



Photograph 9 – looking north towards Darcy Business Park.



Photograph 10 – Looking north across the Coed Darcy Village junction.



Photograph 11 – Looking southwest towards the Coed Darcy Village junction.



Photograph 12 – Looking southwest towards the Coed Darcy Village junction.



Photograph 1 : Street lighting with gas main underneath



Photograph 2: Stable trench



Photograph 3: Gas Main



Photograph 4: Depth to recorded gas main



Photograph 5: Depth to street lighting



Photograph 6: Cast iron main



Photograph 7: Base of open trench



Photograph 8: Depth of identified street lighting



Photograph 9: Depth to main



Photograph 10: Depth to base of excavations near to main



Photograph 11: Exposed services



Photograph 12: Depth to concrete obstruction

Appendix B. Atkins Technical note, dated November 2011

Technical note

Project	Coed Darcy J43 Improvements & Site Access	To	Andy Keen
Subject	Ground Investigation	From	Alison Graham
Date	28 th November 2011	cc	

Introduction

A new road alignment is required to improve access into the northern part of the proposed Coed Darcy Urban Village development. As part of the design process Atkins Ltd has prepared a Preliminary Sources Study Report (PSSR) in October 2008. The report provided a summary of the available geotechnical information at the time and identified ground hazards that may impact on the scheme. Further to completion of the Preliminary Sources Study Report and subsequent design development of the proposed junction improvements and site access road at Coed Darcy, an additional ground investigation has been carried out to address the identified ground hazards and provide further information on the ground conditions underlying the site for the detailed design of the scheme.

The ground investigation was carried out by Soil Mechanics in August 2011. A factual report providing detailed description of the fieldworks and laboratory testing undertaken will be provided by Soil Mechanics. In addition, further desk study information relating to mining risk and Coal Authority recorded mine shafts located in the area of the existing motorway junction has been obtained in order to inform the investigation.

This technical note has been prepared for issue to Dawnus Construction Limited (the Client) and summarises the findings of the ground investigation, identifies the ground conditions and material parameters, and provides an engineering assessment of the ground conditions encountered in relation to the proposed works and options to manage the geotechnical risks.

Sources of Information and Desk Study

In addition to the ground investigation data from the Soil Mechanics investigation, the following available information is considered relevant to this assessment and should be read in conjunction with this technical note:

- Coed Darcy Urban Village, M4 J43 Improvement and Access into the Square. Preliminary Sources Study Report – Atkins Ltd, October 2008 (Reference 5041216/702/GEO/01 Rev 1).
- The Coal Authority – shaft data sheets relating to Shaft 2 and Shaft 3 as identified in the Coal Authority Ground Stability Report dated August 2008, a copy of which is enclosed within the Preliminary Sources Study Report (PSSR).
- BGS Geological Map of Great Britain Sheet 247 (Swansea) 1:50,000 Scale; and
- BGS recorded borehole logs relating to Shaft 2 and Shaft 3 as identified on the Coal Authority Records referenced above.

Site Description

A detailed site description is included in the PSSR. The following provides a brief general description of the site and describes the key areas of the site (Areas A-E as shown in Figure 4.1) which have been identified based on the anticipated underlying ground conditions and associated geotechnical risks. Where applicable this section also summarises additional desk study information obtained as part of investigations carried out since October 2008.

General

As part of the proposed Coed Darcy Urban Village Development, a new road alignment is required to improve access into the northern part of the development. This northern access will commence at the M4

Technical note

Junction 43 interchange and traverse westerly toward the former Llandarcy Oil Refinery, which forms the site of the Urban Village development.

Ground levels generally fall from south to north across the site area, towards the main carriageway of the M4. The main carriageway of the proposed road alignment passes from the proposed Urban Village site entrance eastwards along the north facing hillside towards Junction 43 of the M4. The proposed road levels fall as the road turns north-eastwards towards the B4290 where this section of road reaches a low point before levels rise towards the motorway junction roundabout. Levels of the proposed link road crossing the site access road fall in a northerly direction. This road connects the B4290 from Llandarcy Village in the south to D'Arcy Business Centre and then links back to the B4290 to the north.

The latest vertical and horizontal alignment indicates that finished levels are to remain broadly similar to the present levels with relatively shallow cuttings and low embankment sections.

geology

The BGS 1:50,000 geological map Sheet 247 (Swansea), digital extracts of which are provided in the available Envirocheck report, indicates that the general area is underlain by the Hughes Member of the Lower Pennant Measures of Carboniferous age. The lithology of these units is known to comprise interbedded sandstones, siltstones and mudstones with occasional coal seams. The Hughes Member predominately comprises relatively massive, coarse to fine grained sandstone with a regional dip of approximately 6° towards the NNW, directly underlying or outcropping within the site.

In the lower lying areas the solid geology was indicated to be overlain by a variable thickness of the Glacial Deposits. Localised areas of peat are shown to be present but are only likely to be encountered some distance north and east of the site.

An unnamed fault running southwest to northeast traverses the eastern side of the site and displaces the younger strata to the northwest with a down-throw of approximately 60 to 80m being indicated.

To the east of the noted fault two coal seams trending ENE to WSW are noted sub-cropping below the superficial cover. None of these noted seams are indicated to the west of the fault within the site area, and are anticipated to be present at approximately 60-80m below bedrock level.

Coal seams

The geological map indicates that the Hughes Seam and an unnamed seam are shown to crop to the south of the site dipping in the NNW direction and are therefore anticipated to be present beneath the site area.

A Shaft Log, SS79MNW66, obtained from the BGS in 2008 and referenced in the PSSR, indicates that to the west of the M4 J43 coal seams are likely to be encountered at the following depths:

- 60.0m depth Garland Vein (GV), seam of approximate 0.5m thickness
- 78.0m depth Bwdwr Vein (BV), seam of approximate 2.3m thickness
- 96.5m depth Hughes Vein (HV), seam of unknown thickness

Recorded mine Entries

In addition to the Ground Stability Report obtained as part of the original desk study, a copy of which is included within the PSSR, a Coal Authority Mining Report (Reference 00049711-11) dated 17th August 2011 has been obtained. The report provides shaft data sheets for the two mine entries shown in the immediate vicinity of the site area.

The following mine entry data are provided in the Coal Authority Mining Report:

Technical note

Shaft no	Entry name	Mine Entry Reference	Treatment details	Easting	Northing
Shaft 2	Pit	272196-007	Shaft plugged with 3m deep concrete mass and capped with reinforced concrete cap 6.2m x 4.2m x 0.5 deep. Underside of plug 3.75m below ground level and foundation depth of cap is 0.75m. Work carried out in 1995 by IMCL for the Coal Authority	272049	196099
Shaft 3	Old Coal Pit	272196-001	This shaft was filled to an unknown specification in June 1972	272028	196012

Historical OS records

A full description of the site history is given in the PSSR. The historical mapping specific to the mineshafts, indicates that the mine shaft identified as Shaft 3 is shown on the maps dated between 1881 and 1971. There is no historical mapping information showing Shaft 2.

Field and Laboratory Studies

Ground Investigation

For the purpose of carrying out the ground investigation works the site was been separated into the following areas, as illustrated in Figure 4.1, based on the anticipated ground conditions, identified ground hazards at the PSSR stage and their implications on the earthworks and pavement design.

- Area A – area for investigation of coals seams;
- Area B – area for investigation of recorded mine entries;
- Area C – area of demolition works including former Bath House;
- Area D – area of anticipated poor subgrade; and
- Area E – area of anticipated poor embankment founding material.

Ground investigation works were carried out by Soil Mechanics in August 2011. A full description of the fieldwork will be provided in Soil Mechanics factual report, a copy of which is provided separately. The fieldwork carried out can be summarised as follows:

- Window Sampling carried out to investigate properties of subgrade material and founding conditions for proposed embankment sections;
- Dynamic Probing carried out to provide information relating to the relative density of soils for assessment of subgrade and investigation of founding conditions for proposed embankment sections;
- Machine Trial Pitting undertaken to investigate properties of subgrade material and founding conditions for proposed embankment sections and for investigation of weathered bedrock material. Trial pitting also concentrated on investigating the Made Ground in the area of demolition works to assess the nature of the fill;
- Hand-dug Trial Pitting carried out to determine the nature of the material at the back and in front of the existing retaining wall on the section of the B4290 immediately north of its junction with the approach road leading from Llandarcy Village to the motorway junction roundabout;
- Cable Percussive Boring to investigate nature and properties of superficial deposits at depth;
- Rotary Drilling carried out to investigate the bedrock and coal seams beneath the road alignment to confirm the absence of worked seams for the assessment of mining risks;
- Geophysical Investigations comprising electromagnetic, magnetometry, ground penetrating radar and micro-gravity surveys carried out to identify the location of known mine entries for further investigations

Technical note

Laboratory Testing

The following geotechnical tests were carried out on samples taken from trial pits, boreholes and window sample probe-holes as part of the ground investigation works. Results are presented in Soil Mechanics' laboratory test result sheets:

- Moisture Content;
- Atterberg Limits;
- Particle Size Distribution;
- Dry density/moisture content relationship (2.5kg Rammer method);
- total sulphur, total acid soluble sulphate and water soluble sulphate; and
- pH.

Ground Conditions and Material Properties

This section summarises the ground and groundwater conditions recorded during the ground investigation. Historical borehole and previous ground investigation information is contained within the PSSR, which although does not provide detailed information to allow determination of geotechnical parameters, does provide an indication of the general ground profile and has been used to inform the recent Soil Mechanics Ground Investigation. In addition, no information from the within Area C was available to allow assessment of the ground conditions in this area post-demolition.

At the time of preparing the investigation scope, the proposed road layout included an embankment section at the western end of the scheme, labelled Area E for the purposes of the investigations. However, the latest road alignment shows that the westbound lane of this section is to be constructed in cutting and the eastbound lane at grade. The ground conditions and material properties have therefore been considered in terms of their suitability as a subgrade, and founding conditions for an embankment construction have not been considered as part of this report.

Ground Conditions

The ground conditions derived from the ground investigation are presented in the table below together with typical strata descriptions. Ground and groundwater conditions are discussed in further detail below.

Table **Ground Conditions**

Location	Strata	General description	Depth to top of stratum m bgl	Depth to base of stratum m bgl
Area A	Made Ground	Medium dense, dark grey and brown, clayey, sandy to very sandy gravel of mudstone, sandstone, coal brick and brick with low cobble content	0.00	3.90
	Glacial Deposits	Dense becoming medium dense, brown, slightly clayey, sandy, sub-rounded to rounded, fine to coarse gravel of sandstone and occasional quartzite with low to medium cobble content overlying sandy, gravelly, sub-rounded to rounded cobbles of sandstone	3.90	6.30
	Hughes Member	Generally strong to very strong dark grey fine to medium-grained sandstone with occasional laminae of siltstone and carbonaceous deposits.	6.30	Proven to 40.60
Area B	No intrusive investigations carried out as geophysics results indicated mine shaft probable outside the current area of construction. Historical borehole at the location of the shaft indicates rock-head at 4.5m below ground level.			

Technical note

Location	Strata	General description	Depth to top of stratum m bgl	Depth to base of stratum m bgl
Area C	Made Ground	Typically demolition rubble consisting of silty, sandy, angular to sub-angular, fine to coarse gravel of brick, concrete and sandstone with a high cobble content. Cobbles were typically recorded as angular brick and concrete. Boulders were typically recorded as angular concrete.	0.00	0.45 – 3.40
	Glacial Deposits	Occasional firm to very occasionally slightly gravelly sandy clay/silt	0.45 – 1.20	0.90 – 1.90
		Light brown, silty, sandy, occasionally clayey, subangular to sub-rounded, fine to coarse gravel of sandstone with medium cobble content. Cobbles are sub-rounded of sandstone	0.90 – 3.40	2.50 – 5.80
	Hughes Member	Weak to medium strong dark grey sandstone recovered as an angular to sub-angular, tabular coarse gravel	2.50 – 5.80	Proven to 6.00
Area D	Made Ground	Typically dark grey slightly to very silty, sandy, angular, to subangular, fine to coarse gravel of mudstone, sandstone and occasional brick with low to high cobble content Occasional stiff, dark greyish brown, slightly sandy, gravelly clay with low to medium cobble content.	0.00	0.40 – 2.10
	Glacial Deposits	Generally soft to firm but occasionally soft and occasionally stiff to very stiff, brownish grey and grey, slightly sandy, gravelly clay with low cobble content;	0.70 – 2.10	1.90 – >3.70m
		Generally grey or orange-brown, sandy, sometimes clayey angular to subangular fine to coarse gravel of sandstone with low cobble content	1.40 – 3.10	Proven to 3.80
Area E	Made Ground	Variable in composition comprising firm sandy clayey silts; stiff gravelly clays; medium dense, clayey, gravelly sands; and loose, clayey, sandy, gravels.	0.00	1.00 – 2.20
	Glacial Deposits	Stiff to very stiff, grey to dark grey, slightly sandy clay.	2.20	Proven to 2.80
		Dense, orange-brown, clayey, sandy, angular to subangular, fine to coarse gravel of sandstone	1.20	>2.40
	Hughes Member	Weak to medium strong, grey sandstone recovered as angular gravel.	1.00	Proven to 1.10

Ground Conditions and material properties

Soil descriptions and material properties are discussed in further detail below:

6.2.1 Made Ground

Made Ground was encountered in all exploratory holes and is generally granular in nature, although occasional cohesive layers up to 0.70m in thickness were recorded generally in Area E.

Classification Properties

Ten samples were selected for Particle Size Distribution (PSD) analysis which has provided information on the grading characteristics of the material. The results, presented in Figure 5.1, indicate that samples were generally moderately well-graded sands and gravels with three samples being well-graded slightly gravelly

Technical note

sandy silty clays. A single sample could be classified as a poorly graded gravel. All samples satisfied the grading requirements for either a Class 1A well graded granular material for use as general fill or Class 2C stoney cohesive material for use as general fill in accordance with Table 6/2 of the Specification for Highway Works (SHW). Of these, four samples satisfied the grading requirements for Class 6F2 selected granular material (coarse grading) for use in forming capping. Overall suitability will depend on the compaction characteristics of the material and other specific requirements set out in Table 6/1 of SHW.

Moisture content and Atterberg limits testing has been carried out on cohesive samples of the Made Ground. Results are presented in Figure 5.2 and summarised in the table below.

Table Atterberg Limits for made ground

property	Range
Moisture Content (%)	16 – 32
Liquid Limit (%)	35 – 43
Plastic Limit (%)	24 – 34
Plasticity Index (%)	9 – 13
Consistency Index	0.82 – 1.92
Liquidity Index	-0.62 – 0.18

The results indicate that fines within the Made Ground can be classified as generally low to medium plasticity clay.

Bulk Unit Weight

No laboratory tests have been carried out to determine the unit weight of the Made Ground.

BS 8002:1994 Code of Practice for Earth Retaining Structures suggests a range of bulk unit weights for soils depending upon their grading. For loose, moderately well-graded sands and gravels, values of 18kN/m³ for moist deposits to 20kN/m³ for saturated deposits have been estimated. For slightly gravelly sandy silty clays a value of 19kN/m³ has been estimated.

Drained Shear Strength (Effective Stress)

BS8002:1994 provides a method of estimating values for peak effective angle of shear strength (Φ') and critical angle of shear strength (Φ'_{crit}) for siliceous sands and gravels based on the material description, specifically the grading of the soil, the angularity of the particles and recorded SPT N-values. For a loose, to dense, moderately well-graded gravel with rounded to sub angular particles, a minimum Φ'_{peak} and Φ'_{crit} of 32° are indicated. However, peak effective angles of shearing resistance (Φ'_{peak}) will vary with relative densities which are discussed further in Section 6.2.5.

Compaction Characteristics

Compaction related testing has been carried on samples taken from the Made Ground from gravel and clay samples taken from TPC6 and TPC11 respectively. Moisture content/dry density relationship testing was carried out using the 2.5kg rammer method. Results indicate that acceptable moisture content limits that meet the basic requirements of the Specification for Highway Works (SHW), notably that a minimum dry density of 95% of the average maximum dry density established using the 2.5kg rammer method can be obtained, are between approximately 12% and 21%. Initial moisture content values indicate that the granular material is likely to be suitable for compaction, although some material may need to be stockpiled and allowed to drain to ensure moisture contents are within acceptable limits. However, it is likely that the clay soils within the Made Ground at the former Bath House site will be too wet to achieve the required standards of compaction.

6.2.2 Glacial Deposits – cohesive soils

Classification Properties

Technical note

Cohesive strata within the Glacial Deposits are recorded overlying granular strata in TPC2, TPC3, TPC10, TPD2, TPD3, TPD5, WSD1, WSD2 and WSE2. Soils were typically described as soft to firm, brownish grey and grey, slightly sandy, gravelly clay with low cobble content but descriptions of consistency vary from soft to very stiff, generally depending on which of the main areas of the site they are found.

Particle Size Distribution (PSD) analysis has provided information on the grading characteristics of the soil. The results, presented in Figure 5.3 indicate that the samples were generally well-graded, sandy silty clays. The majority of samples satisfied the grading requirements for a Class 2C stoney material for use as general fill in accordance with the SHW. The remaining cohesive sample satisfied the grading requirements for Class 2A/2B wet/dry cohesive material for use as general fill. Overall suitability will depend on the compaction characteristics of the material and other specific requirements set out in Table 6/1 of SHW.

Moisture content and Atterberg limits testing has been carried out on cohesive samples of the Glacial Deposits. Results are presented in Figure 5.4 summarised in the table below.

Table Atterberg Limits for Glacial Deposits

Property	Range
Moisture Content (%)	9 – 26 (Average 18)
Liquid Limit (%)	20 – 40 (Average 30)
Plastic Limit (%)	14 – 22 (Average 19)
Plasticity Index (%)	5 – 21 (Average 11)
Consistency Index	0.64 – 2.88
Liquidity Index	-1.88 – 0.36

The results indicate that cohesive soils within the Glacial Deposits can be classified as generally low to medium plasticity clay.

Bulk Unit Weight

No laboratory tests have been carried out to determine the unit weight of the Glacial Deposits.

BS 8002:1994 suggests a range of bulk unit weights for soils depending upon their grading. For, sandy silty clays, a value of 18kN/m³ has been estimated.

Undrained Shear Strength

No laboratory undrained strength testing of soil samples has been carried out.

In addition to Stroud's correlation between SPT N_{300} values (which are comparable with the sum of 3 consecutive DPSH N_{100} values) and mass shear strength c_u for different values of plasticity index, Butcher *et al* (1995) provide a correlation between the number of blows recorded by dynamic probing and undrained strength, through the determination of the dynamic point resistance of the ground (q_d). Unfortunately, as discussed in Section 6.2.5, it has not been possible to correlate particular test drives given in the dynamic probing results precisely with individual strata recorded in adjacent window samples and trial pits and this has presented difficulty in establishing which sets of blow counts relate to the cohesive layer of the Glacial Deposits. However, assuming the minimum N_{300} values recorded in the Glacial Deposits close to the boundary with the overlying Made Ground relate to the cohesive layers, c_u values could be as low as 10 to 25kPa in places. This assumes the sensitivity of the clay soils (S_t) to be 4.0 and a maximum plasticity index of 21%.

Drained Shear Strength (Effective Stress)

No laboratory tests to allow direct determination of drained strength parameters have been carried out on the samples of the Glacial Deposits.

Technical note

Using the correlation between plasticity index and shear strength from BS 8002, the test data indicates a critical effective angle of shear strength (Φ'_{crit}) value ranging between 27° and 30° based on plasticity index values of between 5% and 21%.

In addition, CIRA Report C504 provides values of Φ'_p for different ranges of plasticity index from studies carried out on by Sladen and Wrigley (1983) on various UK glacial tills. Based on the average plasticity index of 11% from the Atterberg limit testing carried out on samples of the Glacial Deposits, this would indicate a Φ'_p value of approximately 33°. Based on comparisons made by Sladen and Wrigley (1983), the upper bound plasticity index value of 21% would indicate a Φ'_p value of 31°. A Φ'_p of 31° and a Φ'_{crit} of 27° with a c' of 0 kPa is considered appropriate for this material.

Compaction Characteristics

Compaction related testing has been carried on single sample clay recovered from TPC2. Moisture content/dry density relationship testing was carried out using the 2.5kg rammer method. Results indicate that acceptable moisture content limits that meet the basic requirements of the Specification for Highway Works (SHW), notably that a minimum dry density of 95% of the average maximum dry density established using the 2.5kg rammer method can be obtained, are between approximately 12% and 20%. Initial moisture content values suggest that without treatment, the clay soils of the Glacial Deposits will be generally too wet to be used as general fill.

6.2.3 Glacial Deposits – granular soils

Granular strata within the Glacial Deposits were recorded within the cohesive strata or directly underlying the Made Ground. Soils were typically described as light brown, silty, sandy, occasionally clayey, sub-angular to sub-rounded, fine to coarse gravel of sandstone with medium cobble content. Cobbles are sub-rounded of sandstone.

Classification Properties

A single Particle Size Distribution (PSD) test, the results of which are presented Soil Mechanics' laboratory test report, was carried out on a granular sample of the Glacial Deposits. The results show that the sample satisfied the grading requirements for a Class 2B uniformly graded granular fill and 6F2 selected granular material (coarse grading) for use as capping. However, soil descriptions suggest the material is more moderately well-graded, including sands and some silt. Overall suitability will depend on the compaction characteristics of the material and other specific requirements set out in Table 6/1 of SHW.

Bulk Unit Weight

BS 8002:1994 suggests a range of bulk unit weights for soils depending upon their grading. For medium dense uniformly to moderately well-graded gravels values of 19kN/m³ for moist deposits to 21kN/m³ for saturated deposits have been estimated.

Drained Shear Strength (Effective Stress)

BS8002:1994 provides a method of estimating values for peak effective angle of shear strength (Φ') and critical angle of shear strength (Φ'_{crit}) for siliceous sands and gravels based on the material description, specifically the grading of the soil, the angularity of the particles and recorded SPT N-values. For a loose, to dense, moderately uniformly-graded gravel with sub-rounded to sub angular particles, a minimum Φ'_{crit} of 31° is indicated. Peak effective angles of shearing resistance (Φ'_{peak}) will vary with relative densities which are discussed further in Section 6.2.5.

6.2.4 Hughes Member (Sandstone)

Sandstone bedrock was encountered in BHA1, BHC1, TPE1 and TPC11 and was typically described as weak to medium strong dark grey sandstone recovered as an angular to sub-angular, tabular coarse gravel. No laboratory tests were carried out on core samples obtained from the boreholes.

6.2.5 Dynamic Probe Results and Relative Density

Technical note

Dynamic probing has been carried out at various locations throughout Areas C, D and E in order to assess relative densities for the general earthworks design (including assessment of founding conditions for embankment sections that were proposed before the ground investigation works were carried out) and to provide an indication of subgrade conditions for pavement design. Since this time, the design has been revised and no significant embankments are included.

All dynamic probe-holes were remote from trial pits and window samples and it has therefore not been possible to correlate particular test drives precisely with individual strata recorded in adjacent window samples and trial pits. Instead, a broad assessment of the general ground profile against the overall pattern of N_{300} values with depth (presented in Figure 5.5) for each area (C, D and E) is discussed as follows. N_{300} values up to 50 have been included; values of greater than 50 have been omitted from the graph as to ensure an appropriate scale at the lower end of the range. The plots also mark the range in stratigraphic boundaries between the Made Ground, Glacial Deposits and Hughes Member as recorded in trial pits, window samples and boreholes to broadly illustrate how the DPN values relate to the recorded ground profile.

Area C:

The general pattern indicates N_{300} values increasing steadily from around 15 to 25 at 1.50mbgl to in excess of 50 by 2.50m to 3.50mbgl. It has not been possible to identify which results correspond to which soil types although it is likely that granular Made Ground below 1.50mbgl and the glacial gravels beneath the Made Ground can generally be classified within the medium dense to very dense ranges of relative densities using the relative density (D_r) classification provided in CIRIA Report R143 which assumes an N/D_r^2 value of 60 and based on a minimum N_{300} value of 15.

Area D:

Made Ground extends to depth up to 2.10mbgl in this area although the base of the stratum is generally at around 1.20m. It is therefore likely that many of the consistently low N_{300} values of between 1 and 6 from 1.50m to around 2.30mbgl were recorded in soft clays described in trial pits and window samples over this depth range. Below around 2.30mbgl N_{300} values increase with depth up to around 25 at approximately 4.50m. It is possible that many of these were recorded in the underlying gravels, although N_{300} values remain low at around 3.3m and 3.70mbgl in DPD1 and it is unclear whether this represents a loose gravel or sand, or continuation of the soft clays described above.

Area E

A similar pattern of low N_{300} values between 1.50m and around 2.00mbgl can be observed in this area of the site as seen in Area D. The ground profile is similar with the Made Ground overlying a cohesive layer of the Glacial Deposits which in turn overlie granular soils of the Glacial Deposits; although the cohesive layer, which consists generally firm to stiff clays, is generally thinner and often not present, particularly in the area of the road alignment in southern area of Area E. Probable bedrock levels indicated by refusal of the dynamic probes between 1.60 m and 3.40mbgl are consistent with a thinning of the overlying soils in southerly direction as indicated by sandstone bedrock exposed immediately below the Made Ground at 1.00mbgl in TPE1.

roundwater Conditions

Generally no groundwater was recorded in the majority of exploratory holes. Groundwater strikes were recorded at 0.90m at the base of the Made Ground in TPE1, at 3.00mbgl, 3.10mbgl and 3.20mbgl in the granular layer of the Glacial Deposits in TPC2, TPD2 and TPC3, respectively and at 11.60m in the sandstone bedrock in BHA1, rising to 10.20m after 20 minutes.

Very few groundwater strikes were recorded during the investigation. Those that were encountered were recorded in the sandstone beds of the Hughes Member but were recorded at depths as shallow as 1.00m bgl in TPE1 to a depth of 11.60m bgl in BHA1.

No long term groundwater monitoring has been carried out as part of this investigation. However long term ground water monitoring has been undertaken in the area to the north west of the proposed access road this indicates groundwater levels of between 0.4m to 2.5mbgl in the superficial deposits and 0.94mbgl and

Technical note

2.98mbgl in the rock. Based on this the ground water level for design purposes are 1.0m in the superficial deposits and 2.0mbgl in the rock.

reliminary Engineering Assessment

Subgrade Conditions

Pavement design should reflect both the subgrade conditions during pavement construction and the long term subgrade 'equilibrium' conditions which are influenced by soil classification, weather conditions, depth to water table and pavement thickness.

Based on the material descriptions and index properties of the soils, as determined from laboratory test results, values of long-term CBR can be estimated based on Table 5.1 in the Highways Agency Interim Advise Note (IAN) 73/06 Revision 1 (2009), as follows.

- Area C – compacted gravels and demolition rubble at formation level – Design CBR greater than 5%
- Area D – generally soft clays below Made Ground – Design CBR of 2% although localised soft spots with a CBR of <1% may exist
- Area E – generally firm to stiff clays and loose to medium dense gravels underlying variable made ground – Design CBR anticipated to be 2% to 5%
- Other Areas – Design CBR 2% to 5%.

No in-situ CBR testing was undertaken as part of the ground investigation works.

Any soft spots should be excavated and backfilled with selected granular material and any loose areas proof rolled to provide a suitable and even subgrade

Cuttings

Much of the site area is underlain by Made Ground of variable nature, which in turn is underlain by Glacial Deposits that are characterised generally soft to firm and in places stiff, slightly sandy, gravelly clay and silty, sandy, occasionally clayey, sub-angular to sub-rounded, fine to coarse gravels of sandstone.

It is anticipated that the proposed shallow cuttings will in places be formed within the Made Ground which is of variable thickness across the site and the underlying Glacial Deposits. In places the cuttings will be formed within the underlying sandstone bedrock.

CIRIA Report C504 Engineering in Glacial Tills has been used as best practice guidance when considering the stability of cuttings in the Glacial Deposits. An initial generic assessment of slope stability has been based on adopting a characteristic value for peak effective angle shearing resistance (Φ'_p) and an assumed peak effective cohesion (c') of zero, as set out in Section 6.

Based on this assessment, it is likely that 1V:2H cut slopes within the Made Ground and Glacial Deposits will be suitable for road cuttings in order that they meet the general requirements set out in BS 6031:2009 Code of Practice for Earthworks

A high groundwater table is anticipated in the western area of the site where bedrock is present close to the surface as recorded in TPE1. It is likely that some groundwater seepages will be encountered in the cut slopes and excavations. In order to ensure stability of the cut slopes and achieve an adequate factor of safety appropriate drainage measures will need to be introduced.

Embankments

No significant sections of embankment greater than 0.5m in height are proposed as part of the proposed alignment. The side slopes of the embankments should be no steeper than 1 in 2.

It is anticipated that a combination of excavated Class 1 and Class 2 material will be used to construct embankments.

Moisture content for general fill will need to be within acceptable limits in order to be adequately compacted. The acceptable limits are to be set in order to ensure that the basic requirements of the SHW are met, most notably that a minimum dry density of 95% of the average maximum dry density established using the 2.5kg rammer method can be obtained.

Technical note

Consideration will need to be given to groundwater flows onto formations for embankments and fill areas in order to prevent softening of both the formation and general fill materials. It is recommended that filter drains are constructed at the toe of slopes to help ensure they can be adequately drained.

Existing retaining wall

It is understood that the existing 1.80m high concrete retaining wall located at the section of the B4290 immediately north of its junction with the approach road leading from Llandarcy Village to the motorway junction roundabout is to be retained as part of the scheme.

Hand dug pits were carried out in front (TPD5) and adjacent to the carriageway from behind the wall (TPD4) indicating the foundation depth at 0.90m below ground level in front of the wall. Wall thickness at top of wall of 0.30m was measured (as indicated on TPD4 and TPD5). In addition records indicate that the back of the wall was inclined at an angle of 60° with 0.20m wide concrete blocks placed behind the wall from 0.20mbgl to at least 0.7mbgl (max depth of trial hole). It is unclear whether these blocks extend over the full length of the wall or are only present at the trial pit location.

ining

7.5.1. Underground Workings

Rotary borehole BHA1 was carried out to in an area of historic underground mine-workings in order to confirm the absence of workings within the anticipated zone of influence on the proposed works area. No coal seams or evidence of mine-workings were recorded in the borehole which recorded sandstone bedrock from 6.30m to a final depth of 40.60m bgl.

7.5.2 Mine Shafts

A review of the geophysics results relating to the suspected mine shafts discussed in Section 2 and discussions with Neath Port Talbot Council have taken place to assess the risk and impact of the two mineshafts identified during the desk study phase. It has been agreed that Shaft 2 is well away from the area of construction and is not discussed further here.

As part of the initial works for the scheme an additional site investigation was undertaken. This included a geophysical survey of the area of the two mineshafts to help determine their possible locations. The Geophysical Survey Report by Terradat is included in Soil Mechanics' Factual report. The report covers both Shaft 2 and 3; however, as mentioned above, only Shaft 3 is discussed further in this report.

Four different geophysical techniques were used in the area surrounding the location of Shaft 3 as provided by the Coal Authority. These included a Magnetic survey (maps buried ferrous metal), a Ground Penetrating Radar Survey (maps changes in ground type and buried structures) and a Microgravity survey (maps changes in material density). The results of these surveys are presented in Figure 4 of the Terradat report. Each indicates an anomaly at a location in the verge formed by the B4290 to Skewen and the access road onto the roundabout at Junction 43 on the M4.

The historical mapping has been overlain onto the current mapping for the area indicating the location of the shaft as shown on the 1881, 1899 and 1940 maps correlates with the anomalies picked up by the Geophysical survey as shown on Sketches 1 and 2. It has therefore been concluded that this is a probable location of the mineshaft. In addition the historical mapping and local records indicate that the M4 Junction 43 was constructed in the early 1970's which coincides with the recorded infilling of Shaft 3. It has therefore been concluded that the mineshaft was likely to have been in-filled as part of the junction construction works and as such the quality of filling should have been fit for purpose.

Based on this and in agreement with Neath Port Talbot Council the risk of subsidence due to the mineshaft on the proposed road realignment is considered to be low and no further intrusive work is to be undertaken during this stage of the works at Junction 43. However, proposed realignment works of Junction 43 may impact on this location and the probing for the mineshaft is likely to be required at this stage.

Technical note

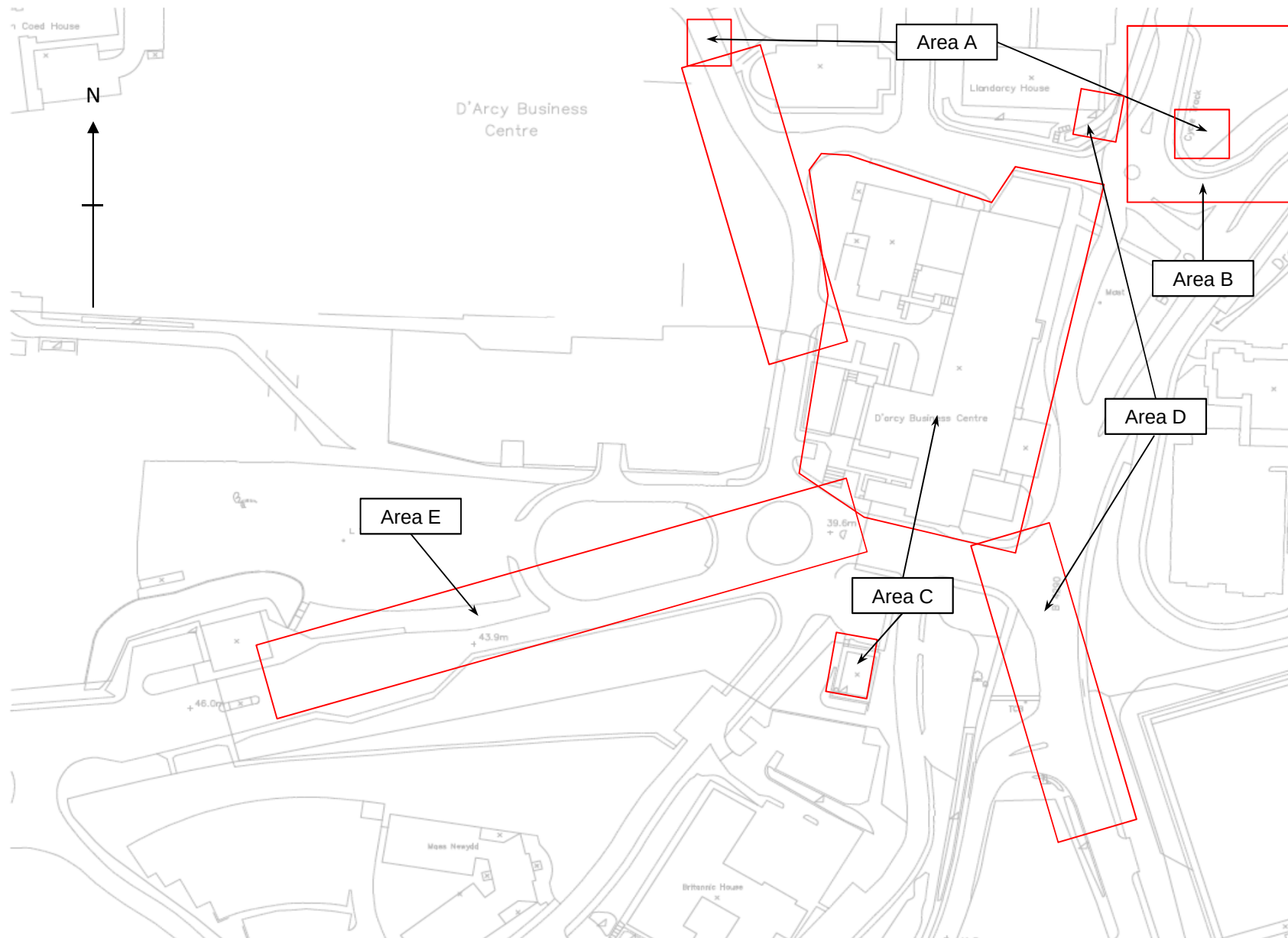
Project Options Ris

A geotechnical risk register is tabulated below.

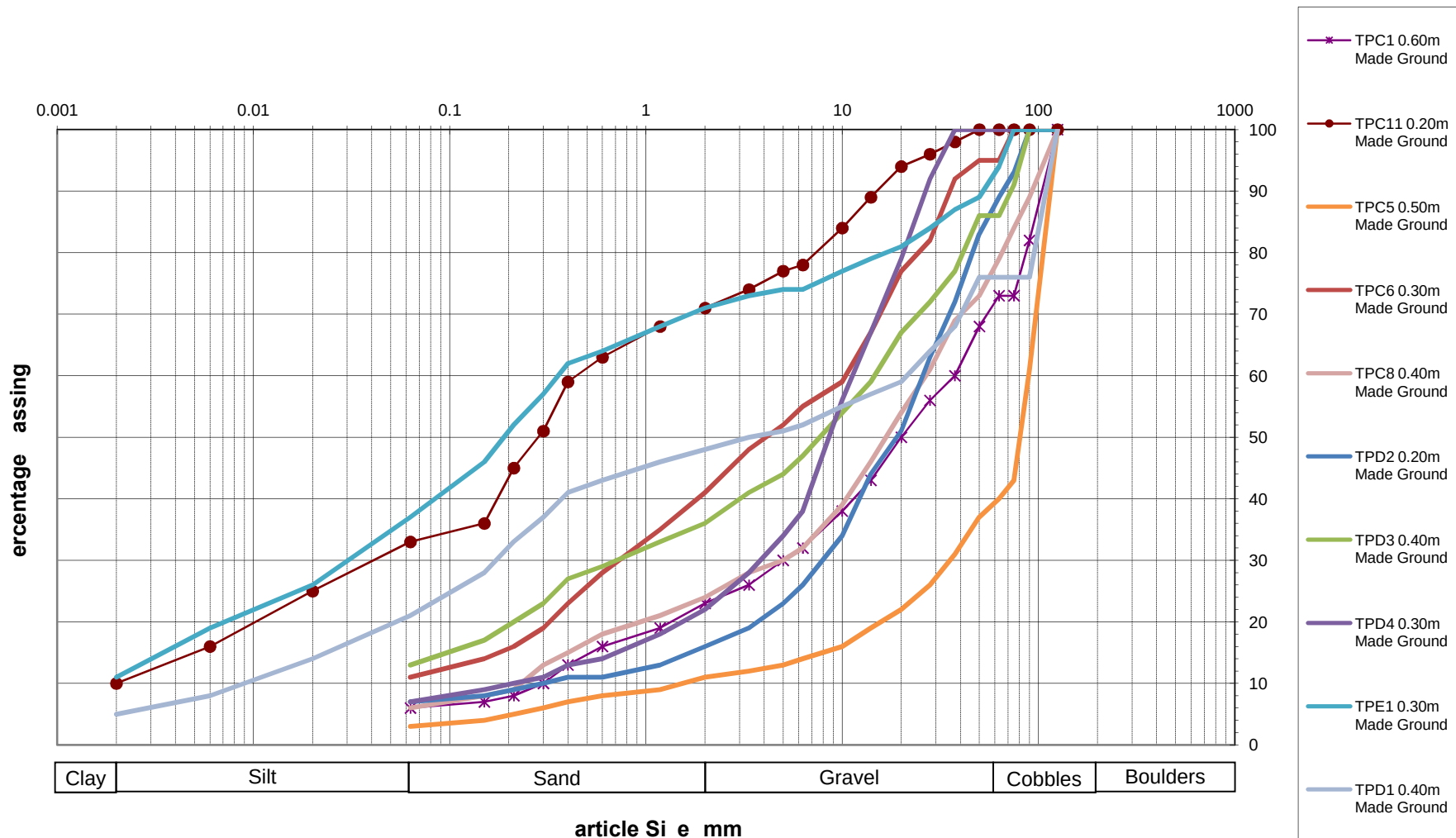
Table **Geotechnical Risk Register**

Probability		Impact Consequence I		Ris Rating	RIS I R
Very likely	5	Very high	5	Intolerable	17 to 25
Probable	4	High	4	Intolerable	13 to 16
Likely	3	Medium	3	Substantial	9 to 12
Unlikely	2	Low	2	Tolerable	5 to 8
Negligible	1	Very low	1	Trivial	1 to 4

	Hazard Ris	Consequence To Project	Initial Ris Rating			Mitigation Measures	Hazard Rating after Mitigation Measures		
				I	R			I	R
1	Soft compressible soils beneath made ground in the north of Area D	Unsuitable subgrade leading to settlement and deformation of road pavement requiring mitigation	3	3	9	Designer to ensure appropriate pavement design to take account of soft subgrade conditions.	2	6	6
2	Demolition rubble of varying densities and constituent material in Area C including cobbles and boulders of brick and concrete and possible building remains left in-situ	Obstruction to excavation, varying degree of compaction and voids leading to differential settlements and deformation of pavement requiring mitigation	3	3	9	Contractor to choose appropriate method of excavation to account for dense, highly compacted areas of fill and ensure removal of obstructions. Backfilling with selected granular material and proof rolling of any loose/soft areas to provide a suitable and even subgrade	2	3	6
3	Mine shafts located in area of proposed works	Collapse of mine shafts and surrounding ground surface affecting proposed road requiring mitigation	3	3	9	Review of Geophysics survey and historical maps indicates mineshaft outside the area of the proposed works. Contractor to ensure that the probable location of the mineshaft is kept clear and not used for storage of materials during construction	2	3	6
4	Shallow bedrock	Obstruction to excavation leading to delays and additional cost	3	3	9	Contractor to select appropriate method of excavation based on ground investigation data and known ground conditions	1	3	3
5	High groundwater level at western end of access road in Area E as recorded in TPE1	Instability of slope requiring redesign and delay in works	3	3	9	Designer to ensure appropriate drainage design. Contractor to ensure appropriate permanent and temporary drainage implemented for cut slopes in this area	1	3	3



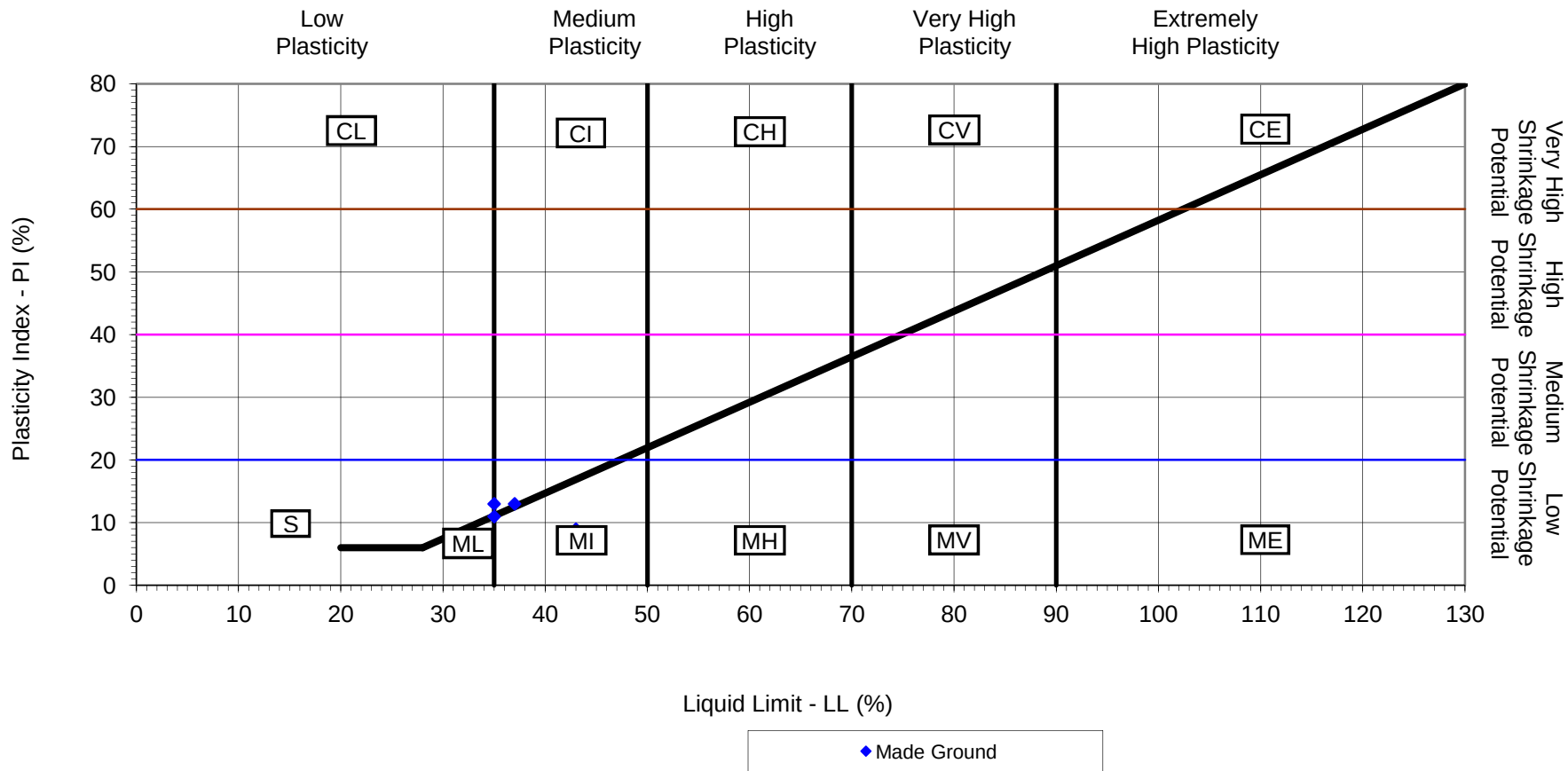
Project	Coed arcy Improvements Site Access	Scale	Compiled JD Date 02/11/2011	Checked AKG Date 02/11/2011
Title	Site Area Locations	Job No. 5105477	Figure 4.1	



