobbles | 0 |
| Gravel | 35 |
| Sand | 57 |
| Silt/Clay | 8 |

**Remarks:**

See Summary of Soil Descriptions

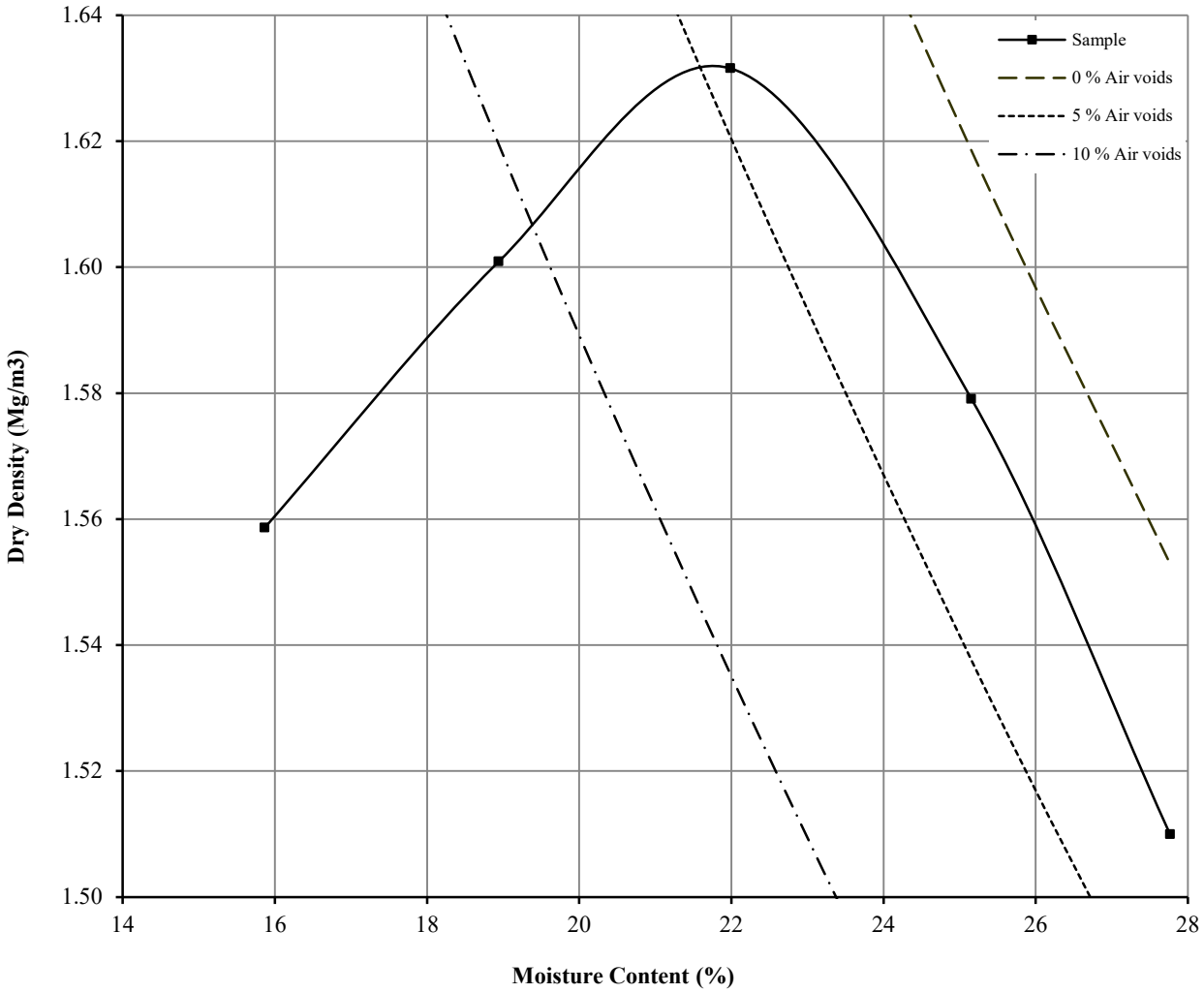
# DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

