Tween Bridge Solar Farm

Environmental Statement
Appendix 9.2: Volume 3 of Phase 1 Ground Conditions Desk Study – Tween Bridge Wind Farm Factual Site Investigation Report

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Revision 1

TWEEN BRIDGE WIND FARM

SITE INVESTIGATION REPORT
VOLUME 1: FACTUAL REPORT

E-on UK

JOB NO 1087

R003

JUNE 2009

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VOLUME 1: FACTUAL REPORT

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1.0 INTRODUCTION

1.1 Donaldson Associates Ltd (DAL) was instructed to undertake a site investigation on the site of the proposed Tween Bridge Wind Farm.

1.2 The scope of the investigation was to assess the sub-soils and rock conditions across the site to allow design and construction of foundation bases for proposed wind turbines (WTGs) and associated infrastructure and was carried out in 2 phases between February and April 2009.

1.3 Volume 1 of this site investigation report summarises the results of site work which was undertaken as well as subsequent laboratory testing on samples retrieved. The factual data provided by the ground investigation contractors is presented in Volume 2 as an appendix to this report.

2.0 GENERAL GEOLOGY

2.1 From the maps and memoirs of the British Geological Survey; Sheets 79 for Goole (1972), 88 for Doncaster (1969) and Sheet SE 71 SW for Yorkshire, the solid geology of the site comprises of the Triassic Sherwood Sandstone Group, a grey to red-brown sandstone with pebble beds and thin red mudstone. The sandstone is overlain by the Triassic Mercia Mudstone in the far eastern edge of the site only which generally comprises red-brown mudstone with sandstone beds.

2.2 The Sherwood Sandstone in the proposed wind farm area is approximately 350-400m thick and immediately overlies the Permian Marls and Magnesian Limestone. The Carboniferous Coal Measures are present beneath the Permian beds from around 500m depth, with the Highfield High Hazel coal seam at around 800m depth.

2.3 The superficial deposits across the site vary from alluvial silt and clay in the eastern area of the site to interbedded sand, silt and clay of the '25 foot Drift of Vale of York' covering the western site area. Some thickness of peat was expected also. From previous site investigations and old borehole logs indicated on the geological sheets, the drift in the area was expected to vary between 12 and 16m thick.

2.4 Two faults exist, which cross in the northwest of the site, very close to the site of the abandoned Thorne Colliery Shaft. The larger fault extends roughly southwest to northeast, adjacent to the route of the railway line, with the smaller fault crossing the site west to east roughly. Both faults lie outside the area where the turbines are proposed to be sited.

3.0 SITE WORK

3.1 Phase 1 of the ground investigation, undertaken by Fugro Engineering Services (Fugro), took place between 16 and 19th February 2009 with trial pitting, window sample boreholes, cone penetration tests and seismic cone penetration tests carried out.

3.2 Phase 2 of the ground investigation, undertaken by Soil Mechanics, took place between 30th March and 23rd April 2009 and comprised cable percussive boreholes with rotary follow on, further cone penetration testing, pressuremeter testing, Mostap sampling and California Bearing Ratio (CBR) tests. Laboratory testing was undertaken by Soil Mechanics also on soil and rock samples retrieved during this phase of the ground investigation.

3.3 The site work was undertaken primarily at the proposed locations of the 22 turbines, represented by the co-ordinates shown on Table 1 and the appended location plan, with the exception of the window sample boreholes and trial pitting.

3.4 The boreholes, along with logging of arisings, allowed soil and rock samples to be retrieved for detailed logging and laboratory testing. Standard Penetration Tests (SPTs) were also undertaken to give representative values of soil strength and density.

3.5 Window sample boreholes and trial pits were undertaken across the site to retrieve representative samples for contamination testing. The window sample boreholes were also for the installation of gas monitoring stand pipes.

3.6 California Bearing Ratio (CBR) tests were undertaken at numerous locations around the site along proposed access routes to enable access track design.

3.7 During the site works the proposed wind turbine reference numbers were changed by the Eon to reflect the order of wind turbines encountered from the revised wind farm access point. A decision was made to instruct all ground investigation contractors to abide by the original turbine reference numbers which would then be amended by DAL at a later stage as to avoid any confusion on site.

3.8 The original turbine reference numbers are reflected in the borehole and CPT reference numbers. These, along with the revised turbine reference numbers and a summary of the borehole and CPT details are presented in Table 1 below.

WTG No.	BH/CPT No.	Borehole depth *(Rock Head)* (m)	Groundwater (mbgl)	CPT refusal (m)	Seismic Cone max depth (m)	Mostap (M) & Pressuremeter Test (P) depths (m)
1	3	15.50 *(14.50)*	7.10	13.62	13.60	P @ 4.00 & 5.50, M @3.00-4.00 & 5.50-6.50
2	1			13.40		
3	4			12.96	13.00	P @ 5.50
4	7			12.90		P @ 4.00
5	2			11.34	11.30	P @ 4.00 & 6.00, M @ 4.00-5.00 & 6.00-7.00
6	5	22.70 *(14.40)*	8.80	10.55		
7	6			13.10		
8	8	17.94 *(13.20)*	-	10.05		
9	9			11.30	11.30	P @ 3.00 & 5.50, M @ 3.00-4.00 & 5.50-6.50
10	10	16.64 *(12.38)*	3.80	11.65		
11	11			10.79	10.80	
12	12			6.00		
13	13	15.20 *(11.20)*	2.25	6.79	6.80	
14	22	18.15 *(13.80)*	5.70	8.50		P @ 3.50 & 5.50, M @ 3.50-4.50 & 5.00-6.00
15	21			6.90		
16	14			6.50	6.50	
17	16	22.50 *(16.50)*	8.20	14.20		
18	17			15.64	15.60	P @ 4.00 & 6.50, M @ 4.00-5.00 & 6.50-7.50
19	15			6.10		
20	19			14.94		P @ 4.50 & 6.50, M @ 4.50-5.50 & 6.50-7.50
21	18	24.30 *(13.80)*	6.80	14.80		
22	20			15.23		P @ 4.50 & 7.50, M @ 4.00-5.00 & 7.00-8.00

Table 1: Turbine and ground investigation details

4.0 EXPLORATORY HOLES

4.1 CABLE PERCUSSIVE / ROTARY BOREHOLES

4.1.1 The boreholes were drilled using a Dando 175 cable percussion rig until refusal, where a rotary coring continued with a Beretta T51 rotary rig using mud flush. 8 boreholes were drilled at turbine numbers; 1(BH3), 6(BH5), 8(BH8), 10(BH10), 13(BH13), 14(BH22), 17(BH16) and 21(BH18), with depths varying from 15.20m to 24.30m (See Table 1) with the level at which the ground water was encountered being recorded and shown in Table 1 also.

4.1.2 Borehole 3, positioned at turbine location 1, shows a thin layer of topsoil, underlain by initial sandy clay to 1.80m depth over firm thinly laminated clay to 7.45m depth. These are in turn underlain by medium dense, silty, fine to medium sand grading to fine to coarse sand with depth, before the weak, weathered sandstone bedrock is encountered at 14.50m depth.

4.1.3 Borehole 5 (WTG6) shows a thin layer 0.40m of sandy clay topsoil, overlying a 1.40m thick band of loose, fine to medium sand. Below this layer lies a thin band of soft, sandy silty clay to 2.10m depth, overlying firm, thinly laminated, sandy clay to 6.90m depth. Firm, sandy clay with no distinct laminations continues to 8.80m depth, where medium dense, slightly silty, slightly gravelly sand is encountered to 10.40m depth. A medium dense, fine to medium sand grades to dense sand before bedrock is reached at 14.40m depth in the form of weak to medium strong sandstone which continues to the full depth of the borehole at 22.70m depth, with the exception of a thin band of weak mudstone between 14.87 and 14.98m.

4.1.4 Borehole 8 (WTG8) shows a thin layer (0.30m) of topsoil overlying a firm, sandy clay of 0.60m thick, below which lies a 0.50m thick clayey, fine to medium sand. At a depth of 1.45m, firm, thinly laminated, sandy clay extends to 7.00m where it is underlain by dense, silty, fine to medium sand, which becomes dense, fine to coarse sand (possibly completely weathered bedrock) at 10.75m depth. Very weak to weak, medium to coarse grained sandstone is reached at 13.20m depth which grades to medium strong with increasing depth, extending to the full depth of the borehole at 17.94m.

4.1.5 The first 3.80m of borehole 10 (WTG10) is clay, varying from soft, slightly sandy to a firm, thinly laminated, sandy clay. Beneath the clay lies a medium dense, fine to medium sand to 8.70m depth, interbedded with a thin band (0.20m) of soft, sandy clay at 7.30m.

Medium dense, clayey, fine to medium sand is encountered from 8.70m to 11.00m depth where dense, medium to coarse sand (completely weathered bedrock) is found and grades into the very weak to weak, medium to coarse grained sandstone at 12.38m. This sandstone is interbedded by a 1.56m thick band of very weak to weak, thinly laminated mudstone before a weak to medium strong, medium to coarse grained sandstone is seen to continue from 15.14m to 16.64m depth where the borehole terminates.

4.1.6 Borehole 13, positioned at turbine location 13 reaches a total depth of 15.20m, the top 0.35m consisting of topsoil underlain initially by 0.70m of soft to firm, slightly sandy clay over 1.05m of soft to firm, thinly laminated, sandy clay. At 2.10m depth medium dense, slightly silty sand is encountered to 5.20m, underlain to 6.70m depth by firm, sandy, slightly gravelly clay. Very dense, fine and medium sand is found underlying this clay and extends to 8.00m depth before grading to very dense, slightly silty, slightly gravelly sand to 11.20m where the weak to medium strong, medium to coarse grained sandstone is reached and completes the borehole log.

4.1.7 Borehole 16 (WTG17) displayed soft, sandy clay / topsoil to 1.00m. This was found to overly clayey, pseudo-fibrous peat to 2.60m depth where very soft, sandy clay continues to 3.40m depth. Firm, thinly laminated, sandy clay is shown from 3.40 to 8.20m at which medium dense; slightly silty, fine to coarse sand extends to 15.60m depth. From 15.60m dense, slightly silty, fine and medium sand overlies the very weak to medium strong, medium to coarse grained sandstone at 16.50m. Extremely weak to very weak mudstone forms a thin (0.50m) band at 20.90m between this and the medium strong sandstone beneath, extending to the base of the borehole.

4.1.8 Borehole 18 positioned at turbine location 21 shows 1.70m of peat again beneath the initial 0.20m thick topsoil layer. This is in turn underlain by 1.05m of loose, fine and medium sand and soft to firm, thinly laminated, sandy clay to 6.80m depth. Medium dense to dense, slightly silty sand extends from 6.80m to the extremely weak sandstone bedrock at 13.80m, which grades to very weak to weak, medium to coarse grained sandstone at 19.21m depth to the base of the borehole at 24.30m depth.

4.1.9 Borehole 22 (WTG14) shows a thin layer of soft to firm, sandy clay beneath the topsoil, underlain by slightly clayey, slightly gravelly sand to 1.50m depth where soft to firm, thinly laminated, sandy clay (with fine sand laminae) extends to 5.75m. Medium dense, slightly clayey, fine sand is seen to 7.00m. Medium dense, slightly clayey, slightly gravelly sand grades to dense, extending to 13.80m depth where the weak to medium strong, coarse grained sandstone bedrock is encountered and completes the borehole log at 18.15m.

4.2 MOSTAP SAMPLING

4.2.1 Pushed into the ground by the CPT rig individual 1.00m long undisturbed samples are retrieved from specific depths without having to form a borehole first. Sampling was undertaken at seven locations throughout the site (WTGs 1, 5, 9, 14, 18, 20 and 22). One of the proposed locations (location 4 for WTG3) saw no recovery from the Mostap sample and so was aborted. Two locations, namely turbine locations 1 (CPT3) and 14 (CPT22), are situated in the same locations as a counterpart borehole, thus allowing comparison to occur.

4.2.2 Two 1.00 metre samples were undertaken at each location (S1 & S2), both between 3.00 and 7.50m depth. CPT 22's sample between a depth of 3.50 and 4.50m depth shows largely soft clay, interbedded with a thin layer of soft, thinly laminated clay with occasional fine sand. The borehole for this depth and location shows the same clay with interbedded thinly laminated, sandy clay. At a depth of between 5.00 and 6.00m both the borehole and MOSTAP sampling show soft clay, showing some thinly laminated layers, with occasional areas of fine to medium sand.

4.2.3 CPT3's (WTG1) Mostap sample between the depths of 3.00 and 4.00m (S1) show layers of soft clay, with layers of clayey silt; with the borehole showing thinly laminated clay. At a depth of between 5.50 and 6.50m (S2) both the Mostap and borehole show clay, with soft, thinly laminated silty clay.

4.2.4 The further 5 Mostap locations have S1 initial depths of between 3.00 and 5.50m, and largely show these areas to consist of different grades of clay and silt, soft and thinly laminated with occasional sandy layers. S2 depths of between 5.50 and 8.00m again show areas of thinly laminated clay and silt, with occasional sandy clay and sand layers. Both the S1 and S2 samples correspond to the interpreted stratigraphy of clay with silt zones from the cone penetration tests.

4.3 WINDOW SAMPLE BOREHOLES

4.3.1 Six boreholes were drilled and logged from across the proposed wind turbine site during Phase 1 of the site investigation using a Dando Terrier (percussive) window sampler drill rig. WS1.1 and 2.1 were located at the approximate proposed position of the wind farm control building

4.3.2 The boreholes on the western side of the site, show variations in the composition to those on the eastern side. In general the boreholes have between 0.40m (WS1.1) and 0.60m

(WS5) of a mixture of top soil and made ground, consisting of a mix of soft to firm, sandy, slightly gravelly clay.

4.3.3 Those boreholes in the west, namely WS1.1, WS2.1 and WS4; show beneath the made ground layer, a 1.10m layer of a mainly clayey, very silty, fine to coarse sand, which overlies a firm, thinly laminated, clayey, sandy silt which continues until the boreholes terminate at a depth of 4.00m

4.3.4 WS5 and WS6 lie on the eastern side of the site, with the stratigraphy varying from those on the western side. Below the made ground in WS5, lies 1.10m of sandy clay, with occasional rootlets; whilst in WS6 this layer only reaches 0.40m with an underlying layer of soft, fibrous peat with a strong organic odour. Below these layers in both WS5 and WS6 lies silty, fine to coarse sand

4.3.5 WS3 was terminated at a depth of 10.00m and shows that within the western side the thinly laminated silt grades to sandy silt and onto sand at approximately 8.00m below ground level

4.3.6 A gas monitoring standpipe was installed to 4.00m depth in each window sample borehole on completion, with the exception of the 10.00m installation in WS3.

4.4 TRIAL PITS

4.4.1 The 1.20m deep hand excavated trial pits were excavated in two locations at the toe area of a colliery spoil heap, near the most northern point of the site, primarily for the retrieval of soil samples for contamination testing.

4.4.2 The first 0.20 to 0.40m of the trial pit consisting in both pits of soft to firm, slightly sandy, slightly gravelly clay. The gravel comprises subangular sandstone and mudstone, whilst the sand present is of fine to coarse grains. The clay becomes firmer with depth, whilst the colour changes from a brown near surface to an orange, brown-grey at depth.

5 IN-SITU TESTING

5.1 CONE PENETRATION TESTS

5.1.1 The cone penetration test measures the cone resistance and frictional sleeve resistance of the CPT rods as they are pushed into the ground at a constant rate of 2cm/s by use of a hydraulic ram. 11 WTG locations were logged during Phase 1 with the remaining 11 during Phase 2. A summary of the CPT details are shown in Table 1.

5.1.2 The CPT data has been used to derive assumed soil logs by Fugro and Soil Mechanics and is presented in their results (Appendix B).

5.1.3 The majority of the CPT results indicate relatively weak strata, with cone resistance typically around 1 to 2 MPa, to between 7.00 and 8.00m depth where the cone resistance rises to around 5 to 12 MPa. The interpretation of this on both the Fugro and Soil Mechanics logs is that of the predominantly soft to firm clay and silt overlying the medium dense sand which grades into the weathered bedrock where the CPTs refused (20MPa+) at between 10.00 and 13.00mbgl.

5.1.4 There are consistent 'spikes' in the cone resistance, generally rising from 1MPa to around 5MPa between 1.00m and 2.00m depth in many of these CPT records, which are accounted for by layers of sand or sandy, stiffer clay deposits, interbedded with the softer superficial material.

5.1.5 CPTs 12 to 15 and 21 and 22 presented a shallower cover of low cone resistance material to around 5.00m to 6.00m depth. CPT 14 and 15 showed a more gradual increase in resistance from 3 to 4m depth whereas the other CPT plots showed a sudden refusal between 6.00 and 8.00m depth as the cone resistance increased from 1 to 3MPa to 20Mpa+ over a small depth.

5.1.6 Very low cone resistance (<1MPa) at shallow depth has been considered as a possible indication of soft peat (CPT14) by Fugro in their logs. The Soil Mechanics logs identify these very low cone resistance areas as peat also or sensitive, fine grained material.

5.1.7 Sleeve friction generally mirrors the cone resistance in that it shows a marked increase from the fine grained superficial material to the coarser, denser sand and weathered sandstone with depth.

5.2 SEISMIC CONE PENTRATION TEST (SCPT)

5.2.1 Undertaken in conjunction with the CPTs, seismic cone tests were undertaken at the same 11 locations throughout the site as the Phase 1 CPTs.

5.2.2 Seismic cone penetration tests measure the vertically propagated, horizontally polarised shear waves (VS_{vh}), to allow for the determination of the shear modulus, a measure of the materials response to shear strain. All tests were undertaken using an assumed constant density of 2.00Mg/m^3.

5.2.3 Internal shear velocity for the initial 4 SCPTs (CPT 011,013,014 and 017) show an increase with depth to velocities of between 260 and 310m/s (3.8m), with initial velocities at a depth of 3.80m below ground level. The further three locations (CPT 019, 020 and 022, show no trends with the velocities ranging between 150 and 280m/s.

5.2.4 Shear Modulus values show general trends, with the shear strain increasing with depth, up to values of between 180MPa and 240MPa.

5.3 PRESSUREMETER TESTS

5.3.1 Pressure meter tests for the site were undertaken at the proposed locations for WTGs 1, 3, 5, 9, 14, 18, 20 and 22. The apparatus briefly comprises a cylindrical rubber membrane expanded against the sides of borehole created as the apparatus is pushed into the ground. The expansion of the membrane is measured directly by the apparatus producing a pressure – strain curve. Two unload-reload loops are undertaken with each test from where the Shear Modulus of the soil can be derived

5.3.2 All tests were undertaken with the superficial predominantly clay material, with some test horizons lying in more sandy clay or silt. Shears Modulus values ranged from 2.8MPa to 9.5MPa for very similar material (both firm clay) recovered from similar depths, indicating the variance across the site. See Appendix 2 for results summary.

5.4 CALIFORNIA BEARING RATIO TEST

5.4.1 California Bearing Ratio (CBR) tests were undertaken at 22 locations along the proposed route of access tracks throughout the site, as shown on the site plan included in the appendices. The CBR value was actually derived from plate load tests using a 300mm diameter plate as opposed to the standard CBR probe, the benefit of this that a greater depth of ground is tested and the larger plate allows a more even distribution of the

applied load, whereas a CBR probe can hit a pebble within the soil matrix and give false high readings.

5.4.2 The load-bearing capacity of the soils at or around track formation depth was recorded with the site's CBR ratios show a split within the site, into three sections; northwest, southeast and southwest, with each area having similar CBR ratios.

5.4.3 The northwest of the area (CBR tests 1, 2, 3, 4, 5, 6, 10 and 11) show higher ratios than both the southern areas; with ratios ranging between 2.5 and 3.8%. The southeast of the site (namely CBR tests 7, 9, 12, 13, 14, 15, 16 and 17) shows low CBR ratios varying from 0.8 to 1.5%; lastly the southwest of the site (locations 18, 19, 20, 21 and 22) have mid range ratio values of between 1.9 and 2.5%.

5.4.4 CBR test location 8 is found within the southeast of the site but shows an anomaly as the ratio seen at this location is higher than the other tests undertaken in the same area.

6 GAS MONITORING & CONTAMINATION TESTING

6.1 Gas monitoring on site was undertaken by WYG, monitoring six locations across the site on multiple visits. Various gases were monitored during these visits including, methane, carbon dioxide, carbon monoxide and oxygen as well as hydrogen sulphide and volatile organic compound content.

6.2 A suite of contamination testing was undertaken by Fugro on selected samples retrieved form the window sample boreholes under the supervision of WYG.

6.3 The results of the gas monitoring and contamination testing will be included in a full environmental assessment report compiled by WYG.

7 LABORATORY RESULTS

7.1 CLASSIFICATION TESTS

7.1.1 Soil testing scheduled comprised; moisture content, Atterberg Limits, particle size distribution (PSD) analysis, and pH and sulphate tests. and pH and sulphate tests.

7.1.2 Index properties for the clay and slightly sandy clay recovered between 0.10m and 7.95m depth revealed Liquid Limits ranging from 42% to 58% and Plasticity Indices of between 22 and 34 indicating clays of intermediate to high plasticity. Silt samples were identified with Liquid Limits of 30% and Plasticity Indices of 10.

7.1.3 Particle size distribution analysis was undertaken on sand samples recovered from a number of boreholes at depths of between 3.60m and 13.00m. The particle sizes are consistent with predominantly fine to medium sand with occasional coarse sand particles. The sampled recovered from 7.50m depth in BH22 was particularly gravelly with a 25% gravel content and the sand was found to be particularly silty (10-25%) in the samples recovered from 7.50m in BH3, 9.10m in BH8 and at 6.00 and 9.00m depth in BH10.

7.1.4 Chemical testing was undertaken on various samples of sand, silt and clay retrieved from depths of between 2.50m and 16.00m across the site. pH levels from these samples were generally neutral to slightly alkaline with values ranging between 7.1 and 8.0. The exception was a slightly more acidic pH value of 5.3 from the sand sample retrieved from 3.60m in BH13. Samples retrieved from 6.00m depth in the same borehole were around a pH of 7. Sulphate tests prepared as 2:1 water to solution sample; produced sulphate levels of between 0.02 and 0.26g/L.

7.2 STRENGTH TESTS

7.2.1 Undrained triaxial compression tests and one dimensional consolidation tests were scheduled on the superficial clay samples recovered. Unconfined compressive strength (UCS) and point load (PL) tests were scheduled for various recovered rock samples also.

7.2.2 Due to the laminated nature and inclusions of silt/fine sand layers in much of the clay samples, some triaxial tests were not undertaken as the samples would be prone to splitting along these planes prior to testing. Similarly none of the UCS tests scheduled on the rock samples were undertaken as either there were no samples of sufficient length to undertake the test or the samples were disturbed during preparation prior to testing.

7.2.3 One dimensional consolidation (oedometer) tests were performed on the superficial clay samples retrieved from depths of between 3.50m and 6.00m. Four samples retrieved from depths of between 3.50 and 4.50m depth were subjected to 4 loading cycles starting at 50kPa rising to 400kPa. Two samples retrieved from 6.00m depth were subjected to 4 loading cycles from 100kPa to 800kPa. For the shallower samples the coefficient of consolidation (c_v) values (log/root) varied under 50kPa applied pressure from 1.4/1.7 m^2/year to 8.1/8.6 m^2/year. Under 400kPa before unloading was undertaken on these samples the c_v ranged from 1.0/1.1 m^2/year to 4.3/4.2 m^2/year. For the samples retrieved from 6.00mbgl the c_v values ranged from 2.8/2.9 m^2/year to 3.2/3.5 m^2/year at 100kPa pressure and 6.3/6.6 m^2/year to 42/45 m^2/year at 800kPa. The coefficient of volume compressibility (m_v) values ranged from 0.112 to 0.548m^2/MN at 50kPa to 0.104 to 0.137m^2/MN at 400kPa in the samples from between 3.50 and 4.50m depth. The m_v of the samples from 6.00m depth ranged from 0.094 to 0.370m^2/MN at 100kPa applied pressure to between 0.028 and 0.066m^2/MN at 800kPa.

7.2.4 Four clay samples recovered from depths of 1.50m to 6.55m in BHs 3, 5, 8 and 22 were subject to quick undrained triaxial compression testing. Results revealed undrained shear strengths of between 35 (soft) and 53 kPa (firm), with bulk density varying between 19 and 20 kN/m^3.

7.2.5 Two consolidated undrained triaxial compression tests were undertaken on clay samples recovered between 3.50m and 6.45m depth revealing effective angles of shearing resistance between 27.5 and 30.5 degrees.

7.2.6 In the absence of any suitable test samples to allow any unconfined compressive strength tests to be undertaken, numerous point load tests were carried out. All tests were undertaken on samples of sandstone retrieved from depths of between 12.11m and 20.75m. The point load index, Is(50), ranged from 0.02 to 0.60MPa with an average around 0.14MPa. The results are summarised in Table 3 below.

Borehole *(WTG)*	**Test Depth (m)**	**Is(50) Point Load Index (MPa)**
BH08 *(8)*	14.54	0.10
BH08 *(8)*	14.51	0.18
BH08 *(8)*	15.31	0.10
BH08 *(8)*	15.27	0.23

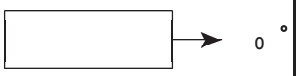
BH10 *(10)*	13.43	0.02
BH10 *(10)*	13.37	0.08
BH10 *(10)*	13.67	0.07
BH10 *(10)*	13.63	0.23
BH10 *(10)*	15.30	0.09
BH10 *(10)*	15.27	0.24
BH13 *(13)*	12.20	0.06
BH13 *(13)*	12.15	0.27
BH13 *(13)*	13.62	0.06
BH13 *(13)*	13.54	0.07
BH13 *(13)*	14.09	0.09
BH13 *(13)*	14.04	0.15
BH16 *(17)*	17.10	0.05
BH16 *(17)*	17.05	0.26
BH16 *(17)*	17.88	0.05
BH16 *(17)*	17.83	0.19
BH16 *(17)*	18.65	0.08
BH16 *(17)*	18.62	0.26
BH18 *(21)*	19.62	0.04
BH18 *(21)*	19.59	0.29
BH18 *(21)*	19.80	0.04
BH18 *(21)*	19.75	0.20
BH18 *(21)*	20.85	0.04
BH18 *(21)*	20.80	0.60
BH22 *(14)*	14.58	0.05
BH22 *(14)*	14.52	0.12
BH22 *(14)*	16.47	0.07
BH22 *(14)*	16.41	0.16
BH22 *(14)*	17.63	0.04
BH22 *(14)*	17.58	0.12

Table 2: Point Load Test Summary

VOLUME 2: APPENDICIES

APPENDIX A: EXPLORATORY HOLE LOGS

Method of Excavation	Hand dug	Plan	TRIAL PIT No. TPA
Surface Dimensions	0.50m x 0.50m		
Date Excavated Start	19/02/2009		
End	19/02/2009		



Logged by	Compiled by	Checked by
IU	ren	BC
19/02/2009	23/02/2009	23/02/2009

In-situ Testing			Samples			Description of Strata	Depth (Thick-ness) (m)	Level	Legend
Depth (m)	Type	Result	Depth (m)	Type	No.				
			0.20-0.40	ES	1	Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and mudstone. Sand is fine to coarse.	(0.20) 0.20		
						Firm becoming stiff orange brown and grey brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of mudstone and sandstone. Sand is fine to coarse.	(1.00)		
			1.00-1.20	ES	2				
						End of Trial Pit	1.20		

Remarks (See notes & keysheets)

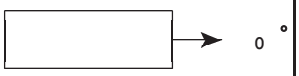
1 The walls of the pit were stable during excavation.
2 Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
3 On completion the trial pit was backfilled with compacted arisings.
4 Groundwater was not apparent during excavation.

Scale 1:25

UGRO	Project TWEEN BRIDGE WINDFARM	Contract No. CPT091107
		Figure No. TPA (1 of 1)

302/03

Method of Excavation	Hand dug	Plan	TRIAL PIT No. TPB
Surface Dimensions	0.50m x 0.50m		
Date Excavated Start	19/02/2009		
End	19/02/2009		
Logged by	Compiled by	Checked by	
IU	ren	MZ	
19/02/2009	23/02/2009	12/06/2009	



In-situ Testing			Samples			Description of Strata	Depth (Thick-ness) (m)	Level	Legend
Depth (m)	Type	Result	Depth (m)	Type	No.				
			0.30	ES	1	Soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and mudstone. Sand is fine to coarse.	(0.35)		
						Firm yellow brown silty CLAY.	0.35 (0.35)		
			1.00-1.20	ES	2	Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of limestone and sandstone. Sand is fine to coarse.	0.70 (0.50)		
						End of Trial Pit	1.20		

Remarks (See notes & keysheets)

1 The walls of the pit were stable during excavation.
2 Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
3 On completion the trial pit was backfilled with compacted arisings.
4 Groundwater was not apparent during excavation.

Scale 1:25

	Project TWEEN BRIDGE WINDFARM	Contract No. CPT091107
		Figure No. TPB (1 of 1)

302/03

Drilling Method: Window Sampler	Borehole Diameter: 87mm to 4.00m	Casing Diameter: 87mm to 2.00m	BOREHOLE No. WS1.1
Equipment: Dando Terrier			
Drill Crew: RU	Logged by: IU 16/02/2009	Compiled by: ren 23/02/2009	Checked by: BC 23/02/2009
Dates Drilled: Start 16/02/2009, End 16/02/2009			

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From	To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10		ES	1		TOPSOIL.	(0.20)		
			0.10	0.40	B	2			0.20		
			0.30		ES	3		Firm brown sandy slightly gravelly CLAY. (Possible MADE GROUND)	(0.20)		
			0.40	1.20	B	4			0.40		
								Yellow brown clayey very silty fine to medium SAND.	(1.10)		
	1.20		1.20	1.50	B	5					
			1.50	3.00	B	6			1.50		
		(100)						Firm thinly laminated brown clayey slightly sandy to sandy SILT. Sand is fine to coarse.			
	2.00										
		(96)							(2.50)		
			3.00	4.00	B	7					
	3.00										
		(100)									
16/02	4.00								4.00		
								End of Borehole			

Remarks (See notes & keysheets)

1. Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2. See installation details on final sheet.
3. Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107
		Figure No. WS1.1 (1 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 16/02/2009, End 16/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 2.00m Logged by: IU 16/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS1.1

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS1.1 (2 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 16/02/2009, End 16/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 3.00m Logged by: IU 16/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS2.1	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From	To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10		ES	1		MADE GROUND: Composed soft to firm brown sandy slightly gravelly clay. Gravel is subangular fine of sandstone and coal. Sand is fine to coarse.	(0.40)		
			0.10-0.20		B	2					
			0.30		ES	3					
									0.40		
								Orange brown clayey silty fine and medium SAND.			
			0.80-1.00		B	4			(0.80)		
	1.20								1.20		
			1.20-1.80		B	5		Firm orange brown clayey SILT and fine to coarse SAND.			
		(100)							(0.60)		
			1.80-3.00		B	6			1.80		
	2.00							Firm thinly laminated brown sandy SILT. Sand is fine to coarse.			
		(100)									
									(2.20)		
			3.00-4.00		B	7					
	3.00										
		(100)									
16/02	4.00								4.00		
								End of Borehole			

Remarks (See notes & keysheets)

1. Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2. See installation details on final sheet.
3. Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS2.1 (1 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 16/02/2009, End 16/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 3.00m Logged by: IU 16/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS2.1

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS2.1 (2 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 17/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 10.00m Casing Diameter: 87mm to 6.00m Logged by: IU 17/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS3	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
17/02	0.00		0.10	ES	1		MADE GROUND: Composed of grey brown sandy slightly gravelly clay with a little ash.	(0.40)		
			0.10-0.40	B	2					
			0.40	D	3		Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. Sand is fine to coarse.	0.40		
			0.40-0.80	B	4			(0.40)		
			0.80-1.20	B	5		Orange brown clayey very sandy SILT. Sand is fine to coarse.	0.80		
								(0.40)		
	1.20	(100)	1.20-2.10	B	6		Orange brown very silty fine SAND.	1.20		
								(1.00)		
	2.00	(95)	2.20-3.10	B	7		Firm thinly laminated brown silty sandy CLAY with pockets of silty sand. Sand is fine to coarse.	2.20		
			3.00-4.00	B	8					
	3.00	(100)								
17/02										
18/02	4.00	(95)						(4.80)		

Remarks (See notes & keysheets)

1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.

2 See installation details on final sheet.

3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS3 (1 of 3)

Drilling Method: Window Sampler	Borehole Diameter: 87mm to 10.00m	Casing Diameter: 87mm to 6.00m	BOREHOLE No. WS3
Equipment: Dando Terrier			
Drill Crew: RU	Logged by: IU 17/02/2009	Compiled by: ren 23/02/2009	Checked by: BC 23/02/2009
Dates Drilled: Start 17/02/2009, End 18/02/2009			

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
	5.00	(60)								
	6.00	(70)								
	7.00	(80)					Soft to firm brown clayey sandy SILT with occasional pockets of silty fine sand.	7.00 (1.00)		
	8.00	(80)					Brown locally slightly silty fine and medium SAND.	8.00 (2.00)		
18/02	9.00 10.00	(60)					End of Borehole	10.00		

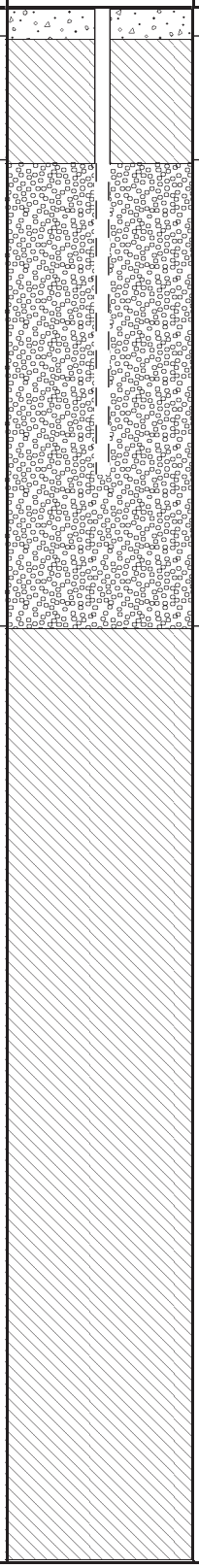
Remarks
(See notes & keysheets)

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107
		Figure No. WS3 (2 of 3)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 17/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 10.00m Casing Diameter: 87mm to 6.00m Logged by: IU 17/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS3

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 3.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		
Bentonite Seal	10.00		Base of Hole



Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS3 (3 of 3)

309/03

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 16/02/2009, End 16/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 16/02/2009 Compiled by: ren 23/02/2009 Checked by: MZ 12/06/2009	BOREHOLE No. WS4	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10	ES	1		MADE GROUND: Composed of soft grey brown sandy slightly gravelly clay. Gravel is subangular fine of sandstone and coal. Sand is fine to coarse.	(0.40)		
			0.10-0.30	B	2					
			0.40	ES	3		Orange brown clayey silty fine and medium SAND.	0.40		
			0.50-1.20	B	4			(1.10)		
	1.20		1.20-1.50	B	5					
			1.50-3.00	B	6		Firm thinly laminated brown silty locally sandy CLAY. Sand is fine and medium At 1.50m: Very sandy silt.	1.50		
	2.00	(100)						(1.50)		
	3.00	(100)						3.00		
		(55)	3.50-4.00	B	7		Brown fine to medium SAND.	(0.50)		
16/02	4.00						Firm brown clayey slightly sandy SILT.	3.50 (0.50) 4.00		
							End of Borehole			

Remarks (See notes & keysheets)

1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.

2 See installation details on final sheet.

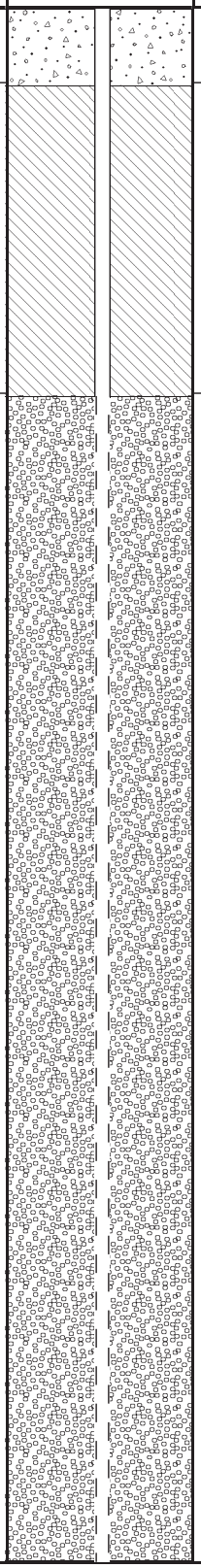
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS4 (1 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 16/02/2009, End 16/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 16/02/2009 Compiled by: ren 23/02/2009 Checked by: MZ 12/06/2009	BOREHOLE No. WS4

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole



Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS4 (2 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: IU Dates Drilled: Start 18/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 18/02/2009 Compiled by: ren 23/02/2009 Checked by: MZ 01/04/2009	BOREHOLE No. WS5	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
18/02	0.00		0.10-0.20	ES	1		Grass over MADE GROUND: Composed of firm grey sandy gravelly clay intermixed with ash. Gravel is subangular fine to coarse of sandstone, brick and concrete.	(0.50)		
			0.10-0.50	B	2					
			0.40-0.50	B	3					
			0.50-1.40	B	4		Firm brown silty sandy CLAY with rootlets. Sand is fine to coarse.	0.50 (0.70)		
	1.20		1.20-1.70	B	5		Firm brown silty CLAY.	1.20 (0.50)		
		(100)								
			1.70-3.00	B	6		Grey locally slightly silty fine to coarse SAND.	1.70		
	2.00	(85)						(2.30)		
			3.00-4.00	B	7					
	3.00	(60)								
18/02	4.00						End of Borehole	4.00		

Remarks (See notes & keysheets)

1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.

2 See installation details on final sheet.

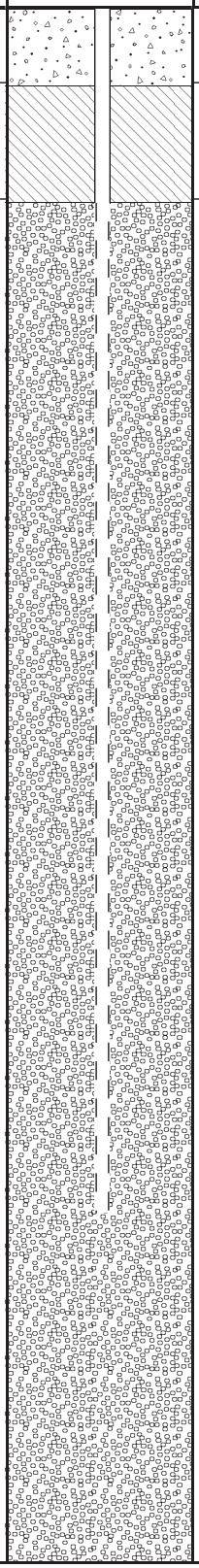
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS5 (1 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: IU Dates Drilled: Start 18/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 18/02/2009 Compiled by: ren 23/02/2009 Checked by: MZ 01/04/2009	BOREHOLE No. WS5

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 3.10m.
Bentonite Seal	0.50		
Gravel Filter			
	4.00		Base of Hole



Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS5 (2 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 18/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 2.00m, 75mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 18/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS6	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
18/02	0.00		0.10-0.20	ES	1		MADE GROUND: Composed of soft brown sandy gravelly clay.	(0.30)		
			0.10-0.30	B	2			0.30		
			0.40-0.70	B	3		Firm grey brown sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone. Sand is fine to coarse. (Possible MADE GROUND)	(0.40)		
			0.70	ES	4			0.70		
			0.70-1.20	B	5		Soft brown fibrous PEAT with strong organic odour.	(0.80)		
	1.20		1.20-1.50	B	6					
			1.50-2.20	B	7			1.50		
		(100)					Brown very silty fine to coarse SAND with occasional bands of clayey silt.			
	2.00		2.00-3.40	B	8			(1.90)		
		(70)								
	3.00		3.40-4.00	B	9			3.40		
		(70)					Firm thickly laminated brown silty CLAY.	(0.60)		
18/02	4.00							4.00		
							End of Borehole			

Remarks (See notes & keysheets)

1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.

2 See installation details on final sheet.

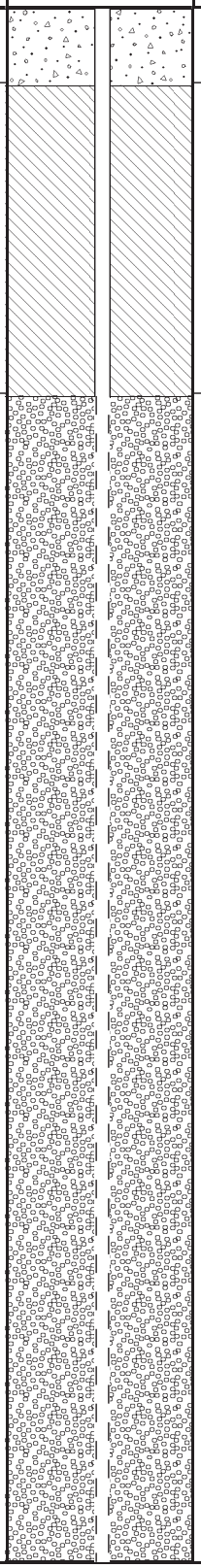
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS6 (1 of 2)

Drilling Method: Window Sampler Equipment: Dando Terrier Drill Crew: RU Dates Drilled: Start 18/02/2009, End 18/02/2009	Borehole Diameter: 87mm to 2.00m, 75mm to 4.00m Casing Diameter: 87mm to 4.00m Logged by: IU 18/02/2009 Compiled by: ren 23/02/2009 Checked by: BC 23/02/2009	BOREHOLE No. WS6

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole



Remarks
(See notes & keysheets)

Not to Scale

FUGRO	Project: TWEEN BRIDGE WINDFARM	Contract No. CPT091107 Figure No. WS6 (2 of 2)

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	07/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	16/04/2009	Dando 175/Beretta T51	0.00m	14.50m	200mm	14.40m	Coordinates	E 471540.91
Checked	RH			Cable percussion boring. Rotary core drilling (GBS size) using mud flush	14.50m	15.50m	146mm	15.50m	National Grid	N 414083.84
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.40	B 1	0.00-1.20 m Hand dug inspection pit		
0.40-1.20	B 2			
1.50-1.95	U 3	49 blows	1.50	dry
2.05	D 4			
2.50-2.95	SPT S	N=9 (1,1/2,2,2,3)	2.50	dry
2.50-2.95	D 5			
2.50-3.00	B 6			
3.50-4.00	B 7		3.00	
3.50-3.95	U NR	51 blows No recovery		dry
4.00-4.45	SPT S	N=12 (2,3/2,3,3,4)	4.00	dry
4.00-4.45	D 8			
4.00-5.00	B 9			
5.00-5.45	U NR	40 blows No recovery	4.50	dry
5.00-6.00	B 10			
6.00-6.45	SPT S	N=11 (1,2/3,2,2,4)	6.00	dry
6.00-6.45	D 11			
6.00-7.00	B 12			
			07/04/2009 6.00	dry
			08/04/2009 6.00	0800 dry
7.50-7.95	SPT S	N=11 (2,3/2,3,3,3)	7.50	6.00
7.50-7.95	D 13			
7.50-8.00	B 14			
9.00-9.45	SPT S	N=14 (2,2/2,4,3,5)	9.00	7.10
9.00-9.45	D 15			
9.00-10.00	B 16			

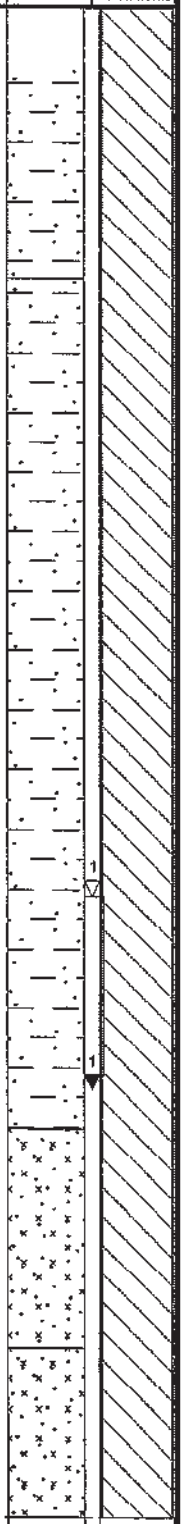
Depth	Type & No	Records	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)
Firm dark brown slightly sandy CLAY (TOPSOIL)	(0.40)
	0.40
Firm orange brown mottled grey sandy CLAY	(1.40)
	1.80
Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	(5.65)
	7.45
Medium dense red brown slightly silty fine to medium SAND	(1.45)
	8.90
Medium dense grey brown slightly silty fine to coarse SAND.	
Stratum continues to 14.50 m	

Legend

Backfill/ Instruments



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	7.10	Rose to 5.90 m after 20 minutes.	-

Depth Related Remarks

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH3

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	07/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	16/04/2009	Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush	0.00m	14.50m	200mm	14.40m	Coordinates	E 471540.91
Checked	RH				14.50m	15.50m	146mm	15.50m	National Grid	N 414083.84
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95 10.50-10.95 10.50-11.00	SPT S D 17 B 18	N=19 (2,4/4,5,5,5)	10.50	7.40
12.00-12.45 12.00-12.45 12.00-13.00	SPT S D 19 B 20	N=22 (3,5/4,6,5,7)	12.00	8.15
13.50-13.95 13.50-13.95 13.50-14.00	SPT S D 21 B 22	N=33 (5,5/7,9,8,9)	13.50	8.50
14.40-14.49 14.40-14.50	SPT S D 23	50 (25 for 50mm/50 for 40mm)	08/04/2009 14.40	9.00
14.50-15.50	90 NI 40 90 34 200	Flush: 14.50-15.50 Mud, 85 %	16/04/2009 13.50 16/04/2009 15.50	0800 1.00 1500
15.50	D-24			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)		Depth, Level (Thickness)	Legend	Backfill/ Instruments
Medium dense grey brown slightly silty fine to coarse SAND.	10.10-10.60 m Foreman reports small pebbles	(5.60)		
	13.50-14.50 m dense			
Weak reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar.	14.50-14.60 m AZCL 14.60-14.75 m Recovered as slightly silty, slightly gravelly sand. Gravel is subrounded coarse of various lithologies	14.50 (1.00)		
EXPLORATORY HOLE ENDS AT 15.51 m	15.31-15.37 m Weak grey mudstone 15.37-15.50 m NI 15.50 m Blowing gravel. Gravel is angular fine to medium grained of various lithologies	15.50		

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: A9057

Carried out for: Morrison Construction Limited

Borehole

BH3

Sheet 2 of 2

Borehole Log

Soil Mechanics

Drilled	AH/PS
Logged	PM
Checked	RH

Start 02/04/2009
End 05/04/2009

Equipment, Methods and Remarks
Dando 175, Beretta T51
Cable percussion boring. Rotary core drilling (GBS size) using mud flush.

Depth from	to	Diameter	Casing Depth
0.00m	14.40m	200mm	13.50m
14.40m	22.70m	146mm	22.70m

Ground Level -
Coordinates E 471580.36
National Grid N 412892.61
Chainage

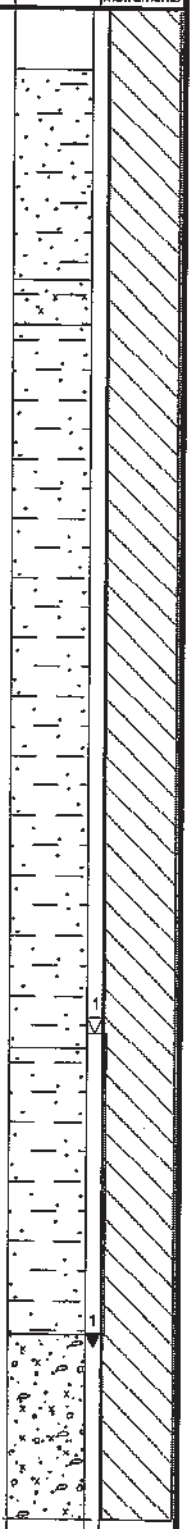
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.40	B 1	0.00-1.20 m Hand dug inspection pit		
0.40-1.20	B 2			
1.50-1.95	SPT S	N=4 (2,2/1,1,1,1)	1.50	dry
1.50-1.80	B 3			
1.80-2.00	B 4			
2.10	D 5			
2.50-2.95	U 6	42 blows	2.50	dry
3.05	D 7			
3.50-3.95	SPT S	N=12 (2,2/3,3,3,3)	3.00	dry
3.50-3.95	D 8			
3.50-4.00	B 9			
4.50-4.95	U 10	47 blows	4.50	dry
5.05	D 11			
6.00-6.45	SPT S	N=11 (3,2/2,3,3,3)	6.00	dry
6.00-6.45	D 12			
6.00-7.00	B 13			
7.50-7.95	SPT S	N=8 (1,2/2,2,2,3)	7.50	dry
7.50-7.95	D 14			
7.50-8.00	B 15			
8.80	W 15a		02/04/2009 9.00	dry
9.00-9.45	SPT C	N=15 (2,3/4,4,3,4)	05/04/2009 9.00	0800 5.60
9.00	D 16			
9.00-10.00	B 17			

Strata

Description	Depth, Level (Thickness)
Soft to firm dark brown sandy CLAY (TOPSOIL)	(0.40)
Loose brown slightly clayey fine to medium SAND	0.40 (1.40)
Soft grey brown slightly sandy silty CLAY	1.80 (0.30)
Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	2.10 (4.80)
Firm red brown sandy CLAY	6.90 (1.90)
Medium dense brown slightly silty slightly gravelly SAND. Gravel is subrounded to rounded fine to coarse of various lithologies.	8.80 (1.60)
Stratum continues to 10.40 m	

Legend / Backfill/Instruments



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	8.80	Rose to 6.80 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1:50
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Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole
BH5
Sheet 1 of 3

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	02/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	05/04/2009	Dando 175, Beretta T51	0.00m	14.40m	200mm	13.50m	Coordinates	E 471580.36
Checked	RH			Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	14.40m	22.70m	146mm	22.70m	National Grid	N 412892.61
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=21 (3,4/4,6,5,6)	10.50	7.10
10.50-10.95	D 18			
10.50-11.00	B 19			
12.00-12.45	SPT S	N=31 (3,5/7,6,9,9)	12.00	7.90
12.00-12.45	D 20			
12.00-13.00	B 21			
13.50-13.70	SPT S	50 (12,13/50 for 50mm)	13.50	8.40
13.50-13.70	D 22			
14.00-14.23	SPT S	50 (15,10/50)		
14.00-14.17	D 23		05/04/2009 13.50	8.80

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
14.40-15.65	80 64 30	NI 50 80		09/04/2009 13.50	0800
15.65-16.60	95 69 46				
16.60-18.10	100 95 55				
18.10-19.60	13 0 0	NI 110 350	Flush: 14.40-22.70 Mud, 80 %		

Strata

Description (Continued from Sheet 1)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Medium dense brown slightly silty slightly gravelly SAND. Gravel is subrounded to rounded fine to coarse of various lithologies.	10.40		
Medium dense to dense red brown fine to medium SAND.	(4.00)		
Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, planar, rough, frequently infilled up to 10mm with clayey medium to coarse sand.	14.40		
14.40-14.65 m AZCL			
14.87-14.98 m weak reddish brown mudstone			
14.88-14.90 m recovered as slightly sandy clay			
15.37-15.50 m subvertical fracture, drilling induced, rough planar clean			
15.65-15.70 m AZCL			
15.70 m orangish brown			
15.70-15.85 m recovered as slightly gravelly medium to coarse SAND. Gravel is angular to subangular fine to coarse			
16.25-16.75 m low cobble content. Cobbles are subrounded of sandstone			
16.60-16.62 m recovered as medium to coarse sand			
17.50 m reddish brown	(8.30)		
18.06-18.10 m recovered as medium to coarse sand			
18.10-19.40 m AZCL			
19.40-19.60 m recovered as slightly clayey slightly gravelly medium to coarse sand. Gravel is			
Stratum continues to 22.70 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH5

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	02/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	05/04/2009	Dando 175, Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	0.00m	14.40m	200mm	13.50m	Coordinates	E 471580.36
Checked	RH				14.40m	22.70m	146mm	22.70m	National Grid	N 412892.61
									Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
19.60-21.10	30 18 0			09/04/2009 13.50	
				14/04/2009 13.50	0800 1.76
21.10-22.70	50 46 34			14/04/2009 22.70	

Strata

Description (Continued from Sheet 2)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, planar, rough, frequently infilled up to 10mm with clayey medium to coarse sand. :: 19.40m - subrounded fine to coarse of sandstone 20.05-21.10 m AZCL 21.10-21.90 m AZCL			
EXPLORATORY HOLE ENDS AT 22.70 m	22.70		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH5

Borehole Log

Soil Mechanics

Drilled	CR/PS
Logged	PM
Checked	RH

Start 07/04/2009
End 16/04/2009

Equipment, Methods and Remarks
Dando 175 / Berretta T51
Cable percussion boring/Rotary core drilling (GBS size) using mud flush.

Depth from	to	Diameter	Casing Depth
0.00m	13.20m	200mm	12.00m
13.20m	17.94m	146mm	17.94m

Ground Level -
Coordinates E 471968.61
National Grid N 413678.89
Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
		0.00-1.20 m Hand dug inspection pit		
0.40-0.80	B 1			
1.00-1.40	B 2			
1.55-2.00	B 3		1.50	
1.55-2.00	U NR	14 blows No recovery		damp
2.60-3.05	SPT S	N=9 (1,1/2,2,2,3)	2.40	damp
2.60-3.05	D 4			
2.60-3.05	B 5			
3.60-4.05	U 6	27 blows	3.40	dry
4.20	D 7			
4.65-5.10	SPT S	N=9 (1,2/2,2,2,3)	4.60	dry
4.65-5.10	D 8			
4.65-5.10	B 9			
5.40-5.80	B 10			
6.10-6.55	U 11	26 blows	6.00	dry
6.70	D 12			
7.00-7.40	B 13			
7.60-8.05	SPT S	N=33 (3,4/6,8,9,10)	7.50	4.00
7.60-8.05	D 14			
7.60-8.05	B 15			
			07/04/2009 7.50	3.50
9.10-9.55	SPT S	N=38 (5,7/8,10,9,11)	08/04/2009 7.50	0800 1.30
9.10-9.55	D 16			
9.10-9.55	B 17			
9.80-10.20	B 18			

Depth	Type & No	Records	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
TOPSOIL	(0.30)		
Firm orange brown mottled grey sandy CLAY	0.30		
	(0.65)		
Brown slightly clayey fine to medium SAND	0.95		
	(0.50)		
Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	1.45		
	(5.55)		
Dense brown slightly silty fine to medium SAND	7.00		
9.70 m Foreman reports, becoming slightly gravelly			
	(3.75)		
Stratum continues to 10.75 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: A9057
Carried out for: Morrison Construction Limited

Borehole
BH8
Sheet 1 of 2

Borehole Log

Soil Mechanics

Drilled	CR/PS	Start	07/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	16/04/2009	Dando 175 / Berretta T51	0.00m	13.20m	200mm	12.00m	Coordinates	E 471968.81
Checked	RH			Cable percussion boring/Rotary core drilling (GBS size) using mud flush.	13.20m	17.94m	146mm	17.94m	National Grid	N 413678.89
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.60-10.69	SPT S	40 (4,5/5,35 for 60mm)	10.50	1.90
10.60-10.90	D 19			
10.60-10.90	B 20			
11.20-11.50	B 21			
12.10-12.30	SPT S	50 (14,11 for 35mm/ 40,10 for 15mm)	12.00	2.30
12.10-12.30	D 22			
12.10-12.30	B 23			
12.70-13.10	B 24			
13.20-13.45	NI	TCR 100, SCR 32, RQD 0	16/04/2009	0800
13.55-13.80	NI 550	CS 26	12.00	1.28
13.45-14.97	100 86 85			
14.46-14.54		CS 25		
15.22-15.31		CS 27		
14.97-16.48	100 81 74 NI 280 550	Flush: 13.20-17.94 Mud, 85 %		
16.48-17.94	100 92 82			
			16/04/2009	1420

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)		Depth, Level (Thickness)
Dense brown slightly silty fine to medium SAND		
Dense red brown fine to coarse SAND.		10.75 (2.45)
Very weak to weak reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar.	13.20-13.30 m Recovered as sand 13.40-13.45 m NI 13.45-13.53 m NI Recovered as sand	13.20 (0.74)
Medium strong yellowish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal medium spaced rough planar.	14.91-14.97 m NI	13.94 (1.07)
Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal medium spaced rough planar.	Recovered as gravelly sand 15.09-15.14 m rare grey mudstone zeolitihs 15.58-15.70 m grey 16.25-16.48 m NI 16.48-16.50 m Recovered as sand	15.01 (2.93)
	17.85-17.94 m NI	
EXPLORATORY HOLE ENDS AT 17.94 m		17.94

Legend / Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From to (m)

Chiselling

Depths (m)	Time	Tools used
11.20 -11.50	45 mins	
11.70 -12.00	45 mins	
12.20 -12.53	45 mins	
12.70 -12.90	45 mins	
12.90 -13.05	45 mins	
13.05 -13.20	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH8

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 06/04/2009 End 07/04/2009	Equipment, Methods and Remarks Dando 175/ Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 12.38m / 200mm / 12.38m 12.38m / 16.64m / 146mm / 16.64m			Ground Level - Coordinates E 472342.00 National Grid N 413158.00 Chainage	

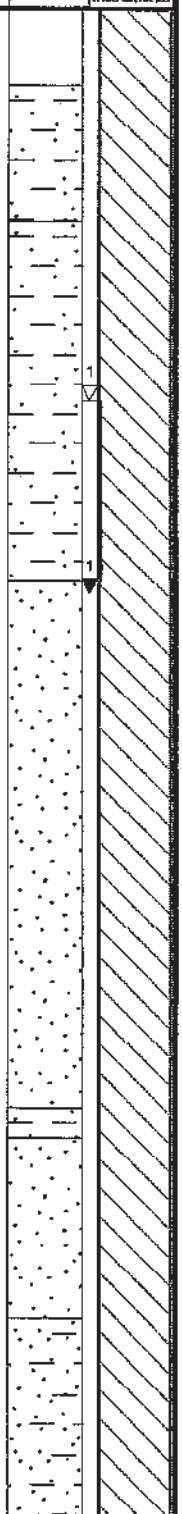
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.50	B 1	0.00-1.20 m Hand dug inspection pit		
0.50-1.20	B 2			
1.50-1.95	U 3	48 blows	1.50	dry
2.05	D 4			
2.50-2.95	SPT S	N=12 (2,3/2,3,4,3)	2.50	dry
2.50-2.95	D 5			
2.50-3.00	B 6			
3.50-3.95	U 7	48 blows	3.00	dry
3.80	W 19a			
4.05	D 8			
4.50-4.95	SPT S	N=10 (2,2/2,3,2,3)	4.50	3.70
4.50-5.00	B 10			
4.50-4.95	D 9			
6.00-6.45	SPT S	N=13 (2,3/2,4,4,3)	6.00	4.40
6.00-6.45	D 11			
6.00-7.00	B 12			
7.30	D 13			
7.50-7.95	SPT S	N=9 (1,3/2,2,2,3)	7.50	5.80
7.50-7.95	D 14			
7.50-8.00	B 15			
9.00-9.45	SPT S	N=15 (3,4/4,3,4,4)	9.00	7.00
9.00-9.45	D 16			
9.00-10.00	B 17			

Strata

Description	Depth, Level (Thickness)
Soft dark brown slightly sandy CLAY. (TOPSOIL)	(0.50)
Soft grey mottled brown sandy CLAY	0.50 (0.90)
Firm thinly laminated brown sandy CLAY	1.40 (2.40)
Medium dense light brown medium to coarse SAND	3.80 (3.50)
Soft brown sandy CLAY	7.30
Medium dense brown fine to medium SAND	7.50 (1.20)
Medium dense red dark brown clayey fine to medium SAND	8.70 (2.30)
Stratum continues to 11.00 m	

Legend / Backfill/ Instruments



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	Rose to 2.60 m after 20 minutes.	-

Depth Related Remarks
From / to (m)

Chiselling
Depths (m) / Time / Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: A9057
Carried out for: Morrison Construction Limited

Borehole
BH10
Sheet 1 of 2

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	06/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	07/04/2009	Dando 175/ Beretta T51	0.00m	12.38m	200mm	12.38m	Coordinates	E 472342.00
Checked	RH			Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	12.38m	16.64m	146mm	16.64m	National Grid	N 413158.00
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=16 (2,4/3,5,4,4)	10.50	7.60
10.50-10.95	D 18			
10.50-11.00	B 19			
			06/04/2009	
12.00-12.20	SPT S	50 (11,14/50 for 50mm)	12.00	8.40
12.00-12.20	D 20		07/04/2009	
12.25-12.46	SPT S	50 (15,10 for 100mm/ 50 for 30mm)	12.38	5.10
12.25-12.38	D 21		15/04/2009	0800
12.38-12.93	100 15 0 NI 50 230		12.38	1.26
12.93-13.58	100 74			
13.33-13.43	60	CS 22		
13.58-15.14	100 91 7 NI 90 210	Flush: 12.38-16.64 Mud, 70 %		
15.23-15.30		CS 23		
15.14-16.64	100 85 38			
			15/04/2009	
			12.38	

Strata

Description (Continued from Sheet 1)		Depth, Level (Thickness)	Legend	Backfill/ Instruments
Medium dense red dark brown clayey fine to medium SAND				
		11.00		
Dense red brown medium to coarse grained SAND. (Possible Weathered BEDROCK)		(1.38)		
		12.38		
Very weak to weak reddish brown grey medium to coarse grained SANDSTONE. Fractures are suborizontal closely spaced rough planar	12.38-12.68 m Recovered as sand	(1.20)		
	12.93-12.98 m Recoved as slightly clayey SAND			
	13.50-13.58 m NI - re	13.58		
Very weak to weak thinly laminated red brown locally grey MUDSTONE. Fractures are subhorizontal closely spaced rough planar.		(1.56)		
	15.02-15.14 m NI			
		15.14		
Weak to medium strong orangish brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar.	15.30-15.45 m Recovered as sand	(1.50)		
	16.60-16.64 m NI	16.64		
EXPLORATORY HOLE ENDS AT 16.64 m				

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH10

Sheet 2 of 2

Borehole Log

Soil Mechanics

Drilled	CR/DS
Logged	PM
Checked	RH

Start	01/04/2009
End	07/04/2009

Equipment, Methods and Remarks
Dando 175/Beretta T51
Cable percussion boring. Rotary core drilling (GBS size) using mud flush.