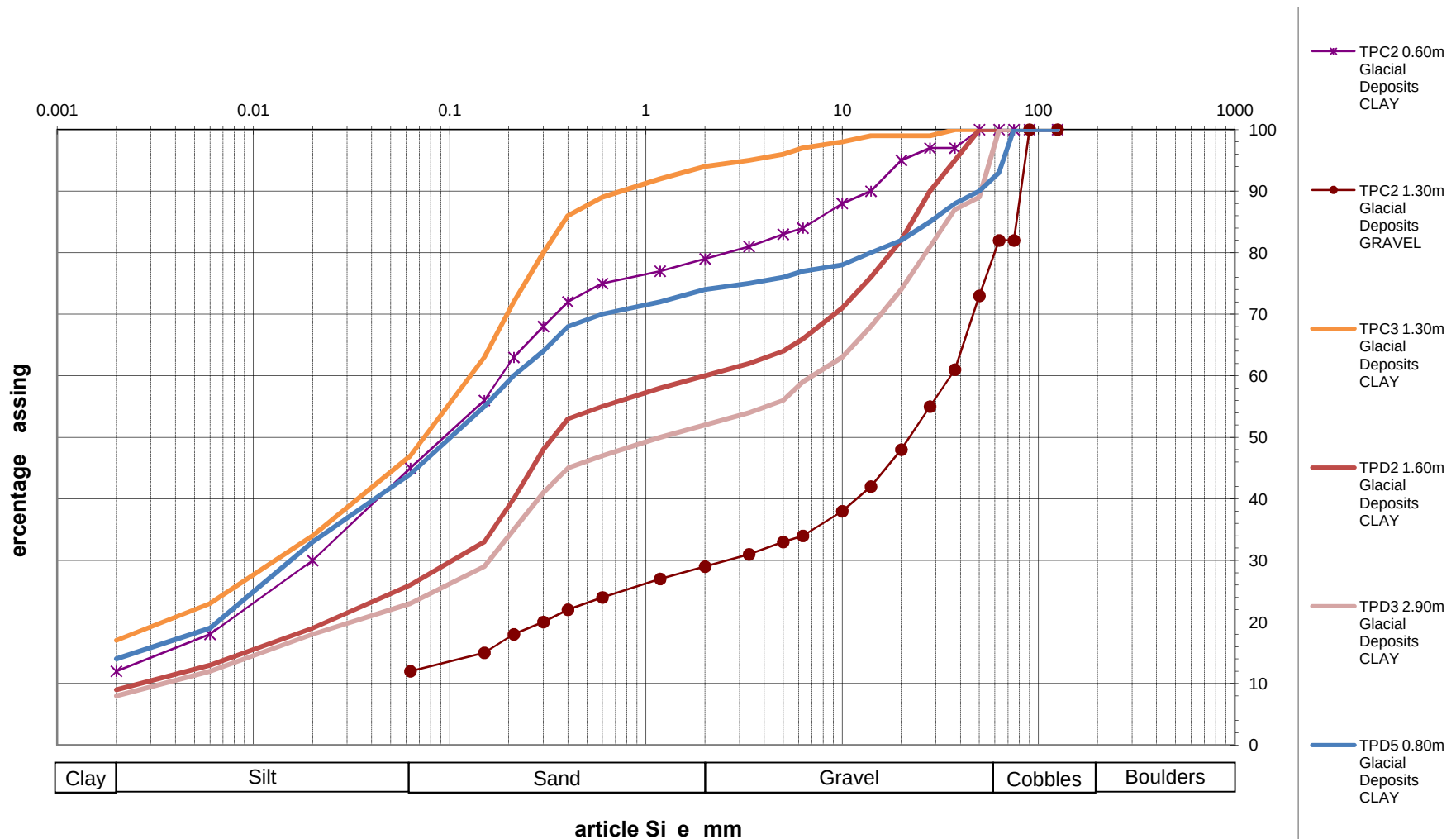
Project:	Compiled	JD	Checked
Coed arcy unction Improvements Site Access Road	Date	19/10/2011	Date
Title:	Job No.	Figure	
article Si e istribution ade round	5105477	5.1	

lasticity Chart I vs LL

Coed Darcy Junction 43 Improvements & Site Access Road



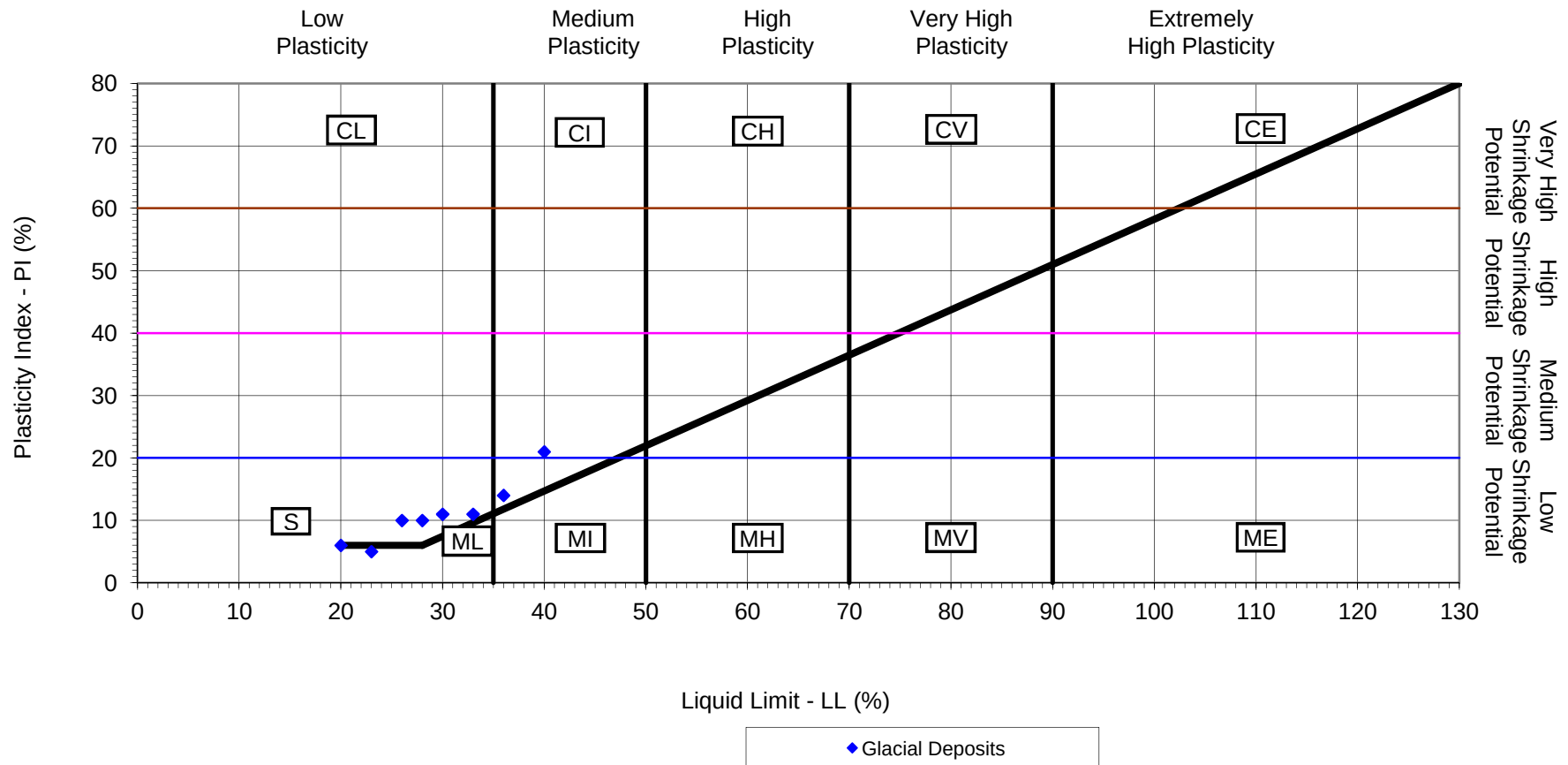
Project: Coed Darcy Junction Improvements Site Access Road	Compiled	JD	Checked	
	Date	17/10/2011	Date	
Title: lasticity Chart I vs LL Made Ground	Job No. 5105477			Figure 5.2



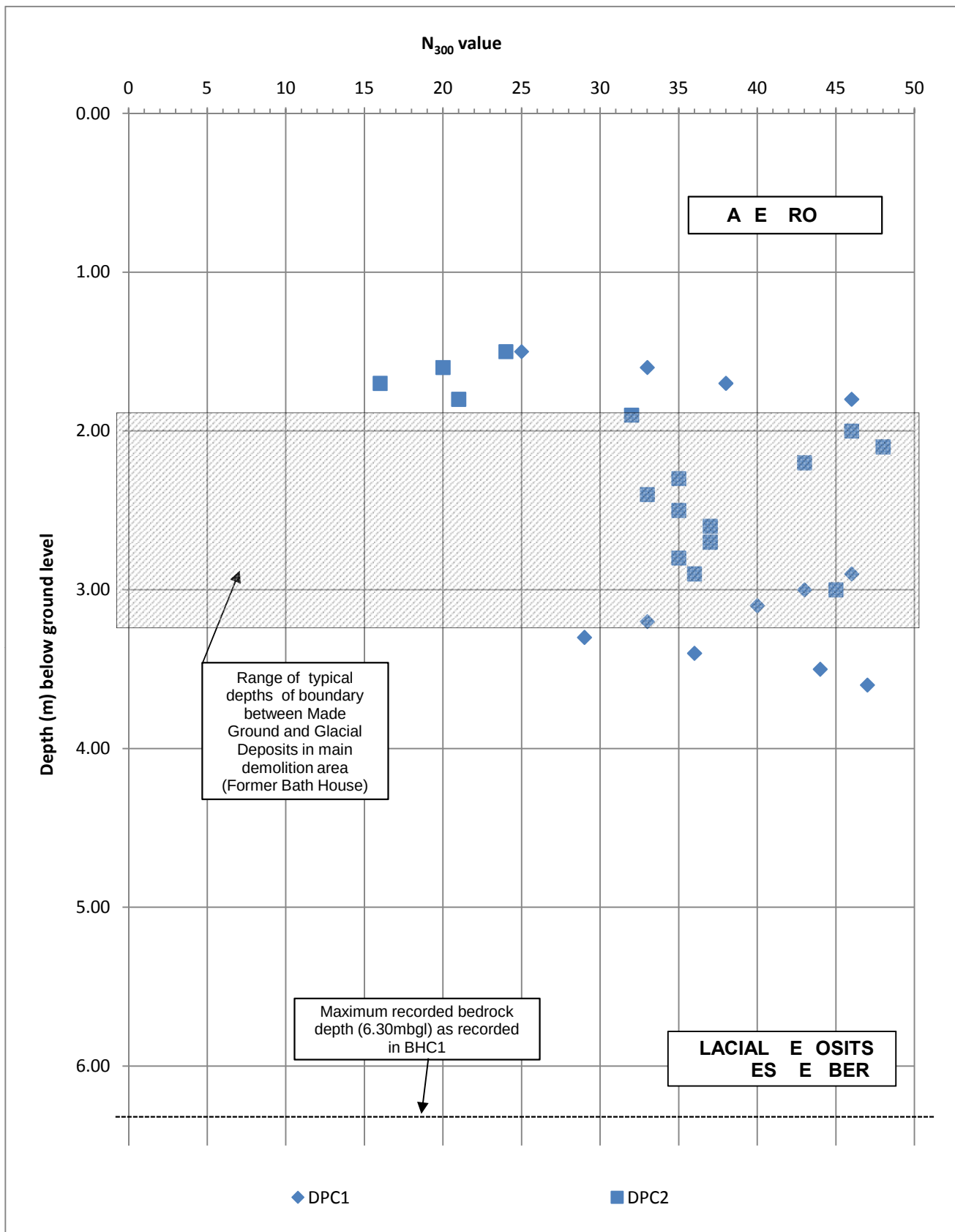
Project:	Compiled	JD	Checked
Coed arcy unction Improvements Site Access Road	Date	19/10/2011	Date
Title:	Job No.	Figure	
article Si e istribution lacial eposits	5105477	5.3	

lasticity Chart I vs LL

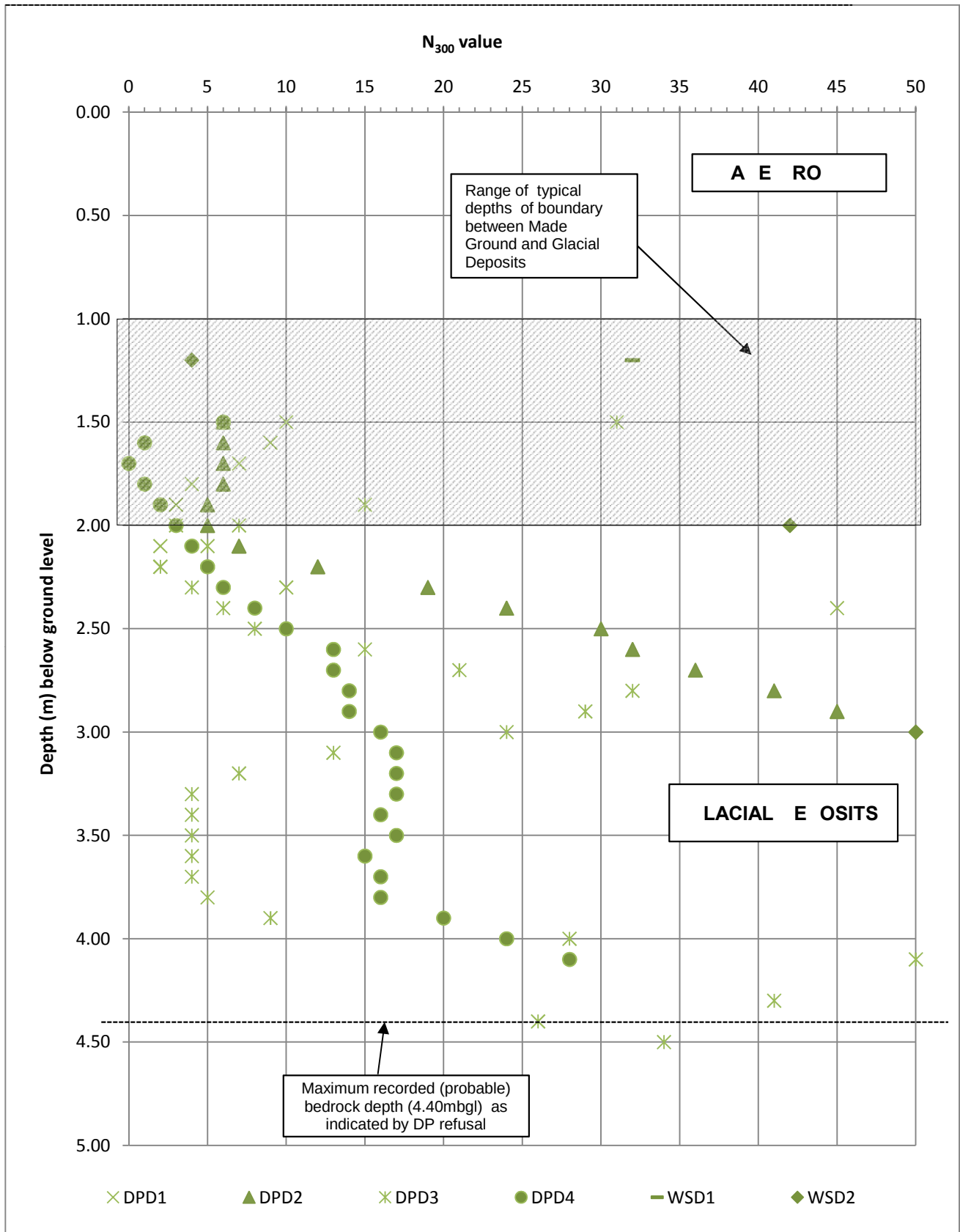
Coed Darcy Junction 43 Improvements & Site Access Road



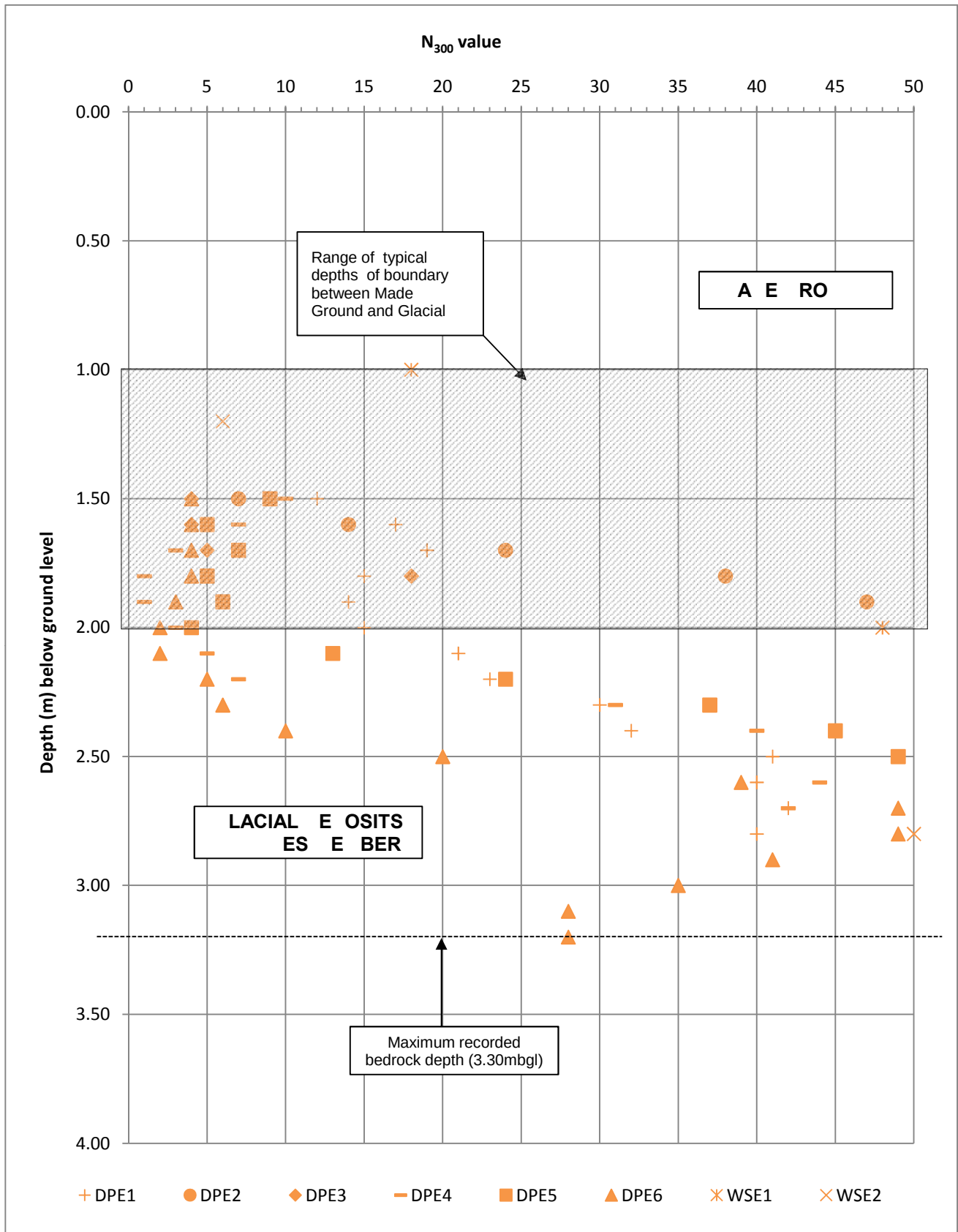
Project:	Coed Darcy Junction Improvements Site Access Road	Compiled	JD	Checked	
Title:	lasticity Chart I vs LL Glacial Deposits	Date	17/10/2011	Date	
		Job No.	5105477	Figure	5.4



Project:				Compiled	JD	Checked	AG
Coedarcy Junction Improvements Site Access Road				Date	02/11/2011	Date	23/11/2011
Title: S T Dynamic Probe S Values vs Depth				Job Number			Figure
Profile Area C				5105477			5.5



Project:				Compiled	JD	Checked	AG
Coed arcy unction Improvements Site Access Road				Date	02/11/2011	Date	23/11/2011
Title: S T ynamic robe S alues vs epth				Job Number			Figure
rofile Area				5105477			5.6



Project:				Compiled	JD	Checked	AG
Coed arcy unction Improvements Site Access Road				Date	02/11/2011	Date	23/11/2011
Title: S T ynamic robe S alues vs epth				Job Number			Figure
rofile Area E				5105477			5.7

Appendix C.ESG Factual Report H1065-11

Report No H1065-11

**Coed Darcy Urban Village, Junction
43 Improvements**

**Factual Report on Ground
Investigation**

Carried out for:

Dawnus Construction Ltd.

Engineer:

Atkins

November 2011



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**COED DARCY URBAN VILLAGE, JUNCTION 43 IMPROVEMENTS
FACTUAL REPORT ON GROUND INVESTIGATION**

Report No: H1065-11

Date: November 2011

Employer:

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Engineer:

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Issue No	Date	Details
1	November 2011	Draft report as submitted

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CONTENTS

	Page
1 INTRODUCTION	2
2 THE SITE AND GEOLOGY	2
2.1 The Site	
2.2 Published Geology	
3 FIELDWORK	3
3.1 General	
3.2 Exploratory Holes	
3.3 In Situ Testing	
4 LABORATORY TESTING	5
4.1 Geotechnical Testing	
4.2 Geoenvironmental Testing	
REFERENCES	6
ENCLOSURES	
A EXPLORATORY HOLE RECORDS	
B IN SITU TESTING	
C GEOTECHNICAL LABORATORY TEST RESULTS	
D GEOENVIRONMENTAL LABORATORY TEST RESULTS	
E PHOTOGRAPHS	
F DRAWINGS	

1 INTRODUCTION

In July 2011 Soil Mechanics (SM) was commissioned by Atkins (Atkins), on behalf of Dawnus Construction (Dawnus), to carry out a ground investigation at Coed Darcy Urban Village, Junction 43. The investigation was required to obtain geotechnical and geoenvironmental information for a proposed road re-alignment and motorway junction improvements.

The scope of the investigation, which was specified by Atkins, comprised cable percussion and rotary drilled boreholes, trial pits, hand excavated pits, window sampling, in situ testing and laboratory testing. The investigation was carried out in accordance with the contract specification, Eurocode 7 and relevant related standards identified below (see also References). The fieldwork was carried out between 1st August and 1st September 2011.

This report presents the factual records of the fieldwork and laboratory testing. The data is also presented separately in digital format following AGS (2005).

2 THE SITE AND GEOLOGY

2.1 The Site

Coed Darcy Urban Village located in Llandarcy, near Junction 43 of the M4, is situated approximately 3.5 km west of Neath and 6.5 km north east of Swansea, see Site Location Plan in Enclosure F. The centre of the site is at National Grid reference SS 719 959.

The area of investigation is located within or close to the former British Petroleum (BP) oil refinery site, Llandarcy. The site is generally rough ground comprising unkempt grass and compacted gravel. The site is bounded to the north by an industrial estate, to the east by the B4290, to the south by office buildings and to the west by the former oil refinery site now part of the Coed Darcy Urban Village project.

2.2 Published Geology

The published geological map covering the site, BGS Sheets 247 (1972), shows the superficial deposits to comprise Glacial Drift deposits.

The solid geology is shown to comprise Upper Coal Measure of the Carboniferous.

The northerly dipping Hughes coal seam is shown to sub-crop approximately 150 m south of the site.

A thrust fault trending in a north-east south-west direction is shown 100 m east of the site.

Additional information, provided by Atkins, indicates two disused mine shafts are located adjacent to the north-east of the site.

3 FIELDWORK

3.1 General

The fieldwork was carried out in general accordance with BS 5930+A2 (2010), BS EN 1997-2 (2007) and BS EN ISO 22475-1 (2006).

The exploratory hole and in situ test locations were selected by Atkins. The locations were set out from local features. A topographical survey was carried out by John Vincent Surveys which included obtaining the co-ordinates and reduced levels to National Grid and Ordnance Datum. The topographical survey is presented separately on compact disc.

A utility service search carried out by ADP Group Ltd and a foul and surface water drain survey carried out by Cardiff Drain Cleaning Company are also included separately on compact disc.

The exploratory hole and in situ test locations are shown on the Exploratory Hole Location Plan in Enclosure F.

3.2 Exploratory Holes

The exploratory holes are listed in the following table.

SUMMARY OF EXPLORATORY HOLES

TYPE	QUANTITY	MAXIMUM DEPTH (m)	REMARKS
Cable Percussion Boring	1	6.00	Designated BHC1
Cable Percussion Boring extended by Rotary Core Drilling/Open Hole Drilling	1	40.60	Designated BHA1
Trial Pits (Machine Excavated)	4	3.90	Designated TPC1 to TPC11, TPD1 to TPD3 and TPE1 to TPE2
Trial Pits (Hand Excavated)	2	1.20	Designated TPD4 and TPD5
Window Sampling	4	3.00	Designated WSD1 to WSD2 and WSE1 to WSE2

The exploratory hole records are presented in Enclosure A and should be read in conjunction with the Key which is included in that enclosure. The records provide descriptions of the materials encountered in accordance with BS EN ISO 14688-1 (2002) and 14689-1 (2003), for soils and rocks respectively, as amplified by BS 5930+A2 (2010). The records also give details of the samples taken together with observations made during boring, drilling, pitting and window sampling. Photographs of the trial pits, window samples and recovered cores are presented in Enclosure E.

Cross section drawings of TPD4 and 5 are presented in Enclosure F.

On completion of the fieldwork geotechnical samples were transported to the Bridgend office of Soil Mechanics for temporary retention, with those required for testing being transferred to the in-house laboratory. Geoenvironmental samples were transported from site directly to the ESG Scientifics laboratory.

3.3 In Situ Testing

In situ testing was carried out in accordance with the relevant standards as tabulated below. The testing is summarised in the following table and the results are presented in Enclosure B unless noted otherwise. Calibration certificates where appropriate are included with the results in the annex.

SUMMARY OF IN SITU TESTING

TYPE	QUANTITY	REMARKS
Dynamic probing	12	BS EN ISO 22476-2 (2005). Designated DPC1 to DPC2, DPD1 to DPD4 and DPE1 to DPE6

A geophysical survey was undertaken to attempt to locate mineshafts two and three in the north of the site, see Exploratory Hole Location plan in Enclosure F. The results of this survey which included magnetic, electromagnetic, ground penetrating radar (GPRS) and micro gravity testing, is presented in Enclosure B.

4 LABORATORY TESTING

4.1 Geotechnical Testing

The testing was scheduled by Atkins and was carried out in accordance with BS 1377 (1990) unless otherwise stated. The testing is summarised below and the results are presented in Enclosure C.

SUMMARY OF GEOTECHNICAL LABORATORY TESTING

TYPE	REMARKS
Moisture Content Determination	13 number
Atterberg Limit Determination	13 number
Particle Size Distribution Analysis	16 number
Dry Density / moisture Content Relationship, Light Compaction	5 number
pH, Water Soluble Sulphate, Acid Soluble Sulphate and Total Sulphur	8 number. Test methods are BS 1377 or others recognised in BRE Special Digest 1 (2005); they are indicated on the results report sheets in Enclosure C.

4.2 Geoenvironmental Testing

The testing was scheduled by Atkins and was carried out by ESG Scientifics. The results are presented in Enclosure D.

Prepared By	Aled Henry BSc FGS
Reviewed By	Hugh Woodroffe BSc FGS
Approved for Issue By	

REFERENCES

- AGS : 2005 : Electronic transfer of geotechnical and geoenvironmental data (Edition 3.1 including addendum May 2005). Association of Geotechnical and Geoenvironmental Specialists.
- BGS England and Wales Sheet 247 : 1972 : Swansea. 1:63360 geological map (drift). British Geological Survey
- BRE Special Digest 1 : 2005 : Concrete in aggressive ground. Building Research Establishment.
- BS 1377 : 1990 : Methods of test for soils for civil engineering purposes. British Standards Institution.
- BS 5930+A2 : 2010 : Code of practice for site investigations (Amendment 2). British Standards Institution.
- BS EN 1997-2 : 2007 : Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.
- BS EN ISO 14688-1 : 2002 : Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description. British Standards Institution.
- BS EN ISO 14689-1 : 2003 : Geotechnical investigation and testing - Identification and classification of rock - Part 1 Identification and description. British Standards Institution.
- BS EN ISO 22475-1 : 2006 : Geotechnical investigation and testing – Sampling methods and groundwater measurements - Part 1 Technical principles for execution. British Standards Institution.
- BS EN ISO 22476-2 : 2005 : Geotechnical investigation and testing - Field testing - Part 2 Dynamic probing. British Standards Institution.
- BS EN ISO 22476-3 : 2005 : Geotechnical investigation and testing - Field testing - Part 3 Standard penetration test. British Standards Institution.

ENCLOSURE A
EXPLORATORY HOLE RECORDS

Key to Exploratory Hole Records
Borehole Logs
Trial Pit Logs
Window Sampler Hole Logs

Key
BHA1 and BHC1
TPC1 to TPC11,
TPD1 to TPD5, TPE1
and TPE2
WSD1 and WSD2,
WSE1 and WSE2

Key to Exploratory Hole Records

SAMPLES

Undisturbed

U	Driven tube sample	} nominally 100 mm diameter and full recovery unless otherwise stated
UT	Driven thin wall tube sample	
TW	Pushed thin wall tube sample	
P	Pushed piston sample	
L	Liner sample (from Windowless or similar sampler), full recovery unless otherwise stated	
CBR	CBR mould sample	
BLK	Block sample	
CS	Core sample (from rotary core) taken for laboratory testing	
AMAL	Amalgamated sample	

Disturbed

D	Small sample
B	Bulk sample

Other

W	Water sample
G	Gas sample

	Environmental chemistry samples (in more than one container where appropriate)
ES	Soil sample
EW	Water sample

Comments

Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that attempt was made to take a tube sample, however, there was no recovery.

Monitoring samples taken after completion of hole construction are not shown on the exploratory hole logs.

TESTS

SPT S or SPT C	Standard Penetration Test, open shoe (S) or solid cone (C)
----------------	--

The Standard Penetration Test is defined in BS EN ISO 22476-3 (2005). The incremental blow counts are given in the Field Records column; each increment is 75 mm unless stated otherwise and any penetration under self weight in mm (SW) is noted. Where the full 300 mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 the total blow count beyond the seating drive is given (without the N = prefix).

IV	<i>in situ</i> Vane shear strength, peak (p) and remoulded (r)
HV	Hand vane shear strength, peak (p) and remoulded (r)
PP	Pocket penetrometer test, converted to shear strength
KFH, KRH, KPI	Permeability tests (KFH = falling head, KRH = rising head; KPI = packer inflow); results provided in Field Records column (one value per stage for packer tests)

DRILLING RECORDS

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930+A2 (2010)

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
If	Fracture spacing, mm. Minimum, typical and maximum spacings are presented. The term non-intact (NI) is used where the core is fragmented.

Flush returns, estimated percentage with colour where relevant, are given in the Records column

CRF	Core recovered (length in m) in the following run
AZCL	Assessed zone of core loss
NR	Not recovered

GROUNDWATER



Groundwater strike



Groundwater level after standing period

Notes:
See report text for full references of standards

Project Coed Darcy Urban Village, Junction 43 Improvements
Project No. H1065-11
Carried out for Dawnus Construction Ltd.

Key

Sheet 1 of 2

Key to Exploratory Hole Records

INSTALLATION

Standpipe/ piezometer

Details of standpipe/piezometer installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill.

SP
SPIE
PPIE
EPIE



The type of instrument installed is indicated by a code in the Legend column at the depth of the response zone:
Standpipe
Standpipe piezometer
Pneumatic piezometer
Electronic piezometer

Inclinometer or Slip Indicator

The installation of vertical profiling instruments is indicated on the Record. The base of tubing is shown in the Legend column.

ICE
ICM
SLIP



The type of instrument installed is indicated by a code in the Legend column at the base of the tubing:
Biaxial inclinometer
Inclinometer tubing for use with probe
Slip indicator

Settlement Points or Pressure Cells

The installation of single point instruments is indicated on the Record. The location of the measuring device is shown in the Legend column.

ESET
ETM
EPCE
PPCE

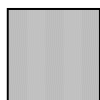


The type of instrument installed is indicated by a code in the Legend column:
Electronic settlement cell/gauge
Magnetic extensometer settlement point
Electronic embedment pressure cell
Electronic push in pressure cell

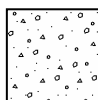
INSTALLATION LEGENDS

A legend describing the installation is shown in the rightmost column. Legends additional to BS5930 are used to describe the backfill materials as indicated below.

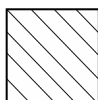
Arisings



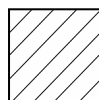
Concrete



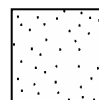
Grout



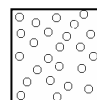
Bentonite



Sand



Gravel



Macadam



NOTES

- 1 Soils and rocks are described in accordance with BS EN ISO 14688-1 (2002) and 14689-1 (2003) respectively as amplified by BS 5930+A2 (2010).
- 2 For fine soils consistency determined in the field by the logger is reported for those strata where undisturbed samples are available. The consistency is qualified and given (in brackets) when, in the opinion of the logger, the sample is disturbed but the assessed consistency is reasonably representative of the in situ conditions; in these circumstances it will normally underestimate consistency in situ. No consistency is given where the samples available are too disturbed to allow a reasonable assessment.
- 3 Evidence of the occurrence of very coarse particles (cobbles and boulders) is presented on the logs, however, because of their size in relation to the exploratory hole these records may not be fully representative of their size and frequency in the ground mass.
- 4 The declination of bedding and joints is given with respect to the normal to the core axis. Thus in a vertical borehole this will be the dip.
- 5 The assessment of SCR, RQD and Fracture Spacing excludes artificial fractures
- 6 Strata legends are in accordance with BS 5930+A2 (2010).
- 7 Water level observations of discernible entries during the advancing of the exploratory hole are given at the foot of the log and in the Legend column. The term "none observed" is used where no discrete entries are identified although this does not necessarily indicate that the hole has not been advanced below groundwater level. Under certain conditions groundwater cannot be observed, for instance, drilling with water flush or overwater, or boring at a rate much faster than water can make its way into the borehole (ref BS5930+A2:2010, Clause 47.2.7). In addition, where appropriate, water levels in the hole at the time of recovering individual samples or carrying out in situ tests and at shift changes are given in the Records column.
- 8 The borehole logs present the results of Standard Penetration Tests recorded in the field without correction or interpretation. However, in certain ground conditions (eg high hydraulic head or where very coarse particles are present) some judgement may be necessary in considering whether the results are representative of in situ mass conditions.

Updated March 2011

Notes:
See report text for full references of standards

Project Coed Darcy Urban Village, Junction 43 Improvements
Project No. H1065-11
Carried out for Dawnus Construction Ltd.

Key

Sheet 2 of 2

3. Scale of aesthetic criteria

Table 3 – Scale of aesthetic criteria

Class	Visual	Olfactory
0	No visible staining of soil, no visible suspect ACM	No detectable odour on soil
1	Occasional staining of soil, no visible suspect ACM	Faint odour on soil
2	Frequent staining of soil	Distinct but not strong odour on soil
3	Occasional heavy staining of soil	Strong odour on soil
4	Heavy staining of soil	Strong odour discernable in ambient air
5	Visible hydrocarbon product	Overwhelming Odour

Borehole Log

PRELIMINARY



Soil Mechanics

Drilled GW/KO Logged GRP/AH Checked	Start 22/08/2011 End 01/09/2011	Equipment, Methods and Remarks Dando 150 / Hands England 36 Lorry Hand dug pit G.L. - 1.20m. Light cable percussion borehole 1.20 - 6.50m. Rotary cored (412 size) 6.50 - 40.60m. Borehole terminated on Engineer's instruction. For Class see Atkins Scale of Aesthetic Criteria				Depth from 0.00m to 6.50m Diameter 150mm 106mm Casing Depth 6.50m	Ground Level +32.49 mOD Coordinates E 271860.37 National Grid N 196049.44 Chainage			
Samples and Tests					Strata					
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments		
0.30	ES 1		22/08/2011	1400	MADE GROUND: Medium dense dark grey and brown clayey very sandy angular to subangular fine to coarse GRAVEL of mudstone with occasional fragments of sandstone, coal, brick and concrete and low cobble content. Cobbles are subangular of mudstone and sandstone (class 0/1). 1.30-1.70 m Possible concrete obstruction	(1.80)				
0.50	B 2									
0.80	ES 3									
1.00-1.30	B 4									
1.20-1.65	SPT C	N=24 (1,2/3,3,4,14)	1.00	dry						
1.80	D 5				MADE GROUND: Medium dense dark greyish black slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of mudstone and sandstone with occasional fragments of concrete and brick (class 1/2).	1.80 +30.69				
1.90	ES 6									
2.00-2.45	SPT C	N=13 (1,2/2,3,4,4)	2.00	1.00						
2.00-2.30	B 7									
2.90	ES 8									
3.00-3.45	SPT C	N=16 (4,3/4,3,4,5)	3.00	2.00	Dense and medium dense brown slightly clayey sandy subrounded to rounded fine to coarse GRAVEL of sandstone and occasional quartzite with low to medium cobble content. Cobbles are subangular to subrounded of sandstone (class 0/0).	(2.10)				
3.00-3.30	B 9									
4.00-4.45	SPT C	N=34 (2,3/5,6,8,15)	4.00	1.50						
4.00-4.50	B 11									
4.10	ES 10									
5.00-5.45	SPT C	N=25 (2,3/5,6,6,8)	5.00	2.00	Brown sandy gravelly subangular to subrounded COBBLES of sandstone. Gravel is subrounded to rounded fine to coarse of sandstone (class 0/0).	3.90 +28.59				
5.00-5.50	B 12									
6.00-6.50	B 13		22/08/2011 1800	5.00 2.00						
6.50	SPT C	(25 for 0mm/50 for 0mm)	23/08/2011 1200	5.00 2.00						
6.50	D 14		30/08/2011 0800	5.00						
6.50-8.00	C 15				Weak brownish grey SANDSTONE recovered as angular to subangular fine to coarse gravel (class 0/0).	5.80 +26.69				
6.50-8.00	73									
6.50-8.00	67									
6.50-8.00	43									
8.00-9.50		C 16								
8.00-9.50	100				Strong to very strong dark grey fine to medium SANDSTONE with occasional laminae of siltstone. Weathering: Generally unweathered, little evidence of staining or weakening, occasional silty deposits (<2mm thick) along discontinuities. Discontinuities: Subhorizontal closely locally medium spaced planar smooth tight. Locally NI; recovered as angular to subangular fine to coarse gravel	6.30 +26.19				
8.00-9.50	100									
8.00-9.50	74									
8.00-9.50	NI									
8.00-9.50	135									
9.50-10.50	270	C 17			9.40-9.60 m Subvertical planar smooth discontinuity	(5.90)				
9.50-10.50										
9.50-10.50										
9.50-10.50										
9.50-10.50										
Depth	TCR RCR ROR	If	Records/Samples	Date Casing	Time Water	Stratum continues to 12.40 m				
Groundwater Entries No. Struck Post strike behaviour Depth sealed (m)						Depth Related Remarks * From to (m) 1.50 6.50 Water added to assist boring				
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.						Chiselling Depths (m) Time Tools used 1.30 -1.70 60 mins Chisel 6.00 -6.30 60 mins Chisel 6.40 -6.40 60 mins Chisel				
Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.						Borehole BHA1 Sheet 1 of 5				

Borehole Log

PRELIMINARY



Soil Mechanics

Drilled Logged Checked	GW/KO GRP/AH	Start 22/08/2011 End 01/09/2011	Equipment, Methods and Remarks Dando 150 / Hands England 36 Lorry Hand dug pit G.L. - 1.20m. Light cable percussion borehole 1.20 - 6.50m. Rotary cored (412 size) 6.50 - 40.60m. Borehole terminated on Engineer's instruction. For Class see Atkins Scale of Aesthetic Criteria				Depth from 0.00m to 6.50m Diameter 150mm 106mm Casing Depth 6.50m	Ground Level +32.49 mOD Coordinates E 271860.37 N 196049.44 Chainage		
Samples and Tests						Strata				
Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description (Continued from Sheet 1)		Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
9.50-10.50	100 82 53		C 18			Strong to very strong dark grey fine to medium SANDSTONE with occasional laminae of siltstone. Weathering: Generally unweathered, little evidence of staining or weakening, occasional silty deposits (<2mm thick) along discontinuities. Discontinuities: Subhorizontal closely locally medium spaced planar smooth tight. Locally NI; recovered as angular to subangular fine to coarse gravel	10.30-10.50 m 45 degree planar smooth discontinuity with light brown staining	12.40	+20.09	
10.50-12.00	77 45 16									
10.50-12.00			C 19							
12.00-13.50										
12.00-13.50	100 94 59		C 20			Strong to very strong dark grey fine to medium SANDSTONE with occasional carbonaceous laminae (<2mm thick). Weathering: Generally unweathered, little evidence of staining, occasional slight loss of strength along discontinuities. Discontinuities: Subhorizontal closely and medium spaced locally widely planar smooth tight. Locally NI; recovered as angular to subangular fine to coarse gravel.	13.50-13.90 m Subvertical planar smooth discontinuity			
13.50-15.00										
13.50-15.00	100 95 77		C 21				14.60-14.75 m Subvertical planar smooth discontinuity with occasional orangish brown staining			
15.00-16.50										
15.00-16.50	80 76 57		C 22							
16.50-17.50										
16.50-17.50	62 52 0		C 23				17.35-17.60 m Subvertical planar smooth discontinuity			
17.50-19.00										
17.50-19.00	67 61 53		C 24							
19.00-20.50										
19.00-20.50	95 93 61									
Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Stratum continues to 32.60 m				
Groundwater Entries No. Struck Post strike behaviour Depth sealed (m) 1 11.60 Rose to 10.10 m after 20 minutes. Medium inflow -						Depth Related Remarks * From to (m)		Chiselling Depths (m)	Time	Tools used
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.						Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Borehole BHA1 Sheet 2 of 5		

Borehole Log

PRELIMINARY



Soil Mechanics

Drilled Logged Checked		GW/KO GRP/AH		Start 22/08/2011 End 01/09/2011		Equipment, Methods and Remarks Dando 150 / Hands England 36 Lorry Hand dug pit G.L. - 1.20m. Light cable percussion borehole 1.20 - 6.50m. Rotary cored (412 size) 6.50 - 40.60m. Borehole terminated on Engineer's instruction. For Class see Atkins Scale of Aesthetic Criteria				Depth from 0.00m 6.50m		to 6.50m 40.60m		Diameter 150mm 106mm		Casing Depth 6.50m		Ground Level +32.49 mOD Coordinates E 271860.37 N 196049.44 Chainage					
Samples and Tests										Strata													
Depth		TCR SCR RQD		If		Records/Samples		Date Casing		Time Water		Description (Continued from Sheet 2)						Depth, Level/ (Thickness)		Legend		Backfill/ Instruments	
20.50-22.00						C 25						Strong to very strong dark grey fine to medium SANDSTONE with occasional carbonaceous laminae (<2mm thick). Weathering: Generally unweathered, little evidence of staining, occasional slight loss of strength along discontinuities. Discontinuities: Subhorizontal closely and medium spaced locally widely planar smooth tight. Locally NI; recovered as angular to subangular fine to coarse gravel.						(20.20)					
20.50-22.00		93 84 65																					
22.00-23.00						C 26						20.32-22.10 m Subvertical planar smooth discontinuity											
22.00-23.00		91 82 59		NI 210 330																			
23.00-24.00						C 27						24.70-25.84 m Subvertical planar smooth discontinuity with slight orangish brown staining											
23.00-24.00		80 71 51																					
24.00-25.50						C 28						27.53-28.00 m Subhorizontal widely spaced discontinuity											
24.00-25.50		100 92 47																					
25.50-27.00						C 29						28.78-29.50 m Generally NI											
25.50-27.00		100 94 51																					
27.00-28.50						C 30						29.75-29.95 m Subvertical											
27.00-28.50		95 93 73																					
28.50-29.00						C 31						Stratum continues to 32.60 m											
28.50-29.00		100 96 0																					
29.00-30.50						C 32																	
29.00-30.50		95 65 56																					
Depth		TCR SCR RQD		If		Records/Samples		Date Casing		Time Water		Stratum continues to 32.60 m											
Groundwater Entries No. Struck Post strike behaviour										Depth sealed (m)		Depth Related Remarks * From to (m)						Chiselling Depths (m)		Time		Tools used	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.										Project Coed Darcy Urban Village, Junction 43 Improvements		Project No. H1065-11						Borehole BHA1					
Scale 1:50 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:27:04										Carried out for Dawnus Construction Ltd.												Sheet 3 of 5	

Borehole Log

PRELIMINARY



Soil Mechanics

Drilled Logged Checked	GW/KO GRP/AH	Start 22/08/2011 End 01/09/2011	Equipment, Methods and Remarks Dando 150 / Hands England 36 Lorry Hand dug pit G.L. - 1.20m. Light cable percussion borehole 1.20 - 6.50m. Rotary cored (412 size) 6.50 - 40.60m. Borehole terminated on Engineer's instruction. For Class see Atkins Scale of Aesthetic Criteria			Depth from 0.00m 6.50m	to 6.50m 40.60m	Diameter 150mm 106mm	Casing Depth 6.50m	Ground Level +32.49 mOD Coordinates E 271860.37 National Grid N 196049.44 Chainage		
Samples and Tests						Strata						
Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description (Continued from Sheet 3)			Depth, Level/ (Thickness)	Legend	Backfill/ Instruments	
30.50-32.00			C 33			Strong to very strong dark grey fine to medium SANDSTONE with occasional carbonaceous laminae (<2mm thick). Weathering: Generally unweathered, little evidence of staining, occasional slight loss of strength along discontinuities. Discontinuities: Subhorizontal closely and medium spaced locally widely planar smooth tight. Locally NI; recovered as angular to subangular fine to coarse gravel.						
30.50-32.00	79 79 71					planar smooth discontinuity						
32.00-33.00			C 34	31/08/2011 6.50	1700 18.80	31.00-31.93 m Subhorizontal widely spaced discontinuity						
32.00-33.00	100 87 80			01/09/2011 6.50	0800 7.80							
33.00-34.50			C 35			Strong to very strong dark grey fine to medium SANDSTONE with occasional carbonaceous laminae (<2mm thick). Weathering: Generally unweathered, little evidence of staining, occasional slight loss of strength along discontinuities. Discontinuities: Subhorizontal medium locally closely spaced planar smooth tight.			32.60	-0.11		
33.00-34.50	61 61 61											
34.50-36.00			C 36			34.22-34.90 m Subvertical planar smooth discontinuity						
34.50-36.00	100 95 81											
36.00-37.50			C 37									
36.00-37.50	87 83 73	190 340 540							(8.00)			
37.50-38.10			C 38			37.22-37.48 m Subvertical planar smooth discontinuity						
37.50-38.10	100 100 100											
38.10-39.60			C 39									
38.10-39.60	92 89 81											
39.60-40.60			C 40									
Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Stratum continues to 40.60 m						
Groundwater Entries No. Struck Post strike behaviour Depth sealed (m)						Depth Related Remarks * From to (m)			Chiselling Depths (m) Time Tools used			
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.						Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.			Borehole BHA1 Sheet 4 of 5			



Borehole Log

PRELIMINARY



Soil Mechanics

Drilled GW/KO Logged GRP/AH Checked		Start 22/08/2011 End 01/09/2011		Equipment, Methods and Remarks Dando 150 / Hands England 36 Lorry Hand dug pit G.L. - 1.20m. Light cable percussion borehole 1.20 - 6.50m. Rotary cored (412 size) 6.50 - 40.60m. Borehole terminated on Engineer's instruction. For Class see Atkins Scale of Aesthetic Criteria				Depth from 0.00m to 6.50m Diameter 150mm 106mm Casing Depth 6.50m		Ground Level +32.49 mOD Coordinates E 271860.37 N 196049.44 Chainage				
Samples and Tests						Strata								
Depth		TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description (Continued from Sheet 4)				Depth, Level/ (Thickness)	Legend	Backfill/ Instruments	
39.60-40.60		100 91 73			01/09/2011	1700 6.50 20.00	Strong to very strong dark grey fine to medium SANDSTONE with occasional carbonaceous laminae (<2mm thick). Weathering: Generally unweathered, little evidence of staining, occasional slight loss of strength along discontinuities. Discontinuities: Subhorizontal medium locally closely spaced planar smooth tight. 40.39-40.60 m Subvertical planar smooth discontinuity EXPLORATORY HOLE ENDS AT 40.60 m				40.60	-8.11		
Depth		TCR SCR RQD	If	Records/Samples	Date Casing	Time Water								
Groundwater Entries No. Struck Post strike behaviour Depth sealed (m)						Depth Related Remarks * From to (m)						Chiselling Depths (m) Time Tools used		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:50						Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.						Borehole BHA1 Sheet 5 of 5		

Borehole Log

PRELIMINARY



Soil Mechanics

Drilled GW Logged GRP Checked	Start 22/08/2011 End 22/08/2011	Equipment, Methods and Remarks Dando 150 Light cable percussion borehole G.L. - 6.00m (through backfilled TPC9, excavated G.L. - 3.80m). Borehole terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria		Depth from 0.00m to 6.00m Diameter 150mm Casing Depth 5.80m	Ground Level +35.84 mOD Coordinates E 271957.75 National Grid N 195999.90 Chainage			
Samples and Tests			Strata					
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
			22/08/2011	0900	Drilled through backfilled trial pit, see strata description for TPC9.			
3.80-4.00 3.80 4.00-4.45 4.00-4.50	B 1 ES 2 SPT C B 3	N=27 (2,7/7,7,5,8)	4.00	2.00	Medium dense brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with low cobble content. Cobbles are subangular of sandstone (class 0/0).	3.80 +32.04 (0.70)		
4.80 5.00-5.45 5.00-5.50	ES 4 SPT C B 5	N=47 (3,8/12,11,12,12)	5.00	1.00	Dense bluish grey silty very sandy subangular to subrounded fine to coarse GRAVEL of sandstone and quartzite with low cobble content. Cobbles are subrounded of sandstone (class 0/0).	4.50 +31.34 (1.30)		
5.80-5.85 5.80-6.00 6.00	SPT C B 6 SPT C	50 (25 for 25mm/50 for 23mm) (25 for 0mm/50 for 0mm)	5.80 22/08/2011 6.00	1.50 1300 2.00	Weak brownish grey SANDSTONE; recovered as angular to subangular tabular gravel (class 0/0). EXPLORATORY HOLE ENDS AT 6.00 m	5.80 +30.04 6.00 +29.84		
Depth	Type & No	Records	Date Casing	Time Water				
Groundwater Entries No. Struck Post strike behaviour None observed (see Key Sheet)					Depth Related Remarks * From 3.70 to 6.00 Water added to assist boring		Chiselling Depths (m) Time Tools used 5.80 -6.00 60 mins Chisel	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.					Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Borehole BHC1 Sheet 1 of 1	