**BS 1377 : Part 4 : Clause 3.3 : 1990**

**Hole Number:** TP102 **Top Depth (m) :** 2.00

**Sample Number:** **Base Depth (m) :**

**Sample Type:** B




| | | | | | |
|---|---|---|---|---|---|
| Initial Moisture Content: | | 28 | Method of Compaction: | 2.5kg | Separate Samples |
| Particle Density (Mg/m3): | 2.73 | Assumed | Material Retained on 37.5 mm Test Sieve (%): | | 0 |
| Maximum Dry Density (Mg/m3): | | 1.63 | Material Retained on 20.0 mm Test Sieve (%): | | 0 |
| Optimum Moisture Content (%): | | 22 | | | |
| Remarks See summary of soil descriptions | | | | | |

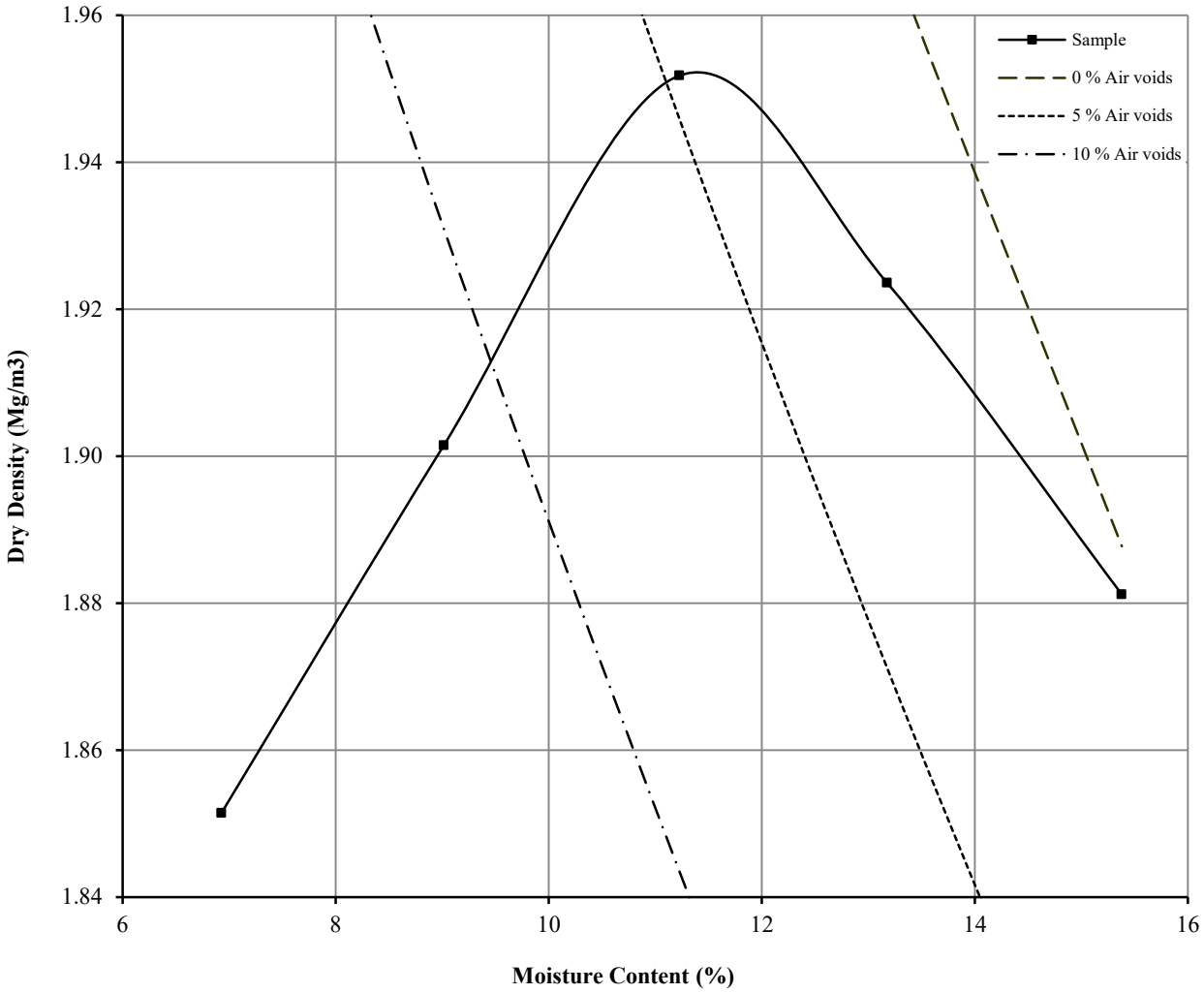
# DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