Depth from	to	Diameter	Casing Depth
0.00m	11.20m	200mm	11.00m
11.20m	15.20m	146mm	15.20m

Ground Level	-
Coordinates	E 473041.00
National Grid	N 412568.00
Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
		0.00-1.20 m Hand dug inspection pit		
0.60-1.00	B 1			
1.15-1.50	B 2			
1.55-2.00	B 3		1.40	
1.55-2.00	U NR	32 blows No recovery		dry
2.60-3.05	SPT S	N=13 (1,1/2,2,3,6)	2.50	2.30
2.60-3.05	D 4			
2.60-3.05	B 5			
3.60-4.05	SPT S	N=11 (1,1/2,2,3,4)	3.50	2.40
3.60-4.05	D 6			
3.60-4.05	B 7			
4.00-4.09	CS 25			
4.60-5.05	SPT S	N=6 (2,1/1,-,1,4)	4.50	2.90
4.60-5.05	D 8			
4.60-5.05	B 9			
5.30-5.65	B 10			
6.00-6.45	SPT S	N=15 (1,2/3,5,3,4)	6.00	3.50
6.00-6.45	D 11			
6.00-6.45	B 12			
6.80-7.20	B 13			
7.50-7.67	SPT S	50 (16,9 for 20mm/50)	7.50	3.80
7.50-7.65	D 14			
7.50-8.00	B 15			
			01/04/2009 7.50	3.40
			02/04/2009 7.50	0800 0.85
8.30	D 16			
8.55-8.64	SPT S	50 (25 for 50mm/50 for 40mm)	8.50	1.20
8.55-8.65	D 17			
8.55-8.65	B 18			
9.00-9.40	B 19			

Strata

Description	Depth, Level (Thickness)
TOPSOIL	(0.35)
	0.35
Soft to firm grey mottled brown slightly sandy CLAY	(0.70)
	1.05
Soft to firm thinly laminated brown sandy CLAY with occasional thin laminae of fine and medium sand.	(1.05)
	2.10
Medium dense becoming loose grey brown slightly silty SAND	(3.10)
	5.20
Firm grey brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium of sandstone.	(1.50)
	6.70
Very dense yellow brown grey fine and medium SAND	(1.30)
	8.00
Very dense brown grey slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	(3.20)
Stratum continues to 11.20 m	

Legend

Backfill/ Instruments

1

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	2.25	-	-

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used
6.50 -6.60	45 mins	
8.55 -8.85	45 mins	
8.90 -9.25	45 mins	
9.40 -9.75	45 mins	
9.85 -10.00	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH13

Borehole Log

Soil Mechanics

Drilled	CR/DS	Start	01/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	07/04/2009	Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	0.00m	11.20m	200mm	11.00m	Coordinates	E 473041.00
Checked	RH				11.20m	15.20m	146mm	15.20m	National Grid	N 412568.00
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.10-10.20 10.10-10.20 10.10-10.20	SPT S D 20 B 21	50 (25 for 55mm/50 for 45mm)	10.00	1.50
11.10-11.19 11.10-11.20 11.10-11.20	SPT S D 22 B 23 NI	50 (25 for 45mm/50 for 40mm)	11.00 02/04/2009 11.00	1.70 2.00
11.20-12.20	72 63 32	30 60 190	07/04/2009 11.00	0800 1.85
12.11-12.20		CS 24		
12.20-13.70	100 85 13	Flush: 11.20-15.20 Mud, 100 %		
13.70-15.20	100 94 56	NI 60 210	07/04/2009 15.20	

Strata

Description (Continued from Sheet 1)		Depth, Level (Thickness)	Legend	Backfill/ Instruments
Very dense brown grey slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.				
Weak to medium strong grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to closely spaced, rough, planar, stained orange brown, infilled with orange brown sandy up to 10mm.	11.20-11.48 m AZCL 11.48-11.54 m recovered as sand 12.27-12.29 m NI 12.59-12.62 m NI 12.75-12.80 m recovered as sandy gravel 13.07-13.34 m 1 No. subvertical undulose rough fracture, surface stained brown 13.54-13.59 m NI 15.05-15.10 m NI 15.12-15.15 m NI	11.20 (4.00)		
EXPLORATORY HOLE ENDS AT 15.20 m		15.20		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From to (m)

Chiselling

Depths (m)	Time	Tools used
10.35 -10.70	45 mins	
10.70 -10.90	45 mins	
10.95 -11.20	45 mins	
11.20 -11.35	45 mins	
11.35 -11.45	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

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Scale 1:50

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AGS

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH13

Sheet 2 of 2

Borehole Log

Soil Mechanics

Drilled	AH/DS
Logged	PM
Checked	RH

Start	31/03/2009
End	06/04/2009

Equipment, Methods and Remarks
Dando 175/Beretta T51
Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.

Depth from	to	Diameter	Casing Depth
0.00m	16.50m	200mm	16.44m
16.50m	22.50m	146mm	22.50m

Ground Level	-
Coordinates	E 473696.94
National Grid	N 412841.27
Chainage	

Samples and Tests

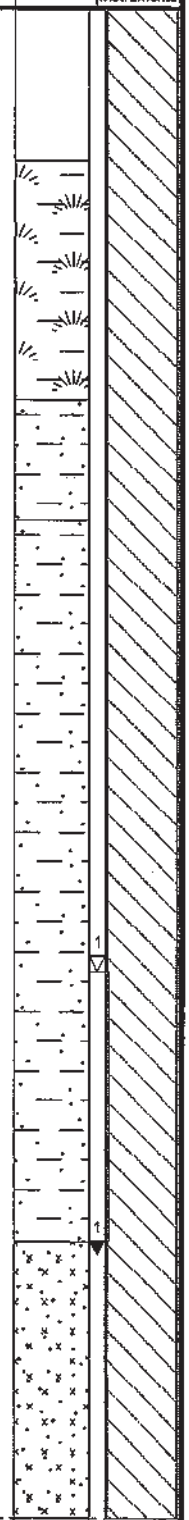
Depth	Type & No	Records	Date Casing	Time Water
0.10-1.00	B 1	0.00-1.20 m Hand dug inspection pit		
1.00-1.50	B 2			
1.50-1.95	U 3	17 blows	1.50	dry
2.05	D 4			
2.50-2.95	SPT S	N=4 (1,1/1,1,1,1)	2.50	dry
2.50-2.95	D 5			
2.50-3.00	B 6			
3.50-3.95	U 7	35 blows	3.00	dry
4.05	D 8			
4.50-4.95	SPT S	N=9 (1,2/3,2,2,2)	4.50	dry
4.50-5.00	B 10			
4.50-4.95	D 9			
6.00-6.45	U 11	47 blows	31/03/2009 6.00	dry
			01/04/2009 6.00	0600 dry
6.55	D 12			
7.50-7.95	SPT S	N=13 (2,2/3,3,4,3)	7.50	dry
7.50-7.95	D 13			
7.50-8.00	B 14			
8.20	D 26a			
9.00-9.45	SPT S	N=16 (3,2/4,4,4,4)	9.00	8.70
9.00-9.45	D 15			
9.00-10.00	B 16			

Strata

Description	Depth, Level (Thickness)
Soft brown sandy CLAY (TOPSOIL)	(1.00)
Plastic dark brown clayey pseudo-fibrous PEAT	1.00 (1.60)
Very soft brown sandy CLAY	2.60 (0.80)
Firm thinly laminated brown sandy CLAY	3.40 (4.80)
Medium dense becoming red brown slightly silty fine to coarse SAND	8.20
Stratum continues to 15.60 m	

Legend

Backfill/ Instruments



Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	8.20	Rose to 6.40 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole
BH16
Sheet 1 of 3

Borehole Log

Soil Mechanics

Drilled	AH/DS	Start	31/03/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	06/04/2009	Dando 175/Beretta T51	0.00m	16.50m	200mm	16.44m	Coordinates	E 473696.94
Checked	RH			Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.	16.50m	22.50m	146mm	22.50m	National Grid	N 412841.27
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=14 (2,4/3,4,3,4)	10.50	6.95
10.50-10.95	D 17			
10.50-11.00	B 18			
12.00-12.45	SPT S	N=26 (3,3/5,7,6,8)	12.00	7.70
12.00-12.45	D 19			
12.00-13.00	B 20			
13.50-13.95	SPT S	N=26 (5,6/5,7,7,7)	13.50	8.40
13.50-13.95	D 21			
13.50-14.00	B 22			
15.00-15.45	SPT S	N=36 (5,6/7,9,9,11)	15.00	8.50
15.00-15.45	D 23			
15.00-15.60	B 24			
15.60-16.00	B 25		01/04/2009 16.44	8.95
16.50-16.63	SPT S	50 (25/50 for 50mm)	06/04/2009 16.44	0800
16.50-16.62	D 26			
16.50-17.00	100 18 0	NI NI 20		
17.00-18.35	100 92 55	CS 27		
17.78-17.88				
18.54-18.65		CS 28		
18.35-19.85	100 95 63	NI 120 280		
		Flush: 16.50-22.50 Mud, 100 %		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)	Depth, Level (Thickness)
Medium dense becoming red brown slightly silty fine to coarse SAND	(7.40)
Dense light brown slightly silty fine and medium SAND.	15.60 (0.90)
Very weak to medium strong red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar. 16.50-16.85 m recovered as sand; 16.95-17.05 m recovered as sandy gravel; 18.30-18.35 m NI; 19.75-19.80 m recovered as	16.50 (4.40)
Stratum continues to 20.90 m	

Legend

Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH16

Borehole Log

Soil Mechanics

Drilled AH/DS Logged PM Checked RH	Start 31/03/2009 End 06/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 16.50m / 200mm / 16.44m 16.50m / 22.50m / 146mm / 22.50m	Ground Level – Coordinates E 473696.94 National Grid N 412841.27 Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
19.85-21.00	87 74 46				
		NI 50 140			
21.00-22.50	100 98 30	NI 60 120		06/04/2009 22.50	

Strata

Description (Continued from Sheet 2)		Depth, Level (Thickness)	Legend	Backfill/ Instruments
Very weak to medium strong red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar.	:: 19.75m - sand 20.00-20.05 m NI 20.25-20.28 m grey mudstone 20.47-20.62 m extremely weak			
Extremely weak to very weak red brown MUDSTONE. Fractures are subhorizontal, closely spaced, planar, smooth.	20.90-20.93 m grey 21.00-21.09 m recovered as slightly clayey sand	20.90 (0.50)		
Medium strong red brown grey SANDSTONE. Fractures are subhorizontal, very closely to closely spaced, rough, planar.	21.35-21.40 m grey 22.20 m 5mm bed of grey mudstone	21.40 (1.10)		
EXPLORATORY HOLE ENDS AT 22.50 m	22.45-22.50 m NI drilling induced	22.50		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From / to (m)

Chiselling

Depths (m) / Time / Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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AGS

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: A9057

Carried out for: Morrison Construction Limited

Borehole BH16

Borehole Log

Soil Mechanics

Drilled AH/MA Logged PM Checked RH	Start 30/03/2009 End 02/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 13.85m / 200mm / 13.34m 13.85m / 24.30m / 146mm / 19.20m		Ground Level – Coordinates E 474092.00 National Grid N 413180.00 Chainage	

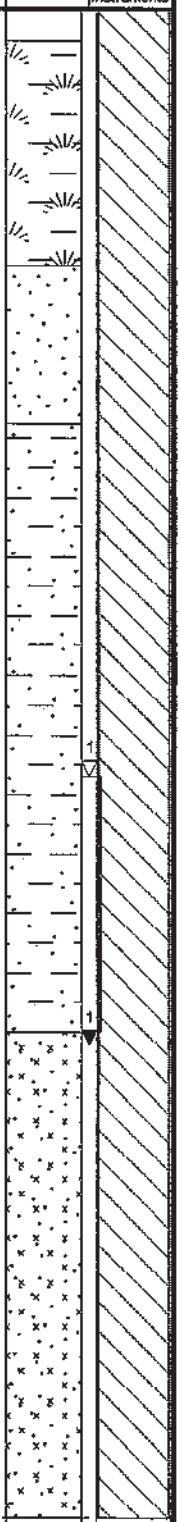
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.20-1.20	B 1	0.00-1.20 m Hand dug inspection pit		
1.50-1.95	U 2	27 blows	1.50	dry
2.05	D 3			
2.50-2.95	SPT S	N=8 (1,2/1,2,3,2)	2.50	dry
2.50-2.95	D 4			
2.50-2.75	B 5			
2.75-3.00	B 6			
3.50-3.95	U 7	41 blows	3.00	dry
4.05	D 8			
4.50-4.95	SPT S	N=9 (1,2/2,2,2,3)	4.50	dry
4.50-5.00	B 10			
4.50-4.95	D 9			
6.00-6.45	U 11	40 blows	6.00	dry
6.55	D 12			
6.80	W 16a			
7.50-7.95	SPT S	N=13 (2,2/3,3,3,4)	7.50	5.95
7.50-7.95	D 13			
7.50-8.00	B 14			
9.00-9.45	SPT S	N=15 (2,3/4,4,3,4)	9.00	6.80
9.00-9.45	D 15			
9.00-10.00	B 16			
			30/03/2009 10.00	7.40

Strata

Description	Depth, Level/ (Thickness)
Firm brown TOPSOIL.	0.20
Plastic dark brown pseudo-fibrous PEAT with occasional cobble size pockets of brown sandy clay.	(1.50)
Loose grey fine and medium SAND	1.70
	(1.05)
Soft to firm thinly laminated brown mottled grey sandy CLAY	2.75
	(4.05)
Medium dense becoming dense red brown slightly silty SAND	6.80
Stratum continues to 13.80 m	

Legend / Backfill/ Instruments



Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	6.80	Rose to 5.10 m after 20 minutes.	-

Depth Related Remarks *

From / to (m)

Chiselling

Depths (m) / Time / Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: A9057

Carried out for: Morrison Construction Limited

Borehole

BH18

Borehole Log

Soil Mechanics

Drilled	AH/MA	Start	30/03/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	02/04/2009	Dando 175/Beretta T51	0.00m	13.85m	200mm	13.34m	Coordinates	E 474092.00
Checked	RH			Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	13.85m	24.30m	146mm	19.20m	National Grid	N 413180.00
									Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			31/03/2009	0800
			10.00	3.60
10.50-10.95	SPT S	N=15 (2,3/4,4,3,4)	10.50	3.90
10.50-10.95	D 17			
10.50-11.00	B 18			
12.00-12.45	SPT S	N=35 (3,4/6,8,10,11)	12.00	4.40
12.00-12.45	D 19			
12.00-13.00	B 20			
13.40-13.85	SPT S	N=50 (6,5/9,14,14,13)	13.40	5.30
13.40-13.85	D 21		31/03/2009	
			13.34	5.45
			01/04/2009	0800
			13.34	
13.85-15.30	17 0 0			
		NI		
15.30-16.80	0 0 0	Flush: 13.85-18.30 Mud, 75 %		
16.80-18.30	11 1 0	NI NI 20		
18.30-18.46		SPT S 50 (9,41/50 for 10mm)		
18.30-19.20	56 2 0	Flush: 18.30-19.20 Mud, 50 %		
			01/04/2009	
			19.20	
19.20-19.80	150 83 18		02/04/2009	0800
			19.20	
19.70-19.80		CS 22		

Strata

Description (Continued from Sheet 1)		Depth, Level (Thickness)	Legend	Backfill/ Instruments
Medium dense becoming dense red brown slightly silty SAND		(7.00)		
Extremely weak red brown SANDSTONE	13.80-15.05 m AZCL	13.80		
	15.05-15.30 m recovered as gravelly sand. Gravel is rounded medium to coarse of various lithologies			
		(5.41)		
	16.80-18.13 m AZCL			
	18.13-18.28 m recovered as sand gravel. Gravel is subrounded of sandstone and quartz.			
	18.30-18.70 m AZCL			
	18.70-18.90 m recovered as sandy gravel. Gravel is subangular to subrounded fine to coarse of sandstone and quartz	19.21		
Very weak to weak red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar, infilled with up to				
Stratum continues to 24.30 m				

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH18

Borehole Log

Soil Mechanics

Drilled	AH/MA
Logged	PM
Checked	RH

Start	30/03/2009
End	02/04/2009

Equipment, Methods and Remarks
Dando 175/Beretta T51
Cable percussion boring. Rotary core drilling (GBS size) using mud flush.

Depth from	to	Diameter	Casing Depth
0.00m	13.85m	200mm	13.34m
13.85m	24.30m	146mm	19.20m

Ground Level	-
Coordinates	E 474092.00
National Grid	N 413180.00
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
19.60-21.30	100 93 53		CS 23		
20.75-20.85					
21.30-22.80	100 90 24	NI 60 240	Flush: 19.20-24.30 Mud, 60 %		
22.80-24.30	100 97 41			02/04/2009 19.20	

Strata

Description (Continued from Sheet 2)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
5mm with clay :: 18.92m - 18.92-19.21 m recovered as brown slightly gravelly sand. Gravel is rounded fine to coarse of various lithologies. 21.18-21.30 m grey 21.20-21.30 m NI 21.30-21.34 m recovered as sand 22.70-22.75 m recovered as sand 24.20-24.27 m recovered as sand	(5.09)		
EXPLORATORY HOLE ENDS AT 24.30 m	24.30		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole
BH18
Sheet 3 of 3

Borehole Log

Soil Mechanics

Drilled	CR/DS	Start	03/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	End	06/04/2009	Dando 175/Beretta T51	0.00m	13.80m	200mm	13.80m	Coordinates	E 472198.13
Checked	RH			Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	13.80m	16.15m	146mm	16.15m	National Grid	N 412553.02
									Chainage	

Samples and Tests

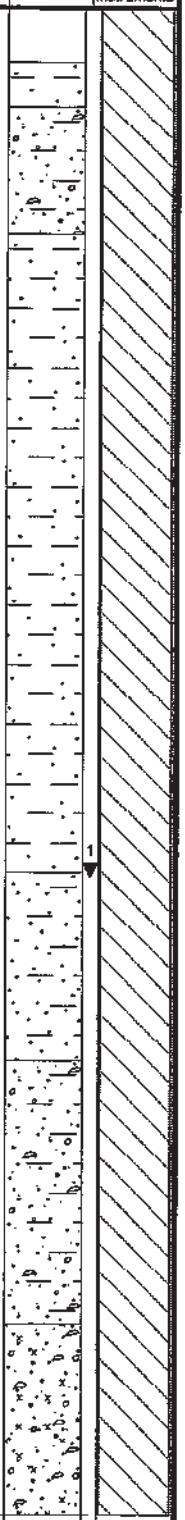
Depth	Type & No	Records	Date Casing	Time Water
		0.00-1.20 m Hand dug inspection pit		
0.35-0.65	B 1			
0.80-1.20	B 2			
1.60-2.05	B 3		1.50	
1.60-2.05	U NR	15 blows No recovery		1.40
2.20-2.65	SPT S	N=8 (1,1/2,2,2,2)	2.50	2.30
2.20-2.60	B 4			
2.60-3.05	D 5			
2.60-3.05	B 6			
3.60-4.05	U 7	30 blows	3.50	damp
4.20	D 8			
4.60-5.05	SPT S	N=12 (1,2/2,3,3,4)	4.40	dry
4.60-5.05	B 10			
4.60-5.05	D 9			
5.15-5.60	B 11			
6.10-6.55	SPT S	N=11 (1,2/2,2,3,4)	6.05	4.20
6.10-6.55	D 12			
6.10-6.55	B 13			
7.00-7.40	B 14	Flush: 0.00-13.80 Water, 100 %		
7.50-7.95	SPT S	N=15 (1,2/3,3,4,5)	7.50	3.90
7.50-7.95	D 15			
7.50-7.95	B 16			
			03/04/2009	
			7.50	3.70
			06/04/2009	0800
			7.50	2.30
8.40-8.70	B 17			
9.10-9.22	SPT S	50 (25 for 65mm/50 for 55mm)	9.00	2.70
9.10-9.25	D 18			
9.10-9.25	B 19			
9.70-10.10	B 20			

Strata

Description	Depth, Level (Thickness)
TOPSOIL	(0.35)
	0.35
Soft to firm grey mottled brown sandy CLAY	(0.30)
	0.65
Brown slightly clayey slightly gravelly SAND. Gravel is subangular to subrounded fine to coarse of sandstone.	(0.85)
	1.50
Soft to firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	(4.25)
	5.75
Medium dense brown slightly clayey fine SAND	(1.25)
	7.00
Medium dense brown slightly clayey slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	(1.75)
	8.75
Dense red brown slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	
Stratum continues to 13.80 m	

Legend

Backfill/Instruments



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.70	-	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m)	Time	Tools used
6.70 -7.05	45 mins	
9.20 -9.55	45 mins	
9.70 -10.05	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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466.24 12/09/2009 14:16:41

AGS

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: A9057

Carried out for: Morrison Construction Limited

Borehole

BH22

Sheet 1 of 2

Borehole Log

Soil Mechanics

Drilled CR/DS Logged PM Checked RH	Start 03/04/2009 End 08/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 13.80m / 200mm / 13.80m 13.80m / 18.15m / 146mm / 18.15m		Ground Level - Coordinates E 472198.13 National Grid N 412553.02 Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.60-10.71 10.60-10.70 10.60-10.70	SPT S D 21 B 22	50 (25 for 60mm/50 for 50mm)	10.50	3.05
11.00-11.40	B 23			
12.10-12.22 12.10-12.25 12.10-12.25	SPT S D 24 B 25	50 (25 for 70mm/50 for 45mm)	12.00	3.60
12.80-13.10	B 26			
13.70-13.81 13.70-13.80 13.70-13.80	SPT S D 27 B 28	50 (25 for 65mm/50 for 40mm)	13.65	3.85
	NI		08/04/2009 13.65	4.25
14.46-14.58 13.80-15.15	61 34 16	CS 29	08/04/2009	0800 2.50
15.15-16.65	100 99 43	Flush: 13.80-18.15 Mud, 100 %		
	NI 90 180			
16.65-18.15 17.53-17.63	100 90 59	CS 30		
			08/04/2009	

Strata

Description (Continued from Sheet 1)

Dense red brown slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.

Depth, Level (Thickness): (5.05)

13.80

Weak to medium strong red brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, rough, planar.

13.80-14.15 m AZCL

14.15-14.36 m recovered as slightly silty sand

15.05-15.15 m 1 No. subvertical rough planar fracture

Depth, Level (Thickness): (4.35)

16.62-16.65 m NI

17.54-17.66 m fracture infilled with grey mudstone

18.02-18.09 m 1 No. subvertical smooth planar fracture, drilling induced

18.09-18.15 m NI

18.15

EXPLORATORY HOLE ENDS AT 18.15 m

Legend: Backfill/Instruments

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From / to (m)

Chiselling

Depths (m)	Time	Tools used
10.80 -11.15	45 mins	
11.60 -11.95	45 mins	
12.35 -12.70	45 mins	
13.10 -13.40	45 mins	
13.60 -13.90	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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408.24 12/05/2009 14:15:42

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole

BH22

Sheet 2 of 2

Split Tube Sample Description

Soil Mechanics

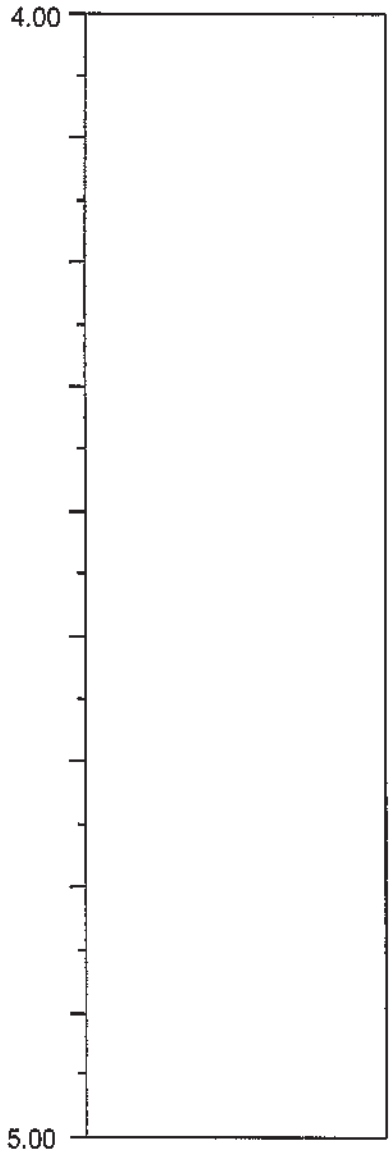
Borehole No	CPT2		
Sample No	1		
Sample Depth, mBGL	4.00	-	5.00
Sample Type	MOSTAP		

Description

4.00-4.17m
Brown slightly fine sandy SILT.

4.17-4.95m
Soft brown CLAY

4.95-5.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT2
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT2		
Sample No	2		
Sample Depth, mBGL	6.00	-	7.00
Sample Type	MOSTAP		

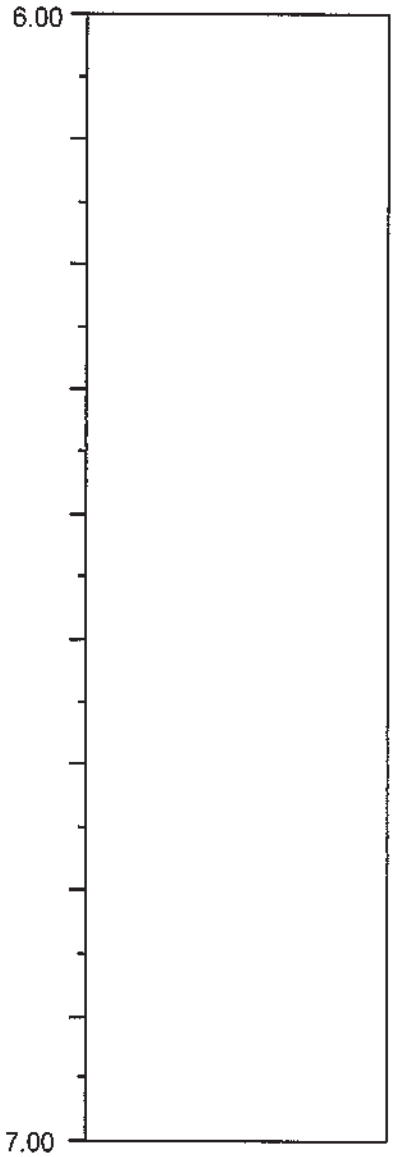
Description

6.00-6.15
Soft brown silty CLAY

6.15-6.65m
Soft thinly laminated brown CLAY with rare partings of fine sand

6.65-6.96m
Soft thinly laminated brown CLAY

6.96-7.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT2
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT3		
Sample No	1		
Sample Depth, mBGL	3.00	-	4.00
Sample Type	MOSTAP		

Description

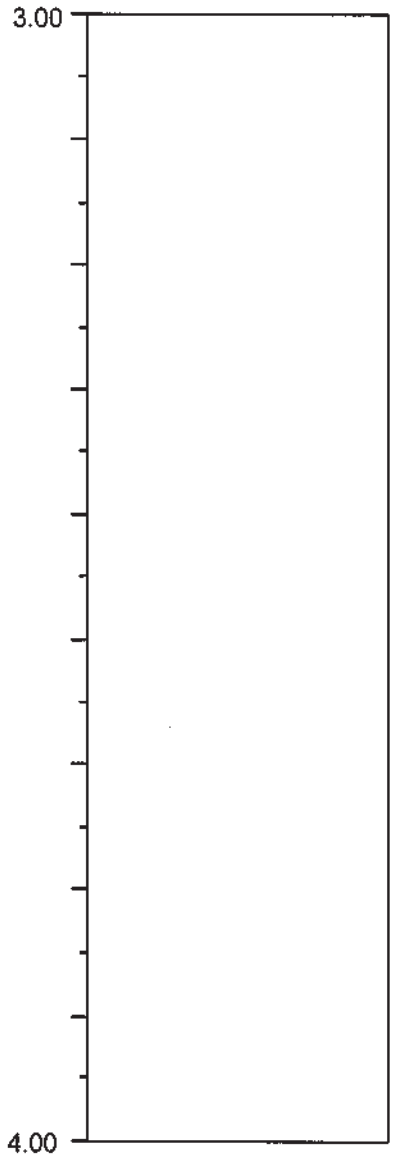
3.00-3.53m
Soft brown CLAY

3.53-3.79m
Brown clayey SILT

3.79-3.84m
Soft brown CLAY

3.84-3.97m
Brown clayey SILT

3.97-4.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT3
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

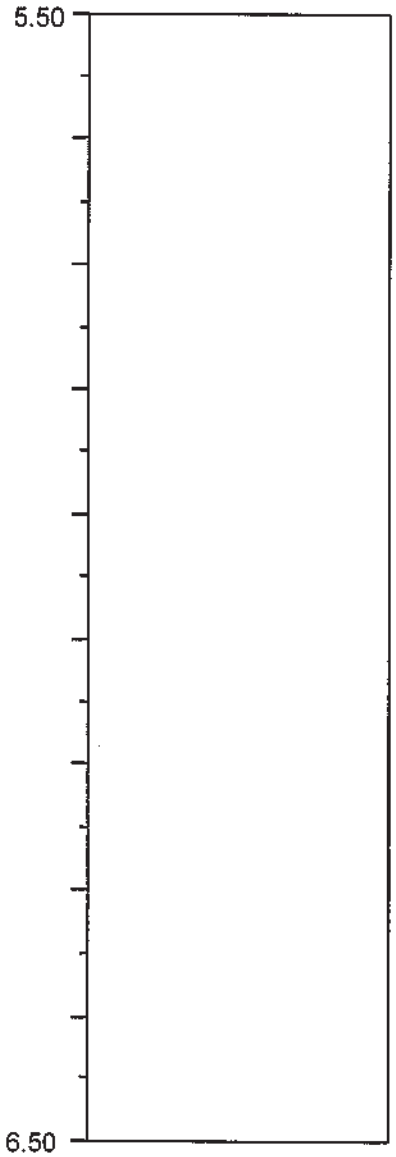
Borehole No	CPT3		
Sample No	2		
Sample Depth, mBGL	5.50	-	6.50
Sample Type	MOSTAP		

Description

5.50-5.64m
Soft brown CLAY

5.64-6.35m
Soft thinly laminated brown silty CLAY with occasional dustings of fine sand and silt on laminae

6.35-6.50m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT3
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT9		
Sample No	1		
Sample Depth, mBGL	3.00	-	4.00
Sample Type	MOSTAP		

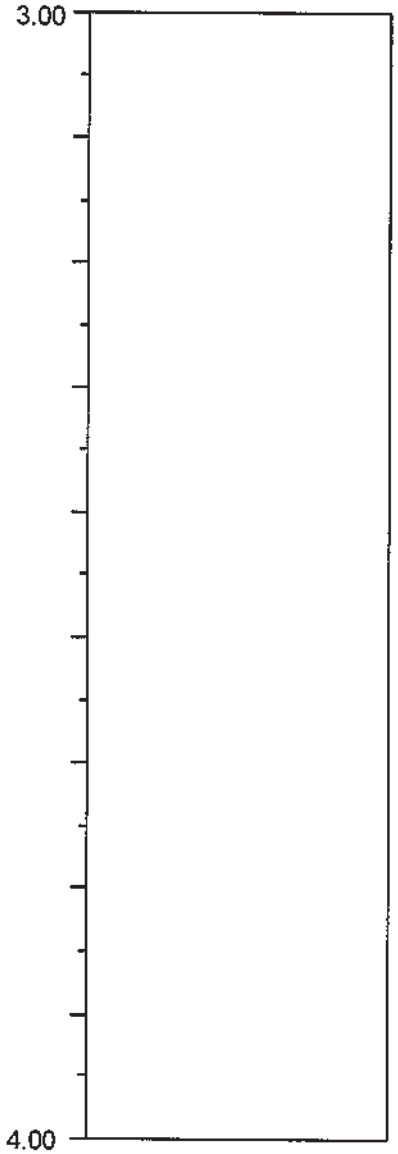
Description

3.00-3.51m
Soft brown CLAY

3.51-3.60m
Soft thickly laminated brown silty CLAY

3.60-3.73m
Brown clayey SILT with rare partings of fine sand and silt

3.73-40m
Soft to firm thinly laminated brown CLAY



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT9
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

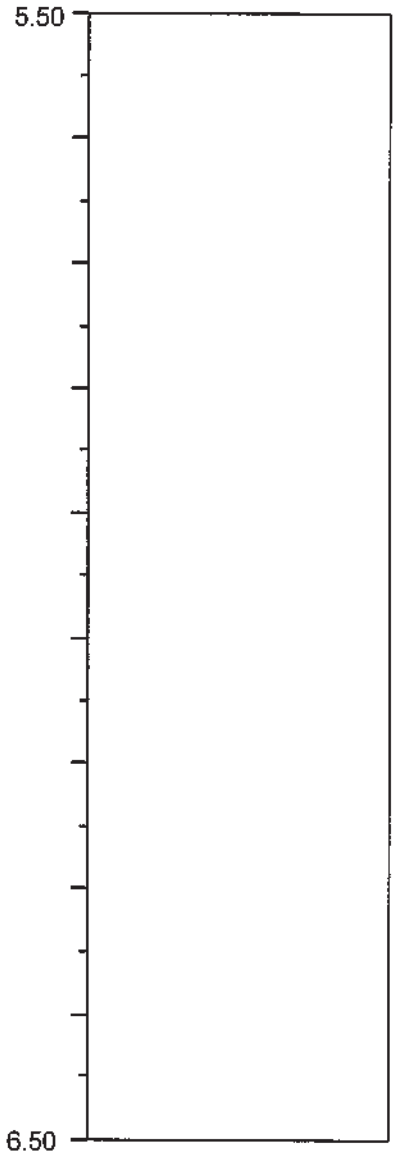
Borehole No	CPT9		
Sample No	2		
Sample Depth, mBGL	5.50	-	6.50
Sample Type	MOSTAP		

Description

5.50-5.74m
Brown clayey SILT

5.74-6.42m
Soft thinly laminated brown CLAY with occasional dustings of silt and fine sand on laminae

6.42-6.50m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT9
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT17		
Sample No	1		
Sample Depth, mBGL	4.00	-	5.00
Sample Type	MOSTAP		

Description

4.00-4.20m
Brown slightly sandy SILT

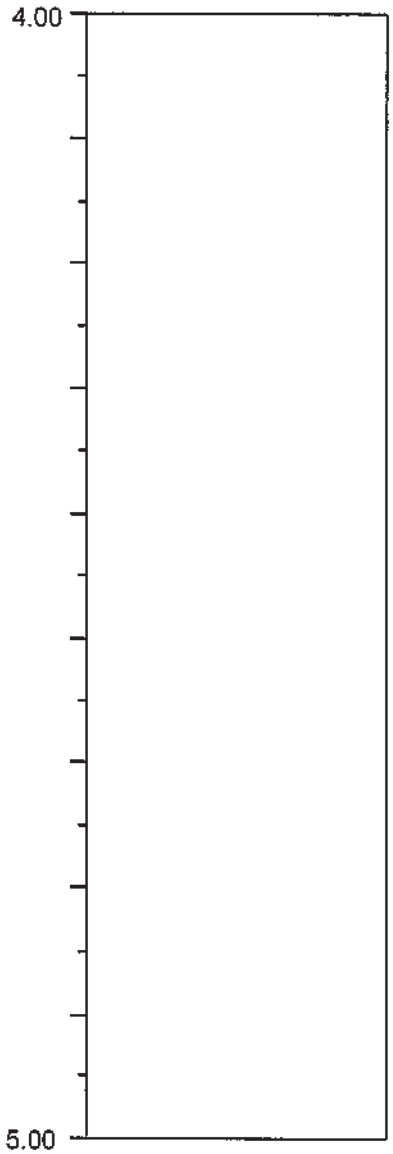
4.20-4.40m
Soft brown slightly sandy CLAY

4.40-4.45m
Brown slightly sandy SILT

4.45-4.71m
Soft brown slightly sandy CLAY. Locally speckled grey.

4.71-4.90m
Brown slightly sandy SILT

4.90-5.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT17
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT17		
Sample No	2		
Sample Depth, mBGL	6.50	-	7.50
Sample Type	MOSTAP		

Description

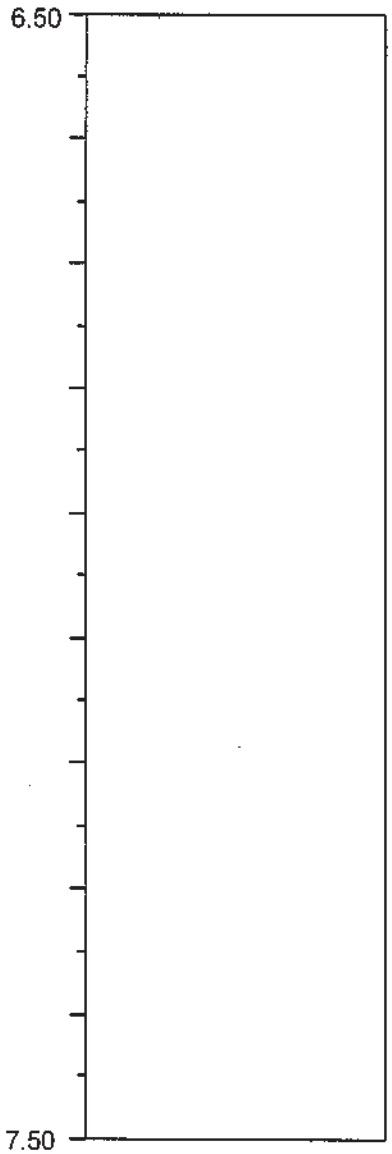
6.50-7.16m
Soft brown slightly sandy CLAY with frequent thinly to thickly laminae of light brown slightly sandy silt

7.16-7.23m
Soft brown slightly sandy CLAY

7.23-7.28m
Light brown fine and medium SAND

7.28-7.35m
Soft brown slightly sandy CLAY

7.35-7.50m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT17
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT19		
Sample No	1		
Sample Depth, mBGL	4.50	-	5.50
Sample Type	MOSTAP		

Description

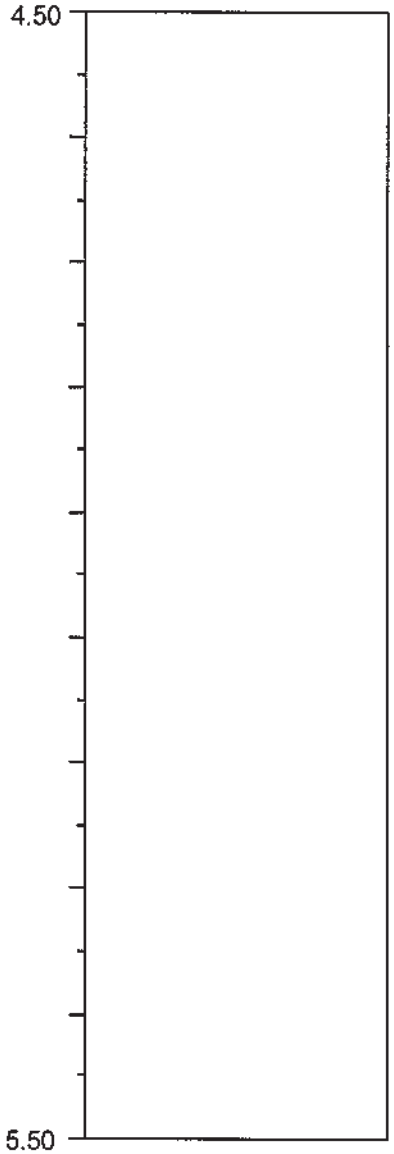
4.50-4.83m
Soft brown slightly sandy CLAY

4.83-4.90m
Soft thinly laminated brown CLAY

4.90-5.32m
Soft brown sandy CLAY

5.32-5.37m
Soft thinly laminated brown slightly sandy CLAY

5.37-5.50m
Soft brown slightly sandy CLAY



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT19
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT19		
Sample No	2		
Sample Depth, mBGL	6.50	-	7.50
Sample Type	MOSTAP		

Description

6.50-6.77m
Soft brown slightly sandy CLAY

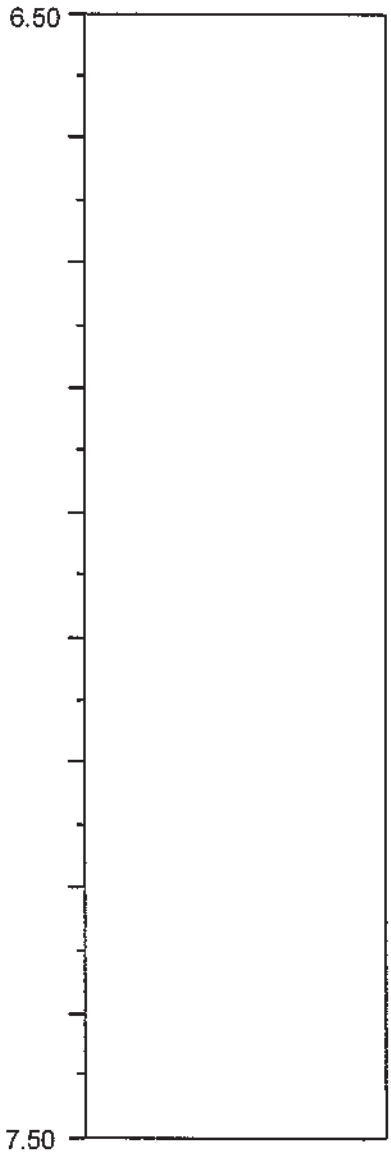
6.77-6.80m
Brown slightly sandy SILT

6.80-7.07m
Soft thinly laminated to very thinly bedded brown slightly sandy CLAY

7.07-7.13m
Soft brown slightly sandy CLAY

7.13-7.23m
Brown slightly sandy SILT

7.23-7.50m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT19
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT20		
Sample No	1		
Sample Depth, mBGL	4.00	-	5.00
Sample Type	MOSTAP		

Description

4.00-4.34m
Soft brown slightly sandy CLAY grading to slightly sandy SILT. Locally speckled light grey

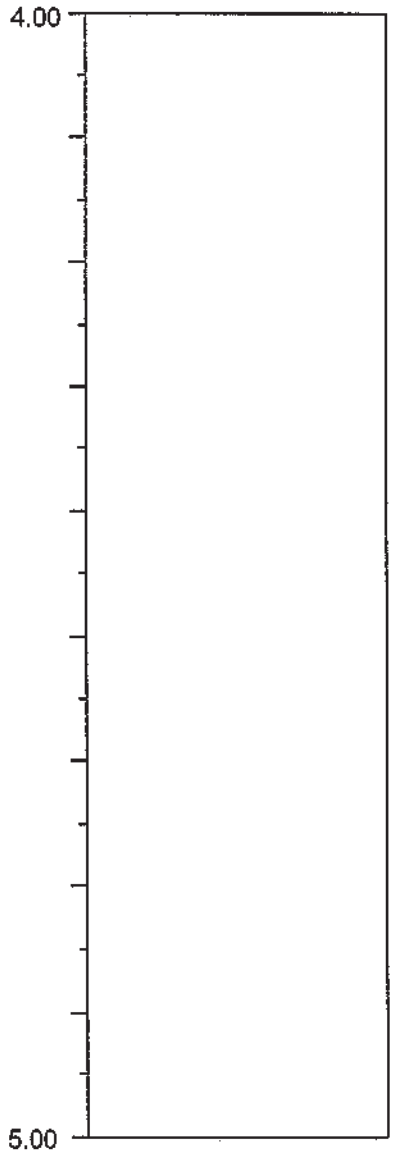
4.34-4.35m
Light brown slightly sandy SILT

4.35-4.68m
Soft bown slightly sandy CLAY. Locally speckled light brown

4.68-4.75m
Brown slightly sandy SILT

4.75-4.90m
Soft brown slightly sandy CLAY

4.90-5.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT20
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT20		
Sample No	2		
Sample Depth, mBGL	7.00	-	8.00
Sample Type	MOSTAP		

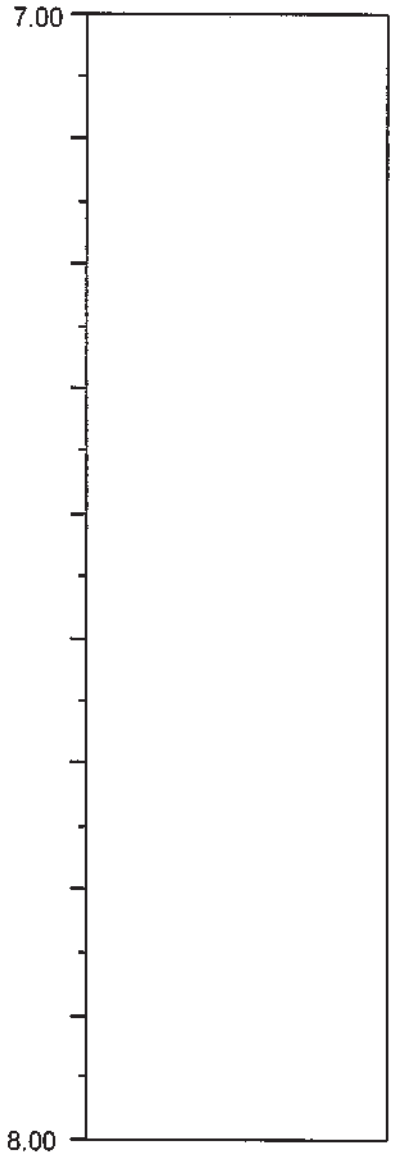
Description

7.00-7.33m
Brown slightly sandy SILT

7.33-7.79m
Brown slightly sandy CLAY with occasional thin laminae of slightly sandy silt

7.79-7.86m
Soft brown slightly sandy CLAY

7.86-8.00m
No recovery



Sampling information:

Blow Count

Recovery mm

Remarks:

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT20
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT22		
Sample No	1		
Sample Depth, mBGL	3.50	-	4.50
Sample Type	MOSTAP		

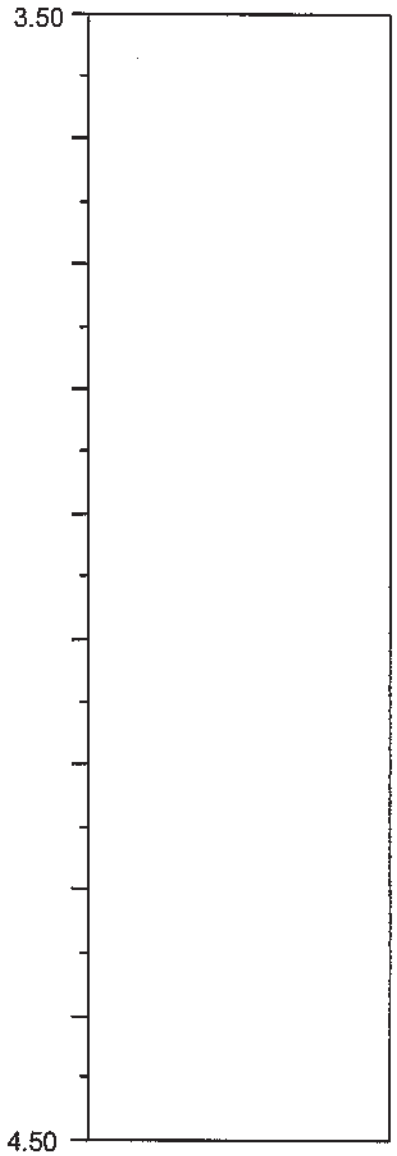
Description

3.50-3.96m
Soft brown CLAY

3.96-4.11m
Soft thinly laminated brown CLAY with rare partings of fine sand

4.11-4.20m
Soft brown CLAY

4.20-4.50m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT22
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT22		
Sample No	2		
Sample Depth, mBGL	5.00	-	6.00
Sample Type	MOSTAP		

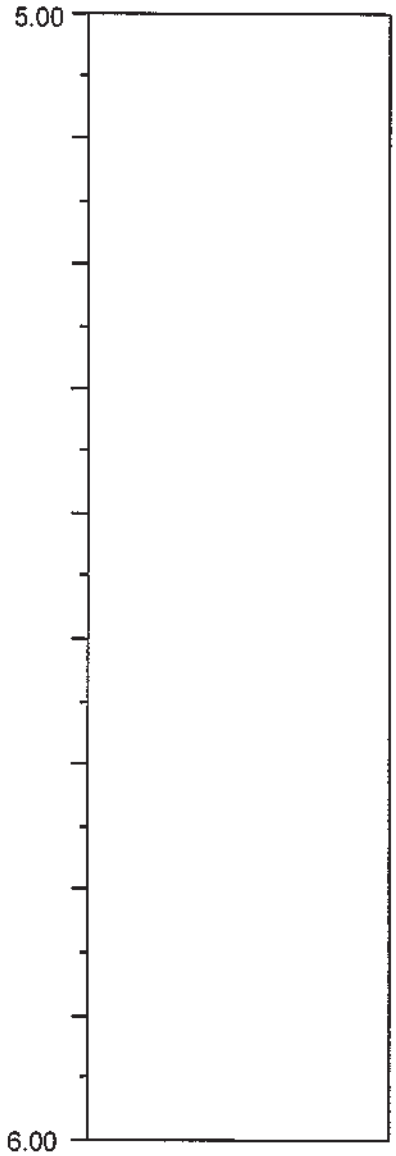
Description

5.00-5.15m
Brown fine to medium SAND

5.15-5.77m
Soft brown CLAY

5.77-5.96m
Soft thinly laminated brown CLAY with rare partings of fine sand

5.96-6.00m
No recovery



Sampling information:

Remarks:

Blow Count

Recovery mm

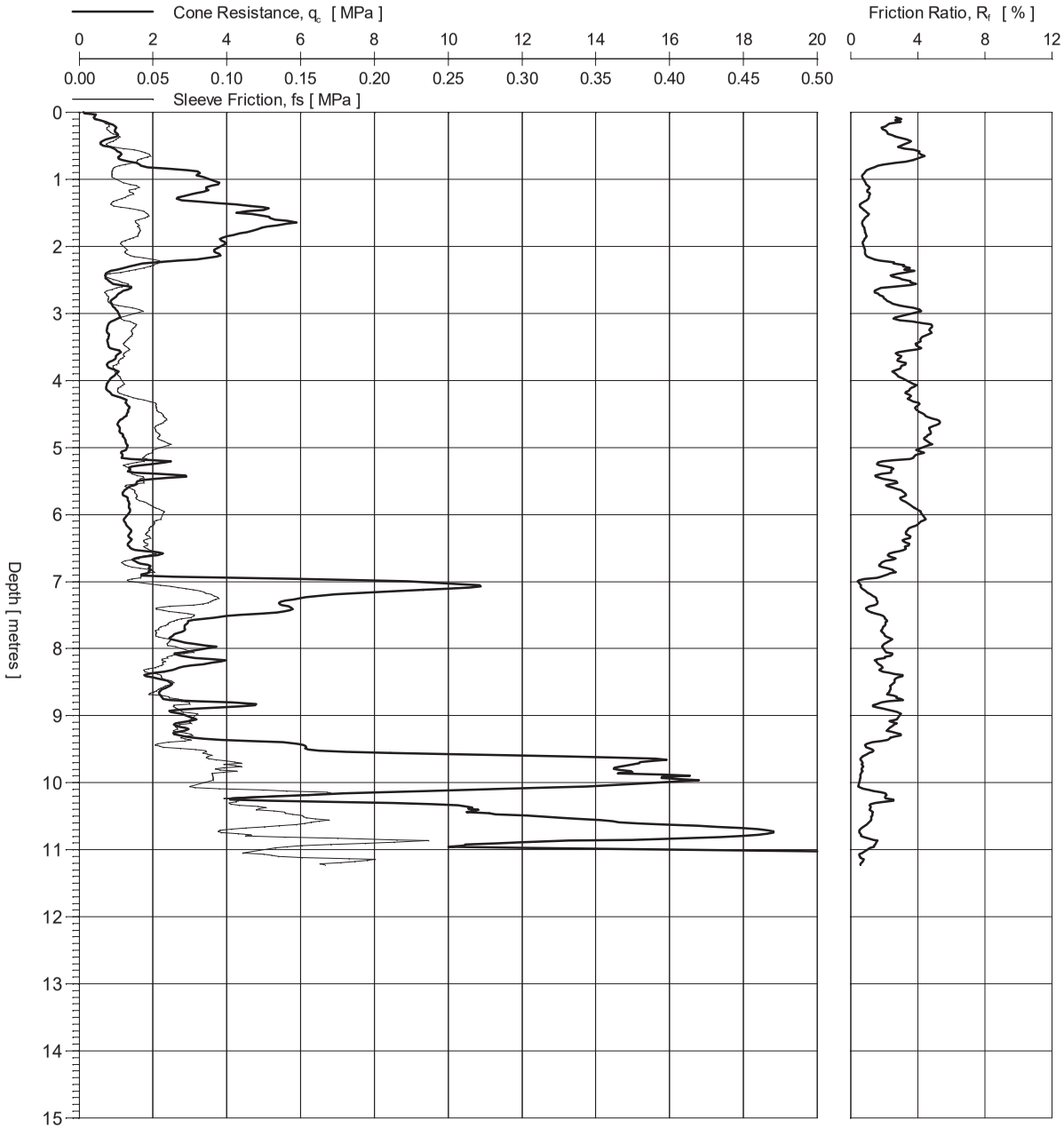
Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT22
	Carried out for	Morrison Construction Limited	

APPENDIX B: IN-SITU & LABORATORY TEST RESULTS

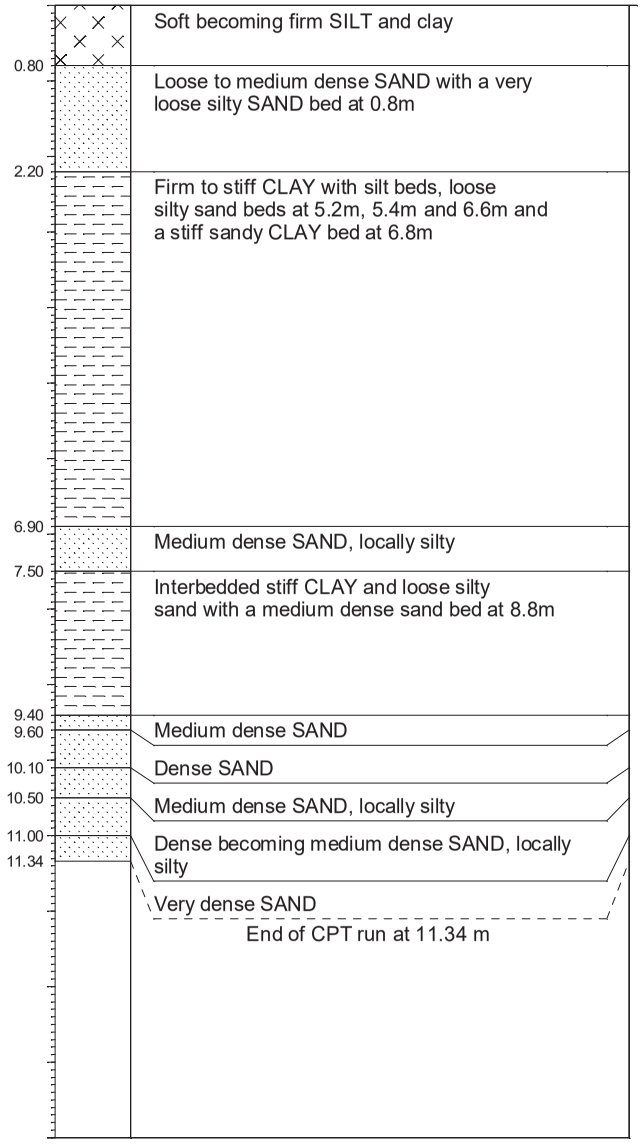
Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT2

Checked by: Date: Approved by: Date:



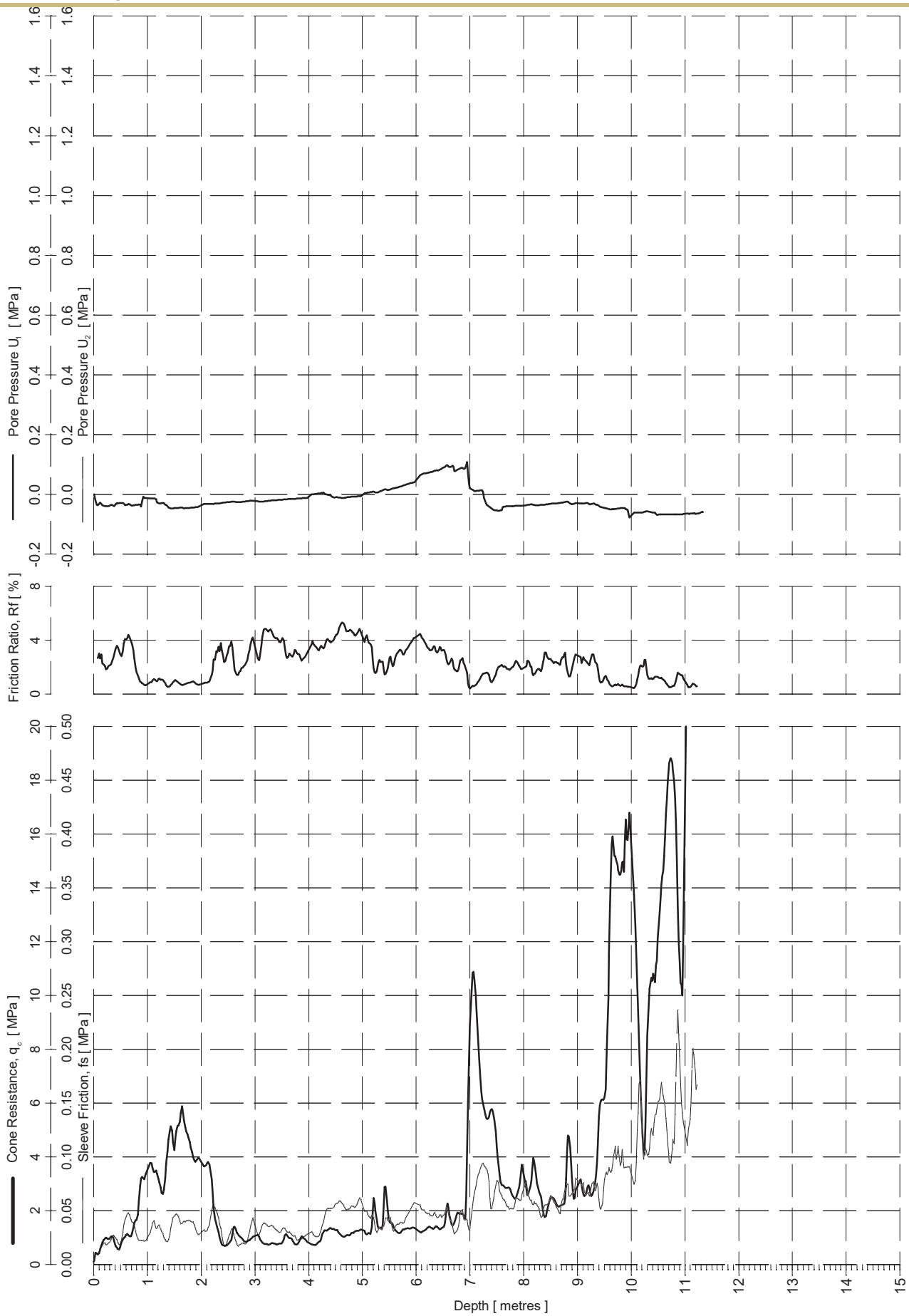
Estimated Soil Type



Location:	CPT2	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO



Checked by: Date:

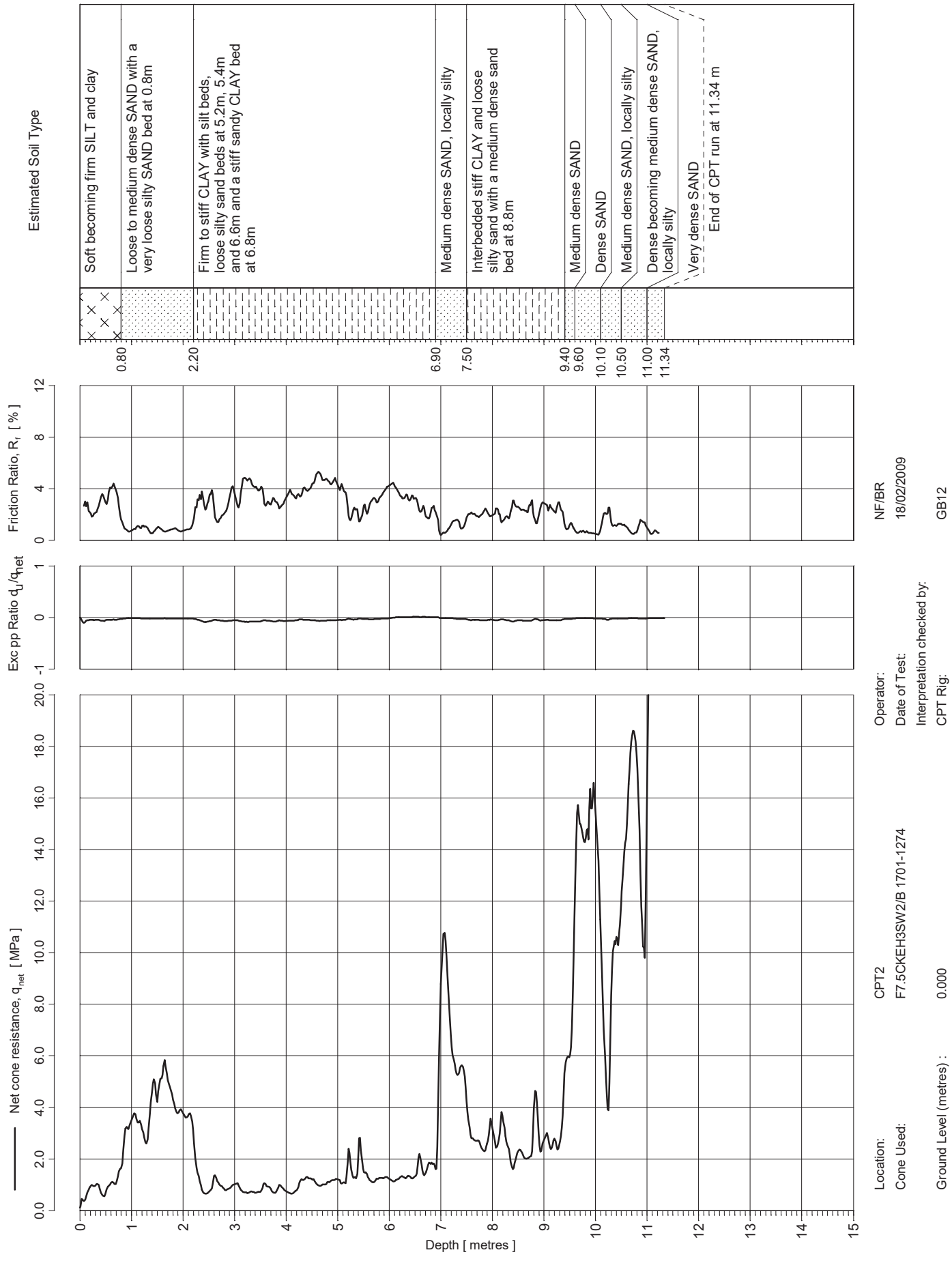
Approved by: Date:

Operator: NF/BR
Date of Test: 18/02/2009
CPT Rig: GB12

Location: CPT2
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

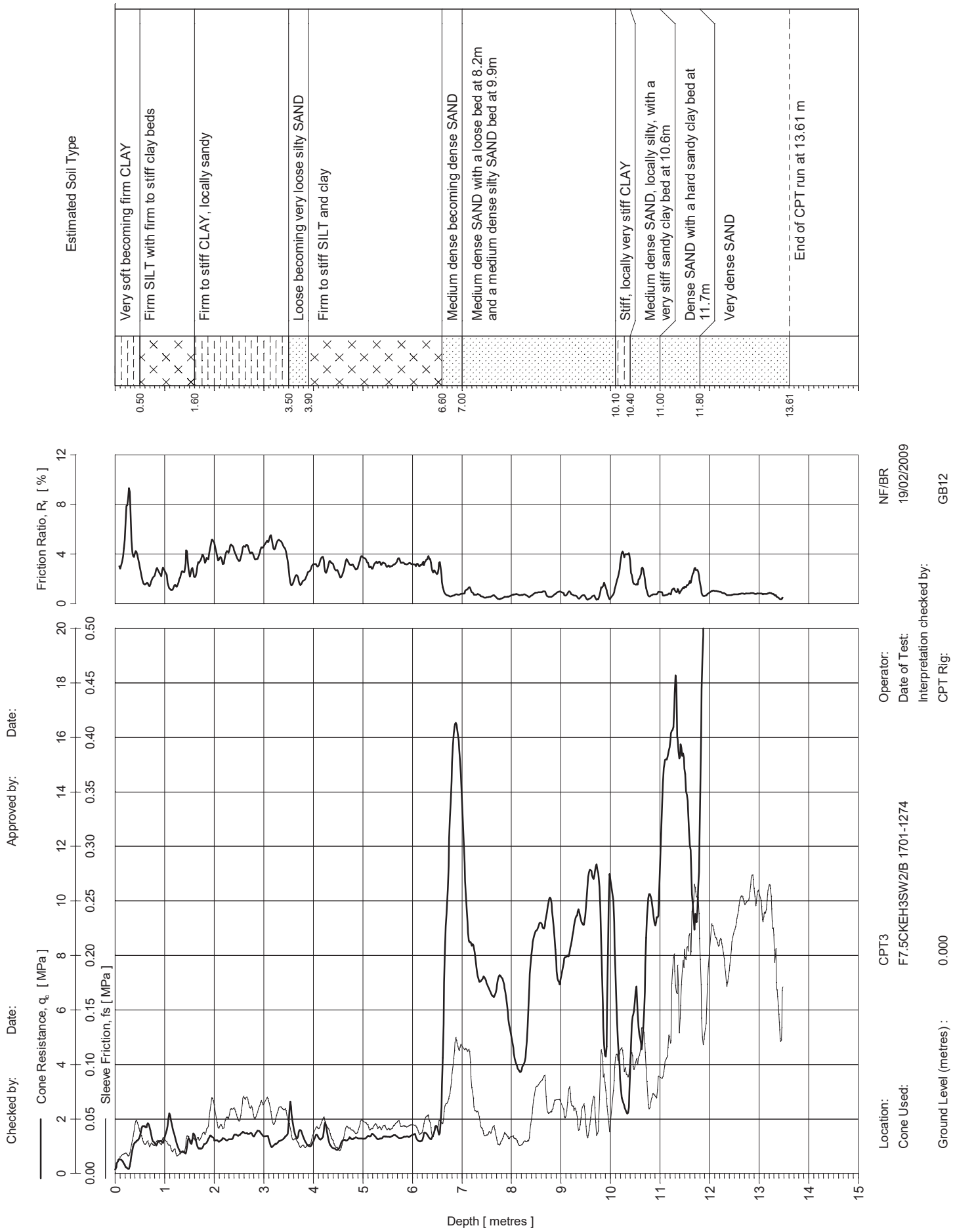
STATIC CONE PENETRATION TEST CPT2

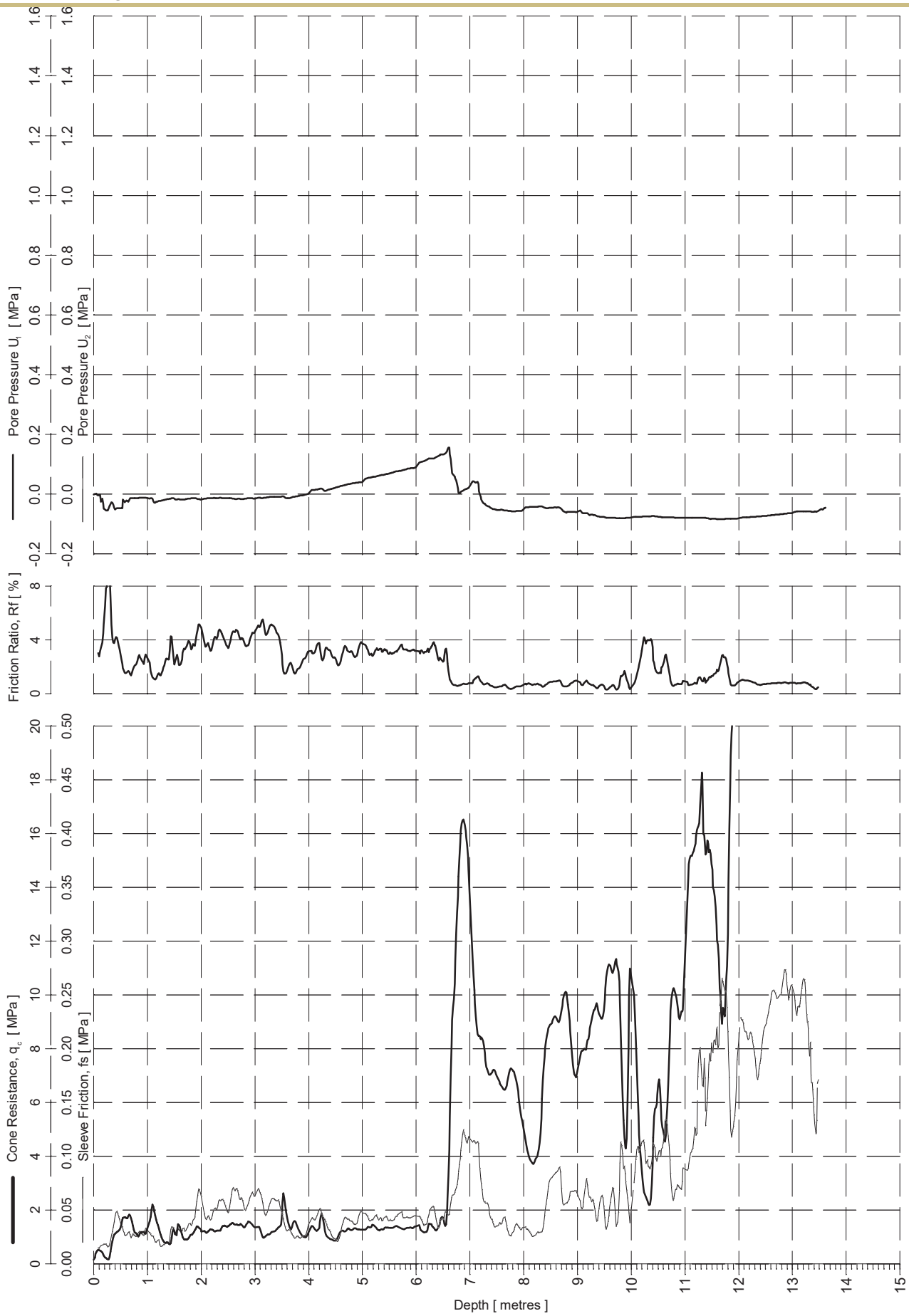
Contract No:CPT091107



STATIC CONE PENETRATION TEST CPT2

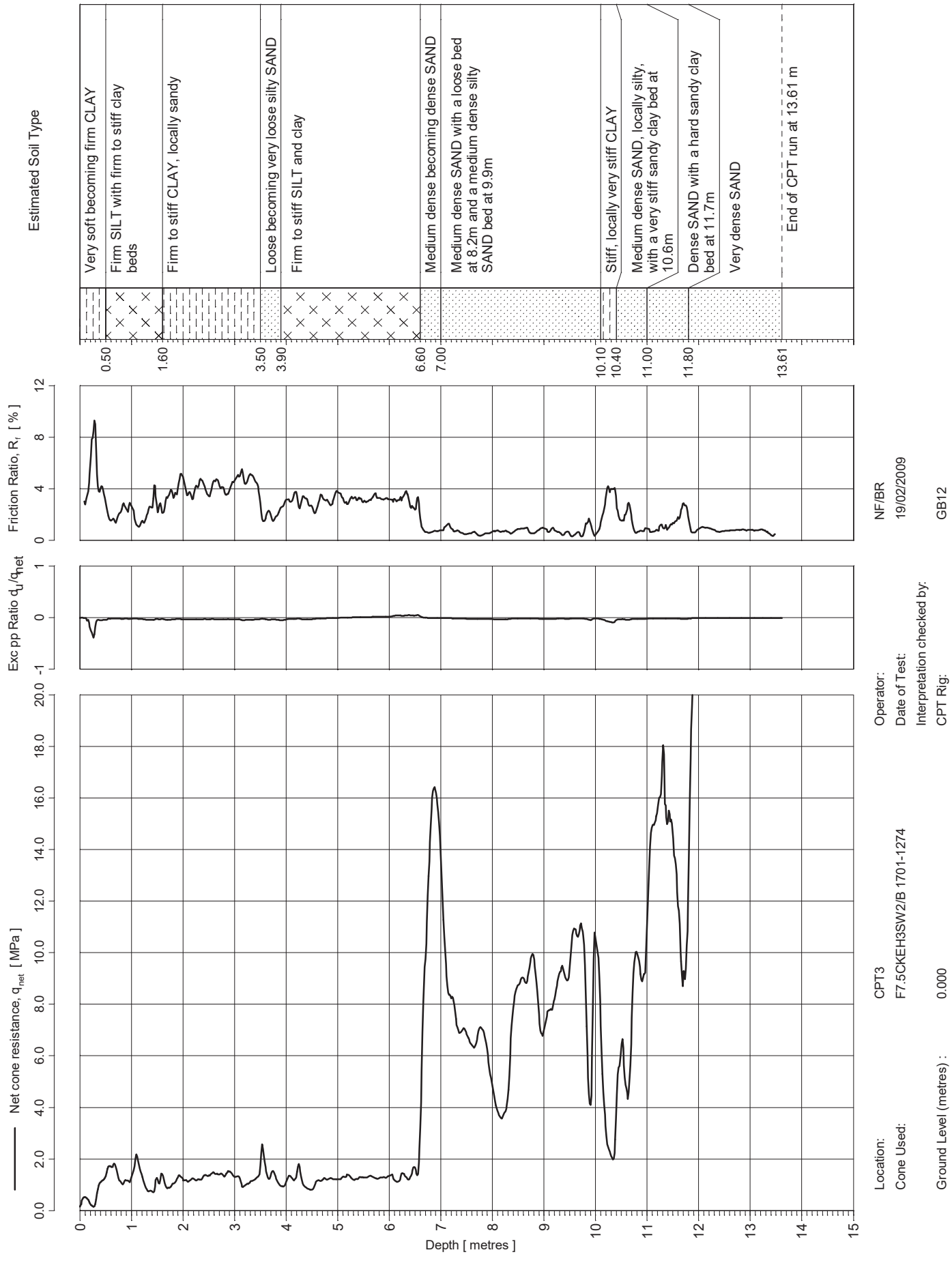
Contract No:CPT091107


Estimated Soil Type
Very soft becoming firm CLAY
Firm SILT with firm to stiff clay beds
Firm to stiff CLAY, locally sandy
Loose becoming very loose silty SAND
Firm to stiff SILT and clay
Medium dense becoming dense SAND
Medium dense SAND with a loose bed at 8.2m and a medium dense silty SAND bed at 9.9m
Stiff, locally very stiff CLAY
Medium dense SAND, locally silty, with a very stiff sandy clay bed at 10.6m
Dense SAND with a hard sandy clay bed at 11.7m
Very dense SAND
End of CPT run at 13.61 m
0.50
1.60
3.50
3.90
6.60
7.00
10.10
10.40
11.00
11.80
13.61
Friction Ratio, R_f [%]
Cone Resistance, q_c [MPa]
Sleeve Friction, fs [MPa]
Depth [metres]
Checked by: Date:
Approved by: Date:
Operator: NF/BR
Date of Test: 19/02/2009
Interpretation checked by:
CPT Rig: GB12
Location: CPT3
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

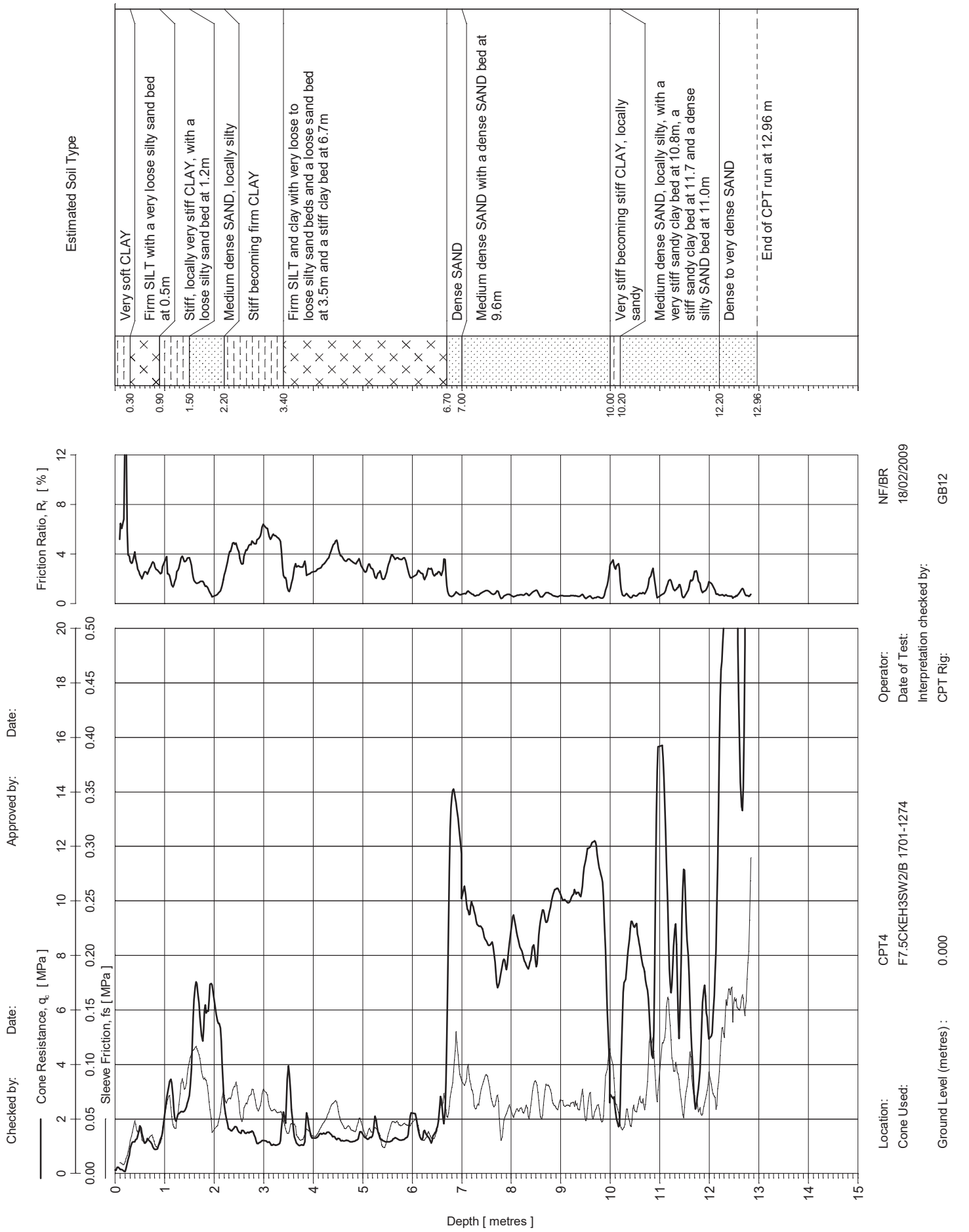


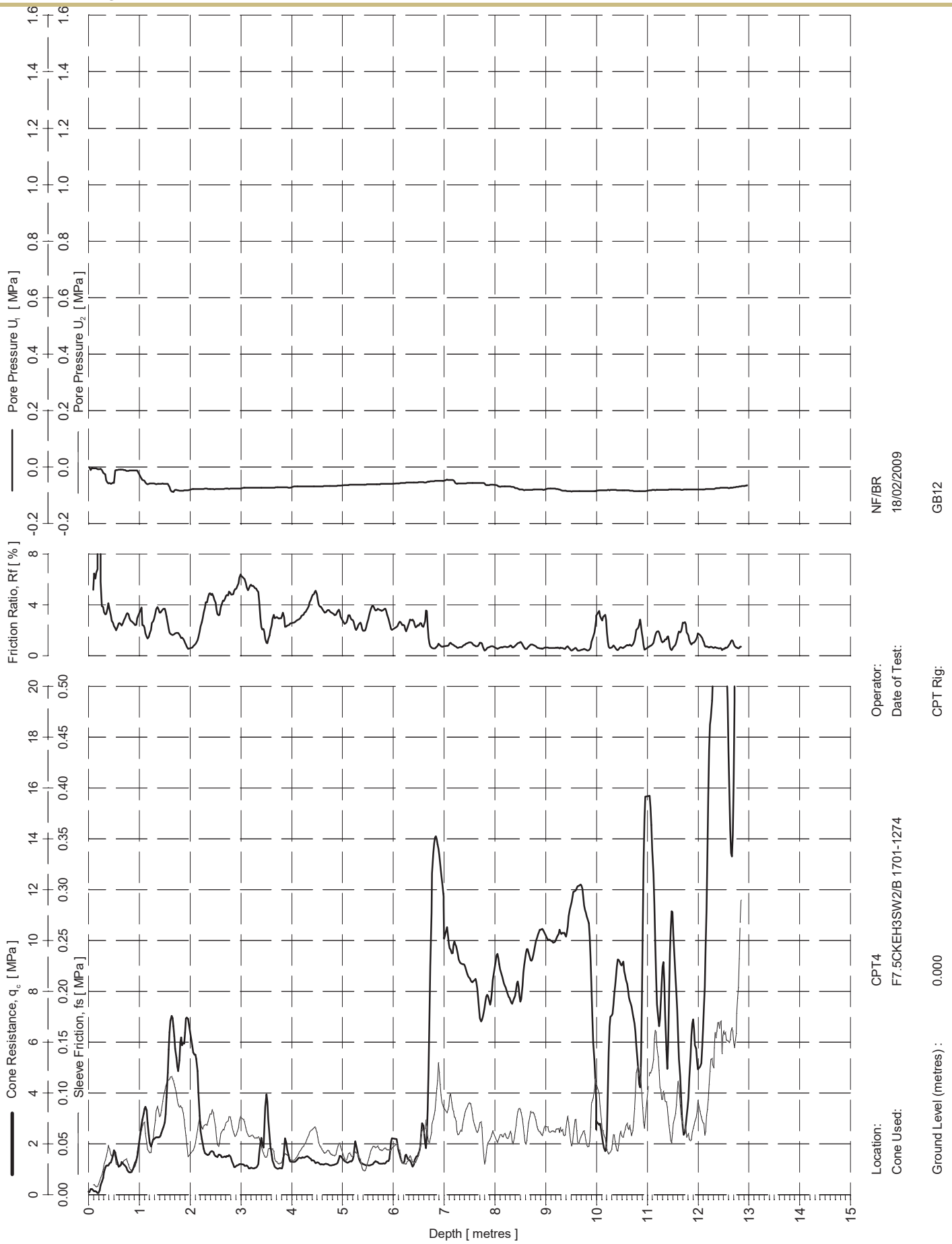
Checked by: Date:
Approved by: Date:

Operator: NF/BR
Date of Test: 19/02/2009
CPT Rig: GB12
Location: CPT3
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000



STATIC CONE PENETRATION TEST CPT3


Estimated Soil Type
Very soft CLAY
Firm SILT with a very loose silty sand bed at 0.5m
Stiff, locally very stiff CLAY, with a loose silty sand bed at 1.2m
Medium dense SAND, locally silty
Stiff becoming firm CLAY
Firm SILT and clay with very loose to loose silty sand beds and a loose sand bed at 3.5m and a stiff clay bed at 6.7m
Dense SAND
Medium dense SAND with a dense SAND bed at 9.6m
Very stiff becoming stiff CLAY, locally sandy
Medium dense SAND, locally silty, with a very stiff sandy clay bed at 10.8m, a stiff sandy clay bed at 11.7 and a dense silty SAND bed at 11.0m
Dense to very dense SAND
End of CPT run at 12.96 m
0.30
0.90
1.50
2.20
3.40
6.70
7.00
10.00
10.20
12.20
12.96
Friction Ratio, R_f [%]
Cone Resistance, q_c [MPa]
Sleeve Friction, fs [MPa]
Depth [metres]
Checked by: Date:
Approved by: Date:
Operator: NF/BR
Date of Test: 18/02/2009
Interpretation checked by:
CPT Rig: GB12
Location: CPT4
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000



Checked by: Date:

Approved by: Date:

Operator: NF/BR

Date of Test: 18/02/2009

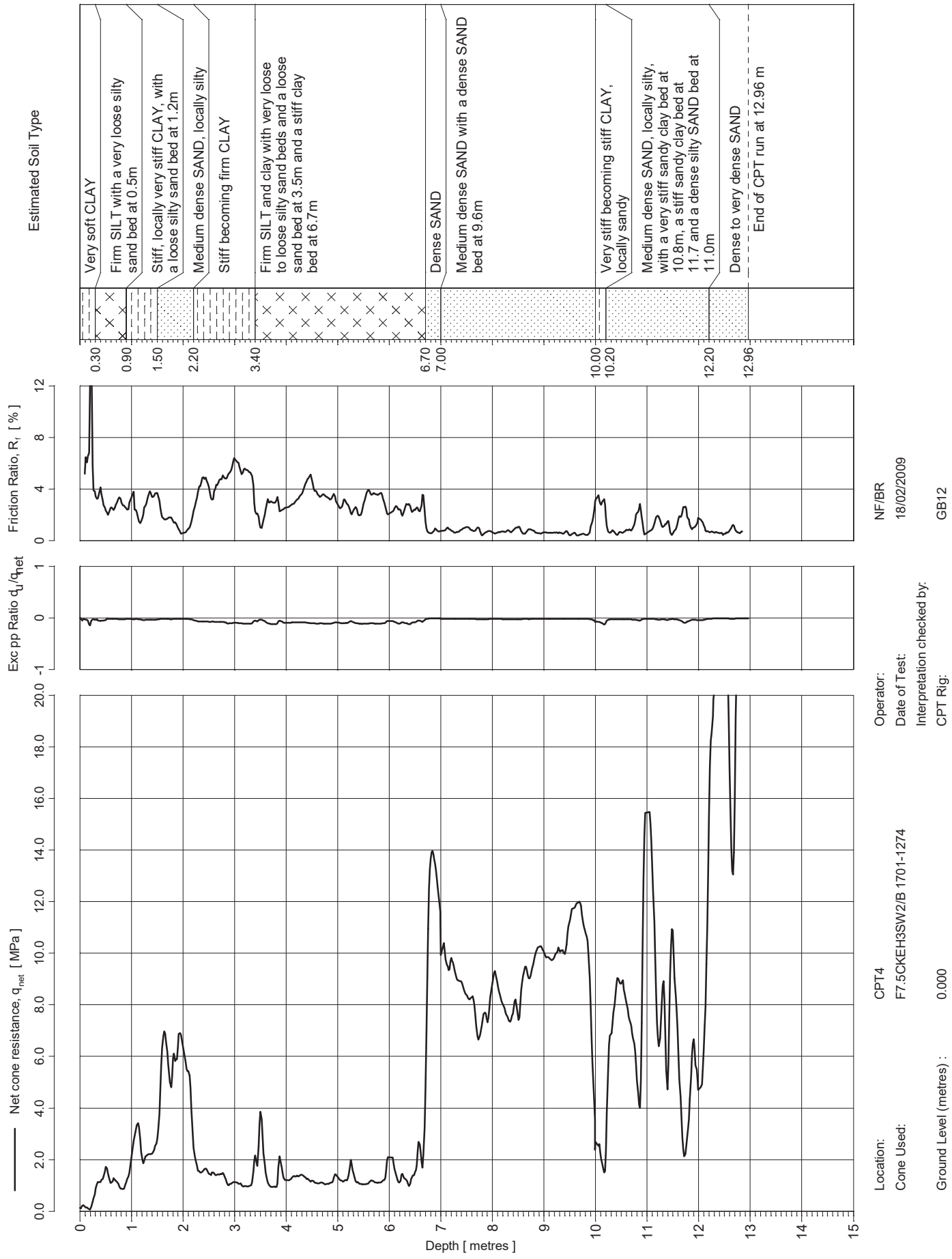
CPT Rig: GB12

Location: CPT4

Cone Used: F7.5CKEH3SW2/B 1701-1274

Ground Level (metres) : 0.000

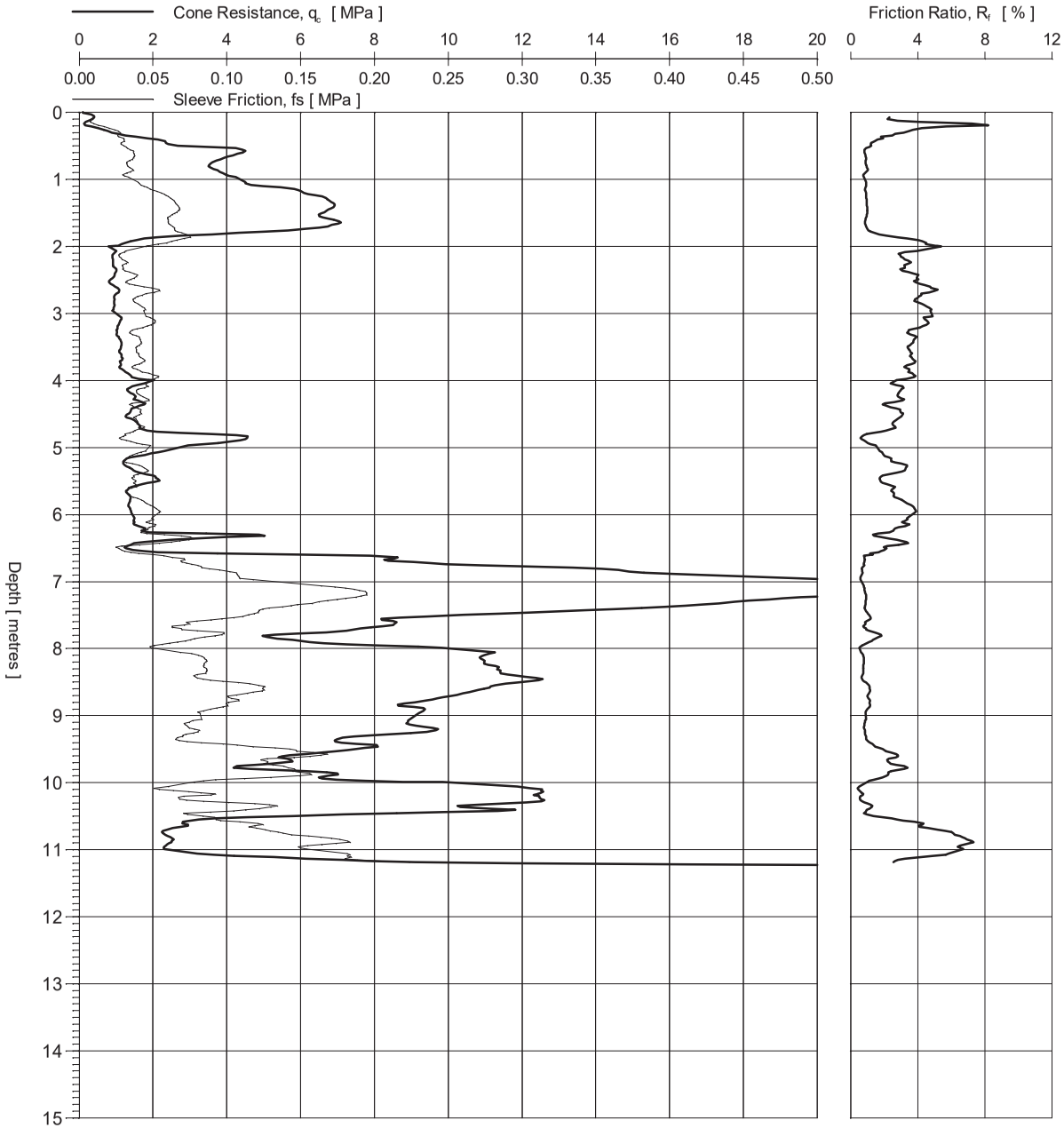
STATIC CONE PENETRATION TEST CPT4


Estimated Soil Type
Very soft CLAY
Firm SILT with a very loose silty sand bed at 0.5m
Stiff, locally very stiff CLAY, with a loose silty sand bed at 1.2m
Medium dense SAND, locally silty
Stiff becoming firm CLAY
Firm SILT and clay with very loose to loose silty sand beds and a loose sand bed at 3.5m and a stiff clay bed at 6.7m
Dense SAND
Medium dense SAND with a dense SAND bed at 9.6m
Very stiff becoming stiff CLAY, locally sandy
Medium dense SAND, locally silty, with a very stiff sandy clay bed at 10.8m, a stiff sandy clay bed at 11.7 and a dense silty SAND bed at 11.0m
Dense to very dense SAND
End of CPT run at 12.96 m
0.30
0.90
1.50
2.20
3.40
6.70
7.00
10.00
10.20
12.20
12.96
Friction Ratio, R_f [%]
Exc pp Ratio d_u/q_{net}
Net cone resistance, q_{net} [MPa]
Depth [metres]
Operator: NF/BR
Date of Test: 18/02/2009
Interpretation checked by:
CPT Rig: GB12
Location: CPT4
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT9

Checked by: Date: Approved by: Date:



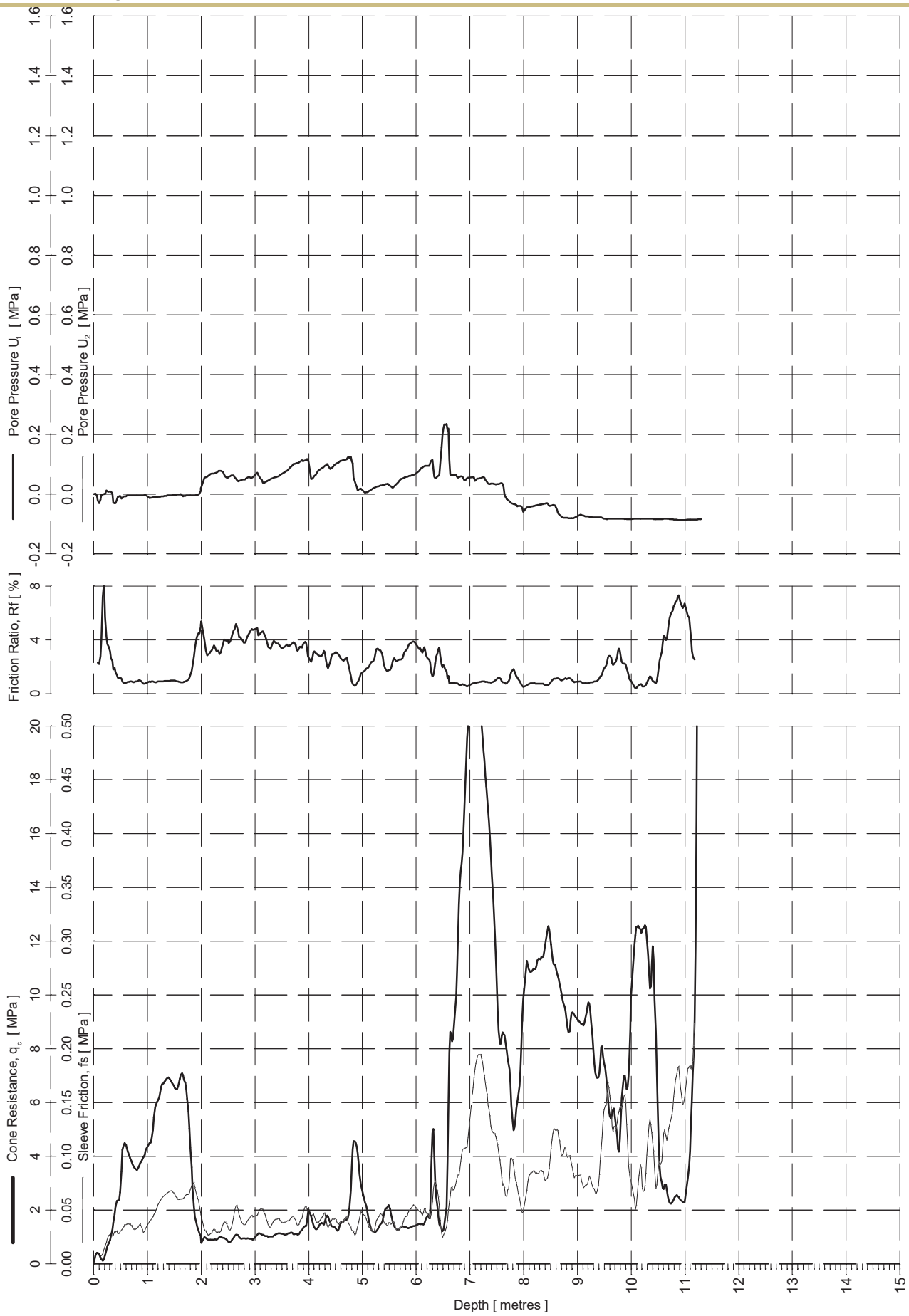
Estimated Soil Type

0.40	Very soft to firm CLAY with a very loose silty sand bed at 0.1m
	Loose becoming medium dense SAND with a very loose silty SAND bed at 0.4m
1.80	Firm CLAY
3.90	Firm SILT with very loose to loose silty sand beds and medium dense sand beds at 4.9m, 6.3m and 6.7m
6.70	Dense to very dense SAND
7.50	Medium dense SAND with a medium dense silty SAND bed at 7.8m and a dense SAND bed at 8.4m
9.50	Interbedded medium dense silty SAND and very stiff to hard sandy clay
9.90	Medium dense to dense SAND
10.50	Stiff, locally very stiff CLAY
11.20	Very dense silty SAND
11.30	End of CPT run at 11.30 m

Location:	CPT9	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

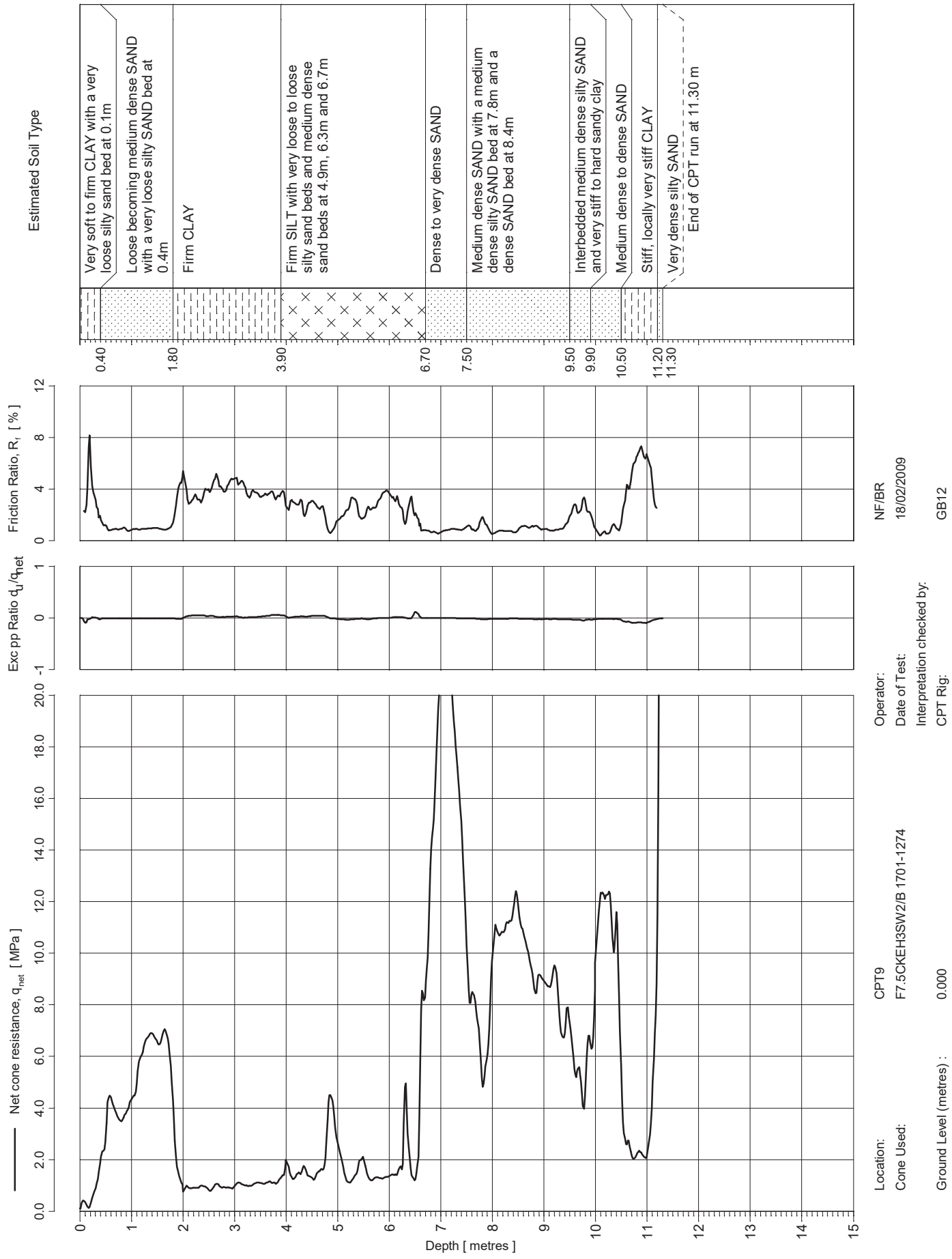
FUGRO



Checked by: Date:
Approved by: Date:

Location: CPT9
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

Operator: NF/BR
Date of Test: 18/02/2009
CPT Rig: GB12

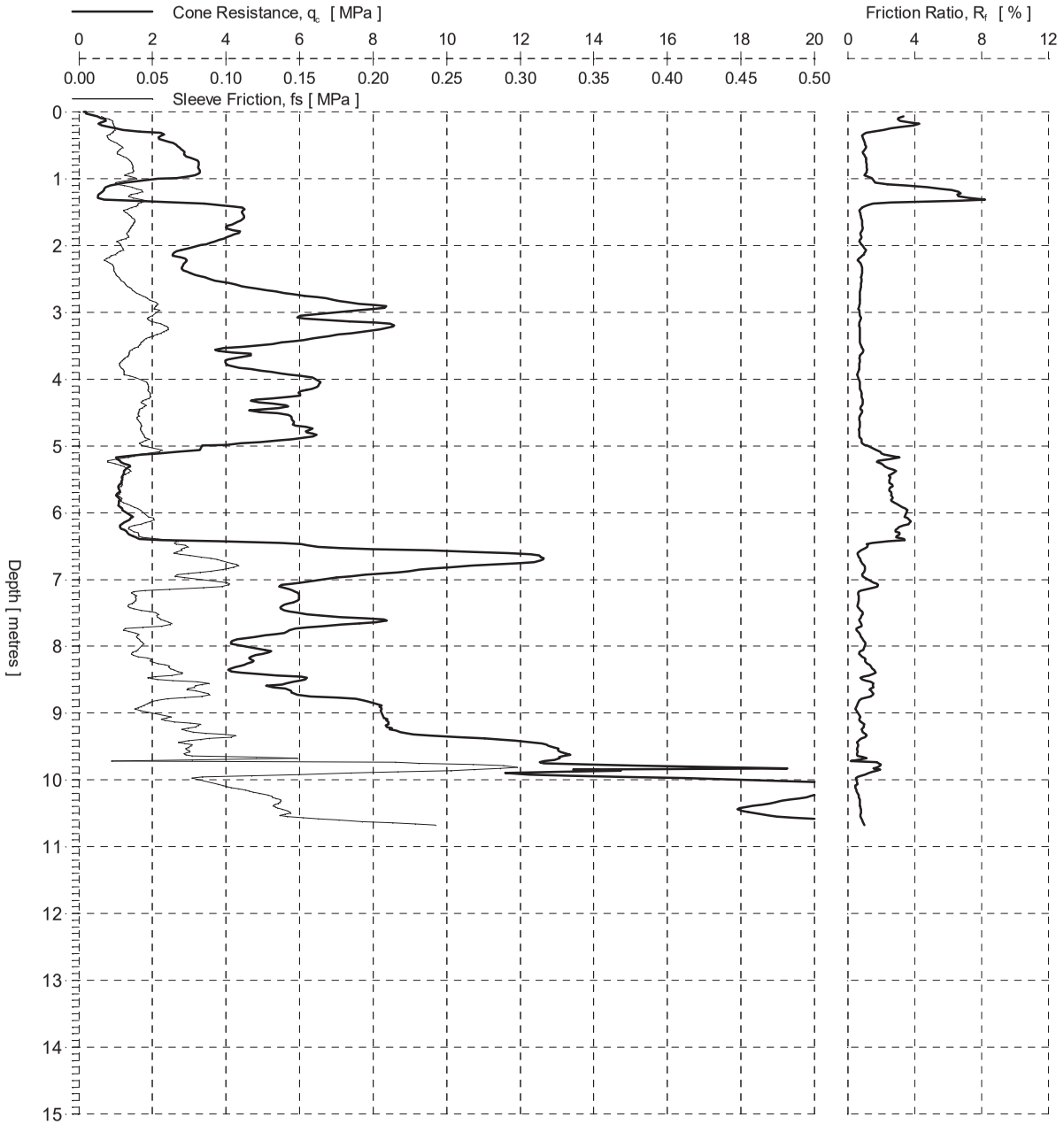


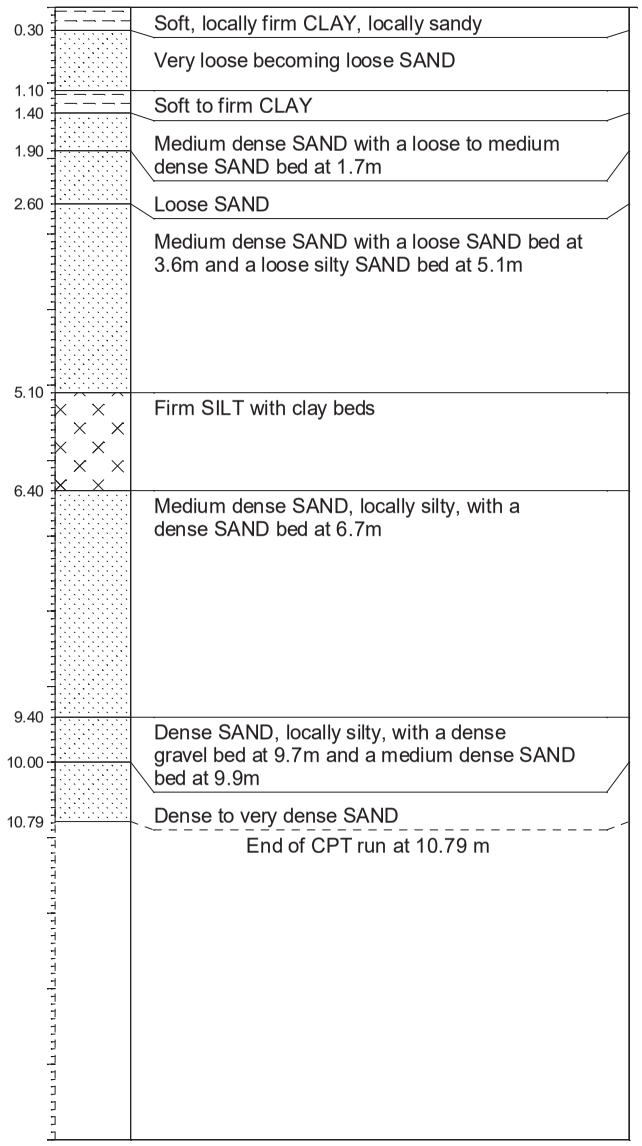
STATIC CONE PENETRATION TEST CPT9

Contract No:CPT091107

Contract No:CPT091107

Checked by: Date: Approved by: Date:



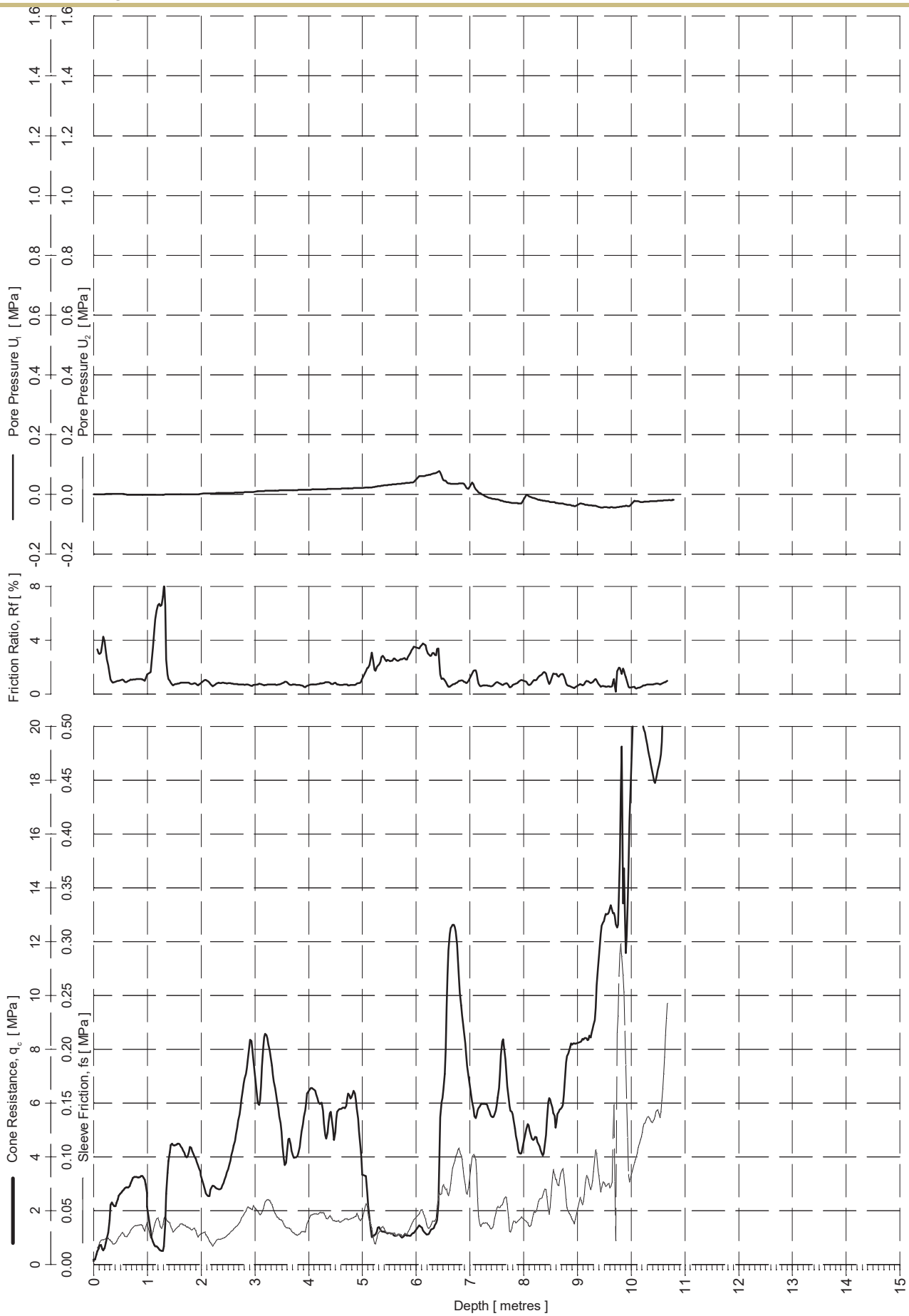


Location:	CPT11	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT11

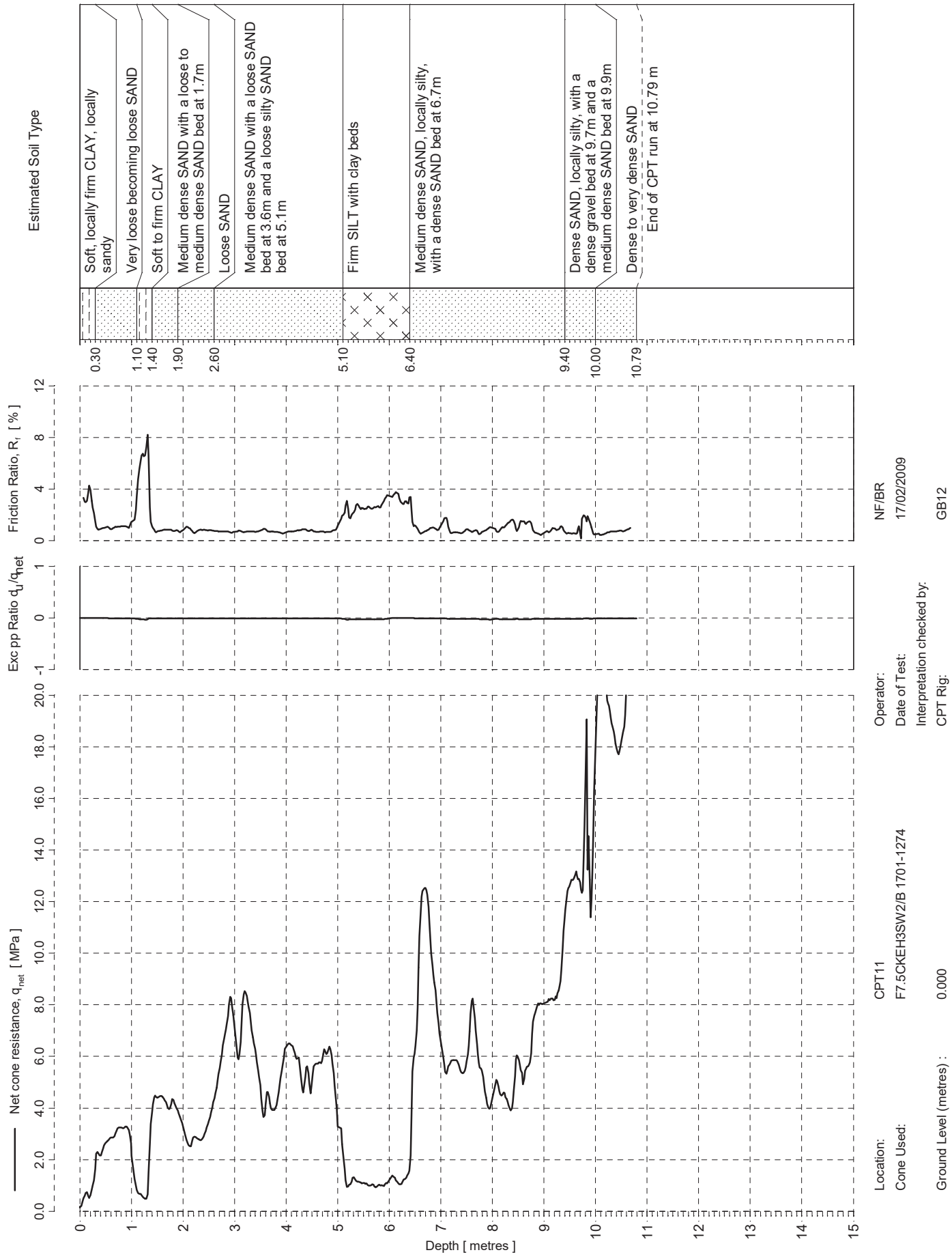
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



STATIC CONE PENETRATION TEST CPT11

Contract No:CPT091107



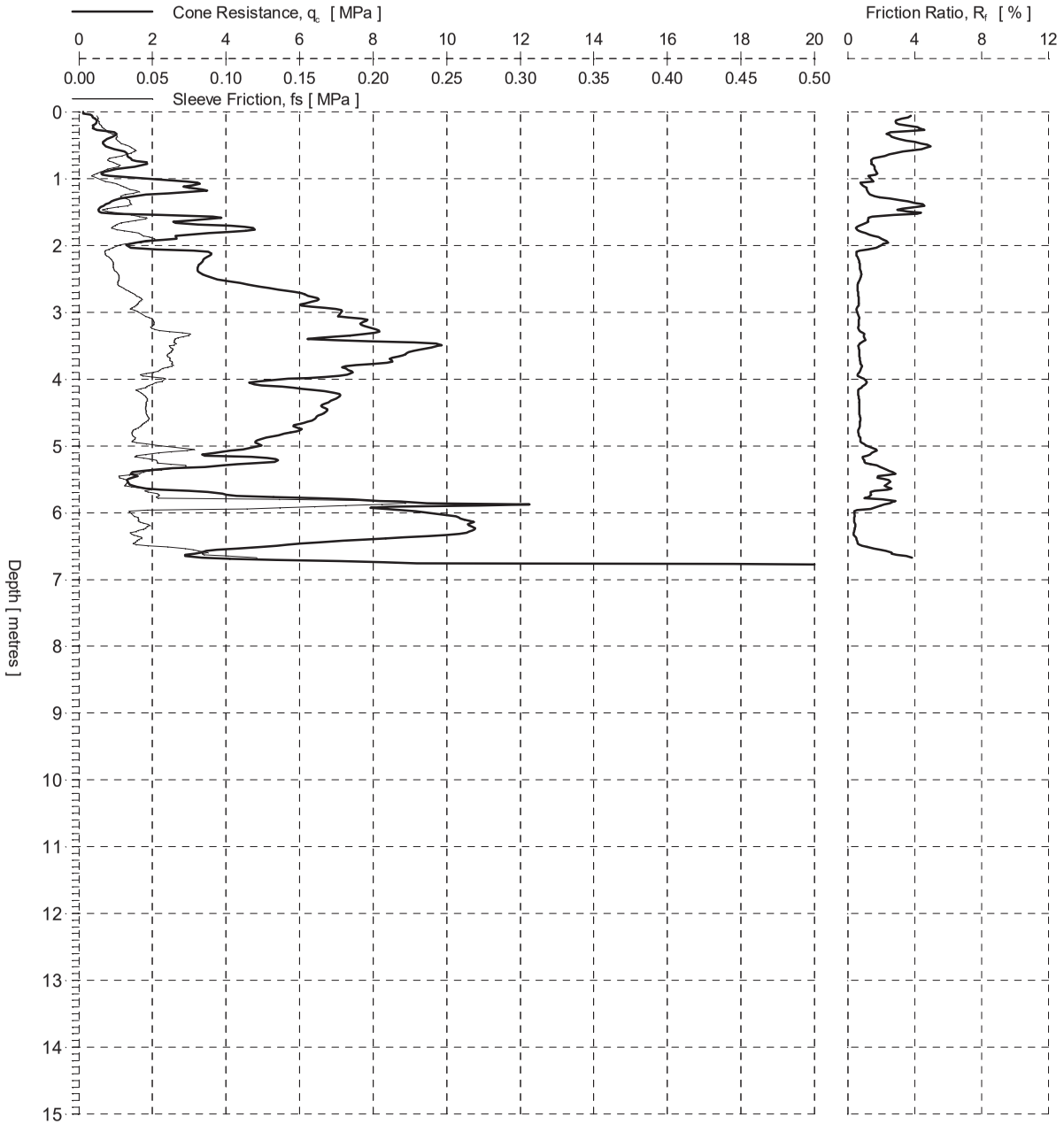
STATIC CONE PENETRATION TEST CPT11

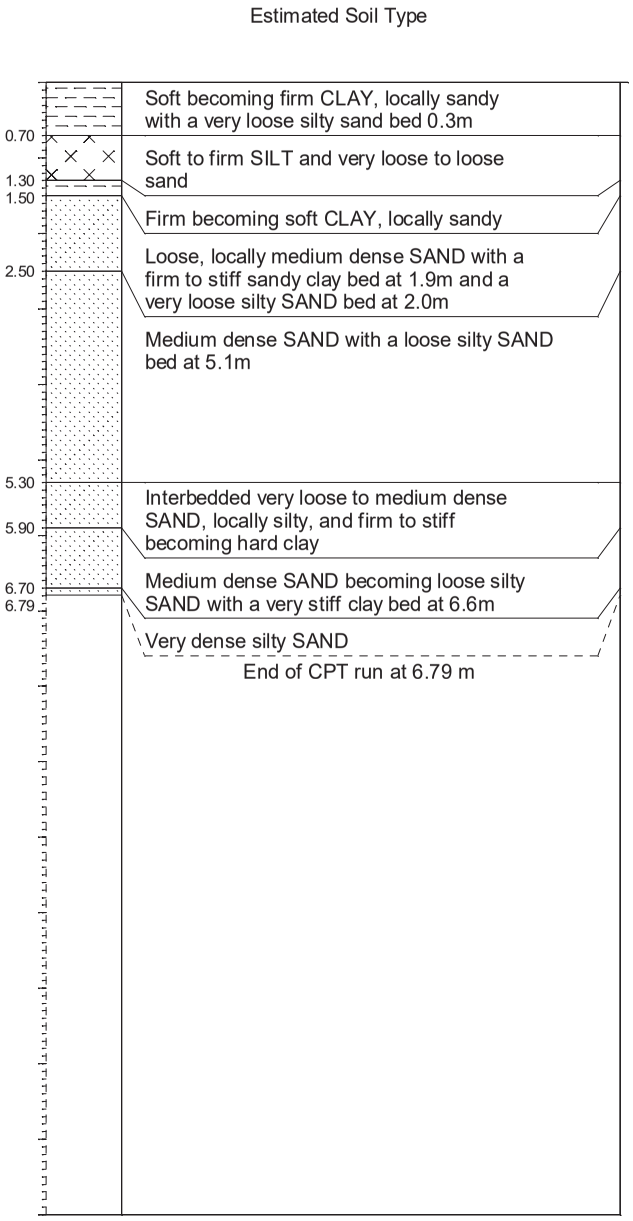
Contract No:CPT091107

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT13

Checked by: Date: Approved by: Date:

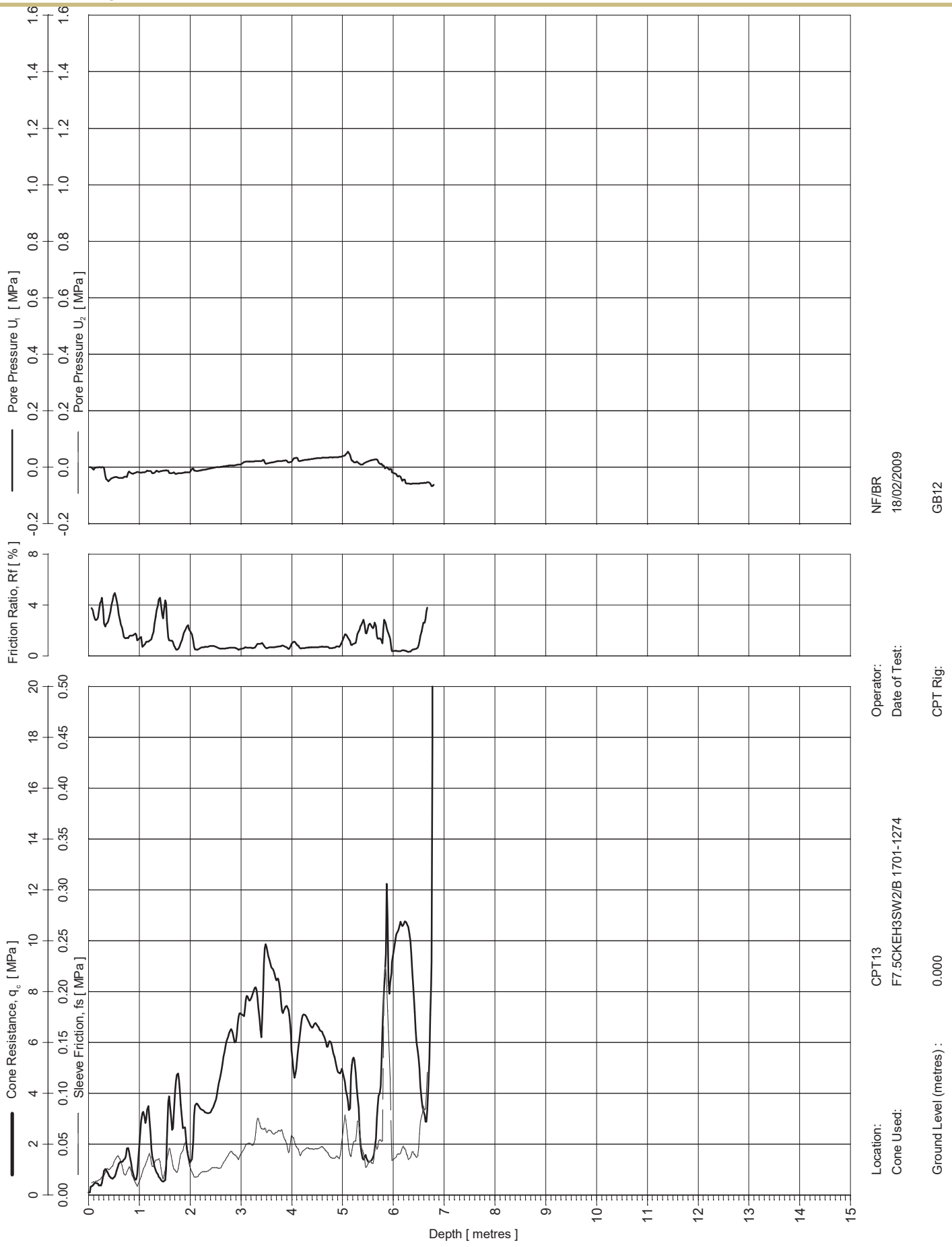




Location:	CPT13	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO



Checked by: Date:

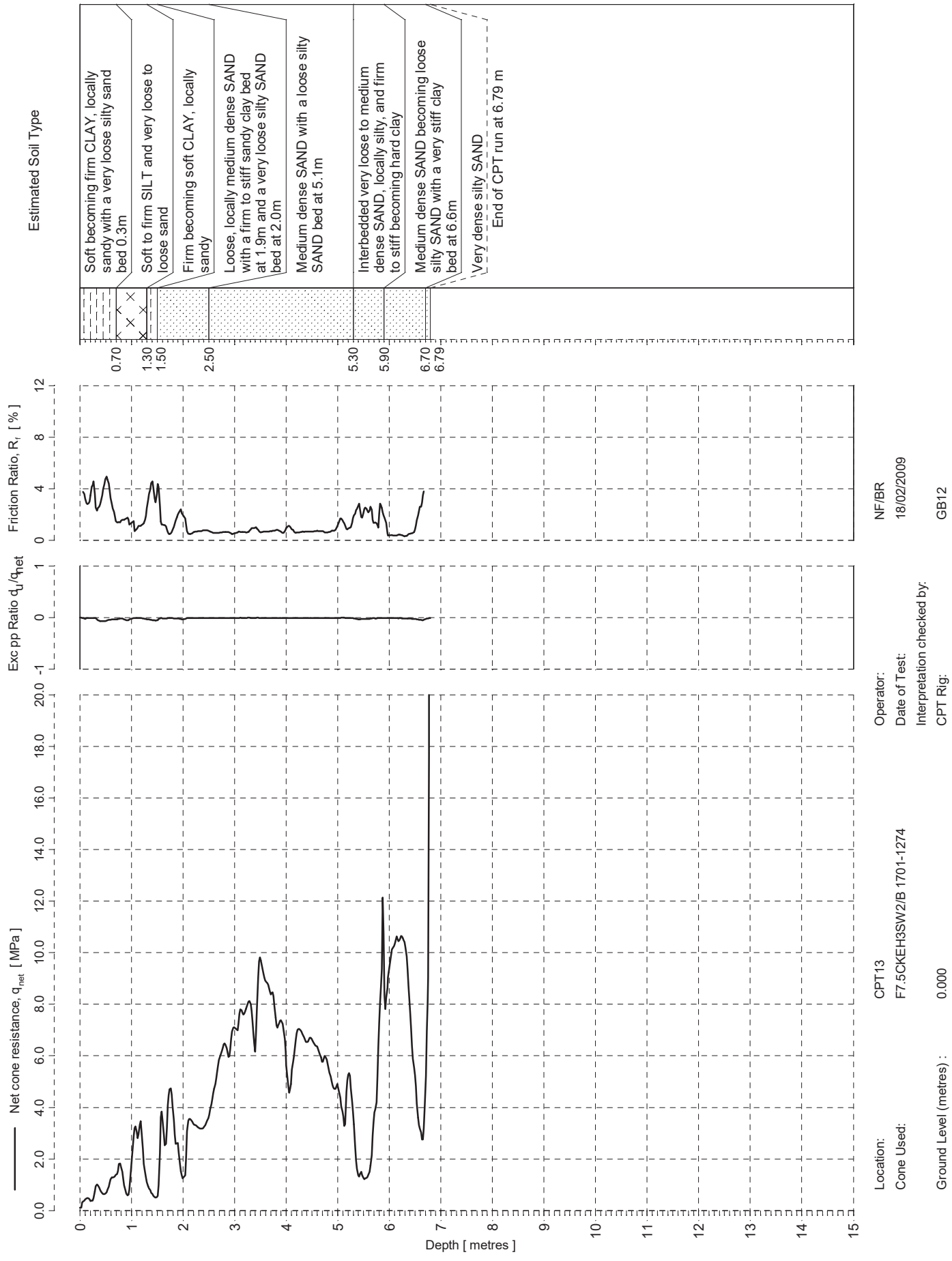
Approved by: Date:

Operator: NF/BR
Date of Test: 18/02/2009
CPT Rig: GB12

Location: CPT13
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

STATIC CONE PENETRATION TEST CPT13

Contract No:CPT091107



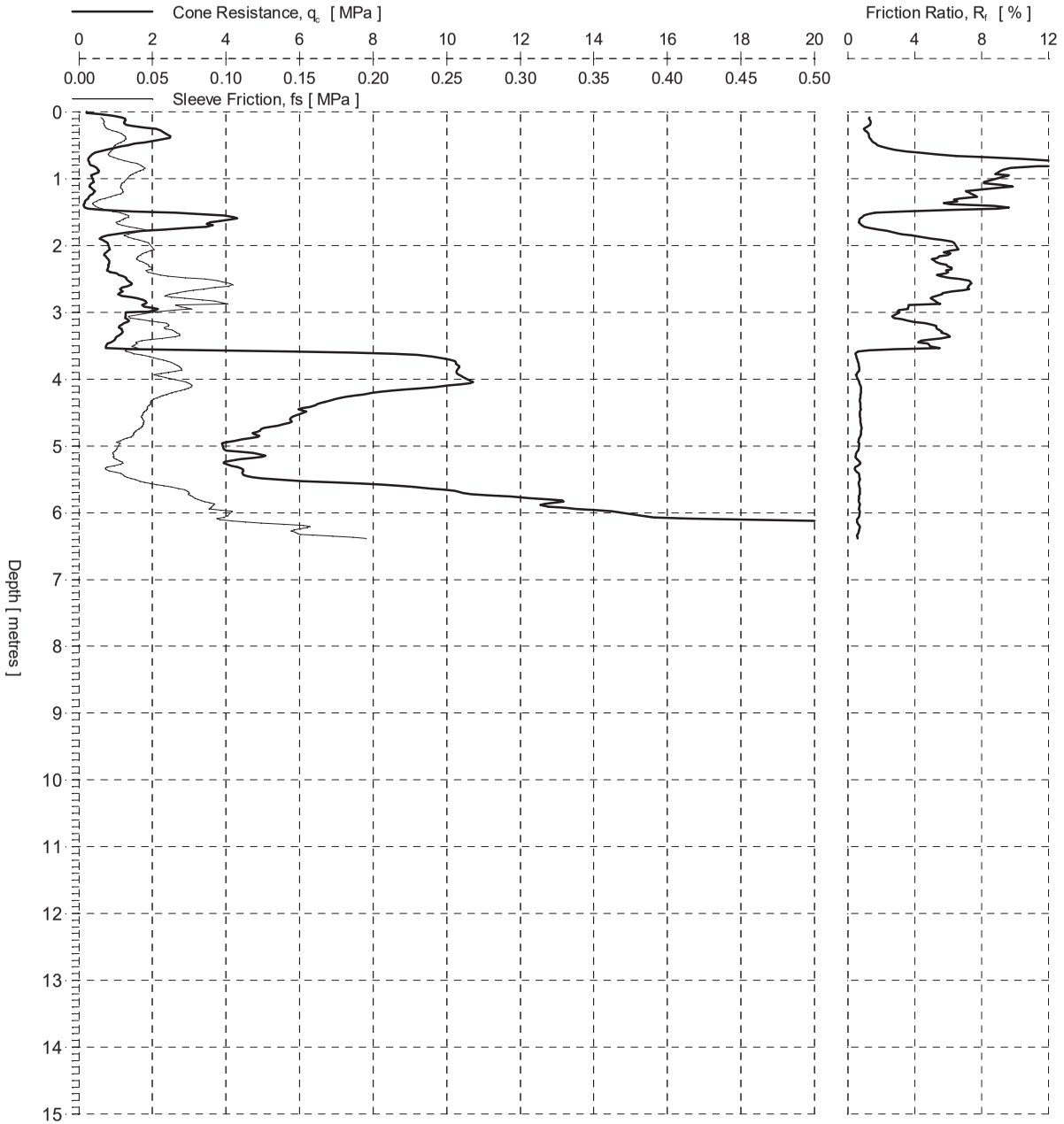
STATIC CONE PENETRATION TEST CPT13

Contract No:CPT091107

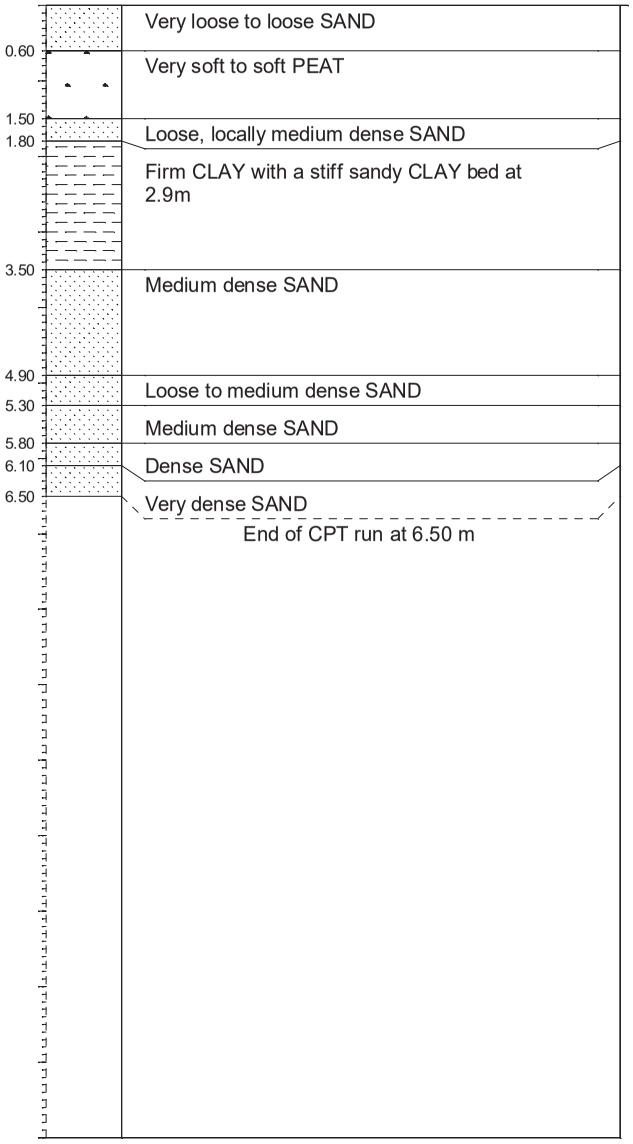
Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT14

Checked by: Date: Approved by: Date:



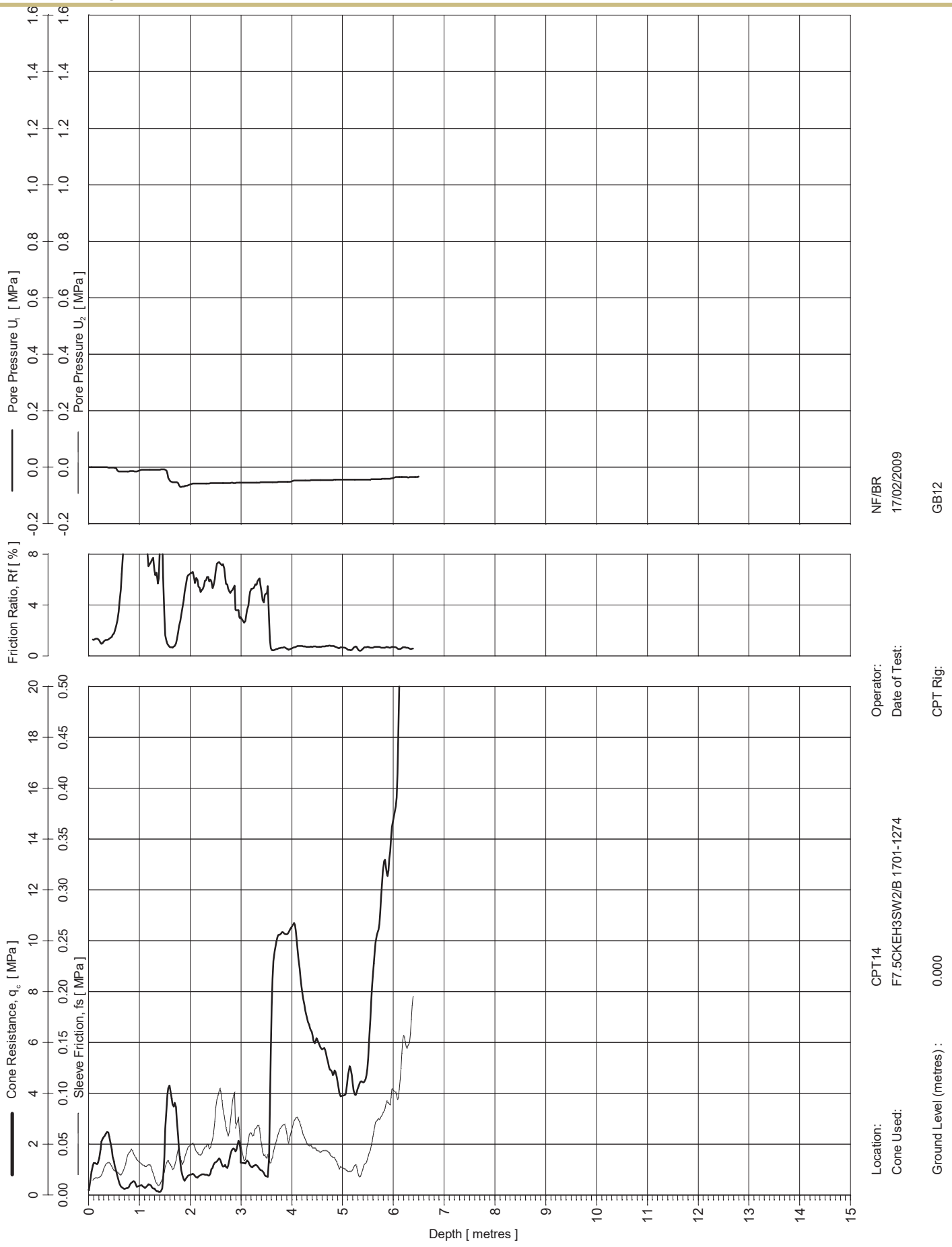
Estimated Soil Type



Location:	CPT14	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO

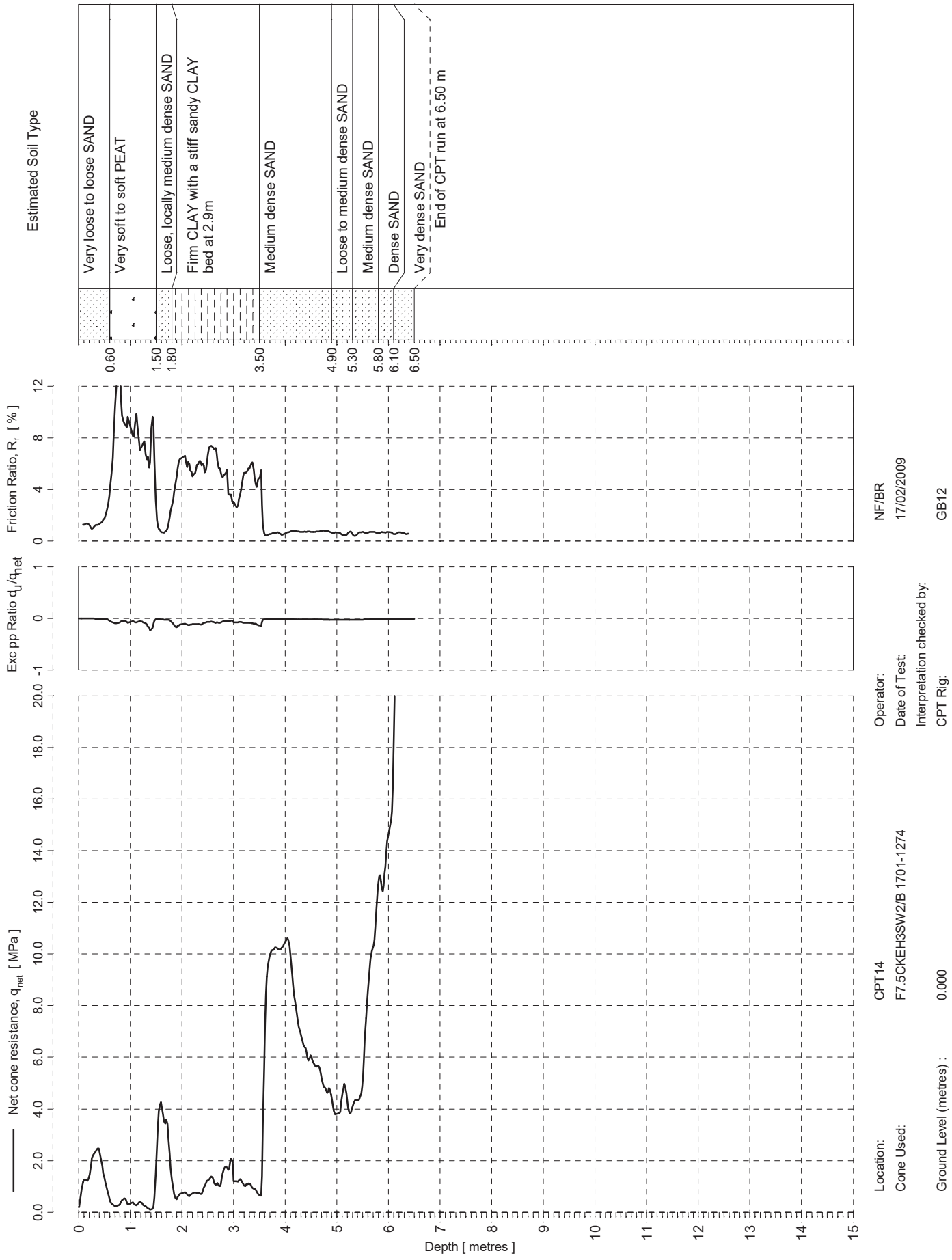


Checked by: Date:

Approved by: Date:

Operator: NF/BR
Date of Test: 17/02/2009
CPT Rig: GB12

Location: CPT14
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000



STATIC CONE PENETRATION TEST CPT14

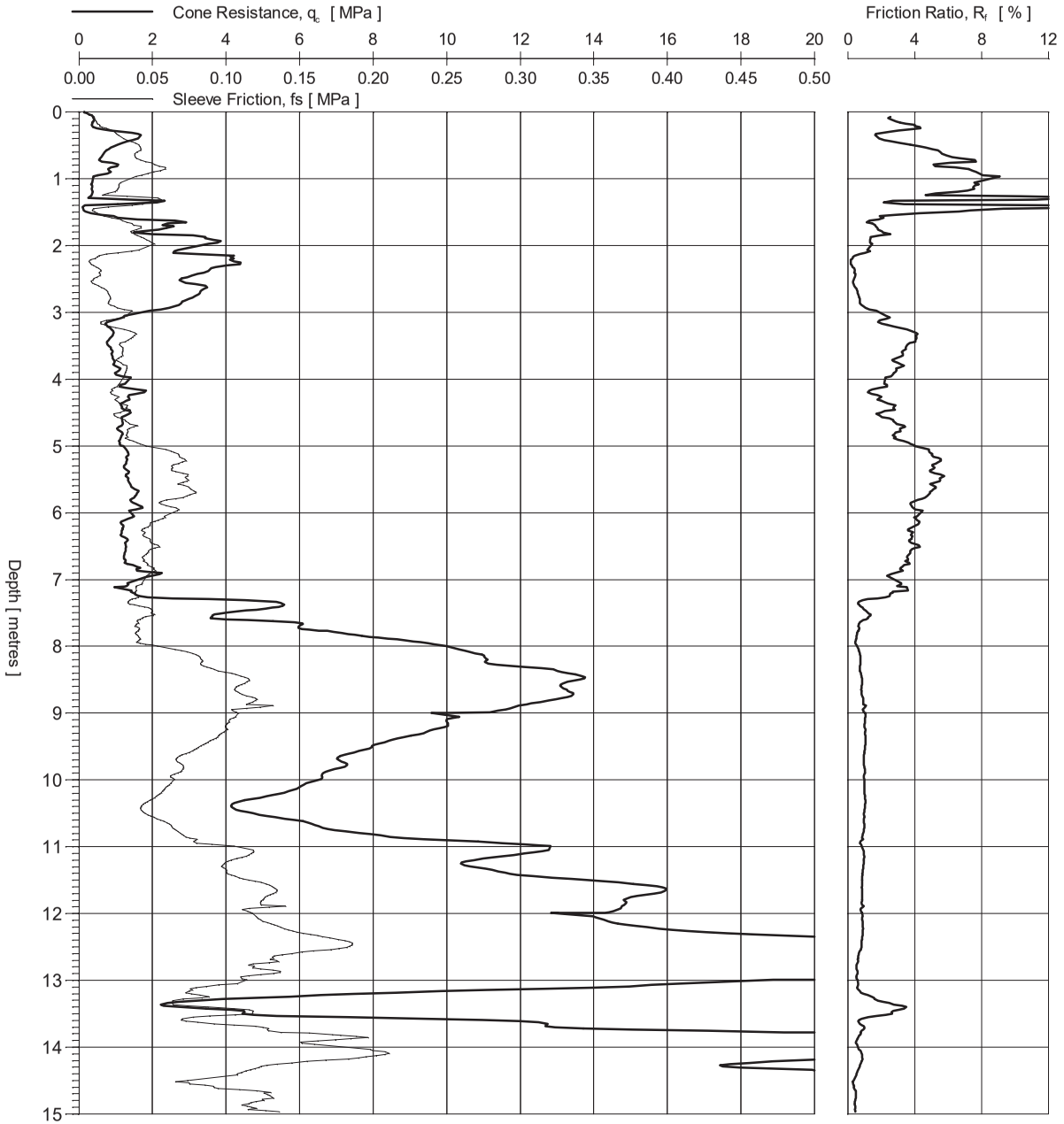
Contract No:CPT091107

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Estimated Soil Type

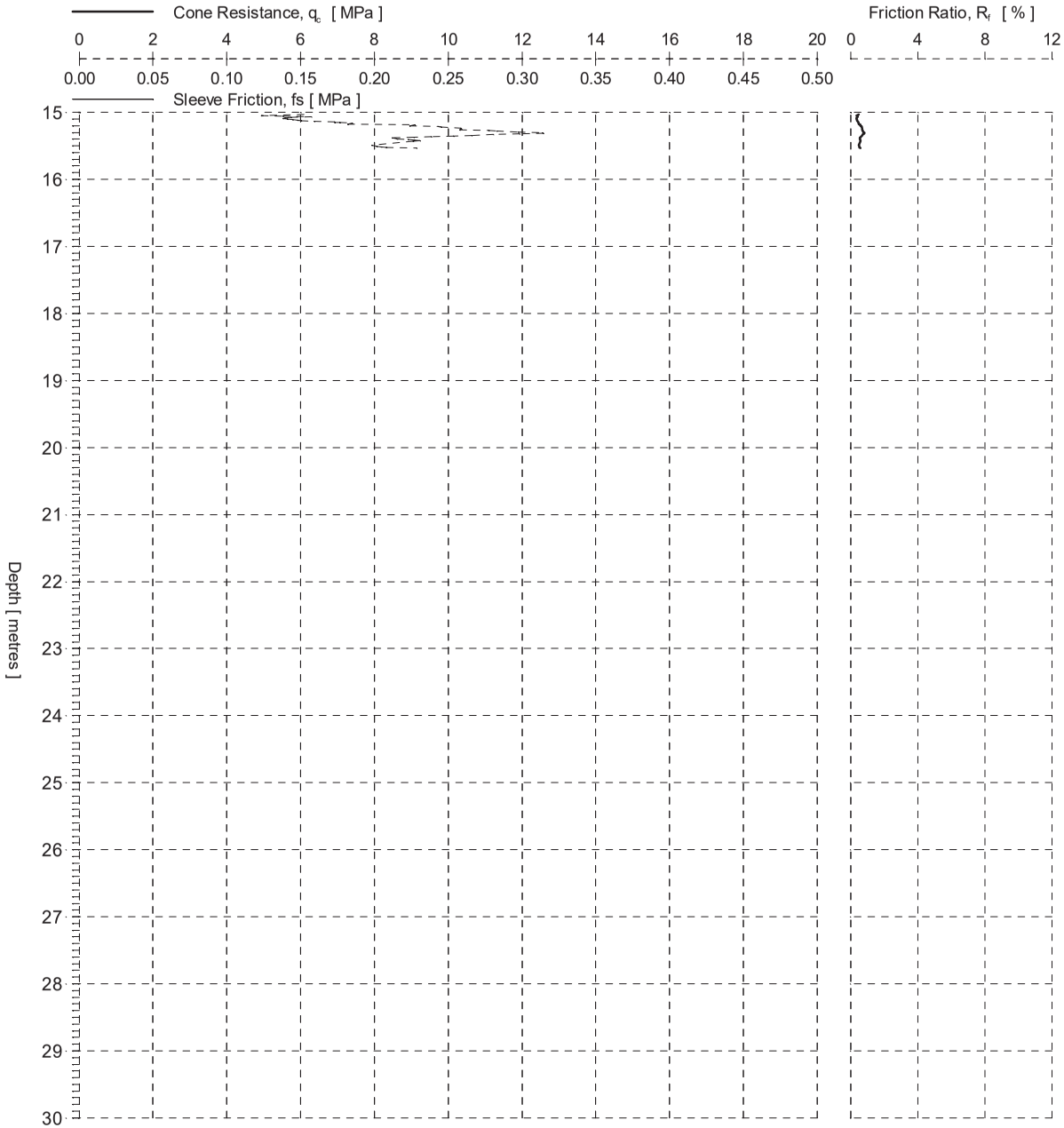
0.50	Very loose silty SAND with a soft clay bed at 0.3m
1.50	Firm becoming very soft organic CLAY and peat with a loose silty sand bed at 1.4m
2.10	Very loose to loose SAND, locally silty
3.00	Loose to medium dense GRAVEL and sand
5.00	Firm SILT with very loose silty sand beds
7.30	Firm to stiff CLAY, locally sandy with a loose silty sand bed at 7.0m
8.30	Medium dense SAND with a loose silty SAND bed at 7.5m
8.90	Dense SAND
11.40	Medium dense SAND with a dense SAND bed at 11.0m
12.40	Dense SAND
13.30	Very dense SAND becoming medium dense silty SAND
13.50	Stiff becoming very stiff sandy CLAY
14.40	Dense to very dense SAND
	Continued next sheet

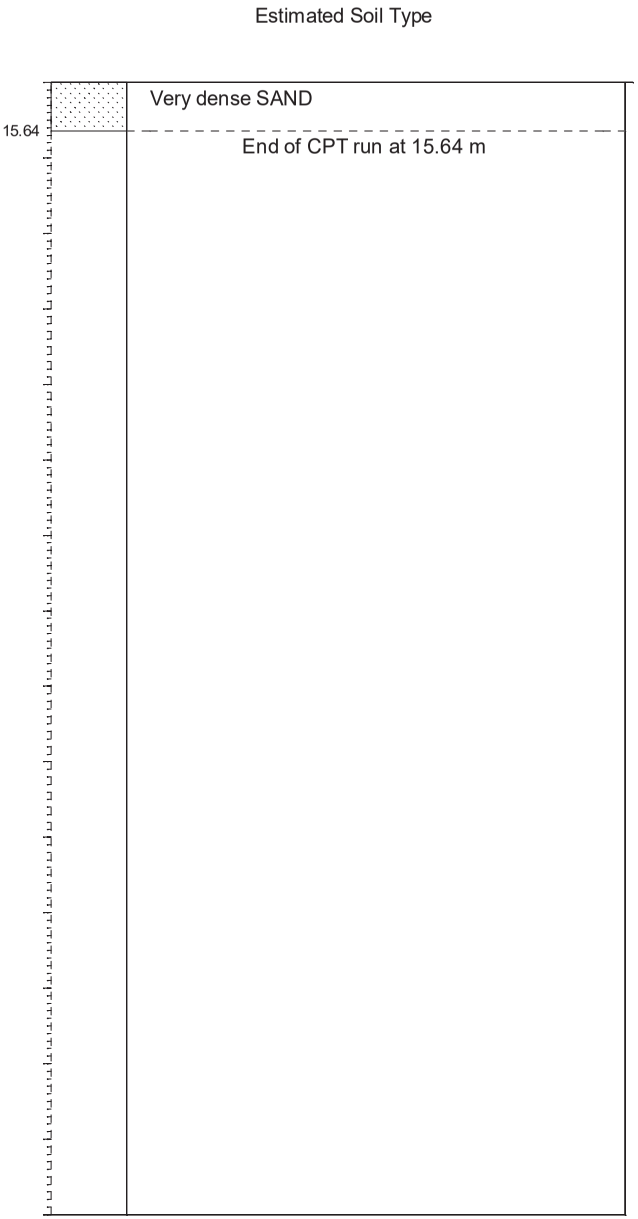
Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17

Checked by: Date: Approved by: Date:



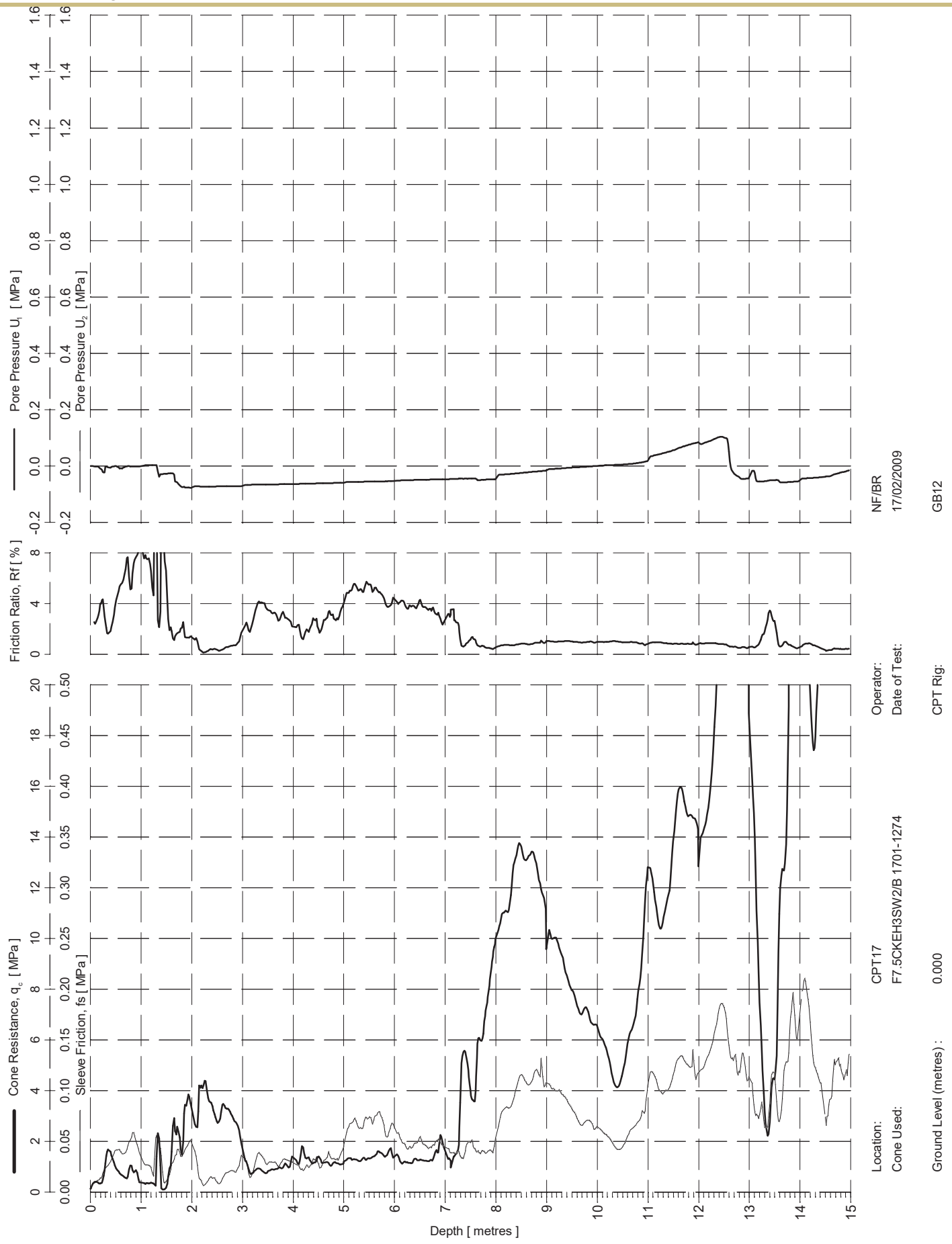


Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

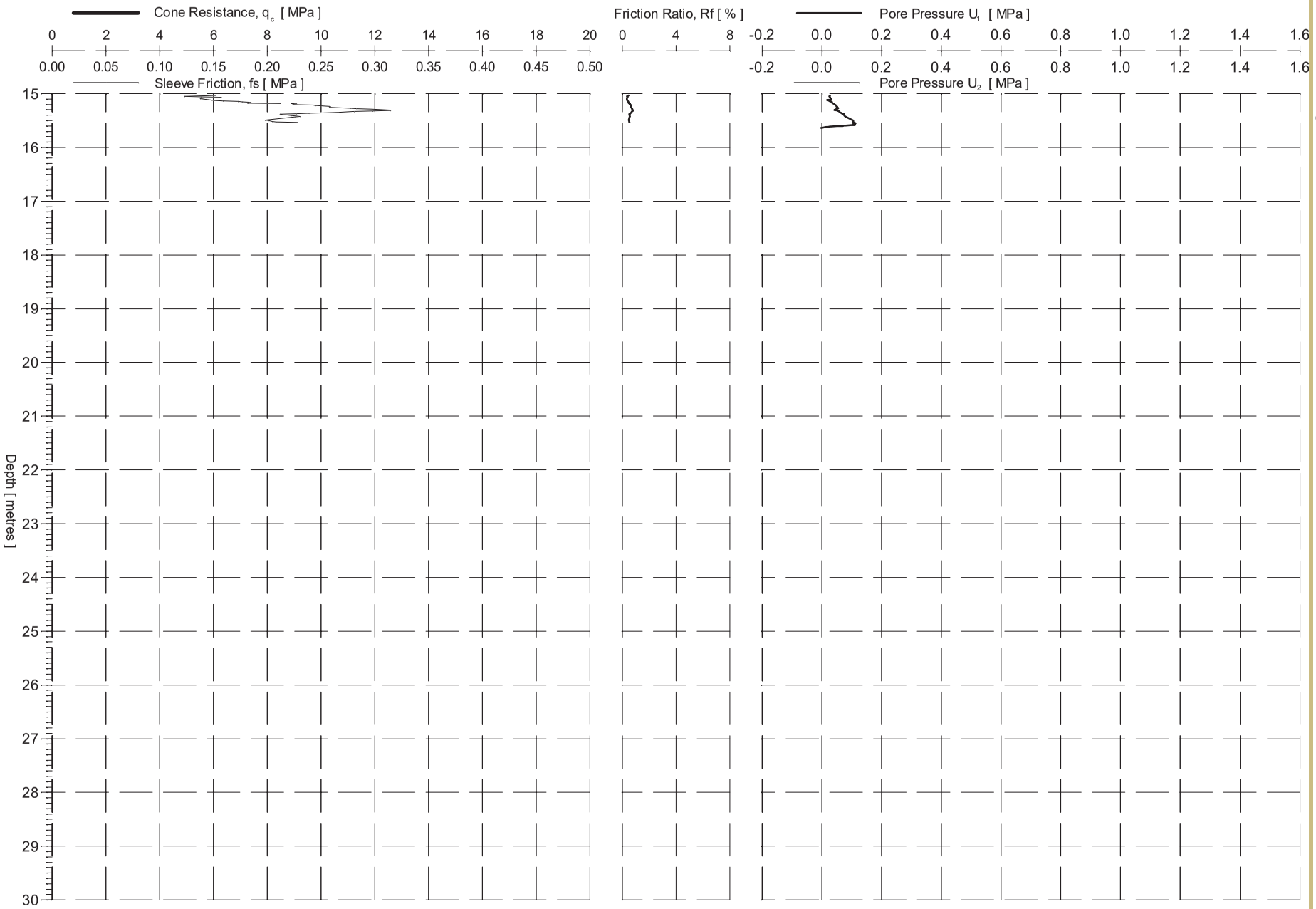


STATIC CONE PENETRATION TEST CPT17

Contract No:CPT091107

Contract No:CPT091107

Checked by: Date: Approved by: Date:



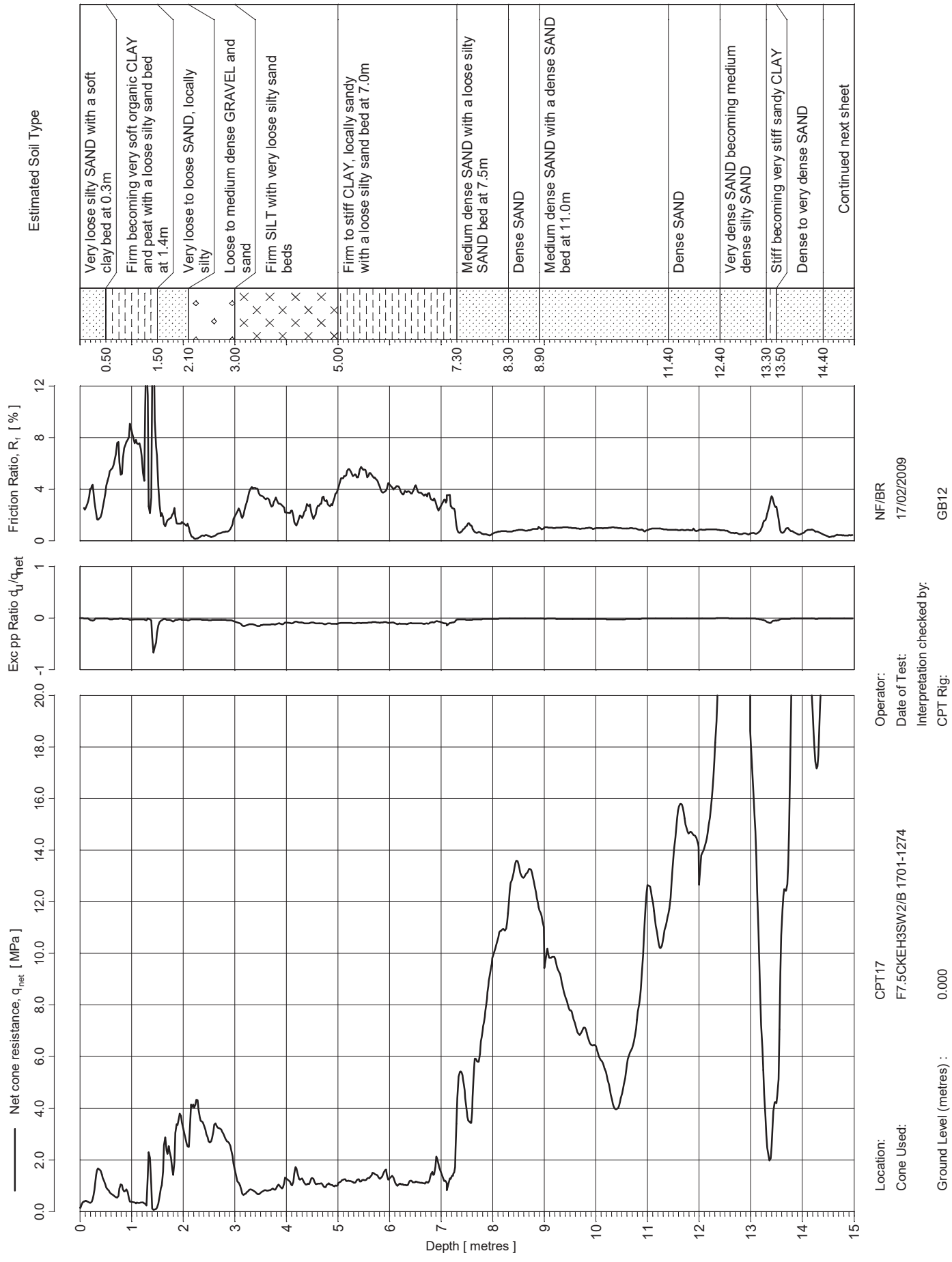
Location: CPT17 Operator: NF/BR

Cone Used: F7.5CKEH3SW2/B 1701-1274 Date of Test: 17/02/2009

Ground Level (metres) : 0.000 CPT Rig: GB12

STATIC CONE PENETRATION TEST CPT17

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

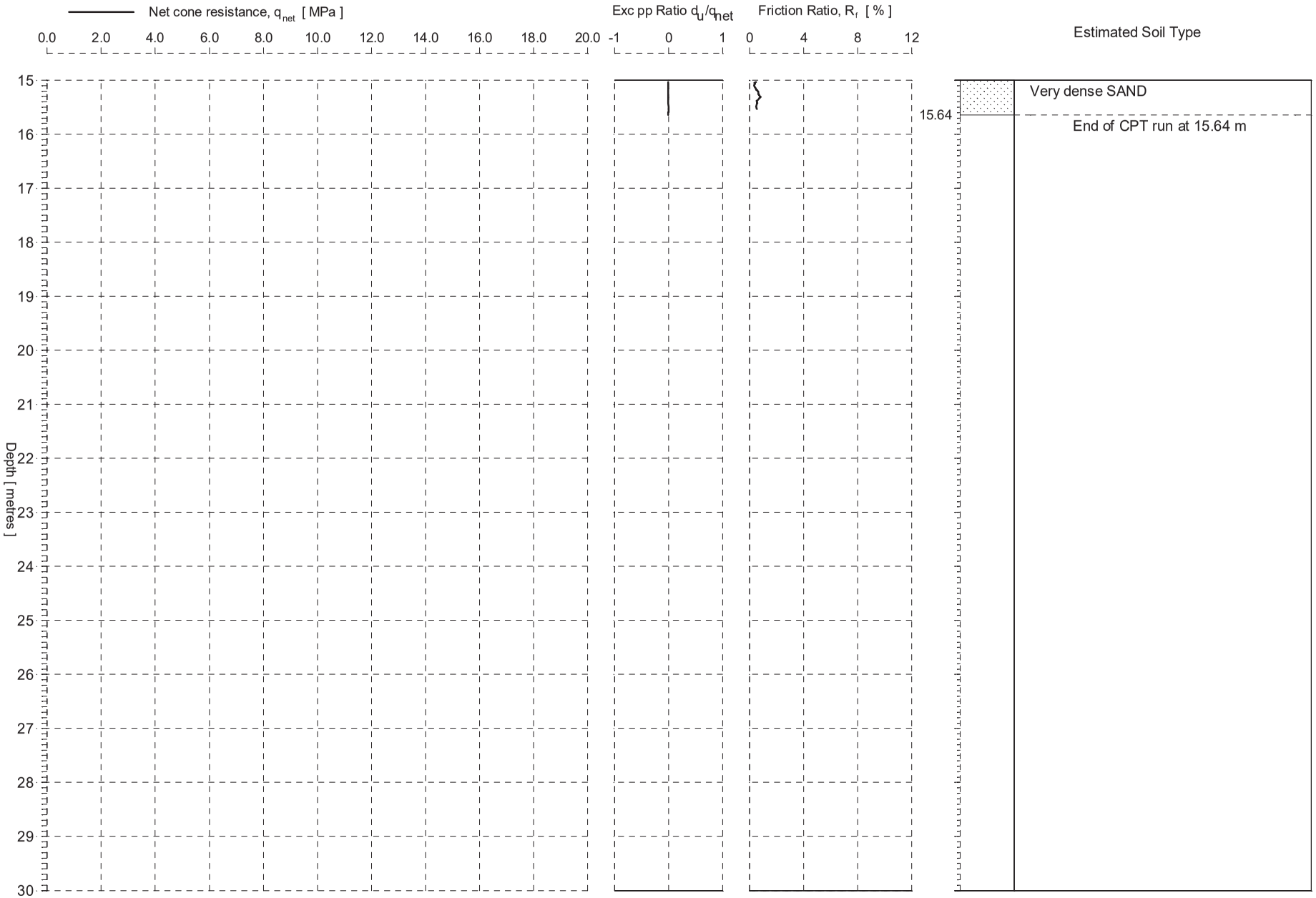


STATIC CONE PENETRATION TEST CPT17

Contract No:CPT091107

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17



Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

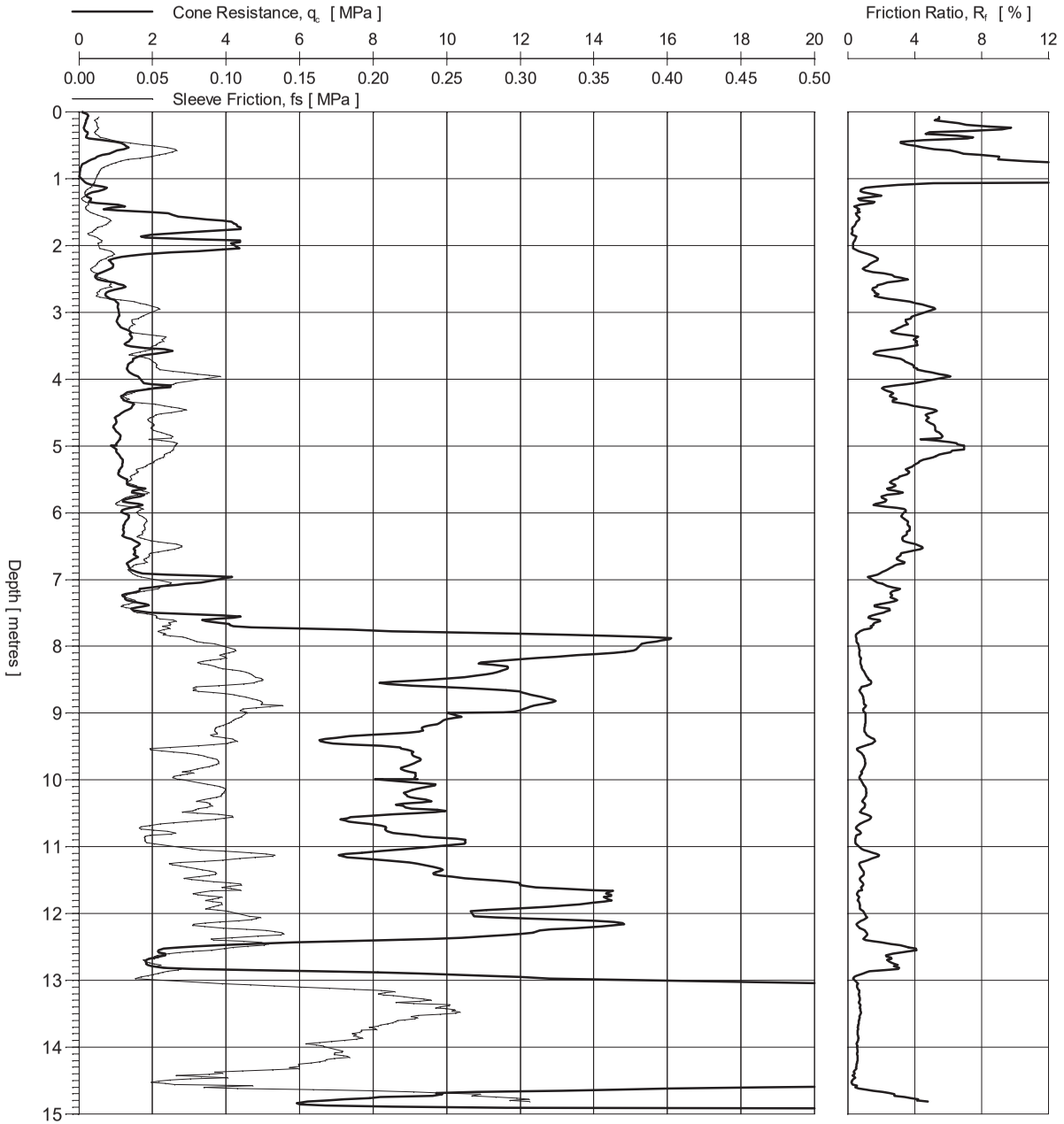
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Estimated Soil Type

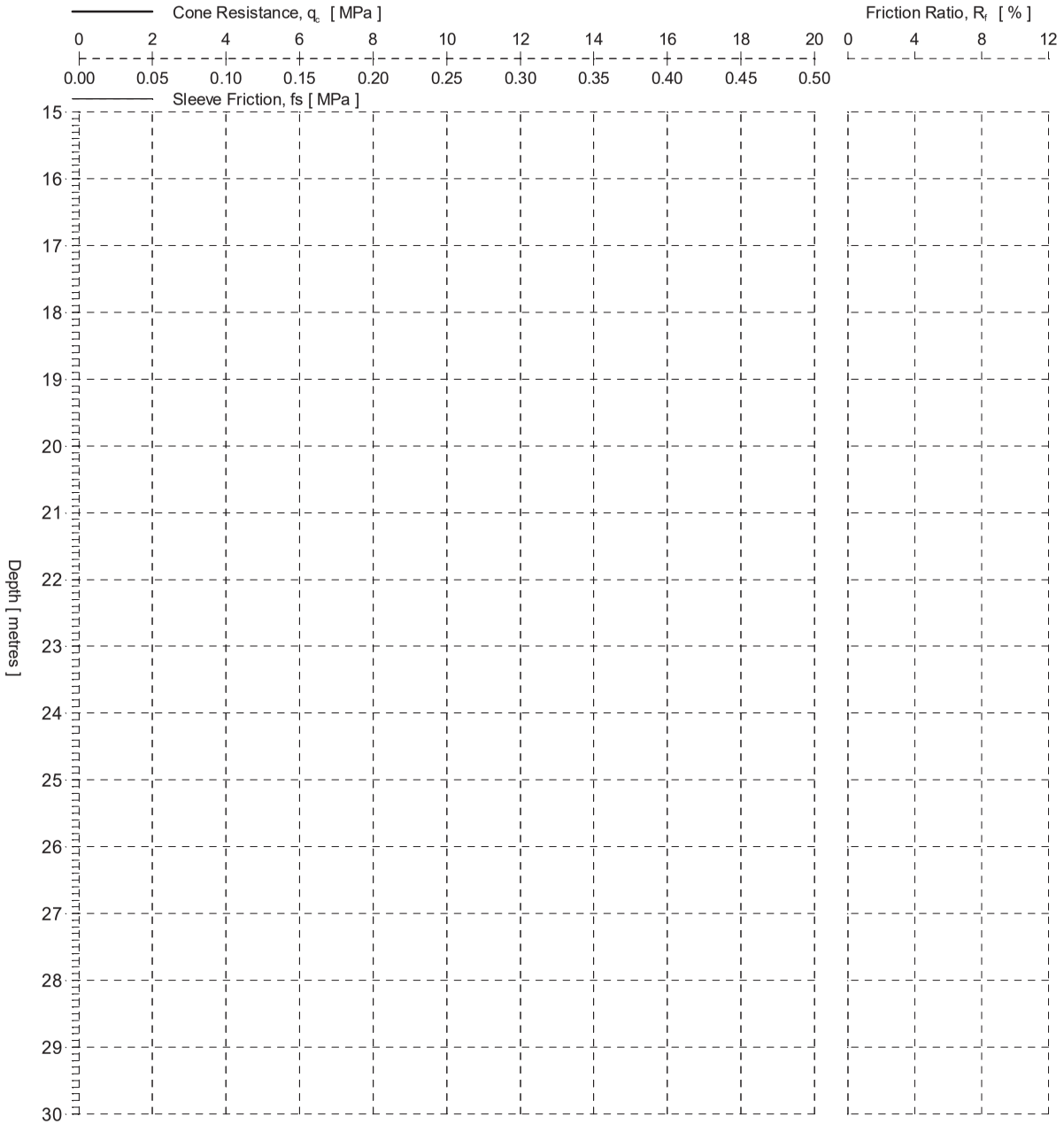
	Very soft to soft CLAY with a firm CLAY bed at 0.5m
1.10	
1.50	Soft becoming firm SILT
	Loose to medium dense SAND, locally gravelly, with a very loose SAND bed at 1.9m
2.10	
2.80	Firm, locally soft SILT
	Firm, locally stiff CLAY, locally sandy with firm silt beds at 3.3m and 4.3m and loose silty sand beds at 3.6m and 4.1m
4.40	
	Firm CLAY
5.50	
	Interbedded firm SILT and stiff clay with very loose silty sand beds at 5.7m and 5.9m and a medium dense sand bed at 7.0m
7.50	
7.80	Loose becoming medium dense silty SAND
	Medium dense to dense SAND
9.00	
	Medium dense SAND with silty SAND beds at 9.5m and 11.1m
11.50	
	Medium dense to dense SAND
12.40	
12.80	Very stiff becoming stiff CLAY, locally sandy, with a loose silty sand bed at 12.7m
	Very dense SAND, locally gravelly, with a medium dense SAND bed at 12.9m
14.60	
14.94	Continued next sheet

Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

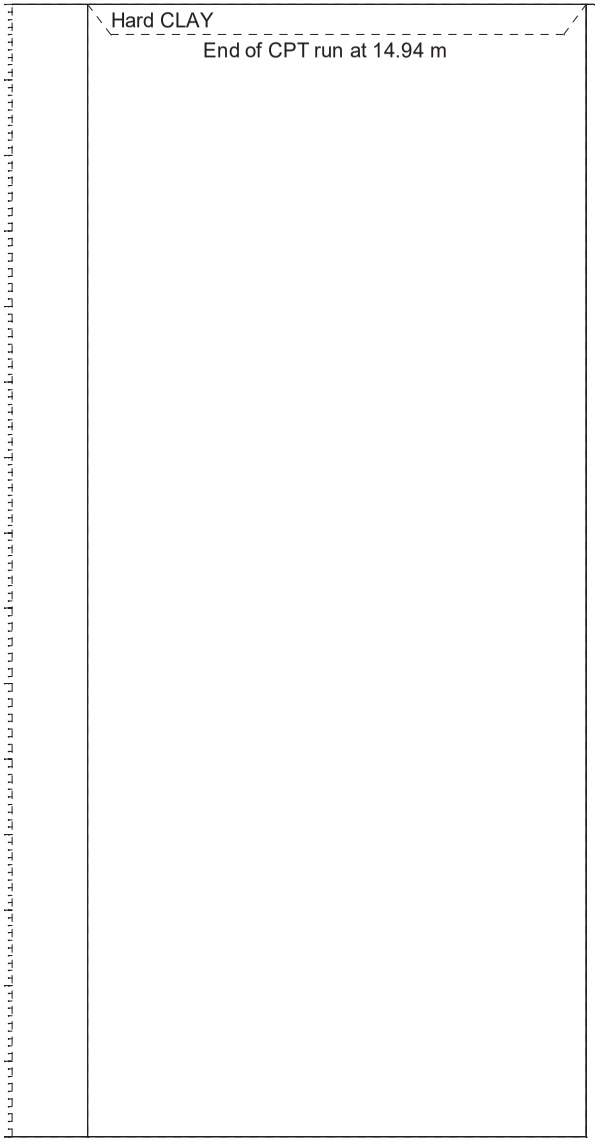
Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

Checked by: Date: Approved by: Date:



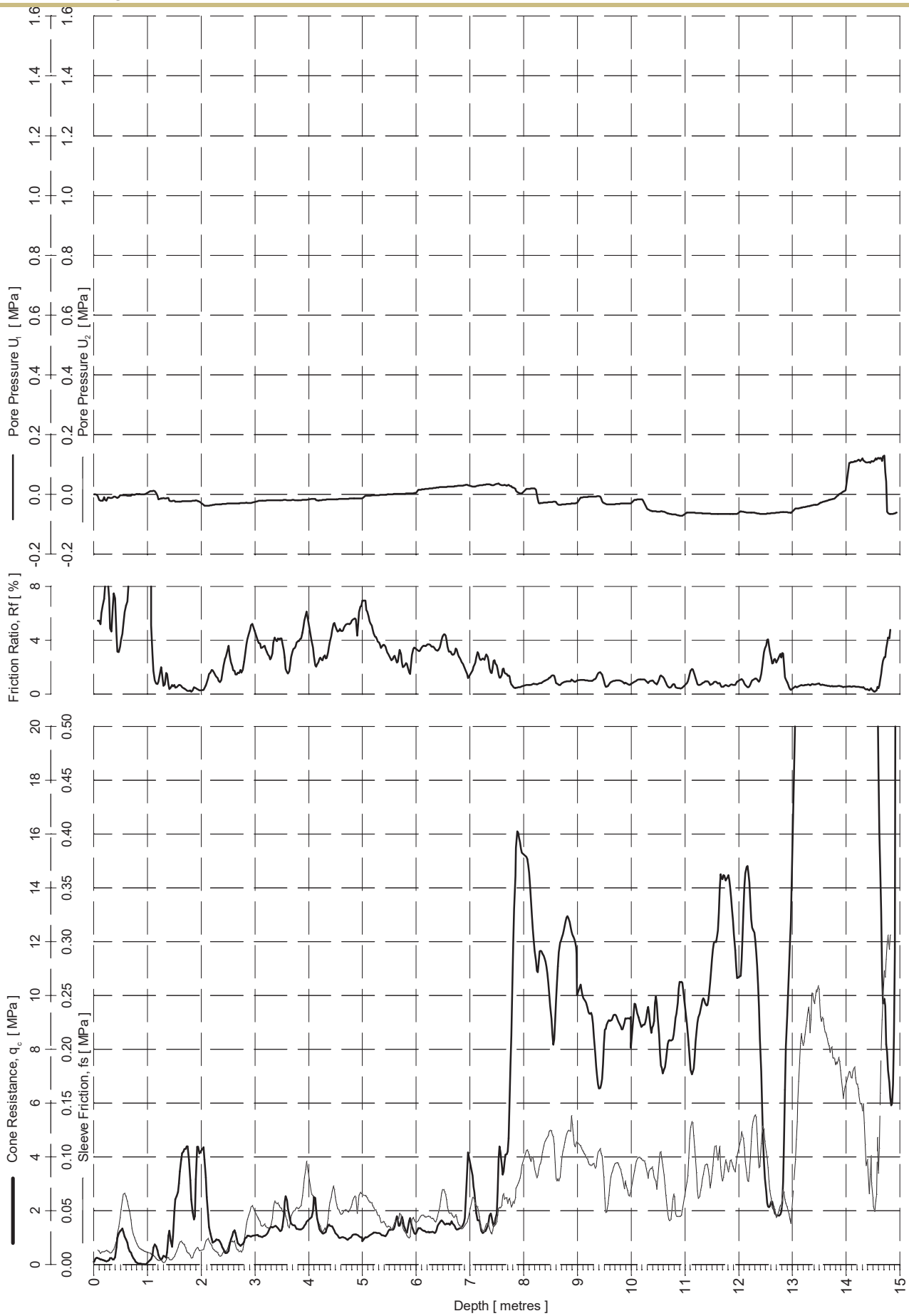
Estimated Soil Type



Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

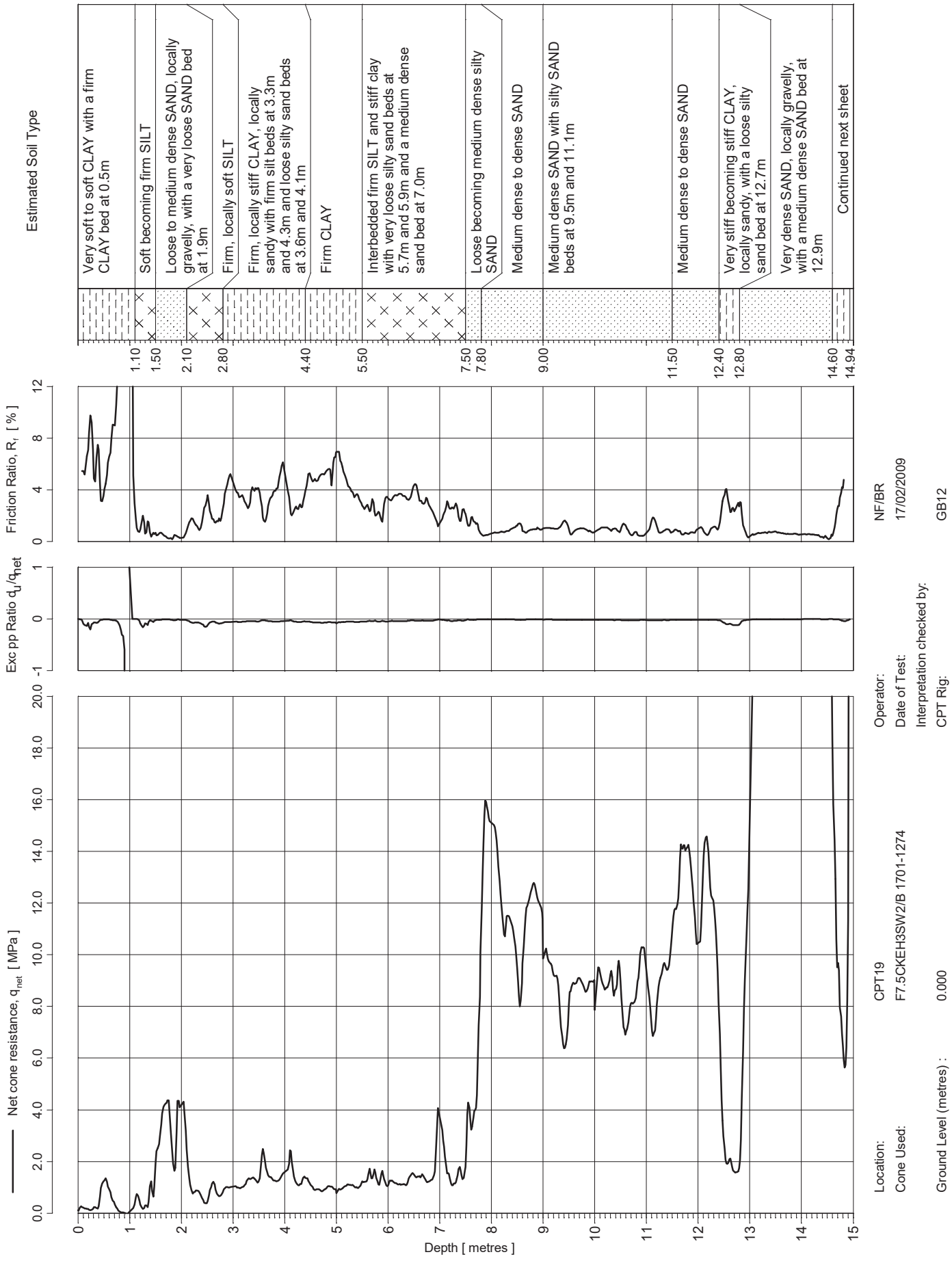
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO



Checked by: Date:
Approved by: Date:

Operator: NF/BR
Date of Test: 17/02/2009
CPT Rig: GB12
Location: CPT19
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

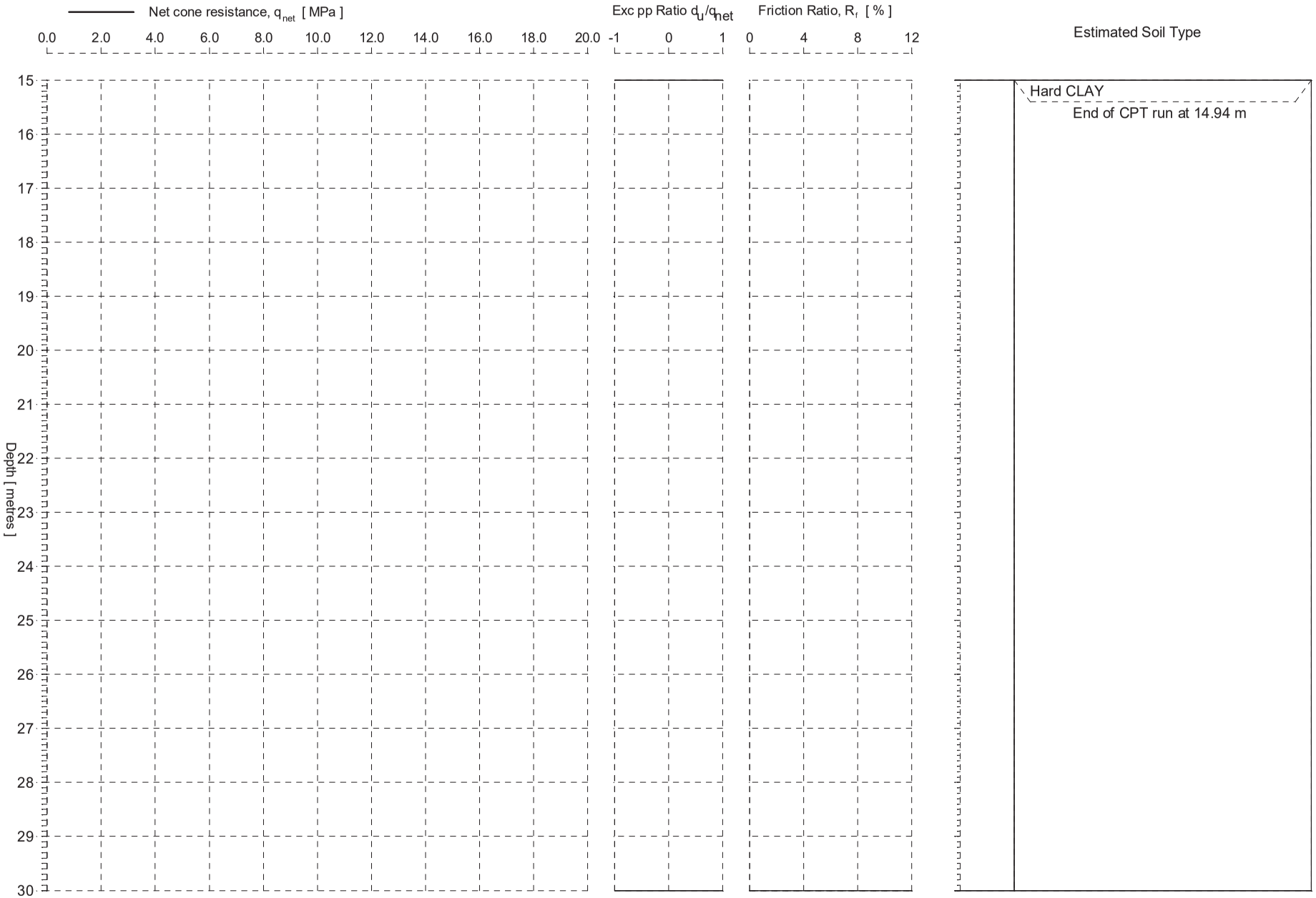


STATIC CONE PENETRATION TEST CPT19

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

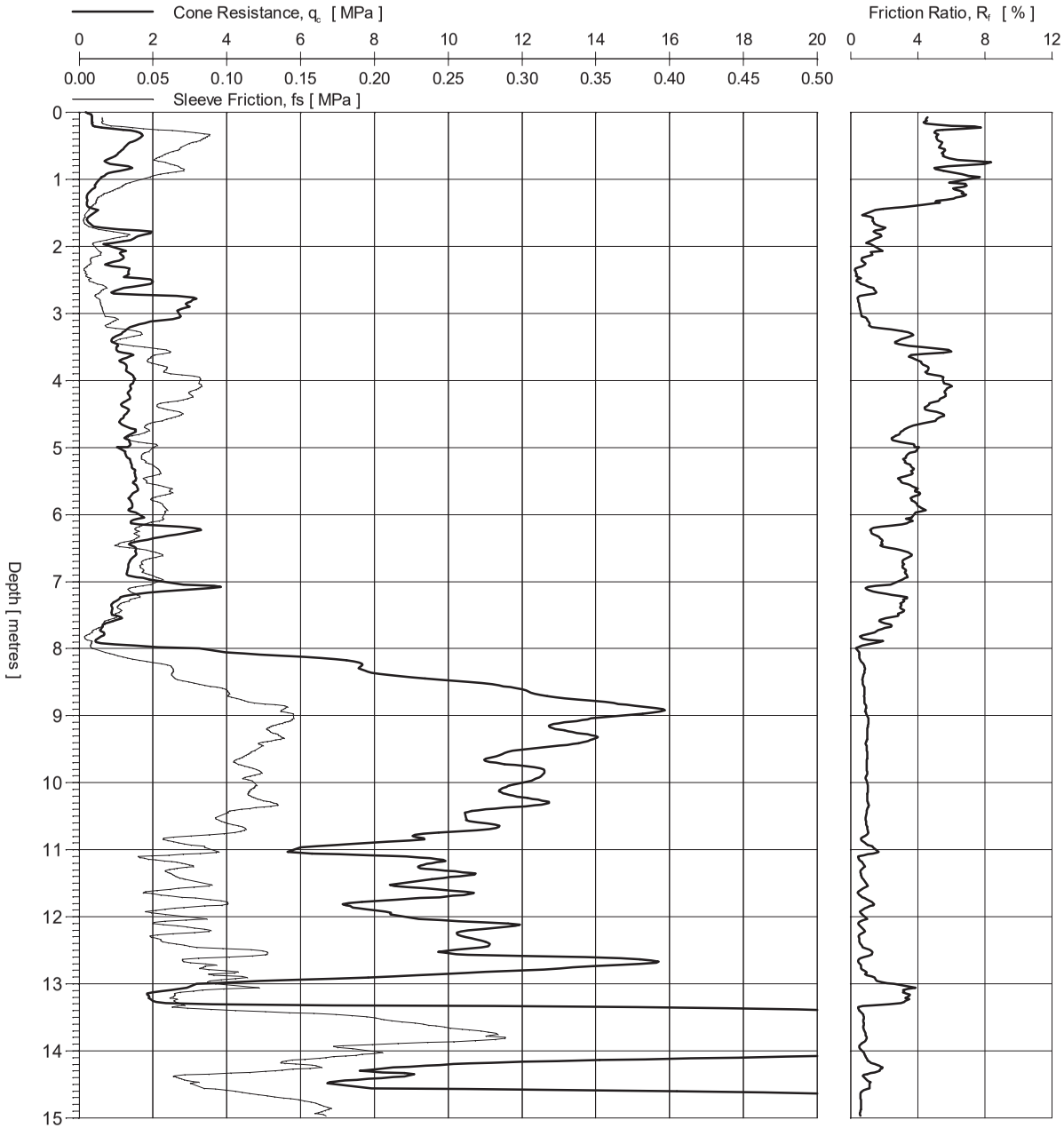


Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

Checked by: Date: Approved by: Date:



Estimated Soil Type

0.20	Soft CLAY
0.90	Firm to stiff CLAY
1.40	Very soft to soft CLAY
3.20	Very loose to loose SAND and silty SAND and firm silt
6.20	Firm to stiff CLAY, locally sandy, with a very loose silty sand bed at 4.9m
7.20	Interbedded firm to stiff CLAY and very loose to loose sand, locally silty
8.00	Firm becoming soft SILT
8.60	loose SAND becoming medium dense
9.50	Dense SAND
10.40	Medium dense to dense SAND
12.60	Medium dense SAND, locally silty
13.00	Dense SAND becoming medium dense silty SAND
13.30	Stiff to very stiff CLAY
14.10	Very dense SAND
14.60	Continued next sheet

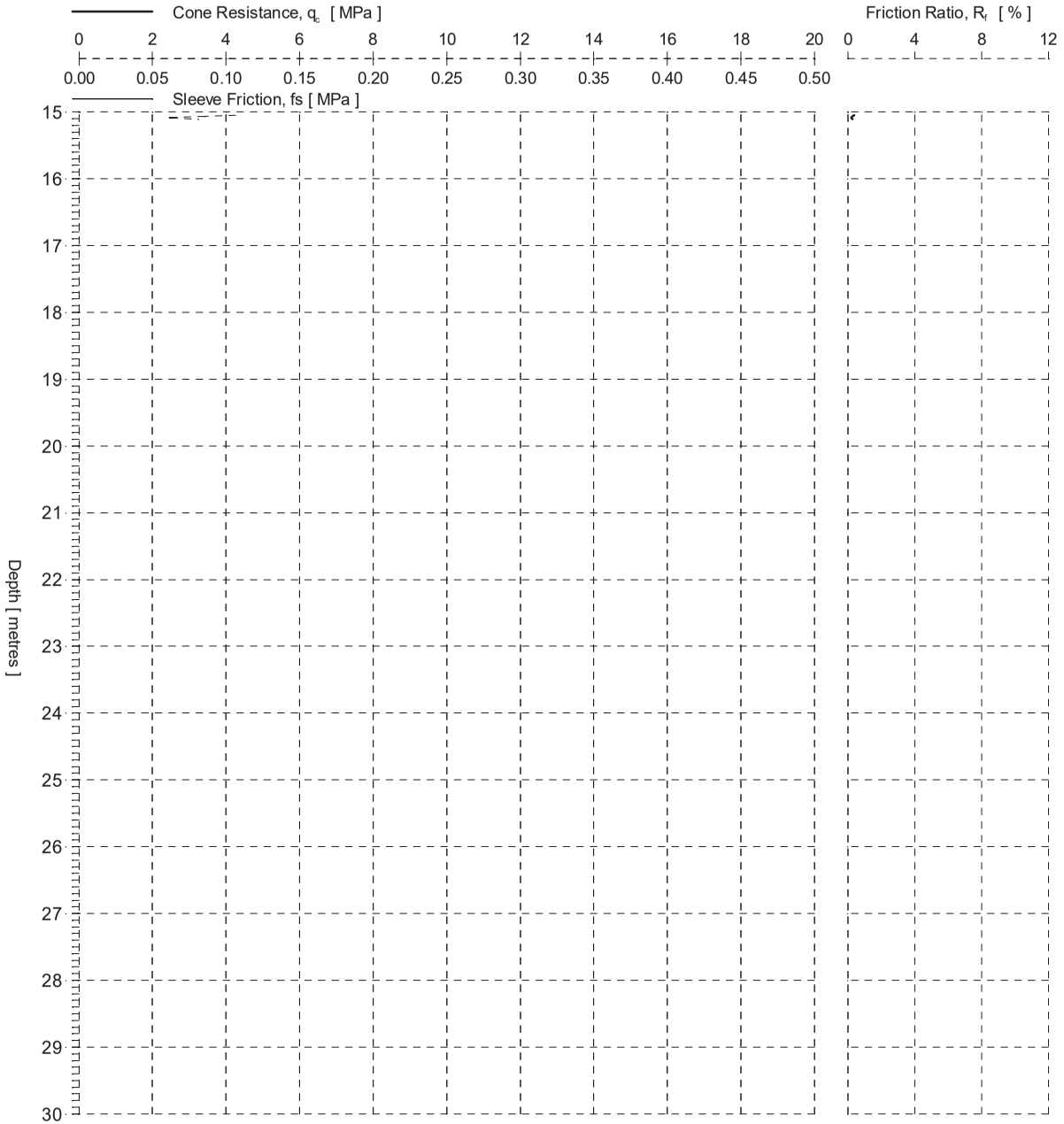
Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

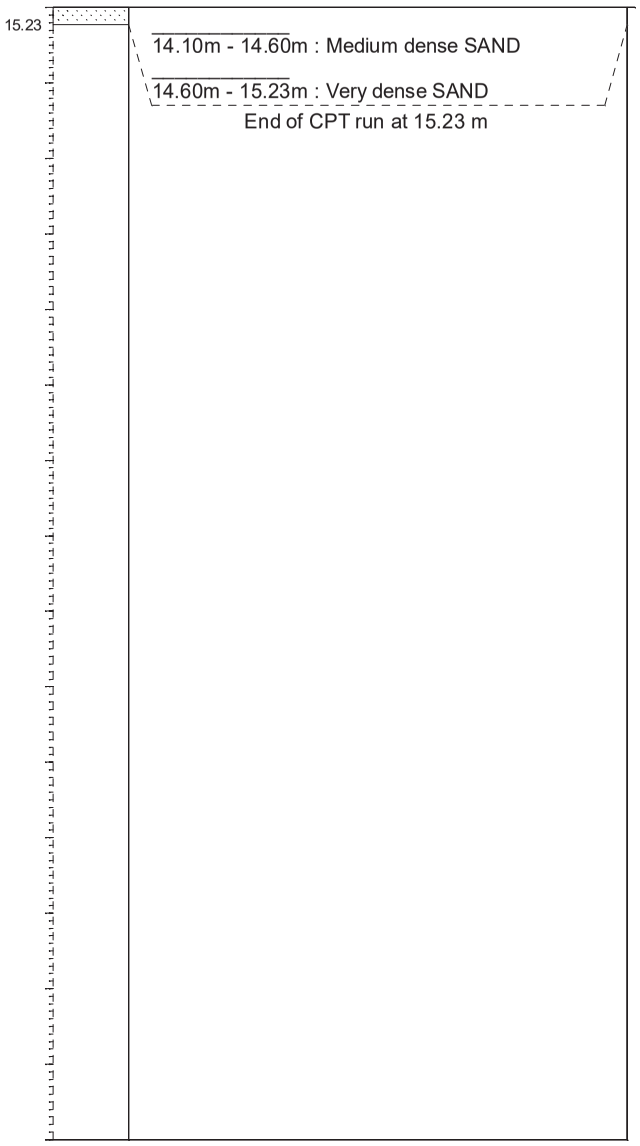
FUGRO

Contract No:CPT091107

Checked by: Date: Approved by: Date:



Estimated Soil Type

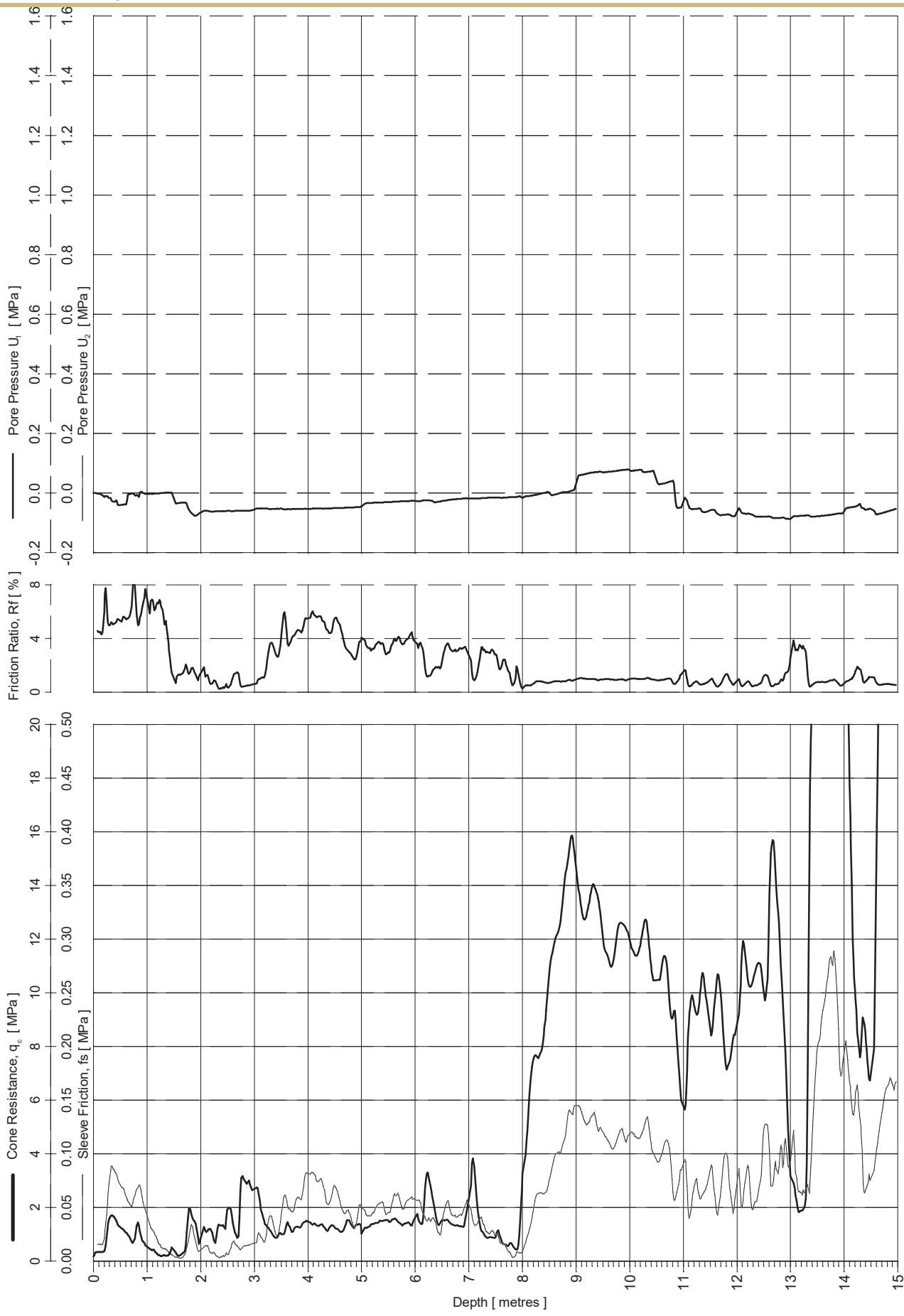


Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO



Checked by: Date:

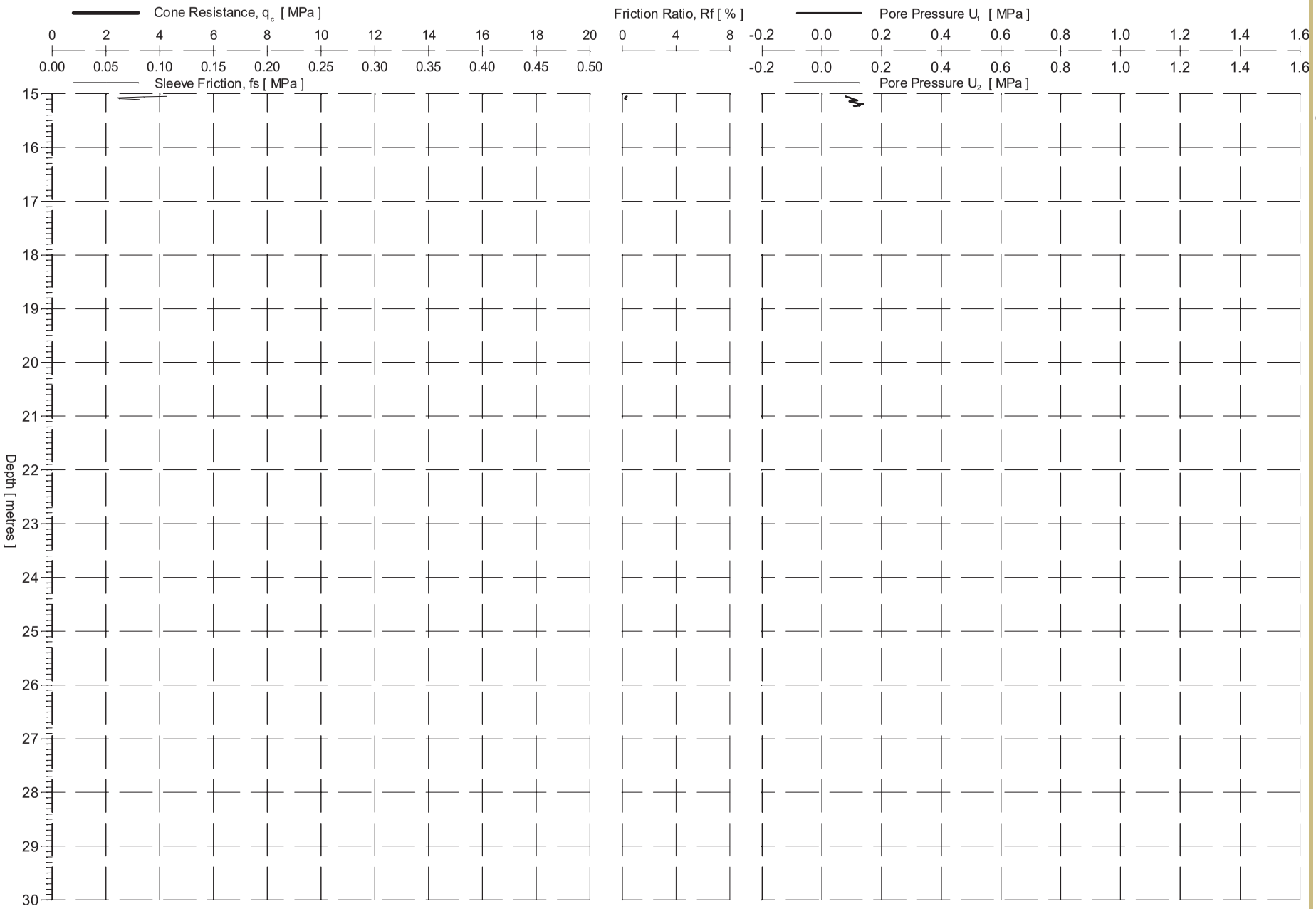
Approved by: Date:

Operator: NF/BR
Date of Test: 17/02/2009
CPT Rig: GB12

Location: CPT20
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

Contract No:CPT091107

Checked by: Date: Approved by: Date:



Location: CPT20 Operator: NF/BR

Cone Used: F7.5CKEH3SW2/B 1701-1274 Date of Test: 17/02/2009

Ground Level (metres) : 0.000 CPT Rig: GB12

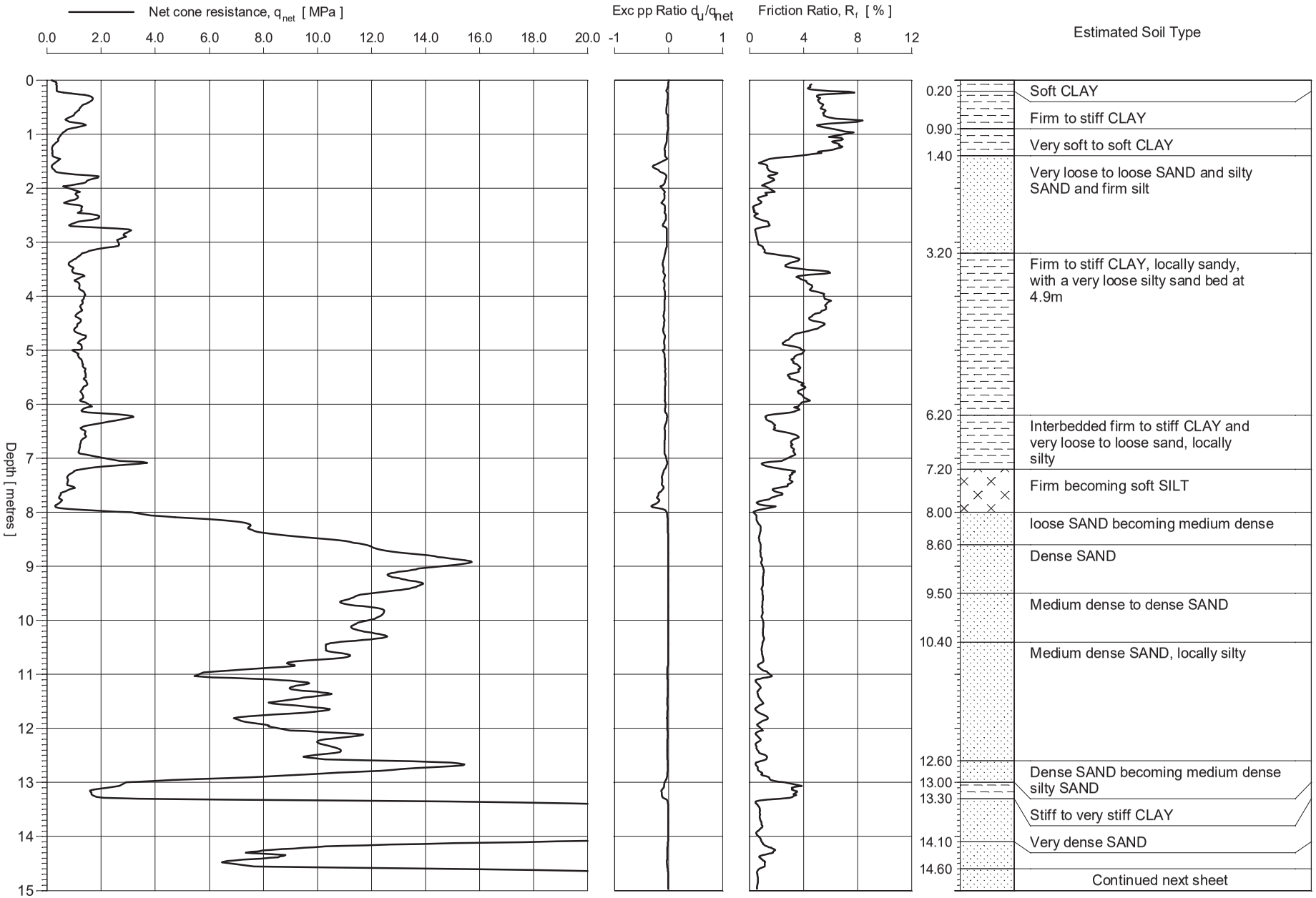
STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

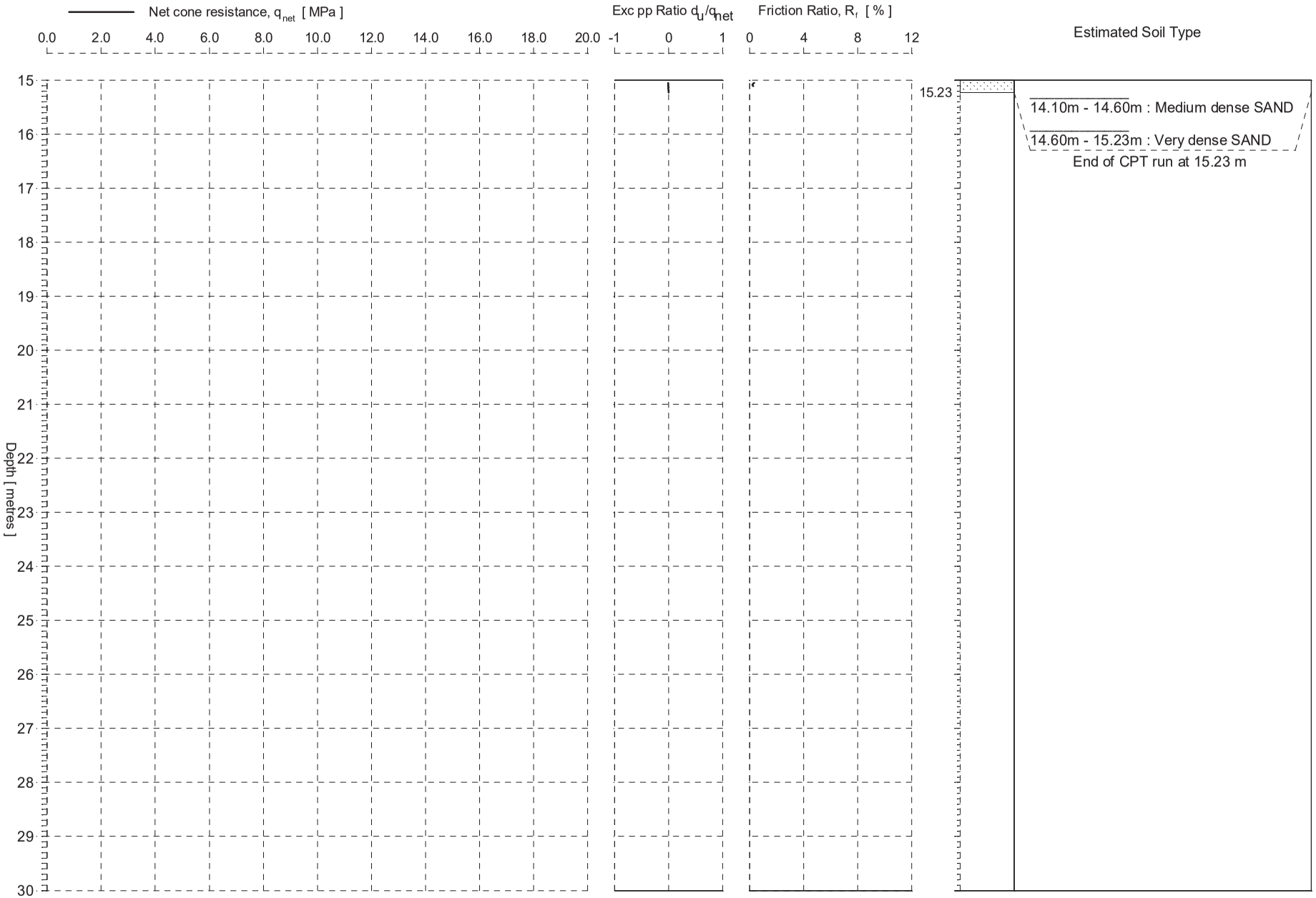
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20



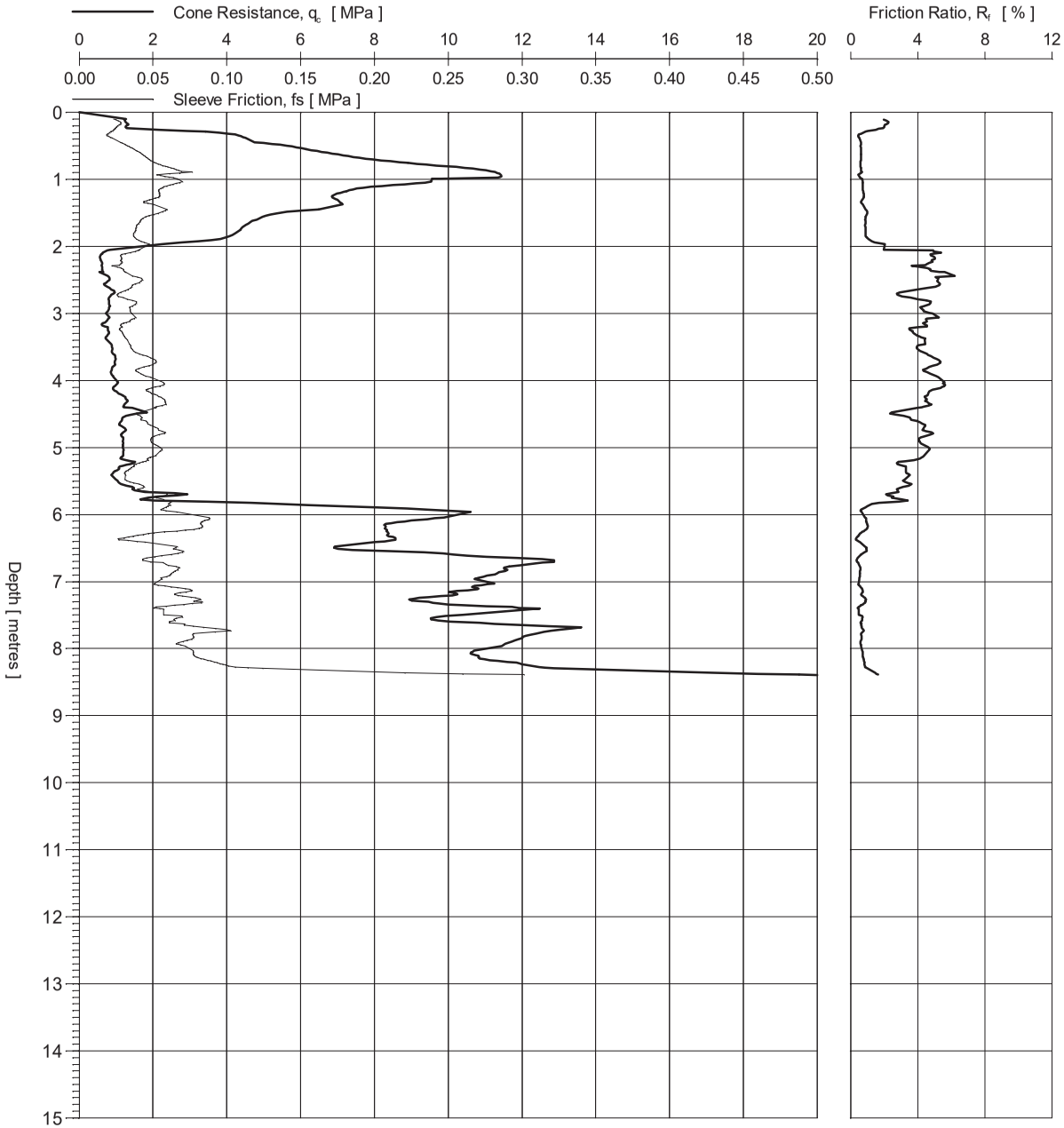
Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

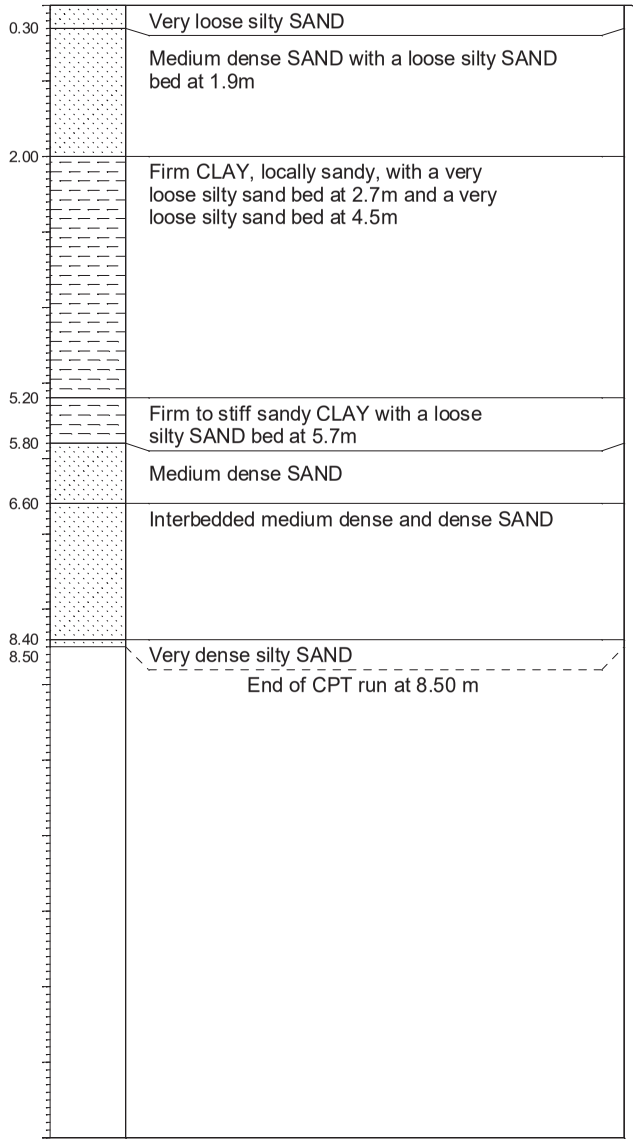
FUGRO

Contract No:CPT091107

Checked by: Date: Approved by: Date:



Estimated Soil Type

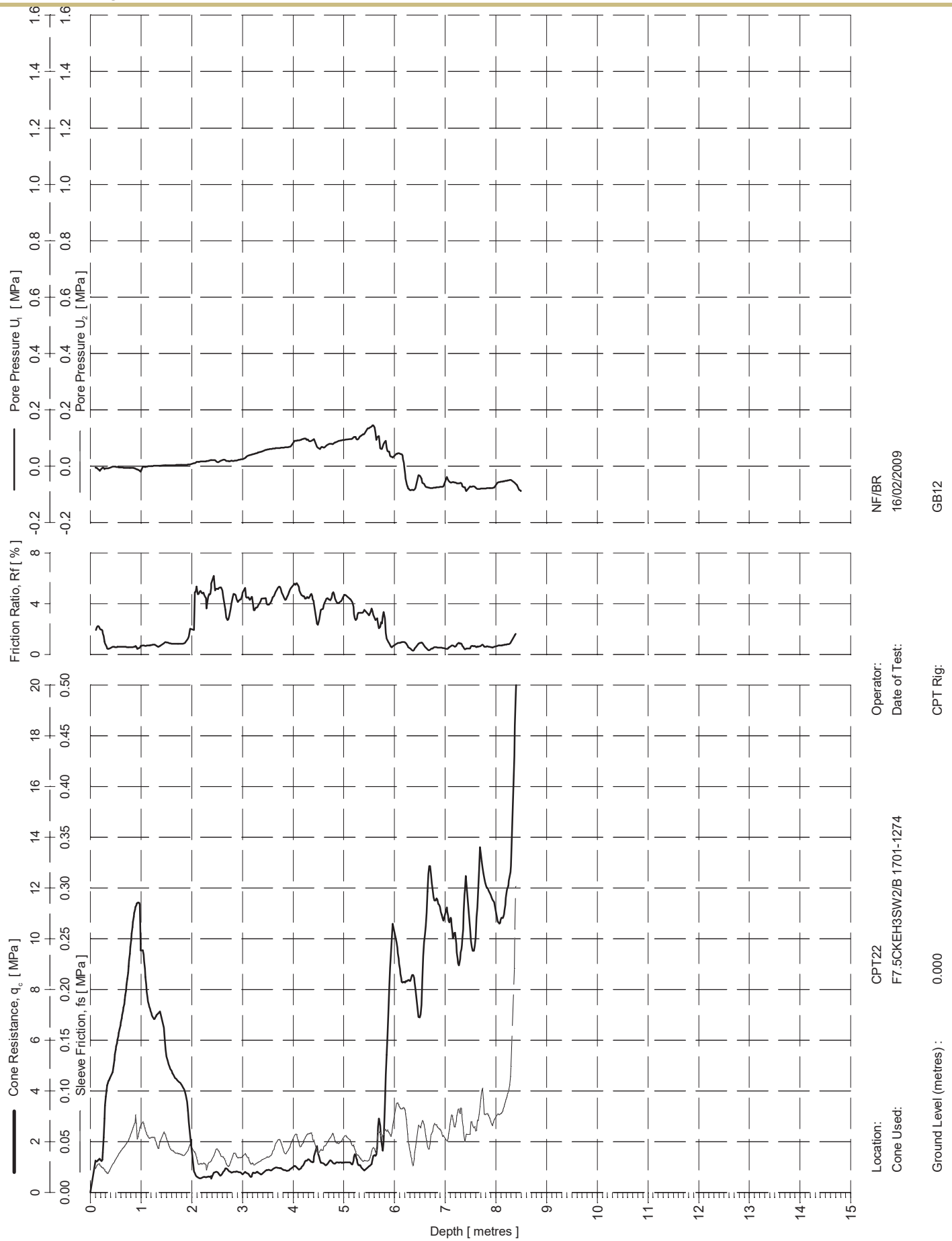


Location:	CPT22	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	16/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT22

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

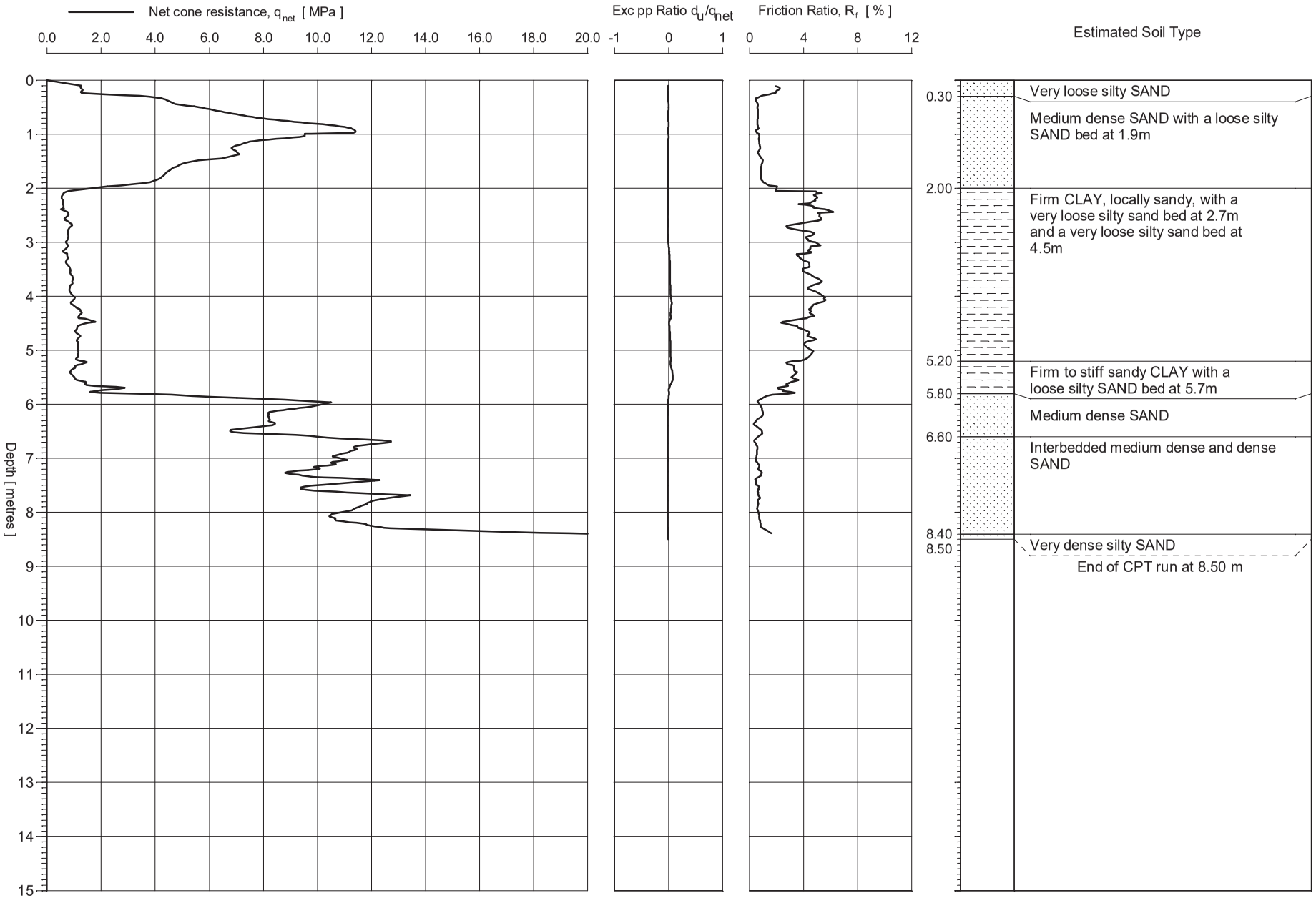
FUGRO


Pore Pressure U_1 [MPa]
Pore Pressure U_2 [MPa]
Friction Ratio, Rf [%]
Cone Resistance, q_c [MPa]
Sleeve Friction, fs [MPa]
Depth [metres]
Checked by:
Date:
Approved by:
Date:
Operator: NF/BR
Date of Test: 16/02/2009
CPT Rig: GB12
Location: CPT22
Cone Used: F7.5CKEH3SW2/B 1701-1274
Ground Level (metres) : 0.000

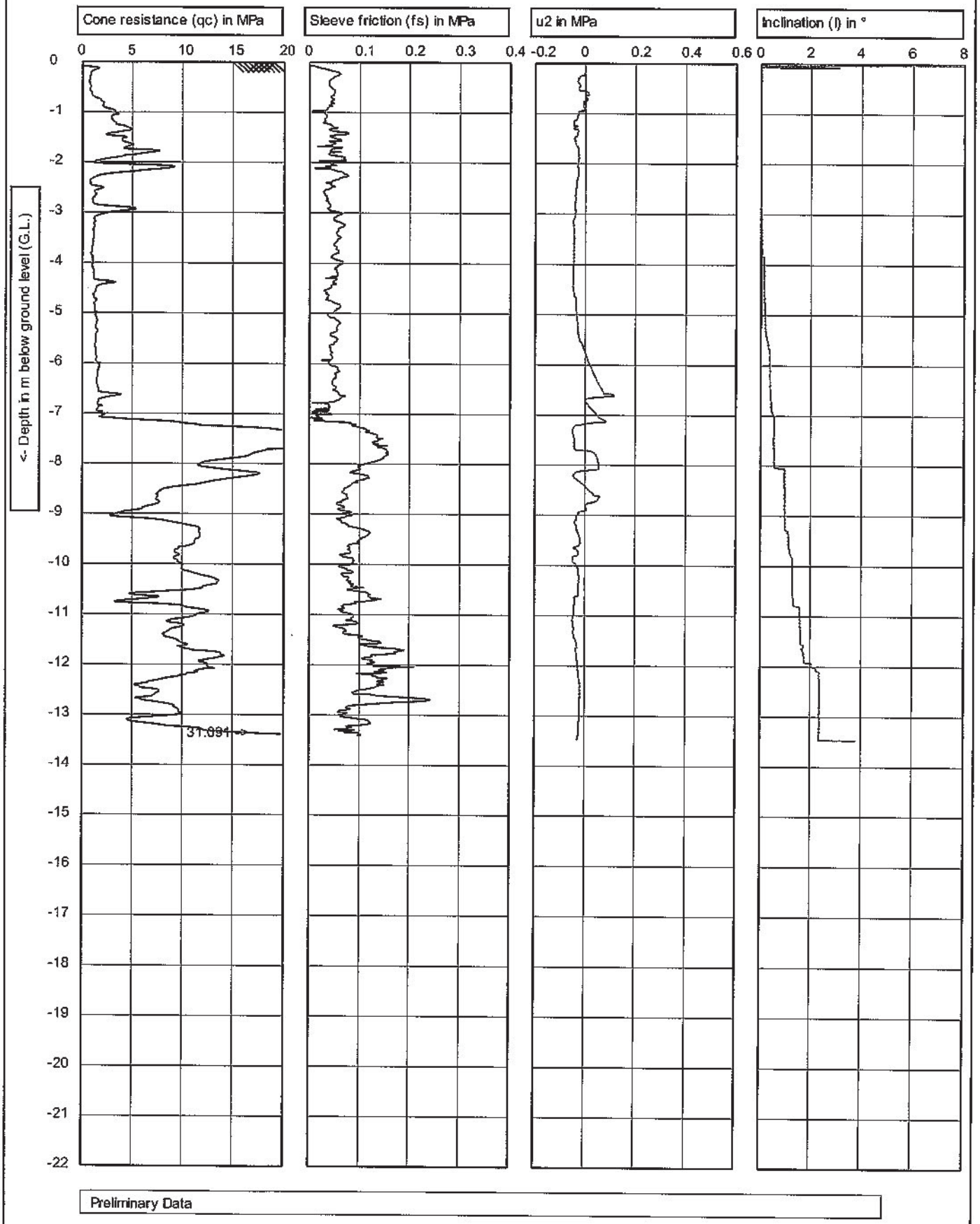
Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT22

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT22	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	16/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12



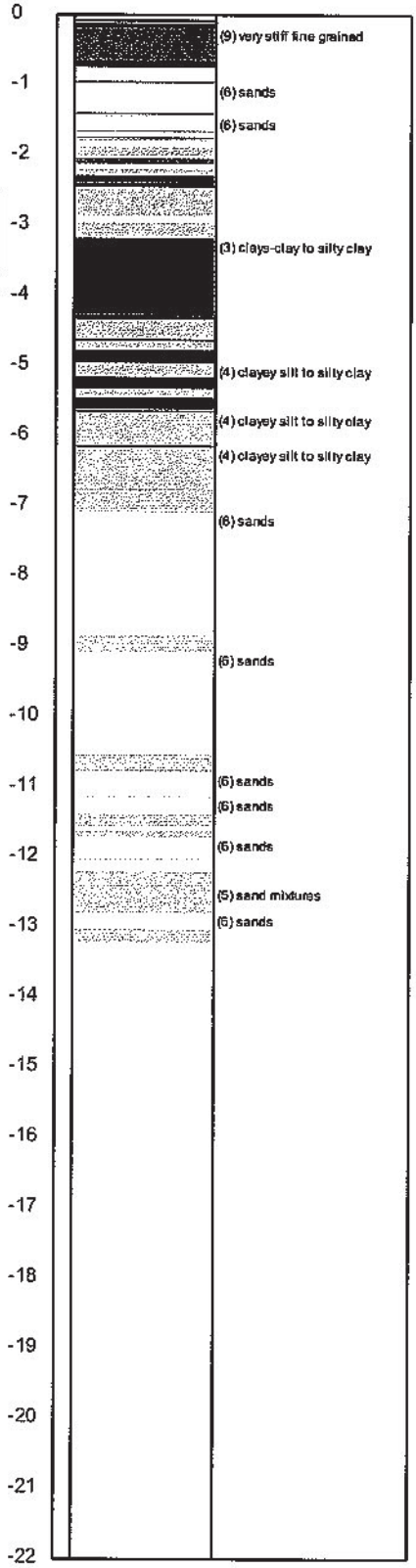
Preliminary Data

SM Geocone

CPTask V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	06/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_01 1/3

Soil Classification (using Fr)

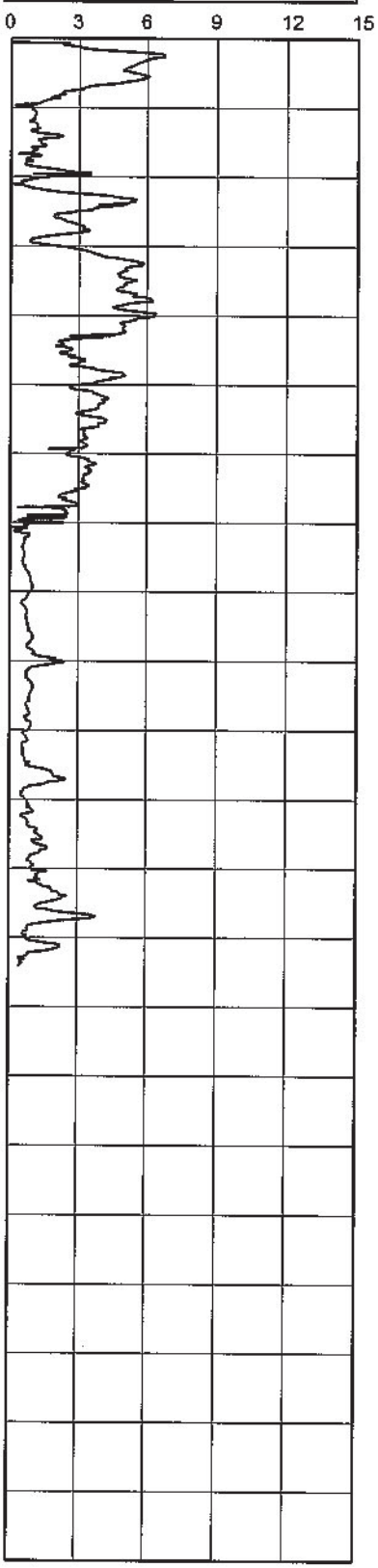


<- Depth in m below ground level (G.L.)

(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %



Preliminary Data

SM Geocone

CPTask V1.13

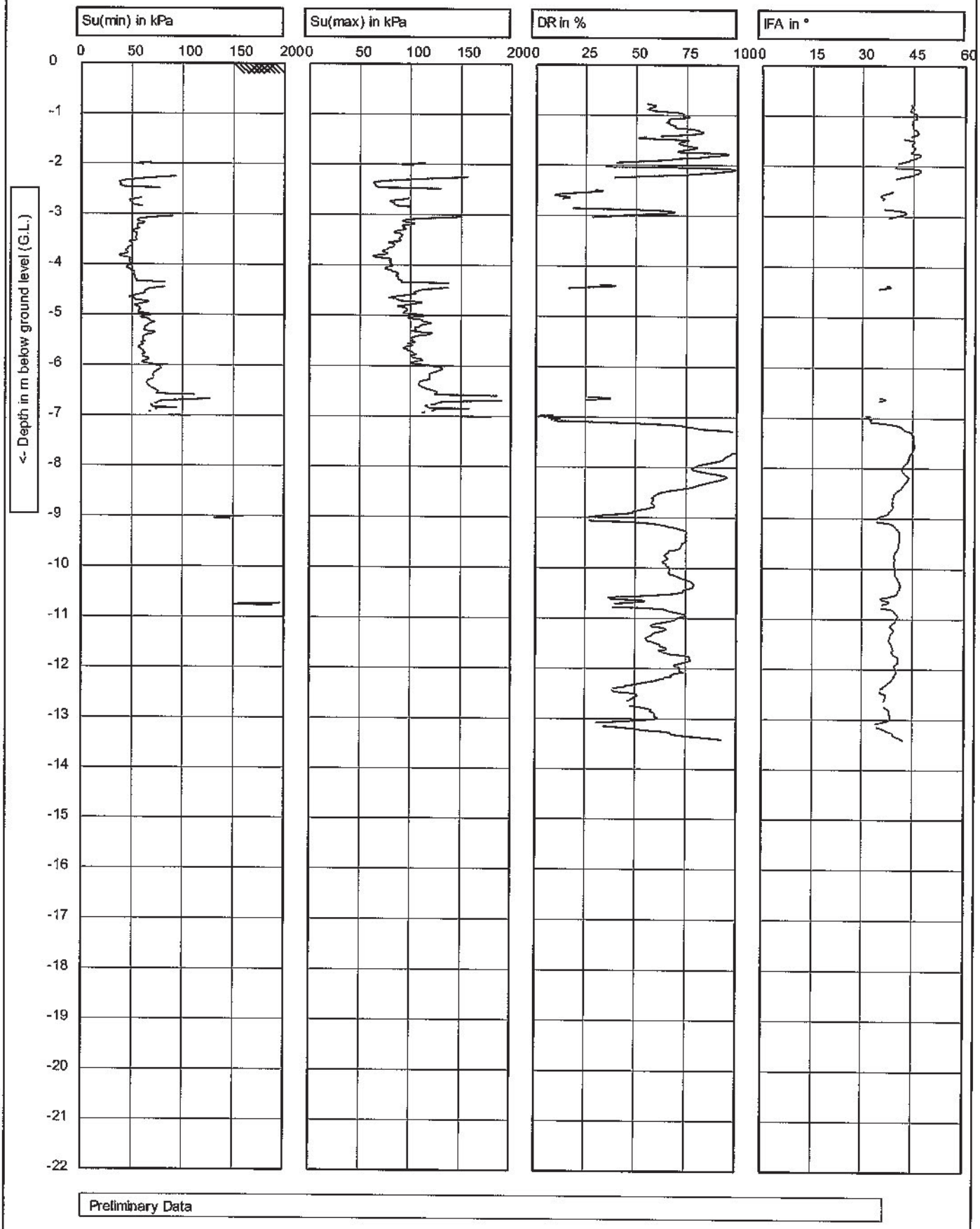
u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 | W.L. : 0

Project : **Client : Morrison Construction**
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**
Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_01

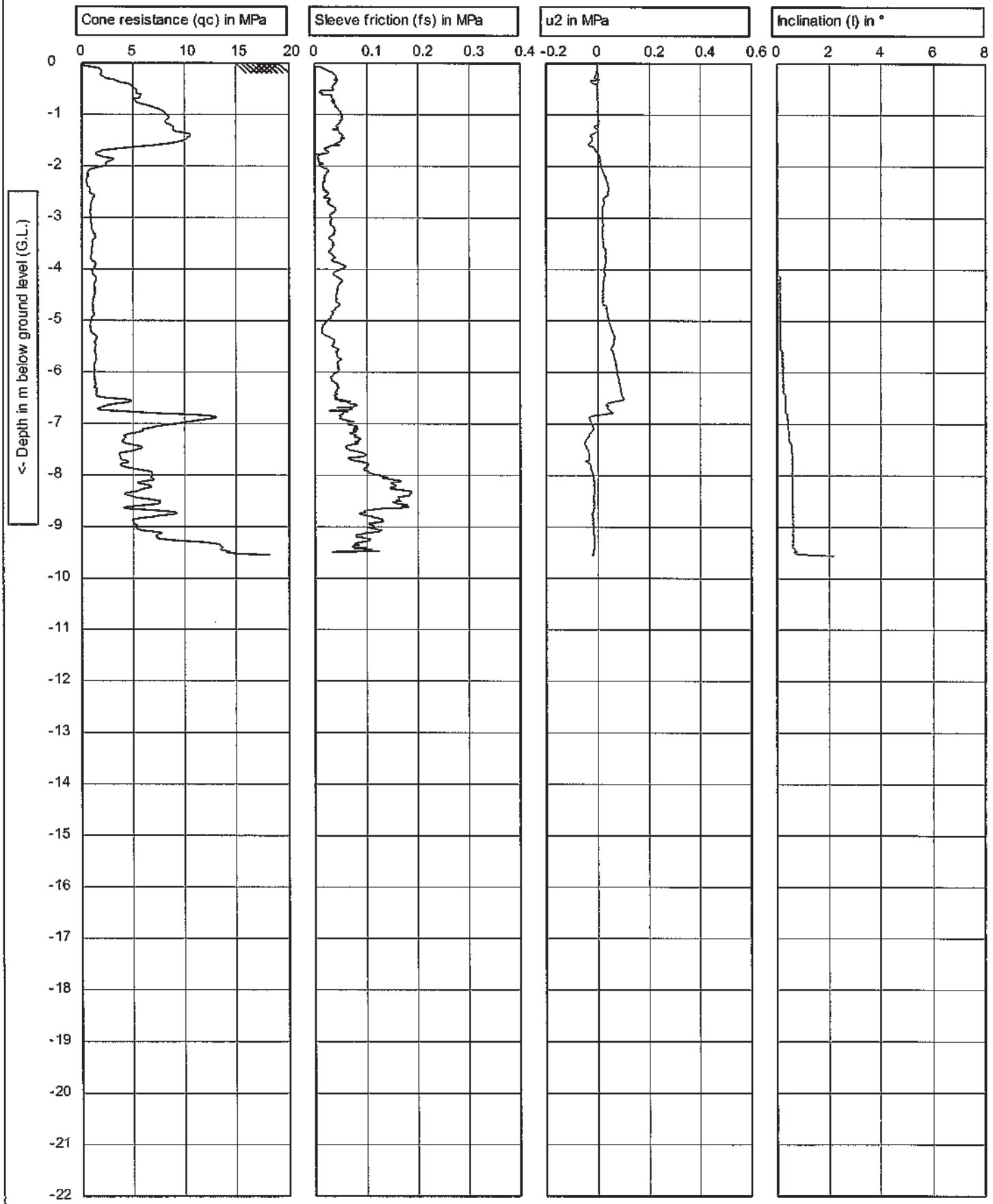


SM Geocone

CPTask V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	06/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_01 3/3

qu2
150 cm²
10 cm²



Preliminary Data

SM Geocone

u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 W.L. : 0

Project : **Client : Morrison Construction**

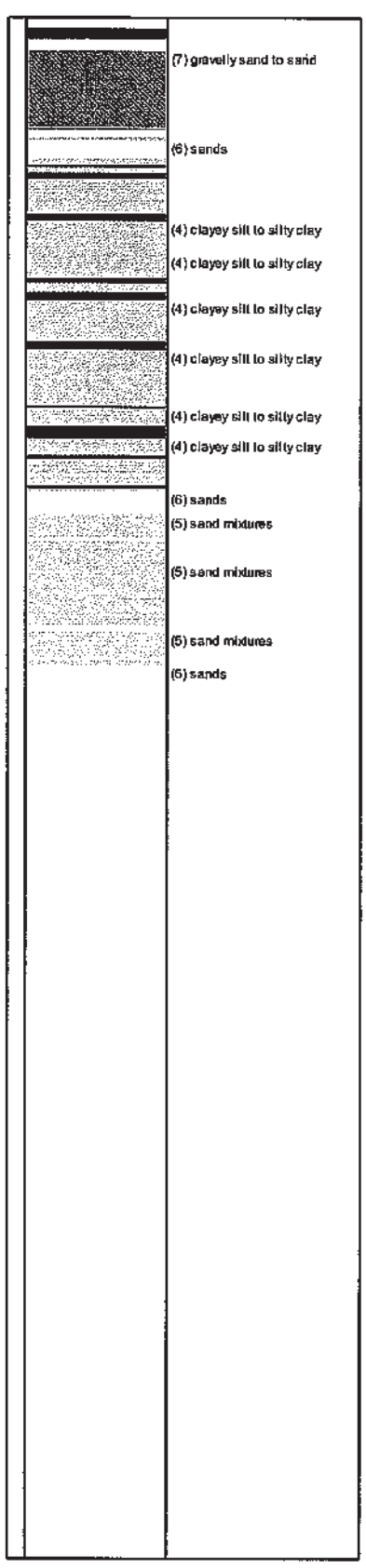
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**

Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_05

CPTdat V1.13

Soil Classification (using Fr)



<- Depth in m below ground level (G.L.)