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked	Start 02/08/2011 End 02/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.90m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.55 m Length 3.10 m 	Ground Level +39.48 mOD Coordinates E 271958.37 National Grid N 195937.53 Chainage		
Samples and Tests		Strata				
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	0900	1 MADE GROUND: Dark brown very silty sandy angular to subrounded fine to coarse GRAVEL of sandstone and brick (class 0/0).	0.15 +39.33		
0.30	ES 2		2 MADE GROUND: Orangish brown to grey silty very sandy angular to subangular fine to coarse GRAVEL of brick and concrete with high cobble content and low boulder content. Cobbles are angular of brick and concrete. Boulders (450x210x340mm) are angular of concrete and brick (class 0/0).	(1.05)		
0.50	ES 3					
0.60-0.90	B 4					
1.00	ES 5			1.20 +38.28		
			3 Brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are subrounded of sandstone (class 0/0)	(2.70)		
1.90-2.20	B 6					
2.00	ES 7					
3.20-3.50	B 8					
		02/08/2011 1100 dry	4 Weak to medium strong grey SANDSTONE recovered as angular coarse gravel (class 0/0). EXPLORATORY HOLE ENDS AT 3.90 m	3.90 +35.58		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)	Stability Stable Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:27:22 AGS			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.	Trial Pit TPC1 Sheet 1 of 1		

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked		Start 01/08/2011 End 01/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.10m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria		Dimensions and Orientation Width 0.45 m Length 3.00 m 		Ground Level +40.15 mOD Coordinates E 271950.17 National Grid N 195915.83 Chainage	
Samples and Tests			Strata					
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments		
0.10	ES 1	0800	1 MADE GROUND: Firm brown slightly sandy gravelly SILT. Gravel is angular to subrounded fine to coarse of sandstone and brick (class 0/0). 2 MADE GROUND: Light brownish grey silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with medium to high cobble content. Cobbles are angular of brick and concrete (class 0/0). 3 Very stiff redish brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone (class 0/0). 4 Orangish brown silty very sandy subangular to subrounded fine to coarse GRAVEL of sandstone with high cobble content. Cobbles are subrounded of sandstone (class 0/0).	0.05 +40.10				
0.20-0.40	B 2			(0.40)				
0.30	ES 3			0.45 +39.70				
0.50	ES 4			(0.45)				
0.60-0.90	B 5			0.90 +39.25				
1.00	ES 6			(2.20)				
1.30-1.60	B 7							
2.30-2.60	B 8							
3.10	B 10	01/08/2011 1000 damp	5 Weak dark grey SANDSTONE recovered as angular coarse gravel (class 1/2). EXPLORATORY HOLE ENDS AT 3.10 m	3.10 +37.05				
3.10	ES 9							
Depth	Type & No.	Records Date						
Groundwater Entries No. Struck Post Strike Behaviour (m) 1 3.00 Slow inflow			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Dry			
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:27:29 AGS			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPC2 Sheet 1 of 1			

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked		Start 02/08/2011 End 02/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.30m. Pit terminated due to possible bedrock. For Class see Atkins Scale of Aesthetic Criteria		Dimensions and Orientation Width 0.60 m Length 3.10 m 		Ground Level +39.88 mOD Coordinates E 271931.74 National Grid N 195923.84 Chainage	
Samples and Tests			Strata					
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments		
0.10	ES 1	1300	1 MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of sandstone (class 0/0).	0.15 +39.73				
0.30	ES 2		2 MADE GROUND: Orangish brown silty sandy angular to subangular fine to coarse GRAVEL of brick and concrete with high cobble content and medium boulder content. Cobbles are angular of brick and concrete. Boulders (400x150x300mm) are angular of concrete (class 0/0).					
0.50	ES 3							
0.60-0.90	B 4			(1.05)				
1.00	ES 5		3 Firm light brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone (class 0/0)	1.20 +38.68				
1.30-1.60	B 6							
1.50	D 7			(0.70)				
2.00	ES 8		4 Orangish brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are subrounded of sandstone (class 0/0).	1.90 +37.98				
2.70-3.00	B 9			(1.40)				
		02/08/2011 1500 damp						
			EXPLORATORY HOLE ENDS AT 3.30 m	3.30 +36.58				
Depth	Type & No.	Records Date						
Groundwater Entries No. Struck Post Strike Behaviour (m) 1 3.20 Slow inflow			Depth Related Remarks * From to (m)			Stability Stable Shoring None Weather Rain showers		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.			Trial Pit TPC3 Sheet 1 of 1		

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked	Start 02/08/2011 End 02/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.40m. Pit terminated at possible bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.65 m Length 3.10 m 	Ground Level +39.33 mOD Coordinates E 271933.14 National Grid N 195943.13 Chainage		
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	1600	1 MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of sandstone and brick (class 0/0).	0.15 +39.18		
0.30	ES 2		2 MADE GROUND: Brown to orangish brown silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with high cobble content and medium boulder content. Cobbles are angular of brick. Boulders (400x300x350mm) are angular of concrete (class 0/0).			
0.50	ES 3					
0.70-1.00	B 4			(1.15)		
1.00	ES 5					
1.90-2.20	B 6		3 MADE GROUND: Light brown silty sandy subangular to subrounded fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are subrounded of sandstone (class 0/0).	1.30 +38.03		
3.10-3.40	B 7	02/08/2011 1800 dry				
			EXPLORATORY HOLE ENDS AT 3.40 m	3.40 +35.93		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Dry	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGI www.esgi.co.uk 408.24 25/11/2011 15:27:43			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnuis Construction Ltd.		Trial Pit TPC4 Sheet 1 of 1	

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked	Start 02/08/2011 End 02/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.20m. Pit terminated at possible bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.55 m Length 3.20 m 	Ground Level +37.37 mOD Coordinates E 271919.97 National Grid N 195957.46 Chainage		
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	1500	1 MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of sandstone and brick (class 0/0).	0.20 +37.17		
0.30	ES 2		2 MADE GROUND: Light brown to orangish brown silty very sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with high cobble content and medium boulder content. Cobbles are angular of brick and concrete. Boulders (600x400x450mm) are angular of concrete (class 0/0).	(1.30)		
0.50 0.50-0.80	ES 3 B 4					
1.00	ES 5					
2.00	ES 6		3 Light brown to orangish brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with medium cobble content. Cobbles are subrounded of sandstone (class 0/0).	1.50 +35.87		
2.20-2.50	B 7			(1.70)		
2.90-3.20	B 8					
		02/08/2011 1600 dry				
			EXPLORATORY HOLE ENDS AT 3.20 m	3.20 +34.17		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Collapsing 0.50 - 1.20m Shoring None Weather Dry	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:27:49			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPC5 Sheet 1 of 1	

Logged AH Checked	Start 01/08/2011 End 01/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 0.80m. Pit terminated due to very difficult excavation. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.70 m Length 1.40 m A B C 190 (Deg)	Ground Level +37.06 mOD Coordinates E 271931.65 National Grid N 195978.20 Chainage
Samples and Tests		Strata		
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness) Legend Backfill/ Instruments
0.10	ES 1	1000	1 MADE GROUND: Firm dark brown sandy SILT (class 0/0).	0.08 +36.98
0.30 0.30-0.60	ES 2 B 4		2 MADE GROUND: Redish brown silty very sandy angular to subangular fine to coarse GRAVEL of brick and concrete with high cobble content. Cobbles are angular of brick and sandstone (class 0/0).	(0.72)
0.50	ES 3	01/08/2011 1200 dry		0.80 +36.26
			EXPLORATORY HOLE ENDS AT 0.80 m	
Depth	Type & No.	Records Date		
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)		Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Rain
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.		Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPC6 Sheet 1 of 1



Soil Mechanics

Logged AH Checked	Start 01/08/2011 End 01/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 1.70m. Pit terminated due to difficult excvation. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.50 m Length 2.70 m A B C 180 (Deg)		Ground Level Coordinates National Grid Chainage	+35.67 mOD E 271927.39 N 195995.97
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.00-0.10 0.10	B 1 ES 2	1200	1 MADE GROUND: Dark brown silty sandy angular to subrounded fine to coarse GRAVEL of sandstone and brick (class 0/0).	0.15 +35.52		
0.30	ES 3		2 MADE GROUND: Brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with high cobble content and low boulder content. Cobbles are angular of brick and concrete. Boulders (350x420.300mm) are angular of concrete (class 0/0).			
0.50	ES 4					
0.80-1.10	B 5			(1.55)		
1.00	ES 6					
1.30-1.60	B 7					
		01/08/2011 1400 dry		1.70 +33.97		
			EXPLORATORY HOLE ENDS AT 1.70 m			
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)			Stability Collapsing 0.60 - 1.40m Shoring None Weather Dry
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:01 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.			Trial Pit TPC7 Sheet 1 of 1

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked		Start 01/08/2011 End 01/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 2.70m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.80 m Length 3.30 m 	Ground Level +38.09 mOD Coordinates E 271961.65 National Grid N 195982.06 Chainage	
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	1400	1 MADE GROUND: Dark brown silty sandy angular to subrounded fine to coarse GRAVEL of sandstone and brick (class 0/0).	0.15 +37.94		
0.30	ES 2		2 MADE GROUND: Brown to orangish brown silty very sandy angular to subangular fine to coarse GRAVEL of brick, sandstone and concrete with high cobble content and high boulder content. Cobbles are angular of brick and concrete. Boulders (600x400x250mm) are angular of brick and concrete (class 0/0)			
0.40-0.70	B 3					
0.50	ES 4					
1.00	ES 5			(1.55)		
1.20-1.50	B 6					
1.90-2.20	B 7		3 Brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with low cobble content. Cobbles are subrounded of sandstone (class 0/0).	1.70 +36.39		
				(0.80)		
			4 Weak to medium strong SANDSTONE recovered as angular coarse gravel (class 0/0).	2.50 +35.59		
				2.70 +35.39		
			EXPLORATORY HOLE ENDS AT 2.70 m			
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)	Stability Collapsing 0.40 - 1.30m Shoring None Weather Rain		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.	Trial Pit TPC8 Sheet 1 of 1		



Trial Pit Log

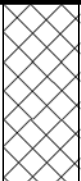
PRELIMINARY



Soil Mechanics

Logged AH Checked	Start 01/08/2011 End 01/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.80m. Pit terminated due to difficult excavation. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.60 m Length 3.00 m 	Ground Level +35.84 mOD Coordinates E 271956.60 National Grid N 195999.83 Chainage		
Samples and Tests		Strata				
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.00-0.15 0.10	B 1 ES 2	1600	1 MADE GROUND: Firm brown slightly sandy gravelly SILT. Gravel is angular to subangular fine to coarse of sandstone and brick (class 0/0).	0.15 +35.69		
0.30	ES 3		2 MADE GROUND: Brown to orangish brown clayey sandy angular to subangular fine to coarse GRAVEL of brick, sandstone and concrete with high cobble content and low boulder content. Cobbles are angular of brick. Boulders (600x200x250) are angular of concrete (class 0/0)	(1.85)		
0.50	ES 4					
0.70-1.00	B 5					
1.00	ES 6					
2.00 2.00-2.30	ES 7 B 8		3 Brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with medium cobble content. Cobbles are subrounded of sandstone (class 0/0).	2.00 +33.84		
3.00-3.30 3.00	B 10 ES 9			(1.80)		
		01/08/2011 1800 dry				
			EXPLORATORY HOLE ENDS AT 3.80 m	3.80 +32.04		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)	Stability Stable Shoring None Weather Rain		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGE www.esge.co.uk 408.24 25/11/2011 15:28:13			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.	Trial Pit TPC9 Sheet 1 of 1		

Logged AH Checked	Start 04/08/2011 End 04/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 0.70m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.60 m Length 1.95 m A B C D 280 (Deg)	Ground Level Coordinates National Grid Chainage	+42.23 mOD E 271923.24 N 195869.47	
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.10 0.10 0.30 0.30-0.60 0.50	ES 1 D 2 ES 3 B 4 ES 5	0800 04/08/2011 1000 dry	1 MADE GROUND: Firm dark brown slightly sandy gravelly silty CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone and occasional brick fragments. Cobbles are angular of sandstone and brick (class 0/0). 2 Light brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with low to medium cobble content. Gravel is subangular to subrounded of sandstone (class 0/0). 3 Weak to medium strong grey SANDSTONE recovered as angular coarse gravel (class 0/0). EXPLORATORY HOLE ENDS AT 0.70 m	0.25 +41.98 (0.35) 0.60 +41.63 0.70 +41.53		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Rain	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:19 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPC10 Sheet 1 of 1	

Logged Ah Checked	Start 04/08/2011 End 04/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 0.70m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.60 m Length 2.30 m A B C 290 (Deg)	Ground Level +42.33 mOD Coordinates E 271920.24 National Grid N 195860.81 Chainage		
Samples and Tests		Strata				
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.10 0.20 0.20-0.50 0.30	ES 1 D 2 B 4 ES 3	1000	1 MADE GROUND: Firm dark brown sandy slightly gravelly clayey SILT with low cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick and concrete. Cobbles are angular of sandstone and brick (class 0/0).	(0.60)		
0.50 0.70	ES 5 B 6	04/08/2011 1200 dry	2 Weak to medium strong dark grey SANDSTONE recovered as angular coarse gravel (class 0/0). EXPLORATORY HOLE ENDS AT 0.70 m	0.60 +41.73 0.70 +41.63		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Rain	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:25 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPC11 Sheet 1 of 1	

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked	Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 2.00m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.60 m Length 3.20 m 	Ground Level +37.47 mOD Coordinates E 271996.63 National Grid N 195831.16 Chainage		
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	0800	1 MADE GROUND: Brown very silty SAND and GRAVEL with low cobble content. Gravel is angular to subangular fine to coarse of sandstone with occasional brick fragments. Cobbles are angular of brick and sandstone (class 0/0).			
0.30	ES 2					
0.40	D 3					
0.40-0.70	B 4					
0.50	ES 5					
1.00	ES 6					
1.70-2.00	B 7	03/08/2011 1000 dry	2 Brown slightly clayey subangular to subrounded fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are subrounded of sandstone (class 0/0).	1.40 +36.07 (0.60)		
			3 Medium strong grey SANDSTONE recovered as angular coarse gravel. EXPLORATORY HOLE ENDS AT 2.00 m	2.00 +35.47		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Dry	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:31			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPD1 Sheet 1 of 1	

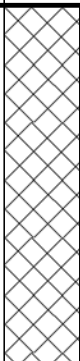
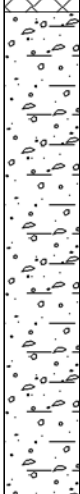
Trial Pit Log

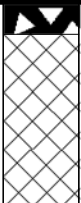
PRELIMINARY

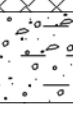


Soil Mechanics

Logged AH Checked	Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.80m. Pit terminated due to collapsing strata. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.60 m Length 3.10 m 	Ground Level +32.86 mOD Coordinates E 271890.39 National Grid N 196011.75 Chainage		
Samples and Tests		Strata				
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.10	ES 1	1000	1 MADE GROUND: Dark grey silty sandy angular to subangular fine to coarse GRAVEL of mudstone with low to medium cobble content. Cobbles are angular of mudstone (class 0/0).	(0.40)		
0.20-0.40	B 2					
0.30	ES 3					
0.50	ES 4		2 MADE GROUND: Brownish grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, mudstone and occasional brick fragments with medium to high cobble content. Cobbles are angular of brick and sandstone (class 0/0).	+32.46		
0.80-1.10	B 5			(0.90)		
1.00	ES 6					
1.60-1.90	B 7	3 Brownish grey and grey very clayey very sandy angular to subangular fine to coarse GRAVEL of sandstone with low cobble content. Cobbles are angular of sandstone (class 0/1).	+31.56			
2.00	ES 8		(1.80)			
2.70-3.00	B 10	4 Grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with low to medium cobble content. Cobbles are angular of sandstone (class 0/1).	+29.76			
3.40-3.70	B 11		(0.70)			
		03/08/2011 1200 damp			3.80 +29.06	
			EXPLORATORY HOLE ENDS AT 3.80 m			
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) 1 3.10 Slow ingress			Depth Related Remarks * From to (m)	Stability Collapsing 3.20 - 3.80m Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:37 AGS			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.	Trial Pit TPD2 Sheet 1 of 1		

Logged AH Checked	Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 3.70m. Pit terminated due to difficult excavation. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.55 m Length 3.10 m A B C D 250 (Deg)	Ground Level +34.42 mOD Coordinates E 271897.12 National Grid N 195997.44 Chainage			
Samples and Tests			Strata				
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments	
0.10	ES 1	1200	1 MADE GROUND: Dark grey silty very sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with medium cobble content. Cobbles are angular of brick and sandstone (class 0/0).	(1.20)			
0.30	ES 2						
0.40-0.70	B 3						
0.50	ES 4						
1.00	ES 5		2 MADE GROUND: Dark grey slightly silty sandy angular to subangular fine to coarse GRAVEL of mudstone with medium to high cobble content. Cobbles are angular of mudstone (class 0/0).	1.20 +33.22 (0.50)			
1.50-1.70	B 6						
1.80-2.10	B 7						
2.00	ES 8						
2.90-3.20	B 9	03/08/2011 1400 dry	3 MADE GROUND: Brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and mudstone with low to medium cobble content. Cobbles are angular of brick and sandstone (class 0/0).	2.10 +32.32 (1.60)			
			4 Brownish grey very clayey very sandy subangular fine to coarse GRAVEL of sandstone with low cobble content. Cobbles are angular of sandstone (class 0/0).				
			EXPLORATORY HOLE ENDS AT 3.70 m	3.70 +30.72			
Depth	Type & No.	Records Date					
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:44 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPD3 Sheet 1 of 1		

Logged AH Checked		Start 04/08/2011 End 04/08/2011		Equipment, Methods and Remarks Hand digging tools Hand excavated pit G.L. - 0.70m. For Class see Atkins Scale of Aesthetic Criteria		Dimensions and Orientation Width 0.50 m Length 0.60 m A B C D		Ground Level +35.07 mOD Coordinates E 271994.16 National Grid N 196032.13 Chainage		
Samples and Tests			Strata							
Depth	Type & No.	Date Records	Description					Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.30-0.60	B 1	1200	1 MADE GROUND: Tarmacadam wearing course (class 0/0).					0.10 +34.97		
		2 MADE GROUND: Orangish brown silty sandy angular to subangular medium to coarse GRAVEL of limestone (sub-base) (class 0/0).					(0.58)			
		04/08/2011 1400 dry	3 MADE GROUND: Concrete (class 0/0). EXPLORATORY HOLE ENDS AT 0.70 m					0.68 +34.39 0.70 +34.37		
Depth	Type & No.	Records Date								
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)					Stability Stable Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:28:50 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.					Trial Pit TPD4 Sheet 1 of 2		

Logged AH Checked	Start 05/08/2011 End 05/08/2011	Equipment, Methods and Remarks Hand digging tools Hnad excavated pit G.L. - 1.20m. For Class see Atkins Scale of Aesthetic Criteria	Dimensions and Orientation Width 0.50 m Length 0.70 m A B C D	Ground Level +32.13 mOD Coordinates E 271993.00 National Grid N 196031.66 Chainage		
Samples and Tests		Strata				
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.10 0.10-0.40 0.20 0.30 0.40-0.70 0.50 0.80-1.10 0.90 1.00	ES 1 B 2 D 3 ES 4 B 5 ES 6 B 7 D 8 ES 9	1000 05/08/2011 1200 dry	1 MADE GROUND: Firm brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of sandstone with occasional brick and concrete fragments. Cobbles are subangular of sandstone (class 0/0). 2 Brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with low to medium cobble content. Cobbles are subangular to subrounded of sandstone (class 0/0). 3 Soft to firm orangish brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subangular of sandstone (class 0/0).	 (0.40) 0.40 +31.73 (0.30) 0.70 +31.43 (0.50) 1.20 +30.93	  	
			EXPLORATORY HOLE ENDS AT 1.20 m			
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)		Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.		Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.		Trial Pit TPD5 Sheet 1 of 2		

Scale 1:25

(c) ESGL www.esgl.co.uk
408.24 25/11/2011 15:28:56





Logged AH Checked		Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 1.10m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria		Dimensions and Orientation Width 0.55 m Length 3.00 m A D B C 090 (Deg)		Ground Level Coordinates National Grid Chainage		+44.87 mOD E 271843.12 N 195868.03		
Samples and Tests			Strata								
Depth	Type & No.	Date Records	Description					Depth, Level/ (Thickness)	Legend	Backfill/ Instruments	
0.10	ES 1	1400	1 MADE GROUND: Firm orangish brown sandy slightly gravelly silty CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone and occasional brick and concrete fragments. Cobbles are angular of sandstone (class 0/0). 2 MADE GROUND: Dark grey silty sandy angular to subangular fine to coarse GRAVEL of sandstone with low to medium cobble content. Cobbles are angular of sandstone (class3-4/3-4). 3 Weak to medium strong grey SANDSTONE recovered as angular coarse gravel (class 3/3). EXPLORATORY HOLE ENDS AT 1.10 m					(0.70)			
0.30 0.30-0.60	ES 2 B 3										
0.50 0.50	ES 4 D 5										
0.80-1.00	B 6										
1.00	ES 7	03/08/2011 1600 damp						1.00 +44.17			
								(0.30)			
								1.00 +43.87			
								1.10 +43.77			
Groundwater Entries No. Struck Post Strike Behaviour (m) 1 0.90 Slow infill			Depth Related Remarks * From to (m)					Stability Stable Shoring None Weather Dry			
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:29:02 			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.					Trial Pit TPE1 Sheet 1 of 1			

Trial Pit Log

PRELIMINARY



Soil Mechanics

Logged AH Checked		Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks CAT 428C Machine excavated pit G.L. - 2.40m. Pit terminated at bedrock. For Class see Atkins Scale of Aesthetic Criteria		Dimensions and Orientation Width 0.60 m Length 3.20 m 		Ground Level +40.16 mOD Coordinates E 271848.60 National Grid N 195913.19 Chainage	
Samples and Tests			Strata					
Depth	Type & No.	Date Records	Description			Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.10 0.10 0.10-0.25 0.30	ES 1 D 2 B 3 ES 4	1600	1 MADE GROUND: Firm dark brown slightly sandy gravelly CLAY with many rootlets. Gravel is angular to subrounded fine to coarse of sandstone and occasional brick and concrete fragments (class 0/0).			0.25 +39.91		
0.50 0.50-0.80	ES 5 B 6		2 MADE GROUND: Brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with medium cobble content. Cobbles are angular of brick, concrete and sandstone (class 0/0).			(0.55)		
			3 MADE GROUND: Tarmacadam wearing course (class 0/0).			0.80 +39.36 (0.40)		
1.50	ES 7		4 Orange brown clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with low to medium cobble content. Cobbles are subrounded of sandstone (class 0/0).			1.20 +38.96		
1.90-2.20	B 8					(1.20)		
2.40	B 9	03/08/2011 1800 dry	5 Weak to medium strong grey SANDSTONE recovered as angular coarse gravel (class 0/0). EXPLORATORY HOLE ENDS AT 2.40 m			2.40 +37.76		
Depth	Type & No.	Records Date						
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)			Stability Stable Shoring None Weather Dry		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:29:08 AGS			Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.			Trial Pit TPE2 Sheet 1 of 1		

PRELIMINARY Window Sampler Hole Log



Soil Mechanics

Drilled Logged Checked	DM AH	Start 04/08/2011 End 04/08/2011	Equipment, Methods and Remarks Competitor Hand excavated pit G.L. - 1.20m. Windowless sampling 1.20 - 1.80m. Terminated on refusal.			Depth from 1.20m	to 1.80m	Diameter 101mm	Casing Depth	Ground Level +35.10 mOD Coordinates E 271899.68 National Grid N 195975.43 Chainage				
Samples and Tests					Strata									
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments						
0.30 0.30	ES 1 B 2				MADE GROUND: Grey to brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with medium to high cobble content. Cobbles are angular to subangular of brick and sandstone (class 0/0).	(0.70)								
0.70 0.70	ES 3 B 4					0.70 +34.40								
1.20-1.65 1.20-1.80	SPT C L 5	N=32 (2,4/4,11,8,9)		dry	MADE GROUND: Stiff dark greyish brown slightly sandy gravelly SILT with low to medium cobble content. Gravel is angular to subangular fine to coarse of sandstone, mudstone and brick. Cobbles are angular of sandstone (class 0/0).	(0.65)								
1.50	ES 6		04/08/2011	1100 dry		1.35 +33.75								
1.80-2.08	SPT-C	-50 (16.9 for 40mm) - 21,23,6 for 15mm)		dry	Stiff to very stiff orangish brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone. Cobbles are subangular of sandstone (class 0/0). EXPLORATORY HOLE ENDS AT 1.80 m	(0.45)								
1.80 +33.30														
Groundwater Entries					Depth Related Remarks *					Chiselling				
No.	Struck (m)	Post strike behaviour	Depth sealed (m)		From	to (m)	Depths (m)	Time	Tools used					
None observed (see Key Sheet)														
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.					Project Coed Darcy Urban Village, Junction 43 Improvements					Borehole WSD1				
(c) ESGL www.esgl.co.uk 408.24 25/11/2011 15:29:14					Project No. H1065-11					Sheet 1 of 1				
Scale 1:50					Carried out for Dawnus Construction Ltd.									

PRELIMINARY
Window Sampler Hole Log



Soil Mechanics

Drilled DM Logged AH Checked		Start 04/08/2011 End 04/08/2011		Equipment, Methods and Remarks Competitor Hand excavated pit G.L. - 1.20m. Windowless sampling 1.20 - 3.00m. Terminated on refusal.		Depth from 1.20m 2.00m to 2.00m 3.00m Diameter 101mm 87mm Casing Depth		Ground Level +32.35 mOD Coordinates E 271881.82 National Grid N 196031.64 Chainage	
Samples and Tests					Strata				
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments	
0.60 0.60	ES 1 B 2				MADE GROUND: Greyish brown to brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with medium to high cobble content. Cobbles are angular to subangular of brick and sandstone (class 0/0).	(1.20)			
1.20-1.65 1.20-2.00	SPT C L 3	N=4 (1,1,1,1,1,1)		dry	Soft light grey sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone (class 0/2).	1.20 +31.15			
1.50	ES 4					(0.70)			
2.00-2.45 2.00-3.00	SPT C L 5	N=42 (3,4/8,9,11,14)		dry	Dense to very dense dark grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with low to medium cobble content. Cobbles are subangular of sandstone (class 0/2).	1.90 +30.45			
2.50	ES 6					(1.10)			
3.00-3.44	SPT-C	50-(5,8/13;12;13,12 for 60mm)	04/08/2011	1400		3.00 +29.35			
					EXPLORATORY HOLE ENDS AT 3.00 m				
Groundwater Entries					Depth Related Remarks *		Chiselling		
No.	Struck (m)	Post strike behaviour	Depth sealed (m)		From to (m)	Depths (m)	Time	Tools used	
None observed (see Key Sheet)									
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.					Project Coed Darcy Urban Village, Junction 43 Improvements		Borehole		
Scale 1:50					Project No. H1065-11		WSD2		
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Window Sampler Hole Log



Soil Mechanics

Drilled DM Logged AH Checked		Start 02/08/2011 End 02/08/2011		Equipment, Methods and Remarks Competitor Hand excavated pit G.L. - 1.00m. Windowless sampling 1.00 - 2.50m. Terminated on refusal.		Depth from 2.00m to 2.00m		Diameter 101mm 87mm		Casing Depth		Ground Level +41.48 mOD Coordinates E 271775.29 National Grid N 195896.67 Chainage					
Samples and Tests						Strata											
Depth		Type & No		Records		Date Casing		Time Water		Description		Depth, Level / (Thickness)		Legend		Backfill / Instrument	
0.20		ES 1		N=18 (6,12/5,4,5,4)				dry		MADE GROUND: (Medium dense) dark brown clayey gravelly fine to coarse SAND with low to medium cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick and concrete. Cobbles are angular of brick and sandstone (class 1/1). 1.00-1.40 m Medium dense		(1.40)					
0.50		B 2															
0.80		ES 3															
1.00-1.45 1.00-2.00		SPT C L 4															
1.50		ES 5		N=48 (9,10/11,12,12,13)		02/08/2011		1100 dry		MADE GROUND: Soft to firm light brown to grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone (class 1/2). Dense and very dense greyish brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone (class 0/1). EXPLORATORY HOLE ENDS AT 2.50 m		1.40 +40.08 (0.50) 1.90 +39.58 (0.60) 2.50 +38.98					
2.00-2.45 2.00-2.50		SPT C L 6															
2.50-2.67 2.50		SPT C ES 7															

Window Sampler Hole Log



Drilled Logged Checked		DM AH	Start 03/08/2011 End 03/08/2011	Equipment, Methods and Remarks Competitor Hand excavated pit G.L. - 1.20m. Windowless sampling 1.20 - 2.80m. Terminated on refusal.		Depth from 2.00m 2.00m			to 1.20m 2.80m	Diameter 101mm 87mm	Casing Depth	Ground Level Coordinates National Grid Chainage		+39.23 mOD E 271911.61 N 195928.02	
Samples and Tests						Strata									
Depth		Type & No		Records		Date Casing	Time Water	Description				Depth, Level (Thickness)		Legend	Backfill/ Instruments
0.20		ES 1						MADE GROUND: Brown clayey sandy angular to subangular fine to coarse GRAVEL of brick, sandstone and concrete with low to medium cobble content. Cobbles are angular of brick and sandstone (class 0/0).				(0.80)			
0.50		B 2										0.80 +38.43			
0.80		ES 3 B 4										(0.80)			
1.20-1.65 1.20-2.00		SPT C L 5		N=6 (3,2/2,2,1,1)			dry	MADE GROUND: Loose grey silty sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional fragments of brick and concrete and low cobble content. Cobbles are angular of sandstone (class 0/0).				1.60 +37.63			
2.00-2.45 2.00 2.00-2.80		SPT C ES 6 L 7		N=16 (2,3/2,3,5,6)			dry	(Stiff) orangish brown slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone with occasional brick fragments (class 1/2).				(0.60)			
2.50		ES 8										2.20 +37.03			
2.80-3.05		SPT C		-50 (19,6 for 30mm/ 18,32 for 65mm)		03/08/2011	1300 dry	Stiff to very stiff grey to dark grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone (class 0/1).				(0.60)			
						EXPLORATORY HOLE ENDS AT 2.80 m						2.80 +36.43			
Depth		Type & No		Records		Date Casing	Time Water								
Groundwater Entries No. Struck Post strike behaviour (m) None observed (see Key Sheet)						Depth Related Remarks * From to (m)						Chiselling Depths (m) Time Tools used			
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.						Project Coed Darcy Urban Village, Junction 43 Improvements Project No. H1065-11 Carried out for Dawnus Construction Ltd.						Borehole WSE2 Sheet 1 of 1			
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**ENCLOSURE B
IN SITU TESTING**

Dynamic Probe Logs

Geophysical Survey Report

DPC1 and DPC2, DPD1
to DPD4, DPE1 to DPE6
Terradat Report No. 3139

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+35.18 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	03/08/2011	Coordinates	E 271974.57 N 196006.17
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			Chainage	

Level	Depth (m)	Blows per 100mm	Blow Count	Torque (Nm)	Description	Legend	Backfill/ Instruments
			5 10 15 20 25				
+35.18	0.00	-			MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with low to medium cobble content. Cobbles are angular to subangular of sandstone, brick and concrete (class 0/0). Samples - ES 0.30m, 0.50m, B 0.50m.		
+34.68	0.50	-					
+34.18	1.00	-					
+33.68	1.50	7 10 8 15 15 16 31			Openhole		
+33.18	2.00	26 23 18 21 14					
+32.68	2.50	22 20 17 14 15					
+32.18	3.00	14 11 8 10 18					
+31.68	3.50	16 13 50			End of Probehole at 3.70 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.70m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPC1

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+36.20 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	03/08/2011	Coordinates	E 271983.73
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			National Grid	N 195996.20
Chainage									

Level	Depth (m)	Blows per 100mm	Blow Count	Torque (Nm)	Description	Legend	Backfill/ Instruments
			5 10 15 20 25				
+36.20	0.00	-			MADE GROUND: Firm dark brown slightly sandy gravelly clayey SILT with low to medium cobble content. Gravel is angular to subangular fine to coarse of sandstone with occasional fragments of brick and concrete. Cobbles are angular of concrete and sandstone (class 0/0). Samples - ES 0.30m, 0.60m, B 0.50m.		
		-					
		-					
+35.70	0.50	-			Openhole		
		-					
		-					
+35.20	1.00	-			Openhole		
		-					
		-					
		9			Openhole		
		9					
		6					
+34.70	1.50	5			Openhole		
		5					
		11					
		16			Openhole		
		19					
		13					
+34.20	2.00	11			Openhole		
		11					
		11					
		11			Openhole		
		13					
		13					
+33.70	2.50	11			Openhole		
		11					
		14					
+33.20	3.00	20			End of Probehole at 3.20 m		
		35					
		50					

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.20m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPC2

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+36.24 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	03/08/2011	Coordinates	E 271914.83
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			National Grid	N 195993.47
Chainage									

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instrument
			5	10	15	20	25				
+36.24	0.00	- - - -							MADE GROUND: Brown to orangish brown silty sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and concrete with medium to high cobble content. Cobbles are angular of brick, concrete and sandstone (class 0/0). Samples - ES 0.30m, 0.80m, B 0.50m.		
+35.74	0.50	- - - -									
+35.24	1.00	- - - -									
+34.74	1.50	- 3							Openhole		
		4									
		2									
		1									
+34.24	2.00	1									
		0									
		1									
		9									
+33.74	2.50	35									
		41									
		26									
		34									
+33.24	3.00	28									
		34									
		38									
		29									
+32.74	3.50	37									
		40									
		36									
		29									
		50							End of Probehole at 3.60 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.60m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPD1

Sheet 1 of 1

Dynamic Probe Log



Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+32.63 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50			Coordinates National Grid	E 271887.96 N 196018.97
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750	Date of Test	04/08/2011	Chainage	

[illegible]

Tested in accordance with BS 1377

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.90m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Scale 1:25

Project No. H1065-11
Carried out for Dawnus Construction Ltd.

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	Dm	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+34.68 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	03/08/2011	Coordinates	E 271915.07 N 196012.13
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			Chainage	

Level	Depth (m)	Blows per 100mm	Blow Count	Torque (Nm)	Description	Legend	Backfill/ Instruments
+34.68	0.00	-			MADE GROUND: Light brown silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with medium cobble content. Cobbles are angular to subangular of brick and concrete (class 0/0). Samples - ES 0.20m, 0.50m, B 0.50m.		
		-					
		-					
+34.18	0.50	-			Openhole		
		-					
		-					
+33.68	1.00	-			Openhole		
		-					
		-					
		5			Openhole		
		7					
+33.18	1.50	19					
		45			Openhole		
		9					
		3					
+32.68	2.00	3			Openhole		
		1					
		1					
		0			Openhole		
		3					
+32.18	2.50	3					
		2			Openhole		
		10					
		9					
		13			Openhole		
+31.68	3.00	7					
		4			Openhole		
		2					
		1					
		1			Openhole		
+31.18	3.50	2					
		1			Openhole		
		1					
		2					
		2			Openhole		
+30.68	4.00	5					
		21			Openhole		
		24					
		10					
		7			Openhole		
+30.18	4.50	9					
		18			Openhole		
		50					

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 4.60m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPD3

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+32.25 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	04/08/2011	Coordinates	E 271875.39 N 196042.59
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			Chainage	

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+32.25	0.00	-							MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, mudstone and brick with low cobble content. Cobbles are angular of brick and sandstone (class 0/0). Samples - ES 0.50m, 0.80m, B 0.50m.		
		-									
		-									
		-									
+31.75	0.50	-									
		-									
		-									
		-									
+31.25	1.00	-									
		-									
		-									
		-									
		5							Openhole		
+30.75	1.50	1									
		0									
		0									
		0									
		1									
+30.25	2.00	1									
		1									
		2									
		2									
		2									
+29.75	2.50	4									
		4									
		5									
		4									
		5									
+29.25	3.00	5									
		6									
		6									
		5									
		6									
+28.75	3.50	5									
		6									
		4									
		6									
		6									
+28.25	4.00	8									
		10									
		10									
		42									
		50									
									End of Probehole at 4.30 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 4.30m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPD4

Sheet 1 of 1

Dynamic Probe Log



Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+45.69 mOD		
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50			Coordinates	E 271790.68		
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750	Date of Test	02/08/2011	National Grid	N 195880.93		
								Chainage			
Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/Instrument
			5	10	15	20	25				
+45.69	0.00	-							MADE GROUND: Brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional brick and concrete fragments with medium cobble content. Cobbles are angular of sandstone (class 0/0). Samples - ES 0.20m, 0.50m, B 0.50m.		
		-									
		-									
		-									
+45.19	0.50	-									
		-									
		-									
		-									
+44.69	1.00	-									
		-									
		-									
		3									
+44.19	1.50	3									
		6									
		8									
		5									
		2									
+43.69	2.00	7									
		6									
		8									
		9									
		13									
+43.19	2.50	10									
		18									
		12									
		12									
		16									
+42.69	3.00	31									
		26									
		18									
		28									
		31									
+42.19	3.50	42									
		50									

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+39.98 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	02/08/2011	Coordinates	E 271847.93
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			National Grid	N 195914.28
Chainage									

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+39.98	0.00	-							MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with medium cobble content. Cobbles are angular of sandstone and brick (class 0/0). Samples - ES 0.10m, 0.40m, B 0.50m.		
		-									
		-									
+39.48	0.50	-							Openhole		
		-									
		-									
+38.98	1.00	-							Openhole		
		-									
		-									
		2							Openhole		
+38.48	1.50	2									
		3									
		9							Openhole		
		12									
		17									
+37.98	2.00	18							Openhole		
		21									
		32									
		24							Openhole		
		36									
+37.48	2.50	29									
		41							Openhole		
		50									
									End of Probehole at 2.60 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 2.60m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPE2

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+43.76 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	02/08/2011	Coordinates	E 271833.01 N 195886.73
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			Chainage	

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+43.76	0.00	-							MADE GROUND: Brownish grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are angular of sandstone (class 0/0). Samples - ES 0.10m, 0.70m, B 0.50m.		
		-									
		-									
+43.26	0.50	-							Openhole		
		-									
		-									
+42.76	1.00	-									
		-									
		-									
		2									
		1									
		1									
+42.26	1.50	1									
		2									
		2									
		14									
		50									
									End of Probehole at 1.90 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 1.90m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPE3

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+40.62 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	02/08/2011	Coordinates	E 271880.08
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			National Grid	N 195911.54
Chainage									

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+40.62	0.00	-							MADE GROUND: Brownish grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with medium to high cobble content. Cobbles are angular of sandstone (class 0/0). Samples - ES 0.30m, 0.60m, B 0.50m.		
+40.12	0.50	-									
+39.62	1.00	-									
+39.12	1.50	4							Openhole		
+38.62	2.00	2									
+38.12	2.50	16									
+37.62	3.00	50							End of Probehole at 3.00 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.00m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPE4

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+41.23 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	02/08/2011	Coordinates	E 271881.10
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			National Grid	N 195901.77
Chainage									

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+41.23	0.00	-							MADE GROUND: Dark brown very silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with medium cobble content. Cobbles are angular of sandstone and brick (class 0/0). Samples - ES 0.20m, 0.50m, B 0.50m.		
		-									
		-									
		-							Openhole		
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-							End of Probehole at 2.80 m		
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									
		-									

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 2.80m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPE5

Sheet 1 of 1

PRELIMINARY Dynamic Probe Log



Soil Mechanics

Operator	DM	Probe Type	DPSH	Cone Diameter (mm)	50.5	Cone tip abandoned at (mBGL)	-	Ground Level	+39.81 mOD
Logged by	AH	Rod Diameter (mm)	35	Hammer Mass (kg)	63.50	Date of Test	03/08/2011	Coordinates	E 271927.13 N 195924.89
Checked by		Rod Mass (kg/m)	8	Fall Height (mm)	750			Chainage	

Level	Depth (m)	Blows per 100mm	Blow Count					Torque (Nm)	Description	Legend	Backfill/ Instruments
			5	10	15	20	25				
+39.81	0.00	-							MADE GROUND: Greyish brown silty sandy angular to subangular fine to coarse GRAVEL of brick, concrete and sandstone with low to medium cobble content. Cobbles are angular of concrete and brick (class 0/0). Samples - ES 0.20m, 0.50m, B 0.50m.		
		-									
		-									
+39.31	0.50	-							Openhole		
		-									
		-									
+38.81	1.00	-							Openhole		
		-									
		-									
		1							Openhole		
		2									
+38.31	1.50	1									
		1							Openhole		
		2									
		1									
+37.81	2.00	0							Openhole		
		1									
		1									
		3							Openhole		
		2									
+37.31	2.50	5									
		13							Openhole		
		21									
		15									
		13							Openhole		
+36.81	3.00	13									
		9									
		6							Openhole		
		13									
		36									
		50							End of Probehole at 3.40 m		

Remarks

Tested in accordance with BS 1377

Equipment, Methods and Comments

Competitor
Hand excavated pit G.L. - 1.20m. Super Heavy Dynamic Probe 1.20 - 3.40m. Terminated on refusal.
For Class see Atkins Scale of Aesthetic Criteria

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres.

Scale 1:25

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Project

Coed Darcy Urban Village, Junction 43 Improvements

Project No.

H1065-11

Carried out for

Dawnus Construction Ltd.

Exploratory Hole

DPE6

Sheet 1 of 1

GEOPHYSICAL SURVEY REPORT

Project

Investigation of former mine workings

Location

**Coed Darcy, Llandarcy
Swansea**

Client

Soil Mechanics

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Job reference: 3139

Date: October 2011

Version: 1

GEOPHYSICAL SURVEY REPORT

Project
Investigation of former mine workings

Location
**Coed Darcy, Llandarcy
Swansea**

Client
Soil Mechanics

Project geophysicist: A R Lewis BEng MSc _____

Reviewer: J Thomas PhD BSc FGS _____

Job Reference: 3139

Date: October 2011

TABLE OF CONTENTS

1	Introduction.....	4
1.1	Site/geological setting	4
1.2	Survey objectives	5
1.3	1.3 Survey design	5
2	Survey description	6
2.1	Data measurement layout / Topographic survey	6
2.2	Geometrics G-858 magnetometer survey (magnetic survey).....	6
2.2.1	Magnetic survey field activity.....	7
2.2.2	Magnetic survey data processing	7
2.3	Geophex Gem-2 electromagnetic survey	8
2.3.1	Gem-2 survey field activity	9
2.3.2	Gem-2 survey data processing.....	9
2.4	Ground Penetrating Radar (GPR)	9
2.4.1	GPR survey field activity.....	9
2.4.2	GPR survey data processing.....	10
2.5	Microgravity survey	11
2.5.1	Microgravity field activity.....	11
2.5.2	Microgravity data processing.....	12
3	SHAFT 2 - Results and Interpretation	14
3.1	Magnetic survey - ferrous metal detection (Figure 2).....	14
3.2	Electromagnetic survey - ground conductivity (Figure 2)	14
3.3	Ground Penetrating Radar survey (GPR) (Figure 3).....	15
3.4	Microgravity survey (Figure 3)	16
4	SHAFT 3 - Results and Interpretation	17
4.1	Magnetic survey - ferrous metal detection (Figure 4).....	17
4.2	Electromagnetic survey - ground conductivity (Figure 4)	17
4.3	Ground Penetrating Radar survey (GPR) (Figure 4).....	18
4.4	Microgravity survey (Figure 4)	19
5	CONCLUSIONS	19
5.1	SHAFT 2	19
5.2	SHAFT 3	20

Figures

- Figure 1 Location of geophysical surveys
 Figure 2 Magnetic and electromagnetic surveys SHAFT 2
 Figure 3 Microgravity and radar surveys SHAFT 2
 Figure 4 Magnetic, electromagnetic, microgravity and radar surveys SHAFT 3

Appendices

- Further information on survey techniques employed
 Gravity models

1 Introduction

This report describes a geophysical survey that was carried out in September and October 2011 at Coed Darcy, Llandarcy, Swansea at a site adjacent to M4 Junction 43. The survey work was commissioned by Soil Mechanics on behalf of Atkins. The aim of the survey was to investigate two former mine shafts identified by the Coal Authority to lie close to or within an area of new road construction.

1.1 Site/geological setting

The Client has requested a survey area of 40m x 40m or whatever may be practicable centred about the Coal Authority coordinates for the two shafts. Table 1 below summarises the Coal Authority information regarding the shafts under investigation.

Name of Colliery and Name and/or No. of Shaft	National Grid Coordinates	Comments
Cwrt-y-bettws No. 2 Shaft	272049E, 196099N	It is likely that this shaft was plugged and capped during 1995 with a reinforced concrete cap of dimension 6.2m x 4.2m x 0.5m
Cwrt-y-bettws No. 3 Shaft	328202E, 351887N	It is likely this shaft was infilled to an unknown specification during 1972

Table 1 - Details of the historical shafts under investigation

The surveyed areas are shown in Figure 1.

The survey area for Shaft 2 is relatively flat and amongst immature woodland forming a humus ground layer. The site is bounded by dense trees and shrubs to the west and a linear drain and steep bank rising to the M4 slip road, to the east.

The survey area for Shaft 3 is situated on the northbound carriageway of the B4290 approximately 50m from the M4 Jnc43 roundabout. The area is comprised of landscaped and engineered made ground with multiple services. The original ground level is unknown but may be as much as 4m below current ground level.

The site geology is believed to comprise approximately 4-5m of Superficial material overlying Coal Measures.

1.2 Survey objectives

The primary objective of the survey:

- Locate two mine shafts in area of new road layout to facilitate remedial engineering work

1.3 1.3 Survey design

Given the nature of the target under investigation, it was decided to adopt an integrated survey approach that was aimed at exploiting ground material variations within the shallow sub-surface, that may be associated with historic mine workings. The geophysical survey comprised of the following techniques:

- **Magnetic Survey (Geonics G-858)** – to map any buried ferrous metal that may be associated with historic mining machinery/structures or used as capping or backfill in a shaft.
- **Electromagnetic Survey (Geophex GEM-2)** – to map the ground conductivity variations in the near surface material across the site and characterise materials using the inphase component of the electromagnetic measurements. This survey technique can locate areas of historic mining activity by directly identifying a contrast between mined ground and natural ground, or buried mining machinery/structures and the surrounding ground. Or by secondary affects, for example reduced groundwater content due to the presence of a free draining shaft, or conversely a water tight cap causing poor ground drainage.
- **Ground Penetrating Radar (Mala Ramac 250MHz)** – to provide detailed time-slice plans in order to identify changes in ground type and buried structures/objects to a depth of ~3m below ground level.
- **Microgravity Survey (Scintrex CG-5)** – to measure relative variations in the Earths' gravity field that may be associated with the presence of mine shaft structures. Such variations relate to a contrast in material density between the shaft and the surrounding ground, such as a capped air filled shaft, unconsolidated backfill material in the shaft or loose ground material resulting from washed out material in to a nearby shaft.