**BS 1377 : Part 4 : Clause 3.3 : 1990**

**Hole Number:** TP114 **Top Depth (m) :** 1.00

**Sample Number:** **Base Depth (m) :**

**Sample Type:** B




| | | | | | |
|---|---|---|---|---|---|
| Initial Moisture Content: | | 11 | Method of Compaction: | 2.5kg | Separate Samples |
| Particle Density (Mg/m3): | 2.66 | Assumed | Material Retained on 37.5 mm Test Sieve (%): | | 0 |
| Maximum Dry Density (Mg/m3): | | 1.95 | Material Retained on 20.0 mm Test Sieve (%): | | 3 |
| Optimum Moisture Content (%): | | 11 | | | |
| Remarks See summary of soil descriptions | | | | | |

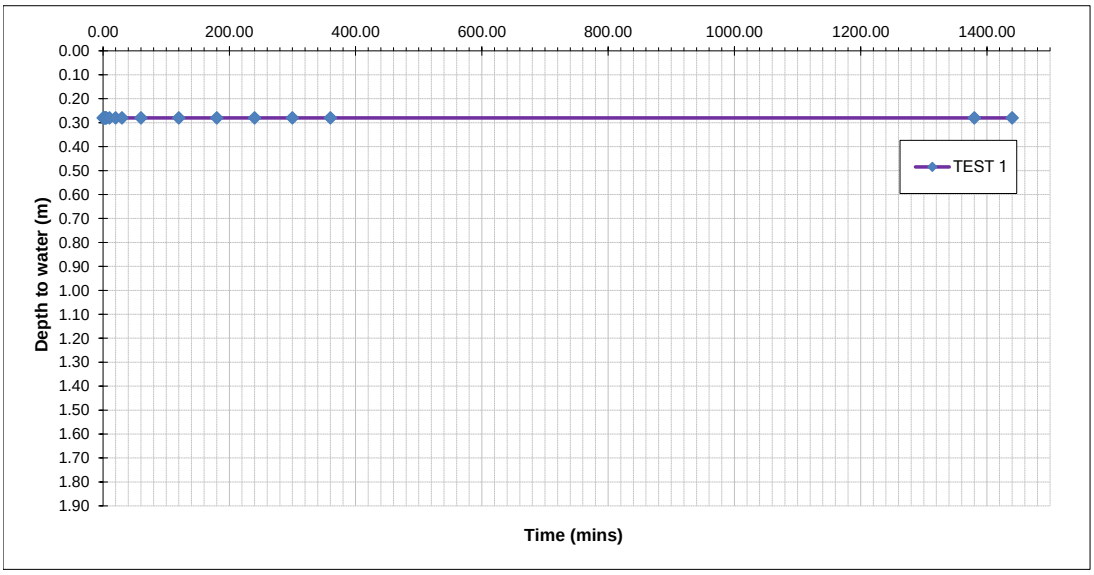
# APPENDIX IX
# SOAKAWAY TEST CERTIFICATES

| | | | |
|---|---|---|---|
| **Site:** | Wrexham Road, Holt | **Trial Pit Number:** | TP101/SA101 |
| **Job Number:** | 14-608 | **Length:** | 2.20 m |
| **Date of Test:** | 28/01/2021 | **Width:** | 1.20 m |
| | | **Depth:** | 1.90 m |
| | | **Groundwater Level:** | 1.50 m |

