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Pantteg Landslide

Factual Ground Investigation Report

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Pantteg Landslide
Factual Ground Investigation Report

Prepared for:
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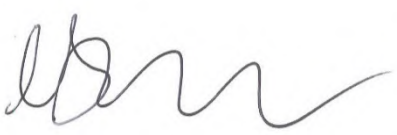
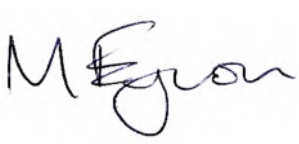
		Signature:		
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1 Introduction and Objectives

1.1 Background

Neath Port Talbot County Borough Council (NPTCBC), (hereafter known as the Client), have a duty of care to the residents and infrastructure affected by the Pantteg Landslide and thus need an understanding of the conditions of the hillside of Pantteg. The site location is shown on Figure 1.

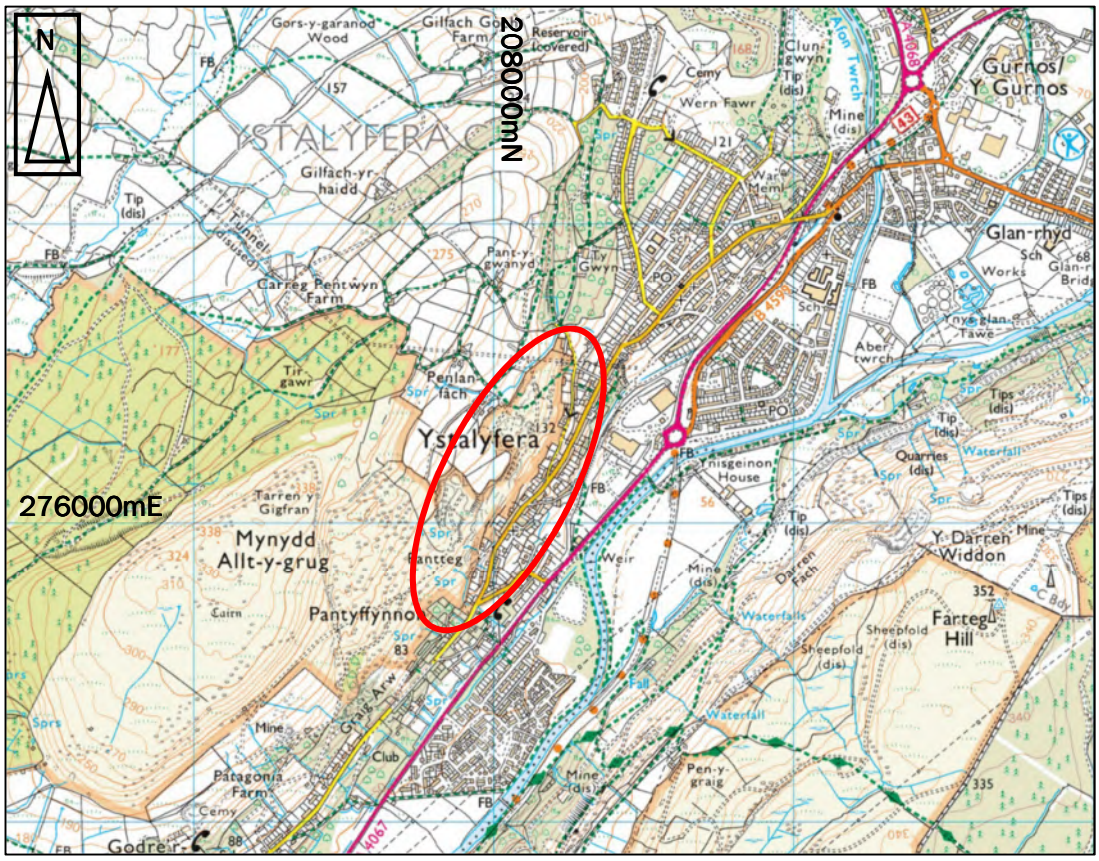

Figure 1: Site Location Plan 1:25,000 (Ordnance Survey License No.: AL100015788).

The Earth Science Partnership Ltd (ESP), Consulting Engineers, Geologists and Environmental Scientists, were instructed by the Client to undertake several phases of intrusive investigation at the site to inform a hazard and risk assessment of the landslide to the surrounding residents and infrastructure.

The scope of works for the various phases of site investigation agreed with the Client, in summary, comprised:

- Obtaining Coal Authority Licence to enter or disturb coal strata;
- A non-intrusive Geophysical Survey, consisting Resistivity Tomography, P and S Wave Seismic refraction and Multichannel Analysis of Surface Waves, has been undertaken across the length of the Pen-y-Graig Area;
- Repeat Light Detection and Ranging (LiDAR) surveys of the entire landslide area, with a consequent comparison of the surveys in the form of an Isopachyte Map;

- Six rotary boreholes (BH301 – BH306) to a maximum depth of 60m and trial pitting in the general area of Pantteg Village;
- Two rotary boreholes (BH601 – BH602) to a maximum depth of 51m and trial pitting in area Pen-y-Graig of Pantteg Landslide (defined by Halcrow, 1989 as an 'area of distress');
- Installation of a Rain Gauge within Pantteg Village;
- Installation of inclinometer casing and groundwater measurement devices, (i.e. vibrating wire piezometers and Herron loggers);
- Monthly monitoring visits to collect piezometer, rainfall data and take inclinometer readings (with a scope for further long-term monitoring); and
- Preparation of a factual and interpretive report.

The interpretative report will follow issue of this factual report and the Hazard and Risk Assessment for Pantteg will be updated.

1.2 Previous Factual Reports

The following previous preliminary ground investigation reports have been issued for the area:

- Pantteg Landslip, Preliminary Factual Ground Investigation Report (Ref. ESP5859e.03.2715). Earth Science Partnership Ltd, March 2017;
- Pantteg Landslip, 86 Cyfyng Road – Factual Ground Investigation Report (Ref. ESP5859e.04.2923). Earth Science Partnership Ltd, July 2017;
- Pantteg Landslide, 96 Cyfyng Road – Factual Ground Investigation Report (ESP5859e.07.2937) Earth Science Partnership Ltd, November 2017; and
- Pantteg Landslide, 100 – 111 Cyfyng Road – Factual Ground Investigation Report (ESP5859e.08.2943) Earth Science Partnership Ltd, January 2018.

This current report collates all ESP ground investigations to date, and supersedes previous ground investigation reports.

1.3 Other Pertinent Reports and Information

The hillside of Pantteg has been the subject to previous investigations and assessments which are detailed (list not exhaustive) below:

- Godre'r Graig & Pantteg Landslides, Report on Hazard Mapping, report for the Lliw Valley Borough Council by Sir William Halcrow and Partners, July 1987;
- Pantteg Landslide, Report on Ground Investigation, report for Lliw Valley Borough Council by Sir William Halcrow and Partners, December 1989;
- Pantteg and Godre'r Graig Landslide Area, Report on Assessment of Landslide Hazard, Neath Port Talbot County Borough Council, February 1998;

- Pantteg and Godre'r-Graig Landslips Slope Stability Review, Jacobs Engineering UK Limited, December 2013;
- Price, C. E., 2015. Hydrometric thresholds for use in a landslide warning system at Pantteg in the Afon Tawe catchment, South Wales. MSc thesis, School of Earth and Environmental Sciences, University of Portsmouth; and
- Pantteg Landslip, Data Review and Management Proposals (Ref. ESP5859e.2393). Earth Science Partnership Ltd, July 2016.

Information in the above reports is not duplicated and the list is provided as a reference point to obtain further information and background to the site and proposed works.

All phases of the intrusive investigations were awarded on the basis of competitive tender quotations, in line with the South Wales Framework Rates. The intrusive investigation was undertaken between July to September 2017, and June to August 2018 with monthly monitoring visits undertaken from September 2017 to March 2019.

This report is issued in digital format only.

2 Exploratory Investigation

2.1 Previous Intrusive Investigation – Halcrow (1989)

A previous ground investigation has been undertaken by Exploration Associates Ltd in 1989 under the direction of Halcrow Consulting Engineers. This consisted 4no. cable percussion boreholes with rotary coring follow-on, 10no. trial pits and laboratory testing. The full report, investigation point records and laboratory records from this previous investigation are presented as Appendix A.

2.2 ESP Investigation Points

A phased intrusive and non-intrusive investigation has been undertaken in accordance with BS5930:2015.

The phased intrusive investigation has consisted:

- 3no. Rotary Open Boreholes, across Pantteg Village – December 2016 (BH100s);
- 1no. Dynamic Sampled and Rotary Cored Boreholes, 86 Cyfyng Road - June 2016 (BH200s);
- 6no. Dynamic Sampled and Rotary Cored Boreholes and 8no. Trial Pits across Pantteg Village – August to November 2017 (BH/TP300s);
- 1no. Dynamic Sampled and Rotary Cored Borehole, 96 Cyfyng Road – November 2017 (BH401);
- 8no. Windowless Sampled Boreholes, 100 & 111 Cyfyng Road – November 2017 (WS500s); and
- 2no. Dynamic Sampled and Rotary Cored Boreholes and 9no. Trial Pits, Pen-y-Graig area – June to September 2018 (BH/TP600s).

The exploratory holes were supervised and logged by an engineering geologist from ESP in general accordance with BS5930:2015.

Descriptions and depths of the strata encountered in each phase of investigation are presented on the trial pit and borehole records in Appendix B to Appendix I. The results of monitoring undertaken to date are presented as Appendix L to Appendix O. The investigation point positions are shown on Figure 2.

2.3 Trial Pits

8no. trial pits (TP301 to TP308) were excavated across the area of Pantteg Village and Cwar Pen-y-Graig on 27rd July 2017 and 28th September using a wheeled, backacting hydraulic excavator. The trial pits were excavated to a maximum depth of 4.5m. The trial pit records are presented as Appendix B, with selected photographs in the Plates.

Further trial pitting in the Pen-y-Graig area was undertaken between the 9th and 11th May 2018. 9no. trial pits were excavated using a tracked excavator to a maximum depth of 4.25m. The trial pit records for this area are presented in Appendix C.

Disturbed samples were collected from the trial pits for laboratory testing. On completion, the trial pits were backfilled with arisings in layers compacted with the excavator bucket, and where possible, the Topsoil was reinstated on the surface. The arisings were left slightly proud of the adjacent surface to allow for future settlement.

2.4 Rotary Open-Hole Boreholes

3no. 100mm diameter rotary percussive open-hole boreholes (BH101 to BH103), were constructed to a maximum depth of 25m between 13th and 15th December 2016. BH101 was located in an area of soft landscaping and the topsoil was removed by hand prior to commencement, the surface tarmacadam was broken out using a hydraulic breaker at BH102 and BH103 and a service inspection pit excavated by hand to a depth of 1.2m in all three locations.

The boreholes were constructed under license to the Coal Authority (ref.13331).

The boreholes were constructed with the objective of locating the rock-head profile and the presence of coal seams, or possible abandoned workings. During the drilling process, the rock chippings returned to the surface were described by the driller and rate of progress monitored. It should be noted that, although adequate for identification purposes, the nature of the drilling method does not permit an accurate description of the strata.

The rotary open-hole borehole records, showing a generalised sequence of strata and approximate strata boundaries, are presented in Appendix D.

On completion, instrumentation was installed in the boreholes as detailed in Section 2.10. Below the instrumentation, the borehole was backfilled with bentonite/cement as required by the Coal Authority.

2.5 Dynamic Sampled and Rotary Cored Boreholes

2.5.1 86 Cyfyng Road

2no. rotary cored boreholes were constructed in the car parking area immediately north of 86 Cyfyng Road to a maximum depth of 10.1m between the 22nd to 23rd June 2017. The first of the two boreholes was abandoned due to poor recovery, and a second borehole was constructed immediately adjacent to the first, and taken to the required depth. The boreholes records from 86 Cyfyng Road are presented as Appendix E.

On completion of the borehole, a 50mm standpipe was installed in the borehole as detailed in Section 2.10.

The boreholes were constructed under license to the Coal Authority (ref 14277).

2.5.2 Pantteg Village and Cwar Pen-y-Graig

6no. rotary cored boreholes were constructed (BH301-BH306) in the area of Pantteg Village and Cwar Pen-y-Graig to depths of between 25 and 60m between 9th August 2017 and 22nd September 2017. The borehole records are presented as Appendix F, with photographs of each core run presented in Appendix I.

The boreholes were constructed under license to the Coal Authority (ref 14390).

On completion, instrumentation was installed in the boreholes as detailed in Section 2.10.

2.5.3 96 Cyfyng Road

1no. rotary cored borehole was constructed in the vacant land immediately south of the former 96 Cyfyng Road to a depth of 12m on the 9th and 10th November. The borehole records are presented as Appendix G with photographs of each core run presented as Appendix I.

The borehole was constructed under license to the Coal Authority (ref.15090).

On completion, instrumentation was installed in the BH401 as detailed in Section 2.10.

2.5.4 Pen-y-Graig Area

2no. rotary cored boreholes were constructed (BH601 and BH602) in the area of Pantteg Village and Cwar Pen-y-Graig to depths of 11.70m and 51.0m between 3rd August to 17th August 2018.

Access restrictions and Health and Safety requirements in the Pen-r-Graig area required a specialist rotary slope-climbing drilling rig to be mobilised.

The boreholes records are presented as Appendix H, with photographs of each core run presented in Appendix I.

The boreholes were constructed under license to the Coal Authority (ref.15237).

On completion, instrumentation was installed in the boreholes as detailed in Section 2.10.

2.6 Drilling Methodology

At the commencement of each borehole, a square of surface material was cut (using a hydraulic breaker where hand-tools were insufficient) and a service inspection pit excavated by hand to a depth of 1.2m.

Dynamic sampling was then carried out from 1.2m, with cores of the material recovered in plastic liners. Where dynamic sampling could not penetrate the ground, rotary coring was utilised to advance the boreholes.

The ODEX 115 system of simultaneous drilling and casing was utilised in all boreholes (except BH601 and BH602) in the superficial deposits. Due to access restrictions in the Pen-y-Graig area, mobilisation of an air compressor to the drilling areas was not possible, and a traditional method of rotary casing was employed in the shallow soils.

Due to difficulties whilst construction of BH306 it was necessary to advance the borehole by cable percussion techniques to advance 8' casing into the borehole to a sufficient depth to allow the ODEX casing to be advanced onto rockhead, where rotary coring was advanced.

Cores of nominal 73mm diameter (93mm diameter in the Pen-y-Graig Area) were recovered in plastic liners using a triple tube barrel system, over runs of nominal 1.5m length. Where recovery was poor, the core length was reduced for the next run to maximise the chances of good recovery.

In the Pen-y-Graig area (BH601 and BH602), a polymer flush was adopted to increase hole stability in an attempt to achieve good core recovery.

The recovered cores were sealed in the plastic liners and placed in solid core boxes to prevent disturbance and swelling before logging. The plastic liners were only cut immediately prior to logging and sampling. In addition to the nature of the rock material, the identified fractures within the rock mass were also logged in accordance with BS5930:2015. The Rock Quality Designation (RQD) recorded was for rock core 100mm or greater in length. The fracture sta153te, and fracture index, of the recovered cores is presented on the borehole records.

In accordance with Coal Authority requirements, given the proximity to occupied properties, water was used as a flushing medium to keep the drill bits cool and return chippings to the surface, and the levels of ground gas were recorded at the drillhole during the drilling works.

Standard Penetration Tests (SPT) were carried out using a split spoon or solid cone in the boreholes (except BH601 and BH602) in accordance with BS EN ISO 22476-3 (2005) and BS5930 (2015) to assess the relative density of the superficial deposits and the weathered zones of bedrock. As required in BS5930:2015, the SPT N-values shown on the borehole records are the direct, uncorrected results obtained in the field.

2.7 Hand-held Window Sampled Boreholes

Eight window sampling boreholes have been constructed to a maximum depth of 2.8m on the 24th and 25th of November 2017. The window sample records are presented in Appendix J.

At the commencement of the borehole, a service inspection pit was excavated by hand to a depth of 1.2m, with a hydraulic breaker utilised in areas of hard standing.

Handheld window sampling was then advanced from 1.2m until refusal of the sampling equipment.

2.8 Mackintosh Probe

A mackintosh probe was advanced from the surface, until refusal, adjacent to each hand-held window position to measure the relative density of the ground encountered. The results of the mackintosh probe holes are presented in Appendix K.

2.9 Surveying

The ground levels and coordinates of the investigation points were surveyed to National Grid and Ordnance Datum on two occasions and are shown on the individual exploratory hole records and provided in Table 1 below.

It was not possible to survey the location of the window sampling boreholes and their positions and levels are interpolated from LiDAR data.

Table 1 - Summary of Coordinates and Elevations for Investigation Points

Position ID	Eastings	Northings	Level (m OD)
BH101*	276059.91	208012.81	100.53
BH102*	276264.66	208101.10	72.11
BH103*	276257.91	208367.03	130.90
BH201	276307.78	208345.91	109.64
BH202	276308.28	208345.62	109.65
BH301	275987.10	208289.45	196.15
BH302	276219.71	208254.61	123.89
BH303	276256.84	208380.32	133.56
BH304	276261.94	208092.76	71.84
BH305	276049.49	207997.65	100.17
BH306	275941.16	207703.84	82.19
TP301	276063.25	208019.07	100.72
TP302	276043.45	207991.67	100.24
TP303	276161.12	208098.69	101.72
TP304	276004.70	208347.60	205.42
TP305	275989.74	208293.48	196.05
TP306	276018.81	208239.80	191.49
TP307	276035.15	208351.90	202.08
TP308	276225.88	208030.21	73.46
BH401	276266.71	208267.85	107.22
WS501	276290	208251	96
WS502	276288	208255	98
WS503	276278	208256	100
WS504	276269	208261	103
WS505	276288	208210	88
WS506	276278	208205	92
WS507	276270	208213	94
WS508	276266	208221	96
BH601	275956.39	208013.94	144.77
BH602	276004.27	208070.28	146.58
TP601	276023.11	208121.74	154.14
TP602	275986.53	208086.55	154.75
TP603	275978.22	208034.06	143.23
TP604	275958.89	208003.11	143.32
TP605	276008.78	208074.24	146.80
TP606[4]	275990	208060	145
TP607	275964.22	208007.37	142.73
TP608	276033.02	208131.61	154.40
TP609	276050.48	208140.83	152.45

Notes:

1. * Denotes surveyed on 20th December 2016. All others survey on 24th September 2018.
2. WS501 to WS508 approximate and based upon LiDAR data.
3. All mackintosh probes adjacent to location of similarly named boreholes i.e. Mackintosh Probe WS501 adjacent to the borehole WS501. Thus, all have near identical coordinates and level.
4. Position interpolated from LiDAR data.

2.10 Instrumentation

Several types of groundwater monitoring standpipes, or devices have been installed during the different phases of investigation across the site.

2.10.1 Groundwater Well Installations

Both 19mm and 50mm diameter HDPE standpipes were installed in selected boreholes to allow monitoring of groundwater. The wells, comprising slotted plastic pipe with a gravel/sand surround (the response zone), bentonite seals above and below the response zone, and a lockable vandal proof cover. A summary of the groundwater standpipes installed across all phases of ESP investigation is provided in Table 1 below:

Table 2 - Summary of Groundwater Well Installations

Borehole ID	***Date of Installation***	***Response Zone depth (m)***	***Response Zone Stratum***	***Rationale***
BH101	14 Dec 2016	6.0 – 8.0	Colluvium	Determine if groundwater in Colluvium
BH101	14 Dec 2016	16.0 – 18.0	Siltstone (MCMF)	Determine if groundwater in bedrock
BH102	15 Dec 2016	4.0 – 5.5	Colluvium	Determine if groundwater in Colluvium
BH102	15 Dec 2016	16.0 – 18.0	Mudstone (MCMF)	Determine if groundwater in bedrock
BH103	15 Dec 2016	4.2 – 4.6	Lower Welsh Coal Seam (MCMF)	Determine if groundwater in coal seam
BH103	15 Dec 2016	13.5 – 15.0	Siltstone (MCMF)	Determine if groundwater in bedrock at level of nearby carriageway.
BH202	23 Jun 2017	1.0 – 10.0	Sandstone (MCMF)	Determine the groundwater conditions adjacent to 86 Cyfyng Road[3]
WS501	23 Nov 2017	0.5 – 2.6	Made ground and Grade E Weathered Coal Measures	Determine the groundwater conditions in the gardens south of 100 &111 Cyfyng Road.
WS504	23 Nov 2017	0.5 – 2.7	Made ground, Colluvium, Grade E Weathered Coal Measures	
WS505	24 Nov 2017	0.5 – 2.6	Made Ground and Colluvium	
WS507	24 Nov 2017	0.5 – 2.5	Made ground and Grade E Weathered Coal Measures	
WS508	24 Nov 2017	0.5 – 2.5	Made Ground and Grade E Weathered Coal Measures	
BH602	17 Aug 2018	2.7 - 11.7	Made Ground and Upper Coal Measures	Allow spot monitoring of groundwater in similar area to piezometer in BH601.

Notes:
5. Details of each monitoring well are presented on the individual borehole records.
6. MCMF denotes Middle Coal Measures Formation
7. Water level data logger installed within standpipe, see Section 2.10 for details.

The results of the spot-monitoring undertaken to date for each well is presented as Appendix L.

2.10.2 Vibrating Wire Piezometers

13no. Vibrating Wire Piezometers have been installed in the boreholes, set in an appropriate cement/bentonite grout. The detail of the installations are shown in Table 3 below:

Table 3 - Summary of Vibrating Wire Piezometer installations.

Borehole ID	***Depth (m)***	***Response Zone Stratum***	***Rationale***
BH301	6	Thin Coal	Determine the range of groundwater levels in the thin coal and overlying quarry spoil.
	21	Thin Coal	Determine the range in groundwater level in the thin coal.
	32	Lower Pinchin Coal Seam	Determine the range in groundwater level from the Lower Pinchin Coal Seam.
BH302	6.5	Colluvium	Determine the range of groundwater levels in the Colluvium
	10.5	Middle Coal Measures Bedrock	Determine the range of groundwater levels in the bedrock.
	21.5		
BH303	6	Lower Welsh Coal Seam/Seatearth	Determine the range in groundwater levels in the Lower Welsh Coal Seam.
BH304	5	Colluvium	Determine the range of groundwater level in Colluvium.
	15	Weathered fracture zone	Determine the range of groundwater levels in a pronounced weathered fracture zone.
BH305	7	Colluvium	Determine the range of groundwater level in Colluvium.
	14	Weathered fracture zone	Determine the range of groundwater levels in weathered fracture zone.
BH306	10	Colluvium	Determine the change in groundwater level in the Colluvium.
BH401	10	Middle Coal Measures Bedrock	Determine the range of groundwater levels in the bedrock adjacent to 96 Cyfyng Road. .
BH601	12	Made Ground and Upper Coal Measures	Determine the change in groundwater level in the Made Ground, Lower Pinchin Coal Seam and Bedrock.

Notes on Table 3:
1. Details of each monitoring well are presented on the individual borehole records.
2. Piezometers attached to the outside of the inclinometer casing.

The data collected to date from the data loggers is shown in a series of graphs in Appendix M.

2.10.3 Water Data Logger

1no. Heron dipperLog NANO water data logger has been installed at the base of the 50mm standpipe in BH202, and takes a reading of groundwater level every hour. The data collected to date is presented as Appendix N.

2.10.4 Inclinometer

5no. inclinometers have been installed to a maximum depth of 41.5m using 70mm easy-connect inclinometer casing. The inclinometer casing is set in place using a cement/bentonite grout, with an approximate mix ratio used which mimics the ground around the inclinometer. A summary of the installs is shown below in Table 4.

Table 4 - Summary of Inclinometer installations

Borehole ID	*Depth (m)*	*No. Visits to Date*	*AO Direction*	*Summary of Response Zone*
BH301	42	14	135	Quarry spoil to 4.2m, over bedrock of Upper and Middle Coal Measures. Coal and associated seatearths identified between 6.6m-7.7m, 22m-23m, 31.2m-33.9m (Lower Pinchin) and 56.25m-56.35m.
BH303	35	14	090	Glacial Diamicton to 2.6m over Middle Coal Measures bedrock. Lower Welsh Coal seam and associated seatearth at 4.5m-5.7m. Lower Cwmgorse Marine Band at 24.5m-25.6m.
BH305	25	15	135	Colluvium to 11m over Middle Coal Measures bedrock. Lower Welsh coal seam and associated seatearth between 11m-12m.
BH306	30	14	070	Made Ground to 3.8m over weathered bedrock to 20.5m. Siltstone of the Middle Coal Measures to the base at 33.8m.
BH401	12	12	115	Made ground to a depth of 4.0m over weathered bedrock to 9.45m and unweathered Middle Coal Measures to 12.0m.
BH601	17.5	7	125	Made Ground (Colliery Spoil – Coarse Discard) to a depth of 8.2m. Potential slip zone identified between 8.3m and 8.4m . Probable Lower Pinchin Coal Seam at 8.7m to 9.0m.

Notes on Table 4:

1. Details of each inclinometer and the ground conditions are presented on the individual borehole logs (Appendix and Appendix D)

The inclinometer casing has been monitored using a digital biaxial inclinometer probe, with the results of each monitoring visit to date presented in Appendix O.

2.10.5 Rain Gauge

An Adcon Rain Gauge has been set up in the graveyard of Pantteg Chapel to record the time and level of rainfall, to an accuracy of 0.1mm. This has been set up following World Meteorological Organisation (WMO) guidelines outlined in by WMO, 2014 (Chapter 6 – Measurement of Precipitation). The location of the rain gauge is shown in Figure 2.

The rainfall records are presented on the graphs form the Vibrating Wire Piezometer and Water Data Loggers of Appendix M and N respectively.

2.11 Sampling Strategy

2.11.1 Soil Sampling

Samples for logging and geotechnical laboratory testing purposes were collected at regular intervals within the exploratory holes.

2.11.2 Soil Sample Quality

Samples of soil recovered from investigations are classified as Classes 1 to 5 in terms of quality and depend on the investigation and sampling method, the particle size of the strata sampled, and the presence of groundwater. Class 1 and 2 samples are those in which there has been no or only slight disturbance of the soil structure, with moisture contents and void ratios being similar to the in-situ soil. Class 3 and 4 samples contain all the constituents of the in-situ soil in their original proportions, and the soil has retained its original moisture content, but the structure of the soil has been disturbed. In Class 5 samples, the soil structure and original layering cannot be identified, and the water content may have changed from that in-situ. The category and class of samples are discussed further in BS EN ISO 22476:2006, EN 1997-2:2007 and BS5930:2015.

In general terms, disturbed samples recovered from trial pits (bulk bags and small tubs) are classed as Class 3 (if dry), Class 4 (fine soil below the water table), or Class 5 (coarse soils from beneath the water table).

The split spoon sample from a Standard Penetration Test (SPT) is usually considered a Class 5 sample however, it can be deemed Class 4 in homogeneous fine-grained soils. Disturbed sampling (bulk bags and small tubs) from boreholes is considered Class 3 (if dry), Class 4 (fine soil below the water table) or Class 5 (coarse soils from beneath the water table).

The samples recovered within the liner in windowless sampling are generally Class 3 in fine-grained soils with good recovery, becoming Class 2 in favourable circumstances, but Class 3 or 4 in coarse-grained soils.

Provided recovery is good, rock cores collected using rotary techniques are classified as Class 2 samples, provided that the plastic liners are sealed and only opened immediately prior to logging. The chippings recovered during open-holes drilling are considered Class 5 samples.

2.12 Geotechnical Laboratory Testing

Geotechnical laboratory testing was undertaken on samples from the suitable quality classes recovered from the exploratory holes to obtain information on the geotechnical properties on the soils and bedrock beneath the site.

The following tests were undertaken by a UKAS accredited laboratory on samples selected by ESP in accordance with the methodologies presented in BS1377:1990. The results of all the geotechnical testing carried out through each phase of investigation is presented in Appendix P.

- Natural moisture content;
- Atterberg limits;

- Particle size analysis (Wet sieve and Pipette methods);
- Loss on Ignition;
- Large (300mm by 300mm) Shear Box – Peak Shear Strength;
- Immediate Shear Box (60mm by 60mm) – Peak Shear Strength;
- Consolidated drained shear strength (60mm by 60mm) – Peak and residual shear strength;
- Ring Shear;
- Bulk Density;
- Uniaxial Compressive Strength; and
- Point Load Test.

2.13 Non-intrusive Geophysical Survey

Prior to the commencement of the Rotary Cored Boreholes in the Pen-y-Graig area, a geophysical survey was conducted across the length of the area (parallel to the break in slope) by TerraDat Ltd on the 21st and 22nd June 2018. This involved an integrated survey approach comprising the following techniques:

- Resistivity Tomography;
- Compressional (P) Wave Seismic Refraction;
- Shear (S) Wave Seismic Refraction; and
- Multichannel Analysis of Surface Waves (MASW).

The results of this survey are detailed in the report, presented in Appendix Q.

2.14 LiDAR surveys

Light Detection and Ranging (LiDAR) is a surveying method that measures the distance to a target (in this case the ground) with a pulsed laser light and measuring the reflected pulses with a sensor.

An initial LiDAR survey of the Pantteg and Godre'r-Graig Landslides was undertaken over two days, on the 17th August 2017 and 4th October 2017. A repeat survey of the whole area was undertaken on the 9th April 2018. Due to the data size and format, this data is not included as an appendix but can be obtained digitally by contacting Earth Science Partnership.

3 References

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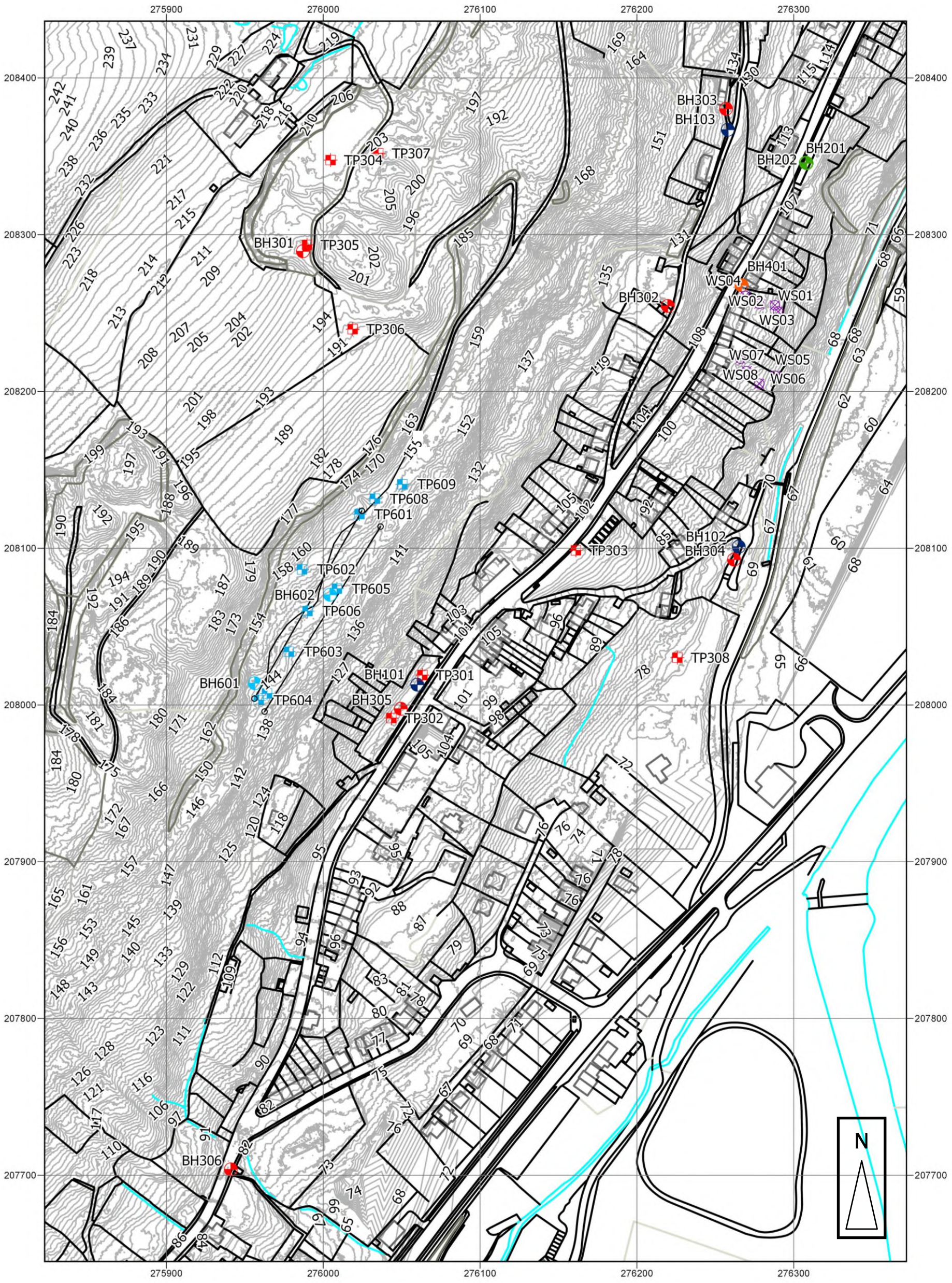

Legend

- Trial Pitting Investigation Points - TP300s (ESP, 2017)
- Trial Pitting Investigation Points - TP600s (ESP, 2018)
- Windowless Sampling Investigation Points - WS500s (ESP, 2017)
- Borehole Investigation Points - BH100s (ESP, 2016)
- Borehole Investigation Points - BH200s (ESP, 2017)
- Borehole Investigation Points - BH300s (ESP, 2017)
- Borehole Investigation Point - BH400s (ESP, 2017)
- Borehole Investigation Points - BH600s (ESP, 2018)

PROJECT: PANTTEG LANDSLIDE

SCALE: 1:2500 (approx. at A3)

FIGURE 2a: INVESTIGATION POINT PLAN – WHOLE AREA

esp
ENGINEERS
GEOLOGISTS
SCIENTISTS

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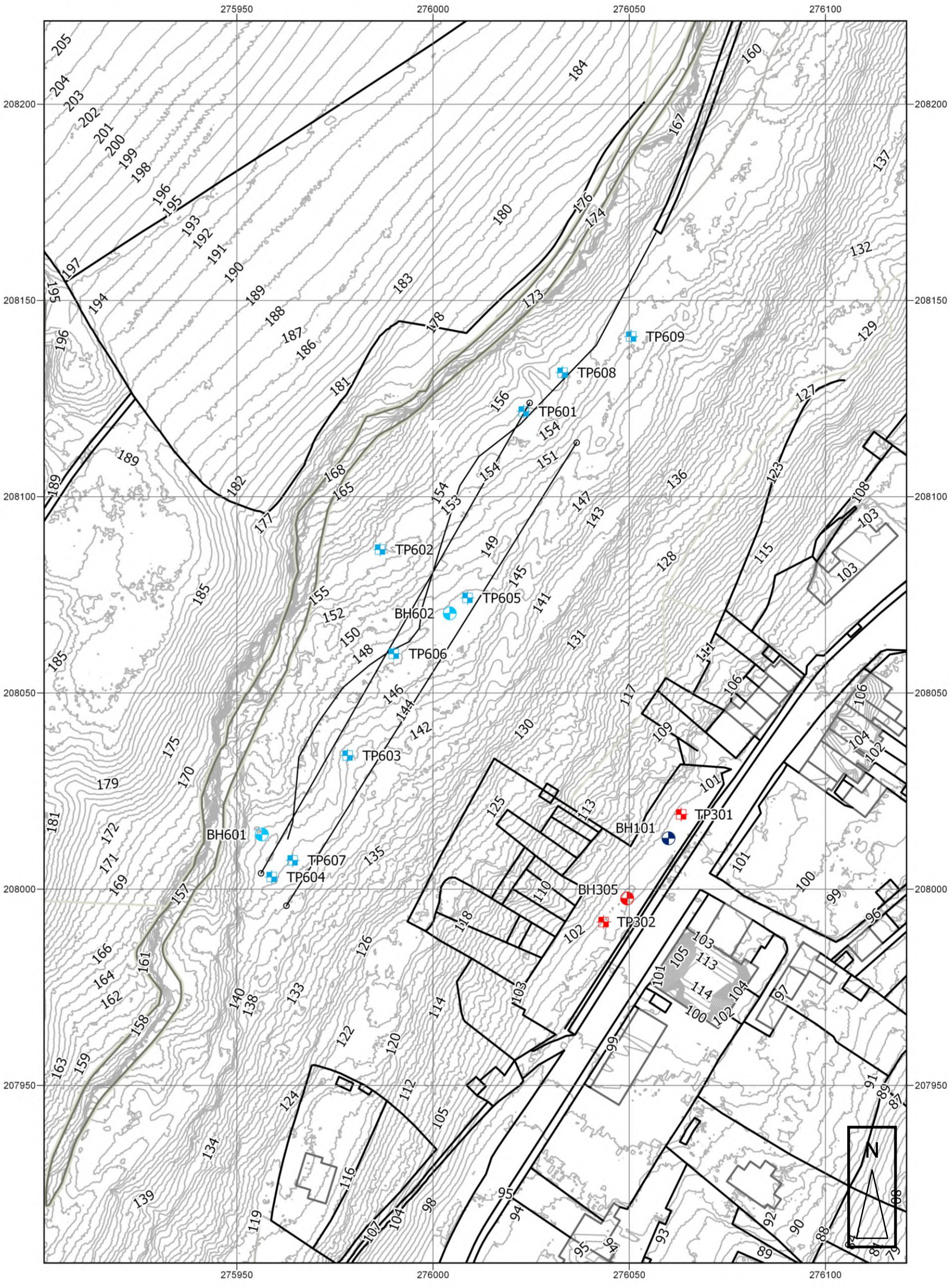

Legend

- Trial Pitting Investigation Points - TP300s (ESP, 2017)
- Trial Pitting Investigation Points - TP600s (ESP, 2018)
- Borehole Investigation Points - BH100s (ESP, 2016)
- Borehole Investigation Points - BH300s (ESP, 2017)
- Borehole Investigation Points - BH600s (ESP, 2018)

PROJECT: PANTTEG LANDSLIDE

SCALE: 1:1000 (approx. at A3)

FIGURE 2b: INVESTIGATION POINT PLAN – PEN-Y-GRAIG AND CHAPEL AREAS

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Legend

- Windowless Sampling Investigation Points - WS500s (ESP, 2017)
- Borehole Investigation Points - BH100s (ESP, 2016)
- Borehole Investigation Points - BH300s (ESP, 2017)
- Borehole Investigation Point - BH400s (ESP, 2017)

PROJECT: PANTTEG LANDSLIDE

SCALE: 1:500 (approx. at A3)

FIGURE 2c: INVESTIGATION POINT PLAN – 100&111 CYFYNG ROAD

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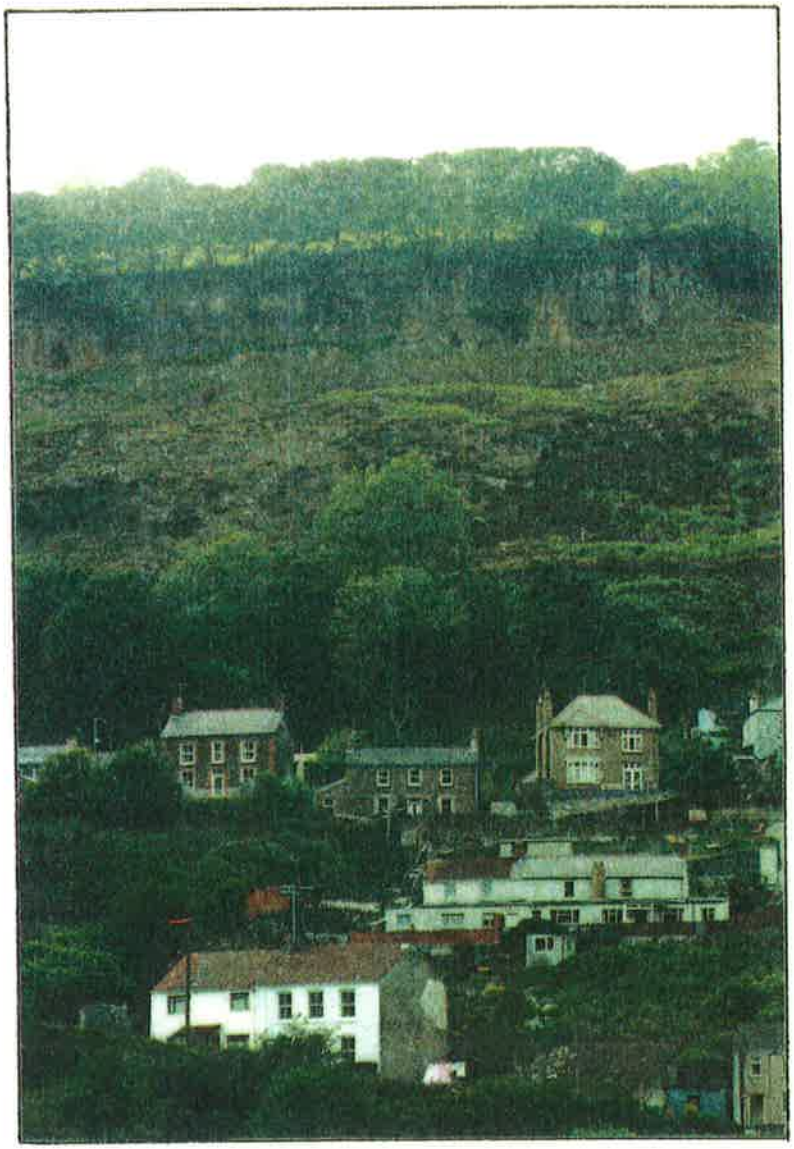
Appendix A

Halcrow Ground Investigation Reports

Pantteg Landslide Report on Ground Investigation

Lliw Valley Borough Council

December 1989



HALCROW

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Director of Amenities
Lliw Valley Borough Council
Civic Centre
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SWANSEA SA4 1GM

17 January 1990 Our ref KC/LVB/2/014 Your ref

Dear Sir

PANTTEG LANDSLIDE
GROUND INVESTIGATION

We have pleasure in enclosing two copies of our final report on the above investigation together with two copies of the Contractor's factual report. The investigation was carried out in response to your verbal instruction of February 1989 and was to determine the degree of risk to properties previously classified within 'Risk Category 4' in our report of July 1987.

On the basis of the results of the investigation, we have concluded that the majority of the properties can be reclassified as Risk Category 3 (ie low risk) for which no remedial measures are recommended. The terrace containing Nos 21 - 29 Pantteg has been reclassified as Risk Category 1 (ie higher risk). The options for reducing the risk to properties within this category were outlined in our previous report.

We hope that this report meets your requirements. If you would like any further information, please contact me.

Yours faithfully

H J SIDDLE
PRINCIPAL GEOLOGIST

HJS/BE.

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W C Gallacher FICE
C J Kirkland FICE
M R Stewart FICE FIHE
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C A Fleming PhD MICE
G D Hillier BSc FICE
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Pantteg Landslide Report on Ground Investigation

Lliw Valley Borough Council

December 1989

HALCROW

LLIW VALLEY BOROUGH COUNCIL

PANTTEG LANDSLIDE

REPORT ON GROUND INVESTIGATION

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DRAWINGS

KC/LVB/R1/1 General Plan
KC/LVB/R1/2 Geological Plan
KC/LVB/R1/3 Geological Section 1-1
KC/LVB/R1/4 Morphology and Geomorphology
KC/LVB/R1/5 Piezometer observations
KC/LVB/R1/6 Results of Laboratory Tests on Landslide Deposits
KC/LVB/R1/7 Stability Section 1-1

1 SUMMARY

1.01 In April 1989, Sir William Halcrow & Partners were commissioned by Lliw Valley Borough Council to carry out a ground investigation of the slope above several properties within the Pantteg landslide, near Ystalyfera in the Swansea Valley. The purpose of the investigation was to evaluate the degree of risk to properties which would be especially vulnerable to landsliding of the type which had affected adjacent parts of the slope in the past. The properties were those designated within 'Risk Category 4' on a hazard map of the landslide and accompanying report, dated July 1987 (Drawing No KC/LVB/R1/1).

1.02 During the course of the investigation, a new contoured map of the area was produced and used as a basis for detailed morphological mapping of the landslide (Drawing No KC/LVB/R1/4). Subsurface conditions were investigated by four boreholes and ten trial pits from which samples of the landslide deposits were recovered for laboratory testing. Piezometers were installed in the boreholes to investigate water pressures within the slope and potential sources of groundwater entering the landslide. These data permitted stability analyses to be carried out on a representative cross-section of the slope above the properties concerned.

1.03 Mapping confirmed that there are two landslide subsystems on the slope concerned which together form a two-tiered landslide. A rotational failure in the upper part of the slope has displaced rock down the slope where it has failed again. The rear scarps of both subsystems are defined by relatively strong siltstone and sandstones whilst their soles follow weaker horizons associated with the Lower Pinchin and Lower Welsh Seams respectively (Drawing Nos KC/LVB/R1/2 and KC/LVB/R1/3). The upper subsystem lies entirely upslope of the properties, whilst the lower subsystem extends from the slope behind the properties to the valley floor.

1.04 Most of the slope above the properties concerned shows no evidence of active or recent movement. However, to the south west an area of active movement encroaches the terrace containing Nos 21 to 29 Pantteg. A small landslide affected No 29 in November 1987 subsequent to the report mentioned above. To the north east, uphill of Craig y Merched, a landslide occurred in November 1986 which damaged six houses (Drawing No KC/LVB/R1/4).

1.05 The investigation revealed that groundwater has the potential to enter the landslide deposits from both the horizon of the Lower Pinchin Seam and a thin coal above the Lower Welsh Seam. However, in the area of the investigation, there was little evidence that the former source contributes any significant inflow into the landslide and it was concluded that workings in the Lower Pinchin Seam may preferentially channel water to adjacent areas of the landslide where there is active or recently active movement described in the preceding paragraph. Piezometers indicated that there were low water pressures in the landslide deposits in the slope above the properties and that beneath the properties, the landslide deposits are almost fully saturated (Drawing No. KC/LB/RI/3). No evidence of artesian pressures within the strata was found.

1.06 Cored and undisturbed samples from the boreholes showed that the landslide deposits were essentially granular, consisting of silty, sandy gravel with many cobbles and boulders, derived mainly from the rock displaced in the rotational failure in the upper part of the slope. The results of tests to determine the peak and residual effective shear strength of the deposits showed some scatter (Drawing No KC/LVB/R1/6). It was concluded that the following parameters were representative for the stress range applicable to failures at Pantteg and were used in the stability analyses:

Peak	$c' = 17kN/m^2$	$\emptyset' = 33^o$
Residual	$c'_r = 0kN/m^2$	$\emptyset'_r = 29^o$

1.07 Stability analyses of the slope above the properties in 'Risk Category 4' produced factors of safety above unity for the type of 'overriding' failures which occurred in adjacent parts of the hillslope in 1986 and 1987 (Drawing No KC/LVB/R1/7). It was concluded that this type of failure is unlikely on the slope but that other failure modes may be possible, particularly if any part of the lower landslide subsystem were to be adversely disturbed.

1.08 Because of their proximity to an area of active movement and the damaging landslide in 1987, it was concluded that the terrace containing Nos 21 to 29 Pantteg should be considered as Risk Category 1 ie properties with a high probability of suffering a total loss as a result of landsliding in their remaining life.

1.09 For the remainder of properties previously contained in Risk Category 4 ie

Dan y graig
Twynegeur
Nos 19 to 28 Pantteg (terrace)
Nos 1 to 11 Pantteg

it was concluded that they could be considered within Risk Category 3, ie properties which are unlikely to be significantly affected by landsliding in their remaining life, under the conditions which presently prevail.

1.10 The report emphasises the need to avoid potentially destabilising influences not only on the slope above the properties concerned but also within the remainder of the landslide area between the properties and the valley floor. Activities associated with changes in surface water flows, mining or development involving any excavation or filling in the landslide area needs to be avoided or rigorously controlled. Failure to observe these precautionary measures could result in an adverse change in the current stable conditions and possible damaging slope movements.

2. GENERAL

2.1 Introduction

2.11 In 1987, Sir William Halcrow & Partners (Halcrow) were requested by Lliw Valley Borough Council (LVBC) to prepare a landslide hazard map of the adjacent landslide complexes at Godre'r graig and Pantteg, near Ystalyfera in the Swansea Valley, together with an interpretative report. The subsequent 'Report on Hazard Mapping' (subsequently referred to as the 'First Report'), catalogued some 20 landslide occurrences within these two ancient landslide complexes, the most recent one of which had damaged five houses within Graig y Merched, at the north eastern end of Pantteg village in November 1986. Concern had been expressed that this incident at Pantteg might herald the onset of a major landslide episode similar to that which had resulted in the complete evacuation of Pantyffynnon village in the 1960's.

2.12 However, the 'First Report' and the hazard map indicated that movement at Pantteg was far more localised and that the landslide occurrences had largely resulted from injudicious human activities which had affected the stability of certain parts of the steep hillslope above the village. Three degrees of landslide hazard (low, medium and high) were recognised depending on the present and past activity of the landslide. Four categories of risk to the existing properties were then defined, based on their location with the respect to the landslides, their vulnerability and the degree of landslide hazard. They were defined as follows:

Risk Category 1 : property and roads which lie within a high or medium hazard area or which lie in the path of a landslide emanating from such an area. In the event of a failure, properties could suffer a total loss and injuries could result.

Risk Category 2 : property located within the path of a landslide from a high or medium hazard area but, for reasons of location or topography are unlikely to suffer total loss in the event of a failure and injuries would be less likely.

Risk Category 3 : property and roads within or downhill of a low hazard landslide area and which are largely outside the direct effects of failures higher on the hillside.

Risk Category 4 : property downhill of a low hazard part of the landslide but where, should failure occur, geological and hydrogeological conditions might be present which could result in total loss of the properties concerned and possible injury.

2.13 Recommendations were made for alternative strategies of remedial treatment or monitoring to protect properties most at risk. However, it was noted that the degree of risk to properties within Risk Category 4 could not be determined from geomorphological investigations alone and a ground investigation was recommended. The aim of this investigation was to evaluate the stability of the hillslope above properties within Risk Category 4 and its susceptibility to the kind of rapid and potentially injurious failure which had affected the houses in Craig y Merched. It was appreciated that stability would depend very much on the hydrogeological conditions within the slope.

2.14 In September 1988, LVBC requested Halcrow to submit proposals for the investigations which had been recommended for properties within 'Risk Category 4'. Halcrow's reply of 16 September 1988 (Ref Appendix 'A') stated that the event of November 1987 indicated that properties adjacent to that affected by the landslide should be considered as Risk Category 1 and that investigations would therefore be confined to the hillslope above the remaining 'Risk Category 4' properties ie:

- Dan y graig
- The terrace containing Nos 19-28 Pantteg (downhill side of road)
- Nos 1 to 11 Pantteg (uphill side of road)
- Twyneglur

These proposals were accepted by LVBC and Halcrow were verbally instructed to proceed with the investigation in February 1989.

2.2 Terms of Reference

2.21 The terms of reference for the investigation are provided in the Appendix to the Memorandum of Agreement between Halcrow and LVBC, dated April 1989 (Appendix 'B'). This provides for a ground investigation of that part of the Pantteg landslide which is a potential hazard to those properties within 'Risk Category 4', as identified in the letter KC/WSW/7/0/757 (Appendix 'A'). Halcrow were requested to prepare and supervise a ground investigation contract, interpret the results of the investigation and report them to LVBC.

2.22 The general area encompassed by the investigation, together with properties in 'Risk Category 4' are shown on Drawing No KC/LVB/R1/1.

3. INVESTIGATIONS

3.1 Site Visits

3.11 The project was carried out between June and November 1989 by staff based in Halcrow's regional office in Cardiff, under the overall control of Dr D H Beasley, the Regional Manager.

3.12 The site was visited by Halcrow staff on numerous occasions during the period of the investigation in order to gather information and to supervise a ground investigation conducted by Exploration Associates Ltd (EAL) under contract to LVBC.

3.2 Surveys

3.21 In order to provide a more accurate base map than had been available for the 'First Report', Engineering Surveys Ltd were commissioned to prepare a contoured plan of the site by photogrammetry using aerial photographs produced for West Glamorgan County Council. These photographs formed part of an aerial survey of the entire County carried out in September 1972 by Fairey Surveys Ltd, negatives of which are now held by Clyde Surveys Ltd. This contoured plan forms the base of Drawing No KC/LVB/R1/1 and was used in the preparation of other plans in this report.

3.22 On completion of the ground investigation, the locations of boreholes and trial pits were surveyed. In addition, a survey was performed of a representative cross-section of the hillslope above the properties concerned. The location of this cross-section, 1-1 (and its extension $1\text{-}1^1$, used to portray geological information) is shown on Drawing No KC/LVB/R1/1.

3.3 Exploratory Holes

3.31 Boreholes were sunk by EAL using cable percussive techniques and rotary drilling at four locations during July and August 1989 to establish the ground and groundwater conditions beneath the hillslope. The percussive holes penetrated most of the

superficial deposits and the remainder, together with the underlying rock were cored in order to prove the entire geological sequence beneath the slope. The locations of the boreholes are shown on Drawing No KC/LVB/R1/1.

3.32 In order to supplement information on the landslide deposits obtained by the boreholes, trial pits were excavated in eight locations (TP01 to TP06 inclusive, TP09 and TP10). Two other pits (TP07 nd TP08) were excavated near borehole 1 to determine reasons for the difficulty in penetrating rockhead within the borehole.

3.33 Records of the exploratory holes are contained in EAL's factual report, ref H169, dated October 1989.

3.4 **Laboratory and In Situ Tests**

3.41 Undisturbed, 100mm diameter (U100) and bulk samples of the landslide deposits were recovered from boreholes and trial pits at the depths shown on their respective records. (Ref Exploration Associates Report). The bouldery nature of much of these deposits severely limited the number of undisturbed samples recoverable from the boreholes. Selected samples were scheduled for laboratory testing by EAL in their Warwick laboratories. This testing included classification tests, particle size distribution analyses, chemical tests, and drained triaxial and shear box tests. Some of the samples proved too coarse for testing in a conventional 60 x 60mm shear box and tests on these samples were subcontracted by EAL to the laboratory of Warwick University for testing in a 300 x 300mm shear box.

3.42 The results of the laboratory tests are presented in EAL's factual report, ref H9169, dated October 1989. A summary of the results is presented in Appendix 'C' and the geotechnical properties of the materials are discussed in Section 4.6.

3.43 Standard penetration tests (SPT's) were carried out in the landslide deposits with the results indicated on the borehole records.

3.5 Piezometer Installations & Observations

3.51 Two Casagrande-type standpipe piezometers were installed in boreholes 2, 3 and 4. A single piezometer was installed in borehole 1. These were to provide information on groundwater pressures within the rock and landslide deposits beneath the hillslope under investigation. The piezometers were subsequently monitored by LVBC at weekly intervals and the results passed to Halcrow for processing.

3.52 The measurements are discussed in detail in Section 4.5.

3.53 As part of the routine monitoring of piezometers, the riser tubes were plumbed with slip indicators. No distortions resulting from ground movement were found.

4. GROUND CONDITIONS

4.1 Description and history

4.11 Pantteg is a small village on the north western side of the Swansea Valley, about 0.5km south west of Ystalyfera. The village together with the neighbouring village of Pentyffynnon straddled the main road through the Swansea Valley (A4068) and were constructed on the lower parts of two large landslide complexes, which have been called the Pantteg and Godre'r-graig landslides respectively. Pantyffynnon was evacuated following a series of landslide occurrences which were detailed in the 'First Report'. A number of occurrences have also affected property at Pantteg since about 1946. Many properties have been demolished or vacated as a result of both landslide activity and general dilapidation. However, a large number of properties remain and most were considered in the 'First Report' to be unlikely to be affected by future landslide activity within their remaining lives (ie Risk Category 3, ref paragraph 2.12).

4.12 The properties forming the subject of this report ('Risk Category 4' ref Drawing No KC/LVB/R1/1) are adjacent to the A4068 in the north eastern part of the village. Uphill of the road, the hillslope rises very steeply to a line of rocky crags, behind which there is a broad, more gently sloping terrace and a further, higher rock face. A number of old coal levels lie at the base of this latter rock face. Behind this uneven part of the slope, which has all been formed by past landsliding, the ground rises more evenly in a succession of scarps and benches which is given over to pasture.

4.13 One small and two large quarries, designated Q2, Q3 and Q4 in the 'First Report' lie uphill of the extremities of the area under investigation.

4.2 Geology

4.21 The sequence of strata within the hillslope proved by the boreholes is shown on the Geological Plan (Drawing No KC/LVB/R1/2) and Geological section (Drawing No KC/LVB/R1/3). This consists of a succession of sandstones, siltstones and claystones of the Middle Coal Measures and the overlying Llynfi Beds of the Upper Coal Measures, the junction between which is defined by the Upper Cwmgorse Marine Band. As described in the 'First Report', these strata dip southwards at about 10 degrees which produces a component of a few degrees towards the valley.

4.22 The upper part of the slope is dominated by thick developments of strong, thinly to medium bedded sandstone which crop in the tall cliff-like face uphill of borehole 2. The sequence was proved in borehole 1 where it contained many thin developments of moderately weak to moderately strong, thinly laminated siltstone in its upper part. These arenaceous rocks, collectively referred to as the Llynfi Rock were formerly quarried uphill of the site in Quarries Q2, Q3 and Q4. Beneath the sandstone, borehole 1 proved a 13m thick sequence containing the three leaves of the Lower Pinchin Seam. The upper leaf was only 0.2m thick and was separated from the lower two by mainly sandy siltstones. The lower two leaves were 0.4m and 0.95m thick respectively. There are extensive workings in the Lower Pinchin Seam in the area and the available mine plan indicates that at least the lowest and thickest seam was mined (ref Section 4.5).

4.23 Between the Lower Pinchin Seam and the next named seam, the Lower Welsh, which crops at the foot of the slope behind the village, boreholes 2 and 3 proved about 38m of moderately strong, laminated arenaceous siltstone with about 10m of weak to moderately weak claystone and a thin coal in its central part. It is believed that the Upper Cwmgorse Marine Band lies within these claystones but type fossils were not found.

4.24 Below the predominantly arenaceous sequence referred to in the proceeding paragraph, borehole 3 proved a further thin coal, separated from the 0.45m thick Lower Welsh Seam by about 4m of clayey siltstone. Beneath the Lower Welsh Seam, boreholes 3 and 4 indicated that there is weak argillaceous, fissured seatearth, which is about 2m thick.

4.25 The 90m thick sequence described above, which forms the hillslope above the village, is underlain by further Middle Coal Measures which are believed to be mainly siltstones and claystones. The Red Vein, which has been worked from levels in the valley floor occurs about 30m beneath the Lower Welsh Seam.

4.26 The solid rocks described in this section are overlain by landslide deposits which are described in more detail in Section 4.4.

4.3 Morphology and Geomorphology

4.31 The hazard map which accompanied the 'First Report' was based on a geomorphological map of both the Godre'r-graig and Pantteg landslides to a scale fo 1:2500. This map depicted the various landforms to which different landslide processes had given rise and provided descriptions of each process in a explanatory legend. The interpretation provided for the Pantteg landslide was that a shallow failure in rock had occurred in the upper part ofthe slope which had displaced the colluvium originally present on the slope downhill towards the valley floor.

4.32 The present investigations have tended to confirm this interpretation and more detailed morphological mapping of the area has been carried out to a scale of 1:1250 (Drawing No KC/LVB/R1/4) Morphological mapping is a method of portraying the shape of the land surface. It differs from the more familiar contour map, which is based on height alone, by showing individual landforms using a recognised set of symbols. In the case of a hillslope, the technique involves the division of the land surface into units possessing similar slope angles, the junctions between which are delineated as convex or concave changes in slope. The object of

this kind of mapping is to portray the spatial relationship of landforms which might then be interpreted in terms of the geomorphological processes (ie landsliding) which have created them.

4.33 Within the area of the investigation, there are two main landslide subsystems whose origins are inter-related. The upper one is defined by an 8-14m high rear scarp which extends form behind Pen-y-Graig in the south west to Quarry Q3 in the north east. The latter seems to have exploited this natural outcrop of sandstone. Downhill of the rear scarp, there is a more gently sloping, uneven terrace on which borehole 2 was drilled and pits TP01 to TP05 were excavated. As illustrated on Drawing No KC/LVB/R1/3, this terrace is interpreted as the surface of one or more blocks of rock which have been rotationally displaced from the rear scarp along a failure surface within or beneath the underlying Lower Pinchin Seam sequence. In the south western part of this terrace, there are active movements, which are described in more detail in paragraph 4.39. The north eastern extent of the terrace appears to lie just downhill of Quarry Q3.

4.34 The second landslide subsystem occurs immediately downhill of the first and it too has a rear scarp in which rock outcrops for some of its length. In this case, the rocks are the moderately strong siltstones which underlie the Lower Pinchin Seam (ref Drawing No KC/LVB/R1/3 and KC/LVB/R1/4). Downhill of this scarp there is a narrow, moderately sloping terrace above very steep slopes which lie immediately behind the houses on the north western side of the A4068 road. As shown on Drawing No KC/LVB/R1/4, this is interpreted as part of a second rotational slide which extends downhill of the road towards the valley floor.

4.35 South west of the area of the present investigation, there is no exposure of rock in the area of the rear scarp of the lower landslide subsystem. Although obscured by a continuous cover of landslide debris, its shape remain discernable from the slope morphology.

4.36 It is interpreted that these two landslide subsystems are components of a two-tiered landslide system in which a rotational failure in the upper part of the slope has displaced rock down the slope where it has failed again. The rear scarps of both subsystems are defined by relatively strong rocks whilst their soles follow weak horizons associated with the Lower Pinchin and Lower Welsh Coal Seams.

4.37 Apart from some very old steps at the crest of the steep slope behind Dan-y-graig and adjacent properties, there is little evidence of any activity of the landslide in the area ofthe investigation. However, No 29 Pantteg at the edge of the area under consideration was affected by a debris slide and flow in November 1987. Inspection of Drawing No KC/LVB/R1/4 indicates that this failure is itself part of the area of active movement which has long affected this part of the slope and which continues to the present day. There is evidence of active displacement extending from the base of the rear scarp to at least 50m downhill and it is known that several properties at the toe of the slope were evacuated and demolished as a result of landslide occurrences in the 1960's and 1970's. Some of these occurrences involved falling or rolling boulders and it is evident that these were all derived from an earlier rock failure as described in 4.36.

4.38 It will be noted that the area of the 1986 landslide occurrence at Craig-y-Merched lies just beyond the north east extremity of the landslide system described above. This rotational slide appears to have been a 'first-time' failure within the colluvium in that part of the hillslope. Although not in any way associated with the much larger area of rock failure to the south west, a similar morphology has been created.

4.39 In summary, it may be seen that the properties within 'Risk Category 4' lie on a landslide subsystem whose toe extends to the valley floor and whose upper part composed of displaced rock debris, rises steeply above the properties. In contrast to the areas to the north east and south west, the area under investigation shows no evidence of recent displacement.

4.4 Landslide deposits

4.41 Deposits within the upper landslide subsystem were investigated by borehole 2 and trial pits TP01 and TP05. Borehole 2 proved 7.8m of landslide deposits comprising gravel, cobbles and boulders of angular siltstone and sandstone debris with some loose silty sand matrix. The trial pits also encountered gravel, cobbles and boulders of weathered siltstone and sandstone, but with little matrix and an open structure which led to caving of the trial pit sides. These materials are interpreted as the remnants of displaced rock produced by rotational sliding of one or more blocks of the Llynfi Rock at the horizon of the Lower Pinchin Seam, as described in paragraph 4.33.

4.42 Deposits within the lower landslide subsystem, immediately uphill ofthe houses in 'Risk Category 4' were investigated in boreholes 3 and 4 and trial pits 06 and 10, whist material in the area adjacent to the 1986 landslide was sampled in Trial pit 09. In borehole 3, 4.45m of landslide deposits were proved but with very poor recovery. It appeared to comprise sandstone cobbles and boulders and fine sandstone and siltstone gravel with a loose silty sand matrix. Like the landslide deposits in borehole 2, these are interpreted as the remnants of displaced rock. Similar bouldery deposits, were found in the basal 6.30m of the landslide deposits in borehole 4, but were overlain by 2.90m of silty sandy clay which contained sandstone gravel. Trial pit 06, which was excavated close to borehole 4, proved 2.5m of made ground which presumably represents the remnants of houses which were demolished in that area in the 1970's. The uppermost 1.5m of the deposits in borehole 4 are also interpreted as made ground.

4.43 At the base of the landslide deposits boreholes 2, 3 and 4, all encountered highly weathered material at rockhead. This consisted both of siltstone (boreholes 2 and 4) and mudstone (boreholes 3 and 4) the latter with some clayey matrix. However, these deposits were very poorly recovered in the boreholes, no slip surfaces were identified and no representative samples could be obtained. Consequently trial pits 09 and 10 were excavated within the rear scarp of the lower landslide subsystem, to recover

samples from the base of the landslide deposits for laboratory testing. Both pits encountered gravel and cobbles of fine sandstone with some matrix of firm brown silty clay, which in trial pit 09 rested on highly weathered, thinly laminated silty mudstone.

4.44 The shear strength parameters used in the stability analyses were based on the laboratory test results described in Section 4.7. The deposits were sub-divided into two zones in the analyses to represent the landslide deposits and those conditions at or close to rockhead where previously sheared material is assumed. Analyses were performed based on peak and residual strengths in the layer above rockhead as part of a parametric study. It is considered that discrete shear surfaces would not have been formed during previous movement of the landslip deposits, except perhaps in more clayey horizons. The rock-soil interface, however, has the potential for realignment of particles in the direction of shear strength reduction caused by this displacement. Inspection of the rear scarps within and adjacent to the study area indicates a preponderance of laminated siltstone, weathering of which produces platey gravel sized fragments which would be susceptible to the formation of such a fabric.

4.45 It is possible that, for the reasons described above shear strength at or close to the residual strength may be present within the rockhead if a realigned fabric exists. However without discrete shear surfaces or realignment of platey material, it is possible that the material at rockhead may not have undergone the transition from peak to residual strength during shearing by landsliding.

4.5 **Mining**

4.51 As described in our 'First Report' the Lower Pinchin Seam has been worked from several levels on the crop of the seam at the toe of the rear scarp of the upper landslide subsystem (ref Drawing No KC/LVB/R1/2). At least two phases of mining are apparent:

a) an early phase of workings from levels situated inthe south west, central and north easterly part of the rear scarp. The extent of these workings are not recorded.

b) more recent workings in the period 1952 to 1960 from Vine Colliery, whose main entrance was a level some 500m north east of the area shown on Drawing No KC/LVB/R1/2. These workings extended south west and encroached into the area immediately uphill of the 1986 landslide at Craig-y-Merched. It will be noted that these workings underlie Quarry Q4 and that two "airways", associated with this mining lie within the area of consideration. Within the area uphill of the landslide, workings from Vine Colliery encountered some of the older workings referred to above and it appears likely that old workings are continuous between the Vine Colliery working and the outcrop of the seam.

4.52 It is likely that these workings exploited the lowest leaf of the Lower Pinchin Seam which is the thickest (ref paragraph 4.22) and the section of the coal shown on the Vine Colliery mine plan substantiates this view. If this is the case, the adits are generally a few metres above the seam and would have to have been inclined downwards for their initial lengths. However, it is possible that some of the earlier workings could have exploited the two upper leaves of coal which are thinner.

4.53 The only other seam believed to have been worked beneath the landslide is the Red Vein which lies some 35m below the Lower Welsh Seam. These workings were probably carried out by pillar and stall methods from Lower Cyfyng level during the 19th century and by longwall stall methods earlier this century from Ystalyfera Colliery. Both these mines are on the valley floor, beyond the area shown on plans in this report. These workings are considered unlikely to have a significant influence on the landslide.

4.6 Hydrogeology

4.601 As described in the 'First Report', the hydrogeology of the landslide is dominated by the Llynfi Rock (predominantly sandstone and arenaceous siltstones) which overlies the Lower Pinchin Group of coals. Given that these sandstones crop over an extensive area uphill and, structurally, up dip of the landslide, there is the potential for groundwater to flow into the landslide from the base of these strata. It is considered that this unfavourable geological configuration is one of the main factors contributing to the initiation of landsliding in the area in ancient times. It was noted in the 'First Report' that the groundwater catchment has a relatively thin cover of superficial deposits and that the quarries immediately uphill of the landslide are especially receptive to infiltrating rainfall.

4.602 Little is known with certainty about the influence of workings within the Lower Pinchin Seam on this hydrogeological regime. However, comparison with other sites in South Wales suggests that their effect may have been substantial, preferentially channelling groundwater towards specific parts of the spring line and away from others. In general terms, adit entrances are potentially likely areas for groundwater emergence and those at the lowest point of the workings are especially susceptible.

4.603 There are records of two locations where groundwater thought to originate from the Llynfi Rock, emerges at the surface. South west of the area under consideration water has been noted to emerge within the area of active movement during some of the landslide events in that area, although none has been seen during the present investigations. It seems likely that this water originates from one of the levels immediately uphill, which are at the lowest points of the workings.

4.604 Groundwater also emerges from a spring in the rear scarp of the 1986 landslide at Craig-y-Merched. Although a spring in this location is noted on past editions of Ordnance Survey maps, it was suggested in the 'First Report' that the large flows which accompanied the failure in 1986 were the result of a diverted

stream sinking into Quarry Q4 and re-emerging at the issue. It was suggested that flows may have exploited workings in the Lower Pinchin Seam which are known to underlie Quarries Q3 and Q4.

4.605 Seven piezometers were installed during the investigation in both the rocks within the slope and the landslide deposits. The results of monitoring are shown on Drawing No KC/LVB/R1/5 and are summarised in Table 4.61.

4.606 A piezometer was installed in the Lower Pinchin Seam in borehole 1 and has fluctuated over a range of about 4 metres (excluding a suspect observation in September, which is believed to have resulted from the probe touching a joint within the piezometer riser tube). The piezometer recorded a small, but pronounced increase in water level in response to rainfall in mid-October, but this declined during the dry weather during November. Compared with other aquifers in South Wales, the response is relatively subdued and suggests that the strata above the Lower Pinchin Seam are being drained by workings in the seam.

4.607 No water was encountered during drilling of the siltstones beneath the Lower Pinchin Seam and piezometer 2a has recorded very small heads of water. It is unlikely that these siltstones contribute water into the landslide deposits.

4.608 Piezometer 3a was installed within the siltstones above the Thin Coal which overlies the Lower Welsh Seam. Water was encountered within these siltstones during drilling and the water levels recorded in piezometer 3a are similar to the standing water levels recorded during drilling. There have been only small fluctuations in the water levels within piezometer 3a, but a moderate response to the rainfall during October indicates that these strata are being recharged by infiltrating rainfall and are therefore a possible source of groundwater entering the base of the landslide deposits in the adjacent slope.

Piezometer Number	Elevation of ground	Elevation of piezometer	Elevation of base of landslide	Maximum Water Level	Minimum Water Level	Remarks
1a	189.27	153.32	-	166.84(?)*	156.42	Installed in Lower Pinchin Seam (lowest leaf)
2a	155.20	135.45	147.48	135.60	135.46	Installed at base of borehole
2b	155.20	148.25	147.48	148.30	148.26	Installed at base of landslide deposits
3a	130.54	107.44	124.54	111.49	108.99	Installed in siltstone, 6.50m above lower Welsh Seam
3b	130.54	124.58	124.54	125.55	124.59	Installed in weathered mudstone at base of landslide
4a	100.70	90.45	90.00	98.45	96.47	Installed at base of landslide deposits
4b	100.70	96.38	90.00	99.05	97.22	Installed within landslide deposits

TABLE 4.61 Summary of piezometer observations

Notes

(i) Based on observations between August and November 1989
(ii) All elevations in metres above Ordnance Datum
* Maximum water level is anomalous. See text.

4.609 No water was encountered within the landslide deposits in the upper part of the slope during drilling of boreholes 2 and 3. Piezometers 2b and 3b subsequently installed at the base of these deposits have recorded very small heads of water, the latter showing a small response to rainfall during October. At the toe of the slope, borehole 4 encountered water within the landslide deposits and which stood at a depth of between 3.10m and 4.20m, before being sealed off by casing. Piezometers 4a and 4b installed at two locations within the landslide deposits have continuously recorded water indicating that the basal 9m of the landslide deposits are saturated. Both piezometers respond to rainfall and it is possible that groundwater within the landslide is being recharged from both surface infiltration and water from the siltstones uphill.

4.610 In summary, the investigation has shown that groundwater may enter the landslide deposits from both the horizon of the Lower Pinchin Seam and from above a Thin Coal above Lower Welsh Seam. However, in the area of the investigation, there is little evidence that the former source contributes any significant inflow into the landslide and it is considered that the workings in the Lower Pinchin Seam preferentially channel groundwater to other parts of the spring-line. Consequently, it is only the landslide deposits in the lowest part of the slope which contain any significant quantities of groundwater, probably from the siltstones which overlie the Thin Coal above the Lower Welsh Seam.

4.7 **Material properties** (Ref Drawing No KC/LVB/R1/6)

4.701 Results of the laboratory tests carried out on samples of landslide deposits recovered during the investigation are summarised in Appendix 'C' and shown on Drawing No KC/LVB/R1/6.

4.702 Particle size distribution analyses were performed on ten samples. These showed that the deposits comprised silty sandy gravel sized fragments with a clay fraction of less than 10 percent. The silt and clay fraction of the material varied between 0 and 42 percent with a mean value of 20 percent. Cobbles were recovered in four samples with a maximum of 67 percent in sample TP2/0.10-3.00.

The gradings of the landslide deposits are generally within the range for superficial deposits derived by Halcrow in a large number of investigations carried out in South Wales (Halcrow, 1972).

4.703 Ten Atterberg Limit determinations indicated that the materials tested are classified as inorganic clays of low plasticity, in accordance with BS5930 : 1981. Sample TP9(2)/1.0m was termed non plastic. Neglecting specimen TP9(2)/1.0, the mean liquid and plastic limits were 30 and 17 precent respectively. Mean plasticity index was 13 percent. The percentage of fine material in the specimens for plasticity testing averaged 71 percent, the figures for each specimen being shown on Drawing No KC/LVB/R1/6. These data are consistent with those determined by Halcrow on similar materials in South Wales.

4.704 Natural moisture contents ranged from 4 to 27 percent with a mean of 14 percent. The highest value was determined for sample BH4/2.60-3.00 which is consistent with the slightly finer nature of this sample compared to the remainder.

4.705 Specific gravity determinations carried out on two samples indicated a range from 2.58 to 2.68 with a mean of 2.63. Bulk densities measured on six samples ranged between 1.74 and 2.11Mg/m^3. A value of 1.96Mg/m^3 was used in the stability analyses. These results are within the anticipated range for similar materials in South Wales.

4.706 Total sulphate contents were measured for two samples. These ranged between 0.04 and 0.08 percent. pH determinations indicated a range of 7.0 to 8.3 with a mean of 7.6. These results indicate near neutral conditions. Organic content was determined for one sample giving a value of 1.72 percent.

4.707 Two 100mm diameter consolidated drained triaxial tests were performed on undisturbed specimens of the landslide deposits. Drained shear box tests were performed on four remoulded samples. Two tests were performed on 300 x 300 specimens and two on 60 x 60mm specimens. Peak shear strengths were obtained in all tests

and, residual shear strengths were determined in the shear box tests. The results are shown on Drawing KC/LVB/R1/6 as plots of effective shear strength against effective normal stress. Also shown on the drawing are shear strength envelopes derived from a statistical analysis of a large number of tests undertaken by Halcrow (1972).

4.708 The peak shear strength results plot from below 'lower limit' to well above 'lower medium'. The lowest result was from sample BH4/2.60. This sample had a moisture content of 27 percent and markedly finer than the other samples tested. On the basis of these results and the materials encountered during the investigation (ref Section 4.4) it is considered that this sample is probably not representative of the landslide deposits. The test result from this sample was therefore discounted from the assessment of representative shear strength parameters for stability analyses.

4.709 With the exception of sample BH4/2.60, discussed above, peak strengths are well represented by the parameters effective cohesion intercept $c' = 17kN/m^2$ effective angle of shearing resistance $\emptyset' = 33$ degrees. This strength has been used in the stability analyses outside any shear zone.

4.710 The residual shear strength test results generally plot between the 'lower limit' and 'lower median' curves (ref Drawing KC/LVB/R1/6). However the results from samples TP9(2) and TP10(2) plot outside the normal range of results. The residual strength of sample TP10/0(2) was only a little lower than the measured peak strength which is consistent with its granular consistency. Sample TP9(2) had a high silt content which accounts for its lower than average strength. Excluding these two results, the residual shear strength of the deposits is represented by the parameters $c_r' = 0kN/m^2$ $\emptyset_r' = 29^o$. For material with a plasticity index of 13%, Lupini et al (1981) publish a range of $\emptyset_r'$ from 25 to 33 degrees. Cripps and Taylor (1981) and Skempton (1985) have also related clay fraction to effective residual friction angle. For a clay fraction of less than 10 percent, the published range of $\emptyset_r'$ is 29 to 34 degrees. These data are in agreement with the

laboratory test results. The parameters $c_r' = 0$, $\phi_r' = 29^o$ were therefore used in the stability analyses where residual strengths were appropriate.

5. HAZARD ASSESSMENT

5.1 Stability analyses

5.11 Stability analyses were performed on one section through the landslide at the location shown on Drawing No KC/LVB/R1/1. The section was chosen to be representative of the landslide above properties within 'Risk Category 4'.

5.12 The surface profile of the section is shown on Drawing No KC/LVB/R1/6 was established by ground survey (ref Paragraph 3.22). Rockhead and sub soil boundaries were determined by interpolation of borehole and trial pit data described in Section 4. The water table was based on the maximum water levels recorded in the piezometers over the period of the investigation (ref Section 4.6)

5.13 As described in Section 4.4, the slope above properties within 'Risk Category 4' is formed of landslide deposits within the lower landslide subsystem, which extends to the valley floor. The present investigation was limited to the slope above the properties and considers the potential for 'over-riding' failures such as that which affected the properties in Craig-y-Merched in 1986. As was demonstrated by this and other failures of the slope concerned, catalogued in the 'First Report', this type of failure is considered to be the most hazardous for the properties concerned. The extent of the investigation does not permit the evaluation of "engulfing" failures involving the entire landslide subsystem except in the qualitative terms described in the following section.

5.14 The potential for over-riding failures within the slope concerned was considered by the analyses of a range of potential failure surfaces. The critical surfaces which are representative of both shallow and deep slope failure mechanisms are shown on Drawing No KC/LVB/R1/7. The deeper surfaces follow rockhead for most of their length along a presumed sheared layer caused by previous landsliding. The shallower surfaces and the basal part of the deeper surfaces are contained within previously unsheared material. Deep failures within intact rock were not considered.

5.15 Both circular and non-circular failure surfaces were analysed using computer-based effective stress programs based on the methods of Bishop (1954) for circular failures and Janbu (1954) for non-circular failure surfaces.

5.16 The results of the stability analyses are shown on Drawing No KC/LVB/R1/7. They demonstrate, in all cases, a factor of safety above unity for 'over-riding' failures. The critical slip surface was S3 and the lowest factor of safety were 1.44 and 1.11 based on peak and residual shear strengths respectively. The analyses indicate that the slope concerned is unlikely to suffer an 'over-riding' failure within the conditions which currently exist. However, it should be noted that the slope concerned is part of a landslide subsystem which extends to the valley floor and that other failure modes, such as an 'engulfing' failure of the entire landslide may be more critical. These could trigger an over-riding failure.

5.2 **Conclusions and Risk Assessment**

5.21 The Terms of Reference for the present investigations were to assess the degree of risk to properties classified in 'Risk Category 4' in the 'First Report' (ref Paragraphs 2.12 and 2.21). These are properties which were downhill of inactive parts of the landslide but which would be very vulnerable if adverse geological and hydrogeological conditions were to result in a failure of the slope, such as that which occurred at Craig-y-Merched in 1986.

5.22 For the purposes of risk assessment, it is convenient to divide the properties in Risk Category 4 into two groups,

i) the block of terraced houses including Nos 21 to 29 Pantteg

ii) Dan-y-graig, Twyneglur, Nos 1 to 11 Pantteg and the terrace containing Nos 19 to 28 Pantteg.

The terrace containing Nos 21 to 29 Pantteg lies at the north east extremity of an area of active movement. As described in our letter of 16 September 1988 (Appendix A), it is considered that

these properties should be reclassified as Risk Category 1 in view of the landslide occurrence which affected No 29 in November 1987. It is evident that in this area of active movement, landslide debris is being continuously transported down the slope from the upper landslide system to the lower. It is suspected that this activity is promoted by water emerging from the levels in the Lower Pinchin Seam immediately uphill (ref Paragraph 4.603).

5.23 For the rest of the properties, it is considered that they can be classified within Risk Category 3 and that they are unlikely to be affected by 'over-riding' failures during the remainder of their life under the conditions which presently prevail. This opinion is based on the following results of the present investigations:

- there is no evidence of active movement within the slope immediately uphill or within the upper landslide system above.

- water pressure within the landslide deposits on the slope uphill are very low.

- there is no evidence of artesion pressures within the rock beneath the slope.

- there is no evidence of significant quantities of water emerging from the Lower Pinchin Seam which seems to have been the major destabilising influence in the areas of recently active movements adjacent to the area of investigation.

In addition, stability analyses have indicated that the slope above the properties has a 'factor of safety' somewhat more than unity even when the more conservative residual strength parameters are used. It should however be noted that the factors of safety obtained in the analyses would not be considered adequate were the feasibility of new development at the toe of the slope being evaluated at the present time. The development which has taken place appears to have been carried out in ignorance of ground conditions.

5.24 The assessment of relative hazard (ie probability of landsliding) and consequent opinions on risk presented above are based on the ground conditions found during the period of the investigations. The 'First Report' indicated that many of the landslide occurrences which have affected the area were apparently the results of injudicious human influences. It is therefore essential that possible destabilising influences associated with future mining, surface water management and earthworks, however minor, are adequately evaluated. In this context, it is important to note that the slope investigated is part of a landslide subsystem which extends to the valley floor and that any of the activities outlined above which are carried out on this landslide subsystem may have the potential to destablise it with adverse consequences for the properties concerned.

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16 September 1988 KC/WSW/7/0/757

Dear Sir

PANTTEG LANDSLIDE - GROUND INVESTIGATION

We refer to your recent telephone conversation with Mr Siddle in which you requested us to submit details for a ground investigation in the area of those properties placed within "Risk Category 4" on our hazard map (Drawing LVA/1/3). The object of the investigation would be to establish whether groundwater conditions are sufficiently adverse so as to place these properties in Risk Category 1 (higher risk) or whether less hazardous conditions prevail. In the latter case, the properties would be included within Risk Category 3 (lower risk).

Since reporting to you in July 1987, a further landslide event occurred in November 1987 which affected one of the properties (No. 29?) within the area concerned. The area of active movement appears therefore to have spread north-east and the hazard map should, in our opinion, be revised to place this property and immediately adjacent ones (21, 23, 25 and 27) within Risk Category 1. The investigation we propose will assess the degree of risk of the remaining houses, ie those between Danygraig and the detached house between the A4068 and Craig y Merched.

Proposed Investigation

Since receiving your request, we have visited the site to locate possible borehole locatins and means of access to them. We propose that the investigation should consist of 4 boreholes in the approximate locations indicated on the attached plan. These boreholes are designed to:

- establish the geological sequence cropping beneath most of the slope concerned
- penetrate the Lower Pinchin Seam immediately behind the slope, in which workings are suspected

- record groundwater pressures in critical locations, including the Lower Pinchin Seam along which horizon water is suspected of being channelled

- recover samples for laboratory testing to determine shear strength and other relevant geotechnical parameters

The investigatiokn will enable the existing factors of safety within the slope to be calculated and to assess whether groundwater conditions are sufficiently adverse to place the properties in Risk Category 1.

Budget

We estimate the costs of the investigations, exclusive of VAT, to be as follows:

		£
(1)	Site Investigation (Contract Cost)	
	Fees:	
(2)	Contract preparation and management	
(3)	Supervision of site works and surveys	
(4)	Analysis and reporting	
	Expenses:	
(5)	Reimbursible expenses associated with (2), (3) and (4)	

The fees involved represent an input of about 5.2 man months of work.

In making these estimates, we have made the following assumptions:

1. (a) Contract costs have been based on the rates received for other recent tenders for site investigations. No allowance has been made for possible higher rates to take account of Contractors' existing workload and willingness to tender.

(b) We have assumed a total of about £3,000 for the site investigation contractor to make and maintain access to borehole locations. This figure could vary significantly due to the Contractor's perception of the site.

2. (a) We would not be involved in negotiations for access to the borehole locations across and onto land outside the Council's ownership.

(b) Tenders would be sought from an agreed select list of, perhaps, 4 or 5 contractors. We believe that this is especially important for a project involving public safety.

3. (a) The site works would span a period of 4 weeks, with full-time supervision of 3.5 weeks.

(b) No allowance has been made for delays due to problems of access arising from landowners.

4. (a) No allowance has been made for monitoring of water levels after completion of the site works which we assume the Council will wish to undertake and forward results to us.

(b) Allowance has been made for liaison with the Council's officers but not for any public consultation exercises which we would, of course, be pleased to perform on your behalf if required.

(c) Monitoring of water levels will include some of the present winter period.

All fees have been calculated assuming that our services will be paid for in accordance with Schedule 1 of the ACE Conditions of Engagement, 1981 (as amended) for Report and Advisory Work. Payment will be requested against invoices submitted monthly.

In addition, we would recommend that the Council commissions a contoured plan of the site prepared by photogrammetry. This is an essential basis for the investigation and would be invaluable for any future work carried out at the site. We understand that such a survey of the Pantteg landslide to a scale of 1 : 1250 on an Ordnance Survey base plan would cost £600 - £800 for the required area of about 700 x 400m.

Access

We understand that three of the boreholes are situated on land owned by Ynyscedwyn Estates. The only practicable means of access to these locations is along the track to Pen-y-Graig Farm and through the disused quarry. The fourth borehole lies within the area of Danygraig.

Formal agreements with the owners and/or tenants of these properties will be required. Our experience indicates that such negotiations could be protracted. We would recommend that, should your Council be considering any of the other investigations outlined in our letter TC/LVA/747 of 12 August 1987, then any agreements made with these bodies should take account of this possibility. The agreements should also provide for access after completion of the site works for the purpose of monitoring and any work which the contractor may be asked to do before the Acceptance Certificate is issued.

Programme

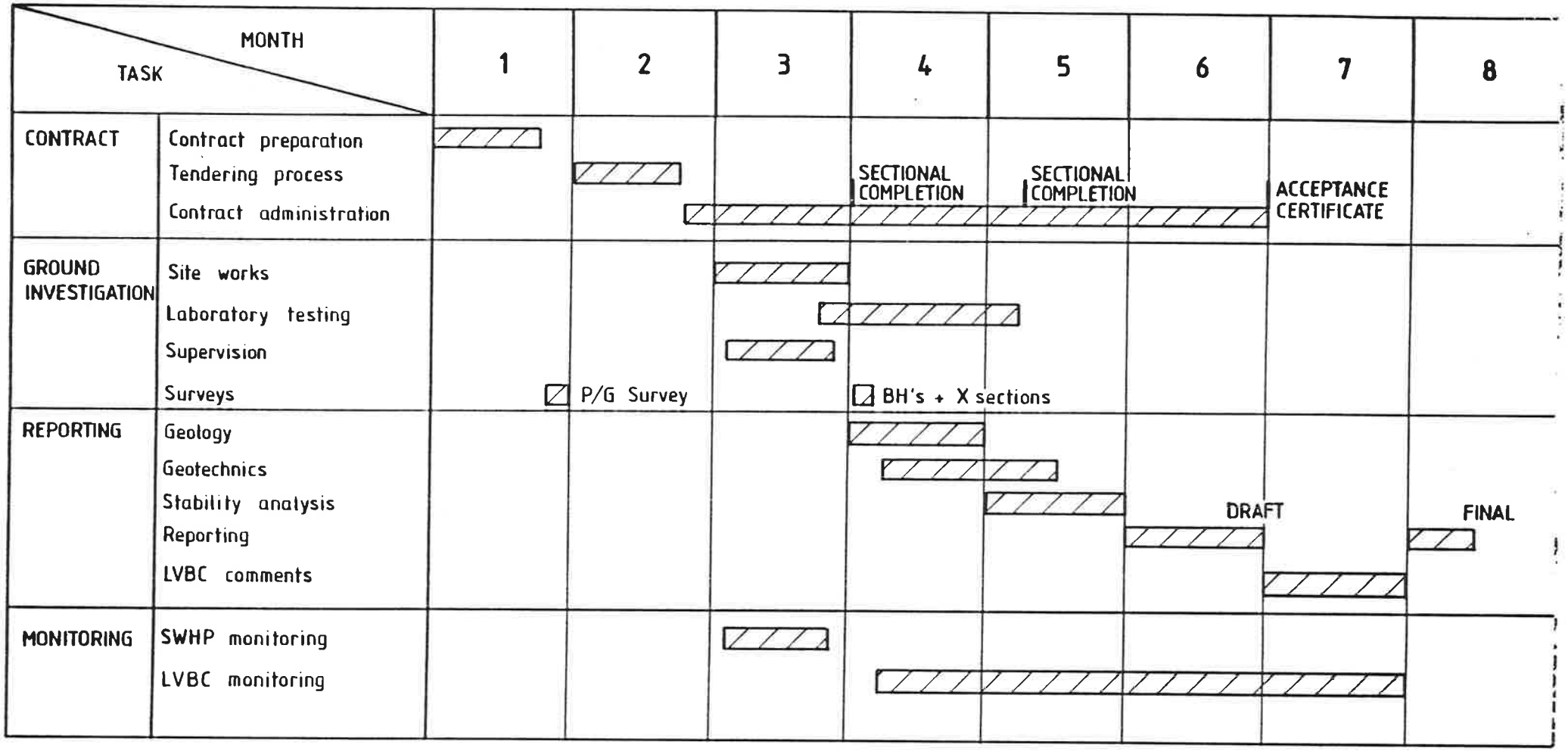
A suggested draft programme for the tasks outlined in this proposal is enclosed. We would recommend that work is commenced on the contract preparation when negotiations for access are nearing certain completion. Thereafter, we believe that the project will take 6 to 8 months to complete, as indicated.

We hope that this information is appropriate for your present considerations. Please ring Mr Siddle if you want more detail on any particular aspects.

Yours faithfully

H J Siddle - Senior Geologist
For and on behalf of
D H Beasley
Regional Manager

HJS/BE.



Pantteg Ground Investigation : Proposed Programme

NOTE

No provision has been made for public holidays

APPENDIX TO THE MEMORANDUM OF AGREEMENT

The services to be provided by the Consulting Engineer shall be as follows:—

A ground investigation of that part of the Pantteg landslide which is a potential hazard to those properties within "Risk Category 4" on Drawing No. LVA/1/3, as identified in the letter KC/WSW/7/0/757, dated 16 September 1988 from Sir William Halcrow & Partners Limited to Lliw Valley Borough Council. The services will include:

- preparation and supervision of a ground investigation contract
- interpretation of the results of the investigation
- reporting of the results

EXPLANATION OF TERMS USED IN APPENDIX C; "SUMMARY OF LABORATORY TEST DATA"

B	Bulk Sample
U	Undisturbed Sample
TP	Trial Pit
BH	Borehole
MC	Moisture Content
BD	Bulk Denisty
SG	Specific Gravity
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
CDT	Consolidated Drained Triaxial Test
REM	Remoulded Sample
DSB	Drained Shear Box Test
σ_3'	Cell pressure
τ_p'	Peak Shear Strength
τ_r'	Residual Shear Strength

TYPE	B.H. No.	Depth (m)	Sample Description	Test Lab.	M.C. %	B.D. Mg/m³	S.G.	L.L. %	P.L. %	P.I. %	GRADING ANALYSES % PASSING B.S. SIEVE SIZE 2μ	63u	425u	2mm	60mm	STRENGTH TEST DATA Test Type	σ'_3 or σ'_n kN/m²	$\sigma'_1 - \sigma'_3$ or τ'_p kN/m²	u_f or τ'_r kN/m²	REMARKS
B	4	1.00 1.15	Silty sandy GRAVEL	EXPLORATION ASSOCIATES (WARWICK) LIMITED	10			34	19	15	2	20	28	40	84					
U	4	1.50 1.80	Silty sandy GRAVEL		14	2.10		33	19	14	5	25	32	41	100	CDT	50	200		pH 7.4, organic content 1.72% 75% of material retained for DSB
U	4	2.60 3.00	Sandy very gravelly SILT		27	1.97		32	18	14	3	45	55	61	100	CDT	100	177		90% of material retained for DSB
B	4	3.95 4.50	Silty sandy GRAVEL		20			31	18	13	3	20	28	34	88					
B	TP1	1.50 3.00	Silty sandy GRAVEL		8			24	15	9	5	7	9	13	88					
B	TP2	0.10 3.00	Gravelly COBBLES		4			24	15	9	0	0	0	1	33					
B	TP9(1)	1.00	Silty sandy GRAVEL		14	2.11	2.68	31	15	16	3	30	33	38	100	REM DSB300	50 100 150	51 88 139	31 62 95	 pH 7.0, total sulphate 0.04% 95% of material retained for DSB
B	TP9(2)	1.00	Silty GRAVEL		17	1.74		24	NP	NP	7	40	43	53	100	REM DSB60	75 150 200	73 128 148	54 86 94	 53% of material retained for DSB
B	TP10(1)	1.00	Slightly sandy GRAVEL		8	2.11	2.58	31	18	13	3	3	5	7	100	REM DSB300	75 100 125	65 78 97	44 56 74	 pH 8.3, total sulphate 0.08% 80% of material retained for DSB
B	TP10(2)	1.00	Silty sandy GRAVEL		13	1.77		30	15	15	9	9	12	20	100	REM DSB60	50 125 200	80 147 186	53 106 172	 20% of material retained for DSB

PANTTEG LANDSLIDE GROUND INVESTIGATION

SUMMARY OF LABORATORY TEST DATE

Exploration Associates

Pantteg Landslide

Factual Report on Ground Investigation

H9169
October 1989

Client
Lliw Valley Borough Council
Civic Centre
Penellergaer
Swansea
West Glamorgan SA4 1GH

EXPLORATION ASSOCIATES LIMITED

PANTTEG LANDSLIDE

Factual Report on Ground Investigation
H9169 October 1989

ERRATUM

Borehole Records

BH 4

i) The **'SANDSTONE'** recorded between 450 and c9.7m should be described as boulders. Rockhead was encountered at around 10.7m.

ii) Two standpipe piezometers were installed with the tips at 4.50 and 10.50m. These should be shown in the legend column.

H J SIDDLE
PRINCIPAL GEOLOGIST
SIR WILLIAM HALCROW & PARTNERS LTD.

Pantteg Landslide
Factual Report on Ground Investigation

H9169
October 1989

Client
Lliw Valley Borough Council
Civic Centre
Penellergaer
Swansea
West Glamorgan SA4 1GH

Engineer:
Halcrow Consulting Engineers
25 Windsor Place,
Cardiff
CF1 3BZ

Exploration Associates Limited, Geotechnical House, Hatton, Warwick, CV35 7JL.
Tel: (0926) 491743

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H9169

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REFERENCES

ENCLOSURES

A Exploratory Hole Records

B Laboratory Test Results

C Drawings

D General Notes

1. INTRODUCTION

On the instructions of Halcrow Consulting Engineers, acting on behalf of Lliw Valley Borough Council, given in a letter dated 22nd June, 1989, reference KC/LVB(4)/510, a ground investigation was undertaken by Exploration Associates Limited to provide information on the Pantteg Landslide.

Ground conditions were determined by drilling boreholes using both cable percussion and rotary techniques and excavation of trial pits. Subsequently a programme of laboratory testing was undertaken, leading to the production of a factual report.

The investigation was carried out under the direction of Halcrow Consulting Engineers who were appointed as Consultants by Lliw Valley Borough Council.

This report presents a description of the site, a summary of the investigation procedures adopted, together with the factual data obtained from the site works and subsequent laboratory programme.

2. THE SITE

The site is located just south west of Ystalyfera, West Glamorgan, South Wales, at approximate National Grid Reference 761 081 on Ordnance Survey 1:50,000 series sheet No. 160. The location of the site is shown on Drawing No. 1, Enclosure C.

3. THE INVESTIGATION

3.1 General

The fieldwork comprised the drilling of 4 rotary cored boreholes and ten trial pits, together with the installation of piezometers in all boreholes. The fieldwork was carried out during the period 19th July, 1989 to 16th August, 1989.

The investigation was generally carried out in accordance with BS: 5930 1981, "Code of practice for site investigation" and the specification of the contract.

3.2 Boreholes and Trial Pits

Four rotary boreholes were drilled to depths of between 15.00 and 36.50 metres below ground level, producing rotary core of between 113mm and 76mm diameter. Rotary techniques were started from ground level in all boreholes except Borehole 4 which was drilled using cable percussion techniques to a depth of 4.50 metres.

Ten trial pits were excavated in total, eight being excavated using a Poclain 62 mechanical excavator to depths of between 1.50 and 3.25 metres below ground level two being hand dug to a depth of 1 metre below ground level. The locations of both boreholes and trial pits were determined by Halcrow Consulting Engineers.

The locations of the boreholes and trial pits are shown on Exploratory Hole Location Plan, Drawing No. 2, Enclosure C.

3.3 Sampling

During the course of pitting and where rotary coring techniques were unsuitable for producing core, within the initial superficial deposits of each borehole, representative small disturbed (jar) and large disturbed (bulk) samples were obtained for identification and classification purposes. In addition 100mm diameter samples were obtained in cohesive soils from within the borings using standard open drive sampling equipment. Selected samples were subsequently used for the laboratory testing.

3.4 In Situ Testing

Standard penetration tests were performed in the superficial deposits to provide an indication of the relative density and strength of these deposits.

Where the full test penetration was not achieved, the number of blows for the actual penetration of such tests has been recorded.

The results, uncorrected for the effects of overburden, are presented on the Borehole Records.

3.5 Instrumentation

Piezometers were installed in all boreholes to facilitate monitoring of long term water levels. Details of the installations are shown on the individual borehole records.

3.6 Exploratory Hole Records

The depths and descriptive details of samples obtained are presented on the Exploratory Hole Records, Enclosure A. The strata descriptions are based on an examination of the samples obtained together with the laboratory and in situ test data. All soil and rock descriptions are based on definitions outlined in BS 5930.

4. LABORATORY TESTING

A schedule of laboratory testing was prepared by Halcrow Consulting Engineers and undertaken by Exploration Associates Limited.

Standard testing was generally carried out in accordance with BS 1377:1975 and the Specification of the Contract and comprised:

Natural Moisture Content
Atterberg Limits
Bulk Density
Specific Gravity
Particle Size Distribution
Sulphate Content

pH

Organic Content

Consolidated Drained Triaxial

Drained Shear Box 60mm x 60mm and 300mm x 300m

The results of the laboratory testing are presented in Enclosure B.

5. GROUND CONDITIONS

5.1 Published Data

Information published by the British Geological Survey shows the site as being underlain by sandstones, siltstones, mudstones, and coals of the Coal Measure Group.

5.2 Data Obtained

The exploratory holes generally confirmed the published geology, however, a number of holes encountered landslip material comprising sand, clay and gravel to boulder sized rock fragments of varying proportions, up to a depth of 4.40m as in Borehole 4.

5.3 Groundwater

Groundwater was encountered in all boreholes, except Borehole 2, from between 3.10m and 34.50m below ground level. The trial pits revealed only dampness with the exception of Trial Pit 1 which showed slight seepages from one of its faces. Three trial pits remained dry during excavation.

Piezometers were installed in all boreholes to enable the long term monitoring of groundwater levels.

P.M. Scrimshaw,
B.Sc., F.G.S., A.M.I.Geol.
Project Geologist

R.J. Hutchison,
B.E., M.Sc., D.I.C., C.Eng., M.I.C.E., M.I.P.E.N.Z.
Engineering Manager

EXPLORATION ASSOCIATES LIMITED
PMS/RJH/HMB/H9169/OCTOBER 1989

REFERENCES

1. The Site Investigation was performed, where appropriate, in accordance with:-

   British Standard Code of Practice BS 5930 "Site Investigations" 1981

2. Field and Laboratory Testing was performed, where appropriate, in accordance with:-

   British Standard 1377 (1975) "Methods of Test for Soils for Civil Engineering Purposes"

ENCLOSURE A

Exploratory Hole Records

i) Borehole Records
ii) Trial Pit Records

BOREHOLE RECORDS - SYMBOLS

All linear dimensions are in metres.

U	Undisturbed 0.100m diameter samples (The figure in brackets is the number of blows required to drive the sampler)
Ø	Undisturbed sample not recovered
B	Bulk Sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
S	Standard Penetration Test
C	Standard Penetration Test with 60° Cone Tip
w%	Natural Water Content
Fr	Flush Return - An estimate of flushing medium returning to the top of the borehole
Cr	Total Core Recovery - the figure beneath represents Solid Core Recovery (SCR)
F.I.	Fracture Index (Not accurately recorded in excess of 30)
R.Q.D.	Rock Quality Designation
▽	Depth at which Groundwater was encountered
▼	Standing level of groundwater
N	Standard Penetration Test Value - Blows for 0.300m after seating blows
$\frac{x}{y}$	Denotes x blows for y mm of the Standard Penetration Test
$\frac{x}{y}$*	Denotes x blows for y mm seating penetration only
**	Drillers Description

	Project Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

Sampling		Properties			Strata			
Drill Run	Fr	Cr	FI	RQD	Description	Depth	Level	Legend
G.L.-0.30	ØB				TURF over TOPSOIL: Loose, mid-brown, silty, sandy, angular, fine to coarse gravel of siltstone and sandstone with some rootlets.	G.L.	189.27	
0.30						0.30	188.97	
(1.20)		83 (0)	NI	(0)	Medium dense friable mid to light grey-brown silty, slightly clayey fine SAND with much sub-rounded to angular, fine to coarse sandstone gravel and occasional fine gravel sized coal fragments.			
1.50			<30			1.30	187.97	
			18					
(1.50)		93 (29)	>30	(0)	Light brown-grey, slightly weathered, very thinly to thinly bedded, micaceous silty fine SANDSTONE, moderately strong with closely to very closely spaced horizontal planar rough discontinuities. Frequently orange-brown, iron-oxide stained on bedding surfaces.			
3.00								
(1.50)		100 (93)	19	21	1.50-2.23m: heavily orange-brown stained, sub-vertical joint with discontinuous thin, grey clay coating on parting surfaces.			
4.50					2.30-2.50m: band of thinly laminated,			
(1.50)		100 (93)	21	13	2.93-2.98m: highly micaceous silty fine SANDSTONE, weak. 2.70m: becoming thinly bedded, moderately weak to moderately strong. 3.50-4.85m: much iron staining and thin clay infill of very closely spaced horizontal discontinuities.			
6.00			NI		4.40m: becoming thickly to thinly planar laminated, light to mid grey.	6.00	183.27	
(1.50)		100 (59)	23	0	Light to mid grey, slightly weathered, thinly bedded, fine to medium, occasionally coarse grained SANDSTONE, strong with closely spaced sub-horizontal rough, planar, discontinuities.			
7.50			NI					
			22		7.25-7.30m: very thin band of highly weathered ironstone shale, very weak.			
(1.50)		100 (39)	NI	17	Mid yellow-brown, moderately weathered silty fine SANDSTONE, weak, micaceous on parting, lamination surfaces.	7.96	181.31	
						8.08	181.19	
			7		Anthracite coal.	8.50	180.77	
9.00					8.37m: becoming black, carbonaceous, silty MUDSTONE, very weak to weak (seat earth).			
(1.50)		100 (69)	16	8				
					Continued over from 10.00m.			

Drilling

Type	From	To	Size	Fluid
Rotary	0.30	18.60	S	Air
Coring	18.60	22.40	P	Air
(mylar)	22.40	36.50	H	Air

Groundwater

Co-ordinates: E 276008, N 208208

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
			1.8.89	G.L.	-	-
			1.8.89	9.00	-	Dry
			2.8.89	9.00	-	Dry
			2.8.89	17.20	-	Dry

Remarks Inspection pit excavated to 2.00m, logged by Engineer's staff. Piezometer installed at 35.40m, sand filter from 34.50 to 35.80m.

Borehole Record

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Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH1(C) (1 of 4)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
10.50			NI		Continued from 10.00m. Mid to dark grey slightly weathered to fresh, indistinctly thinly laminated, fine sandy SILTSTONE moderately weak to moderately strong, with closely to very closely spaced sub-horizontal, sub-planar and planar discontinuities, frequently orange brown stained. 8.50–8.85m: moderately to highly weathered, weak to very weak. 8.50–8.73m: mid to dark, brown yellow. 11.20–12.00m: very closely sub-horizontally and 45° jointed, heavily orange brown and purple brown stained on surfaces. 11.10m: becoming distinctly laminated. 12.50m: becoming thinly to thickly laminated in places flaser bedded silty fine SANDSTONE, moderately strong to strong.			
(1.50)		100 (23)	20	17				
12.00			NI					
(1.20)		100 (0)	12	0				
13.20								
(1.40)		100 (73)	7	73				
14.60						14.85	174.42	
(1.30)		100 (94)	10	88	Mid grey, fresh, thickly cross-laminated, fine to medium SANDSTONE, strong with closely to medium spaced sub-horizontal, planar discontinuities.			
15.90								
(1.30)		100 (94)	7	88				
17.20					16.95m: becoming silty and fine grained slightly micaceous SANDSTONE, moderately strong. 17.35m: sub-horizontal open joint with 10mm firm, grey silty clay infill.			
(1.40)		100 (70)	3	69				
18.60					18.60m: becoming fine to medium grained SANDSTONE, strong.			
(2.30)		100 (66)	15	47				
			12		Continued over from 20.00m.			

Drilling					Groundwater						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
								3.8.89	17.20	-	Dry
								3.8.89	18.60	19.00	Dry
								4.8.89	18.60	19.00	Dry
								4.8.89	22.40	19.00	Dry

Remarks

Borehole Record

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Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BHI(C) (2 of 4)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
			12		Continued from 20.00m. 20.10–20.45m: sub-vertical, irregular joint, orange brown stained with slight clay infilling. 20.80–20.90m: conglomeritic band with some sub-angular to sub-rounded, fine to coarse gravel sized tabular clasts of dark grey silty mudstone.			
20.90								
			19					
		100						
(1.50)		(76)		5				
			11					
22.40								
			25					
		100			Light to mid grey, slightly weathered, fine to medium SANDSTONE CONGLOMERATE, very strong with many sub-rounded, tabular, fine to coarse gravel sized clasts of grey silty mudstone in a matrix of ferous cemented fine to medium sand with occasional pyritic nodules to 0.05m.	22.60	166.67	
(1.60)		(14)	NI	10	Anthracite coal.	22.80	166.47	
					Dark grey, slightly weathered fissured, silty MUDSTONE, weak. Extremely closely fractured (seat earth).	23.00	166.27	
24.00						23.80	165.47	
					Thickly to thinly interlaminated in places flaser bedded, mid and dark grey slightly weathered to fresh, micaceous, fine sandy SILTSTONE, moderately strong, with closely to medium spaced sub-horizontal planar discontinuities. 25.90–26.40m: very to extremely closely fractured, with some orange brown staining on parting surfaces. 26.40–27.40m: closely spaced, irregular, sub-horizontal discontinuities.			
		100	5	50				
(2.40)		(53)						
			NI					
26.40								
		100						
(3.00)		(94)	7	83				
29.40								
(2.60)			5		29.98m: becoming slightly fine sandy. Continued over from 30.00m.			

Drilling					Groundwater						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
								9.8.89	22.40	19.00	Dry
								9.8.89	35.00	19.00	34.80
								10.8.89	35.00	19.00	34.75
								10.8.89	36.50	19.00	34.50

Remarks

Borehole Record

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Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH1(C) (3 of 4)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
			NI		Continued from 30.00m.			
			8		Mid to dark grey, slightly weathered, silty MUDSTONE, moderately weak to moderately strong with extremely closely spaced sub-horizontal and vertical discontinuities.	30.45	158.82	
(2.60)		100 (42)	NI	30				
					Anthracite COAL.	31.45	157.82	
32.00					Mid to dark grey, slightly weathered, slightly fine sandy clayey SILTSTONE, moderately weak extremely closely, irregularly fractured.	31.85	157.42	
			12			32.40	156.87	
(3.00)		100 (88)	7	62	Mid grey, slightly weathered to fresh silty fine SANDSTONE, moderately strong to strong with closely to medium spaced sub-horizontal sub-planar and planar discontinuities.			
35.00					Dark grey to black slightly weathered, slightly silty MUDSTONE, moderately weak to weak, extremely closely fractured and fissured below 34.90m.	34.80	154.47	
			NI			35.00	154.27	
(1.50)		93 (38)		19	Anthracite COAL.			
			15		Dark grey to black, slightly weathered fine sandy SILTSTONE, moderately strong with closely spaced sub-horizontal to 45° irregular discontinuities.	35.95	153.32	
36.50						36.50	152.77	
					End of Borehole			

Drilling					Groundwater						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water

Remarks

Borehole Record

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Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH1(C) (4 of 4)

135.20

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
G.L.						G.L.	149.28	
		0/H			Loose, mid brown, silty, sandy, angular, fine to coarse GRAVEL, COBBLES and some BOULDERS of siltstone and silty fine sandstone.			
1.00								
1.00–1.45	D(12)	0/H						
1.50								
1.50	D	0/H						
2.00								
2.00–2.45	SD	13	0/H					
2.50								
2.50–2.95	D(29)		0/H					
3.00								
3.00–3.45	SD	42	0/H					
3.50								
		0/H						
4.25								
(0.30)		0	–	0				
4.55								
(0.20)		0	–	0				
4.75		0	–	0				
4.85								
(0.30)	SD	63 (53)	10	53	Probable boulder of light to mid grey, slightly weathered, slightly micaceous fine to medium SANDSTONE, strong with orange brown staining.	4.85	144.43	
5.15	50*/15							
(0.15)		80(60)	>30	0				
5.30								
(0.60)		100 (100)	2	100				
5.90					Angular fine to coarse GRAVEL of sandstone with a little matrix of firm brown silty clay.			
(0.50)		43 (0)	NI	0		5.90	143.38	
6.40								
(0.60)		0	–	0				
7.00								
(0.40)		25 (0)	NI	0				
7.40					Orange brown, mottled mid grey, highly weathered, poorly cemented, slightly sandy, clayey SILTSTONE, very weak with some sub-angular to sub-rounded clasts of sandstone.			
(0.75)		51 (33)	26	0		7.80	141.48	
8.15						8.00	141.28	
					Anthracite COAL.	8.15	141.13	
		100 (91)	11	84	Mid to dark grey, slightly weathered to fresh, slightly clayey SILTSTONE, moderately weak to moderately strong with closely to medium spaced, sub-horizontal planar discontinuities, frequently orange brown stained.			
(1.40)								
9.55								
(0.50)		72 (60)	22	56	Continued over from 10.00m.			

Drilling

Type	From	To	Size	Fluid
Rotary Coring (mylar)	4.25	20.5	S	Air

Groundwater

Co-ordinates: E 276065, N 208169

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
			8.8.89	G.L.	–	–
			8.8.89	3.00	2.50	Dry
			9.8.89	3.00	2.50	Dry
			9.8.89	4.85	4.25	Dry

Remarks Open holed G.L.–1.0m, 1.0–1.5m, 1.5–2.0m, 2.0–2.5m, 2.5–3.0m, 3.0–3.5m, 3.5–4.5m. Piezometers installed 7.0m & 19.50m, sand filters at 5.0–8.0 & 18.0–20.0m.

Borehole Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH2 (1 of 2)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
10.05								
(0.95)		100 (100)	6	77	Continued from 10.00m. 9.55-10.05m: band of silty fine SANDSTONE, moderately strong.			
11.00								
(0.50)		80 (60)	18	28	11.25m: becoming indistinctly thinly to thickly laminated.			
11.50								
(0.45)		100 (100)	7	100				
11.95								
(1.00)		100 (78)	4	78				
12.95								
(0.85)		100 (100)	8	100				
13.80								
(0.75)		100 (91)	12	73				
14.55								
(1.00)		100 (100)	5	92				
15.55								
(0.30)		100 (93)	17	77				
15.85								
(1.70)		100 (100)	5	81				
17.55								
(1.45)		100 (100)	4	92	17.60m: sub-horizontal to 45° planar, smooth joint with <2mm stiff grey silty clay infill.			
19.00								
(1.50)		100 (92)	6	87				
20.50					End of Borehole	20.50	128.78	

Drilling

Type	From	To	Size	Fluid

Groundwater

Struck	Behaviour				Sealed
	11.8.89	5.30	4.25	Dry	
	14.8.89	6.40	5.20	Dry	
	15.8.89	15.85	5.20	Dry	

Date	Hole	Cased	Water
10.8.89	4.85	4.25	Dry
10.8.89	5.30	4.25	Dry
11.8.89	6.40	5.20	Dry
14.8.89	11.00	5.20	Dry
16.8.89	20.50	5.20	Dry

Remarks

Borehole Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH2 (2 of 2)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	FI	RQD	Description	Depth	Level	Legend
G.L. G.L.-1.50	B				Loose, dark brown grey, silty, slightly clayey fine SAND with much sub-angular to angular fine to coarse gravel of dark grey, silty fine sandstone.	G.L.	130.54	
0.50-1.95	SD	9 0/H						
1.50					1.50-2.70m: large cobble (0.40m) of mid to light grey, slightly weathered silty fine SANDSTONE, moderately strong.			
(1.20)		36% (10)	NI	0				
2.70 2.70-4.00	B							
(1.30)		0 (0)	N/A	0				
4.00 4.00-4.40	SD	55/ 45	CORE LOSS		Dense, mid brown, silty, sandy, angular fine to coarse GRAVEL of siltstone and silty fine sandstone.	4.00	126.54	
		47%	9	0		4.45	126.09	
(1.50)		(3)	NI		Dark grey, slightly weathered, slightly silty MUDSTONE, weak with closely spaced, sub-planar, vertical joints.	4.80	125.74	
5.50 5.50-6.00	B(61)	0/H			Grey brown to light brown, highly weathered, silty, slightly fine sandy MUDSTONE, very weak, with much residual firm silty clay and fine to coarse gravel sized sub-angular lithorelicts.			
6.00						6.00	124.54	
(0.60)		92 (92)	4	92	Dark grey, slightly weathered, slightly silty MUDSTONE, moderately weak, with closely to medium spaced sub-horizontal sub-planar discontinuities and occasional sub-vertical and vertical planar joints. Much orange brown, iron oxided staining on joint and bedding surfaces.			
6.60								
(1.60)		94 (74)	2	74	7.90-8.20m: sub-vertical, orange brown, iron oxide stained joint.			
8.20			4					
(2.40)		94 (60)		60	9.20-9.40m: vertical, sub-planar joint.			
			18					
					Continued over from 10.00m.			

Drilling

Type	From	To	Size	Fluid
Rotary	G.L.	25.70	P	Air
Coring	25.70	30.10	H	Air

Groundwater

Co-ordinates: E 276109, N 208151

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
21.50-22.00	Rose to 19.20m in 20mins		24.7.89	G.L.	-	-
			24.7.89	4.00	4.00	Dry
			25.7.89	4.00	4.00	Dry
			25.7.89	10.60	6.00	Damp

Remarks Open holed from G.L.-1.50m, 5.50-6.00m.
Piezometers installed at 5.80m & 22.90m, sand filters from 5.00-6.00m & 21.50-23.00m.

Borehole Record

exploration associates

Project Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH3 (1 of 3)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
10.60			5		Continued from 10.00m. 9.90–10.05m: lenticular, sideritic nodules to 0.10m across.			
(1.50)		90 (47)	8	35	10.60m: sub-horiztonal, planar, 10.65m: slickensided discontinuity 10.78m: surface, no infill material. 11.40–11.60m: heavily iron oxide stained 45° joint.			
12.10			>30		Anthracite coal.	11.60	118.94	
(1.30)		92 (66)	4	47	Mid to dark grey, slightly weathered, indistinctly thickly to thinly laminated, clayey, slightly fine sandy SILTSTONE, moderately strong, with closely to medium spaced sub-horizontal planar discontinuities and occasional sub-vertical, orange brown, iron oxide stained joints. 12.44–12.53m: band of impure anthracitic coal.	12.00	118.54	
13.40								
(1.50)		93 (93)	6	77	13.40m: 14.74m: 15.20m: 15.70m: sub-horizontal, planar slickensided discontinuity surfaces.			
14.90								
(1.30)		100 (59)	6	59	13.69m: 14.37m: 14.90m: 45° slickensided discontinuity surfaces. 15.50m: vertical, open, sub-planar joint with minor orange brown iron oxide staining and thin coating of firm grey silty clay.			
16.20								
(1.50)		85 (85)	5	69	16.10–17.65m: fine sandy distinctly laminated.			
17.70								
(2.30)		100 (34)	10	20	17.65m: becoming non-laminated, closely to medium bedded, slightly fine sandy SILTSTONE. 17.70–19.15m: vertical, sub-planar, rough joint. 19.25m: sub-horizontal, undulating, slickensided discontinuity.			
20.00					Continued over from 20.00m.			

Drilling

Type	From	To	Size	Fluid

Groundwater

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
			26.7.89	10.60	6.00	Dry
			26.7.89	20.00	6.00	Dry
			27.7.89	20.00	6.00	Dry
			27.7.89	25.70	6.00	21.20

Remarks

Borehole Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH3 (2 of 3)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	Fl	RQD	Description	Depth	Level	Legend
20.00								
(1.50)		100 (87)	5	73	Continued from 20.00m. 20.68-23.75m: 45° highly polished, slickensided discontinuity surfaces.			
21.50								
(1.70)		100 (92)	>30 2	92	22.98-23.13m: vertical planar, heavily orange brown stained joint.			
23.20								
(1.50)		91 (86)	4	80	24.10m: sub-horizontal to 45°, planar, polished discontinuity surface.			
24.70								
(1.00)		100 (100)	3	93				
25.70					Anthracite COAL.	25.70	104.84	
(1.40)		100 (93)	>30 3	91	Dark grey, slightly weathered to fresh, indistinctly thinly laminated very clayey SILTSTONE, moderately strong with medium spaced, horizontal, sub-planar discontinuities.	25.85	104.69	
27.10								
(1.50)		100 (52)	7 23	37	27.55m: becoming slightly to moderately weathered, highly carbonaceous and moderately weak, with closely spaced horizontal discontinuities.			
28.60								
(1.50)		100 (35)	12 NI	23	Anthracite COAL. Dark grey to black, moderately weathered, very silty MUDSTONE, weak to moderately weak (seat earth).	29.60	100.94	
30.10					End of Borehole at 30.10m.	30.05 30.10	100.49 100.44	

Drilling

Type	From	To	Size	Fluid

Groundwater

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
			31.7.89	25.70	25.50	20.50
			31.7.89	28.60	26.00	-
			1.8.89	28.60	26.00	21.00
			1.8.89	30.10	26.00	-

Remarks

Borehole Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH3 (3 of 3)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	FI	RQD	Description	Depth	Level	Legend
G.L. G.L.-1.50	B				Medium dense mid brown, silty, clayey, fine to medium SAND with much angular, fine to coarse gravel and cobbles of fine to medium sandstone.	G.L.	100.70	
1.50-2.00	U(41)				Firm, dark brown grey, silty sandy CLAY with some to much angular fine to coarse gravel and cobbles of fine to medium sandstone, shale and coal fragments.	1.50	99.20	
2.00 2.00-2.60	D B							
2.60-3.00	U(32)							
3.00 3.00-3.50	D B							
3.50-3.95	SD	35						
4.00-4.40	B							
4.40-4.50 4.50	D S	30*/ NO PEN	13	23	Medium dense, dark brown, sub-angular, coarse GRAVEL of silty fine sandstone moderately weak (probably sandstone boulder weathered in situ).	4.40 4.50	96.30 96.20	
(2.40)		56 (25)	VOID VOID		Light to mid grey, slightly weathered thinly bedded, thickly cross-laminated, fine to medium SANDSTONE, moderately strong with closely spaced 45°, planar discontinuities frequently micaceous, fossiliferous (plant stems), cross-laminated surfaces.	5.27	95.43	
6.90		44			Dark brown grey, highly weathered, extremely closely fractured silty fine SANDSTONE, very weak with some to much residual matrix of stiff grey brown silty clay.			
(1.60)		(14)	NI	0				
8.50		44	VOID					
(1.00)		(0)		0	Mid to dark grey, very silty, clayey, fine SANDSTONE, moderately weak. Becoming highly weathered, as sub-angular lithorelicts in stiff to very stiff grey silty clay matrix below 9.83m. Continued over from 10.00m.	9.43	91.27	
9.50 (0.50)		100 (52)	20	38				
10.00			NI					

Drilling					Groundwater			Co-ordinates: E 276065, N 208019			
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
Cable Tool	G.L.	4.50	0.15m	-				19.7.89	G.L.	-	-
Rotary Coring (myler)	4.50	15.00	H	Air				19.7.89	4.50	4.50	3.10
								25.7.89	4.50	4.50	4.20

Remarks Rock head encountered at 10.70m.

Borehole Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Borehole BH4 (1 of 2)

Sampling		Properties			Strata			
Drill Run	Fr	Cr	FI	RQD	Description	Depth	Level	Legend
10.00					Continued from 10.00m.			
		53			10.00–10.70m: probable zone of core loss.			
(1.50)			NI	0		10.70	90.00	
		(0)			Black, highly weathered, thickly to thinly laminated, clayey, slightly fine sandy, carbonaceous SILTSTONE, weak to very weak.	10.95	89.75	
11.50								
(0.50)		96			Dark grey to black, highly weathered,			
		(22)		0	very closely fissured, silty MUDSTONE,			
12.00			17		very weak (seat earth).			
					11.90m: becoming moderately weathered	12.15	88.55	
					very closely jointed, weak.			
					Mid to dark grey, slightly weathered,			
		100			SILTSTONE, moderately weak with medium to closely spaced, horizontal, sub-planar discontinuities.			
(3.00)			5	83				
					13.75m: thin lamination of coal on undulating, sub-horizontal, polished joint surface.			
		(97)						
15.00						15.00	85.70	
					End of Borehole			

Drilling					Groundwater						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
								25.7.89	10.00	4.50	4.00
								26.7.89	11.50	4.50	4.10
								15.8.89	15.00	12.00	10.38

Remarks

Borehole Record

exploration associates

Project

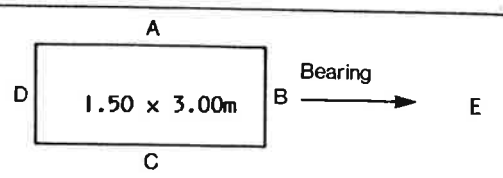
Lliw Valley Borough Council
Pantteg Landslide

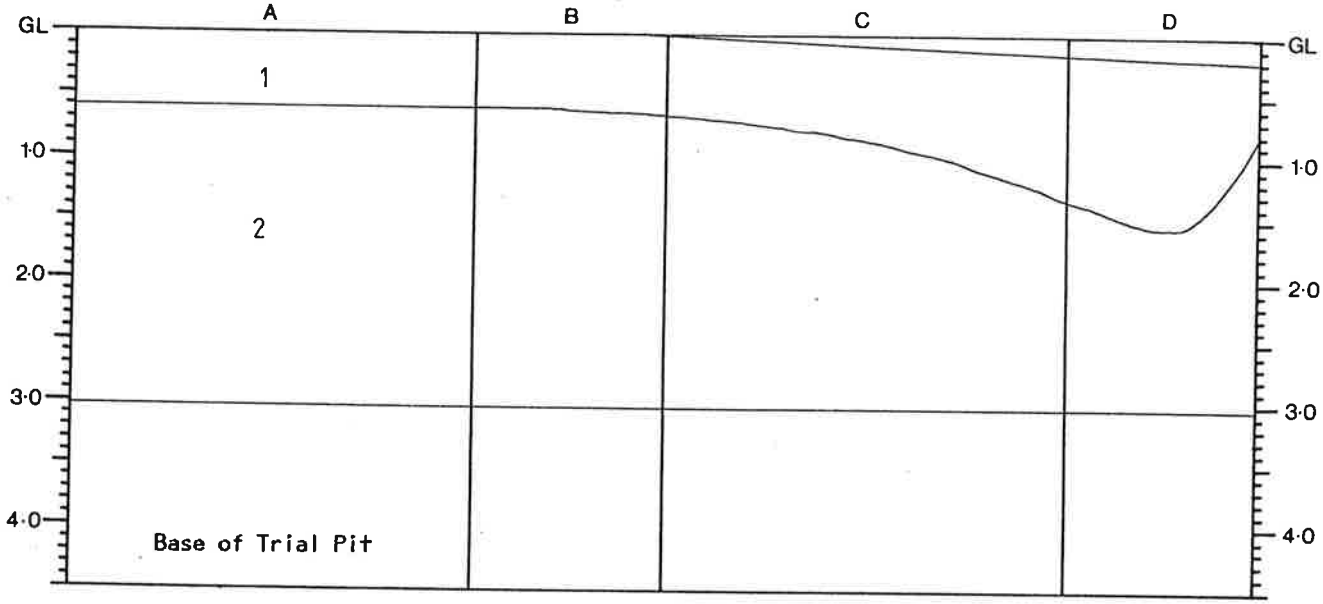
Contract H9169

Borehole BH4 (2 of 2)

Date 20th July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
G.L.-1.50	B	1	Topsoil over loose mid grey to brown grey, angular to sub-angular slightly clayey, fine sandy fine to coarse GRAVEL COBBLES and some small boulder sized fragments of moderately weathered micaceous fine sandstone with some rootlets to 0.40m. (Colluvium)			
1.50-3.00	B	2	Boulders of closely to very closely bedded slightly to moderately weathered, IRONSTONE SHALE, moderately weak to moderately strong. Close to medium spaced vertical joints, open, infilled. Becoming more massive below 1.50m (Face A) to 2.00m (Face B). General dip - 15 - 20° south. (spalled blocks, weathering in situ)			

Plant	POCLAIN 62	Water	Damp, below 0.60m. Very slight seepage from base of 1. in Face B.	Cu-Approximate value of undrained shear strength from hand vane
Shored to	-	Stability	Sovere spalling all faces.	

Trial Pit Record

exploration associates

Project

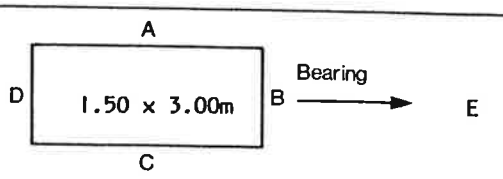
Lliw Valley Borough Council
Pantteg Landslide

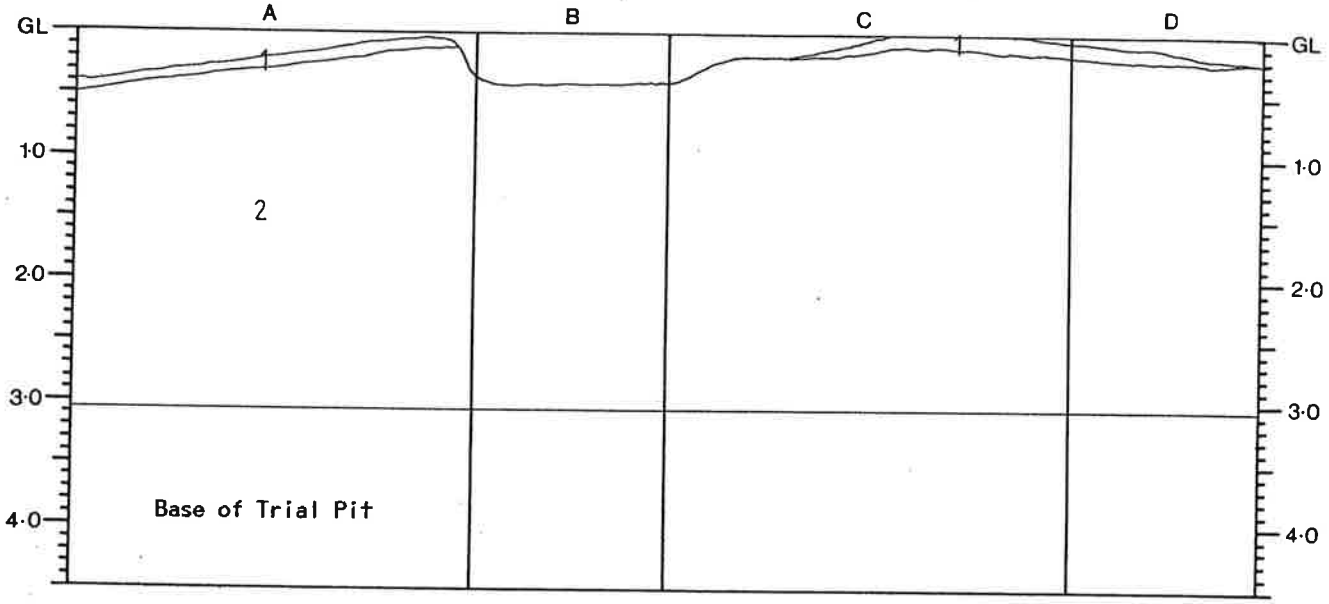
Contract H9169

Trial Pit TP01

Date 20th July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
0.10-3.00	B	1	TOPSOIL.			
		2	Dark grey to black, stained orange brown, moderately weathered, very thinly bedded, micaceous, carbonaceous, SHALE, moderately weak closely spaced, irregular vertical joints. Face A: Occasional closely spaced, vertical, pervasive joints, trend - N-S. Much orange brown, ferrous, staining on bedding and joint surfaces.			

Plant	POCLAIN 62	Water	Damp below 0.50m.	Cu-Approximate value of un-drained shear strength from hand vane
Shored to	-	Stability	Slight/moderately spalling from A,B,D.	

Trial Pit Record

exploration associates

Project

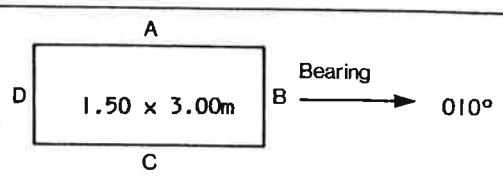
Lliw Valley Borough Council
Pantteg Landslide

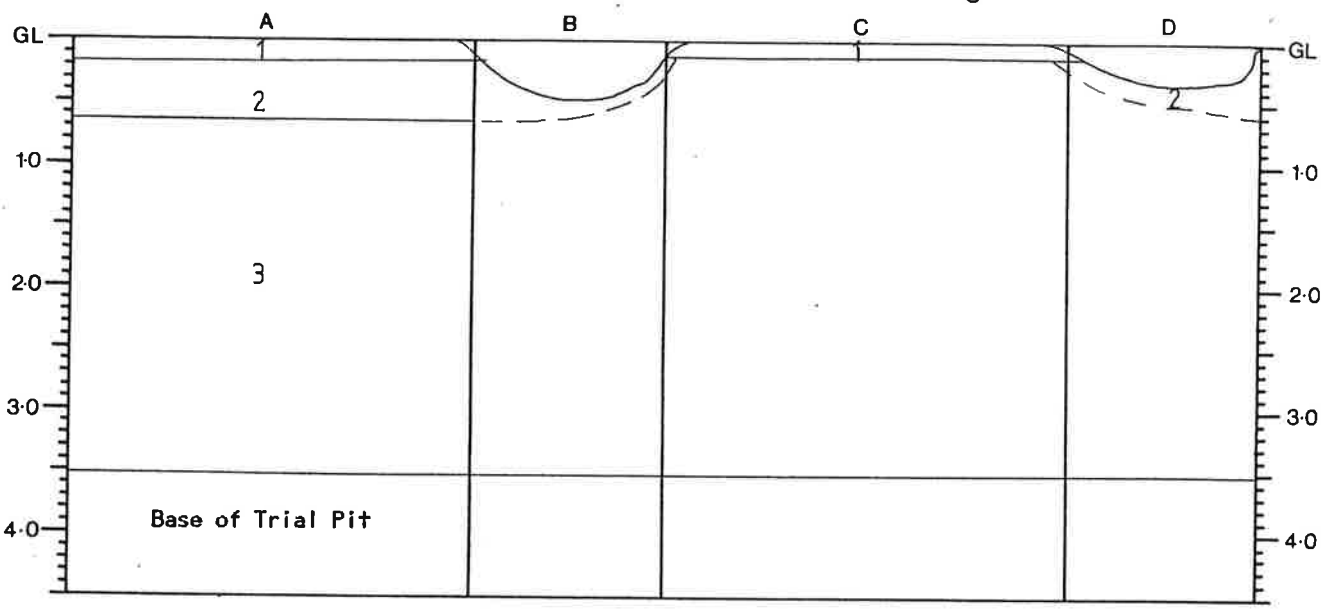
Contract H9169

Trial Pit TP02

Date 21st July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
		1	TOPSOIL.			
		2	Loose, angular imbricated fine to coarse GRAVEL of ironstone shale with some soft to firm silty clay and infilling. (Colluvium)			
		3	Loose to medium dense, highly weathered, angular, tabular, imbricated fine to coarse GRAVEL and COBBLES of ironstone shale with occasional boulders of moderately weathered, shaley fine sandstone. Some thin clay coating and infilling (possibly weathered in situ rock material).			

Plant	POCLAIN 62	Water	Damp below 0.60m.	Cu-Approximate value of undrained shear strength from hand vane
Shored to	–	Stability	Severe spalling from A,B,C.	

Trial Pit Record

exploration associates

Project

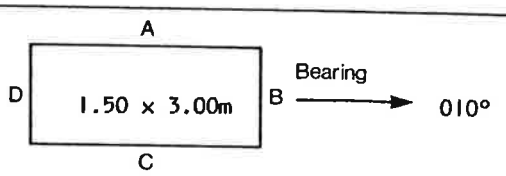
Lliw Valley Borough Council
Pantteg Landslide

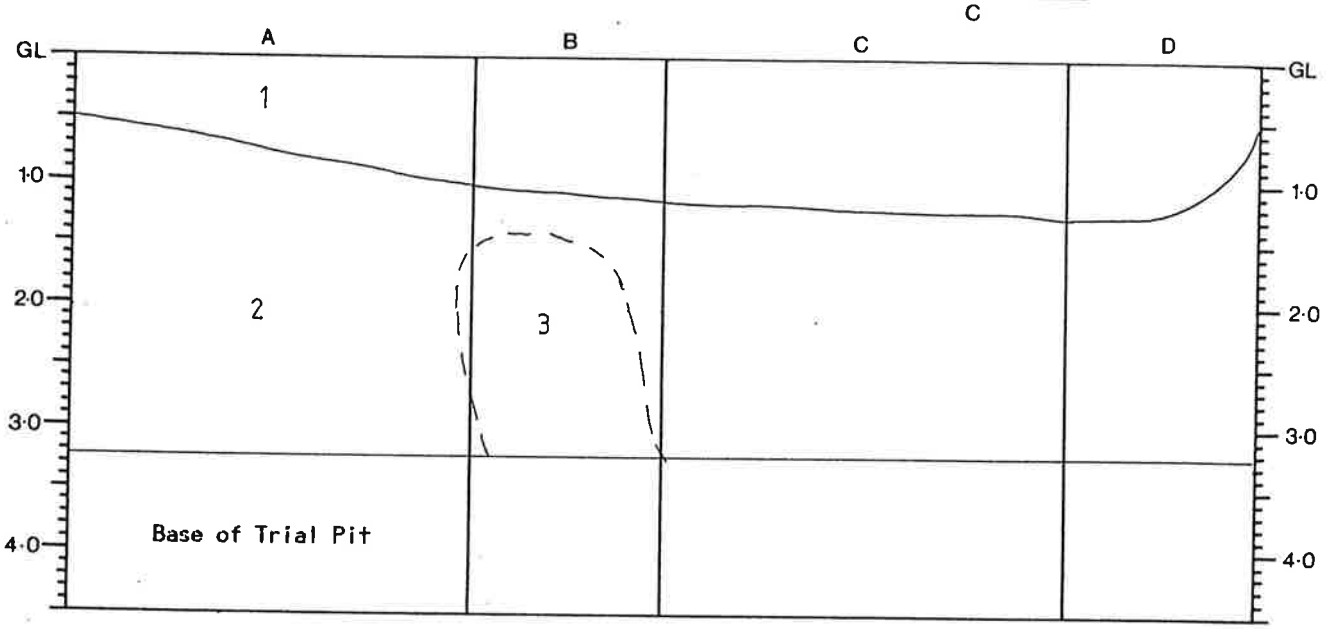
Contract H9169

Trial Pit TP03

Date 21st July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
		1	Topsoil over loose, randomly orientated, angular fine to coarse GRAVEL of ironstone shale with a little to some matrix of residual sandy clay.			
2.20 - 3.20	B	2	Mid grey, moderately to highly weathered, very thinly bedded to thickly laminated, extremely closely fractured IRONSTONE SHALE with much orange brown, iron-oxide staining on bedding and joint surfaces. Occasional medium spaced, sub-vertical, sub-planar joints with a little thin clay coating on surfaces (trend 118° (ESE)). Becoming medium to thickly bedded below 1.90m.			
		3	Medium dense, brown grey, angular fine to medium, occasionally coarse, clayey, GRAVEL of shale with some fine gravel sized coal fragments.			

Plant	POCLAIN 62	Water	Damp in 3. below 2.20m.	Cu-Approximate value of un-drained shear strength from hand vane
Shored to	-	Stability	Severe caving in B,C,D.	

Trial Pit Record

exploration associates

Project

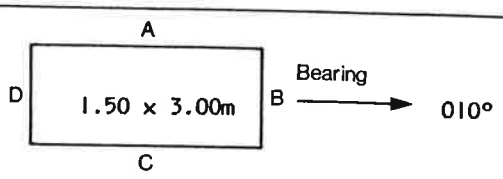
Lliw Valley Borough Council
Pantteg Landslide

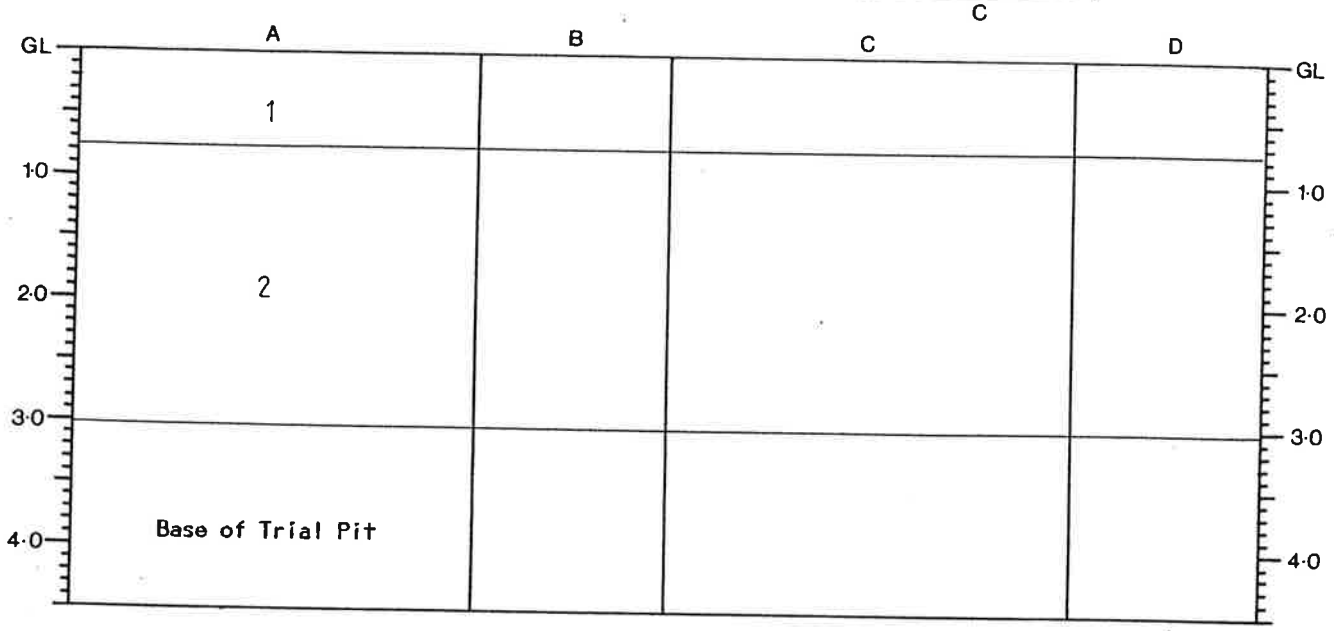
Contract H9169

Trial Pit TP04

Date 21st July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
		1	Topsoil over loose, randonly orientated, angular fine to coarse GRAVEL of sandstone with some rootlets to 0.50m. (Colluvium)			
		2	Loose, angular, tabular, fine to coarse GRAVEL and COBBLES with occasional boulders of fine to medium grained sandstone. Poorly developed imbricate frabric, strike - 030° (ESE). (Colluvium)			

Plant	POCLAIN 62	Water	Dry.	Cu-Approximate value of undrained shear strength from hand vane
Shored to	-	Stability	Severe caving, all faces.	