2 Survey description

The survey was carried out measuring the following geophysical properties:

- Magnetometer (magnetic)
- Ground conductivity (electromagnetic)
- Ground Penetrating Radar (electromagnetic)
- Microgravity (gravity)

The geophysical data were acquired on a survey grid centred about the marked out survey coordinates for the two shaft locations.

The results are presented in the form of interpreted data plots indicating the location and physical characteristics of subsurface anomalous zones together with a text description. Background information for each of the survey methods is provided in the appendices and descriptions of the actual survey work carried out on site are provided in the sections below.

2.1 Data measurement layout / Topographic survey

The magnetic and electromagnetic datasets were acquired in 'walking' mode on an orthogonal grid marked out using a Topcon GPT7003i EDM. Shaft 2 area was situated in woodland where no GPS signal could be established and therefore a marked rope was used to locate the measurements along the survey lines. The Shaft 3 area was open and a Trimble ProXT DGPS system was used to locate the instrument readings.

The GPR survey was acquired along 1m spaced survey lines on the same grid as the magnetic and electromagnetic datasets

The microgravity survey was acquired on a 2m staggered grid using the same grid layout used for the other survey techniques. A survey area of approximately 18m x 18m was acquired and centred about the marked out shaft locations.

2.2 Geometrics G-858 magnetometer survey (magnetic survey)

The magnetic survey technique is based on mapping localised variations in the Earth's magnetic field caused sub-surface magnetic materials, which range from naturally occurring

magnetic minerals to man-made ferrous objects. Data are acquired on a grid covering the area of interest and a contoured plan of the variation in ferrous material across the site is produced.



Plate 1 – G858 Magnetic Gradiometer (library photograph)

2.2.1 Magnetic survey field activity

A *GEOMETRICS G858* magnetic gradiometer (Plate 1) was used to acquire total magnetic field data along a series of 2m spaced parallel survey lines. Readings along the survey lines were taken at approximately 0.2m intervals and positioned using either a marker rope or a GPS NMEA string from a Trimble ProXT DGPS system.

The Shaft 2 area was under immature woodland and constrained in a west-east direction by dense vegetation and a steep bank respectively. The accessible survey area was therefore approximately 40m x 20m.

The Shaft 3 area had to be surveyed at night due to road traffic obstructions and noise with a traffic management system in place. The survey area comprised of road verges, pavement and a dual carriageway tarmac road with numerous road signs and lamp posts.

2.2.2 Magnetic survey data processing

The magnetic data is downloaded from the data logger and compiled using dedicated software *MagMap2000*. Initial editing is then carried out to remove positional errors and rogue values. The data is then exported as a 'xyz' file and if required, translated to the appropriate coordinate system. The next step is to bring the data into *OASIS MONTAJ*,

where it can be edited and manipulated to enhance any features of interest. The colour contour plots are then integrated with the base plan information and the resulting plans are exported to CORELDRAW for final annotation.

2.3 Geophex Gem-2 electromagnetic survey

A Gem-2 ground conductivity survey involves transmitting multiple electromagnetic frequencies into the subsurface and then recording the returning signals via a receiver in the same instrument (Plate 2).

Data acquired over the survey area is colour contoured to produce a plan of the variation in ground conductivity across the site. The presence of conductive materials in the subsurface such as clay, water, ash or metal (cultural noise) will be evident as regions of high values on the ground conductivity plan, while materials such as coarse grained sediments and dry zones will appear as regions of low values. A description of the field activity is provided below and some background information on the survey methods can be found in the Appendix.

The instrument was configured to transmit five frequencies effectively investigating different depth ranges from approximately 0-7m bgl. The actual depth of investigation is a function of the selected frequency and resistivity of the underlying geology. Deeper frequencies tend to suffer from a high signal-to-noise ratio making the results uninterruptible. In practical terms a particular frequency is used for interpretation that most clearly shows subsurface responses.



Plate 2 - Geophex GEM-2 with Trimble DGPS positioning (library picture)

2.3.1 Gem-2 survey field activity

The Gem-2 ground conductivity data was acquired along the same 2m spaced parallel survey lines as the magnetic survey described in section 2.2.1. Readings along the survey lines were taken at approximately 0.2m intervals and positioned using a marker rope or a GPS NMEA string from a Trimble ProXT DGPS system.

2.3.2 Gem-2 survey data processing

The data is downloaded from the data logger and compiled using dedicated software *WINGEM v3*. Initial editing is then carried out to remove positional errors and rogue values. The data is then exported as a 'xyz' file and if required, translated to the appropriate coordinate system. The next step is to bring the data into *OASIS MONTAJ*, where it can be edited and manipulated to enhance any features of interest. The colour contour plots are then integrated with the base plan information and the resulting plans are exported to *CORELDRAW* for final annotation.

2.4 Ground Penetrating Radar (GPR)

A Ground Penetrating Radar (GPR) survey involves the transmission of a pulsed electromagnetic (radio) wave and the recording of any returning reflection events. Readings can either be taken as the radar unit is towed continuously or at closely spaced intervals along the selected traverse line. The transmitted waves are focused into the ground and can penetrate soils, rock, concrete, and many other natural and man-made materials. Given a sufficient contrast, reflection events from geological or hydrological boundaries can be observed together with 'point' sources such as buried services, rebar, voids and large boulders.

2.4.1 GPR survey field activity

A *MALA RAMAC* radar system with shielded 250MHz antennae in a cart was used to acquire the radar data in both survey areas on parallel 1m spaced profile lines marked out on a local grid and later translated to OS coordinates for presentation (Plate 3).

In the Shaft 2 area survey lines were acquired in one direction from west to east starting at the same baseline and continuing as far as possible before meeting an obstruction.

In the Shaft 3 area survey lines were acquired in one direction from south to north along the road carriageway to enable the radar cart to stay on the same ground surface type as much as possible for optimised data quality.

2.4.2 GPR survey data processing

The data processing was carried out using GPR Slice v7 software. Each radargram is first processed with an appropriate gain function to enhance features of interest and increase the signal from weak responses at depth. The radargram is then 'time zero' corrected to allow a depth conversion to be calculated using a nominal velocity of 0.1m/nanosecond that is usually suitable for made ground conditions. Additional processing routines (e.g. background removal, deconvolution, FK filtering, migration etc) may be applied to improve the coherency of the reflection events and remove any multiple reflections and diffractions. The radargrams are then resampled to provide same size data blocks that can be gridded using a squared amplitude function to produce a 3D block of radar signal response. This block is then time sliced to produce interpretable depth slices between 15 and 20cm thick. All the depth slices are analysed and then specific slices showing significant features and anomalies are used for the interpretation plots. The final depth slice plots are exported to CorelDraw for annotation and presentation.



Plate 3 – MALA RAMAC 250MHz GPR cart system (library photograph)

2.5 Microgravity survey

The density contrast between different Earth materials provides a useful means for mapping subsurface structures through measurement of associated localised variation in the Earth's gravitational field. The presence of an anomalously high (or low) density body in the subsurface causes a localised high (or low) anomaly in the measured gravitational field. The gravity effects described are extremely small, however, modern instrumentation and exhaustive data processing techniques enable detection of geological and artificial structures relevant to the engineering and groundwater industries.

An increase in both the size of a body and the density contrast with its host material proportionally increases its detectability using gravitational methods. However, there is a reduction in both spatial resolution and detectability with increased depth of burial. Typical targets for a microgravity survey include historic mine shafts and shallow adits, buried channels, solution features, voiding, vertical structures, geological lineations and groundwater movement through monitoring with time.

One of the main advantages of the Scintrex CG-5 is that it enables statistical averaging and filtering of readings taken every second over a fixed period of time (typically 1-3 minutes) thereby significantly reducing low level noise from wind, seismic activity and nearby traffic.

A description of the field activity is provided below and some background information on the survey method is found in the appendix.

2.5.1 Microgravity field activity

The microgravity surveys were acquired using TerraDat's high precision *Scintrex CG-5* instrument (Plate 4). Gravity measurements were taken on a staggered parallel line grid with 2m spacing between stations. Both gravity grids were centred on the marked out coordinates obtained from the Coal Authority report. Acquisition in The Shaft 2 area was compromised by soft and uneven ground conditions and constrained by trees to the west and the steep bank up to the motorway slipway to the east. Acquisition in The Shaft 3 area was achieved at night using traffic management to enable readings to be made within the carriageways.

2.5.2 Microgravity data processing

In order to remove (reduce) background gravitational effects *i.e.* those that do not originate from the target features, the following processing steps were applied to the acquired dataset using a combination of internal CG-5 software and TerraDat proprietary software *GRED*.

Earth Tide, Temperature & Tilt Correction: applied automatically by the gravity meter software.

Un-modelled Temporal Residual Correction: obtained by least-squares fitting of a polynomial through the base station readings for each day. The Bouguer Anomaly dataset for each day was set to zero using this base station.

Latitude Correction: calculated on the basis of latitude 51.6 degrees north and due to the small latitude extent of the survey gird, it is assumed to be linear.

Free-air Correction: applied to the dataset based on the instrument elevations, which were recorded to a 1 μ Gal precision (<0.3cm error) using an EDM survey system.

Bouguer Correction: A reduction density of 1.7g/cm³ was chosen for the Bouguer correction after considering the general geology of the site.

Terrain Corrections: based on the measured ground level at each gravity station.

Detrending: A linear detrend was applied to the Bouguer anomaly results to remove long wavelength terrain and deep geological effects that mask subtle features. The detrended data highlights local density variations.

By modifying the contours/colour scale, the resulting gravity plot is enhanced to show subsurface density variations within the survey area.



Plate 4 – Scintrex CG-5 gravity meter being used in Shaft 2 area

3 SHAFT 2 - Results and Interpretation

The results of the geophysical surveys for Shaft 2 area are presented as a series of colour contour plots in Figures 2 and 3.

3.1 Magnetic survey - ferrous metal detection (Figure 2)

The magnetometer survey results are presented as a colour contoured plot showing the analytical signal response. The analytical signal plot indicates the source positions of dipole type magnetic anomalies. Generally the interpretation of a magnetic anomaly is based on observing the type (pole/dipole), amplitude and wavelength of the anomalous features.

Two zones of relatively extreme response can be seen on the western side of the survey area that are of unknown origin. These may be associated with historic remnant structures or made ground.

Isolated magnetic anomalies can be seen close to the suspected shaft location that correlate with zones of low ground conductivity and high gravity. This indicates the presence of material of different composition to the surrounding area such as backfill material or possible concrete capping material.

3.2 Electromagnetic survey - ground conductivity (Figure 2)

Following a review of all the Gem-2 electromagnetic data, it was decided to consider the ground conductivity response from the highest of the five frequencies of the instrument (40,075Hz), as this provided the greatest resolution whilst still identifying all significant variations in response. Table 1 shows typical responses to different geological materials.

A relative increase in conductivity values usually indicates a localised increase in the clay content or groundwater saturation. However, an increase in conductivity may also occur if there is ash, metalliferous slag and/or metal present within the range of the instrument. Extreme fluctuations in conductivity values is usually indicative of instrument 'overload' (very high or negative readings) due to nearby metal structures/ debris and usually correlates with high inphase response (sensitive to the influence of cultural noise), at the same location.

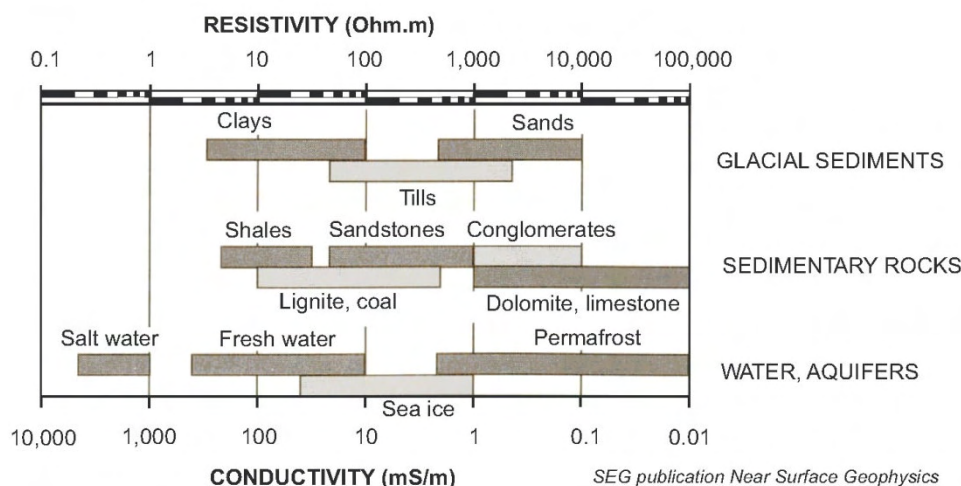


Table 1- A simplified relationship between conductivity/resistivity and geological setting

The survey has identified a relatively very high conductive area along the west edge of the survey grid as well as a zone in the north. These indicate a change in ground material composition to wetter and/or more clayey material, or may be associated with remnant structures containing metalliferous material.

A broad zone of elevated response can be seen in the middle of the survey area also indicating a change in material composition of unknown origin. Between here and the very high response to the west an apparent linear feature can be seen of low resistivity material. This is indicative of a path/track or tramway type feature that may have been related to the historical mining activity.

Isolated zones of decreased conductivity can be seen on the east side of the survey area, close to the given Shaft 2 location that correlate with isolated magnetic anomalies. These zones indicate a decreased water/clay content that can be related to preferentially drained ground in close proximity to voids.

3.3 Ground Penetrating Radar survey (GPR) (Figure 3)

The GPR technique was carried out with the aim of obtaining radar data across the entire ground surface within the survey area using a 250MHz antennae to acquire data to an approximate depth of 3m bgl. All the radar data was combined in to a 3D block and processed to emphasize features of interest. The results are presented as two selected depth slices used for interpretation, one relatively shallow (0.68m-0.82m bgl) and one deeper (2.14m-2.28m bgl).

The shallow depth slice has been selected as it appears to show an isolated linear feature in the north of the survey area that is indicative of a buried service or structure. Two groups of isolated radar anomalies can also be seen, one of which is a high response that correlates with an isolated magnetic anomaly and a zone of decreased ground conductivity as discussed in the previous sections.

The deeper depth slice shows numerous scattered anomalies that are indicative of made ground, however a broad zone of response in the north of the survey area indicates a bulk change in ground character that may be indicative of a remnant structure related to historic mining activity.

No geometric radar response within the range of the instrument has been measured that would suggest a concrete cap.

3.4 Microgravity survey (Figure 3)

The results of the microgravity are presented as a colour contour plot of the Bouguer Anomaly at a reduction density of 1.7g/cm^3 in Figure 3. This reduction density was used as it is representative of the Superficial material comprising the shallow geology in the area. For the untrained observer, the Bouguer Anomaly plot may be considered as a map of the variation in ground density targeting up to a maximum of 10m below ground level. For a given gravity feature or anomaly, its interpretation is based on observing its shape, amplitude and wavelength. Examples of gravity responses to different targets can be seen in the Appendices.

The most significant feature of the microgravity survey is a zone of relatively high ground density north of the given shaft location. The area of this anomaly is approximately the same proportion as the suspected concrete cap (6m x 4m) and may be indicative of this relatively high density material.

Another smaller high density zone can be seen to the east of the given shaft location that correlates with a radar anomaly and suggesting buried man made material.

Immediately south of the given shaft location the gravity survey shows a zone of lower density ground material that leads in from the east edge of the survey area. It is not indicative of an isolated mine shaft anomaly but could still be as a result of historical mine workings.

4 SHAFT 3 - Results and Interpretation

4.1 Magnetic survey - ferrous metal detection (Figure 4)

The magnetometer survey results are presented as a colour contoured plot showing the analytical signal response. The analytical signal plot indicates the source positions of dipole type magnetic anomalies. Generally the interpretation of a magnetic anomaly is based on observing the type (pole/dipole), amplitude and wavelength of the anomalous features.

The survey results show numerous scattered magnetic anomalies throughout the survey area that are probably associated with the road construction material or services. The larger anomaly on the northeast edge of the survey area has been caused by the Armco road barrier. There are minor isolated anomalies in the vicinity of the given Shaft 3 location, but their size and distribution are not indicative of a buried mine structure.

A relatively large isolated magnetic anomaly can be seen next to the wooden fence in the north of the survey area, centred at (272021E, 196024N). This feature correlates with high responses in the electromagnetic and radar surveys indicating the presence of a buried ferrous object or structure in the shallow subsurface.

4.2 Electromagnetic survey - ground conductivity (Figure 4)

Following a review of all the Gem-2 electromagnetic data, it was decided to consider the in-phase response from the highest of the five frequencies of the instrument (40,075Hz), as this provided the most information in identifying significant variations in response relating to man made ground. The ground conductivity survey showed large areas of conductivity variation across the site and did not aid in the investigation.

A relative increase in conductivity values usually indicates a localised increase in the clay content or groundwater saturation. However an increase in conductivity may also occur if there is ash, metalliferous slag and/or metal present within the range of the instrument. Extreme fluctuations in conductivity values is usually indicative of instrument 'overload' (very high or negative readings) due to nearby metal structures/ debris and usually correlates with high inphase response (sensitive to the influence of cultural noise), at the same location.

The in-phase results show extreme responses from known surface metal features in the northeast of the survey area, namely a road sign and the Armco barrier which has caused the instrument to overload (blue colours). However a zone of extreme response can be seen north of the fence that correlates with the magnetic and radar anomalies to indicate a buried object or structure.

Minor changes in response across the site show the non homogeneity of the subsurface associated with the site construction that may comprise up to 2m or more of made ground.

The presence of a gas pipe trench can be seen in the west of the survey area as a low response linear feature.

No anomalous features are present in the vicinity of the given mine shaft location.

4.3 Ground Penetrating Radar survey (GPR) (Figure 4)

The GPR technique was carried out with the aim of obtaining radar data across the entire ground surface where practicable using a 250MHz antennae to acquire data to an approximate depth of 3m bgl. The radar lines were not acquired on the road islands as the data quality would be insufficient for analysis. All the radar data was combined in to a 3D block and processed to emphasize features of interest. The results are presented as a selected depth slice (2.35m-2.5m bgl) used for interpretation that shows all significant features. It should be noted that some surface features cause a 'multiple' response that is seen through the full depth of the radargram and therefore appears in all depth slices.

The depth slice shows an extreme response north of the fence that correlates with the magnetic and radar anomalies to indicate a buried object or structure at approximately 2m bgl.

The radar depth slice also shows some anomalies in the road indicating changes in material character beneath the road surface. These can be seen in the vicinity of the given mine shaft location and may warrant further investigation as possible wash-out zones of missing sediment associated with void space.

4.4 Microgravity survey (Figure 4)

The results of the microgravity are presented as a colour contour plot of the Bouguer Anomaly at a reduction density of 1.7g/cm^3 in Figure 4. This reduction density was used as it is representative of the Superficial material comprising the shallow geology in the area. For the untrained observer, the Bouguer Anomaly plot may be considered as a map of the variation in ground density targeting up to a maximum of 10m below ground level. For a given gravity feature or anomaly, its interpretation is based on observing its shape, amplitude and wavelength. Examples of gravity responses to different targets can be seen in the Appendices.

The most significant feature of the microgravity survey is a zone of relatively low ground density northwest of the given shaft location in the vicinity of the most significant magnetic, electromagnetic and radar anomalies. It is of particular interest as it is an isolated feature indicating a change in ground density unique to that location. The anomaly is situated off the road and on the vegetated verge. It may be associated with a shaft type causative body directly or may be an artefact of unconsolidated made ground which in turn may be associated with loss of material to a void space.

It can be seen that the road carriageway itself is a region of generally high gravity, high density ground. A small, subtle gravity low anomaly can be seen immediately west of the given shaft location, and is in a zone of changing material character as identified by the radar survey. It is too small to be indicative of a mine shaft but may be associated with loose material as a result of material loss in to void space.

5 CONCLUSIONS

5.1 SHAFT 2

The Shaft 2 surveys show several anomalies of interest. Large zones and features of magnetic, electromagnetic and radar response may warrant further investigation to ascertain their causative effect. Of particular interest are the isolated magnetic, electromagnetic and radar anomalies at north of the given shaft location.

The gravity survey shows several regions of ground with anomalous densities. Of particular significance is the gravity high zone to the north of given shaft location that correlates with the isolated magnetic anomalies discussed above, and may warrant further investigation as

possible concrete capping material. The low density ground immediately to the south of given shaft location may also warrant further investigation to establish the cause for this anomaly. A slip trench located from the gravity low zone at (272050E, 196096N) to the west edge of the grid at (272038E, 196101N) would intercept and ground truth numerous anomalies.

5.2 SHAFT 3

The Shaft 3 area surveys all show an anomalous area in the north of the survey grid located on the road verge either side of the wooden fence. This area warrants further investigation to ground truth the cause of these anomalies.

A subtle gravity and radar anomaly immediately west of the given shaft location (272025.5E, 196011.5N) may also warrant further investigation to ground truth the reason for the change in ground character at this location.

Disclaimer

This report represents an opinionated interpretation of the geophysical data. It is intended for guidance with follow-up invasive investigation. Features that do not produce measurable geophysical anomalies or are hidden by other features may remain undetected. Geophysical surveys compliment invasive/destructive methods and provide a tool for investigating the subsurface; they do not produce data that can be taken to represent all of the ground conditions found within the surveyed area. Areas that have not been surveyed due to obstructed access or any other reason are excluded from the interpretation.

FI RES

KEY



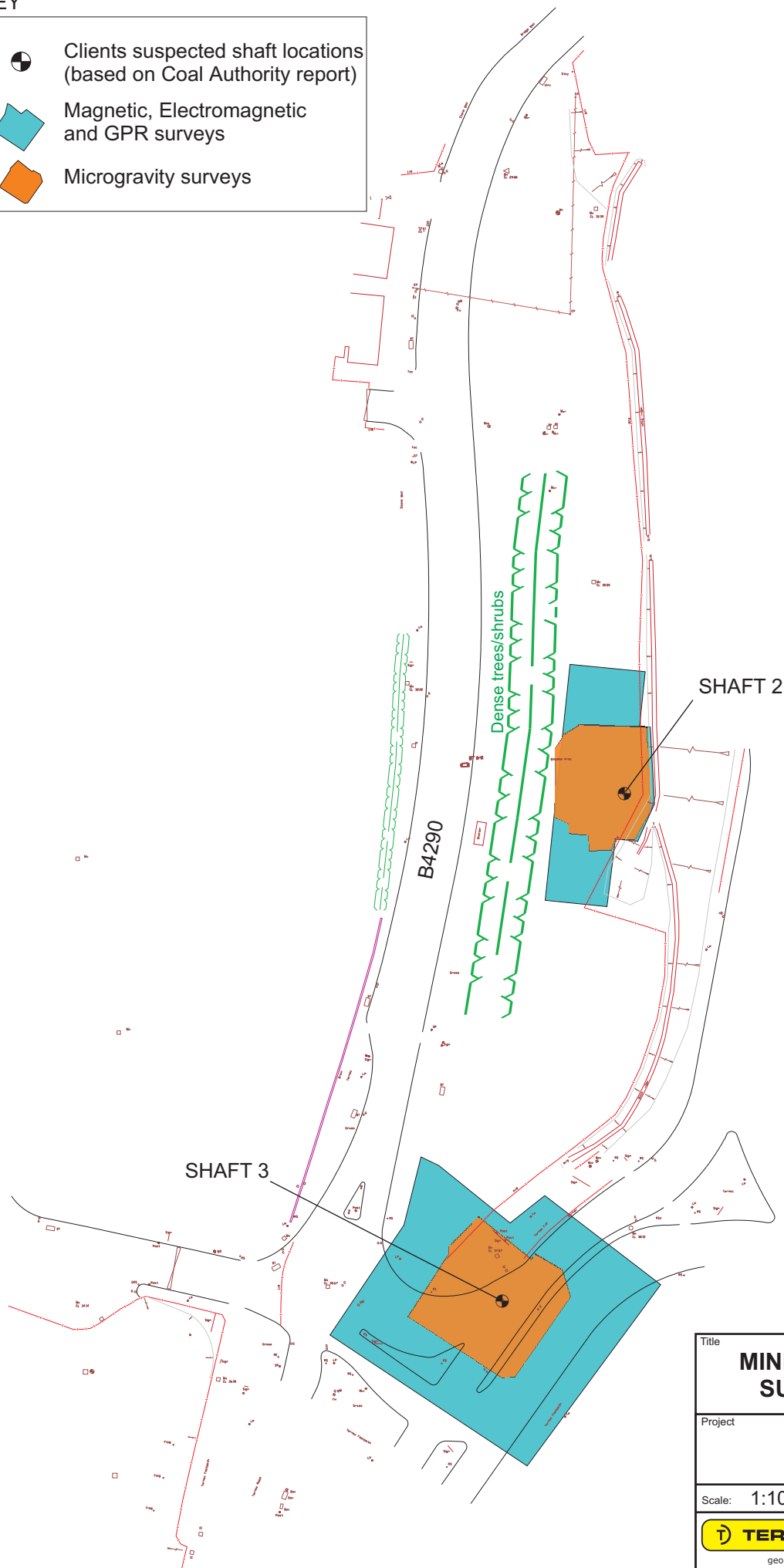
Clients suspected shaft locations
(based on Coal Authority report)



Magnetic, Electromagnetic
and GPR surveys



Microgravity surveys



Title

**MINESHAFT DETECTION
SURVEY LOCATIONS**

Project

**COED DARCY
LLANDARCY**

Scale: 1:1000 at A4

Drawn by/Ref: AL/3139



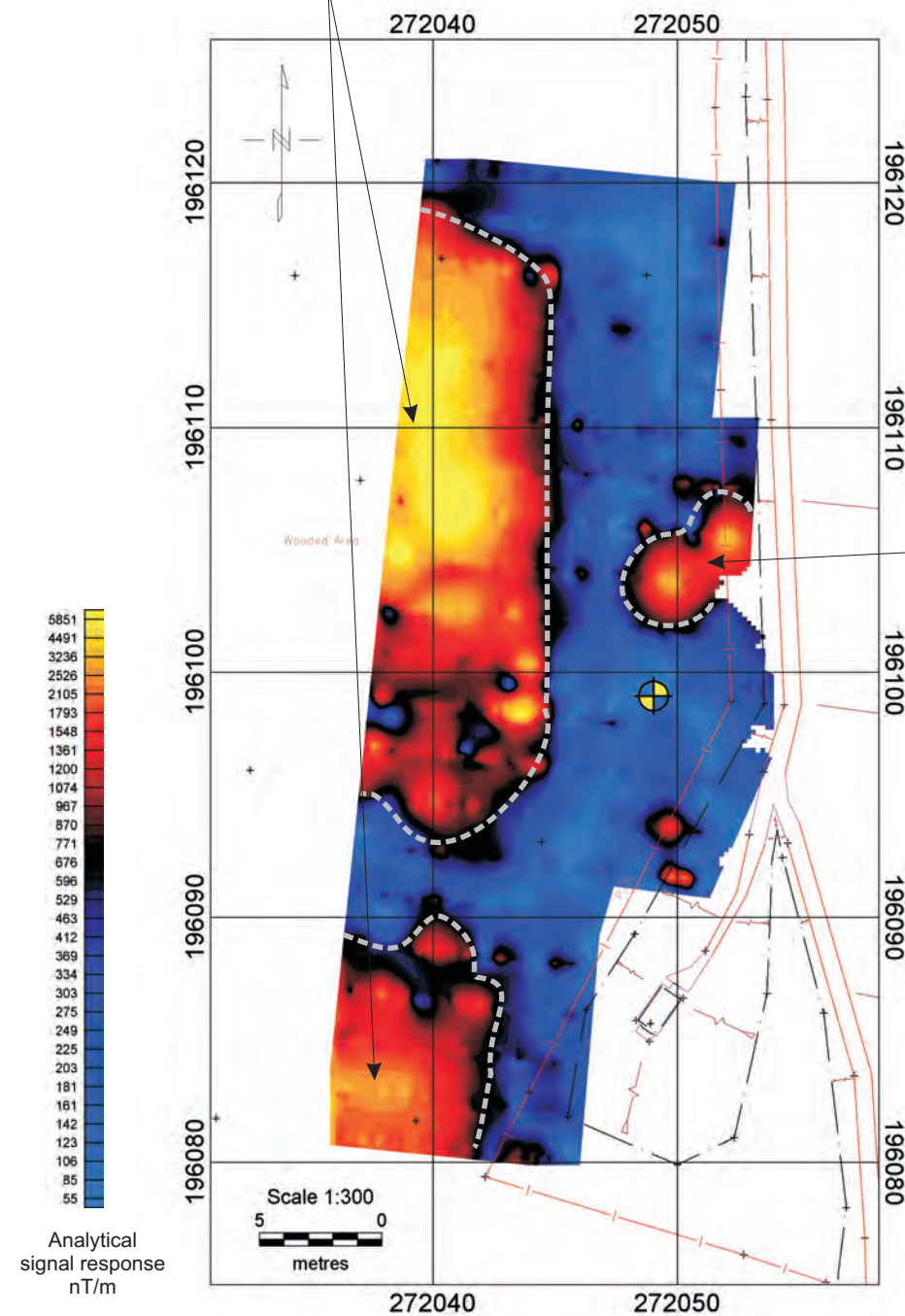
Date: October 2011

Tel: +44 (0) 8707 303050

Figure 1

MAGNETOMETRY SURVEY FERROUS METAL DETECTION

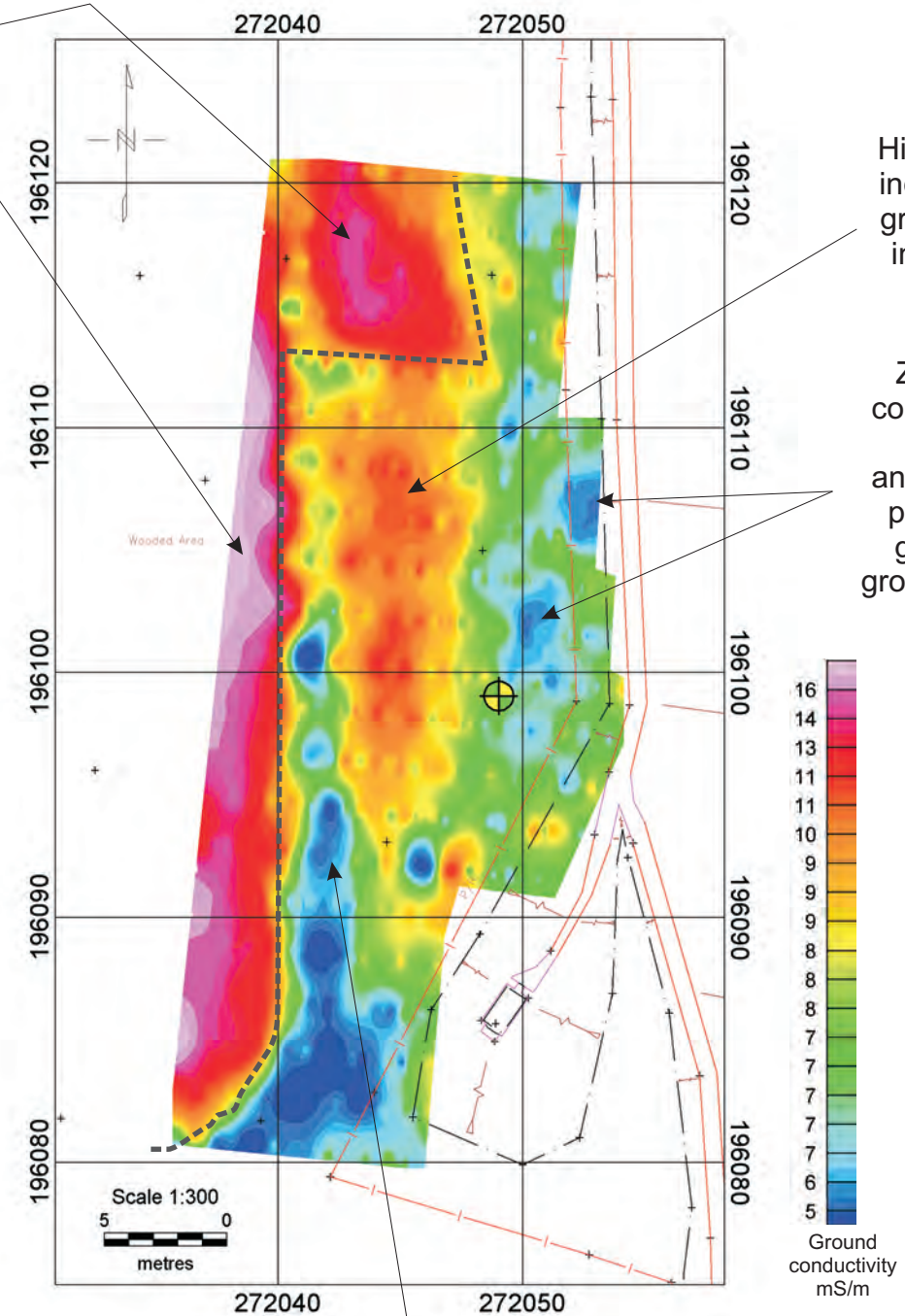
Broad zones of elevated response may indicate the presence of buried structures or areas of buried ferrous material



Zones of high conductivity - may be indicative of a buried remnant structure or change of ground material composition

Isolated magnetic anomaly close to suspected shaft location indicating buried ferrous material. May be of significance as capping or backfill material

ELECTROMAGNETIC SURVEY GROUND CONDUCTIVITY SURVEY



Linear low conductivity feature - possible buried structure/service



Clients suspected shaft location
(based on Coal Authority report)

Title MINESHAFT DETECTION SURVEYS FOR SHAFT 2	
Project COED DARCY LLANDARCY	
Scale: 1:300 at A3	Drawn by/Ref: CB/3139
TERRA DAT geophysical innovation	Date: October 2011
Tel: +44 (0) 8707 303050	
Figure 2	

MICRO-GRAVITY SURVEY

GROUND PENETRATING RADAR SURVEY

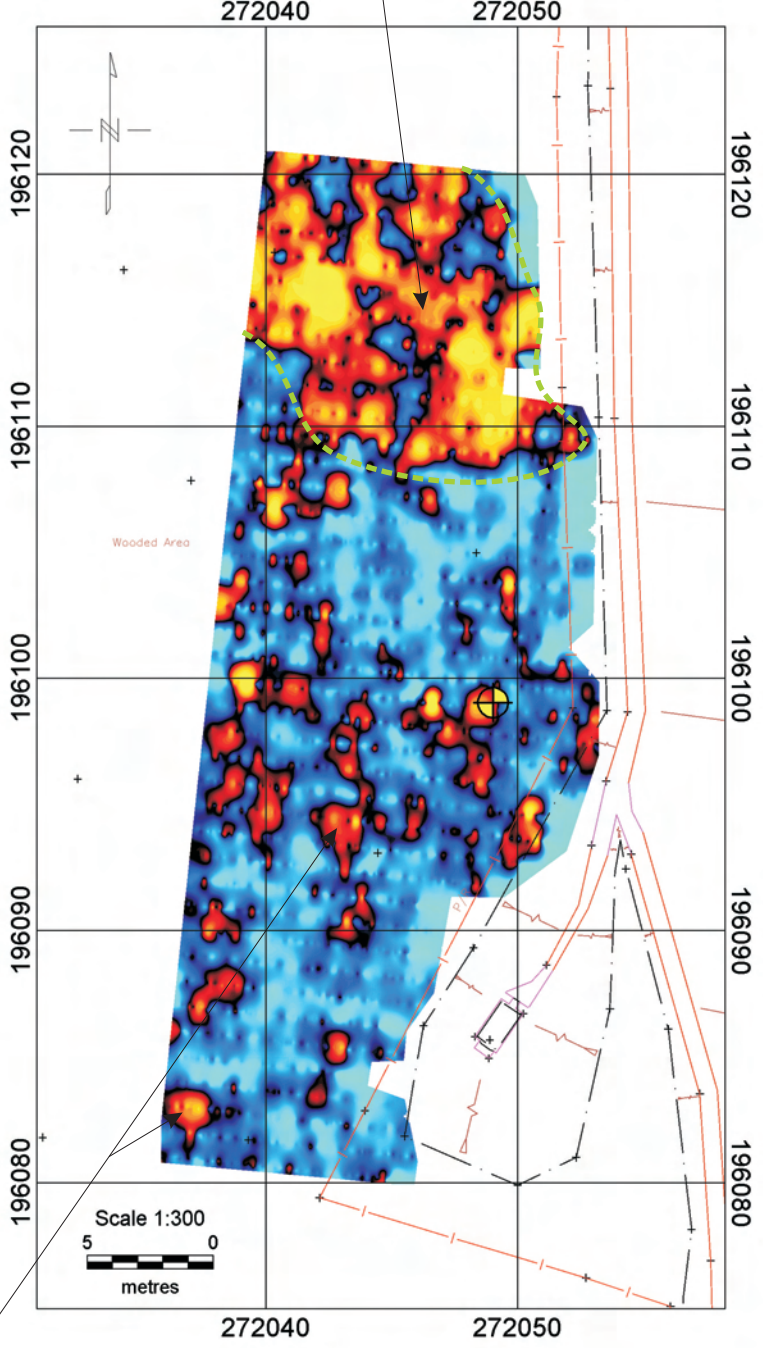
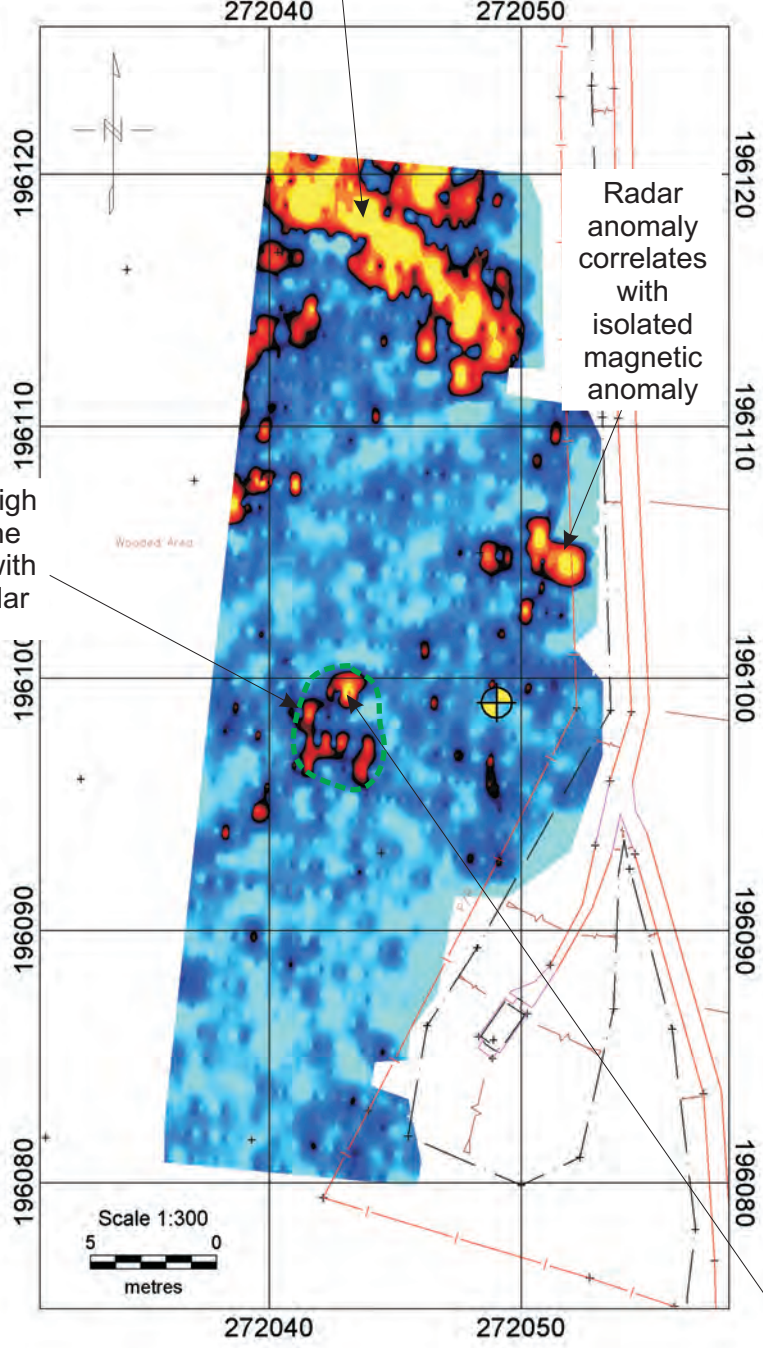
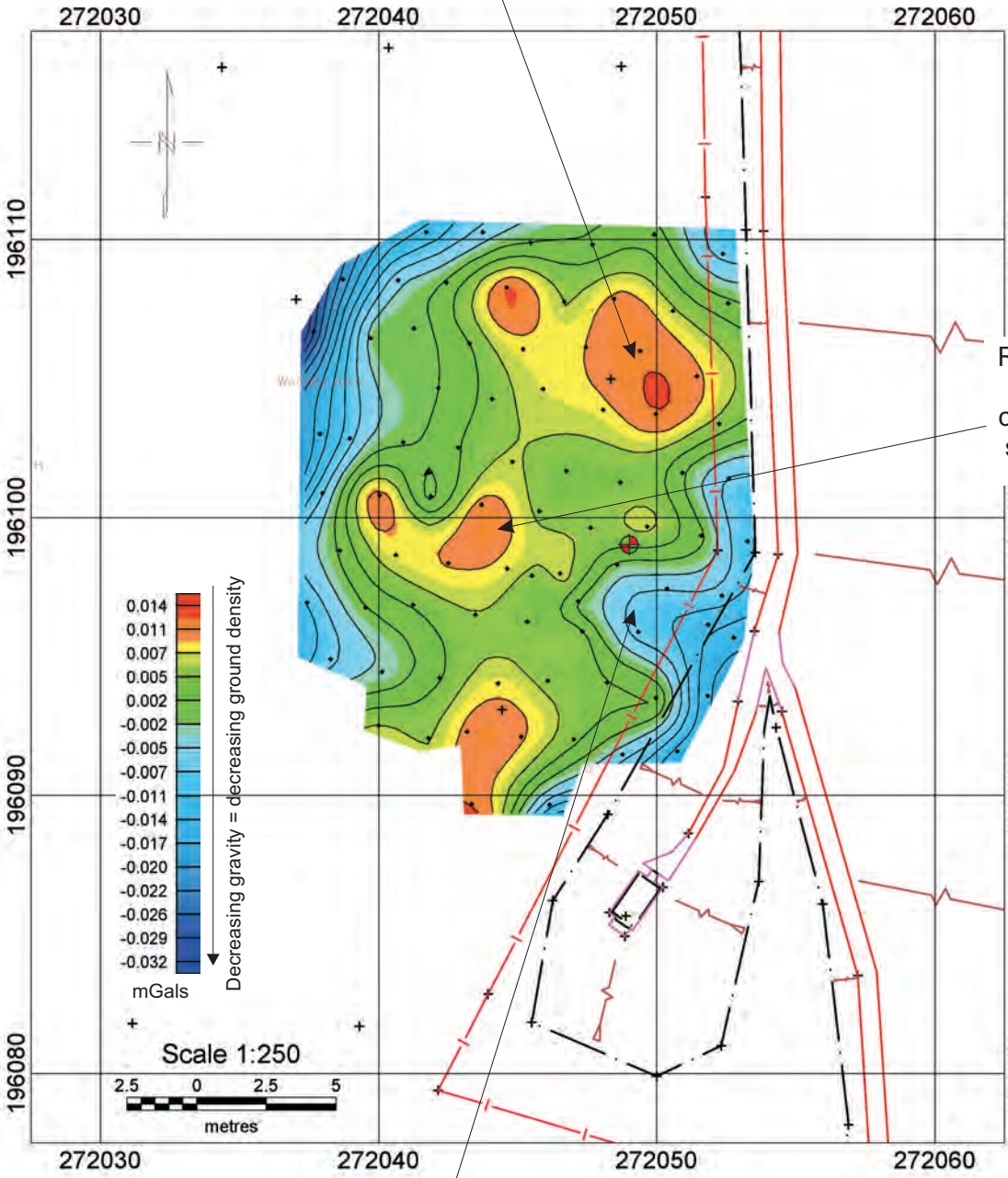
Shallow depth slice - (0.68-0.82m bgl)

Deep depth slice - (2.14-2.28m bgl)

Relatively high gravity zone - may be associated with concrete cap
Highest gravity area correlates with isolated magnetic anomaly and shallow radar anomaly

High radar response
Apparent linear feature

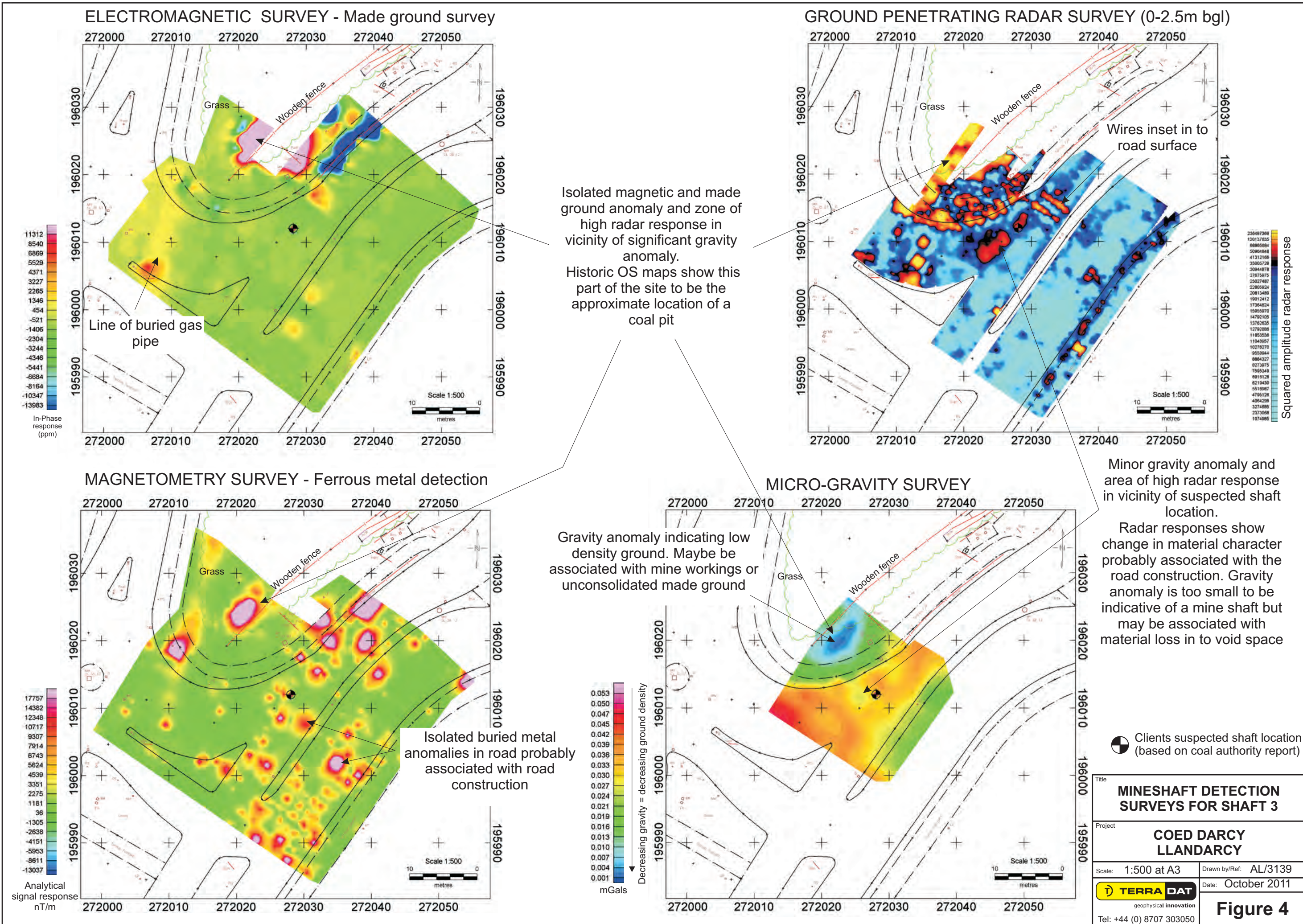
Broad zone of high radar responses indicates change in ground composition may indicate remnant structures



Clients suspected shaft location (based on Coal Authority report)

Title MINESHAFT DETECTION SURVEYS FOR SHAFT 2	
Project COED DARCY LLANDARCY	
Scale: as indicated	Drawn by/Ref: AL/3139
TERRA DAT geophysical innovation	Date: October 2011
Tel: +44 (0) 8707 303050	

Figure 3



A E ICES

Appendix - Magnetic Survey

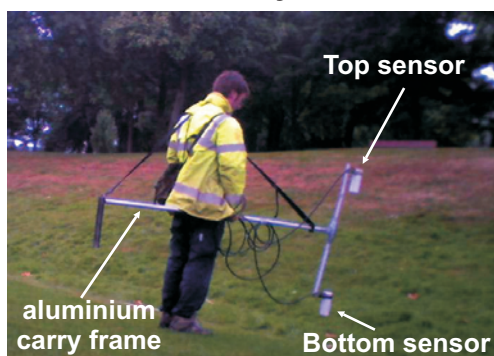
The Magnetic survey technique is based on mapping localised variations in the Earth's magnetic field caused by sub-surface magnetic materials, which range from naturally occurring magnetic minerals to man-made ferrous objects. This leads to a wide range of applications from small-scale archaeology and engineering surveys to detect buried metallic objects, to large-scale surveys carried out to investigate regional geological trends or mineralisation.