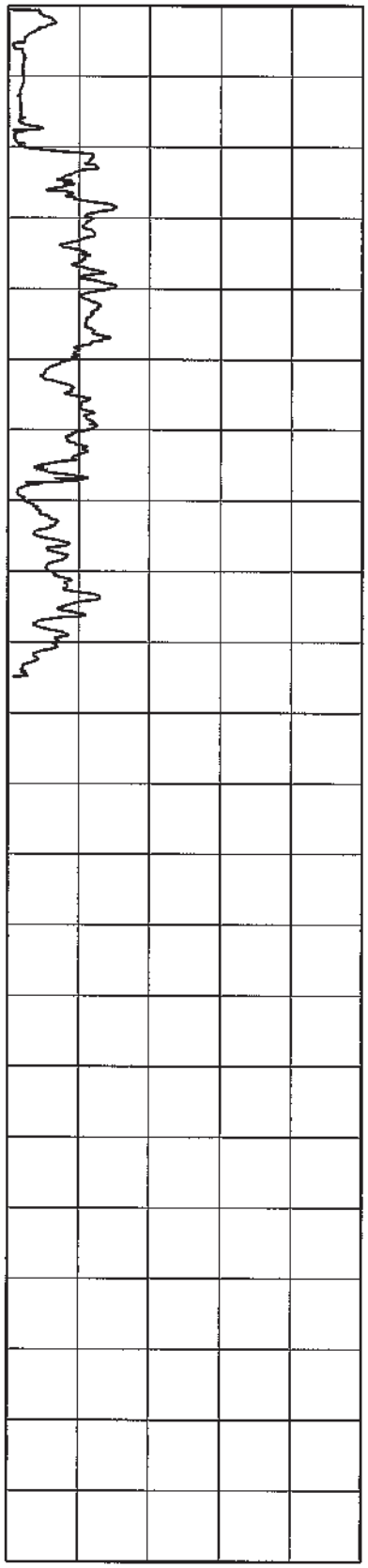
0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12 -13 -14 -15 -16 -17 -18 -19 -20 -21 -22

(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %

0 3 6 9 12 15



Preliminary Data

SM Geocone

u2
150 cm²
10 cm²

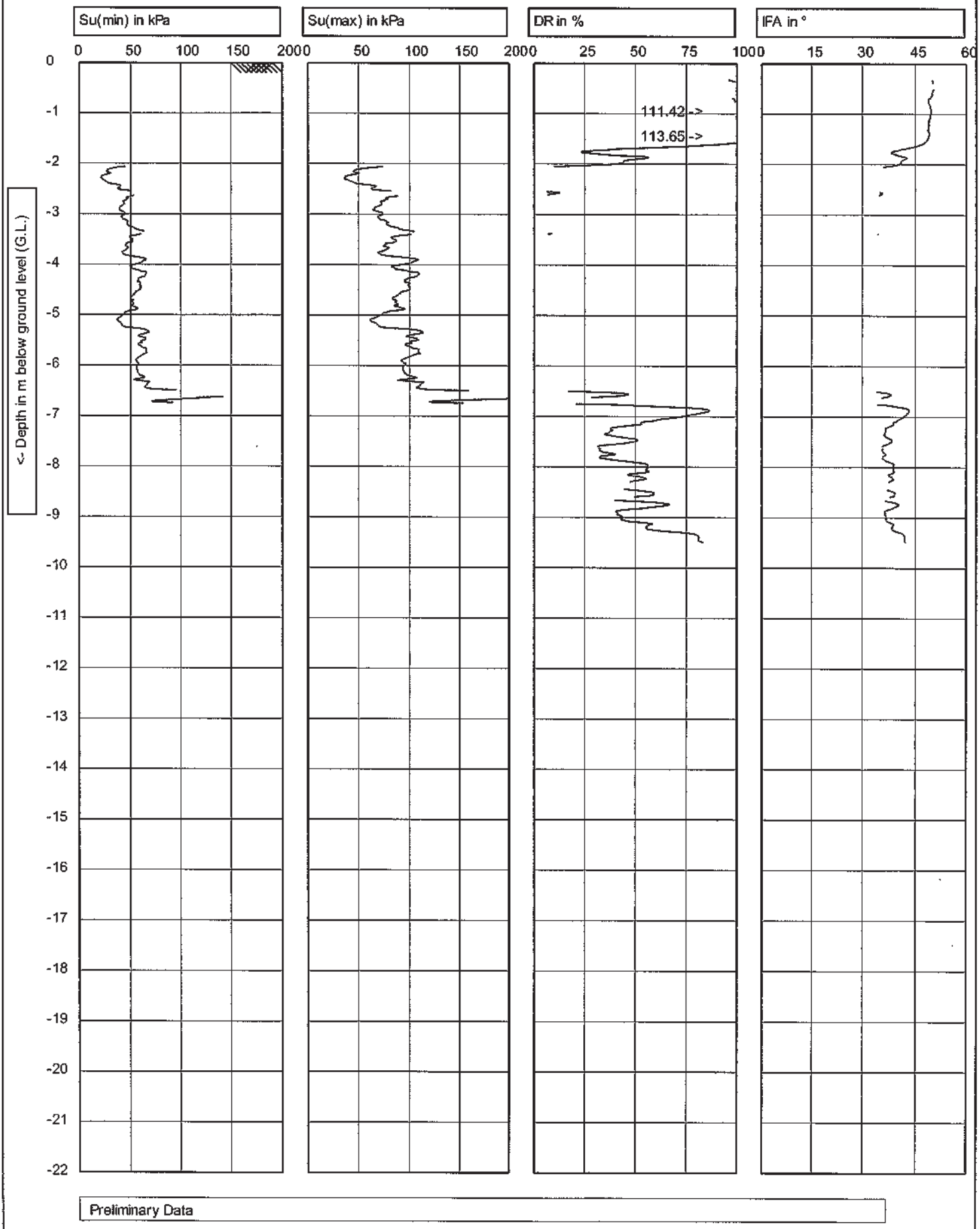
Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 | W.L. : 0

Project : Client : Morrison Construction
Location : TWEEN BRIDGE WIND FARM, PHASE 2
Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_05

CPTrack V1.13



Preliminary Data

SM Geocone

u2 150 cm² 10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 W.L. : 0

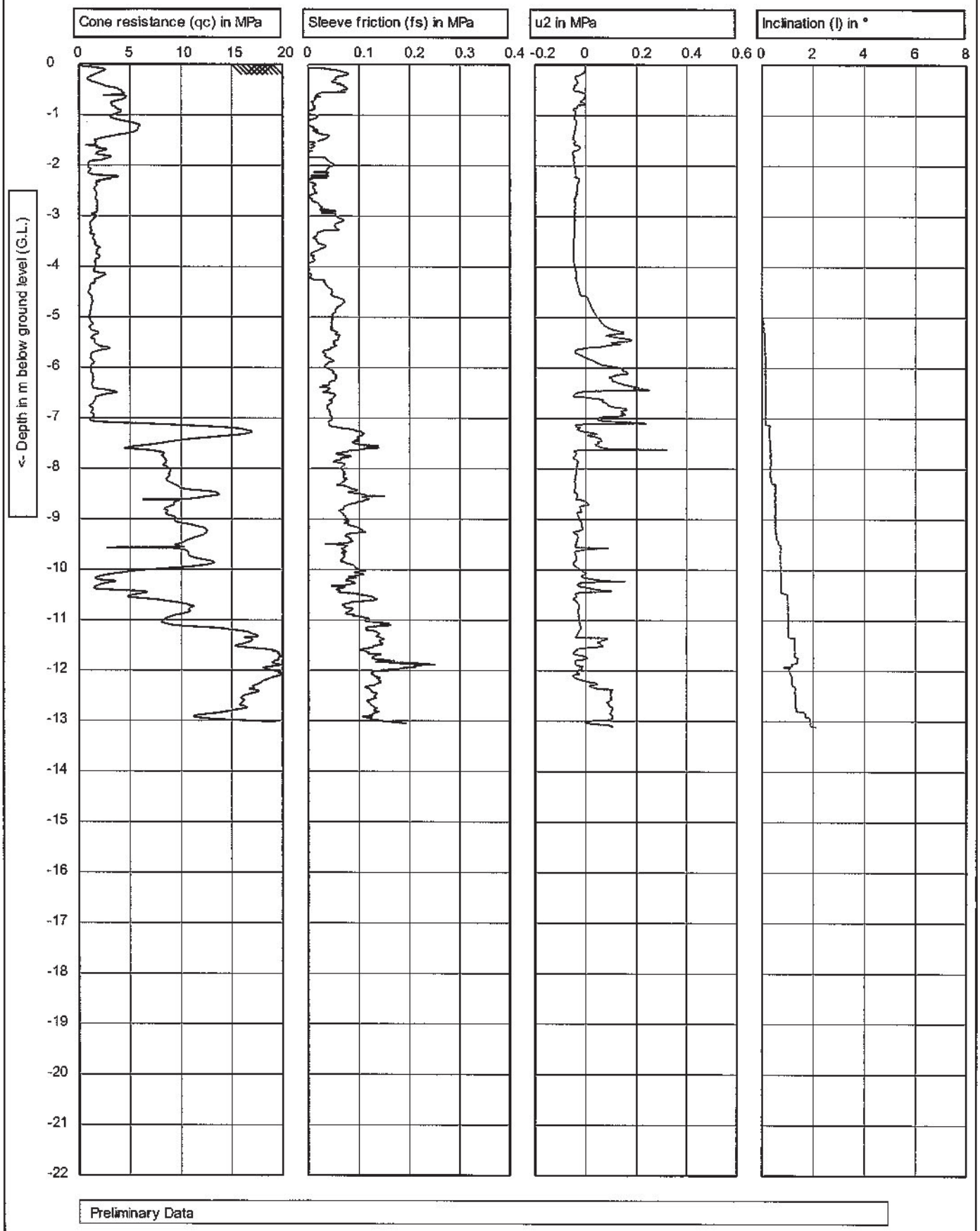
Project : Client : Morrison Construction

Location : TWEEN BRIDGE WIND FARM, PHASE 2

Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_05 3/3

CPTsak V1.10



Preliminary Data

SM Geocone

f u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 W.L. : 0

Project : **Client : Morrison Construction**

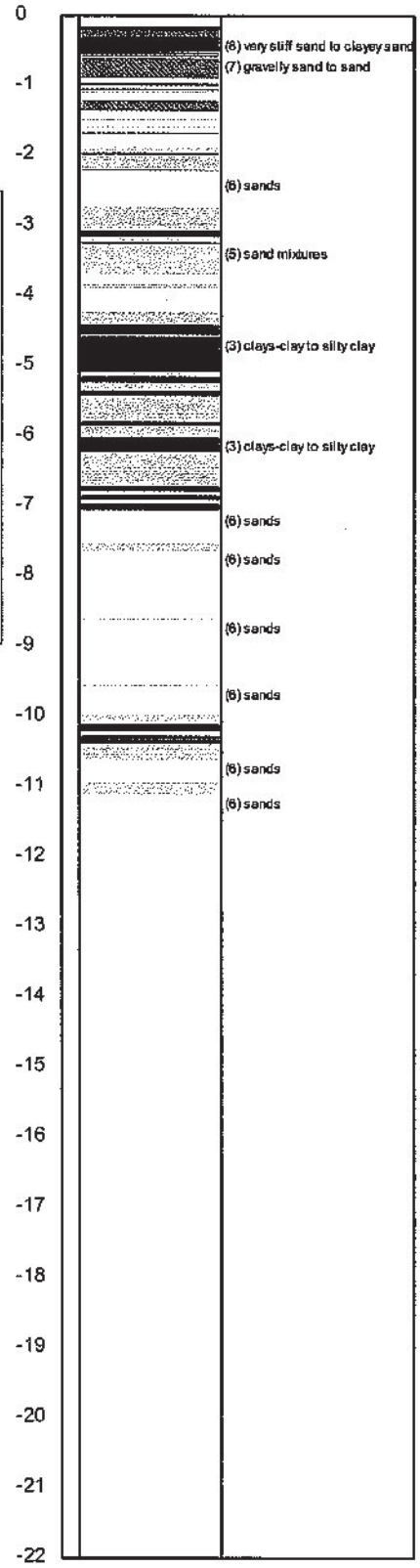
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**

Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_06

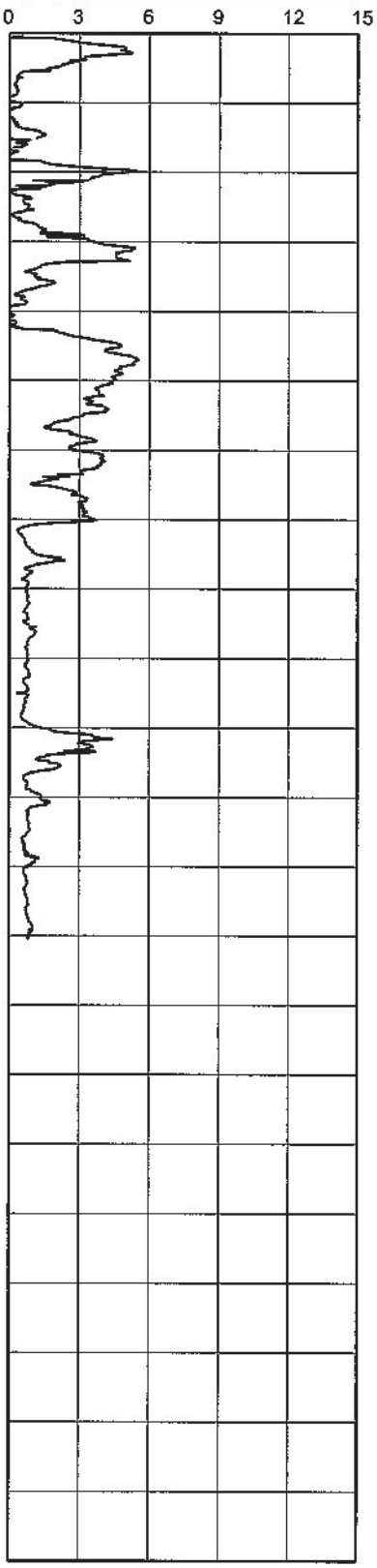
CPTask V1.13

Soil Classification (using Fr)



(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures
(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %



Preliminary Data

SM Geocone

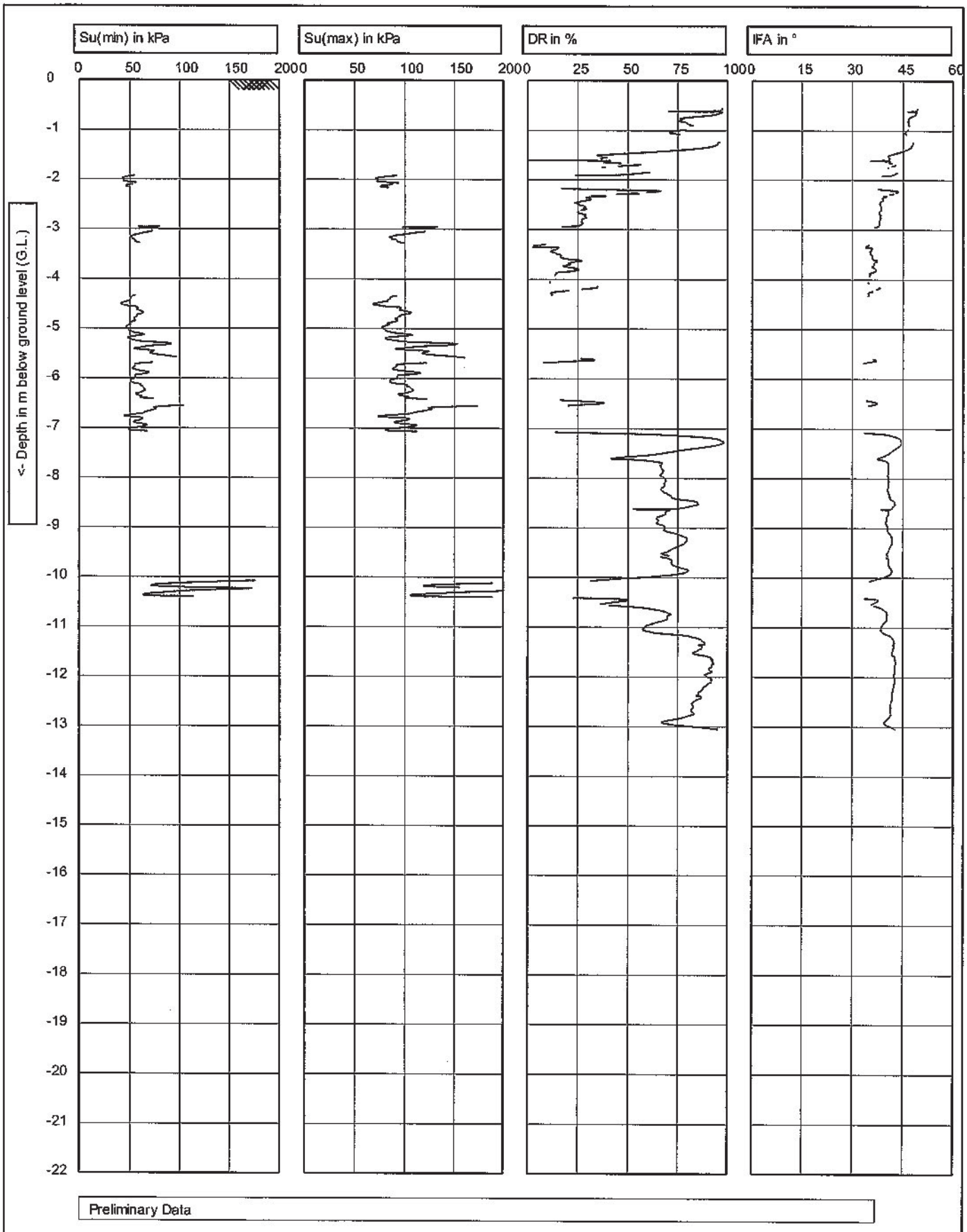
Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 | W.L. : 0

Project : **Client : Morrison Construction**
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**
Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_06 2/3

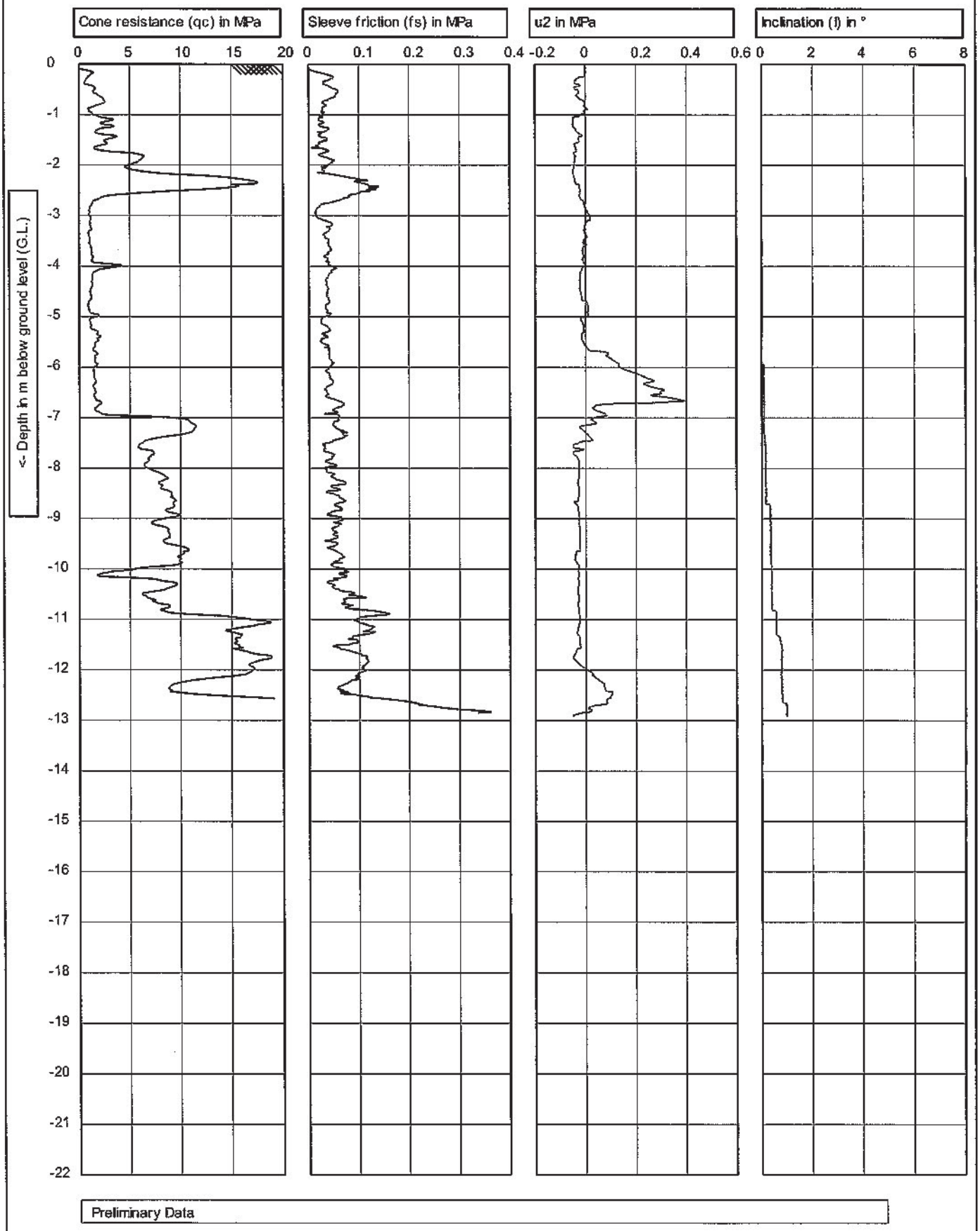
CPTsoft V1.03



SM Geocone

CPTask V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	06/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_06 3/3



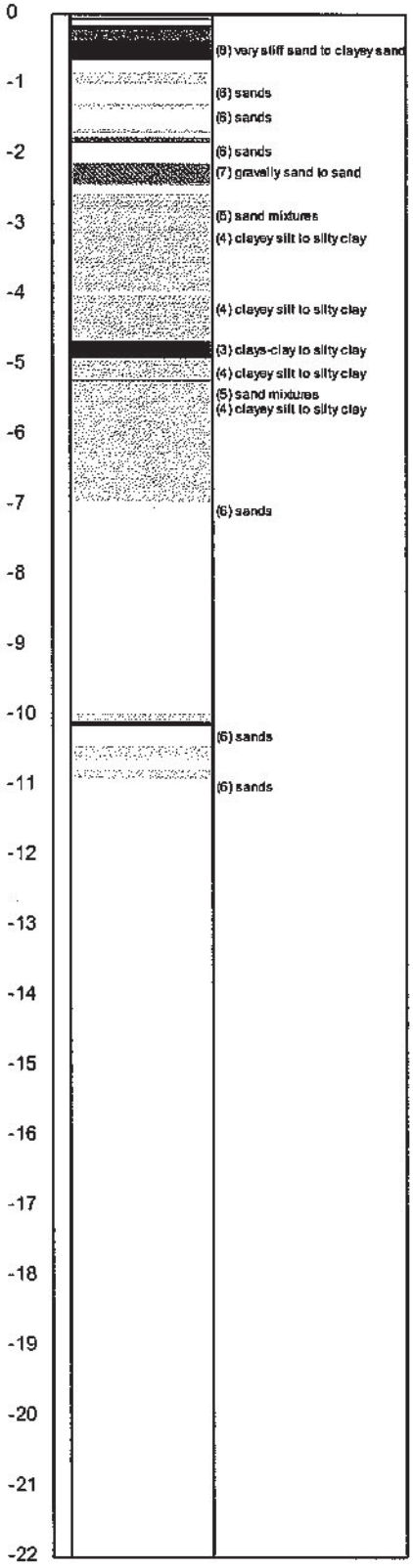
SM Geocone

CPTsoft V1.19

u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	07/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_07 1/3

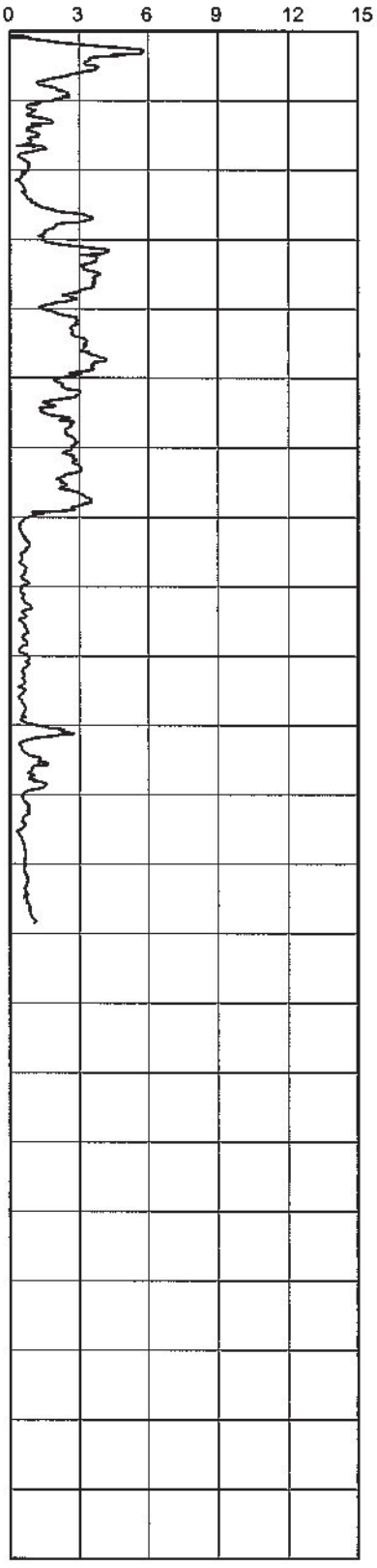
Soil Classification (using Fr)



(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %

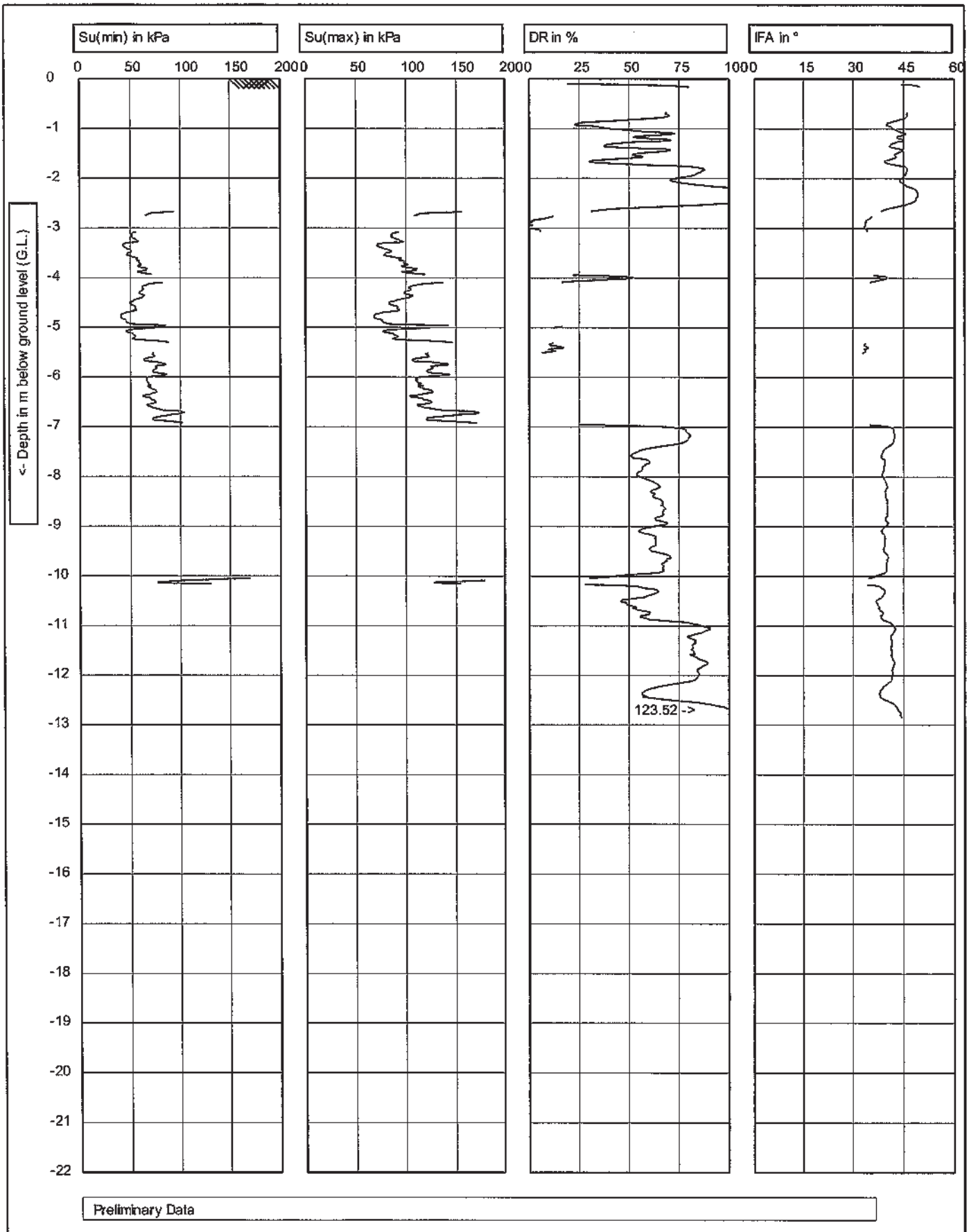


Preliminary Data

SM Geocone

CPTech V1.13

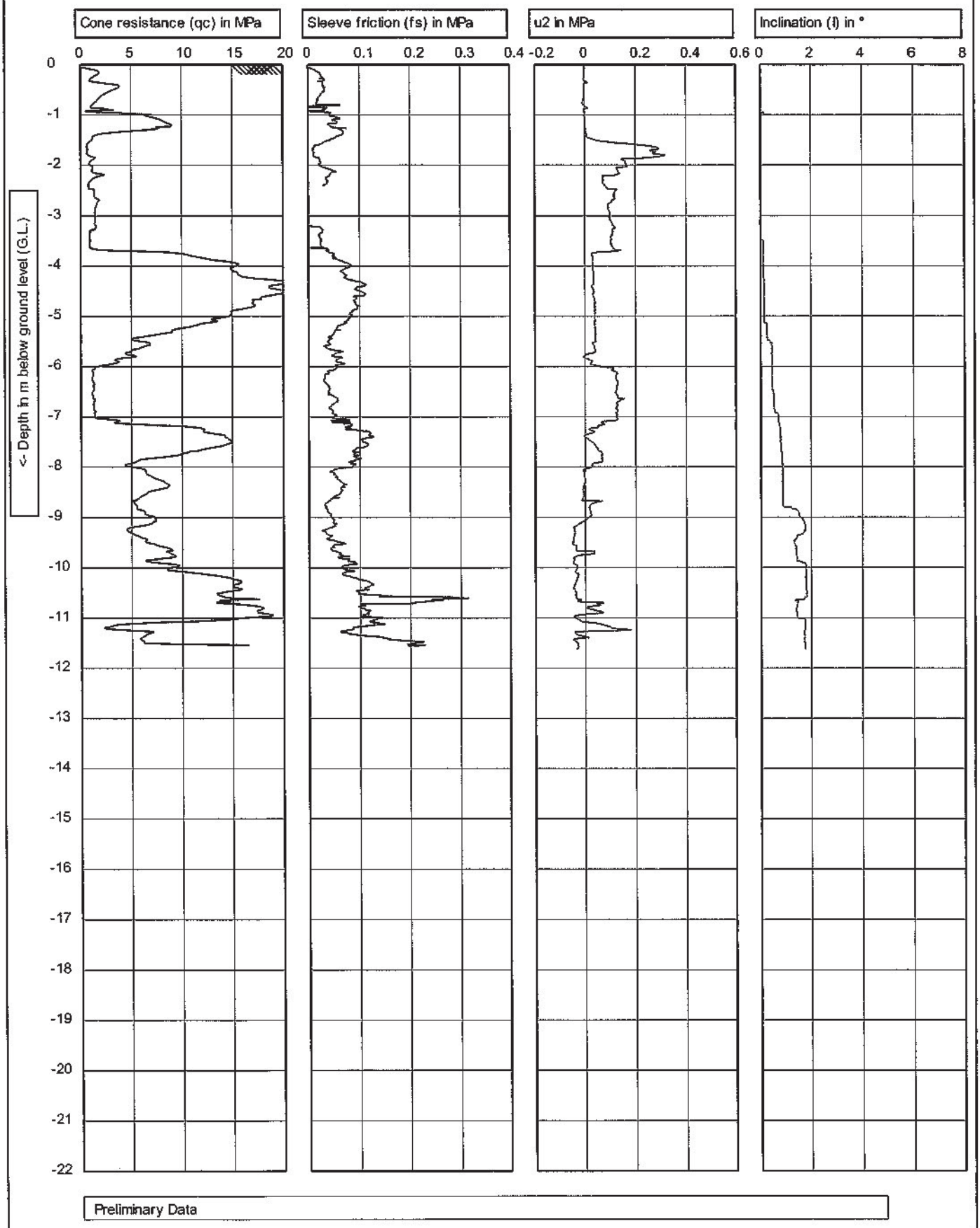
Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	07/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_07 2/3



SM Geocone

CPTpak V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	07/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_07 3/3



Preliminary Data

SM Geocone

CPTlab V1.13

u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 W.L. : 0

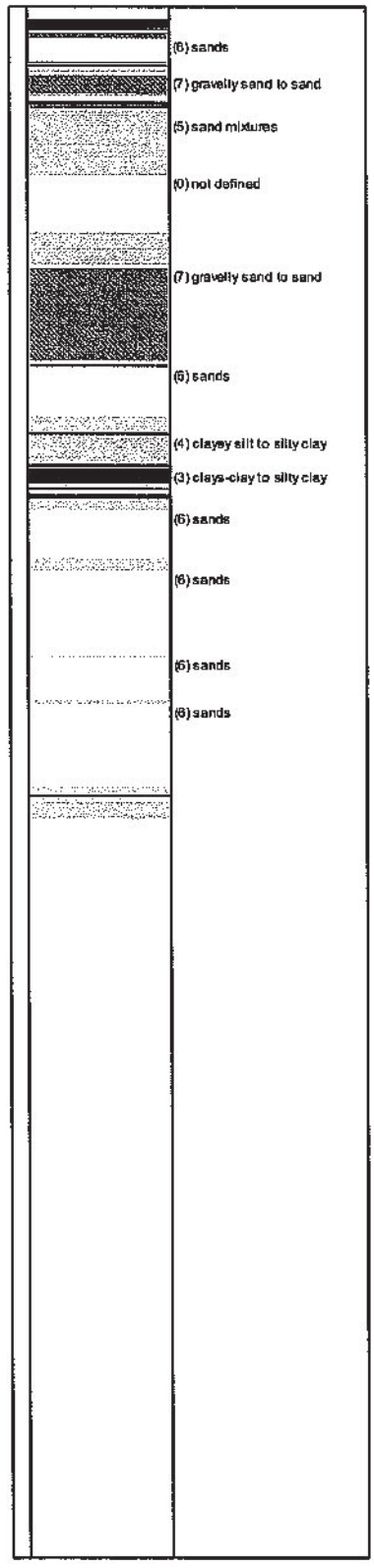
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Location : **TWEEN BRIDGE WIND FARM, PHASE 2**

Position :

Pre drill :	0
Date :	06/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_10 1/3

Soil Classification (using Fr)

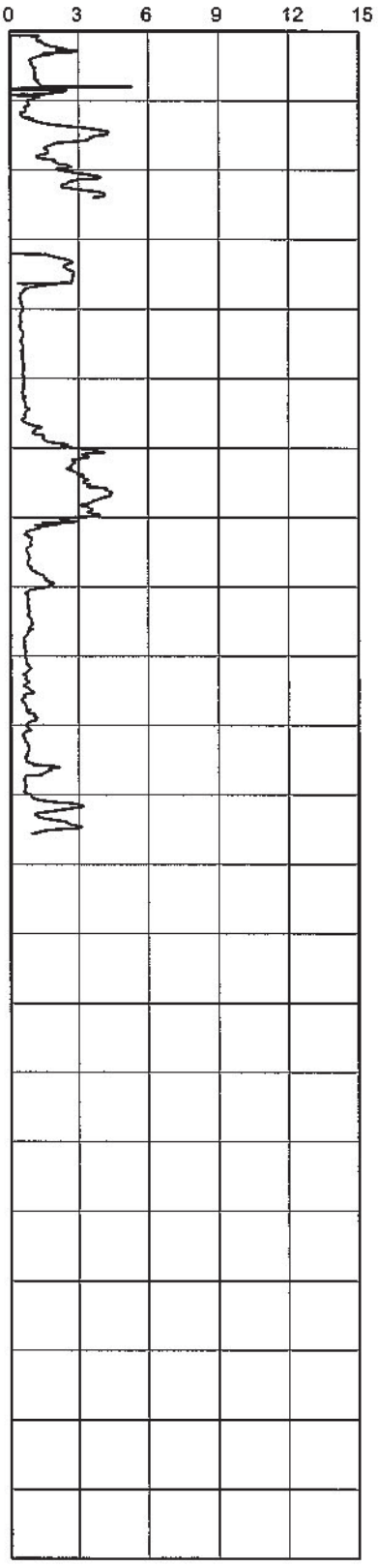


<- Depth in m below ground level (G.L.)

(0) not defined
(1) sensitive, fine grained
(2) organic soils-peals
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %

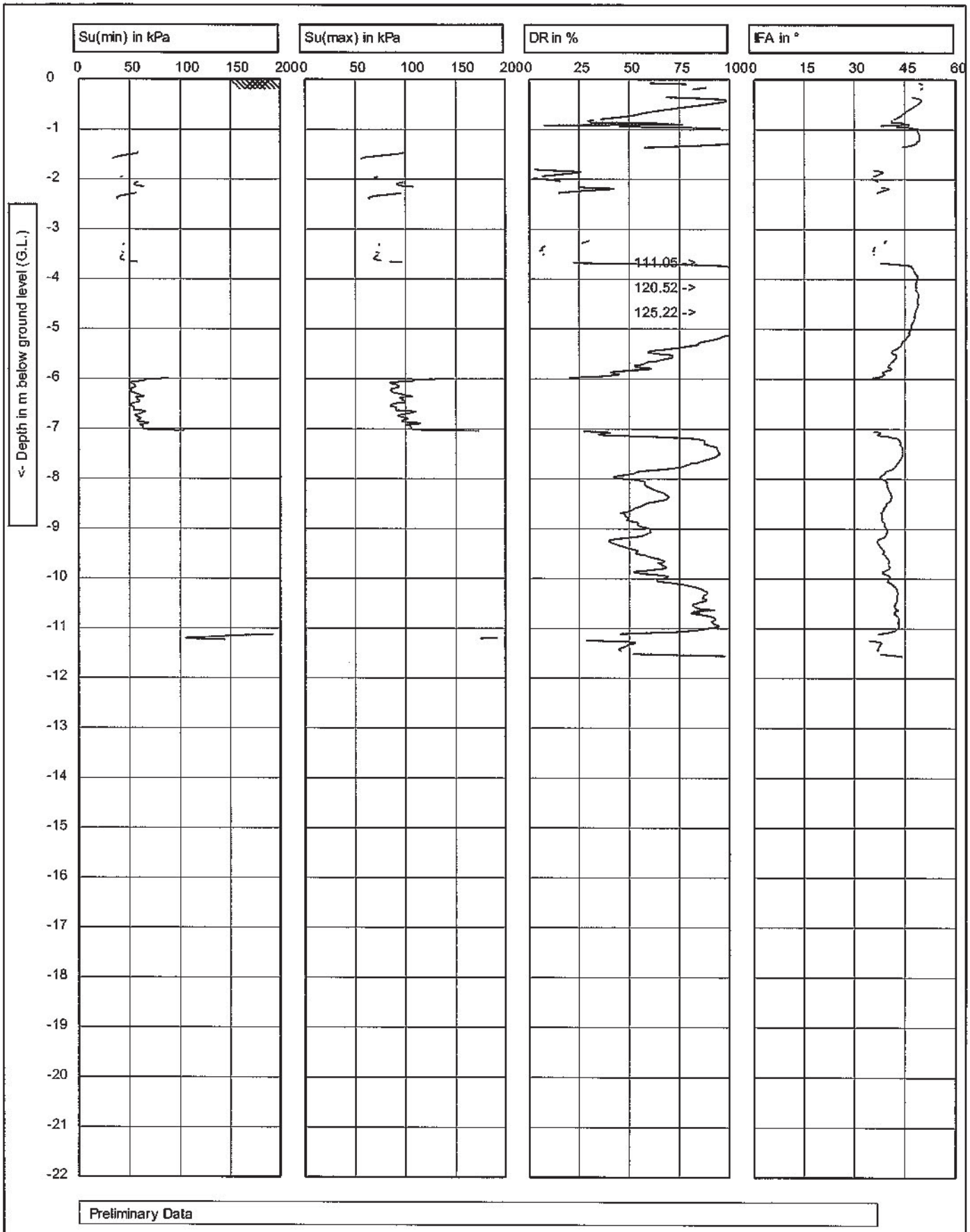


Preliminary Data

SM Geocone

CPTeik V1.13

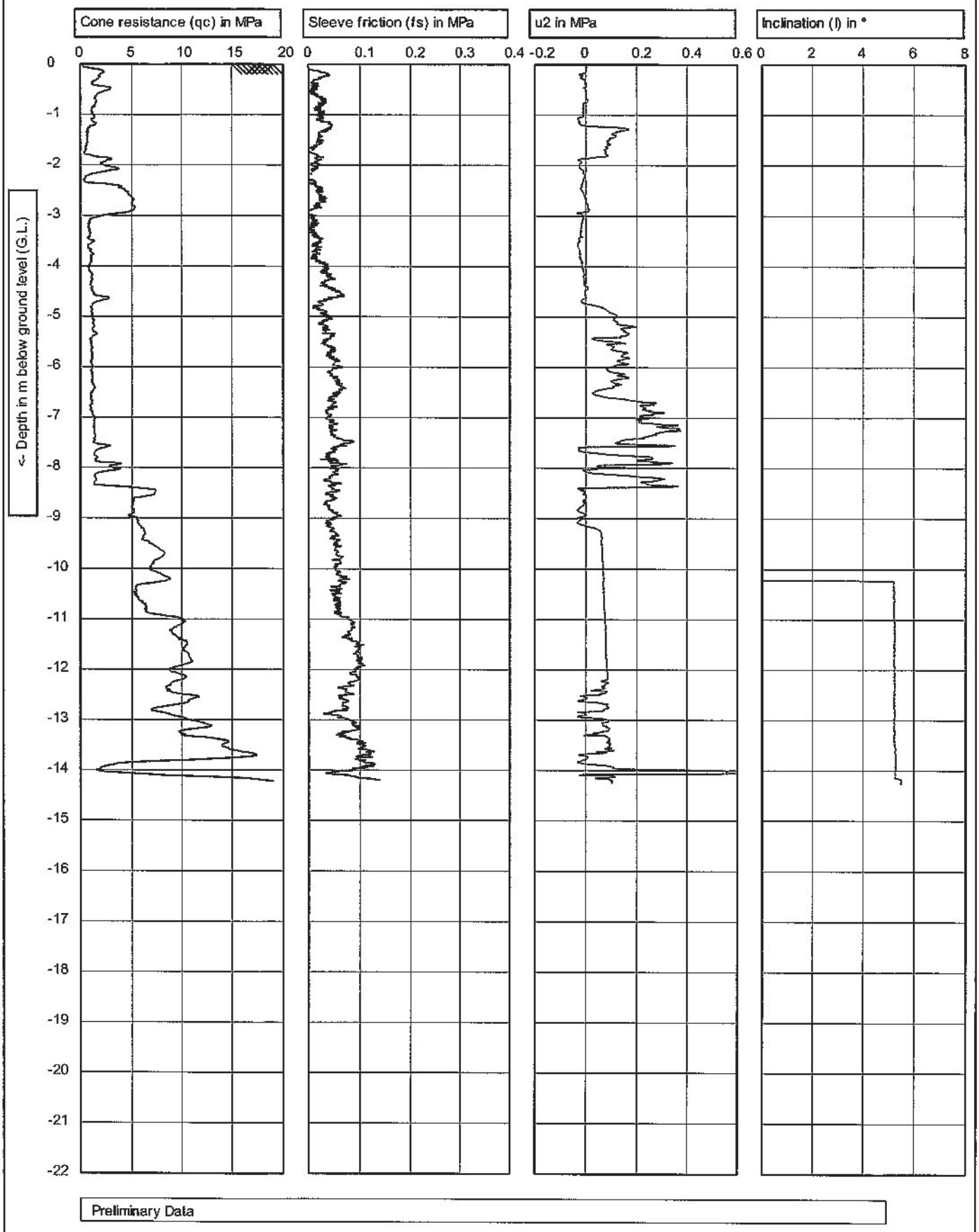
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Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_10 2/3



SM Geocone

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	06/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_10 3/3

CPTwin V1.13

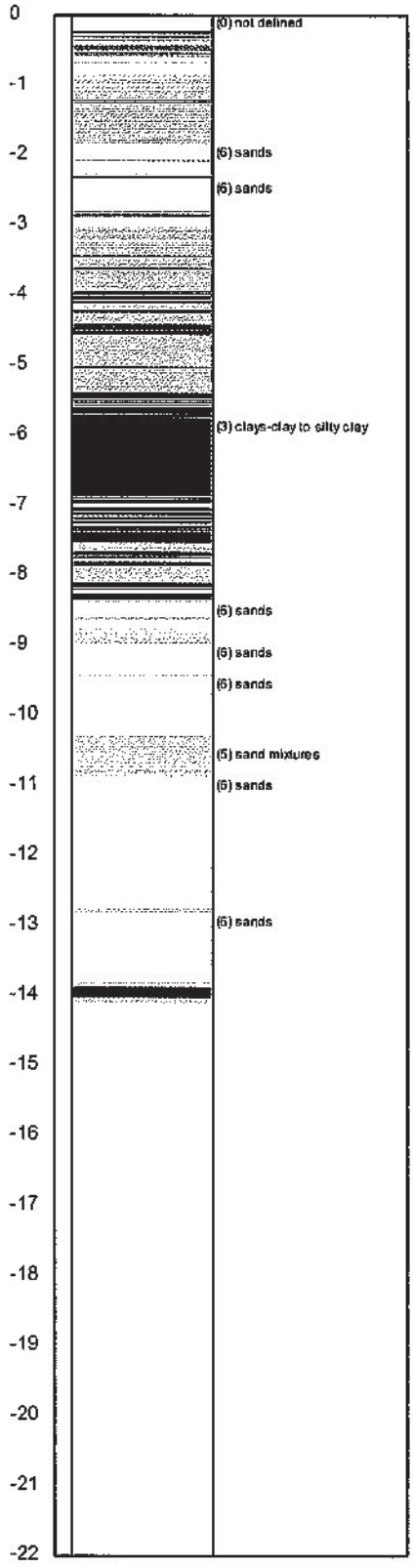


SM Geocone

CPTadt V1.13

f u2 / 150 cm² / 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill : 0
	G.L. : 0	W.L. : 0	Date : 03/04/2009
Project : Client : Morrison Construction			Cone no. : S10CFIP.208
Location : TWEEN BRIDGE WIND FARM, PHASE 2			Project no. : M9015
Position :			CPT no. : cpt_16 1/3

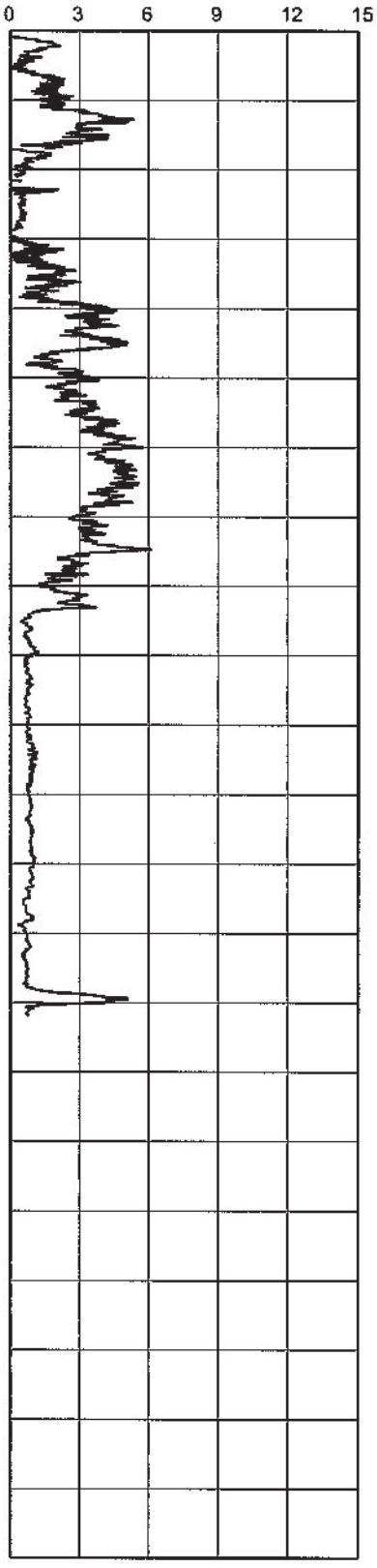
Soil Classification (using Fr)



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(1) sensitive, fine grained
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(5) sand mixtures

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(8) very stiff sand to clayey sand
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Friction ratio (Rf) in %

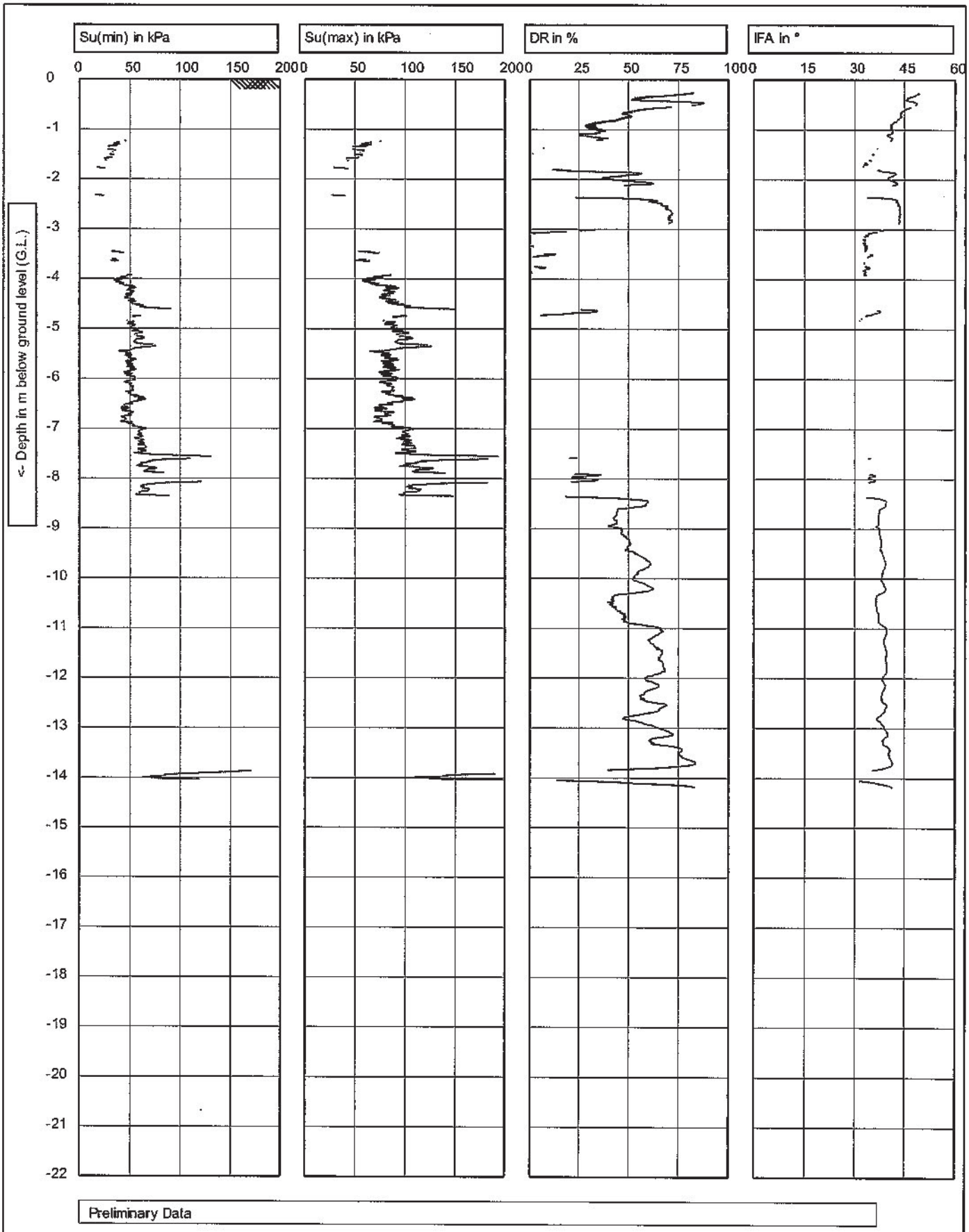


Preliminary Data

SM Geocone

CPTsoft V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	03/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.208
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_16 2/3



Preliminary Data

SM Geocone

r u2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 | W.L. : 0

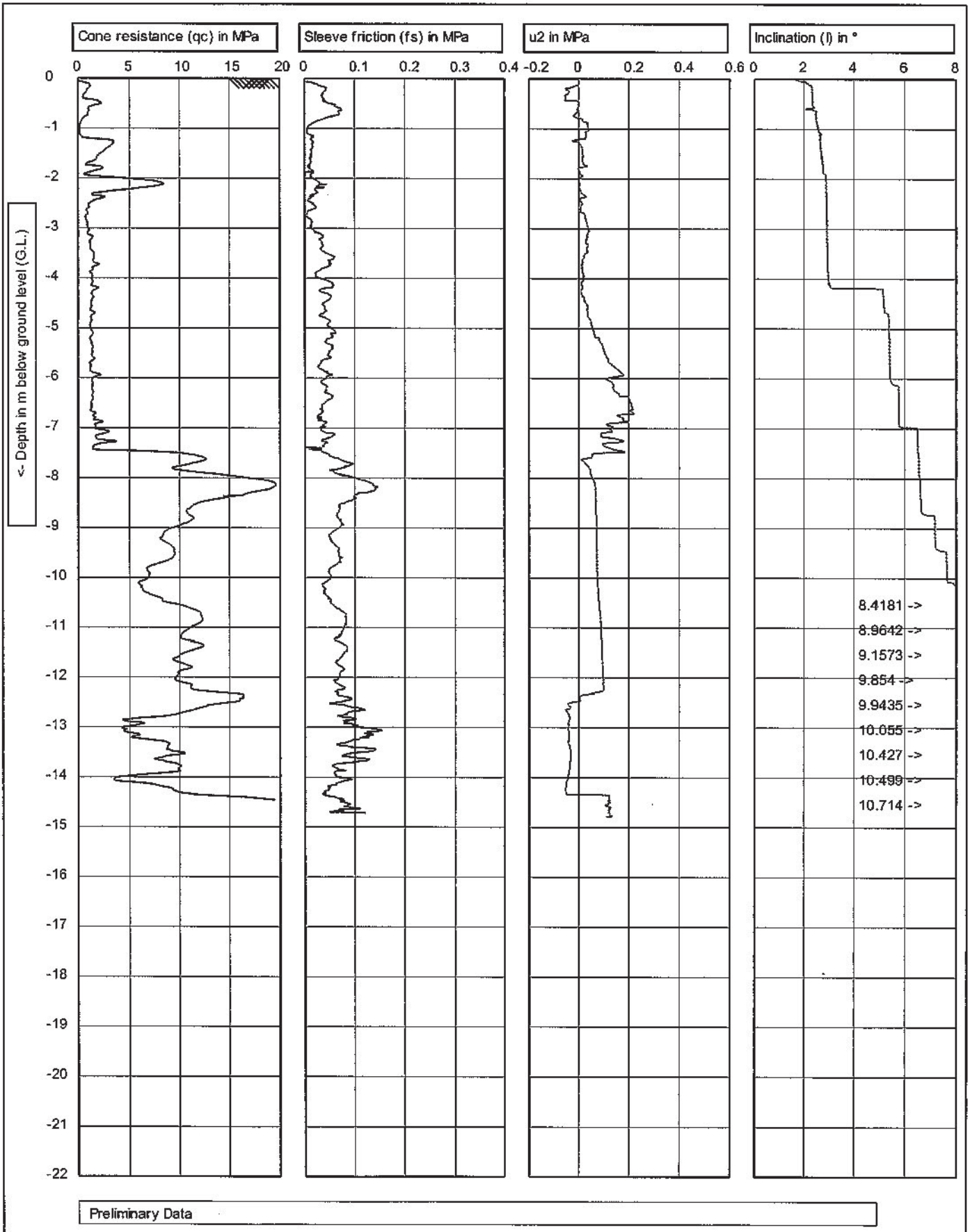
Project : **Client : Morrison Construction**

Location : **TWEEN BRIDGE WIND FARM, PHASE 2**

Position :

Pre drill :	0
Date :	03/04/2009
Cone no. :	S10CFIP.208
Project no. :	M9015
CPT no. :	cpt_16 3/3

CPTpak V1.13

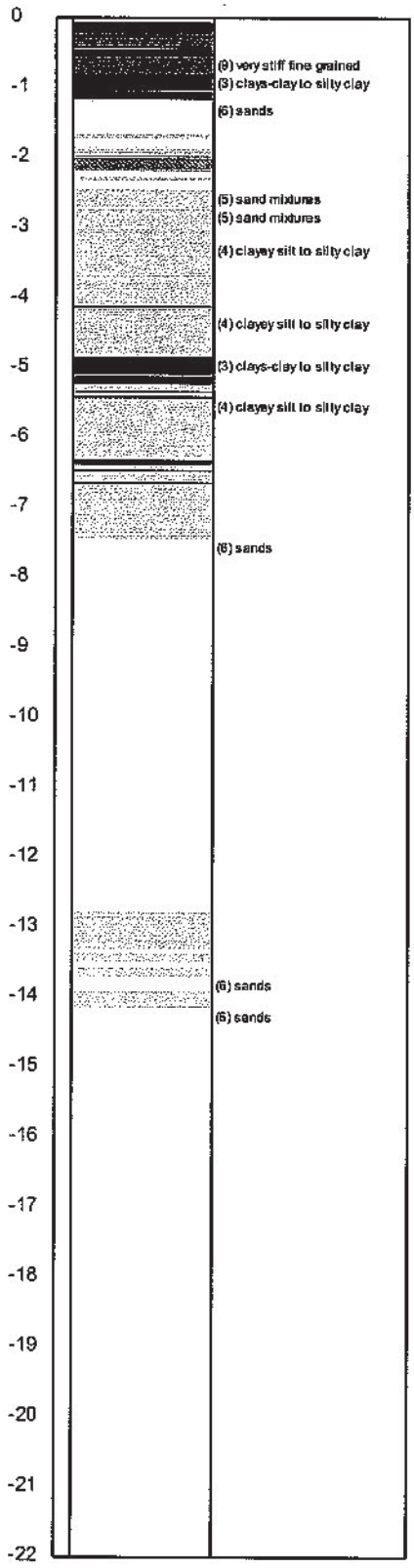


SM Geocone

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
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Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_18 1/3

CPTdat V1.13

Soil Classification (using Fr)

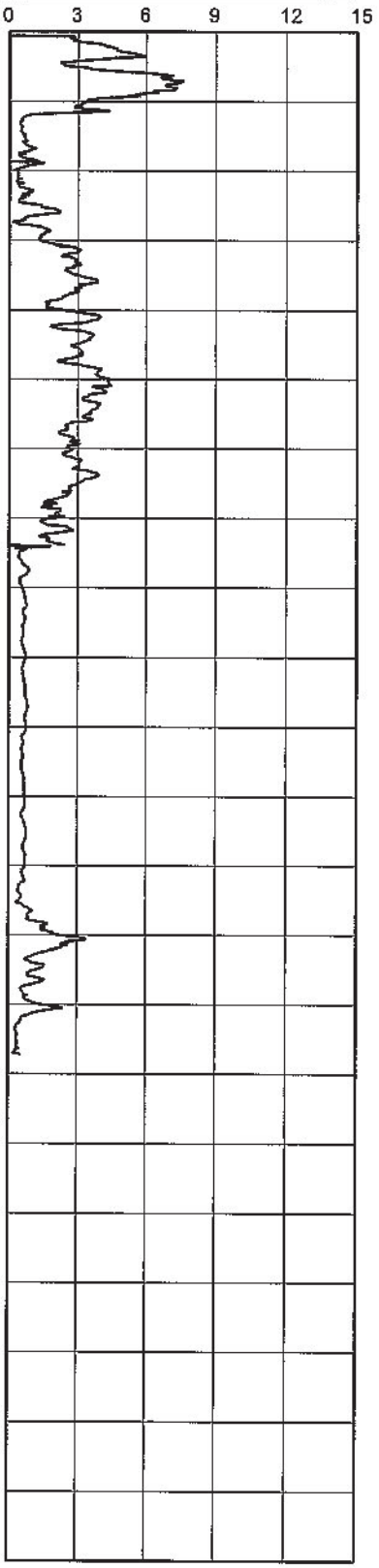


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(9) very stiff fine grained

Friction ratio (Rf) in %



Preliminary Data

SM Geocone

DPTdat V1.19

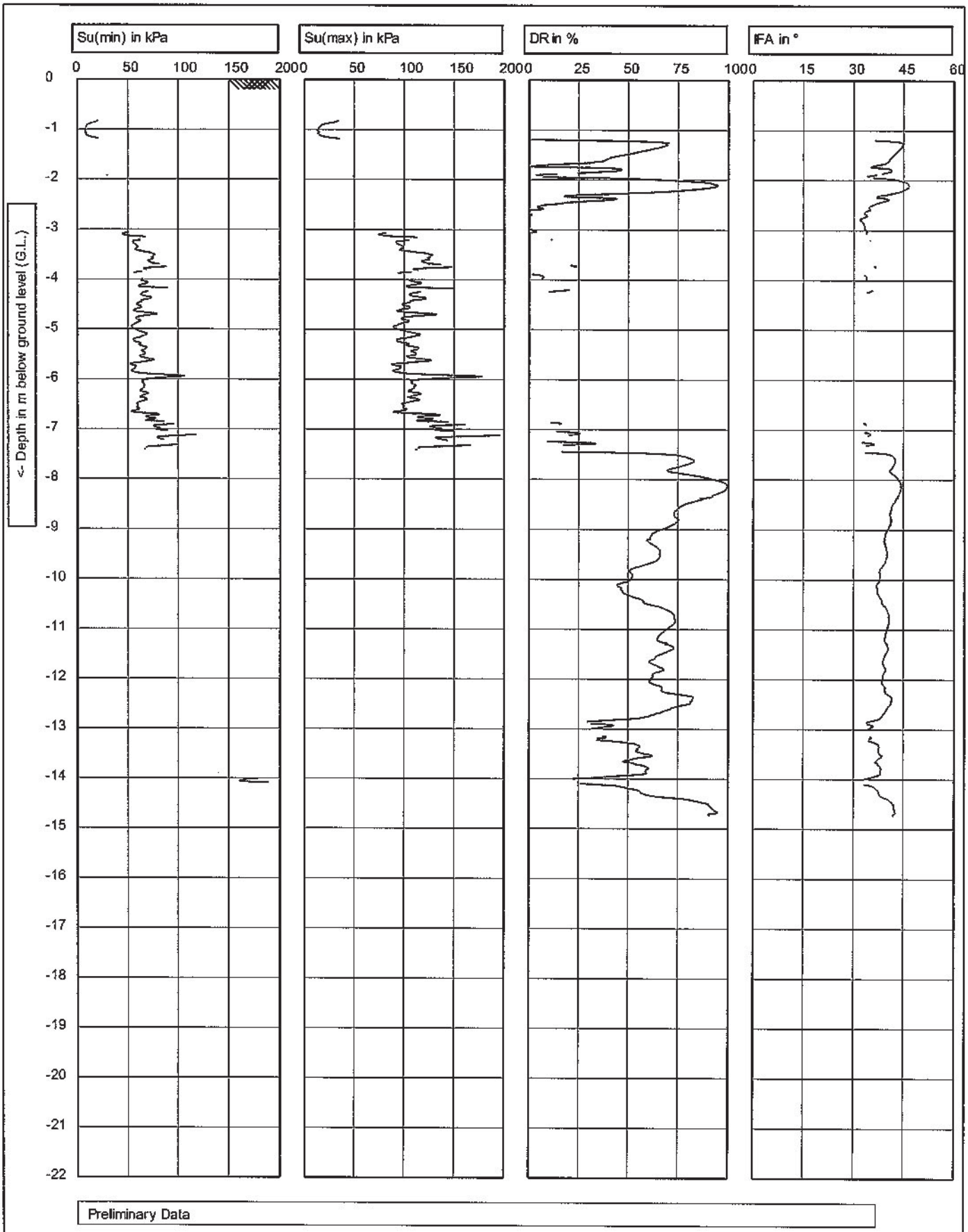
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10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 | W.L. : 0

Project : **Client : Morrison Construction**
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**
Position :

Pre drill :	0
Date :	03/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_18



SM Geocone

qu2
150 cm²
10 cm²

Test method BS 1377 : Part 9 : 1990 : 3.1

G.L. : 0 W.L. : 0

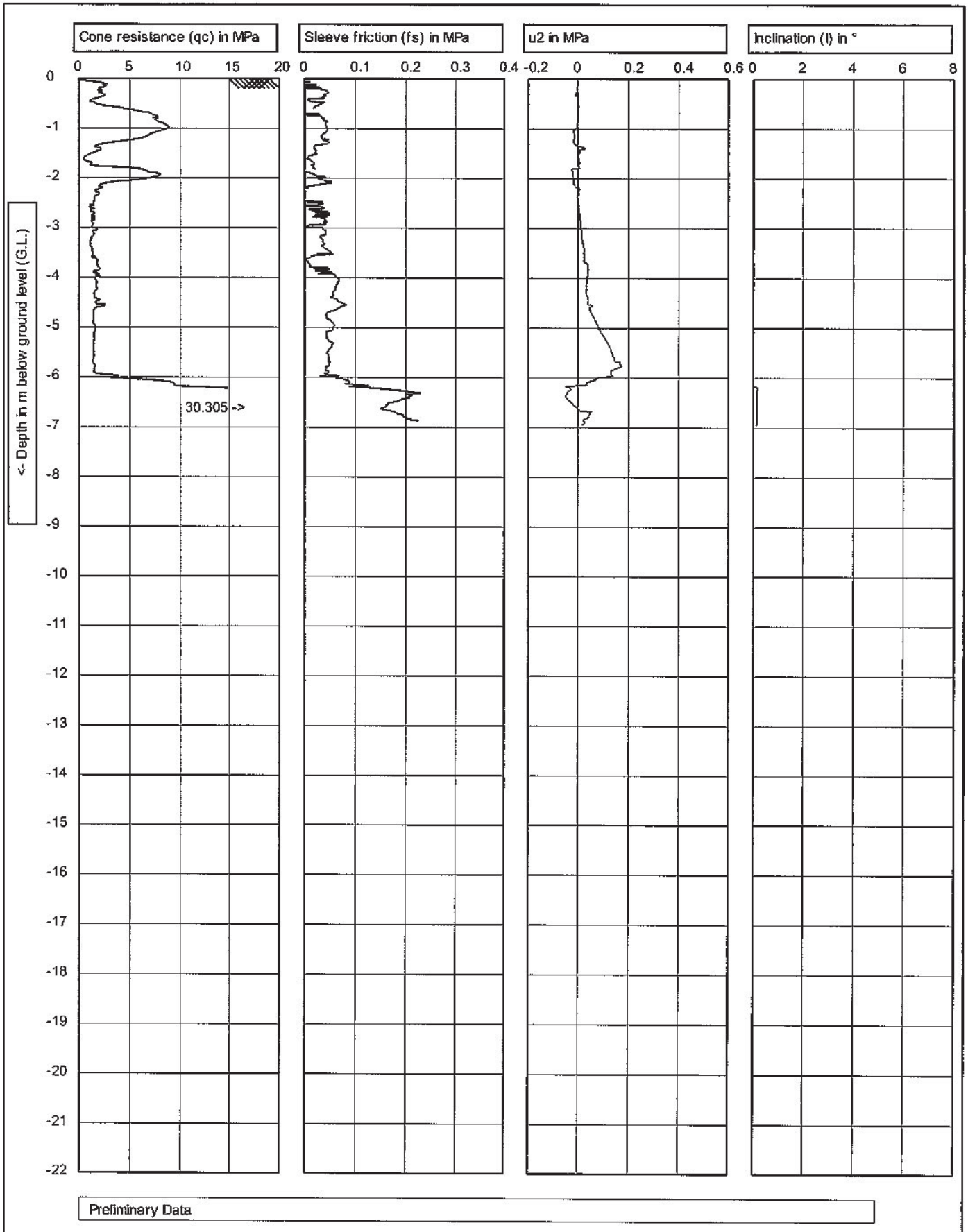
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Location : **TWEEN BRIDGE WIND FARM, PHASE 2**

Position :

Pre drill :	0
Date :	03/04/2009
Cone no. :	S10CFIP.361
Project no. :	M9015
CPT no. :	cpt_18 3/3

CPTask V1.13

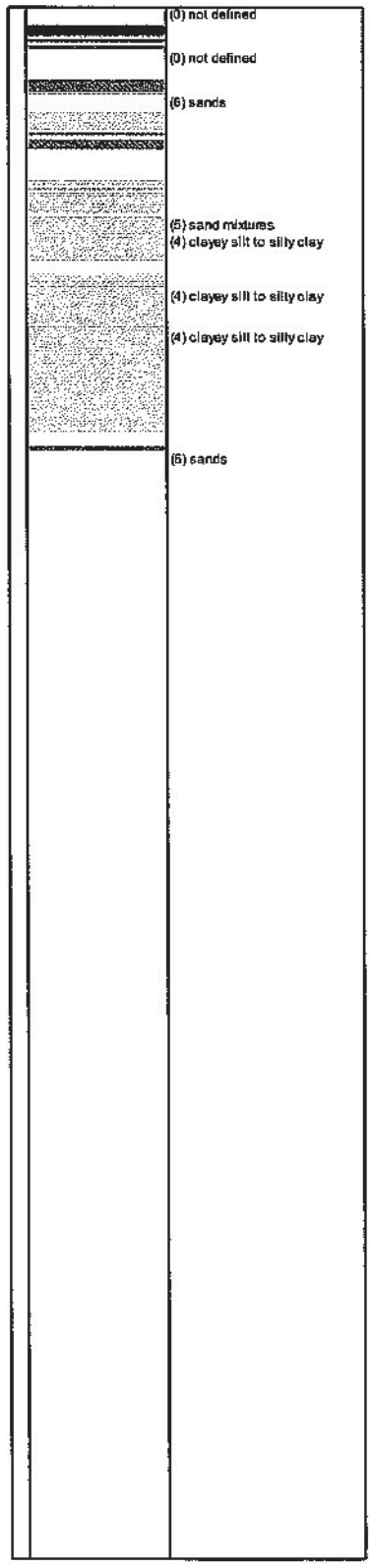


SM Geocone

CPTpak V1.13

r u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill : 0
	G.L. : 0	W.L. : 0	Date : 07/04/2009
Project : Client : Morrison Construction			Cone no. : S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2			Project no. : M9015
Position :			CPT no. : cpt_21 1/3

Soil Classification (using Fr)

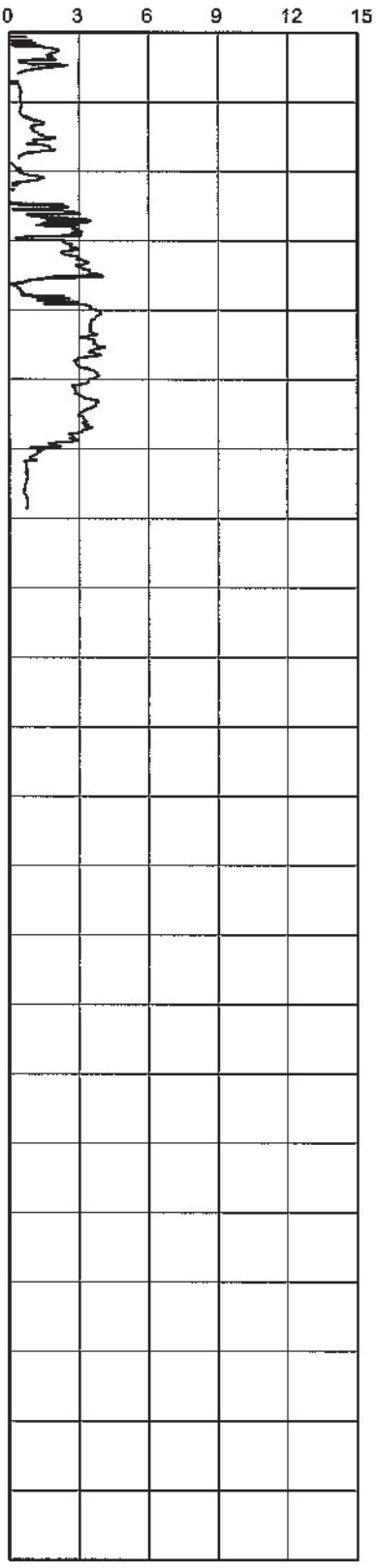


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Friction ratio (Rf) in %

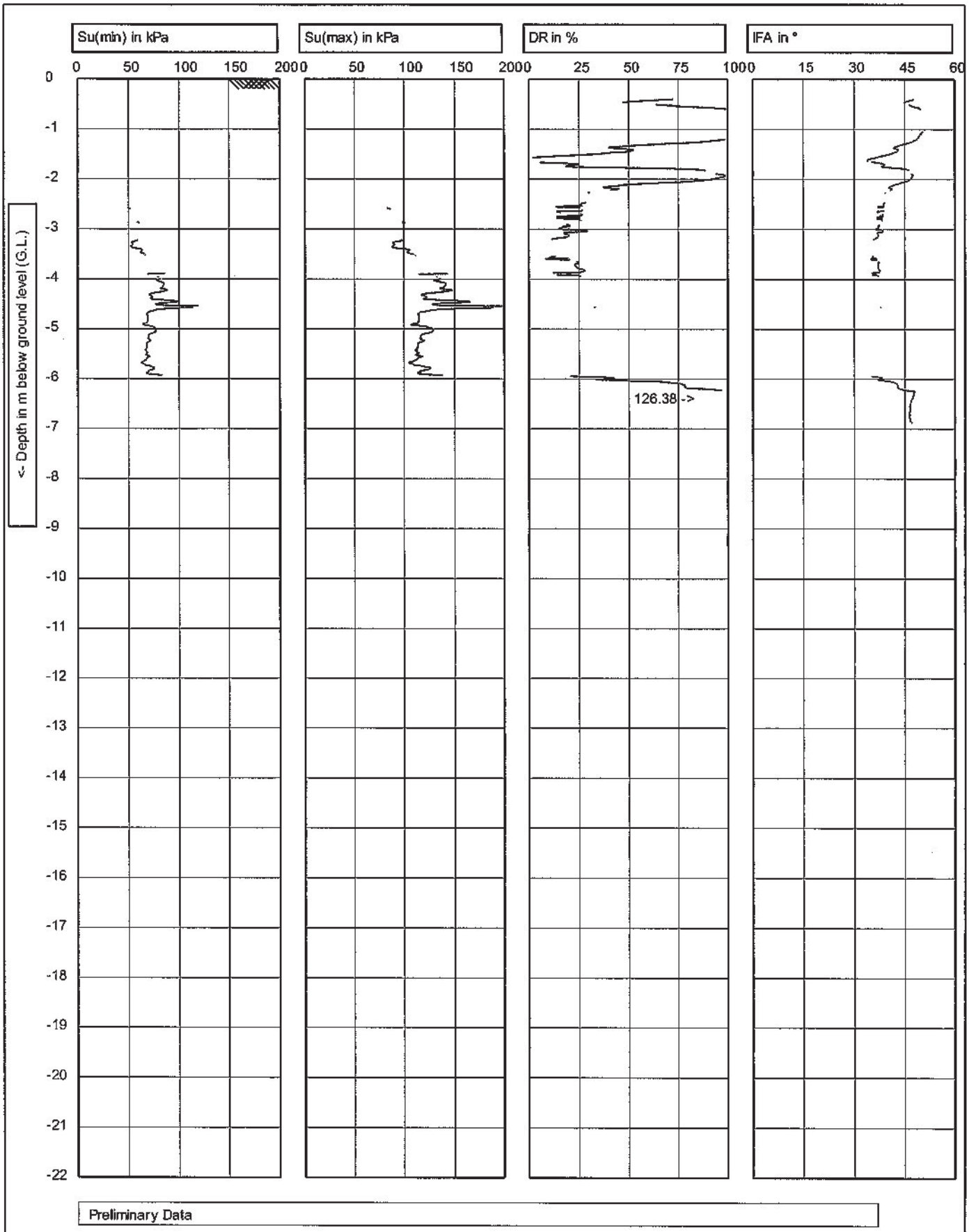


Preliminary Data

SM Geocone

CPTpk V1.13

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	07/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_21 2/3



SM Geocone

CPTwin V1.19

qu2 / 150 cm² / 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill : 0
	G.L. : 0	W.L. : 0	Date : 07/04/2009
Project : Client : Morrison Construction			Cone no. : S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2			Project no. : M9015
Position :			CPT no. : cpt_21 3/3

CLIENT: MORRISON CONSTRUCTION ENGINEER: DONALSON ASSOCIATES

TWEEN BRIDGE WIND FARM SI

SEISMIC CPT REPORT

FES Contract Number: CPT0911074

Fugro Aperio Project Number: J3379

REPORT ISSUE STATUS

02	06/03/09	**Final Report**	OG	DK	[redacted]	
01	03/03/09	**Digital Draft**	OG	AD		
Issue	**Date**	**Description**	**Prepared**	**Checked**	**Approved (Printed)**	**Approved (Signature)**
[redacted]						
GEOPHYSICIST			**DIVISION HEAD**			

EXECUTIVE SUMMARY

- This report documents the results of the field work undertaken as part of the Tween Bridge Wind Farm geophysical investigation.
- The overall brief was to provide an analysis of seismic cone penetration test (SCPT) data at eleven CPT locations.
- Specific objectives were to provide a commentary on the acquisition of SCPT measurements, calculate shear wave velocities for each measurement and derive values of shear modulus.
- The seismic source utilised for the SCPT tests produced horizontally polarised, vertically propagating shear waves, therefore, all dynamic moduli derived from measurements taken on site are confined to this plane only.
- No assessment of anisotropic stiffness can be made using the data acquired by SCPT methods.
- Seismic data quality was generally sufficient to provide estimates of shear wave velocity as a function of depth.