Trial Pit Record

exploration associates

Project

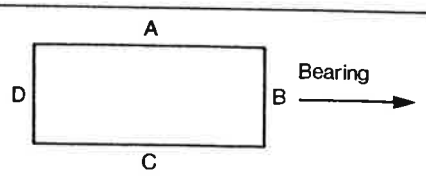
Lliw Valley Borough Council
Pantteg Landslide

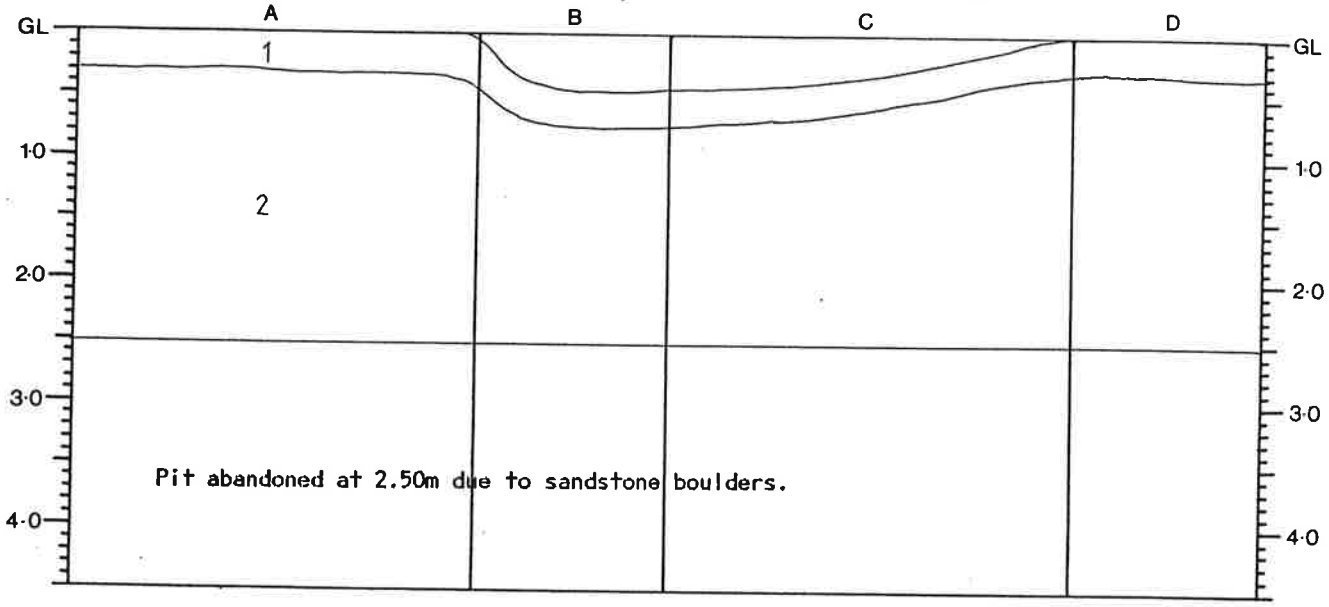
Contract H9169

Trial Pit TP05

Date 18th August, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
1.50-2.50	B	1	Turf over topsoil, loose to medium dense, brown, silty slightly clayey fine sand with much sub-angular, fine to medium occasional coarse gravel of sandstone.			
		2	MADE GROUND: Firm to stiff, mid brown mottled yellow brown and black, silty slightly sandy clay with some to much, sub-angular to angular fine to coarse gravel and cobbles, with occasional blocks to 0.50m of sandstone/building stone and some brick and coal fragments, occasional pockets of firm/soft grey silty clay to 0.30m across.			
			Bands of sandstone cobbles/boulders at 0.30m to 0.90m; 1.90m to 2.30m; 2.50m.			

Plant	POCLAIN 61	Water	Damp below 0.50m.	Cu-Approximate value of un-drained shear strength from hand vane
Shored to	-	Stability	Slight caving in A & C at 1.50-2.00m.	

Trial Pit Record

exploration associates

Project

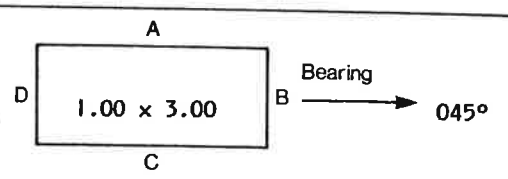
Lliw Valley Borough Council
Pantteg Landslide

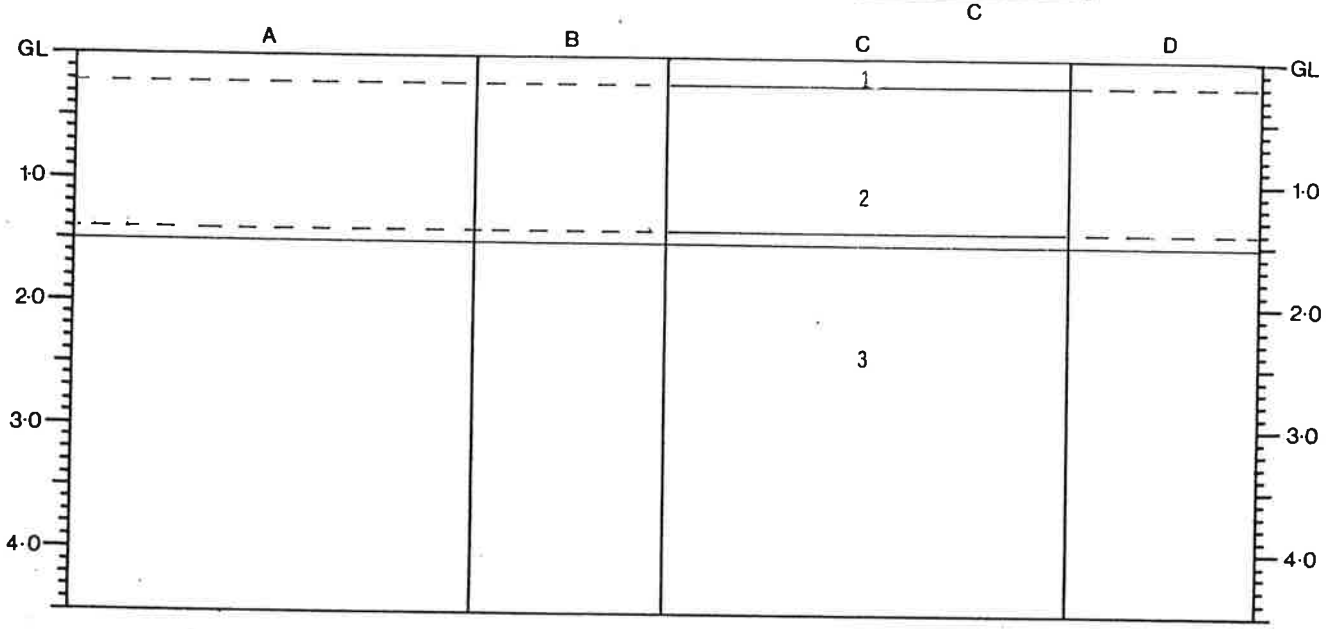
Contract H9169

Trial Pit TP06

Date 28th July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
1.45–1.50	B	1	Firm grey brown silty TOPSOIL.			Pit logged by Engineer's staff
		2	Firm/dense light brown very gravelly SILT and SAND with some cobbles of sandstone containing rounded dark grey iron-rich nodules.			
		3	Brown orange grey coarse grained IRONSTONE, very strong.			

Plant	POCLAIN 62	Water	Dry.	Cu - Approximate value of undrained shear strength from hand vane
Shored to	-	Stability	Stable.	

Trial Pit Record

exploration associates

Project

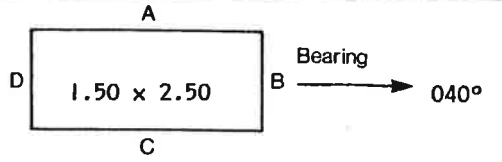
Lliw Valley Borough Council
Pantteg Landslide

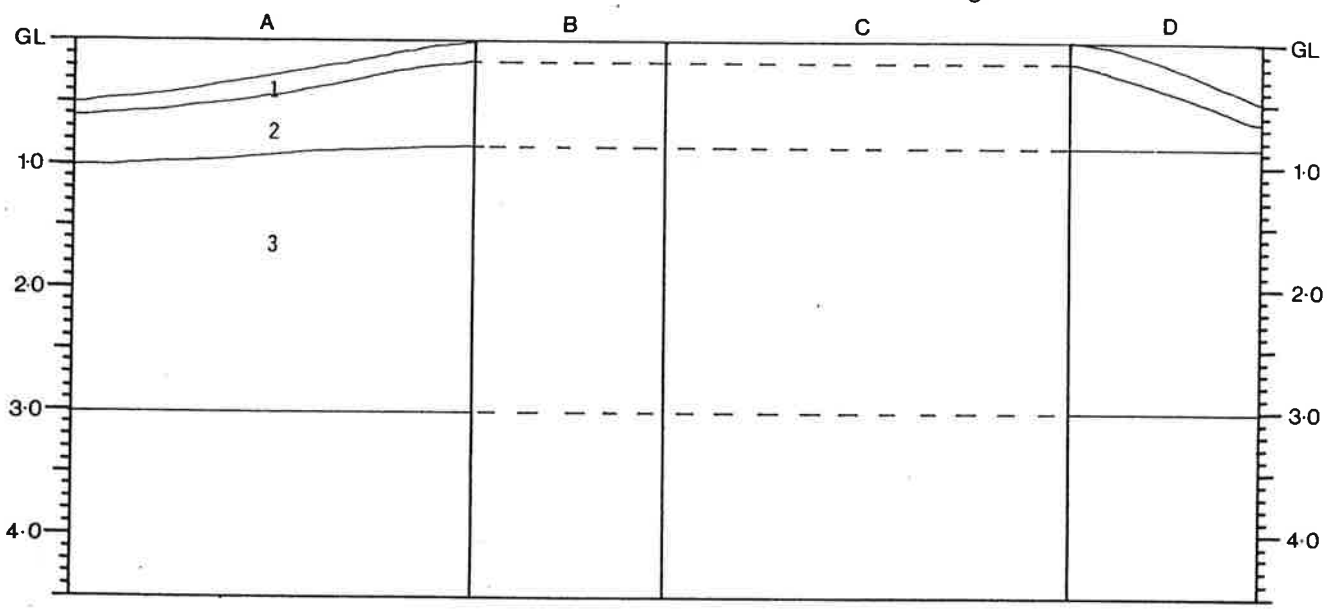
Contract H9169

Trial Pit TP07

Date 28th July, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
NONE TAKEN		1	Loose mid brown, silty TOPSOIL with rootlets.			Pit logged by Engineer's staff
		2	Firm/dense light brown very gravelly SAND and SILT.			
		3	Grey brown, thinly laminated moderately to highly weathered SANDSTONE, moderately strong. Some bands of ironstone and siltstone interbedded with sandstone.			

Plant	POCLAIN 62	Water	Dry.	Cu-Approximate value of undrained shear strength from hand vane
Shored to	-	Stability	Stable.	

Trial Pit Record

exploration associates

Project

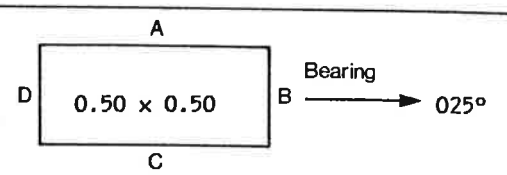
Liiw Valley Borough Council
Pantteg Landslide

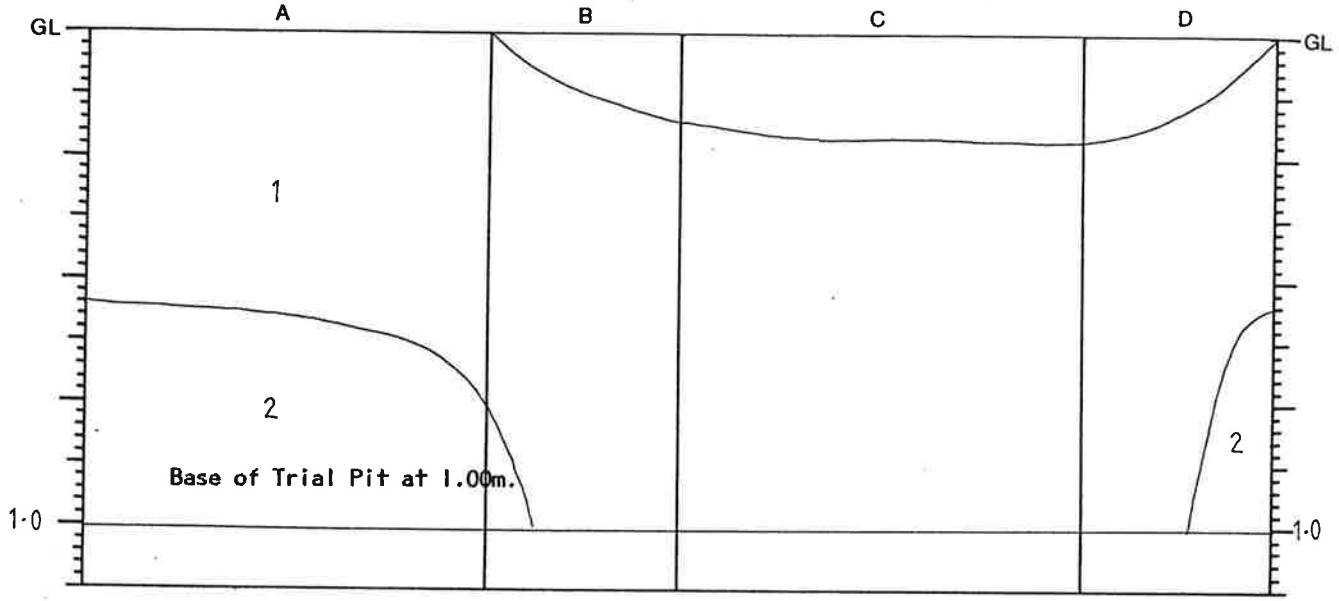
Contract H9169

Trial Pit TP08

Date 18th August, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
G.L.– 1.00	B B	1	Loose, angular, occasionally sub-angular, tabular fine to coarse GRAVEL and some COBBLES of moderately to highly weathered, mid to dark grey, stained orange brown silty mudstone and silty fine sandstone, weak in matrix of firm mid brown to dark brown grey silty clay. (Colluvium)			
		2	Mid purple grey, heavily stained purple brown and mid brown, highly weathered, thinly laminated, silty MUDSTONE, very weak.			

Plant	Hand Dug	Water	Damp below 0.15m.	Cu-Approximate value of un-drained shear strength from hand vane
Shored to	–	Stability	Stable.	

Trial Pit Record

exploration associates

Project

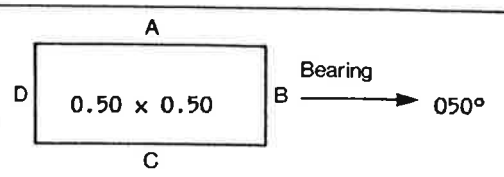
Lliw Valley Borough Council
Pantteg Landslide

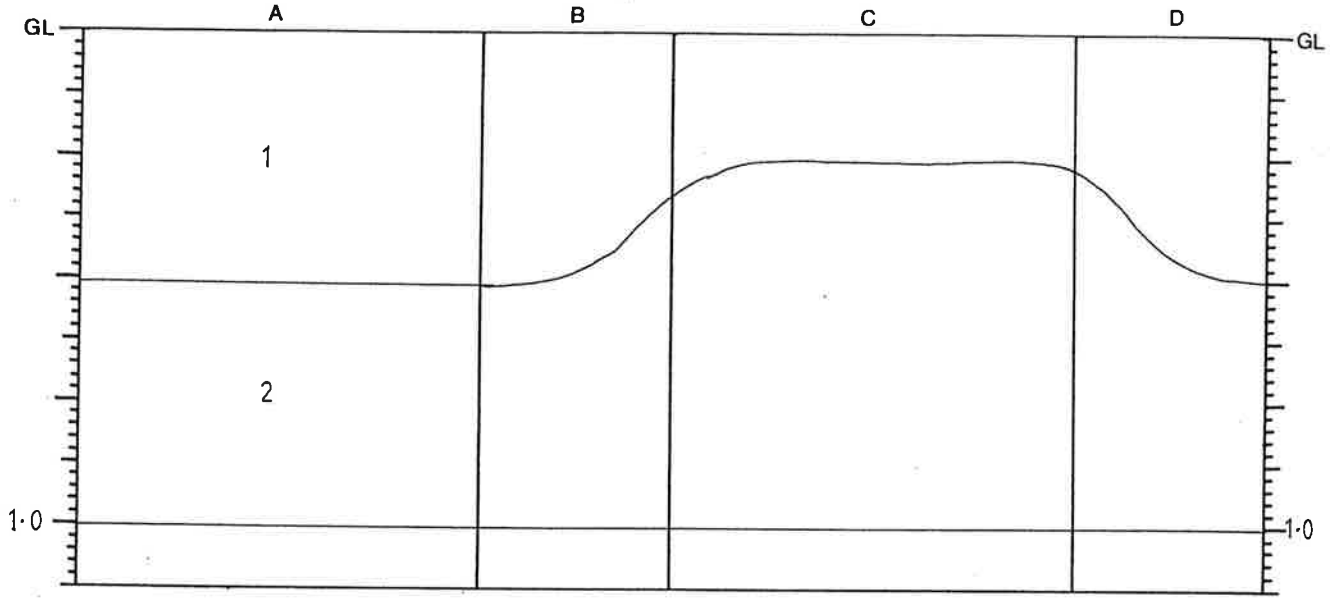
Contract H9169

Trial Pit TP09

Date 18th August, 1989

Level





Samples		Strata		Test Depth m.	Cu kN/m²	Remarks
Depth	Type	No.	Description			
0.50-1.00	B	1	Turf over loose, angular, predominantly tabular, fine to coarse GRAVEL and COBBLES of moderately to highly weathered silty fine sandstone, moderately weak to moderately strong with a little matrix of firm, dark brown, silty clay. (Colluvium)			
		2	Loose to medium dense, angular, tabular, fine to coarse GRAVEL and occasional COBBLES, of silty fine sandstone, moderately weak to moderately strong with some matrix of firm, brown silty sandy clay. (Colluvium)			

Plant	Hand Dug	Water	Damp below 0.50m.	Cu-Approximate value of undrained shear strength from hand vane
Shored to	-	Stability	Slight caving in 2. at 0.30m.	

Trial Pit Record

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Trial Pit TP10

ENCLOSURE B

Laboratory Test Results

i) Symbols
ii) Summaries
iii) Particle Size Distribution
iv) Consolidated Drained Triaxial
v) Drained Shear Box

LABORATORY RESULTS - SYMBOLS

U	Undisturbed Sample
P	Piston Sample
B	Bulk Sample - Disturbed
D	Jar Sample - Disturbed
W	Water Sample
pH	Acidity/Alkalinity Index
SO_3	Sulphate Content
I_P	Plasticity Index
___%	% of fine material in sample for Index Tests
w_L	Liquid Limit
w_P	Plastic Limit
w	Water Content
γ_b	Bulk Density
U	Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
T	Single Stage Triaxial
M	Multistage Triaxial
100/40	Sample Diameter (mm)
REM	Remoulded Triaxial Test Specimen
LVT	Laboratory Vane Test
DSB	Drained Shear Box
RSB	Residual Shear Box
σ_3	Cell Pressure
$\sigma_1 - \sigma_3$	Deviator Stress
c	Cohesion
c'	Effective Cohesion Intercept
Ø	Angle of Shearing Resistance - Degrees
Ø'	Effective Angle of Shearing Resistance
m_v	Coefficient of Volume Decrease
c_v	Coefficient of Consolidation
γ_d	Dry Density
Opt	Optimum
Std	Standard Compaction
Hvy	Heavy Compaction
CBR	California Bearing Ratio
*	Failed under 1st load
**	Failed under 2nd load
#	Untestable
##	Excessive Strain
+	Calcareous Reaction
++	Sulphate in accordance with BRE 250
¶	CBR Remoulded to BS Test 16 2.5kg rammer
§	CBR Remoulded to BS Test 16 4.5kg rammer
•	Undisturbed Sample
••	CBR Remoulded to 5%, Air Voids at Natural Moisture Content
VT	Hand Vane Test

	Project	Contract H9169
exploration associates	Lliw Valley Borough Council Pantteg Landslide	**Figure**

Samples				Chemical		Classification					Strength				
Hole	Depth	Type	Description	pH	SO_3	I_P	w_L	w_P	w%	γ_b Mg/m³	Test	σ_3 kN/m²	σ_f-σ_3 kN/m²	C kN/m²	$\phi°$
4	1.00 1.15	B	Mid brown silty clayey SAND with much gravel			80% 15	34	19	10						
	1.50 1.80	U	Grey silty sandy CLAY with many shale and coal fragments	7.4	org = 1.72%	62% 14	33	19	14	2.10					
	2.60 3.00	U	Grey silty sandy CLAY with some shale fragments			61% 14	32	18	27	1.97					
	3.95 4.50	B	Dark grey brown silty sandy CLAY with some gravel, cobbles and occasional rootlets			70% 13	31	18	20						

Remarks

Laboratory Results - Summary

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract
H9169

Figure

Samples				Chemical		Classification					Strength					
Hole	Depth	Type	Description	pH	SO_3	I_P	w_L	w_P	w%	γ_b Mg/m³	Test	σ_3 kN/m²	$\sigma_1-\sigma_3$ kN/m²	C kN/m²	$\phi°$
TP1	1.50 3.00	B	Grey brown black slightly clayey silty laminated SHALE with much ironstaining slightly micaceous			72% 9	24	15	8.27						
TP2	0.10 3.00	B	Grey brown black slightly clayey silty laminated SHALE with much ironstaining slightly micaceous			90% 9	24	15	4.25						
TP9	1.00 (1)	B	Brown sandy CLAY with fine to coarse gravel and cobbles	7.0 SG=	0.04% 2.68	92% 16	31	15	14	2.11					
	1.00 (2)	B	Grey brown silty slightly sandy CLAY with some fine siltstone gravel			34% – Non Plastic	24	–	17	1.74					
TP10	1.00 (1)	B	Grey fine to coarse shaley mudstone GRAVEL with occasional sandy clay	8.3 SG=	0.08 2.58	98% 13	31	18	8	2.11					
	1.00 (2)	B	Dark grey fine sandstone GRAVEL with a trace of silty clay			53% 15	30	15	13	1.77					

Remarks

Laboratory Results - Summary

exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure

Remarks

Laboratory— Plasticity chart

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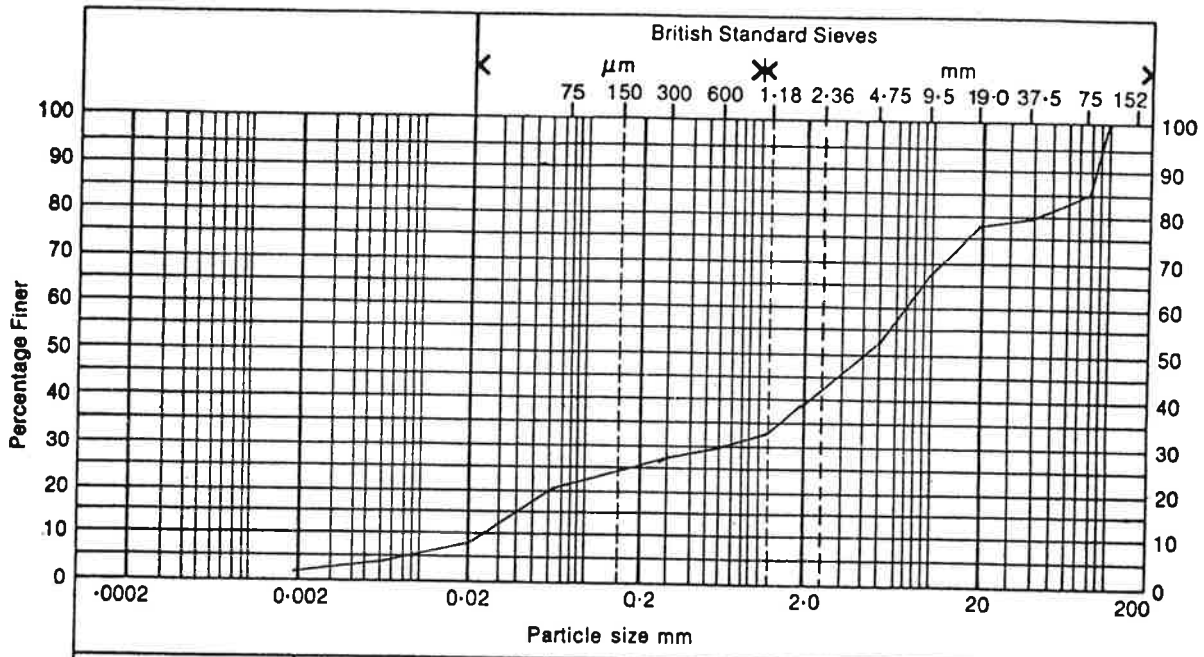
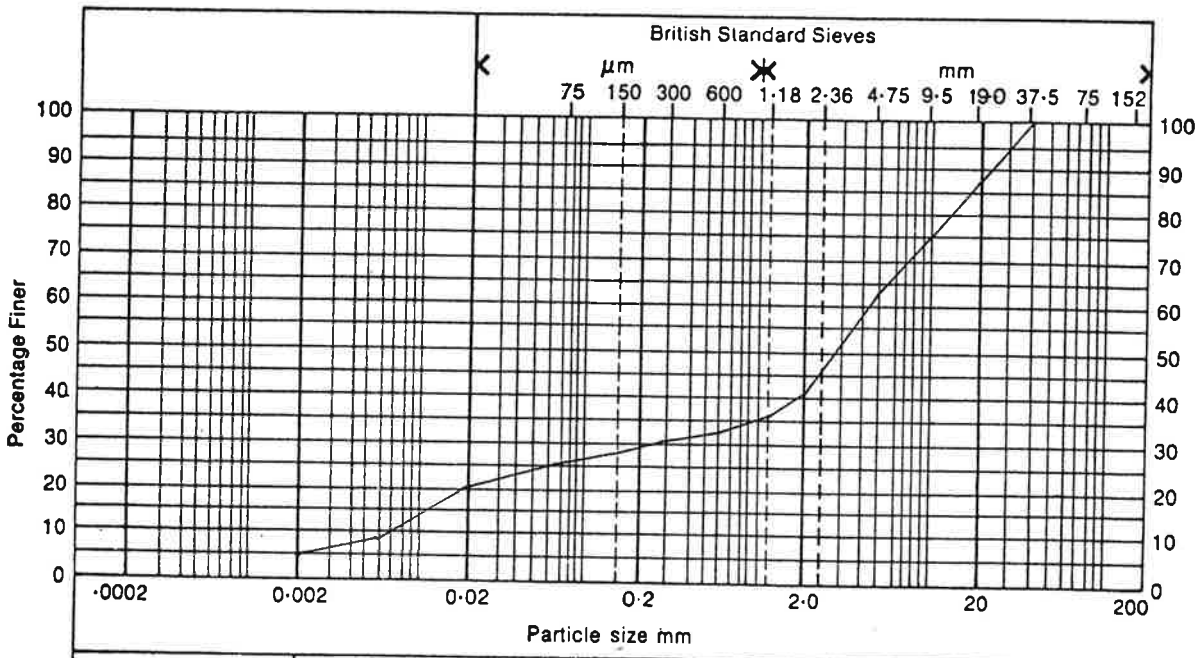
Project

Lliw Valley Borough Council
Pantteg Landslide

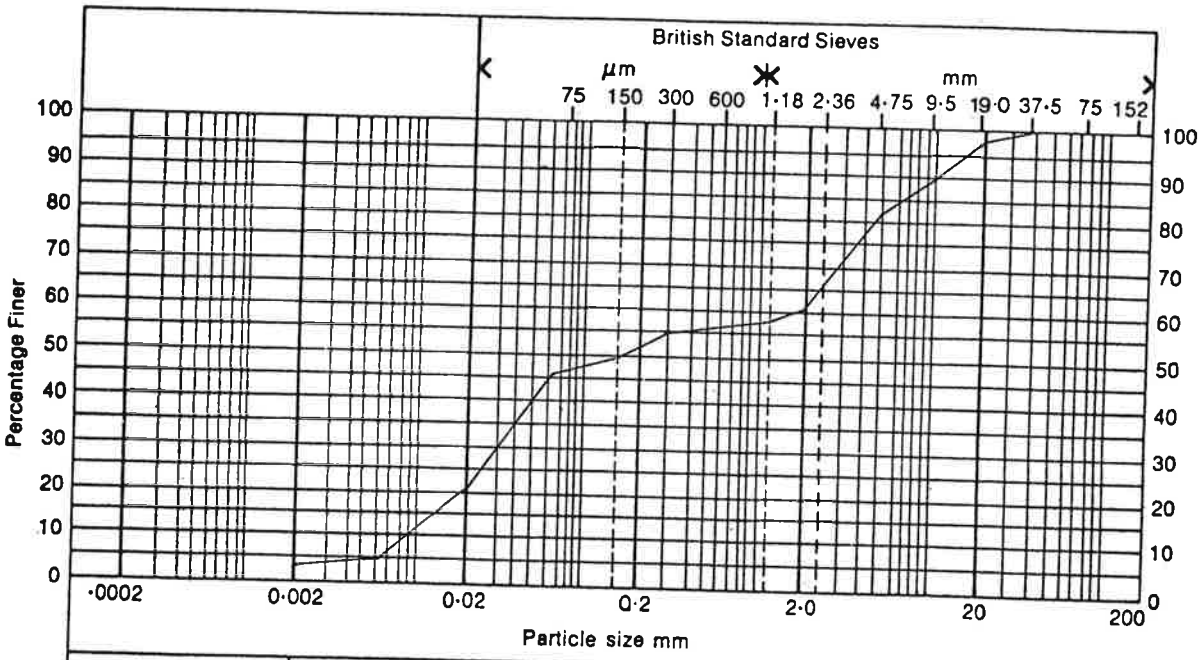
Contract H9169

Figure





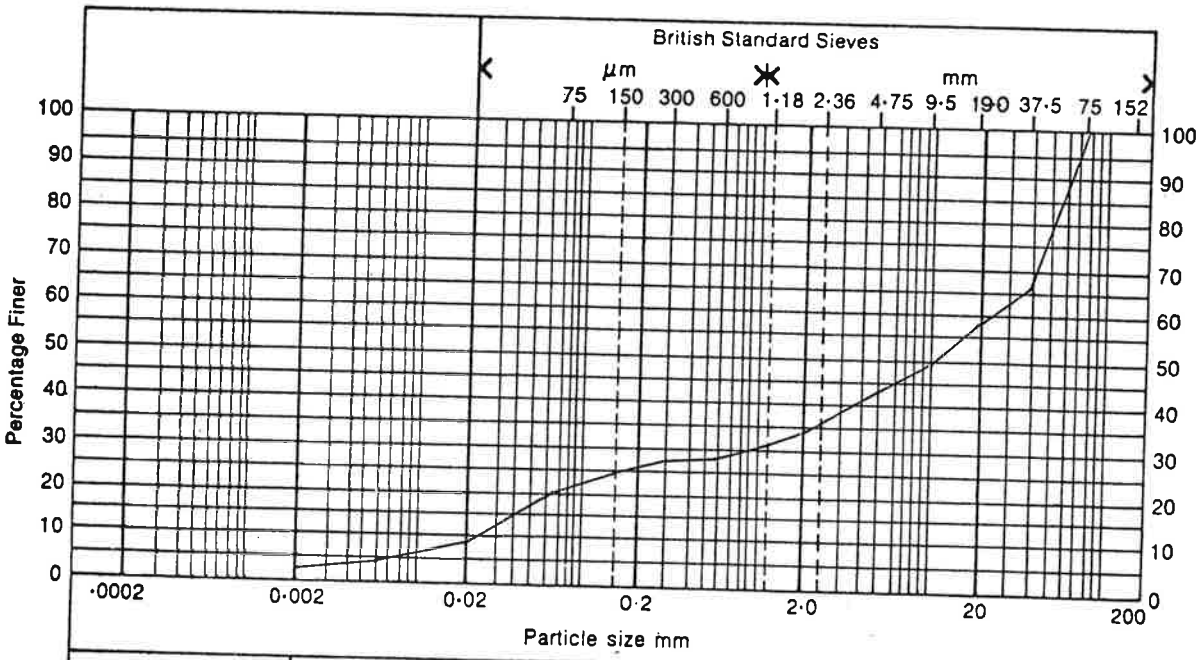
Laboratory- Particle Size	**Project**	Contract
	Lliw Valley Borough Council	H9169
Exploration Associates	Pantteg Landslide	**Figure**



Clay	Silt			Sand			Gravel			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Depth (a) 2.60
(b)
(c)

Borehole 4

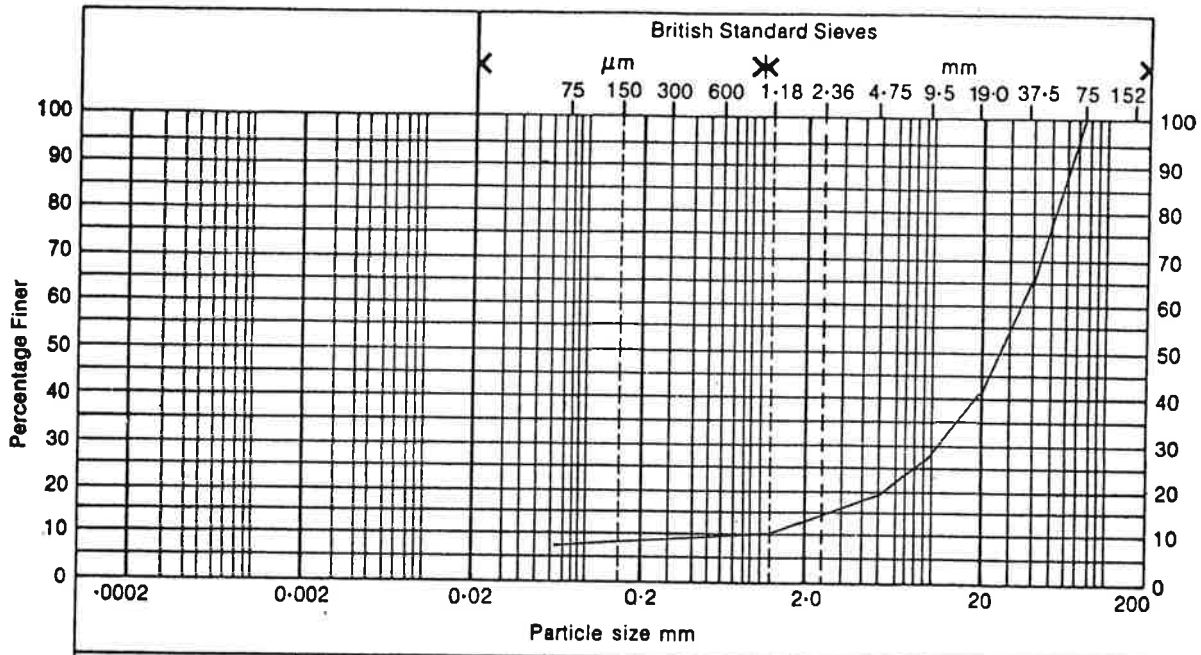


Clay	Silt			Sand			Gravel			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Depth (a) 3.95
(b)
(c)

Borehole 4

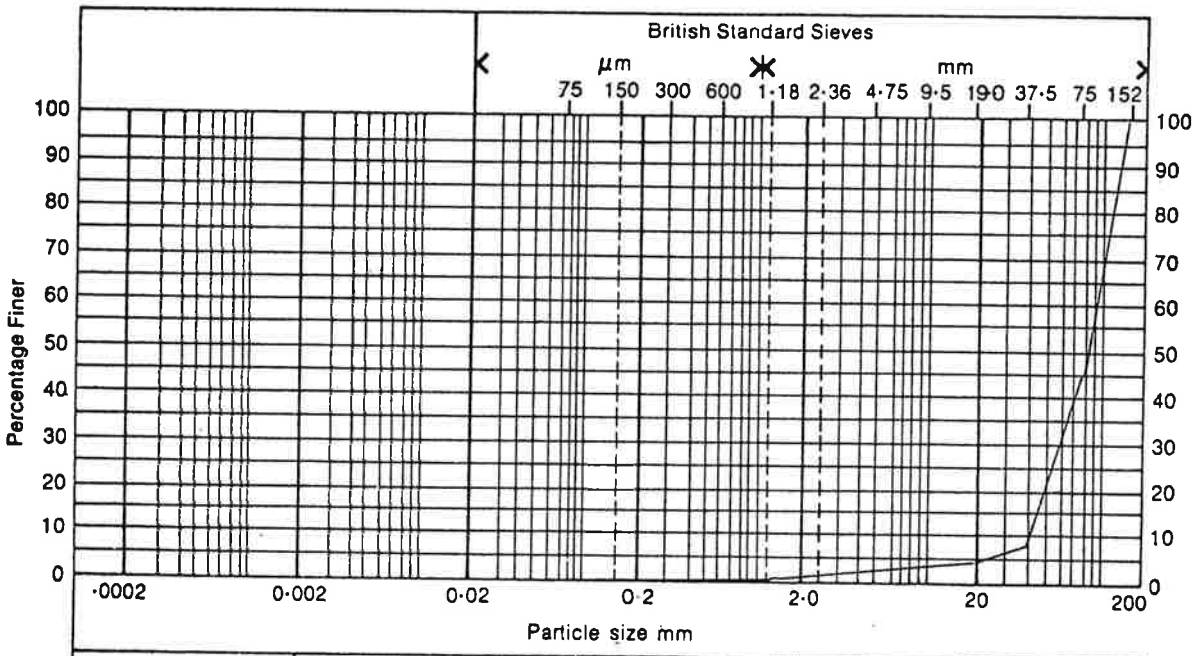
Laboratory- Particle Size	**Project**	Contract H9169
Exploration Associates	Lliw Valley Borough Council Pantteg Landslide	**Figure**



Clay	Silt			Sand			Gravel			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Depth (a) 1.50 - 3.00
(b)
(c)

Borehole TP1

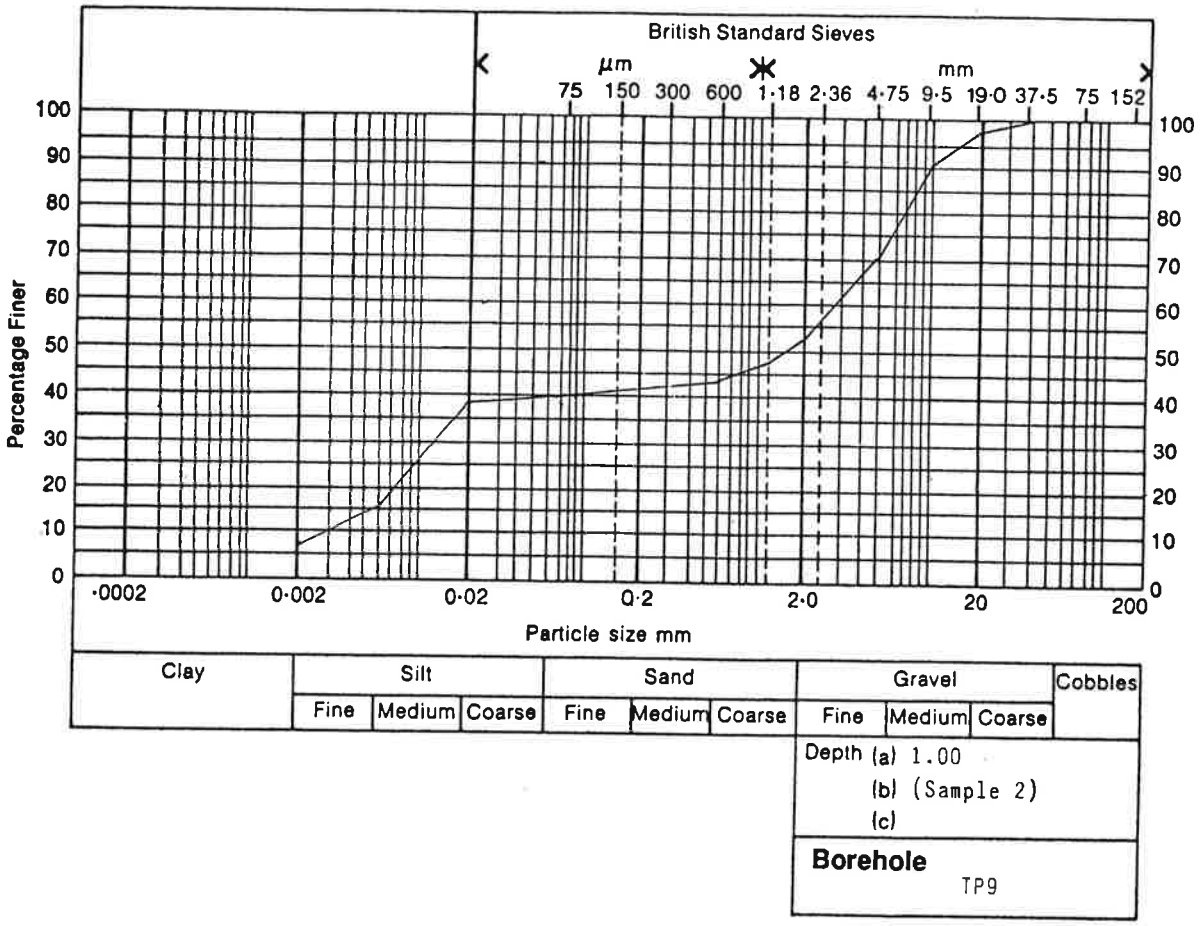


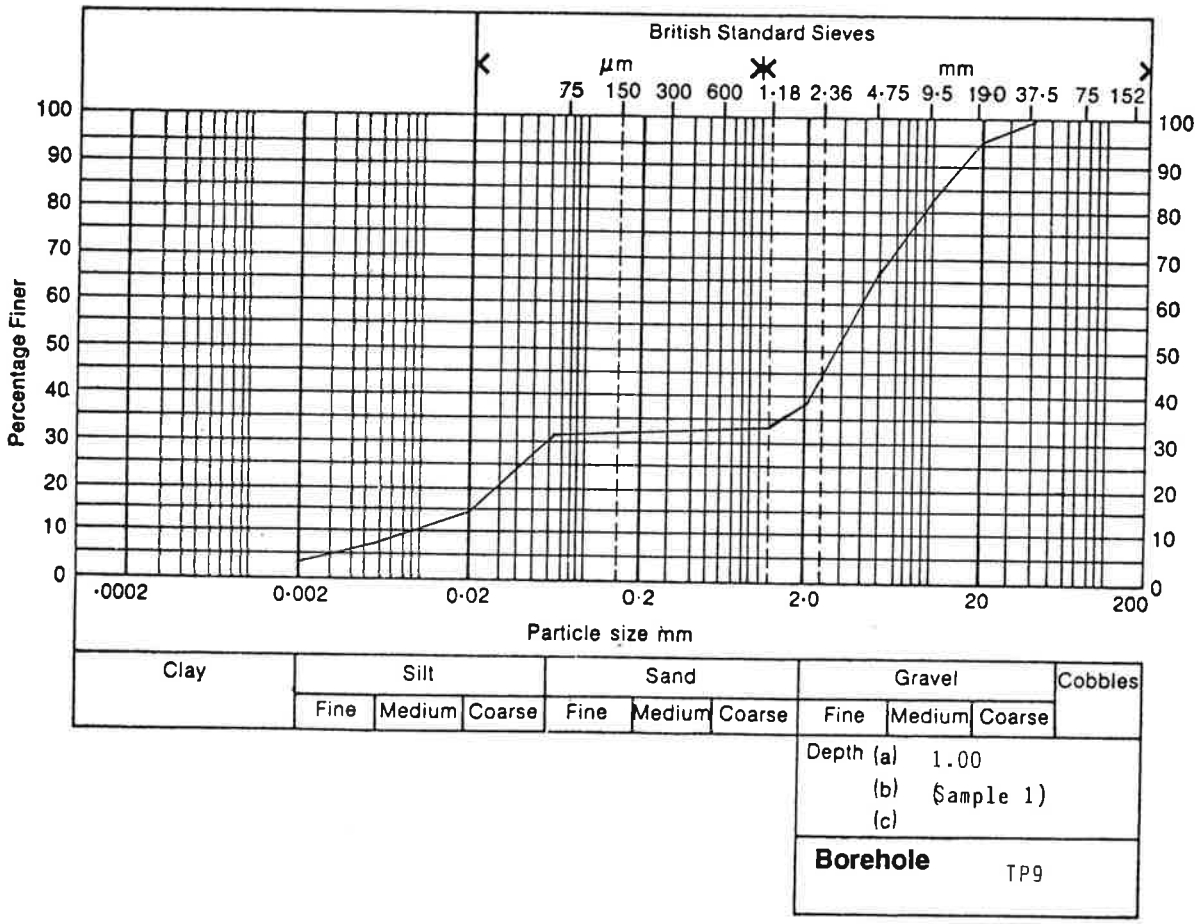
Clay	Silt			Sand			Gravel			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Depth (a) 0.10 - 3.00
(b)
(c)

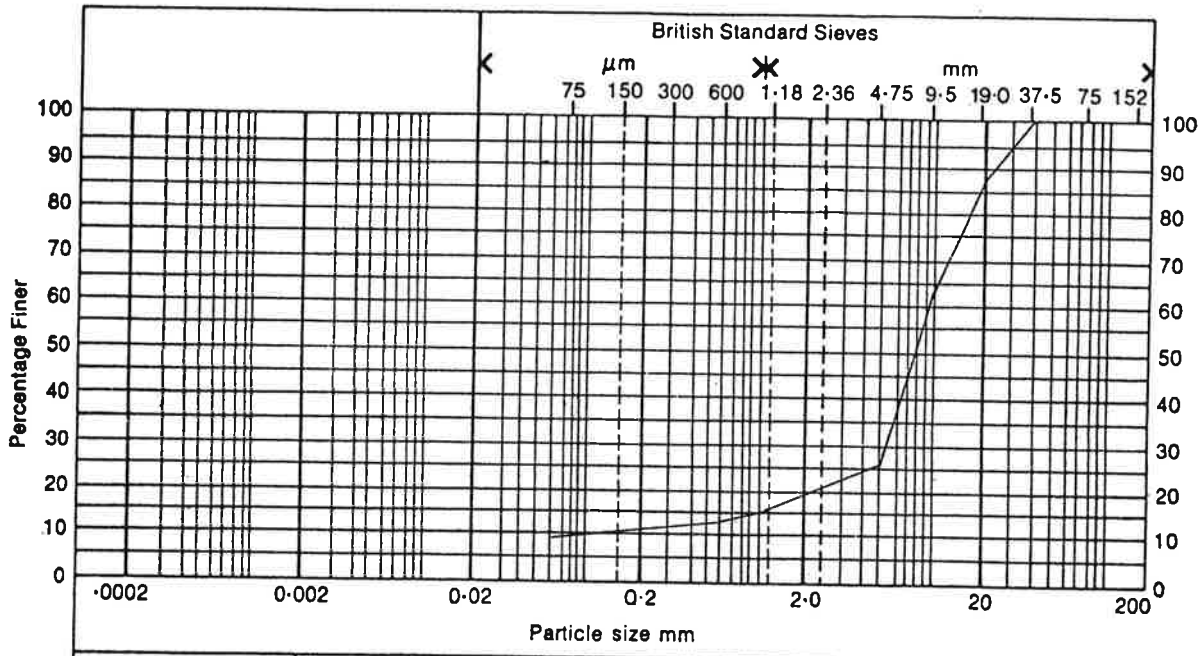
Borehole TP2

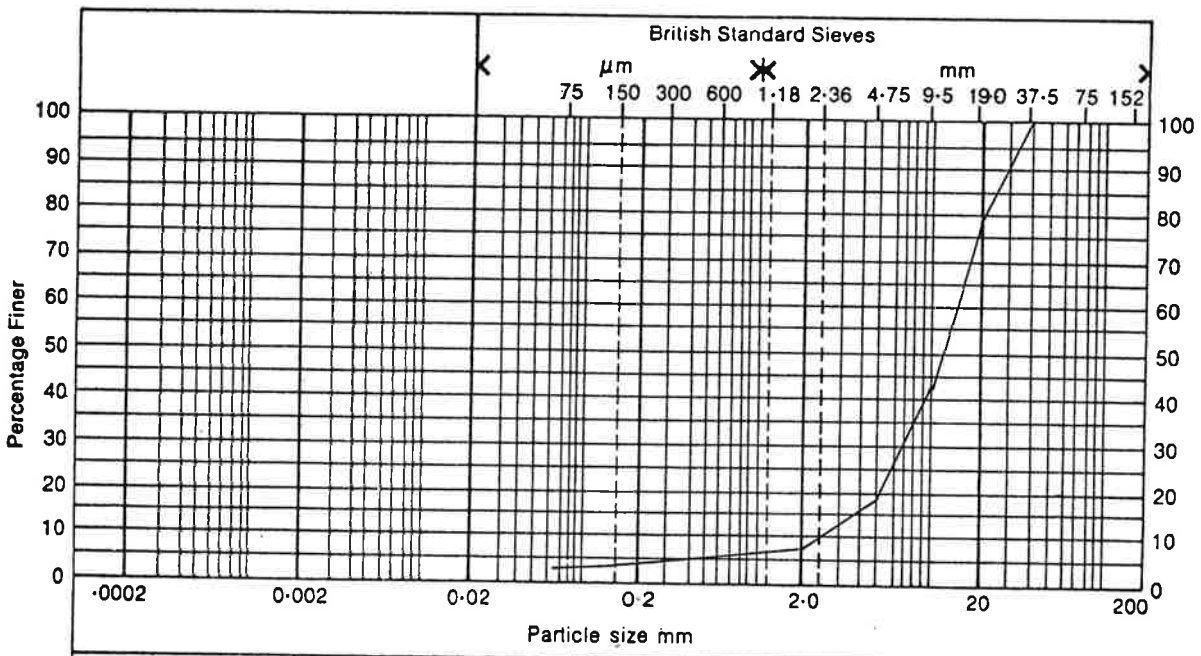
Laboratory- Particle Size	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
Exploration Associates		**Figure**





Laboratory- Particle Size	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
Exploration Associates		**Figure**





Laboratory- Particle Size	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
Exploration Associates		**Figure**

Samples				Water Content		Density			Shear Strength							
Hole	Depth	Type	Description	Initial %	Final %	Initial Mg/m3	Final Mg/m3	Dry Mg/m3	Prep.	Test	P'o kN/m2	u_f kN/m2	$\sigma_1'-\sigma_3'$ kN/m2	c' kN/m2	$\phi'°$
4	1.50 1.80	U	Grey silty CLAY with abundant shale and coal fragments	14	14	2.10	2.14	1.85	Nat	SCDT 105	50	0	200	0	42
	2.60 3.00	U	Grey silty CLAY with some fine to medium shaly siltstone gravel	27	22	1.97	2.04	1.55	Nat	SCDT 105	100	+1	177	0	28

Remarks

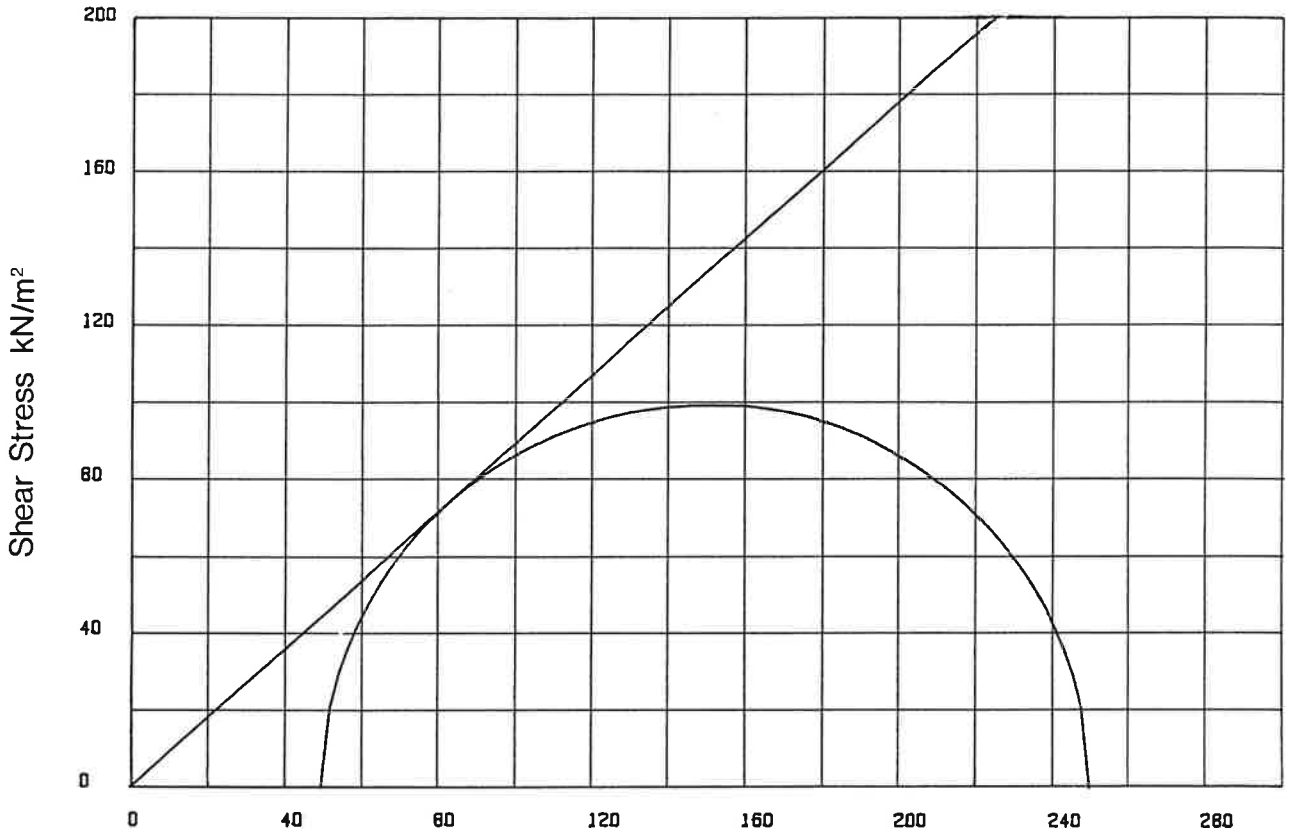
Laboratory Results – Triaxial Effective Stress

exploration associates

Project Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



B	(Initial)		0.56			
B_s	(After application of Back Pressure)		1.00			
ϵ	(Rate of Strain)	% min	.0086			
σ_3	(Cell Pressure during Shear)	kN/m²	450			
υ_0	(Applied Back Pressure)	kN/m²	400			
$P'_0 = \sigma_3 - \upsilon_0$	(Mean effective stress prior to shear = Consolidation Pressure)	kN/m²	50			
$(\sigma_1 - \sigma_3)_f$	(Maximum Deviator Stress)	kN/m²	200			

Triaxial Compression Test
Consolidated
Drained

Description Silty CLAY with abundant shale and coal fragments.

Mohr Circles and Summary

C' 0 kN/m²
ϕ' 42 Degrees

Depth 1.50-1.80
Borehole 4

Remarks 105mm dia' single stage.

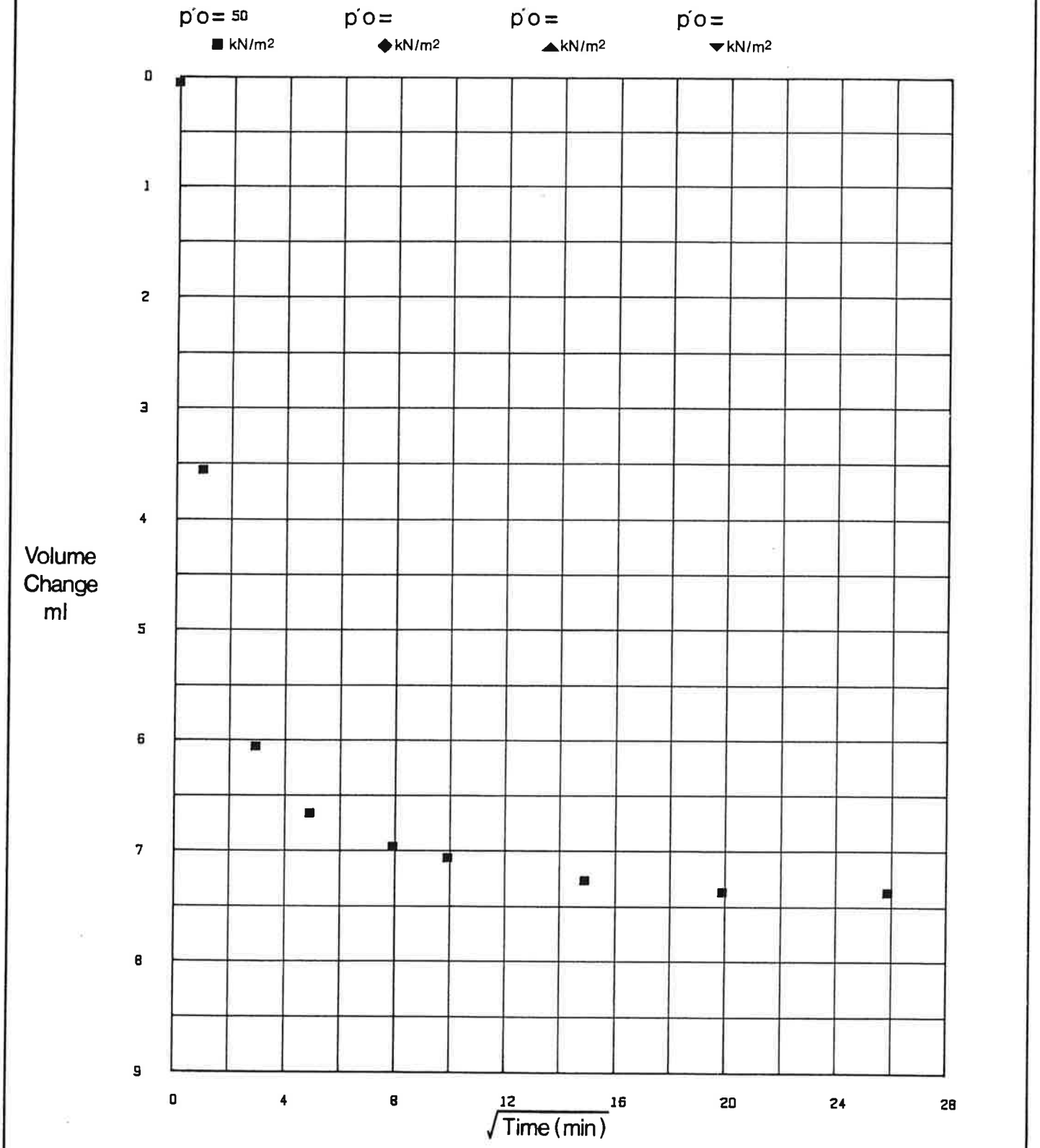
Laboratory – Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

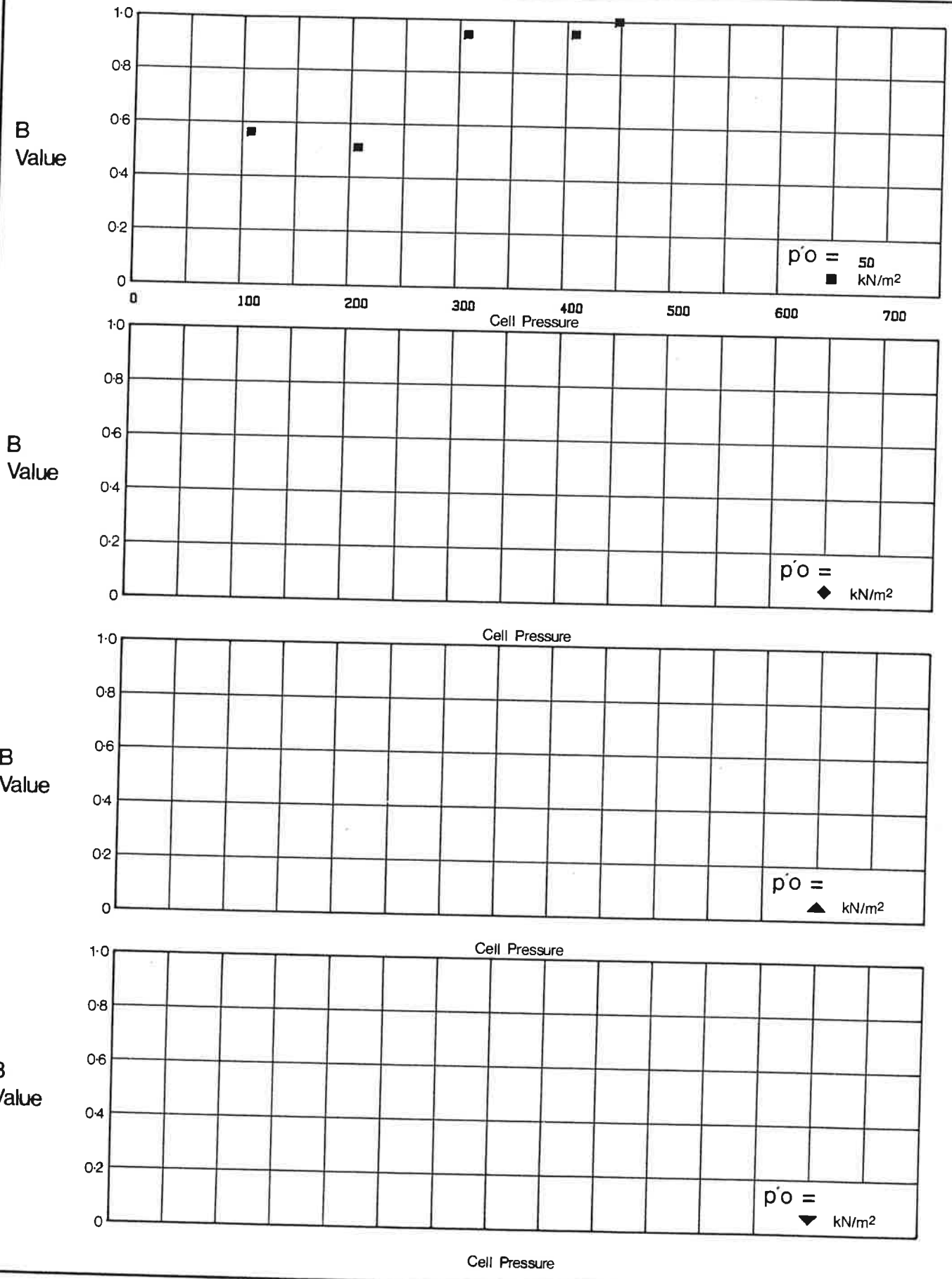
Contract H9169

Figure



p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Side Drains Fitted
50	8.32	0.10	2.57x10⁻¹⁰	Yes

Triaxial Consolidation Volume Change / √Time		Depth 1.50-1.80 Borehole 4
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**



B Value / Cell Pressure

Depth 1.50-1.80
Borehole 4

Remarks

Laboratory–Effective Stress

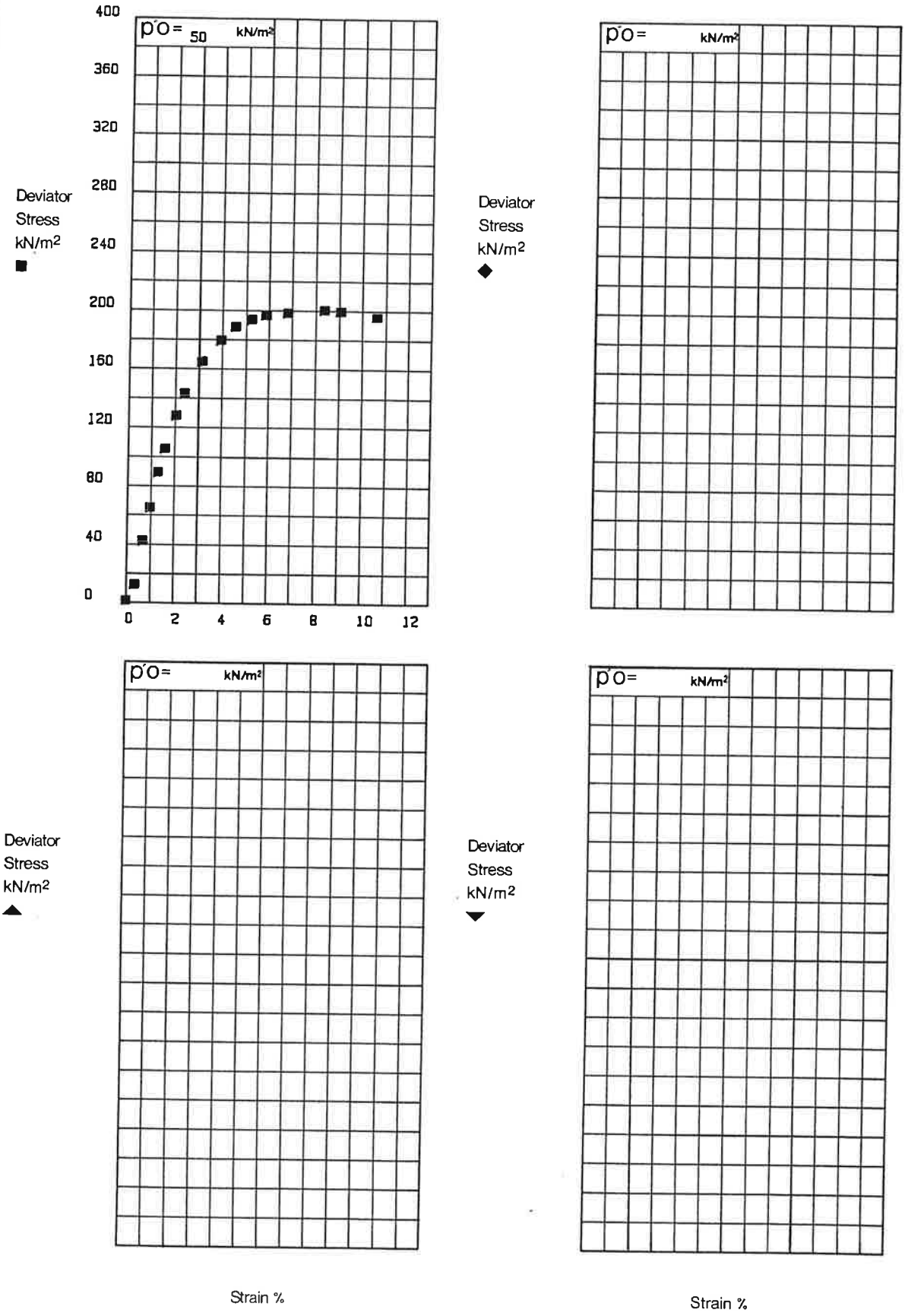
exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Deviator Stress / Strain

Depth 1.50-1.80
Borehole 4

Remarks

Laboratory– Effective Stress

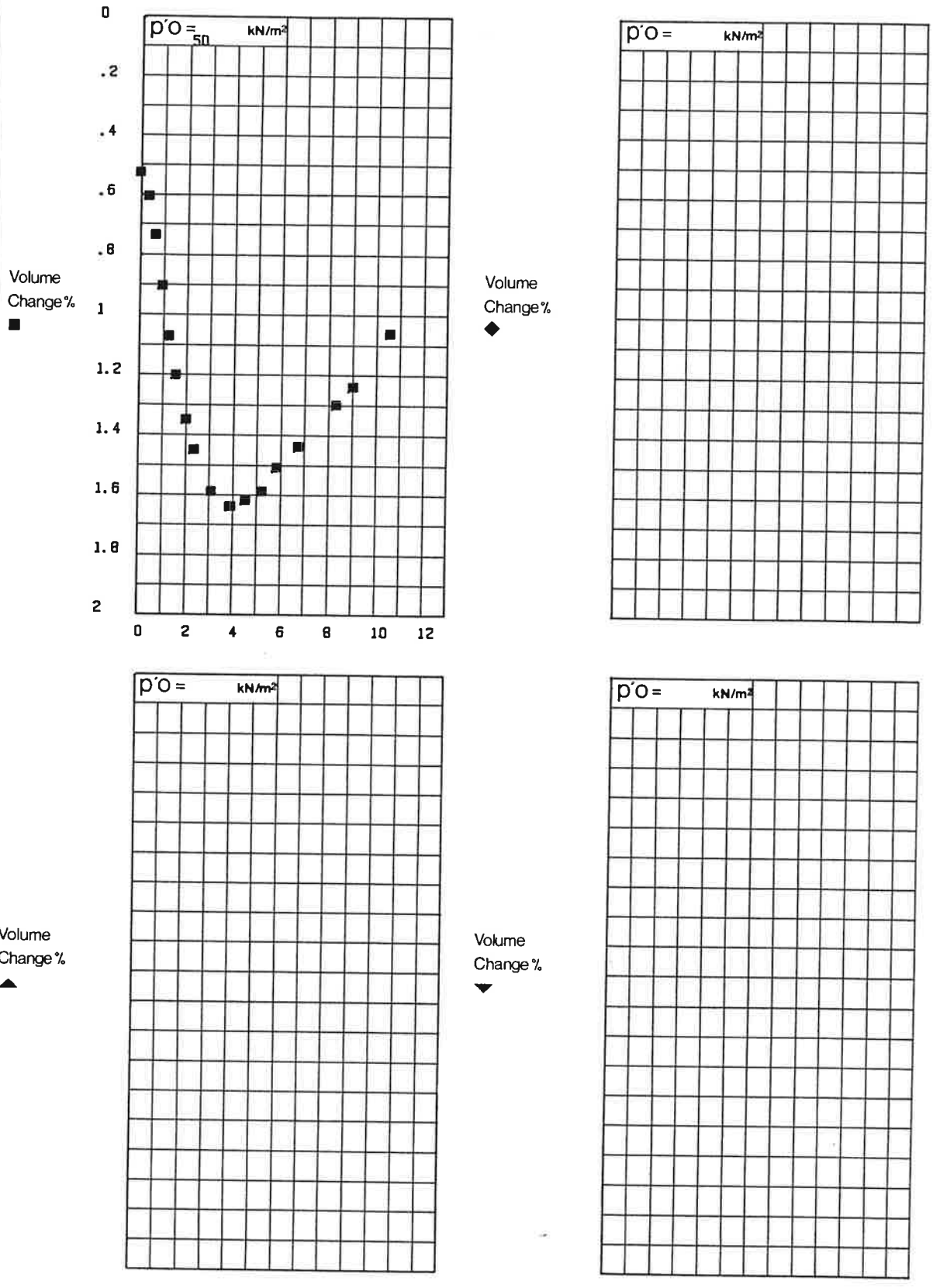
Project

Lliw Valley Borough Council
Pantteg Landslide

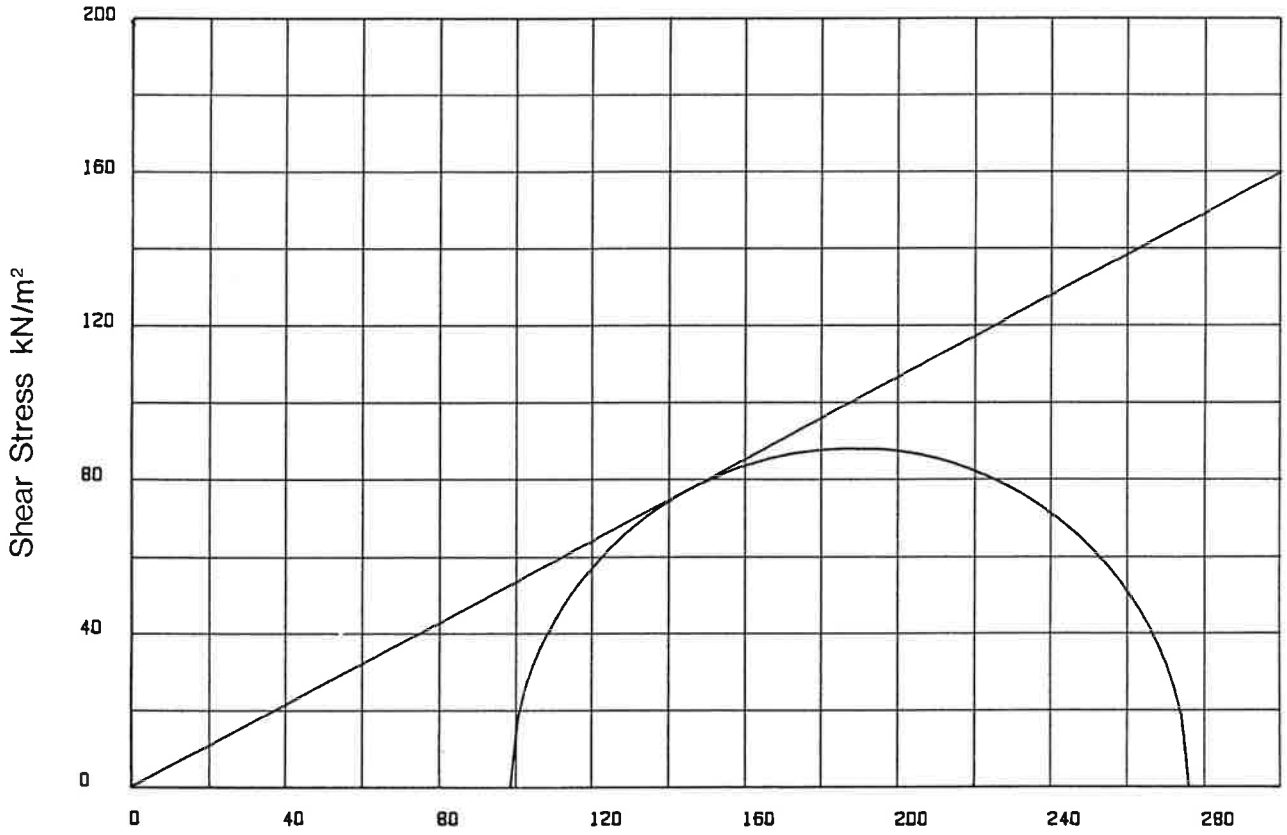
Contract H9169

exploration associates

Figure



Volume Change / Strain	Depth 1.50-1.80 Borehole 4
Remarks	
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide Contract H9169
exploration associates	**Figure**



B	(Initial)		1.00			
B_s	(After application of Back Pressure)		1.00			
ϵ	(Rate of Strain)	% min	.0015			
σ_3	(Cell Pressure during Shear)	kN/m²	300			
υ_0	(Applied Back Pressure)	kN/m²	200			
$P'_0 = \sigma_3 - \upsilon_0$	(Mean effective stress prior to shear = Consolidation Pressure)	kN/m²	100			
$(\sigma_1 - \sigma_3)_f$	(Maximum Deviator Stress)	kN/m²	177			

Triaxial Compression Test
Consolidated
Drained

Description: Soft grey silty CLAY with some fine to medium shaly siltstone gravel.

Mohr Circles and Summary

C'	0	kN/m²
ϕ'	28	Degrees

Depth 2.6-3.0
Borehole 4

Remarks 105mm dia' single stage.

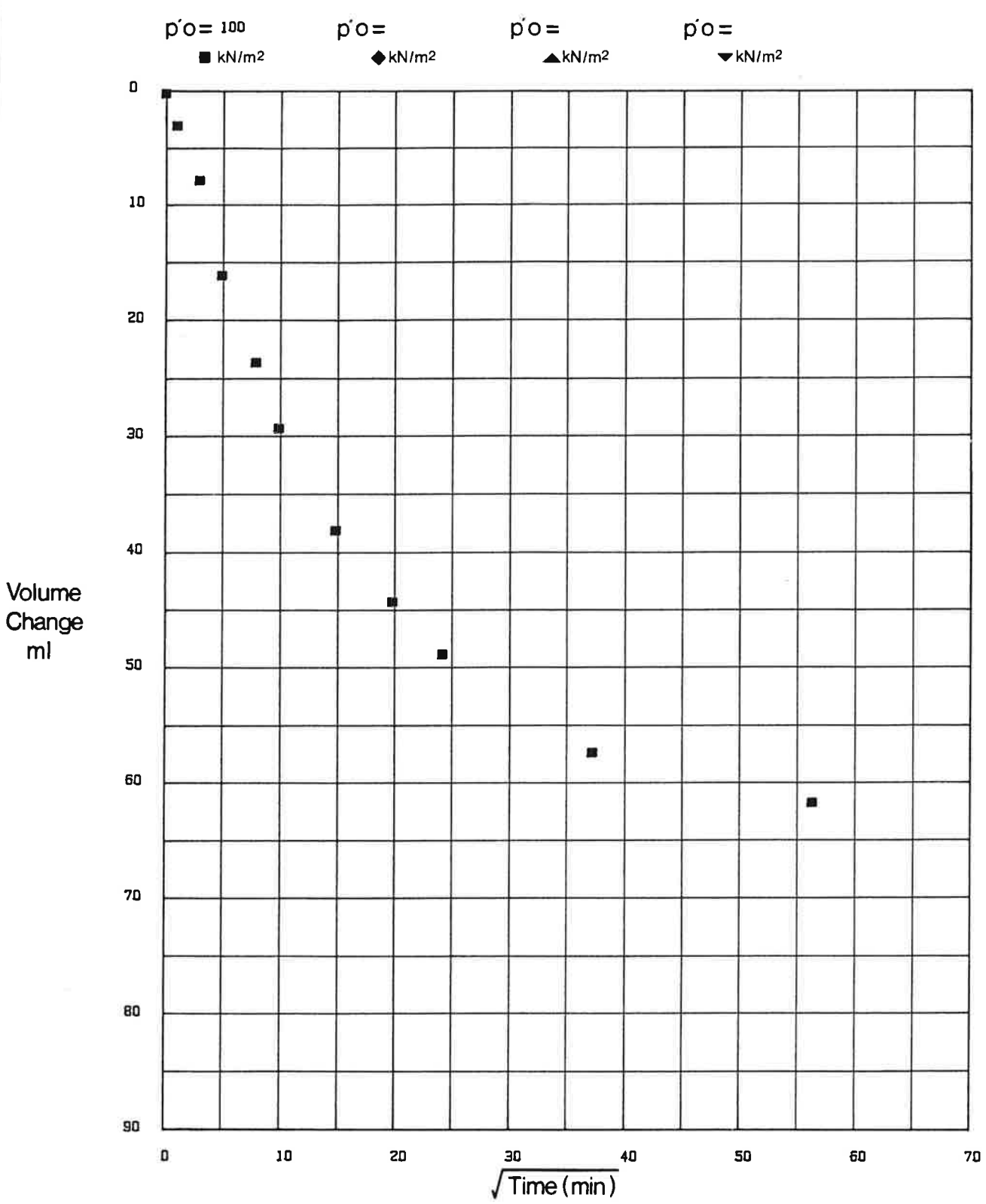
Laboratory–Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

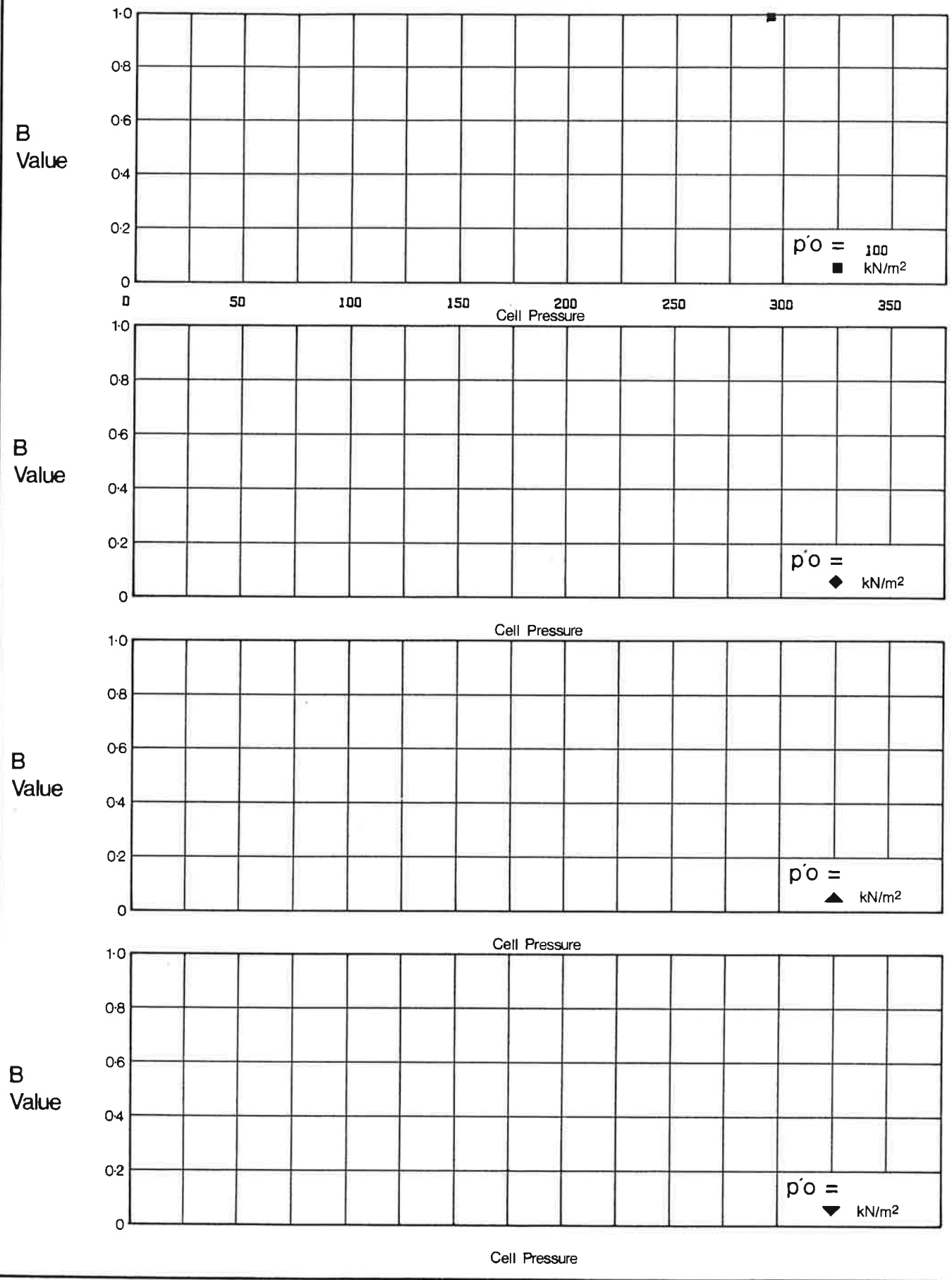
Figure



p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Side Drains Fitted
100	0.48	0.35	5.2x10⁻¹¹	Yes

Triaxial Consolidation Volume Change / √Time		Depth 2.6-3.0 Borehole 4
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

SL 4



B Value / Cell Pressure

Depth 2.6-3.0
Borehole 4

Remarks

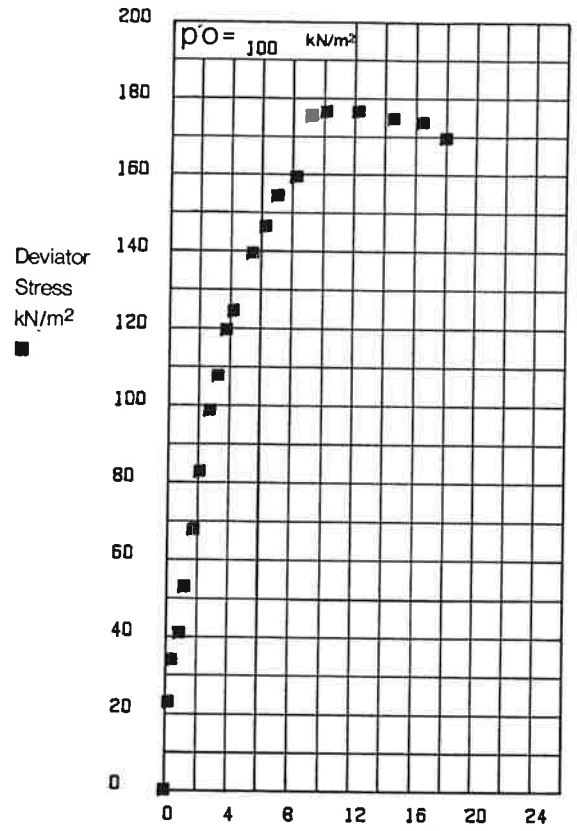
Laboratory–Effective Stress

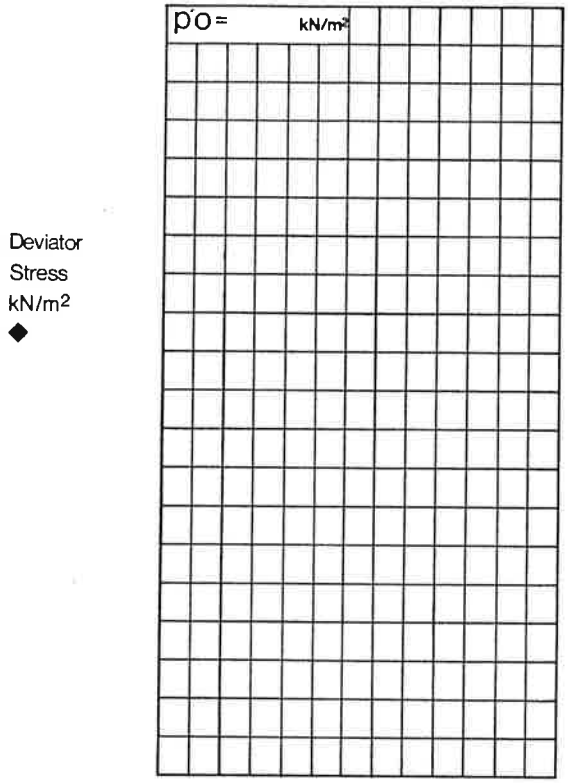
exploration associates

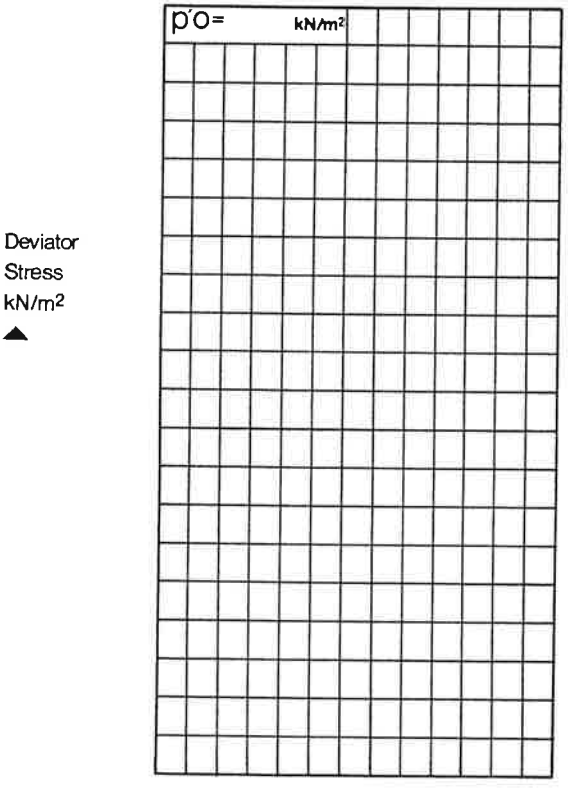
Project
Lliw Valley Borough Council
Pantteg Landslide

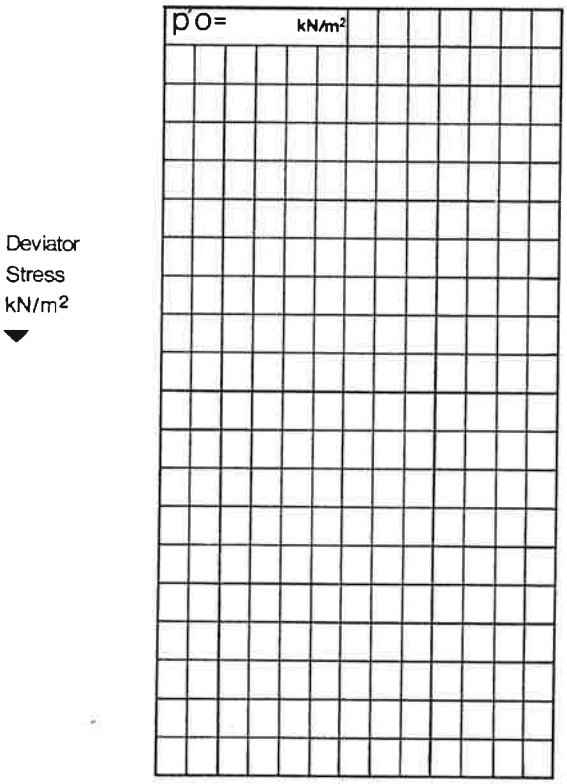
Contract H9169

Figure









Deviator Stress / Strain

Depth 2.6-3.0
Borehole 4

Remarks

Laboratory – Effective Stress

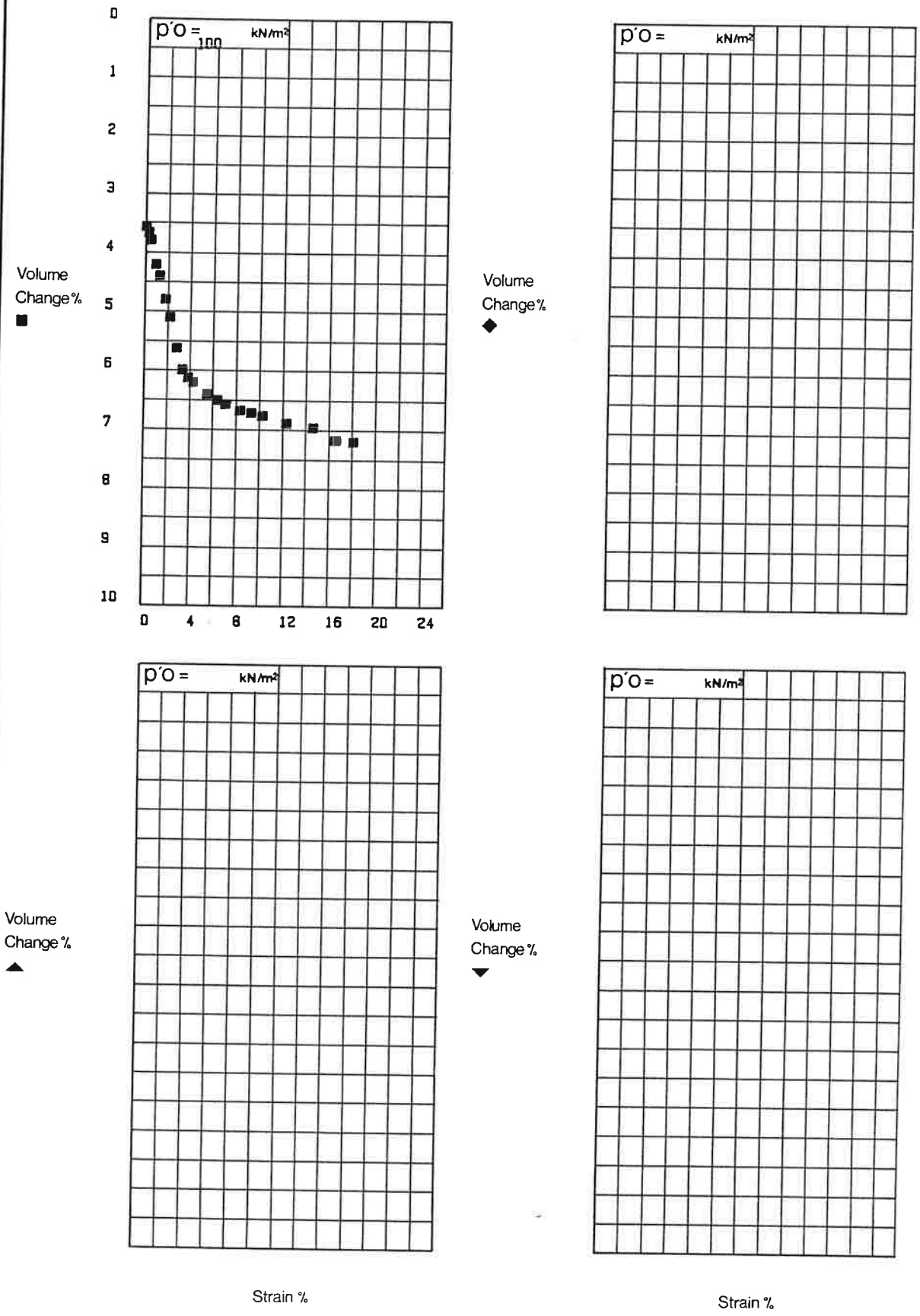
exploration associates

Project

Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Volume Change / Strain	Depth 2.6-3.0 Borehole 4
Remarks	
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide
exploration associates	Contract H9169 **Figure**

Samples				Water Content		Height		Density			Shear Strength				
Hole	Depth	Type	Description	Initial %	Final %	Initial mm	Final mm	Initial Mg/m³	Final Mg/m³	Dry Mg/m³	Test	σ_1 kN/m²	τ_f kN/m²	c kN/m²	ϕ'
TP9	1.00 SAMPLE 1	B	Brown sandy CLAY with fine to coarse gravel and cobbles	14	13	135.00	129.3	2.11	2.19	1.85	DSB 300	50	51 (37) *31	4	41
				14	13	130.00	124.0	2.09	2.18	1.84		100	88 (68) *62	(4) *0	(32) *32
				14	13	132.00	126.4	2.11	2.20	1.85		150	139 (101) *95		
TP10	1.00 SAMPLE 1	B	Grey fine to coarse shaley mudstone GRAVEL with occasional sandy clay	8	8	135.00	134.2	2.09	2.09	1.93	DSB 300	75	65 (51) *44	16	32
				8	8	140.00	138.6	2.11	2.12	1.95		100	78 (62) *56	(8) *0	(29) *30
				8	8	144.00	142.6	2.11	2.12	1.95		125	97 (79) *74		

Remarks ( ) = Residual value after 5 reversals
* = Residual value after being preformed

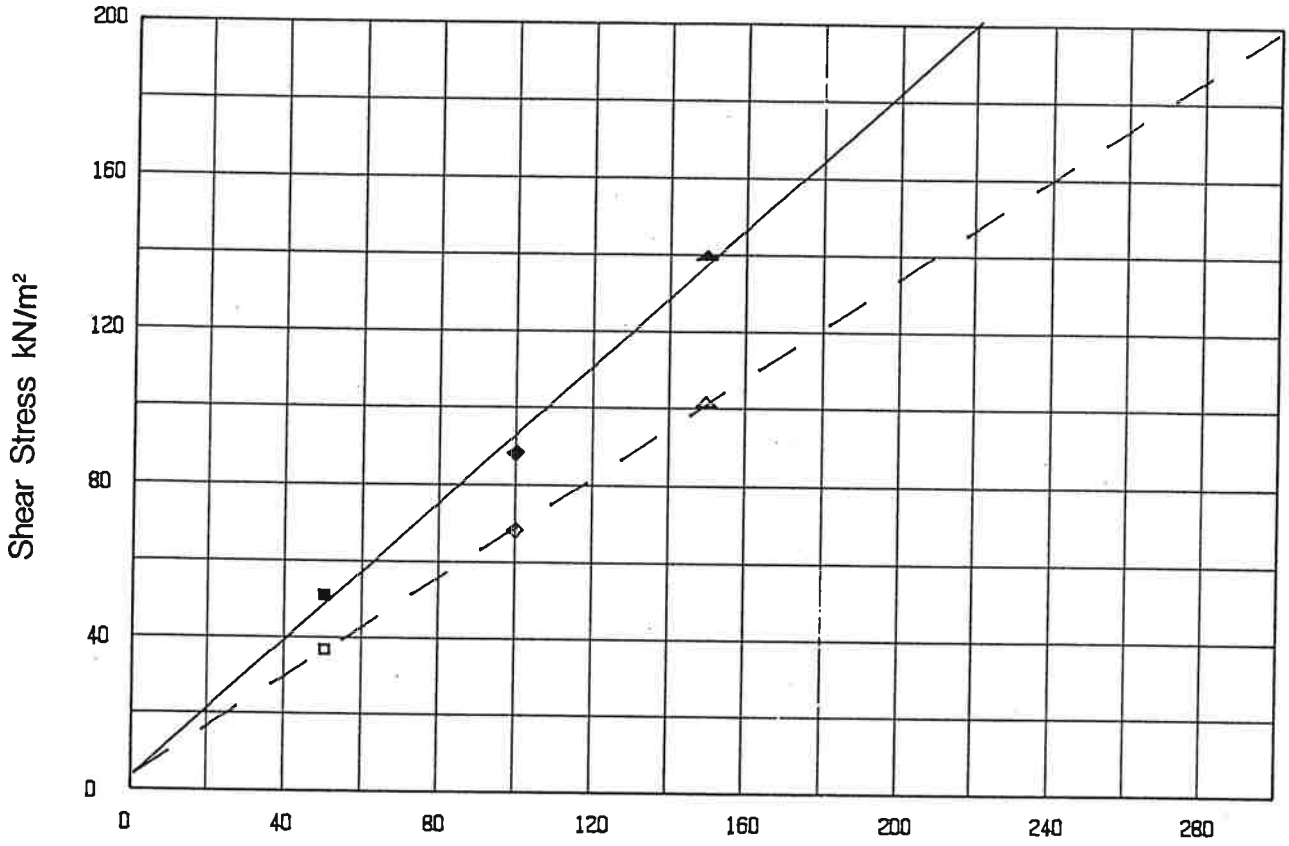
Laboratory Results– Shear Box

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Normal Stress	kN/m²	50	100	150	
Peak Shear Stress	kN/m²	51	88	139	
Residual Shear Stress	kN/m²	37	68	101	
Rate of Strain	mm/min	.05	.05	.05	
Strain at Peak Shear Stress	%	2.623	1.967	1.639	
Method of Residual Shear Stress Determination		Cut Plane / Reversal			
Sample Preparation		Undisturbed / Remoulded			

Shear Box
Drained

Description Brown sandy CLAY with fine to coarse gravel and cobbles.

c'	4	cr'	4	kN/m²
φ'	41	φr'	32	Degrees

Shear Stress / Normal Stress

Depth 1.00 (sample 1)
Borehole TP9

Remarks

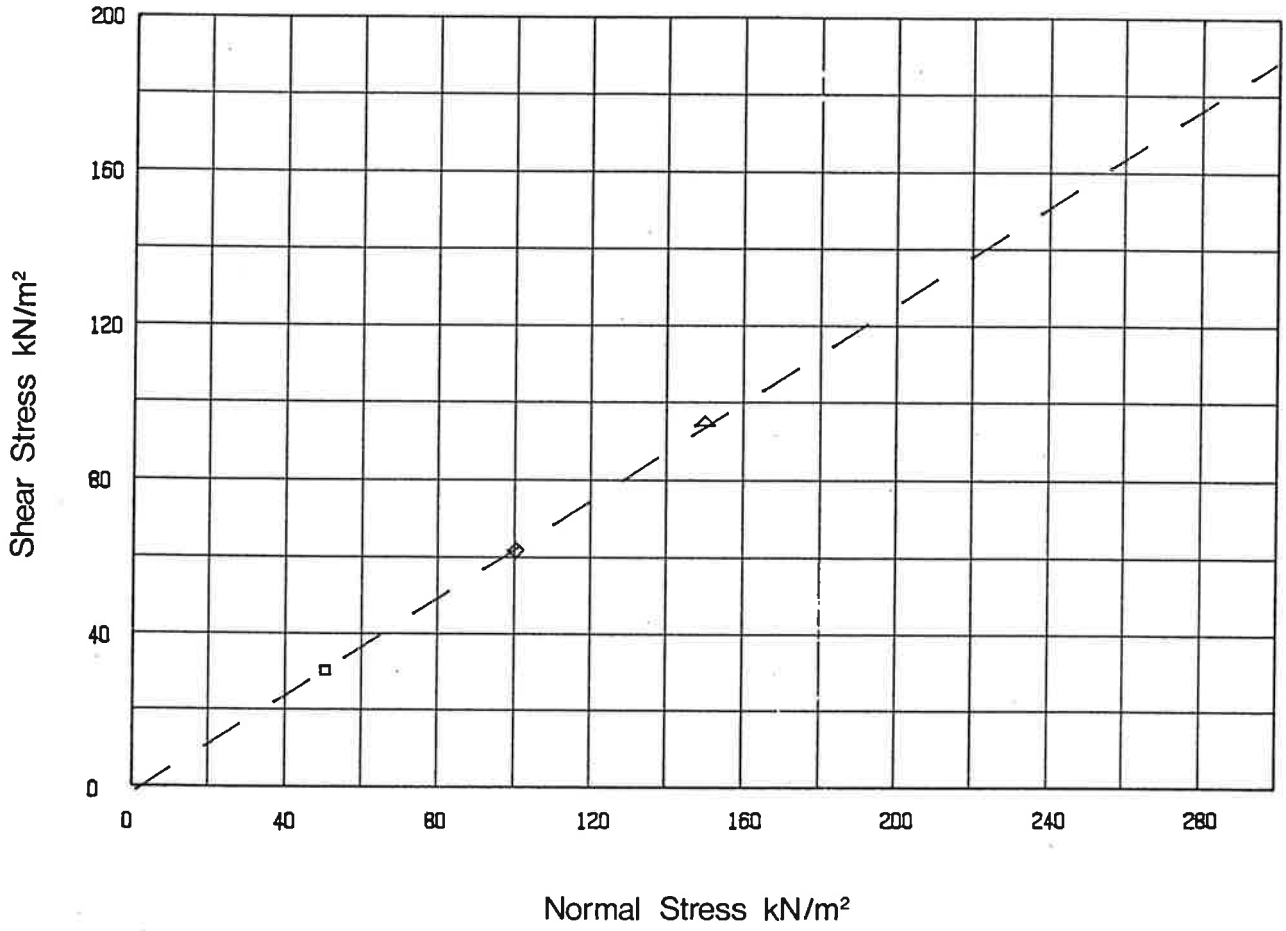
Laboratory - Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Normal Stress	kN/m²	50	100	150	
Peak Shear Stress	kN/m²				
Residual Shear Stress	kN/m²	31	62	95	
Rate of Strain	mm/min	.05	.05	.05	
Strain at Peak Shear Stress	%	2.623	1.967	1.639	
Method of Residual Shear Stress Determination		Cut Plane / ~~Reversal~~			
Sample Preparation		~~Undisturbed~~ / Remoulded			

Shear Box
Drained

Description Brown sandy CLAY with fine to coarse gravel and cobbles.

c'	$c'r$	0	kN/m²
ϕ'	$\phi'r$	32	Degrees

Shear Stress / Normal Stress

Depth 1.00 (sample 1)
Borehole TP9

Remarks

Laboratory - Effective Stress

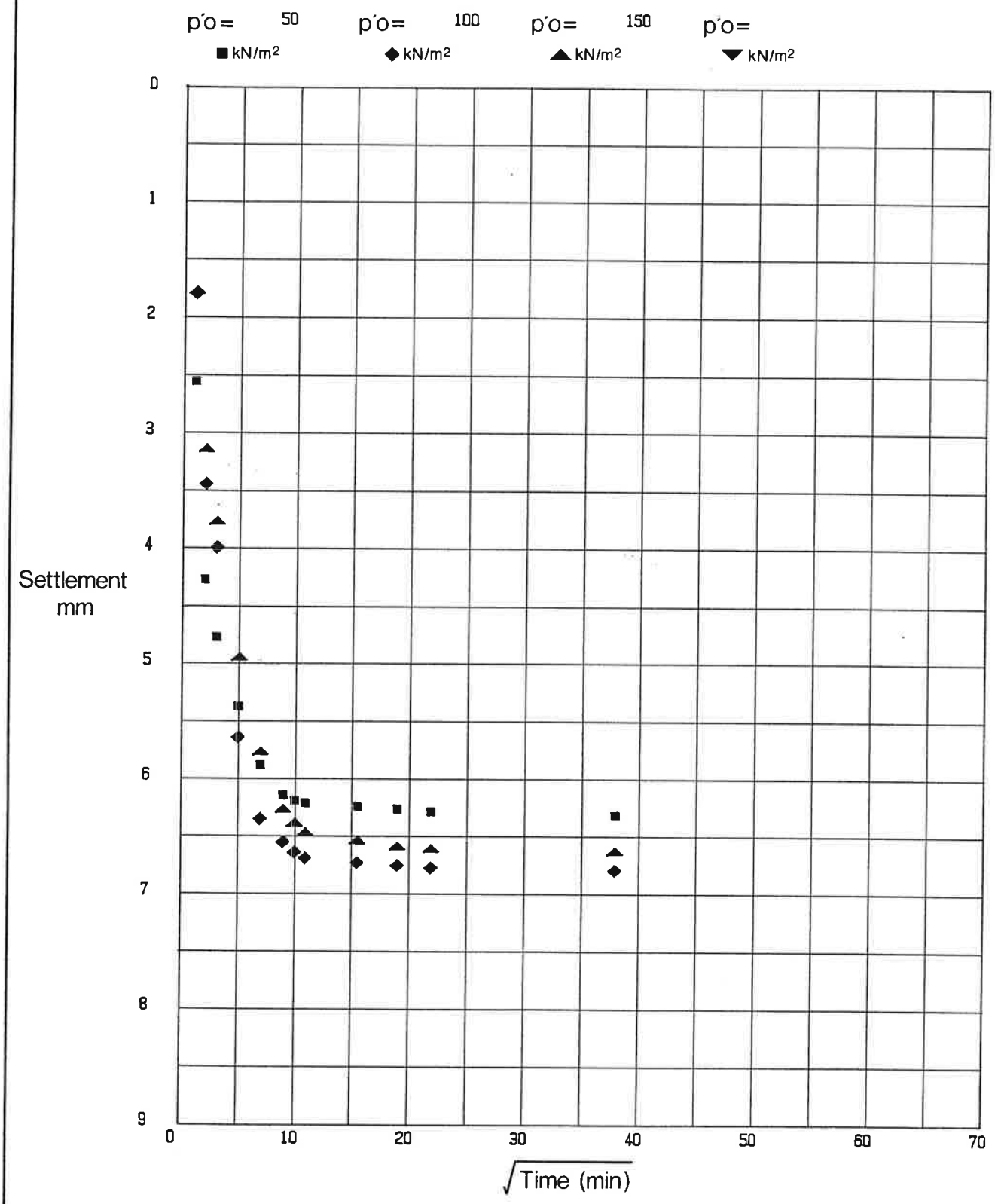
exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

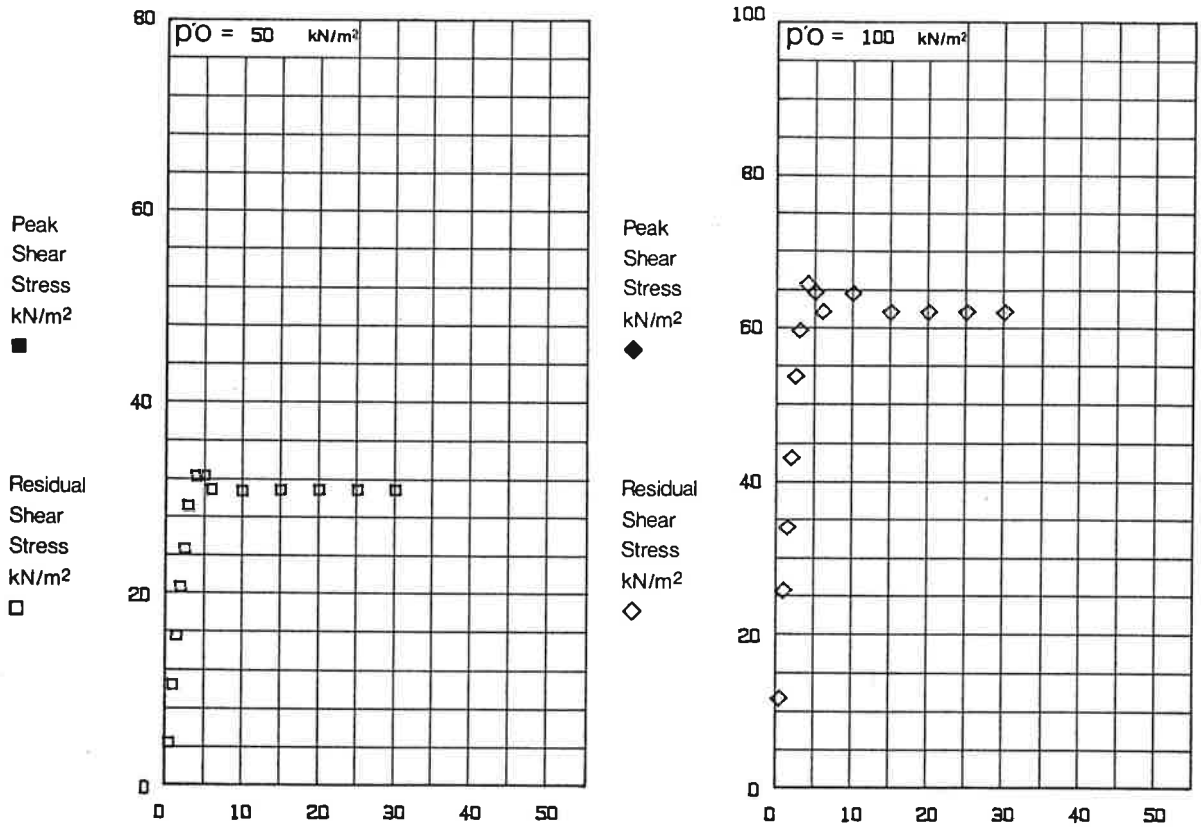
Figure

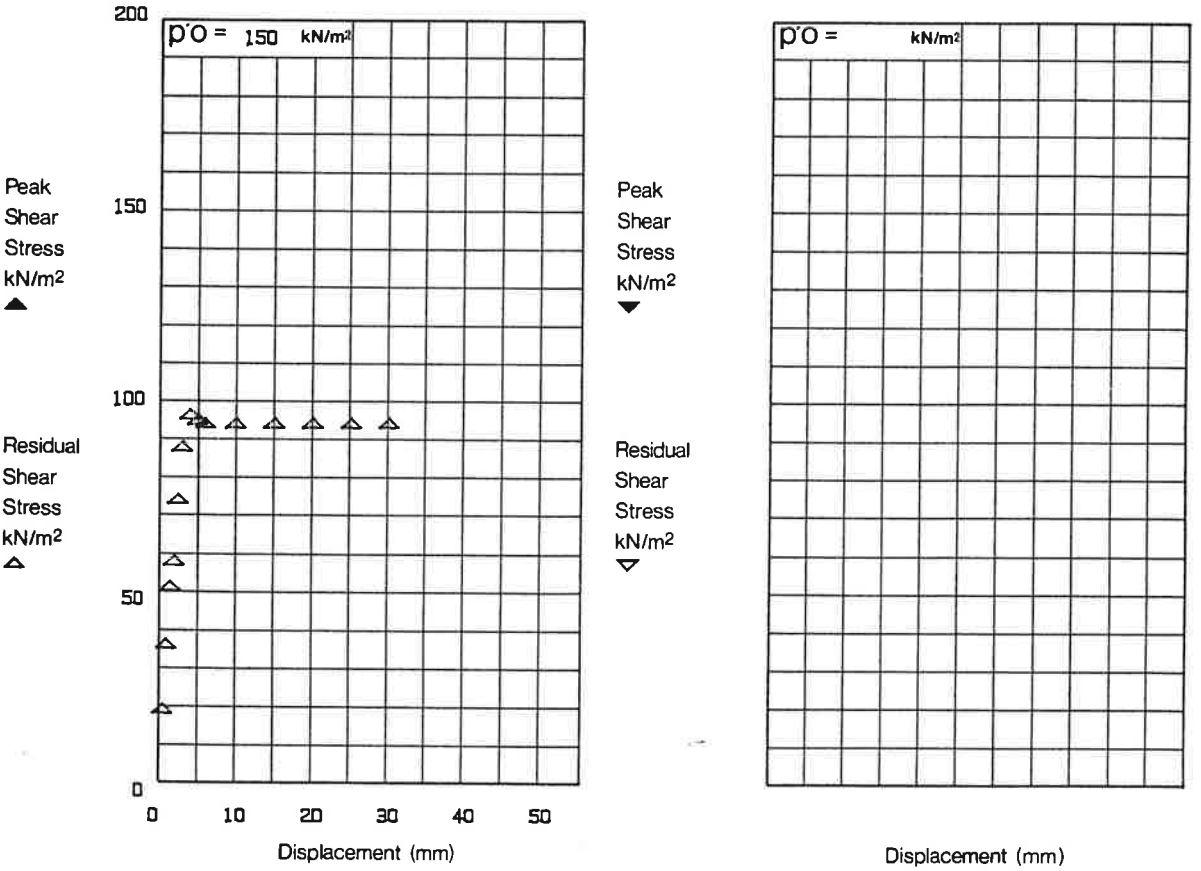
SI 9



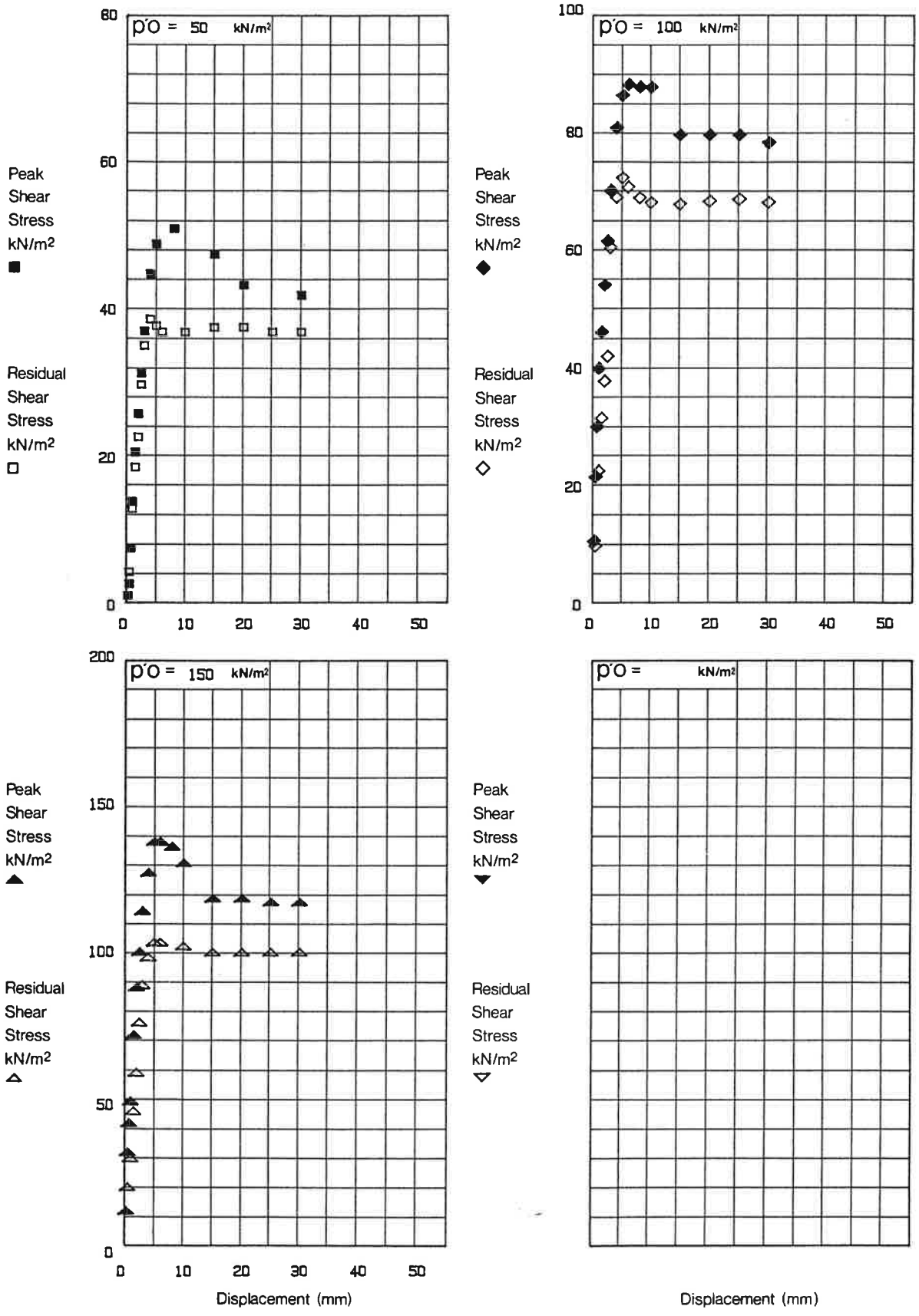
p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Initial Voids Ratio
50	186.83	0.93	5.42 x10^-8	0.432
100	108.27	0.52	1.75 x10^-8	0.44
150	87.68	0.33	9.11 x10^-9	0.432

Shear Box Settlement / √Time		Depth 1.00 (sample 1) Borehole TP9
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**



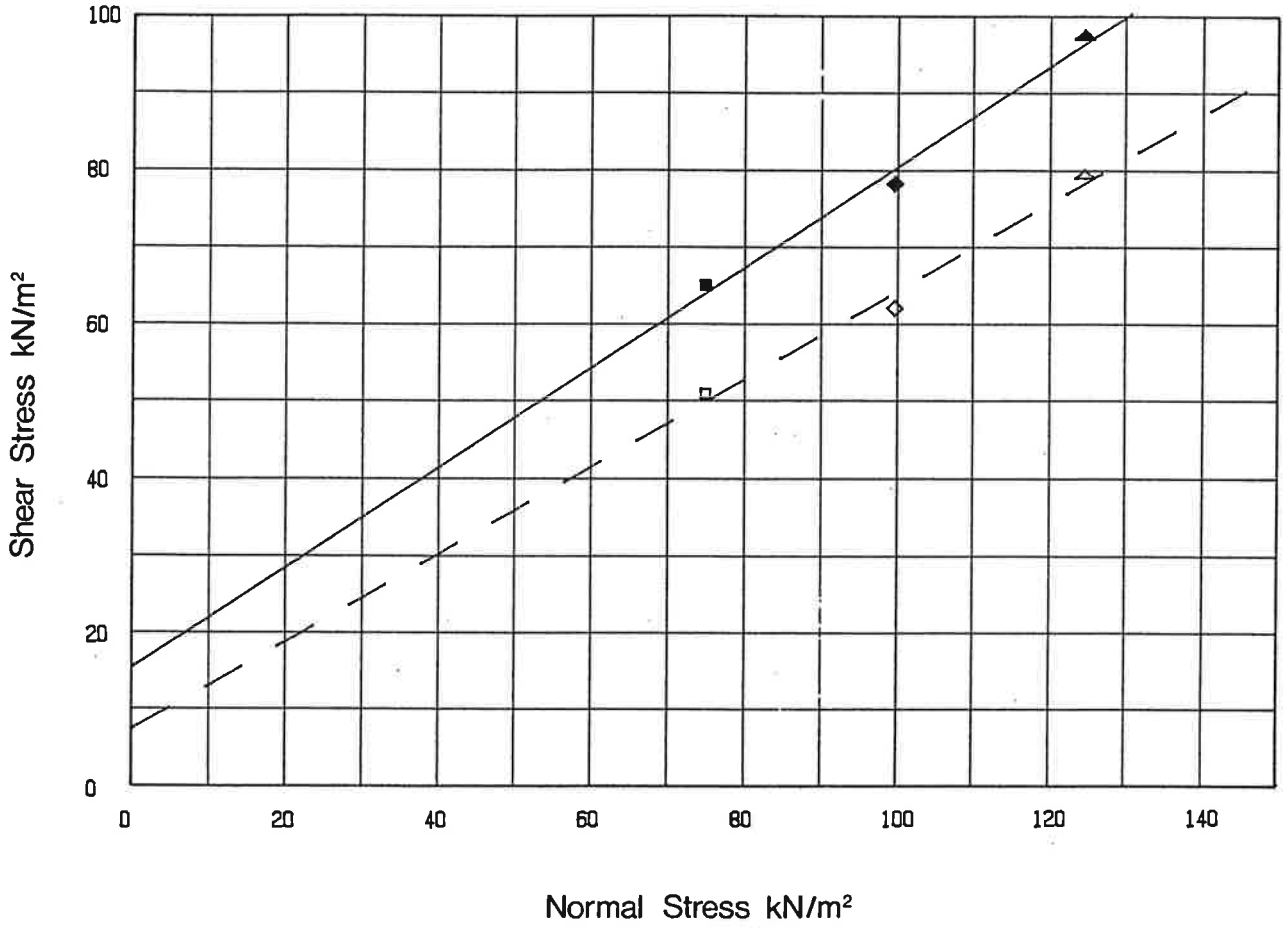


Shear Box Shear Stress / Displacement	Depth 1.00 (sample 1) Borehole TP9
Remarks * Residual value after being preformed *	
Laboratory - Effective Stress **exploration associates**	**Project** Lliw Valley Borough Council Pantteg Landslide
	Contract H9169 **Figure**



Shear Box Shear Stress / Displacement		Depth 1.00 (sample 1) Borehole TP9
Remarks * Residual Value after 5 reversals *		
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

SL10



Normal Stress	kN/m²	75	100	125	
Peak Shear Stress	kN/m²	65	78	97	
Residual Shear Stress	kN/m²	51	62	79	
Rate of Strain	mm/min	.05	.05	.05	
Strain at Peak Shear Stress	%	1.967	2.623	1.967	
Method of Residual Shear Stress Determination		Cut/Plane / Reversal			
Sample Preparation		~~Undisturbed~~ / Remoulded			

Shear Box
Drained

Description Grey fine to coarse shaley mudstone GRAVEL with occasional sandy clay.

Shear Stress / Normal Stress

c′	16	c′r	8	kN/m²
φ′	32	φ′r	29	Degrees

Depth 1.00 (sample 1)
Borehole TP10

Remarks

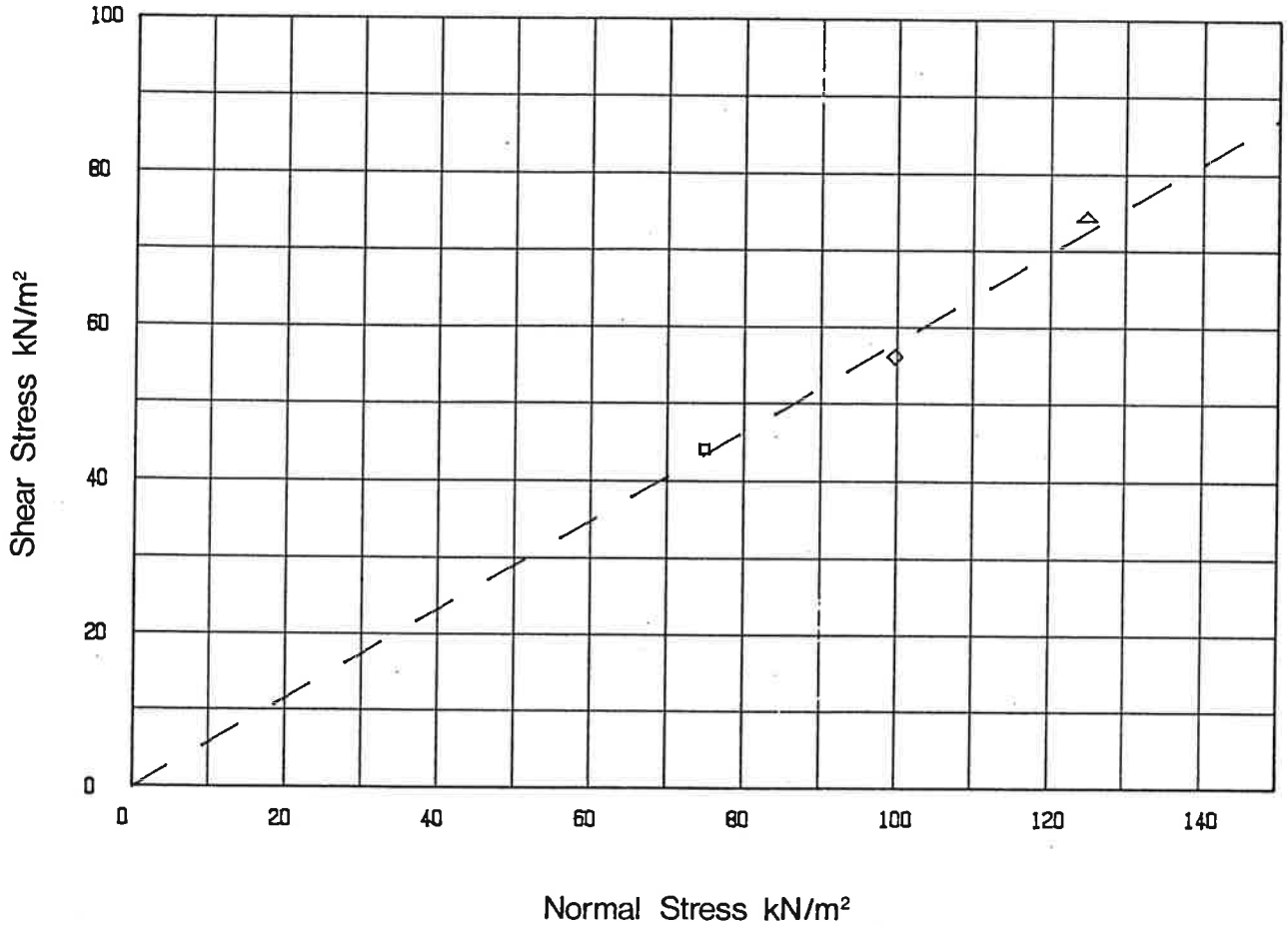
Laboratory - Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Normal Stress	kN/m²	75	100	125	
Peak Shear Stress	kN/m²				
Residual Shear Stress	kN/m²	44	56	74	
Rate of Strain	mm/min	.05	.05	.05	
Strain at Peak Shear Stress	%	1.967	2.623	1.967	
Method of Residual Shear Stress Determination		Cut Plane / ~~Reversal~~			
Sample Preparation		~~Undisturbed~~ / Remoulded			

Shear Box
Drained

Description Grey fine to coarse shaley mudstone GRAVEL with occasional sandy clay.

Shear Stress / Normal Stress

c′	cr′	0	kN/m²
ϕ′	ϕr′	30	Degrees

Depth 1.00 (sample 1)
Borehole TP10

Remarks

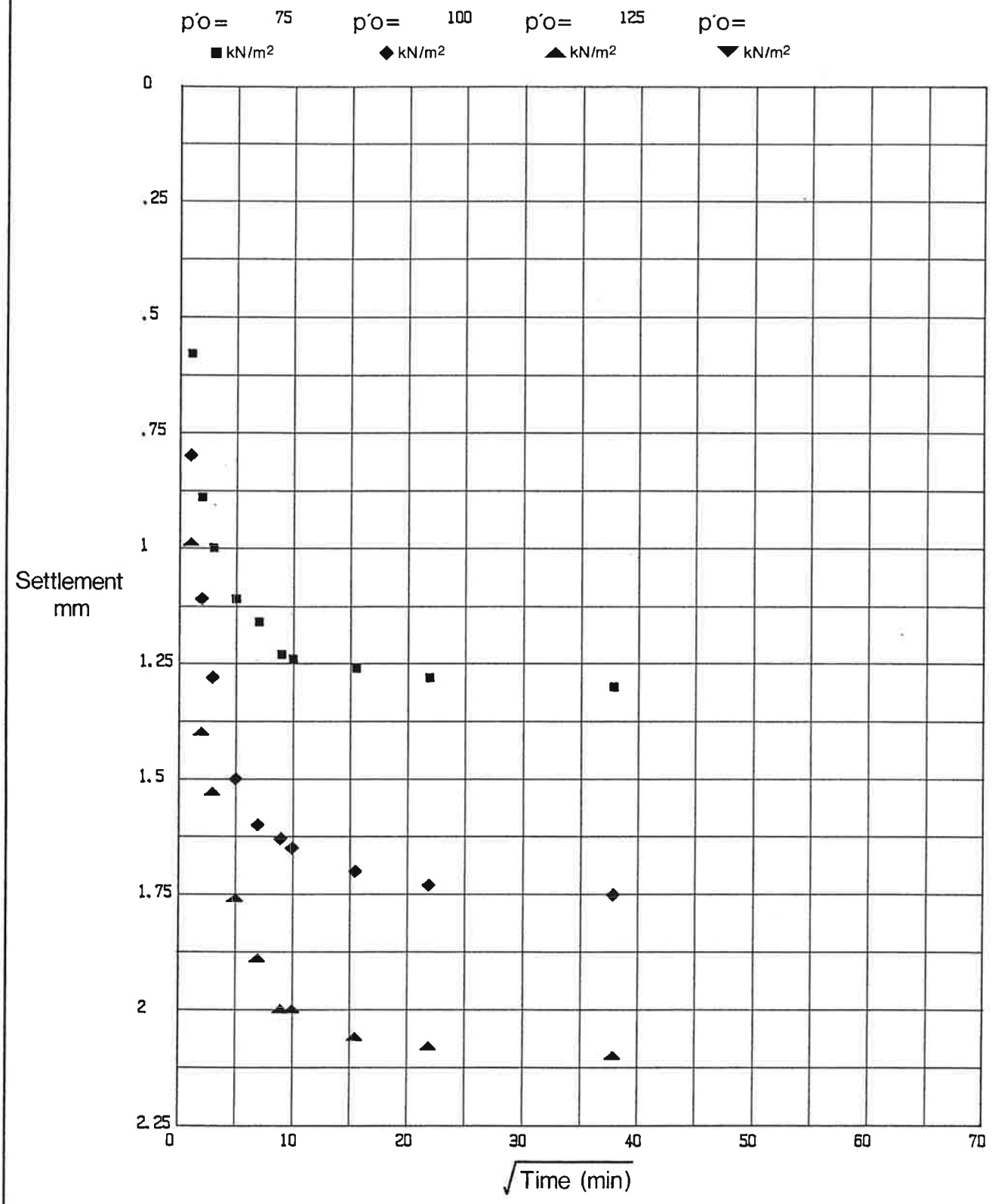
Laboratory-Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

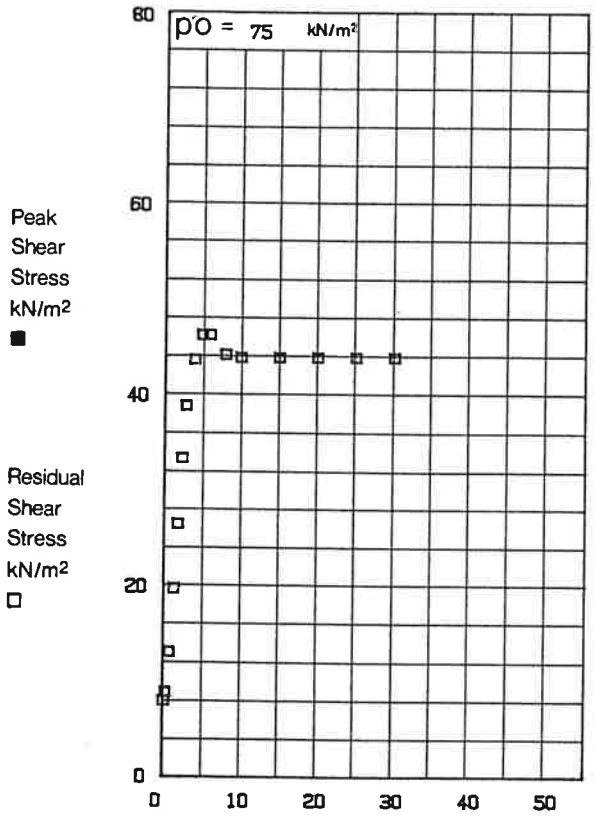
Contract H9169

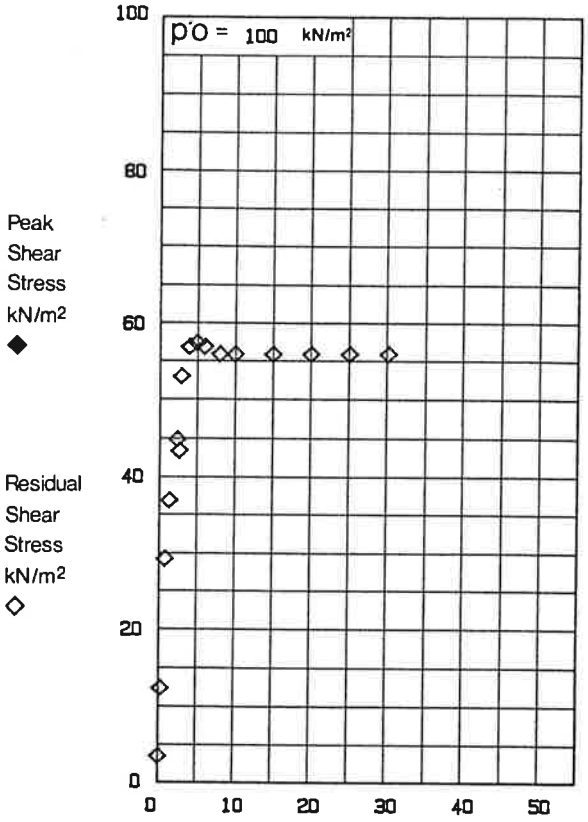
Figure

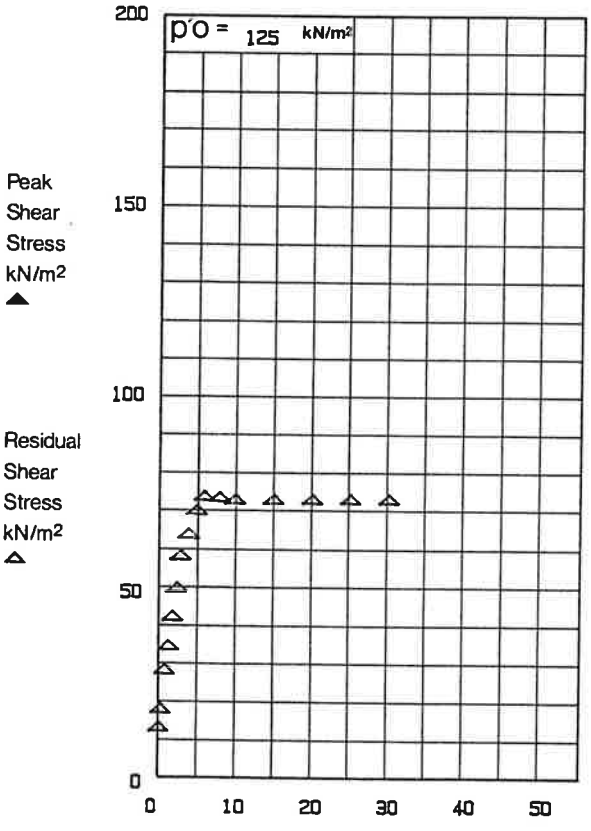


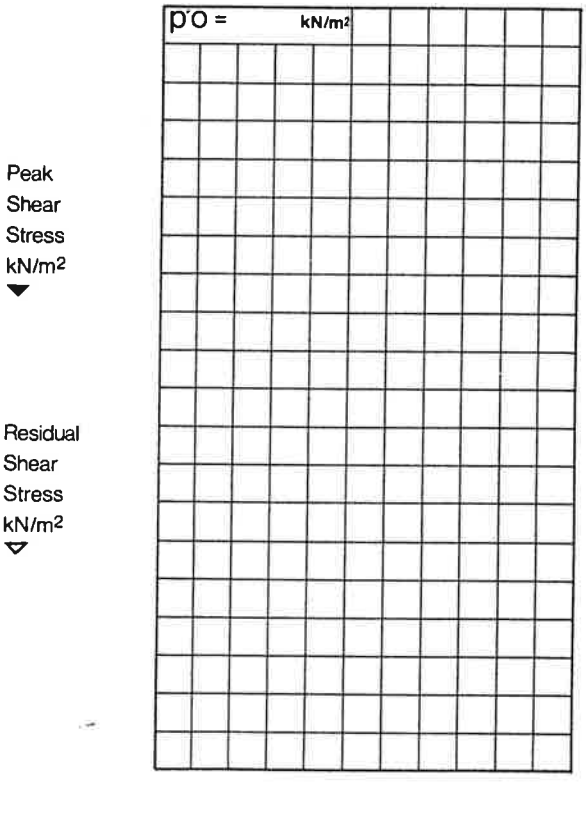
p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Initial Voids Ratio
75	171.79	0.12	6.83 x10^-9	0.373
100	123.46	0.12	4.78 x10^-9	0.358
125	157	0.11	5.67 x10^-9	0.358

Shear Box Settlement / √Time		Depth 1.00 (sample 1) Borehole TP10
Laboratory-Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

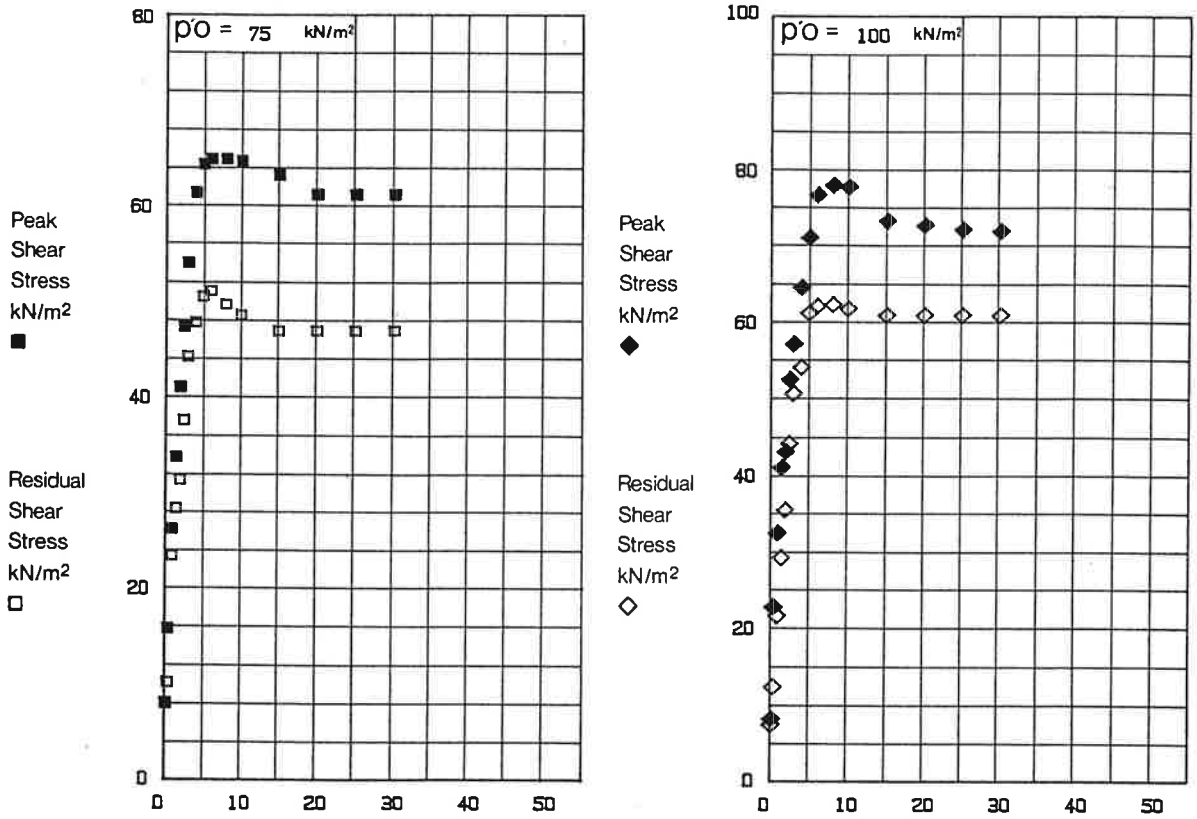


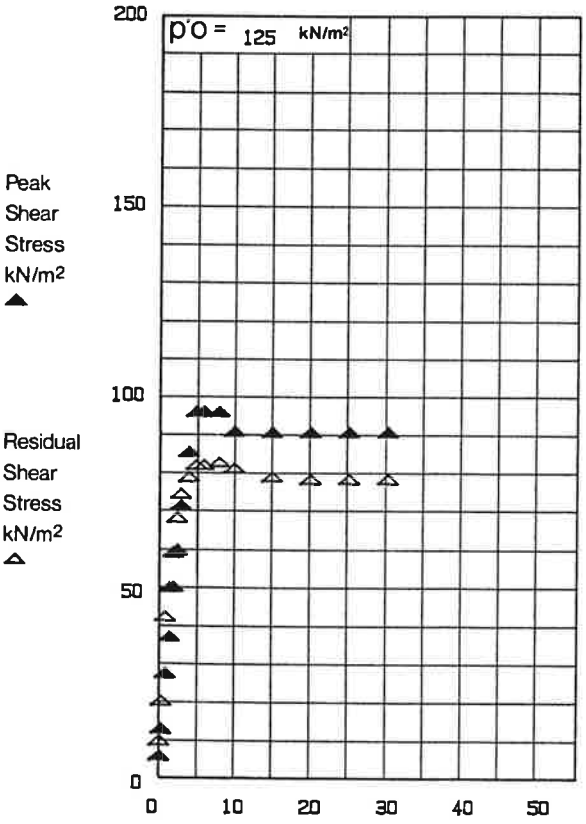


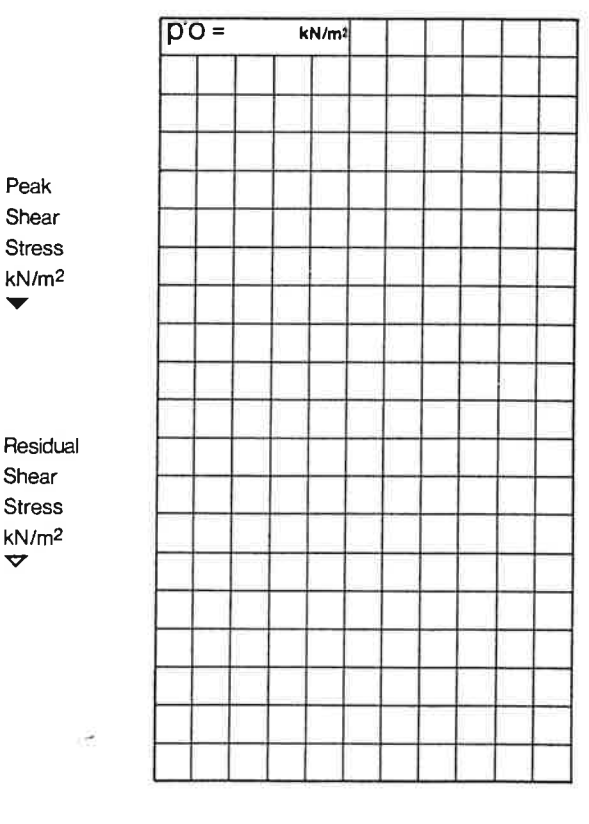




Shear Box Shear Stress / Displacement	Depth 1.00 (sample 1) Borehole TP10
Remarks * Residual value after being preformed *	
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide Contract H9169
exploration associates	**Figure**







Shear Box Shear Stress / Displacement	Depth 1.00 (sample 1) Borehole TP10
Remarks * Residual value after 5 reversals *	
Laboratory – Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide Contract H9169
exploration associates	**Figure**

SL 10

Samples				Water Content		Height		Density			Shear Strength					
Hole	Depth	Type	Description	Initial %	Final %	Initial mm	Final mm	Initial Mg/m^3	Final Mg/m^3	Dry Mg/m^3	Test	σ_1 kN/m^2	τ_f kN/m^2	c kN/m^2	ϕ°
TP9	1.00 sample 2	B	Grey brown silty slightly sandy CLAY with some fine siltstone gravel	17	18	20.00	19.25	2.04	2.13	1.74		75	73 (60) (54)*		
				16	17	20.00	18.94	2.03	2.18	1.75	REM DSB 60	150	128 (101) (86)*	28 (19)*	32 (24)*
				16	19	20.00	17.97	2.00	2.29	1.72		200	148 (116) (94)*		
TP10	1.00 sample 2	B	Dark grey fine sandstone GRAVEL with a trace of silty clay	11	18	20.00	19.37	1.99	2.17	1.79		50	80 (53)		
				14	17	20.00	18.93	2.01	2.19	1.76	REM DSB 60	125	147 (106)	40 (13)	38 (38)
				13	17	20.00	17.82	2.00	2.33	1.77		200	186 (172)		

Remarks () - Reversal Values ()* - Cut Plane Residual Values.