Magnetic surveys are carried out using a man-portable instrument with readings taken on a regular grid or along selected traverse lines. The equipment functions by measuring the Earth's magnetic field to a very high precision at each survey station. Ferrous materials in the subsurface have an induced magnetic field that is superimposed on the Earth's field at that location creating a magnetic anomaly. The spacing of survey stations depends on the width of the expected anomaly, which broadens with the size, and depth of burial of the targeted feature. Continuous profiling methods may be used for a high-resolution dataset.

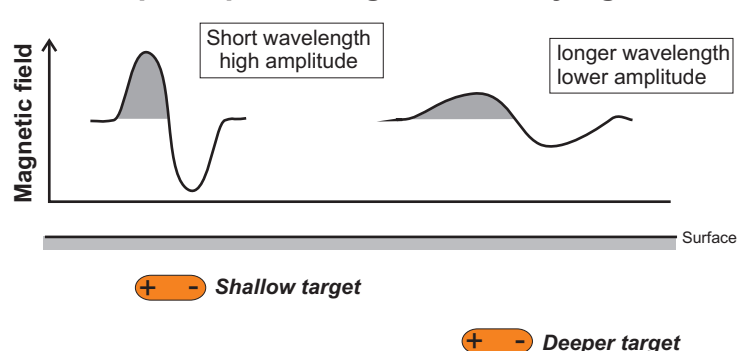
Magnetometer data are stored digitally by the survey instrument and downloaded to a field computer at the end of each day. The magnetic data are then processed to enhance any identifiable anomalies and presented on colour-contoured plots overlain with site maps (when available).

The results of the magnetic survey are usually presented as total field and analytical signal plots. The total field data may be used to observe the general character of the magnetic field across the survey area while the peak values (pink) displayed on the analytical signal plot indicate the source positions for dipole type magnetic anomalies. In general terms, the interpretation of a magnetic anomaly is based on observing the type (pole/dipole), amplitude and wavelength of the anomalous features.

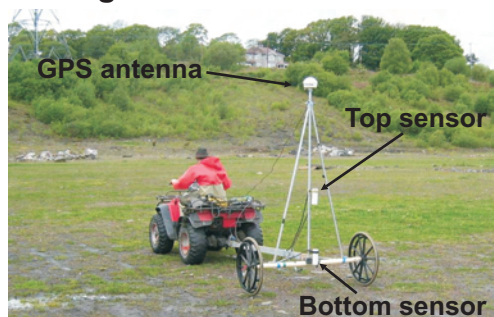
Gradiometer survey



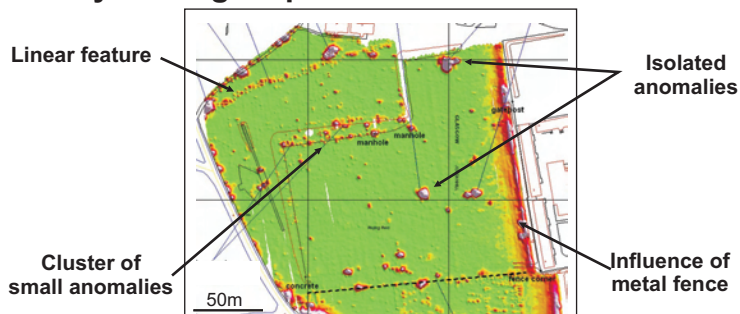
General principle of Magnetic surveying



Towed gradiometer with dGPS



Analytical signal plot



Constraints

Metal objects or structures close to the survey area (fences, vehicles, debris etc.) produce a strong signal that can overshadow more subtle effects of sub-surface anomalies.

Appendix - Electromagnetic Survey

The electromagnetic (EM) technique involves the generation of an EM field at the surface and measuring the response of the ground as it propagates into the subsurface. The main components of an EM survey instrument are a transmitter (for the generation of primary field) and receiver (for measuring the induced secondary field). The instrument functions by inducing current into the ground via a transmitter coil which causes the generation of secondary electromagnetic fields in any ground conductors present within the depth range of the particular instrument. These secondary fields are measured at a receiver coil and the instrument can record ground conductivity and in-phase component (metal indicator) at each survey station.

Electromagnetic (EM) surveys are carried out using man-portable instruments with readings taken on a regular grid or along selected traverse lines. If site conditions permit, the EM instrument may be mounted/towed behind a quad bike and positional control is provided by dGPS. The selection of the particular EM instrument (GEM2/EM-38/EM-31/EM-34) is based on the required penetration depth of the survey.

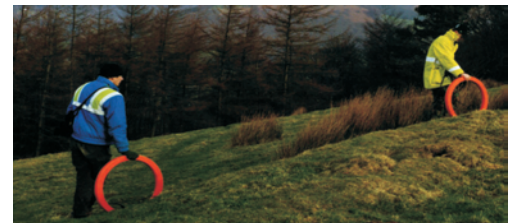
The results from the EM survey can be presented as colour contoured plots of conductivity and inphase (metal response) data. In general terms, a relative increase in conductivity values usually indicates a local increase in clay content or water saturation. However, if there is a corresponding increase in the inphase response, the influence of some artificial source is likely (i.e. metal).



EM-38
(Exploration depth ~1.5m)

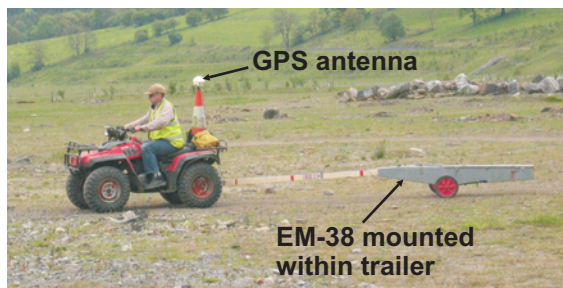


EM-31
(Exploration depth ~3 to 5m)

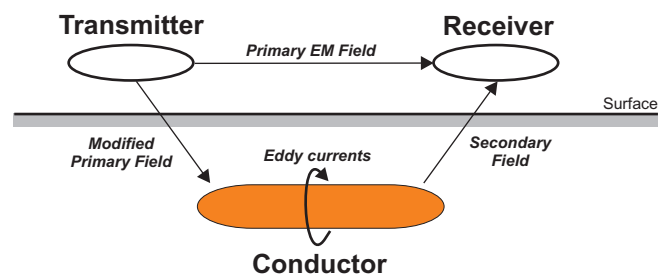


EM-34
(Exploration depth ~7.5 to 60m)

Towed EM-38 with dGPS



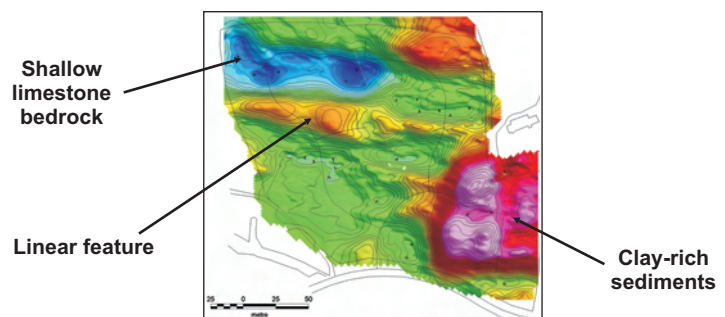
General principle of EM surveying



Mounted EM-31 with dGPS



Conductivity data plot



At the end of the survey, the data are downloaded to a field computer and corrected for instrument, diurnal and positional shifts. Additional editing may be carried out to remove non-essential or 'noisy' data values/positions. The dataset is then processed to enhance any identifiable anomalies.

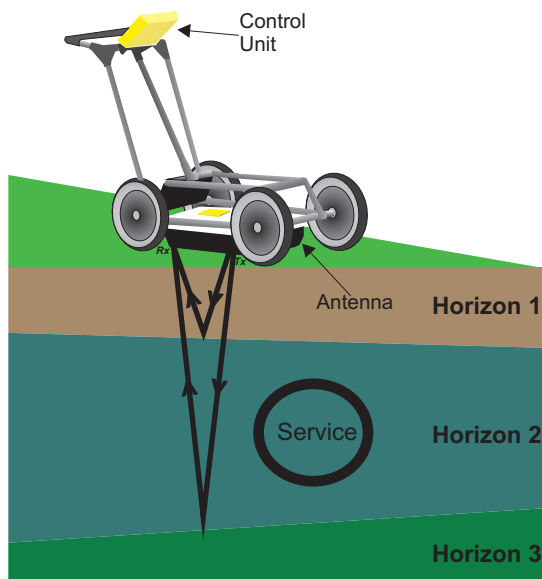
Constraints

Power lines, buildings, metal structures (fences, rebar, vehicles, debris etc.) and buried services can interfere with the electro-magnetic measurements.

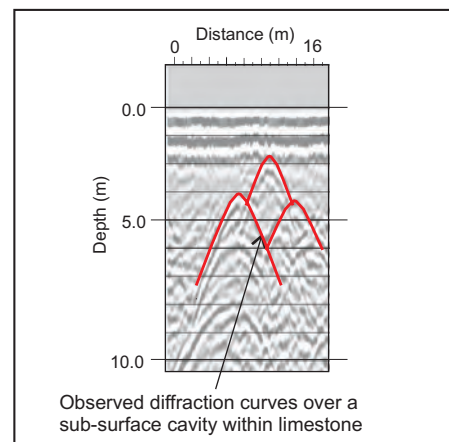
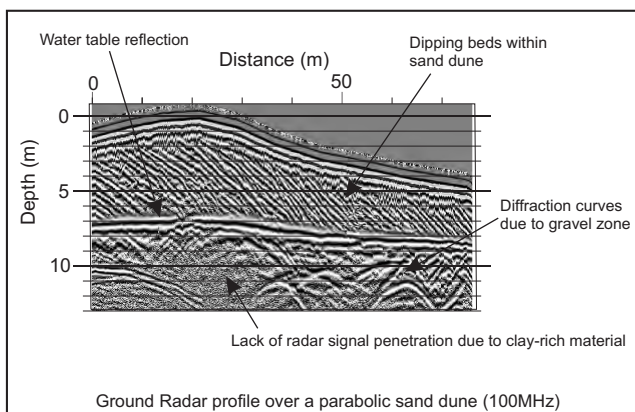
Appendix - Ground Penetrating Radar (GPR)

A Ground Penetrating Radar (GPR) survey involves one or two people either continuously towing a radar system or taking readings at very closely spaced intervals along selected traverse lines. GPR systems use a pulsed electromagnetic (radio wave) transmitted via a tuned frequency antenna that can penetrate soils, rock, concrete, and many other natural and man-made materials. Reflection events from geological or hydrological boundaries between sufficiently contrasting materials are recorded via a receiver antenna. A time-depth cross-section (radargram) of the shallow subsurface is constructed as the radar system is moved along a survey line. The radargram can be depth calibrated to enable detailed interpretation given known or measured velocities for the materials being investigated. While viewing relatively raw radar data can prove useful in the field there are numerous processing routines that can be employed to significantly improve the results. Final sections are presented showing annotated features of interest with apparent depth calibration.

General principle of Ground Radar



GPR Survey in progress



In order to improve the quality of the recorded radar data, a number of processing routines can be applied to the data using dedicated software (REFLEX). The final radar sections are converted to depth by applying a conversion velocity, which is usually based on an average velocity value for the local sediments. Without any additional calibration the measured depth to a particular feature is likely to be resolved within a 20% error margin depending on the local velocity structure.

Constraints:

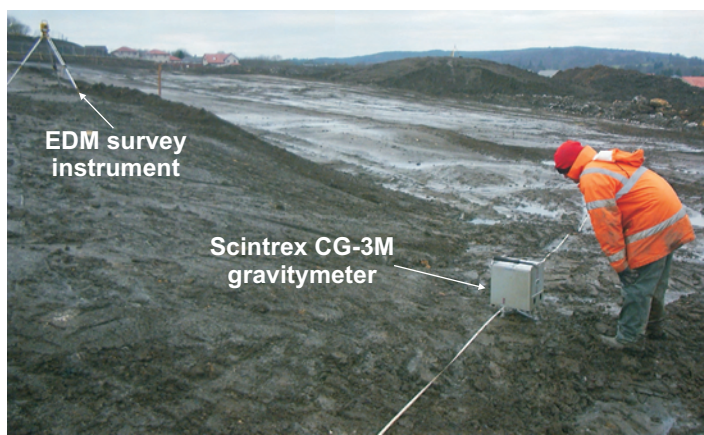
The main limitations affecting radar surveys are the presence of conductive materials near surface (e.g., clay and water) which reduce penetration, and blocky material which scatters signal.

Appendix - Microgravity Survey

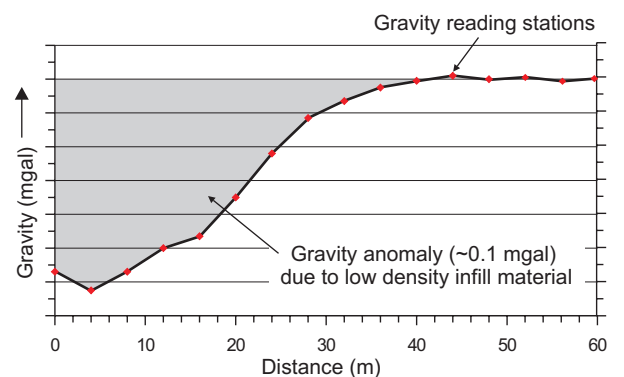
The gravity technique is based on measuring localised variations in the Earth's gravitational field which are caused by materials of different densities. The presence of an anomalously high (or low) density body in the subsurface causes a localised high (or low) anomaly in the measured gravitational field. The gravity effects described are extremely small, however, modern instrumentation and exhaustive data processing techniques enable detection of both geological and artificial structures or voids.

The CG-3M gravity meter is a semi-automated system that enables statistical averaging and filtering of readings taken every second over a fixed period of time (typically 2-3 minutes). The elevation of the gravity instrument was recorded to a 1mm precision ($<0.3\text{cm}$ error) at each survey station to facilitate accurate elevation correction. The results from the microgravity survey can be presented as a series of gravity profiles or colour contoured plot displaying the derived Bouguer Anomaly. Interpretation of the microgravity data is based on observing the shape, amplitude and wavelength of a particular anomaly and comparing it against the modelled gravity profile of a given target feature.

Typical field set-up



Gravity profile over the edge of a backfilled quarry



In order to remove (reduce) background gravitational effects i.e. those that do not originate from the target feature, the following processing steps were applied to the acquired dataset using a combination of internal CG-3M software and TerraDat proprietary software *GRED*.

Earth Tide, Temperature & Tilt Correction: Applied automatically by the gravity meter software.

Un-modelled Temporal Residual Correction: Obtained by least-squares fitting of a quadratic polynomial through the base station readings for each day. It is our normal practice to set the Bouguer anomaly at the base to zero so that the calculated values for the other stations are relative to a base station zero.

Latitude Correction: Calculated on the basis of the site latitude. Typically, due to the small latitude extent of the survey gird the correction is assumed to be linear per metre north.

Free-air Correction: Applied to the dataset based on the instrument elevations, which were recorded to a 1mm precision ($<0.3\text{cm}$ error) using an EDM survey system.

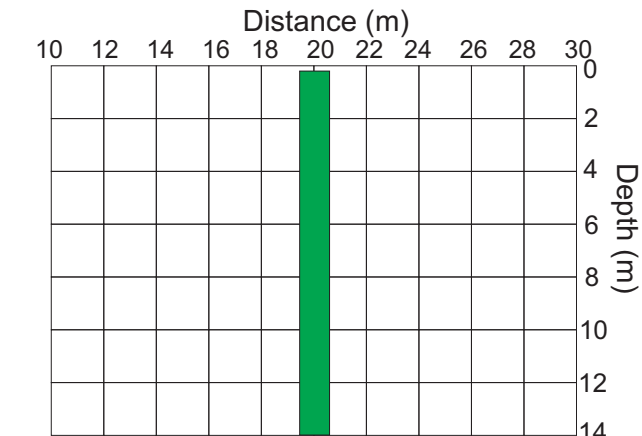
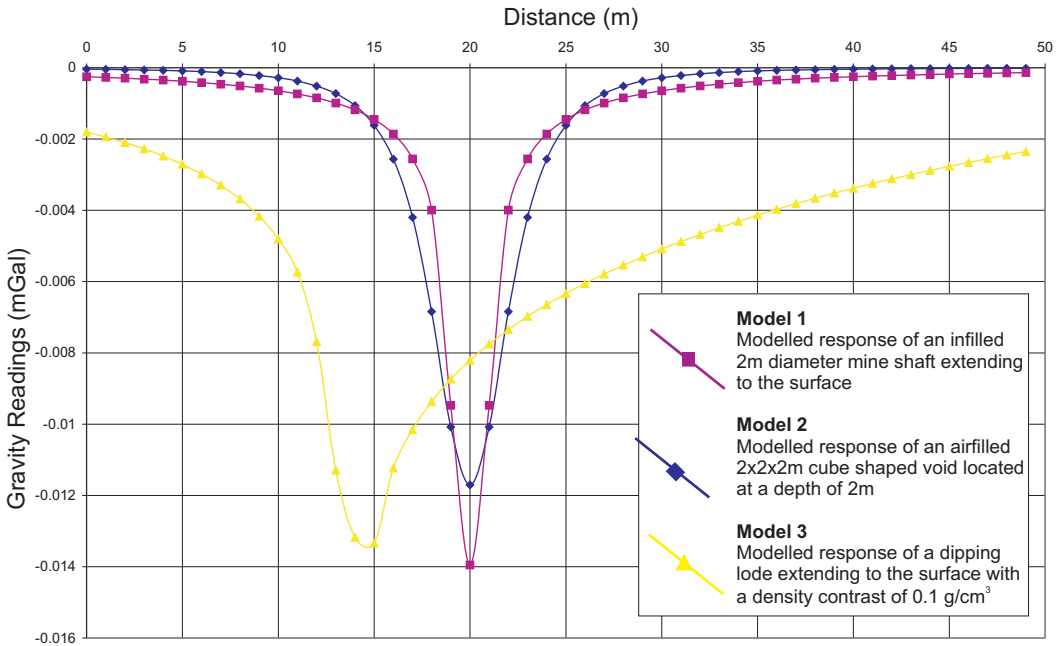
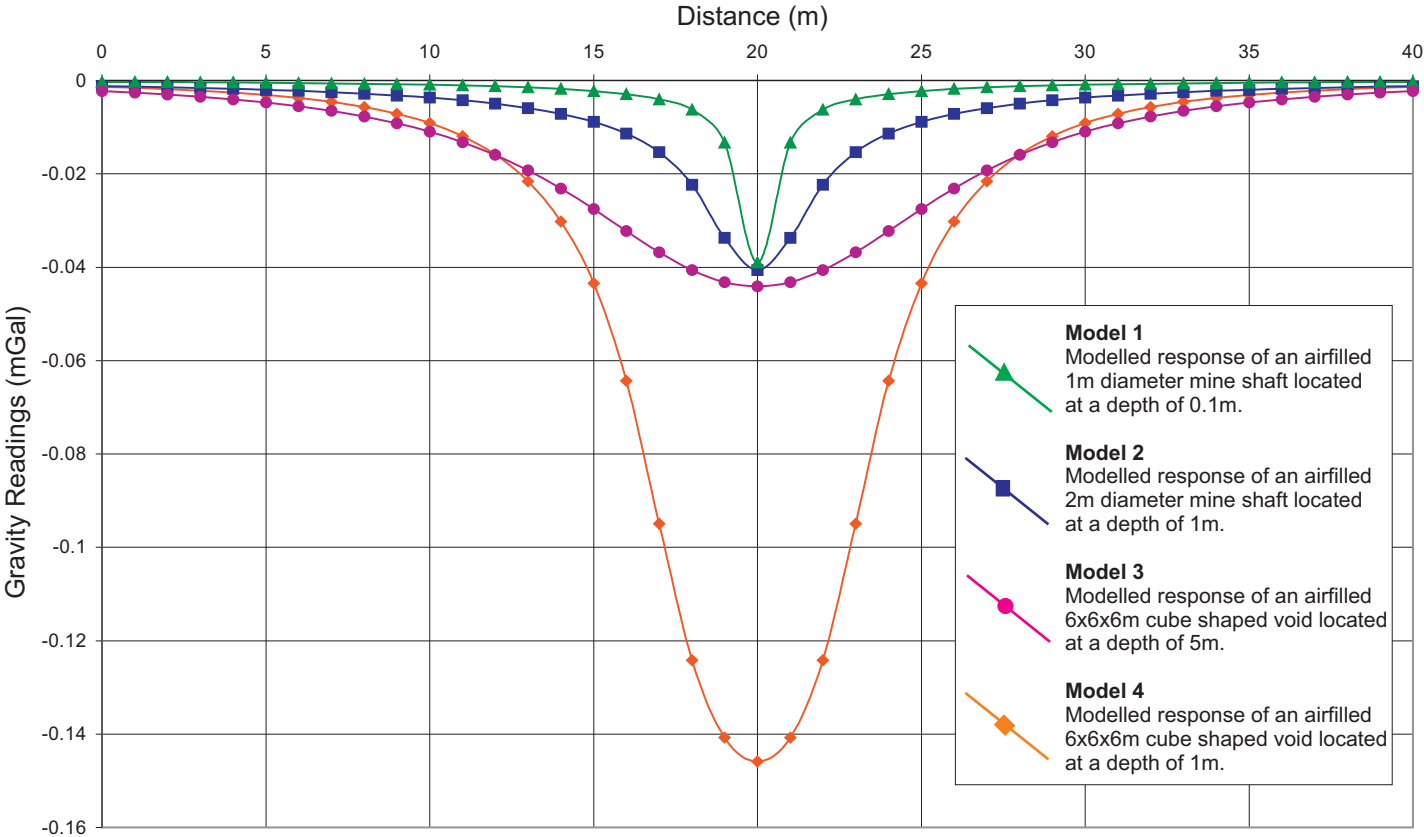
Terrain Correction: Based on the measured ground level at each gravity reading station and selected points beyond the survey grid.

Bouguer Correction: The selection of the reduction density is based on both site and geological

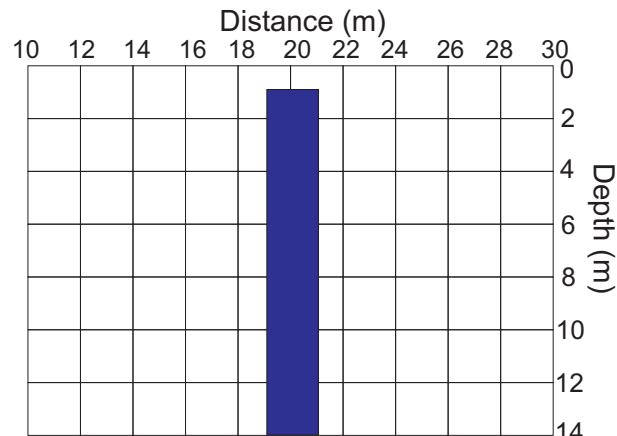
Constraints

The principal limitation on the use of gravity is the time required for careful acquisition and data processing. The detectability of a feature using the gravity methods is proportional to its size/depth ratio and its density contrast with the host material. There is a decrease in spatial resolution with increased depth of burial. In terms of site considerations, it is best to avoid sites with severe terrain or are have excessive vibrational noise.

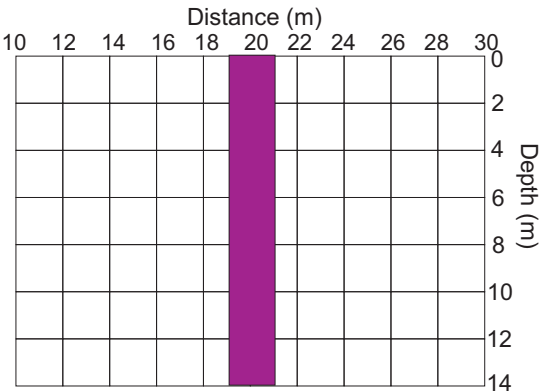
Appendix - Generalised illustrations of gravity responses for infilled and airfilled voids



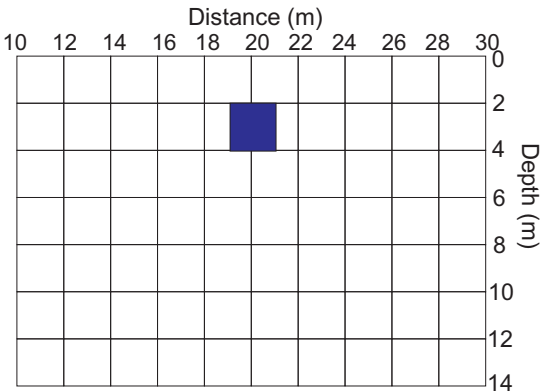
Model 1: 1m diameter airfilled shaft located at 0.1m depth



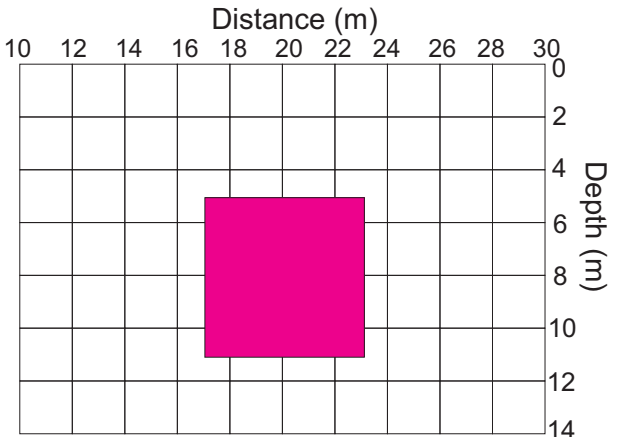
Model 2: 2m diameter airfilled shaft located at 1m depth



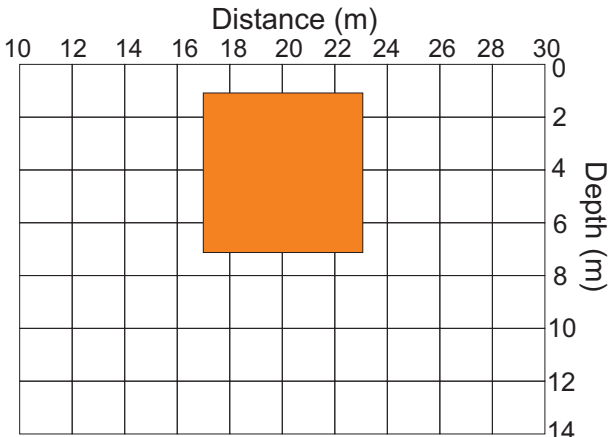
Model 5: 2m diameter infilled shaft extending to the surface



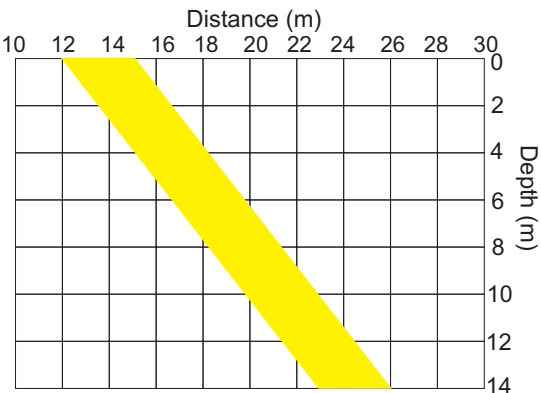
Model 6: 2x2x2m airfilled void located at 2m depth



Model 3: 6x6x6m airfilled void located at 6m depth



Model 4: 6x6x6m airfilled void located at 1m depth



Model 7: Dipping lode with a density contrast of 0.1 g/cm³

The above models represent generalised gravity responses to a series of infilled and airfilled mine shafts and lodes. A density contrast of 2 g/cm³ and 0.5 g/cm³ has been used to represent airfilled and infilled material respectively.

The above models represent generalised gravity responses to a series of airfilled voids. A density contrast of 2 g/cm³ has been used to represent an airfilled void.

ENCLOSURE C
GEOTECHNICAL LABORATORY TEST RESULTS

Index Properties – Summary of Results
Particle Size Distribution Analyses
Dry Density / Moisture Content Relationship

INDX 1
PSD 1 to PSD 16
COMPL 1 to COMPL 3

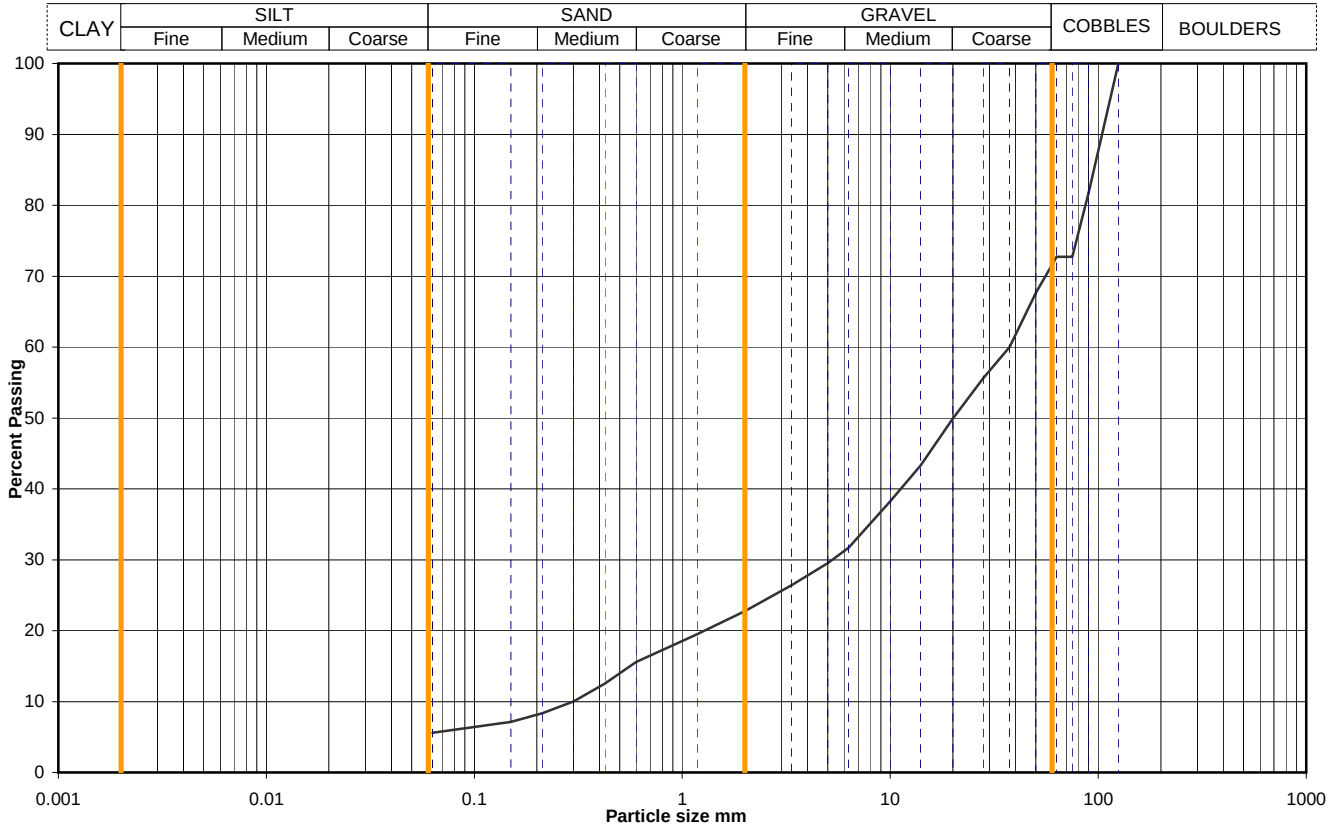
INDEX PROPERTIES - SUMMARY OF RESULTS

Project No	Project Name													
H1065-11	G.I. Works at Coed Darcy, B4290 Realignment													
Hole No.	Sample				Soil Description	p	p_d	W	< 425 μ m sieve	W_L	W_P	I_p	p_s	Remarks
	No.	Depth (m)		type		Mg/m ³	%	%	%	%	Mg/m ³			
		from	to											
TPC11	4	0.20	0.50	B	Brown slightly gravelly sandy SILT with rootlets			32	59 s	43 a	34	9		
TPC2	5	0.60	0.90	B	Brown slightly gravelly sandy CLAY			20	72 s	36 a	22	14		
TPC3	6	1.30	1.60	B	Grey brown slightly gravelly sandy CLAY			26	86 s	33 a	22	11		
TPD1	4	0.40	0.70	B	Grey brown very silty SAND and GRAVEL with high cobble content			10	41 s	b	NP			Sample dilated - non plastic
TPD2	7	1.60	1.90	B	Brown grey very clayey very sandy GRAVEL			17	53 s	26 a	16	10		
TPD3	3	0.40	0.70	B	Brown grey silty very sandy GRAVEL with medium cobble content			10	27 s	35 a	24	11		
TPD3	9	2.90	3.20	B	Brown grey very clayey very sandy GRAVEL with low cobble content			16	45 s	28 a	18	10		
TPD5	7	0.80	1.10	B	Grey brown slightly gravelly slightly sandy CLAY with low cobble content			22	68 s	30 a	19	11		
TPE1	3	0.30	0.60	B	Brown grey slightly gravelly sandy CLAY with low cobble content and rootlets			16	62 s	37 a	24	13		
WSD1	5	1.20	1.80	L	Brown grey gravelly sandy SILT			8.6	63 s	23 a	18	5		
WSD2	3	1.20	2.00	L	Brown grey sandy CLAY			25	100 n	40 a	19	21		
WSE1	4	1.00	2.00	L	Brown grey slightly gravelly slightly sandy CLAY			26	83 s	35 a	24	11		
WSE2	7	2.00	2.80	L	Brown grey slightly gravelly sandy CLAY			11	74 s	20 a	14	6		

General notes: All above tests carried out to BS1377 : 1990 definitive method in all cases unless annotated otherwise. See individual test reports for further details.													
Key :		p	bulk density, linear	W_L	Liquid limit	W_P	Plastic limit	<425um preparation	p_s	particle density			
		p_d	dry density	a	4 point cone test	NP	non - plastic	n	from natural soil	-g	= gas jar		
		w	moisture content	b	1 point cone test	I_P	Plasticity Index	s	sieved specimen	-p	= small pycnometer		
QA Ref		SLR 1 Rev 88 Aug 11						Printed:23/09/2011 15:54				Table	
												INDX 1	

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC1	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.60	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809746655		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	82		
75	73		
63	73		
50	68		
37.5	60		
28	56		
20	50		
14	43		
10	38		
6.3	32		
5.0	30		
3.35	26		
2.00	23		
1.18	19		
0.600	16		
0.425	13		
0.300	10		
0.212	8		
0.150	7		
0.063	6		

Dry mass of sample, kg	
11.6	

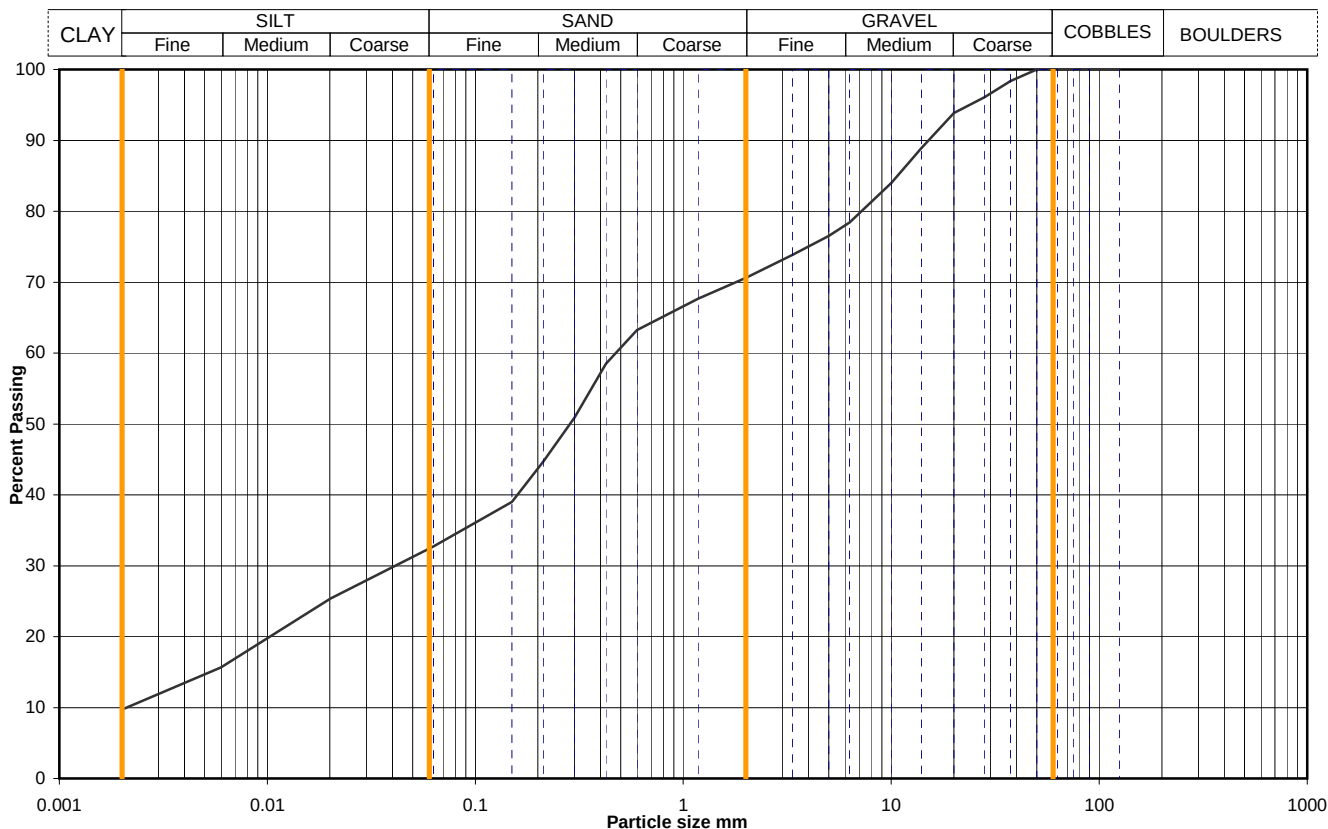
Soil description	Brown grey orange silty very sandy GRAVEL with high cobble content		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions *<60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	*<60mm
		28	0
		49	68
		17	24
		silt+clay =	
		6	8

Uniformity Coefficient	D_{60} / D_{10}	126
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC11	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.20	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809656261		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	25
90	100	0.0060	16
75	100	0.0020	10
63	100		
50	100		
37.5	98		
28	96		
20	94		
14	89		
10	84		
6.3	78		
5.0	77		
3.35	74		
2.00	71		
1.18	68		
0.600	63		
0.425	59		
0.300	51		
0.212	45		
0.150	39		
0.063	33		

Soil description	Brown slightly gravelly sandy SILT with rootlets		
Preparation / Pretreatment	Sieve: natural material Pipette: as BS1377		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders	Whole	* <60mm
	Gravel	0	0
	Sand	29	29
	Silt	38	38
	Clay	23	23

Uniformity Coefficient	D_{60} / D_{10}	224
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

QA Ref

SLR 2,9
Rev 88
Aug 11



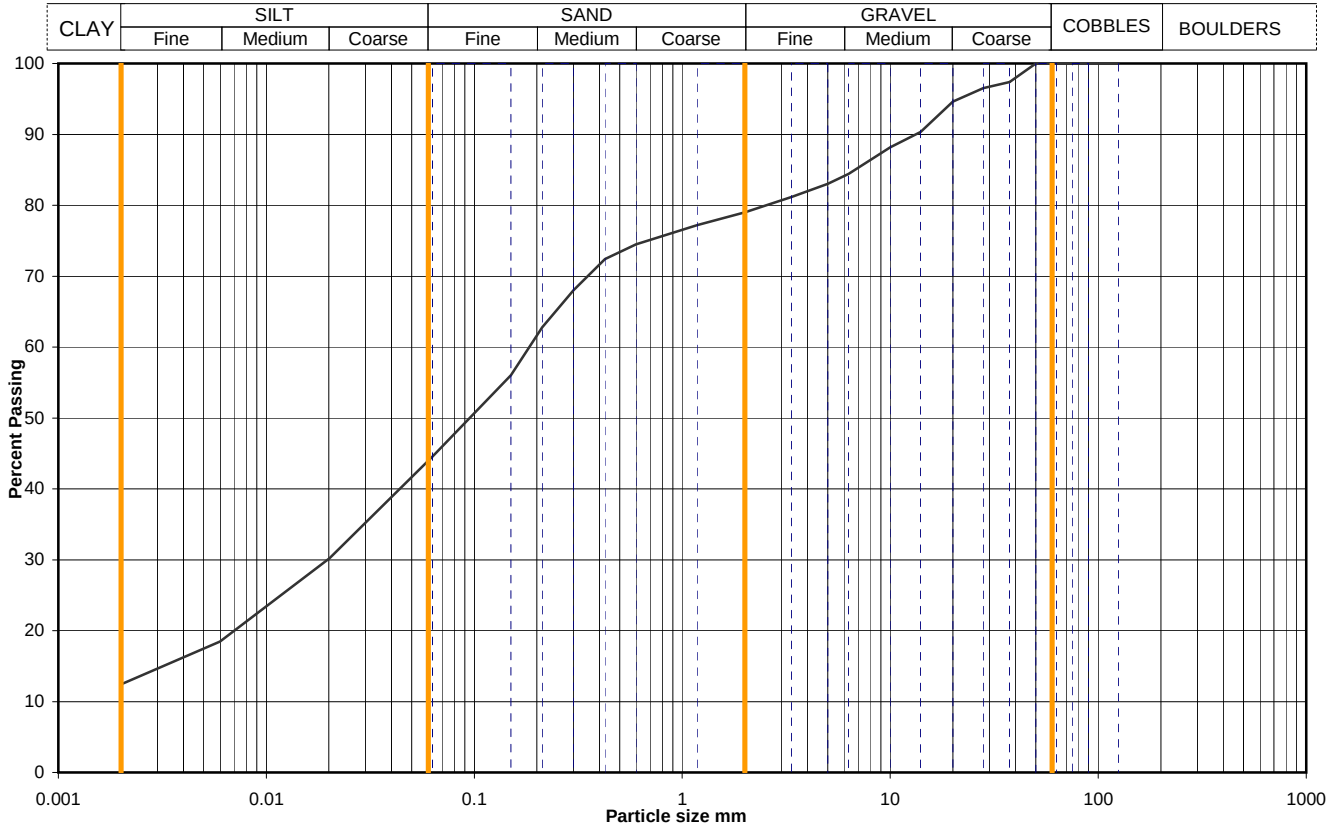
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Figure

PSD 2

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC2	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.60	
			Samp No	5	Type	B
			ID	ESGH1065-1120110809401758		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	30
90	100	0.0060	18
75	100	0.0020	12
63	100		
50	100		
37.5	97		
28	97		
20	95		
14	90		
10	88		
6.3	84		
5.0	83		
3.35	81		
2.00	79		
1.18	77		
0.600	75	Particle density, Mg/m3	
0.425	72	2.65 assumed	
0.300	68	Dry mass of sample, kg	
0.212	63	5.4	
0.150	56		
0.063	45		

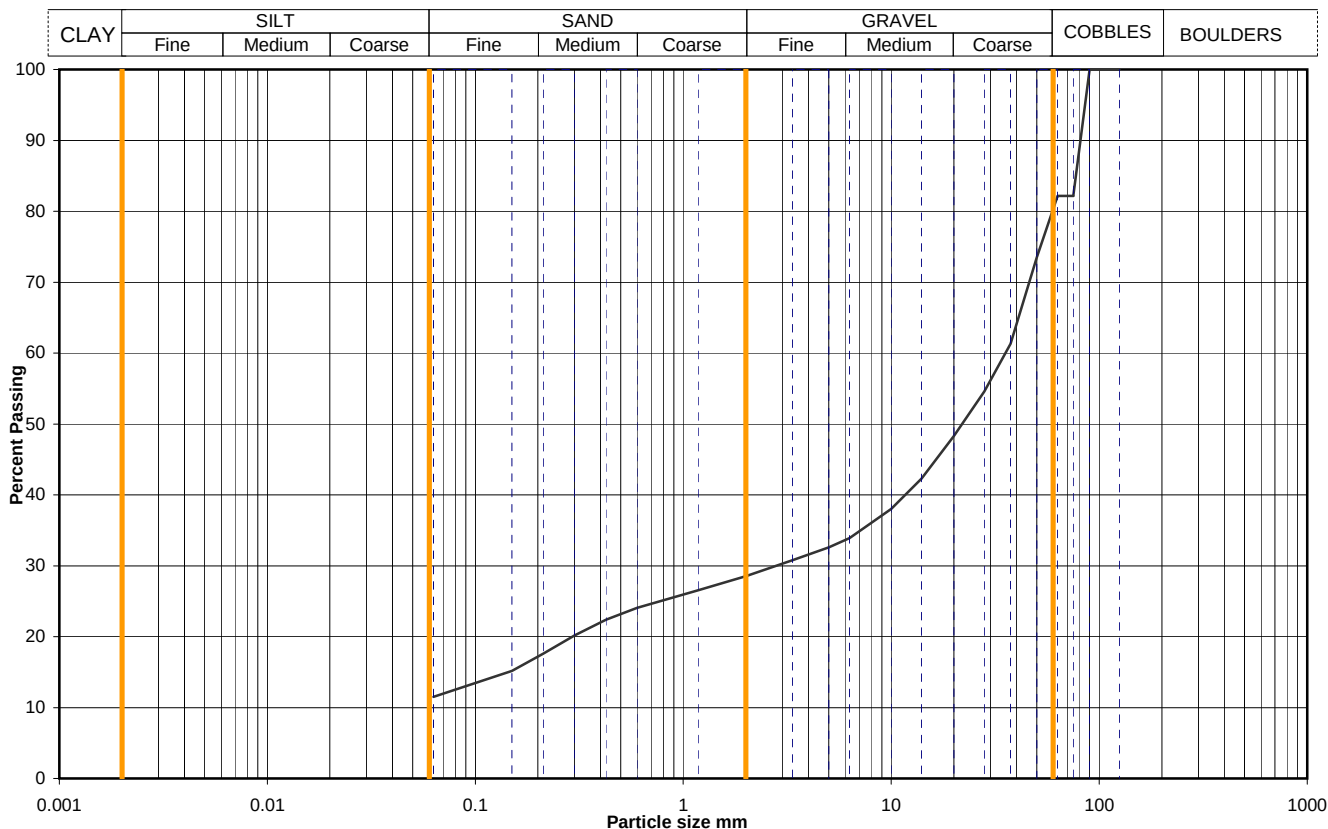
Soil description	Brown slightly gravelly sandy CLAY		
Preparation / Pretreatment	Sieve: natural material Pipette: as BS1377		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders	Whole	* <60mm
	Gravel	0	0
	Sand	21	21
	Silt	35	35
	Clay	32	32