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Figure 6: Interval Shear Velocity versus Depth – SCPT13

Figure 7: Interval Shear Velocity versus Depth – SCPT14

Figure 8: Interval Shear Velocity versus Depth – SCPT17

Figure 9: Interval Shear Velocity versus Depth – SCPT19

Figure 10: Interval Shear Velocity versus Depth – SCPT20

Figure 11: Interval Shear Velocity versus Depth – SCPT22

Figure 12: Interval Shear Modulus versus Depth – SCPT02

Figure 13: Interval Shear Modulus versus Depth – SCPT03

Figure 14: Interval Shear Modulus versus Depth – SCPT04

Figure 15: Interval Shear Modulus versus Depth – SCPT09

Figure 16: Interval Shear Modulus versus Depth – SCPT11

Figure 17: Interval Shear Modulus versus Depth – SCPT13

Figure 18: Interval Shear Modulus versus Depth – SCPT14

Figure 19: Interval Shear Modulus versus Depth – SCPT17

Figure 20: Interval Shear Modulus versus Depth – SCPT19

Figure 21: Interval Shear Modulus versus Depth – SCPT20

Figure 22: Interval Shear Modulus versus Depth – SCPT22

APPENDIX B1 - Service Constraints

APPENDIX B2 - Tabulated Values of Velocities and Moduli

1. INTRODUCTION

1.1 General

1.1.1 This report documents the acquisition, processing and interpretation of geophysical data (SCPT measurements) that formed part of the Tween Bridge Wind Farm site investigation, undertaken between 16th – 19th February, 2009.

1.2 The Brief

1.2.1 The overall brief was to acquire and provide an analysis of SCPT data in the vicinity of eleven test locations.

1.2.2 Specific objectives were to:

- provide a commentary on the acquisition of seismic measurements
- calculate shear wave velocities for each measurement
- derive values of shear modulus

1.3 Definitions

1.3.1 A list of abbreviations and acronyms used in this report are provided below:

Vs_{vh} = Vertically propagating, horizontally polarised shear velocity
G_{vh} = Shear modulus (derived from Vs_{vh} data)
ρ_b = Bulk density

1.3.2 Measurements obtained during SCPT investigations are considered to exert very small strains. For this reason, all moduli mentioned here within should be taken to be small strain moduli.

1.4 Service Constraints

1.4.1 Appendix B1 “Service Constraints”, outlines the limitations of this report, in terms of a range of considerations including, but not limited to, its purpose, its scope, the data on which it is based, its use by Third Parties, possible future changes in design procedures and possible changes in the conditions at the site with time. The Appendix represents a clear exposition of the constraints, which apply to all reports

issued by Fugro Aperio Limited. It should be noted that the Service Constraints do not in any way supersede the terms and conditions of the contract between Fugro Engineering Services Limited and the Client.

1.4.2 The findings presented within this report are the result of the measurement and interpretation of acoustic signals. As such any results derived from the geophysical investigation should be taken in the context of and in reference to the complete ground investigation.

1.4.3 Additionally with specific reference to seismic data and respective derived parameters, the following constraints apply. Engineering properties are derived from seismic velocity calculations resulting from the identification of appropriate seismic waveforms and their time of travel along a source-receiver path from surface to downhole. The shape and phase characteristics of a received compressional or shear-type waveform and associated arrival time selection may be influenced by frequency-selective attenuation, dispersion, reflection, refraction, scattering , mode conversion processes and source and receiver coupling effects dependent on variations in ground conditions along the corresponding source-receiver travel path. In the derivation of elastic parameters or engineering properties such as shear modulus, apparent variations arising from both the relative and absolute influence of these processes along a particular source-receiver path may not be known or be calculable.

2. SITE WORK

2.1 General

2.1.1 Data was acquired from eleven positions as tabulated in table 1 below. The site was located to the east of Thorne near Doncaster, UK off Moor Edges Road.

2.2 SCPT Data

2.2.1 SCPT data were acquired at eleven test locations.

Test Location Reference	Eastings (m)	Northings (m	Refusal depth bgl (m)
CPT02	471367	413113	11.34
CPT03	471540	414854	13.62
CPT04	471589	413526	12.96
CPT09	472223	413457	11.30
CPT11	472543	413009	10.79
CPT13	473041	412588	6.79
CPT14	473332	412877	6.50
CPT17	473714	412511	15.64
CPT19	474133	412891	14.94
CPT20	474232	418589	15.23
CPT22	472208	412571	8.50

Table 1: Location of SCPT

2.2.2 The location of the test holes are presented in the main geotechnical report.

2.2.3 SCPT data were collected using a source that produced vertically propagated, horizontally polarised shear waves (Vs_{vh}).

2.2.4 Shear wave energy was generated by a shear hammer source that produced shear stress at the ground surface to propagate shear wave energy into the formation with particle motion largely in a vertical plane.

2.2.5 A wooden plank was placed on the ground surface and was loaded using the hydraulic legs of the CPT truck. The source was activated at a horizontal distance of 2.86 m from the CPT location, at a surface position perpendicular to the plane containing the CPT cone. This was carried out at depths between 1 m and the refusal depth of the CPT cone (table 1).

2.2.6 The term 'horizontally polarised' describes a decomposition of the shear wave motion A real seismic source will produce both SV and SH motions unless the source polarisation angle (defined as the angle between the SV vector and the resultant of the SV and SH vectors) is zero to produce purely SV motion or $\pi/2$ radians to produce purely SH motion.

2.2.7 In practice, the source will produce a component of shear wave energy that can be considered orthogonal to the primary polarisation direction. The most likely cause of the additional component is that no seismic source is capable of producing particle motion that is restricted to vertical or horizontal planes. In addition receiving geophones are unlikely to have measurement axes precisely co-planar with the dominant polarisation directions and will measure a degree of off-axis particle motion.

2.2.8 The seismic source was actuated in two opposing directions in order to produce shear wave arrivals with first break particle motions in opposing directions.

2.2.9 A single triaxial geophone was close to the cone tip to measure two orthogonal horizontal components and a single vertical component.

2.2.10 Each measurement comprised stacked (summed) data that were recorded to improve the signal to noise ratio. Due to the relatively low levels of ambient noise, three stacks were generally recorded to achieve a satisfactory signal-noise ratio.

2.2.11 The seismograph used was set up using the following acquisition parameters:

- Record length - 200 ms
- Delay - none
- Sample interval - 50 µs
- Acquisition filters - out

2.3 Verticality

2.3.1 No quantitative measure of the verticality of the one path was recorded. For this reason, the ray-paths calculated to be used in derivation of velocities will have an uncertain error introduced into them.

2.3.2 The cone that contains the geophones is capable of measuring the angle from the vertical to its centre line. The value recorded is a scalar quantity and therefore can not be used to calculate absolute position. It is noted that during the course of the SCPT test, the angle of the cone was relatively low and hence the cone pushed into the ground approximately vertically.

2.4 Data quality

2.4.1 Data quality was typically good throughout the acquisition with the shear wave arrival easily identified below 2 m bgl for most CPTs. Typically it was not possible to identify the shear wave at 1 m bgl due to a low signal to noise ratio.

2.4.2 SCPT022 exhibited low signal to noise ratios down to 3 m bgl. As such it was not possible to pick the shear wave above this depth.

3. DATA ANALYSIS

3.1 SCPT Data

3.1.1 Direct arrivals (of earliest detectable shear wave energy) were visually picked from shot records at each 1 m depth interval.

3.1.2 Shear wave energy, subject to signal-to-noise characteristics, was identified based upon polarity reversal between shots from reversed source activation and amplitude/frequency characteristics expected of shear wave arrivals.

3.1.3 Shear wave velocities were determined from pick times and distances between source and associated receiver locations determined from measurements of the offset from hole to source taken on site and the depth of the cone penetrometer.

3.1.4 Quality control of the identified pick times was conducted by comparing calculated interval shear wave velocities from picks of different parts of the shear wave including the first break and first positive maximum. Typically variations in calculated shear velocities at coincident depth intervals were < 10 % within individual tests.

3.2 Engineering Parameters

3.2.1 Shear modulus was derived from calculated shear wave velocities using the equation listed below:

$$G_{vh} = \rho_b * Vs_{vh}^2$$

3.2.2 For the purpose of calculating elastic parameters, the density assumed was 2.00 Mg/m^3. Whilst it is considered that variations in density of these layers will exist, the magnitude will have a minimal effect on derived elastic parameters.

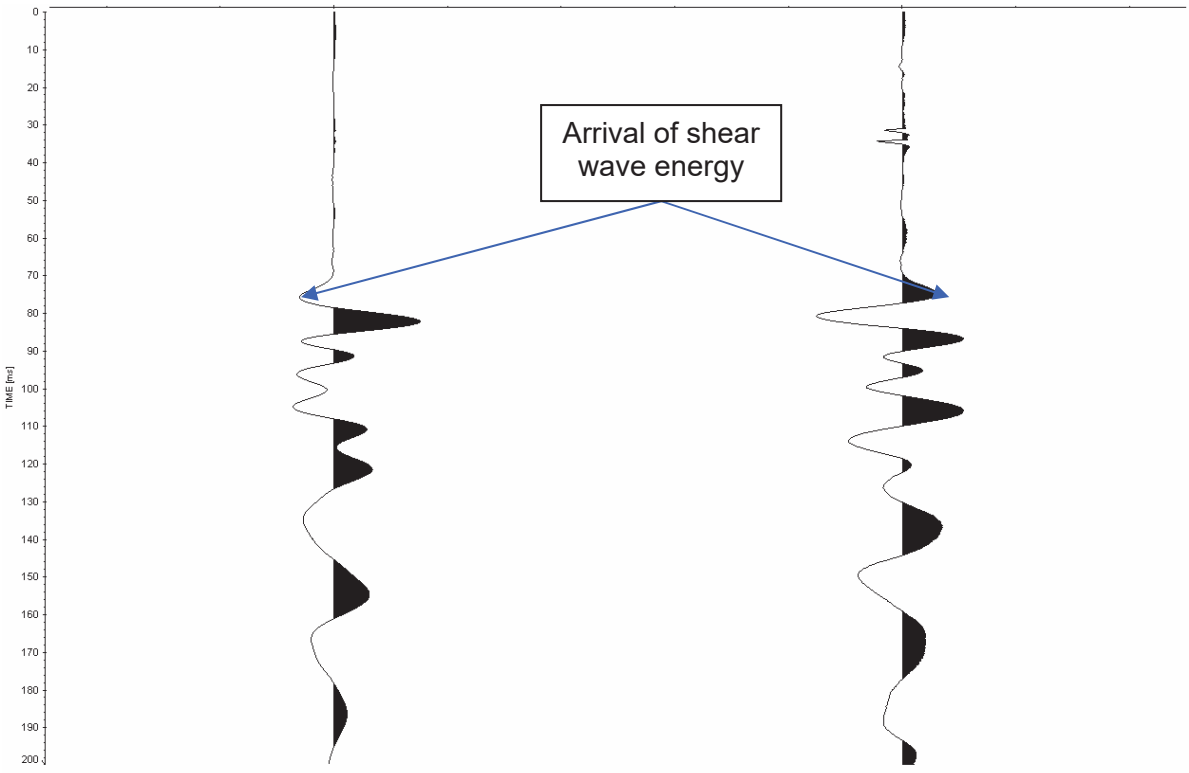
4. FINDINGS

4.1 General Comments

4.1.1 The findings of this investigation are presented on Figures 1-22. Tabulated values of all derived parameters are provided in Appendix B2.

4.1.2 The quality of the seismic signals was examined and post acquisition processing was undertaken where appropriate. High and low pass filters were applied to attempt to remove any unwanted noise that was present in the data. Any processing undertaken was consistent throughout the test to minimise time picking errors that could have arisen from signal phase changes.

4.1.3 Minimal seismic noise was present in all traces collected. The example traces below show the two horizontal components collected by the receivers mounted behind the cone.



Example data from 9.6 m below ground level at CPT20.

4.2 SCPT Testing

4.2.1 Profiles of derived shear wave velocities (Vs_{vh}) are provided on Figures 1-11.

4.2.2 Inspection of the shear wave profiles indicated Vs_{vh} values varied between ~100 m/s at ~2 m depth to up to ~300 m/s at the refusal depth across the site. Large increases in shear velocity are observed in CPT 2, 14, 17, 19 & 22 at the refusal depths that are probably associated with variations in geology at this point.

4.2.3 Profiles of interval shear modulus are provided on Figures 12-22. It should be noted that a constant density of 2 Mg/m^3 has been assumed when calculating these values.

4.2.4 Variations in measurements of Vs_{vh} / shear modulus as a function of depth are generally consistent.

4.2.5 The velocity profile exhibits some scatter in the data, particularly at greater depths. This is thought to be in part due to the effect of calculating interval velocities from non-common ray-paths.

4.2.6 It should also be appreciated that the temporal resolution of identifiable seismic arrivals reduces with increasing depth. The Earth acts as a natural filter to seismic energy, with the result that higher frequency components of seismic energy are removed from deeper propagating waves. Measurement of seismic velocity over an interval of 1m requires precision time picking of first arrival events (i.e. a time picking error of +/- 0.1 ms in 400 m/s media will result in a velocity error of approximately +/- 5%).

4.2.7 For deeper investigation the temporal resolution problem at depth may be mitigated by appropriate use of cross-borehole seismic methods. For this particular investigation the use of SCPT data for velocity calculation is considered to be appropriate.

5. CONCLUSIONS

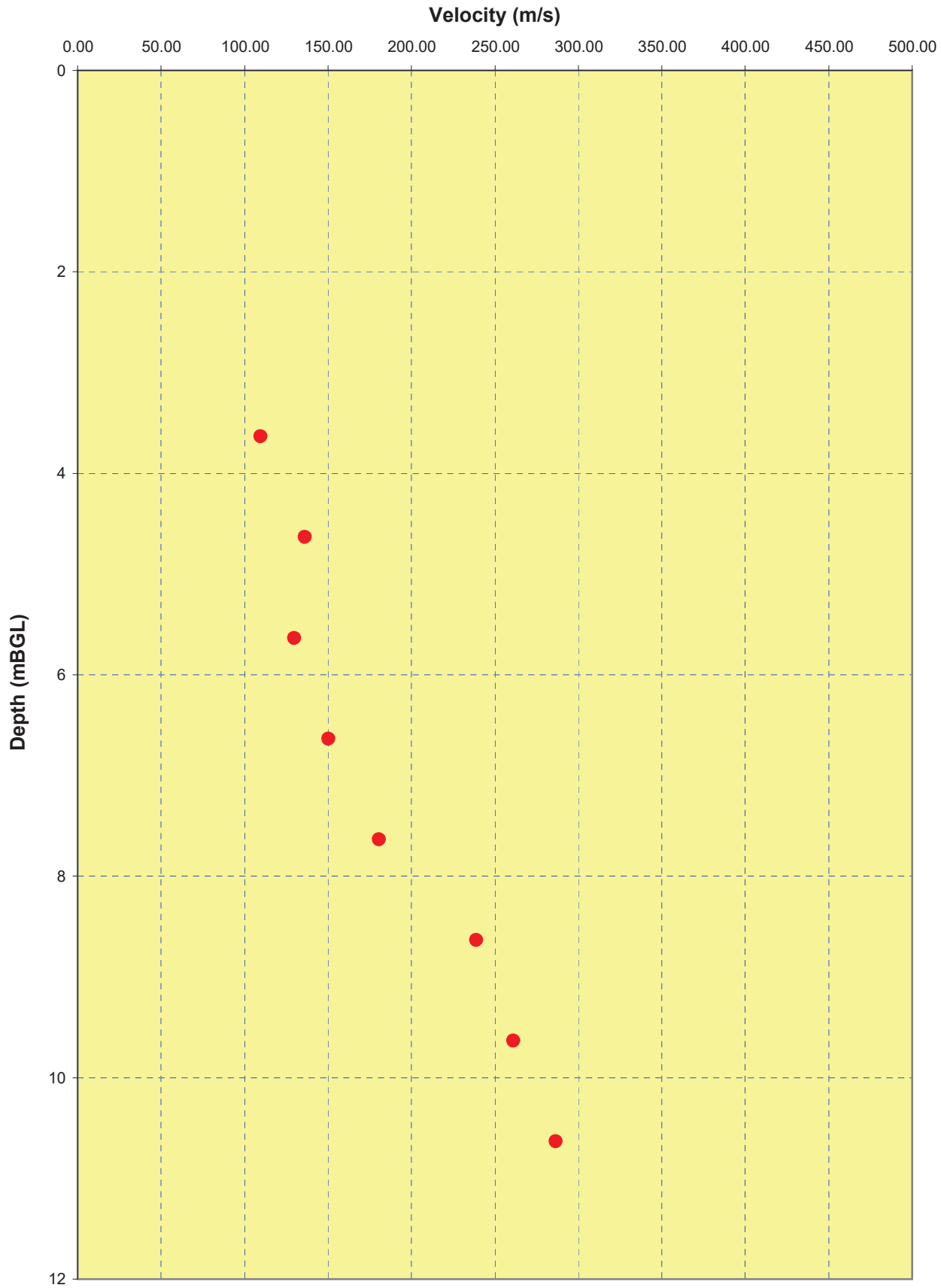
5.1.1 SCPT data acquired at the Tween Bridge Wind Farm site were generally of sufficient quality to provide an estimate of shear-wave velocity as a function of depth.

5.1.2 Determination of shear modulus was made using Vs_{vh} values and an assumed constant density value of 2.00 Mg/m^3.

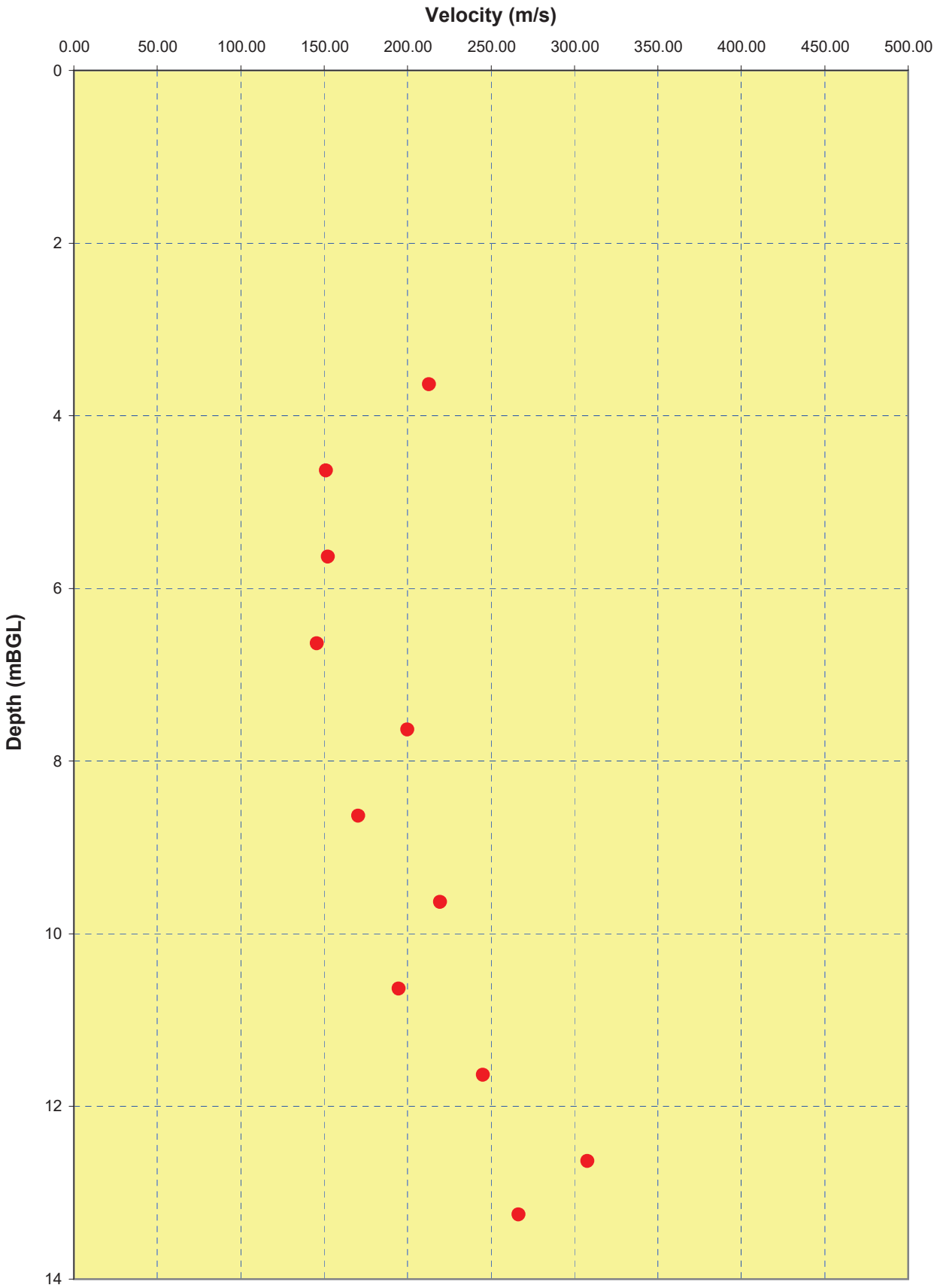
5.1.3 All velocity estimates and subsequent parameter calculations relate to small strain dynamic measurements taken in a vertical plane. Potential anisotropic stiffness behaviour of ground material at this site cannot be ascertained from the data within this report.