The test did not reach 25% or 75% effective storage depth and therefore rate could not be calculated.

| | TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|---|
| | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| | 0.00 | 0.28 | | | | |
| | 1.00 | 0.28 | | | | |
| | 2.00 | 0.28 | | | | |
| | 3.00 | 0.28 | | | | |
| | 4.00 | 0.28 | | | | |
| | 5.00 | 0.28 | | | | |
| | 10.00 | 0.28 | | | | |
| | 20.00 | 0.28 | | | | |
| | 30.00 | 0.28 | | | | |
| | 60.00 | 0.28 | | | | |
| | 120.00 | 0.28 | | | | |
| | 180.00 | 0.28 | | | | |
| | 240.00 | 0.28 | | | | |
| | 300.00 | 0.28 | | | | |
| | 360.00 | 0.28 | | | | |
| | 1380.00 | 0.28 | | | | |
| | 1440.00 | 0.28 | | | | |
| Effective Storage Depth | m | 1.62 | | | | |
| 75% Effective Storage Depth | m | 1.22 | | | | |
| (i.e. depth below GL) | m | 0.69 | | | | |
| 25% Effective Storage Depth | m | 0.41 | | | | |
| (i.e. depth below GL) | m | 1.50 | | | | |
| Effective Storage Depth 75%-25% | m | 0.81 | | | | |
| Time to fall to 75% effective depth | mins | N/A | | | | |
| Time to fall to 25% effective depth | mins | N/A | | | | |
| V (75%-25%) | m3 | 2.14 | | | | |
| a (50%) | m2 | 8.15 | | | | |
| t (75%-25%) | mins | N/A | | | | |
| **SOIL INFILTRATION RATE** | m/s | **N/A** | | | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **N/A** |



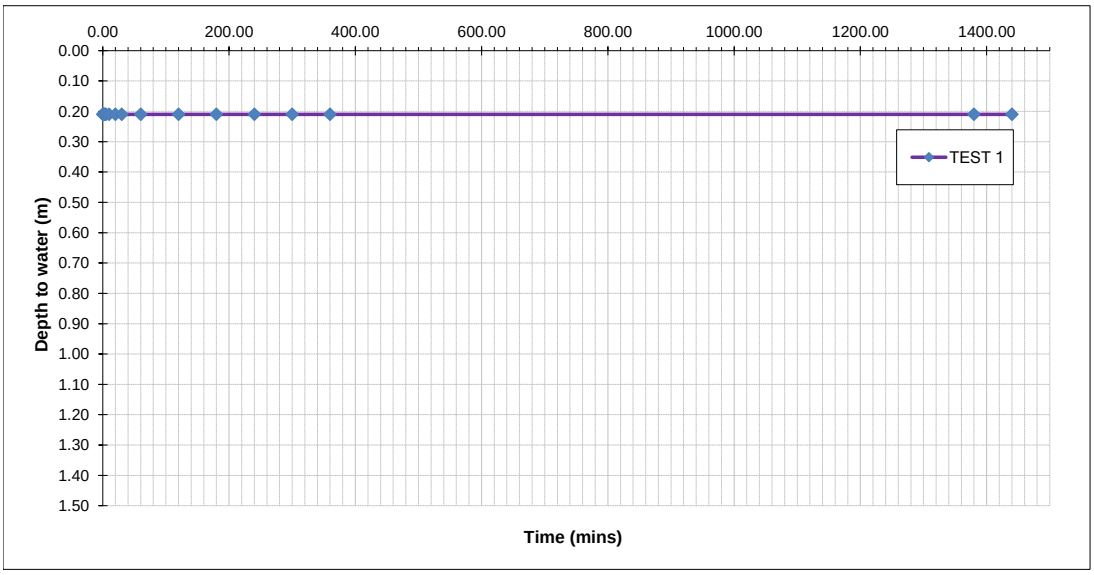
| | | |
|---|---|---|
| e3p | **Site:** Wrexham Road, Holt<br>**Job Number:** 14-608<br>**Date of Test:** 28/01/2021 | **Trial Pit Number:** TP102/SA102<br>**Length:** 2.20 m<br>**Width:** 1.20 m<br>**Depth:** 1.50 m<br>**Groundwater Level:** 0.30 m |