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC2	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		1.30	
			Samp No	7	Type	B
			ID	ESGH1065-1120110809073228		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	82		
63	82		
50	73		
37.5	61		
28	55		
20	48		
14	42		
10	38		
6.3	34		
5.0	33		
3.35	31		
2.00	29		
1.18	27		
0.600	24		
0.425	22		
0.300	20		
0.212	18		
0.150	15		
0.063	12		

Dry mass of sample, kg		13.7	

Soil description	Brown grey silty very sandy GRAVEL with high cobble content		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* <60mm
		20	0
		51	64
		17	21
		silt+clay =	
		12	15

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref

SLR 2,9
Rev 88
Aug 11



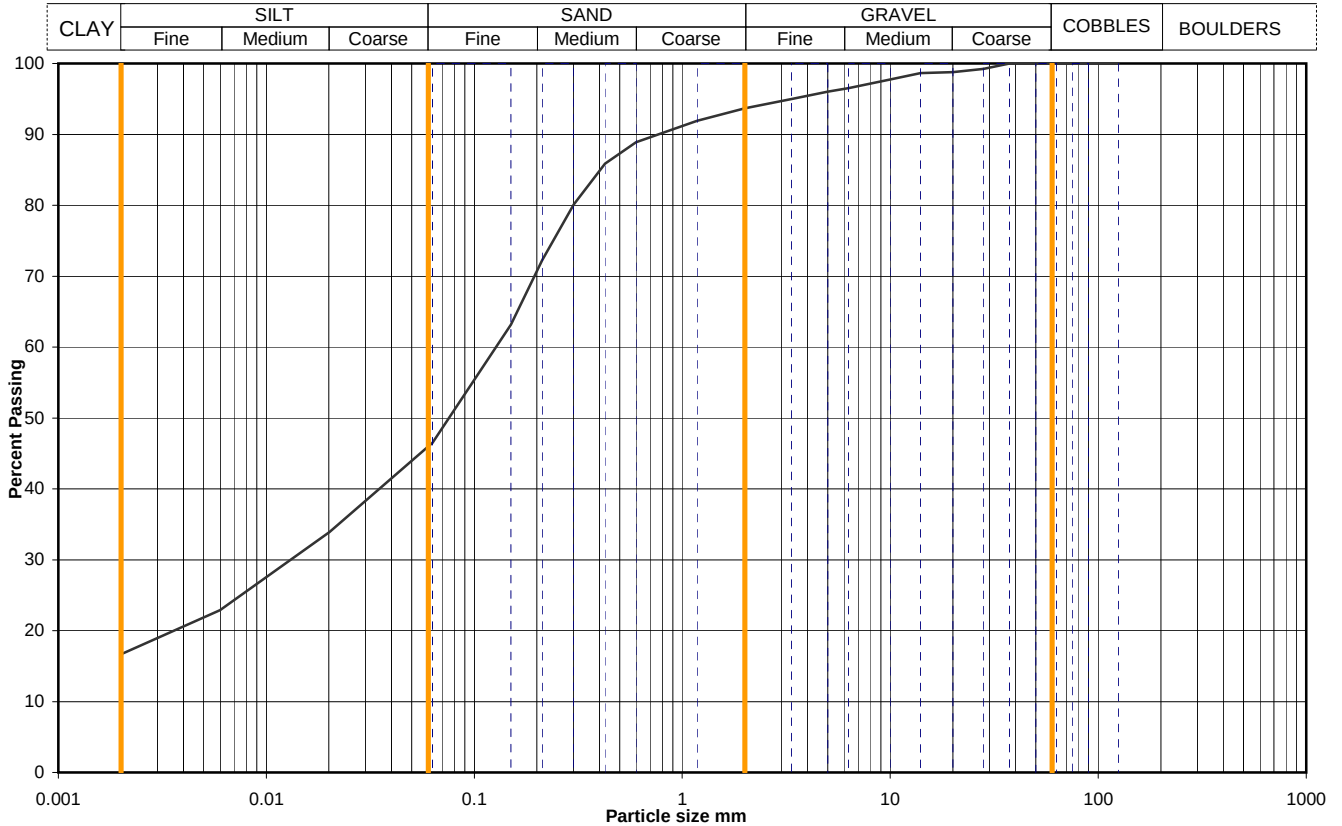
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Figure

PSD 4

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC3	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		1.30	
			Samp No	6	Type	B
			ID	ESGH1065-1120110809175176		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	34
90	100	0.0060	23
75	100	0.0020	17
63	100		
50	100		
37.5	100		
28	99		
20	99		
14	99		
10	98		
6.3	97		
5.0	96		
3.35	95		
2.00	94		
1.18	92		
0.600	89		
0.425	86		
0.300	80		
0.212	72		
0.150	63		
0.063	47		

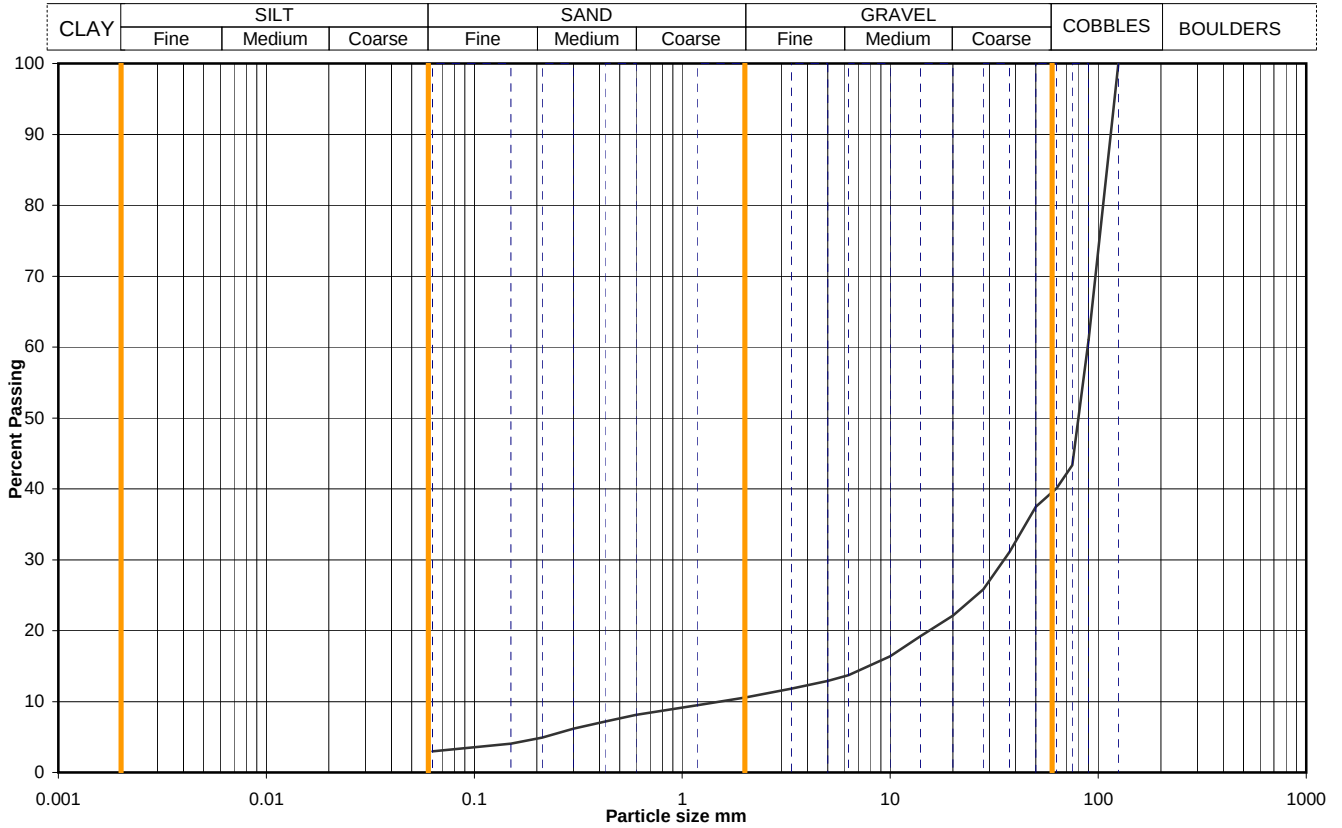
Soil description	Grey brown slightly gravelly sandy CLAY		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders	Whole	* <60mm
	Gravel	0	0
	Sand	6	6
	Silt	48	48
	Clay	29	29

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC5	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.50	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809276228		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	61		
75	43		
63	40		
50	37		
37.5	31		
28	26		
20	22		
14	19		
10	16		
6.3	14		
5.0	13		
3.35	12		
2.00	11		
1.18	9		
0.600	8		
0.425	7		
0.300	6		
0.212	5		
0.150	4		
0.063	3		

Dry mass of sample, kg		10.5	

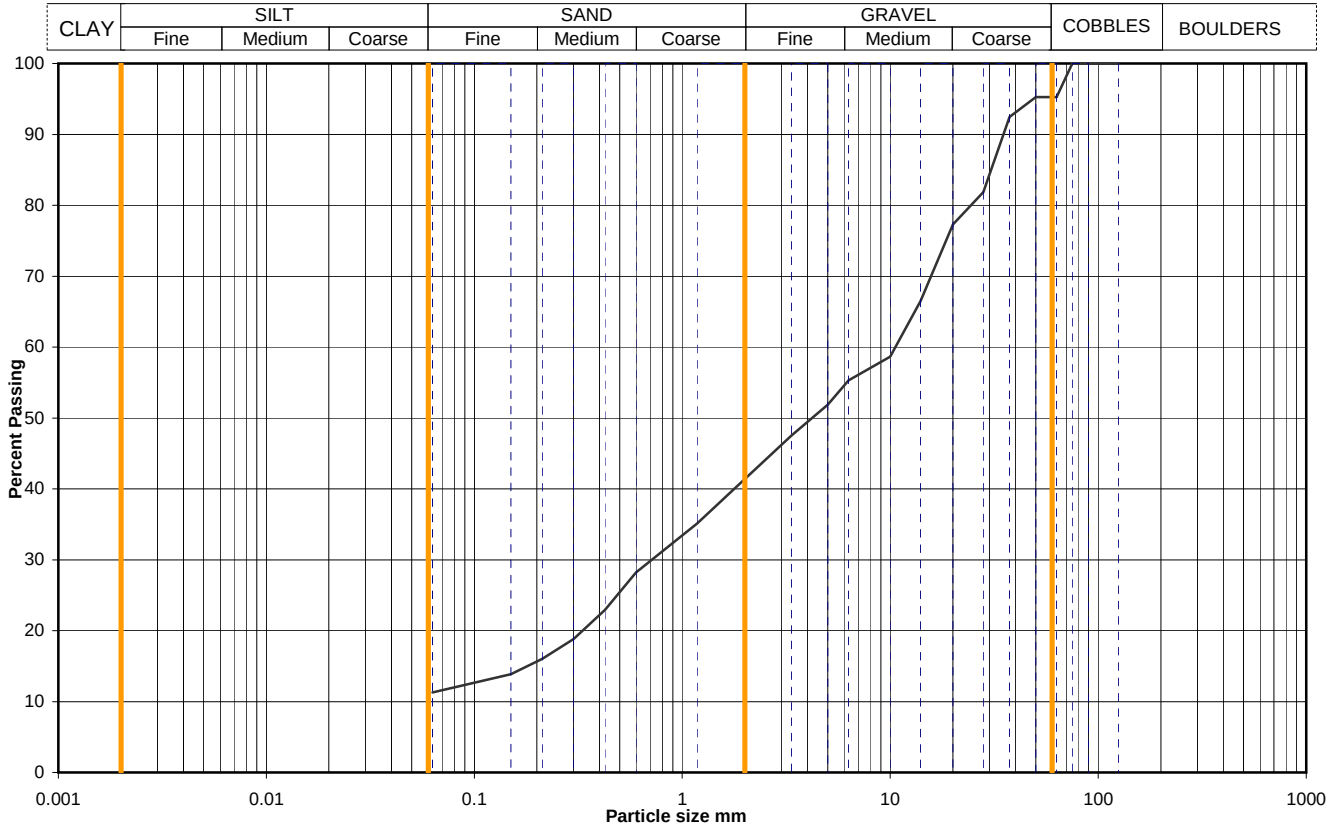
Soil description	COBBLES with much silty very sandy GRAVEL		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* <60mm
		60	0
		29	73
		8	20
		silt+clay =	
		3	8

Uniformity Coefficient	D_{60} / D_{10}	58
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC6	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.30	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809309223		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	95		
50	95		
37.5	92		
28	82		
20	77		
14	67		
10	59		
6.3	55		
5.0	52		
3.35	48		
2.00	41		
1.18	35		
0.600	28		
0.425	23		
0.300	19		
0.212	16		
0.150	14		
0.063	11		

Dry mass of sample, kg 10.9	

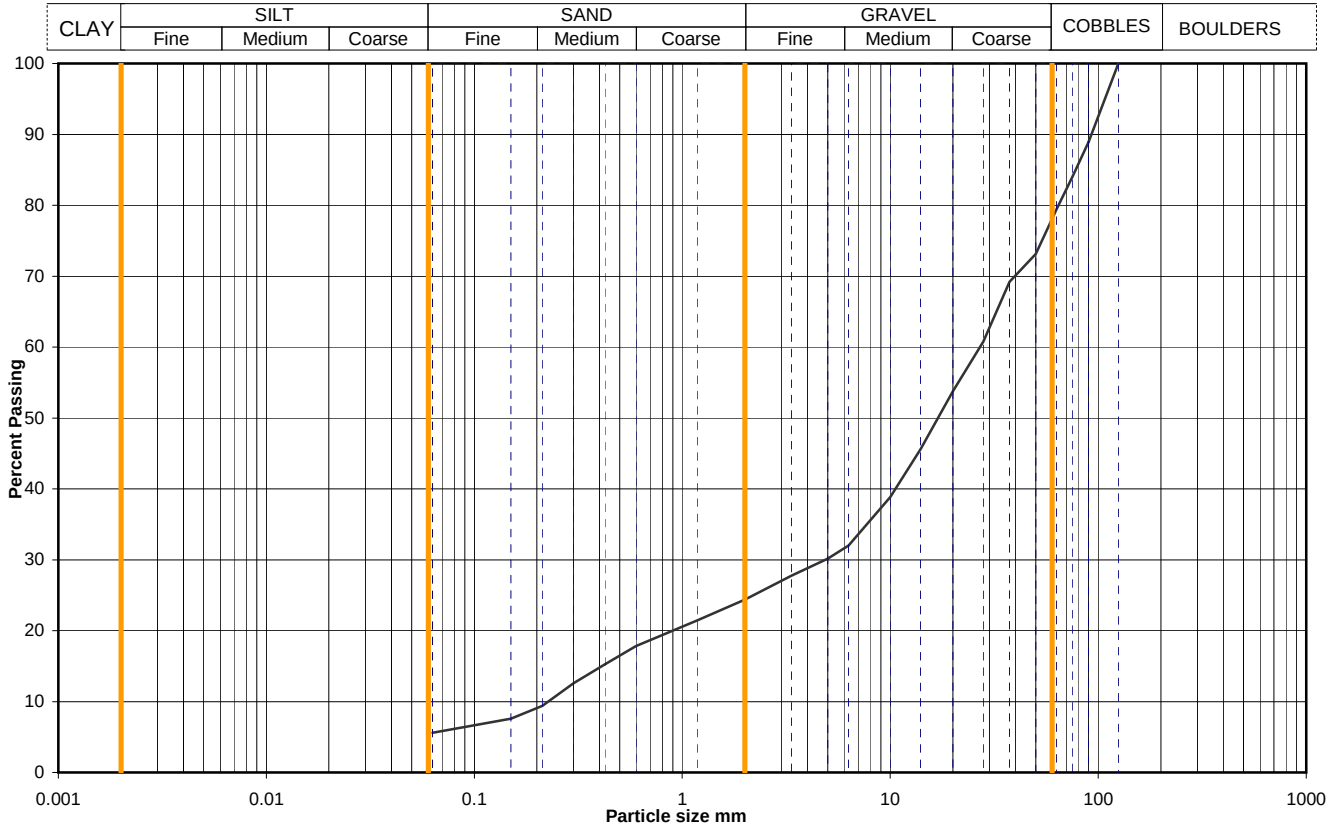
Soil description	Brown grey orange silty very sandy GRAVEL with low cobble content		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions * < 60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* < 60mm
		5	0
		54	57
		30	32
		silt+clay =	
		11	12

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPC8	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.40	
			Samp No	3	Type	B
			ID	ESGH1065-1120110809903648		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	89		
75	84		
63	79		
50	73		
37.5	69		
28	61		
20	54		
14	46		
10	39		
6.3	32		
5.0	30		
3.35	28		
2.00	24		
1.18	21		
0.600	18		
0.425	15		
0.300	13		
0.212	9		
0.150	8		
0.063	6		

Dry mass of sample, kg			
13.6			

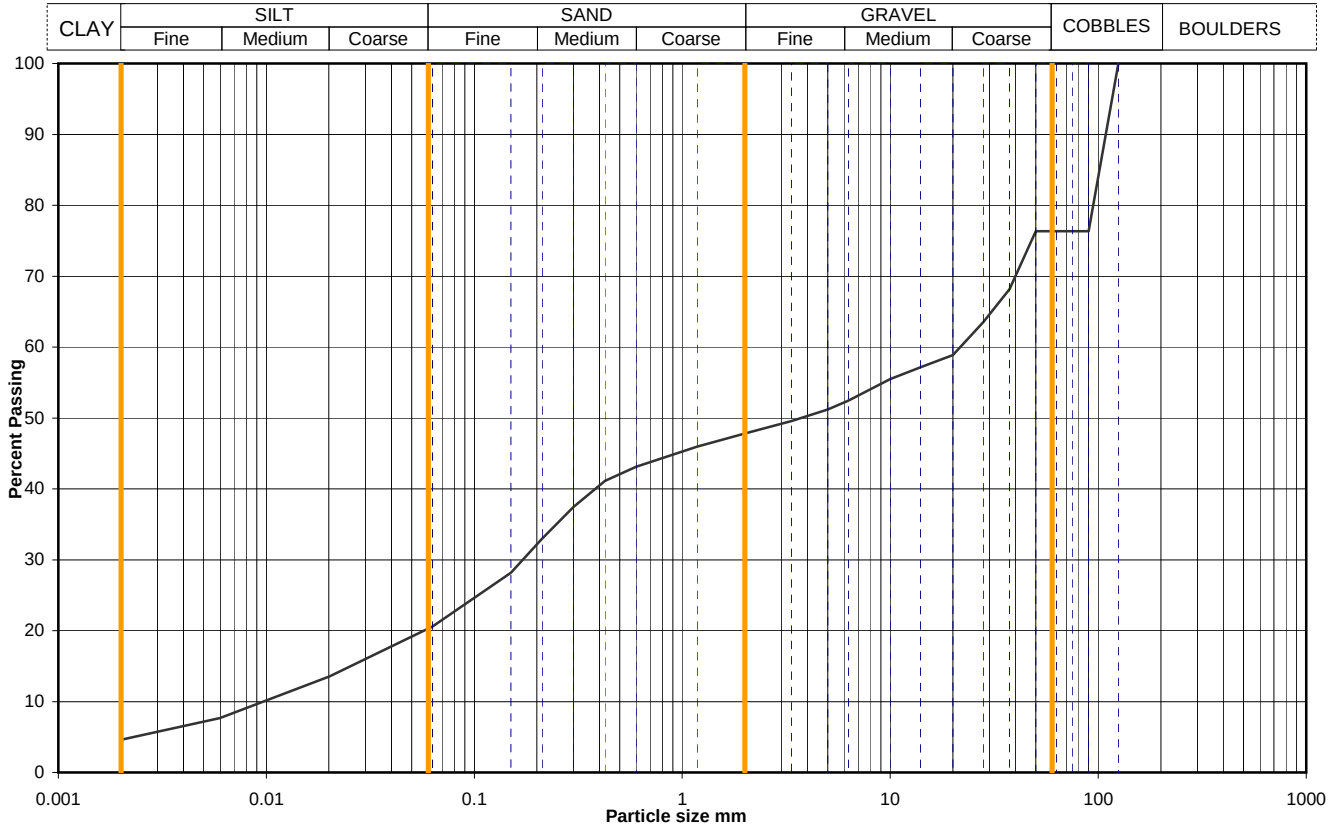
Soil description	Brown grey orange silty very sandy GRAVEL with high cobble content		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* <60mm
		22	0
		54	69
		19	24
		silt+clay =	
		5	6

Uniformity Coefficient	D_{60} / D_{10}	119
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD1	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.40	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809219540		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	14
90	76	0.0060	8
75	76	0.0020	5
63	76		
50	76		
37.5	68		
28	64		
20	59		
14	57		
10	55		
6.3	52		
5.0	51		
3.35	50		
2.00	48		
1.18	46		
0.600	43	Particle density, Mg/m3	
0.425	41	2.65 assumed	
0.300	37	Dry mass of sample, kg	
0.212	33	11.0	
0.150	28		
0.063	21		

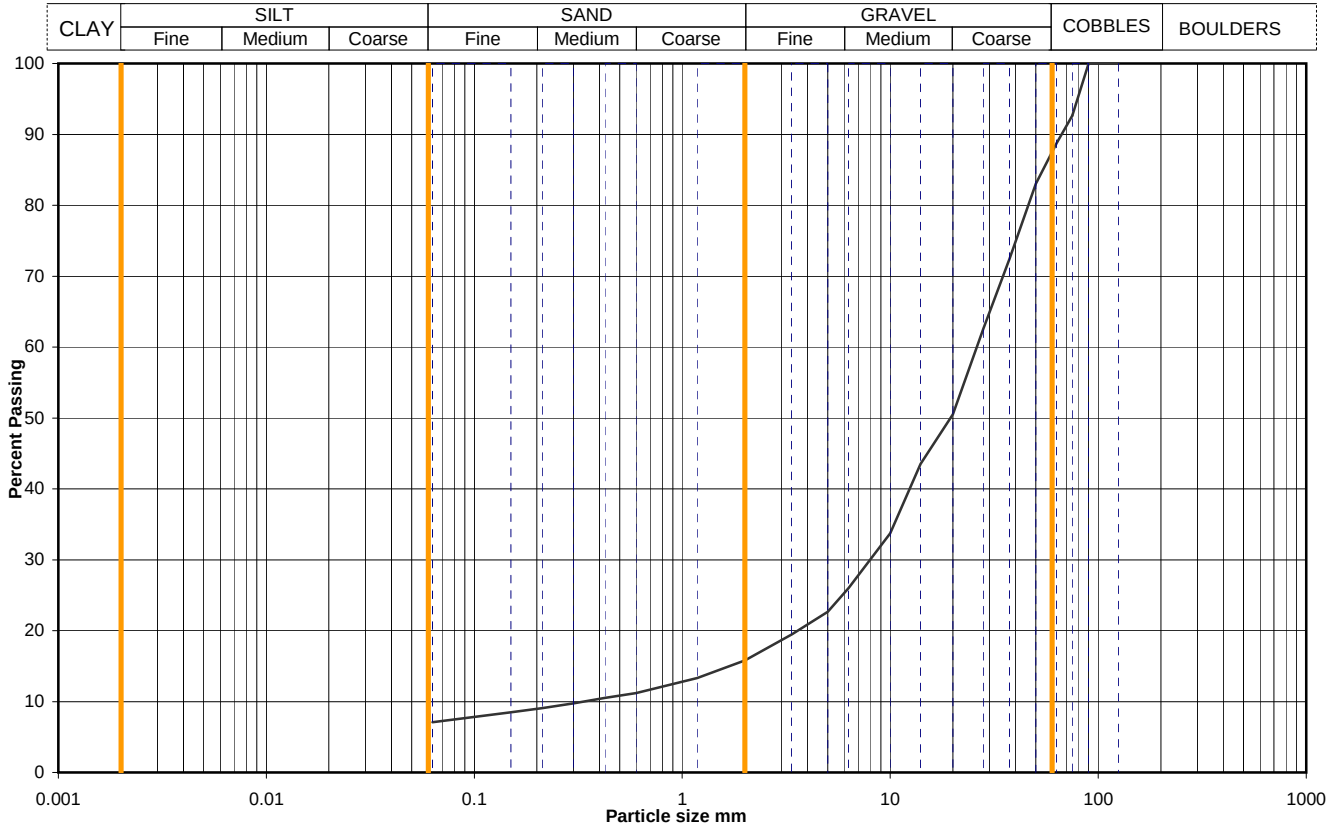
Soil description	Grey brown very silty SAND and GRAVEL with high cobble content		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	*<60mm
		24	0
		28	37
		28	37
		16	21
		4	5

Uniformity Coefficient	D_{60} / D_{10}	2246
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD2	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.20	
			Samp No	2	Type	B
			ID	ESGH1065-1120110809577840		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	93		
63	89		
50	83		
37.5	72		
28	63		
20	51		
14	44		
10	34		
6.3	26		
5.0	23		
3.35	19		
2.00	16		
1.18	13		
0.600	11		
0.425	11		
0.300	10		
0.212	9		
0.150	8		
0.063	7		
		Dry mass of sample, kg	
		15.3	

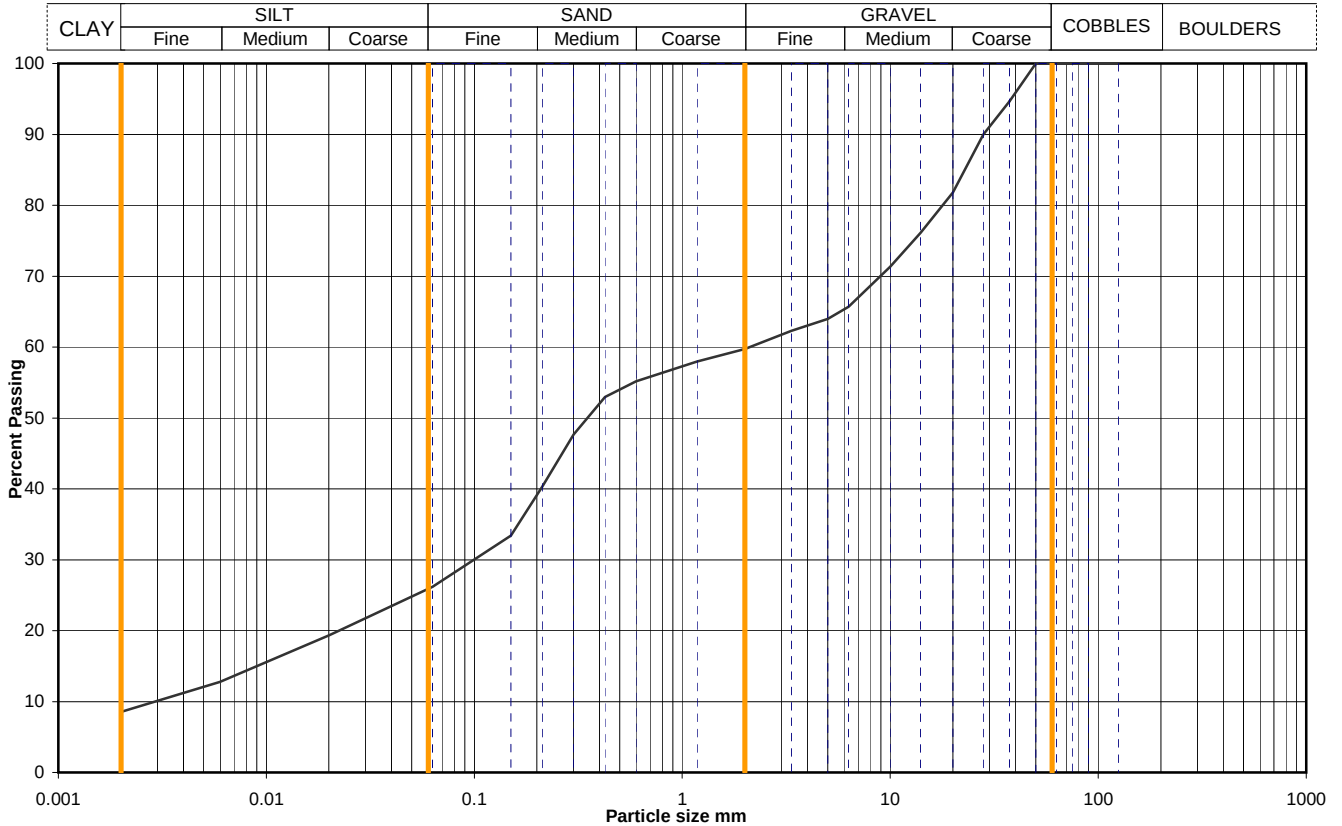
Soil description	Grey silty sandy GRAVEL with medium cobble content		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* <60mm
		12	0
		72	82
		9	10
		silt+clay =	
		7	8

Uniformity Coefficient	D_{60} / D_{10}	78
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD2	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		1.60	
			Samp No	7	Type	B
			ID	ESGH1065-1120110809341134		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	19
90	100	0.0060	13
75	100	0.0020	9
63	100		
50	100		
37.5	95		
28	90		
20	82		
14	76		
10	71		
6.3	66		
5.0	64		
3.35	62		
2.00	60		
1.18	58		
0.600	55		
0.425	53		
0.300	48		
0.212	40		
0.150	33		
0.063	26		

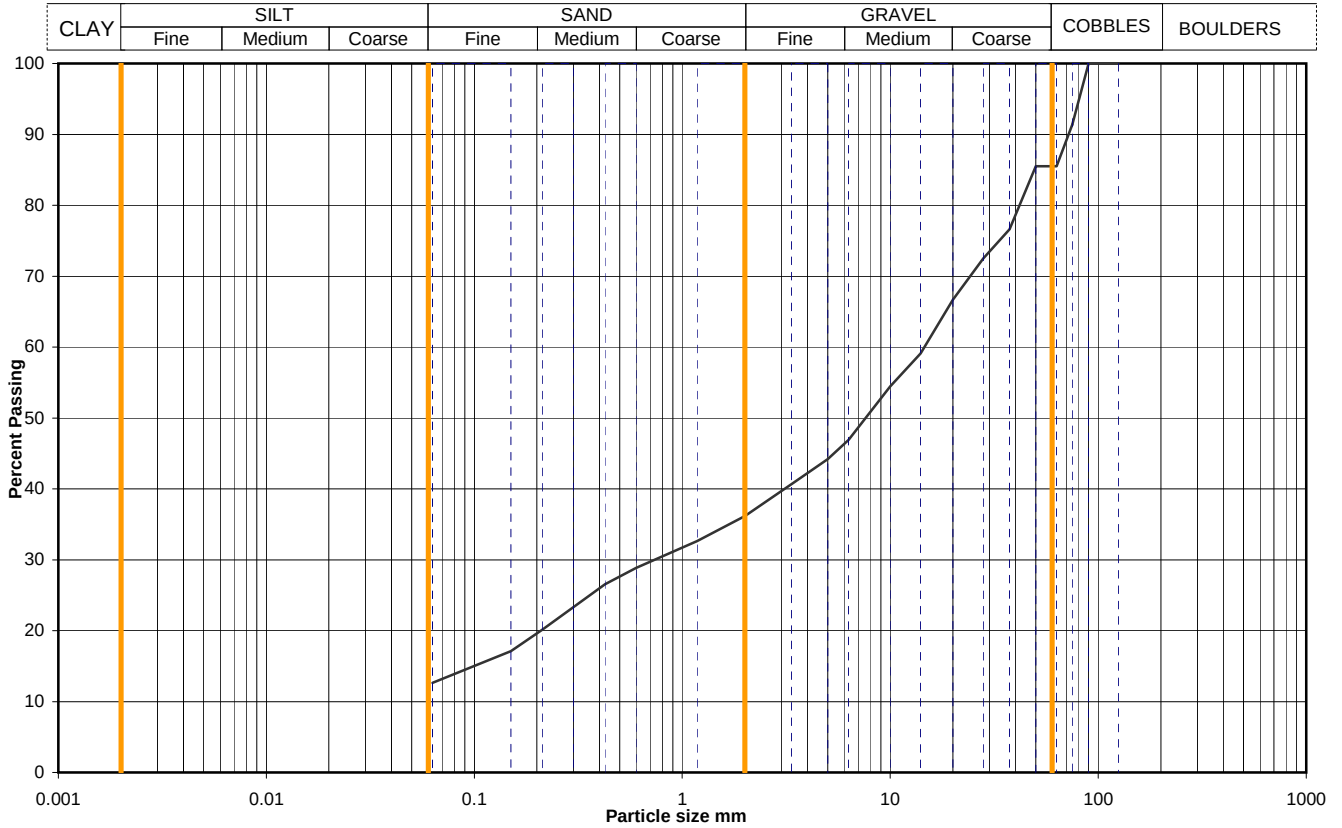
Soil description	Brown grey very clayey very sandy GRAVEL		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	*<60mm
		0	0
		40	40
		34	34
		17	17
		9	9

Uniformity Coefficient	D_{60} / D_{10}	722
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD3	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.40	
			Samp No	3	Type	B
			ID	ESGH1065-1120110809676618		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	91		
63	86		
50	86		
37.5	77		
28	72		
20	67		
14	59		
10	54		
6.3	47		
5.0	44		
3.35	41		
2.00	36		
1.18	33		
0.600	29		
0.425	27		
0.300	23		
0.212	20		
0.150	17		
0.063	13		

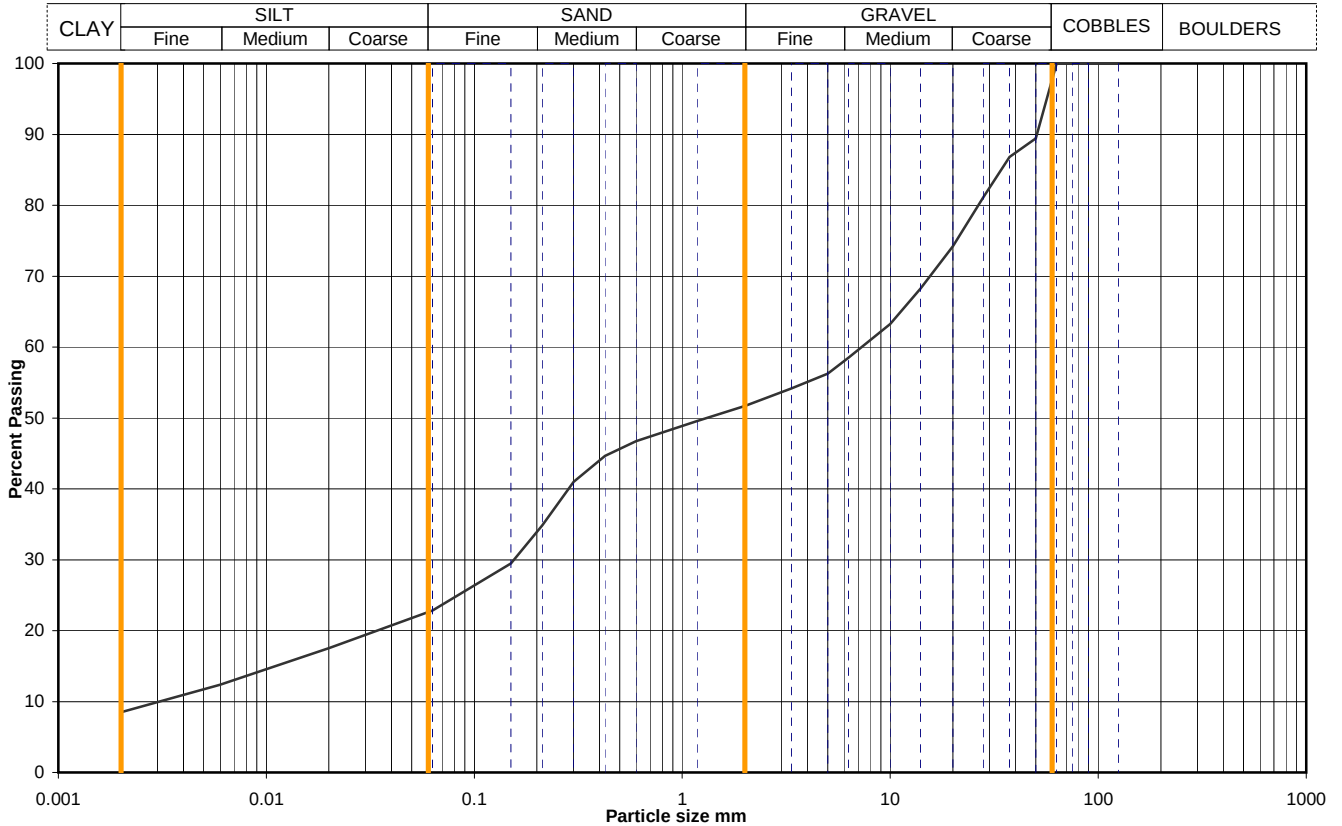
Soil description	Brown grey silty very sandy GRAVEL with medium cobble content		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders	Whole	* <60mm
	Gravel	14	0
	Sand	50	58
	Silt	24	28
	Clay	silt+clay =	

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD3	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		2.90	
			Samp No	9	Type	B
			ID	ESGH1065-1120110809005148		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	18
90	100	0.0060	12
75	100	0.0020	8
63	100		
50	89		
37.5	87		
28	81		
20	74		
14	68		
10	63		
6.3	59		
5.0	56		
3.35	54		
2.00	52		
1.18	50		
0.600	47	Particle density, Mg/m3 2.65 assumed	
0.425	45		
0.300	41	Dry mass of sample, kg 9.5	
0.212	35		
0.150	29		
0.063	23		

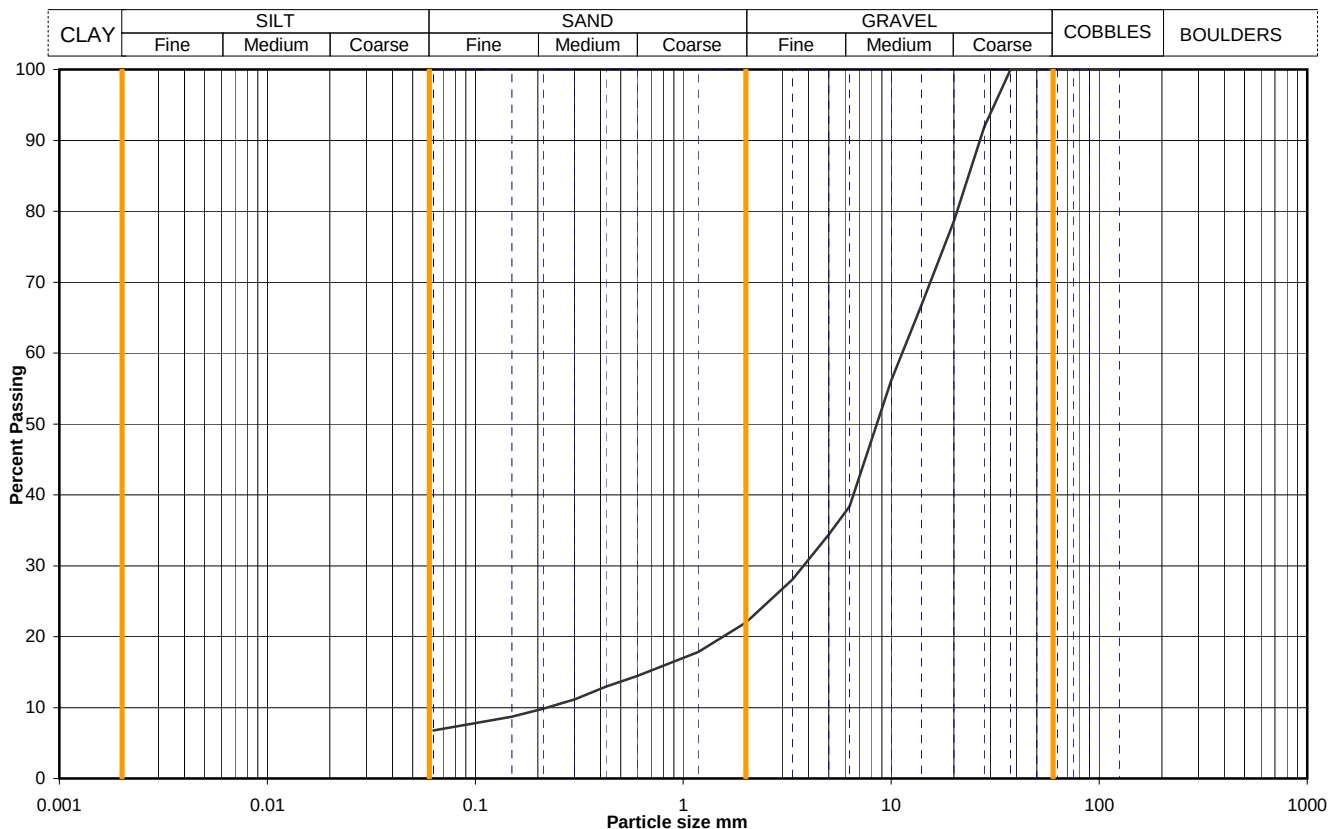
Soil description	Brown grey very clayey very sandy GRAVEL with low cobble content		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders	Whole	* <60mm
	Gravel	2	0
	Sand	46	47
	Silt	29	30
	Clay	14	14
		9	9

Uniformity Coefficient	D_{60} / D_{10}	2379
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD4	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.30	
			Samp No	1	Type	B
			ID	ESGH1065-1120110809755935		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	92		
20	79		
14	67		
10	56		
6.3	38		
5.0	34		
3.35	28		
2.00	22		
1.18	18		
0.600	14		
0.425	13		
0.300	11		
0.212	10		
0.150	9		
0.063	7		

Dry mass of sample, kg		
		9.0

Soil description	Light brown silty sandy GRAVEL		
Preparation / Pretreatment	Sieve: pre dried,		
Remarks			
Sample Proportions * < 60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* < 60mm
		0	0
		78	78
		15	15
		silt+clay =	
		7	7

Uniformity Coefficient	D_{60} / D_{10}	51
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Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref

SLR 2,9
Rev 88
Aug 11



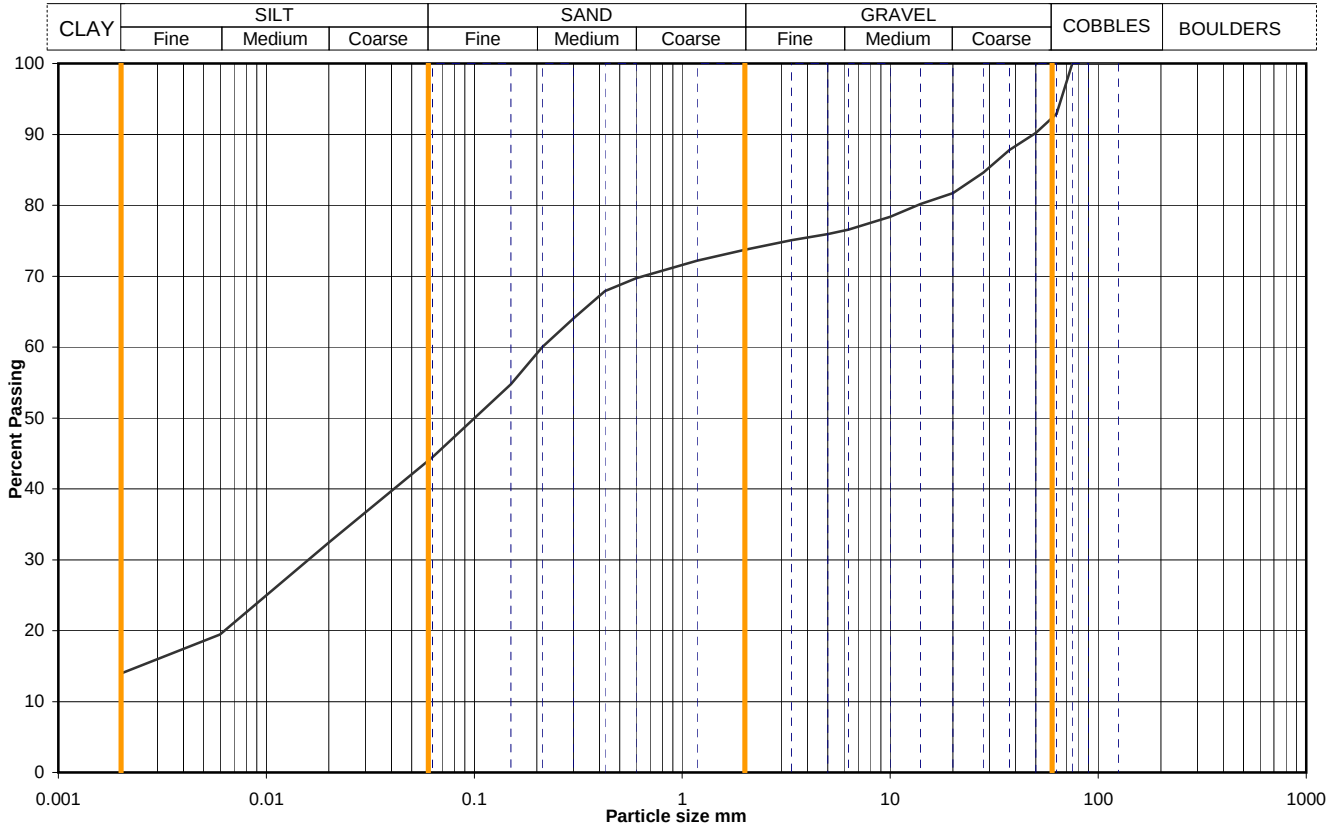
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Figure

PSD 14

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPD5	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.80	
			Samp No	7	Type	B
			ID	ESGH1065-1120110809828933		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	33
90	100	0.0060	19
75	100	0.0020	14
63	93		
50	90		
37.5	88		
28	85		
20	82		
14	80		
10	78		
6.3	77		
5.0	76		
3.35	75		
2.00	74		
1.18	72		
0.600	70	Particle density, Mg/m ³ 2.65 assumed	
0.425	68		
0.300	64	Dry mass of sample, kg 5.1	
0.212	60		
0.150	55		
0.063	44		