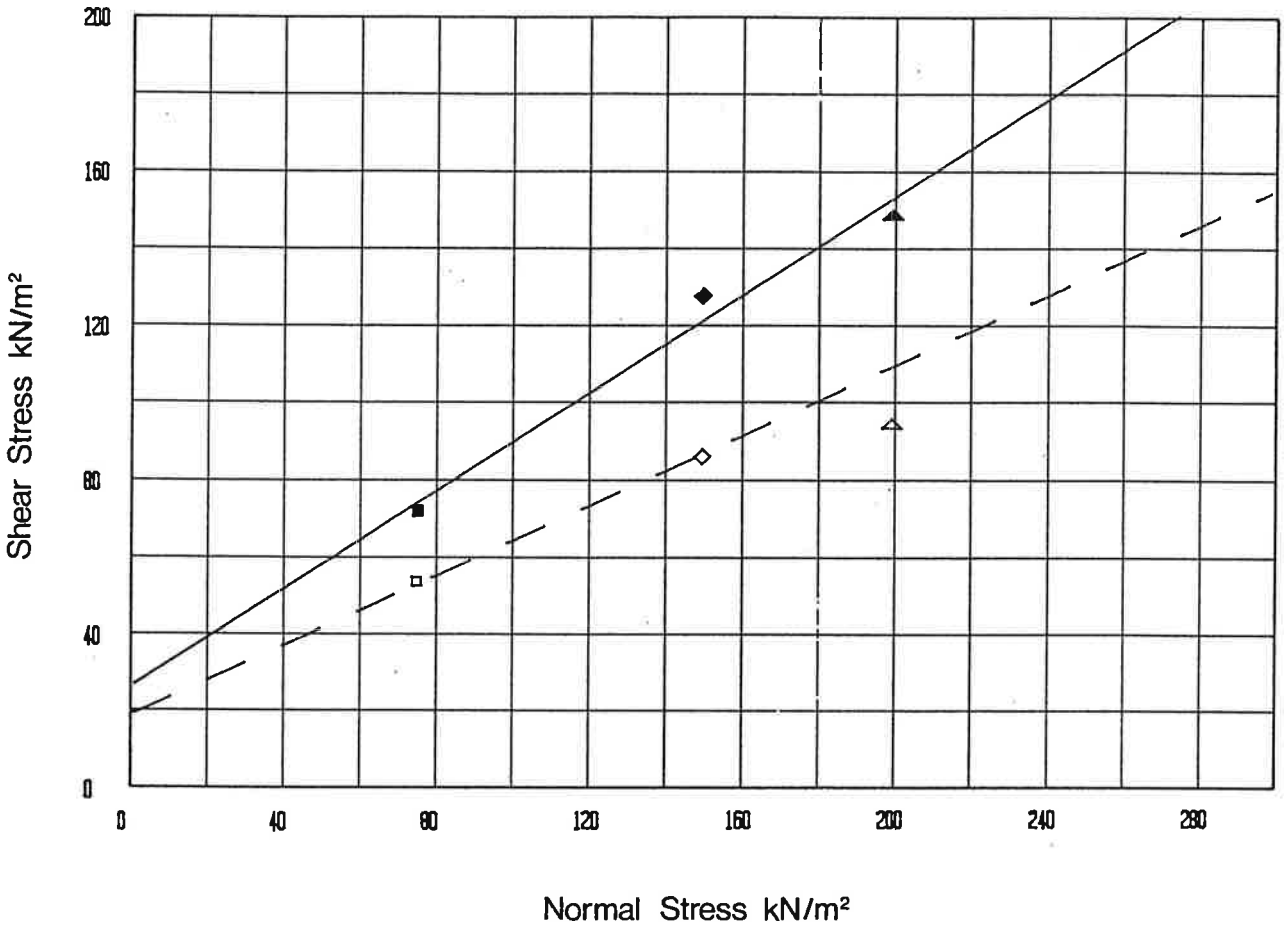
Laboratory Results– Shear Box

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract H9169

Figure



Normal Stress	kN/m²	75	150	200	
Peak Shear Stress	kN/m²	73	128	148	
Residual Shear Stress	kN/m²	54	86	94	
Rate of Strain	mm/min	.0096	.0096	.0096	
Strain at Peak Shear Stress	%	3.07	8.9	6.01	
Method of Residual Shear Stress Determination		Cut Plane / ~~Reversal~~			
Sample Preparation		~~Undisturbed~~ / Remoulded			

Shear Box
Drained

Description Silty CLAY with some fine siltstone gravel.

Shear Stress / Normal Stress

c′ 28 c′r 19 kN/m²
φ′ 32 φ′r 24 Degrees

Depth 1.00 (sample 2)
Borehole TP 9

Remarks Residual shear stress determination by both reversal and cut plane methods.

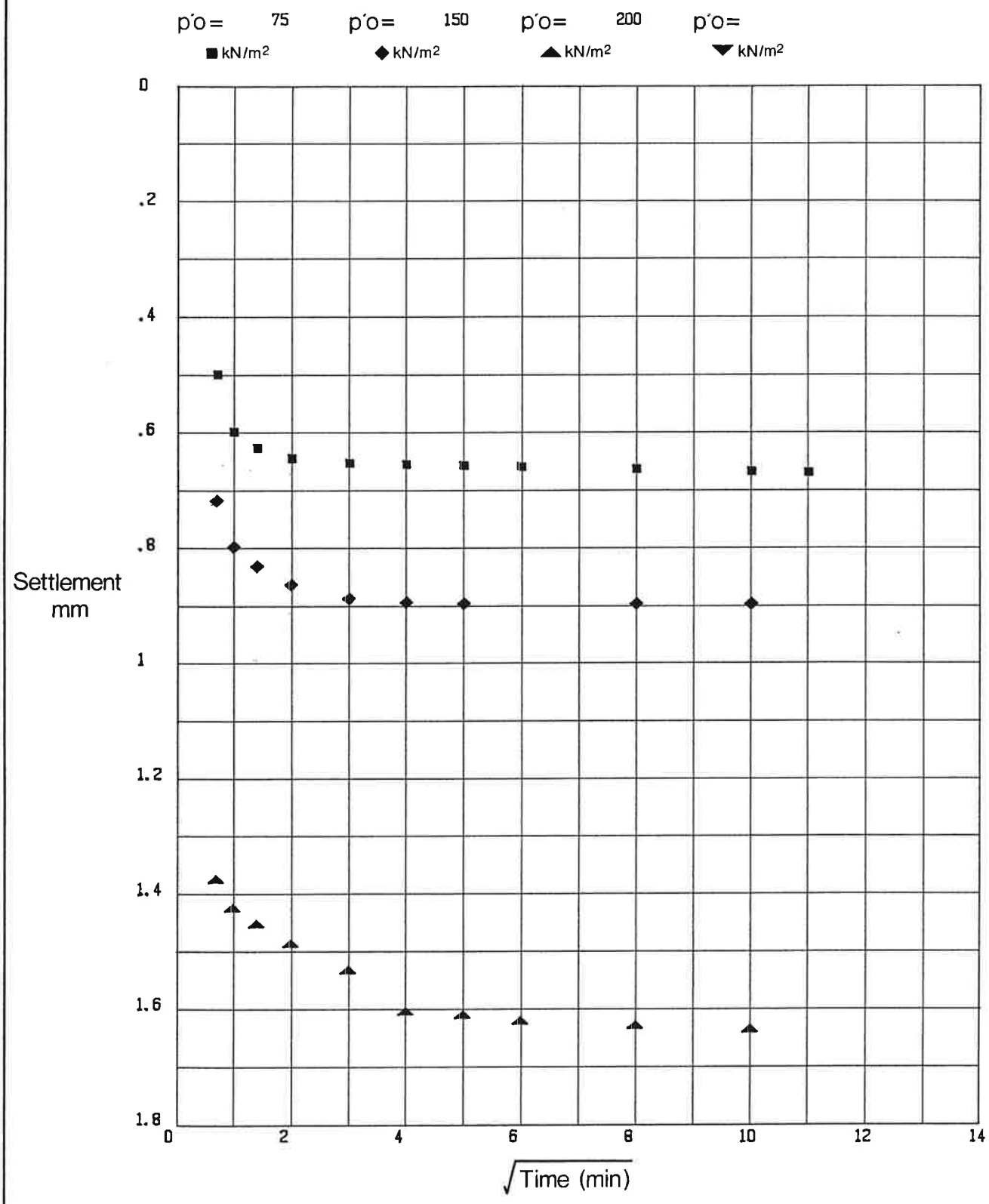
Laboratory - Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

Contract
H9169

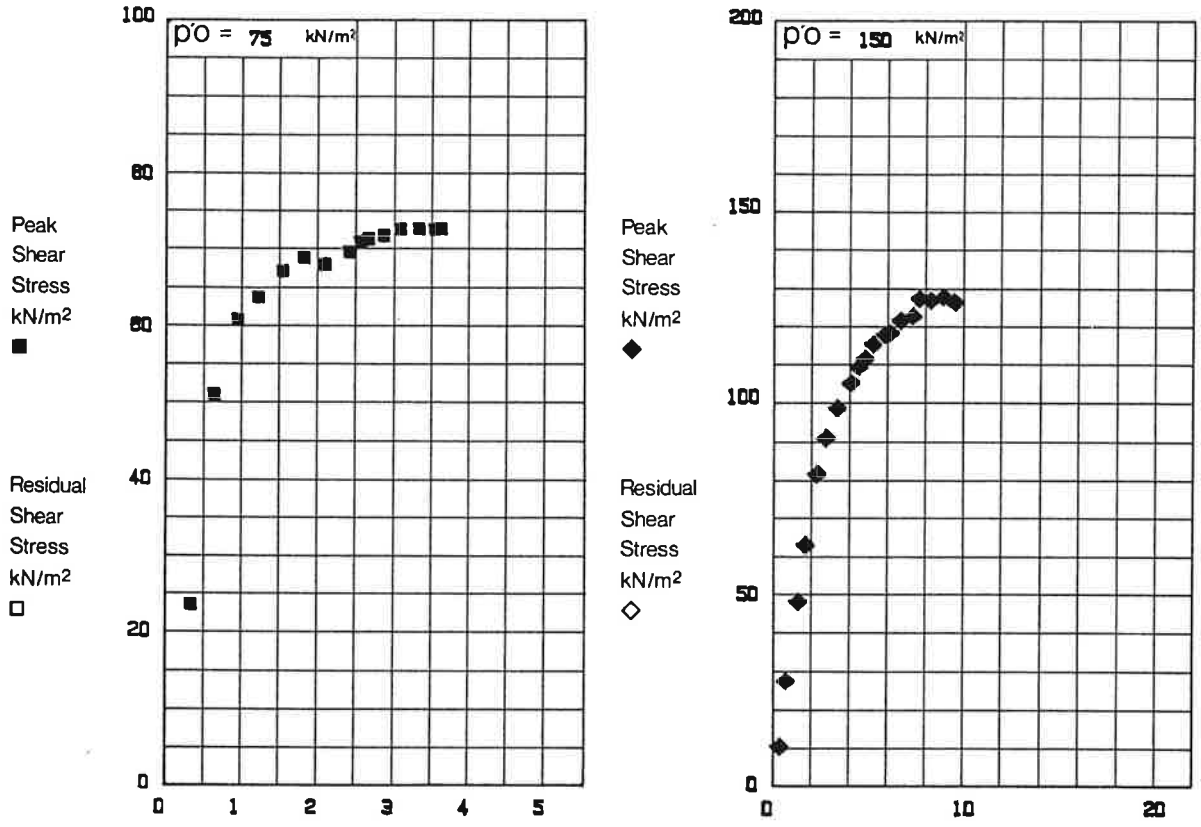
Figure

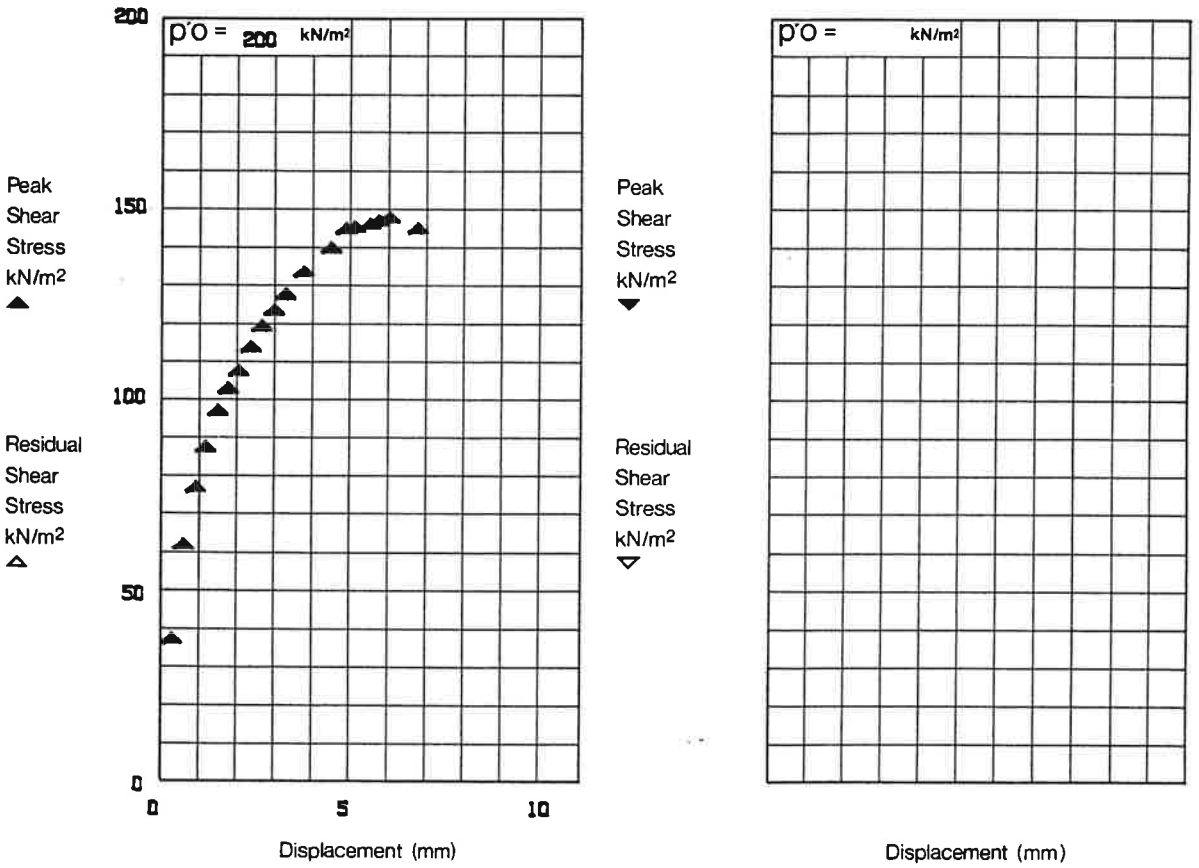


p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Initial Voids Ratio
75	10.04	0.44	1.39 x10^-9	0.522
150	6.86	0.29	6.3 x10^-10	0.514
200	2.16	0.41	2.7 x10^-10	0.54

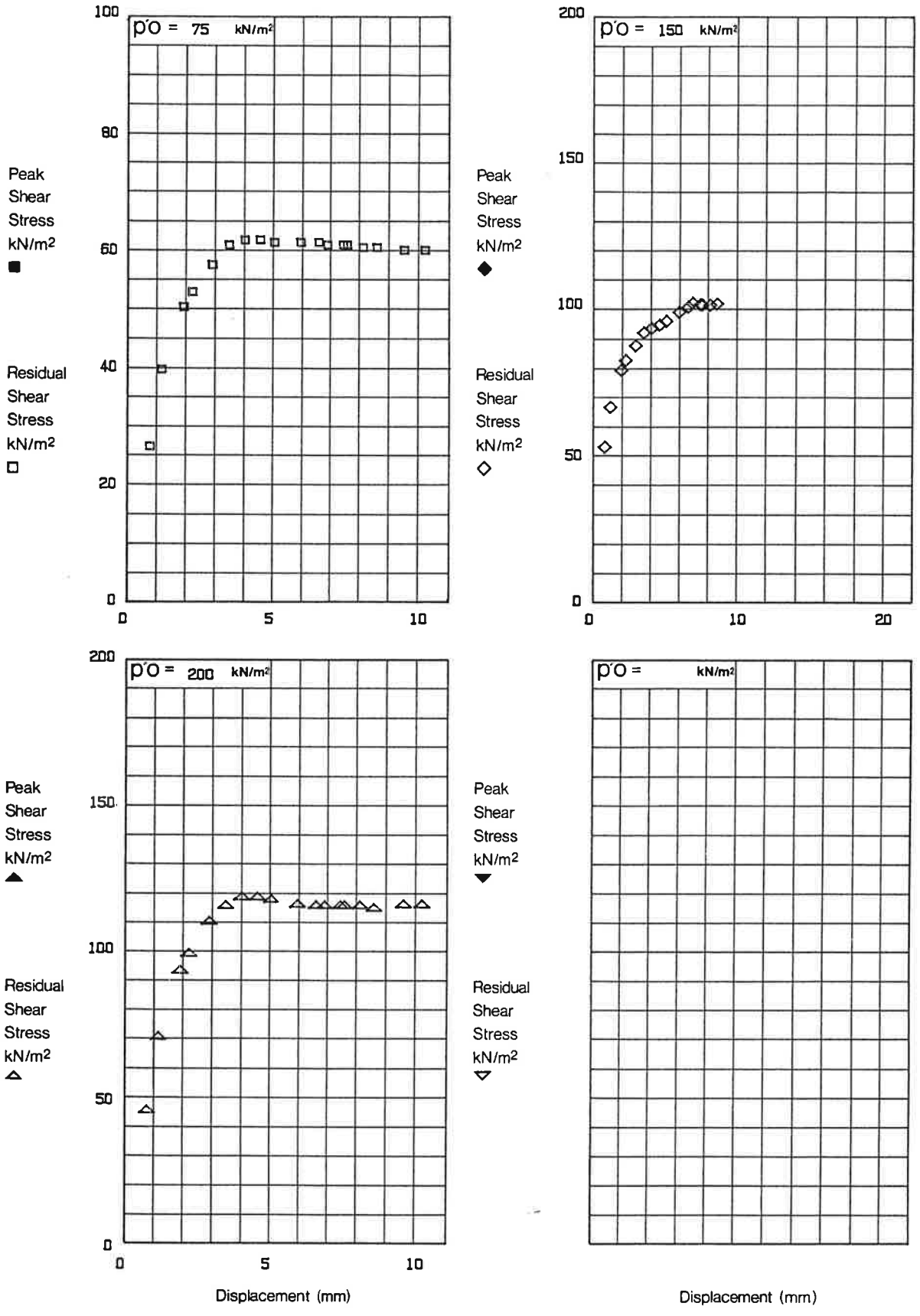
Shear Box Settlement / √Time		Depth 1.00(sample 2) Borehole TP 9
Laboratory–Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

SL11



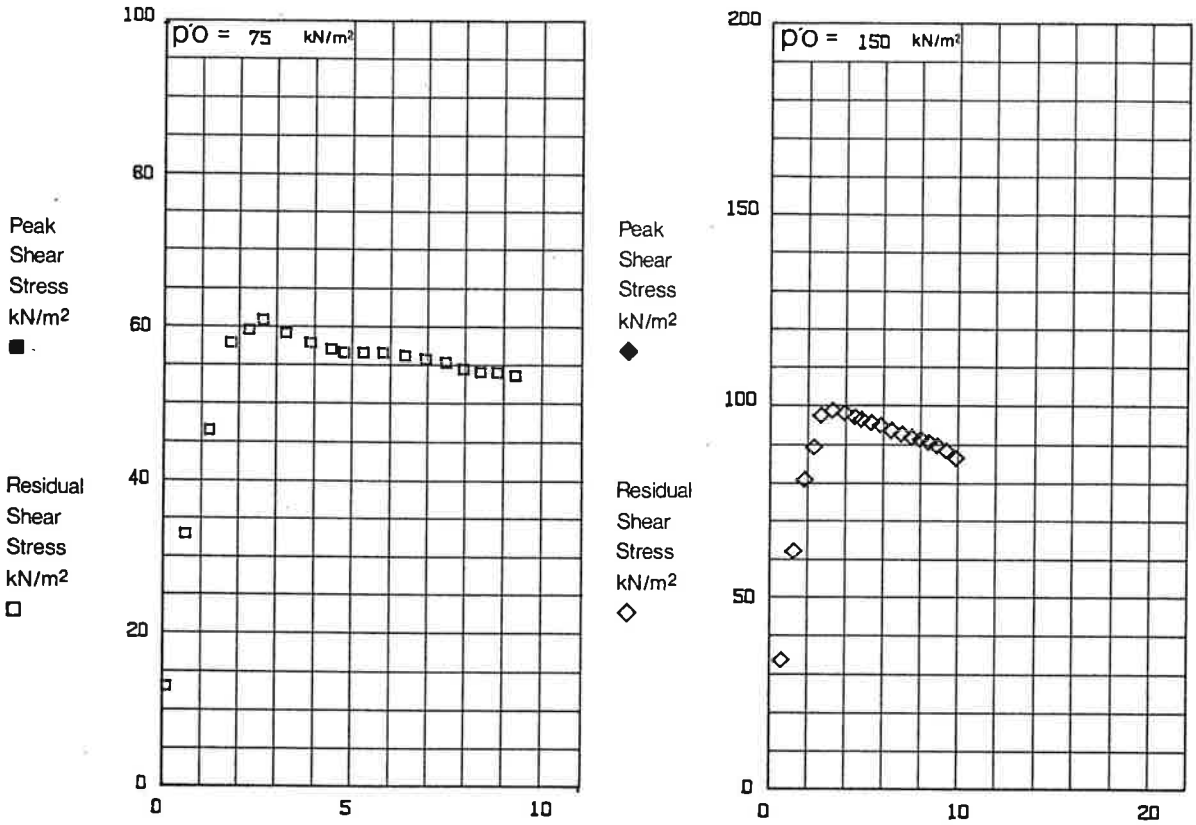


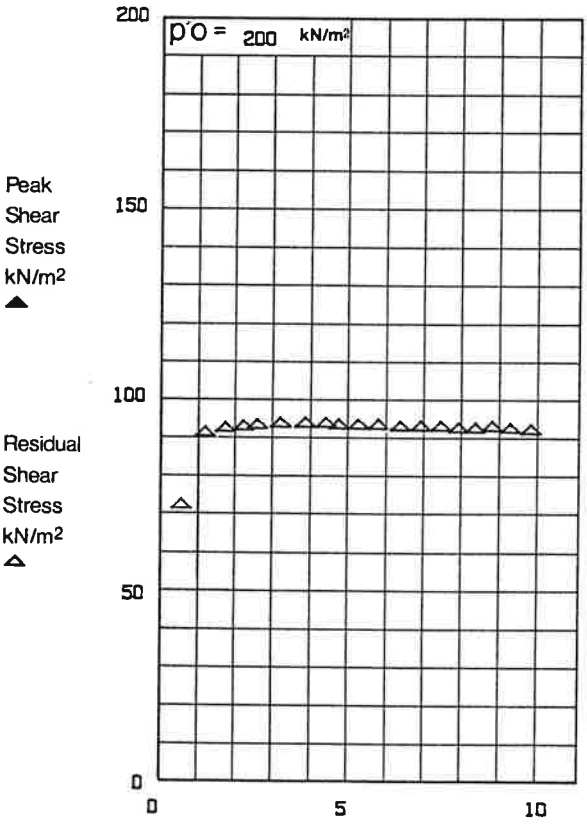
Shear Box Shear Stress / Displacement	Depth 1.00 (sample 2) Borehole TP 9
Remarks	
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide
exploration associates	Contract H9169
	Figure

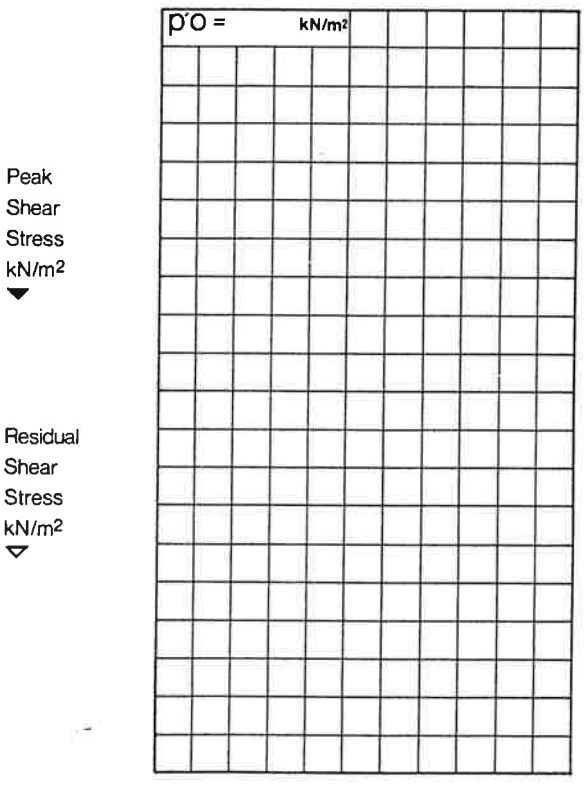


Shear Box Shear Stress / Displacement		Depth 1.00 (sample 2) Borehole TP 9
Remarks Reversal stage.		
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

SL10

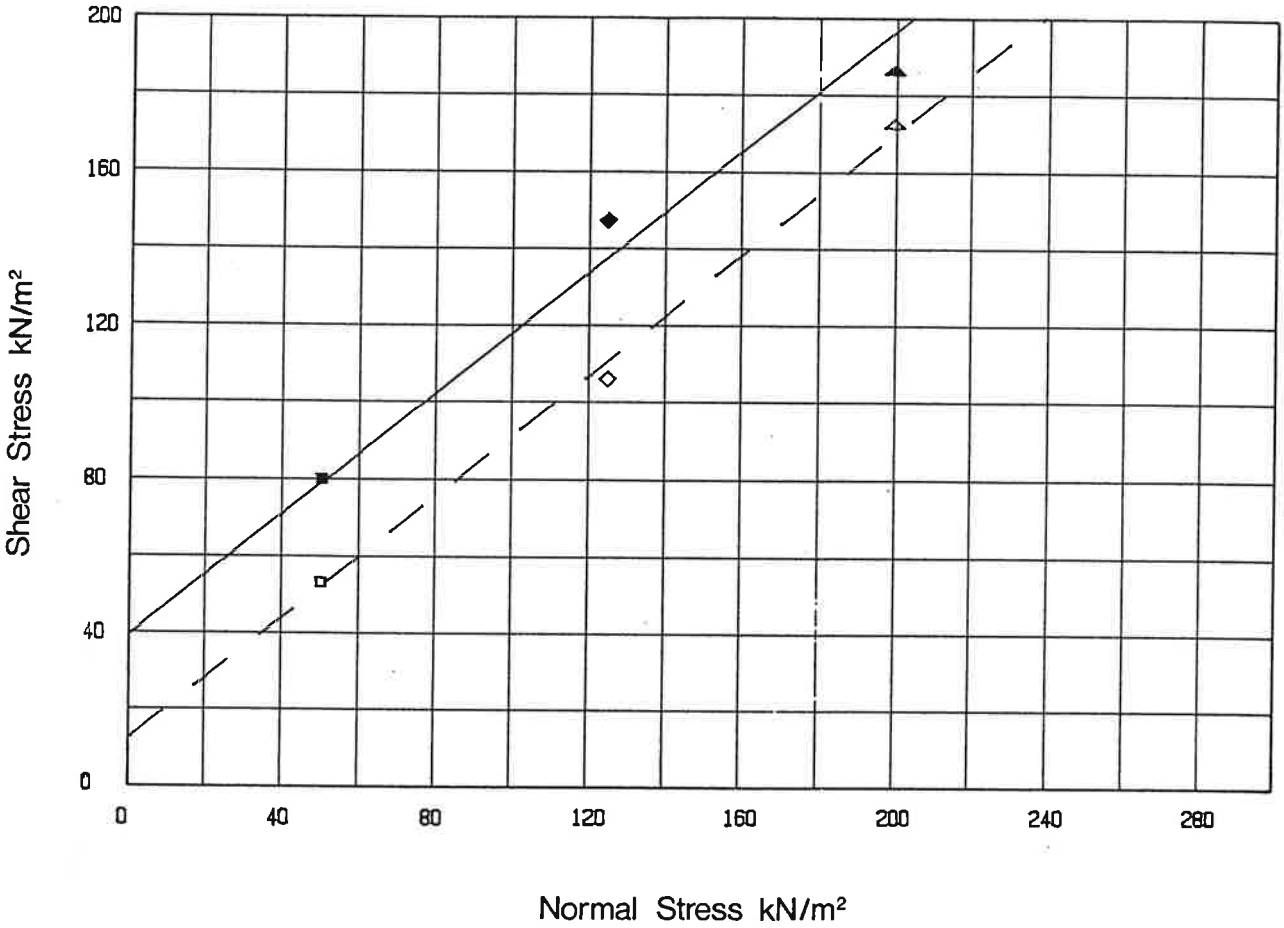






Shear Box Shear Stress / Displacement	Depth / Borehole: 1.00 (sample 2) TP 9
Remarks Cut plane residual stage.	
Laboratory - Effective Stress	**Project**: Lliw Valley Borough Council, Pantteg Landslide; Contract: H9169
exploration associates	**Figure**

SL 10



Normal Stress	kN/m²	50	125	200	
Peak Shear Stress	kN/m²	80	147	186	
Residual Shear Stress	kN/m²	53	106	172	
Rate of Strain	mm/min	.024	.024	.024	
Strain at Peak Shear Stress	%	3.07	5.11	3.95	
Method of Residual Shear Stress Determination		Multiple / Reversal			
Sample Preparation		Undisturbed / Remoulded			

Shear Box
Drained

Description: Remoulded fine SANDSTONE GRAVEL with a trace of silty clay.

Shear Stress / Normal Stress

c' 40 $c'r$ 13 kN/m²
ϕ' 38 $\phi'r$ 38 Degrees

Depth 1.00 (sample 2)
Borehole TP 10

Remarks Residual shear stress determination by reversal method only.

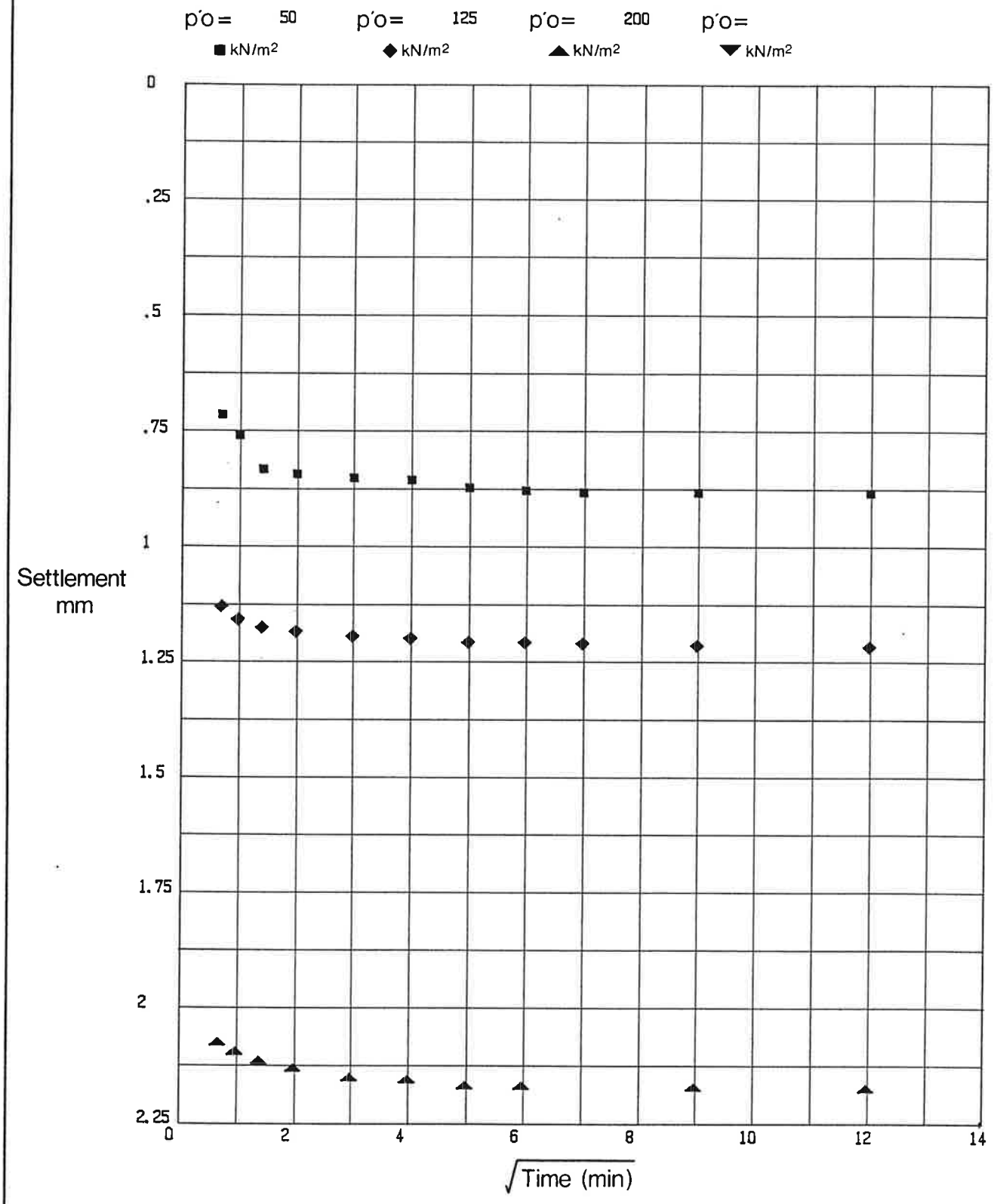
Laboratory - Effective Stress

exploration associates

Project
Lliw Valley Borough Council
Pantteg Landslide

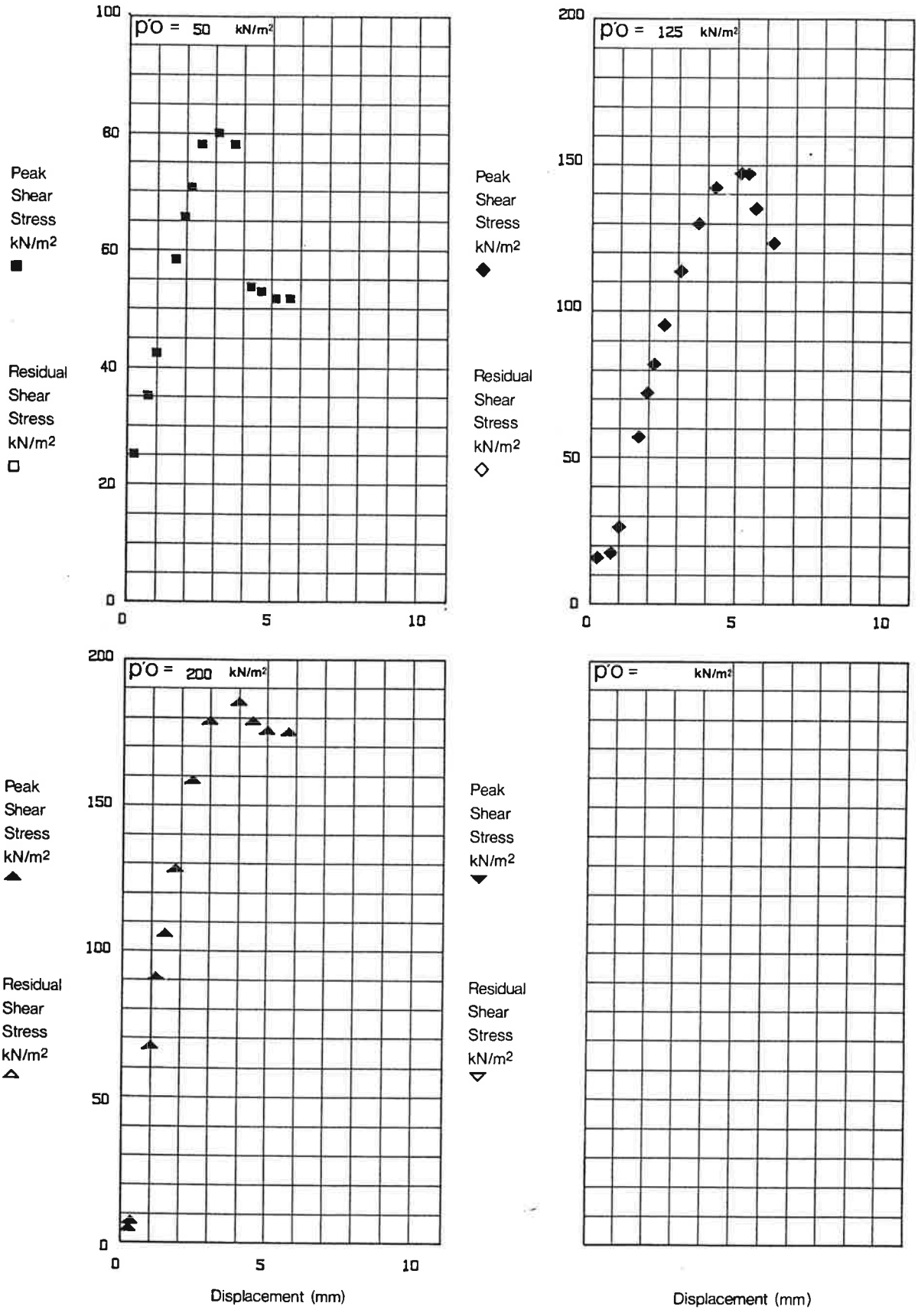
Contract H9169

Figure



p'o kN/m²	Cv m²/year	Mv m²/MN	k m/sec	Initial Voids Ratio
50	14.26	0.88	3.89 x10^-9	0.48
125	47.8	0.48	7.2 x10^-9	0.505
200	49.6	0.54	8.37 x10^-9	0.497

Shear Box Settlement / √Time		Depth 1.00(sample 2) Borehole TP 10
Laboratory-Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**



Shear Box Shear Stress / Displacement

Depth 1.00 (sample 2)
Borehole TP 10

Remarks

Laboratory - Effective Stress

exploration associates

Project

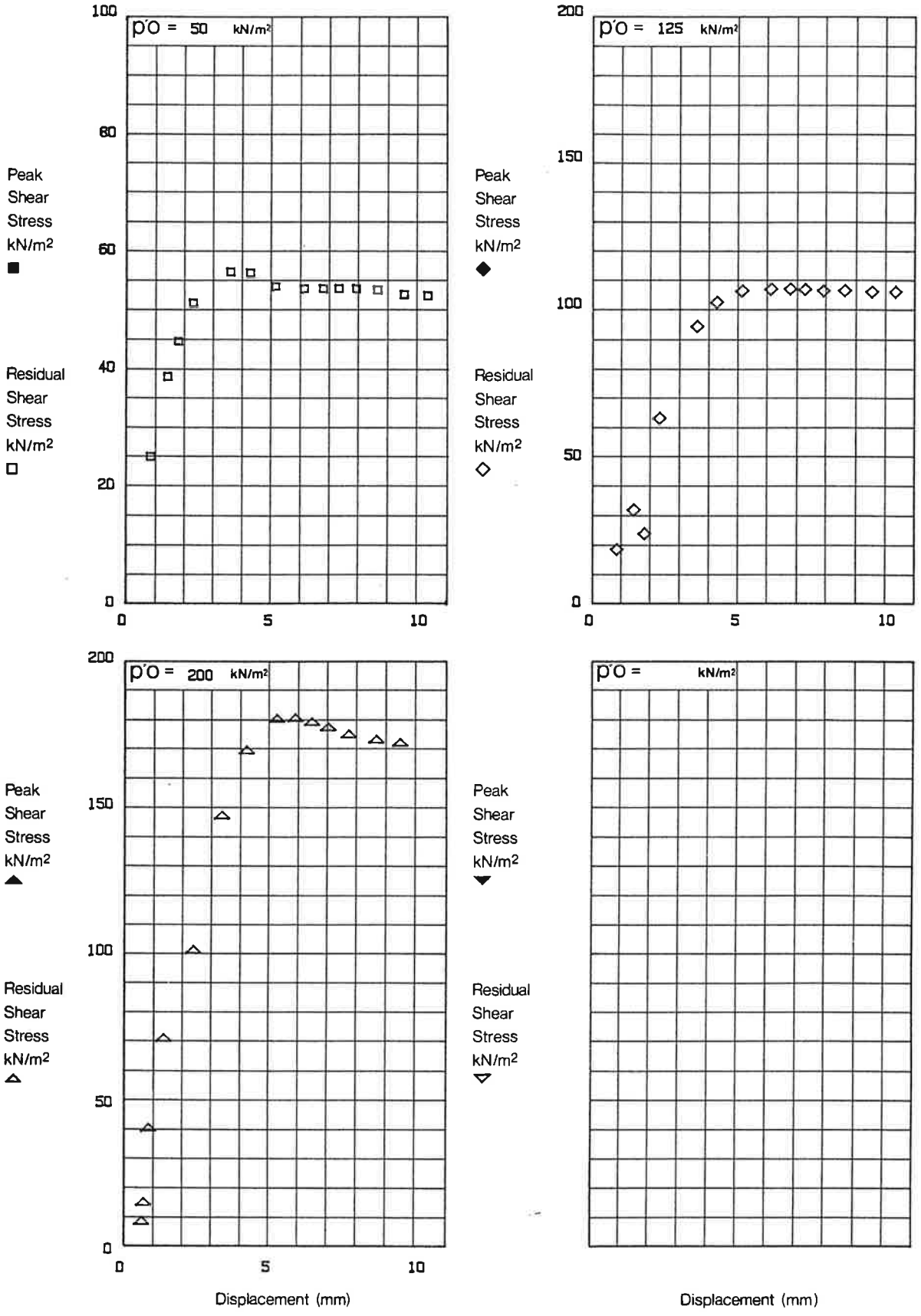
Lliw Valley Borough Council

Pantteg Landslide

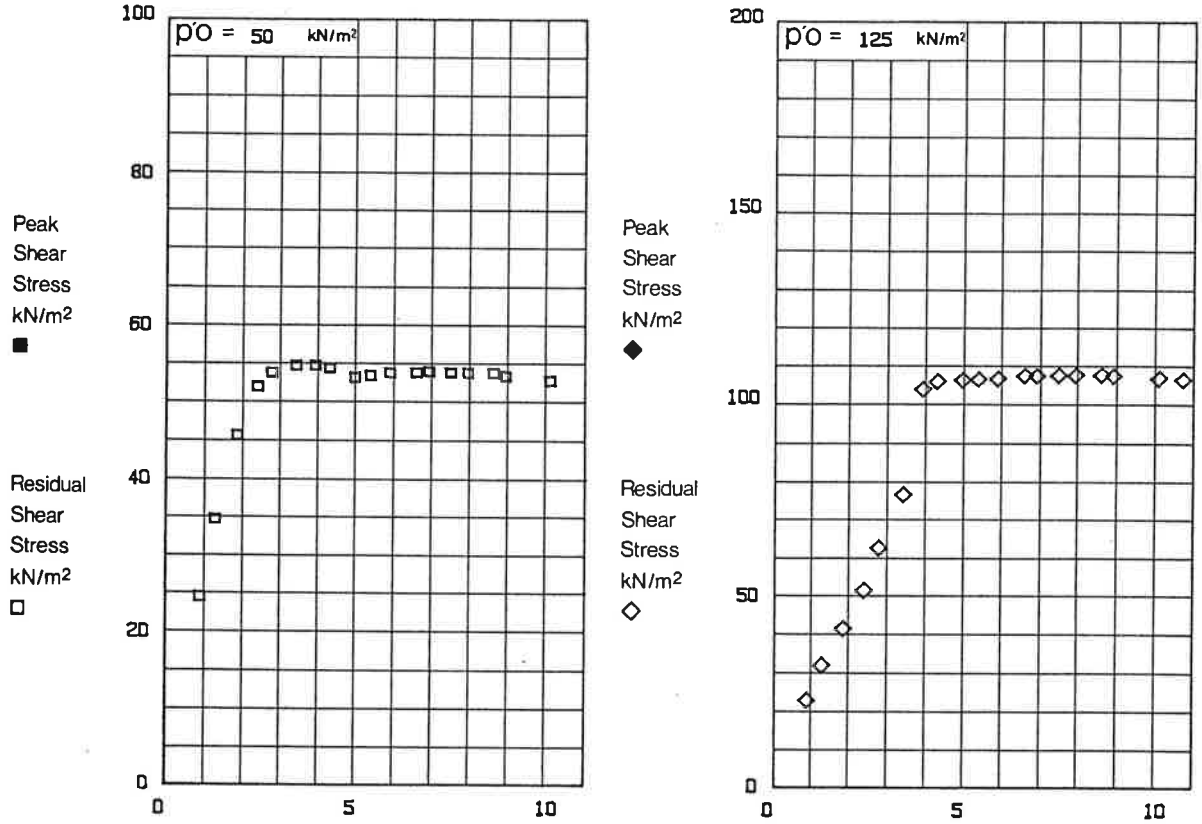
Contract H9169

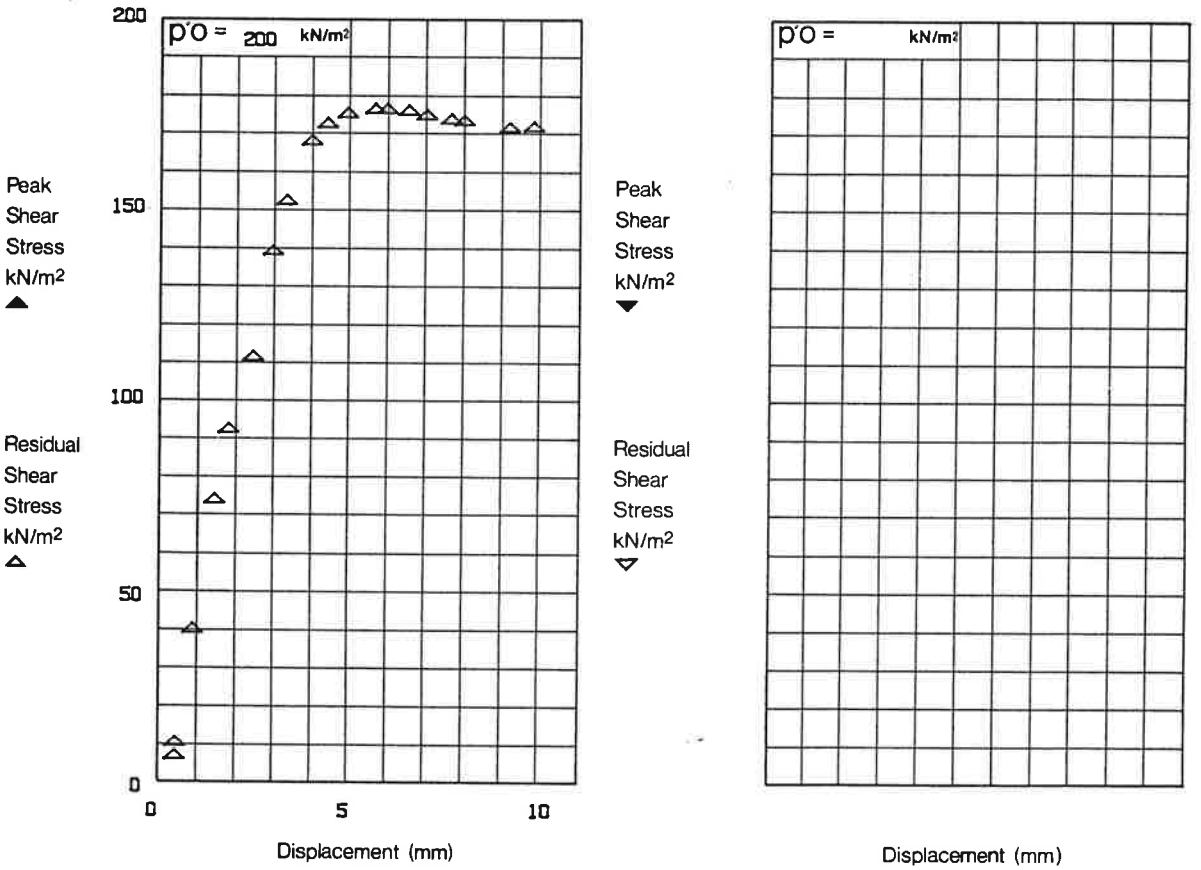
Figure

SL10



Shear Box Shear Stress / Displacement	Depth 1.00 (sample 2) Borehole TP 10
Remarks 1st reversal stage.	
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide Contract H9169
exploration associates	**Figure**



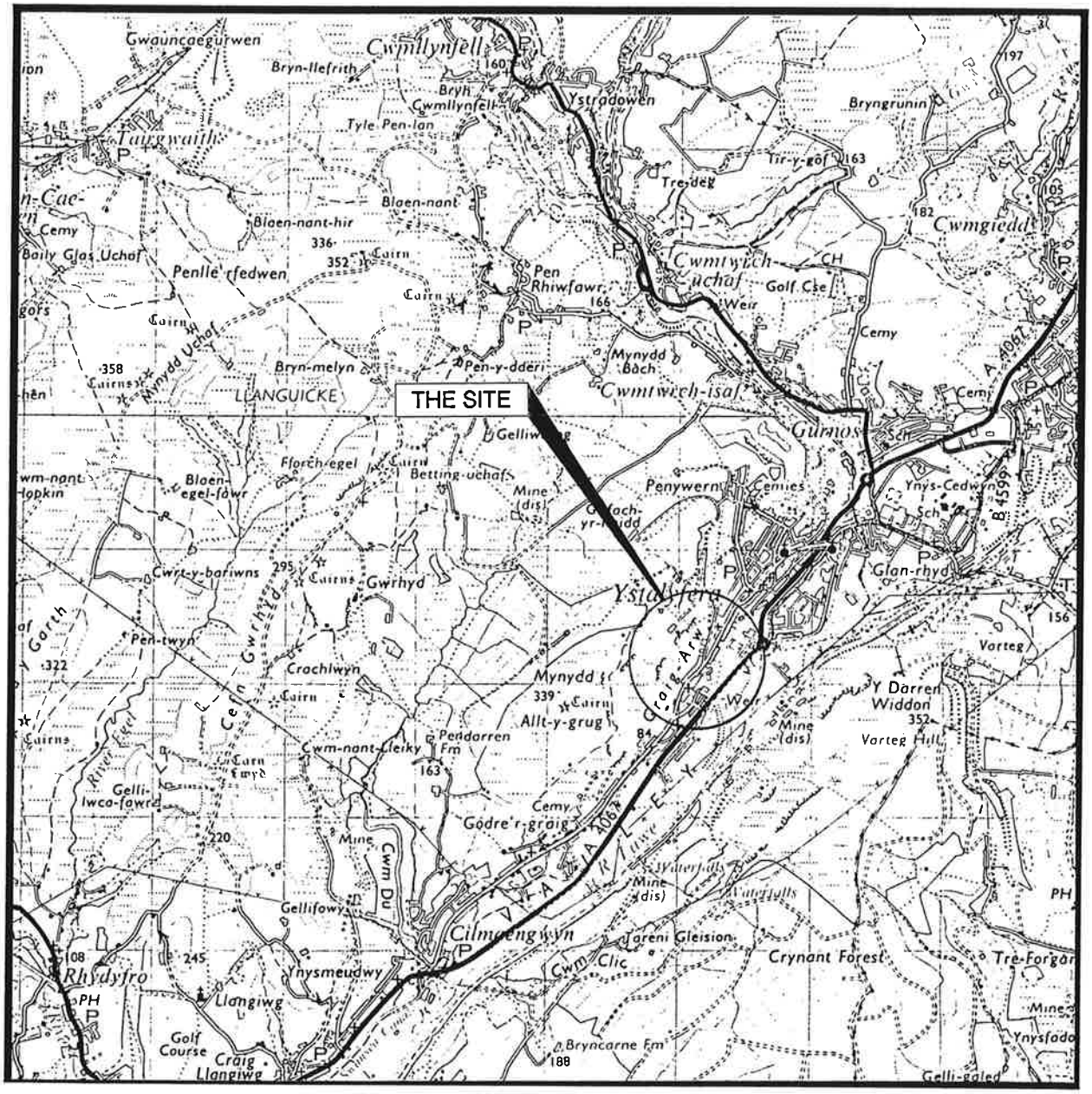


Shear Box Shear Stress / Displacement		Depth 1.00 (sample 2) Borehole TP 10
Remarks 2nd reversal stage.		
Laboratory - Effective Stress	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

ENCLOSURE C

Drawings

i) Site Location Plan
ii) Borehole Location Plan



Scale 1:50,000

Site Location Plan	**Project** Lliw Valley Borough Council Pantteg Landslide	Contract H9169
Exploration Associates		**Drawing** 1

ENCLOSURE D

General Notes

GENERAL NOTES

1. The comments given in this report and the opinions expressed are based on the ground conditions encountered in the boreholes together with the results of field and laboratory tests. There may be however, special conditions at the site which have not been revealed by the boring and which have not therefore been taken into account in this report.

2. The comments on the ground water conditons are based on observations made at the time of the investigation, unless otherwise stated. It should be noted, however, the ground water levels vary due to seasonal or other effects.

	Project Lliw Valley Borough Council Pantteg Landslide	Contract H9169
exploration associates		**Figure**

Contours produced photogrammetrically by Engineering Surveys Ltd , based on aerial photographs by Clyde Surveys Ltd , dated September 1972
BH 1
BH 2
BH 3
BH 5
A 4068
CHURCH ROAD
NEW STREET
Pantteg
Pantteg Canal
Hall
Ruin
Drain
Fountain
Pontypridd Road
Pontypridd Cannon Terrace
Swansea
TO GLANYRAVON
LLIW VALLEY BOROUGH COUNCIL
PANTTEG LANDSLIDE
GROUND INVESTIGATION
DRG No 2
SCALE 1:2500
Sir William Halcrow & Partners Ltd.
Consulting Engineers.
25 Windsor Place,
Cardiff CF1 3BZ

Appendix B

Trial Pit Records – Pantteg Village and Cwar Pen-y-Graig Areas

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP301

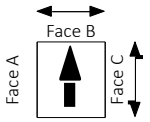
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 27/07/2017
Backfill date: 27/07/2017
Logged by: AW

Survey details:

Ground Level: 100.7 mOD
Easting: 276063 mE
Northing: 208019 mN
Bearing:

Plan details:



Face Stability:

Poor side wall stability from 1.9m to the base.

Groundwater observations:

Slow at 3m on the northern wall.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Grass surface over probably loose to medium dense brown gravelly clayey SAND with roots. Gravel is fine to coarse subrounded to subangular sandstone, with a low subrounded sandstone cobble content. (Placed TOPSOIL)	(0.35)		
					Probably medium dense dark brown clayey sandy GRAVEL. Gravel is medium to coarse, occasionally tabular, sandstone with occasional brick fragments. (MADE GROUND)	0.35 (0.15)	100.37	
					Probably medium dense red brown sandy GRAVEL with pockets of medium to coarse sand. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. (MADE GROUND)	0.50 (0.15)	100.22	
					Probably medium dense dark brown clayey sandy GRAVEL. Gravel is medium to coarse, occasionally tabular, sandstone with occasional brick fragments. (MADE GROUND)	0.65 (0.10)	100.07	
					Probably medium dense red brown sandy GRAVEL with pockets of medium to coarse sand. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. (MADE GROUND)	0.75 (0.25)	99.97	
					Probably dense brown sandy gravelly BOULDERS of tabular angular to subrounded mudstone and sandstone. (MADE GROUND - Possible demolition backfill)	1.00 (0.40)	99.72	
					Probably medium dense to dense brown mottled orange and grey clayey silty sandy GRAVEL with medium cobble and boulder content. Gravel, cobbles and boulders are angular siltstone, mudstone and sandstone with occasional fine angular coal. (Probable COLLUVIUM)	1.40 (1.60)	99.32	
2.00	B					2.0		
2.90	T							
3.00	B				End of Trialpit at 3.000m	3.00	97.72	

Weather and environmental conditions:

1. Overcast with showers.

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works..
2. Trial pit terminated at 3.0m as the ground was too dense to excavate past.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP302

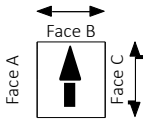
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 27/07/2017
Backfill date: 27/07/2017
Logged by: AW

Survey details:

Ground Level: 100.2 mOD
Easting: 276043 mE
Northing: 207992 mN
Bearing:

Plan details:



Face Stability:

Stable

Groundwater observations:

Slow on northern wall at 2.3m.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Overgrown vegetated surface over probably medium dense dark brown very gravelly slightly sandy CLAY with a moderate cobble content. Gravel (fine to coarse) and cobbles of subrounded tabular sandstone and mudstone. (MADE GROUND - Topsoil)	(*0.20*)		
						0.20	100.04	
					Probably medium dense to dense orange brown slightly sandy very clayey GRAVEL with a high cobble content. Gravel and cobbles are subrounded to subangular, often tabular, weak to strong sandstone, mudstone and siltstone. Occasional fine to medium subangular to angular coal. (Probable COLLUVIUM)			
1.00	B					1.0		
						(*2.20*)		
					Soft grey gravelly clay pockets from 1.5m.			
						2.0		
					Fresh strong coarse-grained sandstone boulder at 2.3m.			
						2.40	97.84	
2.50	B				Probably dense sandy clayey GRAVEL with moderate to high cobble and boulder content. Gravel (fine to coarse), cobbles and boulders of angular to subrounded sandstone and siltstone with angular tabular mudstone. (Possible GRADE E Weathered MIDDLE COAL MEASURES)			
						(*1.10*)		
						3.0		
					End of Trialpit at 3.500m	3.50	96.74	

Weather and environmental conditions:

1. Heavy showers.

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works..
2. Trial pit excavated at the foot of the regraded slope opposite the chapel.
3. Trial pit complete at 3.5m at maximum reach of the JCB.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP303

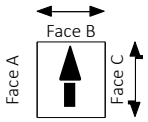
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 27/07/2017
Backfill date: 27/07/2017
Logged by: AW

Survey details:

Ground Level: 101.7 mOD
Easting: 276161 mE
Northing: 208099 mN
Bearing:

Plan details:



Face Stability:

Poor stability throughout.

Groundwater observations:

No groundwater encountered.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Grass over probably medium dense red brown sandy gravelly CLAY with frequent tree roots. Gravel is subrounded to subangular fine to coarse sandstone with occasional cobble sized bricks. (Placed TOPSOIL)	(0.25)		
						0.25	101.47	
					Probably medium dense to dense sandy gravelly COBBLES AND BOULDERS. Gravel (medium to coarse), cobbles and boulders are subangular to angular tabular sandstone with rare brick fragments. (MADE GROUND - Demolition Backfill)			
						1.0		
						(2.65)		
						2.0		
					End of Trialpit at 2.900m	2.90	98.82	
						3.0		

Weather and environmental conditions:

1. Dry and overcast.

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hole terminated at 2.9m due excessive side wall instability causing cambering of the ground at the surface.
3. Breeze block wall encountered on the north-western and south-western extent of the pit. Walls present to the base of the pit.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP304

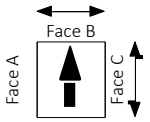
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:

Ground Level: 205.4 mOD
Easting: 276005 mE
Northing: 208348 mN
Bearing:

Plan details:



Face Stability:

Unstable

Groundwater observations:

No groundwater encoutnered.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Very dark brown clayey occasionally gravelly organic SAND with fragments of coal and brick. (Placed TOPSOIL)	(*0.20*)		
						0.20	205.22	
					Probably medium dense brown very clayey angular, fine to coarse siltstone and sandstone GRAVEL. (MADE GROUND)	(*0.30*)		
0.40	B					0.50	204.92	
					Probably loose to medium dense clayey sandy angular fine to coarse siltstone and sandstone GRAVEL with pockets of sandy clay and gravel and fragments of wood, metal sheeting, metal wire, plastic, whole rubber tyres, glass bricks and coal. (MADE GROUND)			
1.00	B					1.0		
						(*2.00*)		
						2.0		
					Probably loose coarse angular siltstone and sandstone GRAVEL with high cobble content. (Probable quarry waste - MADE GROUND)	2.50	202.92	
2.80	B					(*0.50*)		
					End of Trialpit at 3.000m	3.00 3.0	202.42	

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 3.0m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant:	JCB 3CX
Shoring/support:	None

TP305

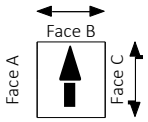
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:

Ground Level: 196.0 mOD
Easting: 275990 mE
Northing: 208293 mN
Bearing:

Plan details:



Face Stability:

Unstable

Groundwater observations:

No groundwater encoutnered.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Very dark brown clayey occasionally gravelly organic SAND with fragments of coal and brick. (Placed TOPSOIL)	(*0.10*)		
						0.10	195.95	
0.50	B				Probably medium dense to dense grey and orange-brown gravelly angular sandstone and siltstone COBBLES with some slightly clayey SAND. (Probable quarry waste - MADE GROUND)			
						1.0		
1.50	B					(*2.80*)		
						2.0		
2.50	B							
					End of Trialpit at 2.900m	2.90	193.15	
						3.0		

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 2.9m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP306

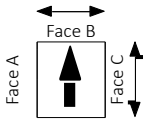
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:

Ground Level: 191.5 mOD
Easting: 276019 mE
Northing: 208240 mN
Bearing:

Plan details:



Face Stability:

Unstable

Groundwater observations:

No groundwater encoutnered.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Very dark brown clayey occasionally gravelly organic SAND with fragments of coal and brick. (Placed TOPSOIL)	(0.20)		
						0.20	191.29	
					Probably loose to medium dense grey sandy fine to coarse angular GRAVEL with high cobble content. Cobbles of sandstone and siltstone are angular. (Probable quarry waste - MADE GROUND)	(0.30)		
0.40	B					0.50	190.99	
					Probably medium dense orange-brown COBBLES with some gravelly CLAY and rare sandstone boulders. (MADE GROUND)			
						(0.80)		
1.00	B					1.0		
						1.30	190.19	
					Firm becoming stiff orange-brown slightly sandy slightly gravelly CLAY. (Probable GRADE E SOUTH WALES COAL MEASURES FORMATION)			
1.50	D							
						2.0		
						(1.70)		
2.50	D							
						3.00 3.0	188.49	
					Weak to medium strong grey coarse grained SANDSTONE. (GRADE C SOUTH WALES COAL MEASURES FORMATION)	(0.20)		
3.10	B					3.20	188.29	
					End of Trialpit at 3.200m			

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 3.2m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant: JCB 3CX

Shoring/support: None

TP307

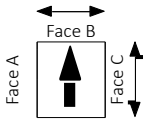
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:

Ground Level: 202.1 mOD
Easting: 276035 mE
Northing: 208352 mN
Bearing:

Plan details:



Face Stability:

Unstable

Groundwater observations:

No groundwater encoutnered.

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Very dark brown clayey occasionally gravelly organic SAND with fragments of coal and brick. (Placed TOPSOIL)	(*0.05*) 0.05	202.03	
0.30	B				Probably medium dense brown very clayey angular, fine to coarse siltstone and sandstone GRAVEL. (MADE GROUND)	(*0.45*)		
					Probably loose dark brown to grey mottled black angular sandstone COBBLES with much slightly clayey slightly gravelly SAND with fragments of metal, metal sheeting, wooden sleepers, plastic, pottery, glass, brick and metal bars. (MADE GROUND)	0.50	201.58	
1.00	B					1.0		
						(*1.50*)		
2.10	B				Probably medium dense to dense grey and orange-brown angular sandstone and siltstone COBBLES with some slightly clayey SAND. (Probable quarry waste - MADE GROUND)	2.00 2.0	200.08	
						(*1.10*)		
						3.0		
					Weak to medium strong grey coarse grained SANDSTONE. (GRADE C SOUTH WALES COAL MEASURES FORMATION)	3.10 (*0.20*)	198.98	
					End of Trialpit at 3.300m	3.30	198.78	

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 3.3m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists

Excavation method/plant:	JCB 3CX
Shoring/support:	None

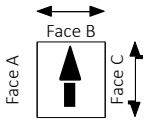
TP308

Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:
Ground Level: 73.5 mOD
Easting: 276226 mE
Northing: 208030 mN
Bearing:

Plan details:



Face Stability:
Stable

Groundwater observations:
Slow at 4m

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
					Dark brown clayey slightly gravelly organic SAND with low cobble content. (MADE GROUND)	(*0.20*)		
						0.20	73.26	
0.50	B				Probably medium dense to dense brown sandy clayey, fine to coarse subrounded to angular sandstone and mudstone GRAVEL with medium cobble content and pockets of angular coarse mudstone gravel. Boulder of sandstone in the side of the pit at a depth of 1.4m measuring approximately 1.2m by 1.5m. (Probable COLLUVIUM)			
1.00	B					1.0		
1.50	B							
						2.0		
2.50	B					(*4.70*)		
						3.0		
3.50	B							

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 4.9m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists

TP308

Excavation method/plant: JCB 3CX
Shoring/support: None

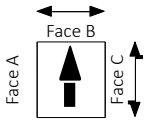
Project Name: Pantteg Landslip
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Excavation date: 28/09/2017
Backfill date: 28/09/2017
Logged by: MTE

Survey details:

Ground Level: 73.5 mOD
Easting: 276226 mE
Northing: 208030 mN
Bearing:

Plan details:



Face Stability:

Stable

Groundwater observations:

Slow at 4m

Depth	Sample		Test Details		Strata Details			
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend
4.50	B				Probably medium dense to dense brown sandy clayey, fine to coarse subrounded to angular sandstone and mudstone GRAVEL with medium cobble content and pockets of angular coarse mudstone gravel. Boulder of sandstone in the side of the pit at a depth of 1.4m measuring approximately 1.2m by 1.5m. (Probable COLLUVIUM)			
					End of Trialpit at 4.900m	4.90	68.56	
						5.0		
						6.0		
						7.0		

Weather and environmental conditions:

1. Overcast, Dry

Other comments:

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Trial pit excavated to a maximum depth of 4.9m.
3. Trial pit backfilled with arisings upon completion and soils left proud of surface.

Appendix C

Trail Pit Records – Pen-y-Graig Area

TRIAL PIT RECORD SHEET

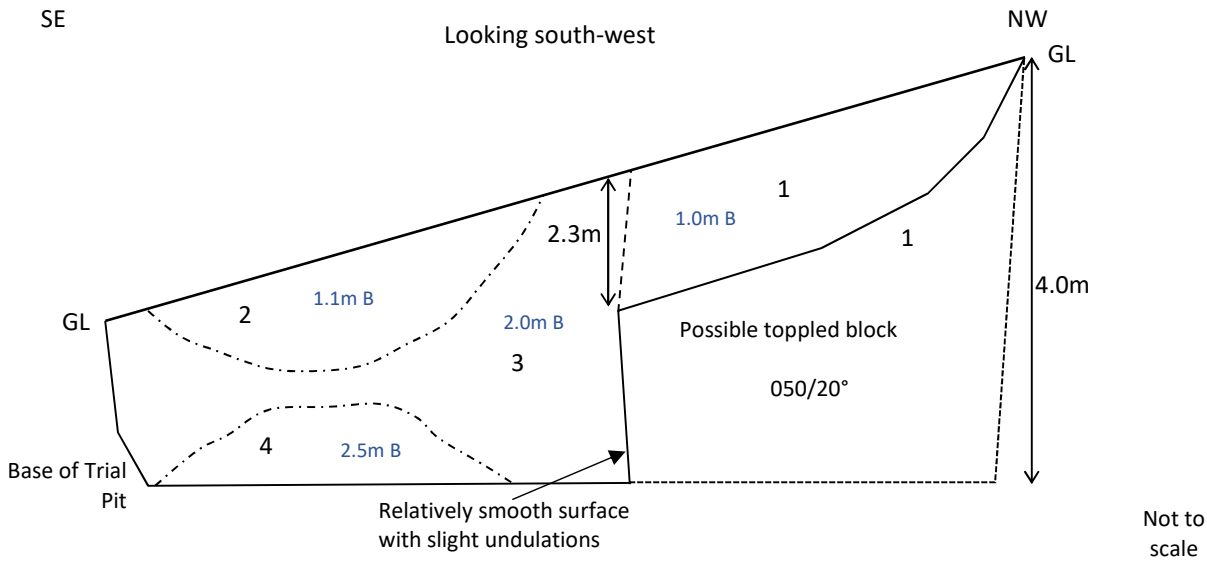
Site:	**Pantteg Landslide – Pen-y-Graig Area**	**Eastings**	**276023**	**Trial Pit No.**	**TP601**
Project No.	5859e.09	Northings	208121		
Date of Excavation:	9th May 2018	Elevation (m)	154.1		

Photographs of Pit:

Looking north-west

Looking north

Schematic Trial Pit Section:



Ground conditions encountered:

1) Weak becoming strong to very strong at 2.3m thinly bedded partially disintegrated and discoloured (orange staining and blackening) SILTSTONE. Rock weak enough to excavate top 2.3m. Dimensions unknown but at least 4.0m deep. Dip of 20° to the NE. (Possible TOPPLED BLOCK)
2) Encountered in the southern wall. Probably very loose to loose brown slightly clayey slightly sandy GRAVEL with a moderate cobble content. Gravel is fine to coarse weathered siltstone and mudstone. Long axis of the gravel and cobbles typically orientated towards E ~10°. (MADE GROUND – Colliery Spoil - Coarse Discard)
3) Probably very loose light brown slightly sandy slightly clayey subrounded to angular partially weathered siltstone and sandstone GRAVEL with a high cobble content. (MADE GROUND – Colliery Spoil - Coarse Discard)
4) Encountered in the northern wall of the pit – probably very loose black very gravelly sandy CLAY with a low cobble content. Gravel is fine to coarse angular coal and fine to coarse partially weathered subangular to subrounded sandstone, mudstone and siltstone. (MADE GROUND – Probable Colliery Spoil)

Samples indicated on above schematic section in blue text.

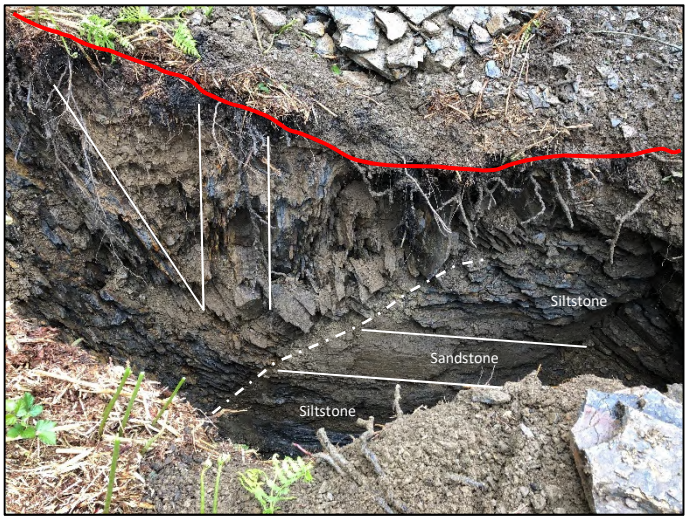
Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Eastings	275986	Trial Pit No.	TP602
Project No.	5859e.09	Northings	208086		
Date of Excavation:	9th May 2018	Elevation	154.8		

Photographs of Trial Pit:

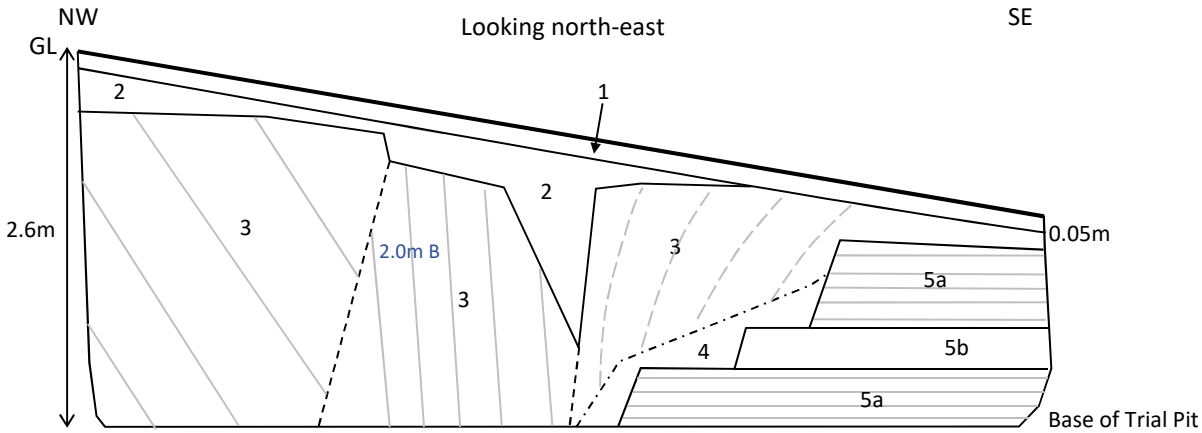
Looking north-west



Looking north-east

Schematic Trial Pit Section:

Not to scale



Ground Conditions encountered:

1) Black slightly clayey gravelly organic SAND (MADE GROUND – Poor Topsoil).
2) Probably loose light brown slightly clayey slightly silty slightly sandy fine to medium with some coarse subrounded to angular partially weathered siltstone and sandstone GRAVEL with high cobble content. (MADE GROUND – Colliery Spoil - Coarse Discard)
3) Highly weathered wholly disintegrated very weak to moderately weak steeply dipping very thin to thinly bedded partially discoloured brown and grey dark grey with orange SILTSTONE. Infill of weathered bedding planes with a clayey sand. Bedding planes indicate a down slope movement. (Possible former TOPPLED BLOCK)
4) Soft light brown gravelly slightly sandy CLAY with a low cobble content. Gravel and cobbles are subangular to subrounded sandstone and siltstone. Slightly wet. (Possible COLLUVIUM)

5a) Partially disintegrated weak to moderately weak thinly sub-horizontally bedded dark grey with orange surface discolouration SILTSTONE. Some clayey sand fill on the surface of the thin bedding planes. Easily excavated. (Possible ROTATED ROCK MASS)

5b) Moderately strong to strong medium bedded slightly discoloured greyish brown to brown SANDSTONE. (Possible ROTATED ROCK MASS)

Samples indicated on above schematic section in blue text.

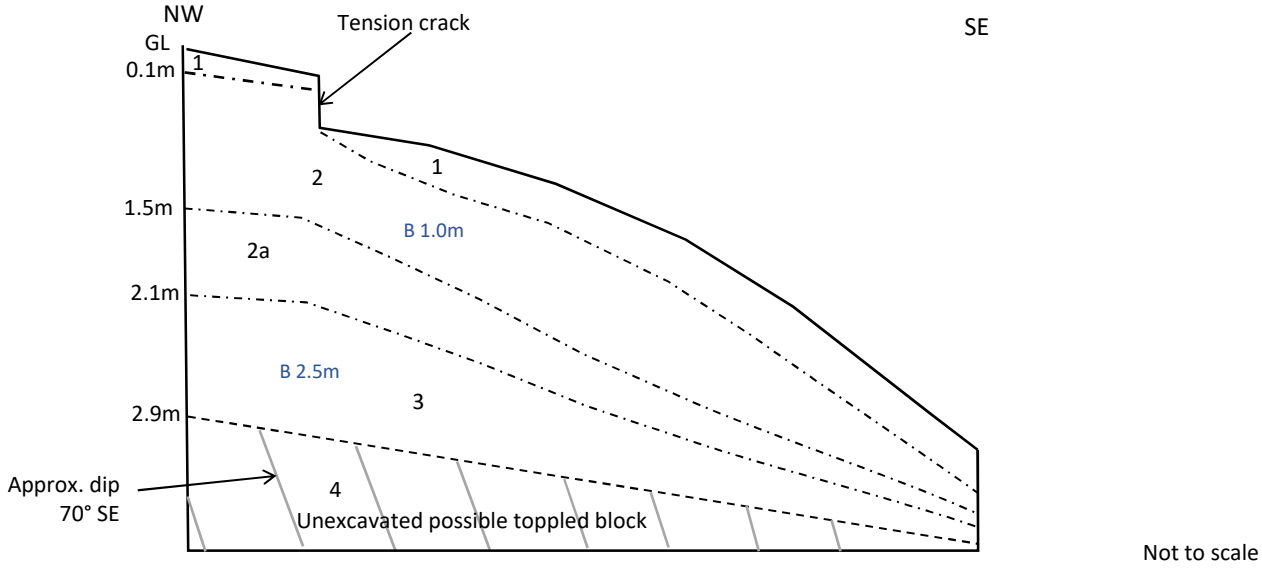
Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Eastings	275978	Trial Pit No.	TP603
Project No.	5859e.09	Northings	208034		
Date of Excavation:	10th May 2018	Elevation (m)	143.23		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Ground Conditions Encountered: :

1) Probably very loose to loose dark brownish grey sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Probably loose brown very clayey GRAVEL with a medium cobble content. Gravel, cobbles and boulders are subrounded to subangular sandstone and siltstone. (MADE GROUND – Colliery Spoil - Coarse Discard)

2a) Probably loose brown very clayey GRAVEL. Gravel, cobbles and boulders are subrounded to subangular sandstone and siltstone. (MADE GROUND – Colliery Spoil - Coarse Discard)

3) Probably loose black very clayey sandy fine to medium GRAVEL with moderate cobble content. Gravel and cobbles are angular to subrounded coal, mudstone and siltstone. Wet. Laboratory testing indicates 9.5% loss on ignition. (MADE GROUND – Possible Colliery Spoil) Stratum present at base of pit and varied between 0.2m and 0.4m in thickness.
4) Strong thinly bedded grey, with slight orange surface discolouration SILTSTONE. (Possible TOPPLED BLOCK). Bedding visibly judged to dip steeply (~70°) towards the south-east.

Samples indicated on above schematic section in blue text.

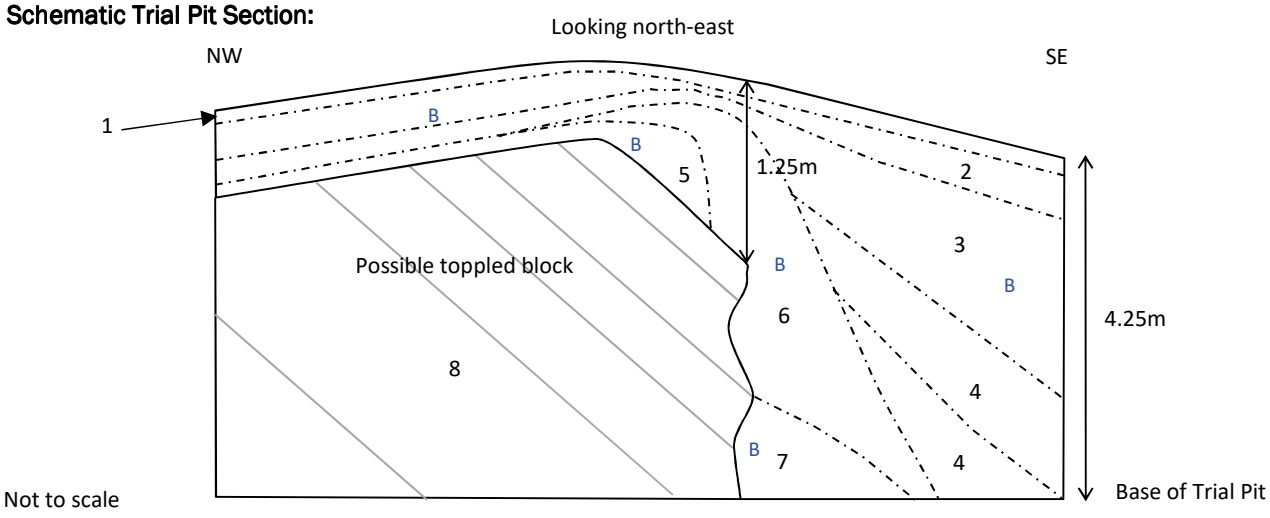
Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

TRIAL PIT RECORD SHEET

Site:	**Pantteg Landslide – Pen-y-Graig Area**	**Eastings**	**275958**	**Trial Pit No.**	**TP604**
Project No.	**5859e.09**	**Northings**	**208003**		
Date of Excavation:	**10th May 2018**	**Elevation (m)**	**143.32**		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Ground conditions encountered:

1) Probably very loose to loose dark brownish grey sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Probably loose to medium dense brown very clayey silty very gravelly SAND with a moderate cobble content. Gravel and cobbles are angular to subangular partially weathered (Slightly disintegrated and discoloured) siltstone and sandstone. (MADE GROUND - Colliery Spoil – Coarse Discard)
3) Probably loose to medium dense brown sandy clayey GRAVEL. Gravel is angular to subangular partially weathered (Slightly disintegrated and discoloured) siltstone and sandstone. (MADE GROUND - Colliery Spoil – Coarse Discard)
4) Probably very loose to loose angular partially weathered (partially disintegrated and discoloured) sandstone and siltstone COBBLES with much clayey SAND. (MADE GROUND - Colliery Spoil – Coarse Discard)
5) Black and grey clayey slightly sandy GRAVEL with bands of dark grey slightly gravelly clay. Gravel is angular to subangular fine to coarse coal, mudstone and siltstone. No structure. (MADE GROUND – Possible Colliery Spoil)
6) Soft light brown gravelly slightly sandy CLAY with a low cobble content. Slightly wet. Gravel and cobbles are subangular to subrounded sandstone and siltstone. (MADE GROUND – Colliery Spoil - Coarse Discard)
7) Soft grey, with orange surface oxidation, gravelly slightly sandy silty CLAY with high organic content and partially decomposed roots. Gravel is fine to coarse, occasionally planar, subrounded to subangular siltstone and sandstone. Some orientation in long axis of the clasts. (Possible NATURAL INFILL BETWEEN BOULDERS)
8) Medium strong to very strong thinly to medium bedded brown and grey with brown discolouration interbedded SILTSTONE and SANDSTONE. (Possible TOPPLED BLOCK) Total dimensions unknown but at least 4.7m wide. Rounded edges and partial discolouration along the southern face. Dip/Dip Dir 40°/140 (SE).

Samples indicated on above schematic section in blue text.

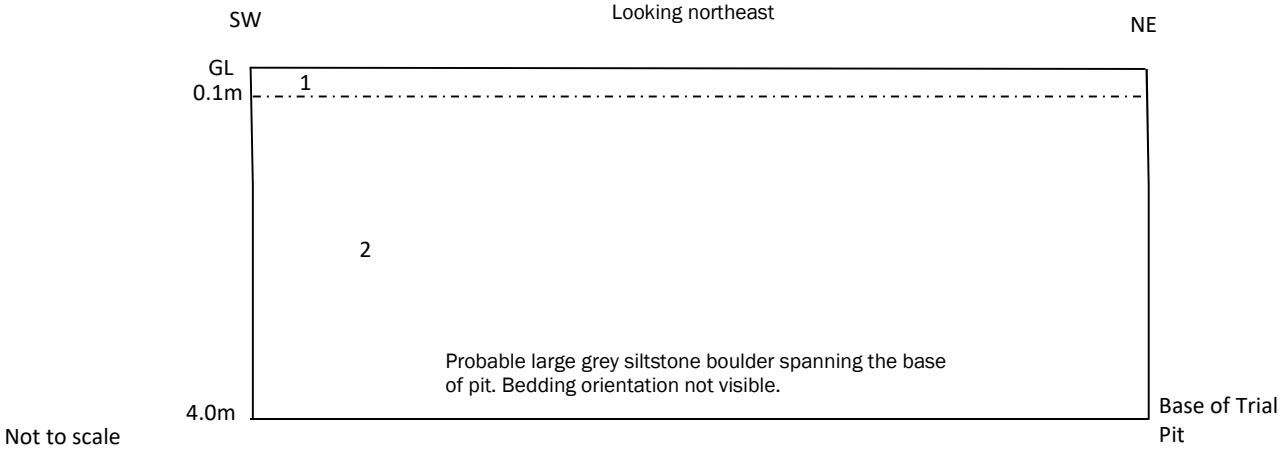
Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Easting	276008	Trial Pit No.	TP605
Project No.	5859e.09	Northing	208074		
Date of Excavation:	10th May 2018	Elevation (m)	146.80		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Ground conditions encountered:

1) Probably very loose to loose dark brownish grey sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Probably loose slightly clayey slightly silty slightly sandy GRAVEL and COBBLES with a medium boulder content. Gravel, cobbles and boulders are subangular to subrounded, occasionally tabular, sandstone and siltstone with surface discoloration. Variable orientation of large boulders from 80° towards south-west and 30° to north-east. (MADE GROUND – Colliery Spoil - Coarse Discard)

Samples indicated on above schematic section in blue text.

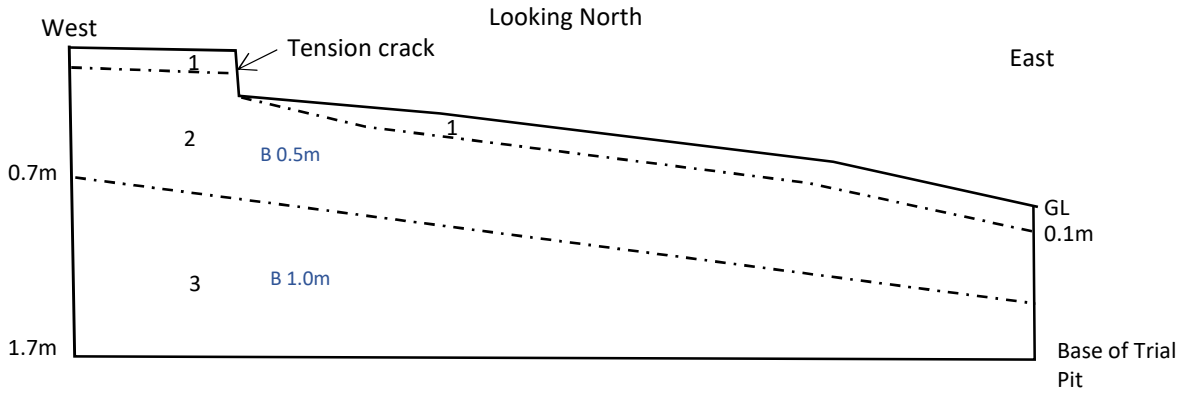
Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Easting	275990	Trial Pit No.	TP606
Project No.	5859e.09	Northing	208060		
Date of Excavation:	10th May 2018	Elevation	145		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Not to scale

Ground Conditions Encountered:

1) Probably very loose dark brownish grey slightly sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Probably loose brown slightly sandy slightly clayey GRAVEL with a high cobble and moderate boulder content. Gravel, cobbles and boulders are slightly weathered (slight surface discolouration) subangular to subrounded. (MADE GROUND – Colliery Spoil - Coarse Discard)
3) Probably loose black and brown slightly clayey slightly sandy medium to coarse with some fine subangular to angular GRAVEL with a high cobble content. Gravel and cobbles are highly weathered (mostly disintegrated and discoloured) subangular to angular coal and mudstone with some partially weathered subangular siltstone. (MADE GROUND – Possible Colliery Spoil)

Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

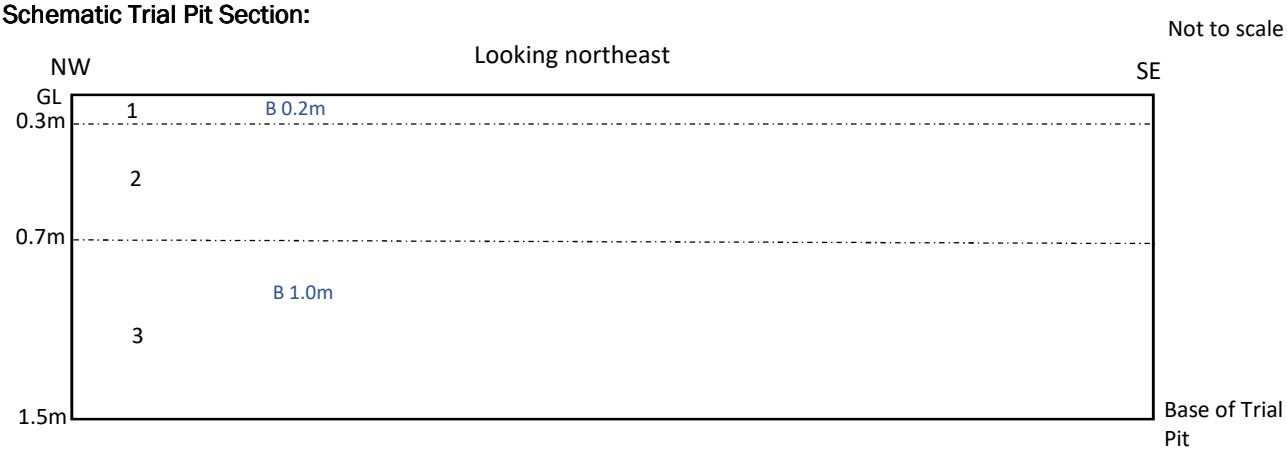
Samples indicated on above schematic section in blue text.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Easting	275964	Trial Pit No.	TP607
Project No.	5859e.09	Northing	208007		
Date of Excavation:	11th May 2018	Elevation	142.73		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Ground conditions encountered:

1) Probably very loose to loose black clayey slightly silty slightly sandy GRAVEL with a medium cobble and boulder content. Gravel, cobbles and boulders are angular, slightly to moderately weathered mudstone, siltstone and sandstone, with some coal. (MADE GROUND – Colliery Spoil – Coarse Discard)
2) Probably loose dark brown to dark grey BOUDLERS with some cobbles and some slightly clayey slightly sandy GRAVEL. Gravel cobbles and boulders are highly weathered (partially disintegrated and discoloured) mudstone, siltstone subangular slightly weathered (slight surface discolouration) sandstone and fine to coarse (gravel) angular to subangular coal. (MADE GROUND – Colliery Spoil – Coarse Discard)
3) Probably loose slightly clayey slightly sandy GRAVEL with medium cobble and boulder content. Gravel, cobbles and boulders are highly weathered (partially disintegrated and discoloured) mudstone and siltstone, subangular slightly weathered (slight surface discolouration) sandstone and fine to coarse (gravel) angular to subangular coal. Laboratory testing shows 34.6% material to be lost on ignition of sample. (MADE GROUND – Colliery Spoil - Coarse Discard).

NB. Top 0.2m of soil removed prior to excavation as part of site preparation works.

Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

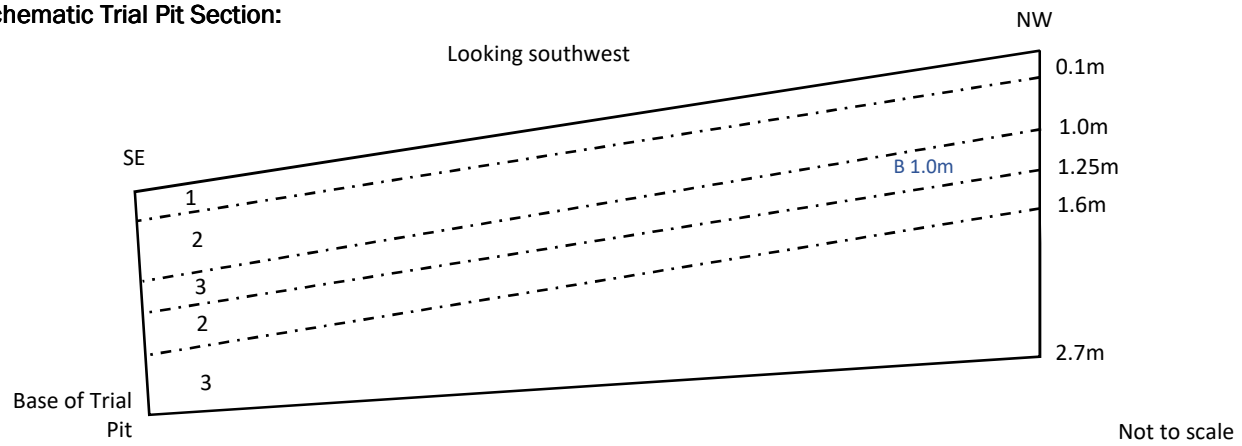
Samples indicated on above schematic section in blue text.

TRIAL PIT RECORD SHEET

Site:	Pantteg Landslide – Pen-y-Graig Area	Easting	276033	Trial Pit No.	TP608
Project No.	5859e.09	Northing	208131		
Date of Excavation:	11th May 2018	Elevation (m)	154.4		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Ground conditions encountered:

1) Probably very loose to loose dark brownish grey sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Soft to firm brown very gravelly slightly sandy CLAY with moderate cobble content. Gravel and cobbles are angular moderately weathered (partially discoloured and disintegrated) mudstone, subangular slightly weathered (surface discolouration) sandstone and siltstone. (MADE GROUND – Colliery Spoil - Coarse Discard)
3) Probably loose brown slightly clayey slightly sandy GRAVEL with moderate cobble and low boulder content. Gravel, cobbles and boulders are angular moderately weathered (partially discoloured and disintegrated) mudstone, subangular slightly weathered (surface discolouration) sandstone and siltstone. (MADE GROUND – Colliery Spoil - Coarse Discard)

Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

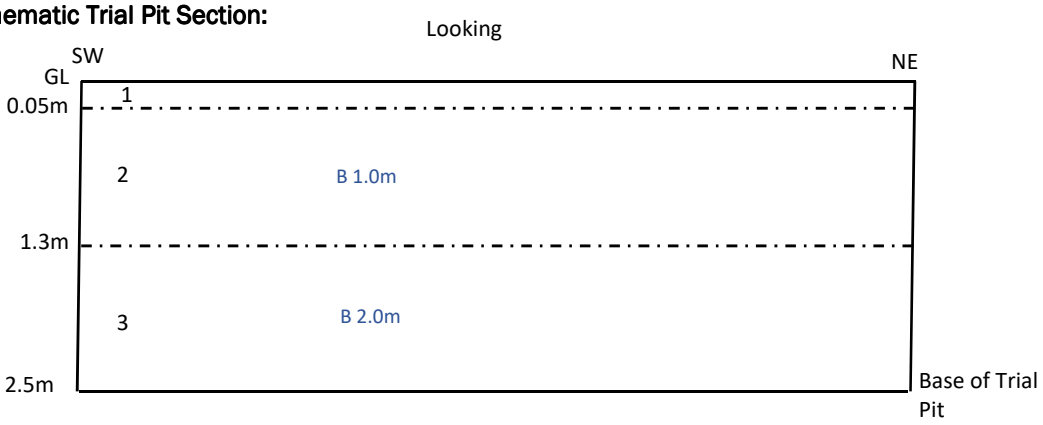
Samples indicated on above schematic section in blue text.

TRIAL PIT RECORD SHEET

Site:	**Pantteg Landslide – Pen-y-Graig Area**	**Easting**	**276050**	**Trial Pit No.**	**TP609**
Project No.	**5859e.09**	**Northing**	**208140**		
Date of Excavation:	**11th May 2018**	**Elevation**	**152.45**		

Photographs of Trial Pit:

Schematic Trial Pit Section:



Not to scale

Ground conditions encountered:

1) Probably very loose to loose dark brownish grey sandy slightly clayey GRAVEL with a moderate cobble content. Gravel and cobbles (fine to coarse) are angular to subrounded partially weathered (surface discoloration) and sandstone and siltstone. (MADE GROUND – Poor Topsoil)
2) Probably loose grey and brown very clayey slightly sandy GRAVEL with moderate cobble and boulder content. Gravel, cobbles and boulders are subangular partially weathered (slightly disintegrated and discoloured) siltstone and mudstone.
3) Probably loose brown slightly clayey slightly sandy GRAVEL with a moderate cobble and boulder content. Gravel, cobbles and boulders are, mostly tabular, angular to subangular sandstone and siltstone with slight surface discolouration. Large boulder dipping ~50° to the south-east in northern wall. (MADE GROUND – Colliery Spoil - Coarse Discard).

Groundwater not encountered. Pit walls extremely unstable with continual collapse of all sides.

Samples indicated on above schematic section in blue text.

Appendix D

Rotary Open-Hole Records –

Pantteg Village

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Start date:	13-12-2016	Driller:	Apex	
End date:	14-12-2016	Logged by:		
Backfill date:	14-12-2016	Date logged:	14-12-2016	

Project Name: Pantteg Landslip
Site Location: Pantteg
Client: NPTCBC
Project No: 5859e.03

Drilling method: Rotary cored
Equipment: Beretta T41

Ground Level: 100.53 mOD
Easting: 276060 m
Northing: 208013 m

BH101

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.00	Grass over clay with Boulders - Drillers Description (MADE GROUND)			(3.20)		
3.20	Alluvium with Gravel - Drillers Description (POSSIBLE COLLUVIUM)			(1.40)	97.33	
4.60	Weathered MUDSTONE with clay - Drillers description (POSSIBLE COLLUVIUM)			(5.00)	95.93	
9.60	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)				90.93	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
13-12-2016	12:00	7.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using an air mist flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 100.53 mOD		
Project No: 5859e.03	Easting: 276060 m		
Start date: 13-12-2016	Driller: Apex	Northing: 208013 m	
End date: 14-12-2016	Logged by:		
Backfill date: 14-12-2016	Date logged: 14-12-2016		

BH101

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			(3.60)		
13.20	SILTSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			(6.00)	87.33	
19.20	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)				81.33	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
13-12-2016	12:00	7.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using an air mist flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 100.53 mOD		
Project No: 5859e.03	Easting: 276060 m		
Start date: 13-12-2016	Driller: Apex	Northing: 208013 m	
End date: 14-12-2016	Logged by:		
Backfill date: 14-12-2016	Date logged: 14-12-2016		

BH101

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
20.5	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			(2.40)		
21.0						
21.5				21.60	78.93	
	SILTSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
22.0						
22.5						
23.0				(3.40)		
23.5						
24.0						
24.5						
25.0	End of Borehole at 25.000m			25.00	75.53	
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
13-12-2016	12:00	7.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using an air mist flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 72.11 mOD		
Project No: 5859e.03	Easting: 276265 m		
Start date: 15-12-2016	Driller: Apex	Northing: 208101 m	
End date: 15-12-2016	Logged by:		
Backfill date: 15-12-2016	Date logged: 15-12-2016		

BH102

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.00	Tarmac over colliery spoil - Drillers description (MADE GROUND)			(3.20)		
3.20	Clay with boulders - Drillers description (POSSIBLE COLLUVIUM)			(2.20)	68.91	
5.40	Grey clay and weathered MUDSTONE - Drillers description (POSSIBLE COLLUVIUM)			(3.10)	66.71	
8.50	Clay with weathered shale and boulders - Drillers description (POSSIBLE COLLUVIUM)				63.61	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
15-12-2016	12:00	5.20		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 21m using an air mist flush and gas monioring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 72.11 mOD		
Project No: 5859e.03	Easting: 276265 m		
Start date: 15-12-2016	Driller: Apex	Northing: 208101 m	
End date: 15-12-2016	Logged by:		
Backfill date: 15-12-2016	Date logged: 15-12-2016		

BH102

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
10.5	Clay with weathered shale and boulders - Drillers description (POSSIBLE COLLUVIUM)			(4.80)		
11.0						
11.5						
12.0						
12.5						
13.0						
13.30					58.81	
13.5	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
14.0						
14.5						
15.0						
15.5						
16.0				(5.10)		
16.5						
17.0						
17.5						
18.0						
18.40					53.71	
18.5	SANDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
19.0						
19.5				(2.60)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
15-12-2016	12:00	5.20		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 21m using an air mist flush and gas monioring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		**BH102**
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 72.11 mOD		
Project No: 5859e.03	Easting: 276265 m		
Start date: 15-12-2016	Driller: Apex	Northing: 208101 m	
End date: 15-12-2016	Logged by:		
Backfill date: 15-12-2016	Date logged: 15-12-2016		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
20.5	SANDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
21.0	End of Borehole at 21.000m			21.00	51.11	
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
15-12-2016	12:00	5.20		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 21m using an air mist flush and gas monioring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Start date:	14-12-2016	Driller:	Apex
End date:	14-12-2016	Logged by:	
Backfill date:	15-12-2016	Date logged:	14-12-2016

Project Name: Pantteg Landslip
Site Location: Pantteg
Client: NPTCBC
Project No: 5859e.03

Drilling method: Rotary cored
Equipment: Beretta T41

Ground Level:	130.90 mOD
Easting:	276258 m
Northing:	208367 m

BH103

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.00	Tarmac over hardcore - Drillers description (MADE GROUND)			(0.30)	130.60	
0.30	SHALE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			0.30		
4.20	COAL - Drillers description (LOWER WELSH COAL SEAM)			(3.90)		
4.60	MUDSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			4.20 (0.40) 4.60	126.70 126.30	
5.20	SILTSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)			(0.60) 5.20	125.70	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using both air water flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored			**BH103**
Site Location: Pantteg	Equipment: Beretta T41			
Client: NPTCBC	Ground Level: 130.90 mOD			
Project No: 5859e.03	Easting: 276258 m			
Start date: 14-12-2016	Driller: Apex	Northing: 208367 m		
End date: 14-12-2016	Logged by:			
Backfill date: 15-12-2016	Date logged: 14-12-2016			

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
10.5	SILTSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0				(19.80)		
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using both air water flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslip	Drilling method: Rotary cored		**BH103**
Site Location: Pantteg	Equipment: Beretta T41		
Client: NPTCBC	Ground Level: 130.90 mOD		
Project No: 5859e.03	Easting: 276258 m		
Start date: 14-12-2016	Driller: Apex	Northing: 208367 m	
End date: 14-12-2016	Logged by:		
Backfill date: 15-12-2016	Date logged: 14-12-2016		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	SPT-N (penetration)

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
20.5	SILTSTONE - Drillers description (PENNINE MIDDLE COAL MEASURES FORMATION)					
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0	End of Borehole at 25.000m			25.00	105.90	
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole coordinates and level surveyed in following site works.
2. Service pit excavated to a depth of 1.2m by hand.
3. Borehole complete at a depth of 25m using both air water flush and gas monitoring undertaken throughout works.
4. Two 19mm groundwater monitoring standpipes installed as per instalation drawings.

Appendix E

Rotary Coring Records –

86 Cyfyng Road

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Start date:	22/06/2017	Driller:	APEX	Ground Level:	109.65 mOD
End date:	22/06/2017	Logged by:	APEX	Easting:	276308 m
Backfill date:	22/06/2017	Date logged:	22/06/2017	Northing:	208346 m

Project Name: Pantteg Lanslip
Site Location: Pantteg
Client: NPTCC
Project No: 5859e.04

Drilling method: Rotary cored
Equipment: Beretta T41

BH201

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.0	Fill (Suspected infilled basment/lower ground level of former properties. Drillers log only - no recovery).			(4.10)		
4.10	Sandy CLAY. (No recovery - drillers description only - possible Grade E MIDDLE COAL MEASURES FORMATION).			(0.80)	105.55	
4.90	Weak MUDSTONE. (No recovery, driller description only - possible Grade C MIDDLE COAL MEASURES FORMATION FORMATION).			(0.80)	104.75	
5.70	End of Borehole at 5.700m				103.95	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Borehole constructed in car park which occupies the footprint of former residences of Cyfyng Road.
2. Coordinates and elevation surveyed in using DGPS following site works.
3. Service pit dug to 1.2m with insulated digging tools.
4. Dry sampling attempted and refused each time, recovering no material. Borehole moved 0.5m to the side and attempted again (see BH202).
5. No groundwater encoutnered during construction of the borehole.
6. Borehole backfilled with arisings upon completion.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pantteg Lanslip
Site Location:	Pantteg
Client:	NPTCC
Project No:	5859e.04
Drilling method	Rotary cored
Equipment	Beretta T41

BH202

Start date:	22/06/2017	Driller:	APEX
End date:	23/06/2017	Logged by:	ESP-AW
Backfill date:	23/06/2017	Date logged:	10/07/2017
Ground Level:	109.64 mOD		
Easting:	276308 m		
Northing:	208346 m		

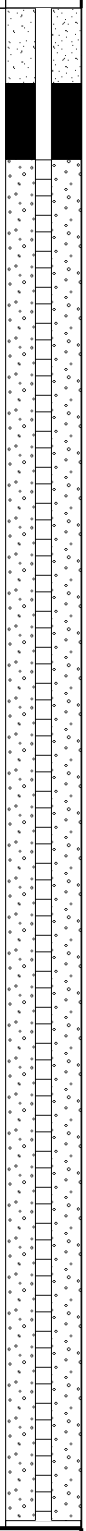
Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.00 - 6.50 (1.50)	70	11	7	NI / >20	
6.50 - 7.10 (0.60)	100	58	42	NI	
7.10 - 7.60 (0.50)	100	86	46	18	
7.60 - 7.80	100	60	60	3.3	
7.80 - 8.80 (1.00)	35	32	20		
8.80 - 10.10 (1.30)	30	19	8		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD
0.0	Fill (Suspected infilled basment/lower ground level of former properties. Drillers log only - no recovery.)			(3.90)	
3.90	Sandy clay (No recovery - drillers description only - possible Grade E MIDDLE COAL MEASURES FORMATION).			(0.30)	105.74
4.20	Firm to stiff brown gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse angular weak mudstone. (Grade E MIDDLE COAL MEASURES FORMATION).			(0.40)	105.44
4.60	Black clayey slightly sandy GRAVEL of fine to coarse angular tabular weak mudstone, with orange staining on the planes. (Grade C MIDDLE COAL MEAURES - Mudstone).			(0.40)	105.04
5.00	Dark grey clayey slightly sandy GRAVEL of fine to coarse angular weak sandstone. (Grade C MIDDLE COAL MEASURES FORMATION - Mudstone).			(0.20)	104.64
5.20	Dark grey clayey slightly sandy GRAVEL of fine to coarse angular tabular weak mudstone. (Grade C MIDDLE COAL MEASURES FORMATION - Mudstone).			(1.30)	104.44
6.50	Light grey very strong coarse grained SANDSTONE. (MIDDLE COAL MEASURES FORMATION - Sandstone).			(0.45)	103.14
6.95	Dark grey clayey slightly sandy GRAVEL of fine to coarse angular tabular mudstone with 1mm clay covering on beddings planes. (Grade C MIDDLE COAL MEASURES FORMATION - Mudstone).			(0.15)	102.69
7.10	Light grey very strong coarse grained SANDSTONE. Occasional 1mm thick quartz infill on joints, and orange staining on the faces. (MIDDLE COAL MEASURES FORMATION - Sandstone).			(3.00)	102.54

Backfill/ Install-ations



Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
10.10	

Casing Diameter

Casing Diameter	Casing Depth
	3.90

General Remarks

1. Borehole constructed in car park which occupies the footprint of former residences of Cyfyng Road.
2. Coordinates and elevation surveyed in using DGPS following site works.
3. Service pit dug to 1.2m with insulated digging tools.
4. Dry sampling utilised between 1.2m to 5.0m, where the sampler refused. Rotary coring utilised from 5.0m to 10.1m. Rotary coring refusing between 7.6m to 7.8m.
5. No groundwater encoutnered during construction of the borehole.
6. Groundwater monitoring standpipe installed upon completion, with a responce zone between 1.0-10.0m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pantteg Lanslip
Site Location:	Pantteg
Client:	NPTCC
Project No:	5859e.04
Drilling method	Rotary cored
Equipment	Beretta T41

BH202

Start date:	22/06/2017	Driller:	APEX
End date:	23/06/2017	Logged by:	ESP-AW
Backfill date:	23/06/2017	Date logged:	10/07/2017
Ground Level:	109.64 mOD		
Easting:	276308 m		
Northing:	208346 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
10.5	Light grey very strong coarse grained SANDSTONE. Occasional 1mm thick quartz infill on joints, and orange staining on the faces. (MIDDLE COAL MEASURES FORMATION - Sandstone).			10.10	99.54	
	End of Borehole at 10.100m					

11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
10.10	

Casing Diameter

Casing Diameter	Casing Depth
	3.90

General Remarks

1. Borehole constructed in car park which occupies the footprint of former residences of Cyfyng Road.
2. Coordinates and elevation surveyed in using DGPS following site works.
3. Service pit dug to 1.2m with insulated digging tools.
4. Dry sampling utilised between 1.2m to 5.0m, where the sampler refused. Rotary coring utilised from 5.0m to 10.1m. Rotary coring refusing between 7.6m to 7.8m.
5. No groundwater encoutnered during construction of the borehole.
6. Groundwater monitoring standpipe installed upon completion, with a responce zone between 1.0-10.0m.

Appendix F

Rotary Coring Records – Pantteg Village and Cwar Pen-y-Graig Areas

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pantteg Landslide
Site Location:	Pantteg, Ystalyfera
Client:	NPTCBC
Project No:	5859e.05
Drilling method	Rotary cored
Equipment	Beretta T44

BH301

Start date:	24/08/2017	Driller:	APEX
End date:	01/09/2017	Logged by:	ESP-AW
Backfill date:	04/09/2017	Date logged:	21/09/2017
Ground Level:	196.15 mOD		
Easting:	275987 m		
Northing:	208289 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
4.20 - 5.50 (1.30)	10	0	0	NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.0	See TP305 Log (Quarry Fill)			(2.90)		
2.90	No Recovery - Probably Quarry Fill			(1.30)	193.25	
4.20	Dark grey clayey sandy GRAVEL. Gravel is fine to coarse angular tabular siltstone. (GRADE C weathered SOUTH WALES UPPER COAL MEASURES)			(1.30)	191.95	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 196.15 mOD				
Project No: 5859e.05	Easting: 275987 m				
Start date: 24/08/2017	Driller: APEX	Northing: 208289 m			
End date: 01/09/2017	Logged by: ESP-AW				
Backfill date: 04/09/2017	Date logged: 21/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.50 - 7.00 (1.50)	100	57	10	>20 7	
7.00 - 8.50 (1.50)	100	73	31	20 NI 12	
8.50 - 10.00 (1.50)	93	83	41	10 NI 10	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Dark grey clayey sandy GRAVEL. Gravel is fine to coarse angular tabular siltstone. (GRADE C weathered SOUTH WALES UPPER COAL MEASURES)					
5.5	Moderately strong to strong dark grey fresh sandy SILTSTONE with occasional fossilised plant debris. Orange iron oxide weathering present on the surface of horizontal beddings and shallow joints. (SOUTH WALES UPPER COAL MEASURES)			5.50 (1.10)	190.65	
6.0						
6.5				6.60	189.55	
	Weak black fresh anthracite COAL Good condition, with slightly stepped 70° joints. (SOUTH WALES UPPER COAL MEASURES - Thin Coal)			(0.40)		
7.0	Weak to moderately strong dark grey fresh MUDSTONE with a very high fossilised plant debris content. (SOUTH WALES UPPER COAL MEASURES - Seateath)			7.00 (0.70)	189.15	
7.5	Strong dark grey fresh slightly sandy SILTSTONE with a high fossilised plant debris content. (SOUTH WALES UPPER COAL MEASURES)			7.70	188.45	
8.0	8.3m-8.4m: Rough, stepped, fresh and unweathered vertical joint.			(0.90)		
8.5				8.60	187.55	
9.0	Medium strong to strong dark grey fresh sandy SILTSTONE. Rough 75° joints with orange surface discolouration. (SOUTH WALES UPPER COAL MEASURES)					
9.5				(2.25)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 196.15 mOD				
Project No: 5859e.05	Easting: 275987 m				
Start date: 24/08/2017	Driller: APEX	Northing: 208289 m			
End date: 01/09/2017	Logged by: ESP-AW				
Backfill date: 04/09/2017	Date logged: 21/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
10.00 - 11.40 (1.40)	100	87	57	3	
				15	
11.40 - 12.90 (1.50)	97	86	51	14	
				10	
				9	
12.90 - 14.40 (1.50)	97	91	76	5	
				11	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Installations
10.5	Medium strong to strong dark grey fresh sandy SILTSTONE. Rough 75° joints with orange surface discolouration. (SOUTH WALES UPPER COAL MEASURES)					
				10.85	185.30	
11.0	Strong light grey and dark grey fresh thinly bedded to thinly laminated SANDSTONE and sandy SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)			(0.25)		
				11.10	185.05	
11.5	Weak dark grey fresh sandy SILTSTONE with occasional thin grey sandstone laminae. Smooth 45° fresh joints. (SOUTH WALES UPPER COAL MEASURES)					
12.0	12.0m-13.3m: Occasionally thinly bedded sandstone.			(2.20)		
12.5	12.6m-13.3m: Subvertical to 50° rough, slightly stepped joint with orange surface staining.					
13.0						
				13.30	182.85	
13.5	Weak to medium strong light grey strong fresh SANDSTONE with occasional thick to thin laminae of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES) 13.3m-13.5m: Largely smooth, slightly undulating, 45° joint with minor orange surface staining.					
14.0						
				(2.10)		
14.5	14.4m-15.1m: Vertical, smooth with minor steps, joint with red, orange and yellow surface staining.					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 196.15 mOD				
Project No: 5859e.05	Easting: 275987 m				
Start date: 24/08/2017	Driller: APEX	Northing: 208289 m			
End date: 01/09/2017	Logged by: ESP-AW				
Backfill date: 04/09/2017	Date logged: 21/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
14.40 - 15.90 (1.50)	100	92	64	7	
15.90 - 17.30 (1.40)	93	58	39	19	
				6	
17.30 - 18.80 (1.50)	97	77	73	5	
				13	
				NI	
				>20	
				NI	
18.80 - 19.90 (1.10)	100	53	53	15	
				>20	
				NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Weak to medium strong light grey strong fresh SANDSTONE with occasional thick to thin laminae of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES)			15.40	180.75	
15.5	Strong grey fresh siltstone CONGLOMERATE with a sandstone matrix. Clasts of siltstone are rounded, fine to coarse gravel sized and have incipient fractures with orange staining. Slight orange discolouration around the perimeter of the clasts. (SOUTH WALES UPPER COAL MEASURES)			(0.02)	180.73	
				15.42		
				(0.68)		
16.0	Strong light grey strong fresh SANDSTONE with occasional thick to thin laminae of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES)			16.10	180.05	
	Strong dark grey strong fresh SILTSTONE with occasional thick to thin laminae of sandstone. (SOUTH WALES UPPER COAL MEASURES)					
16.5						
	16.8m-17.1m: Vertical to subvertical, undulating joint with a rough surface. Minor orange and red surface staining. Apparent pronounciation of thin sandstone beds on the joint.			(1.75)		
17.0						
17.5						
				17.85	178.30	
18.0	Strong light grey strong fresh SANDSTONE with occasional thinly bedded to thinly laminations of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES)			(0.25)		
				18.10	178.05	
	Strong light grey fresh SANDSTONE with rare mudstone, siltstone and coal laminae. (SOUTH WALES UPPER COAL MEASURES)					
18.5	18.3m-18.34m: Thin bed of strong grey siltstone conglomerate with a sandstone matrix.					
	18.7m-18.75m: Smooth vertical joint with 2mm white mineral infill.			(1.30)		
19.0						
				19.40	176.75	
19.5	Strong grey fresh siltstone CONGLOMERATE with a sandstone matrix. Clasts of siltstone are rounded, slightly elongate, fine to coarse gravel sized with the long axis of the clasts roughly aligning to a 10° dip. Slight orange discolouration around the perimeter of the clasts. (SOUTH WALES UPPER			(0.10)	176.65	
				19.50		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 196.15 mOD				
Project No: 5859e.05	Easting: 275987 m				
Start date: 24/08/2017	Driller: APEX	Northing: 208289 m			
End date: 01/09/2017	Logged by: ESP-AW				
Backfill date: 04/09/2017	Date logged: 21/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
19.90 - 21.20 (1.30)	92	82	82	3	
21.20 - 22.70 (1.50)	67	29	29	NI >20 NI 18	
22.70 - 24.20 (1.50)	87	69	63	NI 5	
24.20 - 25.30 (1.10)	100	100	90	8	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD
20.5	Strong grey fresh siltstone CONGLOMERATE with a sandstone matrix. Clasts of siltstone are rounded, slightly elongate, fine to coarse gravel sized with the long axis of the clasts roughly aligning to a 10° dip. Slight orange discolouration around the perimeter of the clasts. (SOUTH WALES UPPER COAL MEASURES)			(2.10)	
21.0	Strong grey fresh SANDSTONE. (SOUTH WALES UPPER COAL MEAURES)				
21.5				21.60	174.55
	Strong grey fresh siltstone CONGLOMERATE with a sandstone matrix. Clasts of siltstone are rounded and fine to coarse gravel sized. Slight orange discolouration around the perimeter of the clasts. (SOUTH WALES UPPER COAL MEASURES)			(0.10)	174.45
				21.70	
				(0.30)	
22.0	Strong grey fresh SANDSTONE. (SOUTH WALES UPPER COAL MEAURES)			22.00	174.15
				(0.20)	
	Weak black partially weathered anthracite COAL. (Recovered as a slightly clayey gravel). (SOUTH WALES UPPER COAL MEASURES - Thin Coal)			22.20	173.95
22.5	Strong dark grey fresh MUDSTONE with a very high fossilised plant debris content. (SOUTH WALES UPPER COAL MEASURES - Seateath)			(0.75)	
23.0	Medium strong to strong dark grey fresh sandy SILTSTONE with thinly bedded to thinly laminated grey sandstone. (SOUTH WALES UPPER COAL MEASURES)			22.95	173.20
23.5					
24.0	24.2m-25.3m: Occasional fossilised plant debris.				
24.5	24.8m-25.3m: Subvertical smooth, partially incipient, joint with minor orange surface staining.			(4.05)	

Backfill/ Install-ations

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
25.30 - 26.80 (1.50)	97	89	48	8	
26.80 - 28.20 (1.40)	100	100	100	5	
				10	
28.20 - 29.70 (1.50)	97	67	64	>20	
				9	
				10	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
25.5	Medium strong to strong dark grey fresh sandy SILTSTONE with thinly bedded to thinly laminated grey sandstone. (SOUTH WALES UPPER COAL MEASURES)					
26.0						
26.5						
27.0				27.00	169.15	
	Strong light grey and dark grey thinly to thickly laminated fresh SANDSTONE and sandy SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)			(0.50)		
27.5	Strong light grey fresh SANDSTONE . (SOUTH WALES UPPER COAL MEASURES)			27.50	168.65	
28.0						
	28.2m-29.4m: Rare thin laminae of coal.			(1.90)		
28.5						
29.0						
				29.40	166.75	
29.5	Strong dark grey fresh SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
29.70 - 31.20 (1.50)	97	83	15	NI	
				>20	
				17	
31.20 - 32.70 (1.50)	90	51	28	NI	
				>20	
				NI	
				>20	
				10	
				16	
32.70 - 34.20 (1.50)	93	62	35	14	
				>20	
				16	
34.20 - 35.70 (1.50)	93	89	87	5	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Strong dark grey fresh SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)			(1.20)		
30.5				30.60	165.55	
	Weak black fresh fissile MUDSTONE. (SOUTH WALES UPPER COAL MEASURES)			(0.60)		
31.0				31.20	164.95	
	Moderately strong black fresh anthracite COAL with thin beds of mudstone with fossilised plant debris. (SOUTH WALES COAL MEASURES - Lower Pinchin Seam)			(0.60)		
31.5	31.2m-33.85m: Coal has smooth 45°, slightly striated, joints.			31.80	164.35	
	Medium strong dark grey fresh sandy SILTSTONE with abundant fossilised plant debris. (SOUTH WALES COAL MEASURES - Lower Pinchin Seam)			(0.70)		
32.0				32.50	163.65	
	Moderately strong black fresh anthracite COAL. Recovered as clayey gravel. (SOUTH WALES COAL MEASURES - Lower Pinchin Seam)			(0.30)		
32.5				32.80	163.35	
	Medium strong dark grey fresh sandy SILTSTONE with abundant fossilised plant debris and rare thin laminae of coal. (SOUTH WALES COAL MEASURES - Lower Pinchin Seam)			(0.60)		
33.0				33.40	162.75	
	Moderately strong black fresh anthracite COAL. Recovered as slightly clayey gravel. (SOUTH WALES COAL MEASURES - Lower Pinchin Seam)			(0.45)		
33.5				33.85	162.30	
	Moderately strong dark grey partially weathered sandy SILTSTONE with a very high fossilised plant debris content. (SOUTH WALES COAL MEASURES - Seatearth)					
34.0						
34.5				(2.25)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
35.70 - 37.20 (1.50)	97	89	73	6	
37.20 - 38.70 (1.50)	100	93	57	>20 NI	
38.70 - 40.20 (1.50)	100	97	83	7	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
35.5	Moderately strong dark grey partially weathered sandy SILTSTONE with a very high fossilised plant debris content. (SOUTH WALES COAL MEASURES - Seatearth)					
36.0				36.10	160.05	
36.5	Weak strong dark grey fresh sandy SILTSTONE with rare fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES)					
37.0						
37.5						
38.0						
38.5						
39.0						
39.5				(7.10)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
40.20 - 41.70 (1.50)	100	63	19	16	
				>20	
41.70 - 43.20 (1.50)	100	92	38	13	
43.20 - 44.70 (1.50)	100	92	49	12	
				NI	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
40.5	Weak strong dark grey fresh sandy SILTSTONE with rare fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES) 40.2m-43.2: Thin grey sandstone laminae.					
41.0	41m: Very closely spaced subvertical to vertical rough joints with orange surface staining.					
41.5						
42.0						
42.5						
43.0				43.20	152.95	
43.5	Strong dark grey fresh SILTSTONE with rare fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES)					
44.0						
44.5				(2.35)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
44.70 - 45.55 (0.85)	100	71	25	10	
45.55 - 46.85 (1.30)	100	88	55	>20	
46.85 - 48.30 (1.45)	100	91	31	14 4	
48.30 - 49.70 (1.40)	100	76	14	>20 NI 19 NI 17	
				NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
45.5	Strong dark grey fresh SILTSTONE with rare fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES) 45m: Light grey thin sandstone laminae.					
	Strong dark grey fresh SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)			45.55 (2.75)	150.60	
48.0						
48.5	Weak dark grey thinly laminated MUDSTONE with pyrite. (SOUTH WALES UPPER COAL MEASURES - Probable Upper Cwmgorse Marine Band)			48.30 (2.30)	147.85	
49.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
49.70 - 51.10 (1.40)	96	47	0	>20	
51.10 - 52.50 (1.40)	100	89	28	16	
52.50 - 54.00 (1.50)	83	61	17	27	
				12	
54.00 - 55.50 (1.50)	100	87	39		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Weak dark grey thinly laminated MUDSTONE with pyrite. (SOUTH WALES UPPER COAL MEASURES - Probable Upper Cwmgorse Marine Band)					
	50.0m-51.1m: Fissile					
50.5				50.60	145.55	
	Strong dark grey fresh SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)					
51.0						
51.5						
52.0						
52.5				(3.90)		
53.0	53.0m-53.5m: Thinly laminated mudstone.					
53.5						
54.0						
54.5	Strong dark grey fresh sandy SILTSTONE with fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			54.50	141.65	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
55.50 - 57.00 (1.50)	95	70	63	12	
				NI	
				5	
57.00 - 58.50 (1.50)	100	87	47	17	
				13	
58.50 - 60.00 (1.50)	100	88	61	NI	
				11	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Strong dark grey fresh sandy SILTSTONE with fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			(1.75)		
55.5						
56.0				56.25	139.90	
	Weak black partially weathered anthracite COAL. (Recovered as a slightly clayey gravel). (SOUTH WALES MIDDLE COAL MEASURES - Thin Coal)			(0.10)	139.80	
56.5				56.35	139.70	
	Moderately strong dark grey SILTSTONE with very high content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			(0.10)		
	Moderately strong to strong dark grey fresh sandy SILTSTONE with a high fossilised plant debris content. (SOUTH WALES MIDDLE COAL MEASURES)			56.45		
57.0				(1.35)		
57.5						
	Strong dark grey fresh sandy SILTSTONE with occasional thin silty sandstone laminae. (SOUTH WALES MIDDLE COAL MEASURES)			57.80	138.35	
58.0						
58.5						
59.0				(2.20)		
59.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH301**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	24/08/2017	Driller:	APEX	Ground Level:	196.15 mOD
End date:	01/09/2017	Logged by:	ESP-AW	Easting:	275987 m
Backfill date:	04/09/2017	Date logged:	21/09/2017	Northing:	208289 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	End of Borehole at 60.000m			60.00	136.15	

60.5 61.0 61.5 62.0 62.5 63.0 63.5 64.0 64.5

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
29/08/2017	12:00	25.00	5.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
60.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring (where the dynamic sampler refused) and followed by continuous rotary coring in the bedrock, to a maximum depth of 60m.
4. BH drilled near TP305 - see TP Logs Appendix A for details of shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Start date:	11/12/2017	Driller:	APEX	Ground Level:	123.89 mOD
End date:	14/12/2017	Logged by:	ESP-AW	Easting:	276220 m
Backfill date:	15/12/2017	Date logged:	18/12/2017	Northing:	208255 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T41

BH302

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.20 - 2.70 (1.50)	83	0	0		
2.70 - 4.20 (1.50)	87	0	0		
4.20 - 5.70 (1.50)	83	0	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.5	Loose brown sandy gravelly COBBLES with abundant fragmented bricks and sandstone building blocks. (MADE GROUND - Demolition Rubble)			(0.60)		
1.0	Soft to firm orange mottled grey very gravelly sandy CLAY. Gravel is fine to medium, occasionally coarse, subangular siltstone and sandstone. Occasional pockets of black coal weathered to a sandy clay. (Probable COLLUVIUM)			0.60	123.29	
1.5						
2.0						
2.5						
3.0				(4.10)		
3.5						
4.0						
4.5	4.6m: Medium angular coal gravel present.					
	Medium dense orange mottled grey and black clayey sandy GRAVEL. Gravel is fine to coarse subangular to angular sandstone and siltstone			4.70	119.19	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH302**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T41				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	11/12/2017	Driller:	APEX	Ground Level:	123.89 mOD
End date:	14/12/2017	Logged by:	ESP-AW	Easting:	276220 m
Backfill date:	15/12/2017	Date logged:	18/12/2017	Northing:	208255 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.70 - 7.20 (1.50)	67	0	0		
7.20 - 8.20 (1.00)	70	46	24	NI 16 NI 13	
8.20 - 9.70 (1.50)	83	57	43	NI 16 14	
				NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Medium dense orange mottled grey and black clayey sandy GRAVEL. Gravel is fine to coarse subangular to angular sandstone and siltstone with orange surface weathering. (Probable COLLUVIUM)			(0.70)		
5.5	Soft to firm orange mottled grey very gravelly sandy CLAY. Gravel is fine to medium, occasionally coarse, subangular siltstone and sandstone. Occasional pockets of black coal weathered to a sandy clay. (Probable COLLUVIUM)			5.40	118.49	
6.0				(1.80)		
6.5						
7.0						
	Strong dark grey fresh sandy SILTSTONE with a moderate to high content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES - Possible seatearth)		→	7.20	116.69	
7.5	7.2m: Medium to coarse coal gravel present.			(1.20)		
8.0	8.2m-8.4m: Low content of fossilised plant debris.					
	Strong dark grey fresh fine grained silty SANDSTONE with rare thin laminae of siltstone. (SOUTH WALES MIDDLE COAL MEASURES)			8.40	115.49	
8.5						
9.0				(1.30)		
9.5						
	Strong dark grey fresh sandy SILTSTONE with rare fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			9.70	114.19	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH302**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T41				
Client: NPTCBC	Ground Level: 123.89 mOD				
Project No: 5859e.05	Easting: 276220 m				
Start date: 11/12/2017	Driller: APEX	Northing: 208255 m			
End date: 14/12/2017	Logged by: ESP-AW				
Backfill date: 15/12/2017	Date logged: 18/12/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
9.70 - 11.20 (1.50)	95	48	39	10 NI 13 NI	
11.20 - 12.70 (1.50)	90	63	41	9	
12.70 - 14.20 (1.50)	87	47	0	>20	
14.20 - 15.70 (1.50)	80	25	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Strong dark grey fresh sandy SILTSTONE with rare fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			(1.30)		
10.5						
11.0	Very strong to strong grey fresh SANDSTONE with occasional thin siltstone laminae. (SOUTH WALES MIDDLE COAL MEASURES)			11.00 (0.20)	112.89	
	Strong dark grey fresh sandy SILTSTONE with rare fossilised plant debris and thin to thick sandstone laminae. (SOUTH WALES MIDDLE COAL MEASURES)			11.20	112.69	
11.5						
12.0				(1.50)		
12.5						
	Weak dark grey to black fresh fissile thinly laminated to thinly bedded MUDSTONE. (SOUTH WALES MIDDLE COAL MEASURES)			12.70	111.19	
13.0						
13.5				(2.00)		
14.0						
14.5						
	Medium strong dark grey fresh SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES)			14.70	109.19	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH302**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T41				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	11/12/2017	Driller:	APEX	Ground Level:	123.89 mOD
End date:	14/12/2017	Logged by:	ESP-AW	Easting:	276220 m
Backfill date:	15/12/2017	Date logged:	18/12/2017	Northing:	208255 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				11	
15.70 - 17.20 (1.50)	90	35	0	>20	
				>20	
17.20 - 18.70 (1.50)	83	51	8	NI	
				>20	
				20	
18.70 - 20.20 (1.50)	100	70	31	>20	
				NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
15.5	Medium strong dark grey fresh SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES)					
16.0						
16.5	16.35m: Rare fine grained gravel sized nodules of amorphous pyrite.			(3.50)		
17.0						
17.5						
18.0						
				18.20	105.69	
18.5	Medium strong to weak fresh dark grey to black silty MUDSTONE with rare thin laminae to thin beds of siltstone. (SOUTH WALES MIDDLE COAL MEASURES)					
19.0						
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T41				
Client: NPTCBC					
Project No: 5859e.05					

BH302

Start date:	11/12/2017	Driller:	APEX	Ground Level:	123.89 mOD
End date:	14/12/2017	Logged by:	ESP-AW	Easting:	276220 m
Backfill date:	15/12/2017	Date logged:	18/12/2017	Northing:	208255 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				>20	
20.20 - 21.70 (1.50)	83	38	25	>20	
				>20	
				NI	
21.70 - 23.20 (1.50)	87	74	17	19	
				NI	
23.20 - 24.70 (1.50)	83	32	0	>20	
				NI	
				>20	
				>20	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Medium strong to weak fresh dark grey to black silty MUDSTONE with rare thin laminae to thin beds of siltstone. (SOUTH WALES MIDDLE COAL MEASURES)					
20.5						
21.0						
21.5				(6.50)		
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
	Very weak to weak black fresh thinly laminae to thinly bedded MUDSTONE. Occasional amorphous pyrite present. (SOUTH WALES MIDDLE COAL			24.70	99.19	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH302**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T41				
Client: NPTCBC	Ground Level: 123.89 mOD				
Project No: 5859e.05	Easting: 276220 m				
Start date: 11/12/2017	Driller: APEX	Northing: 208255 m			
End date: 14/12/2017	Logged by: ESP-AW				
Backfill date: 15/12/2017	Date logged: 18/12/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
24.70 - 26.20 (1.50)	83	35	0	>20 >20 >20 NI	
26.20 - 27.70 (1.50)	97	62	25	>20 NI >20 NI 17	
27.70 - 29.20 (1.50)	73	66	57	>20 NI 6	
29.20 - 30.20 (1.00)	100	86	74		

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
25.5	Very weak to weak black fresh thinly laminae to thinly bedded MUDSTONE. Occasional amorphous pyrite present. (SOUTH WALES MIDDLE COAL MEASURES - Possible Lower Cwmgorse Marine Band)			(3.00)		
26.0						
26.5						
27.0						
27.5				27.70	96.19	
28.0	Medium strong to strong grey fresh sandy siltstone with rare fossilised plant material to 29m. (SOUTH WALES MIDDLE COAL MEASURES)			(2.50)		
28.5						
29.0						
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pantteg Landslide
Site Location:	Pantteg, Ystalyfera
Client:	NPTCBC
Project No:	5859e.05
Drilling method	Rotary cored
Equipment	Beretta T41

BH302

Start date:	11/12/2017	Driller:	APEX
End date:	14/12/2017	Logged by:	ESP-AW
Backfill date:	15/12/2017	Date logged:	18/12/2017

Ground Level:	123.89 mOD
Easting:	276220 m
Northing:	208255 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Medium strong to strong grey fresh sandy siltstone with rare fossilised plant material to 29m. (SOUTH WALES MIDDLE COAL MEASURES)			30.20	93.69	
	End of Borehole at 30.000m					

30.5
31.0
31.5
32.0
32.5
33.0
33.5
34.0
34.5

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
12/12/2017	12:00	7.20	7.20	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter

Casing Diameter

Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 7.2m, follwed by rotary coring to a maximum depth of 30m.