The test did not reach 25% or 75% effective storage depth and therefore could not be calculated.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0.00 | 0.21 | | | | |
| 1.00 | 0.21 | | | | |
| 2.00 | 0.21 | | | | |
| 3.00 | 0.21 | | | | |
| 4.00 | 0.21 | | | | |
| 5.00 | 0.21 | | | | |
| 10.00 | 0.21 | | | | |
| 20.00 | 0.21 | | | | |
| 30.00 | 0.21 | | | | |
| 60.00 | 0.21 | | | | |
| 120.00 | 0.21 | | | | |
| 180.00 | 0.21 | | | | |
| 240.00 | 0.21 | | | | |
| 300.00 | 0.21 | | | | |
| 360.00 | 0.21 | | | | |
| 1380.00 | 0.21 | | | | |
| 1440.00 | 0.21 | | | | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 1.29 | | |
| 75% Effective Storage Depth | m | 0.97 | | |
| (i.e. depth below GL) | m | 0.53 | | |
| 25% Effective Storage Depth | m | 0.32 | | |
| (i.e. depth below GL) | m | 1.18 | | |
| Effective Storage Depth 75%-25% | m | 0.65 | | |
| Time to fall to 75% effective depth | mins | N/A | | |
| Time to fall to 25% effective depth | mins | N/A | | |
| V (75%-25%) | m3 | 1.70 | | |
| a (50%) | m2 | 7.03 | | |
| t (75%-25%) | mins | N/A | | |
| **SOIL INFILTRATION RATE** | m/s | **N/A** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **N/A** |



| | | |
|---|---|---|
| **Site:** | Wrexham Road, Holt | |
| **Job Number:** | 14-608 | |
| **Date of Test:** | 28/01/2021 | |

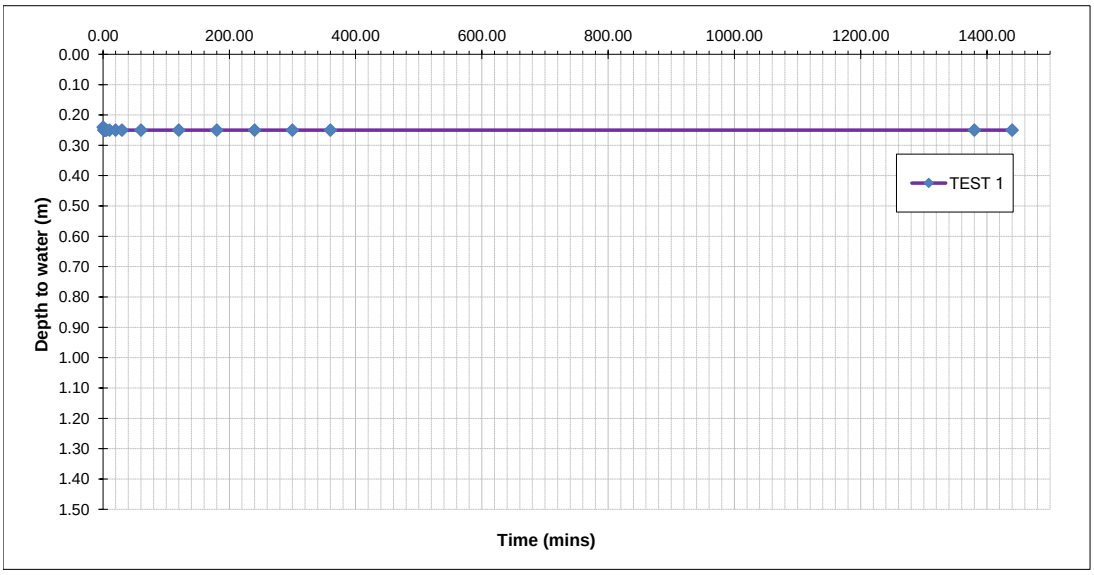
| | | |
|---|---|---|
| **Trial Pit Number:** | TP103/SA103 | |
| **Length:** | 2.20 | m |
| **Width:** | 1.20 | m |
| **Depth:** | 1.50 | m |
| **Groundwater Level:** | 1.00 | m |