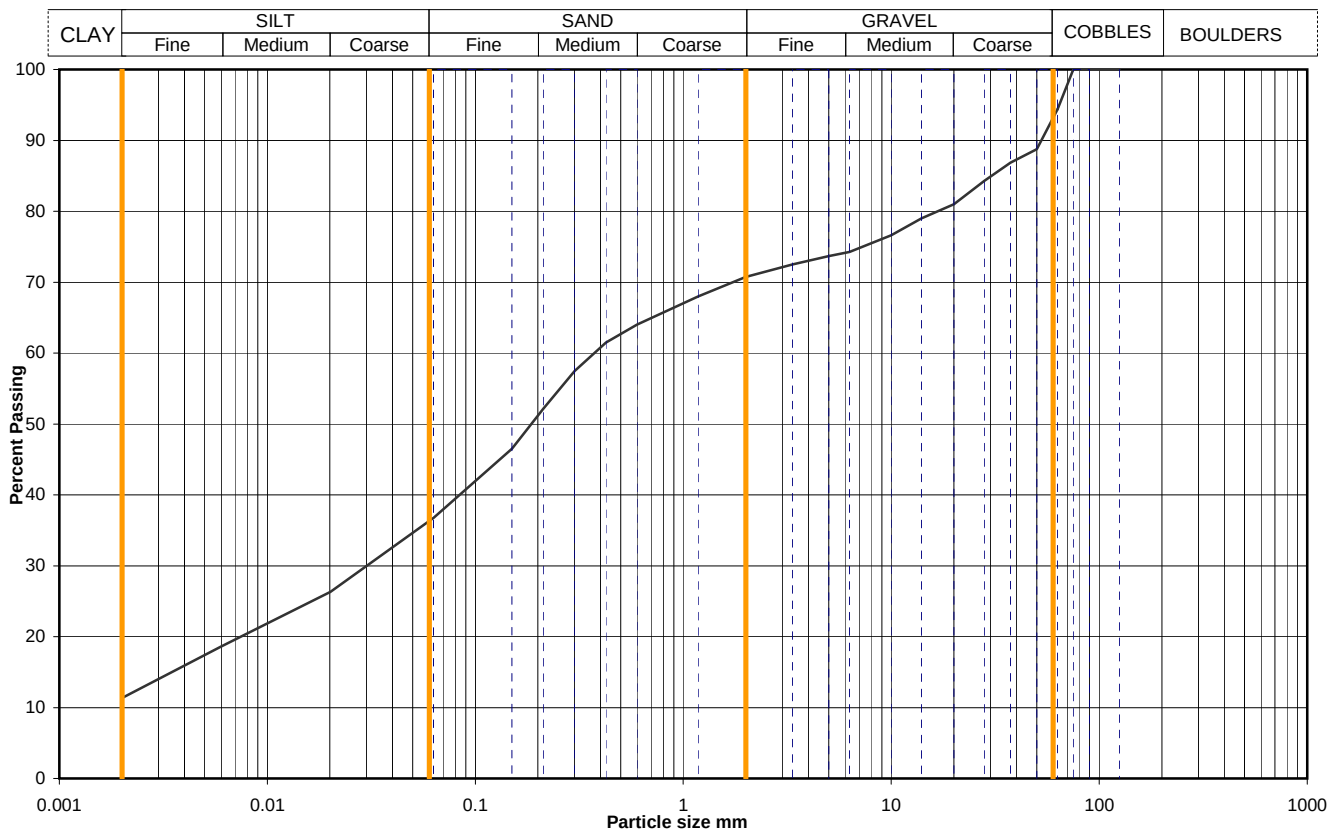
Soil description	Grey brown slightly gravelly slightly sandy CLAY with low cobble content		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions * < 60mm values to aid description only	Cobbles / boulders	Whole	* < 60mm
	Gravel	8	0
	Sand	18	20
	Silt	30	33
	Clay	30	33

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
------------------------	-------------------	----------------

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

Particle Size Distribution Analysis

Project No	H1065-11	Sample Details:	Hole No		TPE1	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.30	
			Samp No	3	Type	B
			ID	ESGH1065-1120110809966785		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	26
90	100	0.0060	19
75	100	0.0020	11
63	94		
50	89		
37.5	87		
28	84		
20	81		
14	79		
10	77		
6.3	74		
5.0	74		
3.35	73		
2.00	71		
1.18	68		
0.600	64	Particle density, Mg/m ³ 2.65 assumed	
0.425	62		
0.300	57	Dry mass of sample, kg 10.9	
0.212	52		
0.150	46		
0.063	37		

Soil description	Brown grey slightly gravelly sandy CLAY with low cobble content and rootlets		
Preparation / Pretreatment	Sieve: pre dried, Pipette: as BS1377		
Remarks			
Sample Proportions * <60mm values to aid description only	Cobbles / boulders Gravel Sand Silt Clay	Whole	* <60mm
		7	0
		22	24
		34	37
		25	27
		12	13

Uniformity Coefficient	D_{60} / D_{10}	Not applicable
------------------------	-------------------	----------------

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.4 pipette

QA Ref

SLR 2,9
Rev 88
Aug 11



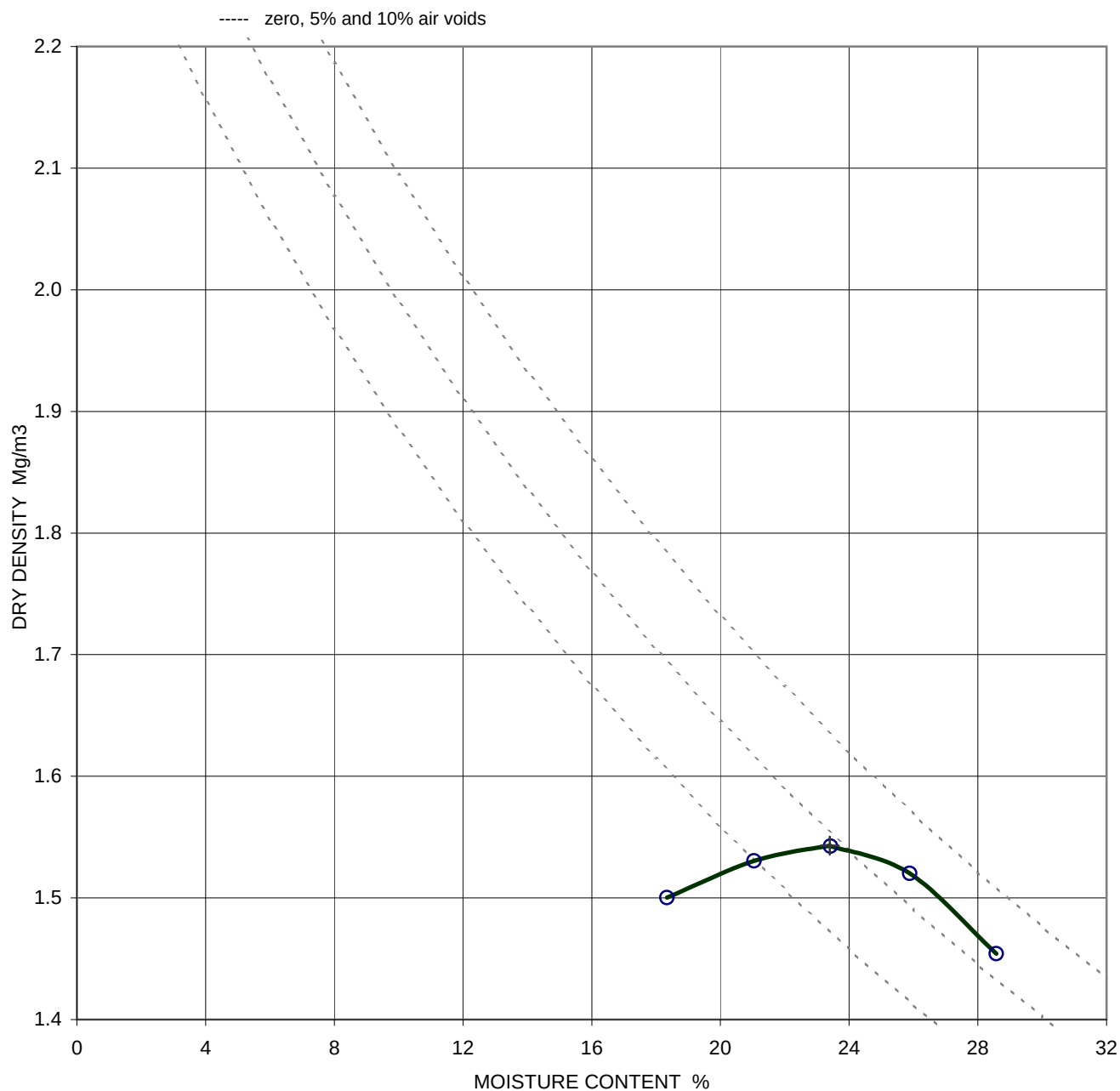
Printed: 23/09/2011 15:55

Figure

PSD 16

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP
BS1377 : PART 4 : 1990 : LIGHT COMPACTION, 2.5 kg rammer

Project No	H1065-11	Sample Details:	Hole No	TPC11		
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)	0.20		
			Samp No	4	Type	B
			ID	ESGH1065-1120110809656261		
			Spec Ref			



Soil description Brown slightly gravelly sandy SILT with rootlets

Test method BS 1377:part 4:1990: clause 3.3, 2.5 kg rammer in a 1 litre mould

Preparation Original material was natural, separate specimens tested

Material > 37.5mm 1 %

Material < 37.5mm > 20mm 4 %

Particle density, Mg/m³ 2.65 assumed

Remarks

Derived Parameters +

Maximum dry density, Mg/m³ **1.54**

Optimum moisture content, % **23**

QA Ref
SLD 4, 3.3/4
Rev 66
Aug 11

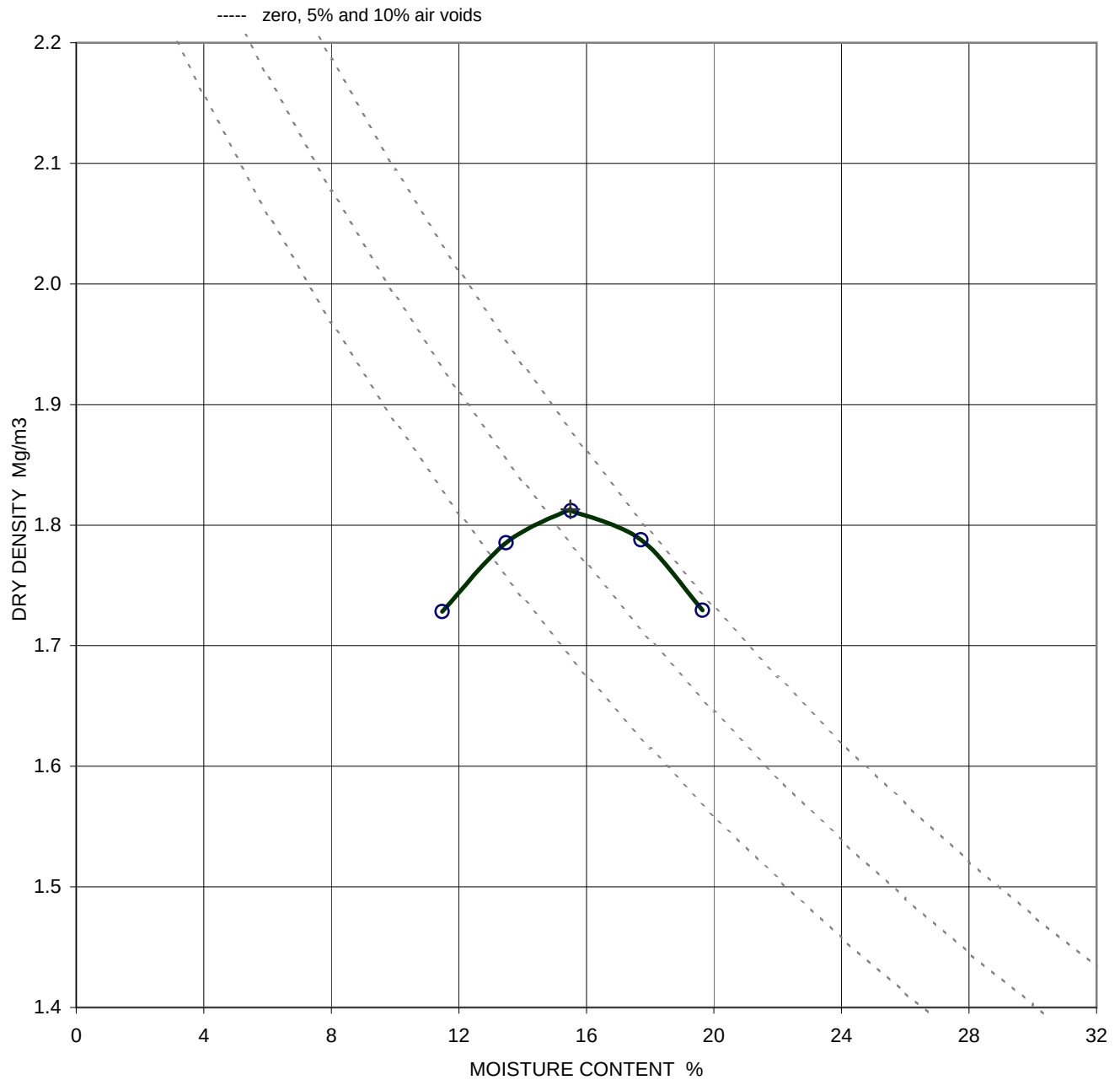


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Figure
COMPL 1

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP
BS1377 : PART 4 : 1990 : LIGHT COMPACTION, 2.5 kg rammer

Project No	H1065-11	Sample Details:	Hole No		TPC2	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.60	
			Samp No	5	Type	B
			ID	ESGH1065-1120110809401758		
			Spec Ref			



Soil description Brown slightly gravelly sandy CLAY

Test method BS 1377:part 4:1990: clause 3.3, 2.5 kg rammer in a 1 litre mould

Preparation Original material was natural, single sample tested

Material > 37.5mm 2 %

Material < 37.5mm > 20mm 2 %

Particle density, Mg/m³ 2.65 assumed

Remarks

Derived Parameters +

Maximum dry density, Mg/m³ **1.81**

Optimum moisture content, % **16**

QA Ref
SLD 4, 3.3/4
Rev 66
Aug 11

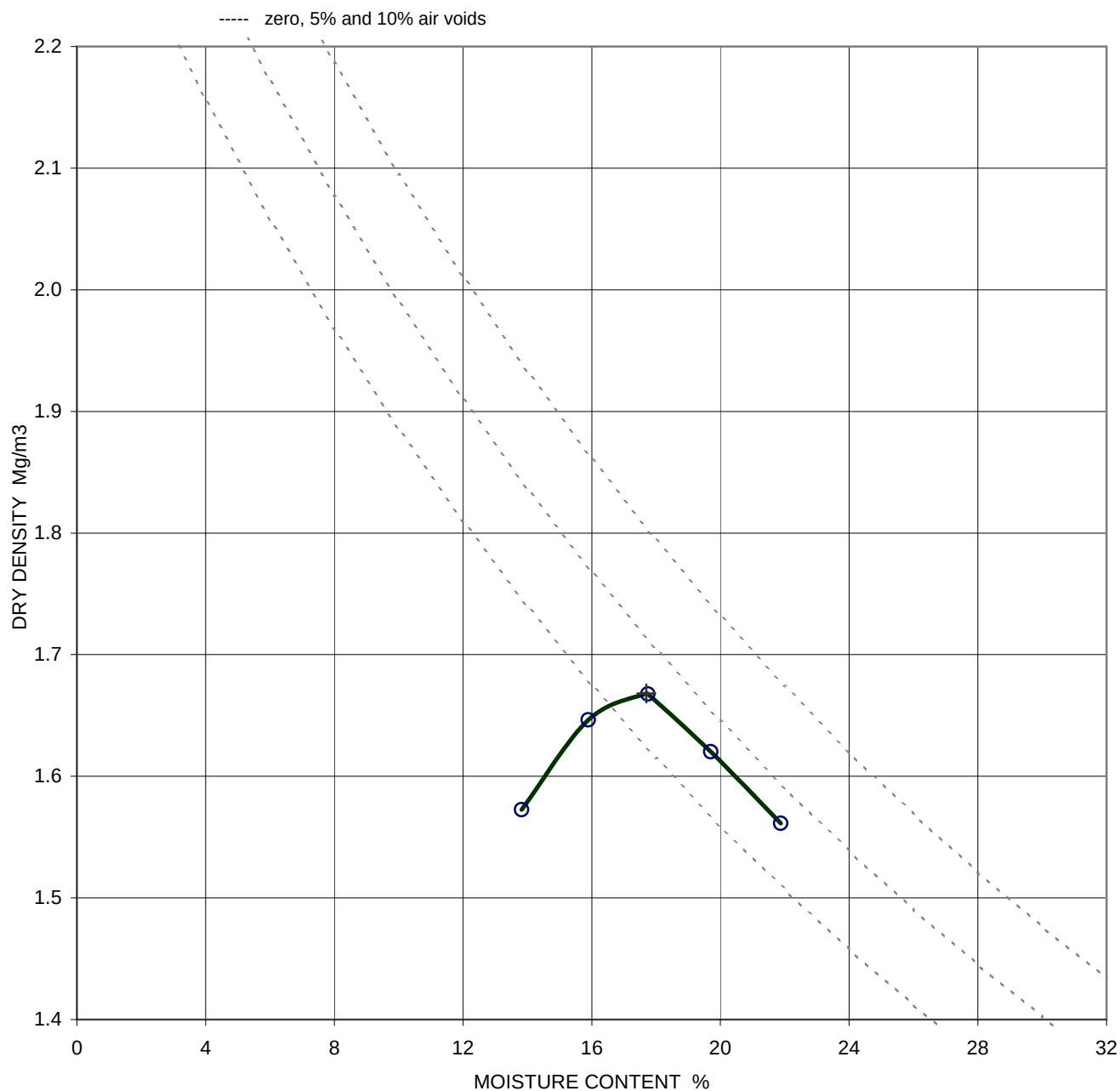


Printed:23/09/2011 15:55

Figure
COMPL 2

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP
BS1377 : PART 4 : 1990 : LIGHT COMPACTION, 2.5 kg rammer

Project No	H1065-11	Sample Details:	Hole No		TPC6	
Project Name	G.I. Works at Coed Darcy, B4290 Realignment		Depth (m BGL)		0.30	
			Samp No	4	Type	B
			ID	ESGH1065-1120110809309223		
			Spec Ref			



Soil description Brown grey orange silty very sandy GRAVEL with low cobble content

Test method BS 1377:part 4:1990: clause 3.4, 2.5 kg rammer in a CBR mould

Preparation Original material was natural, separate specimens tested

Material > 37.5mm 7 %

Material < 37.5mm > 20mm 14 %

Particle density, Mg/m³ 2.65 assumed

Remarks

Derived Parameters +

Maximum dry density, Mg/m³
1.67

Optimum moisture content, %
18

QA Ref
SLD 4, 3.3/4
Rev 66
Aug 11



Printed:23/09/2011 15:55

Figure
COMPL 3

ENCLOSURE D
GEOENVIRONMENTAL LABORATORY TEST RESULTS

ESG Scientifics Report

EFS/117280
EFS/117281
EFS/117282
EFS/117948

TEST REPORT

SOIL SAMPLE ANALYSIS



Report No. EFS/117280 (Ver. 1)

Soil Mechanics
Unit 15
Crosby Yard
Bridgend
Mid Glamorgan
CF31 1JZ

Site: G.I Works at Coed Darcy, B4290

The 20 samples described in this report were logged for analysis by Scientifics on 23-Aug-2011. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 05-Sep-2011

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited
Any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by Scientifics.

The following tables are contained in this report:

Table 1 Main Analysis Results (Pages 2 to 3)
Table of PAH (MS-SIM) (80) Results (Page 4)
Table of GRO Results (Page 5)
Table of TPH (Si) banding (std) (Page 6)
Table of TPH Texas banding (std) (Page 7)
GC-FID Chromatograms (Pages 8 to 11)
Table of Asbestos Screening Results (Page 12)
Analytical and Deviating Sample Overview (Pages 13 to 14)
Table of Method Descriptions (Page 15)
Table of Report Notes (Page 16)

On behalf of
Scientifics :
Andrew Timms

A handwritten signature in black ink, appearing to read 'Andrew Timms', is written over a faint, rectangular background.

Operations Manager

Date of Issue: 05-Sep-2011

Tests marked '^' have been subcontracted to another laboratory.

Scientifics accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.

Units : Method Codes : Method Reporting Limits : UKAS Accredited :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	pH Units		
		GROHSA	ICPACIDS	ICPBOR	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPWSS	PAHMSUS	PHSOIL		
		0.2	20	0.5	0.3	0.1	0.5	0.5	0.5	0.10	0.5	0.5	0.6	3.0	10	0.08			
		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
Laboratory ID Number	CL/ Client Sample Description	GRO (AA)	SO4-- (acid sol)	Boron (H2O Soluble)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Vanadium (MS)	Zinc (MS)	SO4-- (H2O sol) mg/l	PAH by MS,16(0.08)	pH units (AR)		
1133296	TPC9 ES 4 0.50			1.2	16.7	0.45	16.3	30.5	108.6	0.24	16.1	0.5	17.4	193.8			10.4		
1133297	TPC9 ES 7 2.00		1760	0.8	29.3	1.13	15.6	84.4	137	0.17	25.3	0.8	20.6	256.6	821		8.1		
1133298	TPD1 ES 2 0.30			<0.5	30.9	1.14	18.7	86.3	53.1	0.34	24.3	1.0	21.8	136.4			7.5		
1133299	TPD1 ES 6 1.00		255	<0.5	22.8	0.73	16.6	59.4	43.1	0.3	22.5	0.7	16.6	116.1	22		7.6		
1133300	TPD2 ES 3 0.30		259	0.9	10.2	0.24	51.8	32.5	26.3	0.21	30	0.5	26.2	81.1	105		9.3		
1133301	TPD2 ES 8 2.00			<0.5	10.0	0.22	22.5	25.1	21.4	0.54	22.4	<0.5	19.2	63.3					
1133302	TPD3 ES 1 0.10			<0.5	85.8	1.56	195.7	568.8	650.7	0.35	27.3	0.8	88.8	2666			8.2		
1133303	TPD3 ES 2 0.30																		
1133304	TPD3 ES 8 2.00		544	<0.5	28.9	0.73	41.5	102.7	78.4	0.32	23.1	0.5	34	206.4	127		8.1		
1133305	TPD5 ES 4 0.30																		
1133306	TPD5 ES 9 1.00		326	<0.5	11.1	0.15	16.4	84.1	28.5	0.16	10.4	0.9	23.1	48	38		8.2		
1133307	TPE1 ES 4 0.50			<0.5	38.4	1.56	19	100.9	65.7	1.08	23.2	0.9	30.3	182.2			5.9		
1133308	TPE1 ES 7 1.00	Req		0.8	31.2	0.91	20.7	81.2	178.3	2.12	36.5	0.8	27	147.7		Req			
1133309	TPE2 ES 1 0.10			<0.5	26.8	0.95	20	102.7	97.7	0.42	23.1	0.8	24.2	238.6			6.7		
1133310	TPE2 ES 7 1.50			<0.5	11.8	0.26	15.6	25.7	24.4	0.52	23.6	0.6	14.4	80.9	88		7.7		
1133311	WSD1 ES 1 0.30			<0.5	11.7	0.4	13.3	68	32.4	<0.1	24.4	<0.5	16.8	155.4			8.5		
1133312	WSD1 ES 6 1.50		219	<0.5	8.8	0.1	15.4	18.8	14.8	<0.1	22	<0.5	14.7	58.6	47		7.2		
1133313	WSD2 ES 1 0.60			<0.5	19.5	0.55	14.1	64.1	40.8	0.72	23.1	0.5	14.5	92.9					
1133314	WSD2 ES 4 1.50		190	<0.5	7.1	0.12	17.4	9.8	11.5	0.41	14.3	<0.5	18	30.3	27		6.2		
1133315	WSD2 ES 6 2.50			<0.5	6.1	0.13	17.3	9.2	10.5	0.25	27.9	<0.5	12.6	58.4					
scientifics Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Client Name		Soil Mechanics							Soils Sample Analysis								
		Contact		Mr A Figgis															
		G.I Works at Coed Darcy, B4290									Date Printed		05-Sep-11						
											Report Number		EFS/117280						
											Table Number		1						

Units : Method Codes : Method Reporting Limits : UKAS Accredited :			mg/kg	mg/kg	mg/kg	mg/kg													
		Sub002a	TPHFIDUS	TPHFIDUS	TPHFIDUS	TPHUSSI													
			10.0	10.0	10.0	10.0													
		yes	yes	yes	yes	yes													
Laboratory ID Number	CL/	Client Sample Description	Asbestos Screen	DRO (C10-C25) EA	TPH by GC/FID (AR)	TPH Carbon Banding.	TPH by GC/FID (AR/SI)												
1133296		TPC9 ES 4 0.50	Req																
1133297		TPC9 ES 7 2.00																	
1133298		TPD1 ES 2 0.30																	
1133299		TPD1 ES 6 1.00																	
1133300		TPD2 ES 3 0.30																	
1133301		TPD2 ES 8 2.00		37	204	Req													
1133302		TPD3 ES 1 0.10																	
1133303		TPD3 ES 2 0.30	Req																
1133304		TPD3 ES 8 2.00																	
1133305		TPD5 ES 4 0.30	Req																
1133306		TPD5 ES 9 1.00																	
1133307		TPE1 ES 4 0.50	CH																
1133308		TPE1 ES 7 1.00					Req												
1133309		TPE2 ES 1 0.10																	
1133310		TPE2 ES 7 1.50																	
1133311		WSD1 ES 1 0.30																	
1133312		WSD1 ES 6 1.50																	
1133313		WSD2 ES 1 0.60	Req																
1133314		WSD2 ES 4 1.50																	
1133315		WSD2 ES 6 2.50		<10.0	11.0	Req													
 Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422			Client Name		Soil Mechanics						Soils Sample Analysis								
			Contact		Mr A Figgis														
			G.I Works at Coed Darcy, B4290									Date Printed		05-Sep-11					
												Report Number		EFS/117280					
												Table Number		1					

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details:	Soil Mechanics: G.I Works at Coed Darcy, B4290		
Sample Details:	TPE1 ES 7 1.00	Job Number:	S11_7280
LIMS ID Number:	CL1133308	Date Booked in:	23-Aug-11
QC Batch Number:	111742	Date Extracted:	31-Aug-11
Quantitation File:	Initial Calibration	Date Analysed:	31-Aug-11
Directory:	2611PAH.GC5\	Matrix:	Soil
Dilution:	1.0	Ext Method:	Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.63	0.33	89
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	4.84	0.10	74
Fluorene	86-73-7	5.26	0.23	76
Phenanthrene	85-01-8	6.18	0.76	93
Anthracene	120-12-7	6.24	0.08	91
Fluoranthene	206-44-0	7.63	1.50	99
Pyrene	129-00-0	7.93	1.30	96
Benzo[a]anthracene	56-55-3	9.68	1.03	91
Chrysene	218-01-9	9.73	0.94	100
Benzo[b]fluoranthene	205-99-2	11.24	1.66	93
Benzo[k]fluoranthene	207-08-9	11.28	0.54	91
Benzo[a]pyrene	50-32-8	11.68	1.04	94
Indeno[1,2,3-cd]pyrene	193-39-5	13.15	0.93	97
Dibenzo[a,h]anthracene	53-70-3	13.18	0.28	62
Benzo[g,h,i]perylene	191-24-2	13.53	0.89	94
Total (USEPA16) PAHs	-	-	< 11.69	-

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	97
Phenanthrene-d10	91
Chrysene-d12	92
Perylene-d12	107

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	107

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Soil Mechanics : G.I Works at Coed Darcy, B4290
Job Number: s11_7280
Directory: D:\TES\DATA\Y2011\0831HSA_GC9\083111 2011-08-31 16-43-41\028F2801.D
Method: Headspace GCFID

Matrix: Soil
Date Booked in: 23-Aug-11
Date extracted: 31-Aug-11
Date Analysed: 01-Sep-11, 01:2

* Sample data with an asterisk are not UKAS accredited.

[illegible]

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details:	Soil Mechanics : G.I Works at Coed Darcy, B4290	
Job Number:	S11_7280	Soil
QC Batch Number:	111742	Element
Directory:	D:\TESIDATA\Y2011\AUG2011\0830TPH_GC3\071B2901.D	
Method:	Ultra Sonic	

Separation: Silica gel
Eluents: Hexane, DCM

Matrix:	Soil
Date Booked in	23-Aug-11
Date Extracted:	30-Sep-11
Date Analysed:	30-Aug-11

*** This sample data is not UKAS accredited.**

[illegible]

Total Petroleum Hydrocarbons (TPH) Carbon Ranges

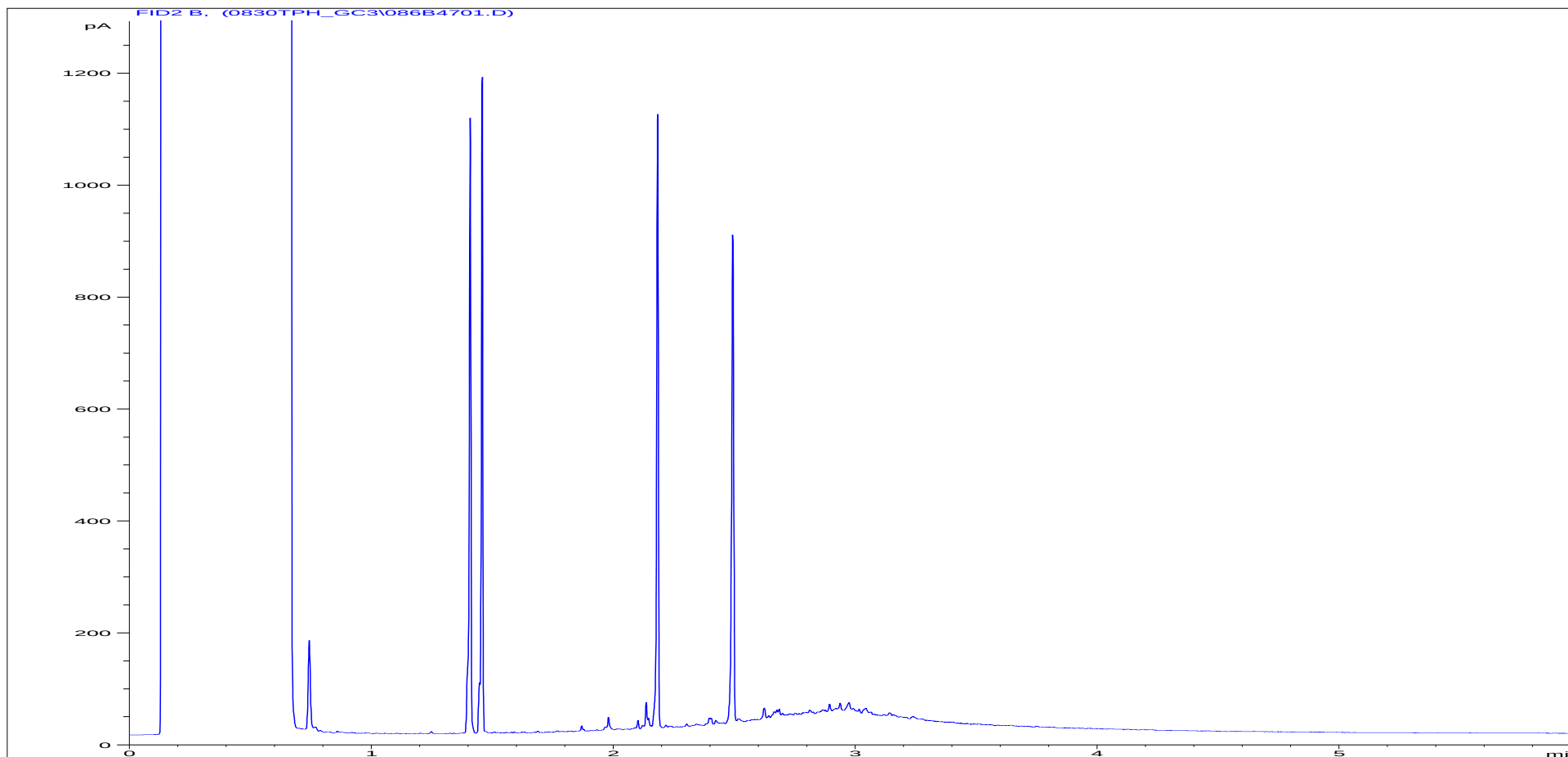
Customer and Site Details:	Soil Mechanics : G.I Works at Coed Darcy, B4290
Job Number:	S11_7280
QC Batch Number:	111742
Directory:	D:\TES\DATA\Y2011\AUG2011\0830TPH_GC3\087B4801.D
Method:	Ultra Sonic

Matrix:	Soil
Date Booked in:	23-Aug-11
Date Extracted:	30-Aug-11
Date Analysed:	30-Aug-11

* Sample data with an asterisk are not UKAS accredited.

[illegible]

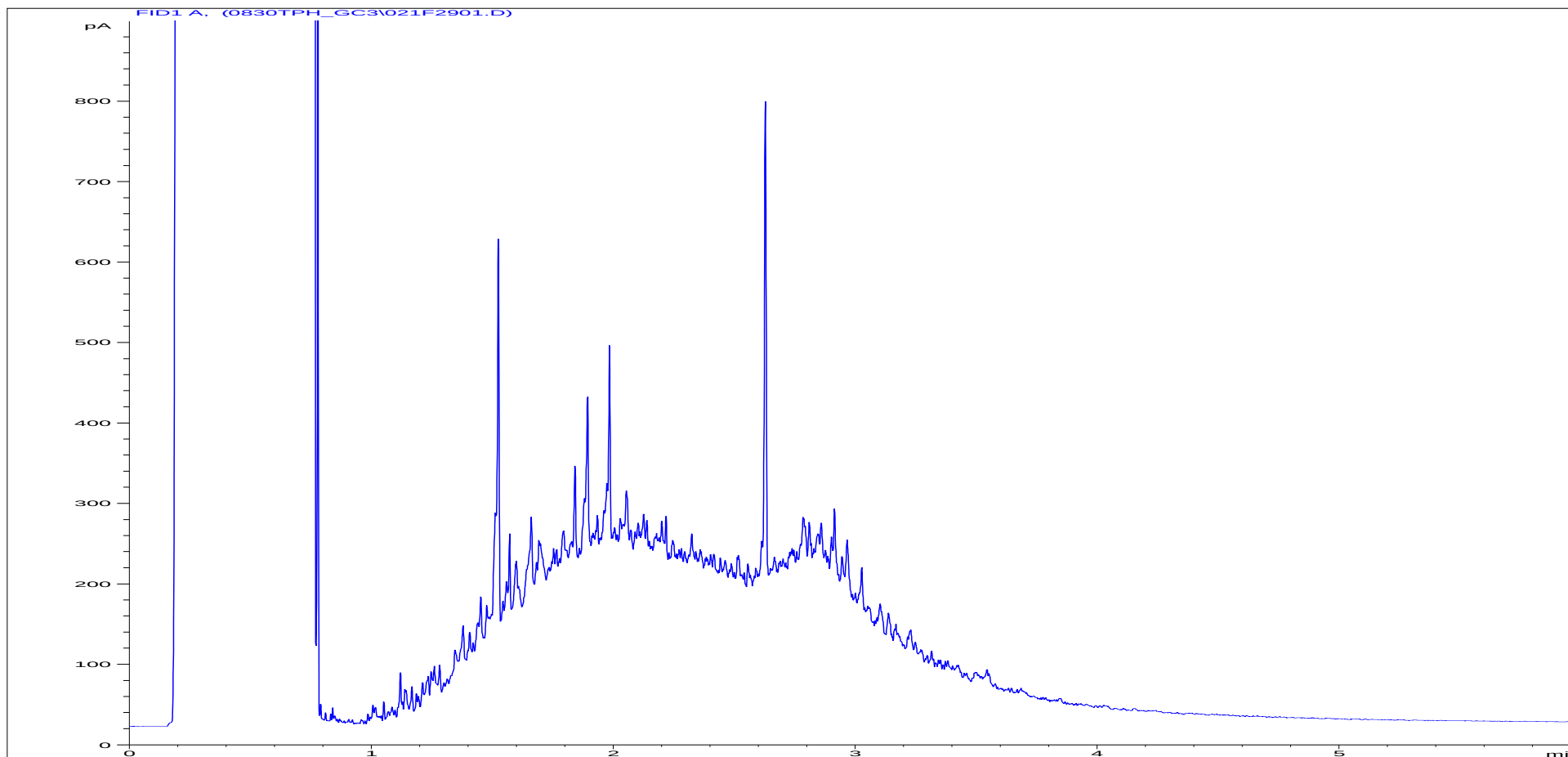
Petroleum Hydrocarbons (C8 to C40) by GC/FID



Sample ID:	CL1133301	Job Number:	S11_7280
Multiplier:	8	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	TPD2 ES 8 2.00
Acquisition Date/Time:	30-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0830TPH_GC3\086B4701.D		

Where individual results are flagged see report notes for status.

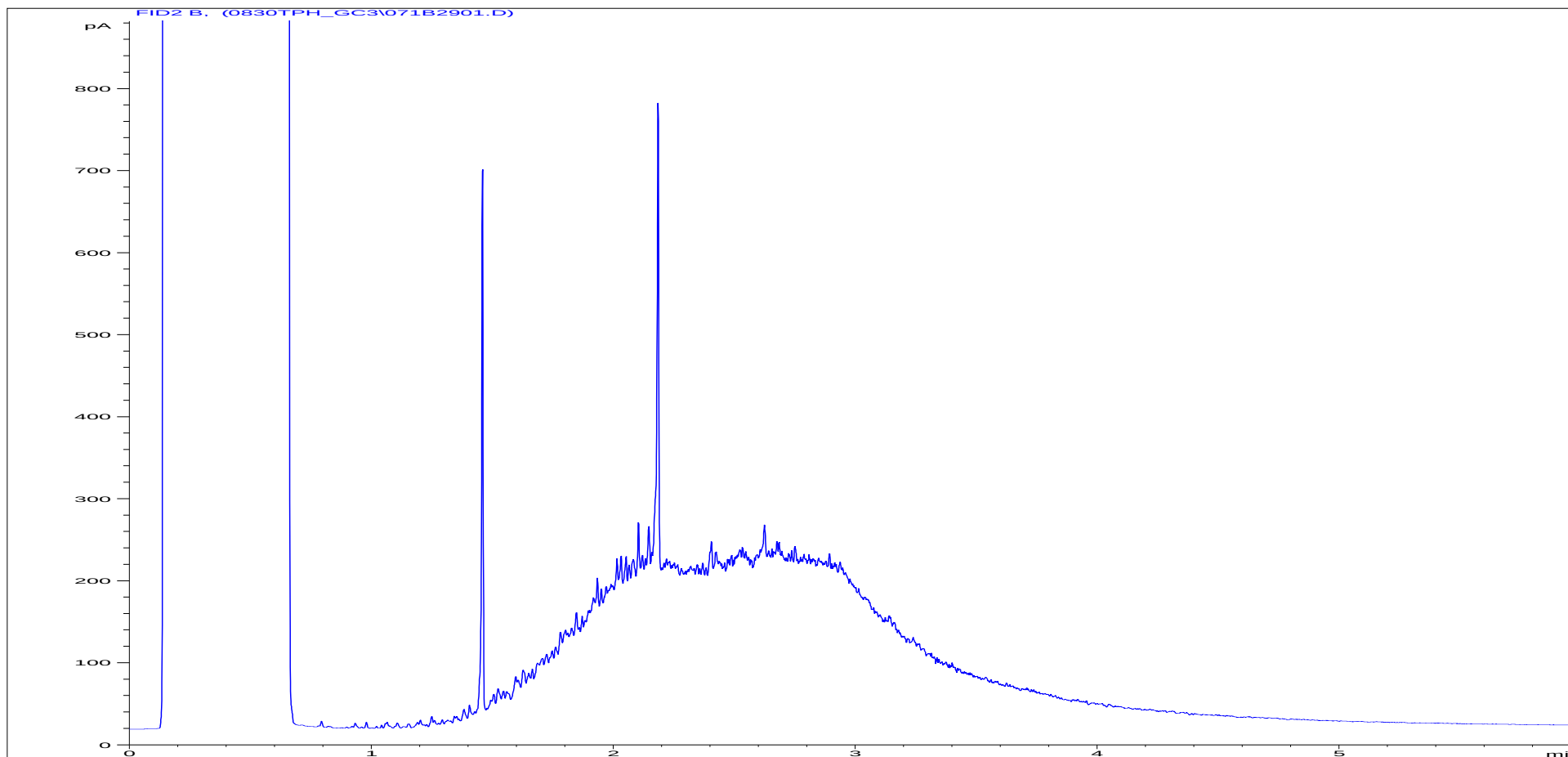
Petroleum Hydrocarbons (C8 to C40) by GC/FID Aliphatics Fraction.



Sample ID:	CL1133308ALI	Job Number:	S11_7280
Multiplier:	14.82	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	TPE1 ES 7 1.00
Acquisition Date/Time:	30-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0830TPH_GC3\021F2901.D		

Where individual results are flagged see report notes for status.

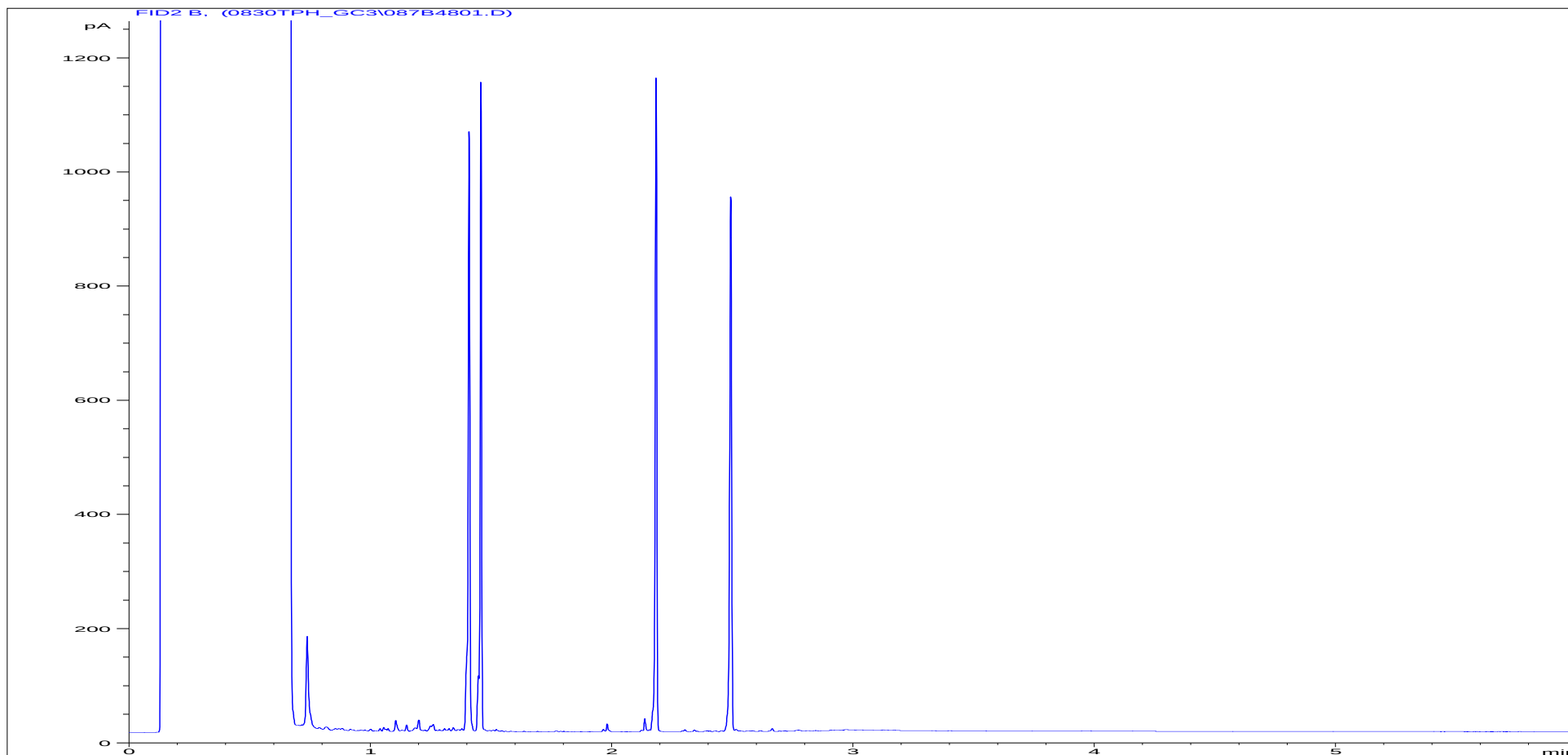
Petroleum Hydrocarbons (C8 to C40) by GC/FID Aromatics Fraction.



Sample ID:	CL1133308ARO	Job Number:	S11_7280
Multiplier:	11.4	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	TPE1 ES 7 1.00
Acquisition Date/Time:	30-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0830TPH_GC3\071B2901.D		

Where individual results are flagged see report notes for status.

Petroleum Hydrocarbons (C8 to C40) by GC/FID



Sample ID:	CL1133315	Job Number:	S11_7280
Multiplier:	8	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSD2 ES 6 2.50
Acquisition Date/Time:	30-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0830TPH_GC3\087B4801.D		

Where individual results are flagged see report notes for status.

ASBESTOS ANALYSIS RESULTS - SOIL ANALYSIS

Client: Scientifics Environmental Chemistry

Page 1 of 1

Address: Etwall House, Bretby Business Park, Ashby Road, Burton upon Trent

Report No: ANO-0488-1994

For the attention of : Soil Mechanics

Report Date: 01/09/2011

Site Address: G.I Works at Coed Darcy, B4290

Project Number:S117280

[illegible]

*Sampling carried out by client ** Detection limit advised by client

The sample analysis for the above results was carried out using the procedures detailed in ESG Asbestos Limited in house method (SCI-ASB-020) based on HSE document MDHS 90 - Asbestos Contaminated Land - Draft 5 - November 1997 (withdrawn). Fibre identification was carried out using ESG Asbestos Limited in house method of transmitted/polarised light microscopy and centre stop dispersion staining (SCI-ASB-007), based on HSE's HSG 248. The analysis of fine fraction for asbestos content only includes fibres and does not discriminate non-asbestos fibres. All fibres are assumed, unless specified, to be amphiboles. All tests were carried out at ESG Asbestos Laboratory, Derwent House, Bretby Business Park, Ashby Road, Burton-upon-Trent, Staffordshire. DE15 0XD. UKAS Laboratory Number 1089.

Key

Authorised Signatory:

Name:

Andrew Elsby

NADIS = No Asbestos Detected in Sample

Position:

Regional Manager

ESG Asbestos Limited is a wholly owned subsidiary of Environmental Scientifics Group Limited (ESG), registered in England and Wales, registered company 04951688.

Where individual results are flagged see report notes for status.

S117280

Report Due 05-Sep-2011

Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - Note: due date may be affected if triggered
	No analysis scheduled
	Analysis Subcontracted

Customer
Site
Report No

Soil Mechanics
G.I Works at Coed Darcy, B4290
S117280

Consignment No 22701
Date Logged 23-Aug-2011
Report Due 05-Sep-2011

ID Number	Description	MethodID	Sampled	CustServ	Dep Opt	GROHSA	ICPACIDS	ICPBOR	ICPMSS	ICPWSS	KONECR	PAHMSUS	PHSOIL	Sub002a	TPHFUS	TPHUSI	TPH by GC/FID (AR/Si)
																	TPH Carbon Banding
					DO Cr6 if Cr>365	GRO (AA)	SO4-- (acid sol)	Boron (H2O Soluble)	Arsenic (MS)		Chromium vi:	PAH by MS.16(0.08)	pH units (AR)	Asbestos (screen)	DRO (C10-C25)	TPH by GC/FID (AR)	TPH by GC/FID (AR/Si)

Note: For analysis where the Report Due date is greater than 7 days (PAH, Pesticides, PCB, Phenols, Herbicides) or 2 days (BOD) after the sampling date, although we will do our utmost to prioritise your samples, they may become deviant whilst being processed in the Laboratory.

In this instance, please contact the Laboratory immediately should you wish to discuss how you would like us to proceed. If you do not respond within 24 hours, we will proceed as originally requested.

Deviating Sample Key

A The sample was received in an inappropriate container for this analysis
B The sample was received without the correct preservation for this analysis
C Headspace present in the sample container
D The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E Sample processing did not commence within the appropriate holding time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - **Note: due date may be affected if triggered**

No analysis scheduled

Analysis Subcontracted

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	GROHSA	As Received	Determination of Total Gasoline Range Organics Hydrocarbons (GRO) by Headspace GCFID
Soil	ICPACIDS	Air Dried	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPBOR	Air Dried	Determination of Boron in soil samples by hot water extraction followed by ICPOES detection
Soil	ICPMSS	Air Dried	Determination of Metals in soil samples by aqua regia digestion followed by ICPMS
Soil	ICPWSS	Air Dried	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	SubCon*	*	Contact Laboratory for details of the methodology used by the sub-contractor.
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	TPHUSSI	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection including quantitation of Aromatic and Aliphatic fractions.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on an air dried basis
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile

CR Denotes Crocidolite

AM Denotes Amosite

NAIIS No Asbestos Identified in Sample

Symbol Reference

[^] Sub-contracted analysis. Note: The accreditation status is that assigned by the subcontract laboratory.