Earth Science Partnership

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Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH303

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.50 - 2.60 (1.10)	91	0			
2.60 - 4.10 (1.50)	100	0			
4.10 - 4.60 (0.50)	100	0			

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Concrete surface over brown probably dense gravelly SAND. (MADE GROUND - Subbase)			(0.30)		
				0.30	133.26	
0.5	Probably loose orange brown sandy gravelly CLAY with rootlets. Gravel is subangular partially weathered (orange discolouration on the surface) fine to coarse sandy siltstone and siltstone. Low subangular siltstone cobble content. (Probable GRADE E SOUTH WALES MIDDLE COAL MEASURES)			(0.80)		
1.0				1.10	132.46	
1.5	Loose orange brown slightly clayey slightly silty gravelly SAND with rootlets to 1.5m. Gravel is subangular partially weathered (orange discolouration on the surface) fine to coarse sandy siltstone and siltstone. Low subangular siltstone cobble content. (Probable GRADE E MIDDLE COAL MEASURES)			(1.50)		
2.0						
2.5				2.60	130.96	
3.0	Grey mottled orange brown clayey slightly sandy GRAVEL. Gravel is partially weathered fine to coarse tabular siltstone. Near horizontal relict bedding visible. (GRADE D SOUTH WALES COAL MEASURES FORMATION)					
3.5				(1.90)		
4.0						
4.5	Moderately strong black partially weathered COAL. (Recovered as soft black very clayey GRAVEL) (SOUTH WALES MIDDLE COAL MEASURES Probable Lower Welsh Seam)			4.50	129.06	
				(0.20)		
	Moderately strong dark grey fresh MUDSTONE			4.70	128.86	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 133.56 mOD				
Project No: 5859e.05	Easting: 276257 m				
Start date: 08/09/2017	Driller: APEX	Northing: 208380 m			
End date: 19/09/2017	Logged by: ESP-AW				
Backfill date: 20/09/2017	Date logged: 22/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
4.60 - 5.50 (0.90)	50	0	0	NI	
5.50 - 6.50 (1.00)	90	41	0	15 NI 17	
6.50 - 8.00 (1.50)	100	25	7	NI 15 NI >20 NI >20 NI >20 NI >20	
8.00 - 9.50 (1.50)	100	41	12	NI >20 NI 12 NI	
				16	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD
	Moderately strong dark grey fresh MUDSTONE with a very high content of fossilised plant debris. (Recovered as loose clayey gravel). (SOUTH WALES MIDDLE COAL MEASURES - Seat earth)			(1.30)	
5.5					
6.0	Medium strong to strong dark grey fresh SILTSTONE with fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			6.00 (0.50)	127.56
6.5	Medium strong to strong dark grey fresh to partially weathered sandy SILTSTONE with fossilised plant debris. Vertical, smooth, joints with orange surface discolouration on fracture surfaces. Roughly horizontal bedding fractures with slight 20mm-30mm wall-rock alteration. NI Zones recovered as clayey fine to coarse angular gravel. (SOUTH WALES MIDDLE COAL MEASURES).			6.50 (2.10)	127.06
7.0					
7.5					
8.0					
8.5	Strong grey fresh SANDSTONE with occasional thinly laminated dark grey sandy siltstone. (SOUTH WALES MIDLE COAL MEASURES)			8.60 (0.50)	124.96
9.0	Strong dark grey fresh SILTSTONE with thinly bedded to thickly laminated black sandy siltstone with fossilised plant debris.(SOUTH WALES MIDDLE COAL MEASURES)			9.10 (0.50)	124.46
9.5	Strong dark grey fresh sandy SILTSTONE with 70° rough, stepped joints with surface orange and staining(SOUTH WALES COAL MEAURES FORMATION)			9.60 (0.70)	123.96

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
9.50 - 11.00 (1.50)	97	51	9	>20 15 NI >20 NI >20 NI 19	
11.00 - 12.50 (1.50)	100	20	0	NI >20 NI 20 NI	
12.50 - 14.00 (1.50)	100	57	24	17 NI >20 NI 9 NI 12 NI >20	
14.00 - 15.50 (1.50)	100	40	30	NI 15 NI 16 NI	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
10.5	Strong dark grey fresh sandy SILTSTONE with 70° rough, stepped joints with surface orange and staining(SOUTH WALES COAL MEAURES FORMATION)			10.30	123.26	
11.0	Weak dark grey fresh fissile MUDSTONE. (SOUTH WALES COAL MEASURES FORMATION)			(5.10)		
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				>20	
				NI	
				>20	
15.50 - 17.00 (1.50)	97	65	40	18	
				NI	
				>20	
				NI	
				12	
17.00 - 18.50 (1.50)	97	42	0	>20	
18.50 - 20.00 (1.50)	100	70	25	>20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Weak dark grey fresh fissile MUDSTONE. (SOUTH WALES COAL MEASURES FORMATION)					
				15.40	118.16	
15.5	Weak to moderately strong dark grey fresh SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
16.0				(1.70)		
16.5						
17.0				17.10	116.46	
	Weak dark grey fresh fissile MUDSTONE. (SOUTH WALES COAL MEASURES FORMATION)					
17.5						
18.0						
18.5						
19.0				(4.40)		
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
20.00 - 21.50 (1.50)	90	29	13	>20	
				>20	
				NI	
				>20	
				NI	
				>20	
				NI	
				>20	
				NI	
				>20	
				NI	
				>20	
				2	
				NI	
				20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
20.5	Weak dark grey fresh fissile MUDSTONE. (SOUTH WALES COAL MEASURES FORMATION)					
21.0						
21.5				21.50	112.06	
22.0	Strong dark grey fresh SILTSTONE. (SOUTH WALES UPPER COAL MEASURES)					
22.5						
23.0				(2.95)		
23.5						
24.0						
24.5	Moderately strong dark grey/black partially weathered MUDSTONE with numerous amorphous pyrite nodules (approximately ≤ 3mm diameter). (SOUTH WALES MIDDLE COAL MEASURES - Possible Lower Cwmgorse Marine Band)			24.45	109.11	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
24.50 - 26.00 (1.50)	77	40	0	NI >20 NI 13 NI 13 NI >20 NI	
26.00 - 27.50 (1.50)	100	75	46	11 NI >20 NI 9	
27.50 - 29.00 (1.50)	80	59	24	10 7	
29.00 - 30.50 (1.50)	97	58	58		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Moderately strong dark grey/black partially weathered MUDSTONE with numerous amorphous pyrite nodules (approximately ≤ 3mm diameter). (SOUTH WALES MIDDLE COAL MEASURES - Possible Lower Cwmgorse Marine Band)			(1.15)		
25.5						
	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES COAL MEAURES FORMATION)			25.60	107.96	
26.0						
26.5				(2.40)		
27.0						
27.5						
28.0	Very strong grey fresh SANDSTONE. (SOUTH WALES MIDDLE COAL MEASURES)			28.00	105.56	
28.5						
29.0						
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH303**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	08/09/2017	Driller:	APEX	Ground Level:	133.56 mOD
End date:	19/09/2017	Logged by:	ESP-AW	Easting:	276257 m
Backfill date:	20/09/2017	Date logged:	22/09/2017	Northing:	208380 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				>20	
				11	
				14	
				NI	
30.50 - 32.00 (1.50)	97	66	49		
				10	
				NI	
32.00 - 33.50 (1.50)	90	61	36	>20	
				NI	
				8	
				8	
				NI	
33.50 - 35.00 (1.50)	100	83	67	9	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Very strong grey fresh SANDSTONE. (SOUTH WALES MIDDLE COAL MEASURES)					
30.5						
31.0						
31.5				(7.00)		
32.0						
32.5						
33.0						
33.5						
34.0						
34.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pantteg Landslide
Site Location:	Pantteg, Ystalyfera
Client:	NPTCBC
Project No:	5859e.05
Drilling method	Rotary cored
Equipment	Beretta T44

BH303

Start date:	08/09/2017	Driller:	APEX
End date:	19/09/2017	Logged by:	ESP-AW
Backfill date:	20/09/2017	Date logged:	22/09/2017
Ground Level:	133.56 mOD		
Easting:	276257 m		
Northing:	208380 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	End of Borehole at 35.000m			35.00	98.56	

35.5
36.0
36.5
37.0
37.5
38.0
38.5
39.0
39.5

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
35.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	4.10

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 4.1m followed by continuous rotary coring to a maximum depth of 35m.

Earth Science Partnership

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Project Name: Pantteg Landslide	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					
Start date: 14/08/2017	Driller: APEX	Ground Level: 71.84 mOD			
End date: 17/08/2017	Logged by: ESP-AW	Easting: 276262 m			
Backfill date: 18/08/2017	Date logged: 25/08/2017	Northing: 208093 m			

BH304

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.20 - 2.70 (1.50)	80				
2.70 - 4.20 (1.50)	78				
4.20 - 5.70 (1.50)	100				

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Grass probably medium dense brown gravelly CLAY with rootlets and fabric. Gravel is subrounded to subangular fine to coarse sandstone with rare fine angular coal. (MADE GROUND)			(0.50)		
0.5	Probably medium dense dark grey slightly clayey sandy GRAVEL. Gravel is subangular to angular fine to coarse mostly tabular mudstone, with fine angular coal. (MADE GROUND - Probable colliery spoil)			0.50	71.34	
1.0						
1.5				(1.70)		
2.0						
	Probably loose to medium dense dark grey gravelly very sandy CLAY. Gravel is fine to medium, occasionally coarse, subrounded to subangular sandstone and mudstone. (MADE GROUND)			2.20	69.64	
2.5				(0.60)		
	Soft orange brown gravelly CLAY. Gravel is fine to coarse angular to subangular sandstone and mudstone, with orange discolouration throughout. (Probable COLLUVIUM)			2.80	69.04	
3.0						
3.5				(1.40)		
4.0						
	Probably loose to medium dense orange brown clayey GRAVEL. Gravel is fine to coarse angular to subangular sandstone and mudstone, with surface orange weathering throughout. (Probable COLLUVIUM)			4.20	67.64	
4.5				(0.40)		
	Soft to firm orange brown gravelly CLAY. Gravel is fine to coarse angular to subangular sandstone and mudstone, with surface orange weathering throughout. (Probable COLLUVIUM)			4.60	67.24	
				(0.50)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

Earth Science Partnership

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Start date:	14/08/2017	Driller:	APEX	Ground Level:	71.84 mOD
End date:	17/08/2017	Logged by:	ESP-AW	Easting:	276262 m
Backfill date:	18/08/2017	Date logged:	25/08/2017	Northing:	208093 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH304

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.70 - 7.20 (1.50)	40	31	31		
7.20 - 8.70 (1.50)	10				
8.70 - 10.20 (1.50)	13				

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Soft to firm orange brown gravelly CLAY. Gravel is fine to coarse angular to subangular sandstone and mudstone, with surface orange weathering throughout. (Probable COLLUVIUM)			5.10	66.74	
5.5	Firm grey gravelly CLAY. Gravel is fine to coarse angular tabular mudstone, with surface orange weathering throughout. (Probable COLLUVIUM)			(2.10)		
6.0						
6.5						
7.0				7.20	64.64	
7.5	Firm to stiff orange brown gravelly CLAY. Gravel is fine to coarse angular to subangular sandstone and mudstone, with orange discolouration throughout. (Probable COLLUVIUM)					
8.0						
8.5						
9.0						
9.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

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Project Name:	Pantteg Landslide
Site Location:	Pantteg, Ystalyfera
Client:	NPTCBC
Project No:	5859e.05
Drilling method	Rotary cored
Equipment	Beretta T44

BH304

Start date:	14/08/2017	Driller:	APEX
End date:	17/08/2017	Logged by:	ESP-AW
Backfill date:	18/08/2017	Date logged:	25/08/2017
Ground Level:	71.84 mOD		
Easting:	276262 m		
Northing:	208093 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
10.20 - 11.70 (1.50)	7	5			
11.70 - 13.30 (1.60)	7				
13.30 - 14.70 (1.40)	37	4			

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Firm to stiff orange brown gravelly CLAY. Gravel is fine to coarse angular to subangular sandstone and mudstone, with orange discolouration throughout. (Probable COLLUVIUM)			(6.10)		
10.5						
11.0						
11.5						
12.0						
12.5						
13.0						
				13.30	58.54	
	Dense dark brown clayey GRAVEL. Gravel is tabular angular to subangular weak mudstone, with surface orange weathering. (Probable GRADE D/E SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
13.5						
14.0				(1.40)		
14.5						
				14.70	57.14	
	Moderately weak dark grey partially weathered (orange surface discolouration) MUDSTONE. (Recovered as a clayey mudstone gravel).					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

Earth Science Partnership

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Start date:	14/08/2017	Driller:	APEX	Ground Level:	71.84 mOD
End date:	17/08/2017	Logged by:	ESP-AW	Easting:	276262 m
Backfill date:	18/08/2017	Date logged:	25/08/2017	Northing:	208093 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH304

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
14.70 - 16.20 (1.50)	70				
16.20 - 17.70 (1.50)	7				
17.70 - 19.20 (1.50)	27	10			
19.20 - 20.70 (1.50)	60	37	19	15 NI 11 NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
15.5	Moderately weak dark grey partially weathered (orange surface discolouration) MUDSTONE. (Recovered as a clayey mudstone gravel). (Probable GRADE C SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(3.00)		
16.0						
16.5						
17.0						
17.5				17.70	54.14	
18.0	Strong grey fresh SANDSTONE. <2mm thick quartz veins. Gravelly clay infill on 45° joint with orange/ brown on the fracture face. (Partially recovered as very clayey gravel). (Probable GRADE B SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(1.50)		
18.5						
19.0				19.20	52.64	
19.5	Strong light grey fresh, with orange staining on some faces, very coarse grained SANDTSONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION) Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.05) 19.25 (1.15)	52.59	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

Earth Science Partnership

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Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH304**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 71.84 mOD				
Project No: 5859e.05	Easting: 276262 m				
Start date: 14/08/2017	Driller: APEX	Northing: 208093 m			
End date: 17/08/2017	Logged by: ESP-AW				
Backfill date: 18/08/2017	Date logged: 25/08/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				6	
20.70 - 22.00 (1.30)	81	79	73	11	
				4	
22.00 - 23.50 (1.50)	80	72	53	NI	
				5	
				NI	
				10	
				NI	
				13	
23.50 - 25.00 (1.50)	60	33	27	NI	
				6	
				7	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
				20.40	51.44	
20.5	Moderately strong to strong black fresh thinly to thickly laminated sandy MUDSTONE with laminae of light grey fine grained sandstone. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.20)		
				20.60	51.24	
				(0.10)	51.14	
	Moderately strong black fresh sandy MUDSTONE with a high contents of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			20.70		
				(0.30)		
21.0				21.00	50.84	
	Strong grey fresh sandy SILTSTONE with a high content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
	Strong to very strong grey fine to medium grained SANDSTONE with rare thin mudstone laminae. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.90)		
21.5						
				21.90	49.94	
22.0	Strong black fresh sandy MUDSTONE. (Mudstone flame structure protruding in the above sandstone). (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
				(1.00)		
22.5						
				22.90	48.94	
23.0	Strong grey fresh fine to medium grained SANDSTONE with very thin mudstone laminae. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.40)		
				23.30	48.54	
	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
23.5				(1.00)		
24.0						
				24.30	47.54	
	Strong fresh thickly to thinly laminated fine to medium grained light grey SANDSTONE and black organic mudstone. Laminae are irregular and undulating with fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.40)		
24.5				24.70	47.14	
	Strong light grey fresh silty fine to medium grained SANDSTONE with sub-vertical joint slightly					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

Earth Science Partnership

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Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH304**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 71.84 mOD				
Project No: 5859e.05	Easting: 276262 m				
Start date: 14/08/2017	Driller: APEX	Northing: 208093 m			
End date: 17/08/2017	Logged by: ESP-AW				
Backfill date: 18/08/2017	Date logged: 25/08/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
25.00 - 26.00 (1.00)	65	59	51	TBC	
26.00 - 27.50 (1.50)	90	58	58	TBC	
27.50 - 29.00 (1.50)	87	75	63	9 NI 2	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
25.5	Strong light grey fresh silty fine to medium grained SANDSTONE with sub-vertical joint slightly undulating with a thin (<2mm) white quartz infill. Joint persists through diameter and to end of core run. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(2.30)		
26.0						
26.5						
27.0	Strong grey fresh SILTSTONE. (Recovered as angular slightly sandy slightly clayey gravel). (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			27.00 (0.50)	44.84	
27.5	Medium strong to strong light grey fresh silty fine to medium grained SANDSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			27.50 (1.50)	44.34	
28.0						
28.5						
29.0	End of Borehole at 29.000m			29.00	42.84	
29.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
14/08/2017	12:00	4.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
29.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	14.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.2 followed by continuous rotary coring to a maximum depth of 29m.

Earth Science Partnership

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Start date:	09/08/2017	Driller:	APEX	Ground Level:	100.17 mOD
End date:	10/08/2017	Logged by:	ESP-AW	Easting:	276049 m
Backfill date:	11/08/2017	Date logged:	13/08/2017	Northing:	207998 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH305

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.20 - 2.70 (1.50)	90				
2.70 - 4.20 (1.50)	100				
4.20 - 5.70 (1.50)	100				

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
0.5	Brown gravelly sandy CLAY with numerous roots and occasional glass fragments. Gravel is fine to coarse subangular sandstone with occasional brick fragments. (MADE GROUND - Topsoil)			(0.30)		
				0.30	99.87	
	Probably loose sandy clayey GRAVEL. Gravel is fine to coarse, subrounded to angular sandstone, mudstone and siltstone. (Probable COLLUVIUM)			(0.90)		
1.0						
1.5	Probably medium dense to dense brown slightly sandy clayey GRAVEL. Gravel is fine to coarse subangular sandstone, mudstone with rare fine angular coal. (Probable COLLUVIUM)			1.20	98.97	
2.0				(1.50)		
2.5						
	Soft to firm grey gravelly slightly silty CLAY. Gravel is fine to coarse subrounded to subangular sandstone and mudstone. (Probable COLLUVIUM)			2.70	97.47	
3.0						
3.5				(1.50)		
4.0						
	Probably loose clayey GRAVEL. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. (Probable COLLUVIUM)			4.20	95.97	
4.5				(0.40)		
	Probably medium dense to dense brown occasionally mottled black and orange slightly sandy clayey GRAVEL. Gravel is subrounded to subangular fine to coarse sandstone and			4.60	95.57	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH305**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	09/08/2017	Driller:	APEX	Ground Level:	100.17 mOD
End date:	10/08/2017	Logged by:	ESP-AW	Easting:	276049 m
Backfill date:	11/08/2017	Date logged:	13/08/2017	Northing:	207998 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.70 - 5.90 (0.20)	100				
5.90 - 7.20 (1.30)	15	8			
7.20 - 8.70 (1.50)	86				
8.70 - 8.95 (0.25)	100				
8.95 - 10.45 (1.50)	5				

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
5.5	Probably medium dense to dense brown occasionally mottled black and orange slightly sandy clayey GRAVEL. Gravel is subrounded to subangular fine to coarse sandstone and mudstone. (Probable COLLUVIUM)			(5.85)		
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

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Start date:	09/08/2017	Driller:	APEX	Ground Level:	100.17 mOD
End date:	10/08/2017	Logged by:	ESP-AW	Easting:	276049 m
Backfill date:	11/08/2017	Date logged:	13/08/2017	Northing:	207998 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH305

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
10.45 - 11.70 (1.25)	72	29	18	NI >20 20 NI 10 NI	
11.70 - 13.20 (1.50)	96	70	55	4 >20	
13.20 - 14.70 (1.50)	93	86	86	4 NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Probably medium dense to dense brown occasionally mottled black and orange slightly sandy clayey GRAVEL. Gravel is subrounded to subangular fine to coarse sandstone and mudstone. (Probable COLLUVIUM)					
10.5	No Recovery. (Probable Grade D/E SOUTH WALES MIDDLE COAL MEASURES)			10.45 (0.55)	89.72	
11.0	Moderately strong black fresh anthracite COAL. (Recovered as angular fine to coarse coal GRAVEL). (Possible Lower Welsh - SOUTH WALES MIDDLE COAL MEASURES FORMATION)			11.00 (0.25)	89.17	
11.5	Weak to moderately strong dark grey fresh MUDSTONE with a high content of fossilised plant debris. Rare thinly laminated coal. (Coal parting - SOUTH WALES MIDDLE COAL MEASURES FORMATION)			11.25 (0.75)	88.92	
12.0	Strong dark grey fresh sandy MUDSTONE with a high content of fossilised plant debris. Orange weathering on fracture surfaces, with a clayey gravel infill. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			12.00 (3.50)	88.17	
12.5						
13.0						
13.5						
14.0						
14.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

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Start date:	09/08/2017	Driller:	APEX	Ground Level:	100.17 mOD
End date:	10/08/2017	Logged by:	ESP-AW	Easting:	276049 m
Backfill date:	11/08/2017	Date logged:	13/08/2017	Northing:	207998 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH305

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
14.70 - 16.20 (1.50)	96	91	68	4 7	
16.20 - 17.60 (1.40)	86	81	76	6 2	
17.60 - 19.10 (1.50)	93	76	57	20 NI 11 NI 6	
19.10 - 20.50 (1.40)	86	78	39	NI 6	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Strong dark grey fresh sandy MUDSTONE with a high content of fossilised plant debris. Orange weathering on fracture surfaces, with a clayey gravel infill. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
15.5				15.50	84.67	
	Strong grey fresh SANDSTONE thinly to thickly laminated with dark grey sandy siltstone, and thinly laminated coal. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(0.40)		
				15.90	84.27	
16.0	Strong dark grey sandy SILTSTONE with thinly to thickly laminated sandstone. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
16.5				(1.10)		
17.0	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			17.00	83.17	
17.5						
18.0				(2.20)		
18.5						
19.0						
	Medium strong to strong very dark grey fresh MUDSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			19.20	80.97	
19.5				(1.10)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

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Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH305**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	09/08/2017	Driller:	APEX	Ground Level:	100.17 mOD
End date:	10/08/2017	Logged by:	ESP-AW	Easting:	276049 m
Backfill date:	11/08/2017	Date logged:	13/08/2017	Northing:	207998 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				NI	
20.50 - 22.00 (1.50)	96	61	33	10	
				6	
22.00 - 23.50 (1.50)	100	82	76	7	
23.50 - 23.95 (0.45)	96	24	0	NI	
				6	
23.95 - 25.00 (1.05)	100	71	58	NI	
				4	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Medium strong to strong very dark grey fresh MUDSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			20.30	79.87	
20.5						
21.0				(1.20)		
21.5	Medium strong to strong partially weathered MUDSTONE. (Recovered as clayey fine to coarse angular gravel). (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			21.50	78.67	
				(0.20)		
	Strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			21.70	78.47	
22.0						
22.5				(2.00)		
23.0						
23.5						
	Strong dark grey fresh SILTSTONE with rare plant fossils. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			23.70	76.47	
24.0						
				(1.30)		
24.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

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Project Name:	Pantteg Landslide
Site Location:	Pantteg, Ystalyfera
Client:	NPTCBC
Project No:	5859e.05
Drilling method	Rotary cored
Equipment	Beretta T44

BH305

Start date:	09/08/2017	Driller:	APEX
End date:	10/08/2017	Logged by:	ESP-AW
Backfill date:	11/08/2017	Date logged:	13/08/2017
Ground Level:	100.17 mOD		
Easting:	276049 m		
Northing:	207998 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	End of Borehole at 25.000m			25.00	75.17	

25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/08/2017	12:00	3.00		0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
25.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	10.20

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to 10.45m followed by continuous rotary coring to a maximum depth of 25m.

Earth Science Partnership

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Start date:	21/08/2017	Driller:	APEX	Ground Level:	82.19 mOD
End date:	06/09/2017	Logged by:	ESP-AW	Easting:	275941 m
Backfill date:	07/09/2017	Date logged:	05/09/2017	Northing:	207704 m

Project Name: Pantteg Landslide
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.05

Drilling method: Rotary cored
Equipment: Beretta T44

BH306

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.20 - 2.70 (1.50)	77	0	0		
2.70 - 4.20 (1.50)	83	0	0		
4.20 - 5.70 (1.50)	60	0	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD
0.5	Tarmacadam surface over soft gravelly silty CLAY. Gravel is fine to coarse subangular to angular mudstone and siltstone and fine to medium coal. Occasional brick, ceramic and slag fragments present. (MADE GROUND)				
1.0					
1.5					
2.0			→	(3.80)	
2.5					
3.0					
3.5					
4.0	Firm grey mottled brown and orange gravelly silty sandy CLAY. Gravel is fine to coarse subangular siltstone and mudstone. Iron oxide staining present on the surface of gravel and cobbles. (Probable COLLUVIUM)			3.80	78.39
4.5					

Backfill/ Install-ations

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH306**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					

Start date:	21/08/2017	Driller:	APEX	Ground Level:	82.19 mOD
End date:	06/09/2017	Logged by:	ESP-AW	Easting:	275941 m
Backfill date:	07/09/2017	Date logged:	05/09/2017	Northing:	207704 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.70 - 6.70 (1.00)	100	0	0		
6.90 - 8.40 (1.50)	20	0	0		
8.40 - 9.90 (1.50)	100	0	0		

Strata Details

Depth	Description	Legend
	Firm grey mottled brown and orange gravelly silty sandy CLAY. Gravel is fine to coarse subangular siltstone and mudstone. Iron oxide staining present on the surface of gravel and cobbles. (Probable COLLUVIUM)	
5.5		
6.0		
6.5		
7.0		
7.5		
8.0		
8.5		
9.0		
9.5		

Water: Strikes/Standing

Depth: Depth (Thickness), mOD

Backfill/Install-ations

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					
Start date: 21/08/2017	Driller: APEX	Ground Level: 82.19 mOD			
End date: 06/09/2017	Logged by: ESP-AW	Easting: 275941 m			
Backfill date: 07/09/2017	Date logged: 05/09/2017	Northing: 207704 m			

BH306

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
9.90 - 10.40 (0.50)	20	0	0		
10.40 - 11.90 (1.50)	67	0	0		
11.90 - 13.10 (1.20)	50	0	0		
13.10 - 14.60 (1.50)	100	0	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Firm grey mottled brown and orange gravelly silty sandy CLAY. Gravel is fine to coarse subangular siltstone and mudstone. Iron oxide staining present on the surface of gravel and cobbles. (Probable COLLUVIUM)			(16.70)		
10.5						
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.05					
Start date: 21/08/2017	Driller: APEX	Ground Level: 82.19 mOD			
End date: 06/09/2017	Logged by: ESP-AW	Easting: 275941 m			
Backfill date: 07/09/2017	Date logged: 05/09/2017	Northing: 207704 m			

BH306

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
14.60 - 16.10 (1.50)	100	0	0		
16.10 - 17.50 (1.40)	0	0	0		
17.50 - 19.00 (1.50)	100	0	0		
19.00 - 20.50 (1.50)	20	0	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
15.5	Firm grey mottled brown and orange gravelly silty sandy CLAY. Gravel is fine to coarse subangular siltstone and mudstone. Iron oxide staining present on the surface of gravel and cobbles. (Probable COLLUVIUM)					
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

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Start date:	21/08/2017	Driller:	APEX	Project Name: Pantteg Landslide	Drilling method: Rotary cored
End date:	06/09/2017	Logged by:	ESP-AW	Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44
Backfill date:	07/09/2017	Date logged:	05/09/2017	Client: NPTCBC	Ground Level: 82.19 mOD
				Project No: 5859e.05	Easting: 275941 m
					Northing: 207704 m

BH306

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
20.50 - 22.00 (1.50)	90	81	71	NI 7 NI 12 NI 5	
22.00 - 23.50 (1.50)	100	73	56	NI 8 NI 6 8	
23.50 - 24.80 (1.30)	96	84	74	10 NI 3	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Firm grey mottled brown and orange gravelly silty sandy CLAY. Gravel is fine to coarse subangular siltstone and mudstone. Iron oxide staining present on the surface of gravel and cobbles. (Probable COLLUVIUM)					
20.5	Medium strong to strong dark grey fresh sandy SILTSTONE with rare content of fossilised plant debris and occasional irregular thickly laminated fresh medium to coarse grained sandstone. Bedding fractures are largely smooth with slight undulations. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			20.50	61.69	
21.0						
21.5				(2.20)		
22.0			→			
22.5						
	Moderately strong dark grey to black thinly to thickly laminated SILTSTONE with fossilised plant debris. Laminae are irregular and undulating. (SOUTH WALES MIDDLE COAL MEASURES)			22.70	59.49	
				(0.10)	59.39	
23.0	Medium strong to strong dark grey fresh sandy SILTSTONE with rare content of fossilised plant debris and occasional thickly laminated fresh medium coarse sand. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			22.80		
				(0.50)		
				23.30	58.89	
23.5	Strong dark grey fresh SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)					
				(0.90)		
24.0						
	Strong dark grey fresh sandy SILTSTONE with black coal thin laminae. (SOUTH WALES MIDDLE COAL MEASURES)			24.20	57.99	
				(0.20)		
24.5	Strong to moderately strong dark grey fresh sandy SILTSTONE with a high content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			24.40	57.79	
				(0.60)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				**BH306**
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 82.19 mOD				
Project No: 5859e.05	Easting: 275941 m				
Start date: 21/08/2017	Driller: APEX	Northing: 207704 m			
End date: 06/09/2017	Logged by: ESP-AW				
Backfill date: 07/09/2017	Date logged: 05/09/2017				

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
24.80 - 26.30 (1.50)	97	76	76	NI NI	
26.30 - 27.80 (1.50)	100	27	0	20 NI >20 NI >20 NI 20 NI >20 NI	
27.80 - 29.30 (1.50)	97	42	24	20 NI >20 NI >20 NI 18 NI >20 NI 17 NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD
25.5	Strong to moderately strong dark grey fresh sandy SILTSTONE. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			25.00 (1.30)	57.19
26.0				26.30	55.89
26.5	Weak to moderately strong dark grey fresh (with partially weathered NI zones) SILTSTONE. NI zones are recovered as fresh, locally partially weathered, angular fine to coarse sandy clayey siltstone gravel. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)				
27.0					
27.5					
28.0					
28.5					
29.0					
29.5			→		

Backfill/ Install-ations

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pantteg Landslide	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC	Ground Level: 82.19 mOD				
Project No: 5859e.05	Easting: 275941 m				
Start date: 21/08/2017	Driller: APEX	Northing: 207704 m			
End date: 06/09/2017	Logged by: ESP-AW				
Backfill date: 07/09/2017	Date logged: 05/09/2017				

BH306

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
29.30 - 30.80 (1.50)	100	68	61		
30.80 - 32.30 (1.50)	100	74	60		
32.30 - 33.80 (1.50)	87	48	28		

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
	Weak to moderately strong dark grey fresh (with partially weathered NI zones) SILTSTONE. NI zones are recovered as fresh, locally partially weathered, angular fine to coarse sandy clayey siltstone gravel. (SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(7.50)		
30.5						
31.0						
31.5						
32.0						
32.5						
33.0						
33.5						
	End of Borehole at 33.800m			33.80	48.39	
34.0						
34.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
31-08-2017	05:00	7.00	7.00	6
01-09-2017	08:00	7.00	7.00	4
01-09-2017	05:00	17.50	17.50	10.4
04-09-2017	08:00	17.50	17.50	3.9
04-09-2017	05:00	19.60	19.60	11.4

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
22/08/2017	12:00	2.00		0.00	0.00	
06/09/2017	12:00	29.50	20.50	0.00	0.00	
06/09/2017	12:00	22.00	20.50	0.00	0.00	

Hole Diameter

Hole Depth	Hole Diameter
33.80	73

Casing Diameter

Casing Diameter	Casing Depth
200	19.60
140	20.50

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling and cable percussion to 19.0m followed by rotary coring to a maximum depth of 33.8m.

Appendix G

Rotary Coring Records – 96 Cyfyng Road

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Start date:	09/11/2017	Driller:	APEX	Ground Level:	107.22 mOD
End date:	10/11/2017	Logged by:	ESP-AW	Easting:	276267 m
Backfill date:	10/11/2017	Date logged:	10/11/2017	Northing:	208268 m

Project Name: 96 Cyfyng Road, Pantteg
Site Location: Pantteg, Ystalyfera
Client: NPTCBC
Project No: 5859e.07

Drilling method: Rotary cored
Equipment: Beretta T44

BH401

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
1.20 - 2.70 (1.50)	67				
2.70 - 4.20 (1.50)	67				
4.20 - 5.70 (1.50)	90	0	0		
5.70 - 6.50 (0.80)	100	0	0		
6.50 - 8.00 (1.50)	100	0	0	NI	
8.00 - 9.00 (1.00)	100	0	0		
9.00 - 9.50 (0.50)	100	0	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
0.5	CONCRETE			(0.15)	107.07	
	Probably medium dense black sandy fine to coarse GRAVEL and COBBLES of subangular sandstone. (MADE GROUND)			0.15		
1.0				(1.05)		
1.5	Very loose dark brown sandy GRAVEL of fine to coarse angular to subangular sandstone with some coal. Occasional pieces of polystyrene. (MADE GROUND)			1.20	106.02	
2.0				(1.10)		
2.5	Very soft brown mottled orange-brown clayey silty very sandy GRAVEL with occasional partially decomposed wood. Gravel is fine to coarse angular mudstone, siltstone and coal. (MADE GROUND)			2.30	104.92	
3.0				(1.20)		
3.5	Soft grey silty sandy slightly gravelly CLAY with occasional partially decomposed wood and fragments of possible slag. Gravel is subangular to angular fine to coarse mudstone. (MADE GROUND)			3.50	103.72	
4.0				(0.50)		
4.5	Stiff brown, orange and grey gravelly very sandy CLAY. Gravel is angular, tabular siltstone with orange surface discolouration. (GRADE E SOUTH WALES MIDDLE COAL MEASURES FORMATION)			4.00	103.22	
5.0				(1.80)		
5.5						
6.0	Very dense slightly clayey sandy GRAVEL of fine to coarse angular siltstone with orange surface discolouration. (GRADE D SOUTH WALES MIDDLE COAL MEASURES)			5.80	101.42	
6.5				(0.70)		
7.0	Very dense grey and orange sandy GRAVEL of angular, tabular mudstone with orange surface discoloration and thin to thick relic laminae. (GRADE D SOUTH WALES MIDDLE COAL MEASURES FORMATION)			6.50	100.72	
7.5						
8.0				(2.50)		
8.5						
9.0	Very weak black partially weathered thinly to thickly laminated MUDSTONE. Orange discolouration on fracture surfaces, and occasionally on the surface of laminae. (Recovered as a slightly clayey fine to coarse angular gravel).			9.00	98.22	
9.5				(0.45)		
				9.45	97.77	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
09-11-2017	04:30	8.00	5.70	Dry
10-11-2017	08:00	8.00	5.70	Dry
10-11-2017	12:00	12.00	5.70	9.7

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/11/2017	12:00	4.20	4.20	0.00	4.20	
10/11/2017	12:00	11.00	5.70	40.00	9.70	

Hole Diameter

Hole Depth	Hole Diameter
12.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 9.0m followed by rotary coring to a maximum depth of 12m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 96 Cyfyng Road, Pantteg	Drilling method: Rotary cored				
Site Location: Pantteg, Ystalyfera	Equipment: Beretta T44				
Client: NPTCBC					
Project No: 5859e.07					

BH401

Start date:	09/11/2017	Driller:	APEX	Ground Level:	107.22 mOD
End date:	10/11/2017	Logged by:	ESP-AW	Easting:	276267 m
Backfill date:	10/11/2017	Date logged:	10/11/2017	Northing:	208268 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
9.50 - 10.50 (1.00)	100	67	27	12	
10.50 - 12.00 (1.50)	100	68	42	7	
				13	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
10.5	Very weak black partially weathered thinly to thickly laminated MUDSTONE. Orange discolouration on fracture surfaces, and occasionally on the surface of laminae. (Recovered as a slightly clayey fine to coarse angular gravel). (GRADE B SOUTH WALES MIDDLE COAL MEASURES FORMATION)			(2.55)		
11.0						
11.5	Weak becoming very strong dark grey fresh sandy SILTSTONE with a high content of fossilised plant debris to 10.4m. (SOUTH WALES MIDDLE COAL MEASURES)					
12.0	End of Borehole at 12.000m			12.00	95.22	
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth
09-11-2017	04:30	8.00	5.70	Dry
10-11-2017	08:00	8.00	5.70	Dry
10-11-2017	12:00	12.00	5.70	9.7

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed
09/11/2017	12:00	4.20	4.20	0.00	4.20	
10/11/2017	12:00	11.00	5.70	40.00	9.70	

Hole Diameter

Hole Depth	Hole Diameter
12.00	73

Casing Diameter

Casing Diameter	Casing Depth
140	5.70

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising dynamic sampling to a depth of 9.0m followed by rotary coring to a maximum depth of 12m.

Appendix H

Rotary Coring Records –

Pen-y-Graig Area

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	02/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	144.77 mOD
End date:	16/08/2018	Logged by:	ESP - AW	Easting:	275956 m
Backfill date:	16/08/2018	Date logged:	04/09/2018	Northing:	208014 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
0.00 - 1.20 (1.20)	100				
1.20 - 2.50 (1.30)	73				
2.50 - 3.60 (1.10)	95				
3.60 - 3.70	100	100	100		
3.70 - 3.90 (0.20)	100	65	65		
3.90 - 4.00	100	0	0		
4.00 - 4.65 (0.65)	100	35	35	11	
4.65 - 5.00 (0.35)	86	0	0	NI	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
0.5	Probably loose dark brown and black slightly clayey silty slightly sandy GRAVEL. Gravel subangular tabular fine to coarse distinctly weathered siltstone. Occasional rootlets present. Coal ashy pocket. (MADE GROUND - Colliery Spoil - Coarse discard)			(2.50)		
1.0						
1.5						
2.0						
2.5	Probably loose dark brown and black slightly clayey silty slightly sandy GRAVEL. Gravel subangular tabular fine to coarse distinctly weathered siltstone. Occasional rootlets present. Coal ashy pocket. (MADE GROUND - Colliery Spoil - Coarse discard)			2.50	142.27	
3.0				(1.00)		
3.5	Strong to very strong light grey medium to very thinly bedded coarse-grained SANDSTONE. Bedding planes are planar slightly rough and orientated 45° degree. <1mm thick white mineral veins, perpendicular to bedding present. (Probable TOPPLED BLOCK)			3.50	141.27	
4.0						
4.5				(2.60)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	02/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	144.77 mOD
End date:	16/08/2018	Logged by:	ESP - AW	Easting:	275956 m
Backfill date:	16/08/2018	Date logged:	04/09/2018	Northing:	208014 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
5.00 - 6.00 (1.00)	75	0	0	2	
				NI	
6.00 - 7.50 (1.50)	60				
7.50 - 9.00 (1.50)	100				
9.00 - 9.15	100			NI	
9.15 - 10.50 (1.35)	100	81	60	>20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
5.5	Strong to very strong light grey medium to very thinly bedded coarse-grained SANDSTONE. Bedding planes are planar slightly rough and orientated 45° degree. <1mm thick white mineral veins, perpendicular to bedding present. (Probable TOPPLED BLOCK)					
6.0				6.10	138.67	
	SEE APPENDED DETAILED LOG.					
6.5						
7.0						
7.5				(2.60)		
8.0						
8.5						
	Weak black fresh COAL. (SOUTH WALES UPPER COAL MEASURES - Possible Lower Pinchin)			8.70	136.07	
				(0.30)		
9.0	Very weak dark grey and black fissile partially weathered sandy SILTSTONE with abundant plant debris. Rough slightly stepped ~70° fresh joint. Bedding fractures are fresh smooth and undulating. (SOUTH WALES UPPER COAL MEASURES - Possible Lower Pinchin)			9.00	135.77	
				(0.45)		
9.5	Medium strong dark grey fresh sandy SILTSTONE with occasional plant debris. Rough slightly stepped ~70° to vertical joint with partial orange discoloration. Bedding fractures are sub horizontal fresh and planar. (SOUTH WALES UPPER COAL			9.45	135.32	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored				
Site Location: Pantteg Landslide	Equipment: P60A				
Client: NPT	Ground Level: 144.77 mOD				
Project No: 5859e.09	Easting: 275956 m				
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Northing: 208014 m			
End date: 16/08/2018	Logged by: ESP - AW				
Backfill date: 16/08/2018	Date logged: 04/09/2018				

BH601

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				6	
10.50 - 12.00 (1.50)	100	60	60	23	
				6	
12.00 - 13.30 (1.30)	100	23	19	>20	
13.30 - 14.10 (0.80)	88	33	29	14	
				NI	
				>20	
				NI	
14.10 - 15.50 (1.40)	100	53	24	20	
				NI	
				>20	
				NI	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
10.5	Medium strong dark grey fresh sandy SILTSTONE with occasional plant debris. Rough slightly stepped ~70° to vertical joint with partial orange discoloration. Bedding fractures are sub horizontal fresh and planar. (SOUTH WALES UPPER COAL MEASURES) 10.50m - 11.50m: Abundant thin to thick laminations of light grey sandstone.			(2.05)		
11.5	Medium strong dark grey and light grey fresh thinly laminated to thinly bedded sandy SILTSTONE and SANDSTONE. Rare fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES)			11.50	133.27	
13.0	Medium strong dark grey fresh sandy SILTSTONE with moderate content of fossilised plant debris. (SOUTH WALES UPPER COAL MEASURES)			(1.50)		
14.5	Medium strong dark grey fresh sandy SILTSTONE with black thin mudstone laminae. (SOUTH WALES UPPER COAL MEASURES)			13.00	131.77	
				(1.40)		
				14.40	130.37	
				(1.10)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored				
Site Location: Pantteg Landslide	Equipment: P60A				
Client: NPT					
Project No: 5859e.09					
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Ground Level: 144.77 mOD			
End date: 16/08/2018	Logged by: ESP - AW	Easting: 275956 m			
Backfill date: 16/08/2018	Date logged: 04/09/2018	Northing: 208014 m			

BH601

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				>20	
				NI	
15.50 - 17.00 (1.50)	100	75	41	17	
				NI	
17.00 - 18.50 (1.50)	90	60	7	>20	
18.50 - 19.00 (0.50)	90	28	0	NI	
19.00 - 20.00 (1.00)	95	13	0	>20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Medium strong dark grey fresh sandy SILTSTONE with black thin mudstone laminae. (SOUTH WALES UPPER COAL MEASURES)					
15.5	Medium strong dark grey fresh SILTSTONE with rare thin laminae and lenses of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES)			15.50	129.27	
16.0						
16.5				(2.00)		
17.0						
17.5	Weak black fresh MUDSTONE. (SOUTH WALES UPPER COAL MEASURES)			17.50	127.27	
18.0				(1.00)		
18.5	Medium strong dark grey fresh SILTSTONE with rare thin to thick sandy siltstone and sandstone laminae and lenses. Subvertical to vertical rough planar joint with surface discoloration to dark red and orange. NI zones locally present between very closely spaced subvertical to vertical fractures. Bedding fractures are sub horizontal fresh and planar. (SOUTH WALES UPPER COAL MEASURES) 18.5m - 18.75m: NI Zone recovered as a slightly sandy medium to coarse angular siltstone gravel.			18.50	126.27	
19.0						
19.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored				
Site Location: Pantteg Landslide	Equipment: P60A				
Client: NPT	Ground Level: 144.77 mOD				
Project No: 5859e.09	Easting: 275956 m				
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Northing: 208014 m			
End date: 16/08/2018	Logged by: ESP - AW				
Backfill date: 16/08/2018	Date logged: 04/09/2018				

BH601

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
20.00 - 21.50 (1.50)	93	2	0	NI >20 NI >20	
21.50 - 23.00 (1.50)	97	4	0	NI >20	
23.00 - 24.50 (1.50)	100	50	40	NI >20 NI >20 NI	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
20.5	Medium strong dark grey fresh SILTSTONE with rare thin to thick sandy siltstone and sandstone laminae and lenses. Subvertical to vertical rough planar joint with surface discoloration to dark red and orange. NI zones locally present between very closely spaced subvertical to vertical fractures. Bedding fractures are sub horizontal fresh and planar. (SOUTH WALES UPPER COAL MEASURES) 20.0m - 21.0m: Abundant thin to thick laminae and lenses of sandstone. 20.55m: Sub-horizontal 2mm thick white quartz vein.			(3.00)		
21.0						
21.5	Medium strong fresh thickly laminated to thinly bedded SILTSTONE with rare lenses of sandy siltstone. (SOUTH WALES UPPER COAL MEASURES)			21.50	123.27	
22.0						
22.5						
23.0				(3.50)		
23.5						
24.0						
24.5	24.5m - 24.8m: Vertical rough planar joint with yellow brown discolouration extending > 1cm in the wall rock. Slightly weakened and breaks to a fine sand/silt.					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	02/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	144.77 mOD
End date:	16/08/2018	Logged by:	ESP - AW	Easting:	275956 m
Backfill date:	16/08/2018	Date logged:	04/09/2018	Northing:	208014 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
24.50 - 25.50 (1.00)	95	60	35		
25.50 - 27.00 (1.50)	97	77	25	13	
27.00 - 27.80 (0.80)	97	58	38	NI 19	
27.80 - 29.30 (1.50)	97	56	14	>20 NI 19	
29.30 - 30.00 (0.70)	100	61	0		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Weak black fresh MUDSTONE with abundant >2mm amorphous pyrite nodules. (Possible UPPER CWMGORSE MARINE BAND)			25.00 (0.40)	119.77	
25.5	Medium strong fresh thickly laminated to thinly bedded SILTSTONE with rare lenses of sandy siltstone. (SOUTH WALES MIDDLE COAL MEASURES)			25.40 (4.00)	119.37	
26.0						
26.5						
27.0						
27.5						
28.0	28.1m - 28.7m: joints are vertical to subvertical undulating rough with orange to dark red surface staining.					
28.5						
29.0						
29.5	Medium strong fresh thickly laminated to thinly bedded SILTSTONE with rare lenses of sandy siltstone and a low content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			29.40	115.37	

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	02/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	144.77 mOD
End date:	16/08/2018	Logged by:	ESP - AW	Easting:	275956 m
Backfill date:	16/08/2018	Date logged:	04/09/2018	Northing:	208014 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
30.00 - 30.60 (0.60)	92	73	27		
30.60 - 32.10 (1.50)	100	92	71	13	
				NI	
				17	
32.10 - 32.60 (0.50)	100	58	32	NI	
				>20	
				NI	
32.60 - 34.10 (1.50)	97	92	92	7	
34.10 - 35.60 (1.50)	100	63	63		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
30.5	Medium strong fresh thickly laminated to thinly bedded SILTSTONE with rare lenses of sandy siltstone and a low content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES) 30.0m - 31.8m: Bedding fractures are fresh subhorizontal planar slightly rough.			(2.75)		
31.0						
31.5						
32.0						
	Weak black fresh COAL. (Recovered as medium to coarse angular coal gravel). (MIDDLE SOUTH WALES COAL MEASURES - Thin Coal)			32.15 (0.05)	112.62 112.57	
	Weak to medium strong dark grey and black thinly bedded organic sandy SILTSTONE with a very high fossilised plant debris content. (SOUTH WALES MIDDLE COAL MEASURES - Seatearth)			32.20 (0.30)		
32.5	Strong light grey fresh fine to medium grained SANDSTONE with occasional thin to thick lenses and laminae of sandy siltstone. (SOUTH WALES MIDDLE COAL MEASURES) 32.6m - 35.3m: Bedding fractures are fresh subhorizontal planar slightly rough. Joints are vertical undulating rough and slightly stepped with partial orange surface staining.			32.50 (0.75)	112.27	
33.0				33.25	111.52	
33.5	Medium strong to strong dark grey fresh sandy SILTSTONE with occasional very thinly bedded to thinly laminated sandstone. (SOUTH WALES MIDDLE COAL MEASURES)			(2.05)		
34.0						
34.5	34.8m: Thin lense of coal.					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	02/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	144.77 mOD
End date:	16/08/2018	Logged by:	ESP - AW	Easting:	275956 m
Backfill date:	16/08/2018	Date logged:	04/09/2018	Northing:	208014 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
				13	
35.60 - 36.10 (0.50)	100	77	46		
36.10 - 37.60 (1.50)	100	80	77	9	
37.60 - 39.10 (1.50)	100	58	43	13	
				NI	
39.10 - 40.60 (1.50)	100	36	8	>20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Medium strong to strong dark grey fresh sandy SILTSTONE with occasional very thinly bedded to thinly laminated sandstone. (SOUTH WALES MIDDLE COAL MEASURES)			35.30	109.47	
35.5	Strong light grey fresh fine to medium grained SANDSTONE with occasional thin to thick lenses and laminae of sandy siltstone. (SOUTH WALES MIDDLE COAL MEASURES) 35.3m - 35.6m: Joints are vertical planar, slightly stepped, with orange surface staining. 35.6m - 37.6m: Joints are - Very close vertical undulating rough and slightly stepped with partial orange surface staining; ~50° fresh planar rough.			(0.80)		
36.0				36.10	108.67	
	Medium strong to strong dark grey fresh sandy SILTSTONE with occasional thin to thick laminae of sandstone. (SOUTH WALES MIDDLE COAL MEASURES)					
36.5						
37.0				(2.40)		
37.5	37.3m - 37.6m: Occasional very thin beds of light grey sandstone. 37.6m - 38.5m: Bedding fractures are fresh subhorizontal planar slightly rough. 37.6m - 38.5m: Rare sandstone beds and laminae.					
38.0						
38.5	Weak black fresh mudstone thinly laminated to very thinly bedded MUDSTONE with a low content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)			38.50	106.27	
39.0						
	39.2m - 40.6m: Joints are vertical very closely spaced planar rough with orange surface staining.					
39.5				(2.30)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT	Ground Level: 144.77 mOD		
Project No: 5859e.09	Easting: 275956 m		
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Northing: 208014 m	
End date: 16/08/2018	Logged by: ESP - AW		
Backfill date: 16/08/2018	Date logged: 04/09/2018		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
40.60 - 42.10 (1.50)	100	88	80	6	
42.10 - 43.60 (1.50)	100	63	61	>20	
43.60 - 45.10 (1.50)	100	52	39	16	
				11	
				>20	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Weak black fresh mudstone thinly laminated to very thinly bedded MUDSTONE with a low content of fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)					
40.5						
	40.6m - 43.1m: Bedding fractures subhorizontal fresh and planar smooth to rough. Joints are ~30° planar rough with partial orange surface staining.					
				40.80	103.97	
41.0	Medium strong dark grey fresh SILTSTONE with rare fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)					
	41.3m - 42.2m: Occasional thinly laminated to very thinly bedded sandstone.					
41.5						
42.0				(2.70)		
42.5						
43.0						
	43.1m - 43.6m: Undulating rough vertical to subvertical orange stained joint.					
43.5				43.50	101.27	
	Medium strong light grey and dark grey fresh thinly to very thinly bedded sandy SILTSTONE and SANDSTONE with occasional fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)					
44.0						
44.5				(2.70)		

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

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Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH601**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT	Ground Level: 144.77 mOD		
Project No: 5859e.09	Easting: 275956 m		
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Northing: 208014 m	
End date: 16/08/2018	Logged by: ESP - AW		
Backfill date: 16/08/2018	Date logged: 04/09/2018		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
45.10 - 46.50 (1.40)	93	54	18	NI	
				15	
46.50 - 48.00 (1.50)	100	52	39	>20	
48.00 - 49.50 (1.50)	83	50	17	NR	
				>20	
				NI	
				NI	

Strata Details

Depth	Description	Legend	Water: Strikes/ Standing	Depth: Depth (Thickness)	Depth: mOD	Backfill/ Install-ations
45.5	Medium strong light grey and dark grey fresh thinly to very thinly bedded sandy SILTSTONE and SANDSTONE with occasional fossilised plant debris. (SOUTH WALES MIDDLE COAL MEASURES)					
46.0				46.20	98.57	
46.5	Weak black fresh thinly to thickly laminated MUDSTONE with occasional fossilised plant debris and occasional very thin beds of siltstone. (SOUTH WALES MIDDLE COAL MEASURES)					
47.0						
47.5				(2.90)		
48.0						
48.5						
49.0				49.10	95.67	
	Medium strong black fresh organic MUDSTONE with a very high content of fossilised plant content and thin lenses of coal. (SOUTH WALES MIDDLE COAL MEASURES)			(0.30)		
				49.40	95.37	
49.5	Weak black fresh COAL. (MIDDLE SOUTH WALES COAL MEASURES - Lower Welsh Coal Seam)			(0.20)		
				49.60	95.17	
	Medium strong black fresh organic MUDSTONE with a very high content of fossilised plant content and thin lenses of coal. Bedding fractures are undulating smooth, occasionally conchoidal.					

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored				
Site Location: Pantteg Landslide	Equipment: P60A				
Client: NPT					
Project No: 5859e.09					
Start date: 02/08/2018	Driller: DN - Geotechnical Engineering	Ground Level: 144.77 mOD			
End date: 16/08/2018	Logged by: ESP - AW	Easting: 275956 m			
Backfill date: 16/08/2018	Date logged: 04/09/2018	Northing: 208014 m			

BH601

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
49.50 - 51.00 (1.50)	100	66	45	>20	
				10	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
	Medium strong black fresh organic MUDSTONE with a very high content of fossilised plant content and thin lenses of coal. Bedding fractures are undulating smooth, occasionally conchoidal. (SOUTH WALES MIDDLE COAL MEASURES - Seatearth)			(0.90)		
50.5				50.50	94.27	
	Medium strong black fresh organic sandy SILTSTONE with a very high content of fossilised plant content and thin lenses of coal. (SOUTH WALES MIDDLE COAL MEASURES - Seatearth)			(0.30)		
	50.5m - 51.0m: Joints are - ~45° slightly stepped rough with orange, yellow and dark red surface staining, ~10° planar smooth with orange and dark red surface staining.			50.80	93.97	
51.0				(0.20)		
	Medium strong to strong dark grey fresh SILTSTONE with occasional plant debris. Bedding fractures are subhorizontal fresh planar rough. (SOUTH WALES MIDDLE COAL MEASURES)			51.00	93.77	
51.5	End of Borehole at 51.000m					
52.0						
52.5						
53.0						
53.5						
54.0						
54.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
51.00	90

Casing Diameter

Casing Diameter	Casing Depth
	9.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 51m.
4. Inlcinometer casing installed to 17.5m, with a vibrating wire peizometer at 12m.
5. Borehole excavated adjacent to TP604 and TP607 - see Trial Pit logs for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH602**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			
Start date: 16/08/2018	Driller: DN - Geotechnical Engineering	Ground Level: 146.58 mOD	
End date: 17/08/2018	Logged by: ESP - AW	Easting: 276004 m	
Backfill date: 17/08/2018	Date logged: 04/09/2018	Northing: 208070 m	

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
0.00 - 0.50 (0.50)	100				
0.50 - 2.00 (1.50)	77				
2.00 - 3.50 (1.50)	73				
3.50 - 4.50 (1.00)	90				

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD
0.5	Soft brown gravelly sandy CLAY. Gravel is weak tabular angular to subangular siltstone and sandstone, and rare subrounded light grey fine to medium coarse-grained limestone. Occasional roots and rootlets. (MADE GROUND - Colliery Spoil - Coarse Discard)			(1.00)	
1.0				1.00	145.58
	Soft dark brown/black slightly gravelly CLAY. Gravelly is black weathered fine to medium angular siltstone. Roots present. (MADE GROUND - Colliery Spoil - Coarse Discard)			(0.10)	145.48
				1.10	
1.5	Probably loose to medium dense clayey silty slightly sandy GRAVEL with a low cobble content. Gravel and cobbles are subangular to angular fine to coarse weathered siltstone. Occasional rootlets. (MADE GROUND - Colliery Spoil - Coarse Discard)			(0.60)	
				1.70	144.88
	Soft light brown mottled orange gravelly slightly sandy CLAY. Gravel is fine to coarse distinctly weathered very weak subrounded to subangular siltstone, very weak to weak subangular orange sandstone. Occasional rootlets. (MADE GROUND - Colliery Spoil - Coarse Discard)			(0.30)	
2.0				2.00	144.58
2.5	Soft brown gravelly slightly sandy CLAY. Gravel is fine to coarse subrounded to rounded partially weathered sandy siltstone and siltstone, weak subrounded orange poorly cemented sandstone. Occasional roots present. Rare pockets of black coal-rich sand and silt. (MADE GROUND - Colliery Spoil - Coarse Discard)			(1.00)	
	2.5m: ~20mm pockets of soft light brown silt.				
3.0				3.00	143.58
	Probably loose to medium dense wet sandy GRAVEL. Gravel is fine to coarse, mostly tabular, subangular siltstone and sandstone. (MADE GROUND - Colliery Spoil - Coarse Discard)			(0.80)	
3.5					
				3.80	142.78
4.0	Probably medium dense dark grey and brown mottled orange sandy slightly clayey GRAVEL. Gravel is fine to coarse partially weathered subangular siltstone. Roots and rootlets present. (MADE GROUND - Colliery Spoil - Coarse Discard)				
	3.8m - 4.0m: Very clayey.				
4.5	4.5m: Becoming very clayey.			(1.50)	

Backfill/ Install-ations

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
11.70	90

Casing Diameter

Casing Diameter	Casing Depth
	8.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 11.7m.
4. 19mm standpipe installed to 11.5m with a response zone between 2.7m-11.5m.
5. Borehole excavated adjacent to TP605 - see Trial Pit log for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: Pen-y-Graig Area	Drilling method: Rotary cored		**BH602**
Site Location: Pantteg Landslide	Equipment: P60A		
Client: NPT			
Project No: 5859e.09			

Start date:	16/08/2018	Driller:	DN - Geotechnical Engineering	Ground Level:	146.58 mOD
End date:	17/08/2018	Logged by:	ESP - AW	Easting:	276004 m
Backfill date:	17/08/2018	Date logged:	04/09/2018	Northing:	208070 m

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
4.50 - 5.50 (1.00)	100				
5.50 - 6.50 (1.00)	100				
6.50 - 7.40 (0.90)	94				
7.40 - 8.20 (0.80)	100	15	0	NI / >20	
8.20 - 9.10 (0.90)	94	80	74	10	
9.10 - 10.20 (1.10)	100	100	100		

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Probably medium dense dark grey and brown mottled orange sandy slightly clayey GRAVEL. Gravel is fine to coarse partially weathered subangular siltstone. Roots and rootlets present. (MADE GROUND - Colliery Spoil - Coarse Discard)			5.30	141.28	
5.5	Dark grey and orange brown gravelly slightly sandy CLAY. Gravel is fine to coarse angular to subangular tabular partially weathered siltstone, rare fine angular coal, and distinctly weathered subangular fine to coarse sandstone and siltstone. (MADE GROUND - Colliery Spoil - Coarse Discard)			(1.30)		
6.0				6.60	139.98	
6.5	SEE APPENDED DETAILED LOG. (Zone of potential relict slip surface)			(0.60)		
7.0				7.20	139.38	
	Very weak black thinly to thickly laminated weathered MUDSTONE. (Probable Grade C Weathered SOUTH WALES UPPER COAL MEASURES)			(0.05)	139.33	
7.5	Weak black fresh COAL. (Recovered as fine to coarse coal gravel to 7.4m) (SOUTH WALES UPPER COAL MEASURES - Possible Lower Pinchin Coal Seam)			7.25 (0.35) 7.60	138.98	
8.0	Weak black and dark grey thinly to thickly laminated organic MUDSTONE with a very high content of fossilised plant debris. Bedding fractures are smooth and undulating, and conchoidal, along the surface of plant debris. (SOUTH WALES UPPER COAL MEASURES - Seatearth)			(0.80)		
8.5	Medium strong dark grey and grey fresh thinly laminated to thinly bedded fine-grained sandstone and siltstone with a moderate content of fossilised plant debris. Rare thin black mudstone laminations. (SOUTH WALES MIDDLE COAL MEASURES)			8.40	138.18	
9.0	8.4m: Bedding fractures are subhorizontal planar rough and fresh. 45° slightly stepped and undulating rough fresh joint. 9.1m - 11.4m: Bedding fractures are subhorizontal fresh planar rough, and locally smooth where plant debris is present along the bedding plane. Joints dipping 70° are planar and slightly rough with partial orange and dark red surface staining.					
9.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

Hole Depth	Hole Diameter
11.70	90

Casing Diameter

Casing Diameter	Casing Depth
	8.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 11.7m.
4. 19mm standpipe installed to 11.5m with a response zone between 2.7m-11.5m.
5. Borehole excavated adjacent to TP605 - see Trial Pit log for further detail of the shallow soils.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name:	Pen-y-Graig Area
Site Location:	Pantteg Landslide
Client:	NPT
Project No:	5859e.09
Drilling method	Rotary cored
Equipment	P60A

BH602

Start date:	16/08/2018	Driller:	DN - Geotechnical Engineering
End date:	17/08/2018	Logged by:	ESP - AW
Backfill date:	17/08/2018	Date logged:	04/09/2018
Ground Level:	146.58 mOD		
Easting:	276004 m		
Northing:	208070 m		

Core Details and SPT Data

Depth (Length)	TCR (%)	SCR (%)	RQD (%)	FI	SPT-N
10.20 - 11.70 (1.50)	100	90	86	9	
				17	

Strata Details

Depth	Description	Legend	Water Strikes/ Standing	Depth (Thickness)	mOD	Backfill/ Install-ations
	Medium strong dark grey and grey fresh thinly laminated to thinly bedded fine-grained sandstone and siltstone with a moderate content of fossilised plant debris. Rare thin black mudstone laminations. (SOUTH WALES MIDDLE COAL MEASURES)			(3.30)		
10.5						
11.0						
	11.4m: Joints are vertical fresh undulating rough and slightly stepped.					
11.5						
	End of Borehole at 11.700m			11.70	134.88	
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						

Progress & Standing Water Levels

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed

Hole Diameter

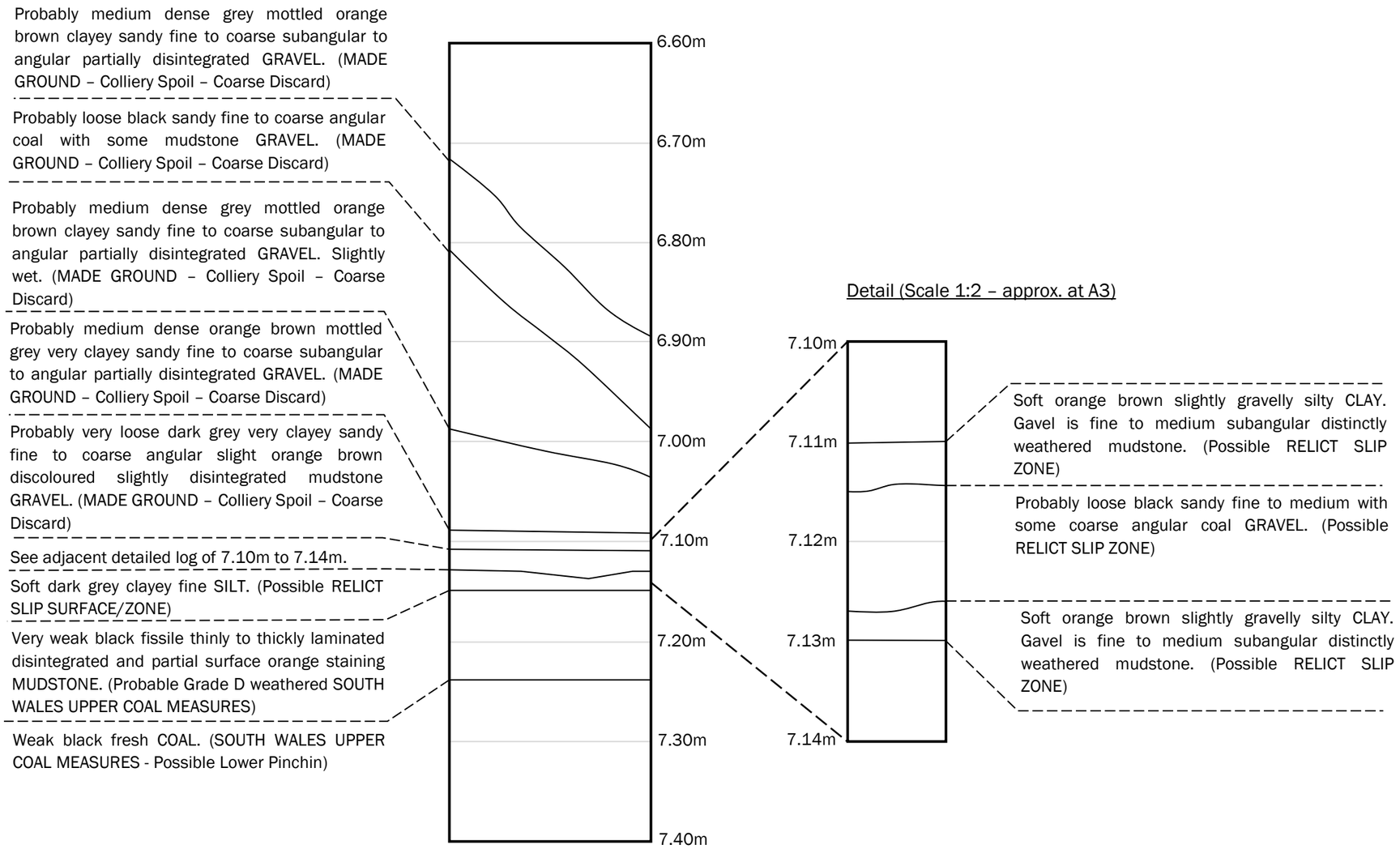
Hole Depth	Hole Diameter
11.70	90

Casing Diameter

Casing Diameter	Casing Depth
	8.00

General Remarks

1. Coordinates and elevation surveyed in using DGPS following site works.
2. Hand-dug pit excavated to 1.2m to check for the presence of services.
3. Borehole excavated utilising dynamic sampling and rotary coring to a maximum depth of 11.7m.
4. 19mm standpipe installed to 11.5m with a response zone between 2.7m-11.5m.
5. Borehole excavated adjacent to TP605 - see Trial Pit log for further detail of the shallow soils.



esp
ENGINEERS
GEOLOGISTS
SCIENTISTS

Notes:

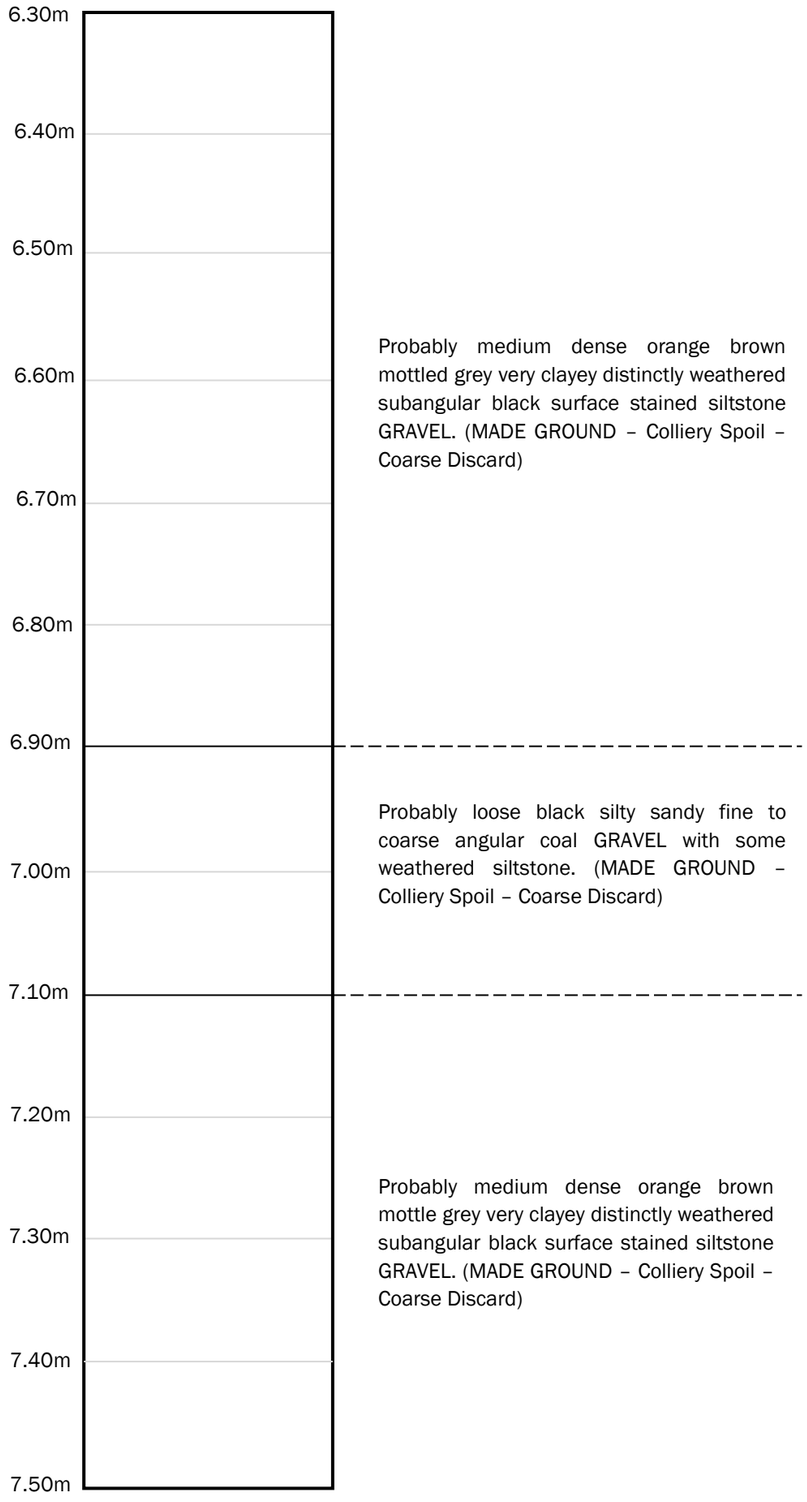
See log of BH602 for detail of the surrounding soils.

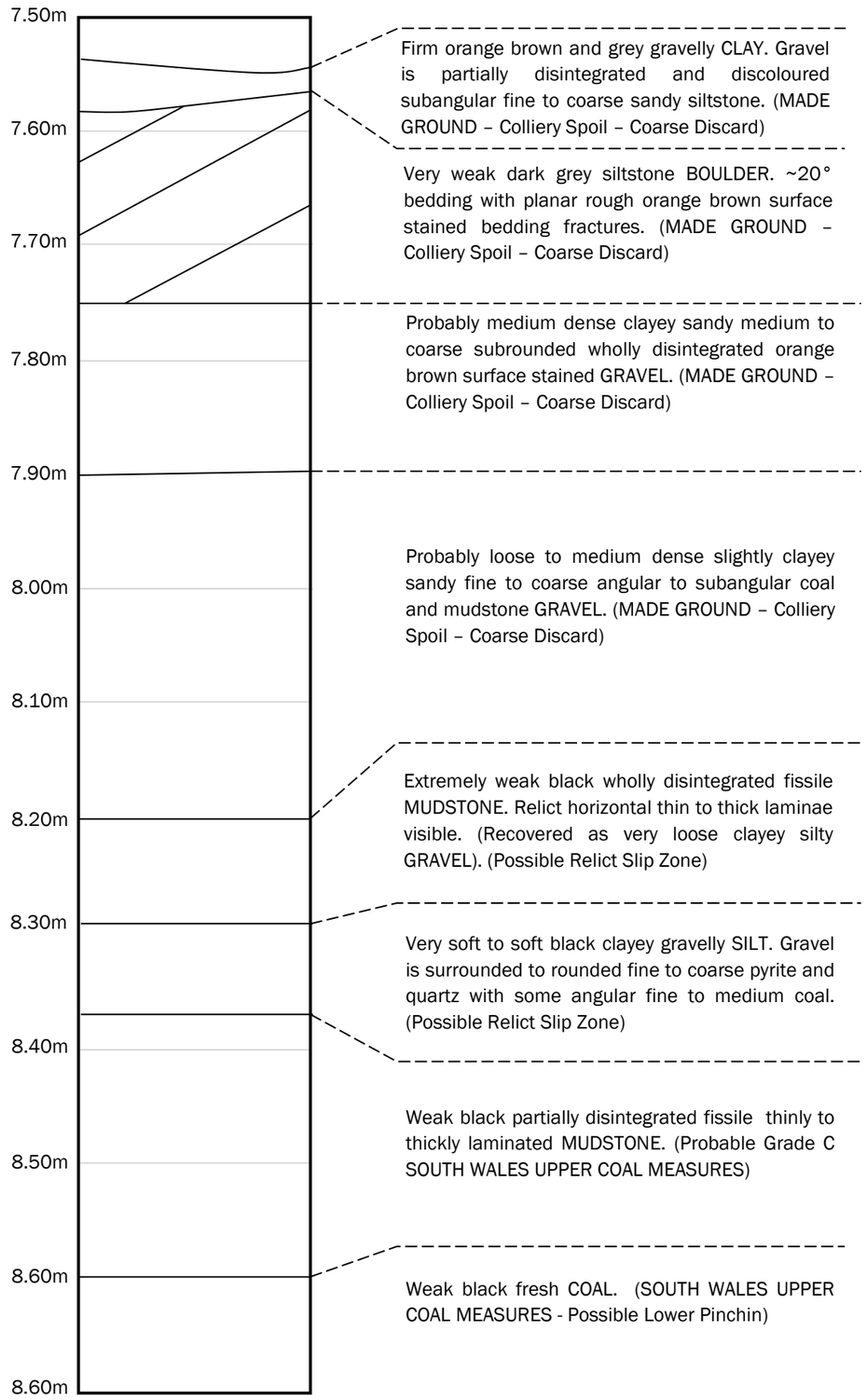
PROJECT:
PANTTEG LANDSLIDE, PEN-Y-GRAIG AREA

Scale: 1:5 (approx. at A3)

DETAILED LOG FOR BH602

EARTH SCIENCE PARTNERSHIP
33 Cardiff Road, Taffs Well,
Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com





esp
ENGINEERS
GEOLOGISTS
SCIENTISTS

Notes:

See log of BH601 for detail of the surrounding soils.

PROJECT:
PANTTEG LANDSLIDE, PEN-Y-GRAIG AREA

Scale: 1:5 (Approx at A3)

DETAILED LOG FOR BH601

EARTH SCIENCE PARTNERSHIP
33 Cardiff Road, Taffs Well,
Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com

Appendix I

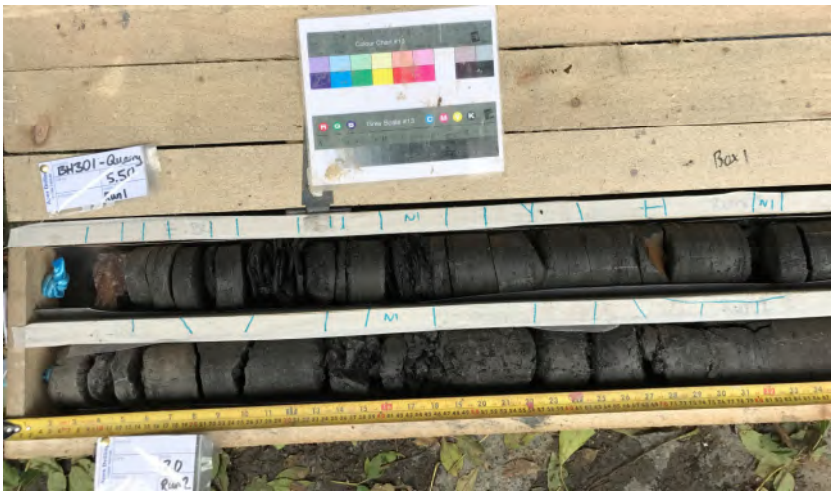
Core Photographs

PANTTEG LANDSLIDE
YSTALYFERA

APPENDIX I – CORE PHOTOGRAPHS

Borehole:	BH301
Depth range:	5.5 – 8.5m

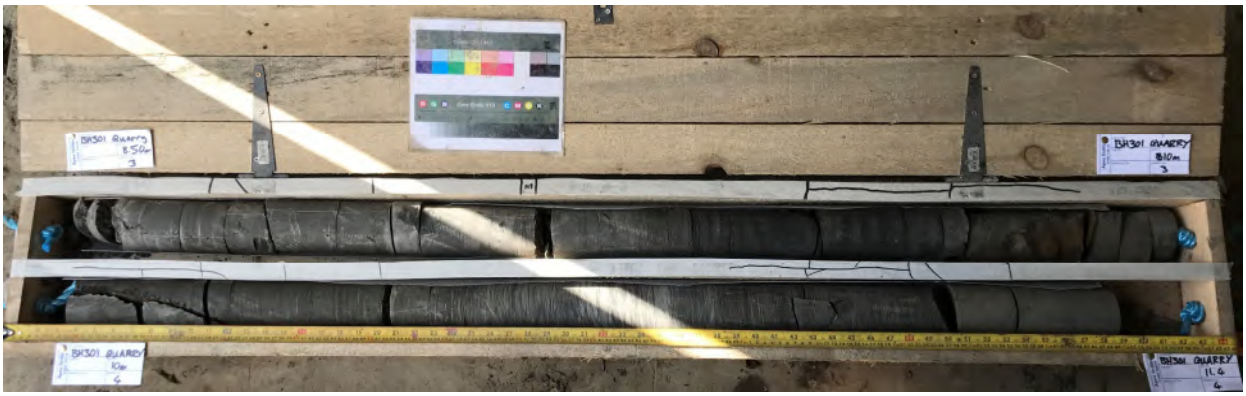
Full core box overview



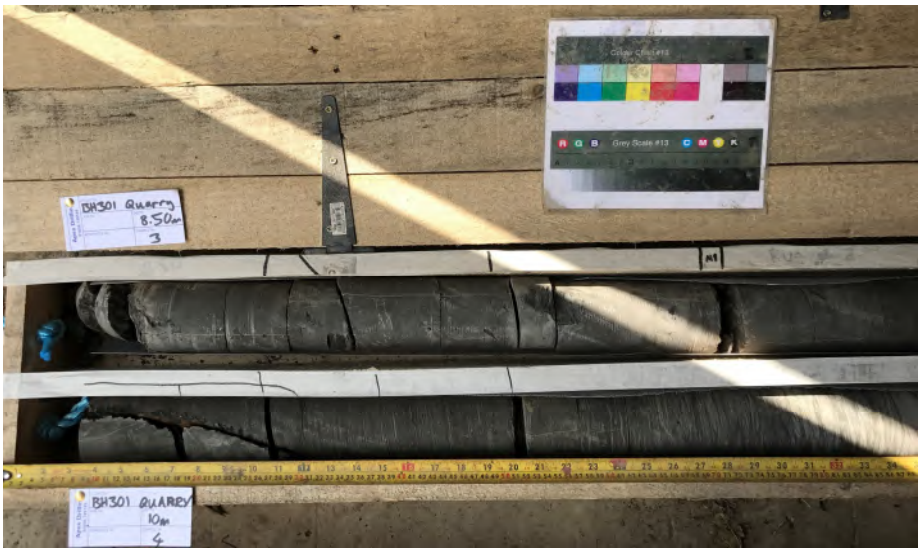
Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	8.5 – 11.4m



Full core box overview



Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	11.4 – 14.4m

Full core box overview

Left hand side of box

Right hand side of box

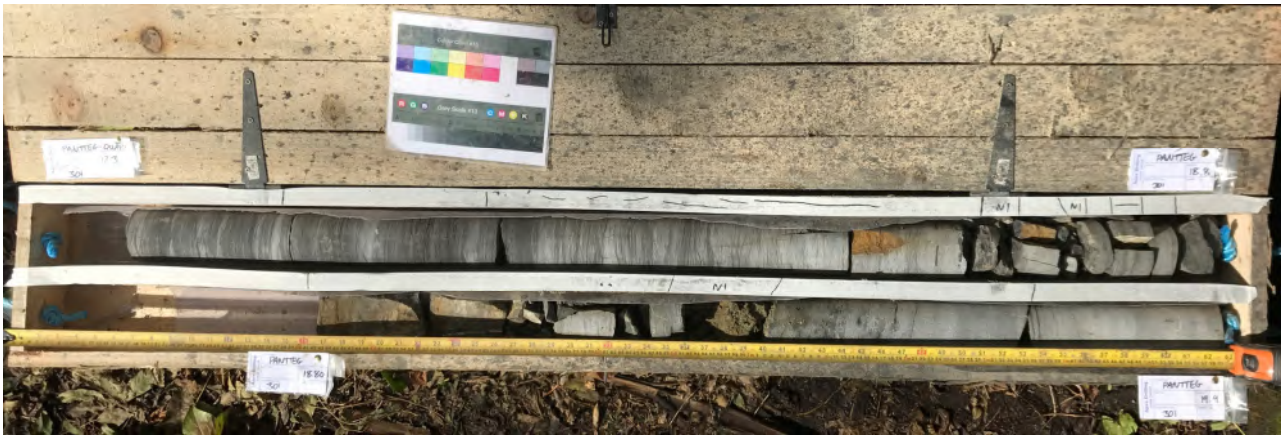
Borehole:	BH301
Depth range:	14.4 – 17.3m

Full core box overview

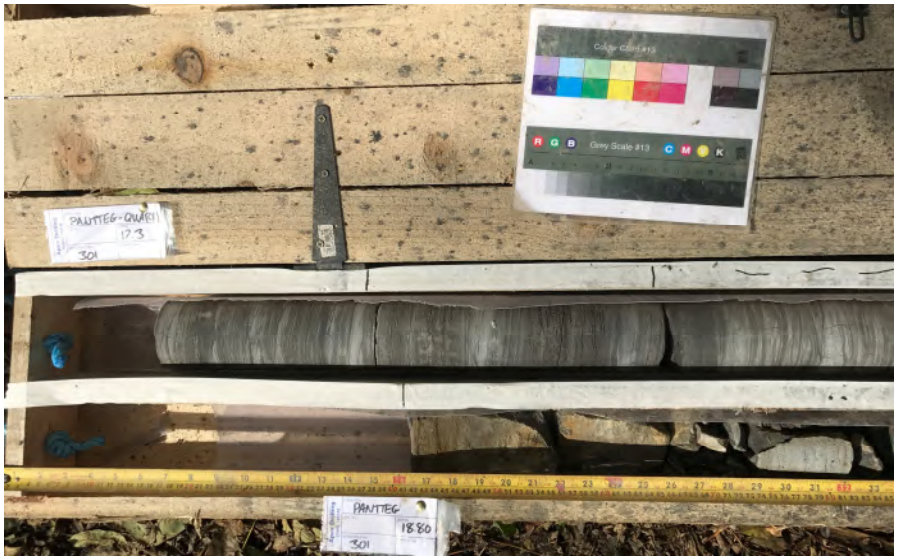
Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	17.3 – 19.9m



Full core box overview

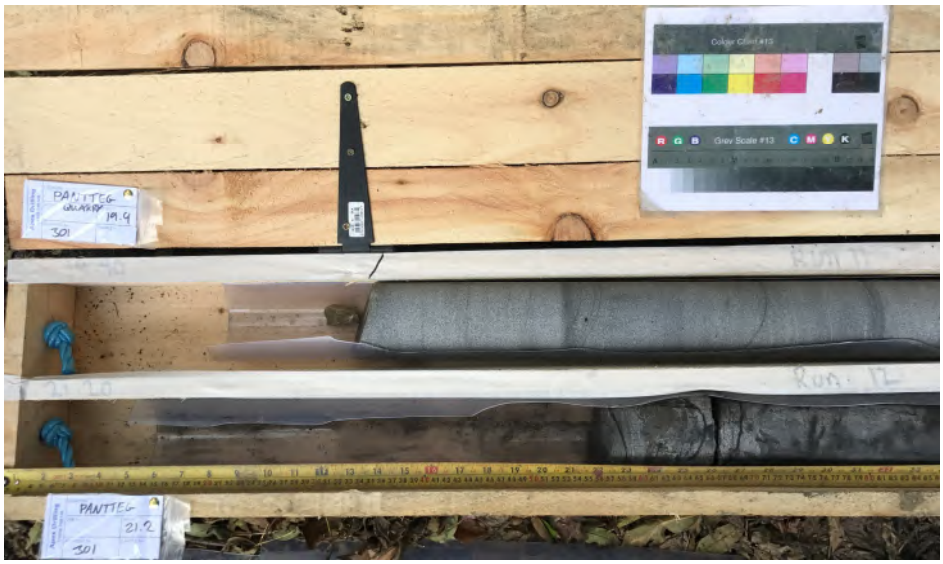


Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	19.9 – 22.7m

Full core box overview

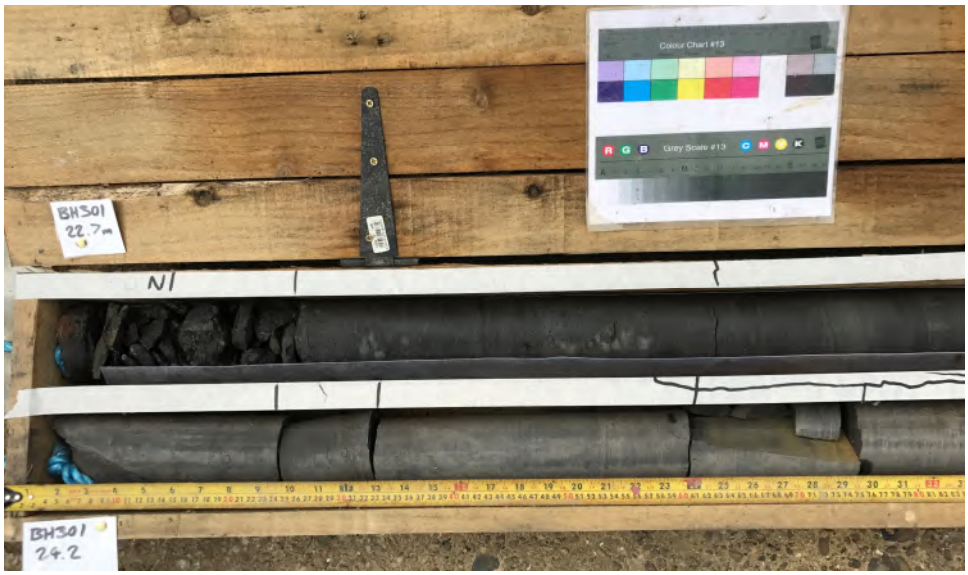


Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	22.7 – 25.3m

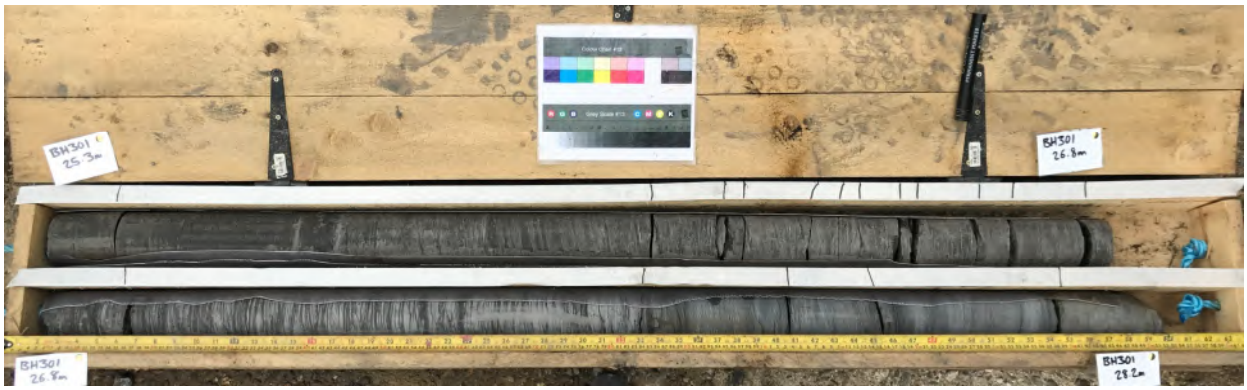
Full core box overview



Left hand side of box

Right hand side of box

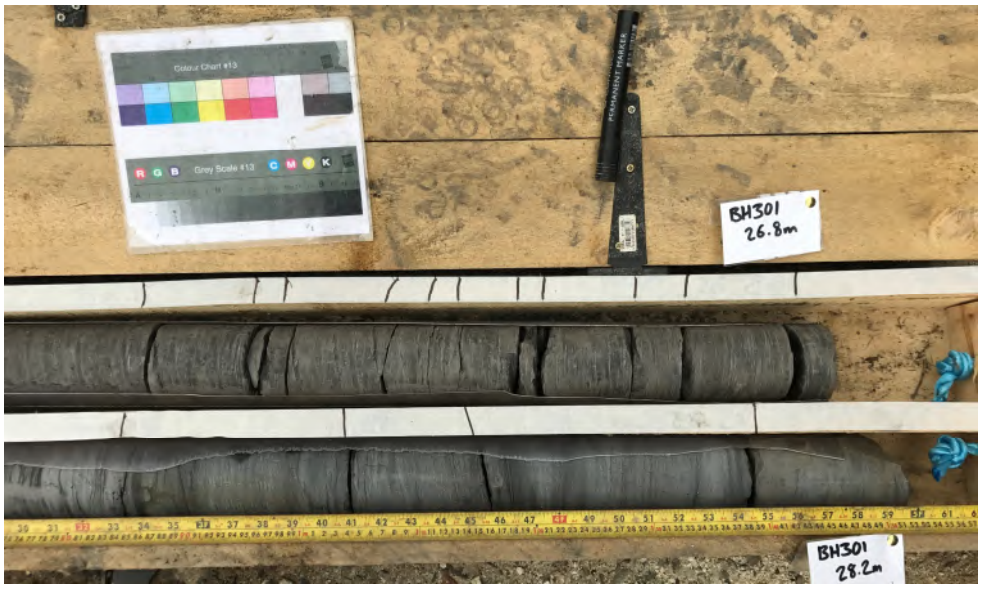
Borehole:	BH301
Depth range:	25.3 – 28.2m



Full core box overview

Left hand side of box

Right hand side of box



Borehole:	BH301
Depth range:	28.2 – 31.2m

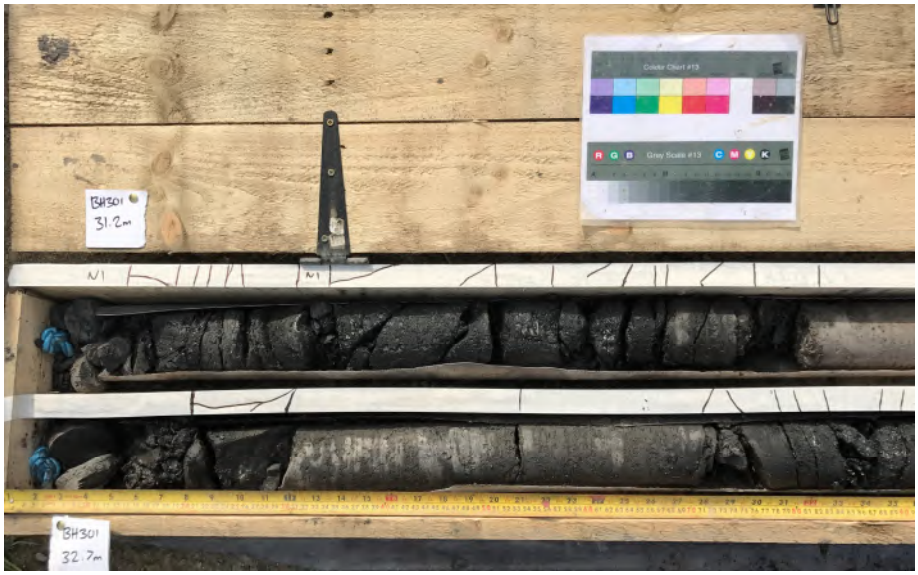
Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	31.2 – 34.2m

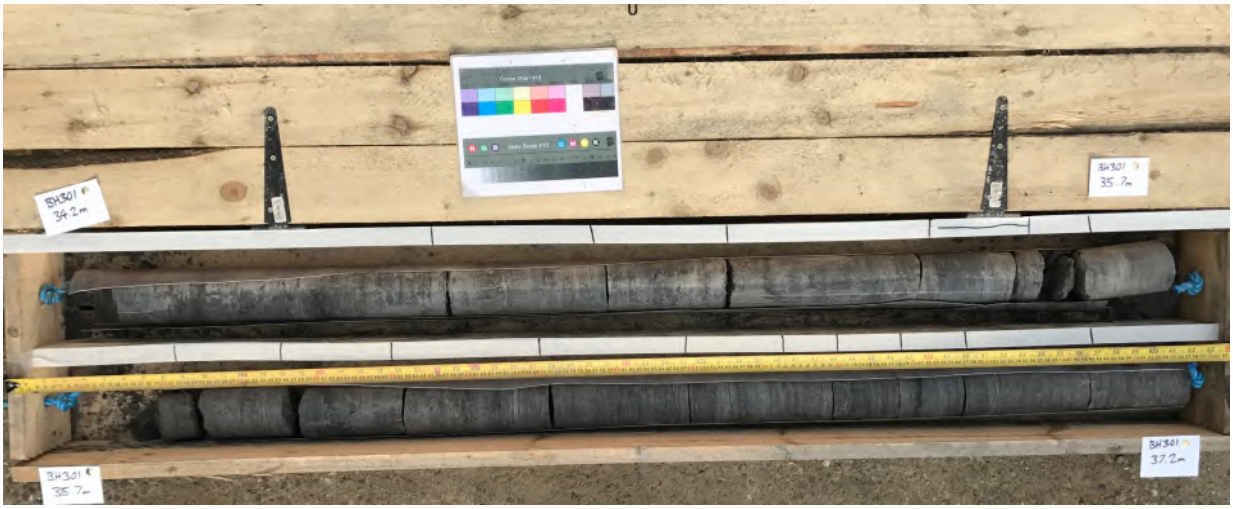
Full core box overview



Left hand side of box

Right hand side of box

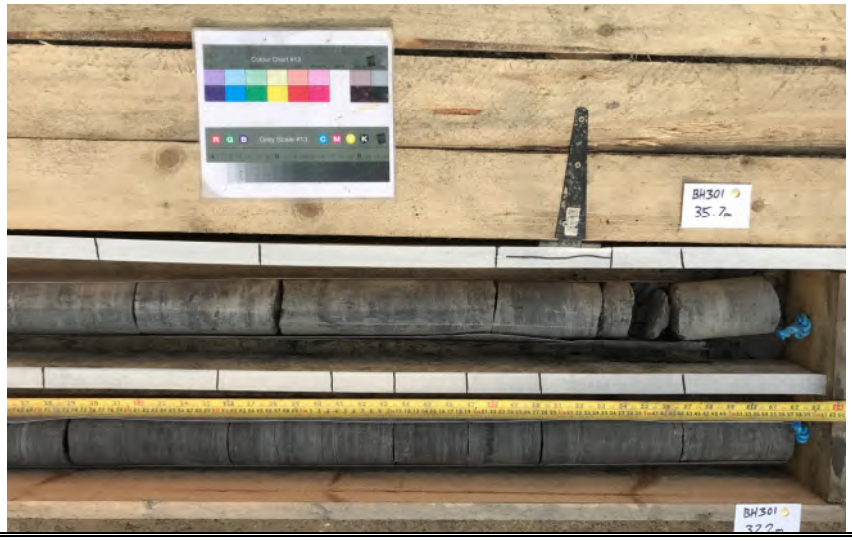
Borehole:	BH301
Depth range:	34.2 – 37.2m



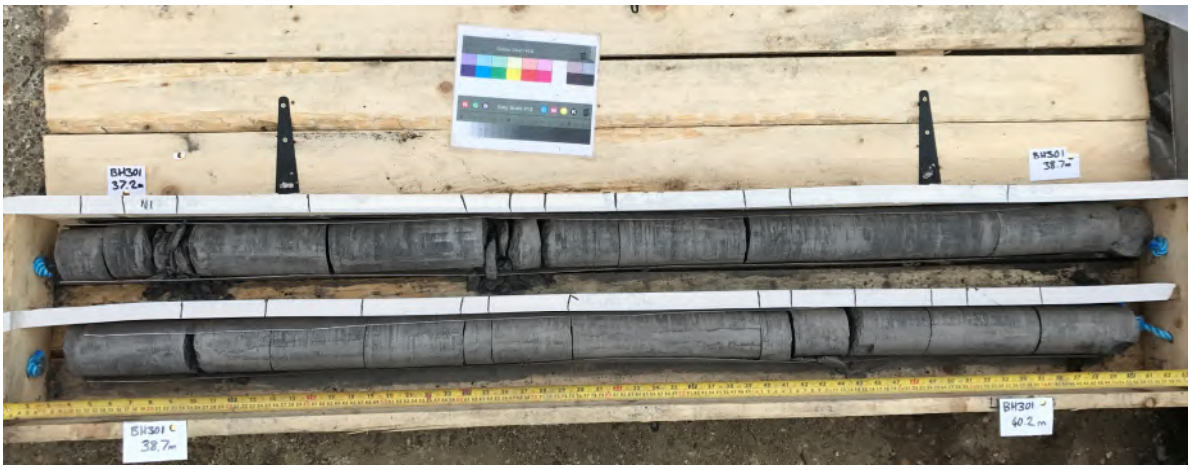
Full core box overview

Left hand side of box

Right hand side of box



Borehole:	BH301
Depth range:	37.2 -

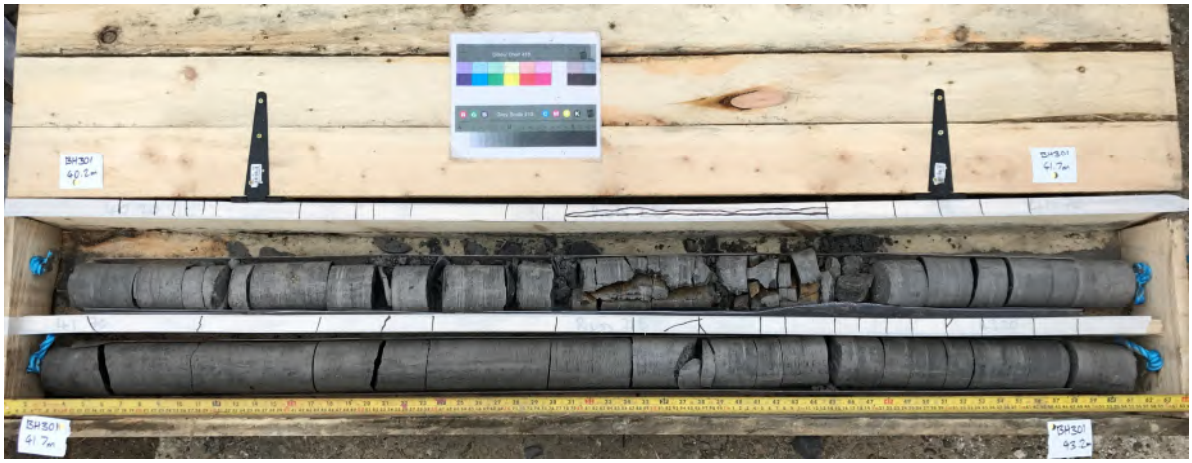


Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	40.2 – 43.2m



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	43.2 – 45.55m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	45.55 – 48.3m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH301
Depth range:	48.3 – 51.1m

Full core box overview

Left hand side of box

Right hand side of box

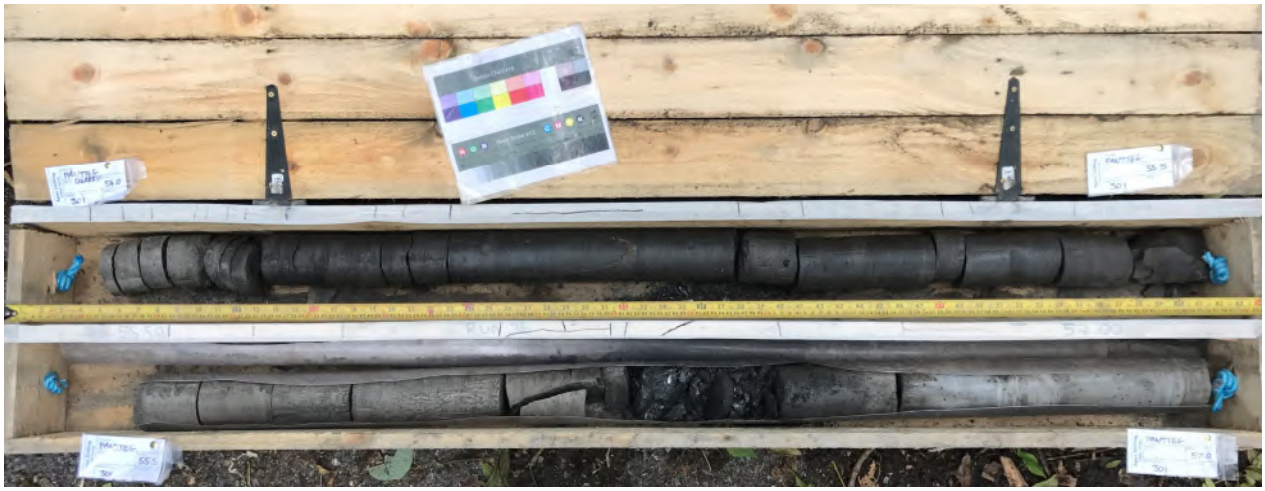
Borehole:	BH301
Depth range:	51.1 – 54.0m

Full core box overview

Left hand side of box

Right hand side of box

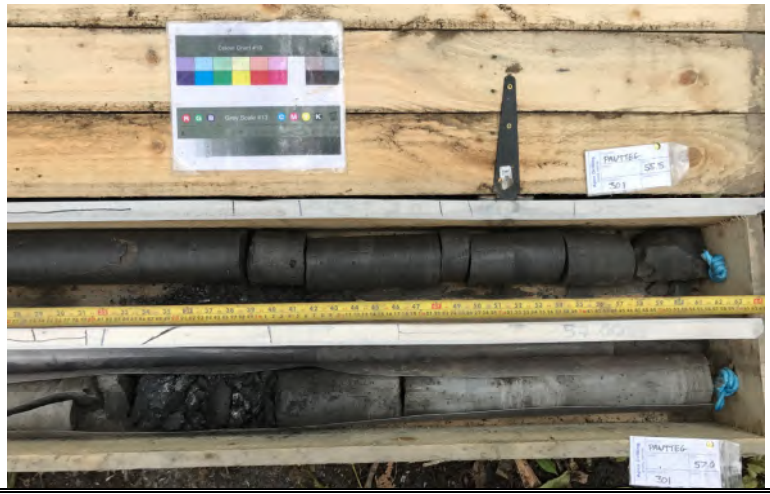
Borehole:	BH301
Depth range:	54.0 – 57.0m



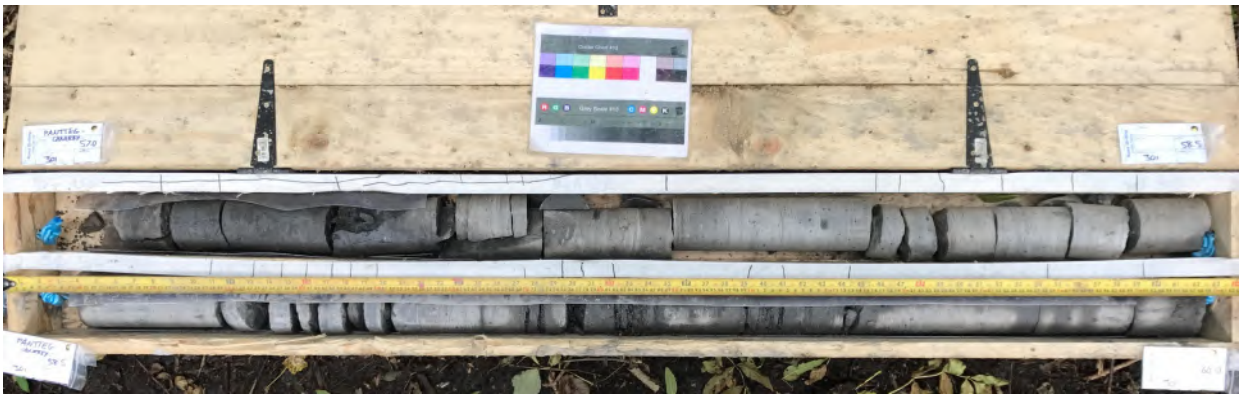
Full core box overview

Left hand side of box

Right hand side of box



Borehole:	BH301
Depth range:	57.0 – 60.0m

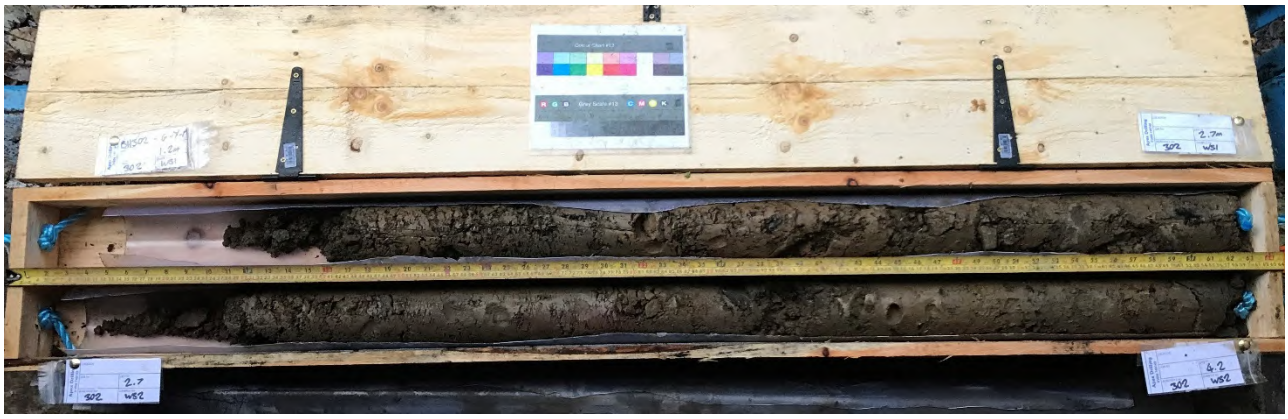


Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH302
Depth range:	1.2 – 4.2m



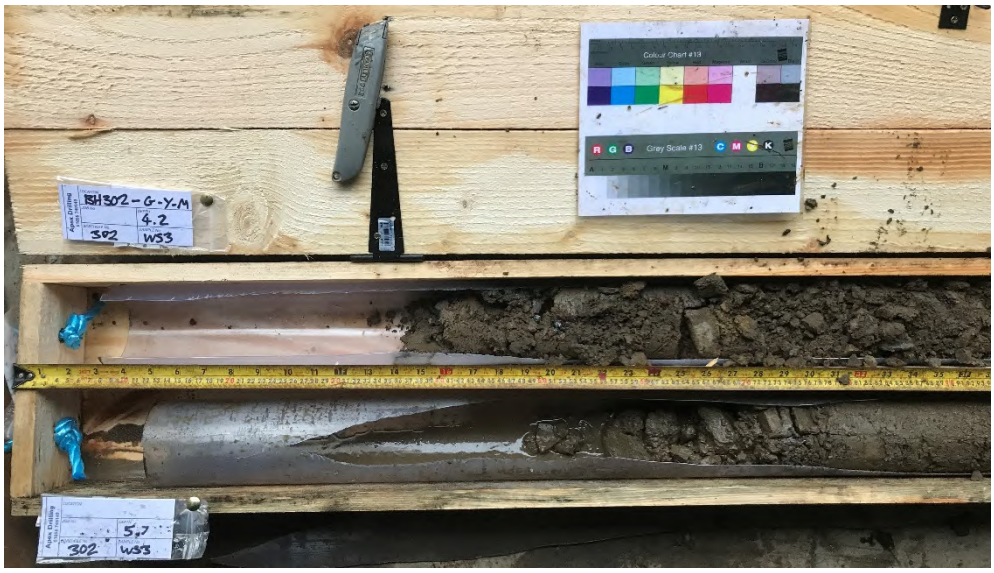
Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH302
Depth range:	4.2 – 7.2m

Full core box overview

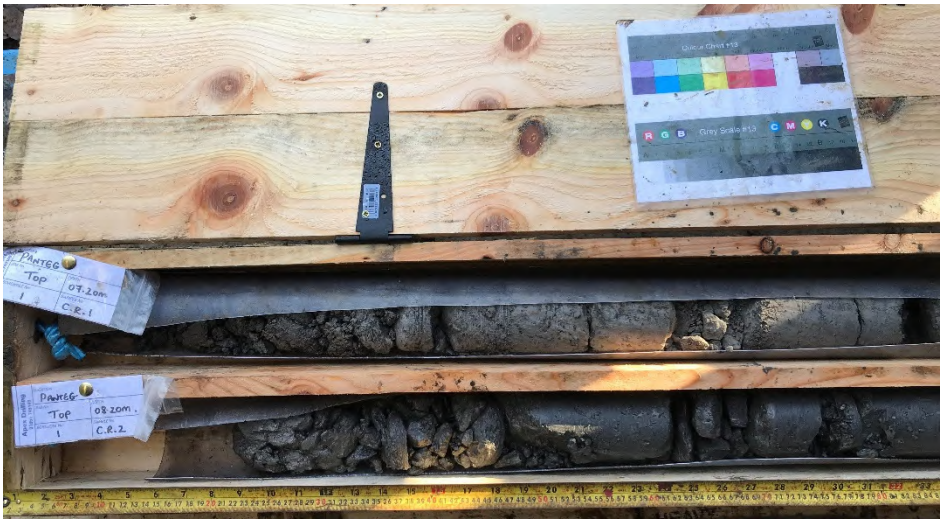


Left hand side of box

Right hand side of box

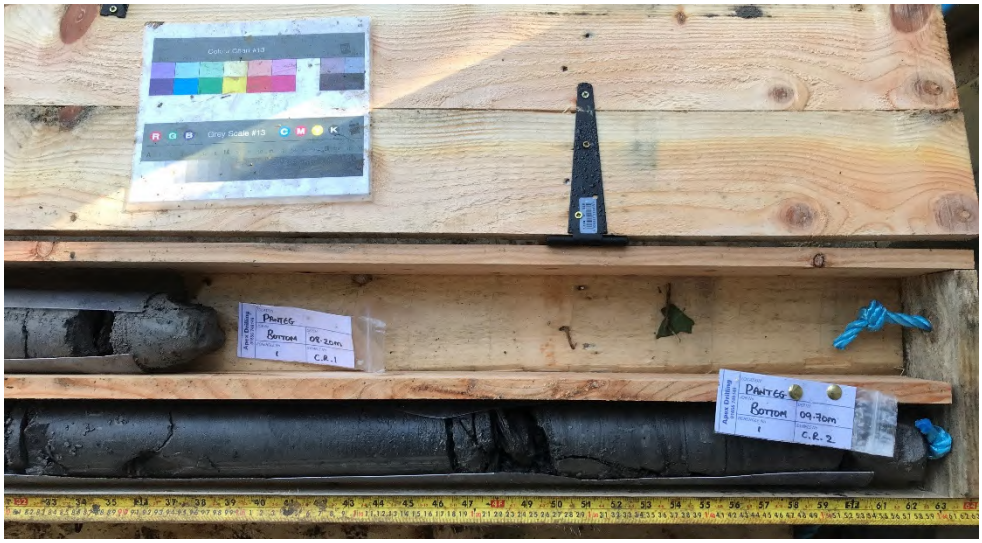
Borehole:	BH302
Depth range:	7.2 - 9.7m

Full core box overview



Left hand side of box

Right hand side of box

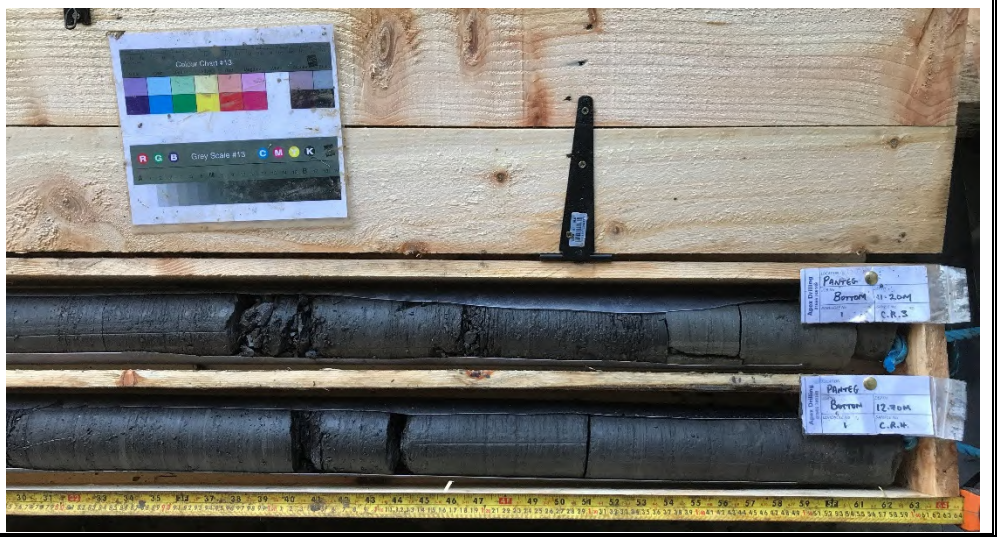


Borehole:	BH302
Depth range:	9.7 – 12.7m

Full core box overview

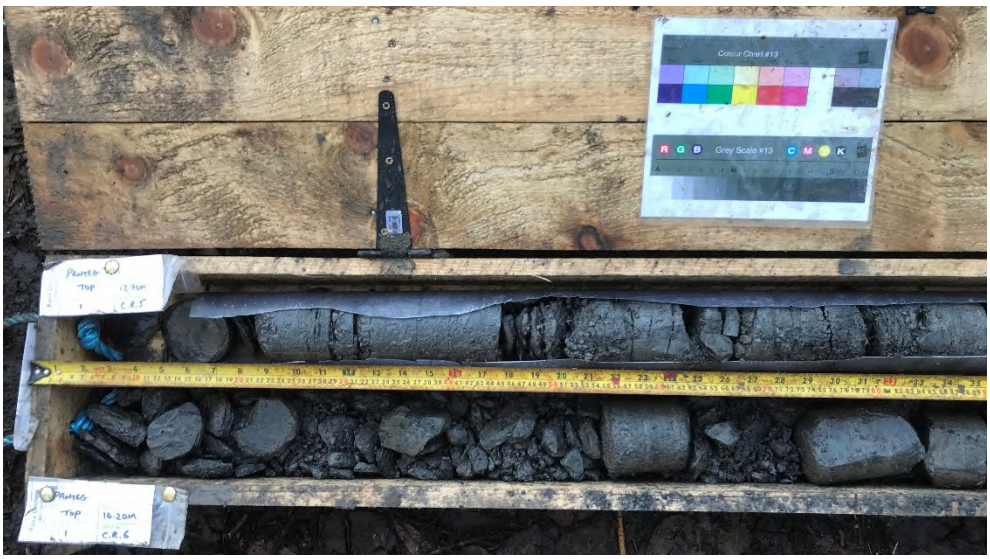
Left hand side of box

Right hand side of box



Borehole:	BH302
Depth range:	12.7 – 15.7m

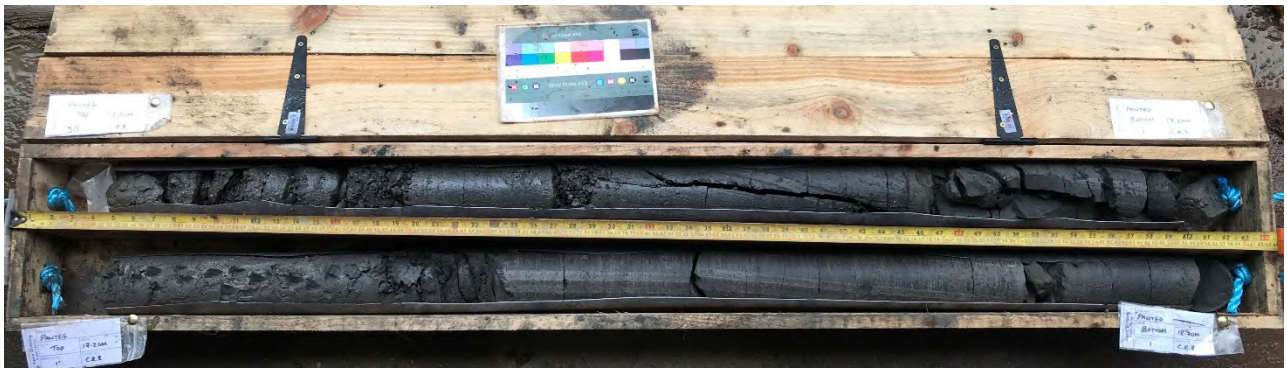
Full core box overview



Left hand side of box

Right hand side of box

Borehole:	BH302
Depth range:	15.7 – 18.7m



Full core box overview

Left hand side of box

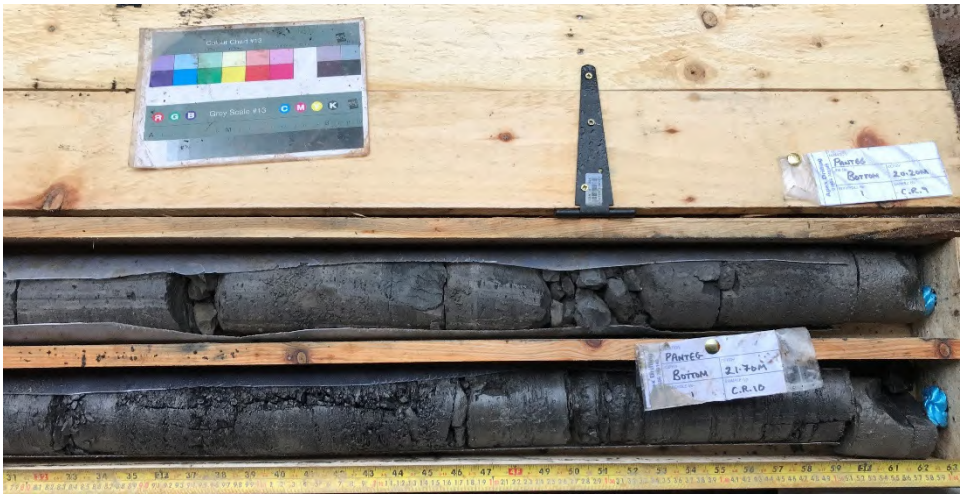
Right hand side of box

Borehole:	BH302
Depth range:	18.7 - m

Full core box overview

Left hand side of box

Right hand side of box

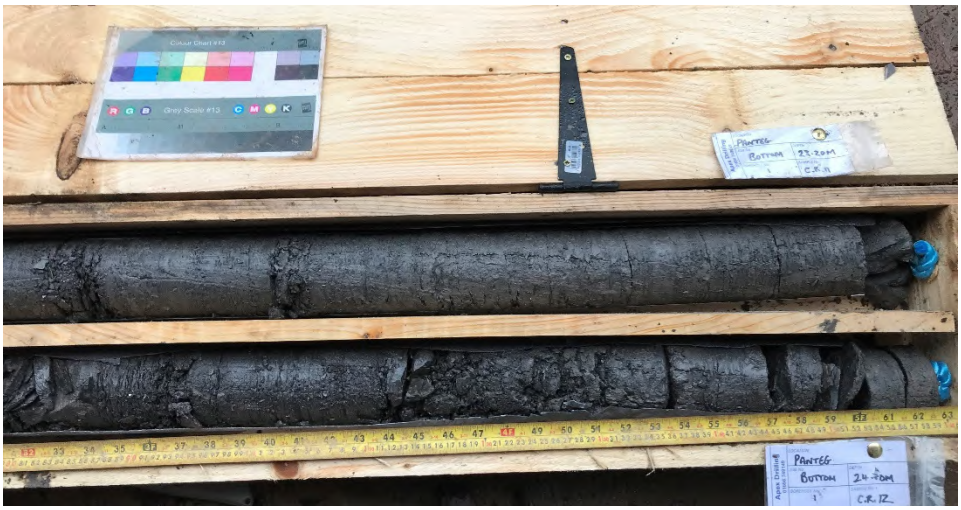


Borehole:	BH302
Depth range:	21.7 - 24.7m

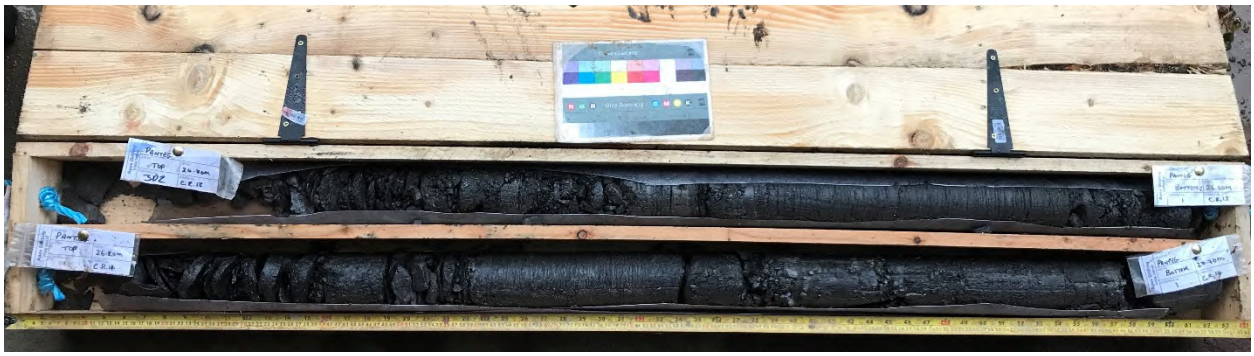
Full core box overview

Left hand side of box

Right hand side of box



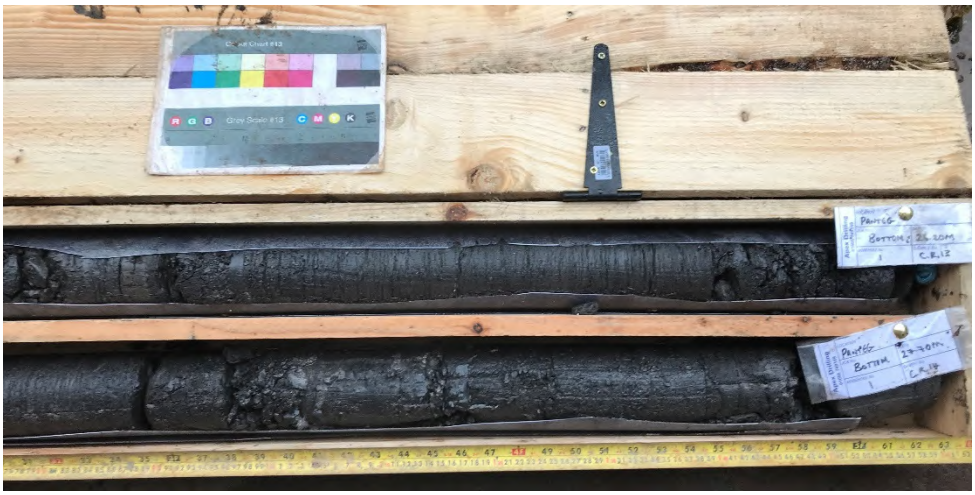
Borehole:	BH302
Depth range:	24.7 - 27.7m



Full core box overview

Left hand side of box

Right hand side of box



Borehole:	BH302
Depth range:	27.7 – 30.2m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	1.5 – 4.1m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	4.1 – 6.5m

Full core box overview

Left hand side of box

Right hand side of box

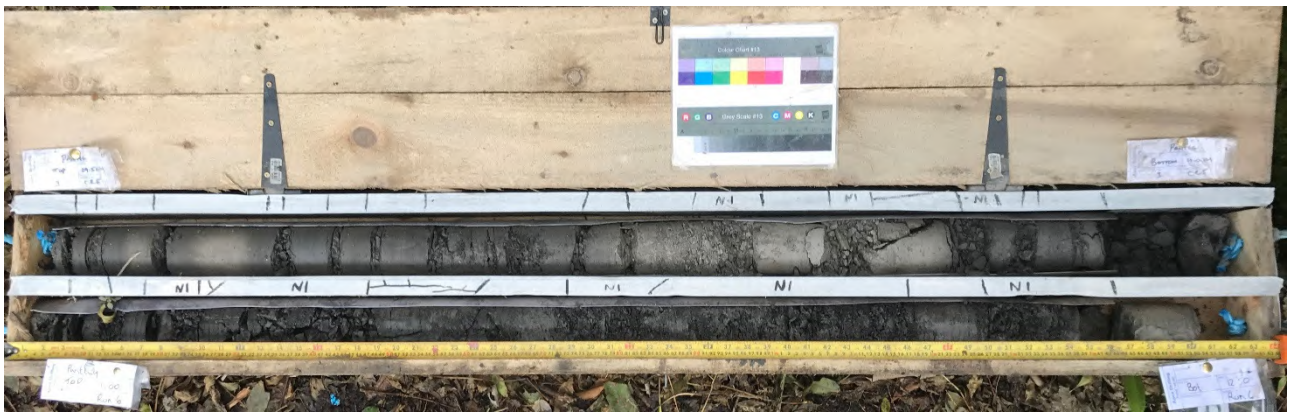
Borehole:	BH303
Depth range:	6.5 – 9.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	9.5 – 12.5m



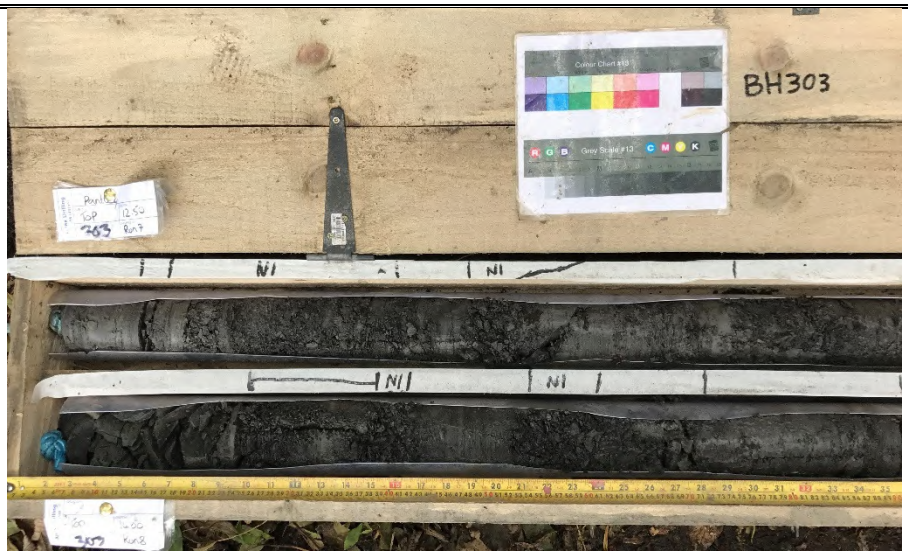
Full core box overview

Left hand side of box

Right hand side of box

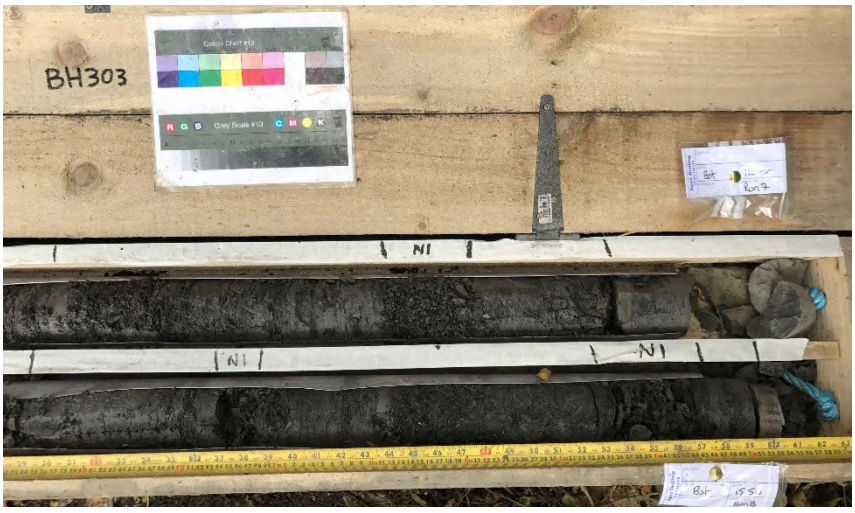
Borehole:	BH303
Depth range:	12.5 – 15.5m

Full core box overview



Left hand side of box

Right hand side of box



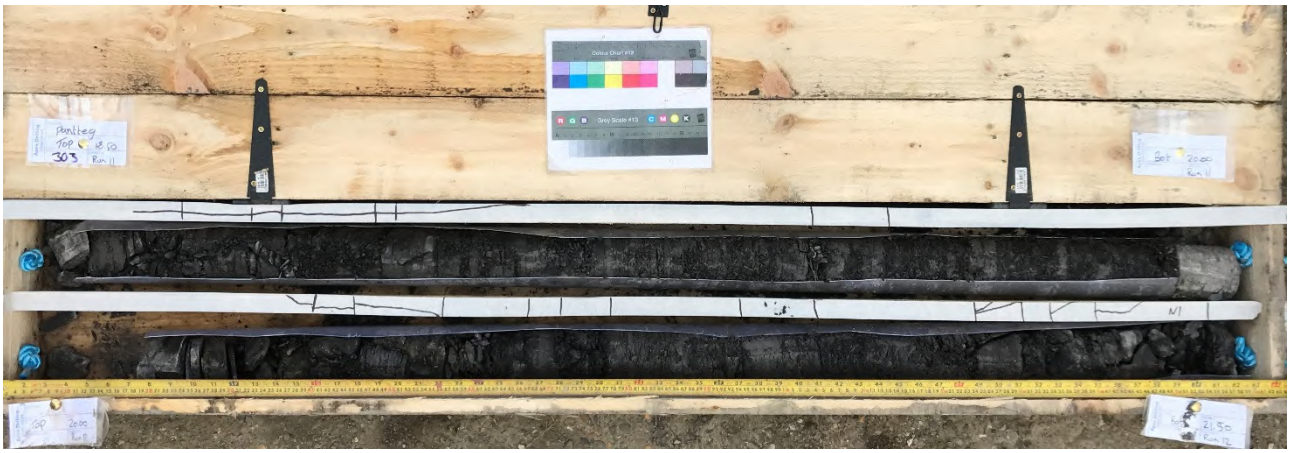
Borehole:	BH303
Depth range:	15.5 – 18.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	18.5 – 21.5m



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303		
Depth range:	21.5 – 24.5m	Date of coring:	27th April 2017

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	24.5 – 26.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	27.5 – 30.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	30.5 – 33.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH303
Depth range:	33.5 – 35.0m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	1.2 – 4.2m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	4.2 – 8.7m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	8.7 – 14.2m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	14.2 – 19.2m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	19.2 – 20.7m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	22.0 – 25.0m

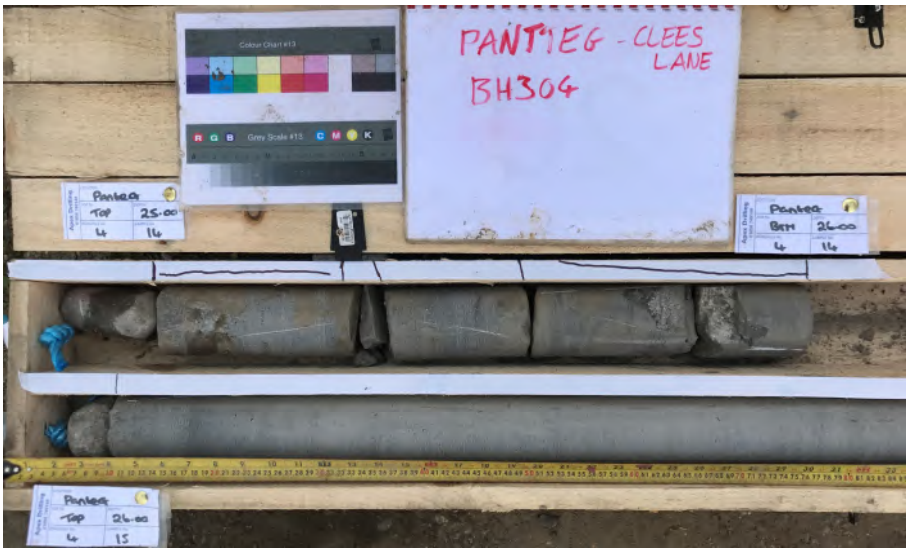
Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	25.0 – 27.5m

Full core box overview



Left hand side of box

Right hand side of box

Borehole:	BH304
Depth range:	27.5 – 29.0m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH305
Depth range:	1.2 – 4.2m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH305
Depth range:	4.2 – 7.2m

Full core box overview

Left hand side of box

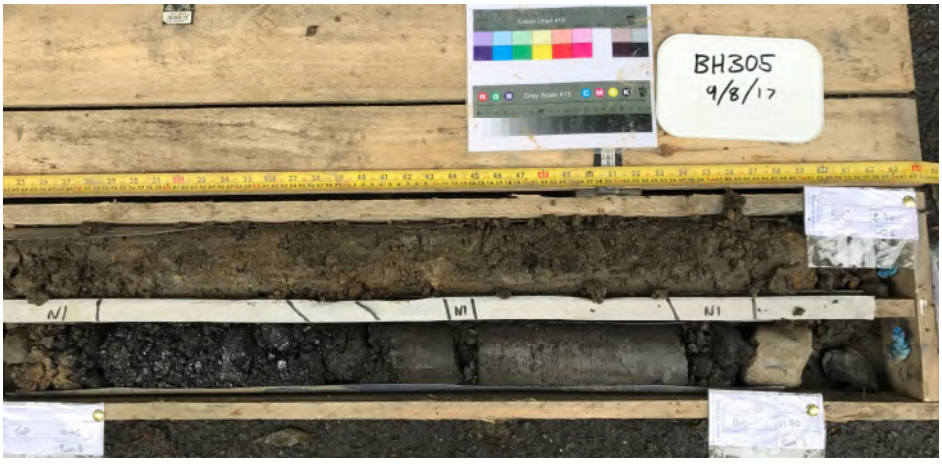
Right hand side of box

Borehole:	BH305
Depth range:	7.2 – 11.7m

Full core box overview

Left hand side of box

Right hand side of box



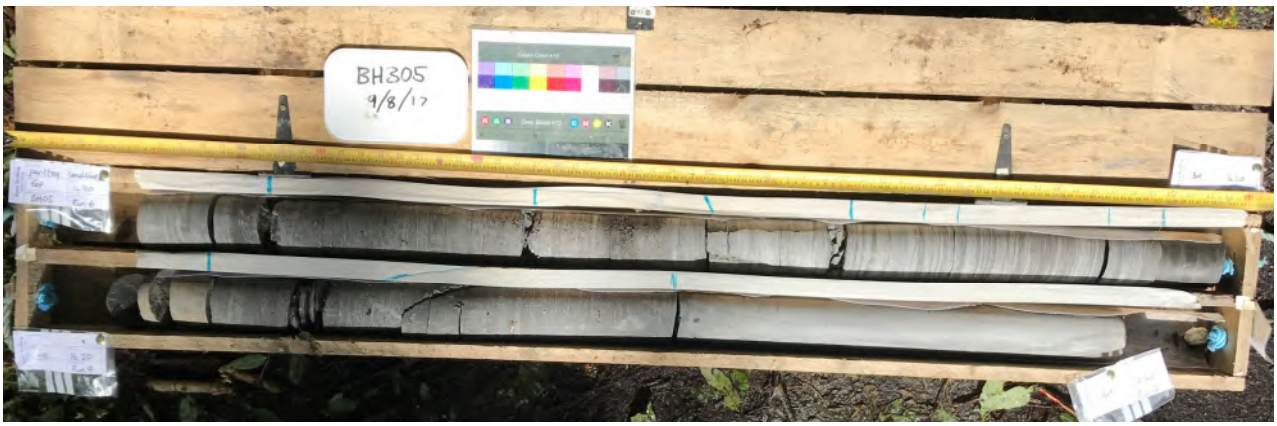
Borehole:	BH305
Depth range:	11.7 – 14.7m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH305
Depth range:	14.7 – 17.6m



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH305
Depth range:	17.6 – 20.5m

Full core box overview

Left hand side of box

Right hand side of box

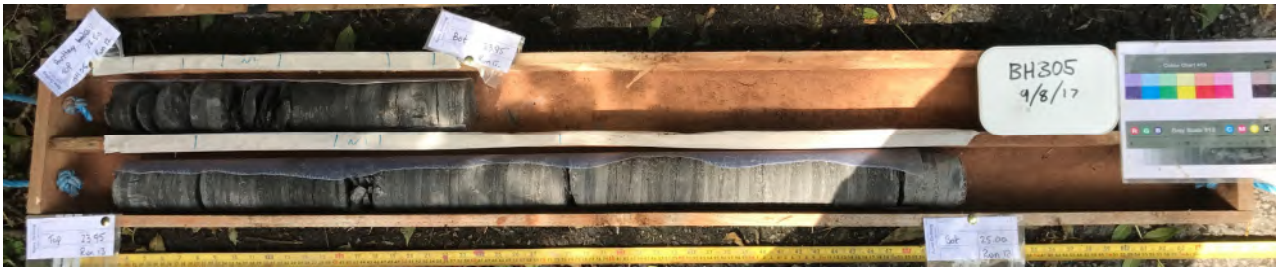
Borehole:	BH305
Depth range:	20.5 – 23.5m

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH305
Depth range:	23.5 – 25.0m



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	1.2 – 4.2m

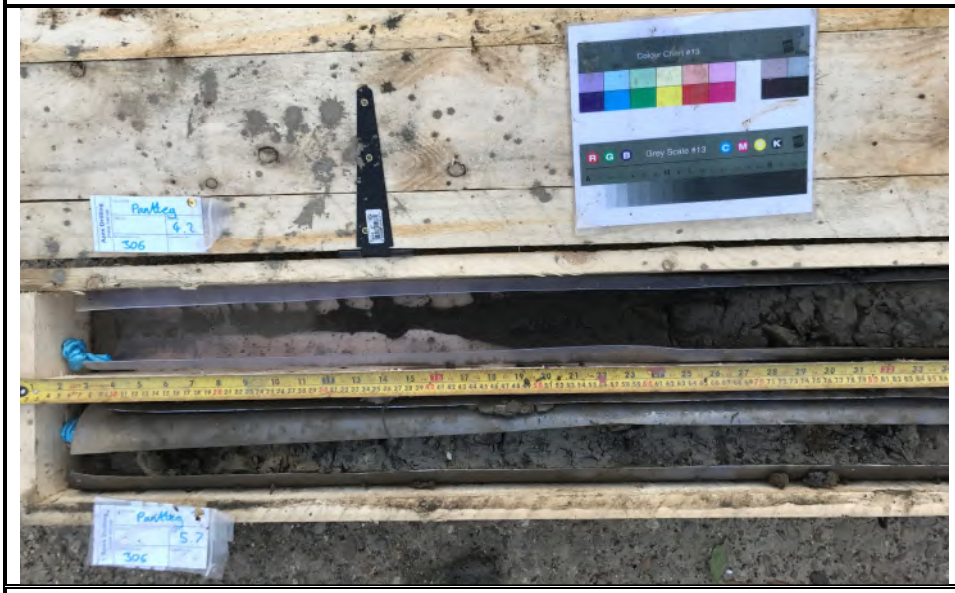
Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	4.2 – 8.4m .