The test did not reach 25% or 75% effective storage depth and therefore could not be calculated.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0.00 | 0.24 | | | | |
| 1.00 | 0.25 | | | | |
| 2.00 | 0.25 | | | | |
| 3.00 | 0.25 | | | | |
| 4.00 | 0.25 | | | | |
| 5.00 | 0.25 | | | | |
| 10.00 | 0.25 | | | | |
| 20.00 | 0.25 | | | | |
| 30.00 | 0.25 | | | | |
| 60.00 | 0.25 | | | | |
| 120.00 | 0.25 | | | | |
| 180.00 | 0.25 | | | | |
| 240.00 | 0.25 | | | | |
| 300.00 | 0.25 | | | | |
| 360.00 | 0.25 | | | | |
| 1380.00 | 0.25 | | | | |
| 1440.00 | 0.25 | | | | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 1.26 | | |
| 75% Effective Storage Depth | m | 0.95 | | |
| (i.e. depth below GL) | m | 0.56 | | |
| 25% Effective Storage Depth | m | 0.32 | | |
| (i.e. depth below GL) | m | 1.19 | | |
| Effective Storage Depth 75%-25% | m | 0.63 | | |
| Time to fall to 75% effective depth | mins | N/A | | |
| Time to fall to 25% effective depth | mins | N/A | | |
| V (75%-25%) | m3 | 1.66 | | |
| a (50%) | m2 | 6.92 | | |
| t (75%-25%) | mins | N/A | | |
| **SOIL INFILTRATION RATE** | m/s | **N/A** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **N/A** |



| | | | |
|---|---|---|---|
| **Site:** | Wrexham Road, Holt | **Trial Pit Number:** | TP104/SA104 |
| **Job Number:** | 14-608 | **Length:** | 2.20 m |
| **Date of Test:** | 28/01/2021 | **Width:** | 1.20 m |
| | | **Depth:** | 1.40 m |
| | | **Groundwater Level:** | N/A m |

The time to fall 25% effective storage depth has been extrapolated to calculate an infiltration rate.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0.00 | 0.25 | | | | |
| 1.00 | 0.25 | | | | |
| 2.00 | 0.26 | | | | |
| 3.00 | 0.26 | | | | |
| 4.00 | 0.26 | | | | |
| 5.00 | 0.27 | | | | |
| 10.00 | 0.28 | | | | |
| 20.00 | 0.31 | | | | |
| 30.00 | 0.33 | | | | |
| 60.00 | 0.37 | | | | |
| 120.00 | 0.5 | | | | |
| 180.00 | 0.56 | | | | |
| 240.00 | 0.6 | | | | |
| 300.00 | 0.62 | | | | |
| 1320.00 | 0.87 | | | | |
| 1380.00 | 0.87 | | | | |
| 1440.00 | 0.87 | | | | |
| 2600.00 | 1.00 | | | | |
| 5000.00 | 1.11 | | | | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 1.15 | | |
| 75% Effective Storage Depth | m | 0.86 | | |
| (i.e. depth below GL) | m | 0.54 | | |
| 25% Effective Storage Depth | m | 0.29 | | |
| (i.e. depth below GL) | m | 1.11 | | |
| Effective Storage Depth 75%-25% | m | 0.58 | | |
| Time to fall to 75% effective depth | mins | 160.00 | | |
| Time to fall to 25% effective depth | mins | 5000.00 | | |
| V (75%-25%) | m3 | 1.52 | | |
| a (50%) | m2 | 6.55 | | |
| t (75%-25%) | mins | 4840.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **7.98E-07** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **7.98E-07** |