\$\$ Unable to analyse due to the nature of the sample

¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

¥ Results for guidance only due to possible interference

& Blank corrected result

I.S Insufficient sample to complete requested analysis

I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined

N.Det Not detected

Req Analysis requested, see attached sheets for results

▯ Raised detection limit due to nature of the sample

***** All accreditation has been removed by the laboratory for this result

‡ MCERTS accreditation has been removed for this result

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

END OF REPORT

Where individual results are flagged see report notes for status.

TEST REPORT

SOIL SAMPLE ANALYSIS



Report No. EFS/117281 (Ver. 1)

Soil Mechanics
Unit 15
Crosby Yard
Bridgend
Mid Glamorgan
CF31 1JZ

Site: G.I Works at Coed Darcy, B4290

The 19 samples described in this report were logged for analysis by Scientifics on 23-Aug-2011. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 02-Sep-2011

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited
Any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by Scientifics.

The following tables are contained in this report:

Table 1 Main Analysis Results (Pages 2 to 3)
Table of TPH Texas banding (std) (Page 4)
GC-FID Chromatograms (Page 5)
Table of Asbestos Screening Results (Page 6)
Analytical and Deviating Sample Overview (Pages 7 to 8)
Table of Method Descriptions (Page 9)
Table of Report Notes (Page 10)

On behalf of
Scientifics :
Andrew Timms

A handwritten signature in black ink, appearing to read 'Andrew Timms', is written over a faint, rectangular background.

Operations Manager

Date of Issue: 02-Sep-2011

Tests marked '^' have been subcontracted to another laboratory.

Scientifics accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.

Units : Method Codes : Method Reporting Limits : UKAS Accredited :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	pH Units		mg/kg	
		ICPACIDS	ICPBOR	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPWSS	PHSOIL	Sub002a	TPHFIDUS	
		20	0.5	0.3	0.1	0.5	0.5	0.5	0.10	0.5	0.5	0.5	0.6	3.0	10		10.0	
		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
Laboratory ID Number	CL/ Client Sample Description	SO4-- (acid sol)	Boron (H2O Soluble)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Vanadium (MS)	Zinc (MS)	SO4-- (H2O sol) mg/l	pH units (AR)	Asbestos Screen	DRO (C10-C25) EA	
1133316	TPC1 ES 3 0.50		1.5	10.9	0.37	14.0	18.1	137.5	<0.1	14.9	<0.5	20.7	105.2		8.9			
1133317	TPC1 ES 7 2.00	807												184	7.8			
1133321	TPC2 ES 1 0.10		<0.5	13.2	0.34	17.6	28.4	213.2	<0.1	19.6	0.6	23.4	98.5		9.0	Req		
1133322	TPC2 ES 6 1.00	604												146	7.8			
1133323	TPC2 ES 9 3.10		<0.5	8.3	0.19	13.1	16.6	16.9	<0.1	24.8	<0.5	12.4	62.5				62	
1133324	TPC3 ES 2 0.30		<0.5	35.6	1.27	17	67.8	481.7	<0.1	20.4	0.5	20.7	927.9		8.0	CH		
1133325	TPC3 ES 8 2.00	828	<0.5	10.3	0.22	16.9	23.5	26.5	<0.1	20.1	0.8	17.3	89	149	6.9			
1133326	TPC4 ES 2 0.30		<0.5	26.5	0.94	58.6	80.1	171.6	0.11	28.5	0.6	55.8	311.2		11.2			
1133327	TPC4 ES 5 1.00		<0.5	15.8	0.47	33.7	43	67.7	<0.1	24.4	0.5	23.7	127.3		10.5			
1133328	TPC5 ES 2 0.30		<0.5	16.5	0.54	17.4	37.9	80	<0.1	20.3	0.6	20.9	177.1		9.1	Req		
1133329	TPC5 ES 3 0.50		<0.5	18.8	0.75	26.8	64.8	167.9	<0.1	19.9	0.8	23	416.2		8.5			
1133330	TPC5 ES 6 2.00	472												72	8.2			
1133331	TPC6 ES 2 0.30		<0.5	10.3	0.37	15.0	19.1	98.2	<0.1	14.6	<0.5	17.7	171.6		11.2	AM		
1133332	TPC7 ES 3 0.30		<0.5	33.8	2.3	15.0	144.5	672	0.14	22.7	0.9	17.8	2850		9.5			
1133333	TPC8 ES 1 0.10		<0.5	18.9	0.89	15.6	61.9	1418	<0.1	19.1	0.8	18.4	359.8		8.5			
1133334	TPC8 ES 4 0.50		<0.5	13.3	0.5	13.6	27	155.9	<0.1	15.6	0.5	16.7	226.1		8.4			
1133318	TPC10 ES 3 0.30		<0.5	11.5	0.18	13.7	19.5	23.8	<0.1	20.1	<0.5	14.8	62.6		7.8	Req		
1133319	TPC10 ES 5 0.50	514	<0.5	10.0	0.16	14.2	21.5	23	<0.1	19.9	<0.5	13.6	64.1	113	8.2			
1133320	TPC11 ES 3 0.30		<0.5	16.6	0.71	16.8	51.1	89.5	0.19	26.8	<0.5	20	151.8		7.8	Req		
scientifics Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Client Name		Soil Mechanics							Soils Sample Analysis							
		Contact		Mr A Figgis														
		G.I Works at Coed Darcy, B4290										Date Printed		02-Sep-11				
												Report Number		EFS/117281				
												Table Number		1				

[illegible]

Total Petroleum Hydrocarbons (TPH) Carbon Ranges

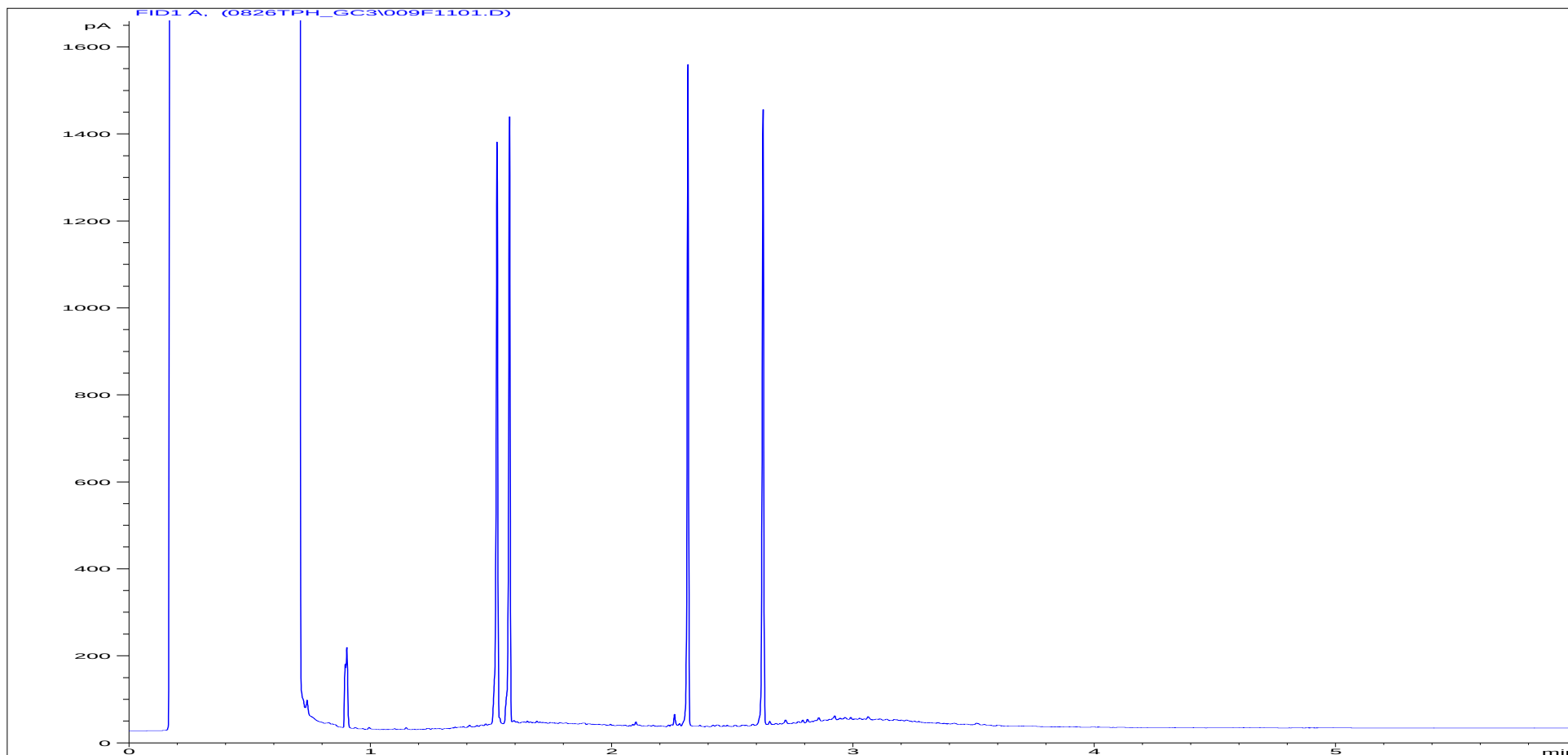
Customer and Site Details: Soil Mechanics : G.I Works at Coed Darcy, B4290
Job Number: S11_7281
QC Batch Number: 111732
Directory: D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\009F1101.D
Method: Ultra Sonic

Matrix:	Soil
Date Booked in:	23-Aug-11
Date Extracted:	25-Aug-11
Date Analysed:	26-Aug-11

*** Sample data with an asterisk are not UKAS accredited.**

[illegible]

Petroleum Hydrocarbons (C8 to C40) by GC/FID



Sample ID:	CL1133323	Job Number:	S11_7281
Multiplier:	8	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	TPC2 ES 9 3.10
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\009F1101.D		

Where individual results are flagged see report notes for status.

ASBESTOS ANALYSIS RESULTS - SOIL ANALYSIS

Client: Scientifics Environmental Chemistry

Page 1 of 1

Address: Etwall House, Bretby Business Park, Ashby Road, Burton upon Trent

Report No: ANO-0488-1995

For the attention of : Soil Mechanics

Report Date: 01/09/2011

Site Address: G.I Works at Coed Darcy, B4290

Project Number:S117281

[illegible]

*Sampling carried out by client ** Detection limit advised by client

The sample analysis for the above results was carried out using the procedures detailed in ESG Asbestos Limited in house method (SCI-ASB-020) based on HSE document MDHS 90 - Asbestos Contaminated Land - Draft 5 - November 1997 (withdrawn). Fibre identification was carried out using ESG Asbestos Limited in house method of transmitted/polarised light microscopy and centre stop dispersion staining (SCI-ASB-007), based on HSE's HSG 248. The analysis of fine fraction for asbestos content only includes fibres and does not discriminate non-asbestos fibres. All fibres are assumed, unless specified, to be amphiboles. All tests were carried out at ESG Asbestos Laboratory, Derwent House, Bretby Business Park, Ashby Road, Burton-upon-Trent, Staffordshire. DE15 0XD. UKAS Laboratory Number 1089.

Key

Authorised Signatory:

Name:

Andrew Elsby

NADIS = No Asbestos Detected in Sample

Position:

Regional Manager

ESG Asbestos Limited is a wholly owned subsidiary of Environmental Scientifics Group Limited (ESG), registered in England and Wales, registered company 04951688.

Where individual results are flagged see report notes for status.

Customer Soil Mechanics
Site G.I Works at Coed Darcy, B4290
Report No S117281

Consignment No 22639
Date Logged 23-Aug-2011

Report Due 05-Sep-2011

ID Number	Description	MethodID	CustServ	Dep.Opt	ICPACIDS	ICPBOR	ICPMSS	ICPWSS	KONECR	PHSOIL	Sub002a	TPHFDUS	PH Carbon Banding
													TPH by GC/FID (AR)
Accredited to ISO17025													✓
CL/1133316	TPC1 0.5	30/12/11	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
CL/1133317	TPC1 2.0	30/12/11	✓										
CL/1133318	TPC10 0.3	30/12/11	✓										
CL/1133319	TPC10 0.5	30/12/11	✓										
CL/1133320	TPC11 0.3	30/12/11	✓										
CL/1133321	TPC2 0.1	30/12/11	✓										
CL/1133322	TPC2 1.0	30/12/11	✓										
CL/1133323	TPC2 3.1	30/12/11	✓									E	E
CL/1133324	TPC3 0.3	30/12/11	✓										
CL/1133325	TPC3 2.0	30/12/11	✓										
CL/1133326	TPC4 0.3	30/12/11	✓										
CL/1133327	TPC4 1.0	30/12/11	✓										
CL/1133328	TPC5 0.3	30/12/11	✓										
CL/1133329	TPC5 0.5	30/12/11	✓										
CL/1133330	TPC5 2.0	30/12/11	✓										

Note: For analysis where the Report Due date is greater than 7 days (PAH, Pesticides, PCB, Phenols, Herbicides) or 2 days (BOD) after the sampling date, although we will do our utmost to prioritise your samples, they may become deviant whilst being processed in the Laboratory.

In this instance, please contact the Laboratory immediately should you wish to discuss how you would like us to proceed. If you do not respond within 24 hours, we will proceed as originally requested.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- B The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised - applicable to all analysis
- E Sample processing did not commence within the appropriate holding time

Requested Analysis Key

- Analysis Required
- Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
- No analysis scheduled
- Analysis Subcontracted

Where individual results are flagged see report notes for status

Customer
Site
Report No

Soil Mechanics
G.I Works at Coed Darcy, B4290
S117281

Consignment No 22639
Date Logged 23-Aug-2011
Report Due 05-Sep-2011

ID Number	Description	MethodID	Sampled	TPH Carbon Banding	TPH by GC/FID (AR)	DRO (C10-C25)	Asbestos (screen)	pH units (AR)	Chromium vi:	SO4-- (H2O sol) mg/l	Zinc (MS)	Vanadium (MS)	Selenium (MS)	Nickel (MS)	Mercury (MS)	Lead (MS)	Copper (MS)	Chromium (MS)	Cadmium (MS)	Arsenic (MS)	Boron (H2O Soluble)	SO4-- (acid sol)	DO Cr6 if Cr<365	Report B	CustServ

Note: For analysis where the Report Due date is greater than 7 days (PAH, Pesticides, PCB, Phenols, Herbicides) or 2 days (BOD) after the sampling date, although we will do our utmost to prioritise your samples, they may become deviant whilst being processed in the Laboratory.

In this instance, please contact the Laboratory immediately should you wish to discuss how you would like us to proceed. If you do not respond within 24 hours, we will proceed as originally requested.

Deviating Sample Key

A The sample was received in an inappropriate container for this analysis
B The sample was received without the correct preservation for this analysis
C Headspace present in the sample container
D The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E Sample processing did not commence within the appropriate holding time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - **Note: due date may be affected if triggered**

No analysis scheduled

Analysis Subcontracted

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Air Dried	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPBOR	Air Dried	Determination of Boron in soil samples by hot water extraction followed by ICPOES detection
Soil	ICPMSS	Air Dried	Determination of Metals in soil samples by aqua regia digestion followed by ICPMS
Soil	ICPWSS	Air Dried	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	SubCon*	*	Contact Laboratory for details of the methodology used by the sub-contractor.
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GC/FID detection.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on an air dried basis
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile

CR Denotes Crocidolite

AM Denotes Amosite

NAIIS No Asbestos Identified in Sample

Symbol Reference

[^] Sub-contracted analysis. Note: The accreditation status is that assigned by the subcontract laboratory.

\$\$ Unable to analyse due to the nature of the sample

¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

¥ Results for guidance only due to possible interference

& Blank corrected result

I.S Insufficient sample to complete requested analysis

I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined

N.Det Not detected

Req Analysis requested, see attached sheets for results

▯ Raised detection limit due to nature of the sample

***** All accreditation has been removed by the laboratory for this result

‡ MCERTS accreditation has been removed for this result

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

END OF REPORT

Where individual results are flagged see report notes for status.

TEST REPORT

SOIL SAMPLE ANALYSIS



Report No. EFS/117282 (Ver. 1)

Soil Mechanics
Unit 15
Crosby Yard
Bridgend
Mid Glamorgan
CF31 1JZ

Site: G.I Works at Coed Darcy, B4290

The 5 samples described in this report were logged for analysis by Scientifics on 23-Aug-2011. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 02-Sep-2011

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by Scientifics.

The following tables are contained in this report:

Table 1 Main Analysis Results (Pages 2 to 3)
Table of PAH (MS-SIM) (80) Results (Pages 4 to 5)
Table of GRO Results (Page 6)
Table of TPH (Si) banding (std) (Page 7)
Table of TPH Texas banding (std) (Page 8)
GC-FID Chromatograms (Pages 9 to 13)
Table of Asbestos Screening Results (Page 14)
Analytical and Deviating Sample Overview (Page 15)
Table of Method Descriptions (Page 16)
Table of Report Notes (Page 17)

On behalf of
Scientifics :
Andrew Timms

A handwritten signature in black ink, appearing to read 'Andrew Timms', is written over a faint, larger signature.

Operations Manager

Date of Issue: 02-Sep-2011

Tests marked '^' have been subcontracted to another laboratory.

Scientifics accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.

[illegible]

[illegible]

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details:	Soil Mechanics: G.I Works at Coed Darcy, B4290		
Sample Details:	WSE1 ES 5 1.50	Job Number:	S11_7282
LIMS ID Number:	CL1133336	Date Booked in:	23-Aug-11
QC Batch Number:	111735	Date Extracted:	25-Aug-11
Quantitation File:	Initial Calibration	Date Analysed:	26-Aug-11
Directory:	2511PAH.GC5\	Matrix:	Soil
Dilution:	1.0	Ext Method:	Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.66	0.58	M
Acenaphthylene	208-96-8	4.73	0.45	M
Acenaphthene	83-32-9	4.86	1.47	72
Fluorene	86-73-7	5.28	2.11	80
Phenanthrene	85-01-8	6.21	3.69	94
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 9.18	-

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	104
Acenaphthene-d10	106
Phenanthrene-d10	108
Chrysene-d12	115
Perylene-d12	99

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	93
Terphenyl-d14	110

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details:	Soil Mechanics: G.I Works at Coed Darcy, B4290		
Sample Details:	WSE2 ES 6 2.00	Job Number:	S11_7282
LIMS ID Number:	CL1133338	Date Booked in:	23-Aug-11
QC Batch Number:	111735	Date Extracted:	25-Aug-11
Quantitation File:	Initial Calibration	Date Analysed:	26-Aug-11
Directory:	2511PAH.GC5\	Matrix:	Soil
Dilution:	1.0	Ext Method:	Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	107
Acenaphthene-d10	103
Phenanthrene-d10	106
Chrysene-d12	111
Perylene-d12	93

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	101
Terphenyl-d14	114

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Soil Mechanics : G.I Works at Coed Darcy, B4290
Job Number: S11_7282
Directory: D:\TES\DATA\Y2011\0901HSA_GC12\090111 2011-09-01 06-01-18\116B1601.D
Method: Headspace GCFID

Matrix: Soil
Date Booked in: 23-Aug-11
Date extracted: 01-Sep-11
Date Analysed: 01-Sep-11, 10:5

* Sample data with an asterisk are not UKAS accredited.

[illegible]

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details:	Soil Mechanics : G.I Works at Coed Darcy, B4290	
Job Number:	S11_7282	Soil
QC Batch Number:	111735	Element
Directory:	D:\TESIDATA\Y2011\AUG2011\0826TPH_GC3\074B3201.D	
Method:	Ultra Sonic	

Separation: Silica gel
Eluents: Hexane, DCM

Matrix:	Soil
Date Booked in	23-Aug-11
Date Extracted:	25-Aug-11
Date Analysed:	26-Aug-11

[illegible]

Total Petroleum Hydrocarbons (TPH) Carbon Ranges

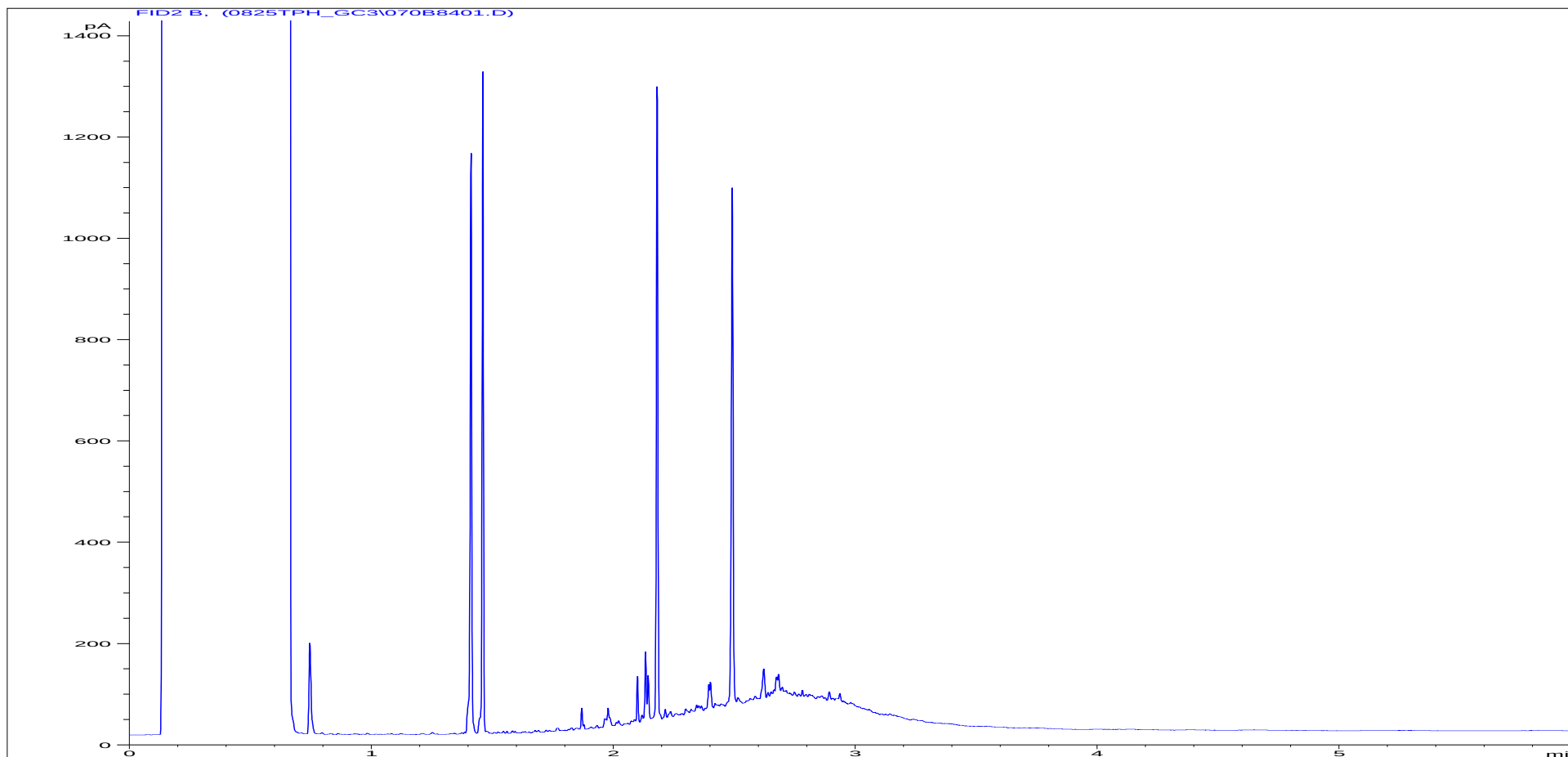
Customer and Site Details:	Soil Mechanics : G.I Works at Coed Darcy, B4290
Job Number:	S11_7282
QC Batch Number:	111735
Directory:	D:\TES\DATA\Y2011\AUG2011\0825TPH_GC3\070B8401.D
Method:	Ultra Sonic

Matrix: Soil
Date Booked in: 23-Aug-11
Date Extracted: 25-Aug-11
Date Analysed: 26-Aug-11

*** Sample data with an asterisk are not UKAS accredited.**

[illegible]

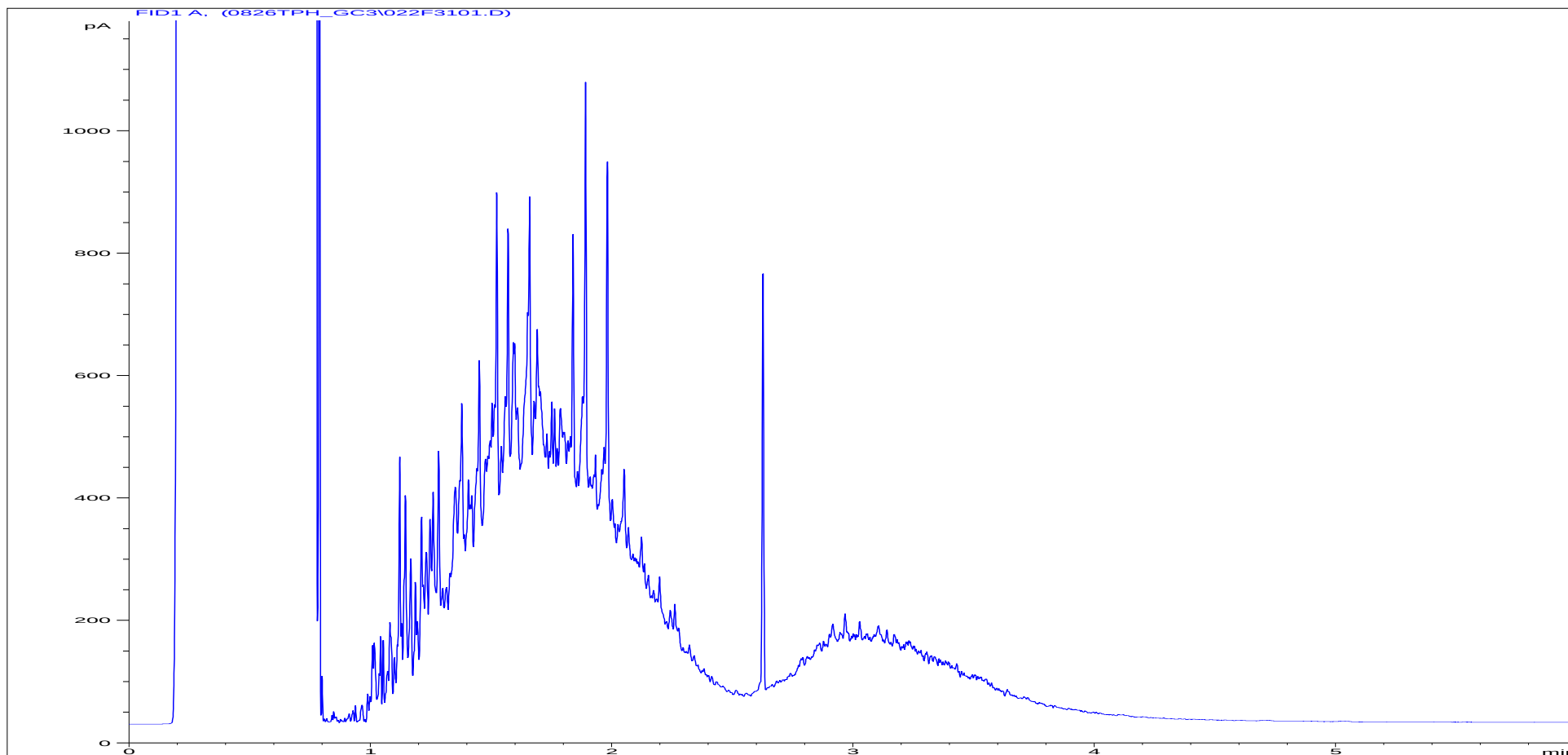
Petroleum Hydrocarbons (C8 to C40) by GC/FID



Sample ID:	CL1133335	Job Number:	S11_7282
Multiplier:	8	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSE1 ES 3 0.80
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0825TPH_GC3\070B8401.D		

Where individual results are flagged see report notes for status.

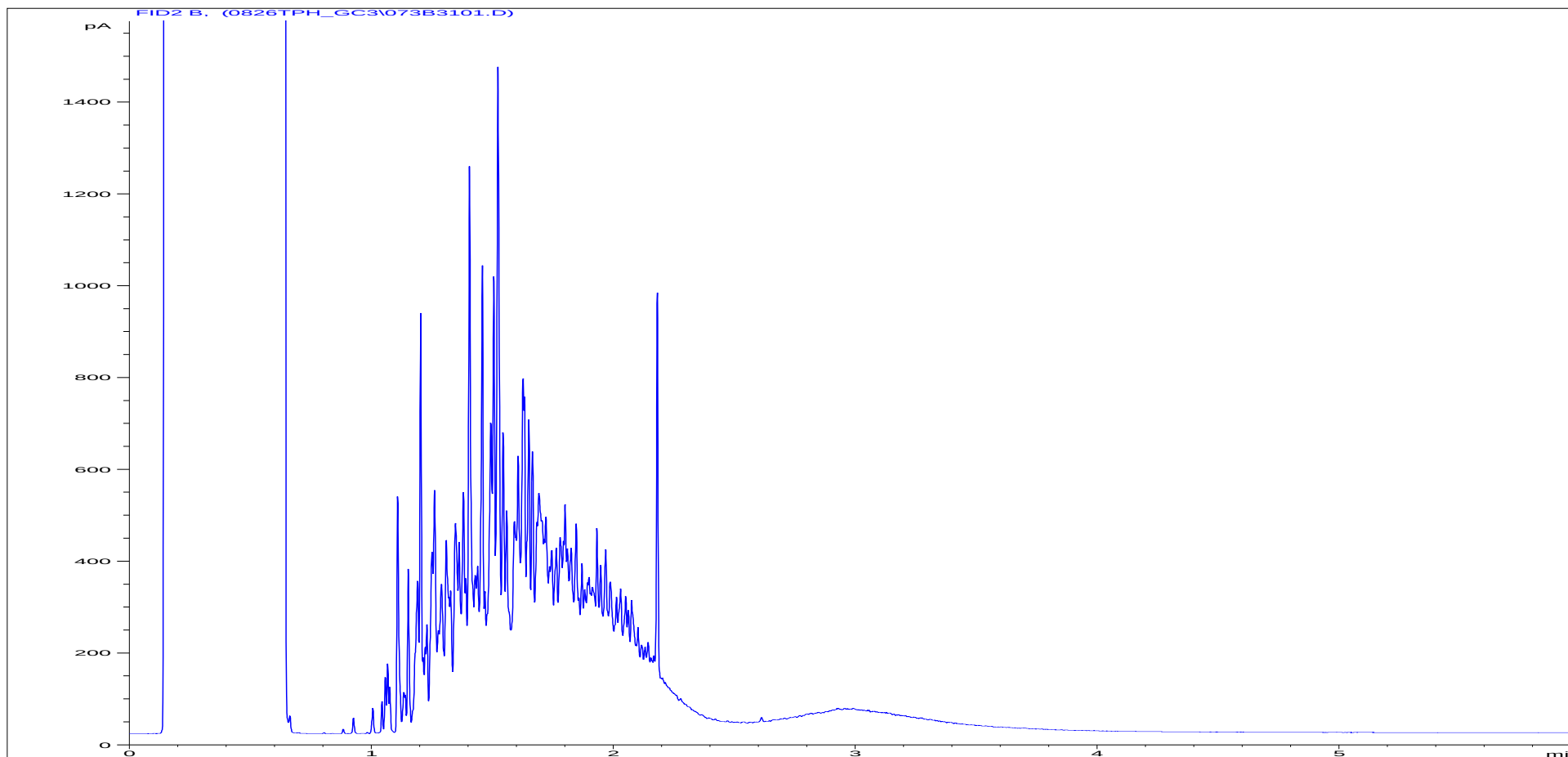
Petroleum Hydrocarbons (C8 to C40) by GC/FID Aliphatics Fraction.



Sample ID:	CL1133336ALI	Job Number:	S11_7282
Multiplier:	15.2	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSE1 ES 5 1.50
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\022F3101.D		

Where individual results are flagged see report notes for status.

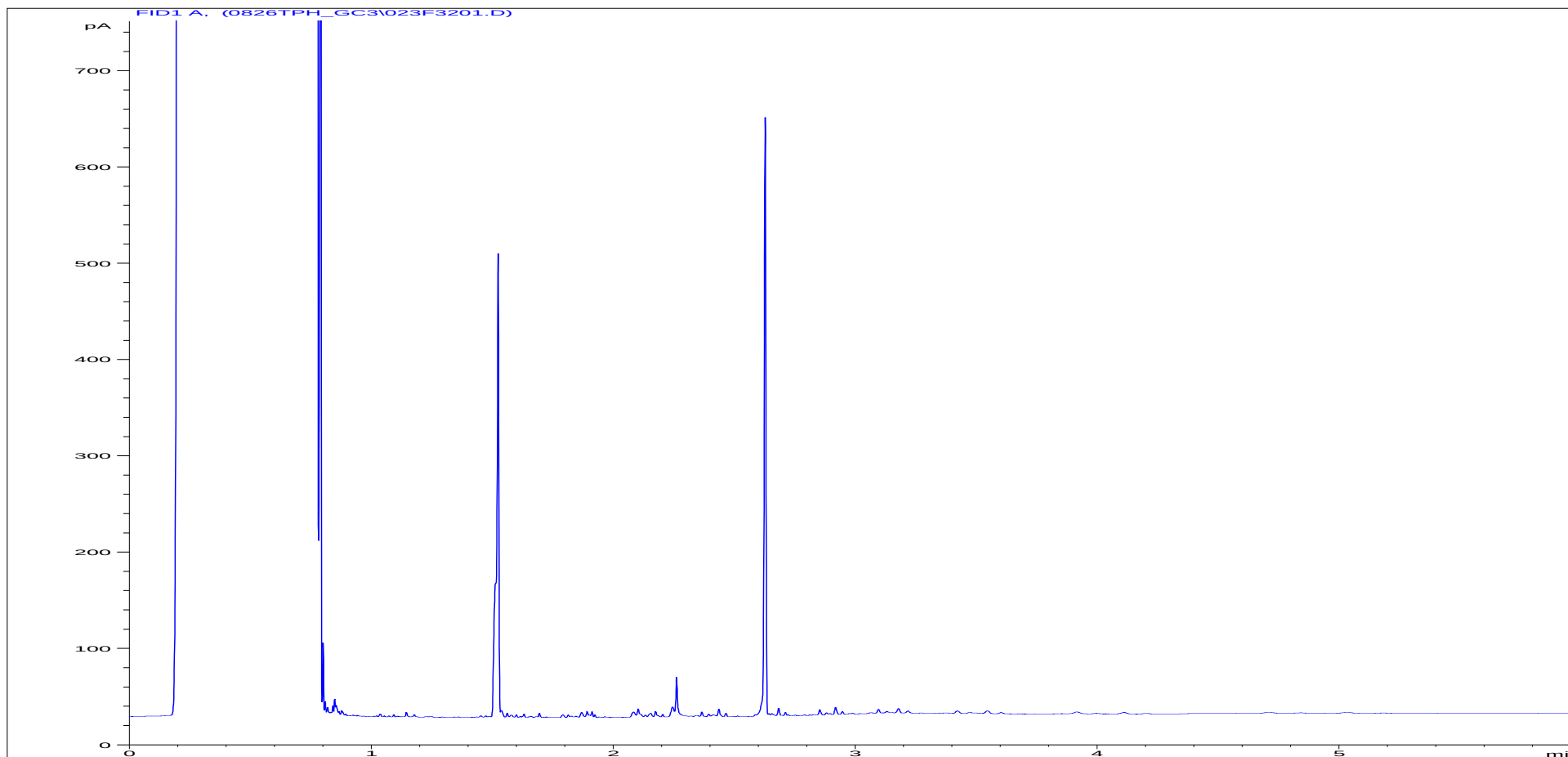
Petroleum Hydrocarbons (C8 to C40) by GC/FID Aromatics Fraction.



Sample ID:	CL1133336ARO	Job Number:	S11_7282
Multiplier:	12.16	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSE1 ES 5 1.50
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\073B3101.D		

Where individual results are flagged see report notes for status.

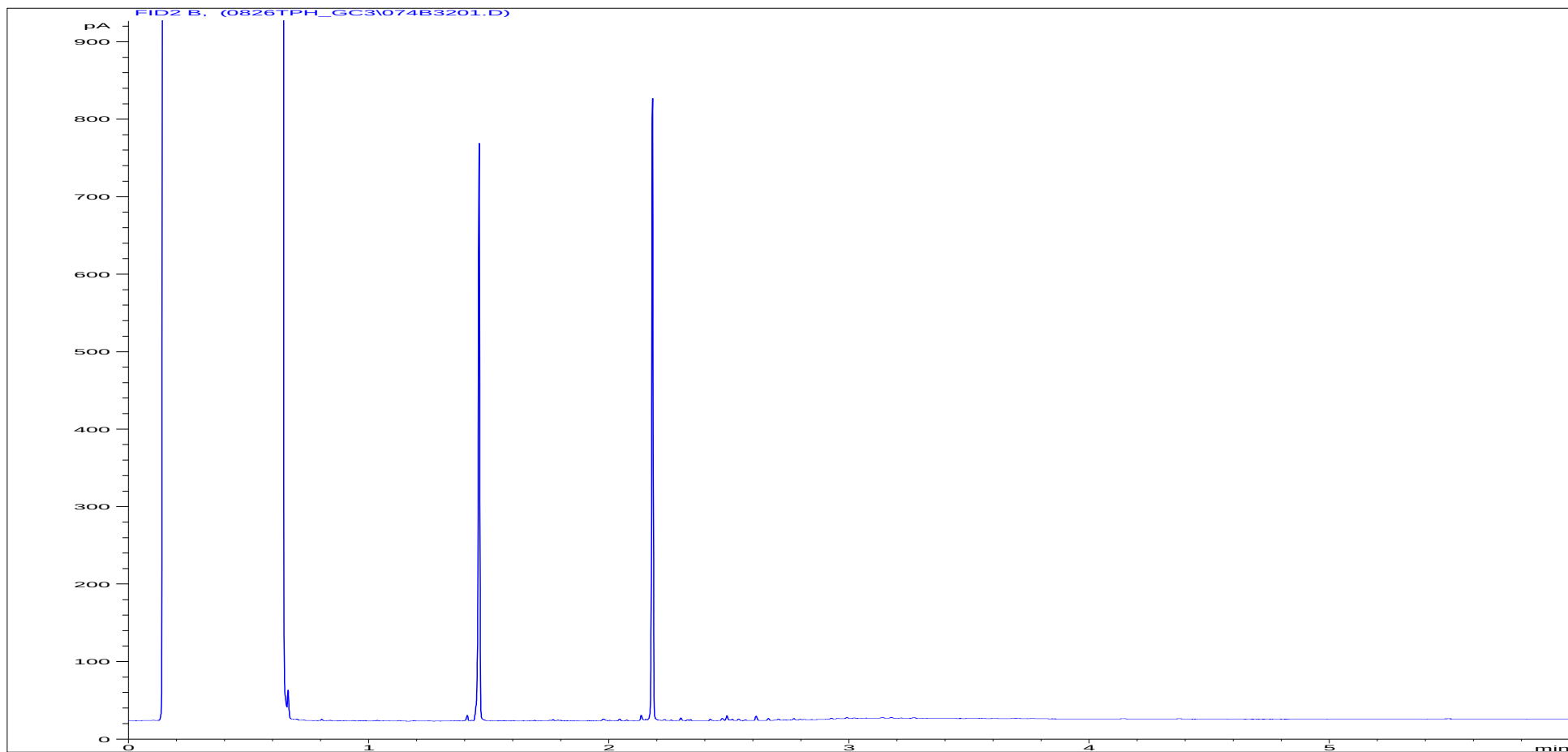
Petroleum Hydrocarbons (C8 to C40) by GC/FID Aliphatics Fraction.



Sample ID:	CL1133338ALI	Job Number:	S11_7282
Multiplier:	16.8	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSE2 ES 6 2.00
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\023F3201.D		

Where individual results are flagged see report notes for status.

Petroleum Hydrocarbons (C8 to C40) by GC/FID Aromatics Fraction.



Sample ID:	CL1133338ARO	Job Number:	S11_7282
Multiplier:	13.02	Client:	Soil Mechanics
Dilution:	1	Site:	G.I Works at Coed Darcy, B4290
Acquisition Method:	5UL_RUNF.M	Client Sample Ref:	WSE2 ES 6 2.00
Acquisition Date/Time:	26-Aug-11		
Datafile:	D:\TES\DATA\Y2011\AUG2011\0826TPH_GC3\074B3201.D		

Where individual results are flagged see report notes for status.

ASBESTOS ANALYSIS RESULTS - SOIL ANALYSIS

Client: Scientifics Environmental Chemistry

Page 1 of 1

Address: Etwall House, Bretby Business Park, Ashby Road, Burton upon Trent

Report No: ANO-0488-1993

For the attention of : Soil Mechanics

Report Date: 01/09/2011

Site Address: G.I Works at Coed Darcy, B4290

Project Number:S117282

[illegible]

*Sampling carried out by client ** Detection limit advised by client

The sample analysis for the above results was carried out using the procedures detailed in ESG Asbestos Limited in house method (SCI-ASB-020) based on HSE document MDHS 90 - Asbestos Contaminated Land - Draft 5 - November 1997 (withdrawn). Fibre identification was carried out using ESG Asbestos Limited in house method of transmitted/polarised light microscopy and centre stop dispersion staining (SCI-ASB-007), based on HSE's HSG 248. The analysis of fine fraction for asbestos content only includes fibres and does not discriminate non-asbestos fibres. All fibres are assumed, unless specified, to be amphiboles. All tests were carried out at ESG Asbestos Laboratory, Derwent House, Bretby Business Park, Ashby Road, Burton-upon-Trent, Staffordshire. DE15 0XD. UKAS Laboratory Number 1089.

Key

Authorised Signatory:

Name:

Andrew Elsby

NADIS = No Asbestos Detected in Sample

Position:

Regional Manager

ESG Asbestos Limited is a wholly owned subsidiary of Environmental Scientifics Group Limited (ESG), registered in England and Wales, registered company 04951688.

Where individual results are flagged see report notes for status.

Customer
Site
Report No

Soil Mechanics
G.I Works at Coed Darcy, B4290
S117282

Consignment No 22716
Date Logged 23-Aug-2011
Report Due 05-Sep-2011

ID Number	Description	MethodID	Sampled	CustServ	Dep Opt	GROHSA	ICPACIDS	ICPBOR	ICPMSS	ICPWSS	KONECR	PAHMSUS	PHSOIL	Sub0002A	THPHUS	TPHUSI	TPH by GC/FID (AR/Si)
																	TPH Carbon Banding
					DO Cr6 if Cr>365	GRO (AA)	SO4-- (acid sol)	Boron (H2O Soluble)	Arsenic (MS)		Chromium vi:	PAH by MS.16(0.08)	pH units (AR)	Asbestos (screen)	DRO (C10-C25)	TPH by GC/FID (AR)	TPH by GC/FID (AR/Si)
												</					

Note: For analysis where the Report Due date is greater than 7 days (PAH, Pesticides, PCB, Phenols, Herbicides) or 2 days (BOD) after the sampling date, although we will do our utmost to prioritise your samples, they may become deviant whilst being processed in the Laboratory.

In this instance, please contact the Laboratory immediately should you wish to discuss how you would like us to proceed. If you do not respond within 24 hours, we will proceed as originally requested.

Deviating Sample Key

A The sample was received in an inappropriate container for this analysis
B The sample was received without the correct preservation for this analysis
C Headspace present in the sample container
D The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E Sample processing did not commence within the appropriate holding time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	GROHSA	As Received	Determination of Total Gasoline Range Organics Hydrocarbons (GRO) by Headspace GCFID
Soil	ICPACIDS	Air Dried	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPBOR	Air Dried	Determination of Boron in soil samples by hot water extraction followed by ICPOES detection
Soil	ICPMSS	Air Dried	Determination of Metals in soil samples by aqua regia digestion followed by ICPMS
Soil	ICPWSS	Air Dried	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	SubCon*	*	Contact Laboratory for details of the methodology used by the sub-contractor.
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	TPHUSSI	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection including quantitation of Aromatic and Aliphatic fractions.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on an air dried basis
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile

CR Denotes Crocidolite

AM Denotes Amosite

NAIIS No Asbestos Identified in Sample

Symbol Reference

[^] Sub-contracted analysis. Note: The accreditation status is that assigned by the subcontract laboratory.

\$\$ Unable to analyse due to the nature of the sample

¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

¥ Results for guidance only due to possible interference

& Blank corrected result

I.S Insufficient sample to complete requested analysis

I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined

N.Det Not detected

Req Analysis requested, see attached sheets for results

▮ Raised detection limit due to nature of the sample

***** All accreditation has been removed by the laboratory for this result

‡ MCERTS accreditation has been removed for this result

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

END OF REPORT

Where individual results are flagged see report notes for status.

TEST REPORT

SOIL SAMPLE ANALYSIS



Report No. EFS/117948 (Ver. 1)

Soil Mechanics
Unit 15
Crosby Yard
Wild Mill
Bridgend
Mid Glamorgan
CF31 1JZ

Site: Coed Darcy

The 8 samples described in this report were logged for analysis by Scientifics on 17-Sep-2011. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 23-Sep-2011

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited
Any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by Scientifics.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Analytical and Deviating Sample Overview (Page 3)
Table of Method Descriptions (Page 4)
Table of Report Notes (Page 5)

On behalf of
Scientifics :
Andrew Timms

A handwritten signature in black ink, appearing to read 'Andrew Timms', is written over a faint rectangular stamp.

Operations Manager

Date of Issue: 23-Sep-2011

Tests marked '^' have been subcontracted to another laboratory.

Scientifics accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.

[illegible]

Customer
Site
Report No

Soil Mechanics
Coed Darcy
S117948

Consignment No S23322
Date Logged 17-Sep-2011

Report Due 21-Sep-2011

ID Number	Description	MethodID	CustServ	Dep. Opt				ICP ACIDS	ICPBRE	ICPWSS	KONECL	KONEIO3	PHSOIL	TSBRE1
		Sampled	Report B	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (2:1): mg/l	pH units (AR)	Total Sulphur.	
Accredited to ISO17025							✓		✓				✓	
CL/1136307	TPC2 1.3-1.6	D												
CL/1136308	TPC4 0.50	D												
CL/1136309	TPC8 1.00	D												
CL/1136310	TPC9 1.00	D												
CL/1136311	TPD1 0.50	D												
CL/1136312	TPD4 0.3-0.6	D												
CL/1136313	TPD5 0.90	D												
CL/1136314	TPE1 0.30	D												

Note: For analysis where the Report Due date is greater than 7 days (PAH, Pesticides, PCB, Phenols, Herbicides) or 2 days (BOD) after the sampling date, although we will do our utmost to prioritise your samples, they may become deviant whilst being processed in the Laboratory.

In this instance, please contact the Laboratory immediately should you wish to discuss how you would like us to proceed. If you do not respond within 24 hours, we will proceed as originally requested.

Deviating Sample Key

A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time

Requested Analysis Key

	Analysis Required
	Analysis dependant upon trigger result - Note: due date may be affected if triggered
	No analysis scheduled
^	Analysis Subcontracted

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Air Dried	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Air Dried	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TSBRE1	Air Dried	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on an air dried basis
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile

CR Denotes Crocidolite

AM Denotes Amosite

NAIIS No Asbestos Identified in Sample

Symbol Reference

^ Sub-contracted analysis. Note: The accreditation status is that assigned by the subcontract laboratory.

\$\$ Unable to analyse due to the nature of the sample

¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

¥ Results for guidance only due to possible interference

& Blank corrected result

I.S Insufficient sample to complete requested analysis

I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined

N.Det Not detected

Req Analysis requested, see attached sheets for results

▮ Raised detection limit due to nature of the sample

***** All accreditation has been removed by the laboratory for this result

‡ MCERTS accreditation has been removed for this result

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

END OF REPORT

Where individual results are flagged see report notes for status.

**ENCLOSURE E
PHOTOGRAPHS**

Trial Pits
Window Samples
Rotary Cores

E1 to E34
E35 and E36
E37 to E42