Full core box overview

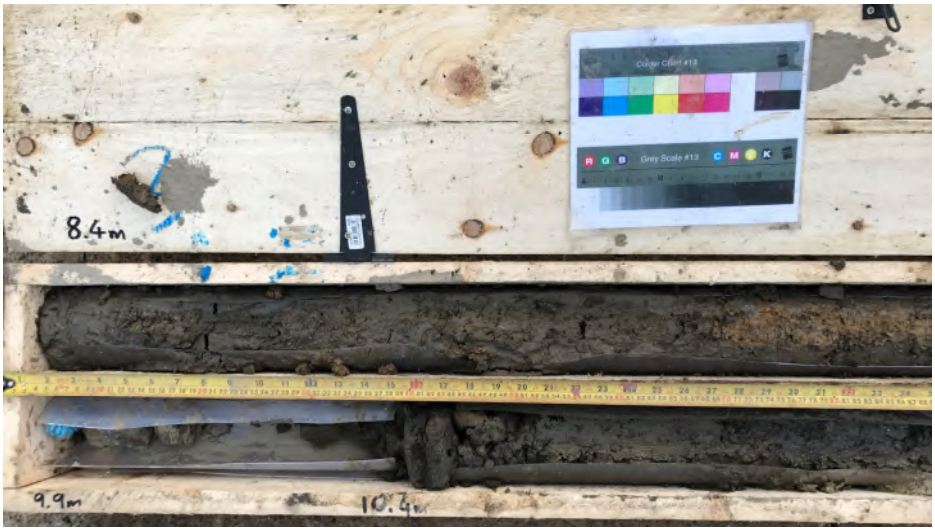


Left hand side of box

Right hand side of box

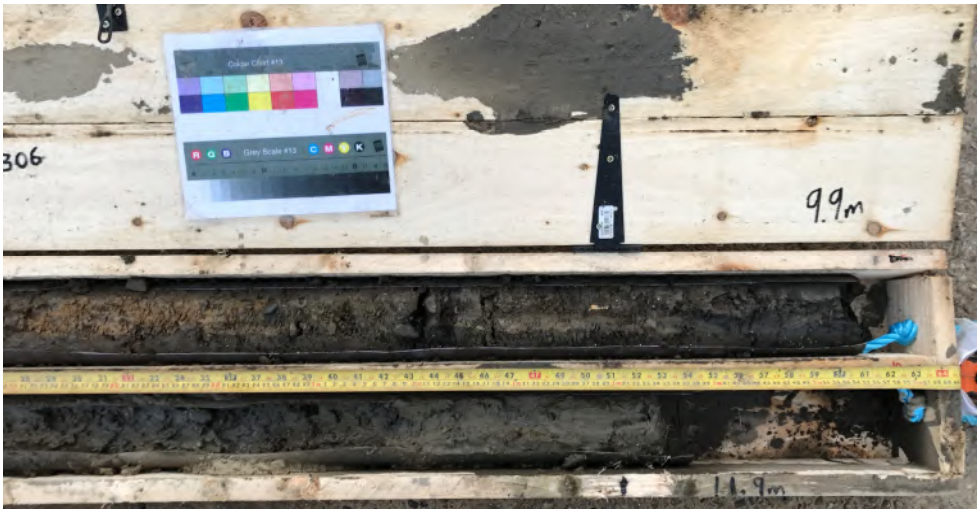
Borehole:	BH306		
Depth range:	8.4 -	Date of coring:	27th April 2017

Full core box overview



Left hand side of box

Right hand side of box



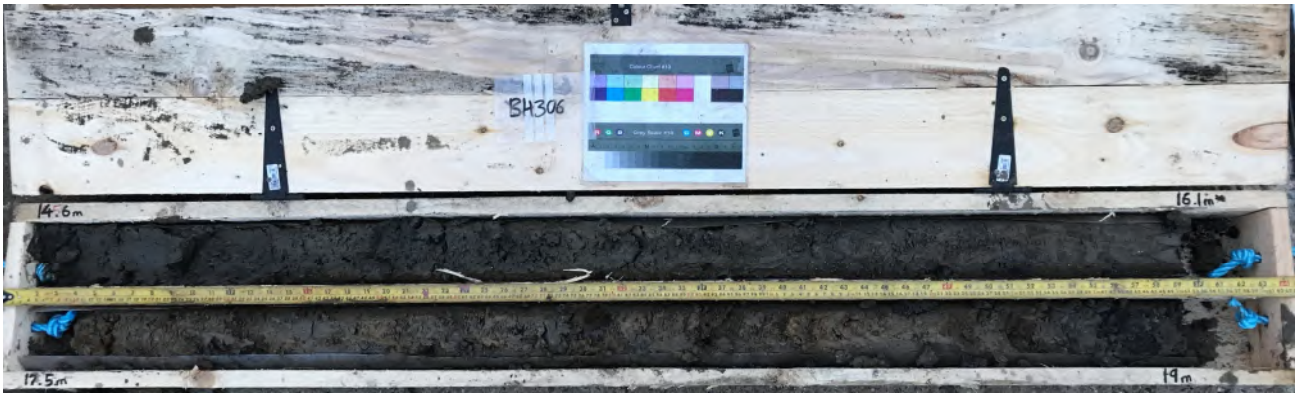
Borehole:	BH306		
Depth range:	11.9 – 14.6m	Date of coring:	27th April 2017

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	14.6 – 19.0m



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	19.5 – 20.5m

Full core box overview

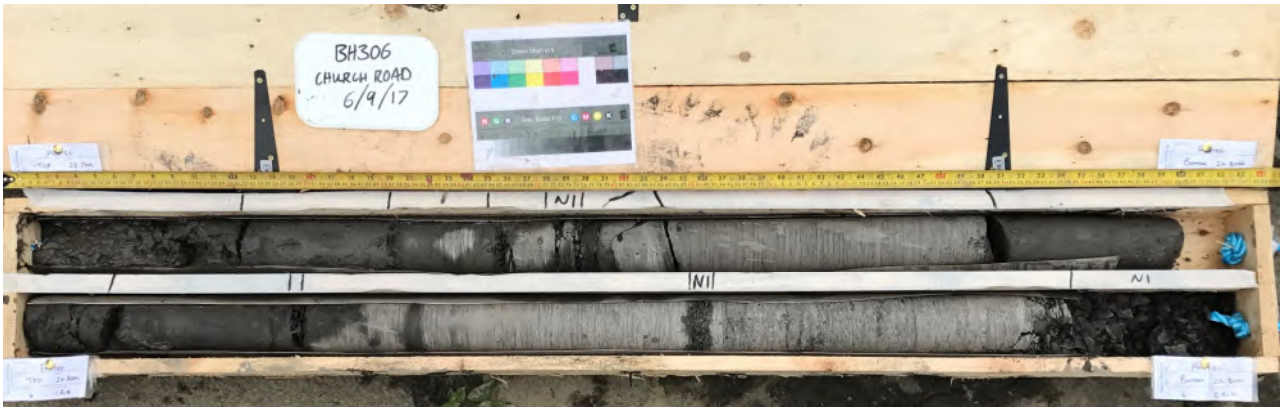
Borehole:	BH306		
Depth range:	30.0 – 33.0m	Date of coring:	27th April 2017

Full core box overview

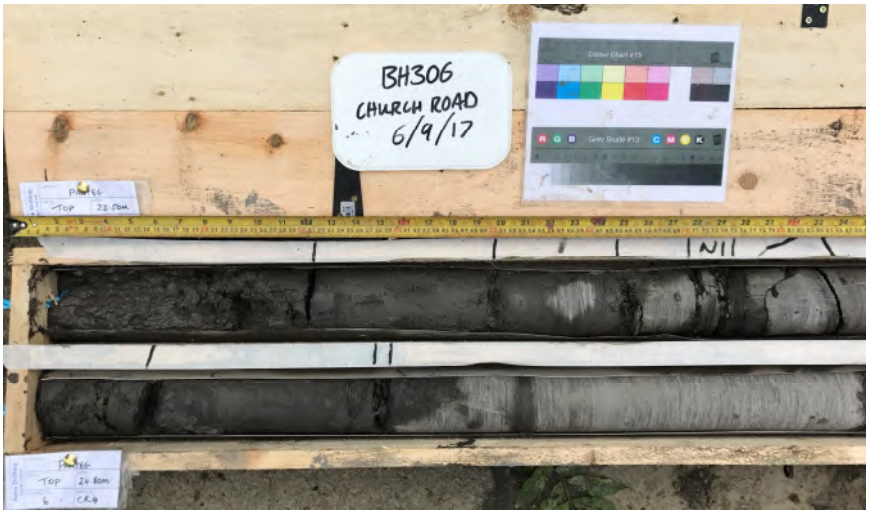
Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	23.5 – 26.3m



Full core box overview



Left hand side of box

Right hand side of box

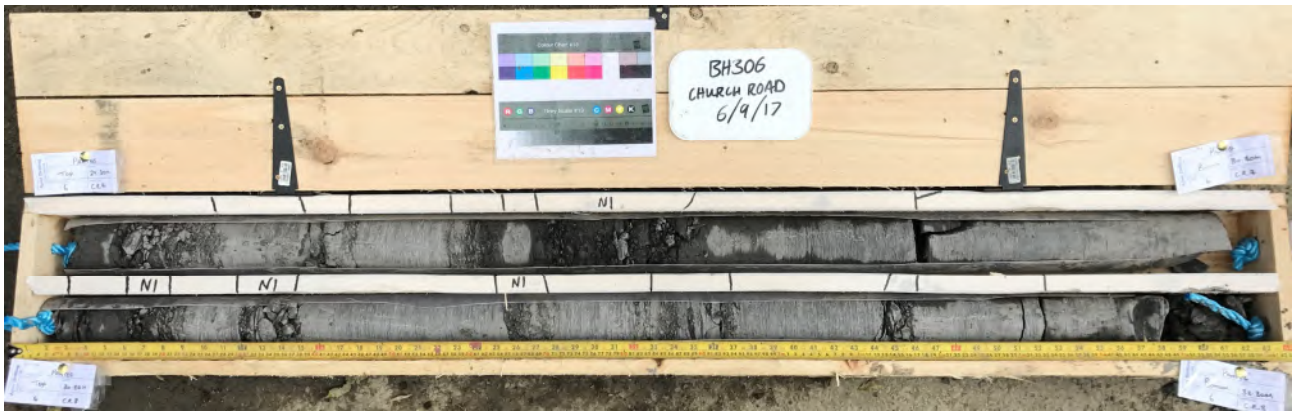
Borehole:	BH306
Depth range:	26.3 – 29.3m

Full core box overview

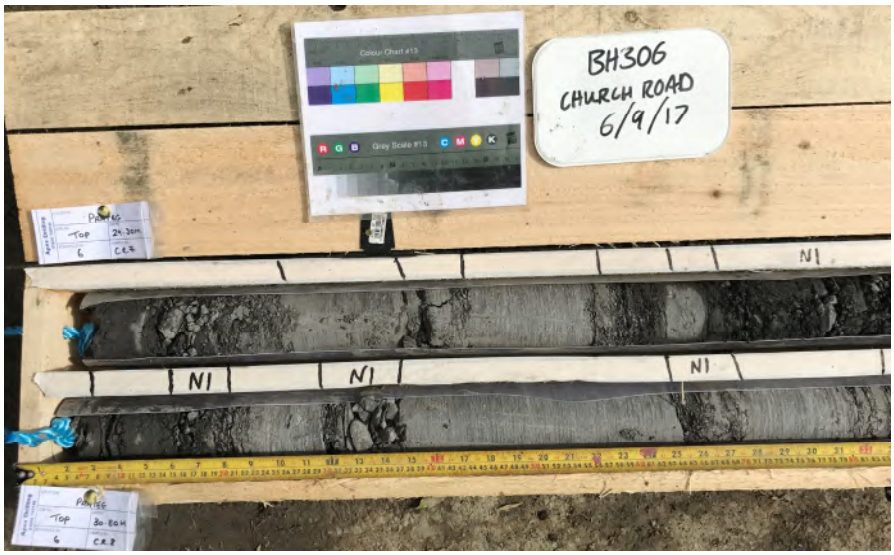
Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	29.3 – 33.3m



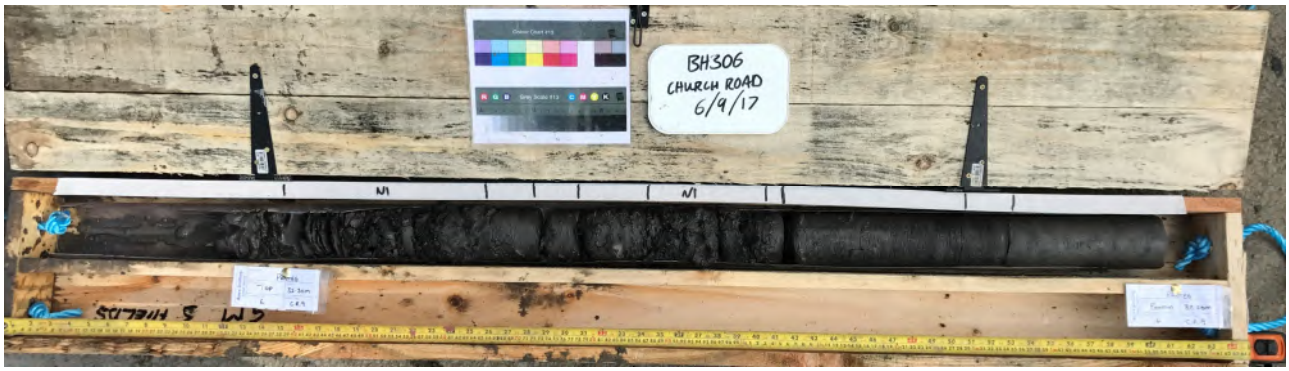
Full core box overview



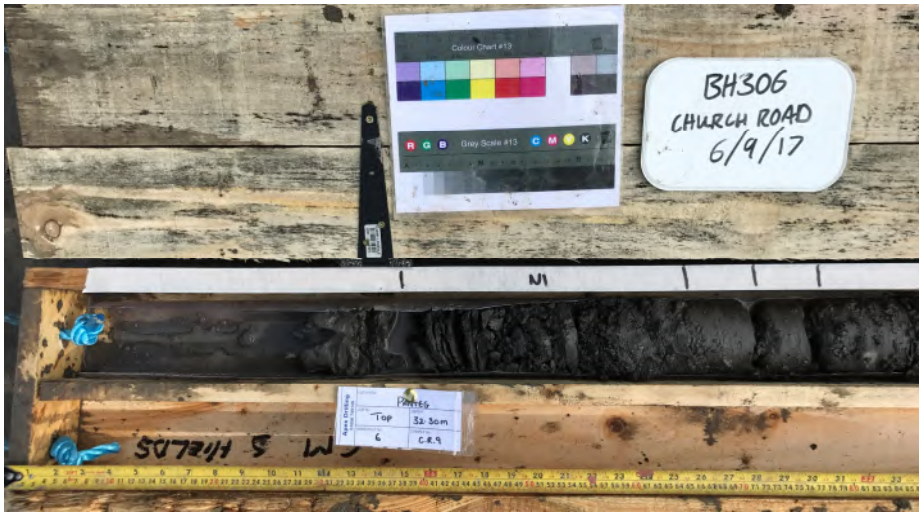
Left hand side of box

Right hand side of box

Borehole:	BH306
Depth range:	33.3 – 34.8m



Full core box overview



Left hand side of box

Right hand side of box

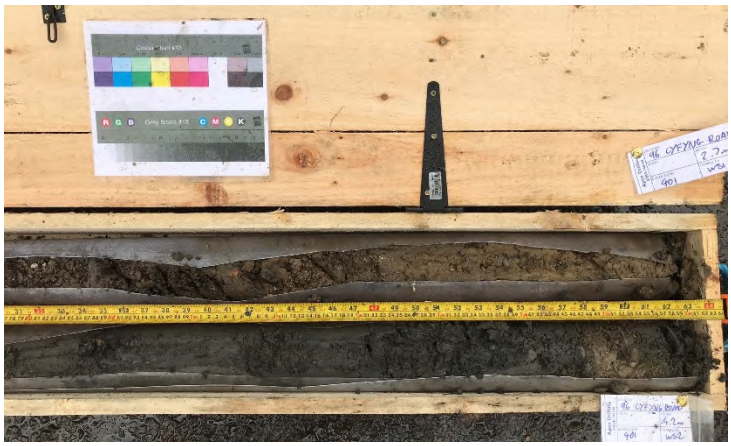
APPENDIX I – CORE PHOTOGRAPHS

Borehole:	BH401		
Depth range:	1.2 – 4.2m	Date of coring:	9th November 2017

Full core box overview

Left hand side of box

Right hand side of box

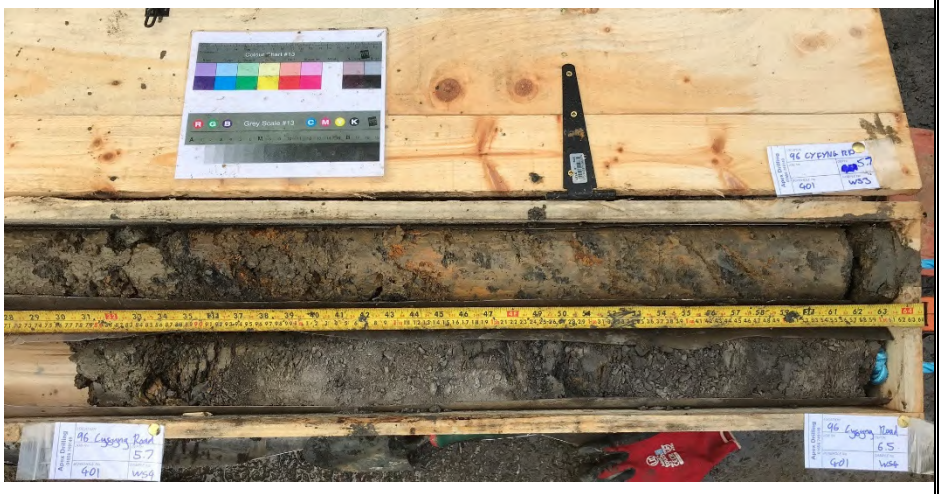


Borehole:	BH401		
Depth range:	4.2 – 6.5m	Date of coring:	9th November 2017

Full core box overview

Left hand side of box

Right hand side of box



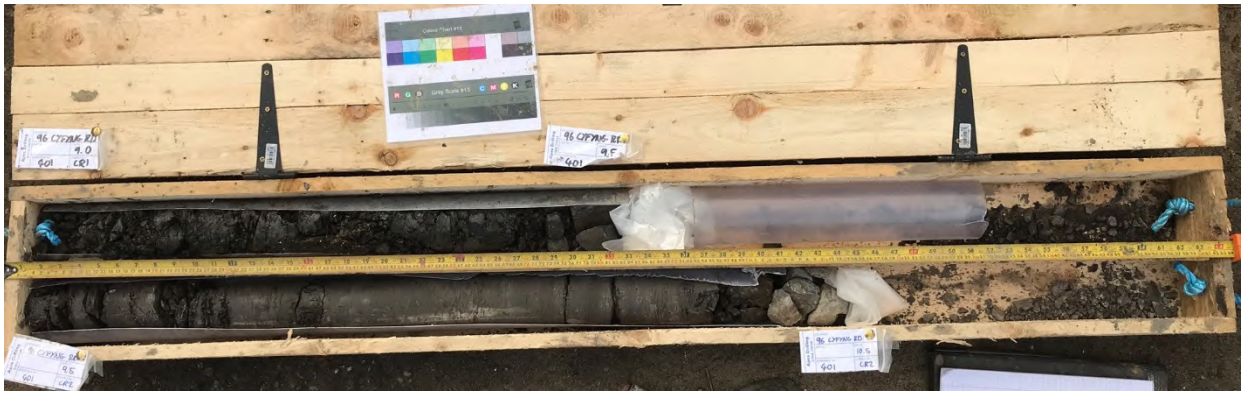
Borehole:	BH401		
Depth range:	6.5 – 9.0m	Date of coring:	9th November 2017

Full core box overview

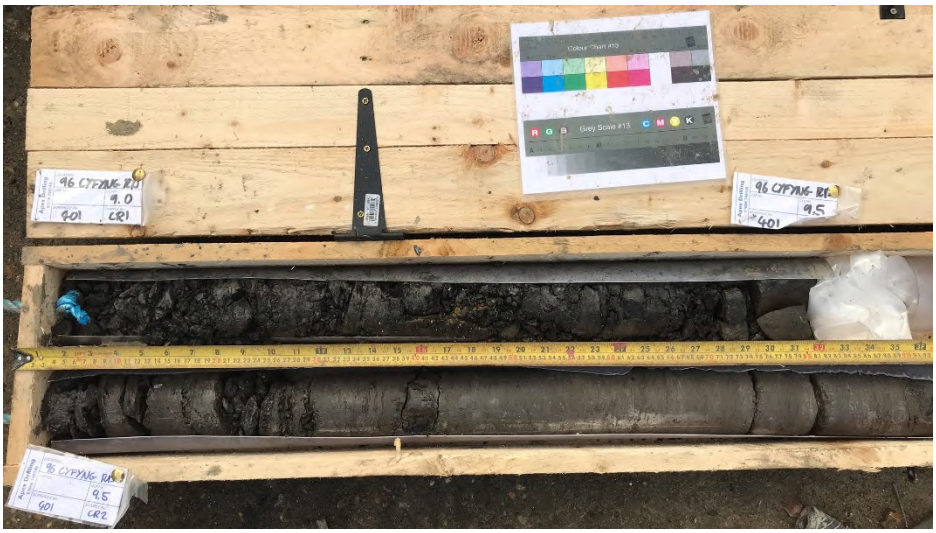
Left hand side of box

Right hand side of box

Borehole:	BH401		
Depth range:	9.0 – 10.5m	Date of coring:	10th November 2017



Full core box overview



Left hand side of box

Right hand side of box

Borehole:	BH401		
Depth range:	10.5 – 12.0m	Date of coring:	10th November 2017

Full core box overview

Left hand side of box

Right hand side of box

APPENDIX I – CORE PHOTOGRAPHS

Borehole:	BH601		
Depth range:	1.2 – 4.0m	Date of coring:	3rd August 2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	4.0 – 7.5m	Date of coring:	06/08/2018-07/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	7.5 – 10.5m	Date of coring:	07/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	10.5 – 13.5m	Date of coring:	07/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	13.5 – 15.5m	Date of coring:	07/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	17.0 – 18.5m	Date of coring:	08/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	18.5 – 21.5m	Date of coring:	08/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	21.5 – 24.5m	Date of coring:	09/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	24.5 - 27.0m	Date of coring:	09/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	27.0 – 30.0m	Date of coring:	09/08/2018 – 10/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	30.0 – 32.6m	Date of coring:	10/08/2018 – 13/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	32.6 – 35.6m	Date of coring:	13/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	35.6 – 37.6m	Date of coring:	13/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	37.6 - 40.6m	Date of coring:	14/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	40.6 – 43.6m	Date of coring:	14/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	43.6 - 46.5m	Date of coring:	14/08/2018 – 15/08/2018

Full core box overview

Left hand side of box

Right hand side of box

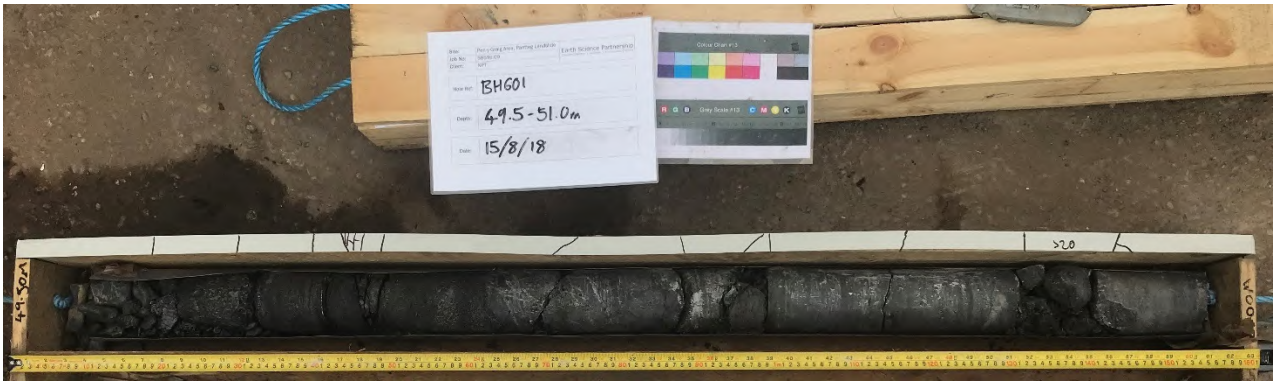
Borehole:	BH601		
Depth range:	46.5 - 49.5m	Date of coring:	15/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH601		
Depth range:	49.5 – 51.0m	Date of coring:	15/08/2018



Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH602		
Depth range:	0.5 – 3.5m	Date of coring:	16/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH109		
Depth range:	3.5 – 6.5m	Date of coring:	16/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH602		
Depth range:	6.5 – 9.1m	Date of coring:	16/08/2018 – 17/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Borehole:	BH602		
Depth range:	9.1 – 11.7m	Date of coring:	17/08/2018

Full core box overview

Left hand side of box

Right hand side of box

Appendix J

Windowless Sampling Drillhole Records –

100-111 Cyfyng Road

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 96.00 mOD		
Project No: 5859e.08	**Easting:** 276290 m		
	Northing: 208251 m		

Start date: 23-11-2017 **Driller:** GSTL
End date: 23-11-2017 **Logged by:** ESP-AW
Backfill date: 23-11-2017 **Date logged:** 23-11-2017

WS501

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.30	D							Very loose dark brown organic very gravelly silty clayey SAND with roots and rootlets. (MADE GROUND)			(0.60)		
											0.60	95.40	
0.80	D							Very soft, becoming firm at 1.5m, orange slightly gravelly slightly sandy CLAY with rootlets and wood fragments. Gravel is fine to coarse angular sandy siltstone and coal. (MADE GROUND - Possible reworked natural)					
1.00	D										1		
											(1.20)		
1.50	D												
1.70	D												
								Loose to medium dense orange brown clayey silty sandy GRAVEL. Gravel is partially weathered fine to coarse angular sandy siltstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES FORMATION)			1.80	94.20	
											2		
											(0.80)		
2.60	D							End of Borehole at 2.600m			2.60	93.40	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.6m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Groundwater well installed with a response zone between 0.5 to 2.6m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler	**WS502**	
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 98.00 mOD		
Project No: 5859e.08	**Easting:** 276288 m		
Start date: 23-11-2017	**Driller:** GSTL	**Northing:** 208255 m	
End date: 23-11-2017	**Logged by:** ESP-AW		
Backfill date: 23-11-2017	**Date logged:** 23-11-2017		

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.20	D							Grass surface over very loose dark brown organic clayey gravelly SAND with roots and rootlets. (MADE GROUND)			(0.50)		
											0.50	97.50	
0.70	D							Soft orange mottled black slightly gravelly slightly sandy CLAY with rootlets and occasional brick and wood fragments. Gravel is fine to coarse angular sandy siltstone and coal. (MADE GROUND - Possible reworked natural)					
1.00	D										1		
											(1.20)		
1.40	D												
1.70	D							Soft to firm orange mottled grey very gravelly CLAY. Gravel is fine to coarse angular sandy siltstone. (Possible COLLUVIUM)			1.70	96.30	
2.00	D										(0.50)		
											2		
								Loose orange mottled grey and brown clayey GRAVEL. Gravel is tabular angular fine to coarse siltstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES FORMATION)			2.20	95.80	
											(0.60)		
								End of Borehole at 2.800m			2.80	95.20	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.8m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Borehole backfilled with arisings on completion.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		**WS503**
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC			
Project No: 5859e.08			

Start date: 23-11-2017	**Driller:** GSTL	**Ground Level:** 100.00 mOD			
End date: 23-11-2017	**Logged by:** ESP-AW	**Easting:** 276278 m			
Backfill date: 23-11-2017	**Date logged:** 23-11-2017	**Northing:** 208256 m			

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
								Paved surface with a sand subbase. (MADE GROUD)			(0.20)		
											0.20	99.80	
0.40	D							Loose brown silty clayey very sandy GRAVEL with rootlets and occasional orange slag fragments. Gravel is fine to coarse angular sandy siltstone and coal. (MADE GROUND)			(0.80)		
0.90	D												
											1.00	99.00	
1.10	D							Very loose orange slightly silty slightly clayey slightly sandy GRAVEL. Gravel is angular fine to coarse siltstone. (Possible COLLUVIUM)			(0.60)		
1.40	D												
											1.60	98.40	
1.70	D							Loose becoming medium dense orange mottled grey very gravelly clayey silty SAND. Gravel is angular fine to coarse siltstone with some fine to medium angular coal. (Possible COLLUVIUM)					
2.00	D										2		
											(1.00)		
2.40	D												
								End of Borehole at 2.600m			2.60	97.40	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.6m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Borehole backfilled with arisings on completion.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 103.00 mOD		
Project No: 5859e.08	**Easting:** 276269 m		
	Northing: 208261 m		
Start date: 23-11-2017	**Driller:** GSTL		
End date: 23-11-2017	**Logged by:** ESP-AW		
Backfill date: 23-11-2017	**Date logged:** 23-11-2017		

WS504

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.20	D							Grass surface over very loose black slightly clayey gravelly SAND with a low angular tabular mudstone cobble content. Occasional rootlets and wood fragments. Gravel is fine to coarse angular mudstone. (MADE GROUND)			(0.40)		
											0.40	102.60	
								Very loose brown very clayey sandy GRAVEL with occasional orange slag fragments. Gravel is partially weathered fine to coarse angular siltstone and mudstone. (MADE GROUND)			(0.60)		
0.80	D												
											1.00	102.00	
1.10	D							Soft to firm becoming stiff very gravelly CLAY. Gravel is fine to coarse subangular to angular mudstone. (Possible COLLUVIUM)					
1.40	D										(1.00)		
2.00	D							Loose brown mottled grey very clayey GRAVEL. Gravel is fine to coarse angular mudstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES)			2.00	101.00	
2.30	D										(0.70)		
								End of Borehole at 2.700m			2.70	100.30	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.7m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Groundwater monitoring well installed with a response zone between 0.5 to 2.7m.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		**WS505**
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 88.00 mOD		
Project No: 5859e.08	**Easting:** 276288 m	**Northing:** 208210 m	
Start date: 24-11-2017	**Driller:** GSTL		
End date: 24-11-2017	**Logged by:** ESP-AW		
Backfill date: 24-11-2017	**Date logged:** 24-11-2017		

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Strata Details Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.40	D							Very loose black organic slightly clayey gravelly SAND with rootlets, occasional brick, ceramic, wood and glass fragments. Rare tin cans present. Gravel is fine to coarse angular coal and siltstone. (MADE GROUND)			(1.10)		
0.70	D										1		
1.20	D							Soft becoming stiff orange mottled grey and brown very gravelly CLAY. Gravel is fine to coarse subangular to angular siltstone. (Possible COLLUVIUM)			1.10	86.90	
1.50	D										(1.50)		
2.00	D										2		
2.40	D												
								End of Borehole at 2.600m			2.60	85.40	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.6m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Groundwater monitoring well installed with a response zone between 0.5 to 2.6m.

Earth Science Partnership

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Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 92.00 mOD		
Project No: 5859e.08	**Easting:** 276278 m		
Start date: 24-11-2017	**Driller:** GSTL	**Northing:** 208205 m	
End date: 24-11-2017	**Logged by:** ESP-AW		
Backfill date: 24-11-2017	**Date logged:** 24-11-2017		

WS506

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Strata Details Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.30	D							Very loose organic slightly gravelly sandy CLAY with roots and rootlets. Rare glass fragments. (MADE GROUND)			(0.50)		
											0.50	91.50	
0.80	D							Very soft becoming soft orange brown clayey silty slightly sandy GRAVEL. Gravel is subangular fine to coarse siltstone. (Possible COLLUVIUM)			(1.00)		
1.20	D												
1.40	D												
											1.50	90.50	
2.00	D							Loose becoming medium dense orange and brown mottled grey clayey silty slightly sandy GRAVEL. Gravel is angular fine to coarse siltstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES)			(1.00)		
2.40	D												
								End of Borehole at 2.500m			2.50	89.50	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.5m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Borehole backfilled with arising on completion.

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		**WS507**
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 94.00 mOD		
Project No: 5859e.08	**Easting:** 276270 m	**Northing:** 208213 m	
Start date: 24-11-2017	**Driller:** GSTL		
End date: 24-11-2017	**Logged by:** ESP-AW		
Backfill date: 24-11-2017	**Date logged:** 24-11-2017		

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.30	D							Very loose organic slightly clayey gravelly SAND with roots and rootlets. Rare glass fragments. (MADE GROUND)			(0.60)		
0.70	D							Very loose becoming loose orange mottled grey and black clayey sandy GRAVEL. Gravel is fine to coarse angular siltstone and sandy siltstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES)			0.60	93.40	
1.10	D										1		
1.20 - 2.20	B										(1.90)		
											2		
								End of Borehole at 2.500m			2.50	91.50	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.5m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Groundwater monitoring well installed with a response zone between 0.5 to 2.5m.

Earth Science Partnership

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Project Name: 100 and 111 Cyfyng Road	**Drilling method** Handheld Window Sampler		
Site Location: Cyfyng Road, Pantteg	**Equipment** Handheld Window Sampler		
Client: NPTCBC	**Ground Level:** 96.00 mOD		
Project No: 5859e.08	**Easting:** 276266 m		
Start date: 24-11-2017	**Driller:** GSTL	**Northing:** 208221 m	
End date: 24-11-2017	**Logged by:** ESP-AW		
Backfill date: 24-11-2017	**Date logged:** 24-11-2017		

WS508

Depth	Sample Type	Sample Class	Test Details Type	Test Details Result	TCR (%)	Water Depth	Casing Depth	Strata Details Description	Legend	Water Strikes/ Standing	Depth (Thickness)	Depth mOD	Backfill/ Install-ations
0.50	D							Very loose dark brown organic gravelly slightly clayey SAND with roots and rootlets. Occasional cobble sized bricks and ceramic fragments. Gravel is fine to coarse subangular to angular siltstone. Rare pockets of orange brown gravelly clay. (MADE GROUND)			(1.90)		
1.00	D										1		
1.20	B												
1.20 - 2.20	D												
2.00	D							Very loose orange mottled grey and brown very gravelly slightly sandy CLAY. Gravel is fine to coarse angular siltstone. (GRADE E SOUTH WALES MIDDLE COAL MEASURES)			1.90	94.10	
											2		
											(0.60)		
								End of Borehole at 2.500m			2.50	93.50	
											3		

Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth

General Remarks

1. Coordinates and elevation interpolated from recent LiDAR data (ESP, 2017) from the area.
2. Hand-dug pit excavated to 1.2m to check location for the presence of services.
3. Borehole excavated utilising hand-held window sampling until refusal at 2.5m.
4. Mackintosh probe carried out adjacent to borehole, see separate sheet for details.
5. Groundwater not encountered during drilling.
6. Groundwater monitoring well installed with a response zone between 0.5 to 2.5m.

Appendix K

Mackintosh Probe Records

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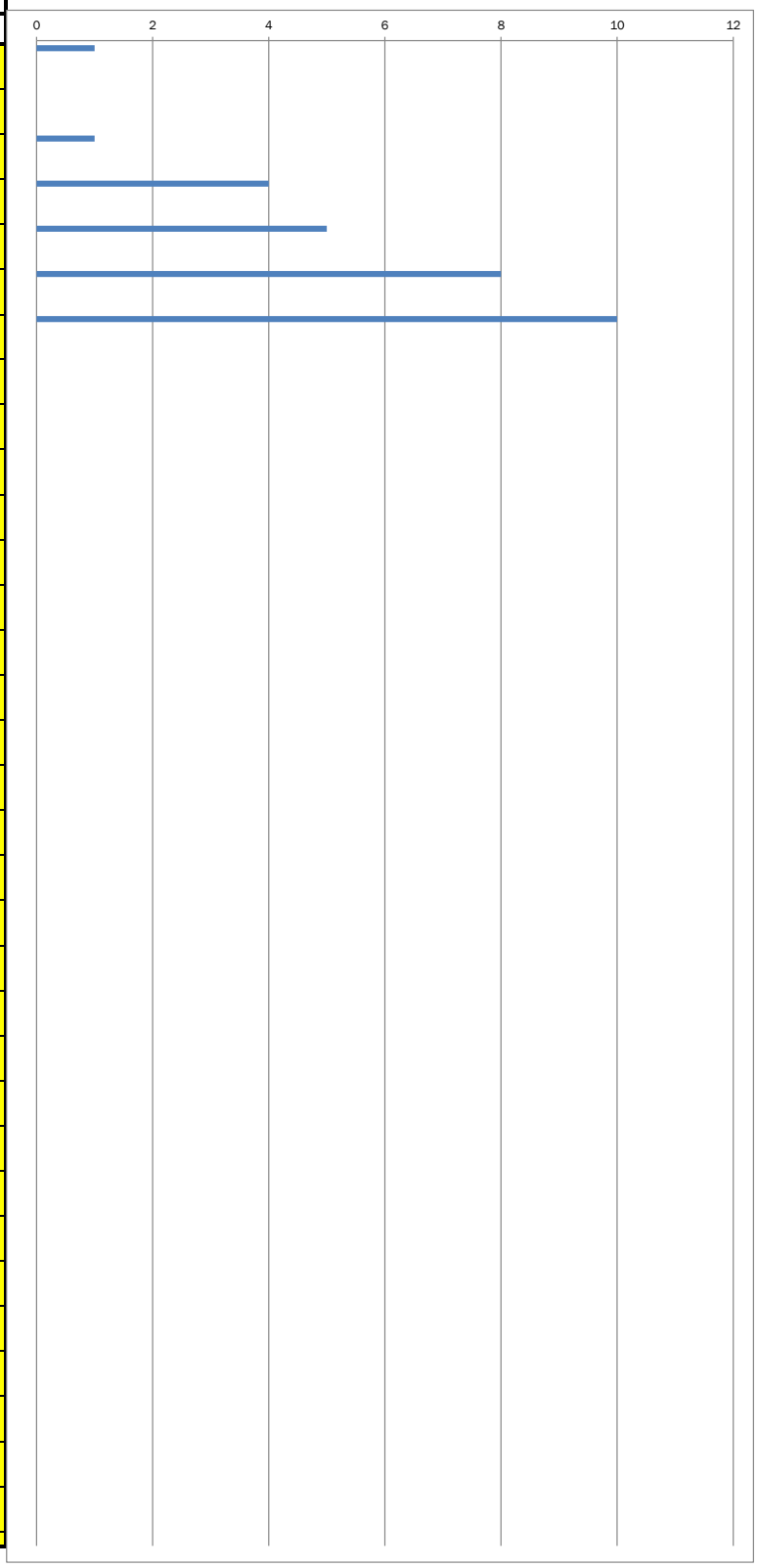
APPENDIX K - MACKINTOSH PROBE RECORD

WS501

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	96 mOAD
Site Location:	Pantteg	**Easting:**	276290 mE
Client :	NPTCBC	**Northing:**	208251 mN
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	3 3 5	1
0.50	3 1	0
	1 4 3	1
1.00	5 9	4
	17 18 10	5
1.50	20 24	
	22 35 29	8
2.00	37 40	10
	35	
2.50		
3.00		
3.50		
4.00		
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS501 for further detail.

Made ground

Made Ground - Possilbe reworked natural

Grade E South Wales Middle Coal Measures Fromation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS501 record for detailed description of the ground conditions.
3. Test ended at 2.1m due to refusal of the Mackintosh Probe.

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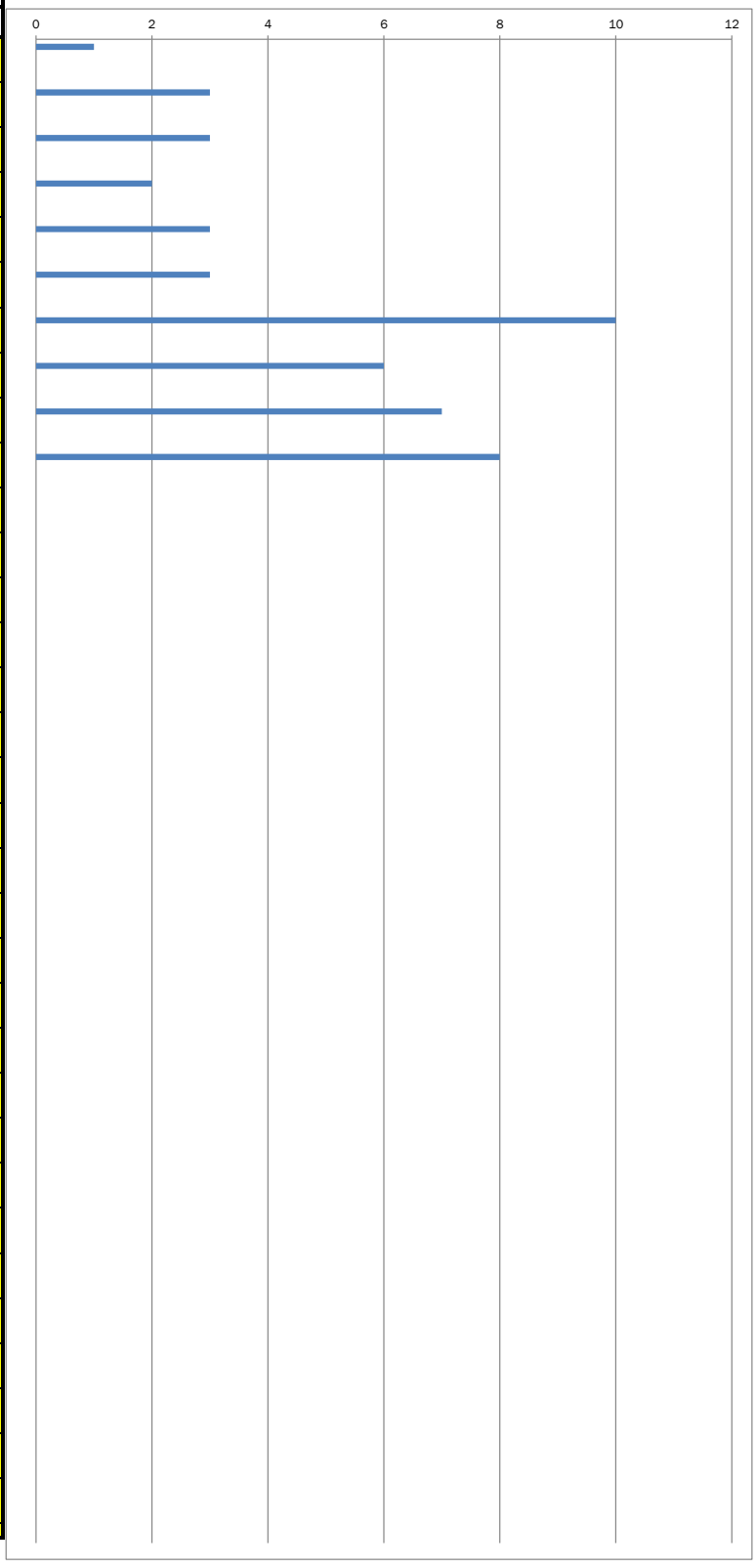
APPENDIX K - MACKINTOSH PROBE RECORD

WS502

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	98
Site Location:	Pantteg	**Easting:**	276288
Client :	NPTCBC	**Northing:**	208255
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	2 3 2 8 8	1
0.50	14 13 5 11 7	3
1.00	8 12 9 13 10	3
1.50	12 15 12 28 38	2
2.00	44 23 20 21 23	3
2.50	25 29 36 50	10
3.00		6
3.50		7
4.00		8
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS502 for further detail.

Made Ground

Made Ground - Possible reworked natural

Possible Colluvium

Grade E South Wales Middle Coal Measures Formation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS502 record for detailed description of the ground conditions.
3. Test ended at 2.9m due to refusal of the Mackintosh Probe.

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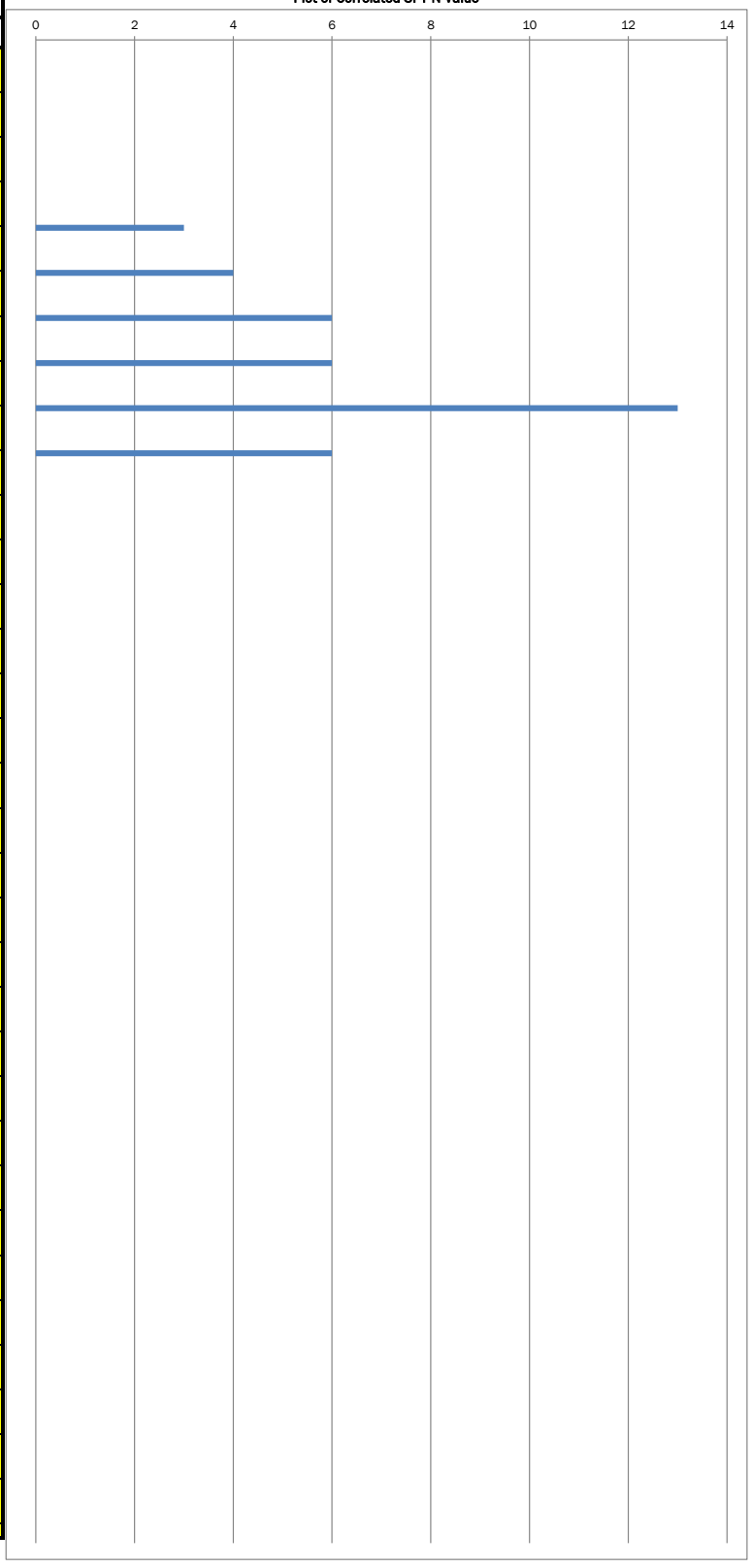
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	100
Site Location:	Pantteg	**Easting:**	276278
Client :	NPTCBC	**Northing:**	208256
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS503

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL		
0.50		
1.00		
1.50	8 12 19	3
	20 15	4
2.00	15 23 18	6
	21 20	6
2.50	23 32	13
	55 62	
3.00	70	6
3.50		
4.00		
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS503 for further detail.

- Paved surface
- Made Ground
- Possible Colluvium
- Grade E South Wales Middle Coal Measures Formation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS503 record for detailed description of the ground conditions.
3. Test ended at 2.8m due to refusal of the Mackintosh Probe.

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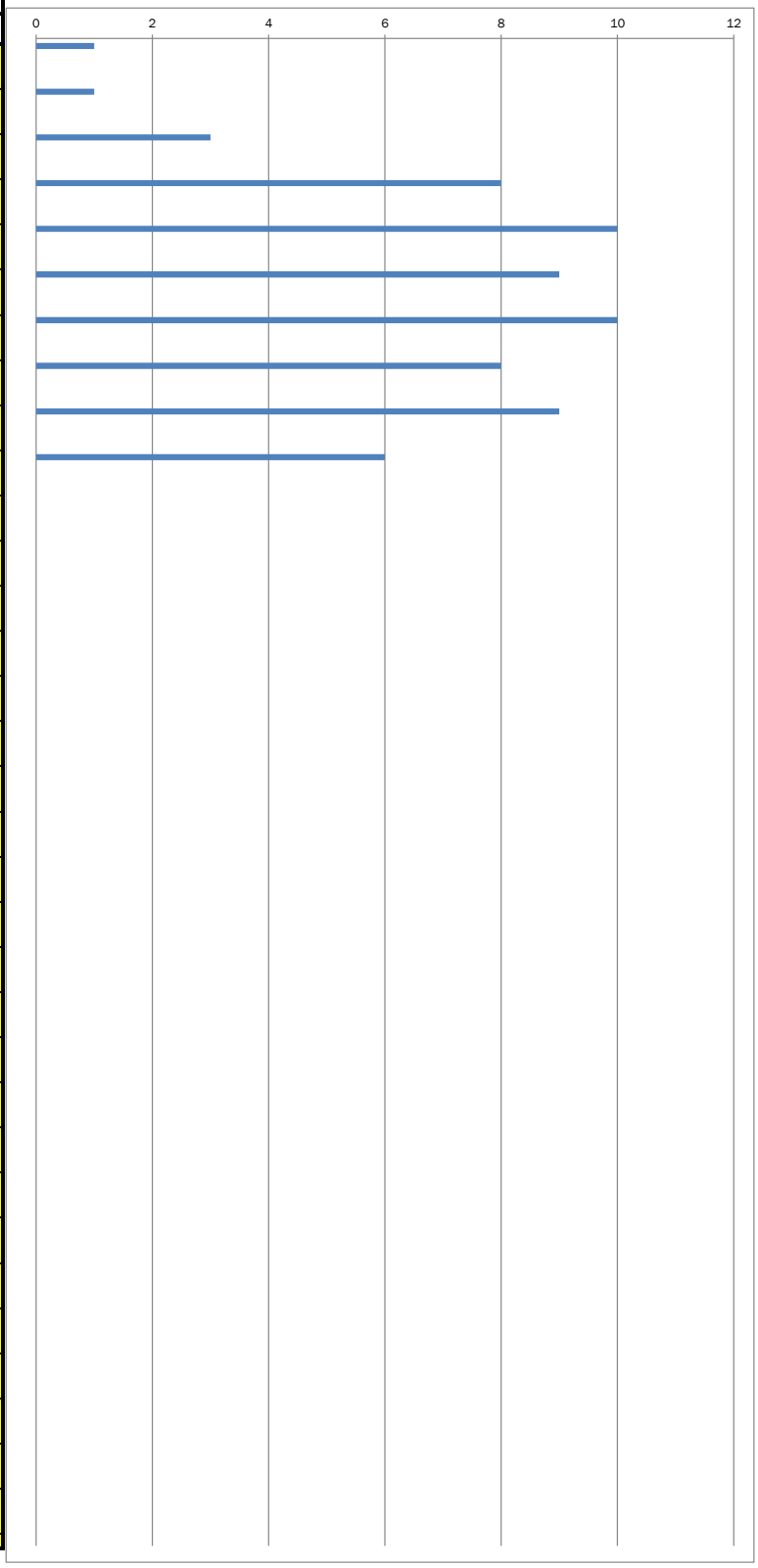
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	103
Site Location:	Pantteg	**Easting:**	276269
Client :	NPTCBC	**Northing:**	208261
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS504

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	3 2 4 5 5	1
0.50	3 2 12 18 25	1
1.00	29 30 40 39 38	3
1.50	35 45 25 48 30	8
2.00	33 25 34 30 34	10
2.50	40 30 65	9
3.00		6
3.50		
4.00		
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS504 for further detail.

Made Ground

Possilbe Colluvium

Grade E South Wales Coal Measures Formation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS504 record for detailed description of the ground conditions.
3. Test ended at 2.8m due to refusal of the Mackintosh Probe.

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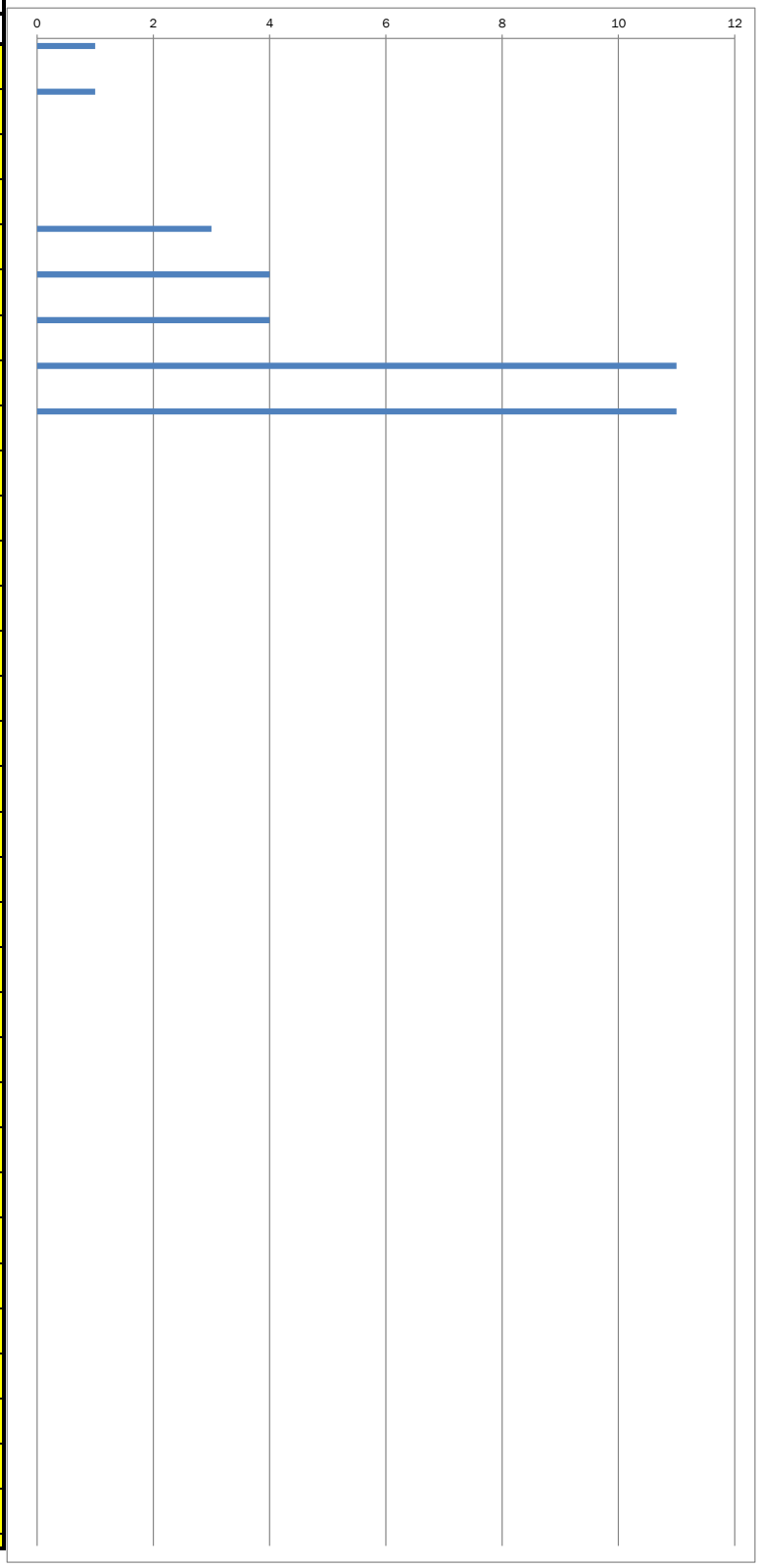
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	88
Site Location:	Pantteg	**Easting:**	276288
Client :	NPTCBC	**Northing:**	208210
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS505

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	4 3 4	1
0.50	4 3	1
	2 1 1	0
1.00	2 1	0
	1 2 7	3
1.50	15 20	
	21 15 13	4
2.00	15 14	4
	20 37 38	11
2.50	50 48	
	75	11
3.00		
3.50		
4.00		
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS505 for further detail.

Made Ground

Possible Colluvium

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS505 record for detailed description of the ground conditions.
3. Test ended at 2.6m due to refusal of the Mackintosh Probe.

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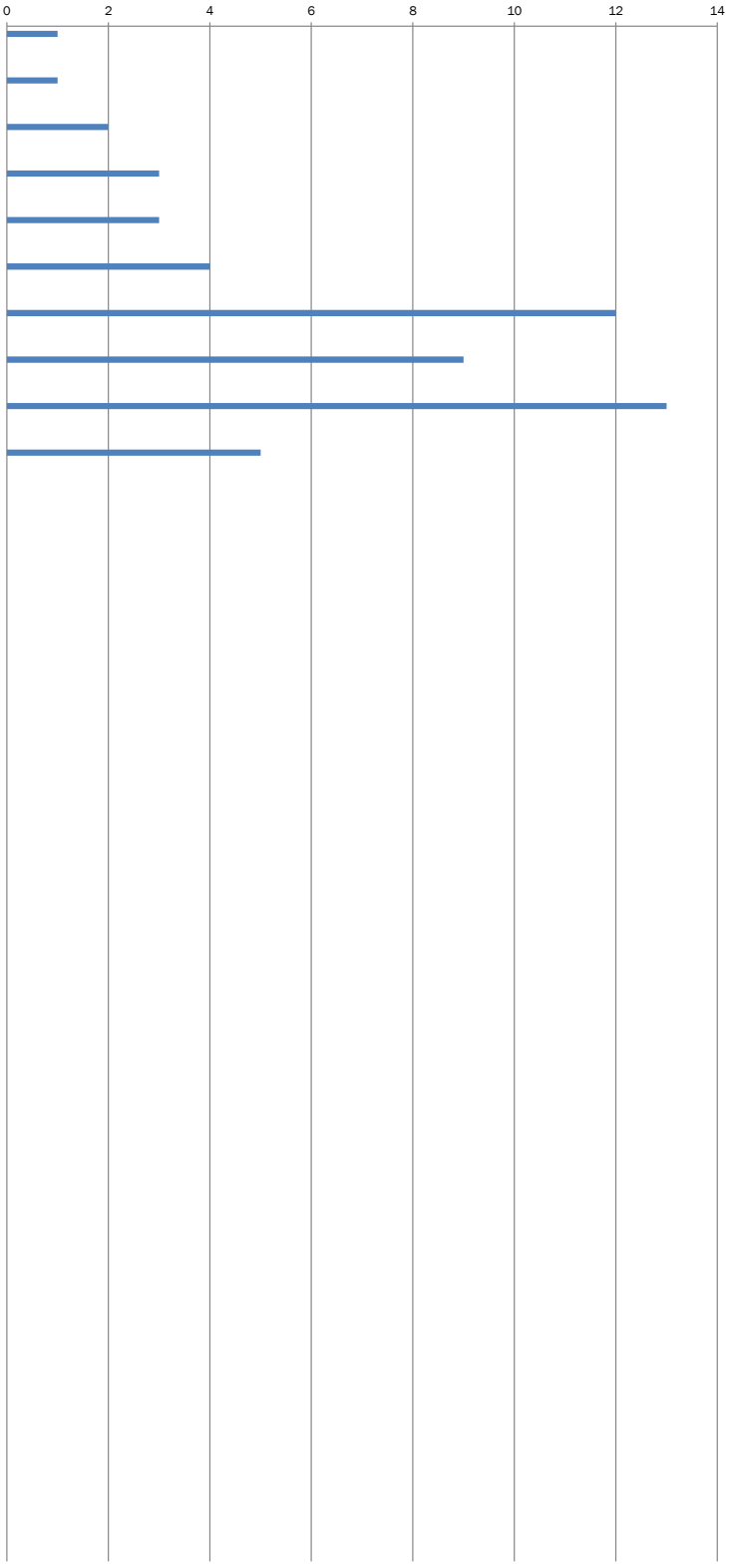
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	92
Site Location:	Pantteg	**Easting:**	276278
Client :	NPTCBC	**Northing:**	208205
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS506

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	2 3 2 2 3	1
0.50	3 8 11 7 12	1
1.00	13 10 10 10 15	2
1.50	13 14 14 25 30	3
2.00	80 34 39 30 35	3
2.50	43 65 59	4
3.00		12
3.50		9
4.00		13
4.50		5
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS506 for further detail.

Made Ground

Possible Colluvium

Grade E South Wales Middle Coal Measures Formation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS506 record for detailed description of the ground conditions.
3. Test ended at 2.8m due to refusal of the Mackintosh Probe.

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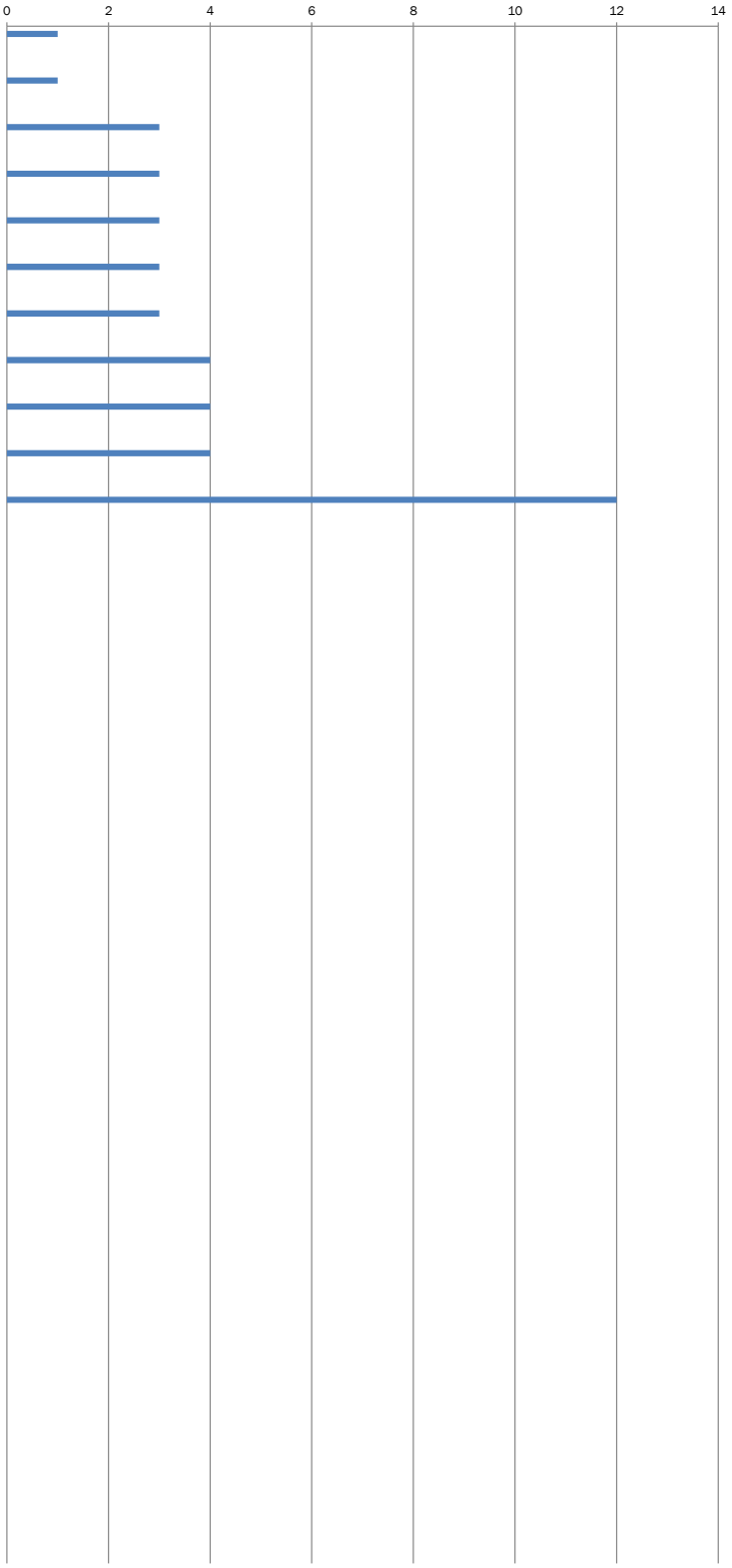
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	94
Site Location:	Pantteg	**Easting:**	276270
Client :	NPTCBC	**Northing:**	208213
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS507

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	2 2 2	1
0.50	3 2	1
	5 11 9	3
1.00	9 11	3
	10 7 12	3
1.50	9 16	3
	15 12 11	3
2.00	12 12	3
	15 14 15	4
2.50	14 10	4
	14 16 11	4
3.00	13 18	4
	26 59 50	12
3.50		
4.00		
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS507 for further detail.

Made Ground

Grade E South Wales Middle Coal Measures

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS507 record for detailed description of the ground conditions.
3. Test ended at 3.3m due to refusal of the Mackintosh Probe.

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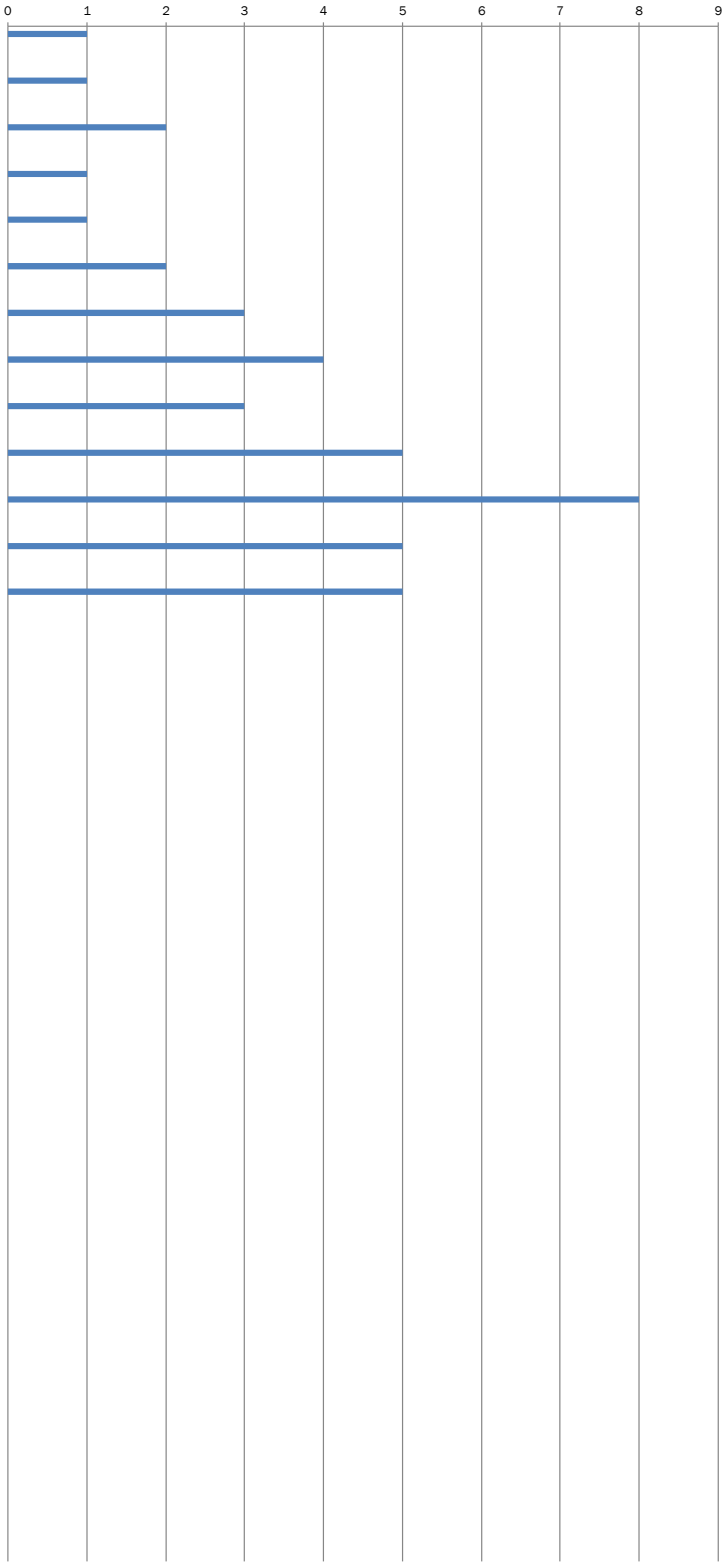
APPENDIX K - MACKINTOSH PROBE RECORD

Project Name:	100 and 111 Cyfyng Road	**Ground Level:**	96
Site Location:	Pantteg	**Easting:**	276266
Client :	NPTCBC	**Northing:**	208221
Date of Testing:	24/11/2017		
Weather:	Dry and Cold		

WS508

Depth (m)	M blows per 100mm per 100mm	Correlated SPT-N Value (per 300mm)
GL	1 3 7 5 4	1
0.50	5 13 7 6 5	2
1.00	7 3 4 4 3	1
1.50	5 6 9 10 15	2
2.00	11 8 9 25 10	3
2.50	9 15 20 16 20	4
3.00	30 35 25 20 20	3
3.50	20 35 25	5
4.00		5
4.50		
5.00		
5.50		
6.00		
6.50		
7.00		
7.50		
8.00		
8.50		
9.00		
9.50		
10.00		

Plot of Correlated SPT-N Value



Anticipated Soils.
See App A. - WS508 for further detail.

Made Ground

Grade E South Wales Middle Coal Measures Formation

REMARKS:

1. Coordinates and elevation inferred from LiDAR data for the area (ESP, 2017)
2. See WS508 record for detailed description of the ground conditions.
3. Test ended at 3.8m due to refusal of the Mackintosh Probe.

Appendix L

Groundwater Well Monitoring Results

Borehole and Standpipe		Ground Level (m OD)	Groundwater Level (m OD)					
			Monitoring Date					
			15/12/2016	22/12/2016	13/01/2017	27/01/2017	23/02/2017	10/09/2018
BH101	shallow (8.18m total)	100.53	92.55	92.48	92.5	92.48	92.48	See notes[3].
Near Chapel	deep (17.6m total)		84.93	85.03	84.09	83.01	83.02	
BH102	shallow (5.25m total)	72.11	-	68.11	68.36	68.16	68.59	68.01
Clees Lane	deep (18.3m total)		-	54.16	54.16	54.15	56.38	Dry
BH103	shallow (4.4 total)	130.90	127.15	127.2	126.77	126.77	126.78	126.8 (wet at base)
Graig y Merched	deep (15.1m total)		118.13	115.98	115.95	115.85	115.94	115.8 (wet at base)
Comments on weather preceding monitoring visit			During site works, generally dry	Following a prolonged period of rain.	Following a prolonged period of rain.	Dry period	Following Storm Doris	Following dry period

Notes
1. Ground levels presented have been surveyed in using DGPS.
2. Detail of the response zone for each monitoring well is presented in the BH100 Logs, see Appendix D.
3. BH101 buried by recent gabion wall construction. Borehole position to be located during upcoming survey of borehole positions.

Borehole and standpipe		Ground Level[1] (m OD)	Groundwater Level (m OD)
			Monitoring Date
			14/09/2018
BH602	Groundwater elevation (m)	146.58	137.55
Pen-y-Graig Area	Base of standpipe (m)		135.08
Comments on weather preceding monitoring visit			Generally dry preceding monitoring

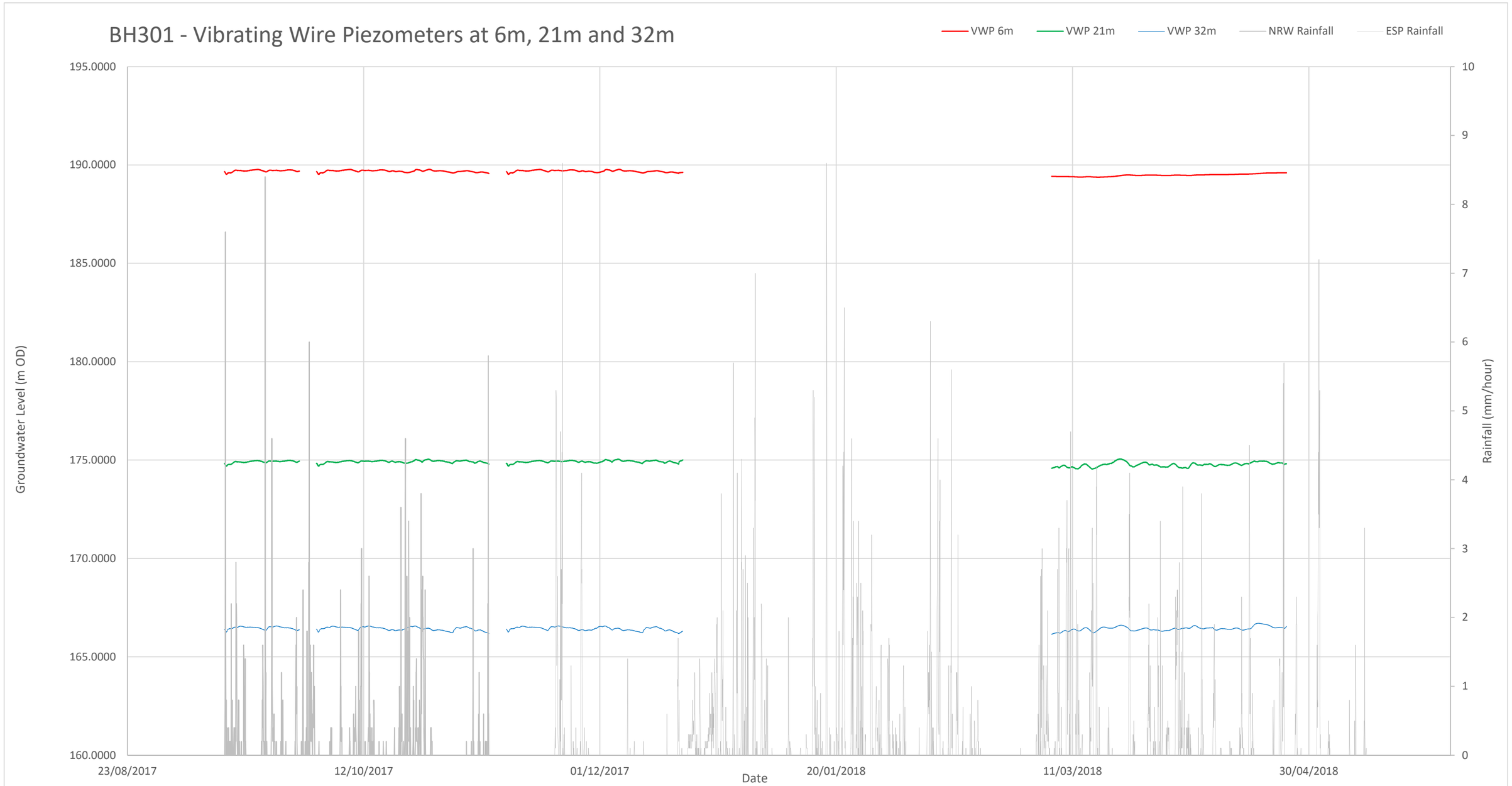
Notes
1. Ground level presented surveyed using DGPS.

Borehole and Standpipe		Ground Level[1] (m OD)	Groundwater Level (m OD)
			Monitoring Date
			7/12/2017
WS501 Garden of 100 Cyfyng Road	Groundwater elevation (m)	96.0	Dry
	Base of standpipe (m)		93.4
WS504 Garden of 100 Cyfyng Road	Groundwater elevation (m)	103.0	Dry
	Base of standpipe (m)		100.3
WS505 Garden of 111 Cyfyng Road	Groundwater elevation (m)	88.0	1.86
	Base of standpipe (m)		85.5
WS507 Garden of 111 Cyfyng Road	Groundwater elevation (m)	94.0	Dry
	Base of standpipe (m)		91.5
WS508 Garden of 111 Cyfyng Road	Groundwater elevation (m)	96.0	Dry
	Base of standpipe (m)		93.5
Comments on weather preceding monitoring visit			Following a prolonged period of rain.

Notes
1. Ground level elevations presented are interpolated from recent LiDAR data for the area (ESP, 2017).

Appendix M

Vibrating Wire Piezometer Results



Notes:

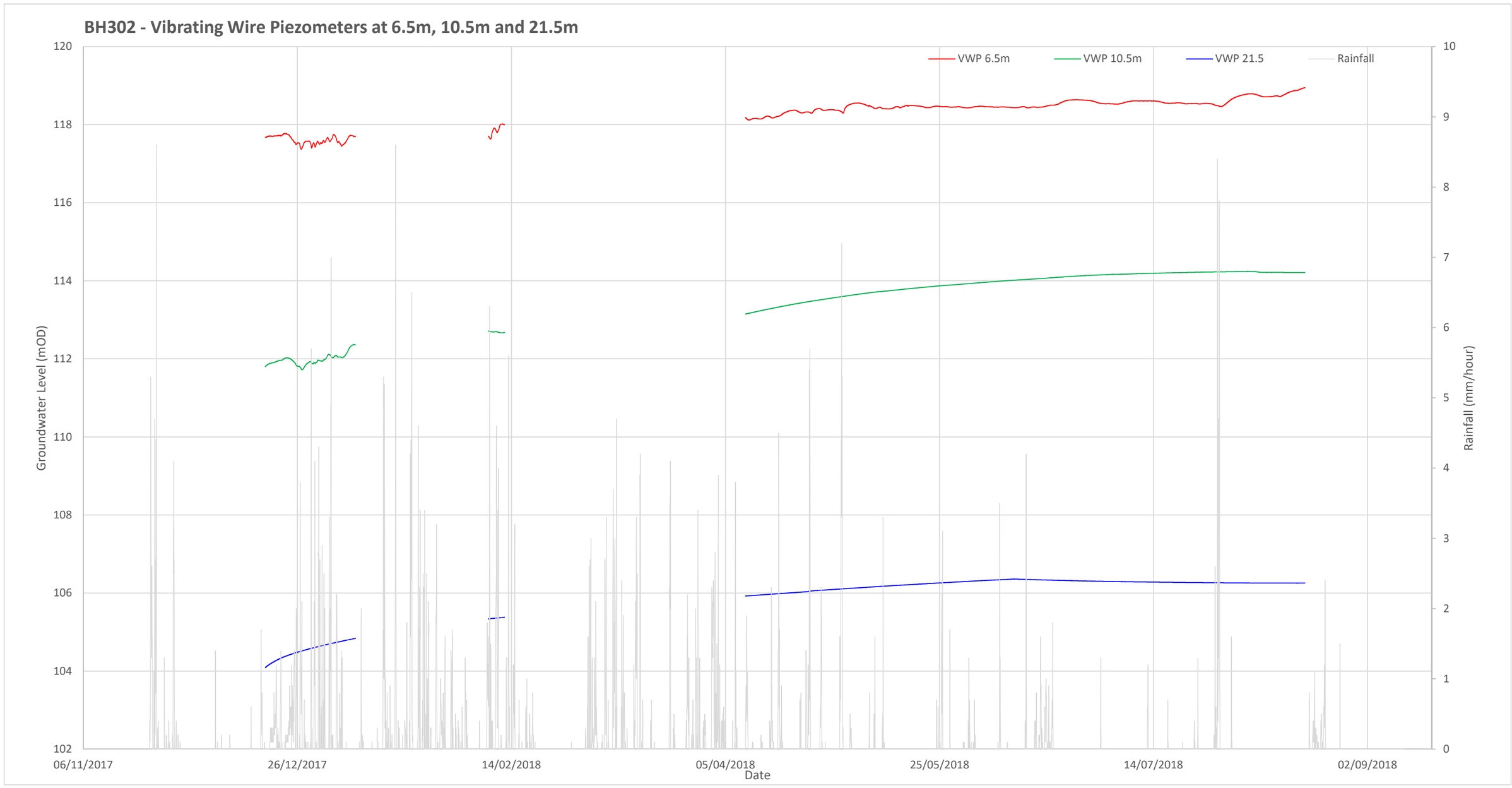
1, Gap in data in Winter 2017/2018 due to suspected tampering with logger box, with the batteries becoming dislodged.

2, Gap in data for Summer 2018 also due to suspected tampering with logger box, with the batteries becoming dislodged.

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH301 – QUARRY MONITORING INFORMATION

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com



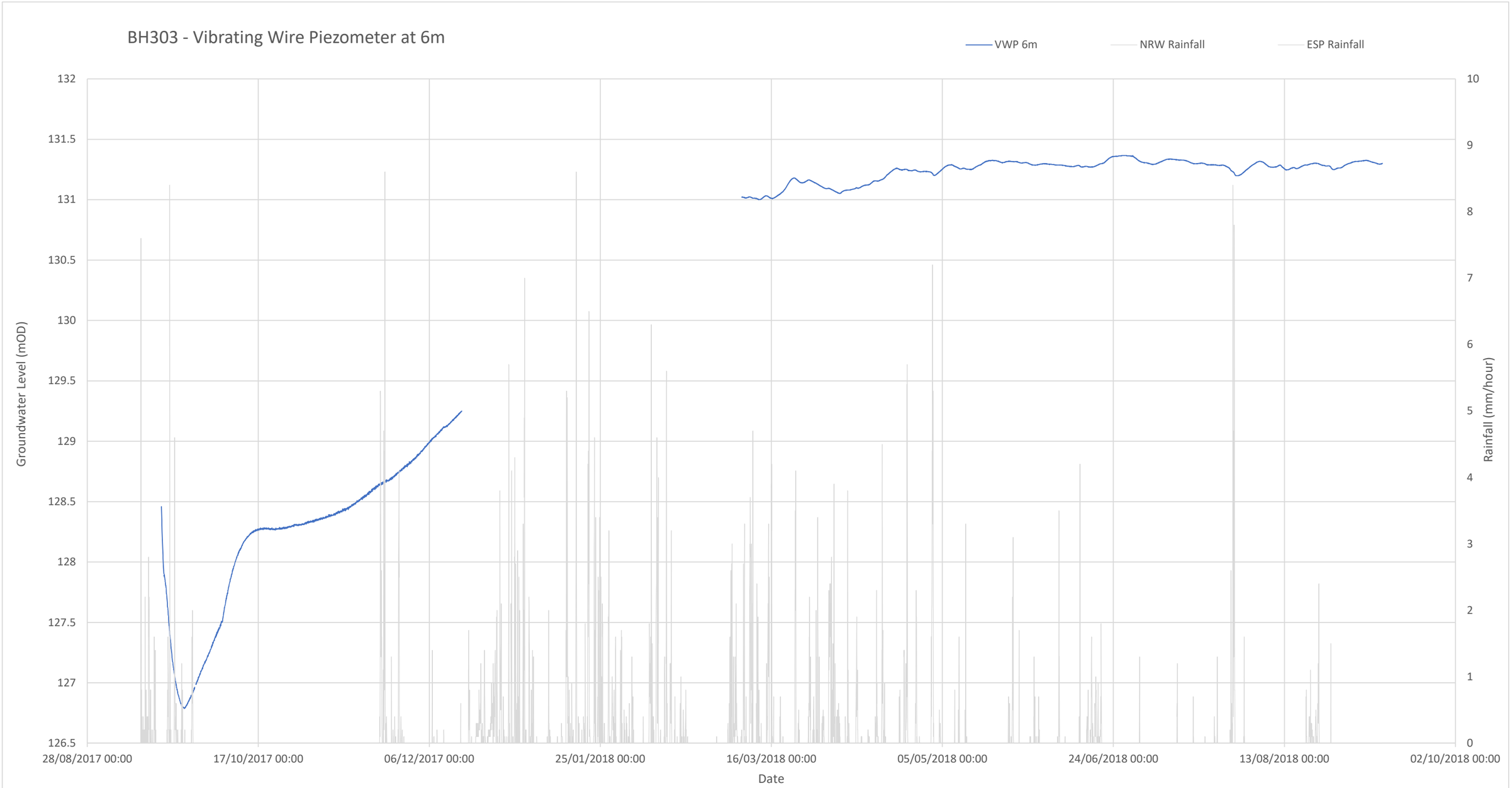
Notes:

1, Gaps in data due to logger box becoming damaged whilst spoil on site removed.

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH302 – LOWER GYM MONITORING INFORMATION

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com



Notes:

1, Gap in vibrating wire piezometer data due to corrupt data files caused by possible vandalism of monitoring installation (magnet wiping memory) Similar data loss noted on records from BH401.

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH303 – HIGHER GYM VIBRATING WIRE PIEZOMETER MONITORING INFORMATION

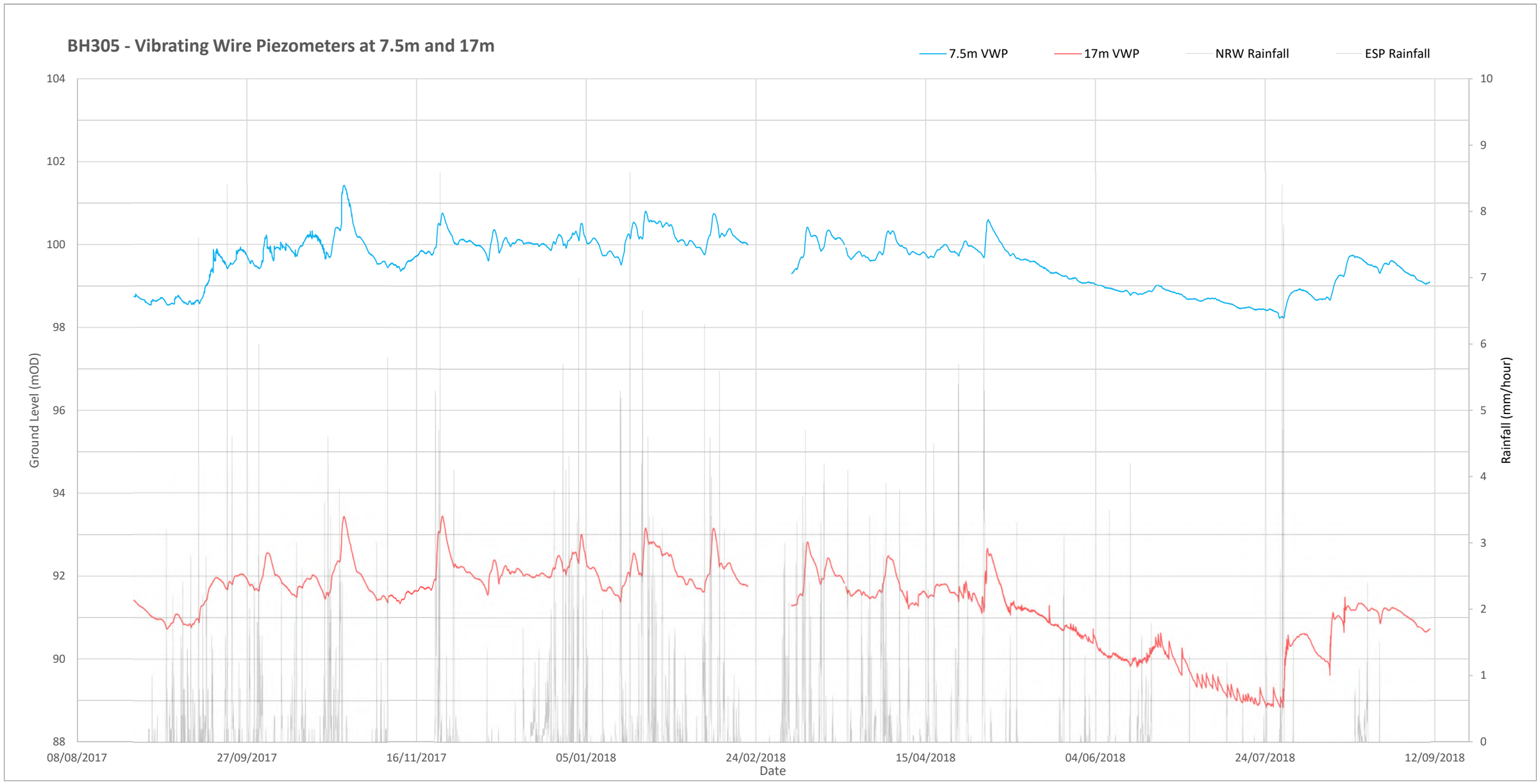
Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com

Notes:

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH304 – CLEES LAND MONITORING INFORMATION

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com



Notes:

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH305 – CHAPEL VIBRATING WIRE PIEZOMETER MONITORING

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com

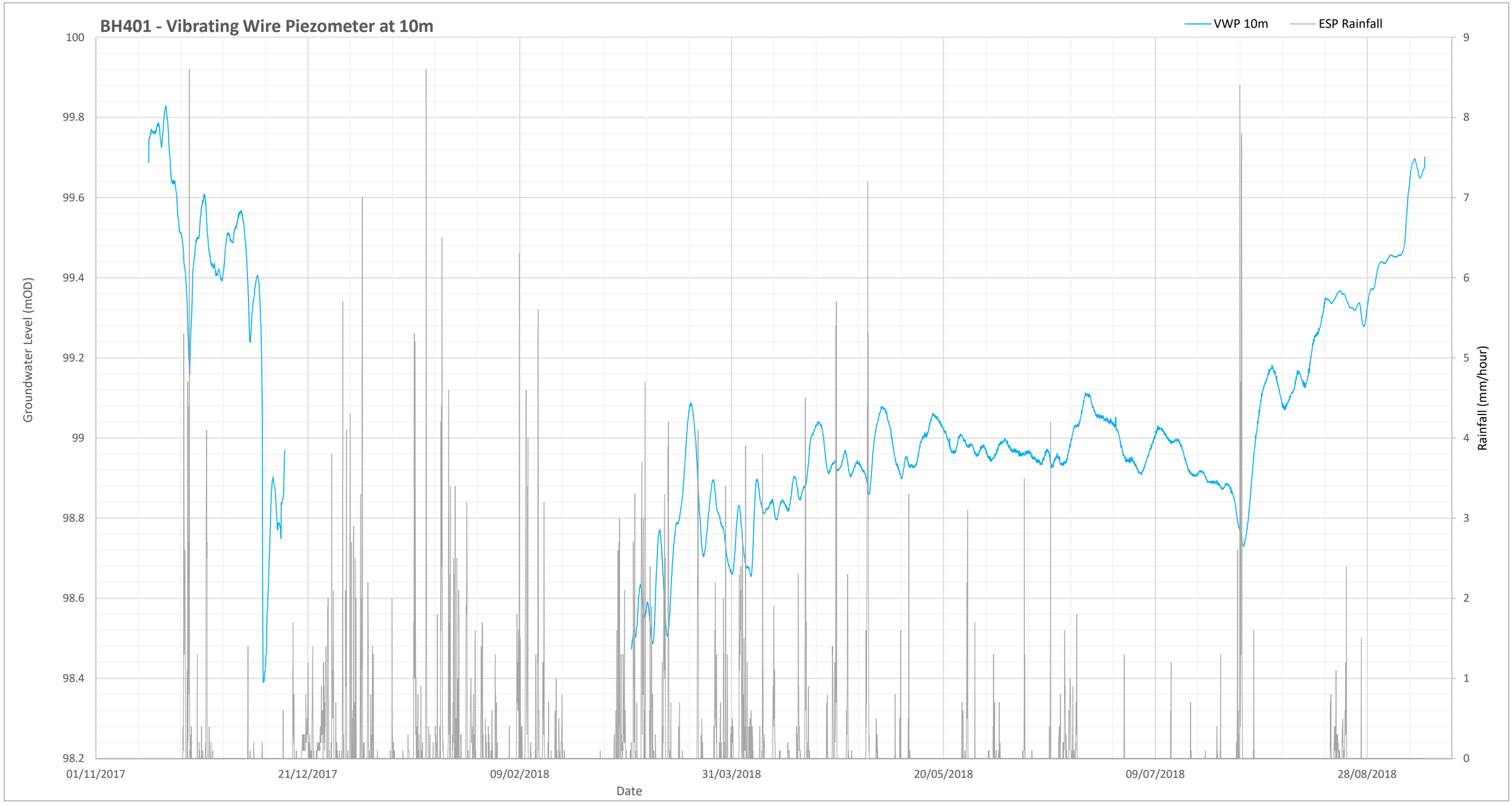
Notes:

1, Logger box became flooded and installation needs altering before monitoring can be resumed.

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH306 – GRAIG ROAD VIBRATING WIRE PIEZOMETER MONITORING

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com



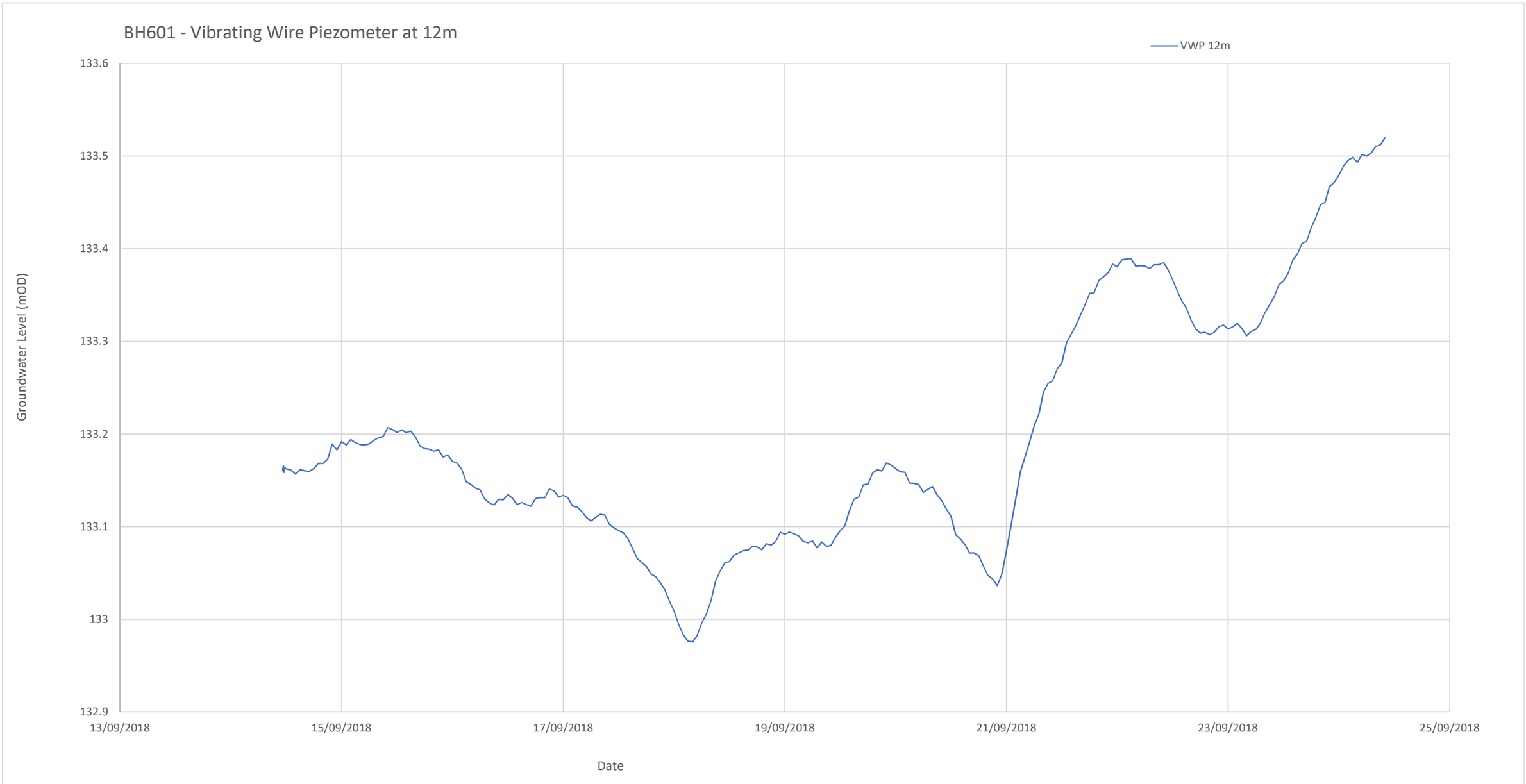
Notes:

1, Gap in vibrating wire piezometer data due to corrupt data files caused by possible vandalism of monitoring installation (magnet corrupting logger box hard-drive).

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH306 – GRAIG ROAD VIBRATING WIRE PIEZOMETER MONITORING

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com



Notes:

1. No rainfall data collected since install of vibrating wire piezometer logging box, to be amended once data becomes available.

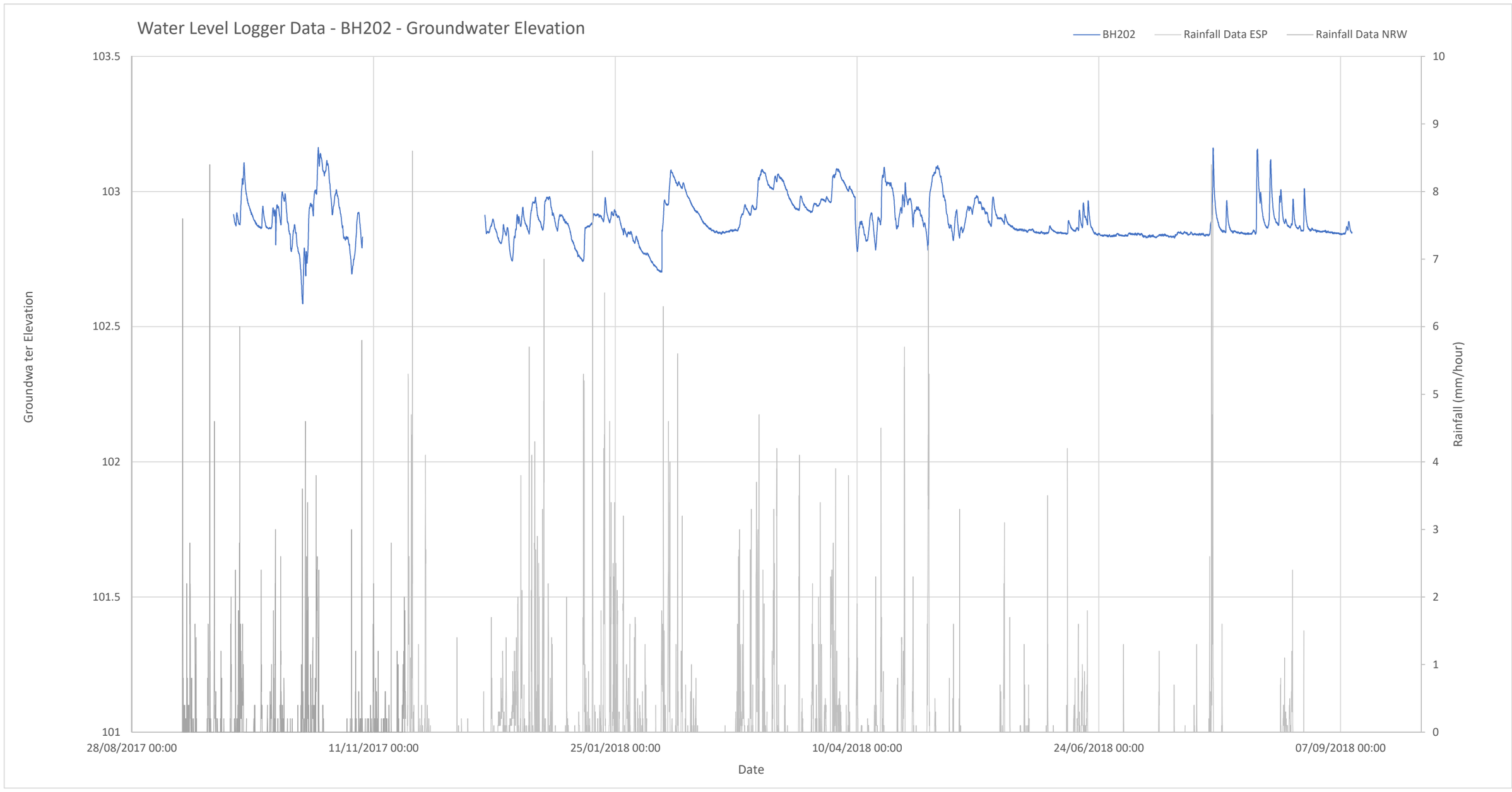
PROJECT:
PANTTEG LANDSLIDE, PANTTEG FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH601 – PEN-Y-GRAIG VIBRATING WIRE PIEZOMETER MONITORING

Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com

Appendix N

Water Data Logger Results (BH202)



Notes:

PROJECT:
PANTTEG LANDSLIDE, PANTTEG
FACTUAL GROUND INVESTIGATION REPORT

TITLE:
BH202 –86 CYFYNG ROAD WATER LEVEL DATA LOGGER MONITORING

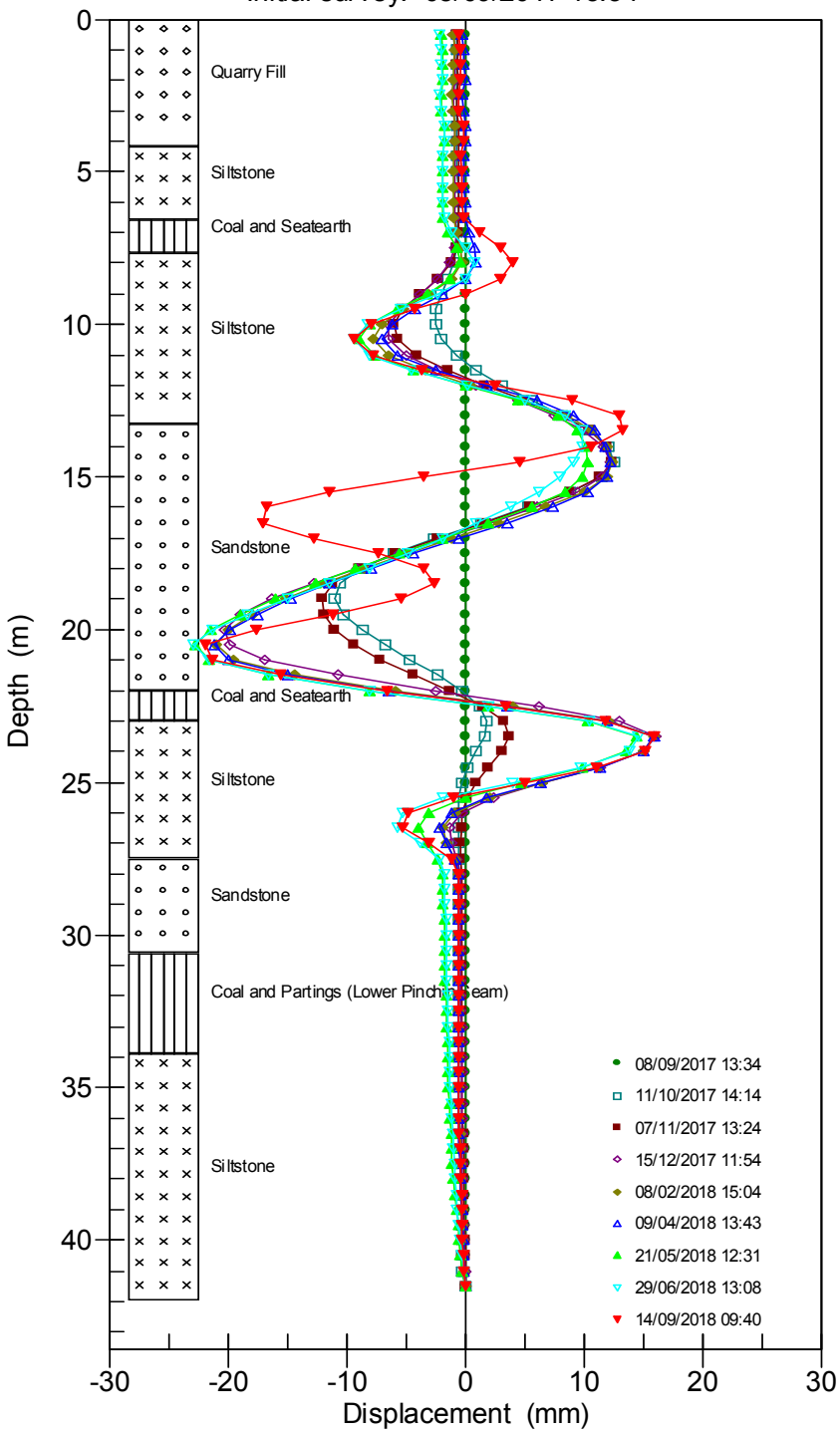
Earth Science Partnership
Consulting Engineers | Geologists | Environmental Scientists
33 Cardiff Road, Taffs Well, Cardiff CF15 7RB Tel: 029 2081 3385
enquiries@earthsciencepartnership.com

Appendix O

Inclinometer Results

5859e:BH301 - A Axis Cumulative

Initial survey: 08/09/2017 13:34

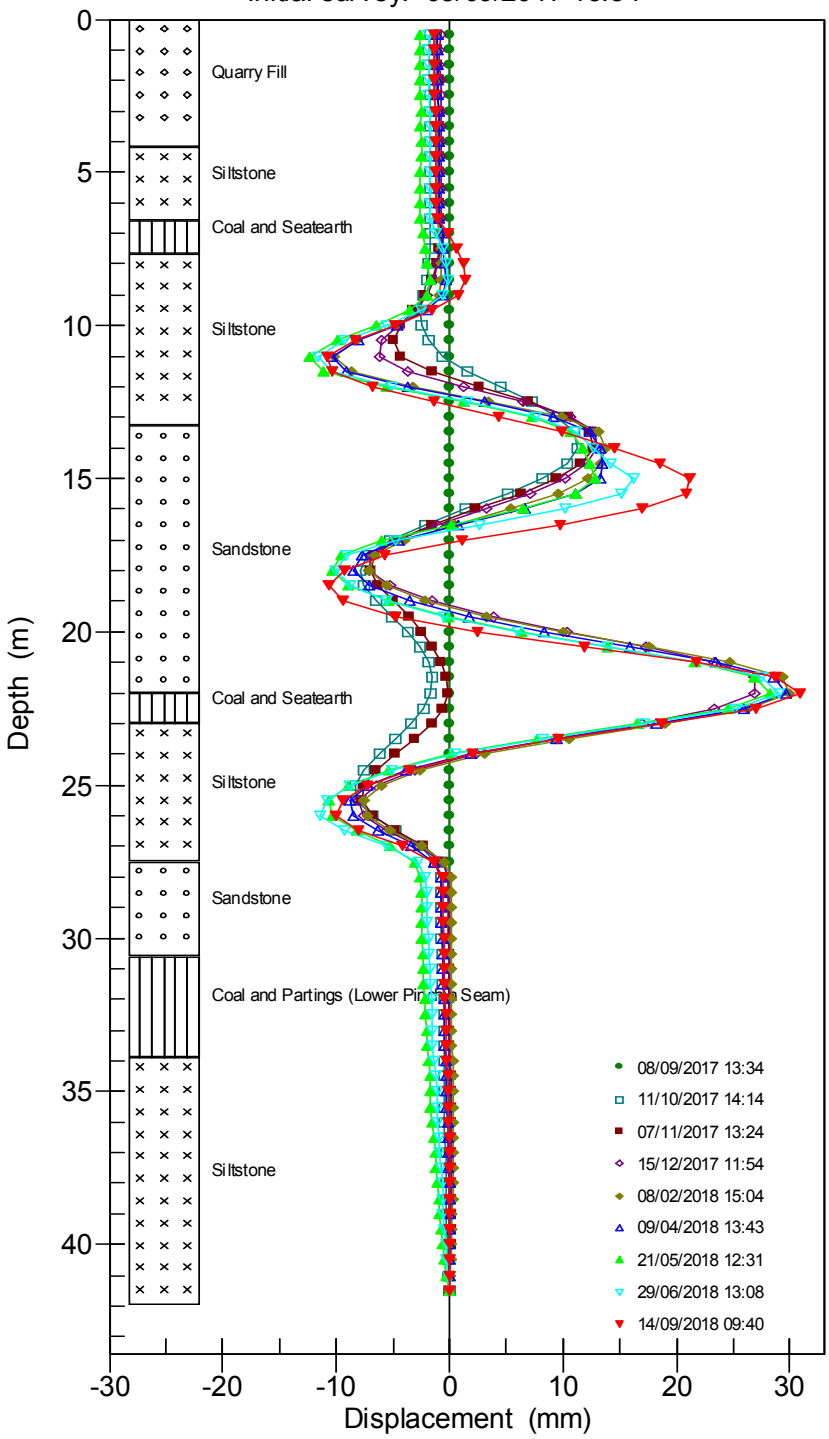


PROJECT:
SITE: 5859e
INSTALLATION: BH301
COMPANY:
CLIENT:

NOTE:

5859e:BH301 - B Axis Cumulative

Initial survey: 08/09/2017 13:34

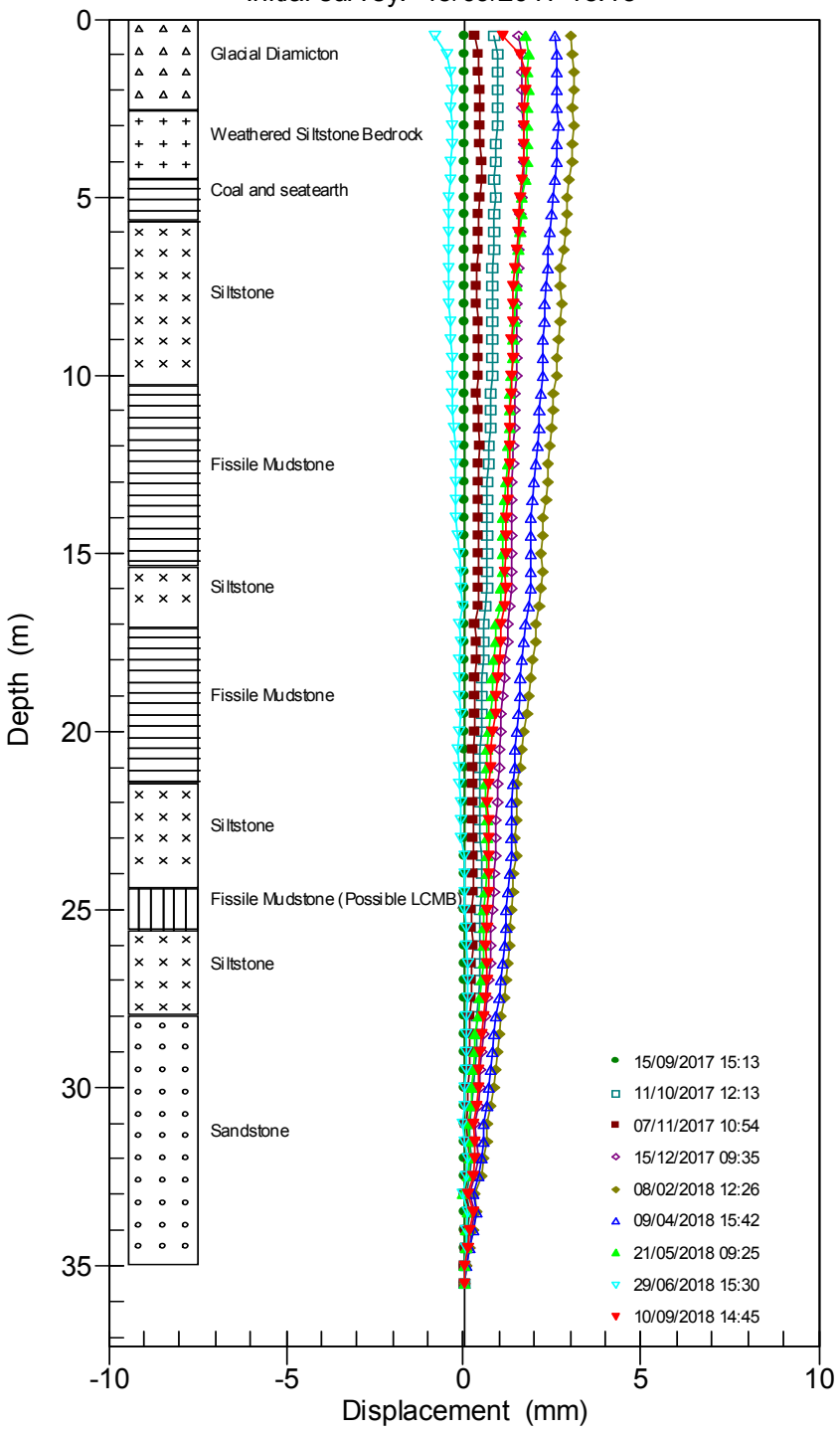


PROJECT:
SITE: 5859e
INSTALLATION: BH301
COMPANY:
CLIENT:

NOTE:

5859e:BH303 - A Axis Cumulative

Initial survey: 15/09/2017 15:13

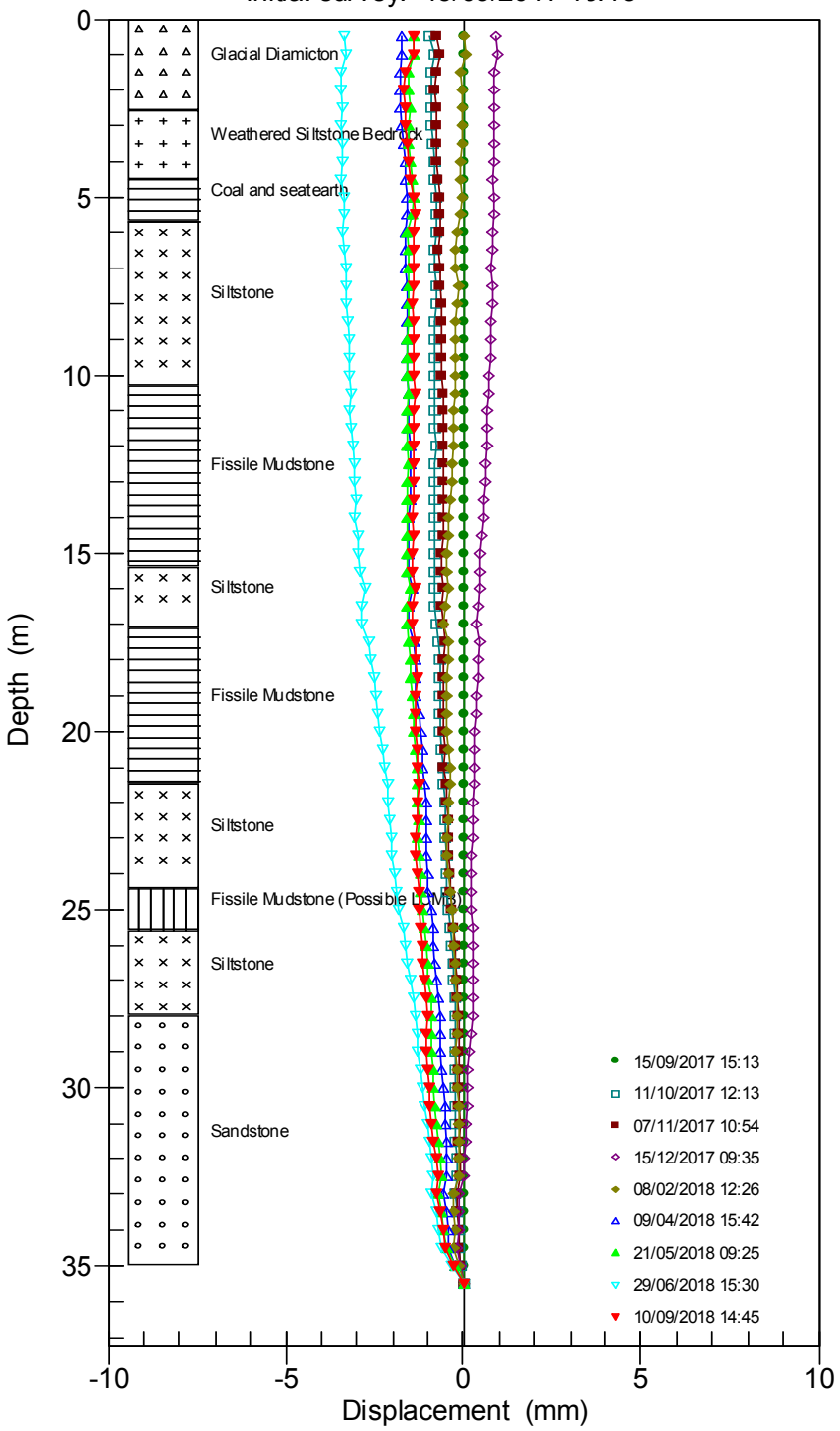


PROJECT:
SITE: 5859e
INSTALLATION: BH303
COMPANY:
CLIENT:

NOTE:

5859e:BH303 - B Axis Cumulative

Initial survey: 15/09/2017 15:13

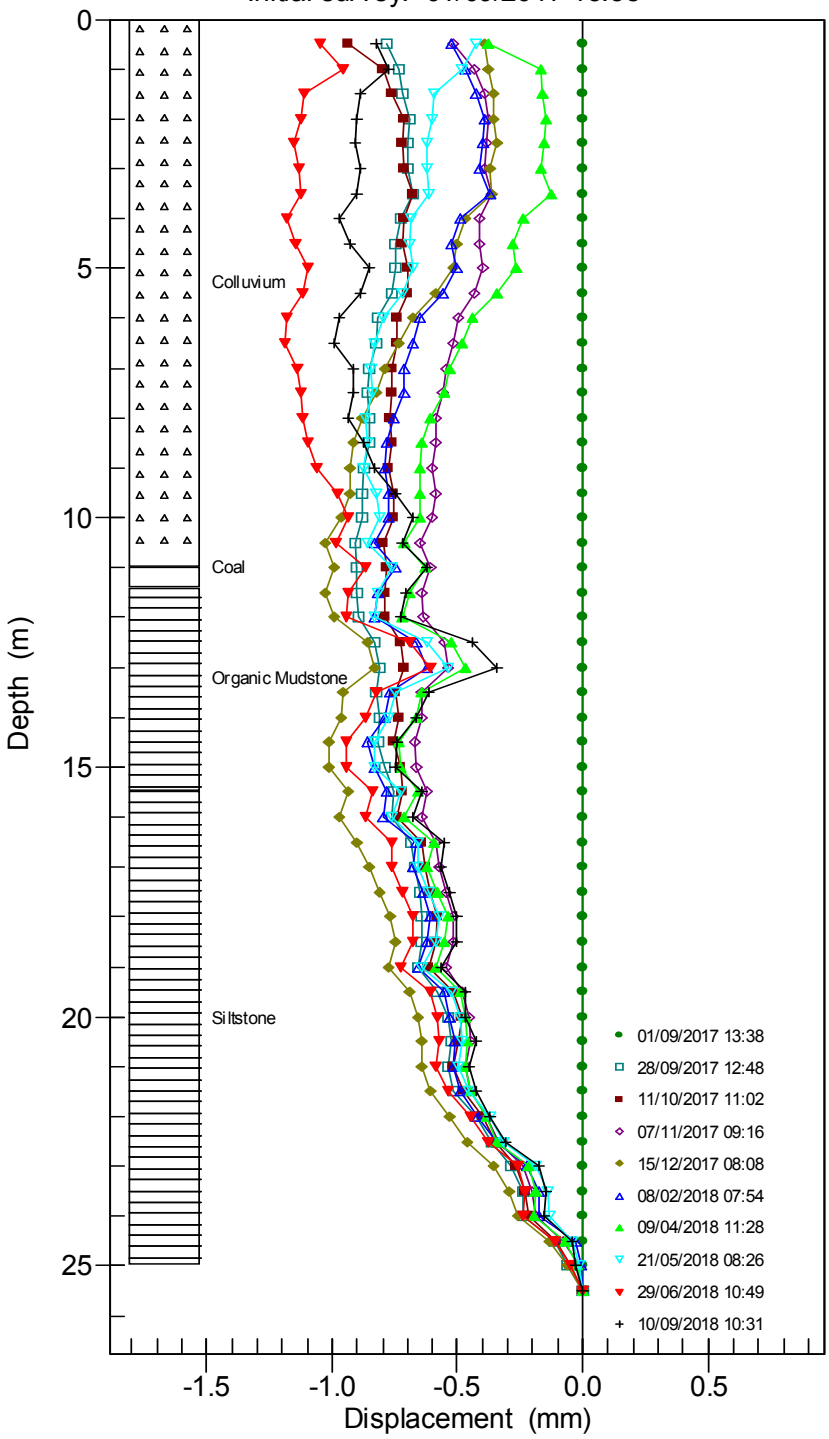


PROJECT:
SITE: 5859e
INSTALLATION: BH303
COMPANY:
CLIENT:

NOTE:

5859e:BH305 - A Axis Cumulative

Initial survey: 01/09/2017 13:38

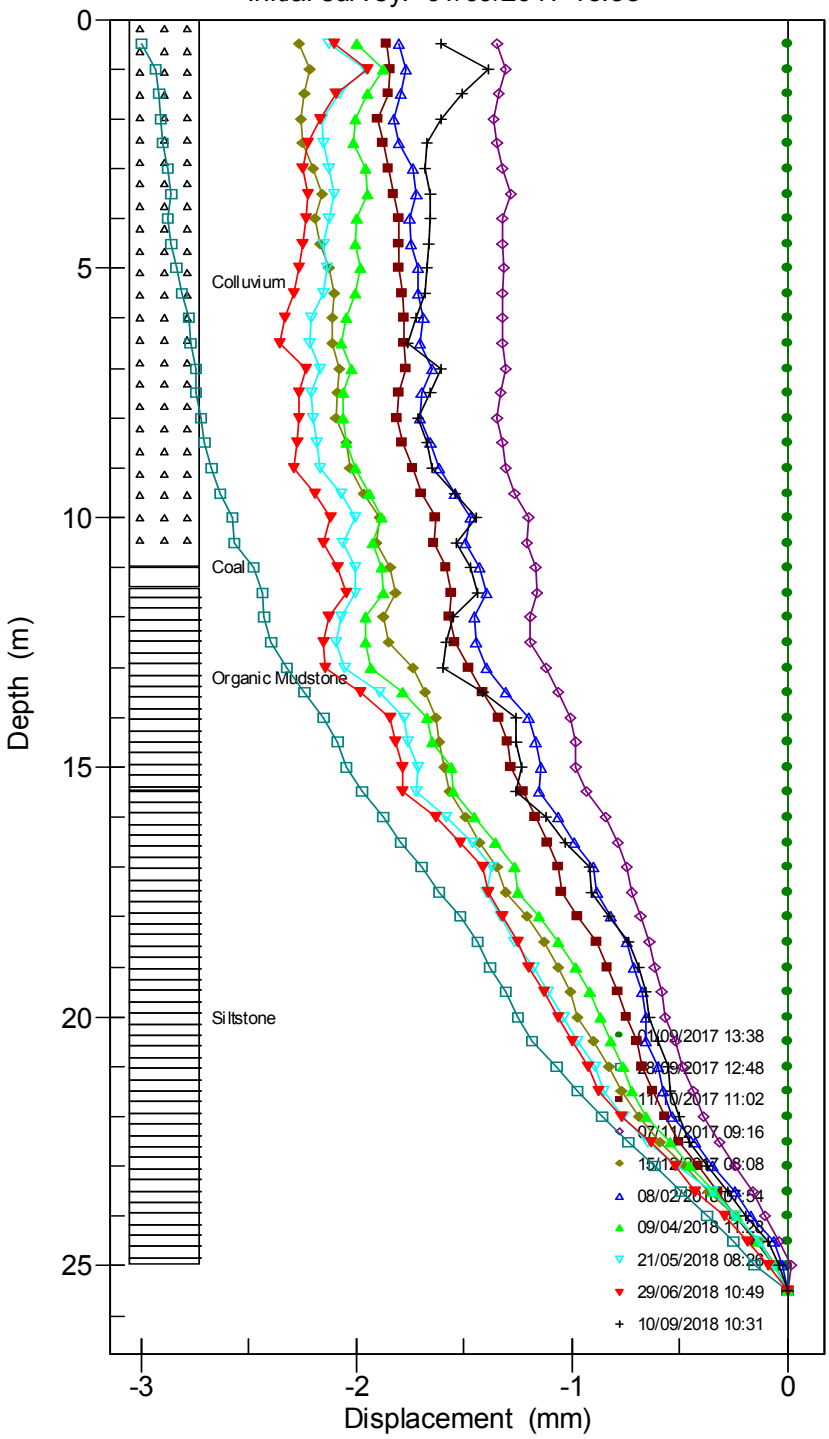


PROJECT: Pantteg Landslip
SITE: 5859e
INSTALLATION: BH305
COMPANY: ESP
CLIENT: NPTCBC

NOTE:

5859e:BH305 - B Axis Cumulative

Initial survey: 01/09/2017 13:38

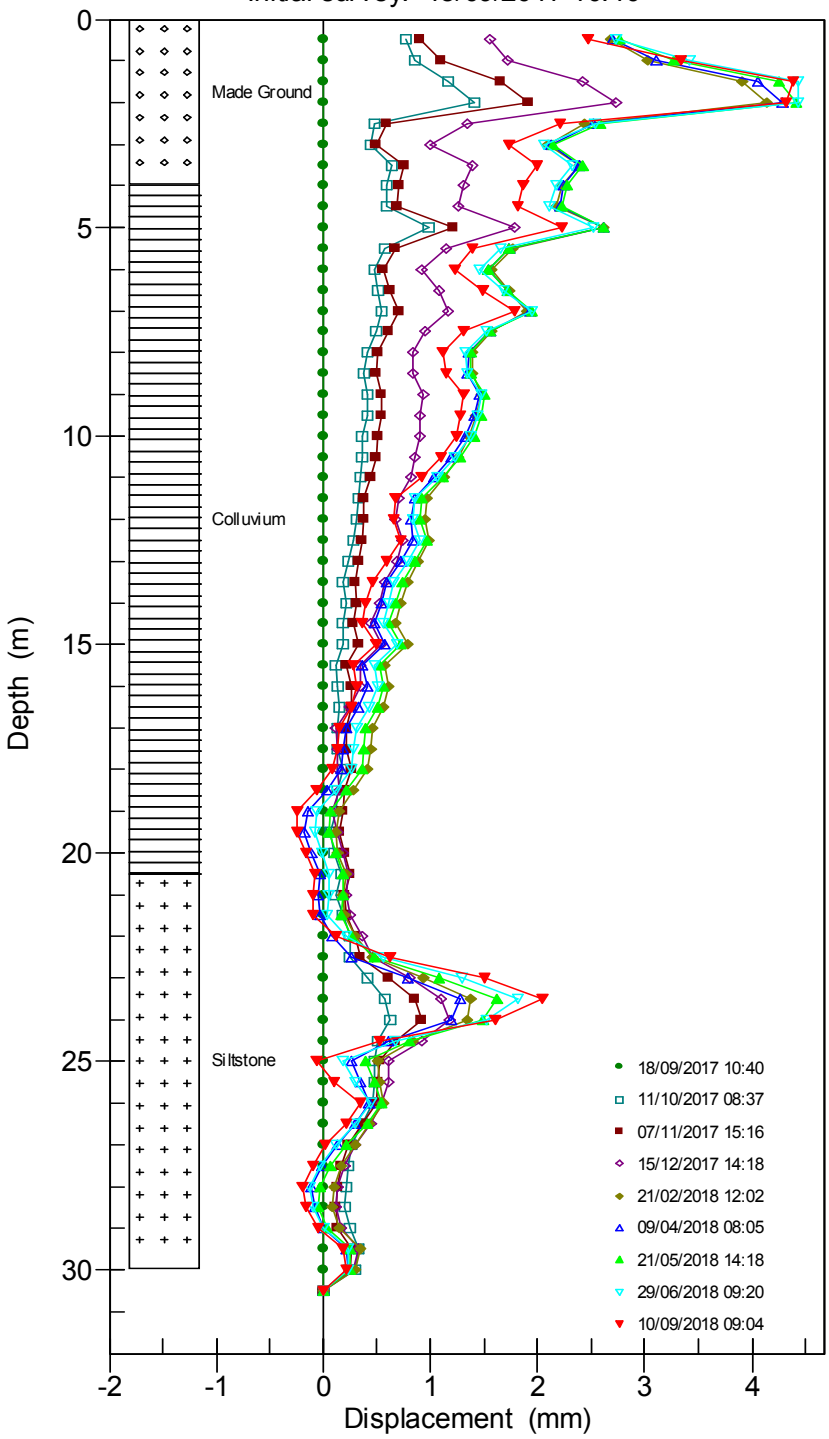


PROJECT: Pantteg Landslip
SITE: 5859e
INSTALLATION: BH305
COMPANY: ESP
CLIENT: NPTCBC

NOTE:

5859e:BH306 - A Axis Cumulative

Initial survey: 18/09/2017 10:40

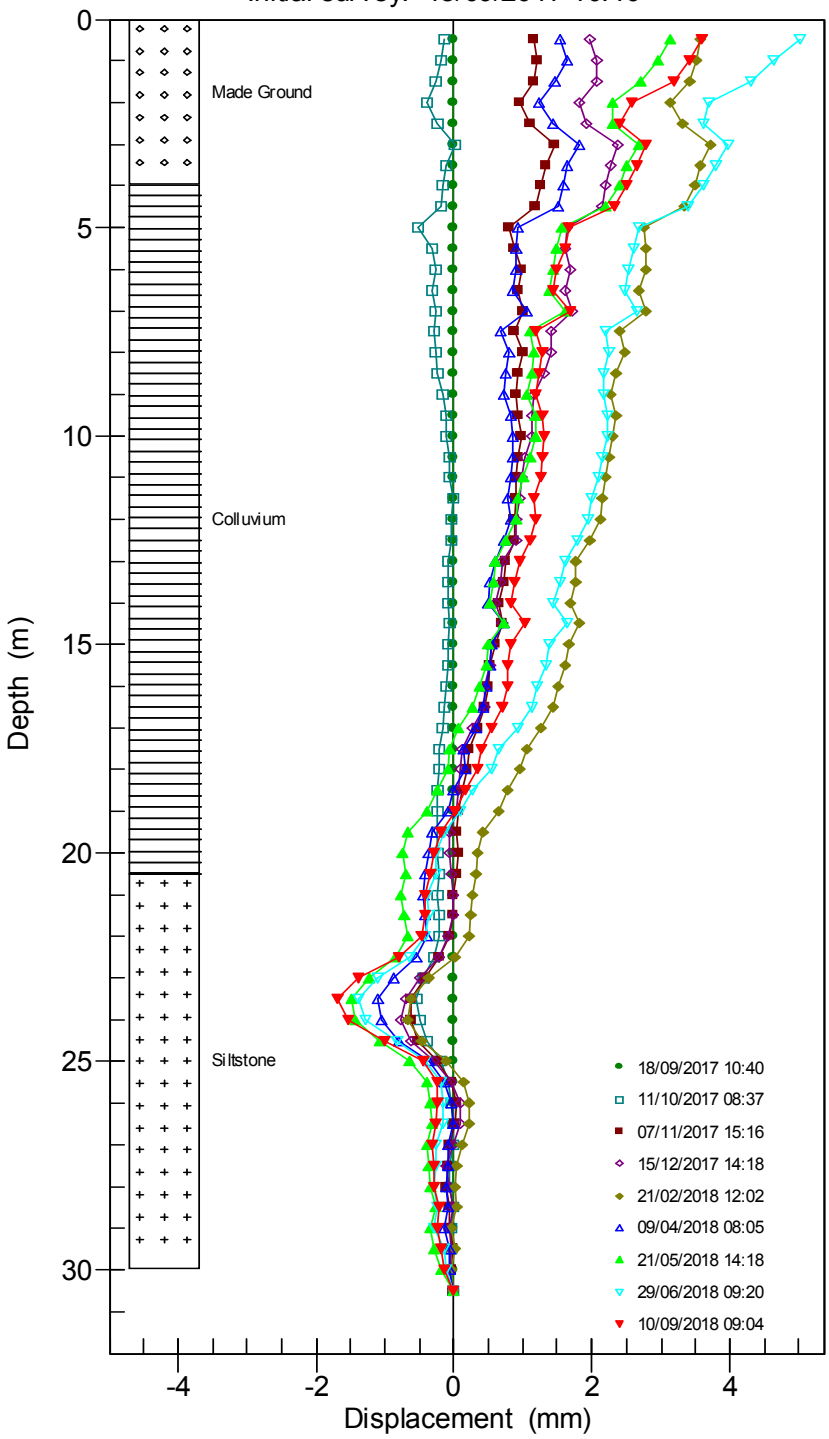


PROJECT:
SITE: 5859e
INSTALLATION: BH306
COMPANY:
CLIENT:

NOTE:

5859e:BH306 - B Axis Cumulative

Initial survey: 18/09/2017 10:40

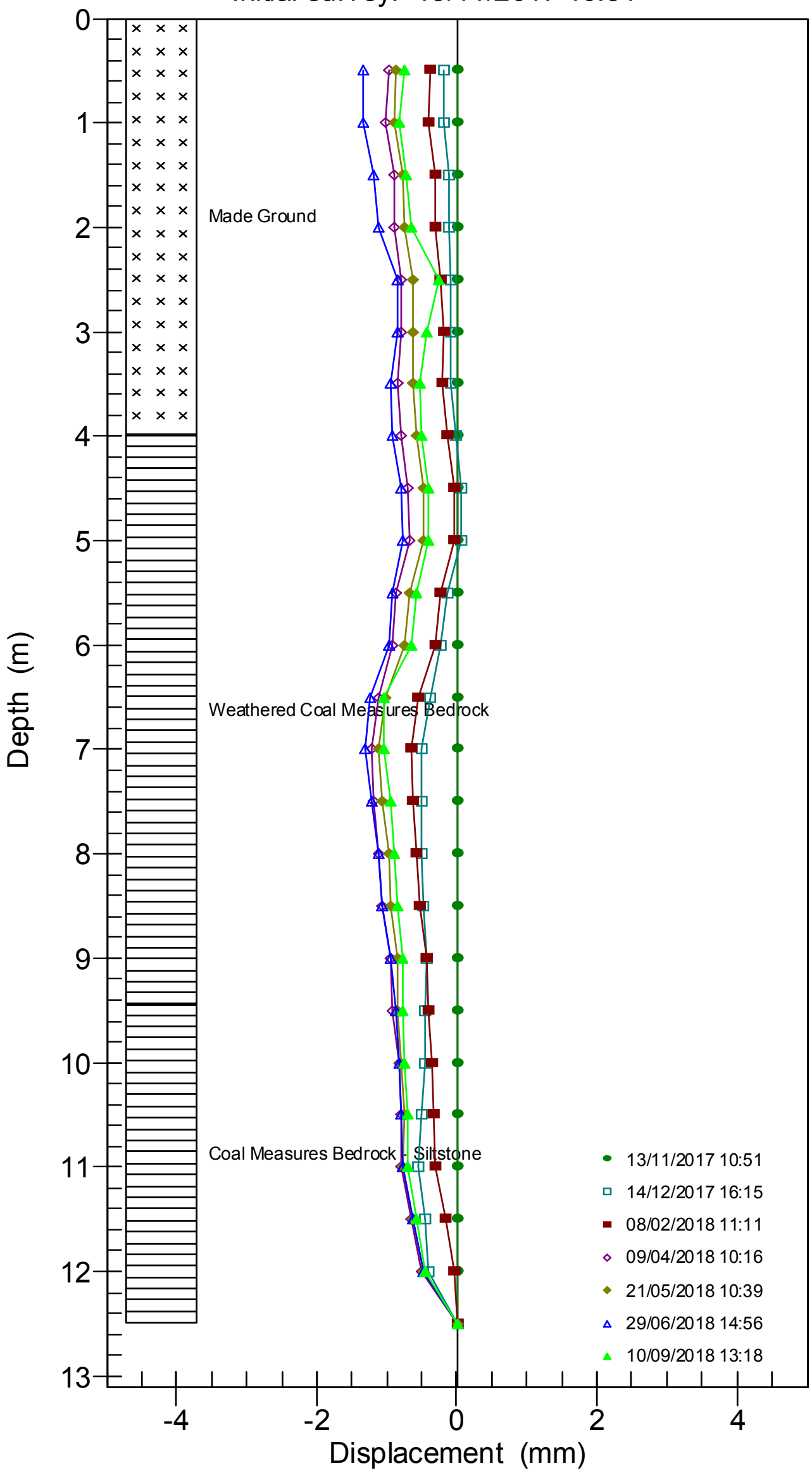


PROJECT:
SITE: 5859e
INSTALLATION: BH306
COMPANY:
CLIENT:

NOTE:

5859e:BH401 - A Axis Cumulative

Initial survey: 13/11/2017 10:51

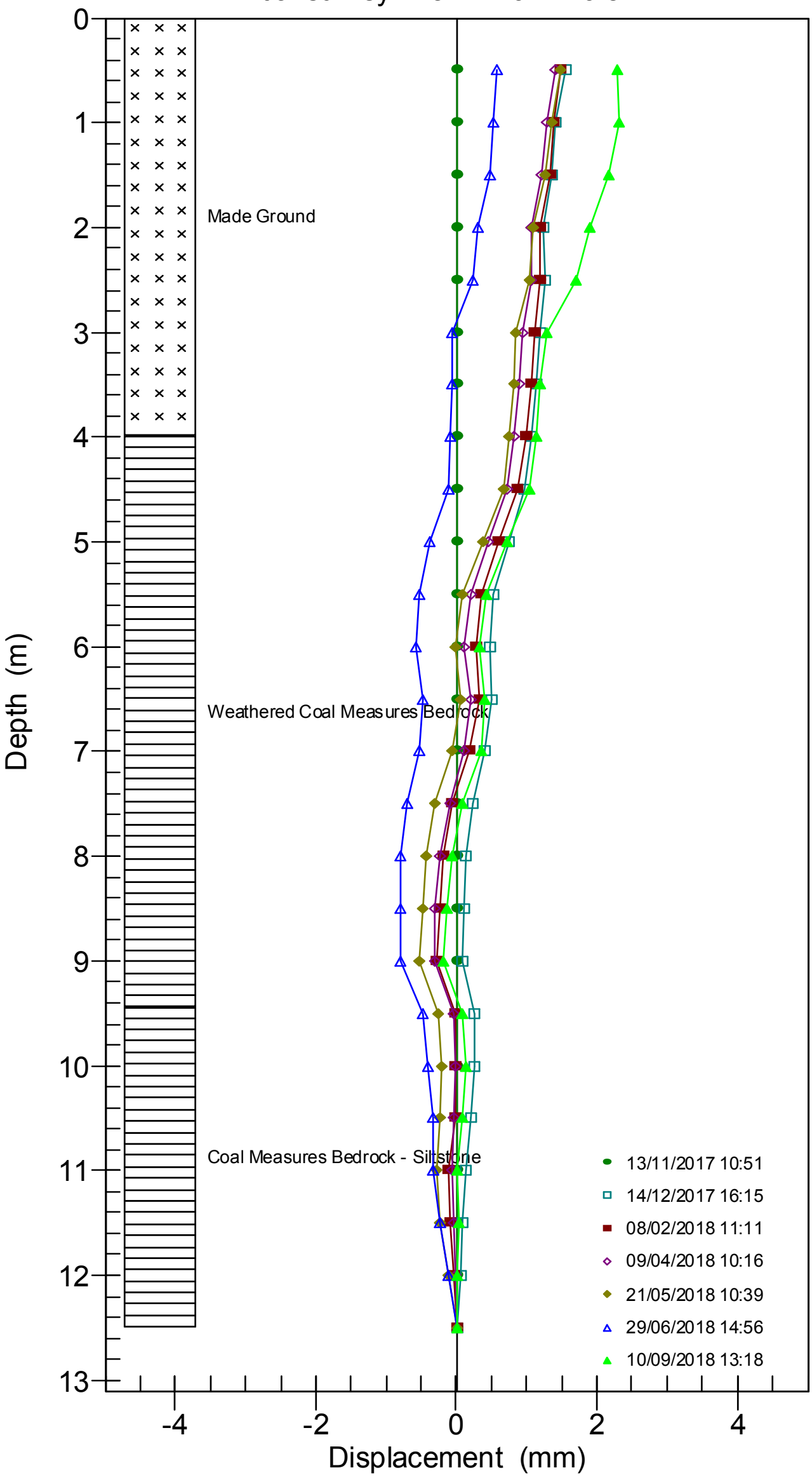


PROJECT: Pantteg Landslide
SITE: 5859e
INSTALLATION: BH401
COMPANY: ESP
CLIENT: NPTCBC

NOTE:

5859e:BH401 - B Axis Cumulative

Initial survey: 13/11/2017 10:51

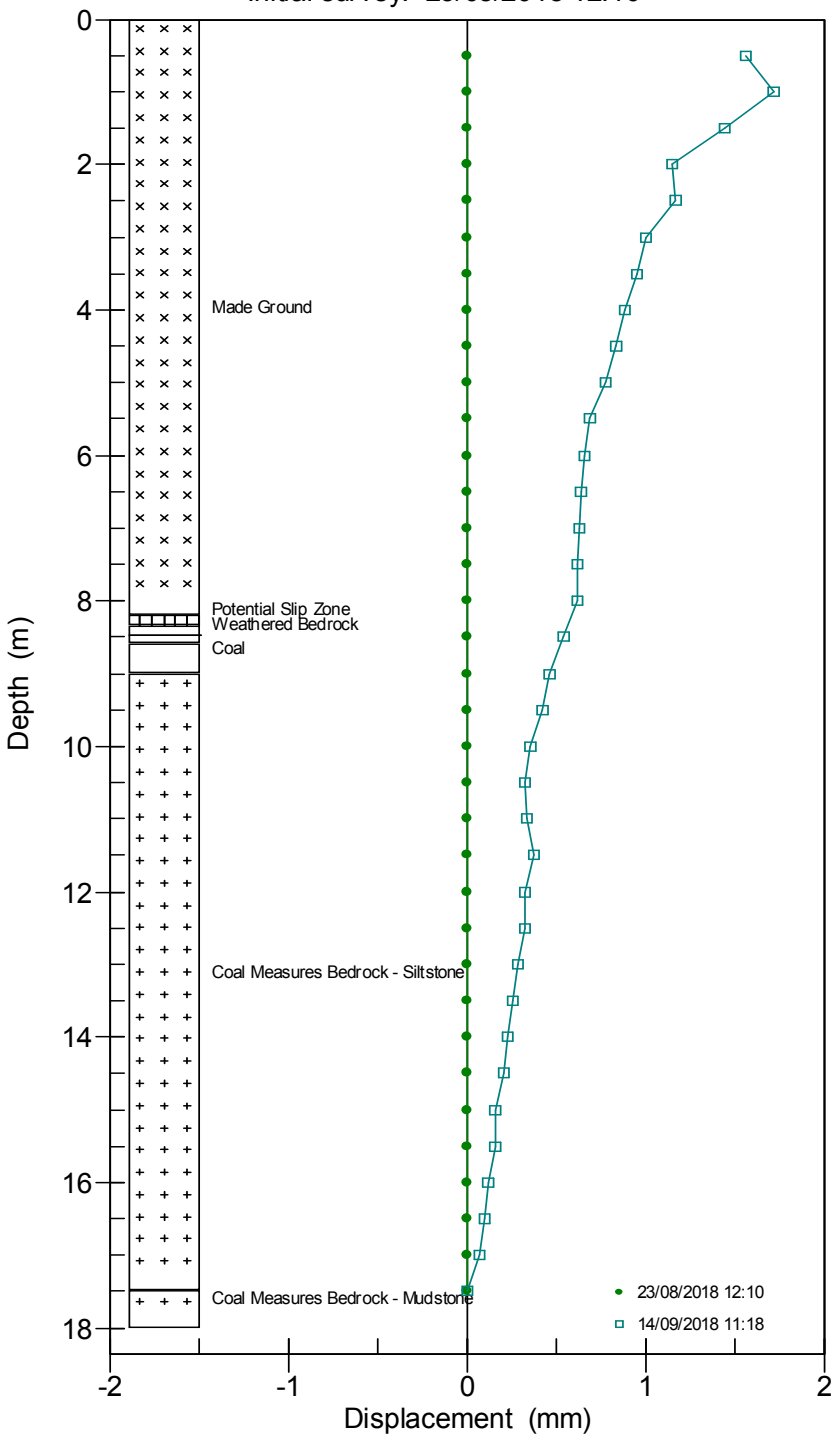


PROJECT: Pantteg Landslide
SITE: 5859e
INSTALLATION: BH401
COMPANY: ESP
CLIENT: NPTCBC

NOTE:

5859e:BH601 - A Axis Cumulative

Initial survey: 23/08/2018 12:10

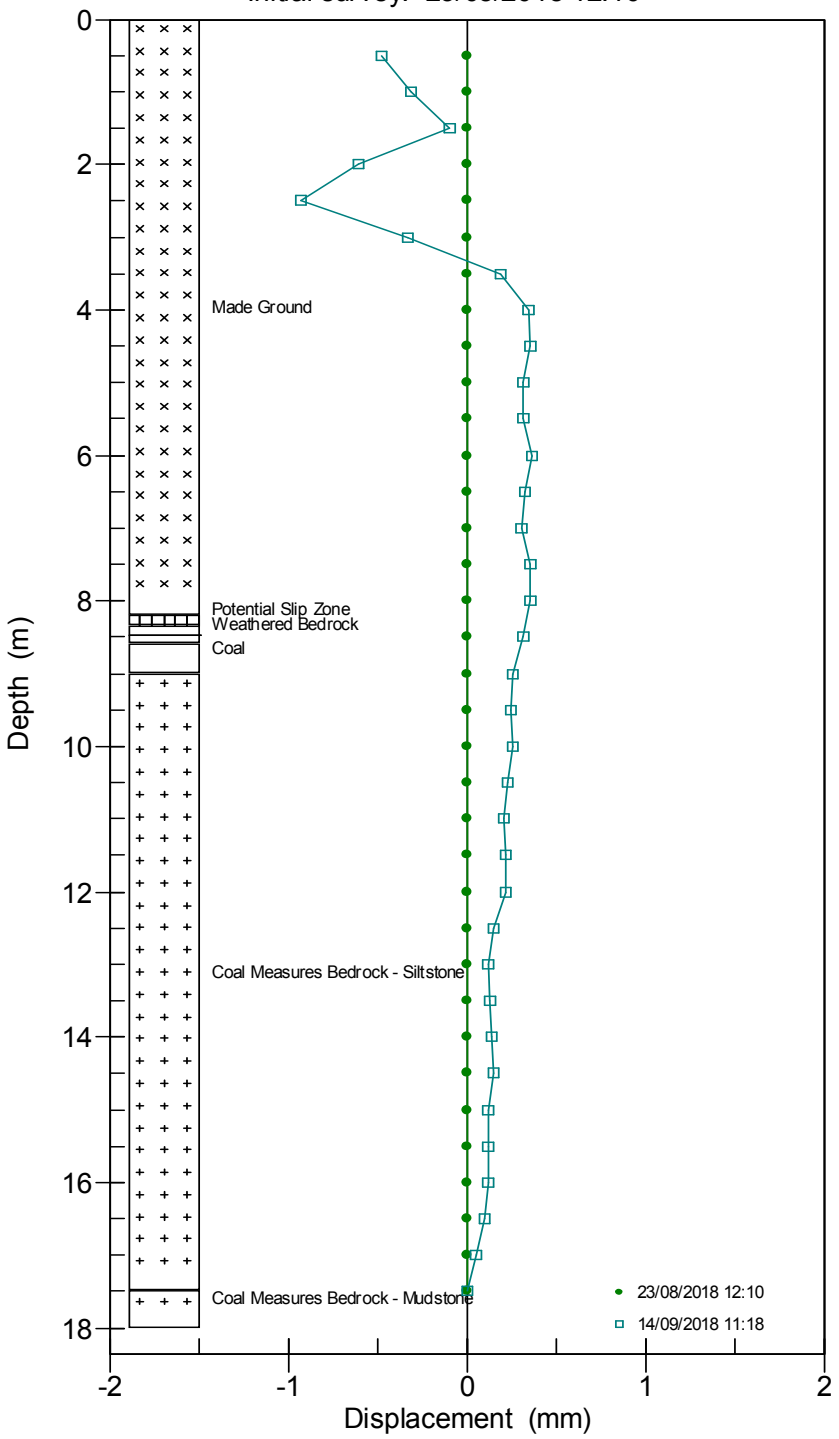


PROJECT:
SITE: 5859e
INSTALLATION: BH601
COMPANY:
CLIENT:

NOTE:

5859e:BH601 - B Axis Cumulative

Initial survey: 23/08/2018 12:10



PROJECT:
SITE: 5859e
INSTALLATION: BH601
COMPANY:
CLIENT:

NOTE:

Appendix P

Geotechnical Laboratory Test Results

Laboratory Report

UKAS TESTING 2788

GSTL

GEO Site & Testing Services Ltd

Contract Number: 36992

Client Ref: **5859e.05**
Client PO: **6492**

Report Date: **29-11-2017**

Client **Earth Science Partnership**
33 Cardiff Road
Taff's Well
Cardiff
CF15 7RB

Contract Title: **Pantteg, Ystalyfera**
For the attention of: **Mat Elcock**

Date Received: **19-10-2017**
Date Commenced: **19-10-2017**
Date Completed: **29-11-2017**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	11
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	11
PSD Wet Sieve method 1377 : 1990 Part 2 : 9.2 - * UKAS	14
Residual Shear Strength using the small Ring Shear apparatus at 3 normal pressures 1377 : 1990 Part 7 : Clause 6, PLEASE NOTE IT IS LIKELY THIS TEST WILL INCUR EXTRA OVER DAY CHARGES. - @ Non Accredited Test	6
Uniaxial Compressive Strength of Rock incl sample prep 54-165mm diameter cores ISRM Part 1 Methods For Rock Characterisation 1974-2006 - @ Non Accredited Test	8
Determination of Point Load Value Axial or Diametrical including WC ISRM Suggested Method for Point Load Strength 1974-2006 - * UKAS	24
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:
Alex Wynn (Associate Director) - Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager) - Sean Penn (Administrative Assistant)
Vaughan Edwards (Managing Director) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5) DESCRIPTIONS	
Contract Number	**36992**	
Site Name	**Pantteg, Ystalyfera**	

TP Trialpit	Sample Number	Sample Type	Depth (m)			Descriptions
TP1	1	B	2.00	-		Brown fine to coarse sandy clayey silty fine to coarse GRAVEL
TP1	1	B	3.00	-		Brown slightly clayey slightly silty fine to coarse sandy fine to coarse GRAVEL
TP2	1	B	1.00	-		Brown fine to coarse sandy silty clayey fine to coarse GRAVEL
TP2	1	B	2.50	-		Brown fine to coarse sandy clayey silty fine to coarse GRAVEL
TP6	1	D	2.50	-		Brown fine to coarse gravelly clayey SILT
TP8	1	B	0.50	-		Brown fine to coarse sandy silty clayey fine to coarse GRAVEL
TP8	1	B	1.00	-		Brown fine to coarse sandy silty clayey fine to coarse GRAVEL
TP8	1	B	1.50	-		Brown slightly fine to coarse sandy silty clayey fine to coarse GRAVEL
TP8	1	B	2.50	-		Brown slightly sandy slightly silty slightly clayey fine to coarse GRAVEL
TP8	1	B	3.50	-		Brown slightly fine to coarse sandy silty clayey fine to coarse GRAVEL
TP8	1	B	4.50	-		Brown fine to coarse sandy silty clayey fine to coarse GRAVEL
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

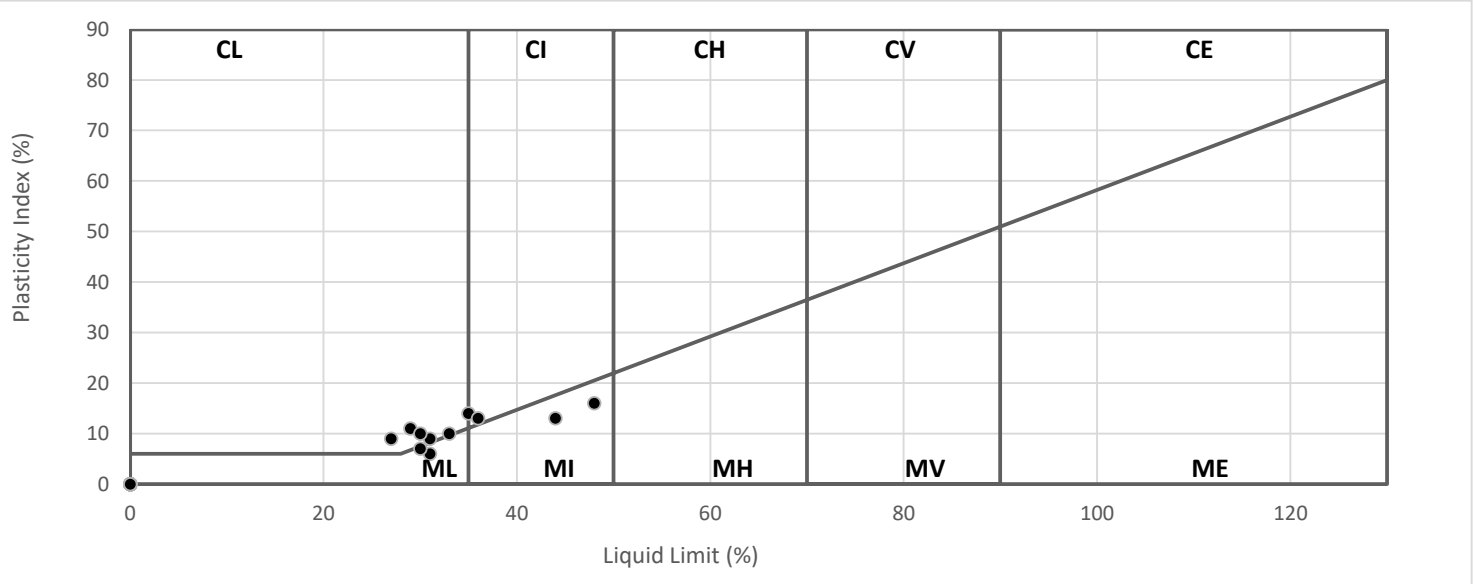
UKAS TESTING
2788

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	**36992**	
Site Name	**Pantteg, Ystalyfera**	

TP Trialpit	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing .425mm %	Remarks
TP1	1	B	2.00	-		20	31	25	6	35	ML Low Plasticity
TP1	1	B	3.00	-		24	44	31	13	11	MI Intermediate Plasticity
TP2	1	B	1.00	-		17	35	21	14	19	CL/I Low/Inter. Plasticity
TP2	1	B	2.50	-		20	30	23	7	19	ML Low Plasticity
TP6	1	D	2.50	-		33	48	32	16	76	MI Intermediate Plasticity
TP8	1	B	0.50	-		20	36	23	13	26	CI Intermediate Plasticity
TP8	1	B	1.00	-		16	31	22	9	27	CL Low Plasticity
TP8	1	B	1.50	-		13	27	18	9	17	CL Low Plasticity
TP8	1	B	2.50	-		13	29	18	11	8	CL Low Plasticity
TP8	1	B	3.50	-		14	30	20	10	16	CL Low Plasticity
TP8	1	B	4.50	-		18	33	23	10	31	CL Low Plasticity
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

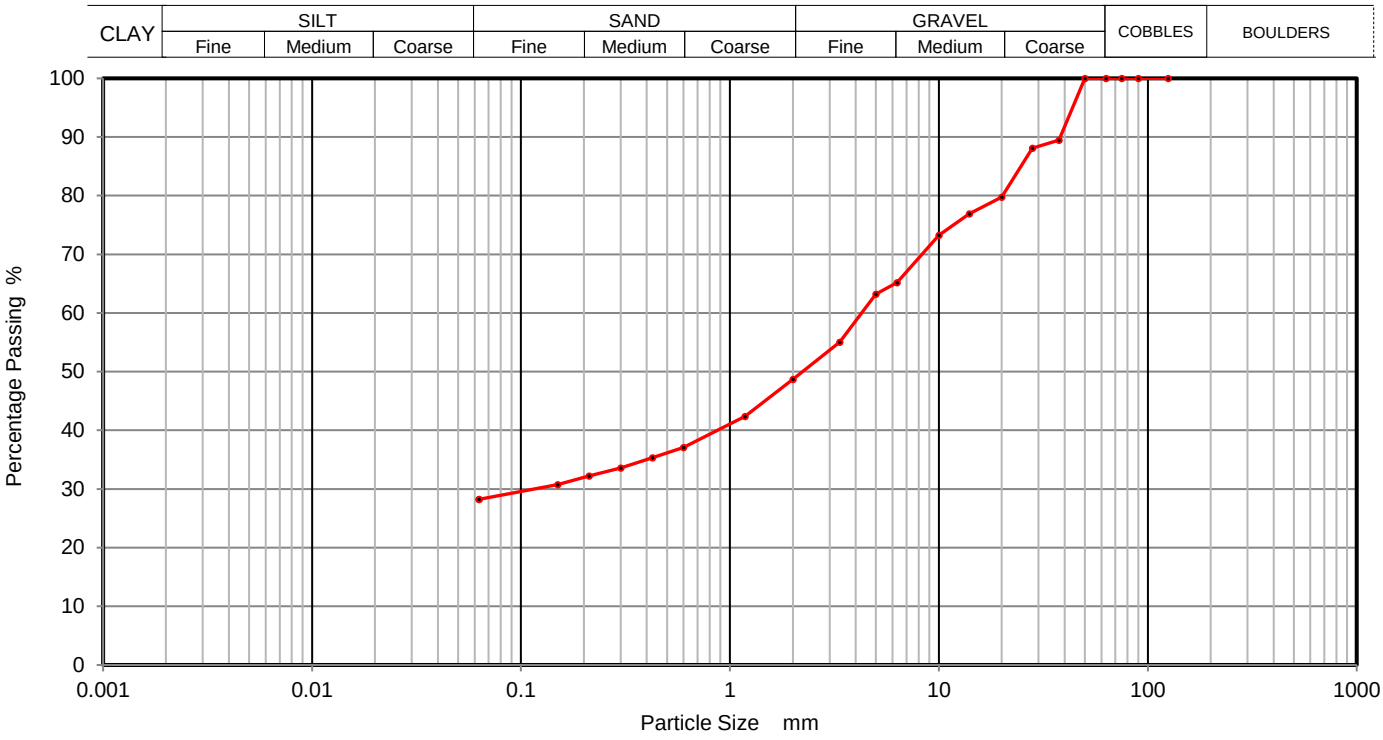
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	31/10/2017	Sean Penn	
DB	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP1
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown fine to coarse sandy clayey silty fine to coarse GRAVEL	Depth Top	2.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	89		
28	88		
20	80		
14	77		
10	73		
6.3	65		
5	63		
3.35	55		
2	49		
1.18	42		
0.6	37		
0.425	35		
0.3	34		
0.212	32		
0.15	31		
0.063	28		

Sample Proportions	% dry mass
Cobbles	0
Gravel	51
Sand	21
Silt and Clay	28

Grading Analysis	
Uniformity Coefficient	

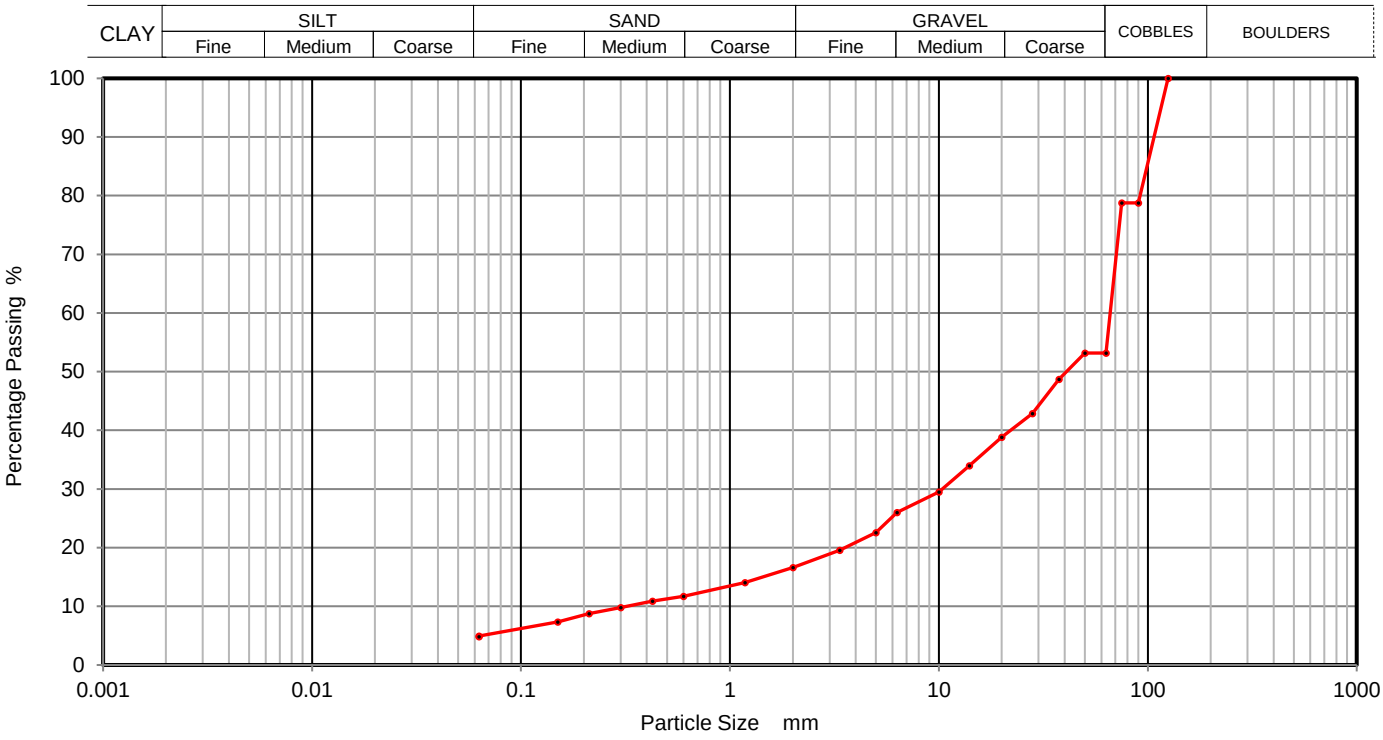
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP1
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown slightly clayey slightly silty fine to coarse sandy fine to coarse GRAVEL.(With some cobbles)	Depth Top	3.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	79	0.0060	
75	79	0.0019	
63	53		
50	53		
37.5	49		
28	43		
20	39		
14	34		
10	30		
6.3	26		
5	23		
3.35	20		
2	17		
1.18	14		
0.6	12		
0.425	11		
0.3	10		
0.212	9		
0.15	7		
0.063	5		

Sample Proportions	% dry mass
Cobbles	47
Gravel	36
Sand	12
Silt and Clay	5

Grading Analysis	
Uniformity Coefficient	

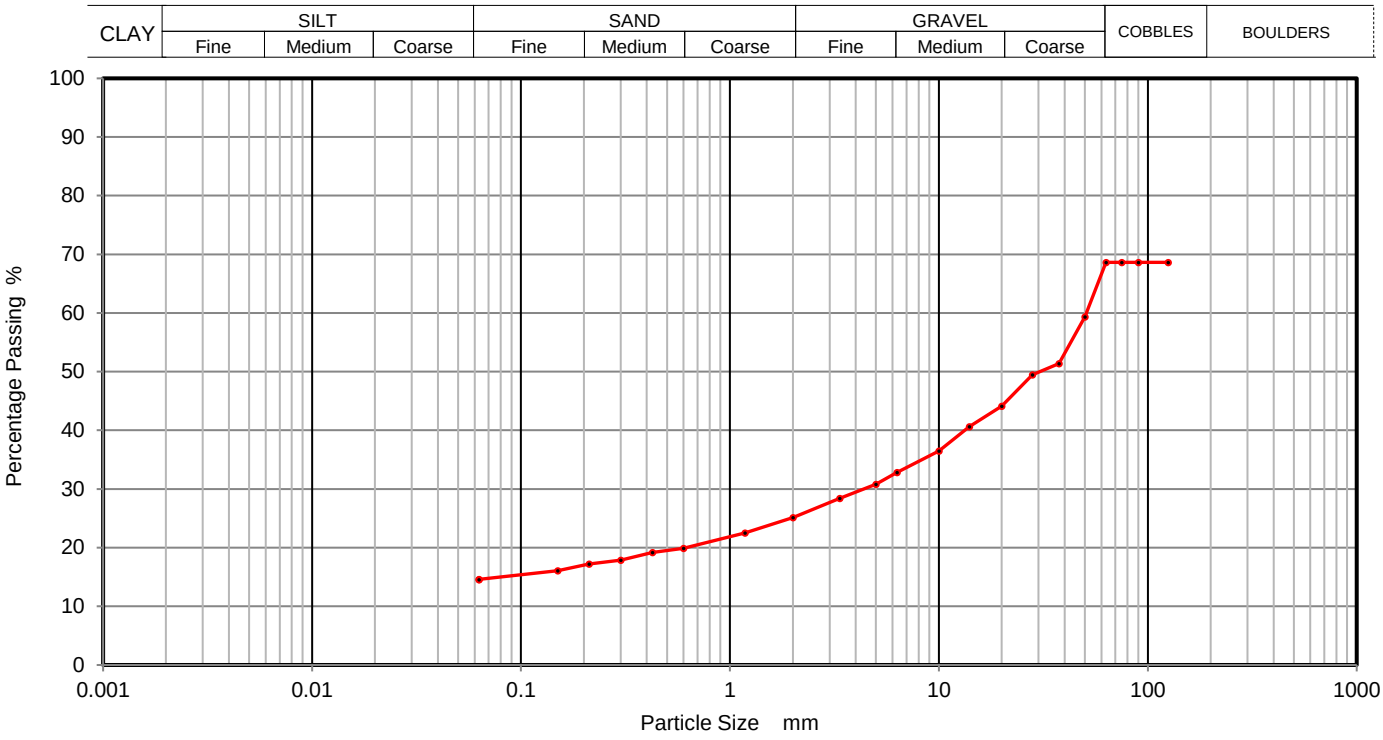
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP2
Site Name	**Pantteg, Ystalyfera**	Sample No.	1
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.(With some cobbles)	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	69	0.0200	
90	69	0.0060	
75	69	0.0019	
63	69		
50	59		
37.5	51		
28	49		
20	44		
14	41		
10	36		
6.3	33		
5	31		
3.35	28		
2	25		
1.18	23		
0.6	20		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	15		

Sample Proportions	% dry mass
Cobbles	31
Gravel	44
Sand	10
Silt and Clay	15

Grading Analysis	
Uniformity Coefficient	

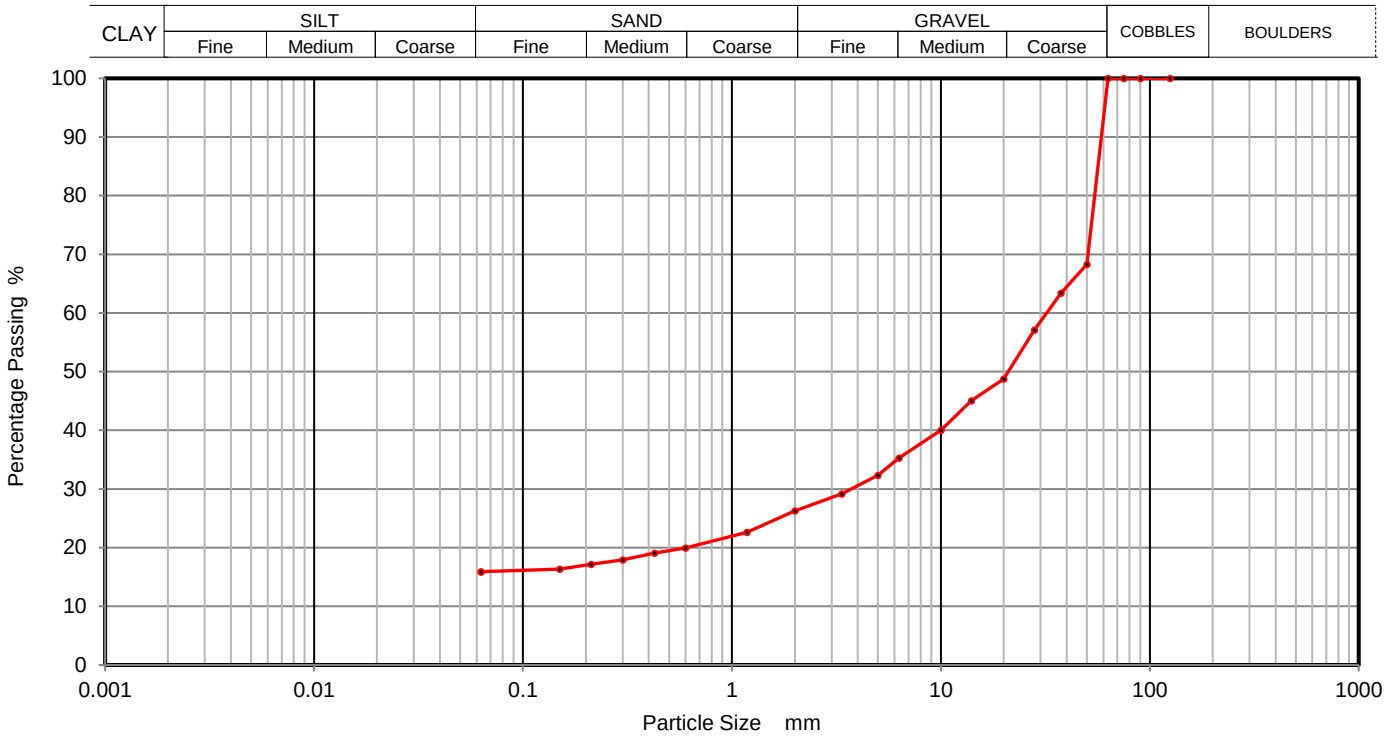
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP2
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown fine to coarse sandy clayey silty fine to coarse GRAVEL	Depth Top	2.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	68		
37.5	63		
28	57		
20	49		
14	45		
10	40		
6.3	35		
5	32		
3.35	29		
2	26		
1.18	23		
0.6	20		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	16		

Sample Proportions	% dry mass
Cobbles	0
Gravel	74
Sand	10
Silt and Clay	16

Grading Analysis	
Uniformity Coefficient	

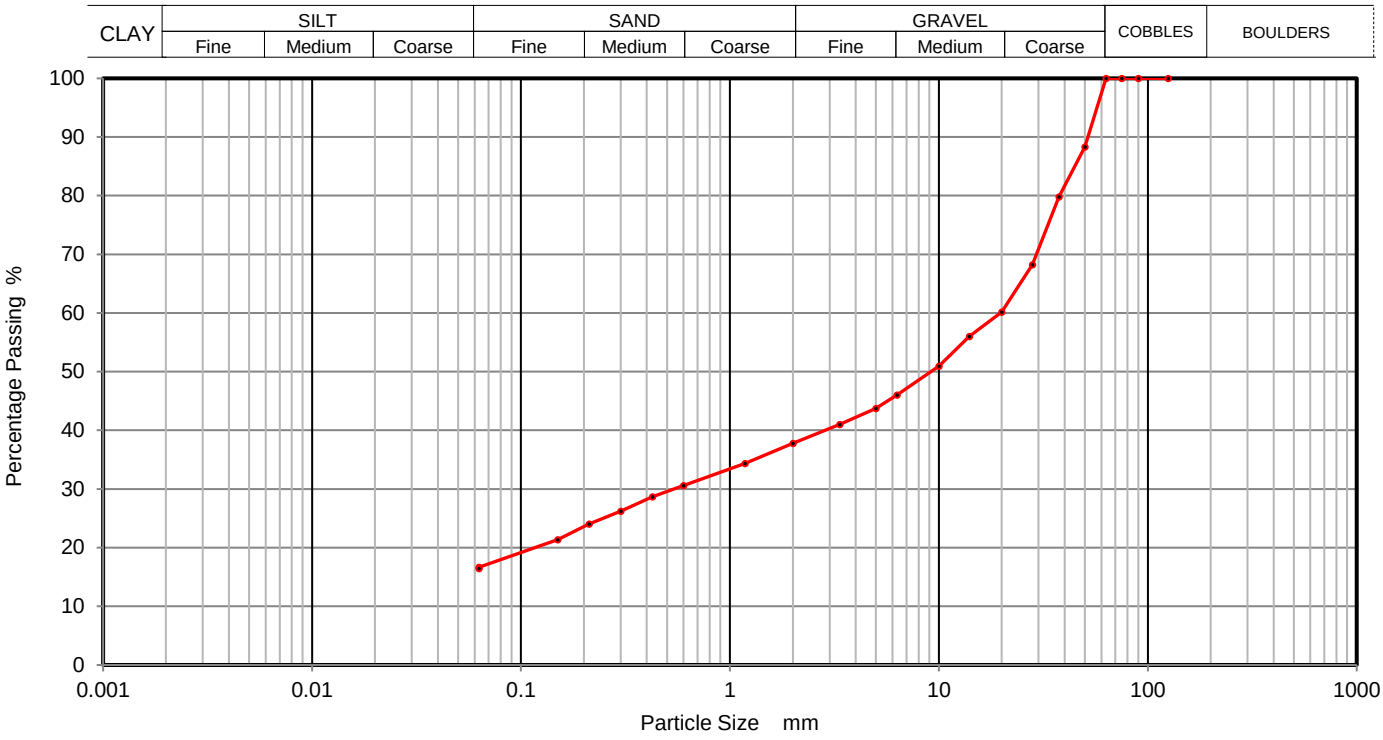
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP4
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown silty clayey fine to coarse sandy fine to coarse GRAVEL	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	88		
37.5	80		
28	68		
20	60		
14	56		
10	51		
6.3	46		
5	44		
3.35	41		
2	38		
1.18	34		
0.6	31		
0.425	29		
0.3	26		
0.212	24		
0.15	21		
0.063	17		

Sample Proportions	% dry mass
Cobbles	0
Gravel	62
Sand	21
Silt and Clay	17

Grading Analysis	
Uniformity Coefficient	

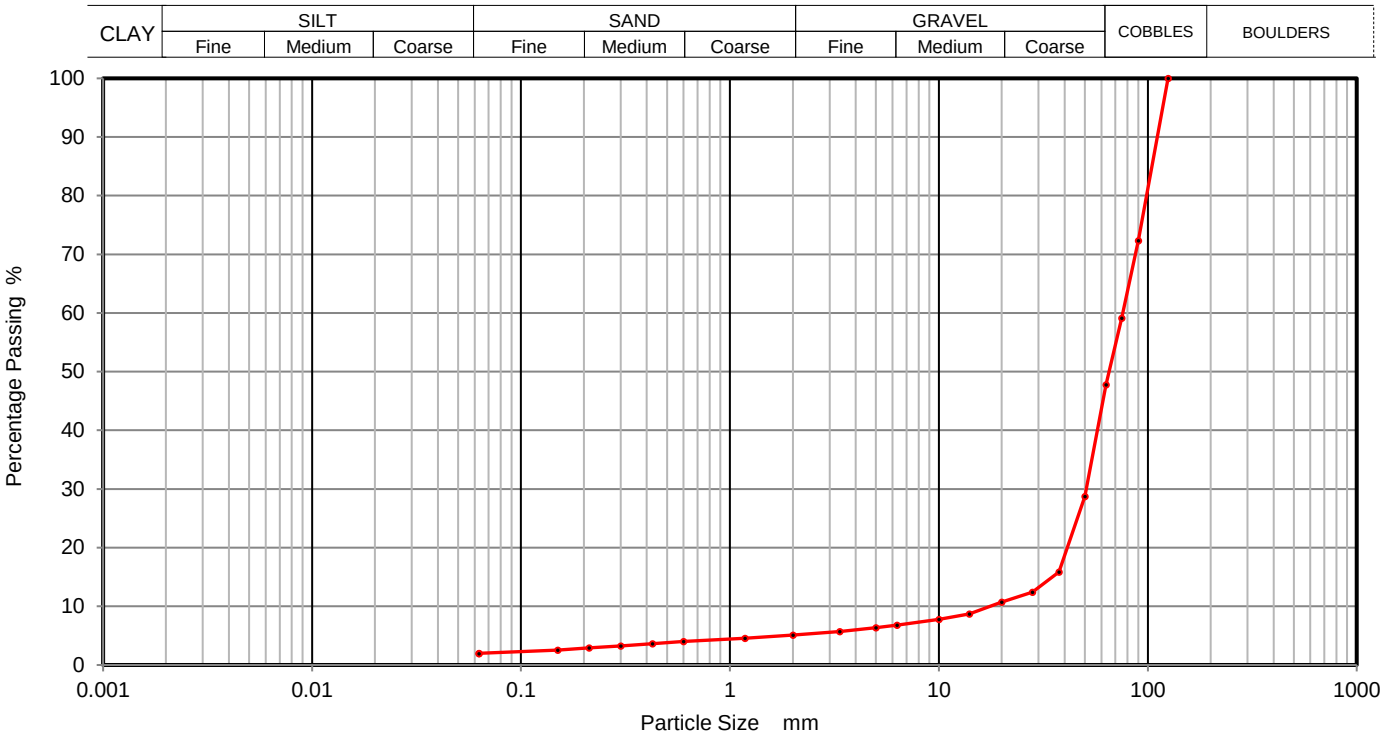
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP4
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown slightly silty slightly fine to coarse sandy fine to coarse GRAVEL.(With some cobbles)	Depth Top	2.80
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	72	0.0060	
75	59	0.0019	
63	48		
50	29		
37.5	16		
28	12		
20	11		
14	9		
10	8		
6.3	7		
5	6		
3.35	6		
2	5		
1.18	5		
0.6	4		
0.425	4		
0.3	3		
0.212	3		
0.15	3		
0.063	2		

Sample Proportions	% dry mass
Cobbles	52
Gravel	43
Sand	3
Silt and Clay	2

Grading Analysis	
Uniformity Coefficient	

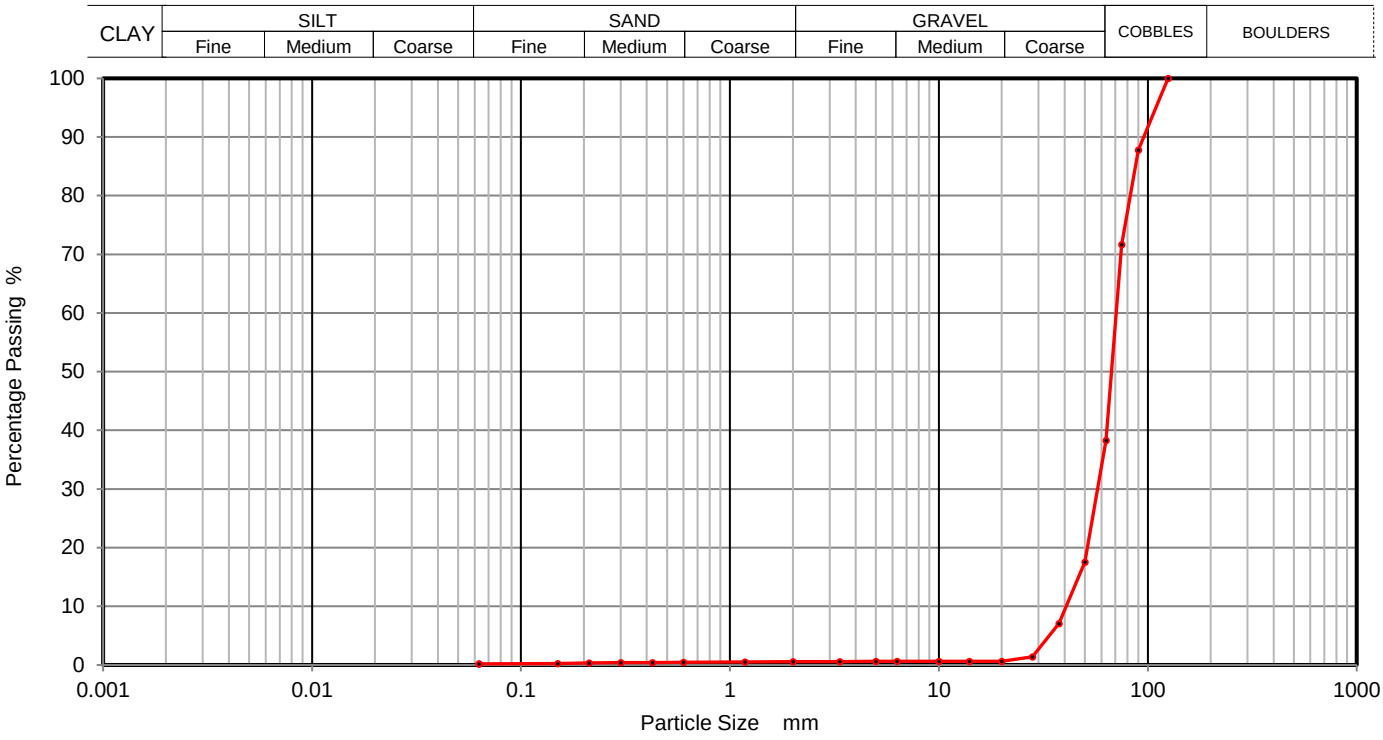
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	**36992**
		Borehole/Pit No.	**TP5**
Site Name	**Pantteg, Ystalyfera**	Sample No.	**3**
Soil Description	Brown slightly fine to coarse sandy fine to coarse GRAVEL.(With some cobbles)	Depth Top	**1.50**
		Depth Base	
		Sample Type	**B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	88	0.0060	
75	72	0.0019	
63	38		
50	18		
37.5	7		
28	1		
20	1		
14	1		
10	1		
6.3	1		
5	1		
3.35	1		
2	1		
1.18	1		
0.6	0		
0.425	0		
0.3	0		
0.212	0		
0.15	0		
0.063	0		

Sample Proportions	% dry mass
Cobbles	62
Gravel	37
Sand	1
Silt and Clay	0

Grading Analysis	
Uniformity Coefficient	

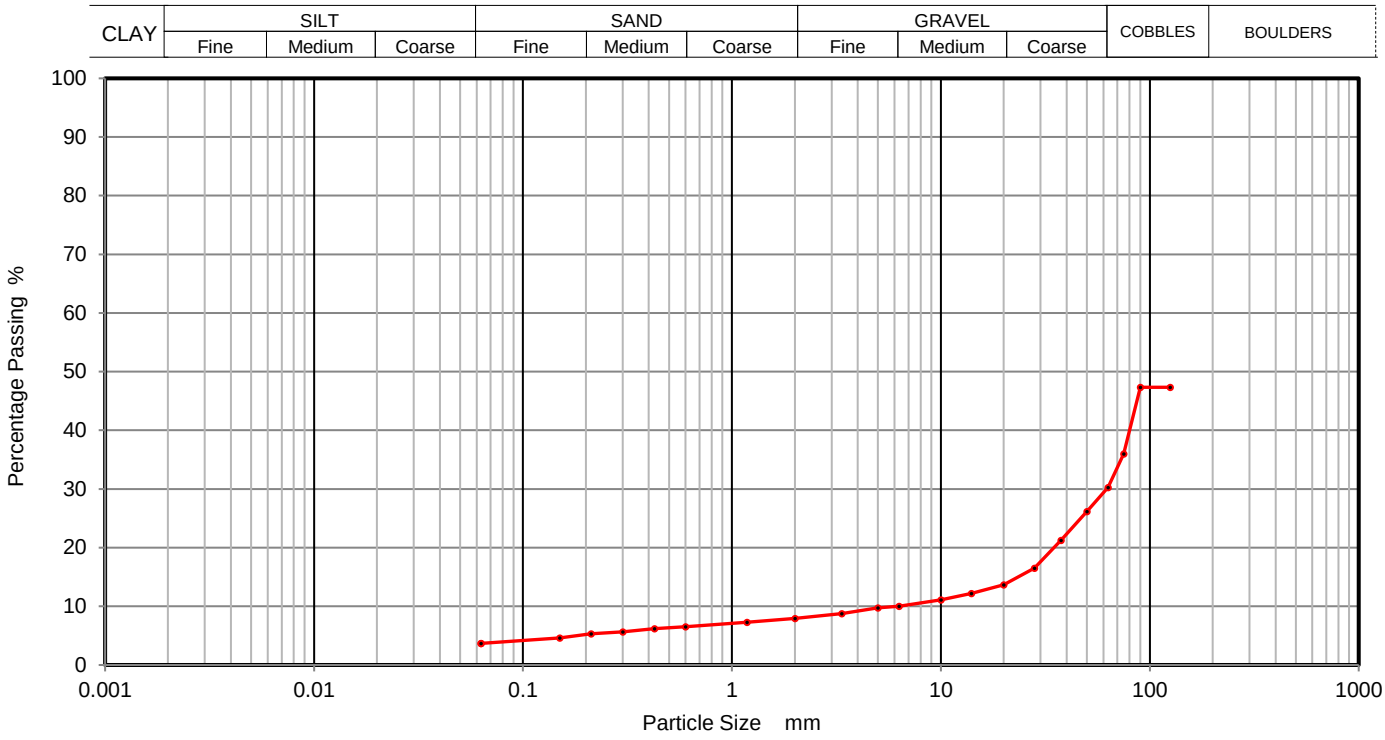
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP7
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown slightly silty slightly clayey slightly fine to coarse sandy fine to coarse GRAVEL.(With some cobbles)	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	47	0.0200	
90	47	0.0060	
75	36	0.0019	
63	30		
50	26		
37.5	21		
28	16		
20	14		
14	12		
10	11		
6.3	10		
5	10		
3.35	9		
2	8		
1.18	7		
0.6	7		
0.425	6		
0.3	6		
0.212	5		
0.15	5		
0.063	4		

Sample Proportions	% dry mass
Cobbles	70
Gravel	22
Sand	4
Silt and Clay	4

Grading Analysis	
Uniformity Coefficient	

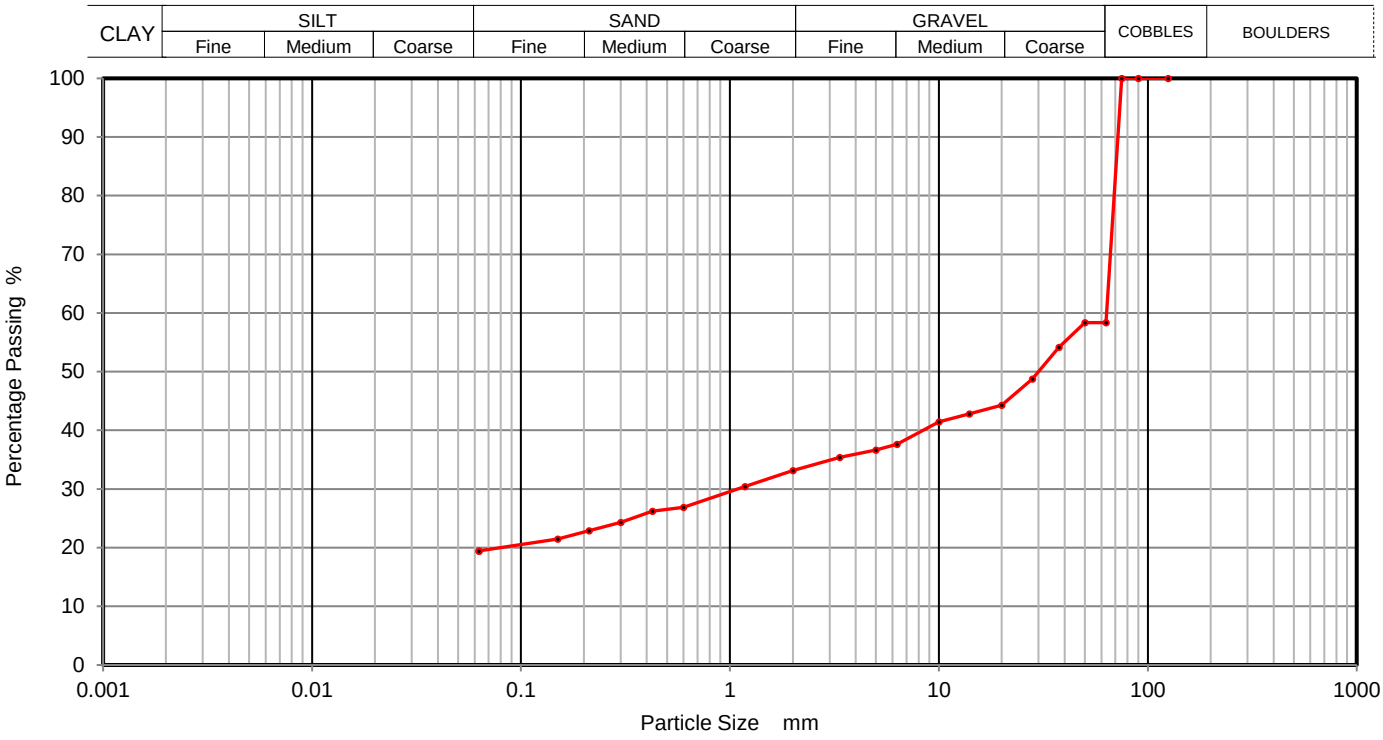
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.(With some cobbles)	Depth Top	0.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	58		
50	58		
37.5	54		
28	49		
20	44		
14	43		
10	41		
6.3	38		
5	37		
3.35	35		
2	33		
1.18	30		
0.6	27		
0.425	26		
0.3	24		
0.212	23		
0.15	21		
0.063	19		

Sample Proportions	% dry mass
Cobbles	42
Gravel	25
Sand	14
Silt and Clay	19

Grading Analysis	
Uniformity Coefficient	

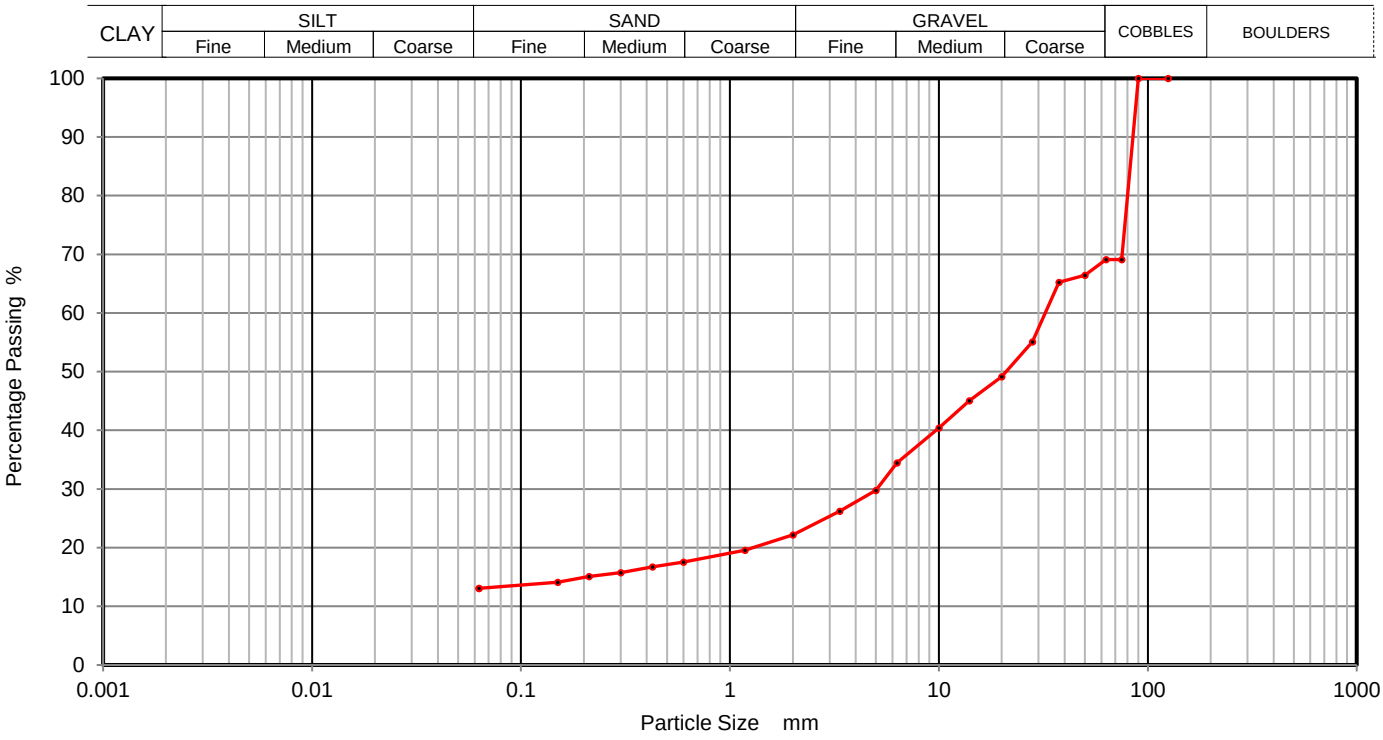
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown slightly fine to coarse sandy silty clayey fine to coarse GRAVEL.(With some cobbles)	Depth Top	1.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	69	0.0019	
63	69		
50	66		
37.5	65		
28	55		
20	49		
14	45		
10	40		
6.3	34		
5	30		
3.35	26		
2	22		
1.18	20		
0.6	18		
0.425	17		
0.3	16		
0.212	15		
0.15	14		
0.063	13		

Sample Proportions	% dry mass
Cobbles	31
Gravel	47
Sand	9
Silt and Clay	13

Grading Analysis	
Uniformity Coefficient	

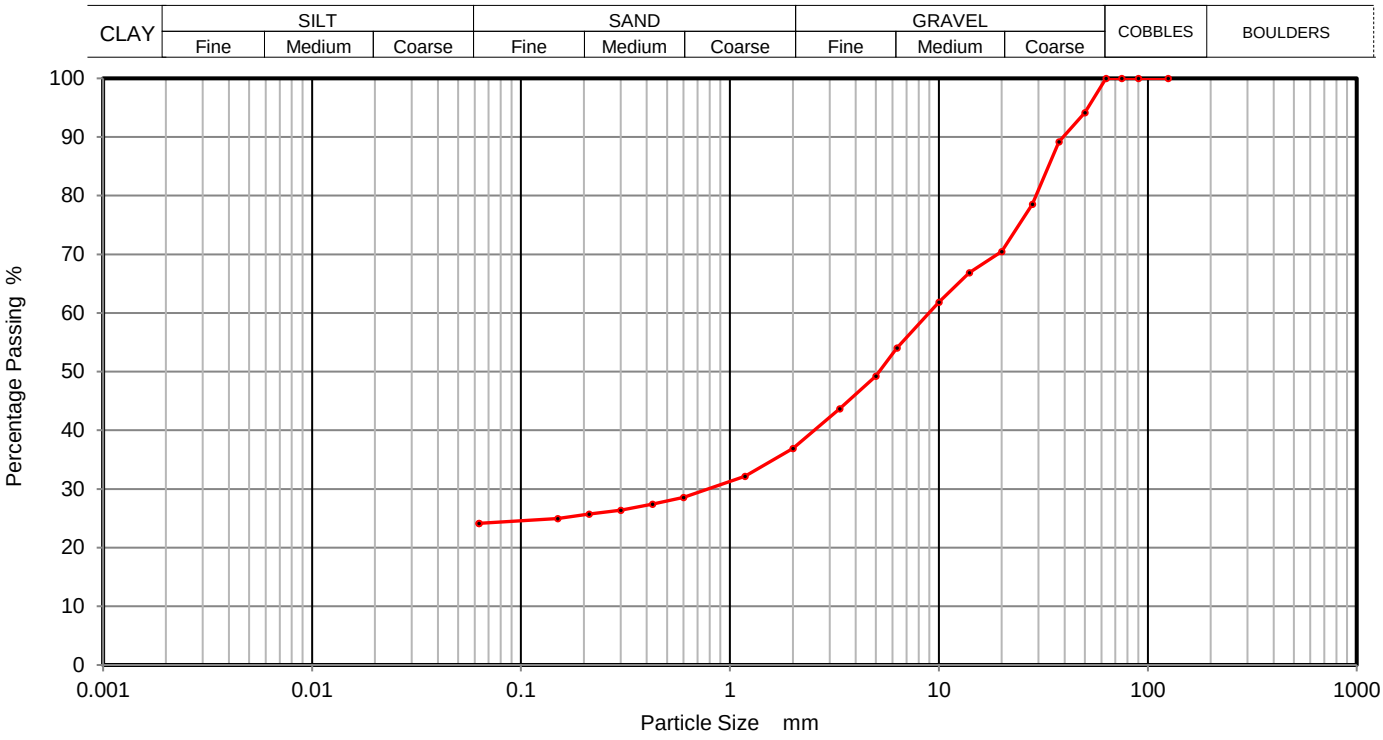
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	94		
37.5	89		
28	79		
20	70		
14	67		
10	62		
6.3	54		
5	49		
3.35	44		
2	37		
1.18	32		
0.6	29		
0.425	27		
0.3	26		
0.212	26		
0.15	25		
0.063	24		

Sample Proportions	% dry mass
Cobbles	0
Gravel	63
Sand	13
Silt and Clay	24

Grading Analysis	
Uniformity Coefficient	

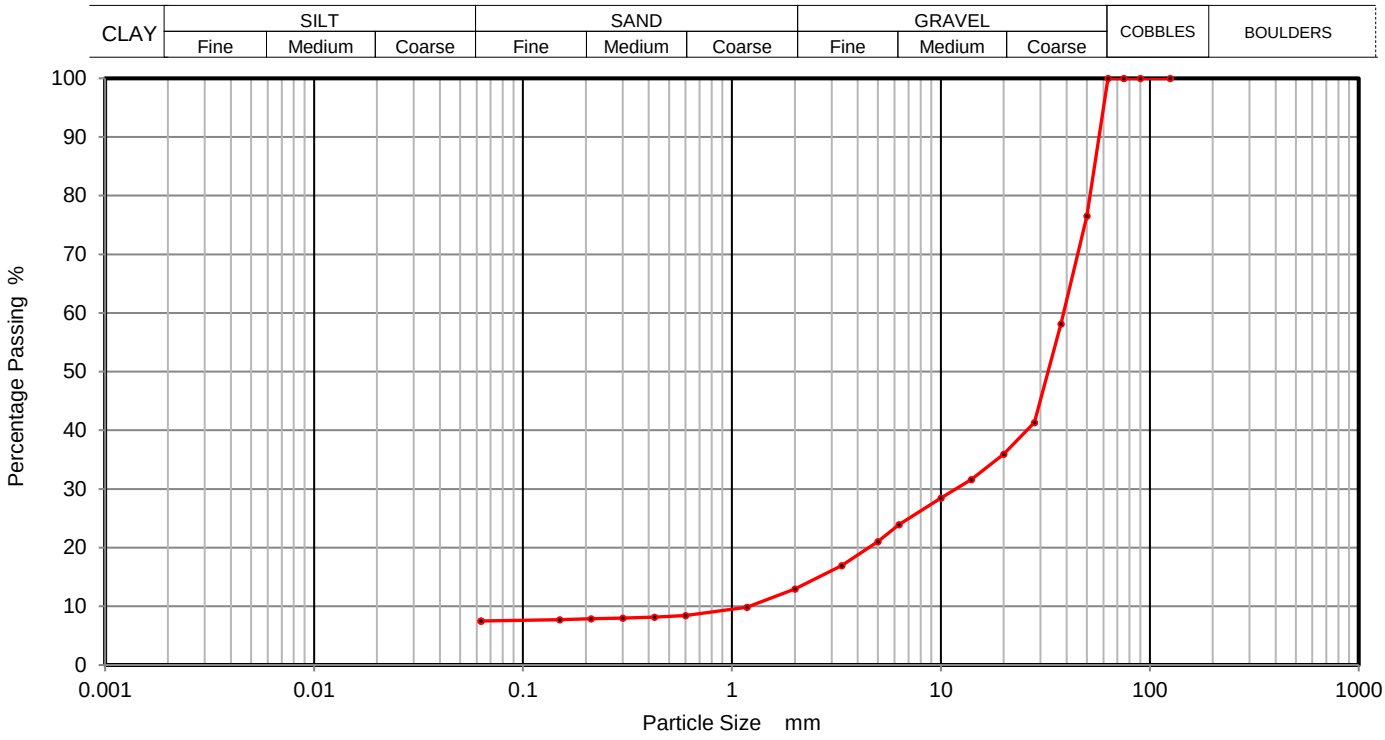
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	**Pantteg, Ystalyfera**	Sample No.	1
Soil Description	Brown slightly fine to coarse sandy slightly silty slightly clayey fine to coarse GRAVEL	Depth Top	2.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	77		
37.5	58		
28	41		
20	36		
14	32		
10	28		
6.3	24		
5	21		
3.35	17		
2	13		
1.18	10		
0.6	8		
0.425	8		
0.3	8		
0.212	8		
0.15	8		
0.063	8		

Sample Proportions	% dry mass
Cobbles	0
Gravel	87
Sand	5
Silt and Clay	8

Grading Analysis	
Uniformity Coefficient	

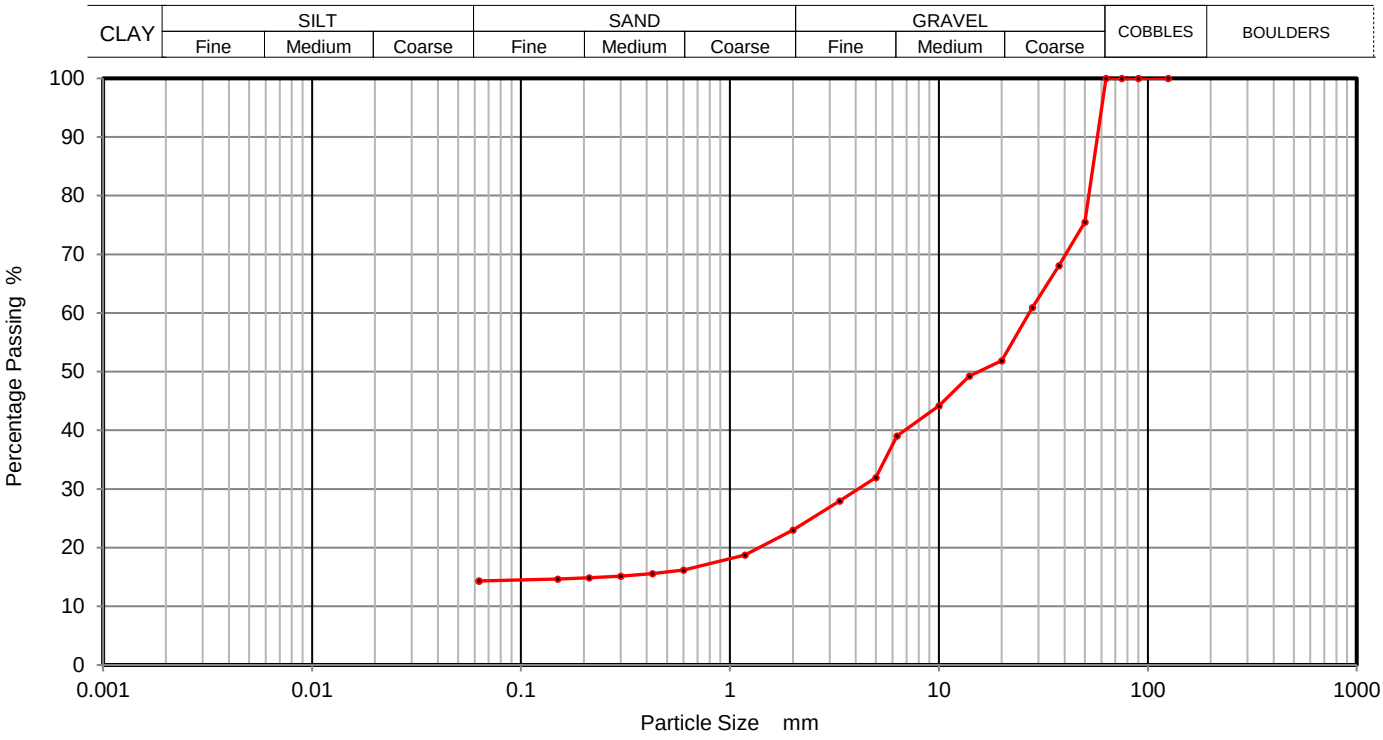
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	**Pantteg, Ystalyfera**	Sample No.	1
Soil Description	Brown slightly fine to coarse sandy silty clayey fine to coarse GRAVEL	Depth Top	3.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	76		
37.5	68		
28	61		
20	52		
14	49		
10	44		
6.3	39		
5	32		
3.35	28		
2	23		
1.18	19		
0.6	16		
0.425	16		
0.3	15		
0.212	15		
0.15	15		
0.063	14		

Sample Proportions	% dry mass
Cobbles	0
Gravel	77
Sand	9
Silt and Clay	14

Grading Analysis	
Uniformity Coefficient	

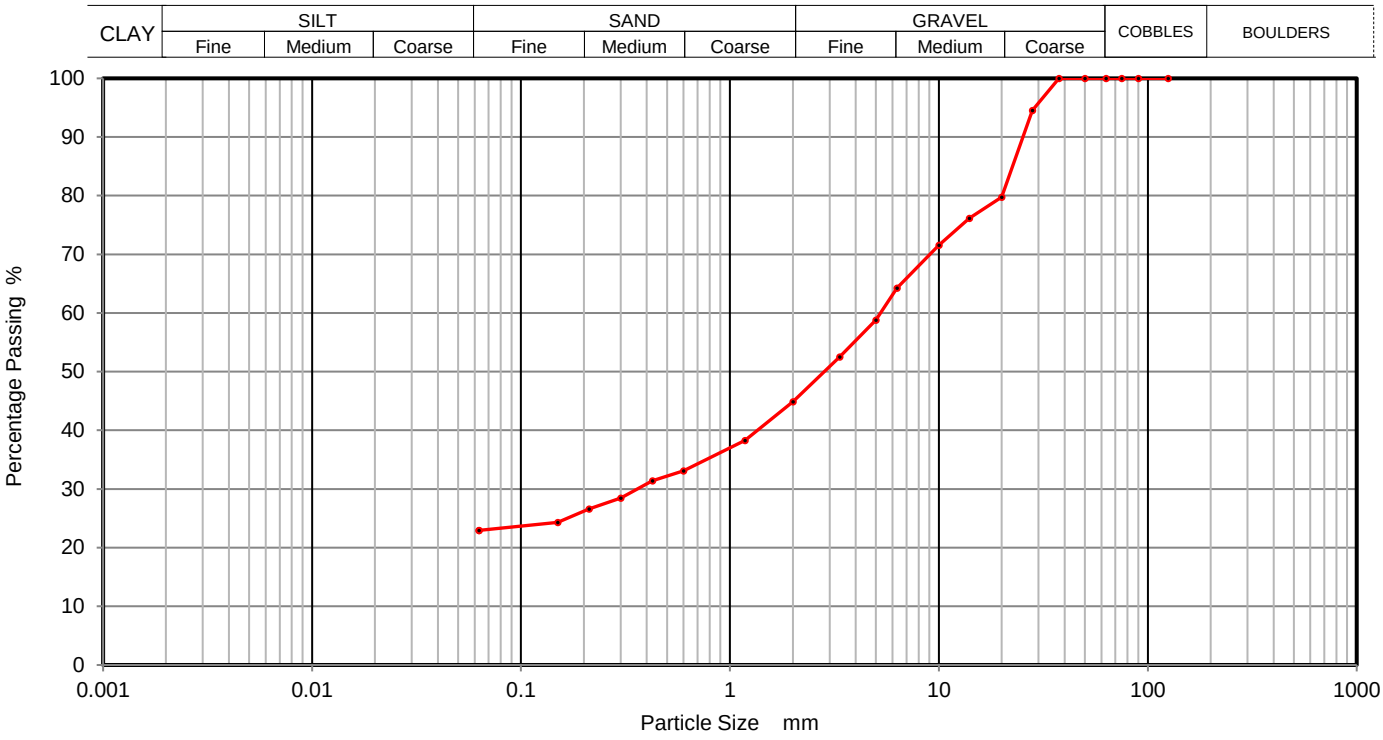
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	36992
		Borehole/Pit No.	TP8
Site Name	Pantteg, Ystalyfera	Sample No.	1
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL	Depth Top	4.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	95		
20	80		
14	76		
10	72		
6.3	64		
5	59		
3.35	53		
2	45		
1.18	38		
0.6	33		
0.425	31		
0.3	28		
0.212	27		
0.15	24		
0.063	23		

Sample Proportions	% dry mass
Cobbles	0
Gravel	55
Sand	22
Silt and Clay	23

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	31/10/2017	Sean Penn	
RO/MH	Approved	01/11/2017	Ben Sharp	

UKAS TESTING 2788

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP1
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy clayey silty fine to coarse GRAVEL.			Depth From m	2.00
Specimen Reference	1	Specimen Depth	2.00 m	Depth To m	
Specimen Description	Brown sandy clayey SILT.			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

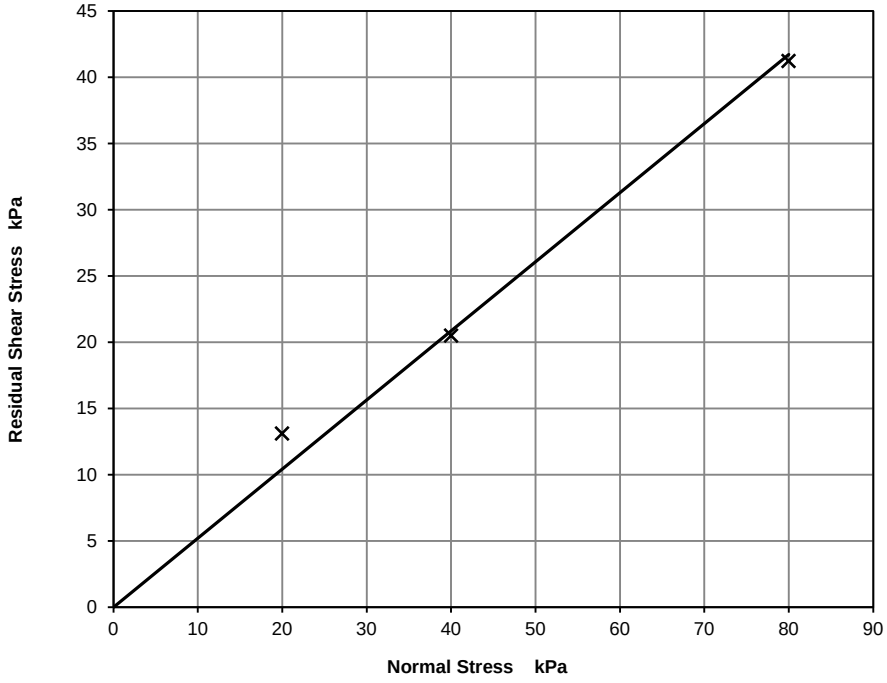
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 58 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0	mm
Inner diameter	70.0	mm
Height	5.00	mm
Bulk Density	1.75	Mg/m³
Moisture Content (trimmings)	20.0	%
Dry density	1.46	Mg/m³
Moisture content after test	19.2	%

			Stage 1	2	3				
Consolidation	Normal Stress applied		**20**	**40**	**80**				kPa
	Change in height during consolidation		-0.134	-0.036	-0.003				mm
Shearing	Number of rotations prior to shearing		2	2	2				
	Distance between force application points		153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular	0.048	0.048	0.048				°/min
		linear	0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative		12.4	26.9	38.2				mm
	Residual Shear stress		13.1	20.5	41.2				kPa
	Vertical Movement at residual shear stress		-0.03	-0.03	-0.03				mm



Residual Shear Strength Parameters

c'_R **assumed zero**

ϕ'_R **27.5 °**

General Remarks

ϕ'r derived by linear regression assuming $c'_R = 0$

Water added to cell immediately after first load applied

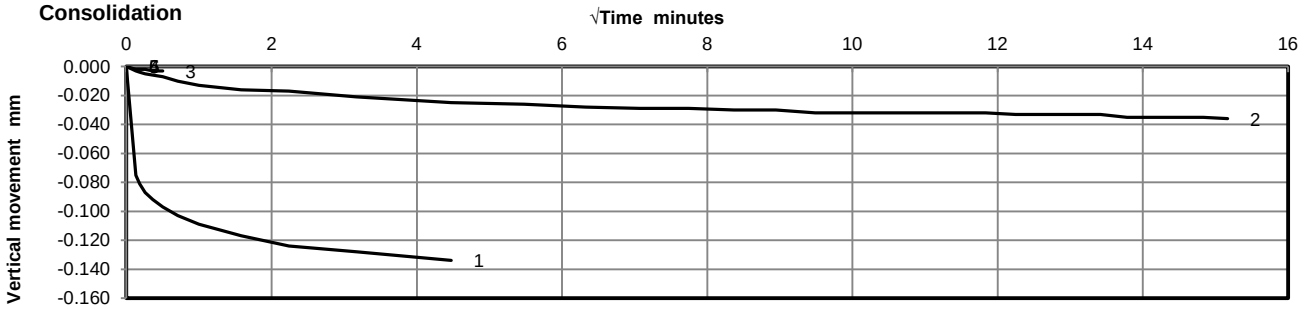
Specimen 1

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

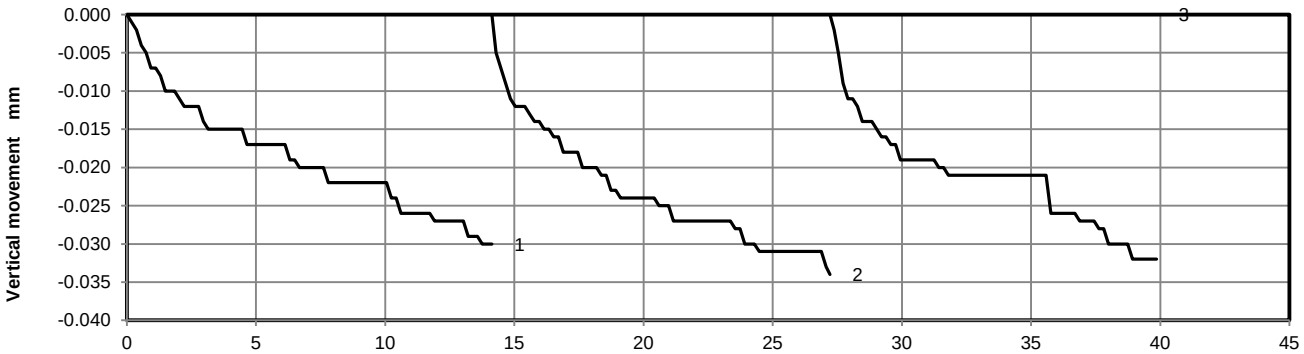
Date printed	Approved	Fig No.
29/11/2017 14:06	Paul Evans	sheet 1 of 2

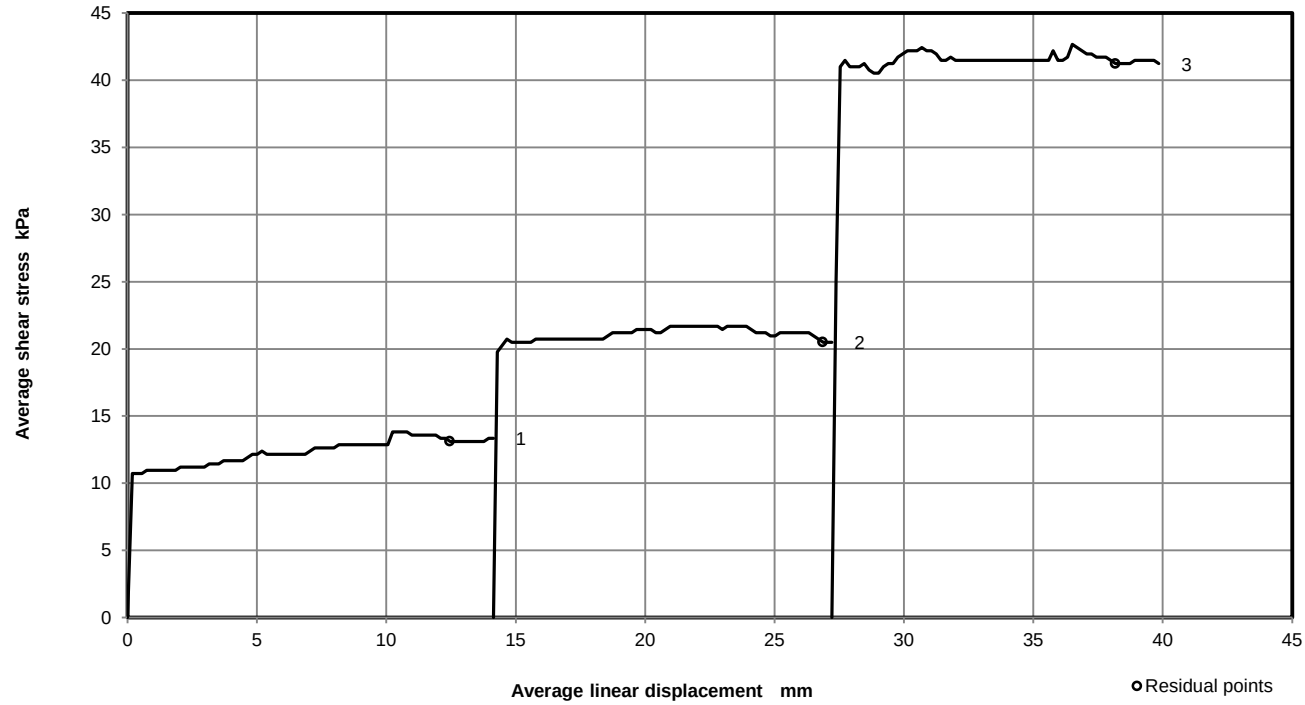
GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP1
Site Name	Pantteg, Ystalyfera			Sample No.	
Specimen Reference	1	Specimen Depth	2.00 m	Depth m	2.00
Graphical data				Sample Type	
					D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:06	Paul Evans	sheet 2 of 2

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP2
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy clayey silty fine to coarse GRAVEL.			Depth From m	1.00
Specimen Reference	1	Specimen Depth	1.00 m	Depth To m	
Specimen Description	Brown sandy clayey SILT.			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

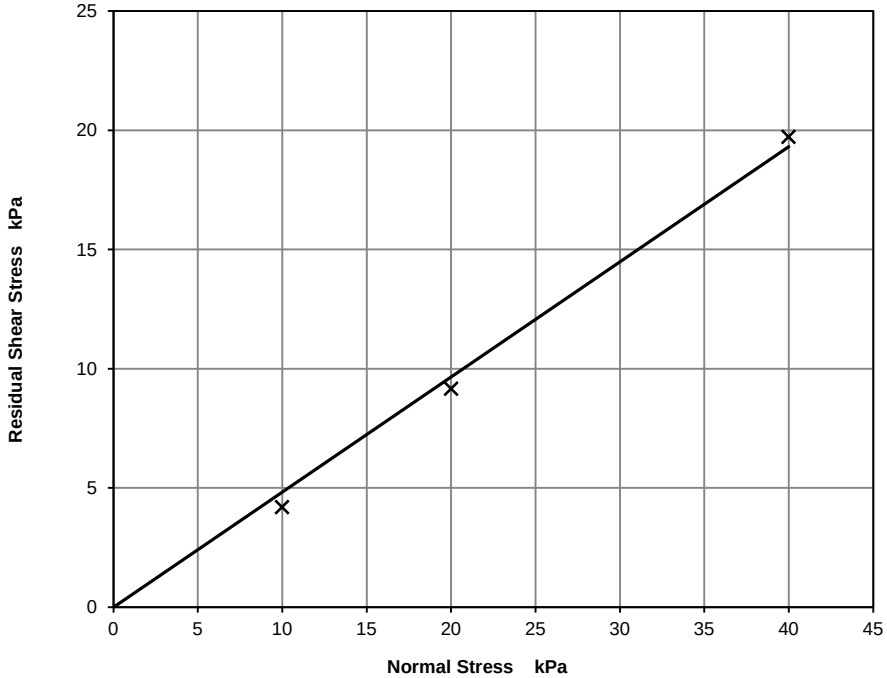
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 75 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0 mm
Inner diameter	70.0 mm
Height	5.00 mm
Bulk Density	1.70 Mg/m³
Moisture Content (trimmings)	17.0 %
Dry density	1.45 Mg/m³
Moisture content after test	17.8 %

			Stage	1	2	3				
Consolidation	Normal Stress applied			**10**	**20**	**40**				kPa
	Change in height during consolidation			-0.080	-0.058	-0.032				mm
Shearing	Number of rotations prior to shearing			2	2	2				
	Distance between force application points			153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular		0.048	0.048	0.048				°/min
		linear		0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative			12.2	24.0	60.2				mm
	Residual Shear stress			4.2	9.2	19.7				kPa
	Vertical Movement at residual shear stress			-0.04	-0.02	-0.01				mm



Residual Shear Strength Parameters

c'_R **assumed zero**

ϕ'_R **25.8 °**

General Remarks

ϕ'r derived by linear regression assuming $c'_R = 0$

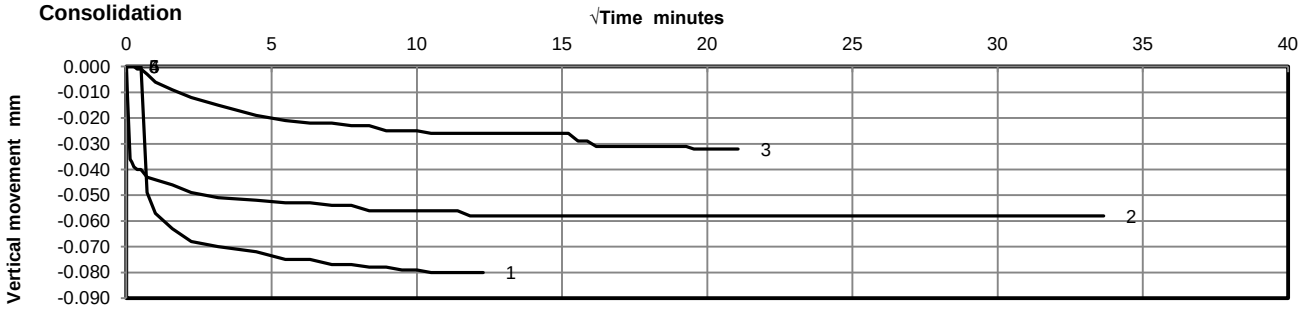
Water added to cell immediately after first load applied

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

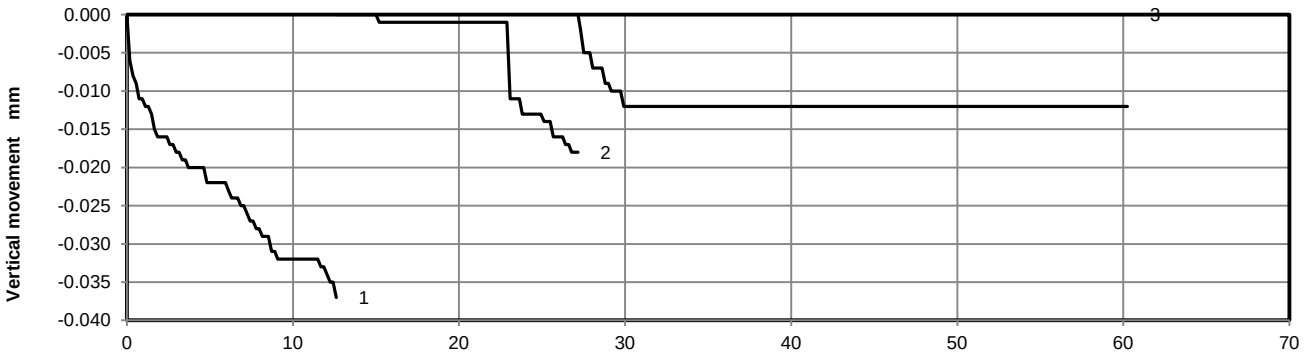
Date printed	Approved	Fig No.
29/11/2017 14:08	Paul Evans	sheet 1 of 2

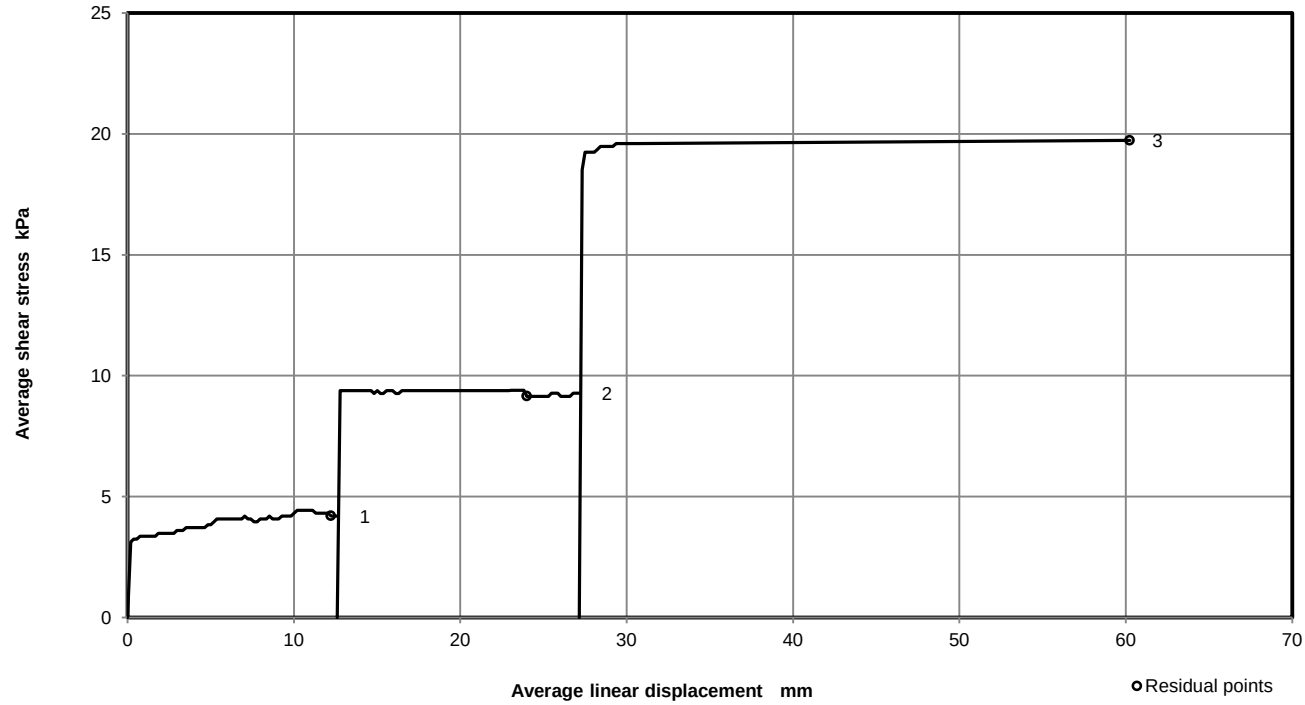
GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP2
Site Name	Pantteg, Ystalyfera			Sample No.	
Specimen Reference	1	Specimen Depth	1.00 m	Depth m	1.00
Graphical data				Sample Type	
					D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:08	Paul Evans	sheet 2 of 2

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy clayey silty fine to coarse GRAVEL.			Depth From m	0.50
Specimen Reference	1	Specimen Depth	0.50 m	Depth To m	
Specimen Description	Brown sandy clayey SILT.			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

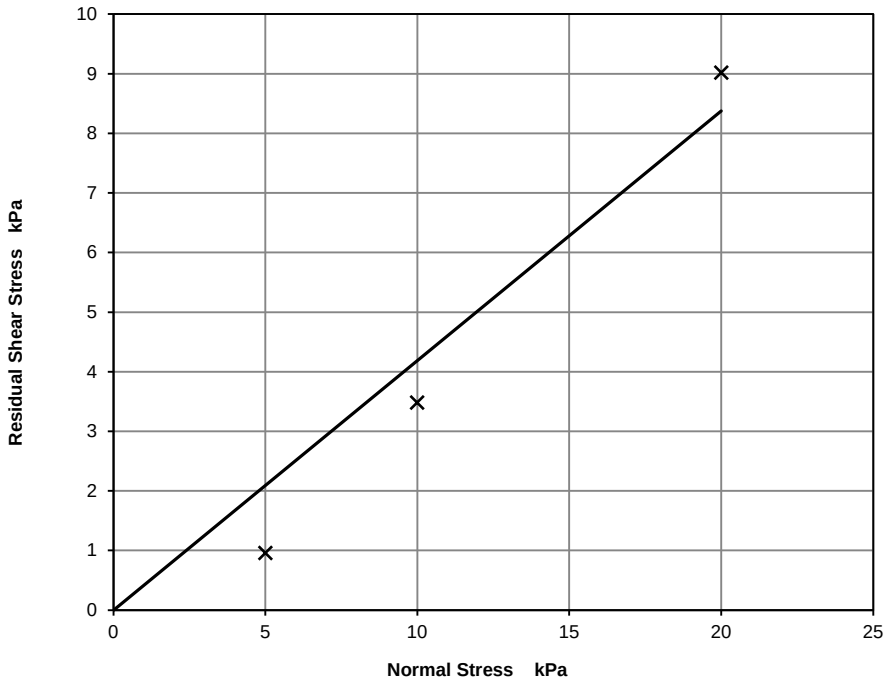
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 66 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0	mm
Inner diameter	70.0	mm
Height	5.00	mm
Bulk Density	1.70	Mg/m³
Moisture Content (trimmings)	20.0	%
Dry density	1.41	Mg/m³
Moisture content after test	20.0	%

			Stage	1	2	3				
Consolidation	Normal Stress applied			**5**	**10**	**20**				kPa
	Change in height during consolidation			-0.023	-0.021	-0.024				mm
Shearing	Number of rotations prior to shearing			2	2	2				
	Distance between force application points			153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular		0.048	0.048	0.048				°/min
		linear		0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative			2.4	13.2	29.9				mm
	Residual Shear stress			1.0	3.5	9.0				kPa
	Vertical Movement at residual shear stress			-0.01	-0.02	-0.03				mm



Residual Shear Strength Parameters

c'_R **assumed zero**

ϕ'_R **22.7 °**

General Remarks

ϕ'r derived by linear regression assuming $c'_R = 0$

Water added to cell immediately after first load applied

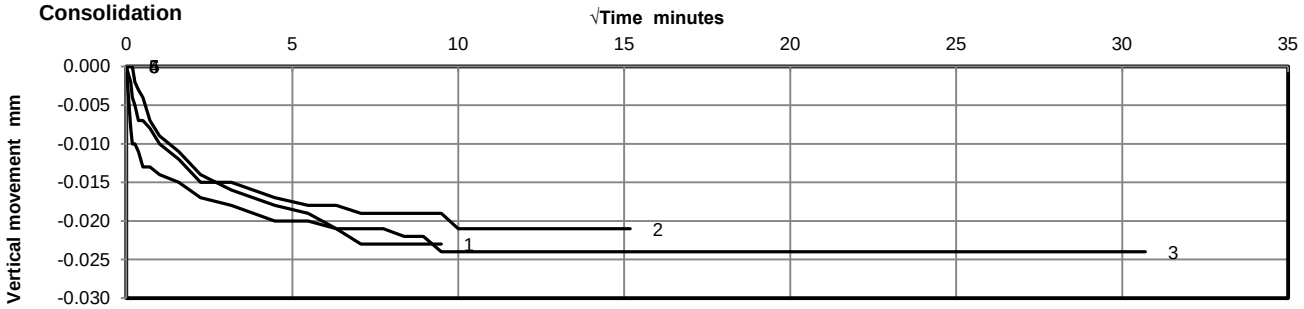
Specimen 1

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

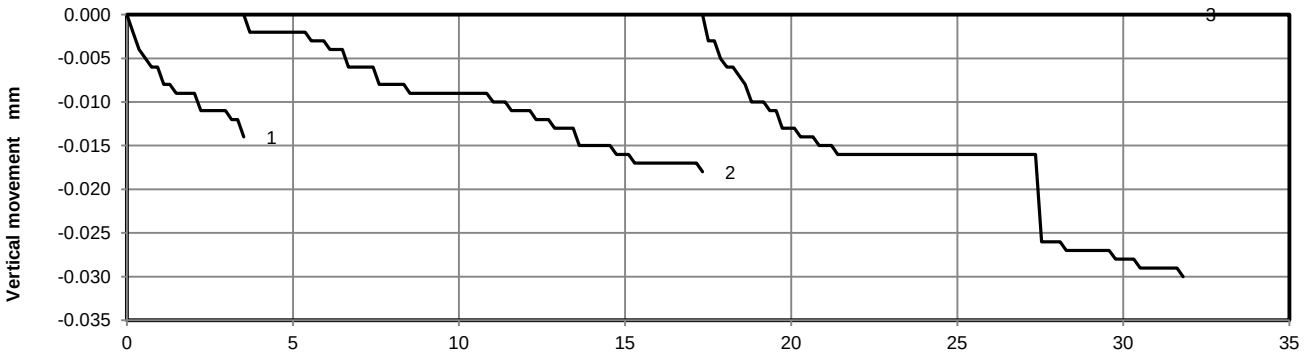
Date printed	Approved	Fig No.
29/11/2017 14:09	Paul Evans	sheet 1 of 2

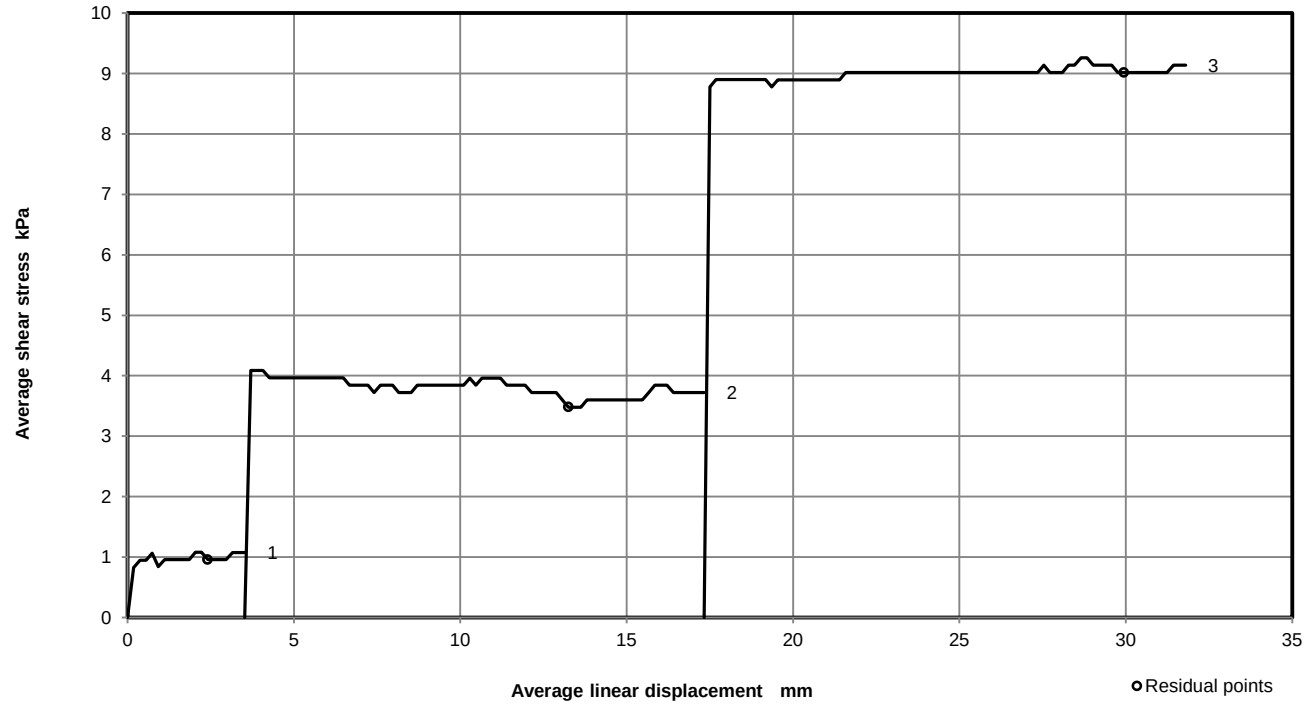
GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Specimen Reference	1	Specimen Depth	0.50 m	Depth m	0.50
Graphical data				Sample Type	
					D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:09	Paul Evans	sheet 2 of 2

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.			Depth From m	1.50
Specimen Reference	1	Specimen Depth	1.50 m	Depth To m	
Specimen Description	Brown sandy silty CLAY			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

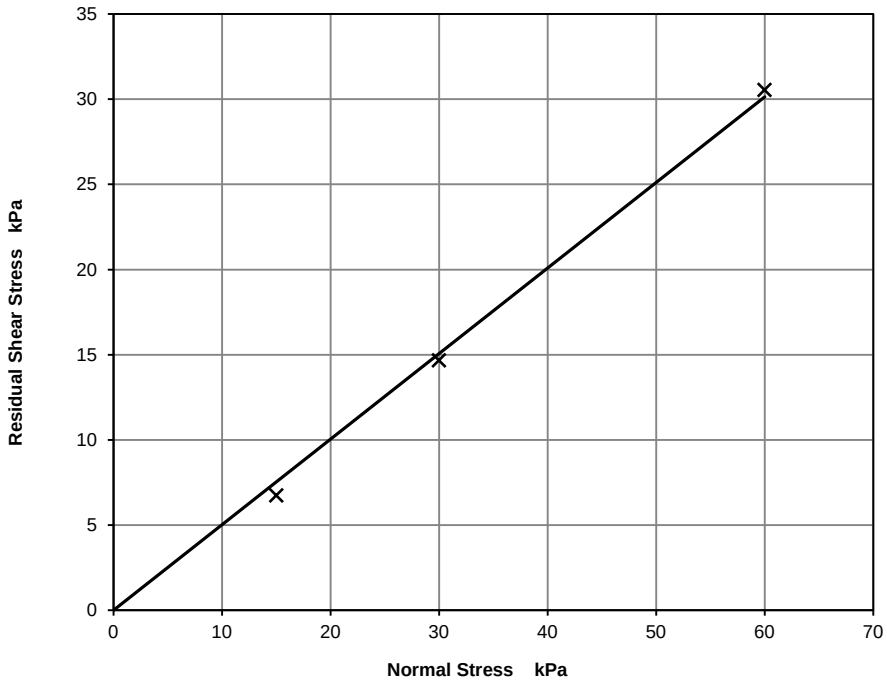
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 77 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0	mm
Inner diameter	70.0	mm
Height	5.00	mm
Bulk Density	1.63	Mg/m³
Moisture Content (trimmings)	13.0	%
Dry density	1.44	Mg/m³
Moisture content after test	14.6	%

			Stage	1	2	3				
Consolidation	Normal Stress applied			**15**	**30**	**60**				kPa
	Change in height during consolidation			-0.138	-0.029	-0.063				mm
Shearing	Number of rotations prior to shearing			2	2	2				
	Distance between force application points			153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular		0.048	0.048	0.048				°/min
		linear		0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative			7.0	10.5	18.3				mm
	Residual Shear stress			6.7	14.7	30.5				kPa
	Vertical Movement at residual shear stress			-0.03	-0.02	-0.02				mm



Residual Shear Strength Parameters

c'_R **assumed zero**

ϕ'_R **26.7 °**

General Remarks

ϕ'r derived by linear regression assuming $c'_R = 0$

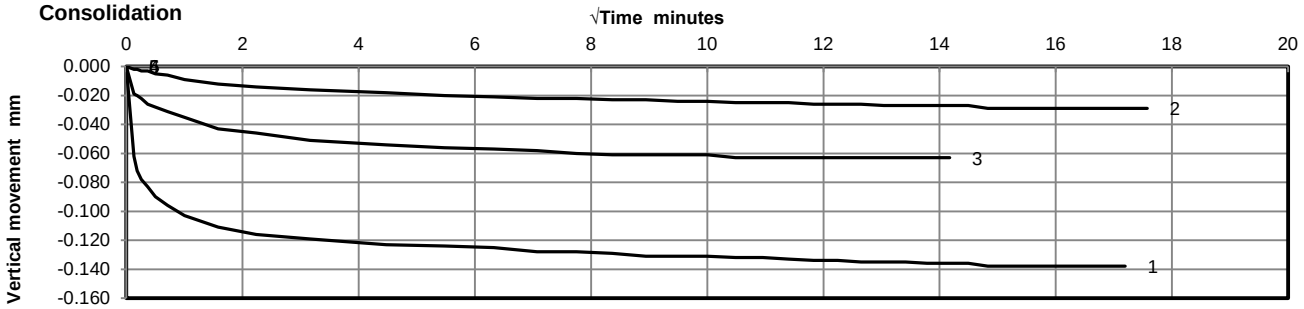
Water added to cell immediately after first load applied

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

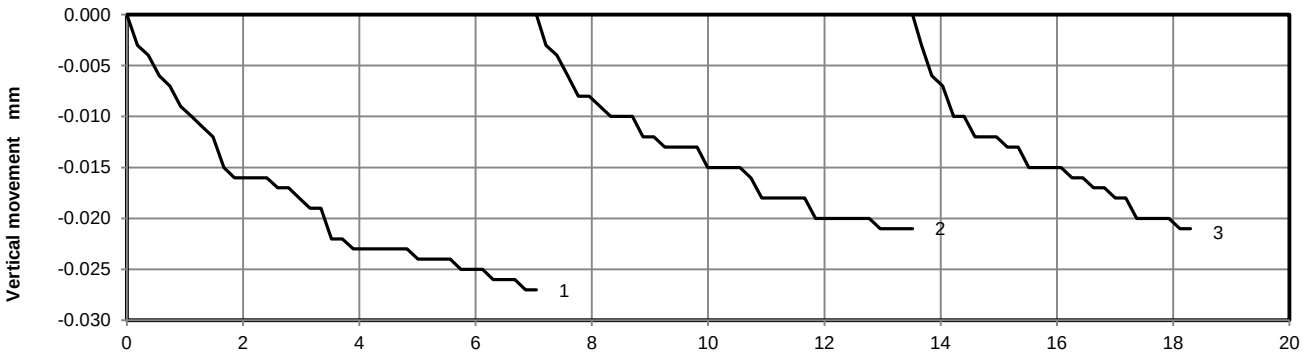
Date printed	Approved	Fig No.
29/11/2017 14:10	Paul Evans	sheet 1 of 2

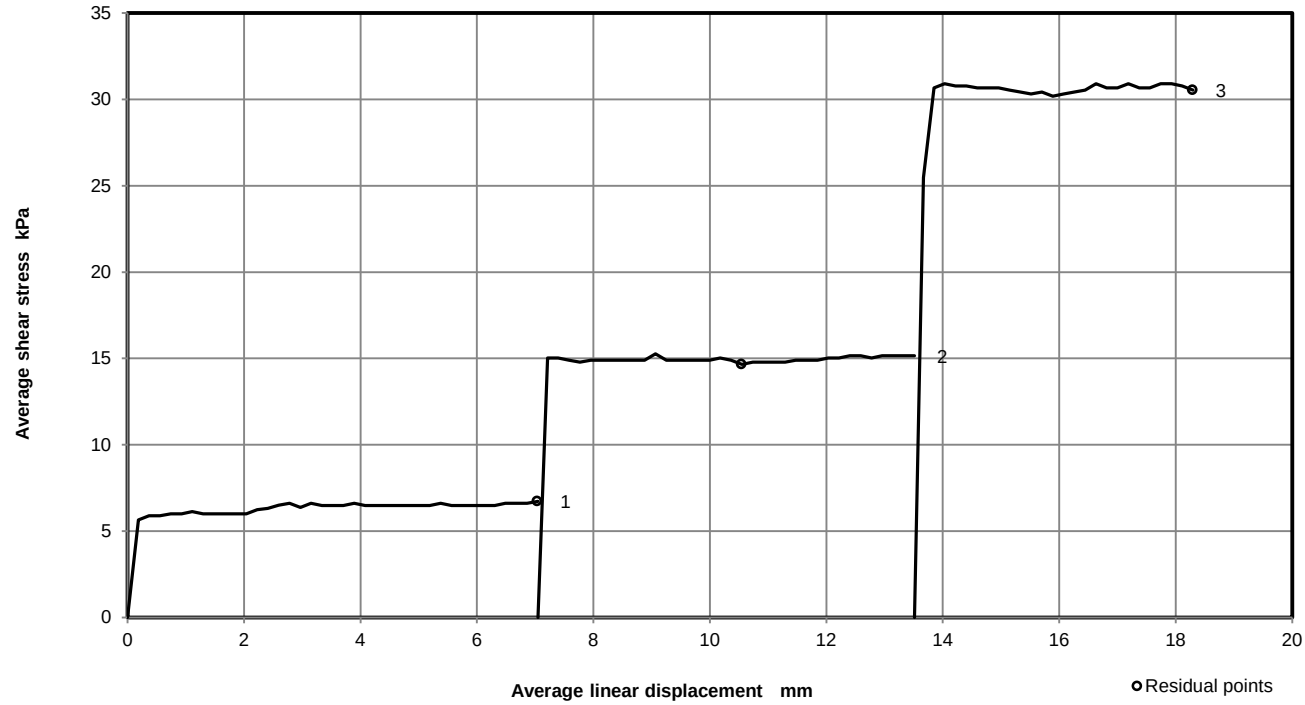
GSTL	Determination of residual shear strength using the small ring shear apparatus				Job Ref	36992
					Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera				Sample No.	
Specimen Reference	1	Specimen Depth	1.50	m	Depth m	1.50
Graphical data					Sample Type	
						D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:10	Paul Evans	sheet 2 of 2

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.			Depth From m	3.50
Specimen Reference	1	Specimen Depth	3.50 m	Depth To m	
Specimen Description	Brown sandy silty CLAY			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

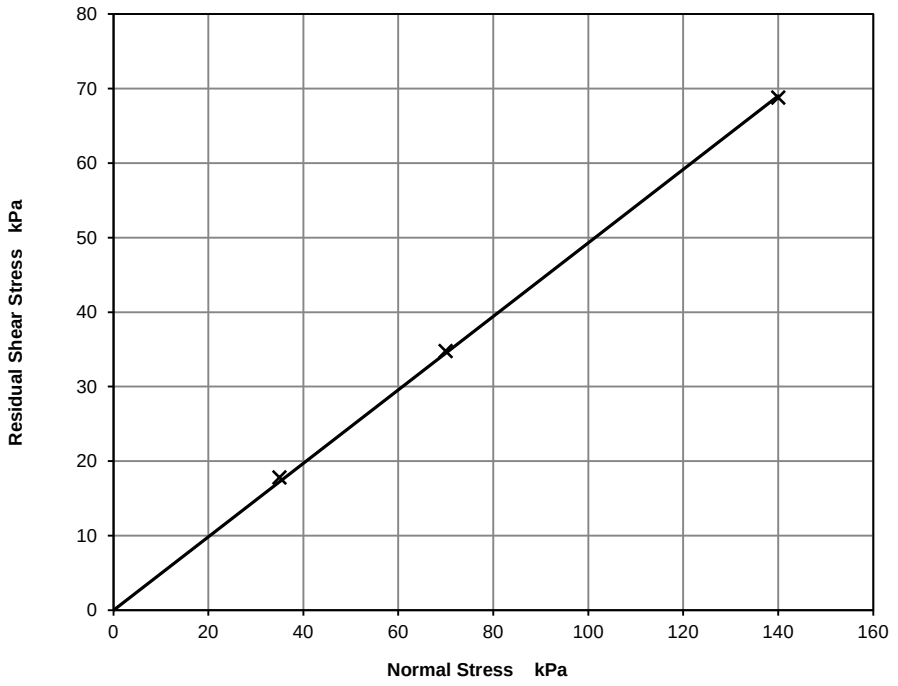
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 76 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0	mm
Inner diameter	70.0	mm
Height	5.00	mm
Bulk Density	1.64	Mg/m³
Moisture Content (trimmings)	14.0	%
Dry density	1.44	Mg/m³
Moisture content after test	14.9	%

			Stage 1	2	3				
Consolidation	Normal Stress applied		**35**	**70**	**140**				kPa
	Change in height during consolidation		-0.184	-0.048	-0.048				mm
Shearing	Number of rotations prior to shearing		2	2	2				
	Distance between force application points		153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular	0.048	0.048	0.048				°/min
		linear	0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative		5.2	10.9	14.7				mm
	Residual Shear stress		17.8	34.7	68.8				kPa
	Vertical Movement at residual shear stress		-0.02	-0.02	-0.02				mm



Residual Shear Strength Parameters

c'_R assumed zero

ϕ'_R 26.2 °

General Remarks

$\phi'r$ derived by linear regression assuming $c'_R = 0$

Water added to cell immediately after first load applied

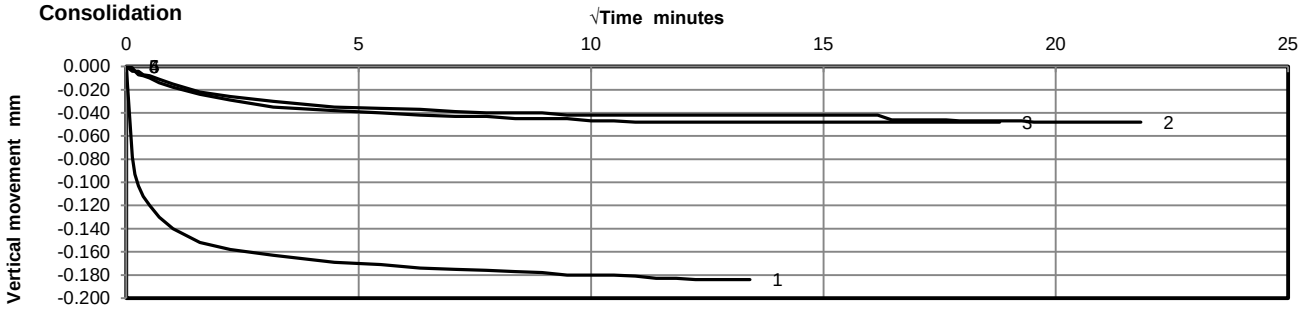
Specimen 1

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

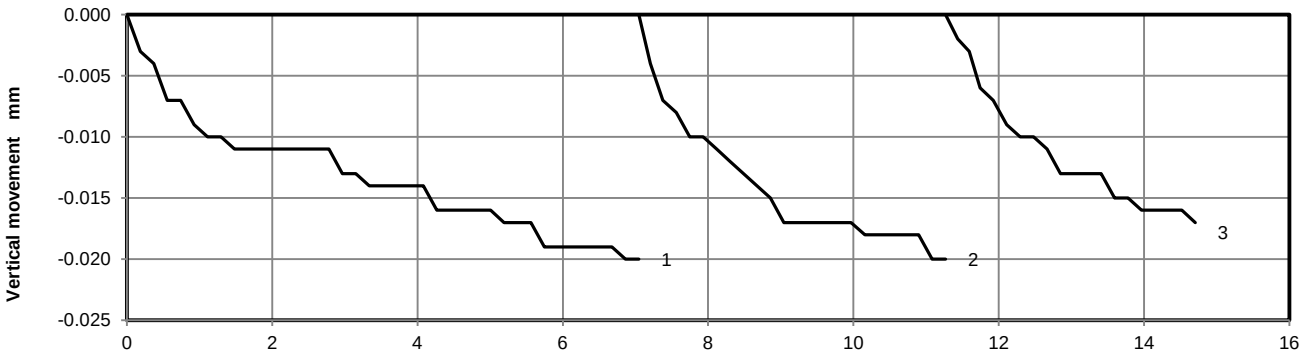
Date printed	Approved	Fig No.
29/11/2017 14:11	Paul Evans	sheet 1 of 2

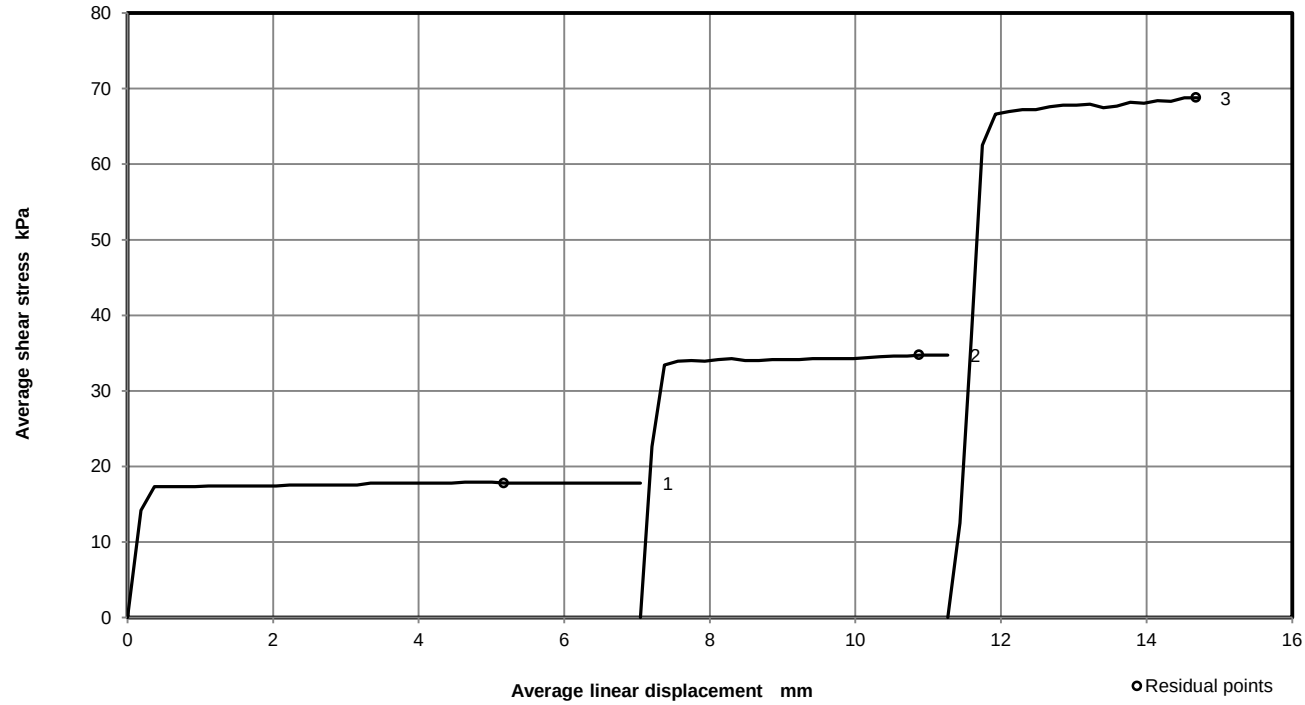
GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Specimen Reference	1	Specimen Depth	3.50 m	Depth m	3.50
Graphical data				Sample Type	
					D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:11	Paul Evans	sheet 2 of 2

GSTL	Determination of residual shear strength using the small ring shear apparatus			Job Ref	36992
				Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera			Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.			Depth From m	4.50
Specimen Reference	1	Specimen Depth	4.50 m	Depth To m	
Specimen Description	Brown sandy silty CLAY			Sample Type	D
Test Method	BS 1377: Part 7: 1990, clause 6				

Preparation Details

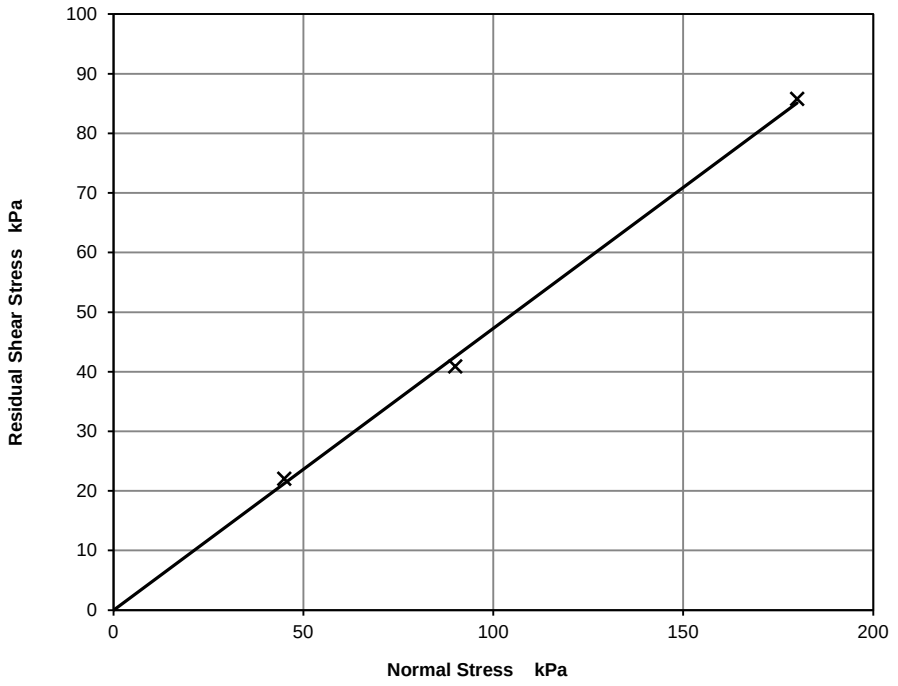
REMOULDED at natural water content using material passing 1.18mm sieve

Material removed 60 % above 1.18 mm sieve

Specimen Details

Outer diameter	100.0	mm
Inner diameter	70.0	mm
Height	5.00	mm
Bulk Density	1.70	Mg/m³
Moisture Content (trimmings)	18.0	%
Dry density	1.44	Mg/m³
Moisture content after test	19.2	%

			Stage 1	2	3				
Consolidation	Normal Stress applied		**45**	**90**	**180**				kPa
	Change in height during consolidation		-0.263	-0.063	-0.081				mm
Shearing	Number of rotations prior to shearing		2	2	2				
	Distance between force application points		153.0	153.0	153.0				mm
	Rate of rotation/displacement applied	angular	0.048	0.048	0.048				°/min
		linear	0.036	0.036	0.036				mm/min
Residual values	Corrected mean linear displacement, cumulative		3.5	6.6	9.3				mm
	Residual Shear stress		22.0	40.9	85.7				kPa
	Vertical Movement at residual shear stress		-0.02	-0.01	-0.02				mm



Residual Shear Strength Parameters

c'_R **assumed zero**

ϕ'_R **25.3 °**

General Remarks

ϕ'r derived by linear regression assuming $c'_R = 0$

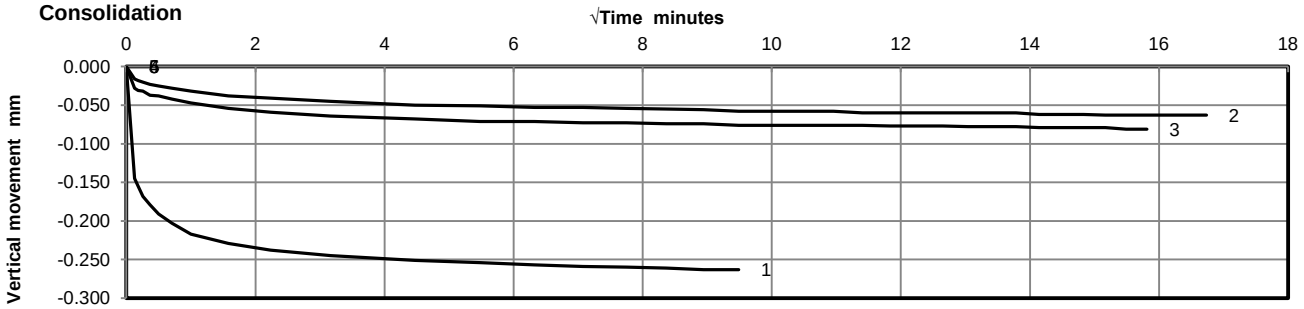
Water added to cell immediately after first load applied

Test reported by GSTL
Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN
Tel 01554 784040
Email info@gstl.co.uk

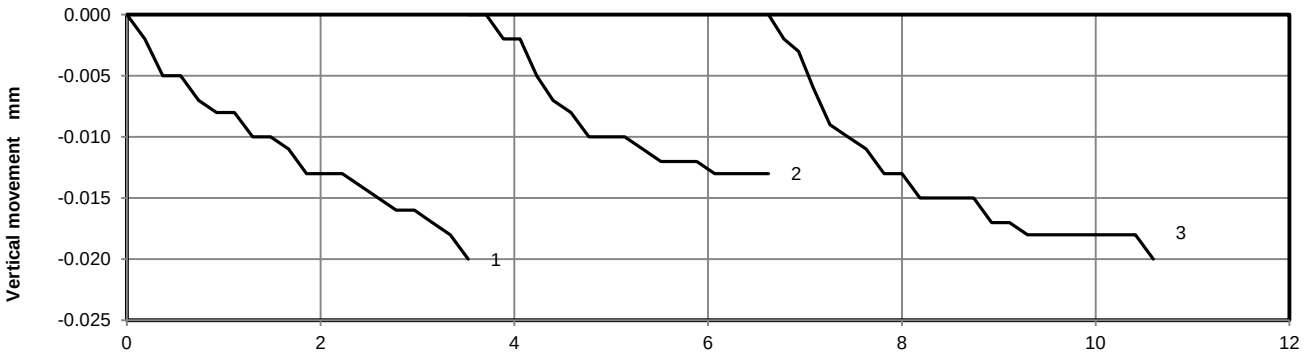
Date printed	Approved	Fig No.
29/11/2017 14:13	Paul Evans	sheet 1 of 2

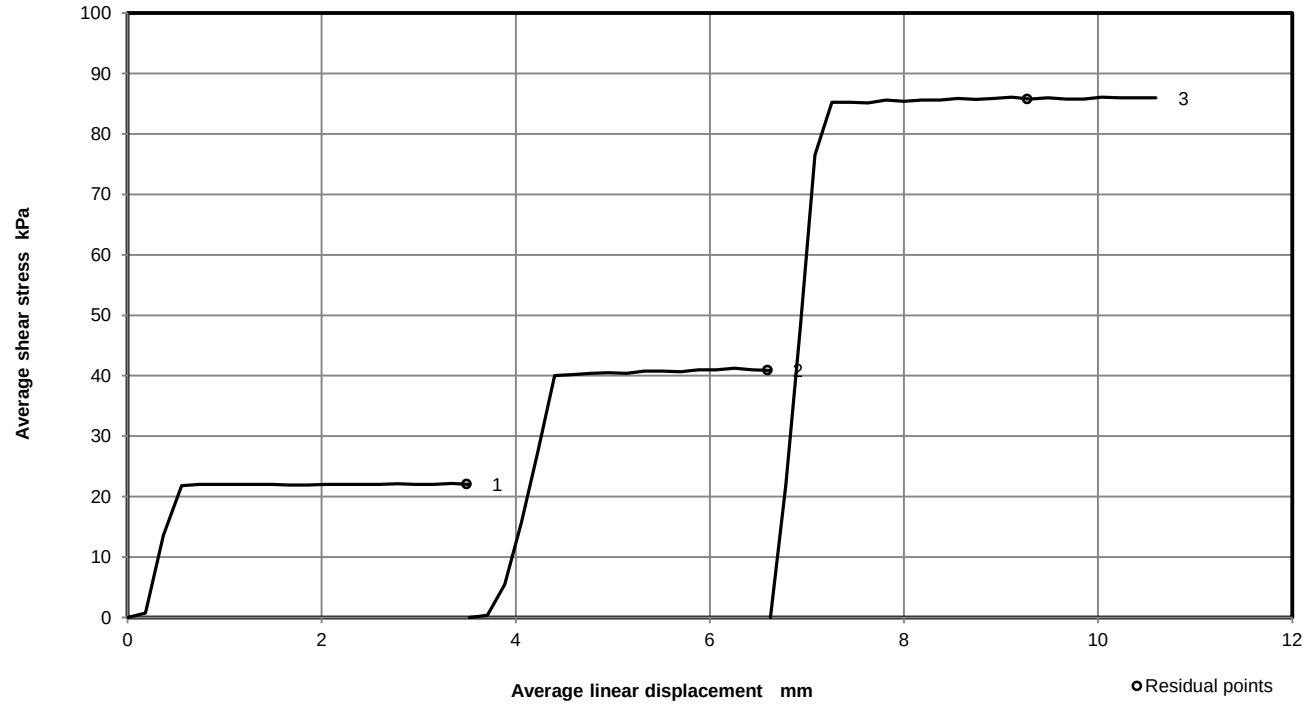
GSTL	Determination of residual shear strength using the small ring shear apparatus				Job Ref	36992
					Borehole/Pit No	TP8
Site Name	Pantteg, Ystalyfera				Sample No.	
Specimen Reference	1	Specimen Depth	4.50	m	Depth m	4.50
Graphical data					Sample Type	
						D

Consolidation



Shear





Test reported by GSTL Unit 4 Heol Aur, Dafen Industrial Estate, Llanelli SA14 8QN Tel 01554 784040 Email info@gstl.co.uk	Date Printed	Approved	Fig. No
	29/11/2017 14:13	Paul Evans	sheet 2 of 2

GSTL	Determination of Unconfined Compressive Strength ISRM Suggested Methods Vol 16, No. 2, pp. 135-140 1979	
Contract Number	36692	
Site Name	Pantteg, Ystalyfera	
Sample Preperation	Sawing and Grinding	
Date Tested	25/10/2017	

Hole Reference	Depth (m)			Diameter	Length	Initial Mass	Moisture Content	Bulk Density	Dry Density	Load Failure	Maximum Strength	Type of Failure
BH301	13.50			73	146.2	1634.2	2.10	2.67	2.62	96.9	23.1	Axial Splitting
BH301	23.50			73.2	163.9	1852.9	1.00	2.69	2.66	131.0	31.1	Axial Splitting
BH301	27.50			73.1	172.3	1939.7	0.50	2.68	2.67	263.9	62.9	Axial Splitting
BH301	36.50			73.1	131.9	1497.8	1.00	2.71	2.68	99.7	23.8	Axial Splitting
BH301	59.00			73.2	183.6	2139.2	0.40	2.77	2.76	275.3	65.4	Axial Splitting
BH303	29.00			73.4	180	2051.2	0.40	2.69	2.68	613.6	145.0	Axial Splitting
BH304	28.00			73.1	140.2	1573.7	0.80	2.67	2.65	153.7	36.6	Axial Splitting
BH306	20.50			73	180.9	2037.1	1.10	2.69	2.66	132.4	31.6	Axial Splitting

Key	Reported As
Diameter	mm
Length	mm
Initial Mass	g
Moisture Content	%
Bulk Density	Mg/m^3
Dry Density	Mg/m^3
Load Failure	kN
Maximum Strength	mpa

Operators	Checked	31/10/2017	Sean Penn	
JD	Approved	01/11/2017	Ben Sharp	

GSTL	**Point Load Test** **Int. J. Rock Mech. Sci. & Geomech. Abstr. Vol. 22, No. 2, pp. 51 - 60, 1985.**	
Contract Number	36992	
Site Name	Pantteg, Ystalyfera	
Sample Type	Core	
Date Tested	25/10/2017	

Hole Reference	Depth (m)			Test Type d / a / b / i	Test Type I //	Width	Platen Seperation	Failure Load	Equivalent Diameter	Point Load	Size Factor	Point Load Index	Moisture Content	Description	Angle Between Plane of Anisotropy & Core Axis	Type of Anisotropy (Bedding or Cleavage)
BH301	7.20	-		d			73	0.77		0.14	1.19	0.17	2.4	SILTSTONE		
BH301	9.00	-		a		73	50	0.45	68.17	0.10	1.15	0.11	1.2	SILTSTONE		
BH301	49.00	-		a		73	47	1.31	66.09	0.30	1.13	0.34	1.4	SILTSTONE		
BH301	50.00	-		a		73	41	1.27	61.73	0.33	1.10	0.37	1.7	SILTSTONE		
BH301	53.00	-		a		73	68	5.31	79.50	0.84	1.23	1.03	1.9	SILTSTONE		
BH303	6.00	-		a		73	43	0.45	63.22	0.11	1.11	0.12	2.6	SILTSTONE		
BH303	8.00	-		a		73	43	5.20	63.22	1.30	1.11	1.45	1.2	SILTSTONE		
BH303	11.00	-		a		73	31	1.28	53.68	0.44	1.03	0.46	3.5	SILTSTONE		
BH303	14.00	-		i		73	55	1.19	71.50	0.23	1.17	0.27	2.1	SILTSTONE		
BH303	16.00	-		a		73	35	3.38	57.04	1.04	1.06	1.10	2.7	SILTSTONE		
BH303	19.00	-		a		73	39	0.87	60.21	0.24	1.09	0.26	2.5	SILTSTONE		
BH304	19.20	-		d			73	23.63		4.43	1.19	5.26	0.6	SANDSTONE		
BH304	22.00	-		a		73	42	12.71	62.48	3.26	1.11	3.60	1.0	SILTSTONE		
BH304	20.00	-		d			73	8.58		1.61	1.19	1.91	0.9	SILTSTONE		
BH305	11.50	-		a		73	48	1.20	66.79	0.27	1.14	0.31	0.9	SILTSTONE		
BH305	14.00	-		i		73	56	7.09	72.15	1.36	1.18	1.61	0.7	SILTSTONE		
BH305	15.75	-		d			73	10.25		1.92	1.19	2.28	0.2	SILTSTONE		
BH305	17.00	-		d			73	3.53		0.66	1.19	0.78	1.2	SILTSTONE		
BH305	22.00	-		a		73	54	4.30	70.85	0.86	1.17	1.00	1.5	SILTSTONE		
BH305	25.00	-		a		73	46	5.15	65.39	1.21	1.13	1.36	1.6	SILTSTONE		
BH306	22.50	-		d			73	2.85		0.53	1.19	0.63	1.7	SILTSTONE		
BH306	24.00	-		a		73	53	6.21	70.19	1.26	1.16	1.47	1.4	SILTSTONE		
BH306	27.00	-		a		73	29	2.59	51.92	0.96	1.02	0.98	0.9	SILTSTONE		
BH306	28.50	-		i		60	34	1.54	50.96	0.59	1.01	0.60	0.9	SILTSTONE		
		-														
		-														
		-											

Laboratory Report

2788

GEO Site & Testing Services Ltd

Contract Number: 37339

Client Ref: **5859e.07**
Client PO: **6561**

Report Date: **28-11-2017**

Client **Earth Science Partnership**
33 Cardiff Road
Taff's Well
Cardiff
CF15 7RB

Contract Title: **Pantteg, Ystalyfera**
For the attention of: **Mat Elcock**

Date Received: **20-11-2017**
Date Commenced: **20-11-2017**
Date Completed: **28-11-2017**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	3
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	3
Uniaxial Compressive Strength of Rock incl sample prep 54-165mm diameter cores ISRM Part 1 Methods For Rock Characterisation 1974-2006 - @ Non Accredited Test	1
Determination of Point Load Value Axial or Diametrical including WC ISRM Suggested Method for Point Load Strength 1974-2006 - * UKAS	5
PSD Wet Sieve method 1377 : 1990 Part 2 : 9.2 - * UKAS	3
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

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Approved Signatories:
Alex Wynn (Associate Director) - Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager) - Sean Penn (Administrative Assistant)
Vaughan Edwards (Managing Director) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	**37339**	
Site Name	**Pantteg, Ystalyfera**	

Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing .425mm %	Remarks
BH401	2		0.50	-		20	38	16	22	41	CI Intermediate Plasticity
BH401	1		3.80	-		27	40	24	16	62	CI Intermediate Plasticity
BH401	2		5.10	-		19	38	25	13	34	MI Intermediate Plasticity
				-							
				-							
				-							
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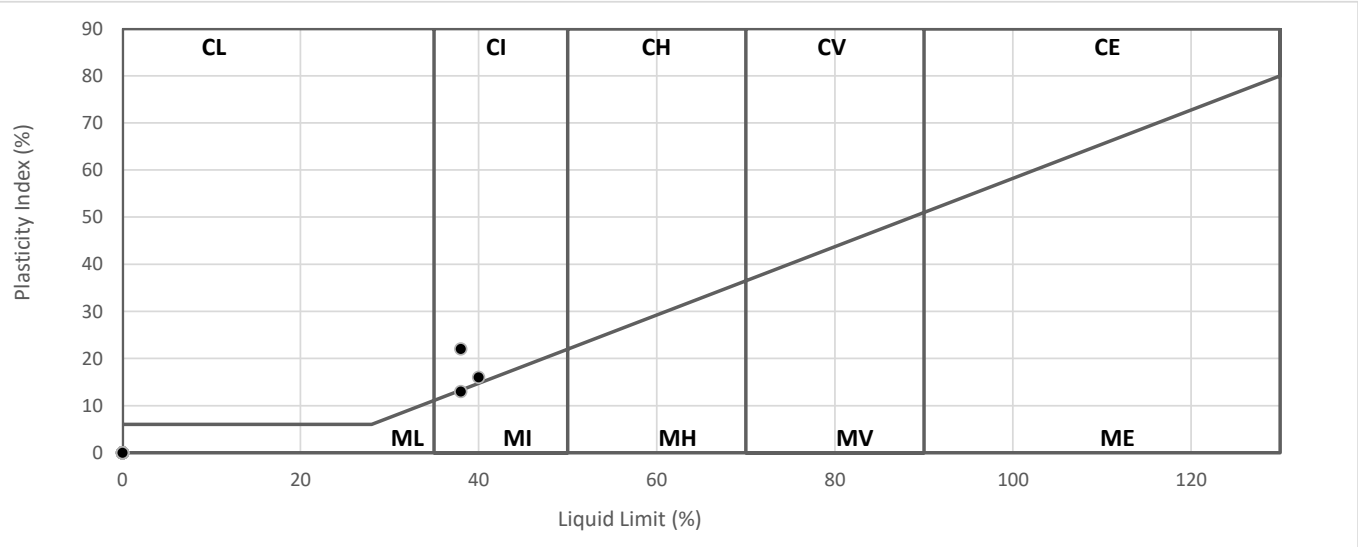
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

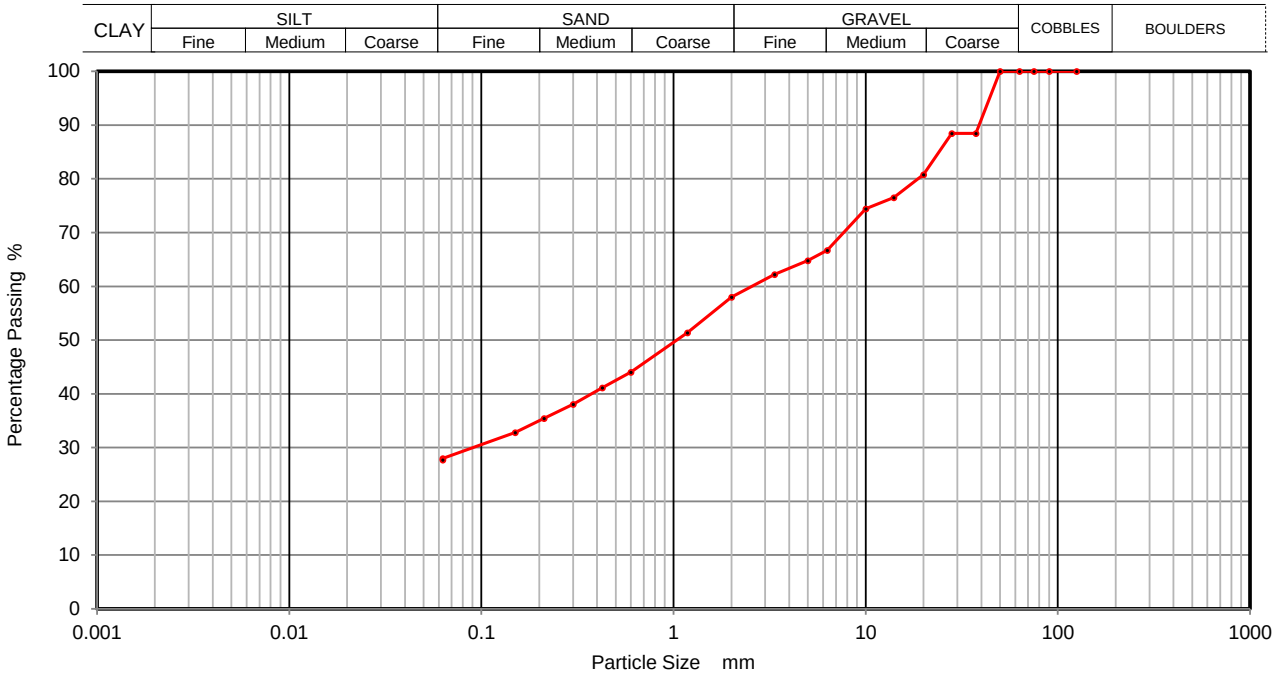
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	27-11-17	Emma Sharp	
DB	Approved	28-11-17	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37339
		Borehole/Pit No.	BH401
Site Name	**Pantteg, Ystalyfera**	Sample No.	2
Soil Description	Brown silty clayey fine to coarse sandy fine to coarse GRAVEL.	Depth Top	2.50
		Depth Base	
		Sample Type	T



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	88		
28	88		
20	81		
14	77		
10	74		
6.3	67		
5	65		
3.35	62		
2	58		
1.18	51		
0.6	44		
0.425	41		
0.3	38		
0.212	35		
0.15	33		
0.063	28		

Sample Proportions	% dry mass
Cobbles	0
Gravel	42
Sand	30
Silt and Clay	28

Grading Analysis	
Uniformity Coefficient	

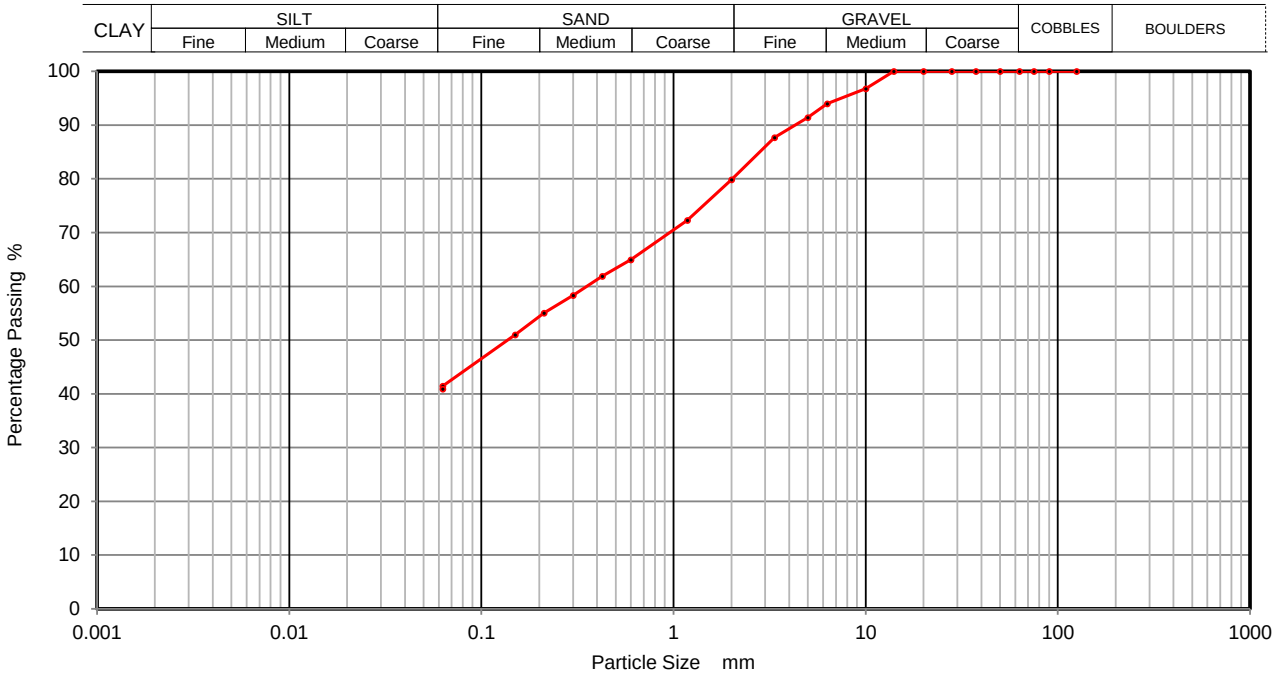
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	27-11-17	Emma Sharp	
RO/MH	Approved	28-11-17	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37339
		Borehole/Pit No.	BH401
Site Name	**Pantteg, Ystalyfera**	Sample No.	1
Soil Description	Grey fine to coarse gravelly fine to coarse sandy silty CLAY.	Depth Top	3.80
		Depth Base	
		Sample Type	T



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	94		
5	91		
3.35	88		
2	80		
1.18	72		
0.6	65		
0.425	62		
0.3	58		
0.212	55		
0.15	51		
0.063	41		

Sample Proportions	% dry mass
Cobbles	0
Gravel	20
Sand	39
Silt and Clay	41

Grading Analysis	
Uniformity Coefficient	

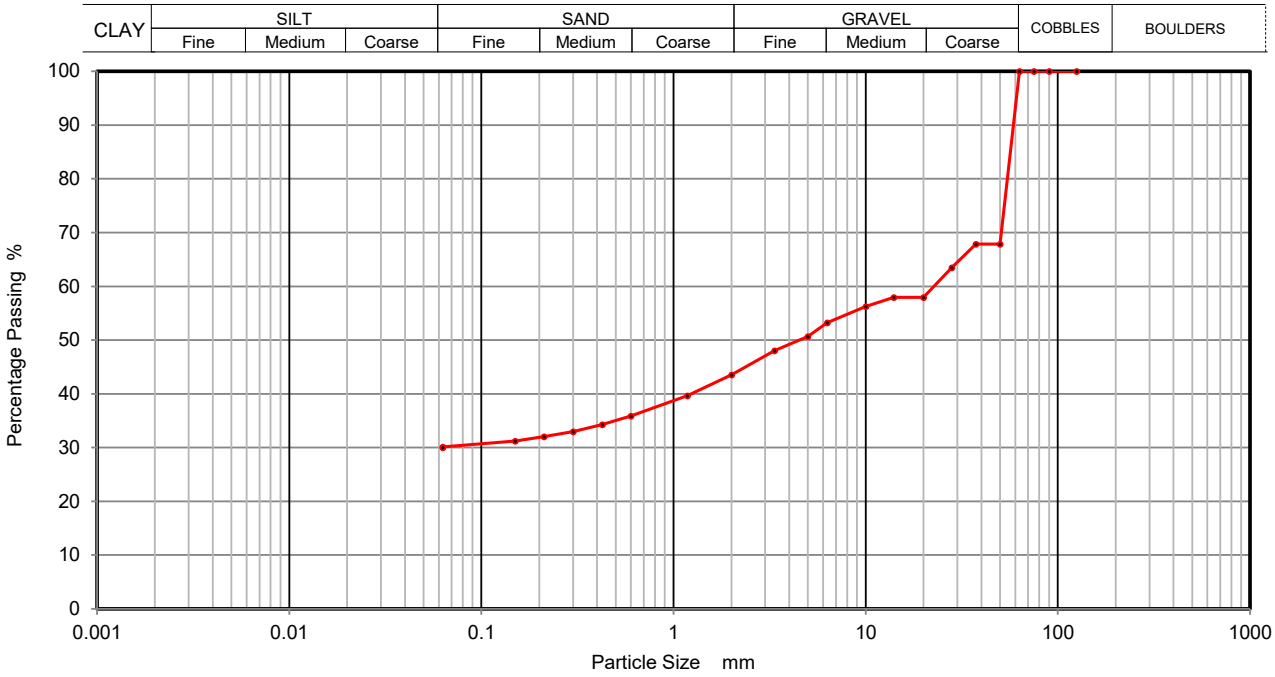
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	27-11-17	Emma Sharp	
RO/MH	Approved	28-11-17	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37339
		Borehole/Pit No.	BH401
Site Name	Pantteg, Ystalyfera	Sample No.	2
Soil Description	Brown fine to coarse sandy silty fine to coarse GRAVEL.	Depth Top	5.10
		Depth Base	
		Sample Type	T



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	68		
37.5	68		
28	63		
20	58		
14	58		
10	56		
6.3	53		
5	51		
3.35	48		
2	44		
1.18	40		
0.6	36		
0.425	34		
0.3	33		
0.212	32		
0.15	31		
0.063	30		

Sample Proportions	% dry mass
Cobbles	0
Gravel	56
Sand	14
Silt and Clay	30

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	27-11-17	Emma Sharp	
RO/MH	Approved	28-11-17	Paul Evans	

UKAS TESTING 2788

GSTL	Point Load Test Int. J. Rock Mech. Sci. & Geomech. Abstr. Vol. 22, No. 2, pp. 51 - 60, 1985.	
Contract Number	37339	
Site Name	Pantteg, Ystalyfera	
Sample Type	Core	
Date Tested	27-11-17	

Hole Reference	Depth (m)			Test Type d / a / b / i	Test Type I //	Width	Platen Seperation	Failure Load	Equivalent Diameter	Point Load	Size Factor	Point Load Index	Moisture Content	Description	Angle Between Plane of Anisotropy & Core Axis	Type of Anisotropy (Bedding or Cleavage)
BH401	9.25	-		a		75	37	0.73	59.44	0.21	1.08	0.22	5.0	SILTSTONE		
	10.20	-		a		74	64	4.99	77.65	0.83	1.22	1.01	2.3	SILTSTONE		
	10.60	-		a		73	42	4.38	62.48	1.12	1.11	1.24	2.1	SILTSTONE		
	11.50	-		a		73	50	3.23	68.17	0.70	1.15	0.80	2.3	SILTSTONE		
	12.00	-		i		73	67	28.21	78.91	4.53	1.23	5.56	0.5	SILTSTONE		
		-														
		-														
		-											

GSTL	Determination of Unconfined Compressive Strength ISRM Suggested Methods Vol 16, No. 2, pp. 135-140 1979	
Contract Number	37339	
Site Name	Pantteg, Ystalyfera	
Sample Preperation	Sawing and Grinding	
Date Tested	28-11-17	

Hole Reference	Depth (m)			Diameter	Length	Initial Mass	Moisture Content	Bulk Density	Dry Density	Load Failure	Maximum Strength	Type of Failure
BH401	10.00			73.3	139.2	1512.6	2.20	2.57	2.52	63.5	15.0	Axial Splitting

Key	Reported As
Diameter	mm
Length	mm
Initial Mass	g
Moisture Content	%
Bulk Density	Mg/m^3
Dry Density	Mg/m^3
Load Failure	kN
Maximum Strength	mpa

Operators	Checked	27-11-17	Ben Sharp	
JD	Approved	28-11-17	Paul Evans	

Laboratory Report

GEO Site & Testing Services Ltd

Contract Number: 37620

Client Ref: **5859e.08**
Client PO: **6614 (Framework Rates)**

Report Date: **06-01-2018**

Client **Earth Science Partnership**
33 Cardiff Road
Taff's Well
Cardiff
CF15 7RB

Contract Title: **Pantteg, Ystalyfera**
For the attention of: **Mat Elcock**

Date Received: **15-12-2017**
Date Commenced: **15-12-2017**
Date Completed: **06-01-2018**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	8
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	8
PSD Wet Sieve method 1377 : 1990 Part 2 : 9.2 - * UKAS	12
Immediate Shear Strength - set of 3 60 x 60 mm Shear Box Specimens by Direct Shearing (note suitable for free draining material only) BS1377 : Part 7 :1990 Clause 4 - * UKAS	1
Consolidated Drained Peak and Residual Shear Strength - set of 3 60 x 60mm Shear Box Specimens (5 days) 1377 : 1990 Part 7 : 4 - * UKAS	3
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
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@ - denotes non accredited tests

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GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	**37620**	
Site Name	**Pantteg, Ystalyfera**	

WS Window Sample	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing .425mm %	Remarks
WS501		D	0.30	-		31		NP		46	
WS501		D	1.00	-		25	52	22	30	79	CH High Plasticity
WS502		D	1.00	-		31	51	26	25	73	CH High Plasticity
WS503		D	0.40	-		26	48	36	12	46	MI Intermediate Plasticity
WS503		D	1.10	-		5.4		NP		5	
WS506		D	0.30	-		19	48	17	31	72	CI Intermediate Plasticity
WS506		D	1.20	-		18	46	13	33	34	CI Intermediate Plasticity
WS508		D	0.50	-		35	49	40	9	38	MI Intermediate Plasticity
				-							
				-							
				-							
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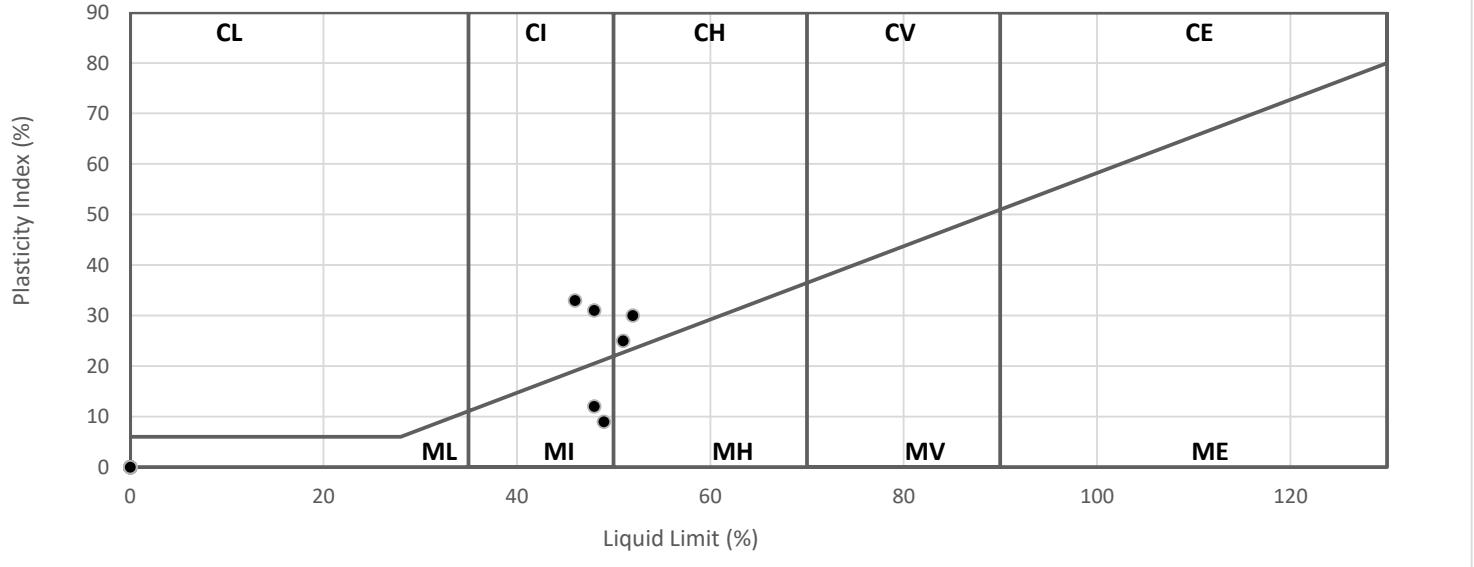
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

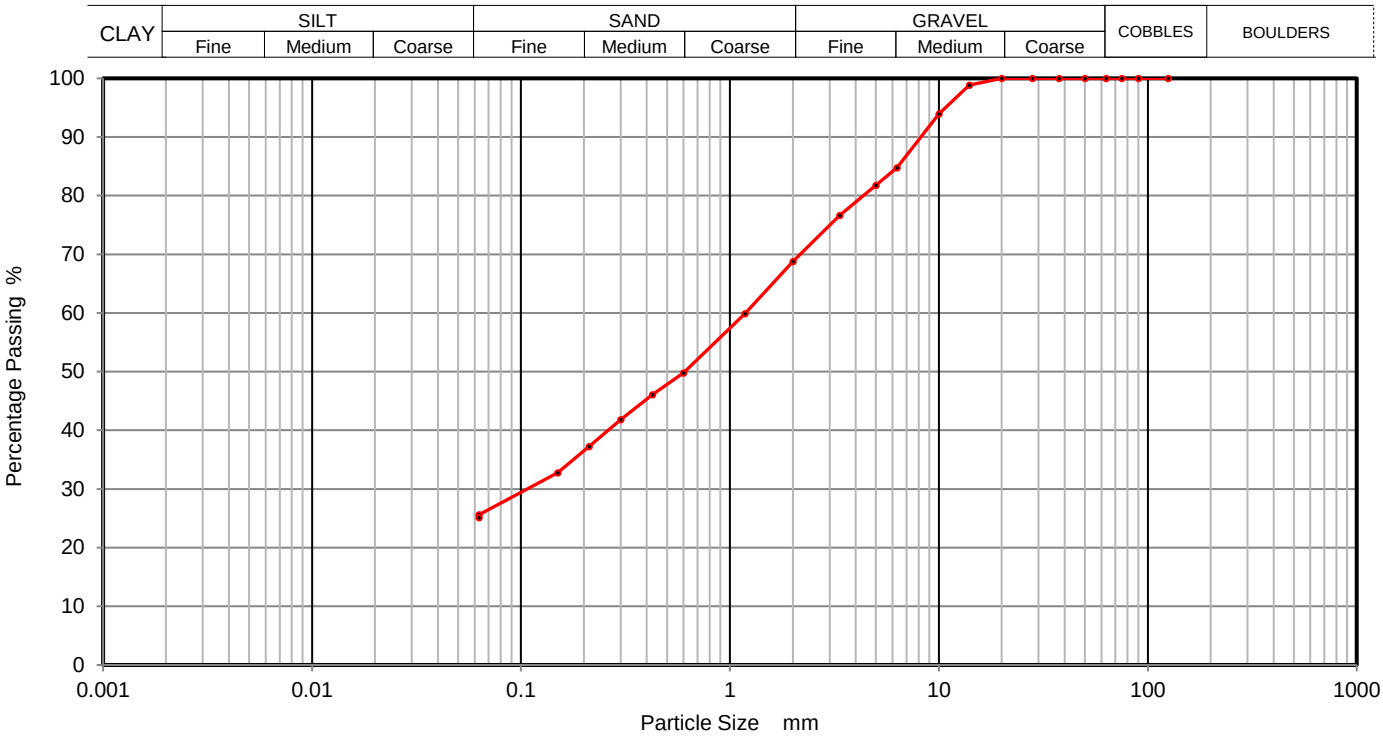
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	05/01/2018	Sean Penn	
DB	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS501
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown slightly clayey silty fine to medium gravelly fine to coarse SAND	Depth Top	0.30
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	94		
6.3	85		
5	82		
3.35	77		
2	69		
1.18	60		
0.6	50		
0.425	46		
0.3	42		
0.212	37		
0.15	33		
0.063	26		

Sample Proportions	% dry mass
Cobbles	0
Gravel	31
Sand	43
Silt and Clay	26

Grading Analysis	
Uniformity Coefficient	

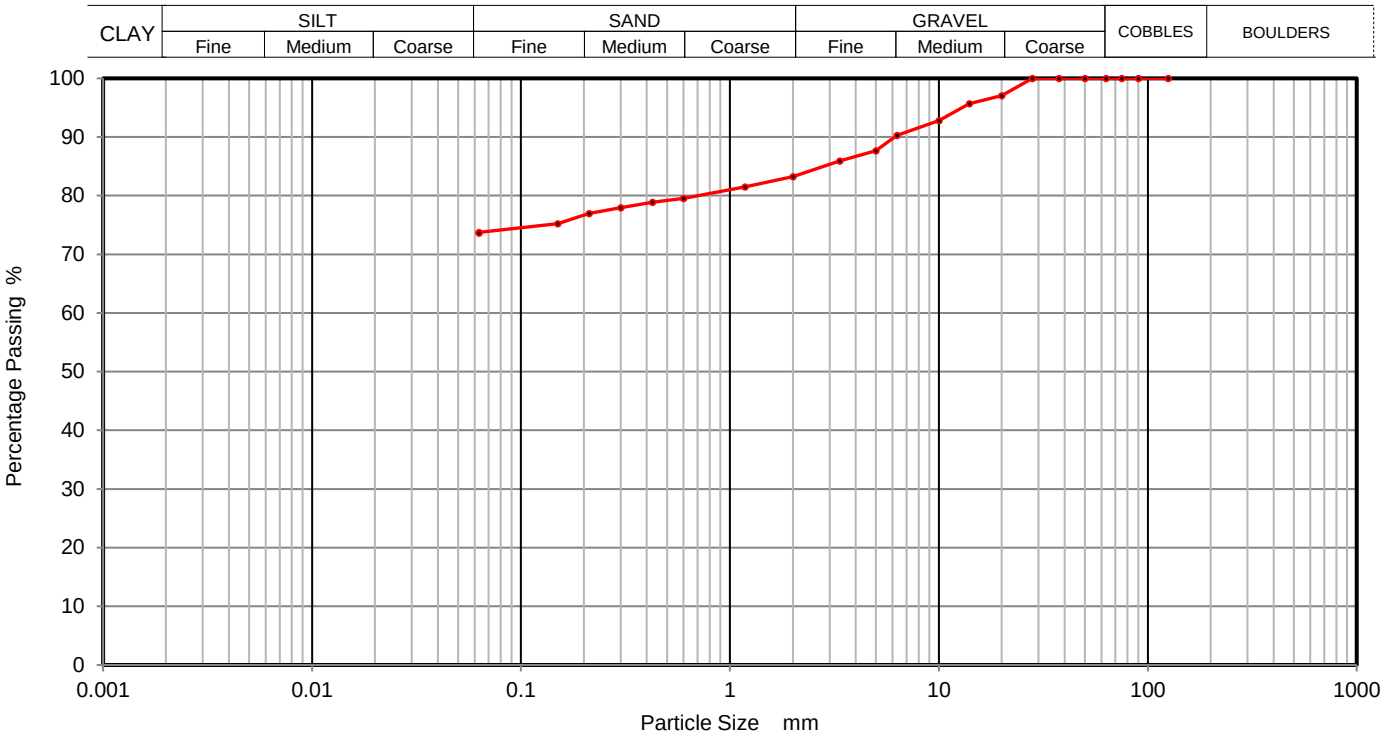
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS501
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown slightly fine to coarse sandy fine to coarse gravelly silty CLAY	Depth Top	1.00
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	97		
14	96		
10	93		
6.3	90		
5	88		
3.35	86		
2	83		
1.18	82		
0.6	80		
0.425	79		
0.3	78		
0.212	77		
0.15	75		
0.063	74		

Sample Proportions	% dry mass
Cobbles	0
Gravel	17
Sand	9
Silt and Clay	74

Grading Analysis	
Uniformity Coefficient	

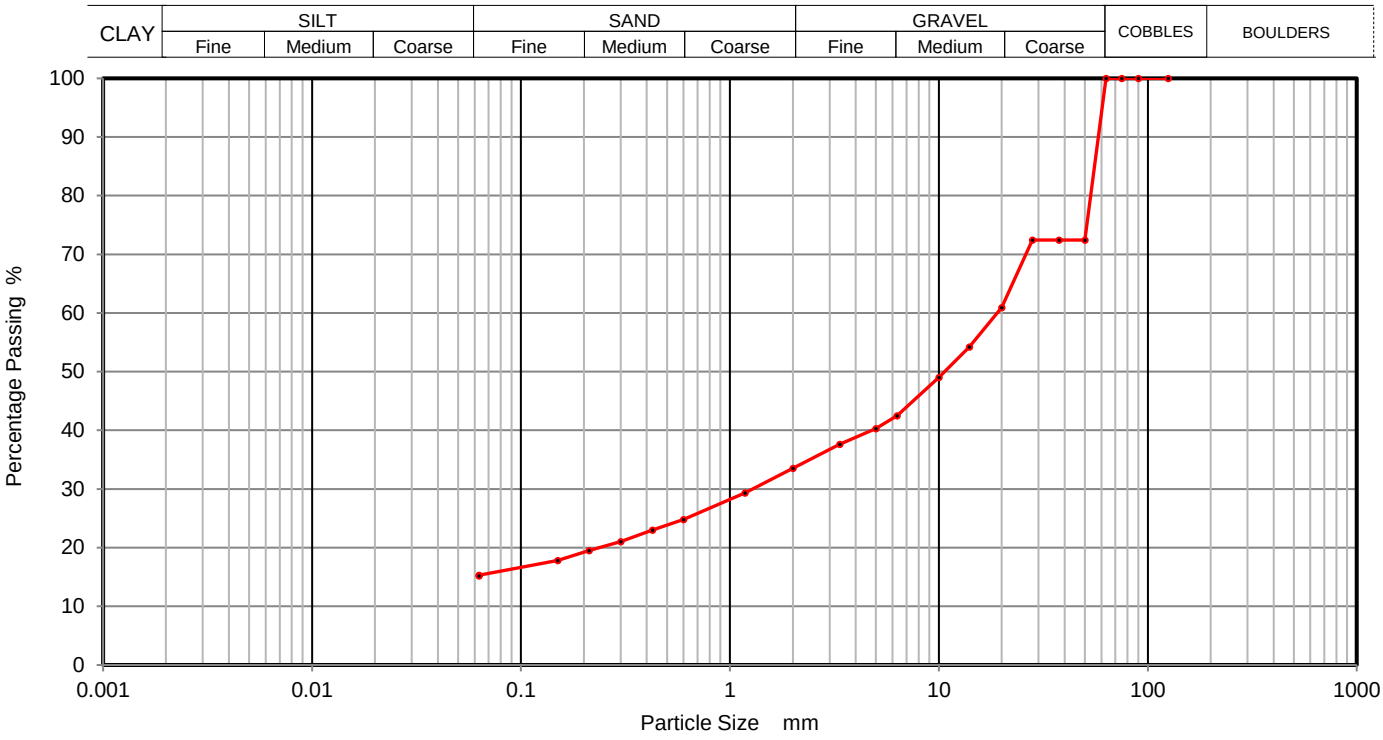
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS501
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown silty fine to coarse sandy fine to coarse GRAVEL	Depth Top	2.60
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	72		
37.5	72		
28	72		
20	61		
14	54		
10	49		
6.3	42		
5	40		
3.35	38		
2	34		
1.18	29		
0.6	25		
0.425	23		
0.3	21		
0.212	20		
0.15	18		
0.063	15		

Sample Proportions	% dry mass
Cobbles	0
Gravel	66
Sand	19
Silt and Clay	15

Grading Analysis	
Uniformity Coefficient	

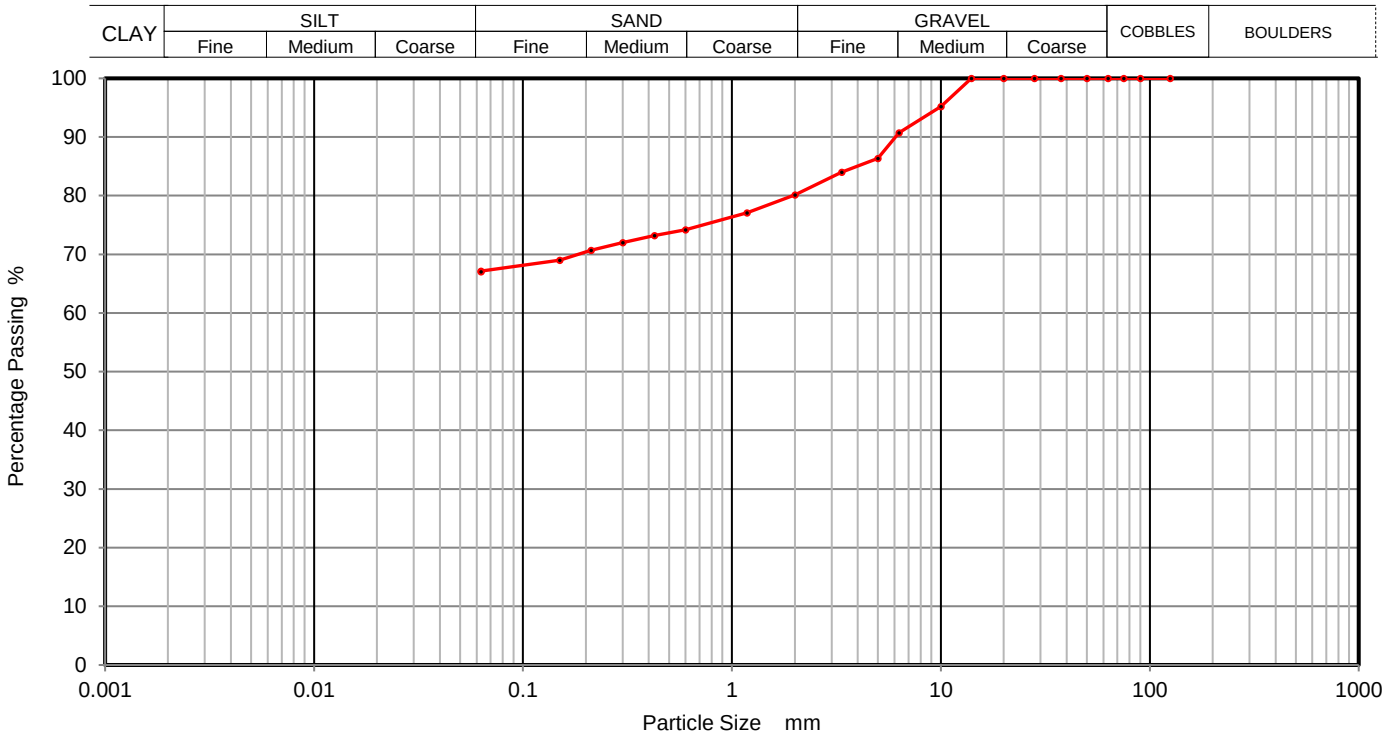
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS502
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown fine to coarse sandy fine to medium gravelly silty CLAY	Depth Top	1.00
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	95		
6.3	91		
5	86		
3.35	84		
2	80		
1.18	77		
0.6	74		
0.425	73		
0.3	72		
0.212	71		
0.15	69		
0.063	67		

Sample Proportions	% dry mass
Cobbles	0
Gravel	20
Sand	13
Silt and Clay	67

Grading Analysis	
Uniformity Coefficient	

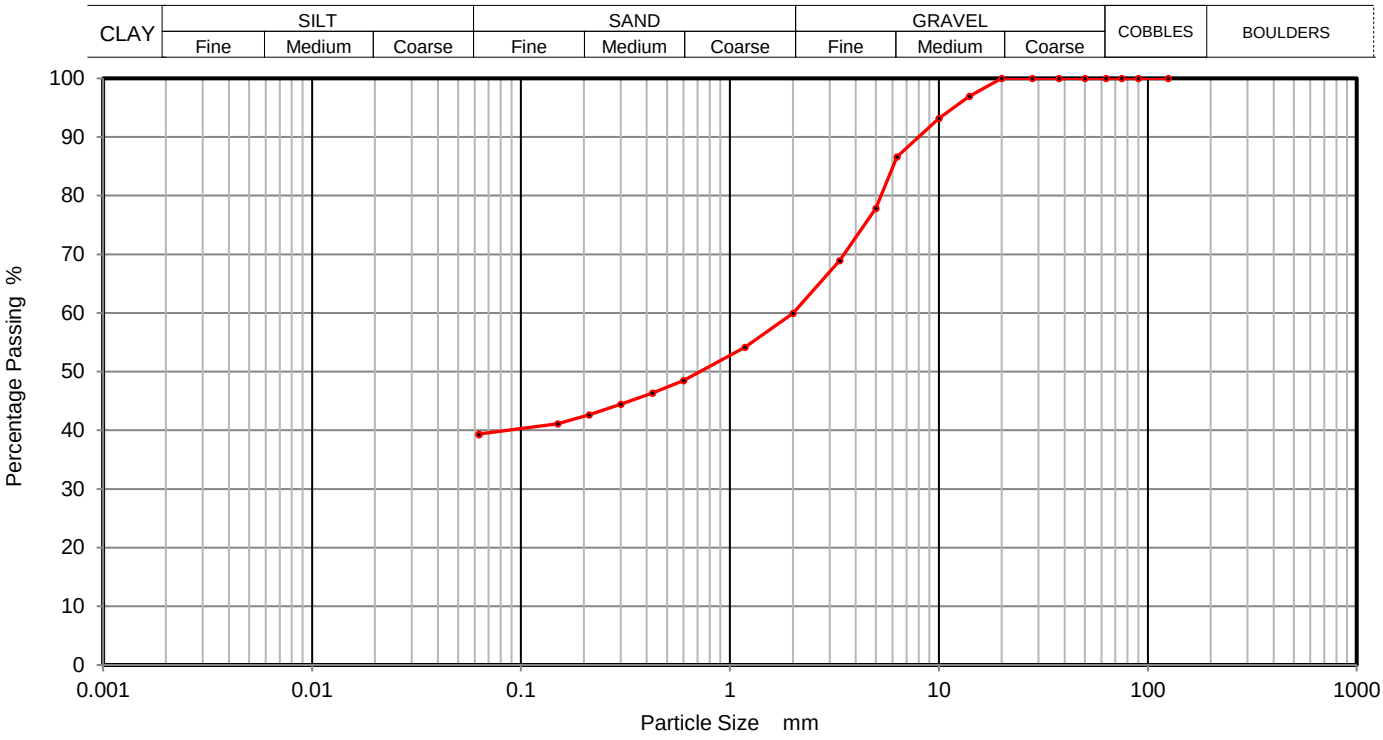
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS503
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown fine to coarse sandy clayey silty fine to medium GRAVEL	Depth Top	0.40
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	97		
10	93		
6.3	87		
5	78		
3.35	69		
2	60		
1.18	54		
0.6	48		
0.425	46		
0.3	44		
0.212	43		
0.15	41		
0.063	39		

Sample Proportions	% dry mass
Cobbles	0
Gravel	40
Sand	21
Silt and Clay	39

Grading Analysis	
Uniformity Coefficient	

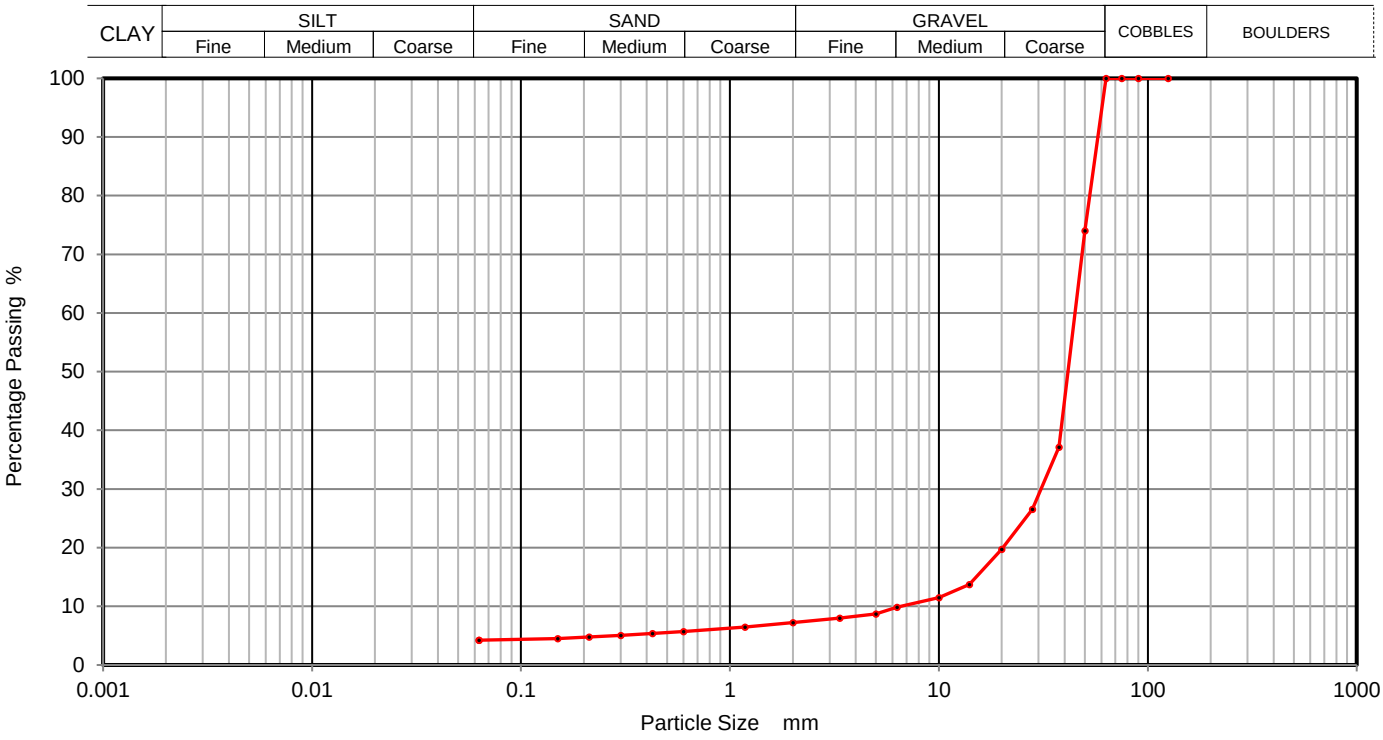
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS503
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown slightly clayey slightly silty slightly fine to coarse sandy fine to coarse GRAVEL	Depth Top	1.10
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	74		
37.5	37		
28	27		
20	20		
14	14		
10	12		
6.3	10		
5	9		
3.35	8		
2	7		
1.18	6		
0.6	6		
0.425	5		
0.3	5		
0.212	5		
0.15	5		
0.063	4		

Sample Proportions	% dry mass
Cobbles	0
Gravel	93
Sand	3
Silt and Clay	4

Grading Analysis	
Uniformity Coefficient	

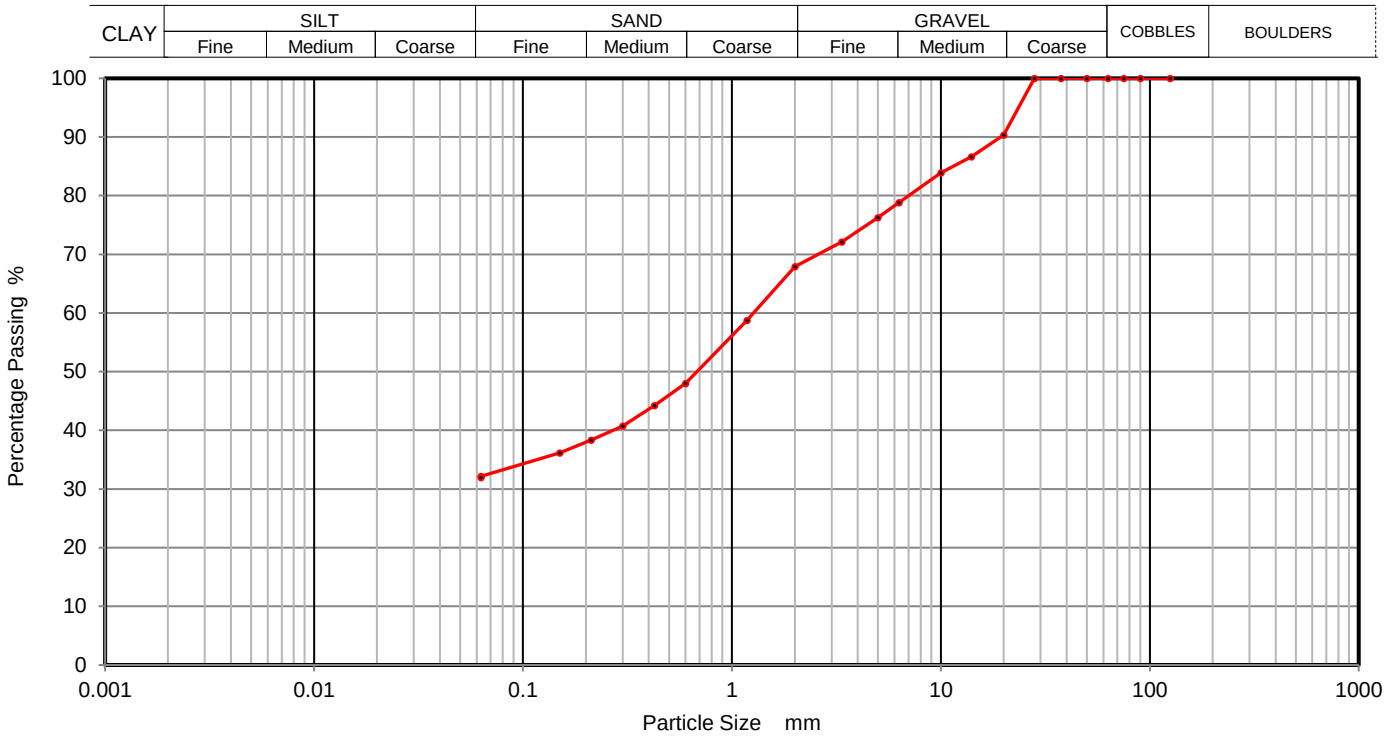
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS503
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown fine to coarse gravelly silty fine to coarse SAND	Depth Top	2.00
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	90		
14	87		
10	84		
6.3	79		
5	76		
3.35	72		
2	68		
1.18	59		
0.6	48		
0.425	44		
0.3	41		
0.212	38		
0.15	36		
0.063	32		

Sample Proportions	% dry mass
Cobbles	0
Gravel	32
Sand	36
Silt and Clay	32

Grading Analysis	
Uniformity Coefficient	

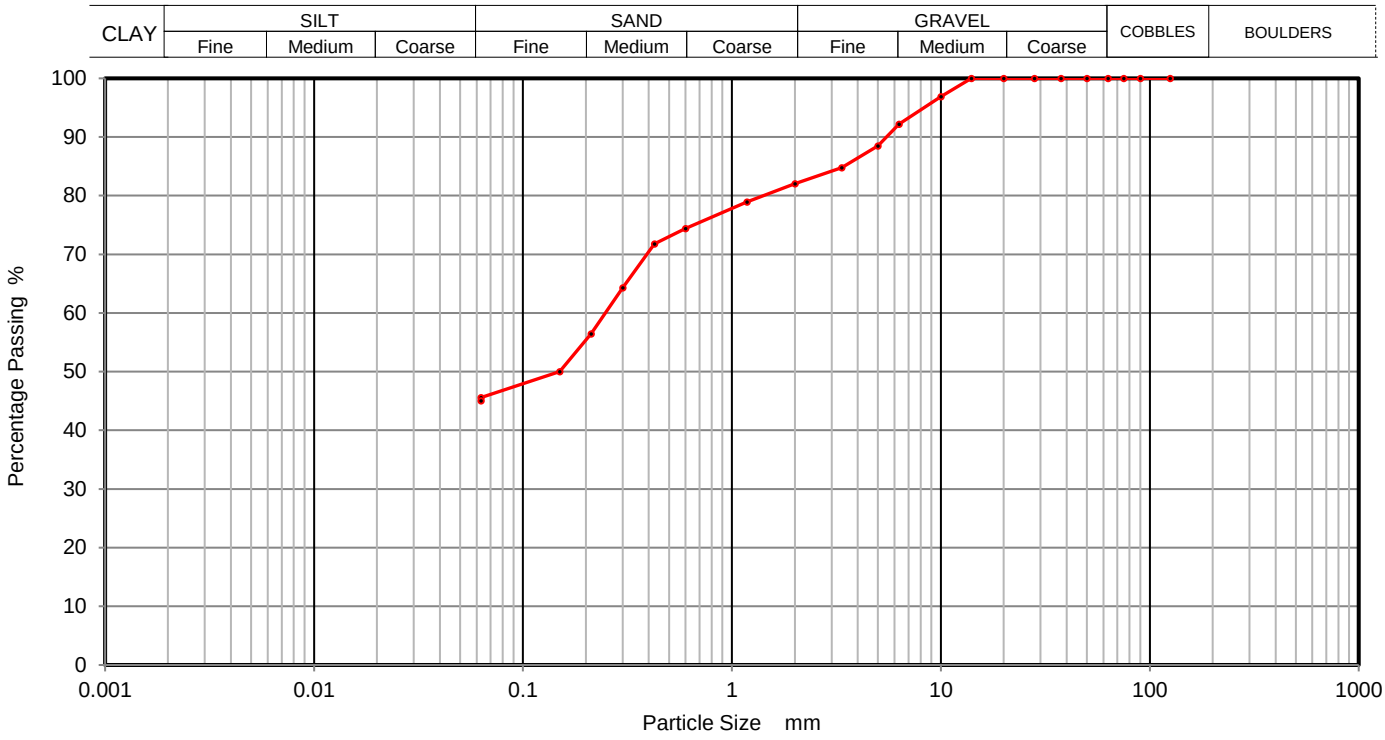
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS506
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown fine to medium gravelly fine to coarse sandy silty CLAY.(With rootlets)	Depth Top	**0.30**
		Depth Base	
		Sample Type	**D**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	92		
5	88		
3.35	85		
2	82		
1.18	79		
0.6	74		
0.425	72		
0.3	64		
0.212	56		
0.15	50		
0.063	46		

Sample Proportions	% dry mass
Cobbles	0
Gravel	18
Sand	36
Silt and Clay	46

Grading Analysis	
Uniformity Coefficient	

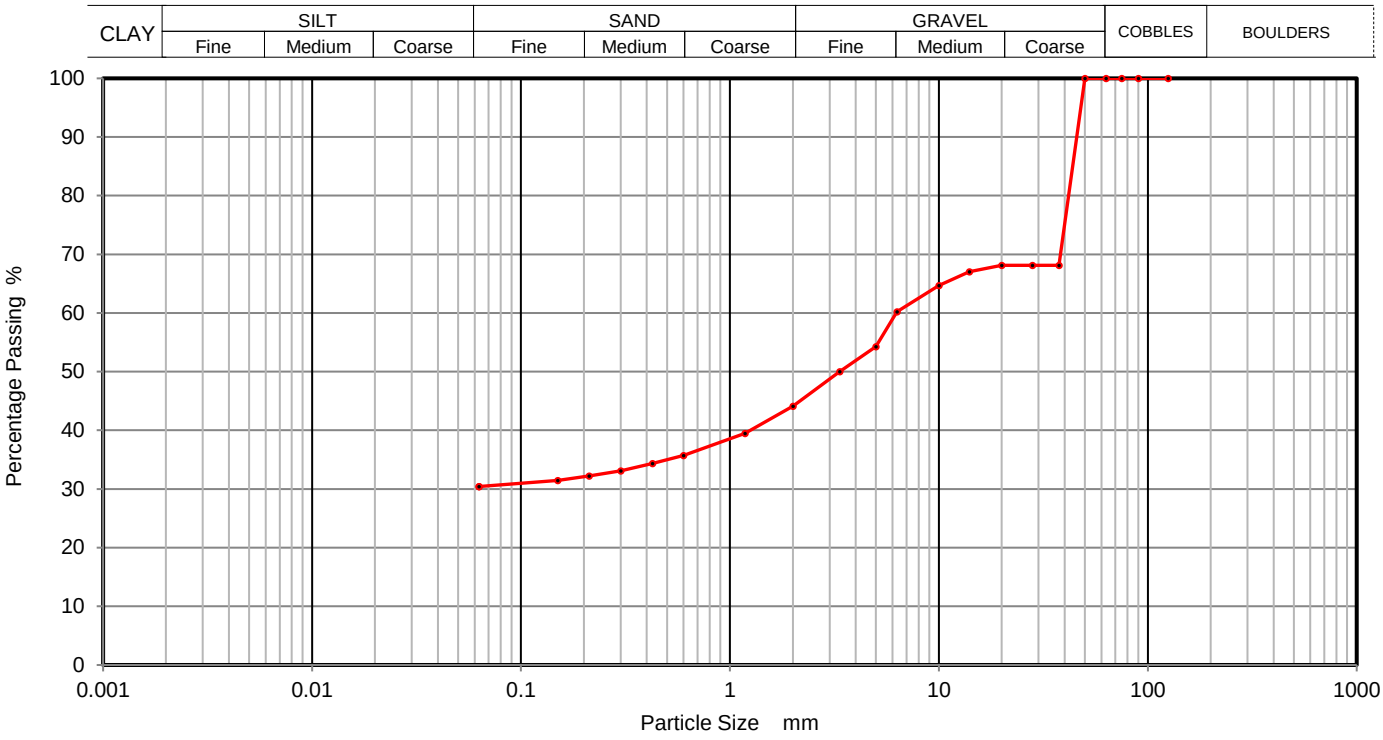
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS506
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL	Depth Top	1.20
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	68		
28	68		
20	68		
14	67		
10	65		
6.3	60		
5	54		
3.35	50		
2	44		
1.18	39		
0.6	36		
0.425	34		
0.3	33		
0.212	32		
0.15	31		
0.063	30		

Sample Proportions	% dry mass
Cobbles	0
Gravel	56
Sand	14
Silt and Clay	30

Grading Analysis	
Uniformity Coefficient	

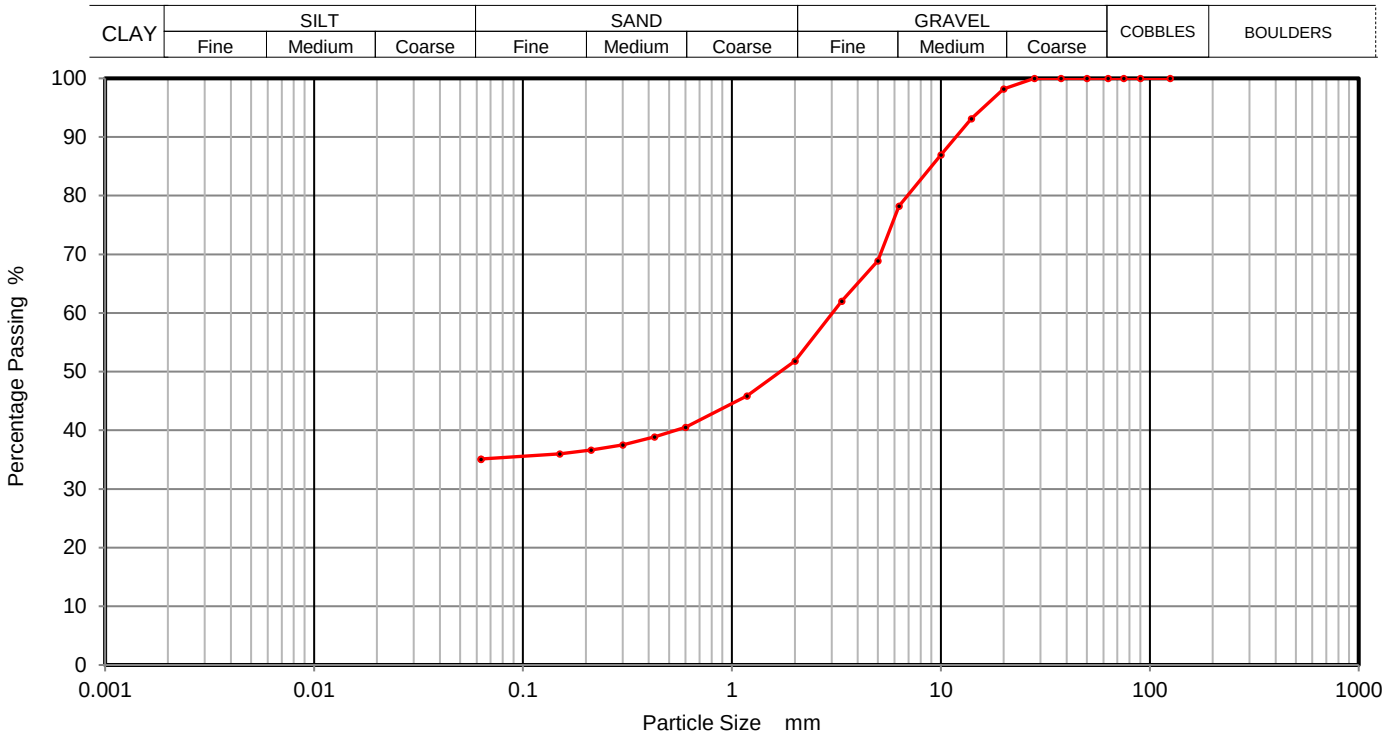
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	**37620**
		Borehole/Pit No.	**WS506**
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL	Depth Top	**2.40**
		Depth Base	
		Sample Type	**D**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	93		
10	87		
6.3	78		
5	69		
3.35	62		
2	52		
1.18	46		
0.6	41		
0.425	39		
0.3	38		
0.212	37		
0.15	36		
0.063	35		

Sample Proportions	% dry mass
Cobbles	0
Gravel	48
Sand	17
Silt and Clay	35

Grading Analysis	
Uniformity Coefficient	

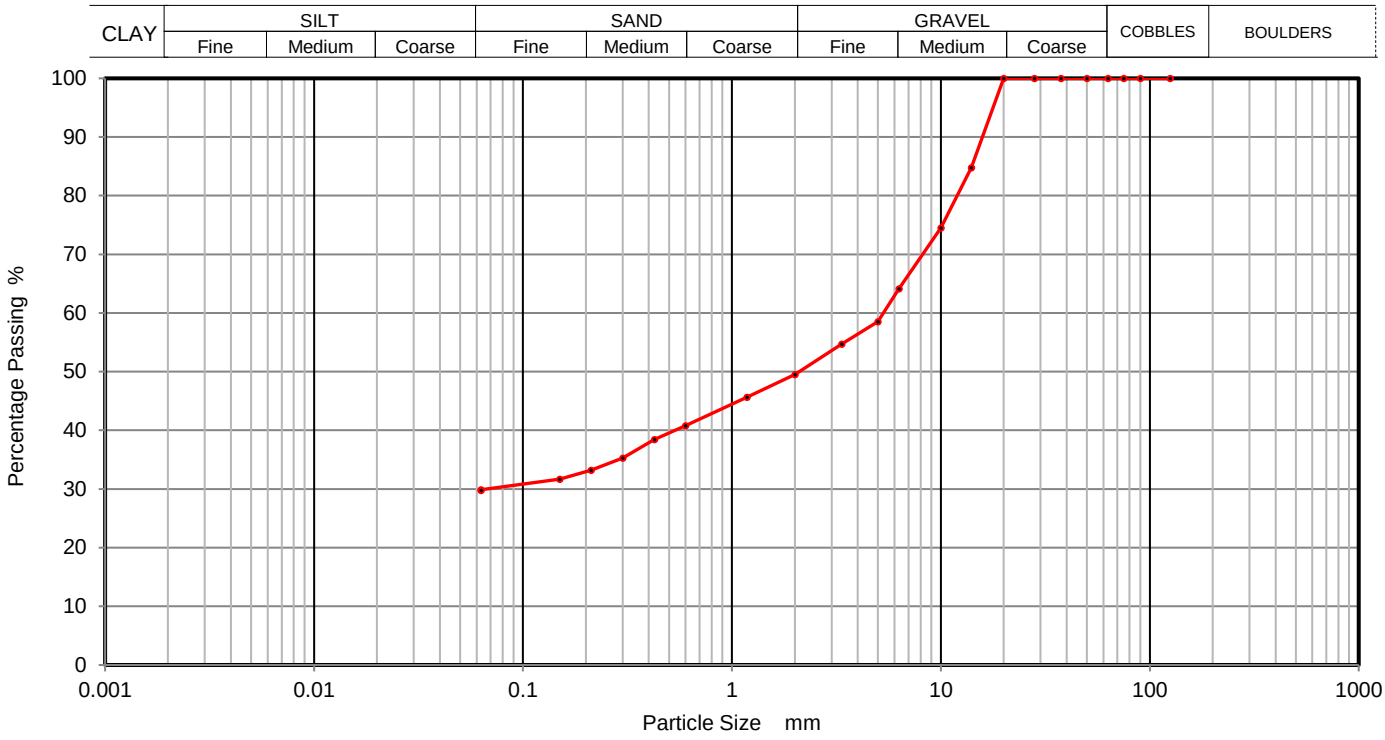
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS508
Site Name	**Pantteg, Ystalyfera**	Sample No.	
Soil Description	Brown fine to coarse sandy clayey silty fine to medium GRAVEL	Depth Top	**0.50**
		Depth Base	
		Sample Type	**D**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	85		
10	75		
6.3	64		
5	59		
3.35	55		
2	50		
1.18	46		
0.6	41		
0.425	38		
0.3	35		
0.212	33		
0.15	32		
0.063	30		

Sample Proportions	% dry mass
Cobbles	0
Gravel	50
Sand	20
Silt and Clay	30

Grading Analysis	
Uniformity Coefficient	

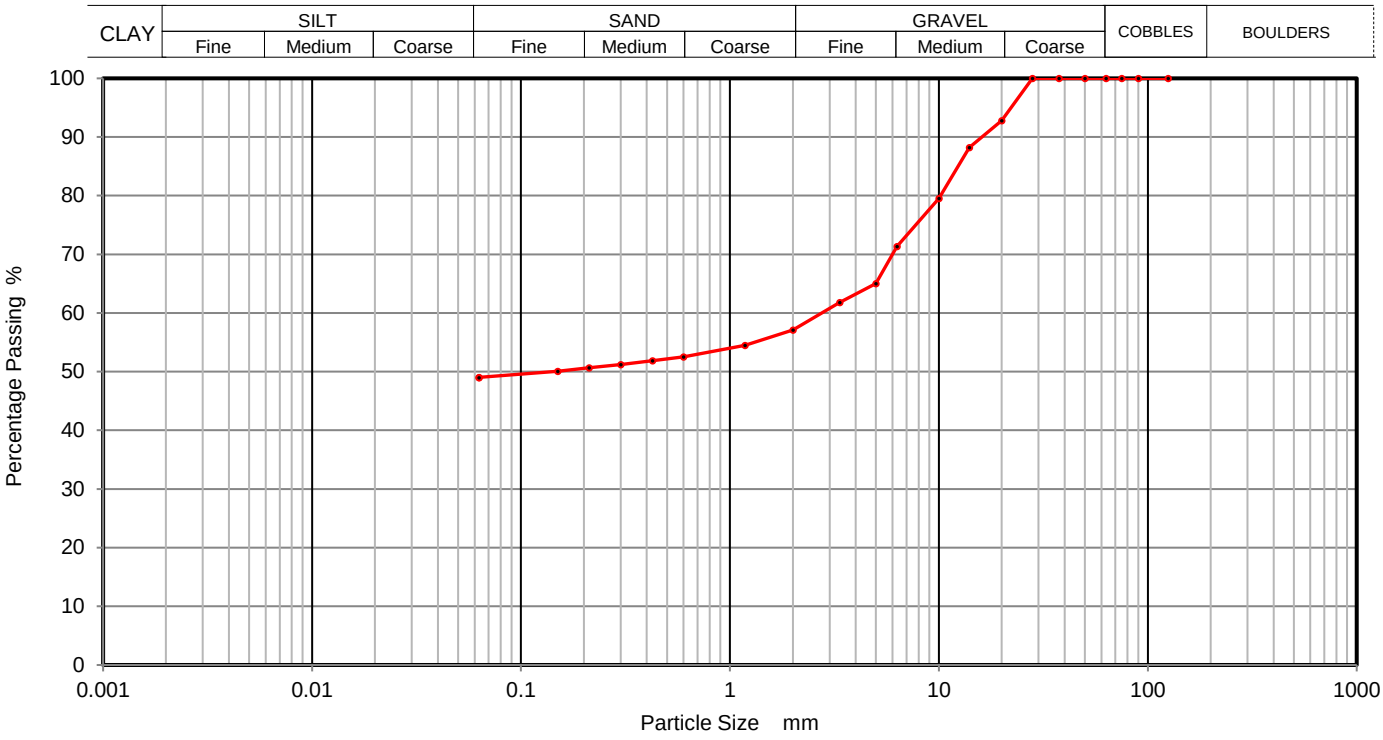
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	37620
		Borehole/Pit No.	WS508
Site Name	Pantteg, Ystalyfera	Sample No.	
Soil Description	Brown slightly fine to coarse sandy fine to coarse gravelly silty CLAY	Depth Top	2.00
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	93		
14	88		
10	80		
6.3	71		
5	65		
3.35	62		
2	57		
1.18	54		
0.6	53		
0.425	52		
0.3	51		
0.212	51		
0.15	50		
0.063	49		

Sample Proportions	% dry mass
Cobbles	0
Gravel	43
Sand	8
Silt and Clay	49

Grading Analysis	
Uniformity Coefficient	

Remarks

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Operators	Checked	05/01/2018	Sean Penn	
RO/MH	Approved	06/01/2018	Ben Sharp	

UKAS TESTING 2788

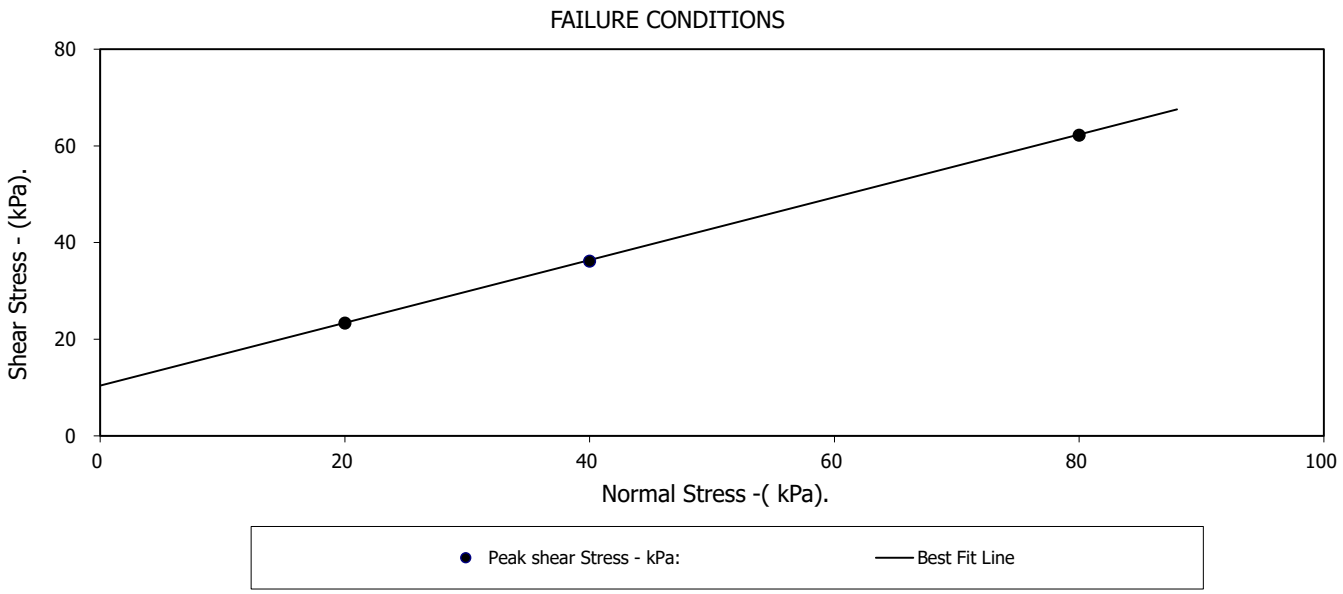
Test Report: Quick Shearbox Test

BS1377:Part 7:4.5 :1990.

Borehole:	WS505 + WS506	Depth (m) from:	0.4 + 0.30
Sample Number :		Depth (m) to:	0.00

Sample Type:	B			
Particle Density - Mg/m3:	2.65 (Assumed)			
Specimen Tested:	Submerged, Remoulded material above 2.00mm removed			
Sample Description: **Black slightly clayey sandy GRAVEL (fine-coarse/angular-subrounded)**				
STAGE		**1**	**2**	**3**
Initial Conditions				
Height - mm:		23.98	23.98	23.98
Length - mm:		60.00	60.00	60.00
Moisture Content - %:		8	8	8
Bulk Density - Mg/m3:		1.33	1.33	1.33
Dry Density - Mg/m3:		1.23	1.23	1.23
Voids Ratio:		1.1542	1.1486	1.1468
Normal Pressure- kPa		20	40	80
Consolidation				
Consolidated Height - mm:		23.89	23.56	23.23
Shear				
Rate of Strain (mm/min)		0.625	0.625	0.625
Strain at peak shear stress (mm)		4.34	5.19	5.26
Peak shear Stress - kPa:		23	36	62

PEAK	
Angle of Shearing Resistance:(θ)	**33.0**
Effective Cohesion - kPa:	**10**



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Contract No.:
37620

Client Ref Number:
5859e.08

Pantteg, Ystalyfera

GSTL
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Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole Number:	WS2	Depth from (m):	0.70
Sample Number:		Depth to (m):	0.00

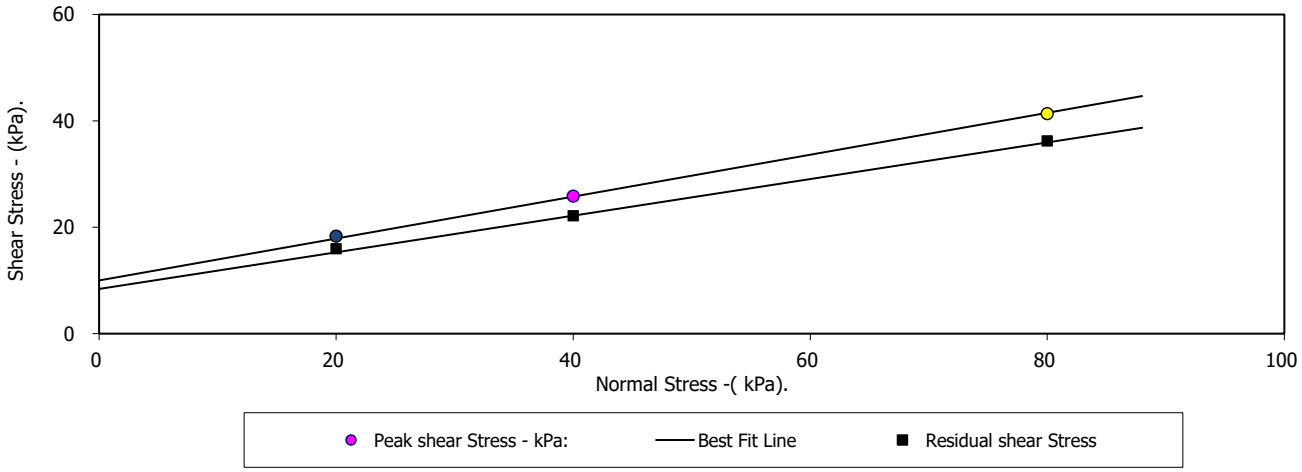
Sample Type: D	Remoulded (Light Tamping) material above 2.5mm removed
Particle Density - Mg/m3:	2.65 (Assumed)
Specimen Tested:	Submerged

Sample Description:
Brown slightly silty slightly gravelly (fine-coarse/angular-subangular) soft CLAY

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.98	23.98	23.98
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	37	37	37
Bulk Density - Mg/m3:	1.77	1.78	1.78
Dry Density - Mg/m3:	1.29	1.29	1.30
Voids Ratio:	1.0531	1.0477	1.0451
Normal Pressure- kPa	20	40	80
Consolidation			
Consolidated Height - mm:	23.84	23.19	22.51
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (mm)	3.69	3.53	5.61
Peak shear Stress - kPa:	18	26	41

PEAK	
Angle of Shearing Resistance:(θ)	**21.5**
Effective Cohesion - kPa:	**10**
RESIDUAL	
Angle of Shearing Resistance:(θ)	**19.0**
Effective Cohesion - kPa:	**8**

Failure Conditions



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Approved Pages 1-4 by Date

Pantteg, Ystalyfera

Contract No.:
37620

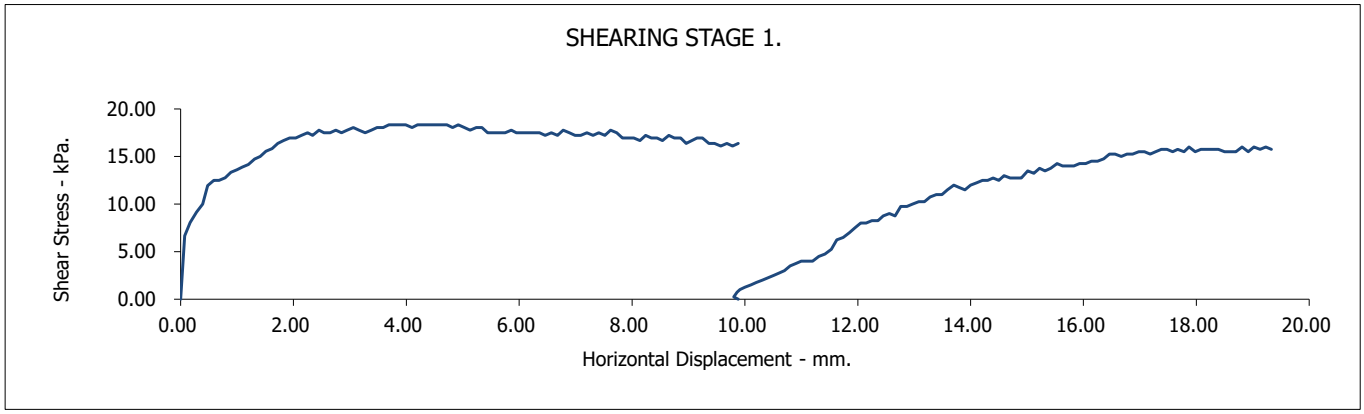
Client Ref Number:
5859e.08

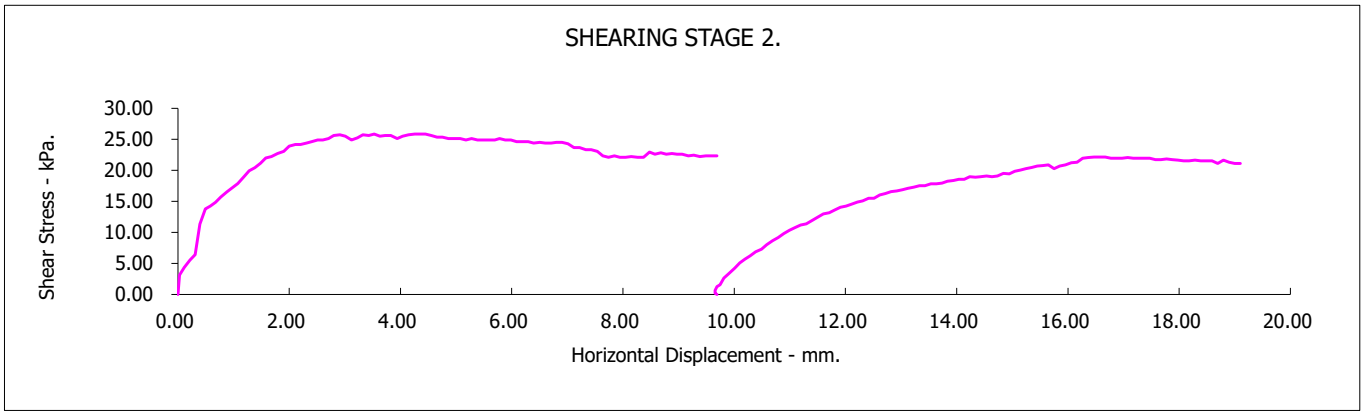
GSTL
GEO SITE & TESTING SERVICES LTD

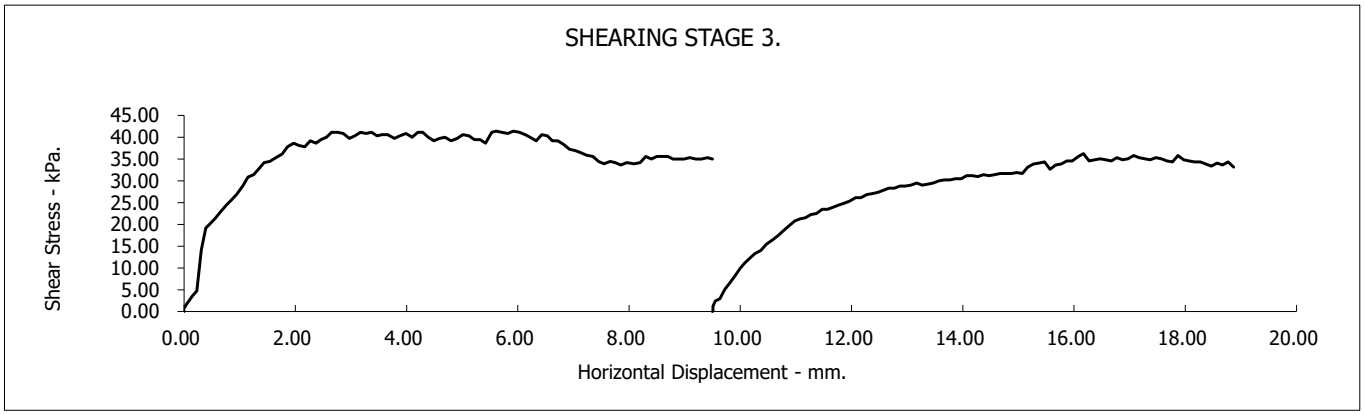
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number:	WS2	Depth (m):	0.70







Pantteg, Ystalyfera

Contract No.:
37620

Client Ref Number:
5859e.08

GSTL
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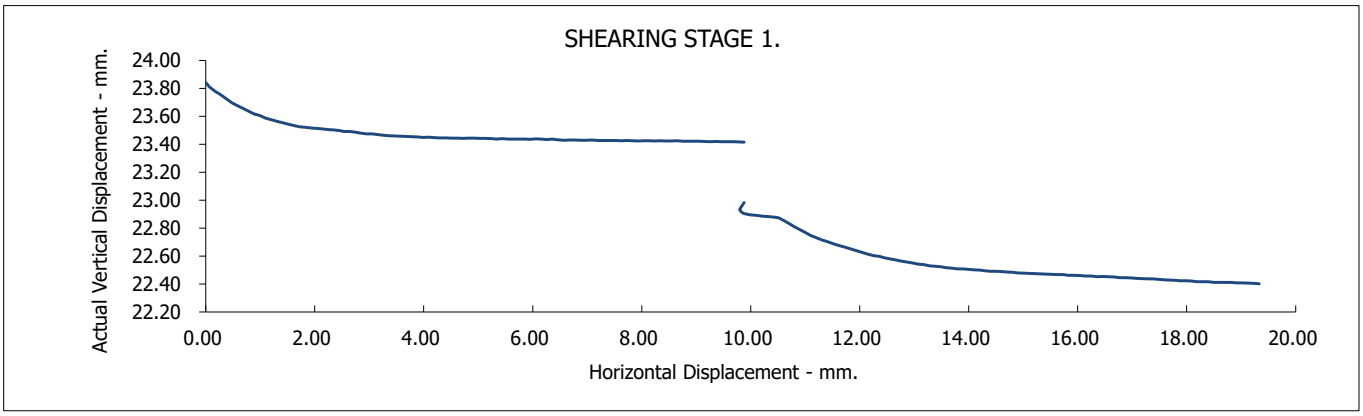
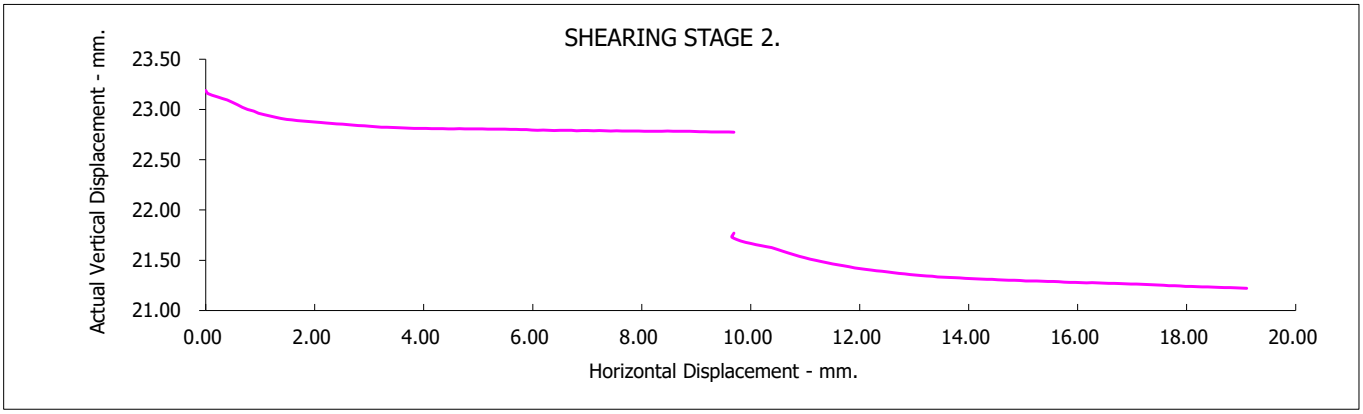
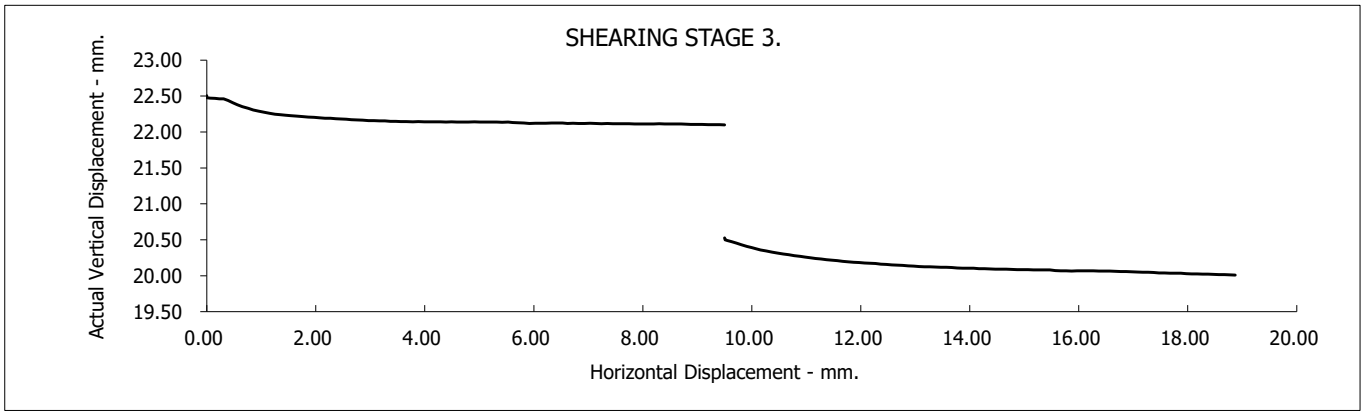
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number: WS2 Depth (m): 0.70







Pantteg, Ystalyfera

Contract No.:
37620

Client Ref Number:
5859e.08

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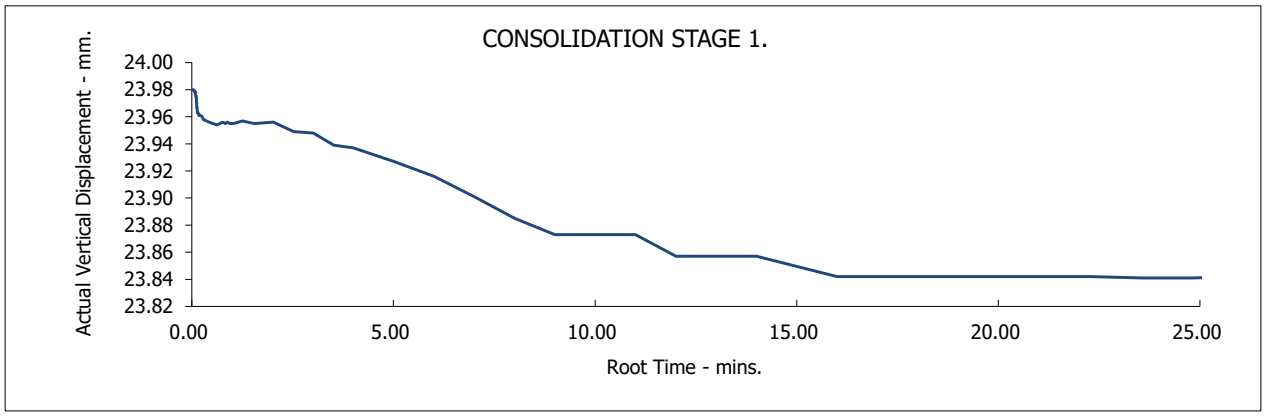
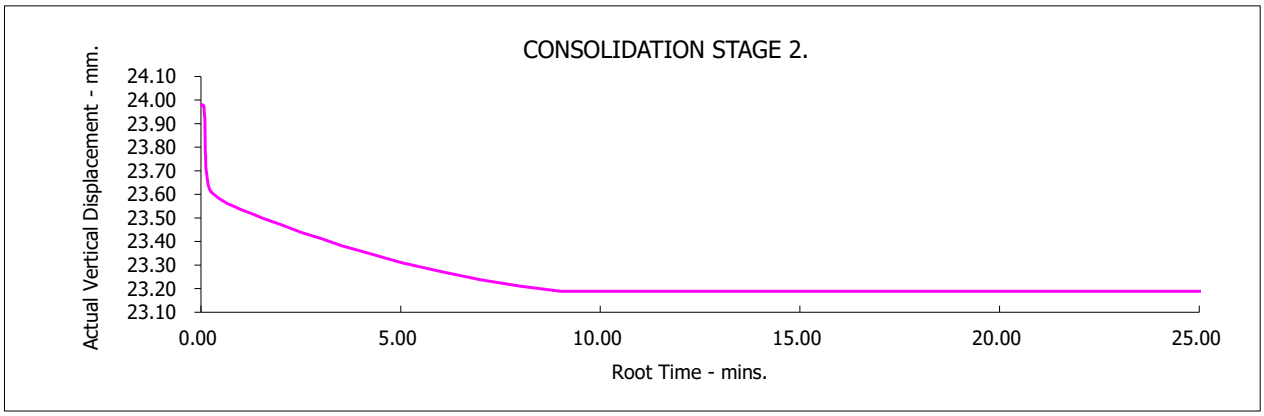
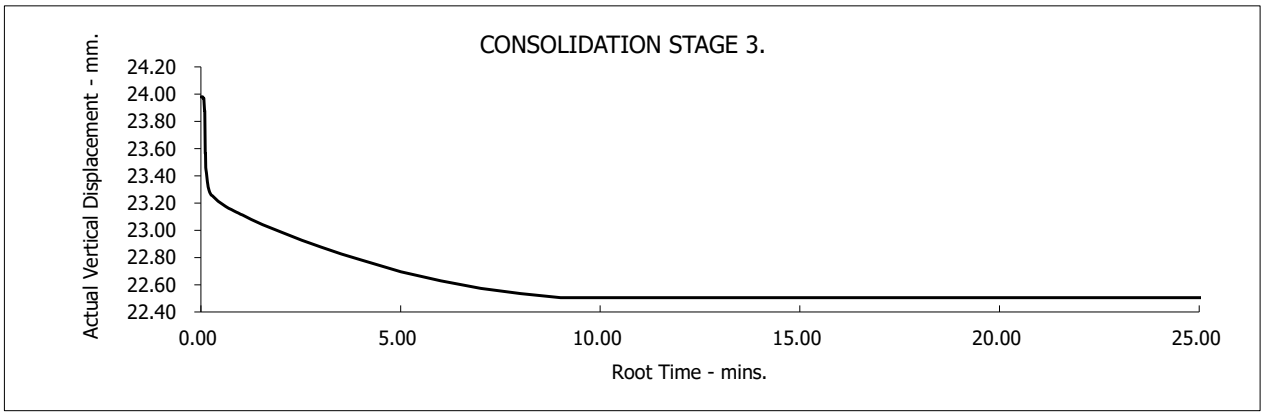
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number: WS2 Depth (m): 0.70







Pantteg, Ystalyfera

Contract No.:
37620

Client Ref Number:
5859e.08

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Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole Number:	WS4	Depth from (m):	2.30
Sample Number:		Depth to (m):	0.00

Sample Type: D	Remoulded (Light Tamping) material above 2.5mm removed
Particle Density - Mg/m3:	2.65 (Assumed)
Specimen Tested:	Submerged

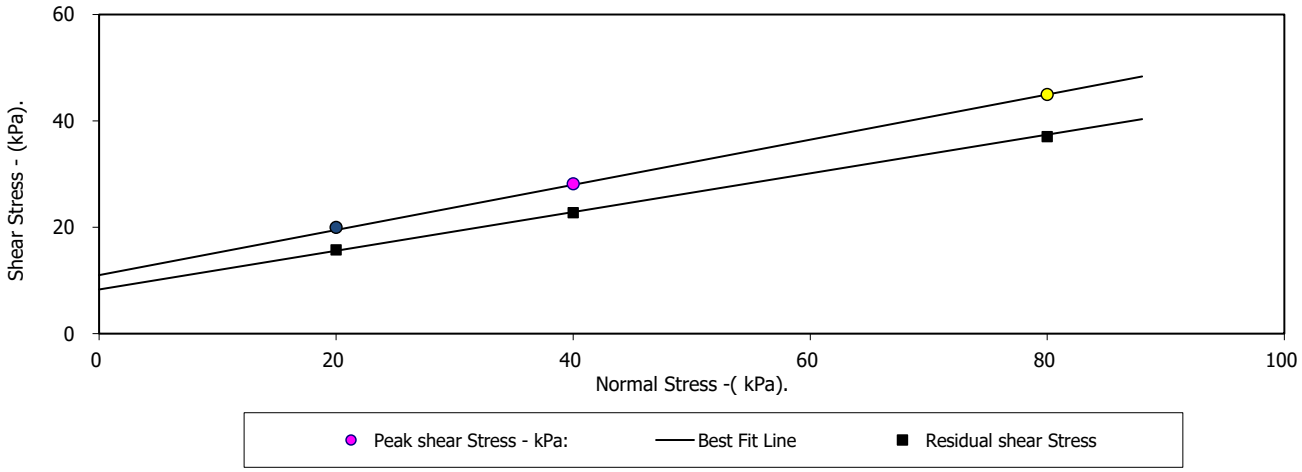
Sample Description:

Orange brown slightly sandy slightly silty gravelly (fine-coarse/angular-sub angular) soft CLAY

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.98	23.98	23.98
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	24	24	24
Bulk Density - Mg/m3:	1.86	1.85	1.85
Dry Density - Mg/m3:	1.49	1.49	1.49
Voids Ratio:	0.7762	0.7796	0.7785
Normal Pressure- kPa	20	40	80
Consolidation			
Consolidated Height - mm:	23.75	23.45	23.08
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (mm)	9.21	6.47	6.22
Peak shear Stress - kPa:	20	28	45

PEAK	
Angle of Shearing Resistance:(θ)	**23.0**
Effective Cohesion - kPa:	**11**
RESIDUAL	
Angle of Shearing Resistance:(θ)	**20.0**
Effective Cohesion - kPa:	**8**

Failure Conditions



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Contract No.:
37620

Client Ref Number:
5859e.08

Pantteg, Ystalyfera

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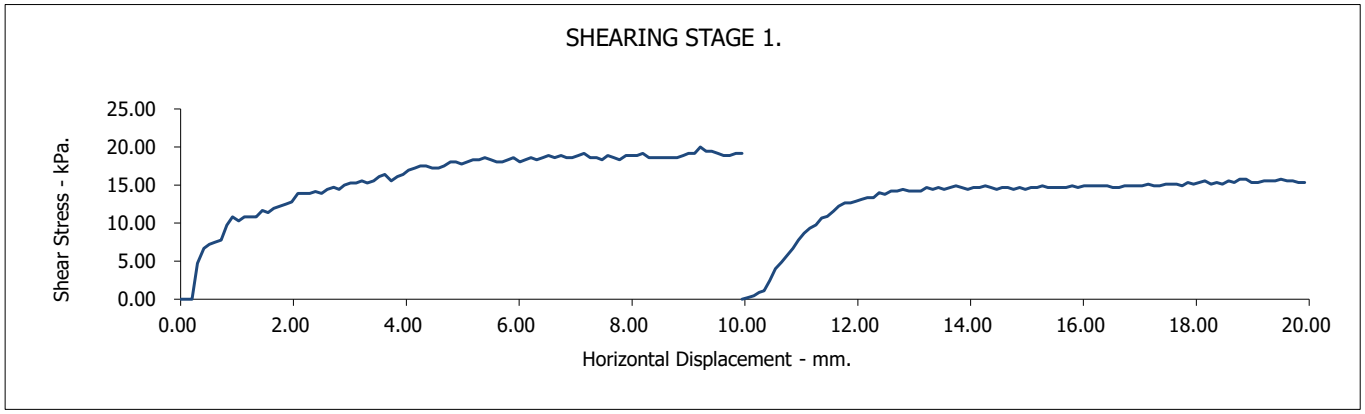
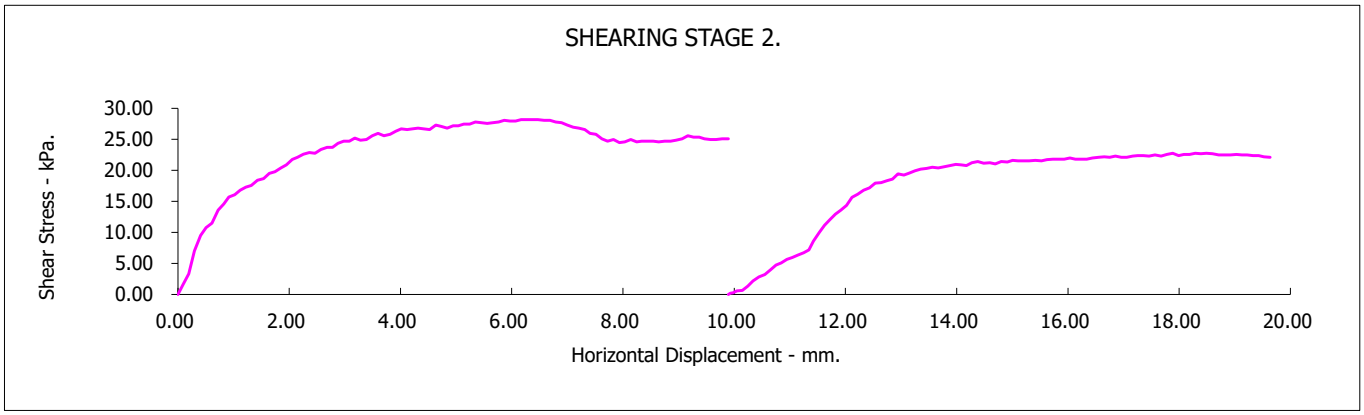
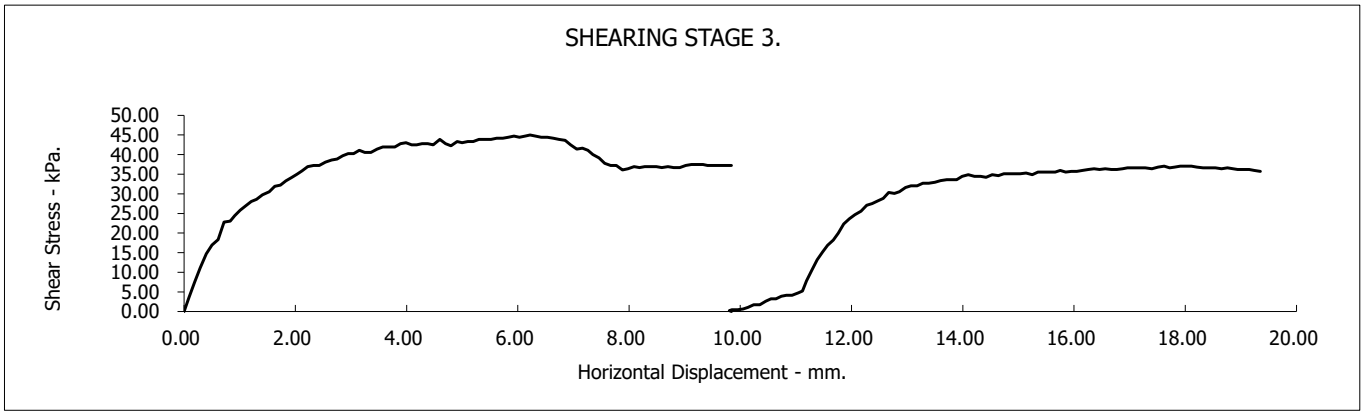
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number:	WS4	Depth (m):	2.30







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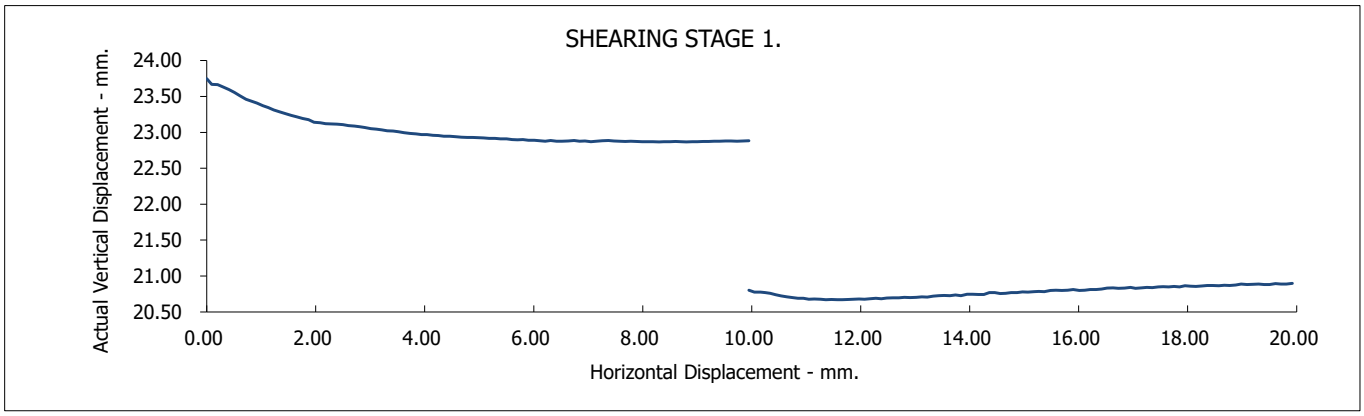
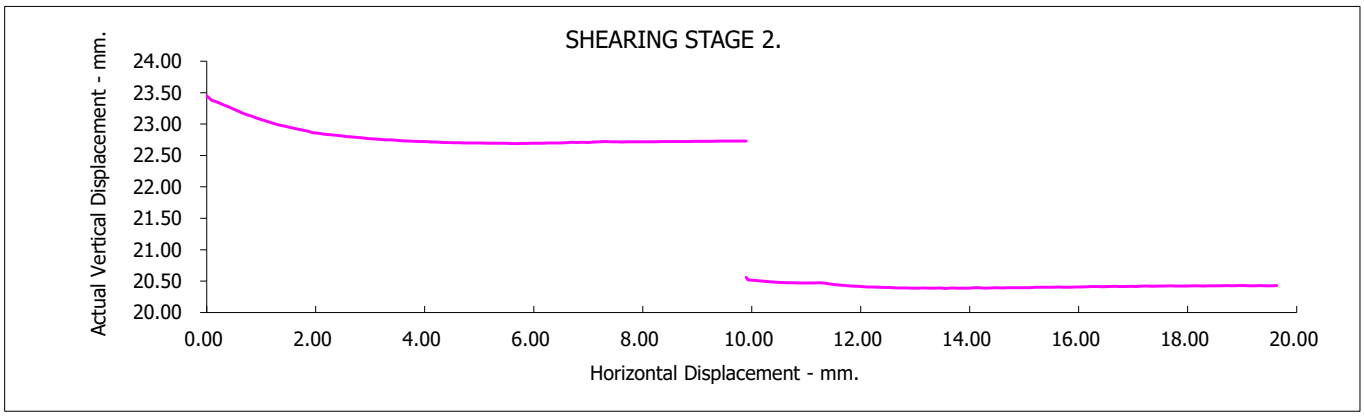
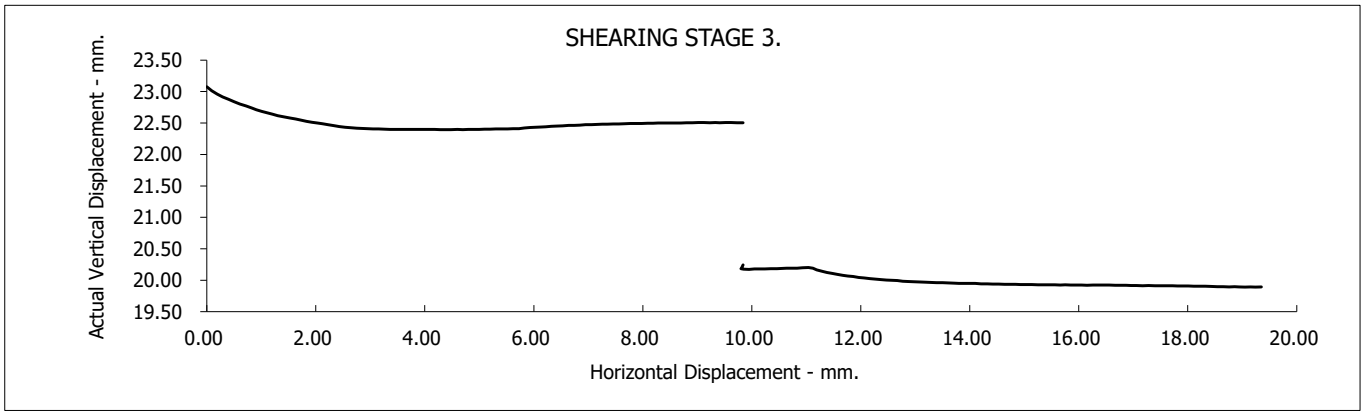
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number:	WS4	Depth (m):	2.30







Pantteg, Ystalyfera

Contract No.:
37620

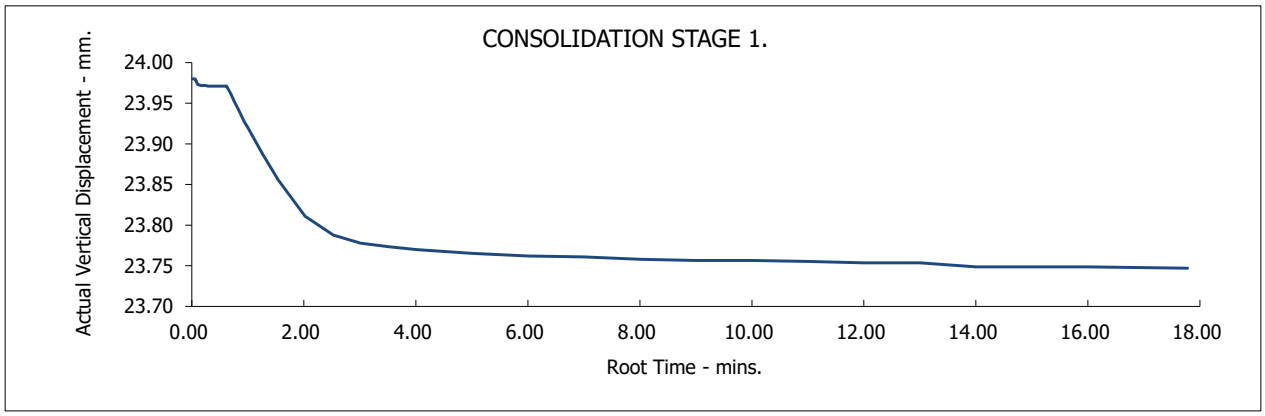
Client Ref Number:
5859e.08

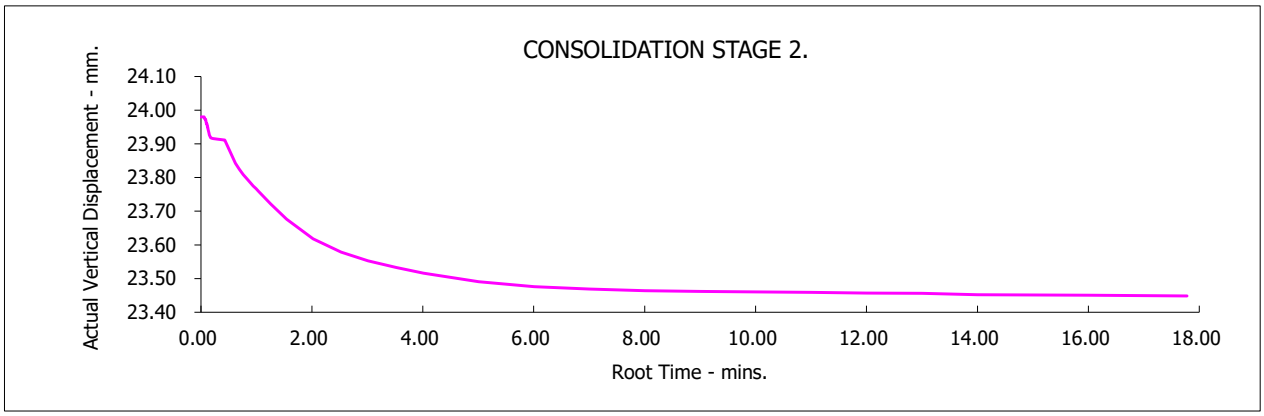
GSTL
GEO SITE & TESTING SERVICES LTD

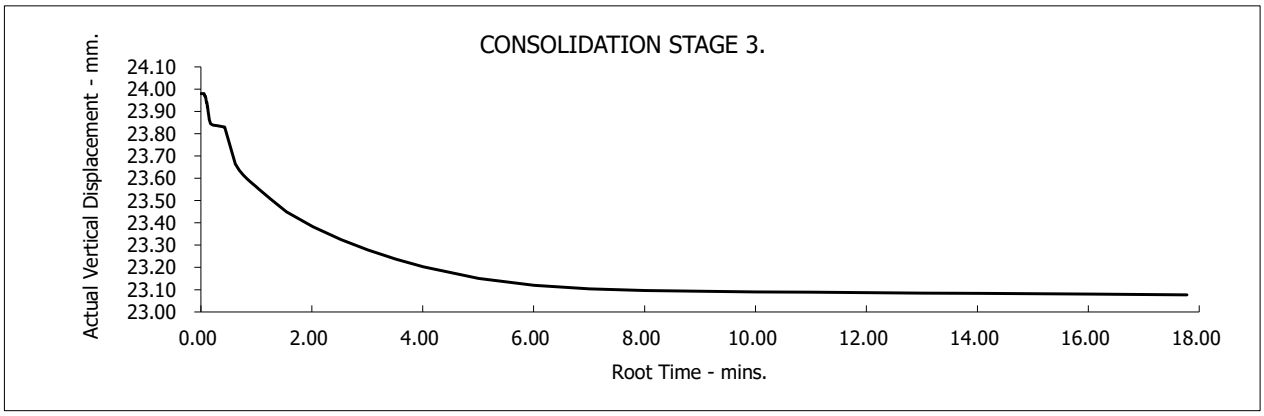
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number: WS4 Depth (m): 2.30







Pantteg, Ystalyfera

Contract No.:
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Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole Number:	WS6	Depth from (m):	0.80
Sample Number:		Depth to (m):	0.00

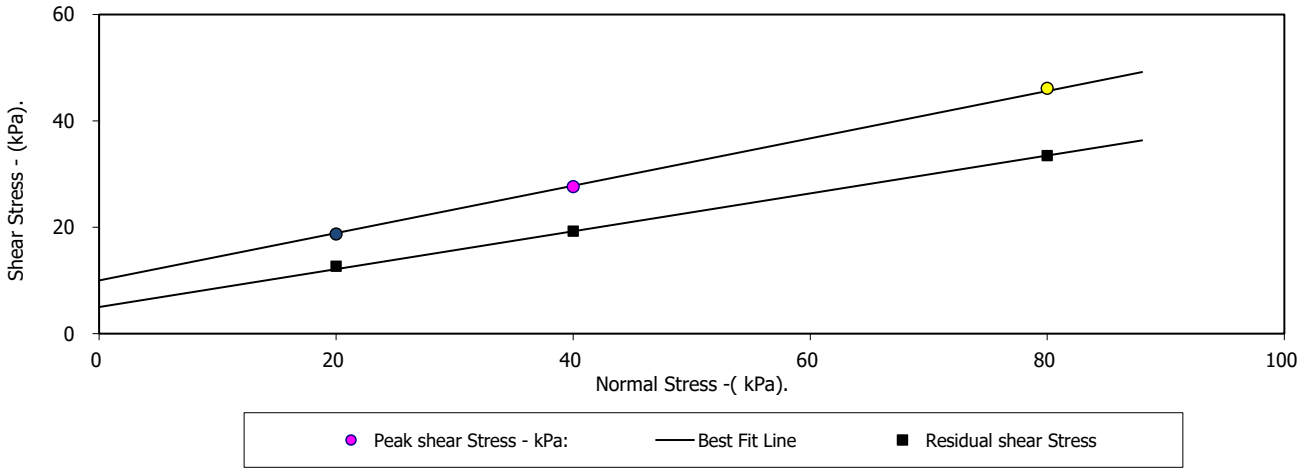
Sample Type: D	Remoulded (Light Tamping) material above 2.5mm removed
Particle Density - Mg/m3:	2.65 (Assumed)
Specimen Tested:	Submerged

Sample Description:
Brown slightly silty gravelly (fine-coarse/angular-subangular) soft CLAY

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.98	23.98	23.98
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	19	19	19
Bulk Density - Mg/m3:	1.91	1.92	1.91
Dry Density - Mg/m3:	1.61	1.61	1.61
Voids Ratio:	0.6424	0.6420	0.6429
Normal Pressure- kPa	20	40	80
Consolidation			
Consolidated Height - mm:	23.92	23.52	23.13
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (mm)	6.57	5.05	4.67
Peak shear Stress - kPa:	19	28	46

PEAK	
Angle of Shearing Resistance:(θ)	**24.0**
Effective Cohesion - kPa:	**10**
RESIDUAL	
Angle of Shearing Resistance:(θ)	**19.6**
Effective Cohesion - kPa:	**5**

Failure Conditions



D P Evans 05/01/18
Checked Pages 1-4 by: Date

D P Evans 05/01/18
Approved Pages 1-4 by Date

Contract No.:
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Pantteg, Ystalyfera

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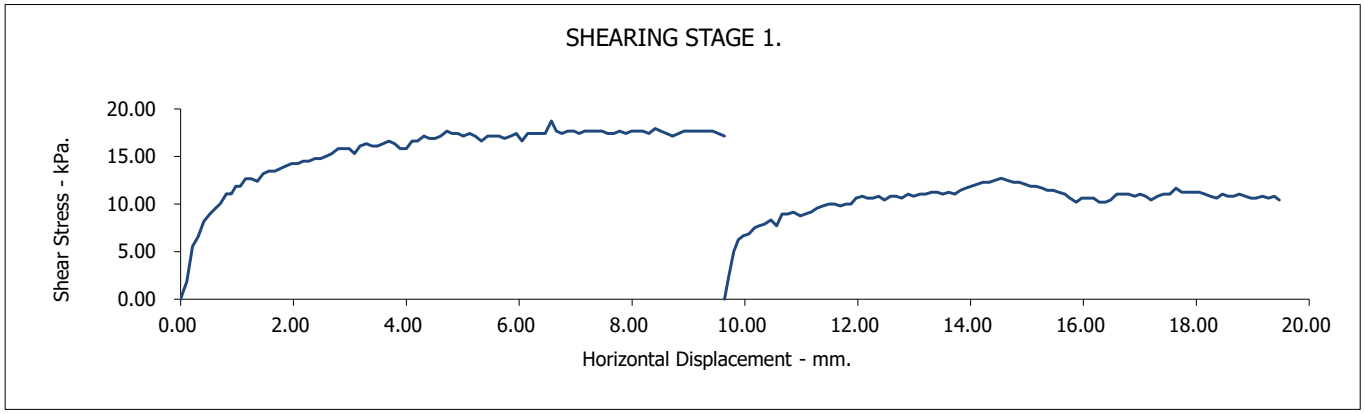
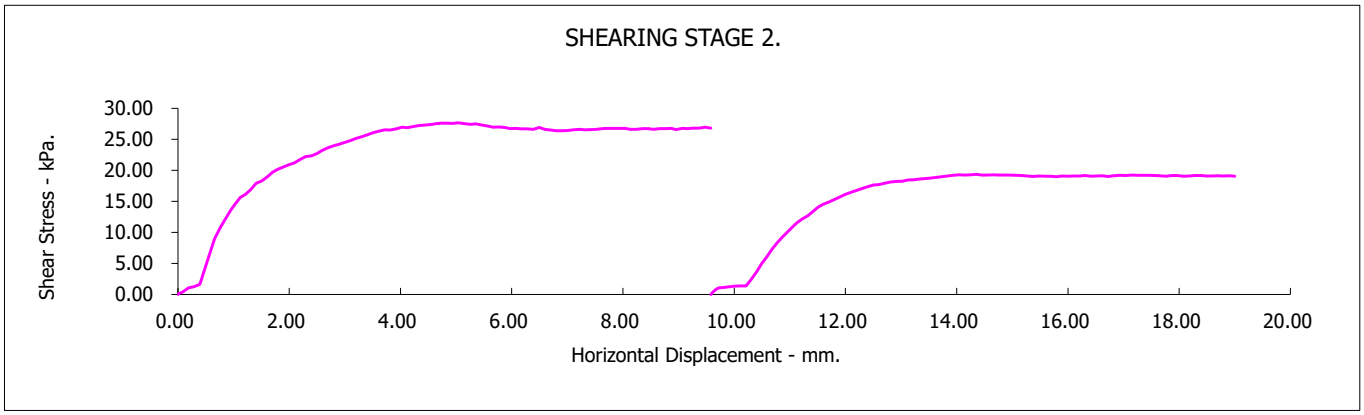
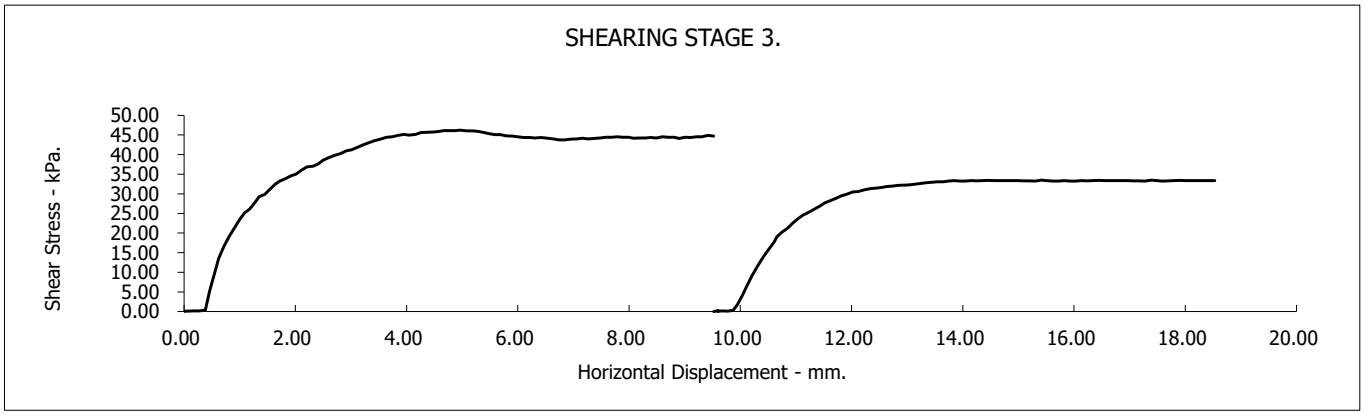
BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number:	WS6	Depth (m):	0.80







Pantteg, Ystalyfera

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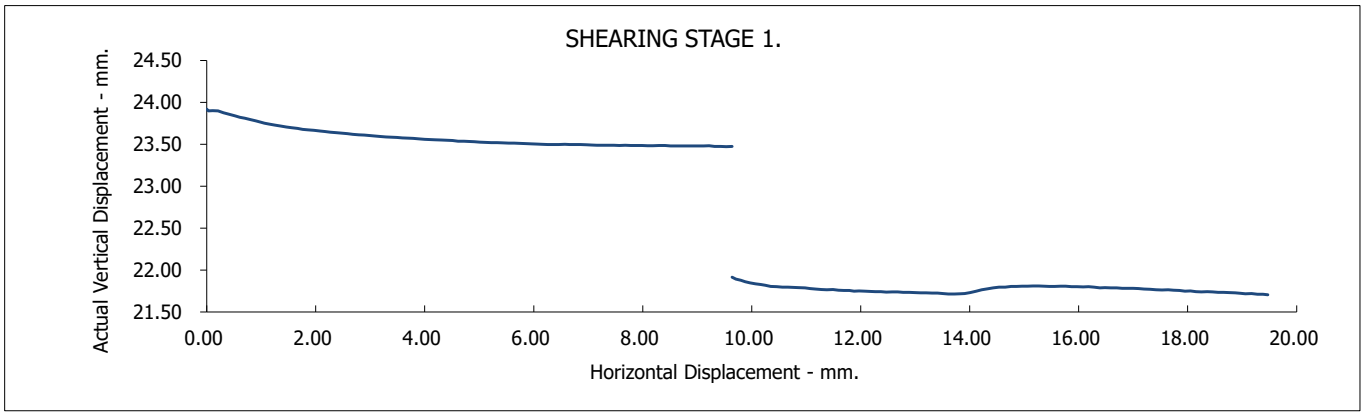
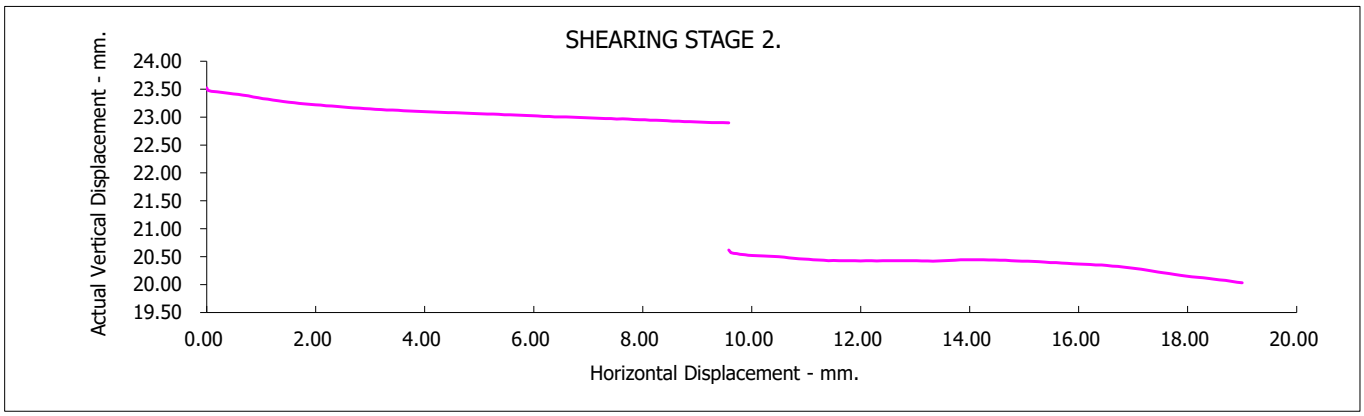
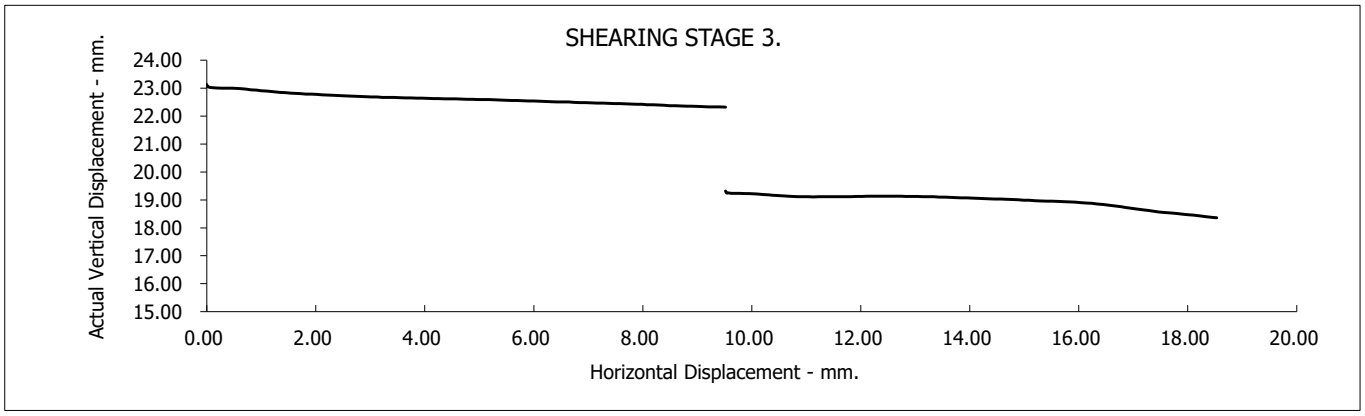
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number: WS6 Depth (m): 0.80







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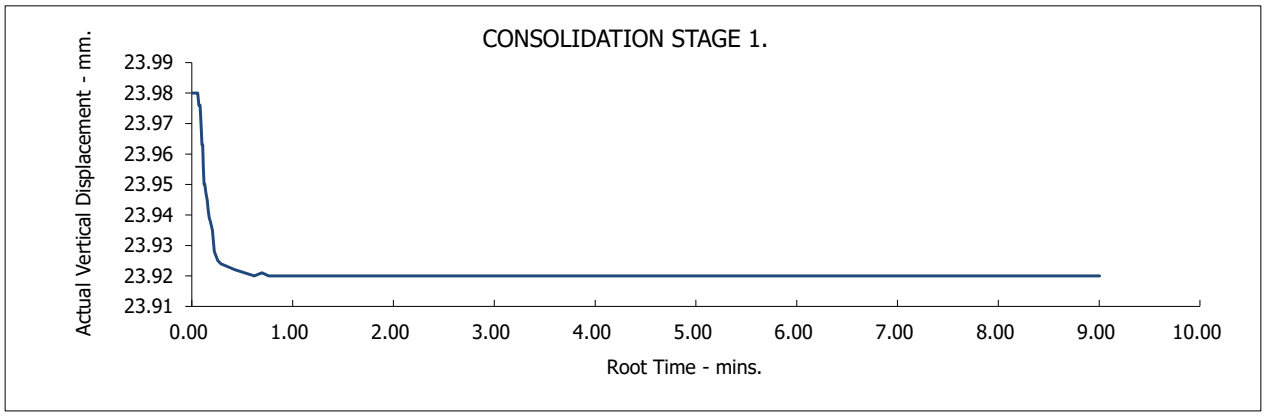
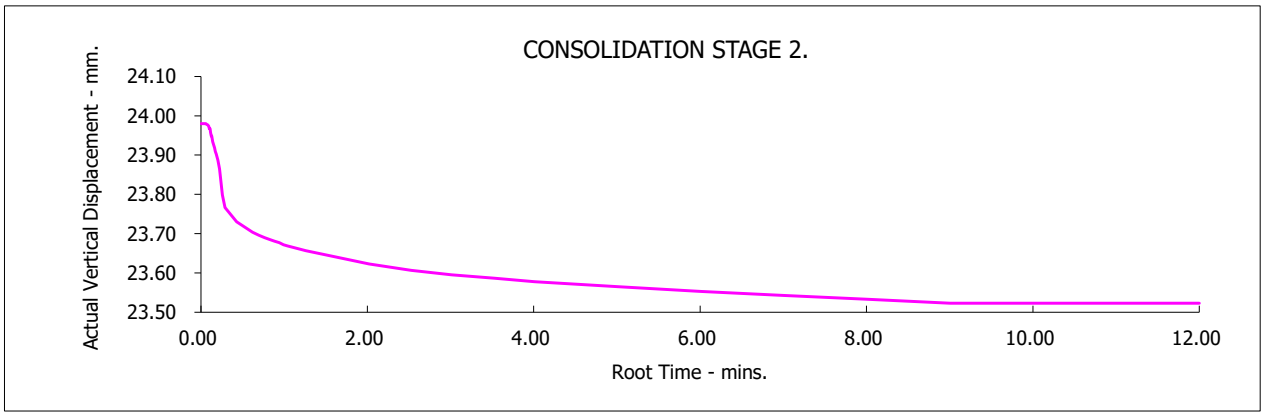
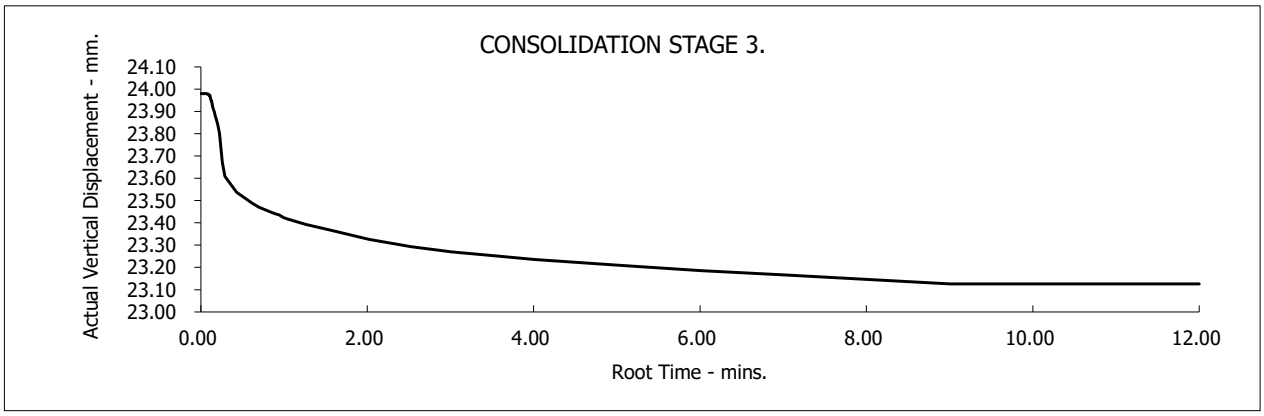
Test Report: CONSOLIDATED DRAINED PEAK AND RESIDUAL SHEARBOX TEST.

BS1377:Part 7.4.5.5 Shearing: multi-reversal test :1990

Borehole/Sample Number: WS6 Depth (m): 0.80







Pantteg, Ystalyfera

Contract No.:
37620

Client Ref Number:
5859e.08

GSTL
GEO SITE & TESTING SERVICES LTD

Laboratory Report

2788

GEO Site & Testing Services Ltd

Contract Number: 40599

Client Ref: **5859E.09**
Client PO: **7253**

Report Date: **04-10-2018**

Client **Earth Science Partnership**
33 Cardiff Road
Taff's Well
Cardiff
CF15 7RB

Contract Title: **Pantteg Landslide, Pen-y-Graig Area**
For the attention of: **Enquiries**

Date Received: **05-09-2018**
Date Commenced: **05-09-2018**
Date Completed: **04-10-2018**

Test Description	Qty
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	7
PSD: Sedimentation by pipette carried out with Wet Sieve (Wet Sieve must also be selected) BS 1377:1990 - Part 2 : 9.4 - * UKAS	2
Loss on Ignition BS 1377:1990 - Part 3 : 4 - @ Non Accredited Test	2
Remoulded Bulk/Dry Density on a disturbed sample BS 1377:1990 - Part 4 : 4.3/4.4 - * UKAS	4
Large Shear Box 300mm Peak with 3 confining pressures includes remoulding BS 1377:1990 - Part 7 : 5 and Specification for Highway Works Vol.1 Clause 636 Part 2 - @ Non Accredited Test	2
Disposal of samples for job	1

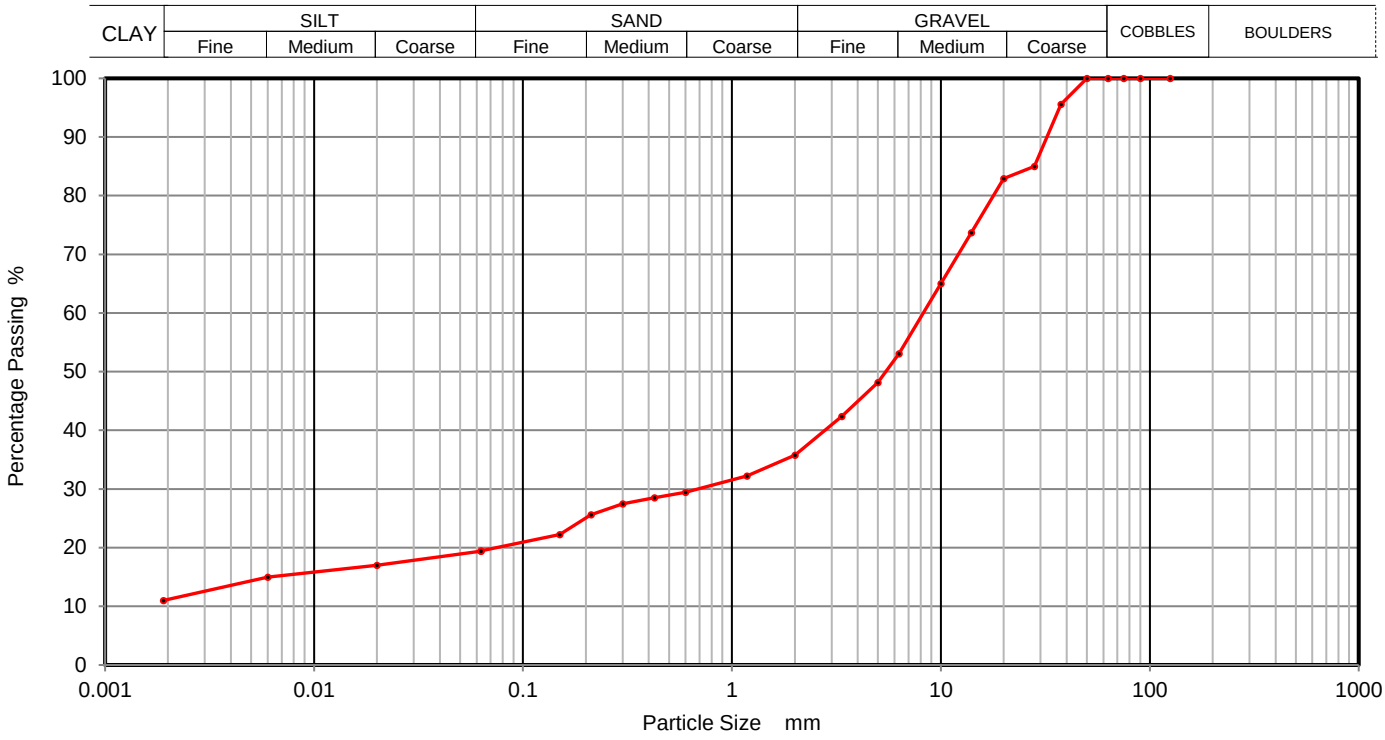
Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:
Alex Wynn (Associate Director) - Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager) - Sean Penn (Administrative/Accounts Assistant)
Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4	Contract Number	40599
		Borehole/Pit No.	TP602
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown silty clayey fine to coarse sandy fine to coarse GRAVEL.	Depth Top	2.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	17
90	100	0.0060	15
75	100	0.0019	11
63	100		
50	100		
37.5	96		
28	85		
20	83		
14	74		
10	65		
6.3	53		
5	48		
3.35	42		
2	36		
1.18	32		
0.6	29		
0.425	29		
0.3	27		
0.212	26		
0.15	22		
0.063	19		

Sample Proportions	% dry mass
Cobbles	0
Gravel	64
Sand	17
Silt	8
Clay	11

Grading Analysis	
Uniformity Coefficient	

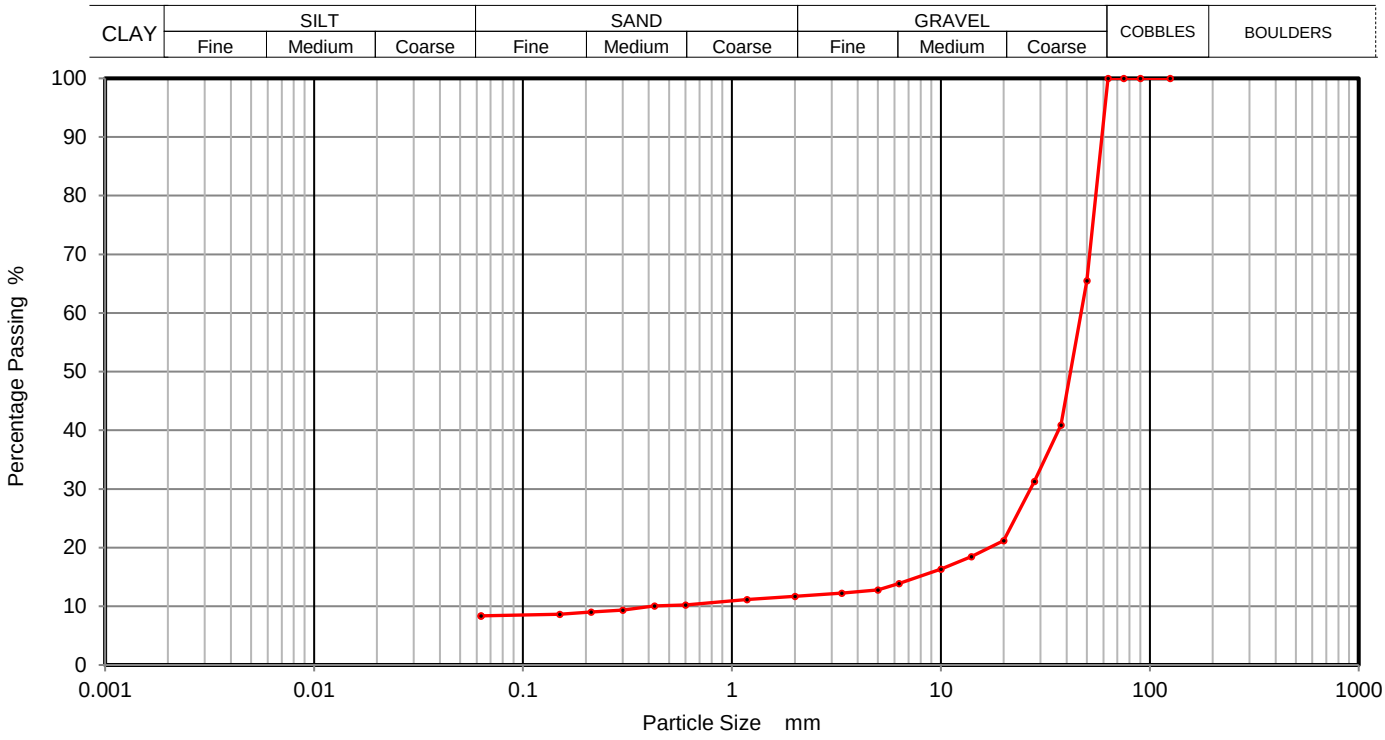
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	40599
		Borehole/Pit No.	TP603
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown fine to coarse slightly sandy silty fine to coarse GRAVEL.	Depth Top	2.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	65		
37.5	41		
28	31		
20	21		
14	18		
10	16		
6.3	14		
5	13		
3.35	12		
2	12		
1.18	11		
0.6	10		
0.425	10		
0.3	9		
0.212	9		
0.15	9		
0.063	8		

Sample Proportions	% dry mass
Cobbles	0
Gravel	88
Sand	4
Silt and Clay	8

Grading Analysis	
Uniformity Coefficient	

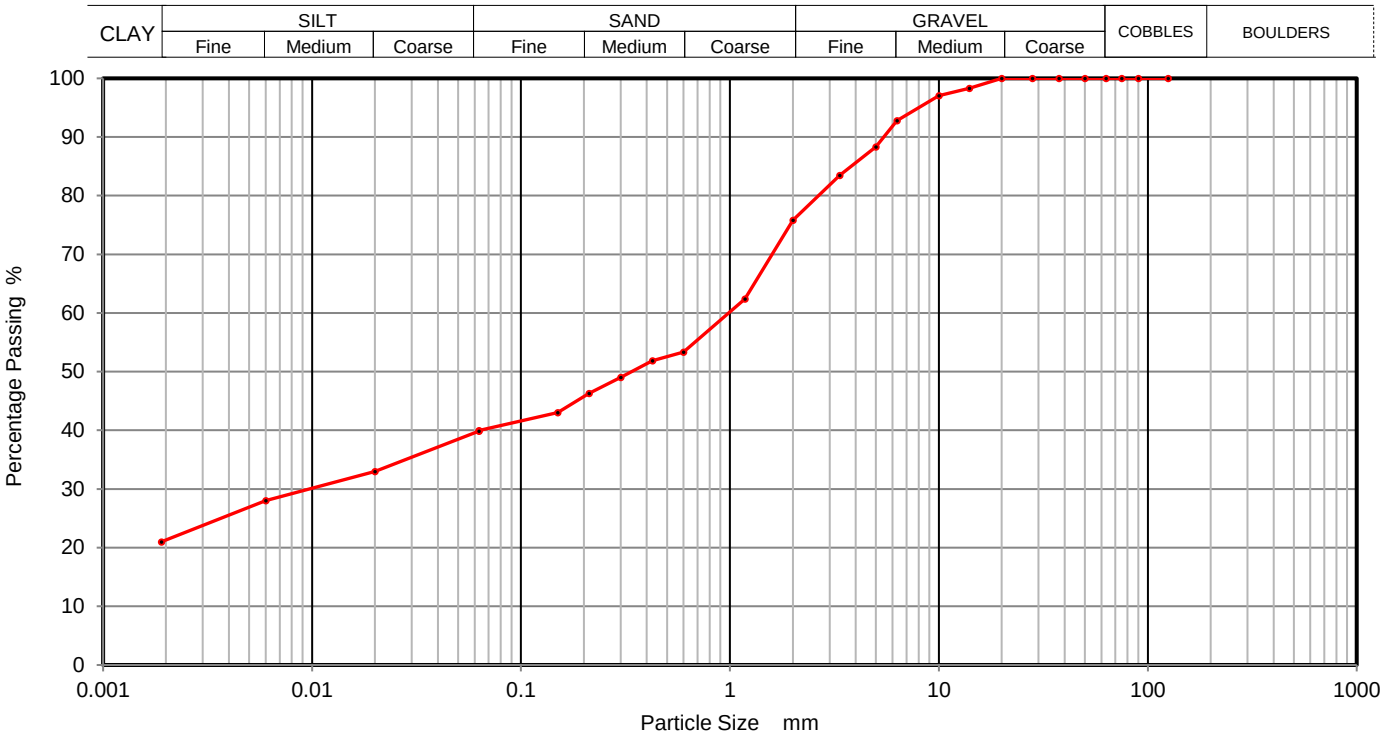
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4	Contract Number	40599
		Borehole/Pit No.	TP604
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown silty clayey fine to coarse sandy fine to coarse GRAVEL.	Depth Top	1.50
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	33
90	100	0.0060	28
75	100	0.0019	21
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	97		
6.3	93		
5	88		
3.35	83		
2	76		
1.18	62		
0.6	53		
0.425	52		
0.3	49		
0.212	46		
0.15	43		
0.063	40		

Sample Proportions	% dry mass
Cobbles	0
Gravel	24
Sand	36
Silt	19
Clay	21

Grading Analysis	
Uniformity Coefficient	

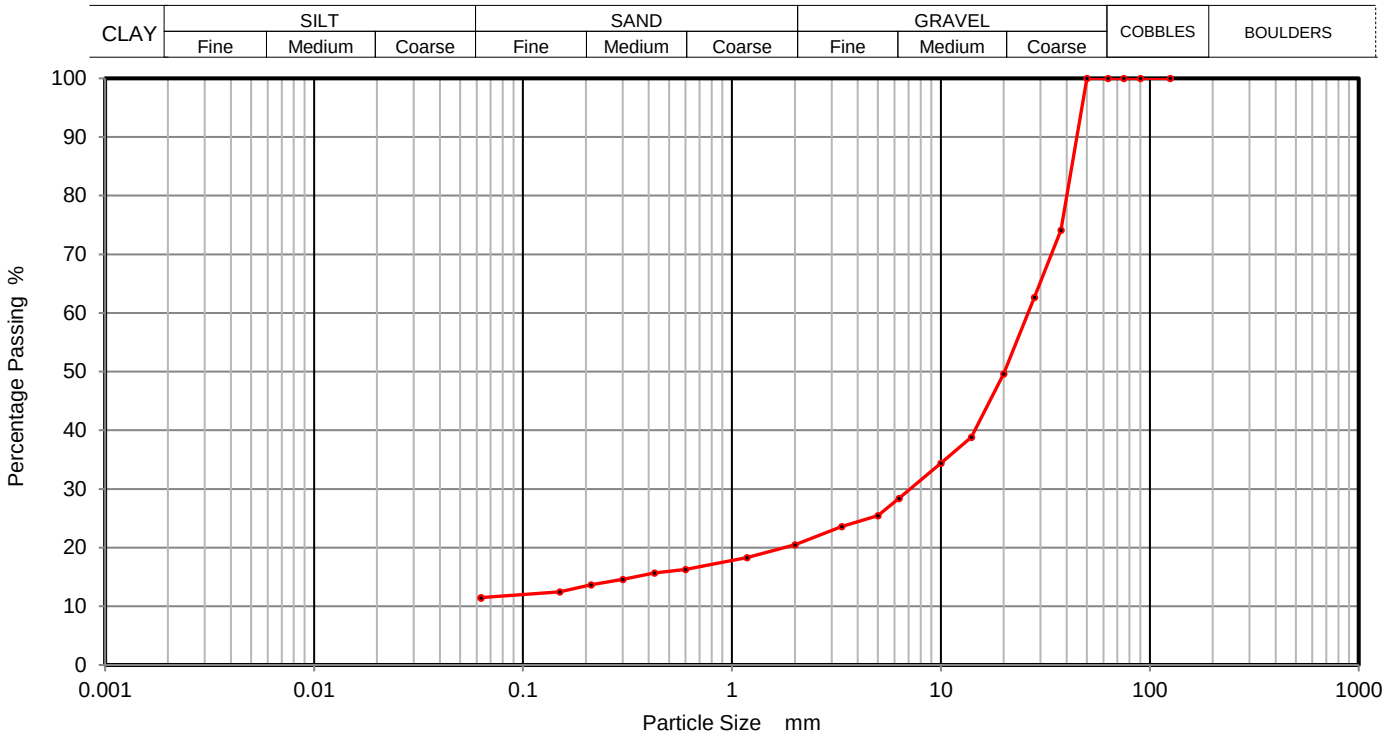
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	40599
		Borehole/Pit No.	TP606
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	74		
28	63		
20	50		
14	39		
10	34		
6.3	28		
5	25		
3.35	24		
2	21		
1.18	18		
0.6	16		
0.425	16		
0.3	15		
0.212	14		
0.15	12		
0.063	11		

Sample Proportions	% dry mass
Cobbles	0
Gravel	79
Sand	10
Silt and Clay	11

Grading Analysis	
Uniformity Coefficient	

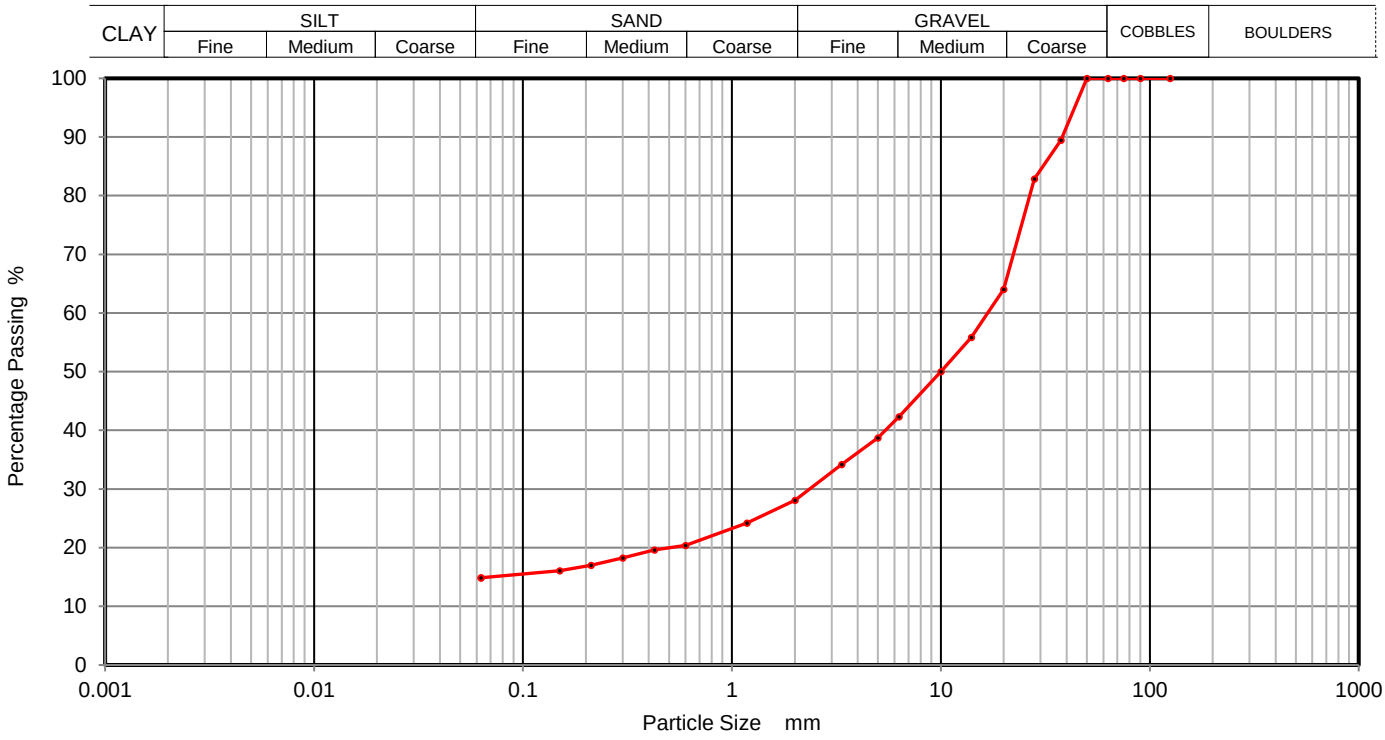
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	40599
		Borehole/Pit No.	TP607
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown fine to coarse sandy silty clayey fine to coarse GRAVEL.	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	89		
28	83		
20	64		
14	56		
10	50		
6.3	42		
5	39		
3.35	34		
2	28		
1.18	24		
0.6	20		
0.425	20		
0.3	18		
0.212	17		
0.15	16		
0.063	15		

Sample Proportions	% dry mass
Cobbles	0
Gravel	72
Sand	13
Silt and Clay	15

Grading Analysis	
Uniformity Coefficient	

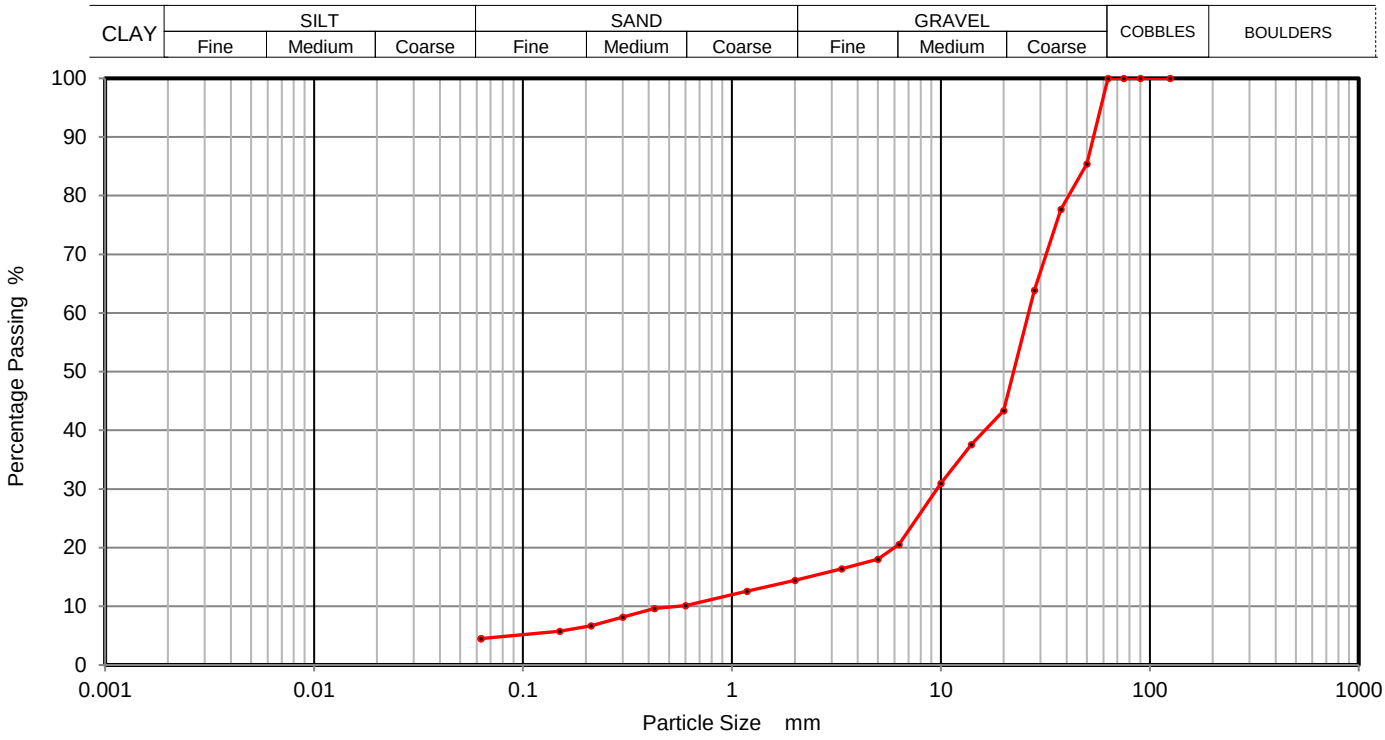
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	40599
		Borehole/Pit No.	TP608
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown silty fine to coarse slightly sandy fine to coarse GRAVEL.	Depth Top	1.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	85		
37.5	78		
28	64		
20	43		
14	38		
10	31		
6.3	21		
5	18		
3.35	16		
2	14		
1.18	13		
0.6	10		
0.425	10		
0.3	8		
0.212	7		
0.15	6		
0.063	5		

Sample Proportions	% dry mass
Cobbles	0
Gravel	86
Sand	9
Silt and Clay	5

Grading Analysis	
Uniformity Coefficient	

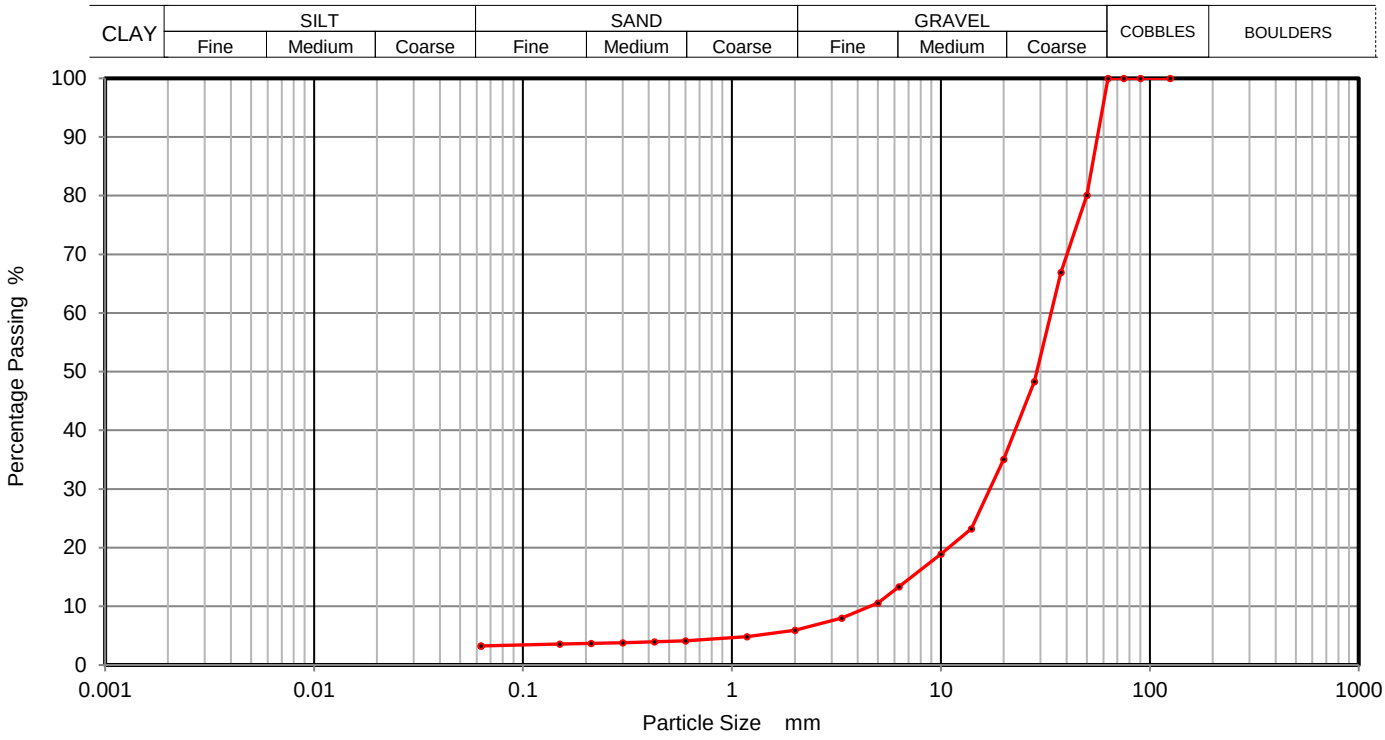
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	40599
		Borehole/Pit No.	TP609
Site Name	Pantteg Landslide, Pen-y-Graig Area	Sample No.	
Soil Description	Brown silty fine to coarse slightly sandy fine to coarse GRAVEL.	Depth Top	2.00
		Depth Base	
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	80		
37.5	67		
28	48		
20	35		
14	23		
10	19		
6.3	13		
5	11		
3.35	8		
2	6		
1.18	5		
0.6	4		
0.425	4		
0.3	4		
0.212	4		
0.15	4		
0.063	3		

Sample Proportions	% dry mass
Cobbles	0
Gravel	94
Sand	3
Silt and Clay	3

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	03/10/2018	Emma Sharp	
RO/MH	Approved	04/10/2018	Paul Evans	

UKAS TESTING 2788

GSTL	Certificate of Chemical Analysis onsuling	Contract Number	40599
		Client Reference	5859E.09
Client	ESP	Date Received	
Site Name	Pantteg Landslide, Pen - Y - Graig Area	Date Started	05/09/2018
		Date Completed	04/10/2018
		No. of Samples	2

Hole Number	Sample Number	Sample Type	Depth (m)			Acid Soluble Sulphate	Aqueous Extract Sulphate	Water Soluble Chloride	PH Value	Organic Matter Content	Acid Soluble Chloride	Loss On Ignition
TP603		B	2.50	-								9.5
TPT607		B	1.00	-								34.6
				-								
				-								
				-								
				-								
				-								
				-								
				-								
				-								
				-								
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Key	Reported As	Clause
Acid Soluble Sulphate	% SO_3	Clause 5.2 & 5.5
Aqueous Extract Sulphate	g/l SO_3	Clause 5.3 & 5.5
2/1 Chloride	%	Clause 7.2
PH Value	@ 25°	Clause 9.5
Organic	%	Clause 3
Redox Mv	Mv	Clause 4
LOI	%	Clause 4

Remarks

NCP = No Chloride Present

Test Operator	Checked and Authorised by		Ben Sharp	
Darren Bourne	Date	04/10/2018		

GSTL

SUMMARY OF SOIL DENSITY TESTS
(BS 1377 : PART 2 : 7/8 : 1990)

Contract Number	**40599**
Site Name	**Pantteg Landslide, Pen-y-Graig Area**

Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content	Bulk Density	Dry Density	Compaction Method	Particle Density	Estimated Air Voids	Remarks
TP606			1.00	-		13.6	2.10	1.85				
TP607			1.00	-		10.8	2.21	2.00				
TP608			1.00	-		16.1	2.16	1.86				
TP609			2.00	-		16.7	2.20	1.88				
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Key	Reported As
Moisture Content	%
Bulk Density	Mg/m^3
Dry Density	Mg/m^3
Particle Density	Mg/m^3
Air Voids	%

Operators	Checked	03/10/2018	Ben Sharp	
CA/JS	Approved	04/10/2018	Paul Evans	

UKAS TESTING
2788

Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole Number:	TP604	Depth from (m):	1.50
Sample Number :	0	Depth to (m):	0.00

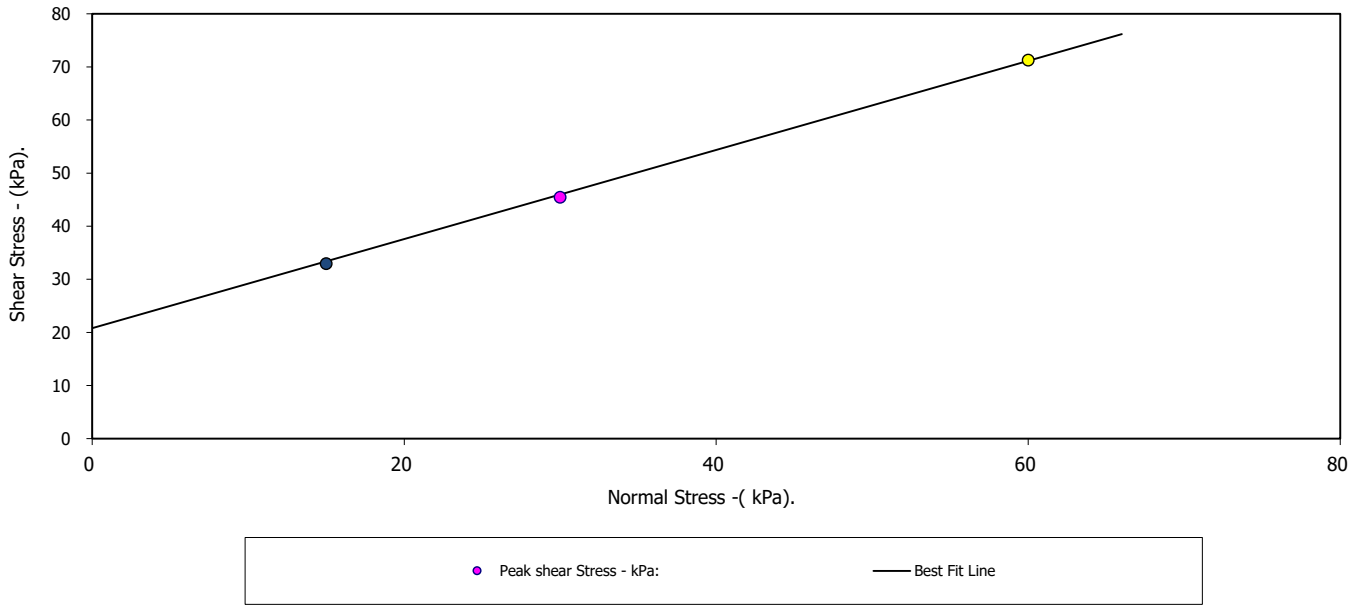
Sample Type:	B
Particle Density - Mg/m3:	2.65 (Assumed)
Specimen Tested:	At natural moisture content, Remoulded (Light Tamping) Material above 20mm removed.

Sample Description:
Brown slightly silty fine to coarse gravelly CLAY

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	145.00	145.00	145.00
Length - mm:	300.00	300.00	300.00
Moisture Content - %:	20	20	20
Bulk Density - Mg/m3:	1.86	1.86	1.86
Dry Density - Mg/m3:	1.54	1.54	1.54
Voids Ratio:	0.7197	0.7198	0.7198
Normal Pressure- kPa	15	30	60
Consolidation			
Consolidated Height - mm:	142.21	140.16	138.10
Shear			
Rate of Strain (mm/min)	0.600	0.600	0.600
Strain at peak shear stress (%)	70.21	72.56	52.90
Peak shear Stress - kPa:	33	45	71

PEAK	
Angle of Shearing Resistance:(θ)	**40.0**
Effective Cohesion - kPa:	**21**

FAILURE CONDITIONS



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Approved Pages 1-4 by: Date

Contract No.:
40599

Pantteg Landslide, Pen-y-Graig Area

Client Ref Number:
5859E.09

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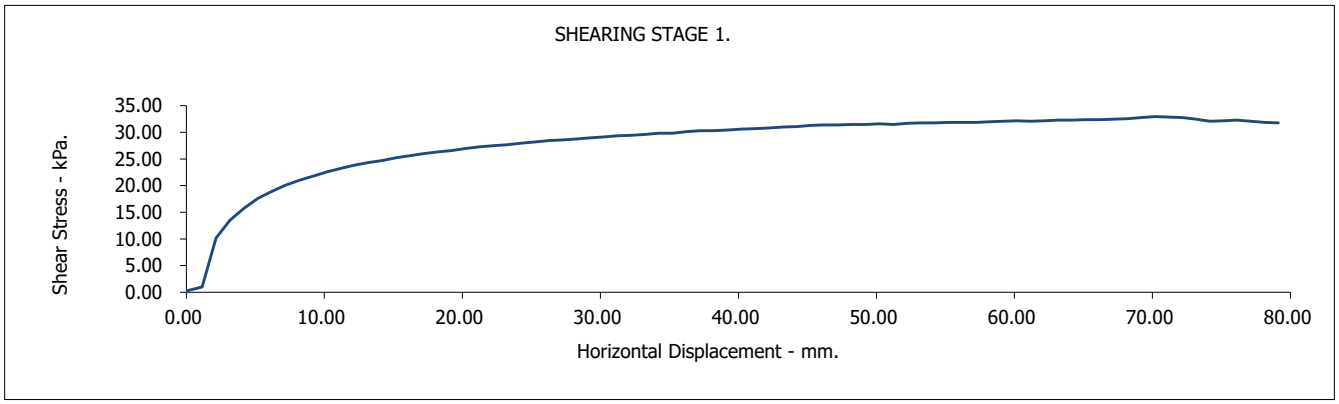
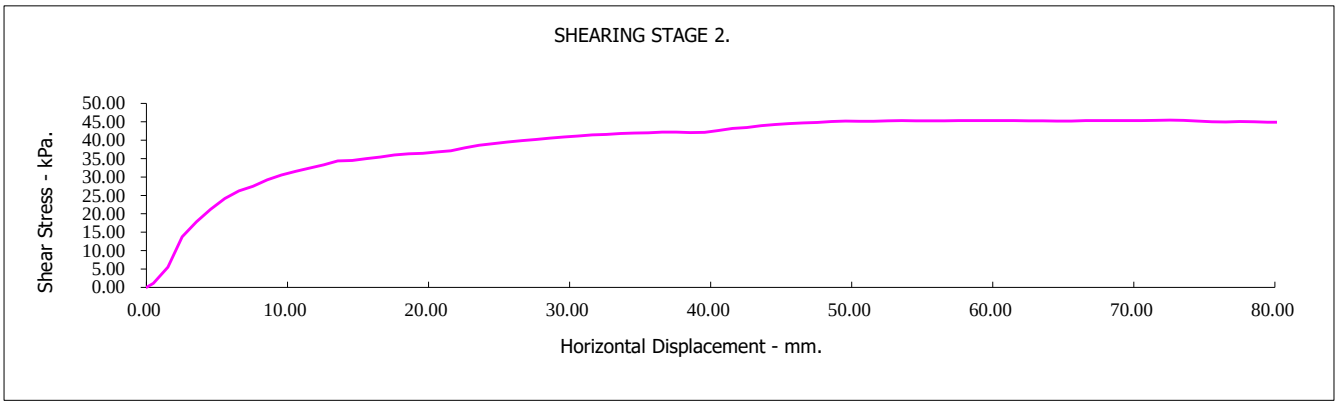
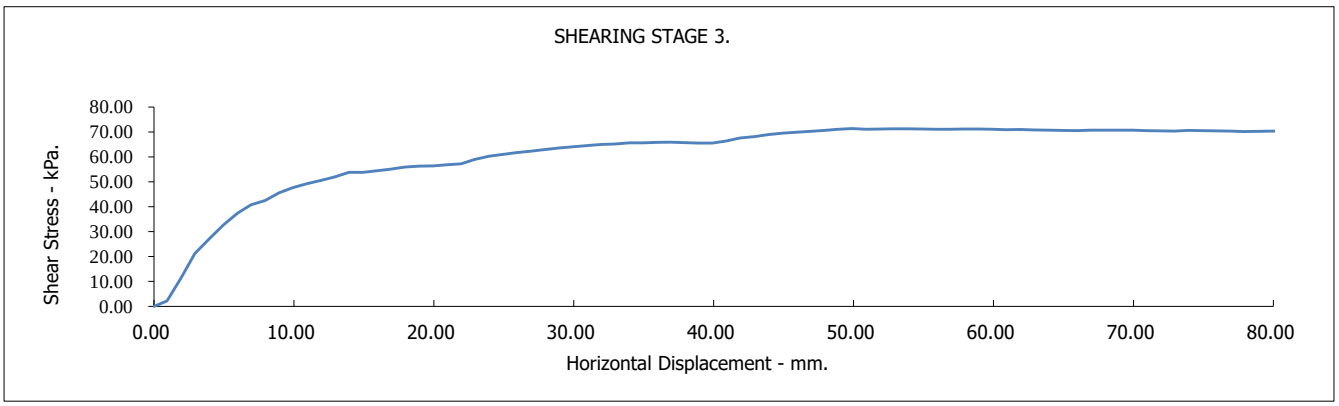
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP604 Depth (m): 1.50







Pantteg Landslide, Pen-y-Graig Area

Contract No.: **40599**

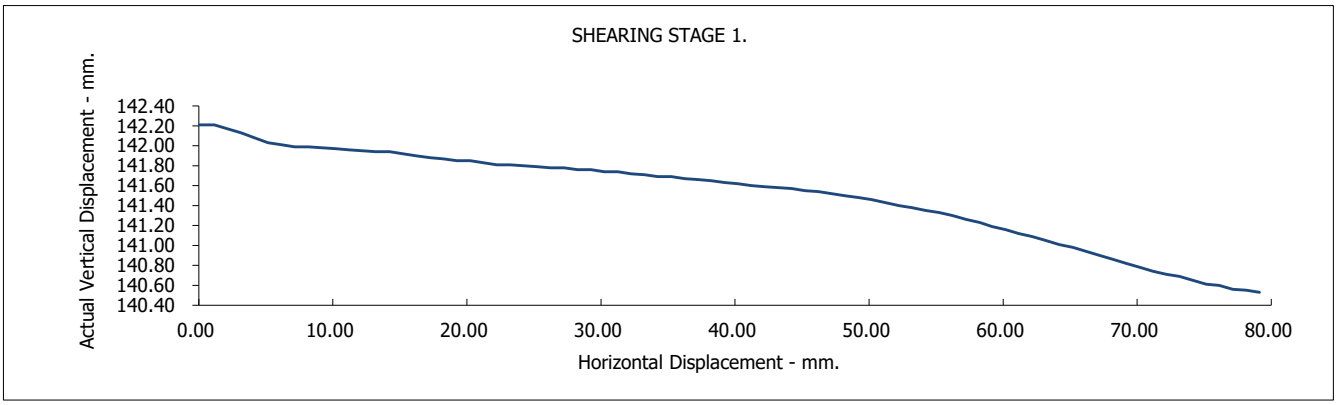
Client Ref Number: **5859E.09**

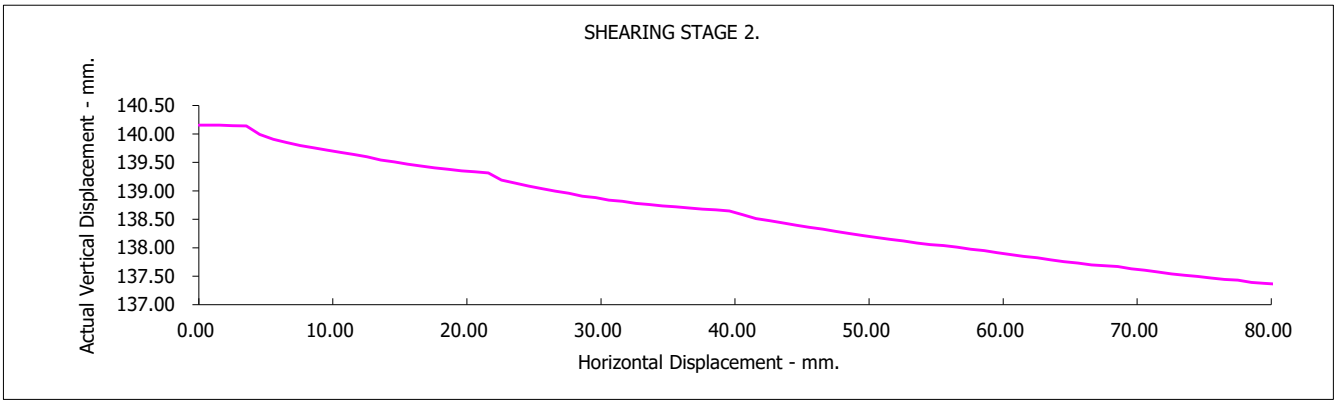
Figure.

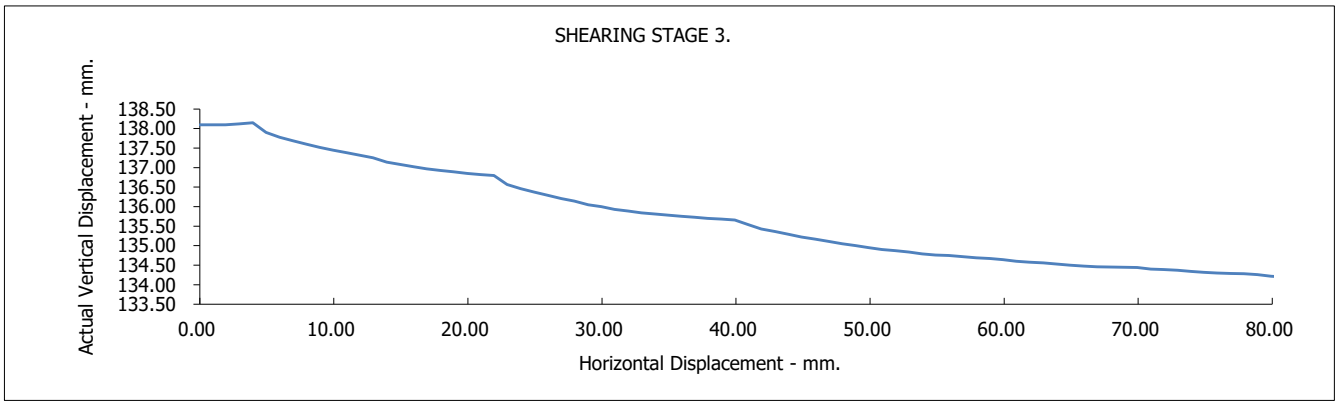
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP604 Depth (m): 1.50







Pantteg Landslide, Pen-y-Graig Area

Contract No.: **40599**

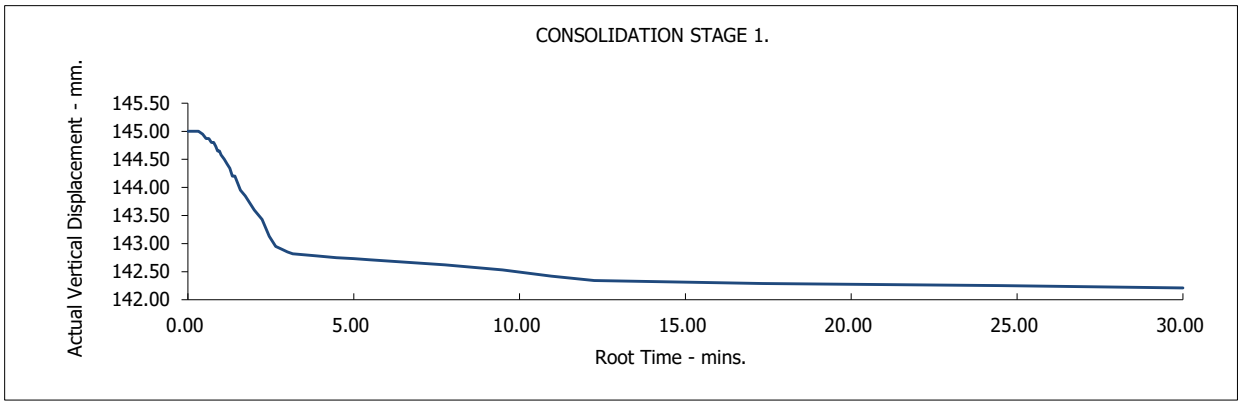
Client Ref Number: **5859E.09**

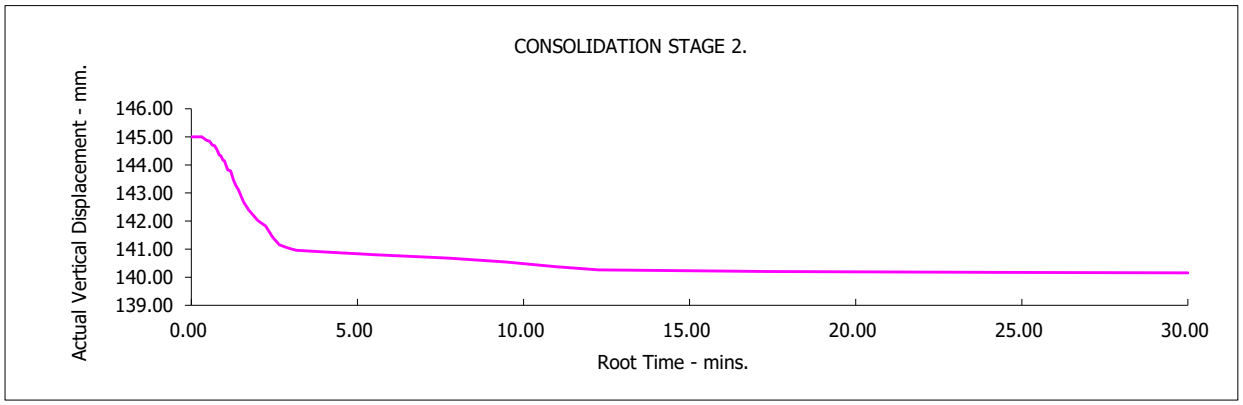
Figure.

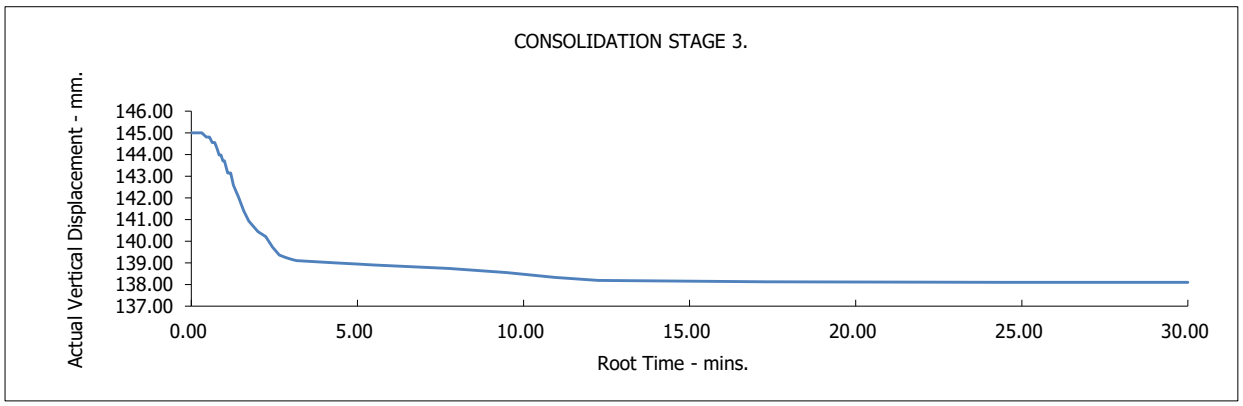
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP604 Depth (m): 1.50







Contract No.: **40599**

Pantteg Landslide, Pen-y-Graig Area

Client Ref Number: **5859E.09**

Figure.

Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole Number:	TP607+TP609	Depth from (m):	1.00+2.00
Sample Number :	0	Depth to (m):	0.00

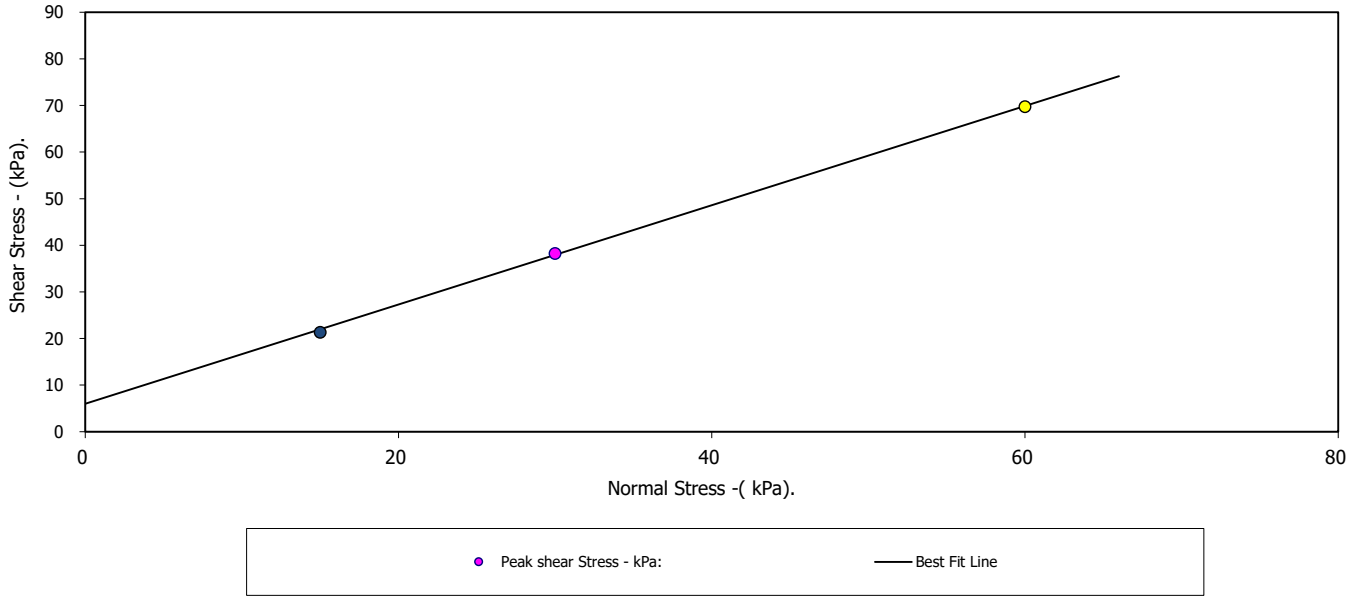
Sample Type:	B
Particle Density - Mg/m3:	2.65 (Assumed)
Specimen Tested:	At natural moisture content, Remoulded (Light Tamping) Material above 20mm removed.

Sample Description:
Brown slightly silty clayey sandy fine to coarse GRAVEL

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	145.00	145.00	145.00
Length - mm:	300.00	300.00	300.00
Moisture Content - %:	11	11	11
Bulk Density - Mg/m3:	2.01	2.01	2.01
Dry Density - Mg/m3:	1.81	1.81	1.81
Voids Ratio:	0.4651	0.4649	0.4650
Normal Pressure- kPa	15	30	60
Consolidation			
Consolidated Height - mm:	143.29	142.07	140.85
Shear			
Rate of Strain (mm/min)	3.000	3.000	3.000
Strain at peak shear stress (%)	36.25	39.93	44.82
Peak shear Stress - kPa:	21	38	70

PEAK	
Angle of Shearing Resistance:(θ)	**46.8**
Effective Cohesion - kPa:	**6**

FAILURE CONDITIONS



DP Evans 04/10/18
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DP Evans 04/10/18
Approved Pages 1-4 by: Date

Contract No.:
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Pantteg Landslide, Pen-y-Graig Area

Client Ref Number:
5859E.09

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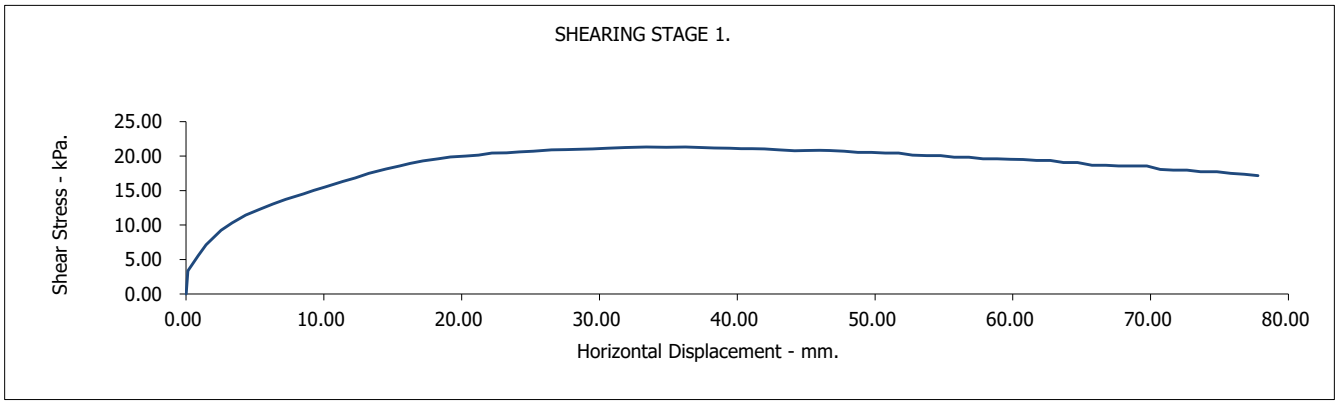
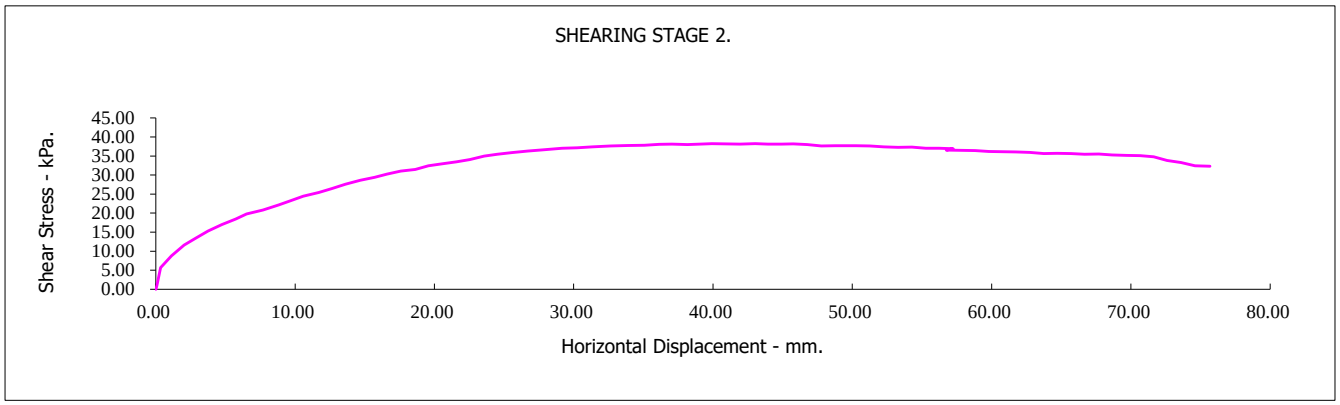
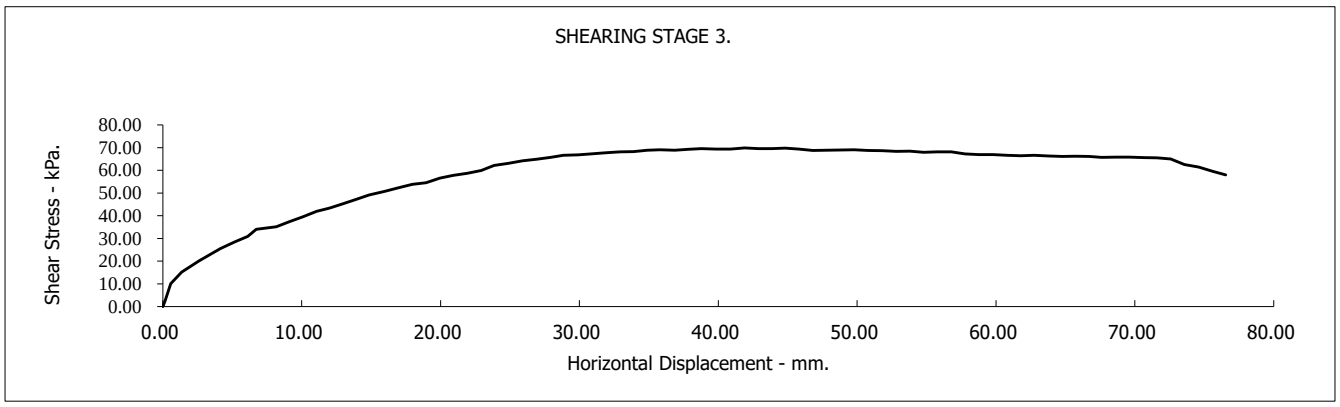
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP607+TP609 Depth (m): 1.00+2.00







Pantteg Landslide, Pen-y-Graig Area

Contract No.:
40599

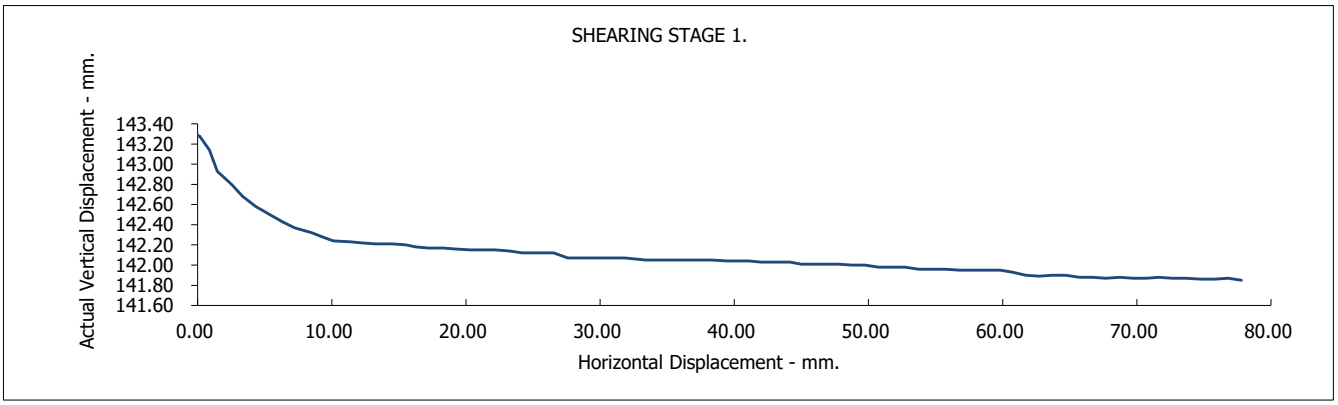
Client Ref Number:
5859E.09

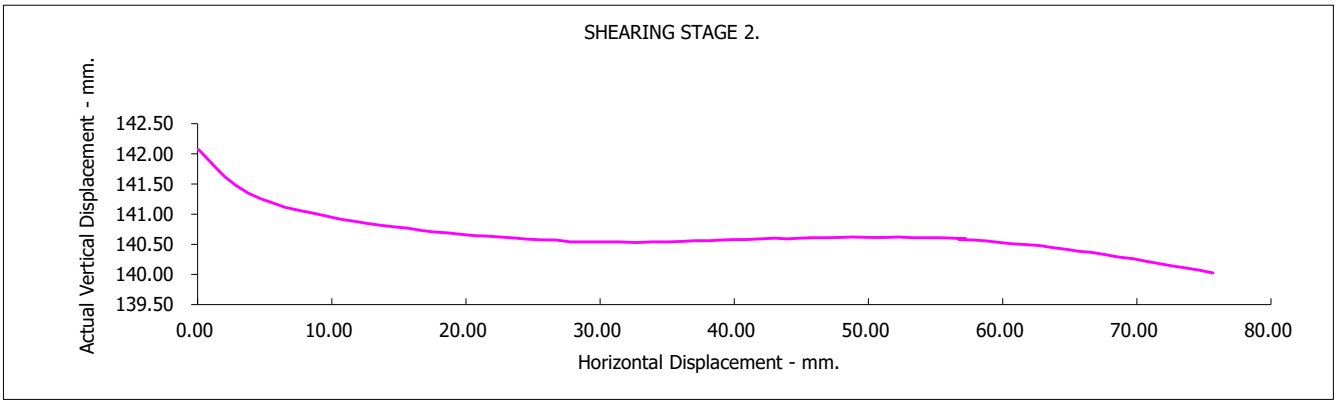
Figure.

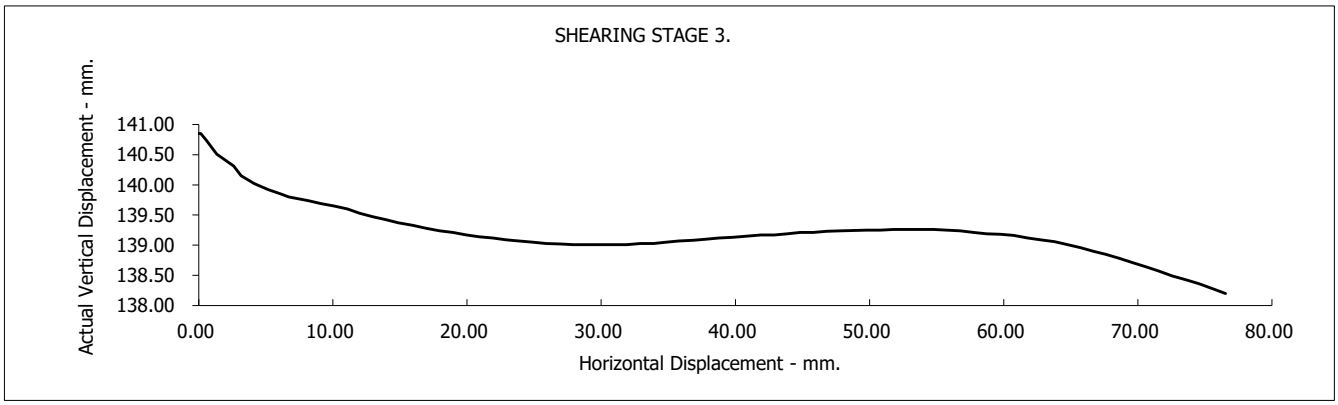
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP607+TP609 Depth (m): 1.00+2.00







Contract No.:
40599

Pantteg Landslide, Pen-y-Graig Area

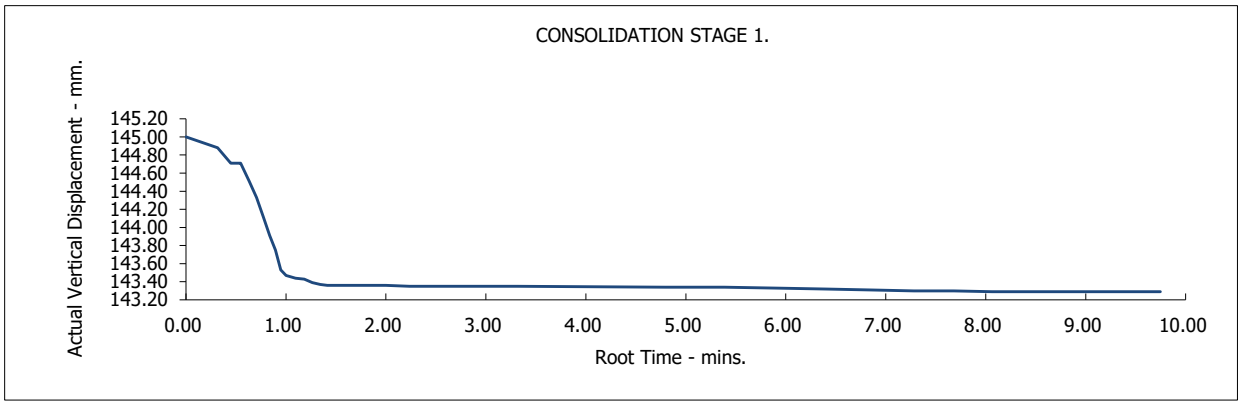
Client Ref Number:
5859E.09

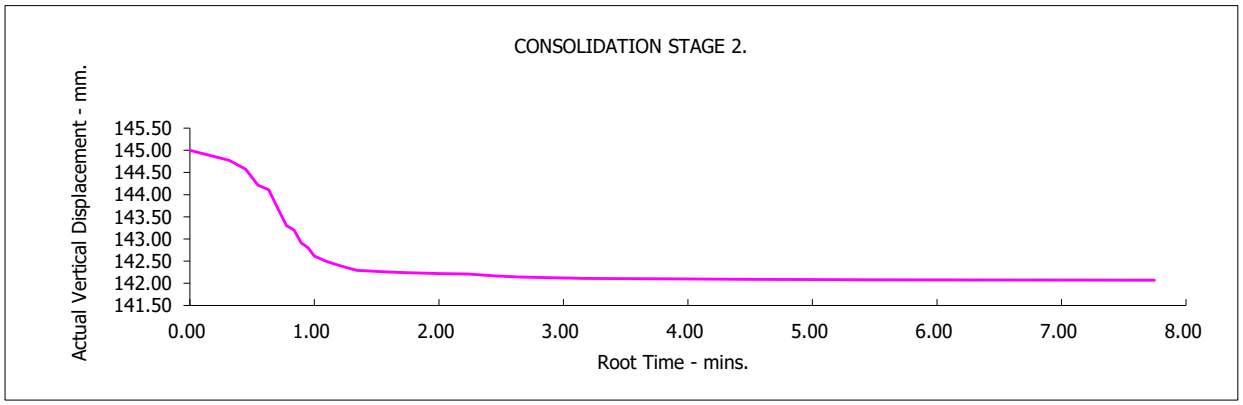
Figure.

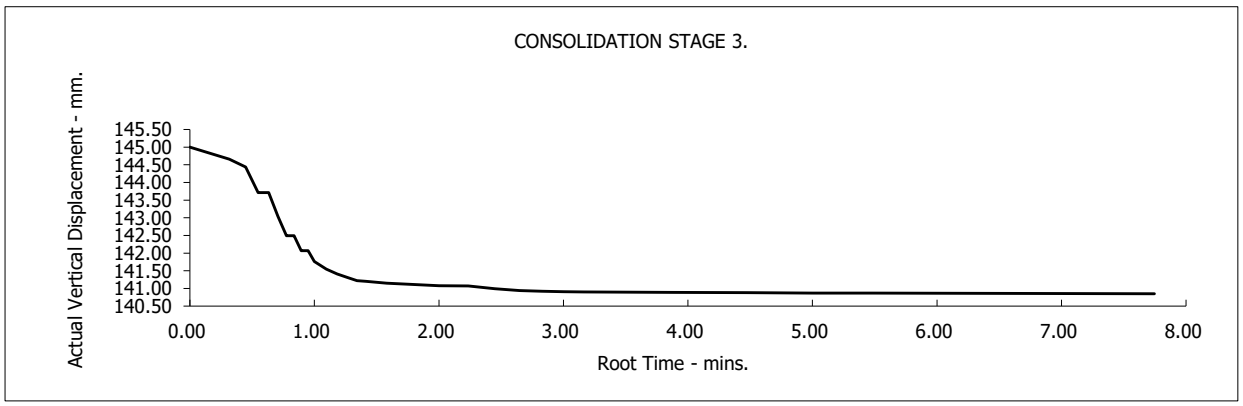
Test Report: CONSOLIDATED DRAINED LARGE SHEARBOX TEST.

BS1377:Part 7:5 :1990.

Borehole/Sample Number: TP607+TP609 Depth (m): 1.00+2.00







Contract No.:
40599

Pantteg Landslide, Pen-y-Graig Area

Client Ref Number:
5859E.09

Figure.

Appendix Q

Geophysical Survey Report

(TerraDat, 2018)

GEOPHYSICAL SURVEY REPORT

Project

Geophysical investigation into slip surfaces

Location

Pantteg, Ystalyfera, South Wales

Client

Earth Science Partnership

Head Office
Unit 1
Link Trade Park
Penarth Road
Cardiff CF11 8TQ
United Kingdom

Telephone: +44 (0)2920 700127
Fax: +44 (0)8707 303051
www.terradat.co.uk

TERRA DAT
geophysical **innovation**

Job reference: 6025
Date: September 2018
Version: 2

GEOPHYSICAL SURVEY REPORT

Project

Geophysical investigation into slip surfaces

Location

Pantteg, Ystalyfera, South Wales

Client

Earth Science Partnership

Project Geophysicist R Stevens MESci (Int) FGS

Reviewer: S Hughes PhD BSc FGS

Job Reference: 6025

Date: September 2018

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APPENDICES

- Resistivity tomography
- Resistivity tables
- Seismic refraction
- Seismic MASW
- Electronic appendix – location map of seismic and ERT profiles

1 EXECUTIVE SUMMARY

A geophysical survey was carried out as part of the ground investigation into an active landslip above Pantteg, Ystalyfera. The survey work was commissioned by Earth Science Partnership (the Client). The work was designed to complement the invasive investigation by providing detailed information on the thickness of superficial deposits and identify potential slip surfaces. The survey took place between on the 21st and 22nd June 2018. Two boreholes have subsequently been drilled in August 2018 and a review of the data was completed.

The geophysical methods used were electrical resistivity tomography (ERT), seismic refraction and Multichannel Analysis of Surface Waves (MASW). Two 142m long profiles were acquired perpendicular to the slope on a plateau region at the top of the landslip area.

The resistivity tomography survey has defined a near-surface highly resistive dry granular superficial/backfill layer that extends in places to a depth of 10 m. Within this layer, there is a central zone of increased conductivity which either reflects increased moisture or clay content. This central conductive zone appears to increases in size downslope. The underlying conductive zone is laterally extensive and based on the seismic data, seems to represent a combination of more compact superficial deposits, weathered bedrock and competent bedrock. There are some local variations, and these may reflect relative changes lithology, weathering, water content or some form of a structural feature. As both boreholes record no groundwater strikes, the main resistivity control factor must be clay content or lithology. The correlation with the boreholes is slightly inconsistent reflecting the variable ground conditions.

The overall quality of the seismic refraction data and resulting velocity models are considered acceptable, but the corresponding RMS error for the velocity modes are higher than what is normally attained. There is a reasonably good correlation between the corresponding P-wave and S- wave velocity boundaries. However, there are some disparities, which can be relatively common where there are local variations in the weathering profile or subtle changes in lithology/groundwater. Comparison of the P and S-wave boundaries suggest an increased transitional zone between weathered and competent bedrock the further upslope. Correlation with the boreholes suggest that rockhead is represented by the top of layer 3 (p-wave), while the lower refraction boundaries are more competent layers within bedrock. This inferred rockhead boundary seems to be gently sloping to the south-east ranging between 7.5 and 11 m bgl (133 to 147 mOD).

A number of possible geophysical monitoring and early warning systems have been suggested; these include time-lapse self-potential and resistivity, micro-seismic monitoring and Interferometric Synthetic Aperture Radar (InSAR).

2 INTRODUCTION

A geophysical survey was carried out as part of the ground investigation into an active landslip above Pantteg, Ystalyfera. The survey work was commissioned by Earth Science Partnership (the Client). The work was designed to complement the invasive investigation by providing detailed information on the thickness of superficial deposits and identify potential slip surfaces. The survey took place between on the 21st and 22nd June 2018. Data was collected for ground engineering properties and detailed geological information along two profiles. Two boreholes have subsequently been drilled in August 2018 and a review of the data was completed.

2.1 Site description

The survey area is situated above the village of Pantteg, which lies between Ystalyfera and Godre'r Graig within the Swansea valley. The focus of the survey was dipping plateau region towards the summit of the hillside and consisted of very uneven ground that was covered in vegetation (ferns, heather and brambles). The survey was centred on National Grid reference 276000E, 208050N and comprised of two 142 m long profile lines that were perpendicular to the slope (Figure 1 and Plate 1). To allow access along the profiles lines, some vegetation clearance was carried out before the survey.

Historically, the area has been extensively mined for coal with several coal levels recorded within the study area. Also, quarrying of sandstone has also occurred with the area, and evidence suggests that this ended before 1960.

Since the earliest records, twenty-six landslip events have been recorded in Pantteg. The most recent large ground movement occurred in 2012 blocking the road opposite Pantteg chapel. Groundwater flow is believed to be a large contributor to the instability.

It is anticipated that the results of the geophysical survey will assist with the development of a ground model that Earth Science Partnership will use as a basis to create a suitable management system and a possible early warning system that enables decisions and reactions to emerging conditions and environmental factors.

Plate 1: *Survey location looking north (left), and looking south (right)*

2.2 Geological setting

British Geological Survey records GeoIndex (NERC, 2018) and borehole logs (Halcrow,1989 and ESP 2018) indicate the presence of the following bedrock and superficial deposits at the site:

Superficial:

- Quaternary-age Landslide/Slip deposits of unknown/unclassified rock type

Bedrock:

- Llynfi Member which comprises of micaceous lithic arenites with thin mudstone/siltstone, seat earth interbeds and thin coals. The Llynfi member is separated into a sandstone member and a mudstone, siltstone and sandstone member.

- South Wales Upper Coal Measures which comprises of coal-bearing mudstones/siltstones with seatearths, minor sandstones, coals and ironstones.
- South Wales Middle Coal Measures which comprises coal seams among mudstones, sandstones and siltstones.

2.3 Survey objectives

The primary objective of the survey is to determine the thickness of superficial deposits and identify potential slip surfaces.

2.4 Survey design

Given the survey brief, it was decided to adopt an integrated survey approach comprising of the following techniques*:*

- **Resistivity tomography (Wenner-Schlumberger configuration)** to provide electrical cross-sections along selected survey profiles that allow identification of geological boundaries, structures and lateral heterogeneities including variation in material composition, weathering, and faulting.

- **Compressional (P) wave seismic refraction** – to provide seismic velocity model sections that indicate the thickness of superficial deposits and the depth to non-rippable bedrock, in correlation with standard tables.

- **Shear (S) wave seismic refraction** – to provide seismic velocity model sections that indicate the depth to compacted sediments, weathered rockhead and more competent (higher shear strength) bedrock.

- **MASW (Multichannel Analysis of Surface Waves)** – to derive shear velocity ('S-wave' or 'V_s') from rolling surface waves, which can be used where velocity inversions are encountered.

Correlation of the models derived from the compressional (P) wave survey, shear (S) wave surveys and MASW can increase the degree of certainty for both seismic methods since they exploit different physical properties of the ground. In addition, overlying seismic model results on the

resistivity sections allows calibration in terms of identifying potential structural features that extend below rockhead.

2.5 Quality control

The geophysical data sets were collected in line with normal operating procedures as outlined by the instrument manufacturer and TerraDat company policy. On completion of the survey, the data were downloaded from the survey instrument on to a computer and backed up appropriately. The acquired data set was initially checked for errors that may be caused by instrument noise, low batteries, positional discrepancies, etc. and any field notes are either written up or incorporated in the initial data processing stage. The data set is then processed using the standard processing routines and once completed; the resulting plots are subject to peer review to ensure the integrity of the interpretation. Our quality control standards are BS EN ISO 9001: 2015 certified.

3 SURVEY DESCRIPTION

The survey was carried out using the following geophysical methods as outlined above in Section 2.4:

- Electrical resistivity tomography
- P-wave seismic refraction (employs compressional waves)
- S-wave seismic refraction (employs shear waves)
- MASW (Multichannel Analysis of Surface Waves)

Background information on the survey methods is provided in the appendices and descriptions of the actual survey work carried out on the site are provided in the sections below.

3.1 Survey limitations and considerations

For the geophysical survey to fulfil the survey brief, there must be a measurable response between the target features and host material. Some of the main limitations and consideration are included below.

Seismic refraction requires that the velocity of the materials in the subsurface increases with the depth of burial. This is usually the case since (i) the degree of compaction within the overburden typically increases with depth, and (ii) bedrock condition improves with depth as weathering is reduced, both of which lead to higher seismic velocities. Therefore, one limitation of the refraction method is the inability to resolve localised weak zones within rock where it resides at a depth below the competent non-weathered rock.

The survey output from both the P and S-wave refraction surveys are cross-sectional models that describe the bulk physical properties of the ground in terms of superficials, weathered rock and competent rock layers. There will be local variations in strength within the interpreted layers as a result of weathering, groundwater, lithology and the fracturing.

One of the main objectives of the resistivity tomography survey is to target potential slip zones. Ideally, weak/broken zones in the rock where clay-rich material/ water have infiltrated, or a loss of fine-grained sediment voiding, will sufficiently alter the local ground resistivity to allow detection.

3.2 Survey layout

TerraDat established two profile lines orientated perpendicular to the slope, on a dipping plateau region at the top of the landslip. The start and end coordinates for each profile are provided in Table 1 and mapped position is shown in Figure 1. They are also provided in electronic format on an accompanying AutoCad plan. To establish if there is a change in the thickness of superficial deposits downslope, one profile was located against the back cliff, while the second was located as close as practically possible to the break in slope.

Profile Line ID	Start		End	
	Eastings	Northings	Eastings	Northings
P1	275962.65	207995.79	276036.60	208113.79
P2	275956.17	208004.04	276024.63	208123.89

Table 1: *Profile start and end coordinates*

The profiles were 142 m in length all locations were surveyed using a *TOPCON HiPer Pro* dGPS system, with an accuracy of +/- 2.5 cm and referenced to National Grid (OSTN02) using the Topcon network correction.

3.3 Resistivity Tomography

3.3.1 Soil resistivity and resistivity tomography – field activity

A 72-channel *IRIS SYSCAL* resistivity system (Plate 2) was used to acquire resistivity tomography profiles using the Wenner-Schlumberger electrode array. To ensure suitable resolution, ground coverage and depth of penetration, the resistivity survey employed an electrode spacing of two meters, yielding modelled sections approximately 20 m deep.

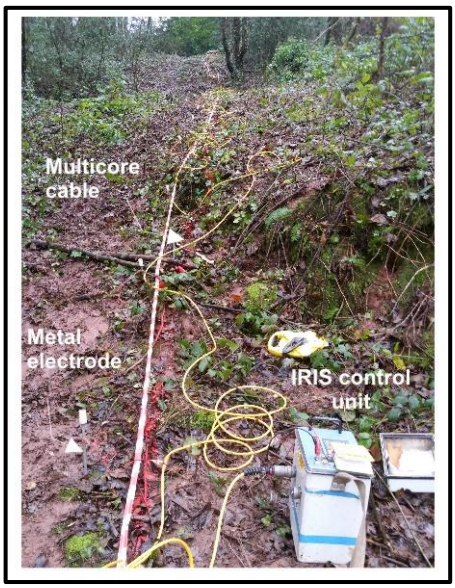


Plate 2: *Typical resistivity tomography field set-up (library photo)*

3.3.2 Resistivity survey data processing

The resistivity data were downloaded from the SYSCAL instrument and initially edited using the dedicated PROSYS software package. For the tomography data set, the ground levels for each electrode were incorporated and the resistivity data set was subsequently processed (inverted) using RES2DINV software to derive modelled 'true' electrical cross-sections of the subsurface. The final inversion models used have an RMS error of less than 10 and are the third iteration. The resulting resistivity section was plotted using SURFER and then exported to CorelDraw for final annotation and presentation.

3.4 Seismic survey – P and S-wave refraction

A seismic survey involves generating a shock wave signal at the surface to investigate the geological structure beneath a chosen profile line. A series of vibration sensors (geophones) are deployed along the line and are used to record the travel times of incident seismic signal as it returns from below ground. Features such as rockhead, the water table, made ground, soft sediments and dense tills all have distinct velocity ranges and can be imaged in cross-section using a seismic refraction survey. A description of the field activity is provided below, and some further background information on the survey method can be found in the appendix.

P, S-wave seismic data were acquired along two 142 m long profile lines (Figure 1) both lines were orientated southwest-northeast, starting in the southwest corner.

3.4.1 Seismic survey field activity - Compressional (P) wave refraction

P-wave seismic refraction data were acquired along profile lines using a high precision 72 channel *GEODE* seismic system (Plate 3a). To target the broad depth range, low frequency (4 Hz) geophones were deployed at two-metre intervals providing individual geophone spread lengths of 142 m. The seismic wave was generated by a combination of sledgehammer striking a plastic plate and Seismic Impulse Device (SID) firing a sequence of 12 and 8 gauge black powder cartridges (Plate 3b). To build up the refraction data set, seismic shots were taken at several positions along the geophone spread (usually every six geophones) and at set distances beyond the geophone spread. For this particular survey, the 'offend' shots were typically taken at 10, 20, 50, and 70 m. Offend shot positions were chosen to ensure signals

from the competent rock were recorded along the entire survey line in both forward and reversed directions.

Plate 3: *a) Field set-up and b) Seismic Impulse Device deployment (library picture).*

3.4.2 Seismic survey field activity - Shear (S) wave refraction

The S-wave seismic refraction data were acquired using the same geophone cable and *GEODE* seismic recording system as the P-wave survey, but utilising the horizontal sensors in the 2-component geophones. A weighted S-wave 'H' plate struck sideways with a sledgehammer was used as the energy source (Plate 4). At each shot location, the 'H' plate was aligned perpendicular to the profile line and subsequently struck on both ends sequentially to generate two sets of shear wave recordings with opposite polarity. This enables precise identification of the shear component of the seismic signal on the field records. Shots were deployed at several positions along the geophone spread and beyond both ends, typically at the same locations as the P-wave survey.

***Plate 4**: S-wave source plate (library photo).*

3.4.3 Seismic refraction survey data processing

The approach used to pick first arrivals: The first stage of data processing involved the accurate determination of the first-arrival times of the seismic signal (time from the shot initiation to arrival at each recording geophone) for every shot record using PICKWIN. This is an involved process and is done manually since auto-picking routines are not reliable for on land environments.

Raytracing and Inversion: Time-distance graphs showing the first-arrival times were generated for each seismic line and analysed using PLOTREFA software. The first step is to determine individual seismic layers and their velocity by '*phantoming*' travel-time curves and '*minus time*' analysis, respectively. Raytracing inversion is then carried out to derive a simple transitional model. Subsequently, the transitional model is converted into a starting layer model using the layers and measured velocities from the first analysis step. The starting model is then run through a repeated inversion process involving significant manual control, allowing layer depths and (to a lesser extent) velocities to vary. This is not an entirely automated process, and manual constraint of the inversion using geophysical principals and known physical parameters of the local geology is required.

The final output of a seismic refraction survey is a velocity model section of the subsurface based on an observed layer sequence with measured velocities that correspond to physical properties such as levels of compaction/saturation in the case of sediments and strength/rippability in the case of bedrock. A transitional velocity model may be considered if

distinct layers are not expected, or velocity contrasts between layers are marginal. However, a layered model appears most appropriate for this site. The final sections were exported to CorelDraw for annotation and presentation.

3.5 Seismic survey – MASW

Multichannel Analysis of Surface Waves (MASW) employs 'rolling' surface waves to derive shear velocity. This is achieved through analysis of the dispersion that occurs as surface wave energy propagates through the subsurface and separates into different frequencies travelling at different velocities depending on the stiffness of the sediments and/or rock encountered.

This technique utilises Rayleigh-type surface waves (normally considered noise in seismic refraction/reflection surveys and called "ground roll") recorded by multiple geophones deployed on an even spacing and connected to a common recording device (seismograph), as shown in Plate 5.

As the dispersion of the seismic wave can be dependent on the geology and ground conditions (i.e. variability, terrain, etc.), MASW profiles are usually limited to relatively flat areas or where the ground is more homogenous.

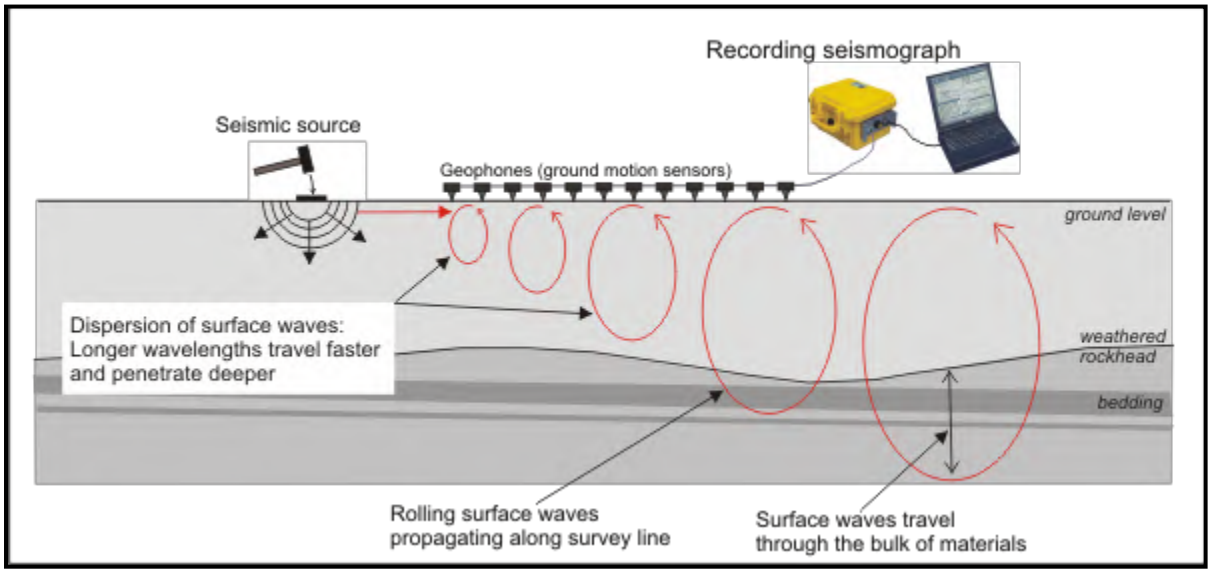


Plate 5: *MASW survey setup*

3.5.1 Seismic survey field activity: MASW

For this particular survey, a static geophone spread approach which was similar to the refraction set-up was used. However, instead of a discrete number of shot points, shots were acquired at every other geophone position along the profile. In this case, low frequency (4Hz) geophones were set at two-meter intervals, and the data were acquired using a sledgehammer plate. 18 geophones were used to create the dispersion curve; this is why the MASW section is shorter than the refraction data sets.

3.5.2 Seismic survey data processing - MASW

Analysis of surface waves recorded on multichannel shot records was carried out using SurfSeis™ 5.0 software, which considers the dispersion properties of all types of waves (both body and surface waves) through a wave field-transformation method. This directly converts the multichannel record into an image, where a dispersion pattern is recognised, and the necessary dispersion properties are extracted. These dispersion properties are used to generate modal dispersion curves that are subsequently inverted and used to produce the resultant shear-wave velocity (Vs) profile.

For this particular data set, only the fundamental mode was picked, and for consistency between the models, the same initial layer model parameters were used in the inversion process. Where it was not possible to pick a dispersion curve, the sounding was replaced with linear infill, between adjacent soundings. The final velocity sections are created in SURFER then exported to CorelDraw for annotation and presentation.

4 RESULTS AND DISCUSSION

The results of the geophysical surveys are presented as resistivity tomography modelled sections in Figure 2 and seismic P, S-wave and MASW velocity modelled sections in Figures 4 and 5. Important boundaries taken from the seismic refraction surveys are overlain on the resistivity sections to aid interpretation. A general description of the interpretation process and summary findings for each technique is given below.

With the subsequent borehole information, it has been possible to correlate the rock head boundary with the resulting velocity model for profile 2. By extrapolation, it was possible to

consider the lateral variation between the profiles lines (Figure 6) and provide additional information on the rockhead geometry.

The overlaid boreholes are simplified to help aid the interpretation, where there is no description present for a layer the legend of the boreholes was used to infer the lithology. For example, the coal seam at the base of the made ground in BH602 is inferred from the lithology, as it has not been described in the given logs.

4.1 Resistivity tomography

The results are presented as a series of colour contoured scaled cross-sections of the subsurface showing changes in resistivity (Figure 2). The horizontal axes display chainage along the profile line with the vertical axes displaying elevation above ordnance datum.

The interpretation of the modelled true resistivity sections is based on published electrical properties of typical sub-surface materials (see appendix), and these have been correlated with on-site information/observations. Available trial pits within 10 m were overlain on the ERT profiles. For the 1989 Exploration Associates Limited trail pits, the location map was first georeferenced in order to locate the trial pits on the landslide.

4.1.1 Resistivity tomography features discussed

There is a good correlation between the adjacent ERT profiles, both exhibiting up to five distinct features. The modelled resistivity values range from ~100-2600 Ohm.m, which is relatively broad considering the anticipated lithologies. This suggests a variety of different materials present within the shallow subsurface of the site together with potential variations in groundwater. Values <100 Ohm.m are generally considered to be clay-bearing with increasing clay content proportional to the declining values (though moisture, where present and depending on its chemistry can also reduce resistivity values). Values over 100 Ohm.m indicate the increasing dominance of granular material and reduction in moisture content. Where they occur at shallow depths, very high values typically indicate relatively more granular materials, where deeper they typically indicate the presence of competent bedrock.

To provide some depth calibration, the inferred shear wave bedrock refraction boundary has been overlaid on to the sections. One of the P-wave refraction boundaries has also been included, and this could either represent the base of the superficial deposits or water table

(please refer to section 4.2.1 for more detail). As there is currently no boreholes along the profile lines, the following interpretation is subjective and may be revised following the additional information.

4.1.2 Resistivity tomography features discussed

There is a good correlation between the two ERT profiles, with four differing geoelectrical units these are described below.

Upper resistive unit F1: This represents a layer of near surface resistive material (600-2600 Ohm.m) that is observed towards both ends of the profile line. This layer varies in thickness of between 2 and 10m and in places, the base of this layer correlates well with the overlain P-wave boundary (i.e. the base of superficials/water table). Comparison between the two profiles, suggests that this layer is better defined (i.e. more consistent) on Profile 1 rather than on Profile 2. The increased variability on Profile 1 may reflect more localised variations in clay/water content. In terms of interpretation, this material is likely to represent dry clay deficient superficial deposits or backfill.

Upper intermediate unit F2: This represents a layer of intermediate resistivity values (300-500 Ohm.m) that seem to extend from the ground surface to around 5 to 8 m bgl and occupies the central region of each profile. On Profile 2, this layers extends between chainage 60 and 80 m, while downslope on Profile 1, it seems to increase in width (chainage 60 to 90 m).

This unit either reflects a relative change in lithology (i.e. increased clay content) within the superficial/backfill material or increase water content. From walking the profile lines, there did not appear to be any obvious change in surface cover/character to suggest a significant change in ground conditions.

Near-surface isolated conductive areas F3: There appear to be isolated conductive zones (400-500 Ohm.m) within the upper resistive unit (F1). These are relatively shallow and are interpreted as pockets of more clay-rich/ increased moisture content.

Lower conductive unit F4: The lower conductive unit (100–500 Ohm.m) is latterly extensive across both profiles and extends from a depth of around 5 m to beyond the base of the section. The upper boundary between this unit and upper resistive unit F1 is relatively well defined but is less constrained below the upper intermediate layer F2. Within this unit, there

are some local variations in resistivity (e.g. F5) which reflect relative changes in clay/water content.

Based on the seismic data, this conductive unit does not seem to be able to differentiate between weathered and competent bedrock strata. Until there is some additional borehole information, then the interpretation is limited.

Localised resistive unit F5: Within the lower conductive unit, there are some local variations in resistivity which reflect relative changes in clay/water content. Feature F5 has been highlighted as this represents a sub-vertical resistive (relative) feature that is observed on both profiles. Depending on the bedding, these features can be indicative of discontinuities such as faulting/fractures or differential weathering.

4.1.3 Resistivity tomography features interpreted with the August 2018 available borehole information

As both boreholes did not encounter any groundwater, the resistivity is therefore interpreted to be controlled by the clay-content/lithology. There is a reasonably good correlation between borehole 601 with the made ground being more resistive than the underlying bedrock. However at borehole 602, this boundary is less defined, due to lack of contrast between the made ground and bedrock. This lack of contrast can be explained by the presence of toppled blocks of bedrock within the made ground.

4.2 Seismic Refraction – compressional (P) and shear (S) wave

Interpretation of the refraction sections (Figures 4 and 5) is based on the widely understood and published velocities of common sub-surface materials as displayed in Figure 3. To assist with the interpretation, the available trial pits within 10 m of the profiles have been overlain on the seismic sections. No boreholes close to the profiles had been undertaken when the survey was commissioned.

Given the prevailing ground conditions, the quality of the seismic data was comparatively good, especially as at some locations, it was difficult to achieve good ground coupling with the geophones. However, during the data processing, it was noticeable that there were some discrepancies between some of the traces/shot records. Even though the resulting seismic refraction velocity models are acceptable, the models do exhibit a higher than normal RMS error. For example, a typical P-wave model should have an RMS error of ≤1m/s, while for this

site, the error was in the order of 2.5m/s. A similar order of increase was observed with the S-wave. While there is no quantitate RMS error with MASW, the dispersions curves were of reduced quality.

4.2.1 Compressional (P) wave

Analysis of the P-wave refraction data for this site suggests that up to four distinct layers of contrasting velocity (V_p) are present. This analysis is based on the examination of the time-distance graphs in combination with the development of a best-fit model that follows an iterative process of forward modelling and tomographic inversion. Initially, the results are considered regarding transitional models and then if appropriate, transformed into a layered model. The key aim is to produce a best-fit layered velocity model that is in equilibrium with both the seismic data and the local geology.

As a guide, the resolution of a given refraction boundary is typically considered to be about 10% of its depth below ground level, which for a boundary at 10 m depth, would be +/- 1m. However, at very shallow depths, the resolution may vary/decrease as a function of geophone spacing and ground consistency. It is worth noting that the seismic refraction section represents the measured bulk characteristics of the subsurface and in some cases, it can prove difficult to correlate with point source data (boreholes/trial pits) where the underlying material is variable.

The typical soil/rock description of each of the layers derived for the four-layer ground model is given in Table 2 below.

Layer	P-wave velocity	Soil/Rock Description
P1 (pink)	280 m/s (very low)	Weak near-surface layer of made ground/colluvium
P2 (orange)	520-659 m/s (Low velocity)	Consolidated superficial/backfill material
P3 (green)	1518 - 1522 m/s (medium velocity)	Very dense/wet sediments or soft/weak/fractured bedrock
P4 (turquoise)	>2269 m/s (high velocity)	More competent/less weathered bedrock strata.

Table 2: *A guide to P-wave velocity related to superficial/rock description for the site.*

Layer P1 has a distinctly low velocity and usually relates to the loose near-surface superficial material (i.e. soft soil/ lose spoil). The range of velocities exhibited by Layer P2 reflects increase consolidation of the dry superficial/backfill material.

Layer P3 can be more intricate to discriminate as the overlap in velocities means that it can represent both sediments (dry compact or wet) and in some cases bedrock strata (weathered/weak/fractured). The most effective way to differentiate between sediment and rock type material is to consider the corresponding S-wave velocity, as discussed below.

Layer P4 represents the highest (and deepest) velocity unit and is likely to reflect a competent boundary within the bedrock strata.

4.2.2 Shear (S) wave

By carrying out a similar analysis of the S-wave refraction data, the subsequently derived three layer velocity model (Table 3) may be correlated against the standard S-wave velocity tables (Figure 3). In general, the shear-wave velocity (V_s) is much more sensitive than the P-wave velocity (V_p), where the ground becomes abruptly stiffer due to increases in rock strength. For this reason, it is possible to use the V_s to distinguish between sediments and 'rock' (i.e. cemented) material, which is particularly useful for differentiating the P-wave layer P3. A further advantage of shear waves is that they are unaffected by the groundwater table.

Layer	S-wave velocity (m/s)	Soil/Rock Description
S1 (light grey)	70-100 m/s	Soft soil - weak near-surface layer
S2 (mid grey)	319-335 m/s	Stiff soil - poorly consolidated sediments
S3 (dark grey)	>771 m/s	Bedrock

Table 3: *A guide to S-wave velocity related to superficial/rock description for the site.*

When comparing the resulting P-wave and S-wave velocity sections, there is a rough 'rule of thumb' with regards to the ratio of the velocities. For unconsolidated sediment, V_p/V_s is usually between 4.0 to 8.0, while for consolidated rocks, the V_p/V_s ratio can vary between 1.5 to 2.0.

Even though these are accepted values, they can vary between sites depending on the geology and ground conditions.

A further consideration is a correlation between the respective P-wave and S-wave refraction boundaries. These can vary depending on survey parameters, weathering profile, lithology and bedding structure.

4.2.3 MASW

The results of the MASW survey are presented as colour contoured S-wave velocity panels showing changes in velocity (i.e. ground stiffness) below the surface. The vertical and horizontal axes respectively display depth/elevation and chainage along the profile line. In principle, an increase in velocity usually indicates a relative increase in material stiffness. The velocity panels have been overlaid with the interpreted S-wave refraction boundaries, which can assist the interpretation. The MASW technique can often resolve velocity layers (especially 'hidden' low-velocity layers) which are not detectable by the refraction method. Generally, though, the calculated S-wave velocities from the MASW survey can be slightly underestimated compared to the refraction survey due to the 'averaging' effect of the seismic wave dispersion.

4.3 Discussion of seismic results

The resulting refraction sections display a very good consistency of the measured velocities. There are some subtle variations between the individual profile lines, but this is likely to reflect the variable conditions associated with the local geology.

The lower P-wave refraction boundary on both profiles (P4) is relatively undulant and varies in depth of between 10.0 and 15.0 m bgl (130 to 135 mOD). This boundary generally rises with the topography towards the northwest. Based on the P-wave velocity (V_p) of greater than 2313 m/s, this lower refraction boundary represents a more competent/less weathered boundary within the bedrock strata (P4).

The top of layer P3 in both sections (V_p 1518 to 1522 m/s) is again slightly undulating 6-8 m bgl. In Profile 1, layer P3 thickens from the southwest to the northeast from 3.5 m to 10 m

respectively. While in Profile 2 there is a more consistent thickness of 5-6 m. This is likely to represent a transitional zone that includes a combination of saturated/compact sediments and weathered bedrock. With the addition of borehole information, this is interpreted as rockhead.

By considering the S-wave sections, it is apparent that at the southern end of the profiles, both the lower P and S-wave boundaries coincides, but further north, it almost correlates with the top of layer P3. Based on the velocity of $>V_s$ 771 m/s, this lower S-wave boundary was previously interpreted as bedrock strata, with the addition of boreholes this now interpreted to not be the case. The slight deviation between the P and S-wave boundaries can be relatively common on sites where there are local variations in the weathering profile or subtle changes in lithology/groundwater. This deviation is slightly different between each profile line and the apparent increase in deviation on Profile 1 may suggest less of a transitional zone further downslope

Layer P2 forms an irregular layer which represents less consolidated; dry sediments interpreted as superficial/backfill material (V_p 520-659 m/s). In Profile 1, this layer varies in thickness from around 0.5 to 5 m. Generally, it is around 4 m thick, with marked reductions at chainage 40, 91 and 125 m. For Profile 2, it seems more consistent in thickness, approximately 3.5 to 4 m.

At the surface, there appears to be a relatively thin layer between 0.5 and 3 m thick of loose soils/spoil material with a typical velocity for the unconsolidated material (P1/S1). The majority of the trial pits only extend into this layer, so this is interrupted as made ground and colluvium.

With regards to the accompanying MASW sections, there is a marked rise in S-wave velocity at around 8m bgl (as represented by a gathering of the contour lines). There is a good correlation on Profile 1 with the corresponding S-wave refraction boundary (as indicated by the dashed lines). However, on Profile 2, the marked rise in S-wave velocity is shallower than the S-wave refraction. By coincidence, this MASW boundary seems to match better with the top of P-wave layer P3 which related to an increase in stiffness towards the base of the base of the superficial/backfill deposits / weathered rock. On Profile 2, there are areas of increased velocity near the surface; this is interpreted to be a result of poor dispersion due to the ground conditions within these areas and possibly a result of large toppled blocks. No velocity inversions are observed within the MASW profiles.

4.4 Review of seismic data with the aid of the August 2018 boreholes

Both boreholes have a good correlation between the rockhead / base of the made ground and the top of the P-wave boundary for layer 3. This is observed in both boreholes. This interpretation has been extrapolated onto profile 1. The combined plot presented in Figure 6a suggest that rockhead dips slightly downslope with a maximum vertical variation of up to 5 m. Given the offset distance between the two profiles of approximately of 10m, simple calculations suggest a nominal dip angle of 14°, increasing to a maximum angle of 27° in places. To illustrate the later variability in elevation, the data has also been gridded and contoured (Figure 6b) and the resulting plot indicates a gentle dip north to south across the survey area.

As for the deeper refraction boundaries, correlation with the boreholes is not as clear, due to the limited depth of BH602, is primarily based on BH601. There is some correlation between the top of the P-wave layer 4 and S-wave layer 3 with the increase in the RQD value in borehole 601. There is a slightly better correlation between boreholes and the MASW, this is possibly related to an increase in stiffness towards the base of the base of the superficial/backfill deposits / weathered rock

5 CONCLUSIONS

- The geophysical survey has provided a non-invasive means for investigating the subsurface with a high degree of spatial coverage in an area of difficult access. The resulting sections exhibit a similar feature throughout the area that reflects the consistency of the ground conditions.

- The modelled resistivity sections were characterised by zones of contrasting resistivity values that reflect lithological, hydrogeological, structural and weathering variations within the sub-surface. Five features have been identified based on their geo-electrical properties and correlation with the seismic boundaries.

- The resistivity tomography survey has defined resistive superficial deposits with an undulating base interpreted to be a result of increased moisture and or clay content.

There is a central area in the superficial material that has a decreased resistivity. This is interpreted as increased moisture and or clay content, this central zone increases in size downslope. As both boreholes indicate dry ground conditions, the resistivity is therefore interpreted to be controlled by the clay-content/lithology. There is a reasonably good correlation between borehole 601 with the made ground being more resistive than the underlying bedrock.

- The overall quality of the seismic refraction data and resulting velocity models are considered acceptable, but the corresponding RMS error is higher than what is normally be attained. This primarily reflects the variability in the shallow ground conditions. However, this has still provided detailed information to assist with the bulk characterisation of the shallow subsurface. There is a reasonably good correlation between the corresponding P-wave and S-wave velocity boundaries. Where there are some disparities, this is interpreted as local variations in the weathering profile or subtle changes in lithology/groundwater.

- On profile line 2, there is a good correlation between the boreholes with made ground/rockhead boundary corresponding with the top of the P-wave layer 3. By extrapolating this interpretation onto profile 1, rockhead seems to vary between 7.5 and 11m bgl (133 to 147m OD). Simple calculations suggests that between the profile lines, it exhibits a nominal dip angle of 14°, increasing to a maximum angle of 27° in places.

- The comparison of the P and S-wave boundaries suggest an increased transitional zone between weathered and competent bedrock the further upslope.

- The MASW profiles are consistent and they correlate with the shear wave refraction data. No significant velocity inversions have been observed.

- An electronic AutoCAD plan (OSTN02 coordinates) of the resistivity tomography profiles and seismic refraction profiles is included. Handheld GPS instruments are not accurate in this area, and survey grade dGPS units should be used for locating features.

6 FUTURE CONSIDERATIONS: GEOPHYSICAL MONITORING / EARLY WARNING SYSTEMS

It was noted in the Data Review, and Management Proposals report from Earth Science Partnership (report No.ESP5859e.2393 - 00) that the overarching future aim for the landslip is the creation of an early warning system that enables decisions and reactions to emerging conditions and environmental factors.

Based on this information, TerraDat can suggest the following geophysical survey approaches that can provide continuous monitoring systems that potentially could be used for early warning notification.

6.1 Time Lapse Self Potential (TLSP):

This target changes in electrical signal (Self Potential) that is caused by the streaming effect of electrons present in *moving* groundwater. A multi-channel monitoring system could be installed spanning the main area of interest and readings are taken across the whole array at set intervals to monitor changes in the flow/seepage of water within the landslide. Typically, the array comprises up to 16 channels, and the readings were taken at 30-minute intervals.

An initial period of observation is required to establish the local relationship between rainfall, acceleration of groundwater flow, preferential flow-paths and any phase lag with observed ground movements. This should significantly increase the understanding of groundwater movements through the landslide and allow the establishment of a warning strategy based on telemetry linked system and physical observation.

6.2 Time Lapse Resistivity Monitoring (TLRM):

If the slip mechanism is not controlled by moving water then a resistivity monitoring approach could work well. Over time it is possible to model any gradual changes in an area that is becoming more conductive due to progressively elevated moisture content. An inferred increase in the relative moisture or the identification of a preferential migration pathway may be indicative of areas of imminent risk.

Ideally, this resistivity monitoring should be carried using a permanent electrode network. However, this can be relatively expensive to install and maintain and there will be increased security considerations. The alternative would be to carry out a conventional resistivity survey at regular time intervals to provide monitoring data.

6.3 Micro-seismic monitoring:

A micro-seismic monitoring array could be installed that would enable observation of micro-earthquakes associated with the ground movement. This would be relatively expensive to install, and there will be increased security considerations. To gain an understanding of the local amplitude of the seismic signal, a period of calibration would be required compare observed signal versus ground movements. Once calibrated, a signal threshold can be set as part of an early warning system.

However, depending on the slip mechanism, there may be no precursor signal before significant slip event.

6.4 Interferometric Synthetic Aperture Radar (InSAR):

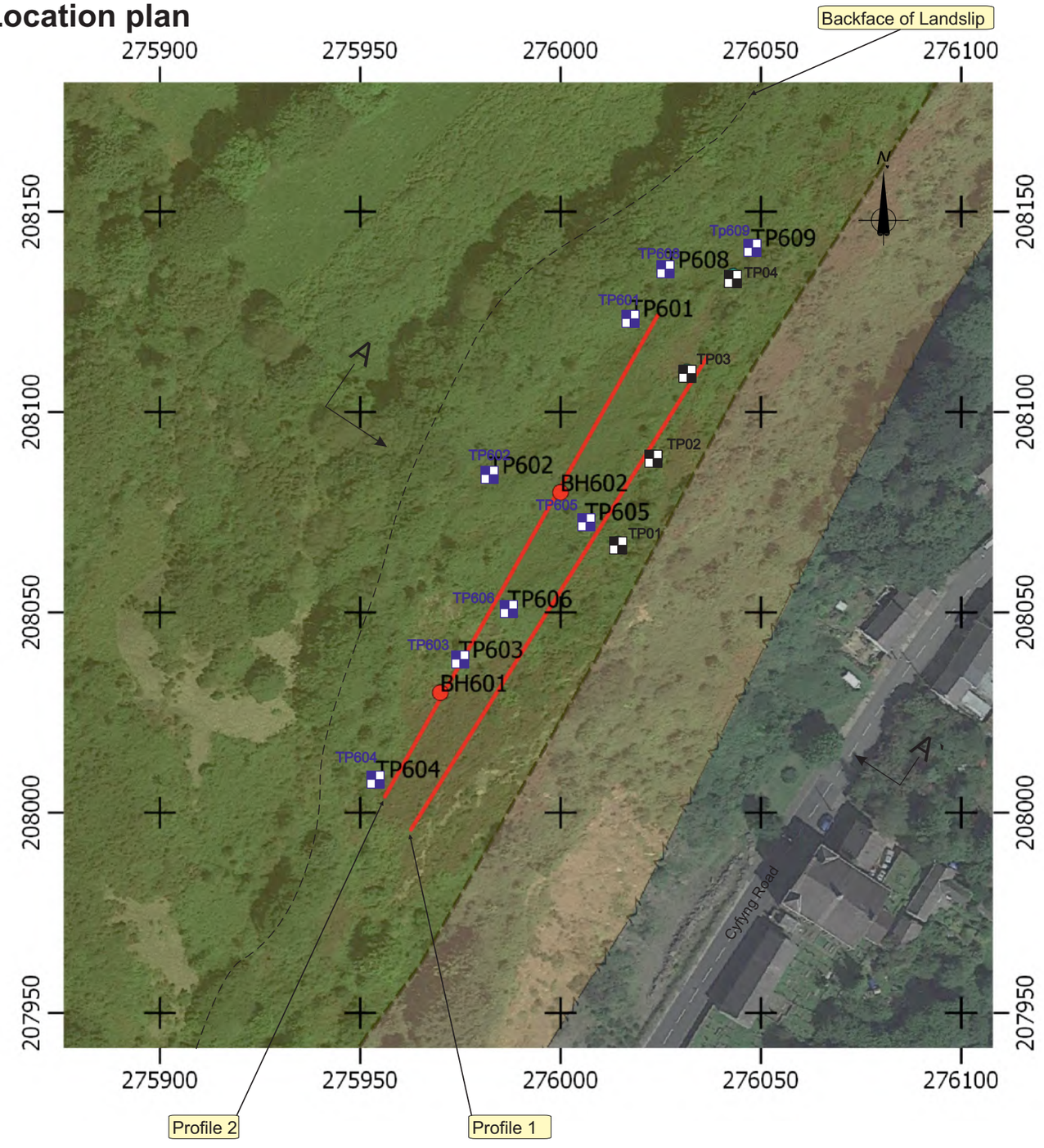
Satellite-based InSAR monitoring utilises radar waves to measure the relative ground movement of coherent points between the two time periods. Even though it can be dependent on local ground conditions, it has been shown to have successfully monitored a number of different landslips across the world. TerraDat is currently working closely with SatSense Ltd to develop a cost-effective approach for engineering applications within the UK.

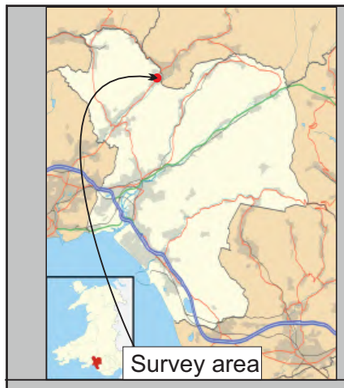
Disclaimer

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.

FIGURES

Location plan





KEY

Survey profile
Both profiles have both electrical resistivity tomography, seismic refraction and MASW techniques.

Cross section line

2018 ESP trial pit locations

2018 ESP borehole locations

1989 Exploration Associates limited trial pit locations

Geological KEY

Llynfi Member sandstone

South wales Upper Coal Measures

South wales Middle Coal Measures

Notes

Source: Map data ©2018 Google.

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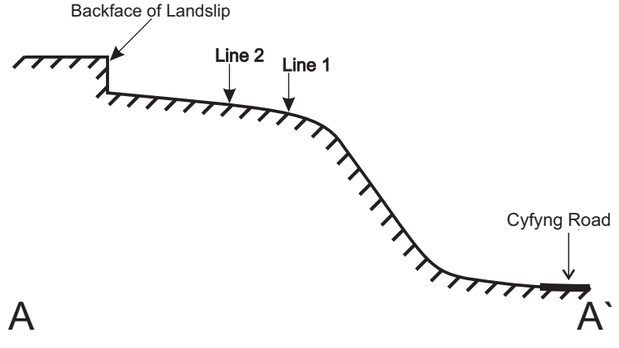
Contains British Geological Survey materials © NERC [2018]

Schematic cross section of landslip



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Title:

LOCATION MAP

Project:

Pantteg Landslip, Ystalyfera

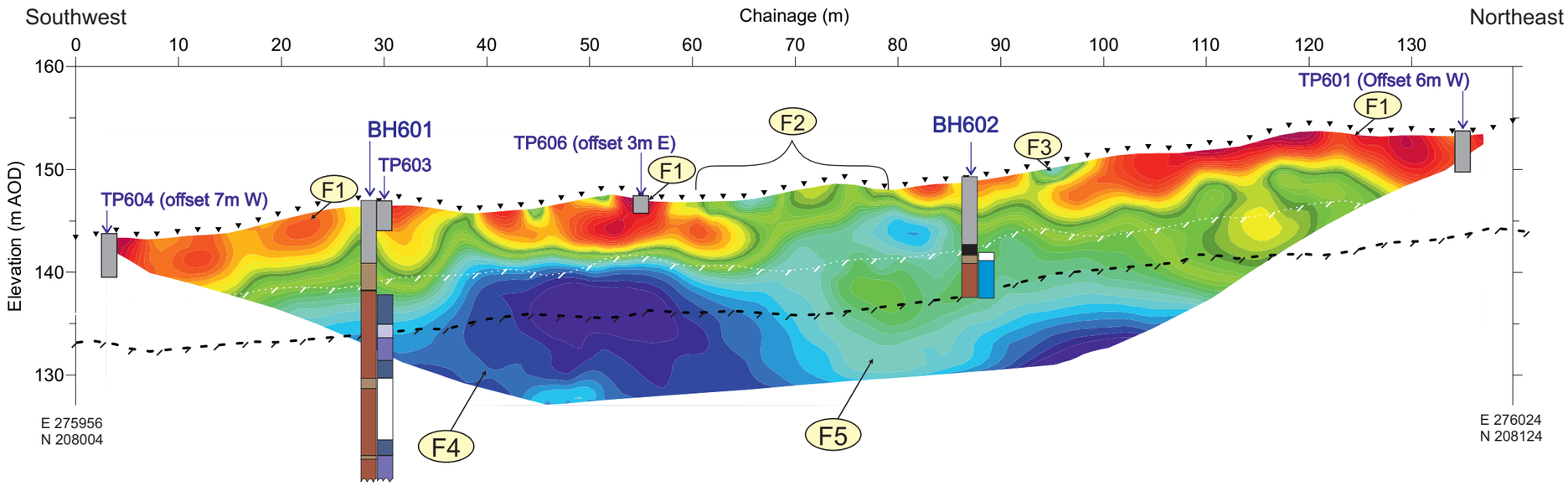
Scale: 1:1250 at A3

Drawn by/Ref: RS/6025/1

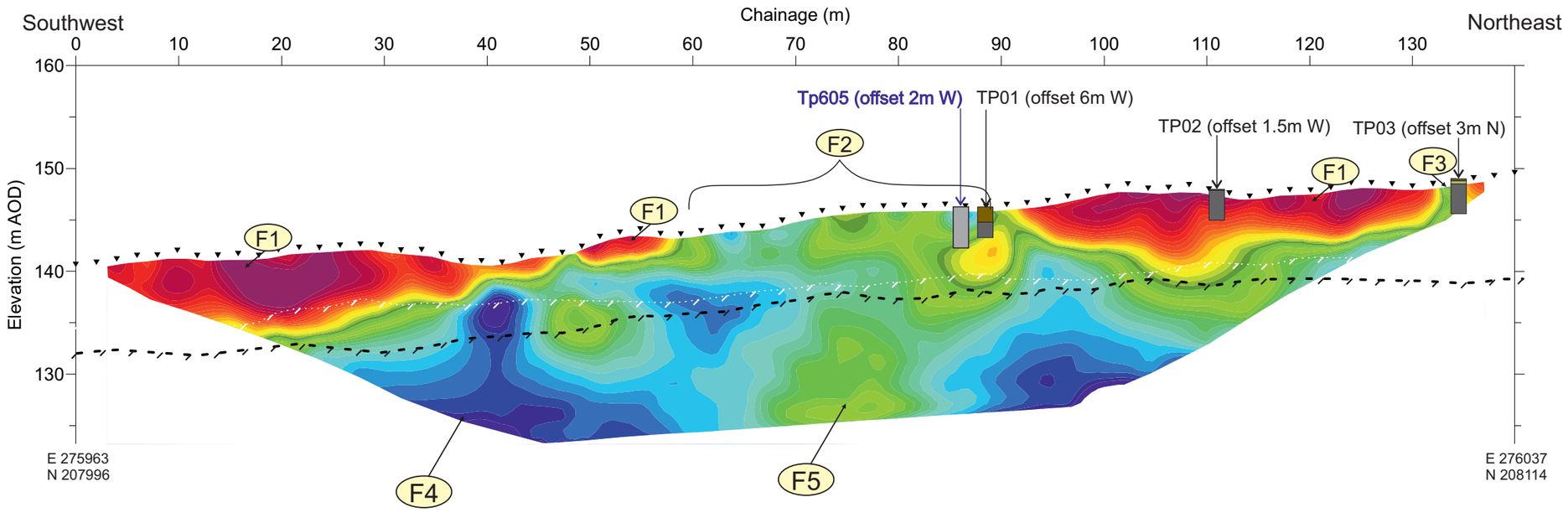
Date: 25th June 2018

FIGURE 1

Electrical resistivity tomography (ERT) Profile 2



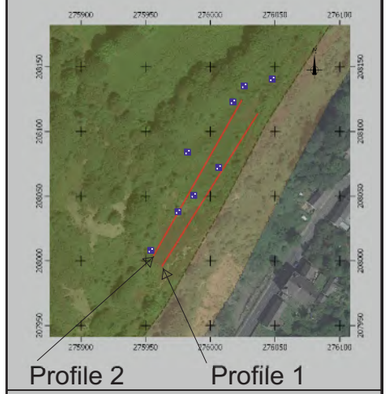
Electrical resistivity tomography (ERT) Profile 1



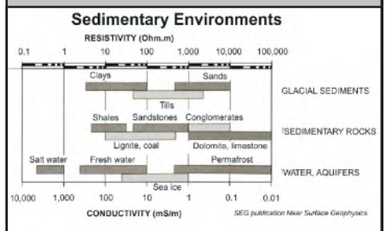
Key to Interpretation

F1 – Upper resistive unit interpreted as clay deficient very dry soils or backfill material
F2 – Upper conductive unit interpreted as increased moisture / clay content in the superficial / backfill material
F3 – Near-surface isolated conductive zone
F4 – Lower conductive unit undifferentiated between weathered bedrock and bedrock
F5 – Localised resistive zone within bedrock strata, represents a relative decrease in clay / moisture content.

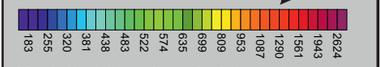
Location Plan (NTS)



Resistivity values of common geological materials



COLOUR SCALE
Increasing resistivity



Modelled "true" resistivity (ohm-m)

KEY

- Electrode location
- S-wave refraction boundary interpreted as competent boundary within bedrock
- P-wave refraction boundary interpreted as base of made ground/superficals
- F* Highlighted feature

Key to trial pits

- Topsoil
- Made ground
- Gravel
- Ironstone Shale
- Siltstone
- Coal
- Mudstone

Rock quality designation RQD INDEX (%): 0-9, 10-19, 20-39, 40-69, 70-100

TP** (**m *) 1989 trial pit locations
TP** (**m *) 2018 trial pit locations
BH*** 2018 Borehole locations

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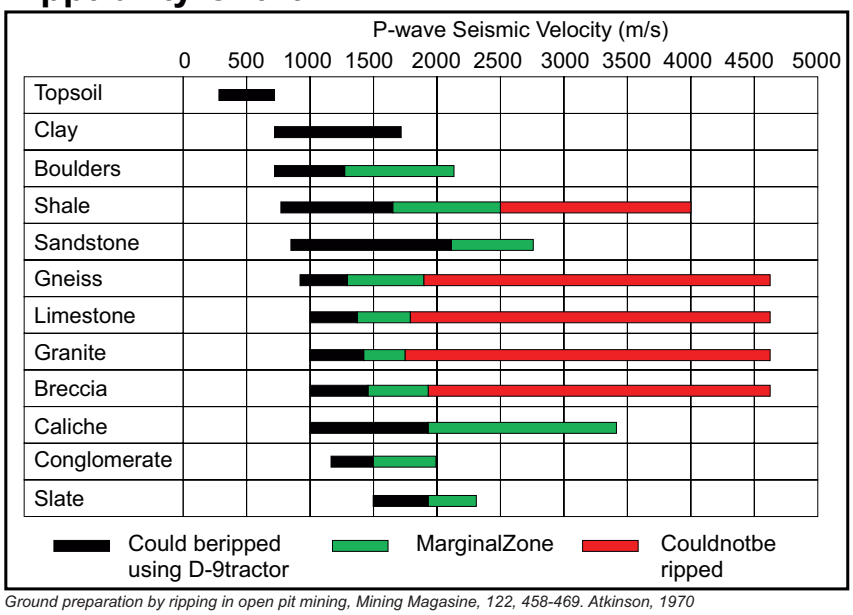
Title: **ELECTRICAL RESISTIVITY TOMOGRAPHY RESULTS**

Project: **Pantteg Landslip, Ystalyfera**

Scale: 1:500 at A3
Drawn by/Ref: RS/6025/2
Date: 25th June 2018

FIGURE 2

Rippability Chart



Ground preparation by ripping in open pit mining, Mining Magasine, 122, 458-469. Atkinson, 1970

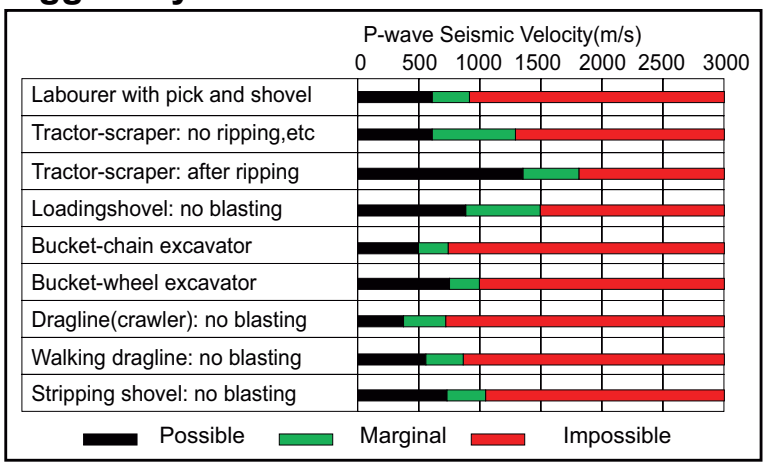
Compressional P-wave

Typical P-wave seismic velocity

Natural Soil and Rock	Velocity (m/s)
Weathered surface material	240 to 610
Gravel or dry sand	460 to 915
Sand (saturated)	1220 to 1830
Clay (saturated)	915 to 2750
Water	1430 to 1665
Sea water	1460 to 1525
Sandstone	1830 to 3960
Shale	2750 to 4270
Chalk	1830 to 3960
Limestone	2134 to 6100
Granite	4575 to 5800
Metamorphic rock	3050 to 7000

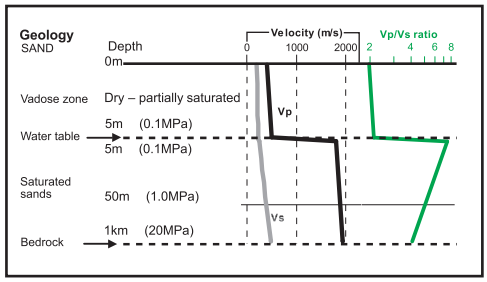
ASTM D577 - 00(2011)e1
Standard guide for using the seismic refraction method for subsurface investigation

Diggability Chart



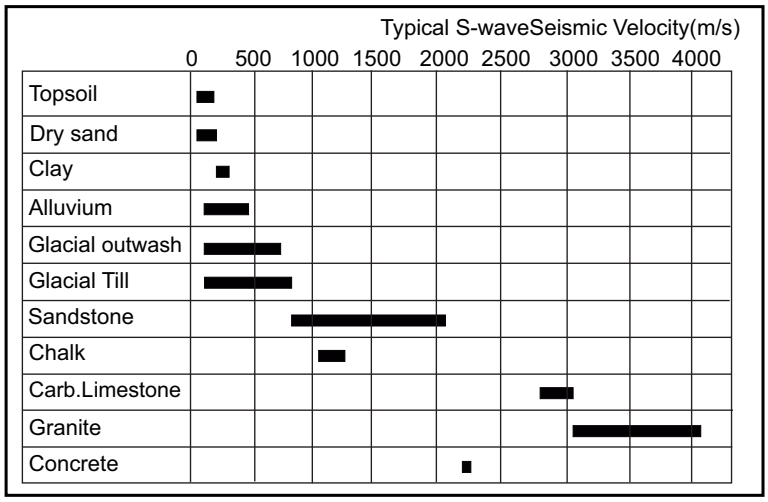
Selection of open pit excavation and loading equipment.
Transactions of the Institute of Mining and Metallurgy, 80, A101-A129, Atkinson 1971

Effect of ground water



Prasad et al., Measurement of velocities and attenuation in shallow soils, Near-Surface Geophysics Volume II Case Histories, SEG, Tulsa (2004)

Shear Waves



Rock / Soil Description	S-wave velocity (m/s) Top 30m
Hard rock	> 1,500
Rock	760 - 1,500
Very dense soil / soft rock	360 - 760
Stiff soil	180 - 360
Soft soil	<180

The NEHRP Recommended Provisions for seismic regulation for new buildings, (FEMA-222A and FEMA-223A, 1994)

Applied Geophysics, Telford et al, 1990
Shear wave velocity determination of unlithified geologic materials (CUSEC region) Illinois State Geological Survey, Bauer, 2004.
Bauer et al., 2007, Illinois State Geological Survey.
Shear Wave Velocity, Geology and Geotechnical Data of Earth Materials in the Central U.S. Urban Hazard Mapping Areas.
An Introduction to Geophysical Exploration, 3rd Edition, Keary and Brooks.
Conceptual Overview of Rock and Fluid Factors that Impact Seismic Velocity and Impedance, Stanford Rock Physics Laboratory, n.d.

Project: **Pantteg Landslip, Ystalyfera**

Title: **SEISMIC VELOCITY TABLES**

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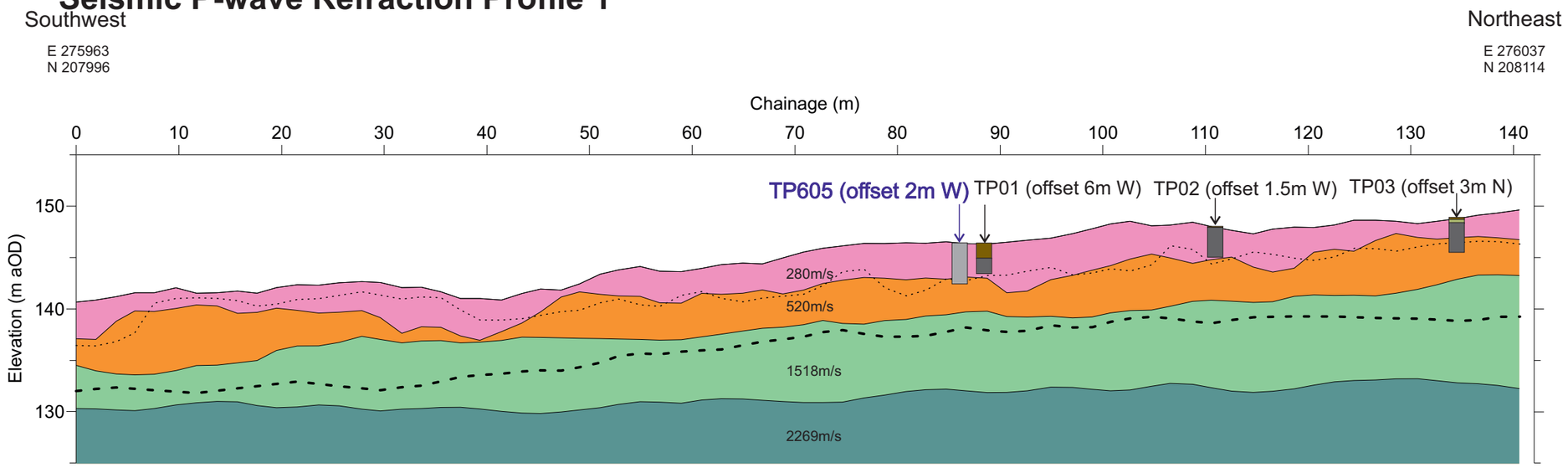
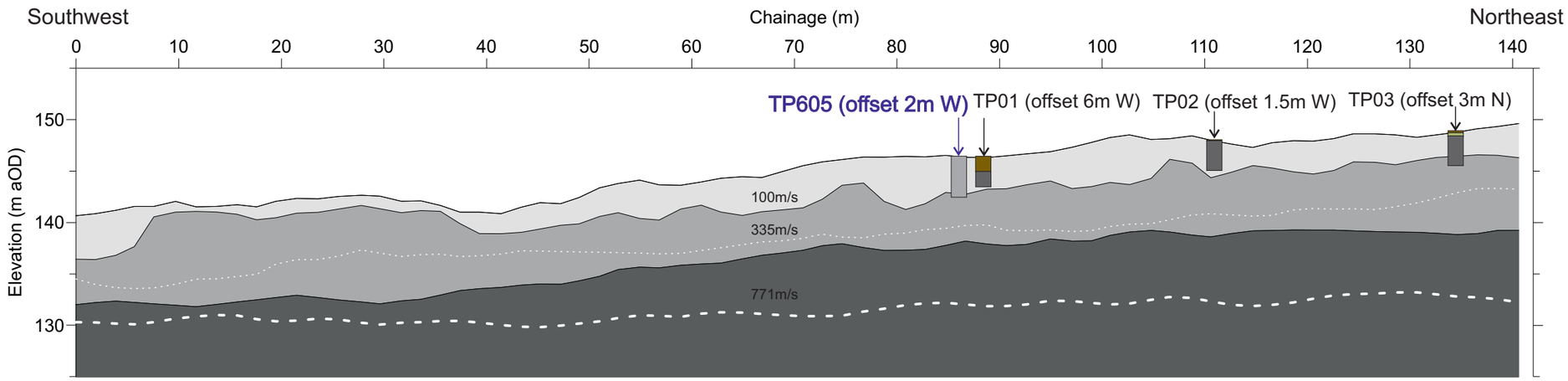
Scale: NTS
Drawn by/Ref: RS/6025/3
Date: 25th June 2018

FIGURE 3

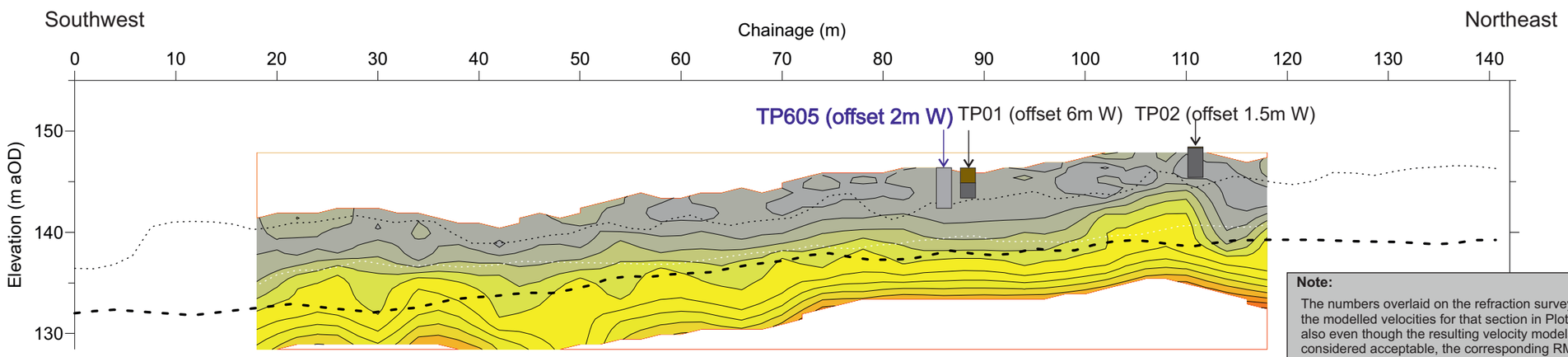
Seismic P-wave Refraction Profile 1



Seismic S-wave Refraction Profile 1

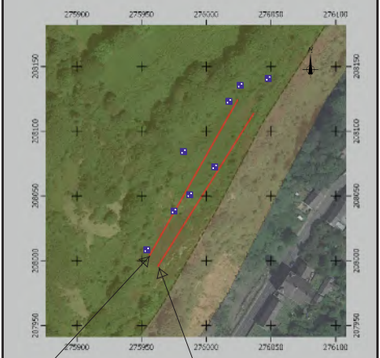


Seismic MASW Profile 1



Note:
The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s) also even though the resulting velocity models are considered acceptable, the corresponding RMS error is higher than what is normally attained. This primarily reflects the variability in the shallow ground conditions.

Location Plan (NTS)



Compressional (p) wave velocity (m/S)
- Layer 1 (280 m/s)
- Layer 2 (520 - 659 m/s)
- Layer 3 (1518 - 1522 m/s)
- Layer 4 (2269- 2313 m/s)
- Major shear wave boundaries overlain

Shear (S) wave seismic velocity (m/S)
- Layer 1 (70-100 m/s)
- Layer 2 (319-335 m/s)
- Layer 3 (771-816 m/s)
- Major P-wave boundaries overlain

Shear (S) wave seismic velocity (m/S) MASW

150 200 250 300 350 400 500 600 700 800

Key to trial pits
- Topsoil
- Made ground
- Gravel
- Ironstone Shale

TP** (**m *) 1989 trial pit locations

TP** (**m *) 2018 trial pit locations

BH** (**m *) 2018 Borehole locations

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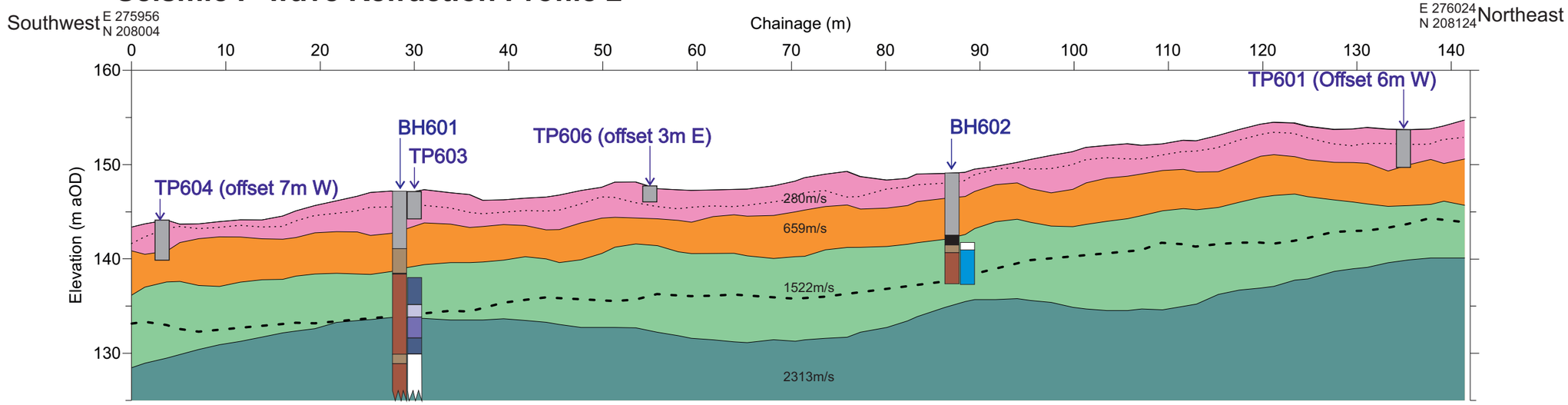
SEISMIC RESULTS FOR PROFILE 1

Project:
Pantteg Landslip, Ystalyfera

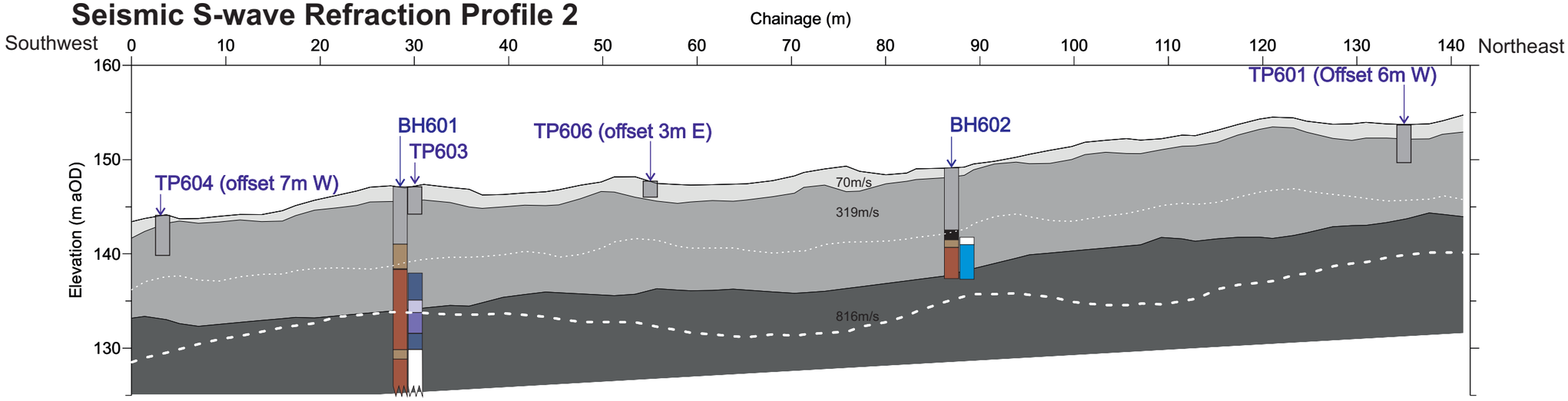
Scale: 1:500 at A3
Drawn by/Ref: RS/6025/4
Date: 26th June 2018

FIGURE 4

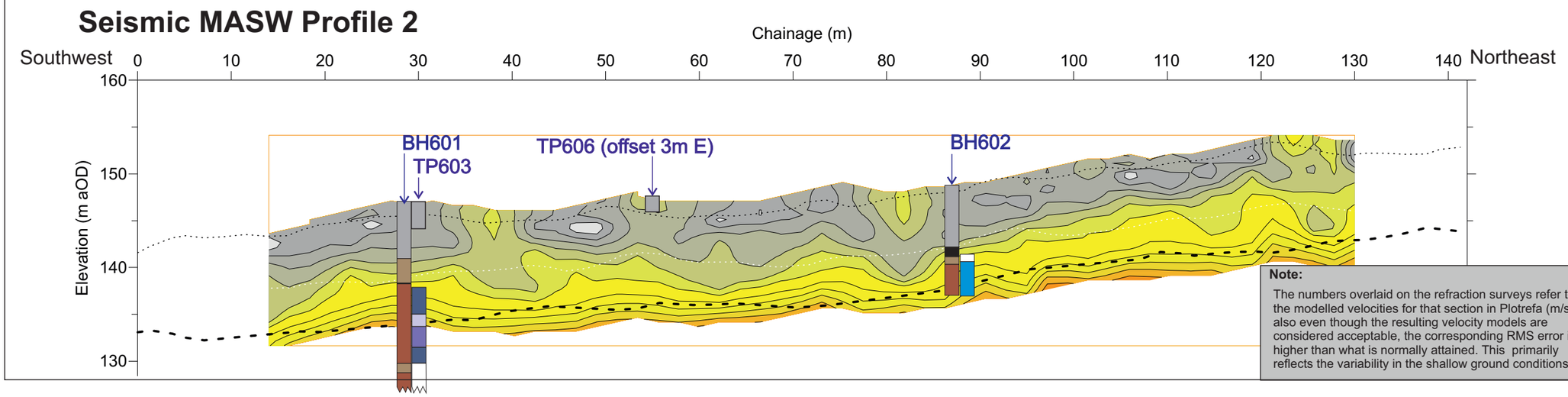
Seismic P-wave Refraction Profile 2



Seismic S-wave Refraction Profile 2

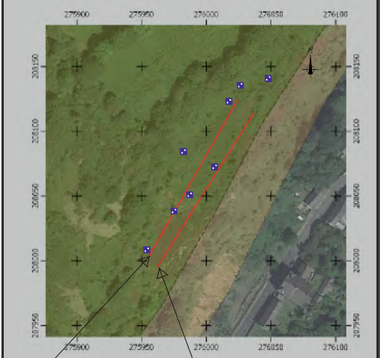


Seismic MASW Profile 2



Note:
The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s) also even though the resulting velocity models are considered acceptable, the corresponding RMS error is higher than what is normally attained. This primarily reflects the variability in the shallow ground conditions.

Location Plan (NTS)



Compressional (p) wave velocity (m/S)
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Major shear wave boundaries overlain

Shear (S) wave seismic velocity (m/S)
- Layer 1 (70-100 m/s)
- Layer 2 (319-335 m/s)
- Layer 3 (771-816 m/s)

Major P-wave boundaries overlain

Shear (S) wave seismic velocity (m/S) MASW

150 200 250 300 350 400 500 600 700 800

Key to trial pits
- Topsoil
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- Ironstone Shale
- Slitstone
- Coal
- Mudstone

Rock quality designation RQD INDEX (%)
- 0-9
- 10-19
- 20-39
- 40-69
- 70-100

TP** (**m *) 1989 trial pit locations
TP** (**m *) 2018 trial pit locations
BH*** 2018 Borehole locations

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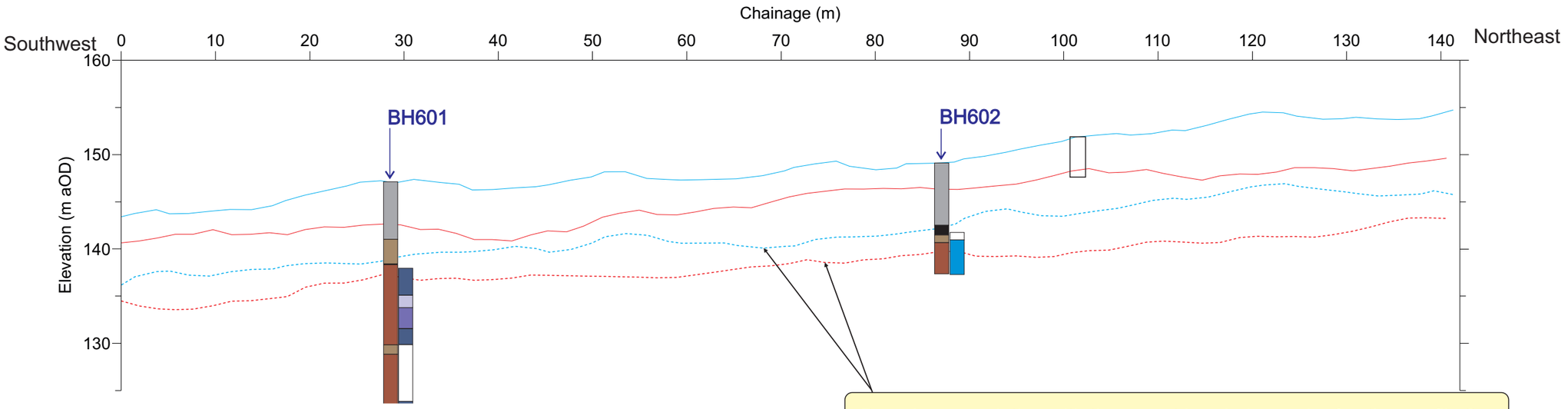
SEISMIC RESULTS FOR PROFILE 2

Project:
Pantteg Landslip, Ystalyfera

Scale: 1:500 at A3
Drawn by/Ref: RS/6025/5
Date: 26th June 2018

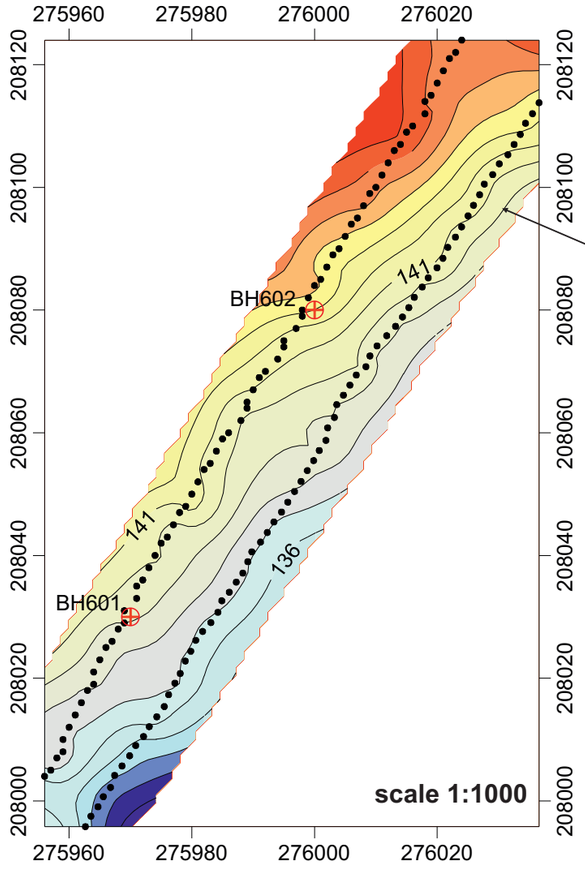
FIGURE 5

6a: Top of layer 3 seismic P-wave Refraction Profiles 1 and 2 overlaid



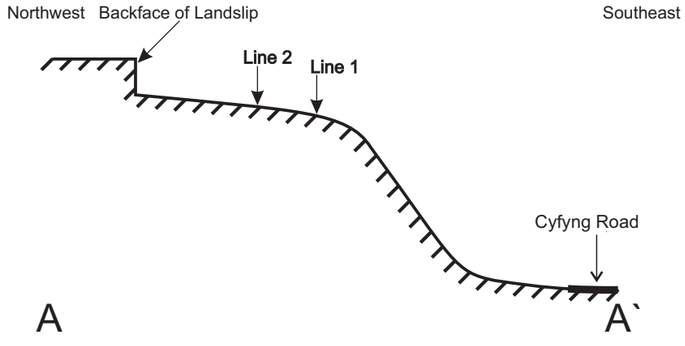
Based on correlation with the recent boreholes and refraction profile 2, it would appear that the 'rock head' boundary corresponds the top of the P-wave layer 3. By condsidering the corresponding boundary on profile 1, it seems that rock head is gently sloping down hill between the two profile (approximately 10m apart). The average vertical step between the two inferred rockhead boundaries is 2.5m, which suggests a slope of approximately 14°. In the northeast, this down slope increasing up to 27° where there is a larger vertical step. At some locations slope of the inferred rockhead boundary does not follow the slope of the ground surface.

6b: Interpreted rockhead elevation in plan view (m aOD)

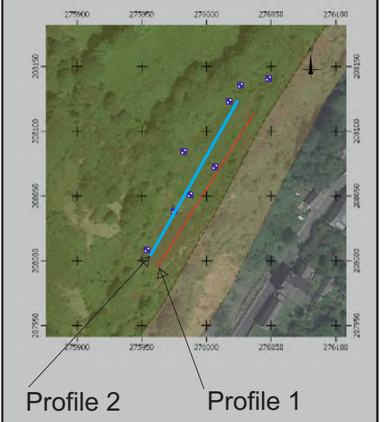


To illustrate the lateral variation, the top of layer 3 on the P-wave refraction has been gridded and a contoured plot produced. There is a gentle slope from north to south of the area.

Schematic cross section of landslip from figure 1



Location Plan (NTS)



Key Compressional (p) wave velocity (m/S)

- Ground level for profile 1
- Ground level for profile 2
- Top of P-wave layer 3 (1518 - 1522 m/s) for profile 1
- Top of P-wave layer 3 (1518 - 1522 m/s) for profile 2
- Geophone
- August 2018 ESP Borehole

COLOUR SCALE

Depth to bedrock (m aOD)

Key to trial pits

- Topsoil
- Made ground
- Gravel
- Ironstone Shale
- Slitstone
- Coal
- Mudstone

Rock quality designation RQD INDEX (%)

- 0-9
- 10-19
- 20-39
- 40-69
- 70-100

TP** (**m *) 1989 trial pit locations

TP** (**m *) 2018 trial pit locations

BH** (**m *) 2018 Borehole locations

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Title:

Interpretation of rock head

Project:

Pantteg Landslip, Ystalyfera

Scale: 1:500 at A3

Drawn by/Ref: RS/6025/6

Date: 19th September 2018

FIGURE 6

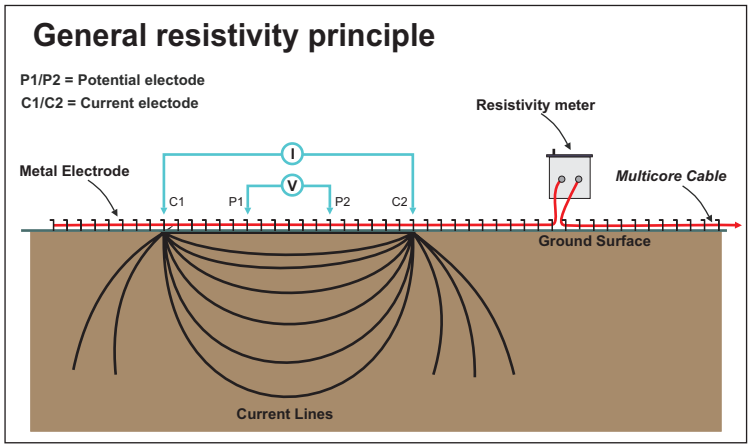
APPENDICES

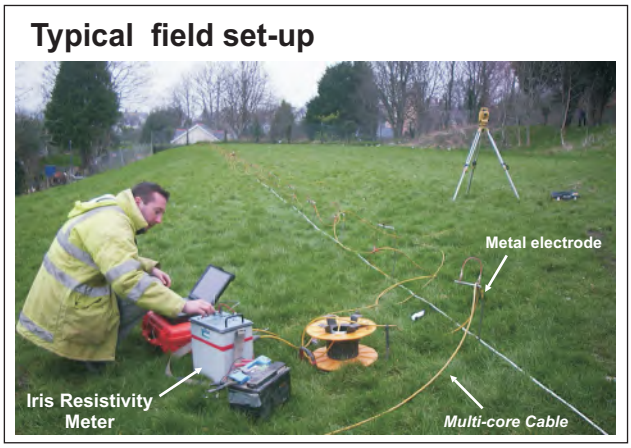
Appendix - Resistivity Tomography

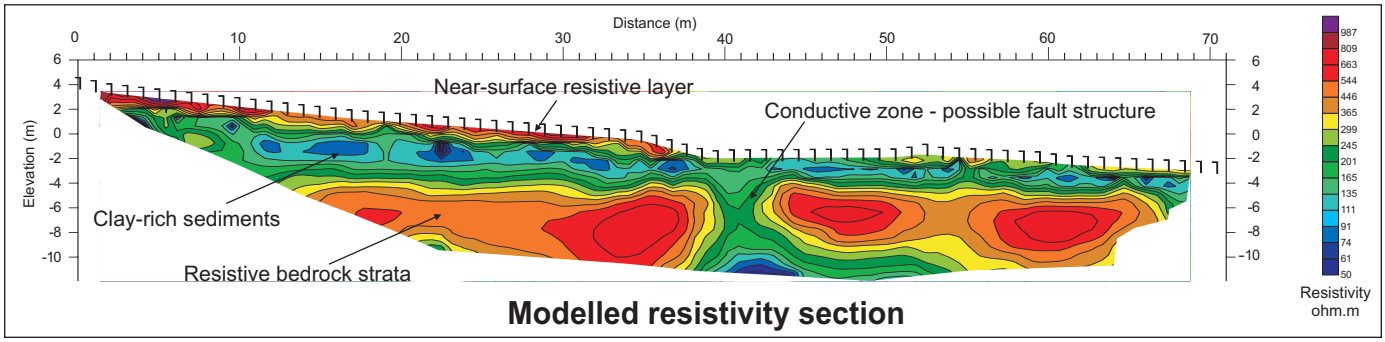
The Resistivity technique is a useful method for characterising the sub-surface materials in terms of their electrical properties. Variations in electrical resistivity (or conductivity) typically correlate with variations in lithology, water saturation, fluid conductivity, porosity and permeability, which may be used to map stratigraphic units, geological structure, sinkholes, fractures and groundwater.

The acquisition of resistivity data involves the injection of current into the ground via a pair of electrodes and then the resulting potential field is measured by a corresponding pair of potential electrodes. The field set-up requires the deployment of an array of regularly spaced electrodes, which are connected to a central control unit via multi-core cables. Resistivity data are then recorded via complex combinations of current and potential electrode pairs to build up a pseudo cross-section of apparent resistivity beneath the survey line. The depth of investigation depends on the electrode separation and geometry, with greater electrode separations yielding bulk resistivity measurements from greater depths.

The recorded data are transferred to a PC for processing. In order to derive a cross-sectional model of true ground resistivity, the measured data are subject to a finite-difference inversion process via RES2DINV (ver 5.1) software.







Modelled resistivity section

Data processing is based on an iterative routine involving determination of a two-dimensional (2D) simulated model of the subsurface, which is then compared to the observed data and revised. Convergence between theoretical and observed data is achieved by non-linear least squares optimisation. The extent to which the observed and calculated theoretical models agree is an indication of the validity of the true resistivity model (indicated by the final root-mean-squared (RMS) error).

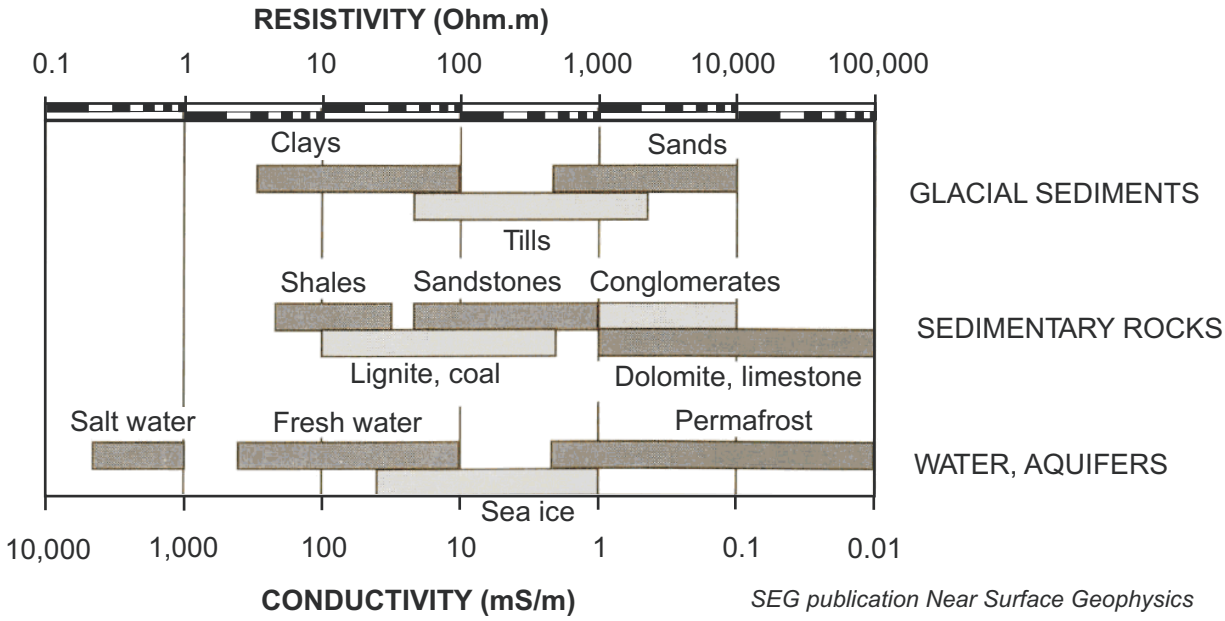
The true resistivity models are presented as colour contour sections revealing spatial variation in subsurface resistivity. The 2D method of presenting resistivity data is limited where highly irregular or complex geological features are present and a 3D survey maybe required. Geological materials have characteristic resistivity values that enable identification of boundaries between distinct lithologies on resistivity cross-sections. At some sites, however, there are overlaps between the ranges of possible resistivity values for the targeted materials which therefore necessitates use of other geophysical surveys and/or drilling to confirm the nature of identified features.

Constraints:

Readings can be affected by poor electrical contact at the surface. An increased electrode array length is required to locate increased depths of interest therefore the site layout must permit long arrays. Resolution of target features decreases with increased depth of burial.

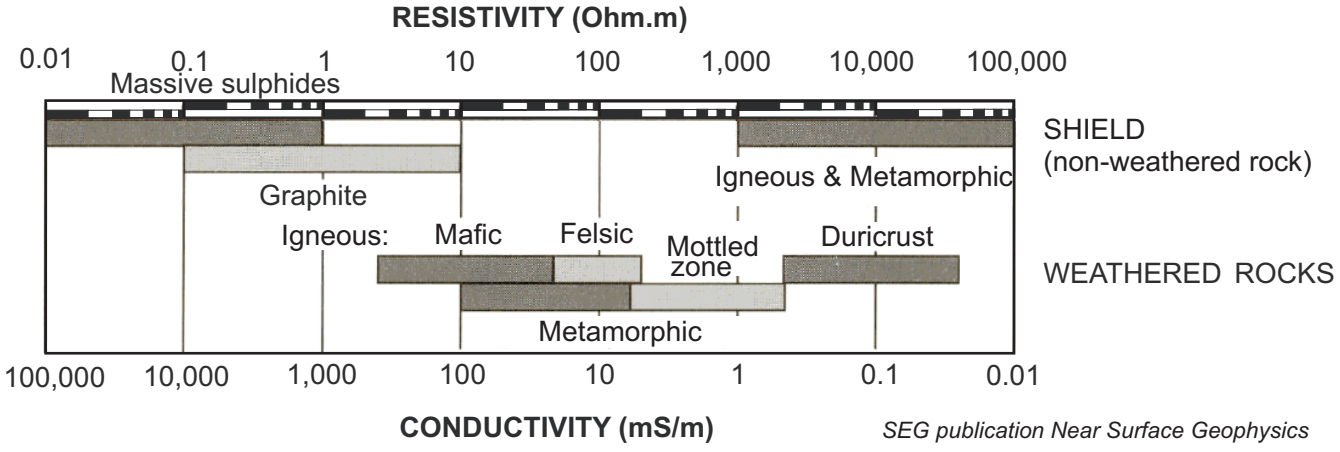
Appendix - Resistivity tables

Sedimentary Environments



SEG publication Near Surface Geophysics

Igneous Environments



SEG publication Near Surface Geophysics

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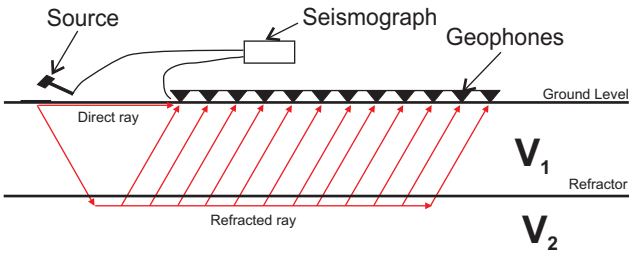
Appendix - Seismic Refraction Survey

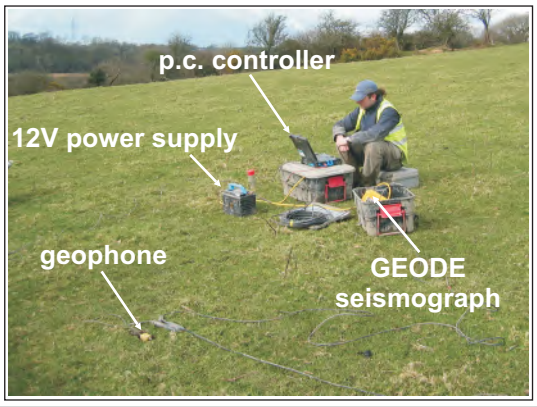
Seismic refraction is a useful method for investigating geological structure and rock properties. The technique involves the observation of a seismic signal that has been refracted between layers of contrasting seismic velocity, i.e., at a geological boundary between a high velocity layer and an overlying lower velocity layer.

Shots are deployed at the surface and recordings made via a linear array of sensors (geophones or hydrophones). Refracted seismic signal travels laterally through the higher velocity layer (refractor) and generates a 'head-wave' that returns to surface. Beyond a certain distance away from the shot, the signal that has been refracted at depth is observed as first-arrival signal at the geophones. Observation of the travel-times of refracted signal from selectively deployed shots enables derivation of the depth profile of the refractor layer. Shots are typically fired at locations at and beyond both ends of the geophone spread and at regular intervals along its length.

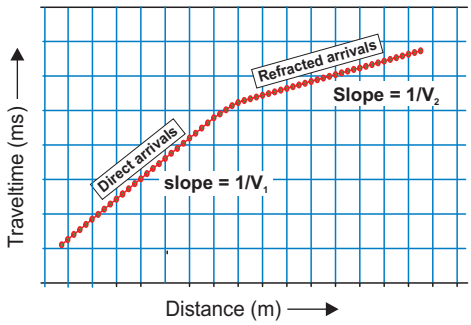
The results of the seismic refraction survey are usually presented in the form of seismic velocity boundaries on interpreted cross-sections. Seismic sections represent the measured bulk properties of the subsurface and enable correlation between point source datasets (boreholes/trialpits) where underlying material is variable. Reference to the published seismic velocity tables enables derivation of rippability values.

Typical field set-up

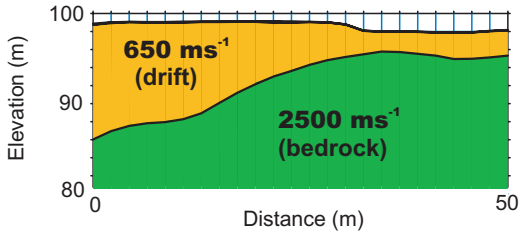




Travel-time curve



Modelled velocity section



The data processing is carried out using PICKWIN & PLOTREFA (OYO ver2.2) software. The first stage involves accurate determination of the first-arrival times of the seismic signal (time from the hammer blow to each recording hydrophone) for every shot record, using PICKWIN. Time-distance graphs showing the first-arrival times were then generated for each seismic shot record and analysed using PLOTREFA software to determine the number of seismic velocity layers. Modelled depth profiles for the observed seismic velocity layers are produced by a tomographic inversion procedure that is revised iteratively to develop a best fit-model. The final output of a seismic refraction survey is a velocity model section of the subsurface based on an observed layer sequence with measured velocities that correspond to physical properties such as levels of compaction/ saturation in the case of sediments and strength/rippability in the case of bedrock.

Constraints

Layer velocity (density) must increase with depth; true in most instances. Layers must be of sufficient thickness to be detectable. Data collected directly over loose fill (landfills) or in the presence of excessive cultural noise may result in sub-standard results. In places where compact clay-rich tills and/or shallow water overly weak bedrock an S-wave survey may be used to profile rockhead where insufficient velocity contrast may prevent use of a P-wave survey.

Appendix - Surface Wave Surveys

MASW survey in progress

Hammer and plate source - the most

Multi-channel Analysis of Surface Waves (MASW) is a very useful method for investigating shallow geological structure and, in particular, the relative shear strength of subsurface materials. By incorporating density values for the local bedrock and overburden sediments it is possible to derive their shear modulus often referred to as dynamic ground stiffness.

The technique is based on the recording of seismic waves that roll much like a seawav e along the surface and extend down to depth beneath the survey line. At each new location it is essential to carry out initial tests to determine optimum acquisition parameters including geophone spacing and shot offset distances. Typically a hammer and plate or buffalo gun is used as the seismic source with the latter offering more power for difficult sites. Surface waves travel more slowly than other seismic signals and are recorded over long time intervals by comparison. The recorded data are first processed to produce dispersion curves for each shot. These curves are then modelled individually to produce 1D depth profiles of shear wave velocity and then combined to produce a depth cross-section revealing the shear wave velocity structure of the ground.

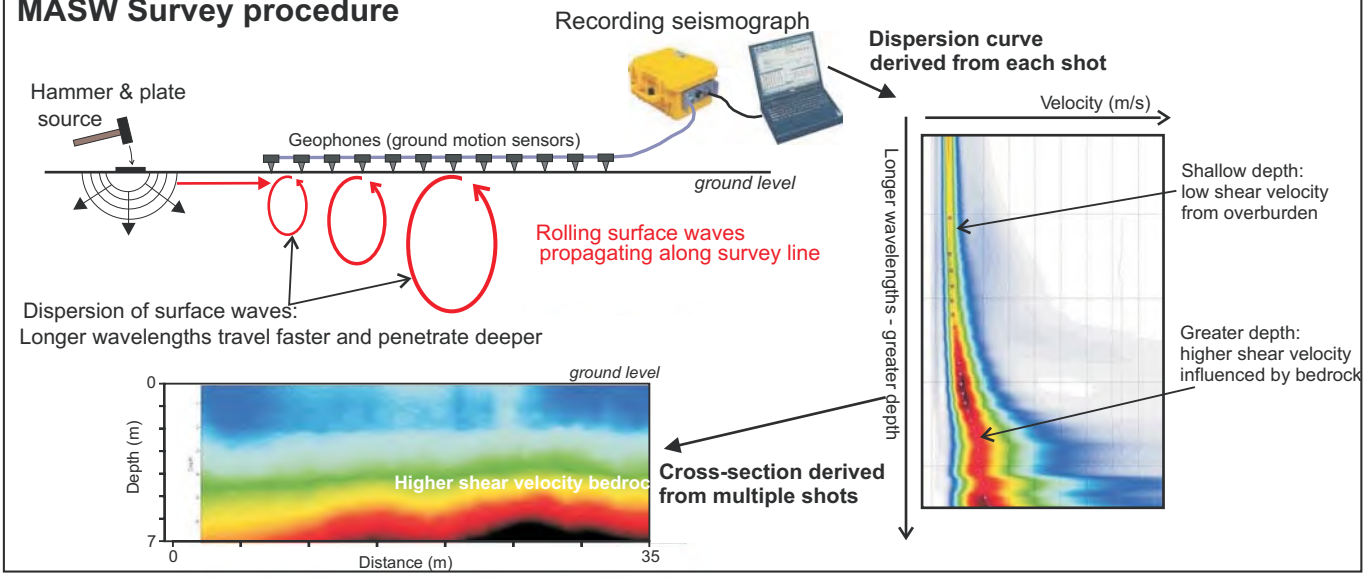
Typical Targets:

Dynamic stiffness modulus
Foundation strength for turbines/structures
Weak but cemented rockhead
Weathered rock beneath dense overburden
Shear strength of landslide materials

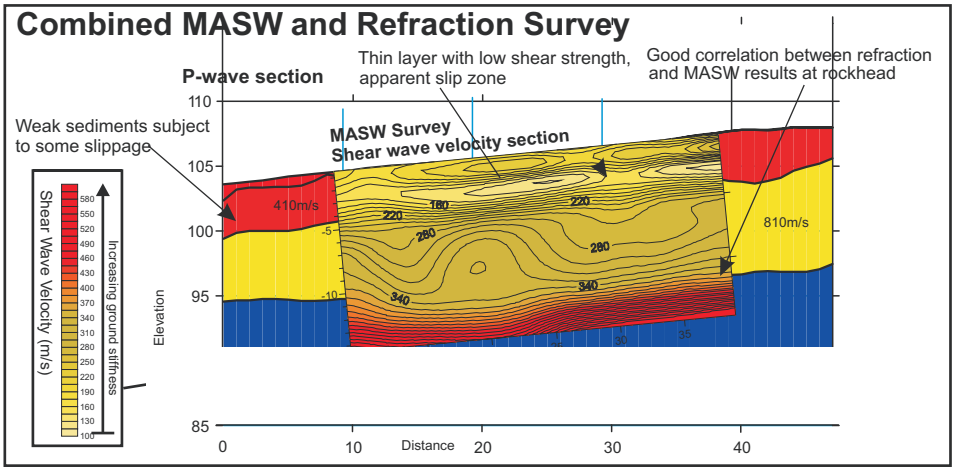
Benefits of MASW:

Low Cost
High productivity
Continuous profiles
Non-invasive
Environmentally friendly

MASW Survey procedure



Combined MASW and Refraction Survey



(ABOVE) A schematic illustration of the MASW data acquisition and processing procedure leading to a final section.

(LEFT) Results of a combined seismic refraction and MASW survey targeting shallow geological structure on an active landslide. The MASW survey results reveal spatial variation in shear wave velocity and dynamic ground stiffness. A shallow zone of low shear strength is clearly observed.

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