FIGURES

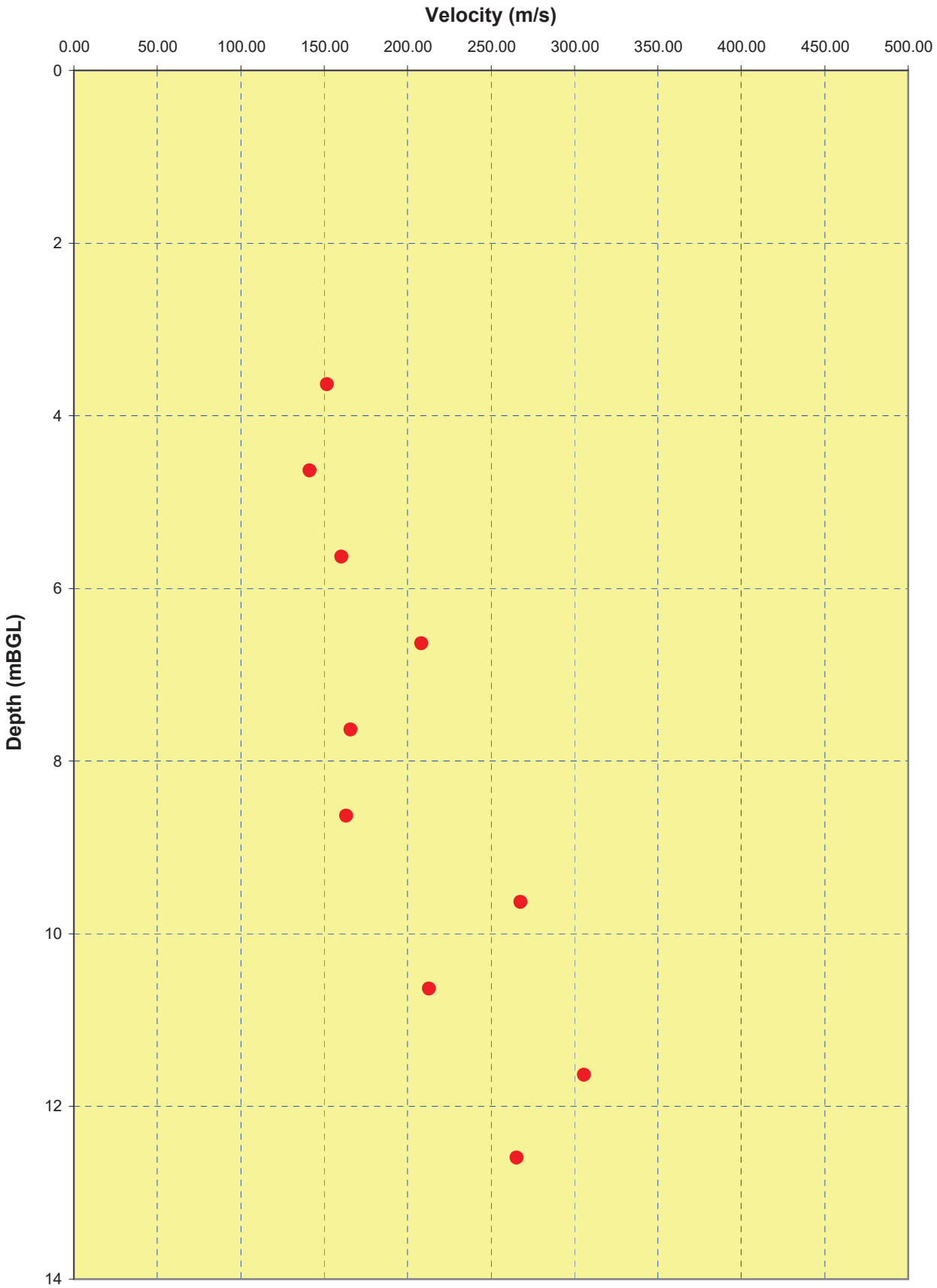
Interval Shear Velocity versus Depth



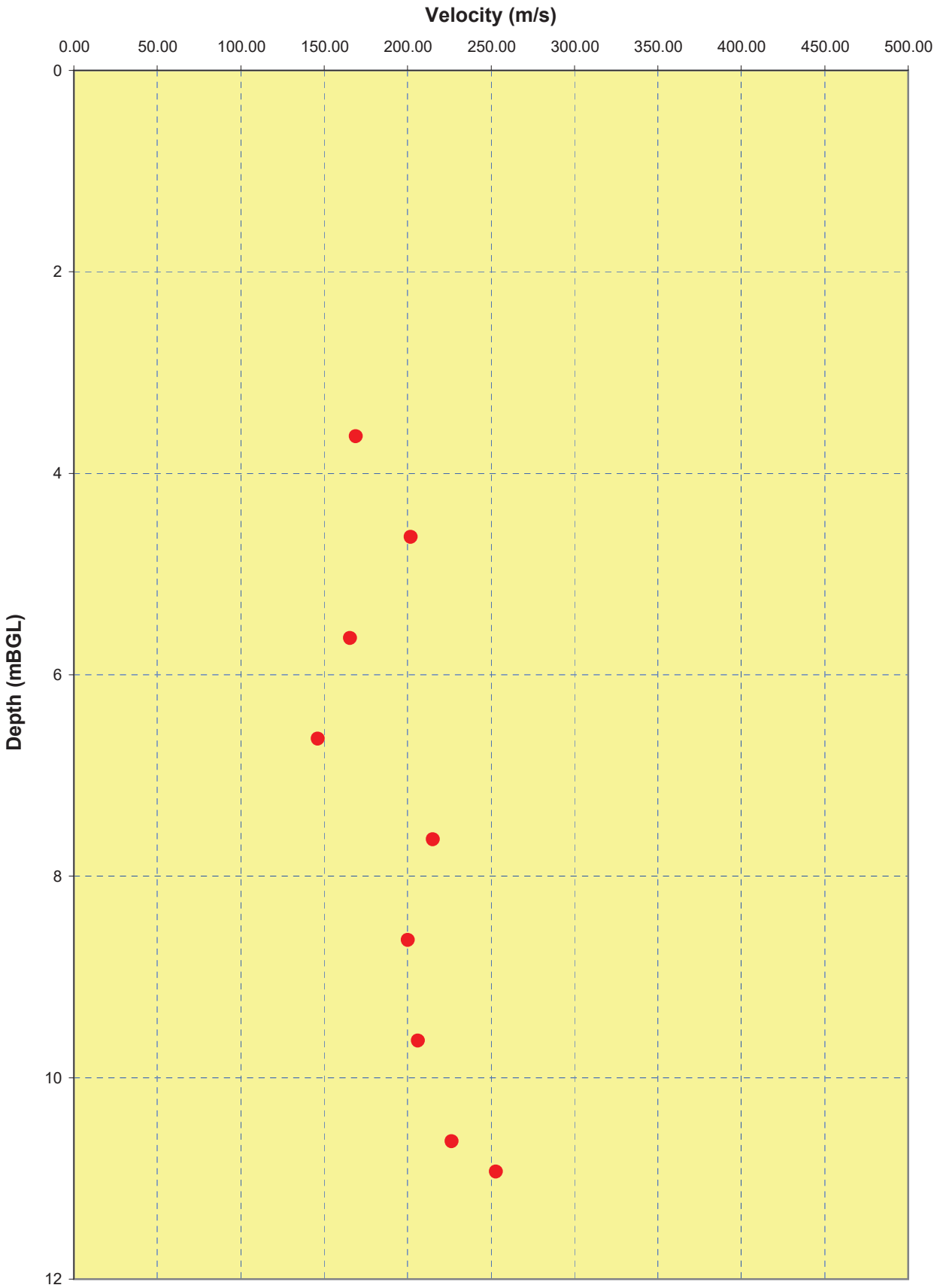
Interval Shear Velocity versus Depth



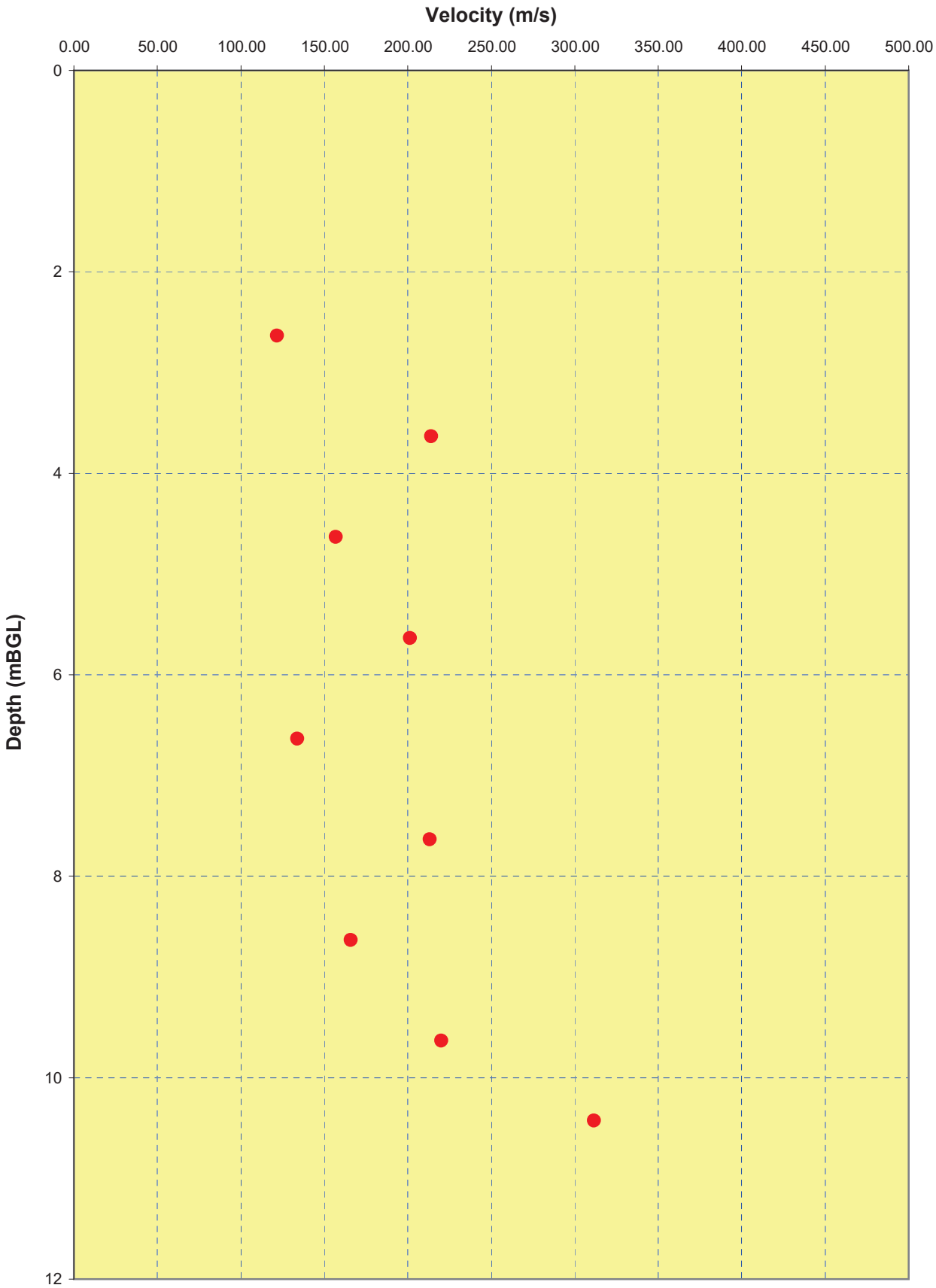
Interval Shear Velocity versus Depth



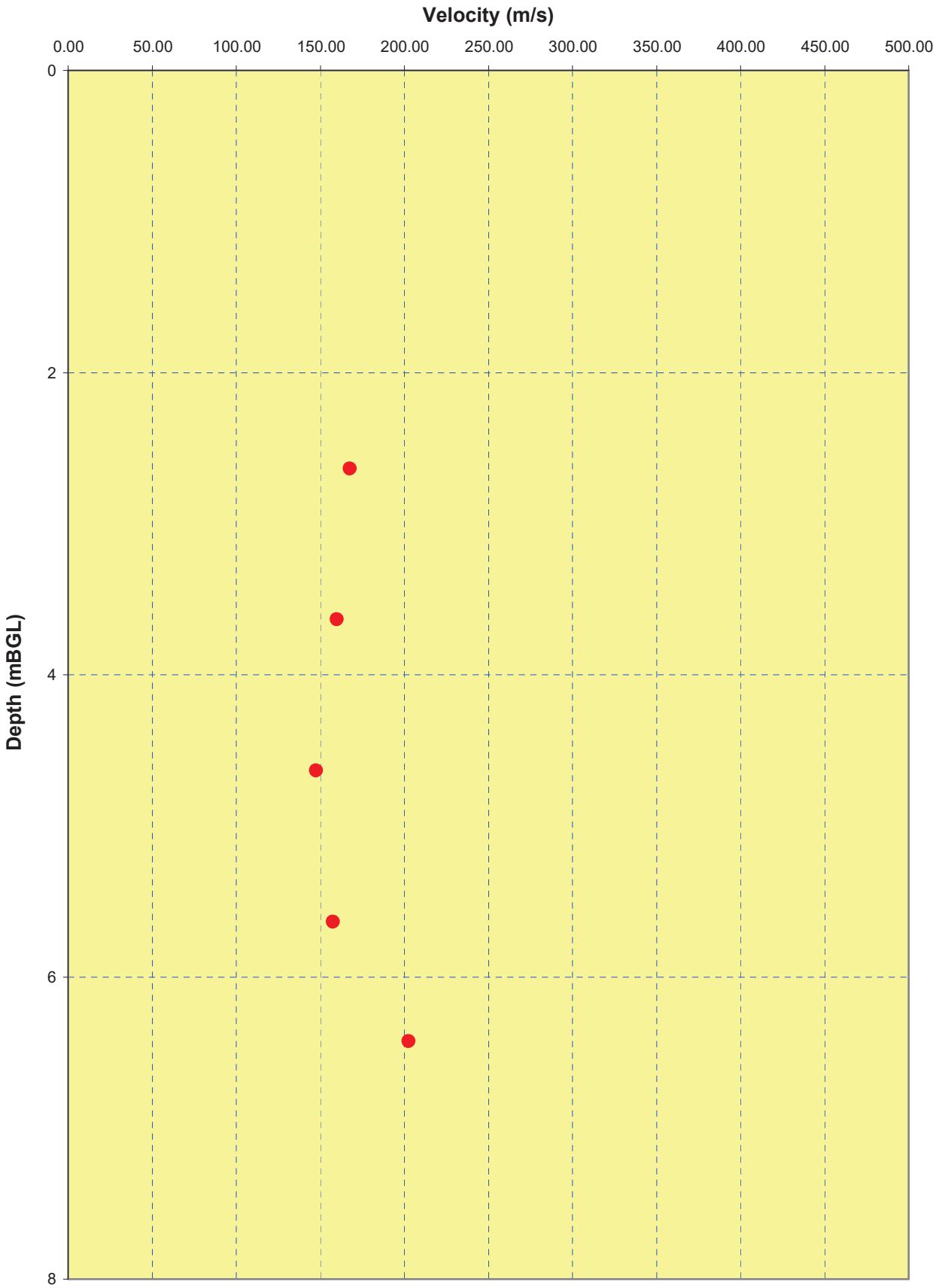
Interval Shear Velocity versus Depth



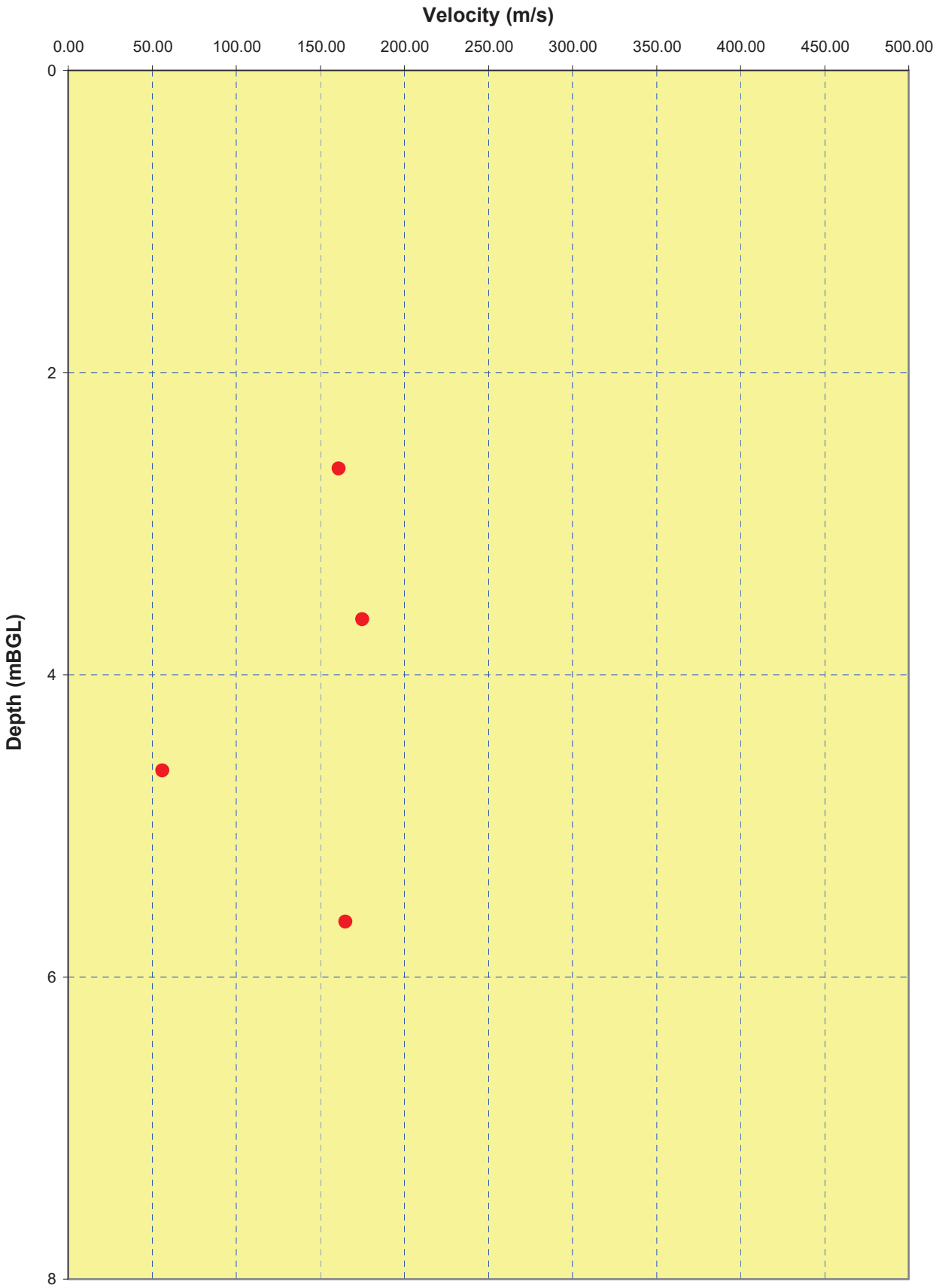
Interval Shear Velocity versus Depth



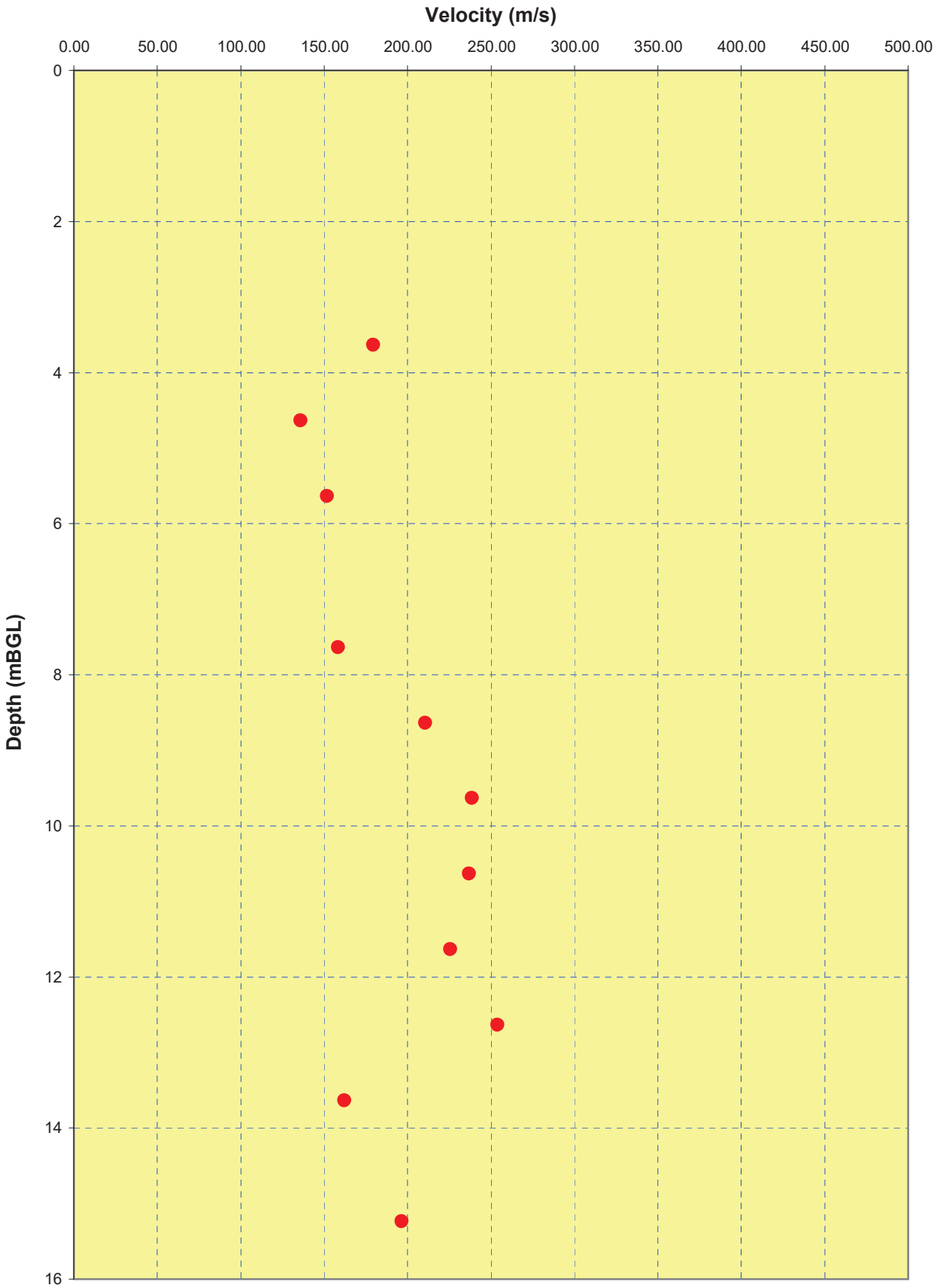
Interval Shear Velocity versus Depth



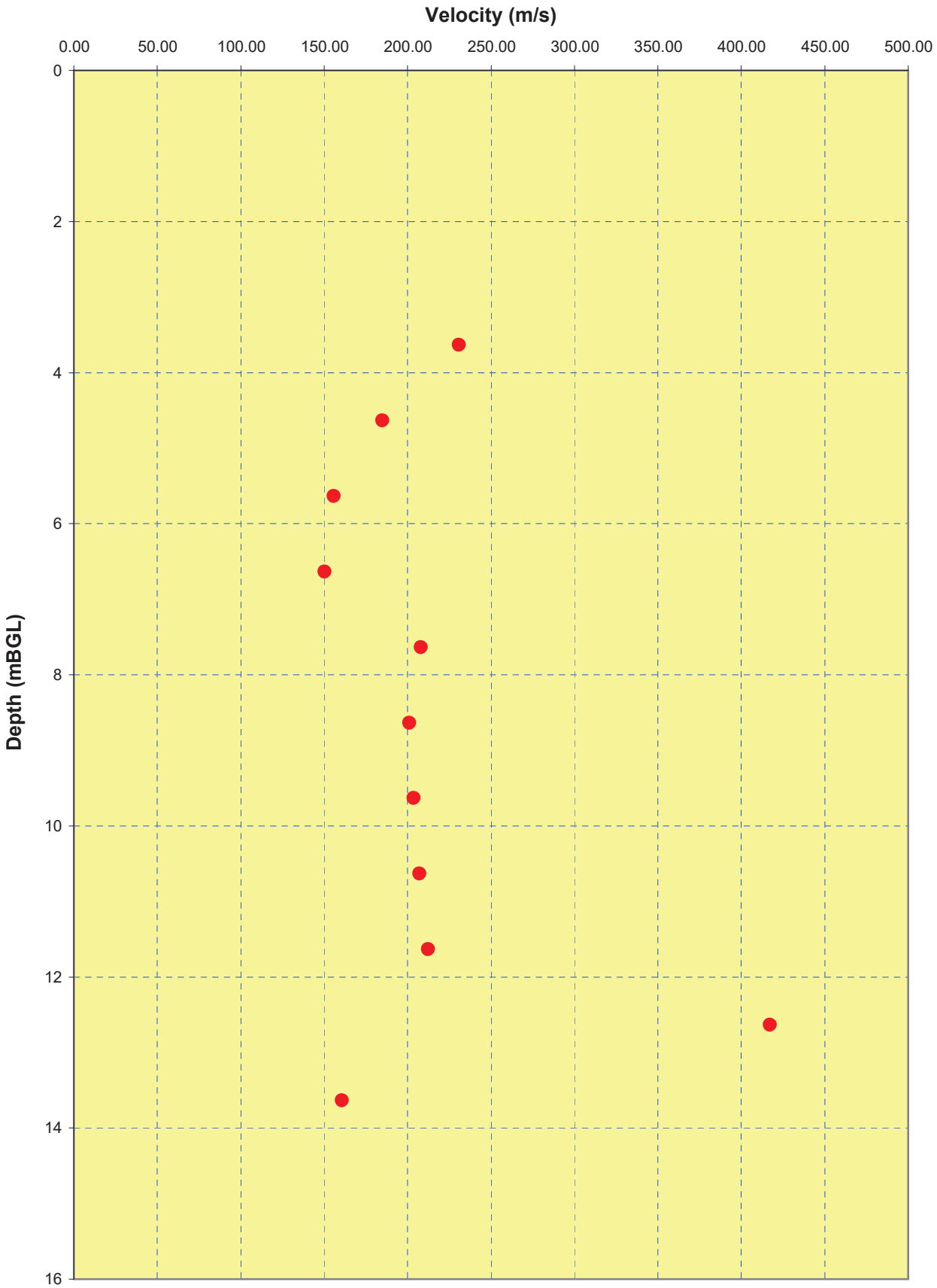
Interval Shear Velocity versus Depth



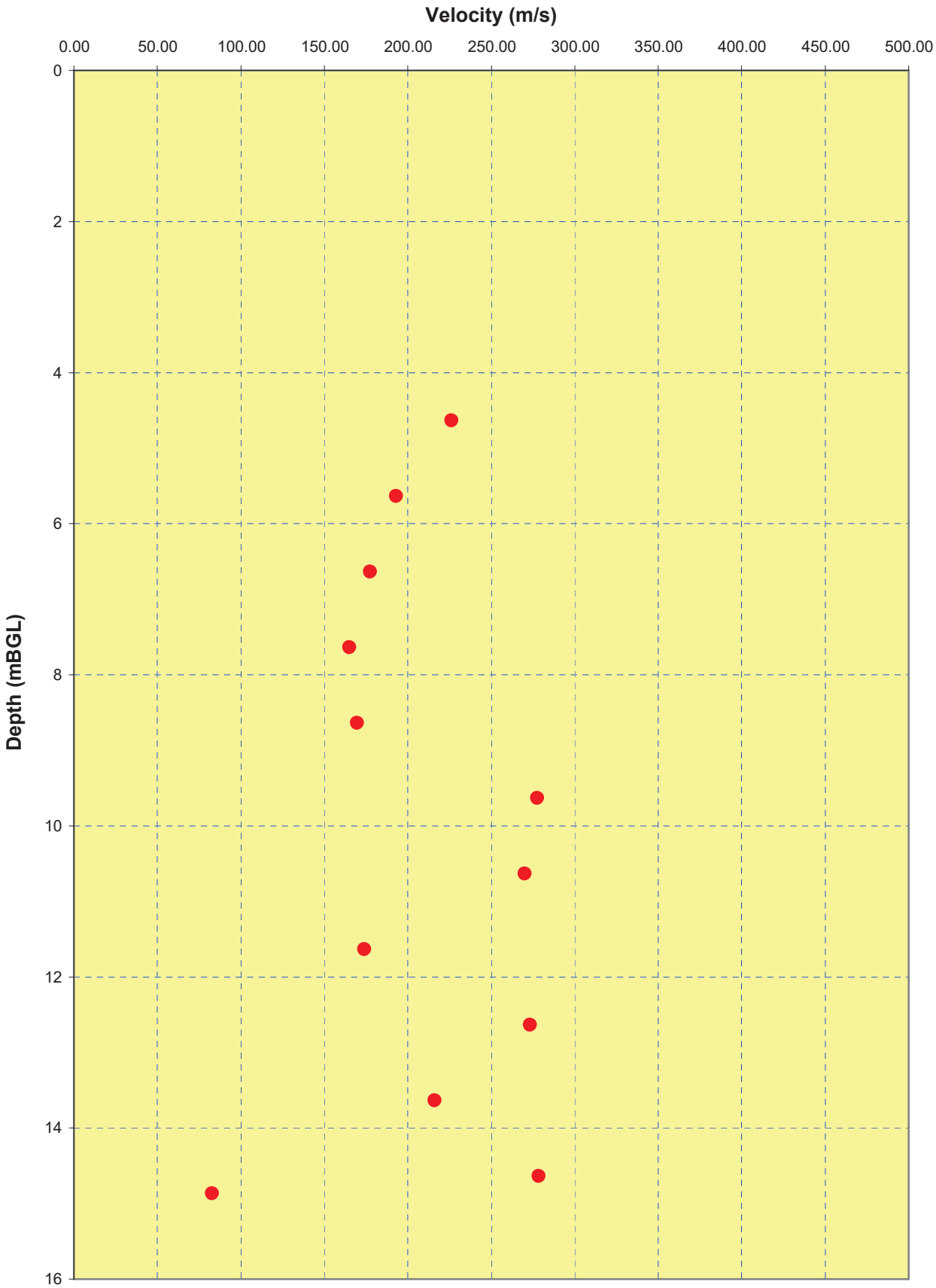
Interval Shear Velocity versus Depth



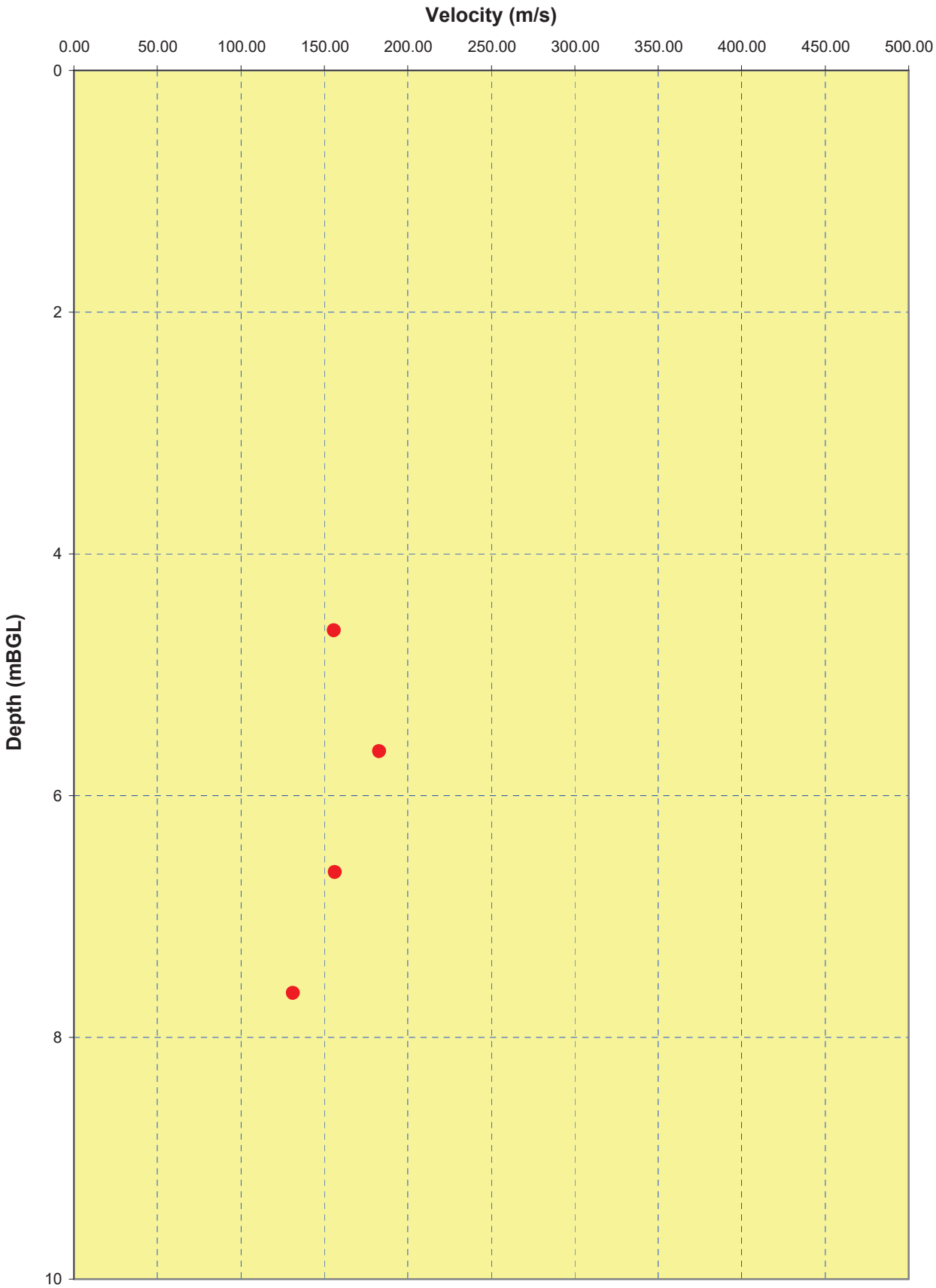
Interval Shear Velocity versus Depth



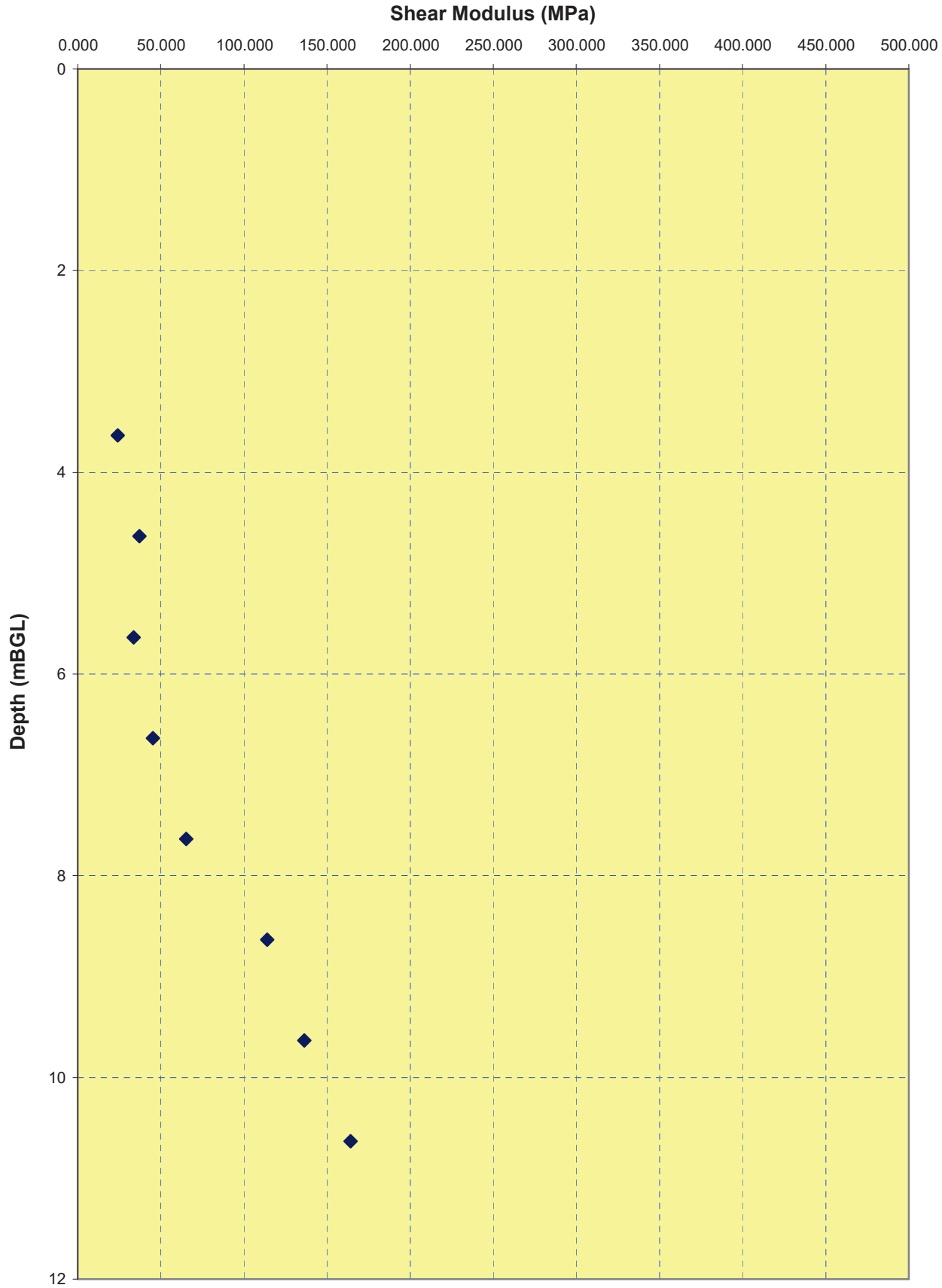
Interval Shear Velocity versus Depth



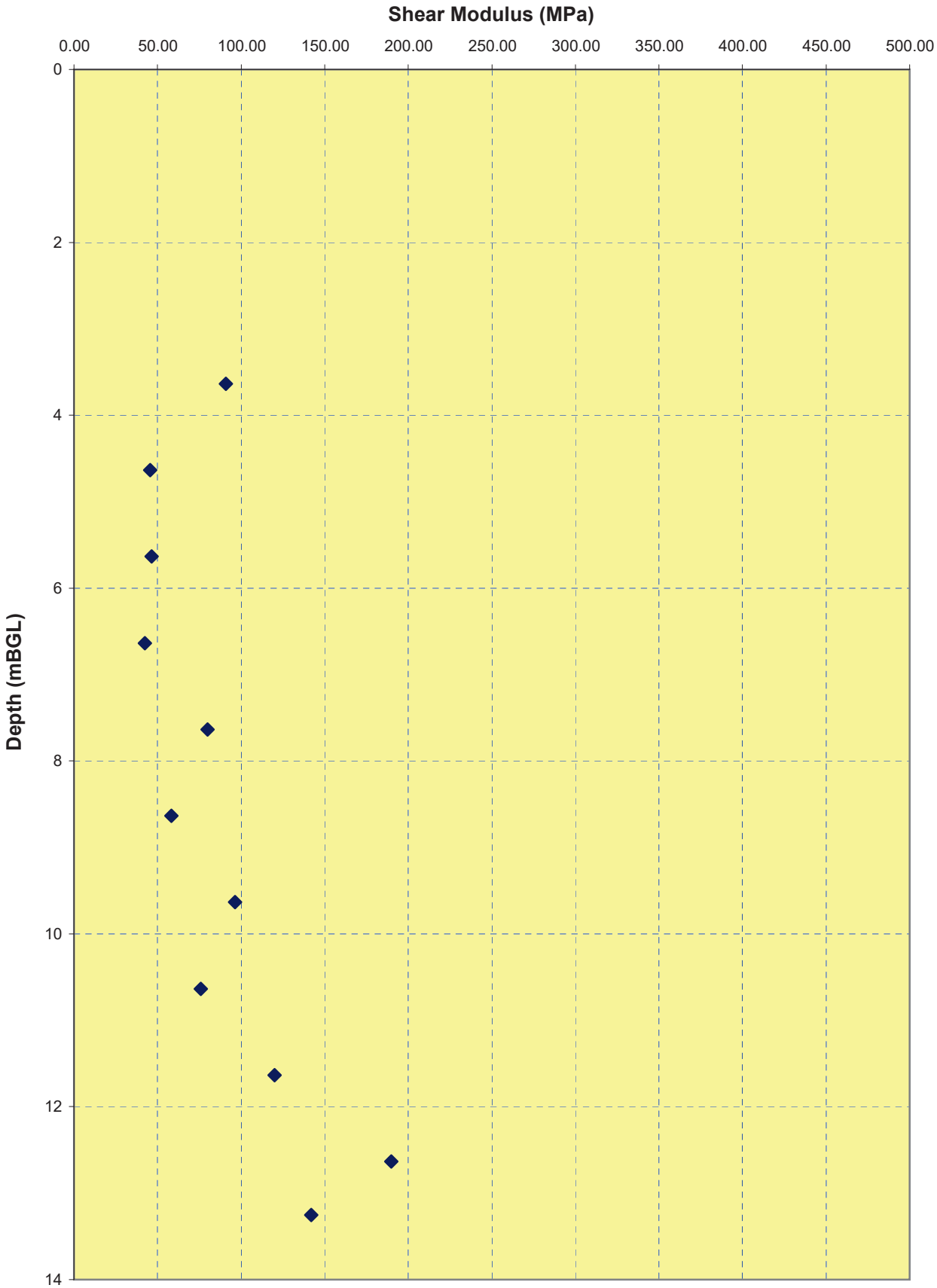
Interval Shear Velocity versus Depth



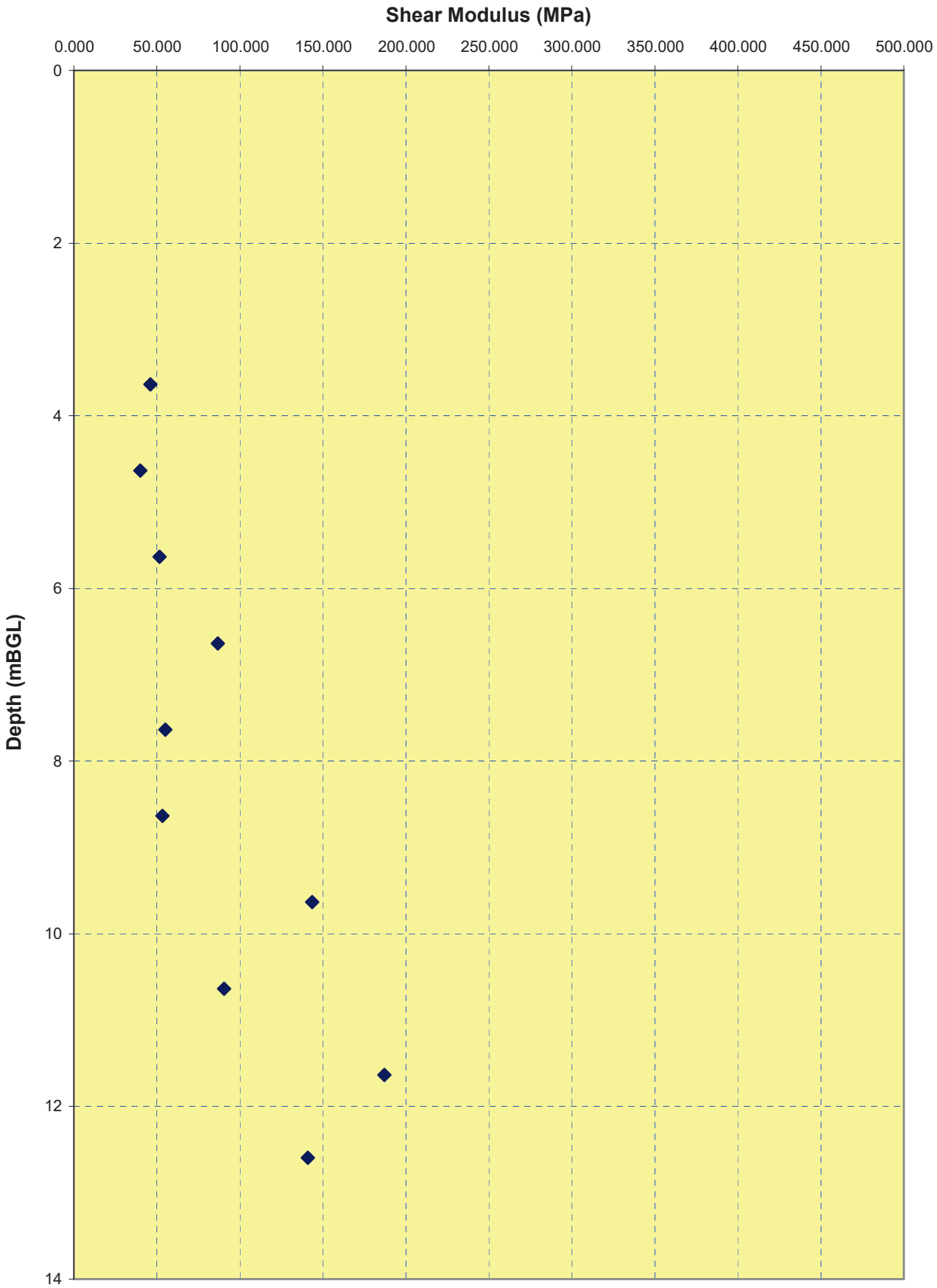
Interval Shear Modulus versus Depth



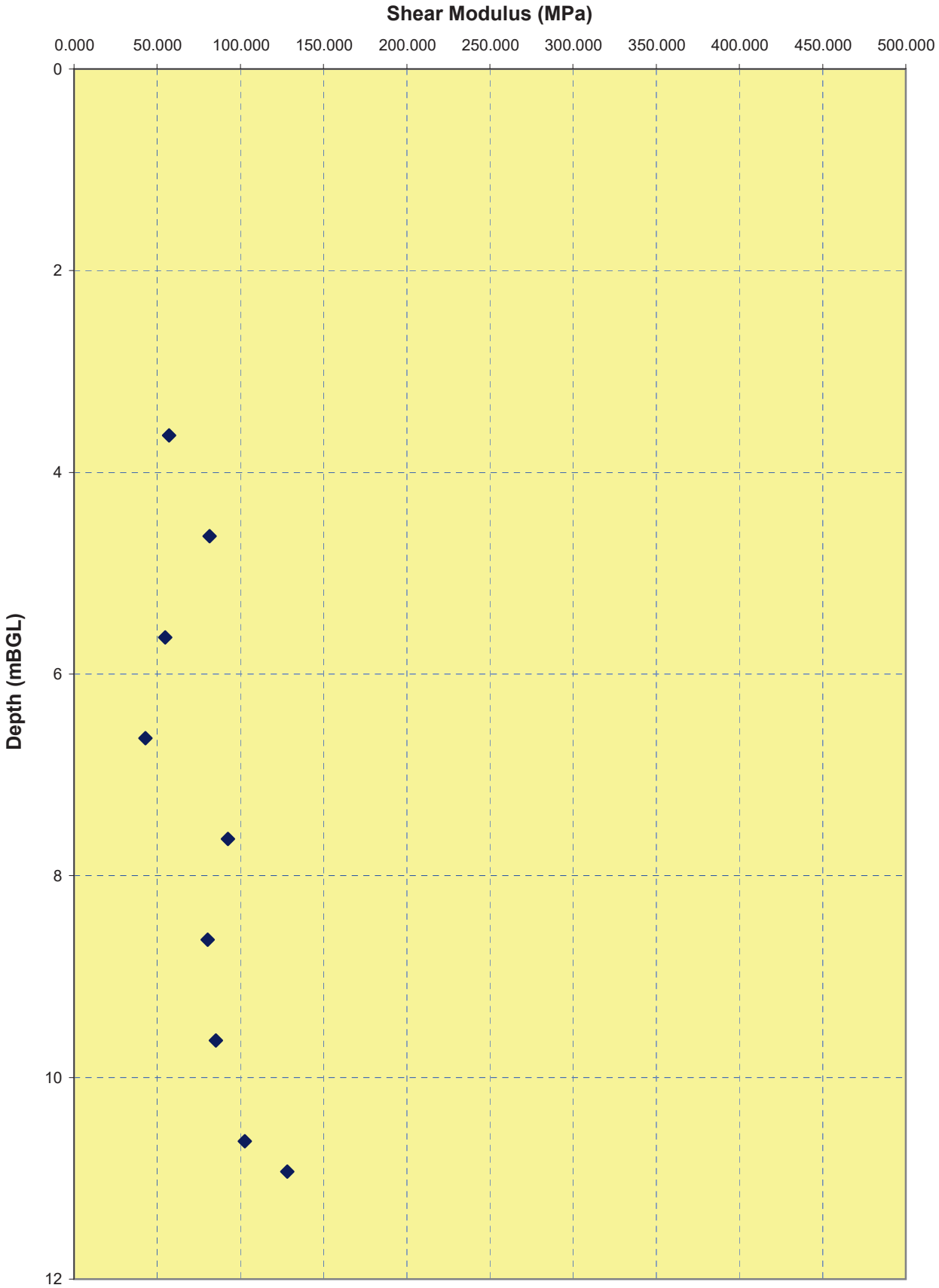
Interval Shear Modulus versus Depth



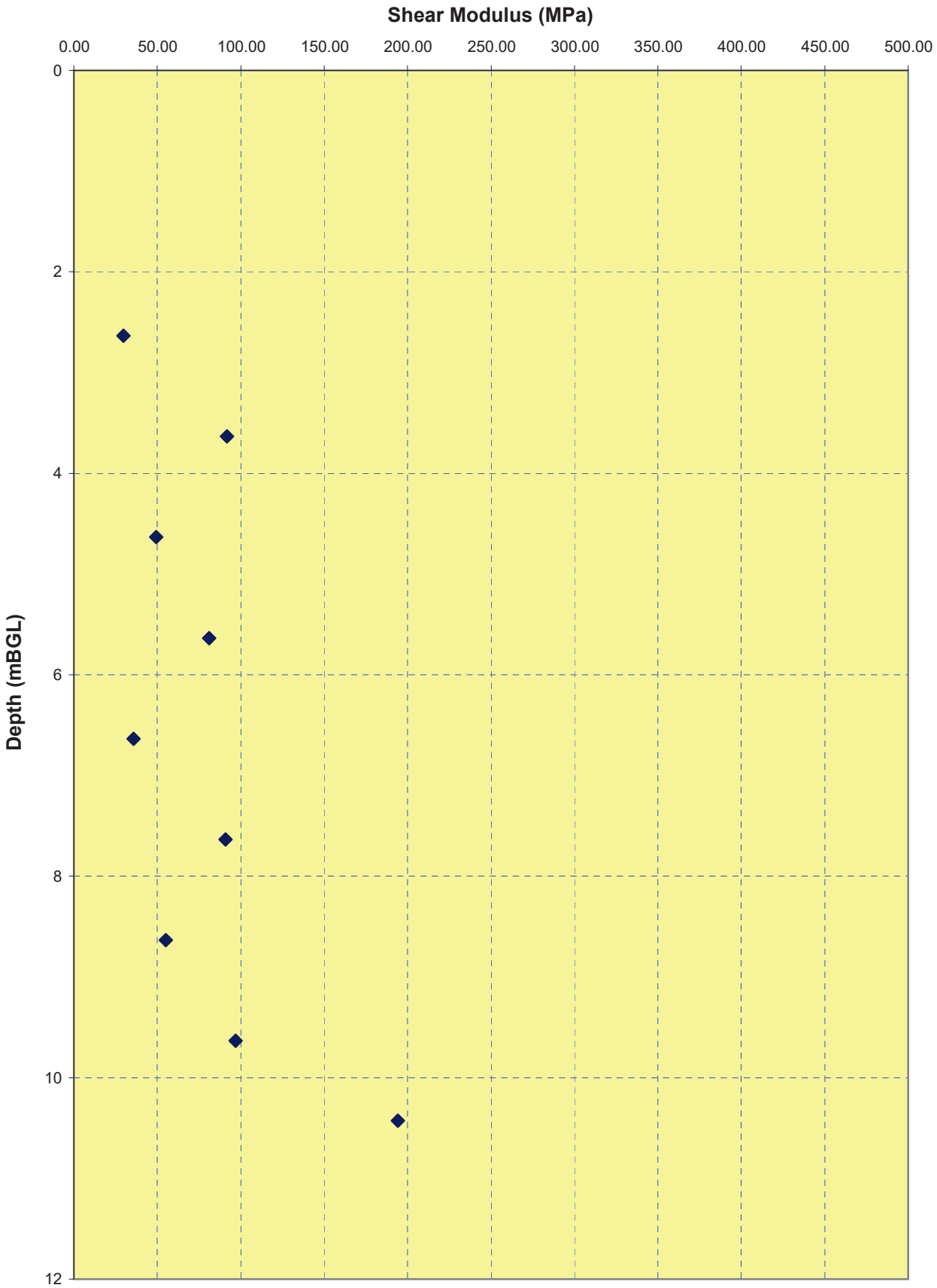
Interval Shear Modulus versus Depth



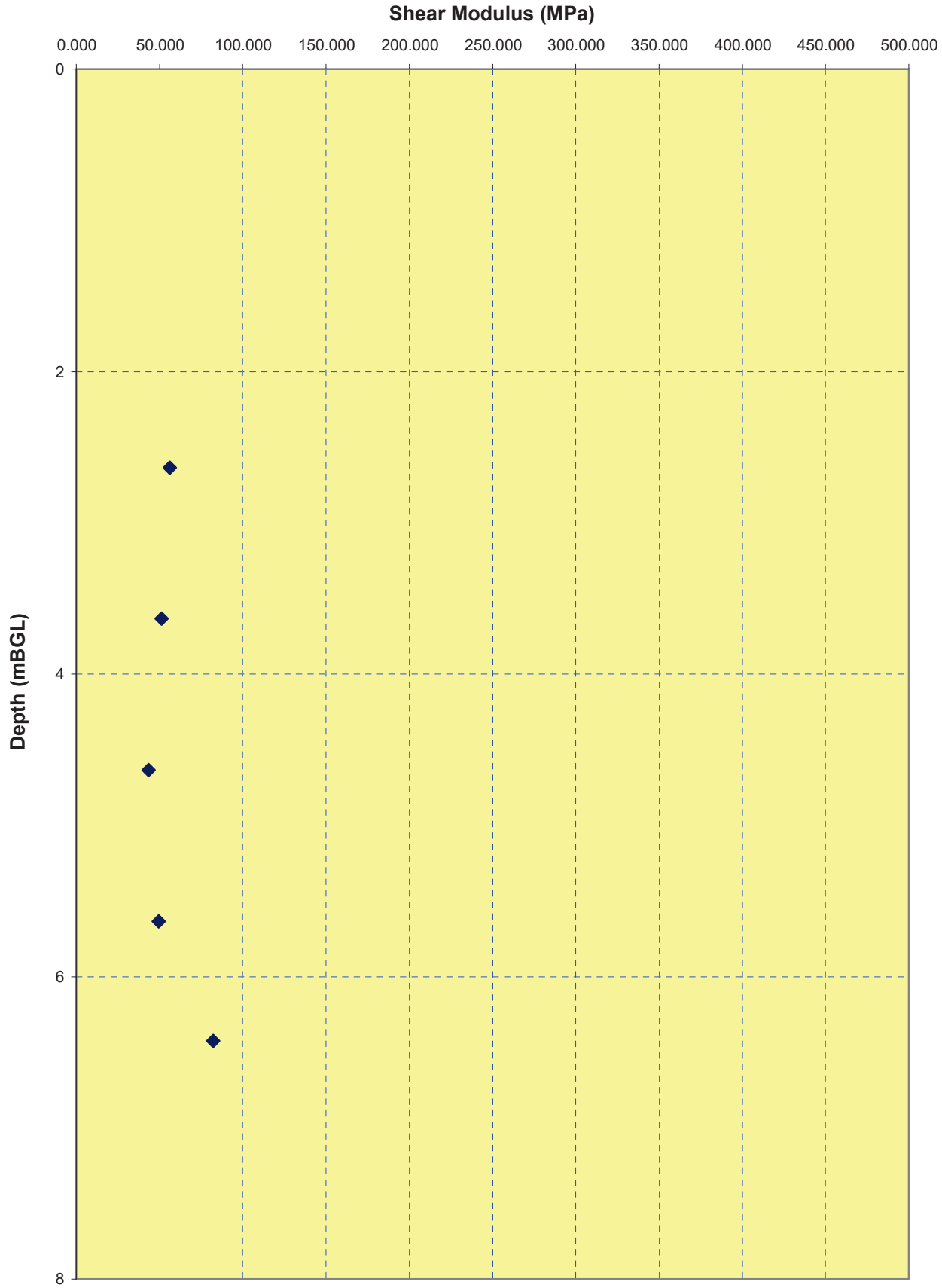
Interval Shear Modulus versus Depth



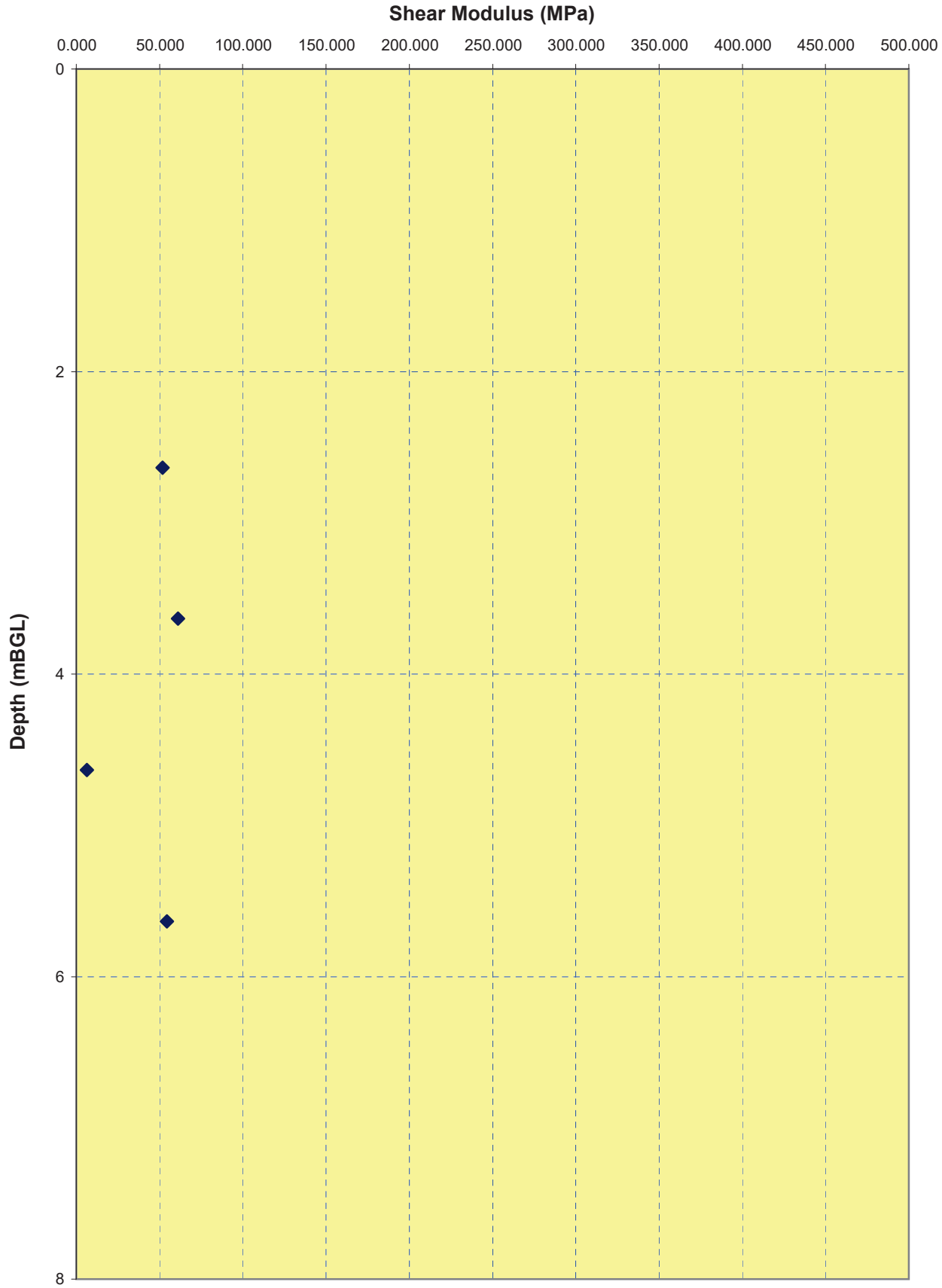
Interval Shear Modulus versus Depth



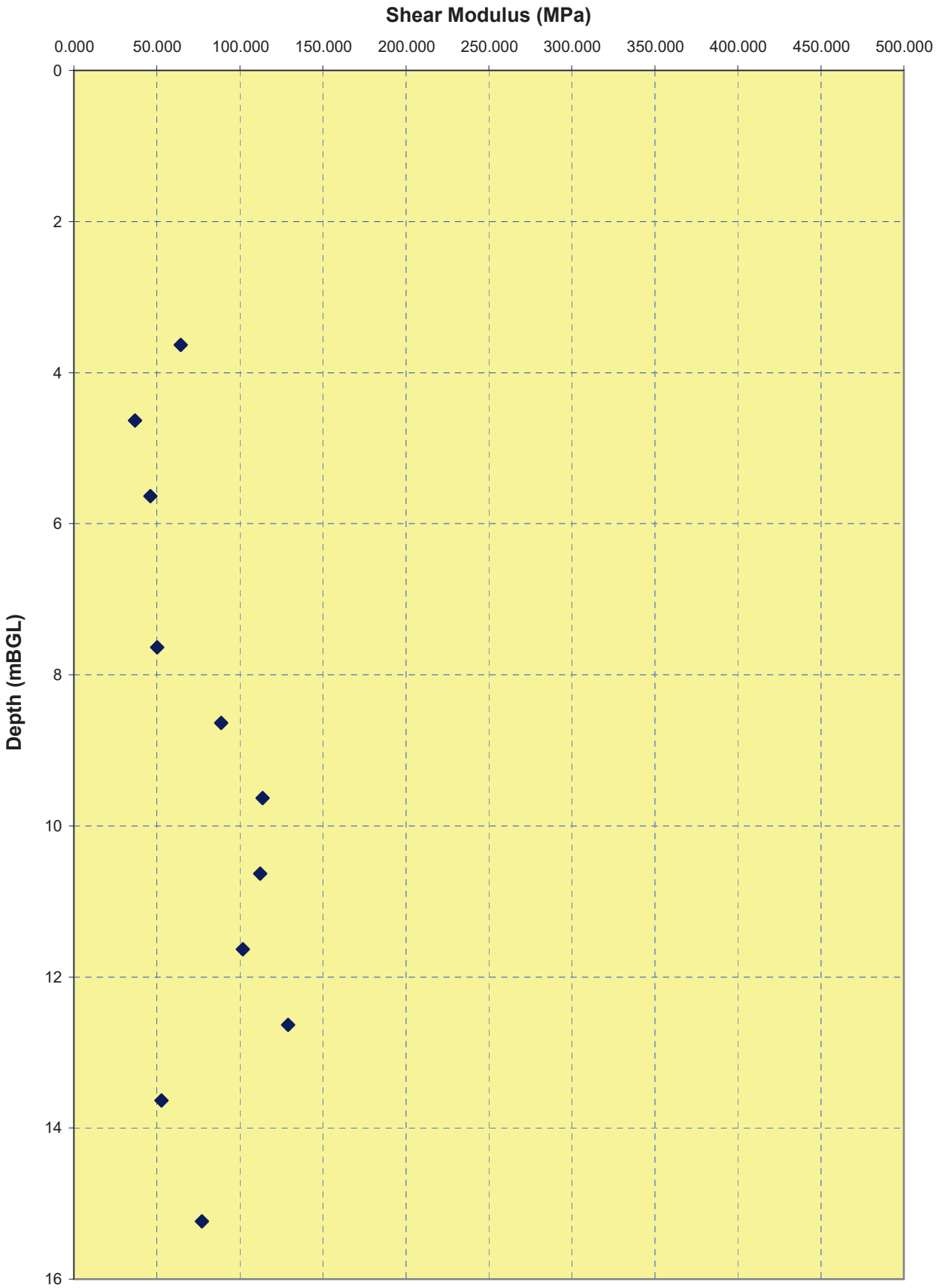
Interval Shear Modulus versus Depth



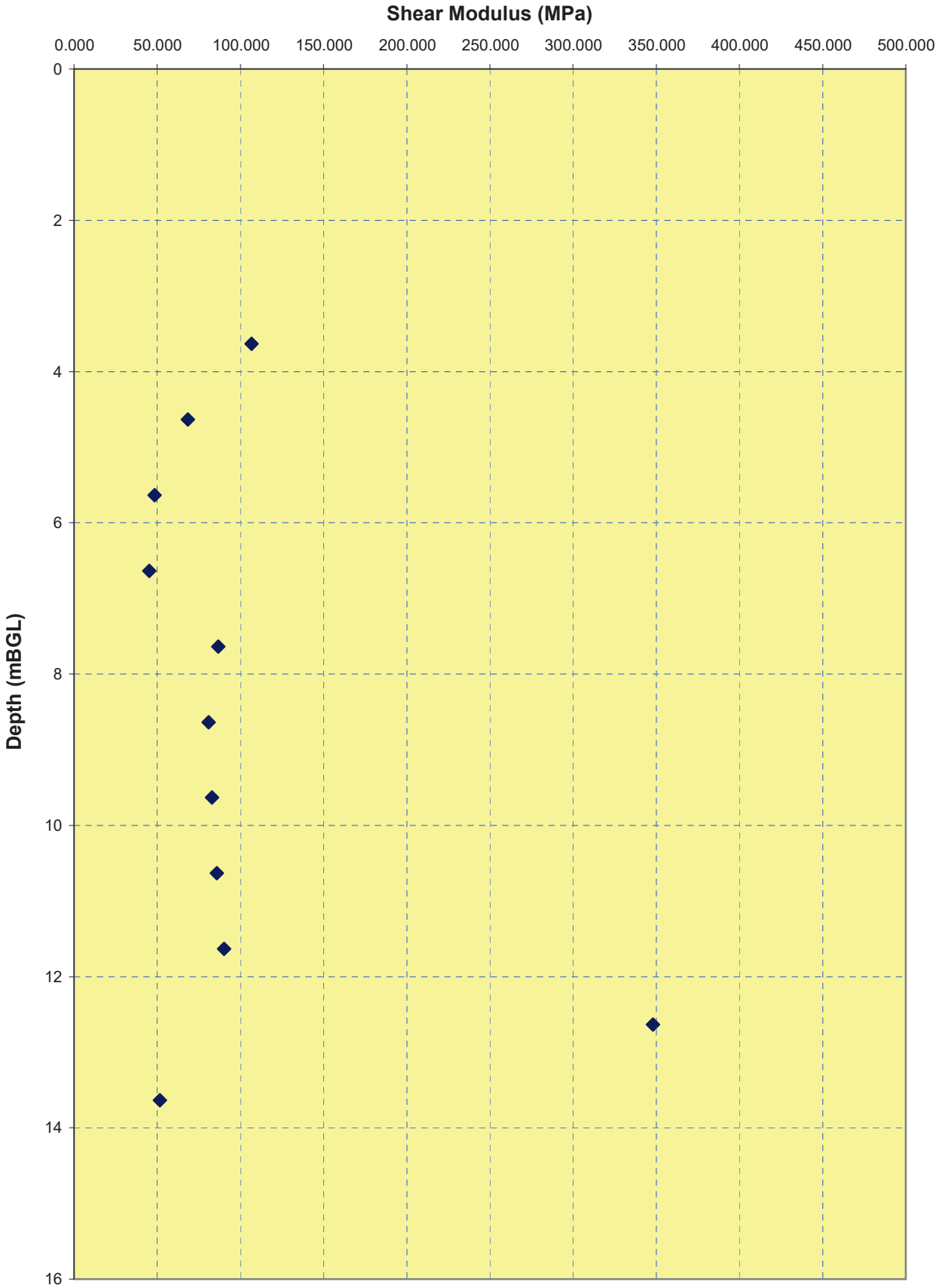
Interval Shear Modulus versus Depth



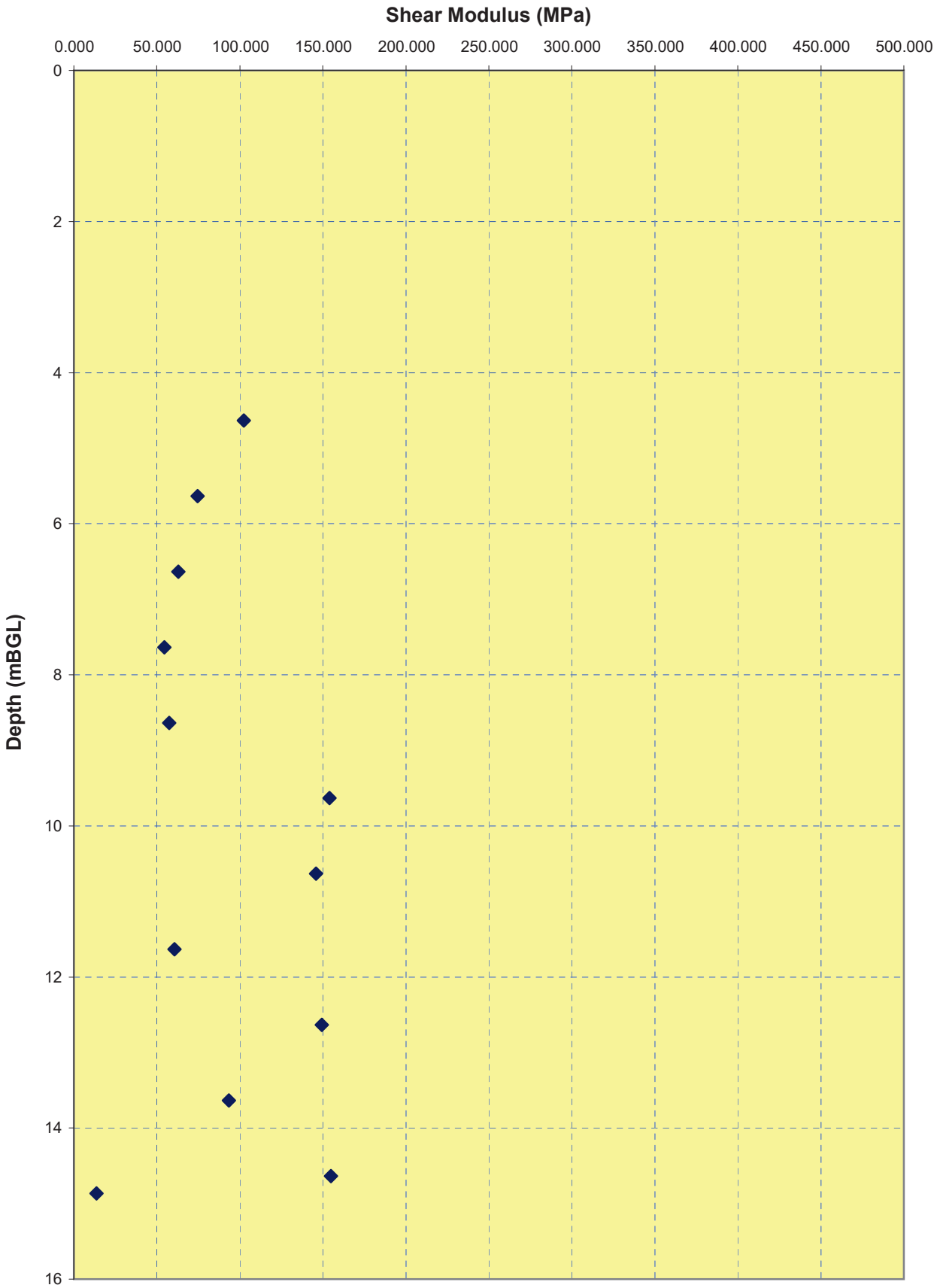
Interval Shear Modulus versus Depth



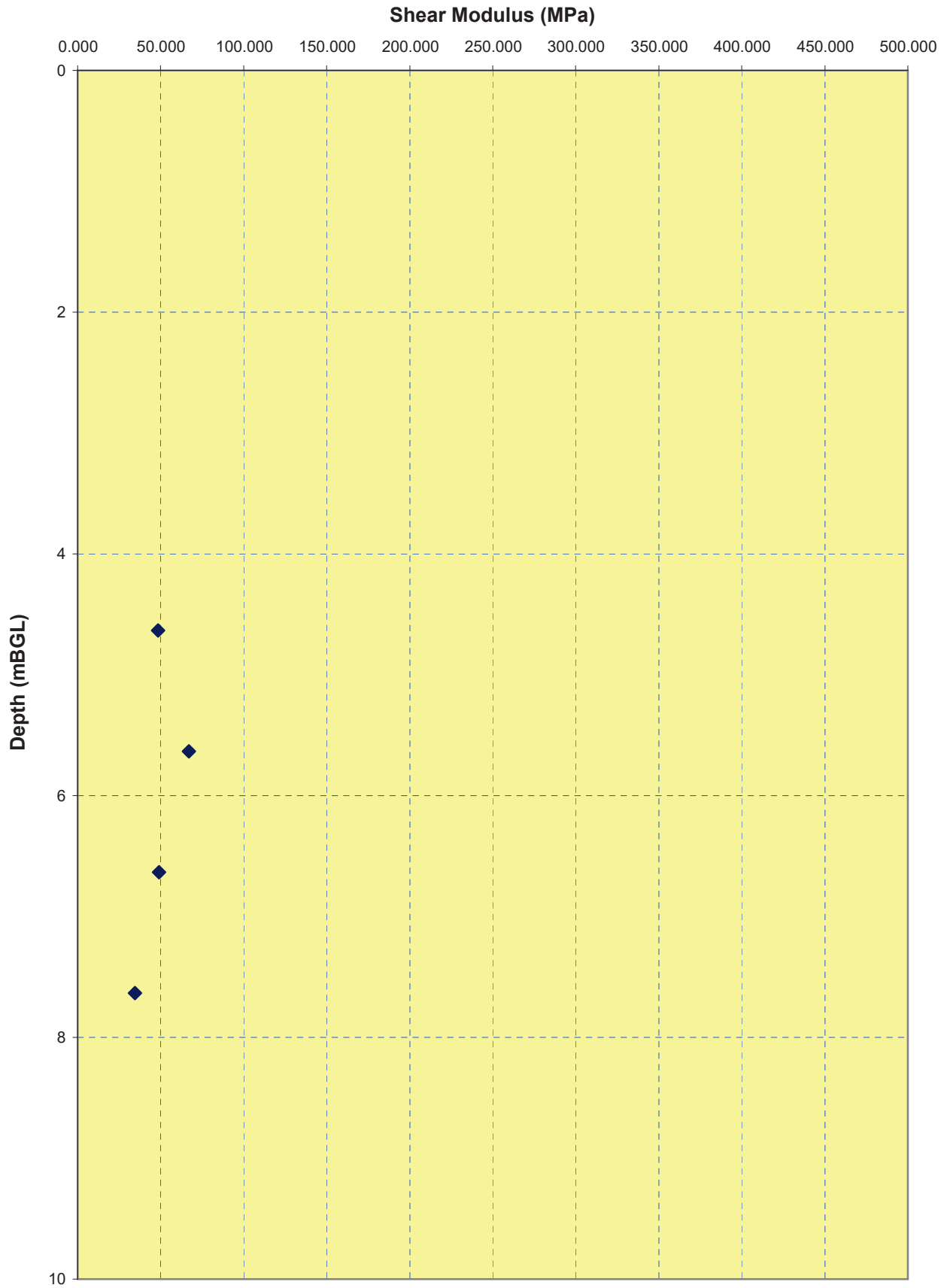
Interval Shear Modulus versus Depth



Interval Shear Modulus versus Depth



Interval Shear Modulus versus Depth



APPENDIX B1 - SERVICE CONSTRAINTS

APPENDIX B1

SERVICE CONSTRAINTS

1. This report and the assessment carried out in connection with the report (together the "Services") were compiled and carried out by Fugro Aperio Limited ("FAPL") on behalf of Fugro Engineering Services (the "Client") for Donalson Associates (the "Engineer") and Morrison Construction (the "Clients") in accordance with the terms of a contract between FES and the Client dated January 2009. The Services were performed by FAPL with the skill and care ordinarily exercised by a reasonable geotechnical specialist at the time the Services were performed. Further, and in particular, the Services were performed by FAPL taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between FAPL and the Client.

2. Other than that expressly contained in paragraph 1 above, FAPL provides no other representation or warranty whether express or implied, in relation to the Services.

3. The Services were performed by FAPL exclusively for the purposes of the Client. FAPL is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, FAPL does not authorise, consent or condone any party other than the Client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and FAPL disclaims any liability to such party. Any such party would be well advised to seek independent advice from a competent geotechnical specialist and / or lawyer.

4. It is FAPL's understanding that this report is to be used for the purpose described in Section 1 - "Introduction" of this report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, and/or should the Client's proposed development or use of the site change (including in particular any change in any design and/or specification relating to the proposed use or development of the site), this report may no longer be valid or appropriate and any further use of or reliance upon the report in those circumstances by the Client without FAPL's review and advice shall be at the Client's sole and own risk. Should FAPL be requested, and FAPL agree, to review the report after the date hereof, FAPL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FAPL and the Client.

5. The passage of time may result in changes (whether man-made or otherwise) in site conditions and changes in regulatory or other legal provisions, technology, methods of analysis, or economic conditions which could render the report inaccurate or unreliable. The information, recommendations and conclusions contained in this report should not be relied

upon if any such changes have taken place or after a period of 2 years from the date of this report or such other period as maybe expressly stated in the report, without the written agreement of FAPL. In the absence of such written agreement of FAPL, reliance on the report after any such changes have occurred or after the period of 2 years has expired shall be at the Client's own and sole risk. Should FAPL agree to review the report after the period of 2 years has expired, FAPL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FAPL and the Client.

6. The observations, recommendations and conclusions in this report are based solely upon the Services, which were provided pursuant to the contract between the Client and FAPL. FAPL has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the Client and FAPL. FAPL is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services.

7. Where the Services have involved FAPL's interpretation and/or other use of any information (including documentation or materials, analysis, recommendations and conclusions) provided by third parties (including independent testing and/or information services or laboratories) or the Client and upon which FAPL was reasonably entitled to rely or involved FAPL's observations of existing physical conditions of any site involved in the Services, then the Services clearly are limited by the accuracy of such information and the observations which were reasonably possible of the said site. Unless otherwise stated, FAPL was not authorised and did not attempt to independently verify the accuracy or completeness of such information, received from the Client or third parties during the performance of the Services. FAPL is not liable for any inaccuracies (including any incompleteness) in the said information, the discovery of which inaccuracies required the doing of any act including the gathering of any information which it was not reasonably possible for FAPL to do including the doing of any independent investigation of the information provided to FAPL save as otherwise provided in the terms of the contract between the Client and FAPL.

8. The soil and ground conditions information provided in the Services are based solely on evaluations of soil and ground condition samples and in-situ tests at determined sample test locations and elevations. That information cannot be extrapolated to any area or elevation outside those locations and elevations unless specifically so stated in the report. In the light of the information available to FAPL, the soil and ground conditions information are considered appropriate for use in relation to the geotechnical design and installation aspects of the structures addressed in the report, but they may not be appropriate for the design of other structures.

APPENDIX B2 – TABULATED RESULTS

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	28.05				2.00	
3.0	2.6	3.89	0.59	35.16	28.05	7.11		2.00	
4.0	3.6	4.63	0.74	41.88	35.16	6.72	109.61	2.00	24.030
5.0	4.6	5.45	0.82	47.90	41.88	6.03	136.25	2.00	37.129
6.0	5.6	6.32	0.87	54.62	47.90	6.72	129.95	2.00	33.772
7.0	6.6	7.23	0.91	60.64	54.62	6.03	150.34	2.00	45.203
8.0	7.6	8.15	0.93	65.78	60.64	5.14	180.65	2.00	65.271
9.0	8.6	9.10	0.94	69.73	65.78	3.95	238.77	2.00	114.022
10.0	9.6	10.05	0.95	73.38	69.73	3.66	261.05	2.00	136.294
11.0	10.6	11.01	0.96	76.74	73.38	3.36	286.56	2.00	164.237
11.3	11.0	11.34	0.33	77.23	76.74	0.49	666.66	2.00	888.861

Tabulated SCPT results – SCPT002

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	27.85				2.00	
3.0	2.6	3.89	0.59	31.70	27.85	3.85		2.00	
4.0	3.6	4.63	0.74	35.16	31.70	3.46	213.01	2.00	90.747
5.0	4.6	5.45	0.82	40.59	35.16	5.43	151.10	2.00	45.661
6.0	5.6	6.32	0.87	46.32	40.59	5.73	152.36	2.00	46.427
7.0	6.6	7.23	0.91	52.54	46.32	6.22	145.58	2.00	42.385
8.0	7.6	8.15	0.93	57.19	52.54	4.64	199.88	2.00	79.902
9.0	8.6	9.10	0.94	62.72	57.19	5.53	170.52	2.00	58.153
10.0	9.6	10.05	0.95	67.06	62.72	4.35	219.54	2.00	96.399
11.0	10.6	11.01	0.96	72.00	67.06	4.94	194.87	2.00	75.950
12.0	11.6	11.98	0.97	75.95	72.00	3.95	245.12	2.00	120.165
13.0	12.6	12.96	0.97	79.11	75.95	3.16	307.99	2.00	189.717
13.6	13.3	13.56	0.61	81.38	79.11	2.27	266.45	2.00	141.989

Tabulated SCPT results – SCPT003

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	30.5				2.00	
3.0	2.6	3.89	0.59	33.7	30.49	3.26		2.00	
4.0	3.6	4.63	0.74	38.6	33.75	4.85	151.66	2.00	46.001
5.0	4.6	5.45	0.82	44.4	38.60	5.81	141.23	2.00	39.894
6.0	5.6	6.32	0.87	49.9	44.42	5.44	160.50	2.00	51.522
7.0	6.6	7.23	0.91	54.2	49.85	4.35	208.39	2.00	86.850
8.0	7.6	8.15	0.93	59.8	54.20	5.59	165.96	2.00	55.085
9.0	8.6	9.10	0.94	65.6	59.79	5.77	163.43	2.00	53.422
10.0	9.6	10.05	0.95	69.1	65.56	3.56	267.83	2.00	143.469
11.0	10.6	11.01	0.96	73.6	69.12	4.52	212.86	2.00	90.617
12.0	11.6	11.98	0.97	76.8	73.64	3.17	305.83	2.00	187.068
13.0	12.6	12.92	0.93	80.3	76.81	3.52	265.35	2.00	140.823

Tabulated SCPT results – SCPT004

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	28.77037				2.00	
3.0	2.6	3.89	0.59	32.77031	28.77	4.00		2.00	
4.0	3.6	4.63	0.74	37.12441	32.77	4.35	169.07	2.00	57.172
5.0	4.6	5.45	0.82	41.19175	37.12	4.07	201.83	2.00	81.470
6.0	5.6	6.32	0.87	46.45759	41.19	5.27	165.73	2.00	54.934
7.0	6.6	7.23	0.91	52.64499	46.46	6.19	146.39	2.00	42.861
8.0	7.6	8.15	0.93	56.95742	52.64	4.31	215.15	2.00	92.582
9.0	8.6	9.10	0.94	61.66568	56.96	4.71	200.32	2.00	80.253
10.0	9.6	10.05	0.95	66.29061	61.67	4.62	206.30	2.00	85.122
11.0	10.6	11.01	0.96	70.54054	66.29	4.25	226.42	2.00	102.534
11.3	10.9	11.30	0.29	71.68636	70.54	1.15	253.06	2.00	128.080

Tabulated SCPT results – SCPT009

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
1.0	0.6	2.93	2.93	19.91635				2.00	
2.0	1.6	3.30	0.36	23.1663	19.92	3.25		2.00	
3.0	2.6	3.89	0.59	28.04122	23.17	4.87	121.88	2.00	29.709
4.0	3.6	4.63	0.74	31.47866	28.04	3.44	214.16	2.00	91.730
5.0	4.6	5.45	0.82	36.70775	31.48	5.23	156.99	2.00	49.291
6.0	5.6	6.32	0.87	41.04101	36.71	4.33	201.40	2.00	81.124
7.0	6.6	7.23	0.91	47.81174	41.04	6.77	133.78	2.00	35.794
8.0	7.6	8.15	0.93	52.16583	47.81	4.35	213.09	2.00	90.818
9.0	8.6	9.10	0.94	57.85324	52.17	5.69	165.83	2.00	54.999
10.0	9.6	10.05	0.95	62.18651	57.85	4.33	220.19	2.00	96.966
10.8	10.4	10.81	0.76	64.62397	62.19	2.44	311.65	2.00	194.250

Tabulated SCPT results – SCPT011

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
1.0	0.6	2.93	2.93	46.85342				2.00	
2.0	1.6	3.30	0.36	49.16588	46.85	2.31		2.00	
3.0	2.6	3.89	0.59	52.70749	49.17	3.54	167.76	2.00	56.288
4.0	3.6	4.63	0.74	57.31158	52.71	4.60	159.89	2.00	51.132
5.0	4.6	5.45	0.82	62.874	57.31	5.56	147.58	2.00	43.561
6.0	5.6	6.32	0.87	68.41557	62.87	5.54	157.49	2.00	49.604
6.8	6.4	7.03	0.71	71.93635	68.42	3.52	202.64	2.00	82.126

Tabulated SCPT results – SCPT013

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
1.0	0.6	2.93	2.93	34.14529				2.00	
2.0	1.6	3.30	0.36	34.5	34.15	0.35		2.00	
3.0	2.6	3.89	0.59	38.18689	34.50	3.69	161.15	2.00	51.939
4.0	3.6	4.63	0.74	42.39516	38.19	4.21	174.93	2.00	61.203
5.0	4.6	5.45	0.82	57.01992	42.40	14.62	56.13	2.00	6.302
6.0	5.6	6.32	0.87	62.3115	57.02	5.29	164.93	2.00	54.401
6.5	6.1	6.77	0.45	62.9	62.31	0.59	763.94	2.00	1167.212

Tabulated SCPT results – SCPT014

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
2.0	1.6	3.30	3.30	45.54				2.00	
3.0	2.6	3.89	0.59	58.87	45.54	13.33		2.00	
4.0	3.6	4.63	0.74	62.98	58.87	4.10	179.37	2.00	64.350
5.0	4.6	5.45	0.82	69.02	62.98	6.04	135.88	2.00	36.925
6.0	5.6	6.32	0.87	74.77	69.02	5.75	151.78	2.00	46.074
8.0	7.6	8.15	1.83	86.35	74.77	11.58	158.30	2.00	50.118
9.0	8.6	9.10	0.94	90.83	86.35	4.48	210.57	2.00	88.675
10.0	9.6	10.05	0.95	94.83	90.83	4.00	238.54	2.00	113.801
11.0	10.6	11.01	0.96	98.89	94.83	4.06	236.87	2.00	112.217
12.0	11.6	11.98	0.97	103.19	98.89	4.29	225.66	2.00	101.848
13.0	12.6	12.96	0.97	107.02	103.19	3.83	253.90	2.00	128.926
14.0	13.6	13.93	0.98	113.04	107.02	6.02	162.28	2.00	52.669
15.0	14.6	14.91	0.98	114.75	113.04	1.71	573.72	2.00	658.304
15.6	15.2	15.50	0.59	117.75	114.75	3.00	196.43	2.00	77.167

Tabulated SCPT results – SCPT017

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
2.0	1.6	3.30	3.30	59.96				2.00	
3.0	2.6	3.89	0.59	61.54	59.96	1.58		2.00	
4.0	3.6	4.63	0.74	64.73	61.54	3.19	230.96	2.00	106.683
5.0	4.6	5.45	0.82	69.17	64.73	4.44	185.00	2.00	68.448
6.0	5.6	6.32	0.87	74.77	69.17	5.60	155.73	2.00	48.503
7.0	6.6	7.23	0.91	80.79	74.77	6.02	150.44	2.00	45.267
8.0	7.6	8.15	0.93	85.25	80.79	4.46	208.12	2.00	86.624
9.0	8.6	9.10	0.94	89.94	85.25	4.69	201.21	2.00	80.968
10.0	9.6	10.05	0.95	94.62	89.94	4.69	203.55	2.00	82.867
11.0	10.6	11.01	0.96	99.27	94.62	4.65	207.13	2.00	85.806
12.0	11.6	11.98	0.97	103.83	99.27	4.56	212.27	2.00	90.116
13.0	12.6	12.96	0.97	106.16	103.83	2.33	417.11	2.00	347.968
14.0	13.6	13.93	0.98	112.25	106.16	6.08	160.61	2.00	51.592
14.9	14.6	14.85	0.92	113.12	112.25	0.87	1052.82	2.00	2216.874

Tabulated SCPT results – SCPT019

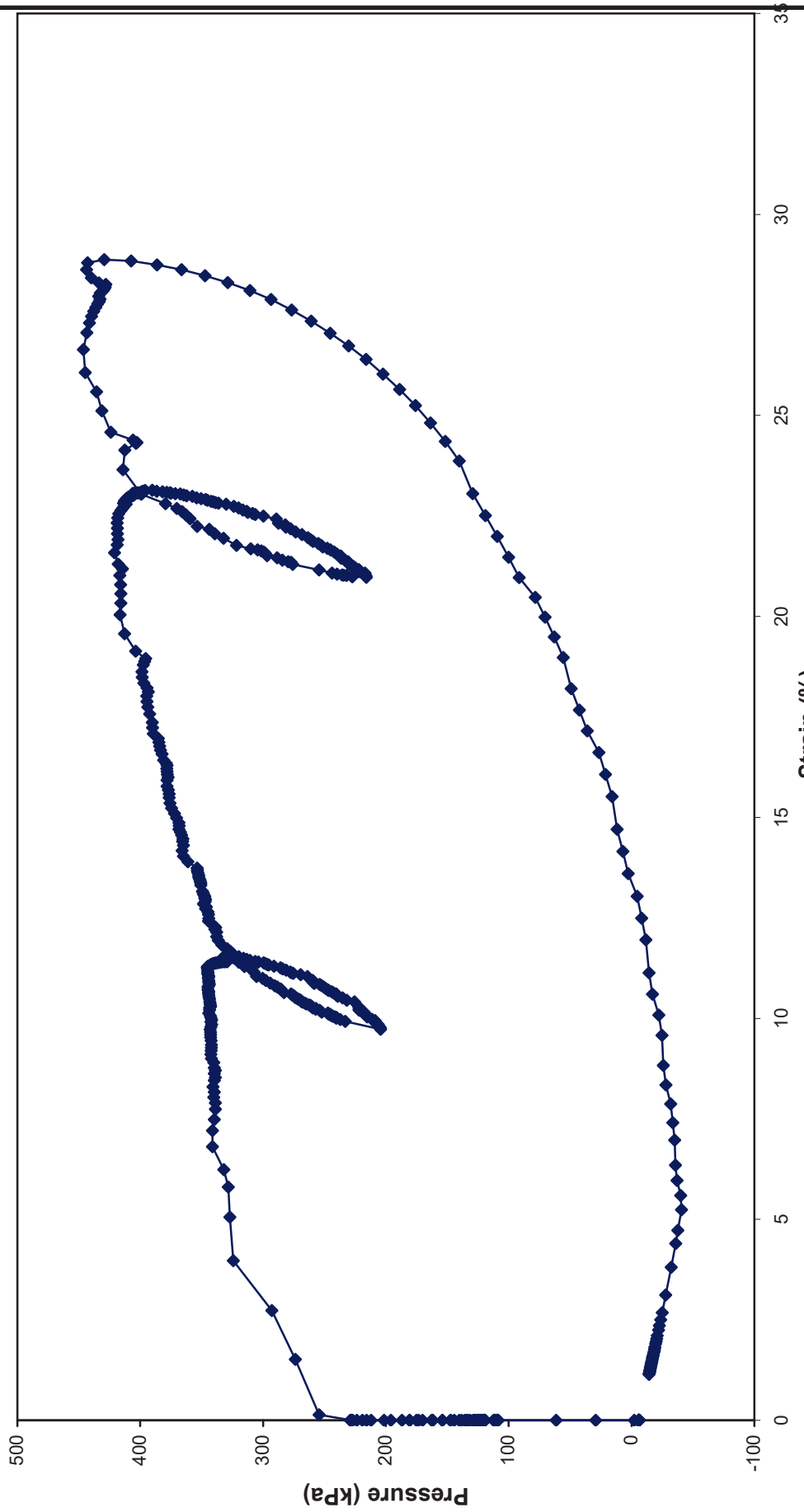
Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
2.0	1.6	3.30	3.30	50.19				2.00	
3.0	2.6	3.89	0.59	55.55	50.19	5.37		2.00	
5.0	4.6	5.45	1.56	62.44	55.55	6.88	226.26	2.00	102.386
6.0	5.6	6.32	0.87	66.96	62.44	4.52	193.05	2.00	74.535
7.0	6.6	7.23	0.91	72.06	66.96	5.10	177.46	2.00	62.986
8.0	7.6	8.15	0.93	77.69	72.06	5.62	164.95	2.00	54.418
9.0	8.6	9.10	0.94	83.25	77.69	5.56	169.56	2.00	57.498
10.0	9.6	10.05	0.95	86.69	83.25	3.44	277.57	2.00	154.093
11.0	10.6	11.01	0.96	90.25	86.69	3.56	270.12	2.00	145.927
12.0	11.6	11.98	0.97	95.81	90.25	5.56	174.11	2.00	60.627
13.0	12.6	12.96	0.97	99.37	95.81	3.56	273.20	2.00	149.274
14.0	13.6	13.93	0.98	103.89	99.37	4.52	216.12	2.00	93.418
15.0	14.6	14.91	0.98	107.41	103.89	3.52	278.37	2.00	154.982
15.2	14.9	15.14	0.23	110.14	107.41	2.73	82.73	2.00	13.689

Tabulated SCPT results – SCPT020

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x)		S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
				Bottom (ms)	Top (ms)				
3.0	2.6	3.89	3.89	40.46				2.00	
4.0	3.6	4.63	0.74	43.21	40.46	2.75		2.00	
5.0	4.6	5.45	0.82	48.48	43.21	5.27	155.75	2.00	48.515
6.0	5.6	6.32	0.87	53.25	48.48	4.77	182.93	2.00	66.928
7.0	6.6	7.23	0.91	59.04	53.25	5.79	156.40	2.00	48.920
8.0	7.6	8.15	0.93	66.10	59.04	7.06	131.38	2.00	34.520
8.5	8.1	8.62	0.47	66.80	66.10	0.70	673.32	2.00	906.708

Tabulated SCPT results – SCPT022

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Remarks

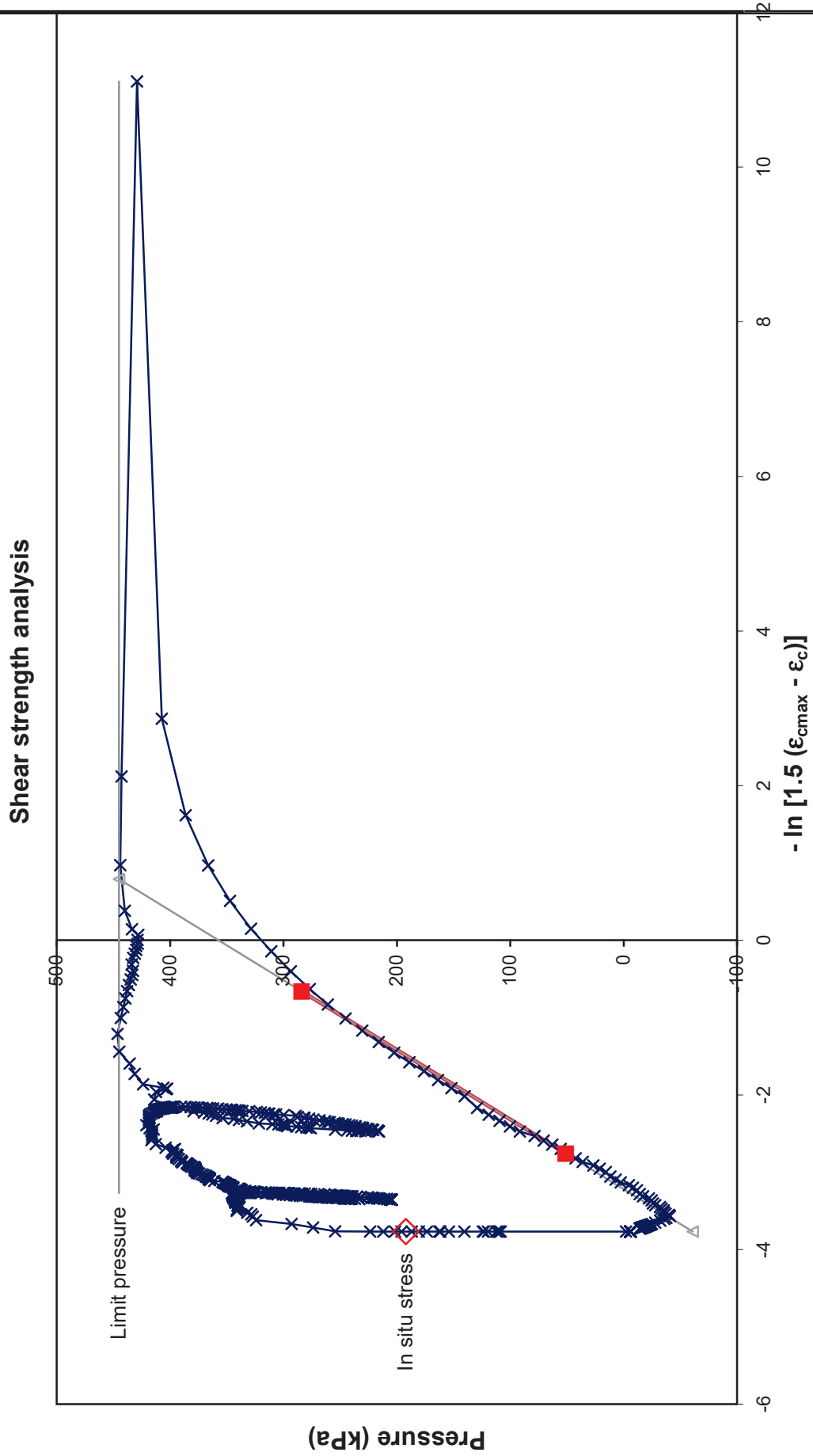
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_02 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Shear strength analysis		
	δε	δπ
	–0.66	284
	–2.76	51
	Gradient	110.95
	Su (kPa)	**55**

In situ stress analysis		
	δε	P
	-3.77	-60.90
	0.79	445.00
	σm (kPa)	**192**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

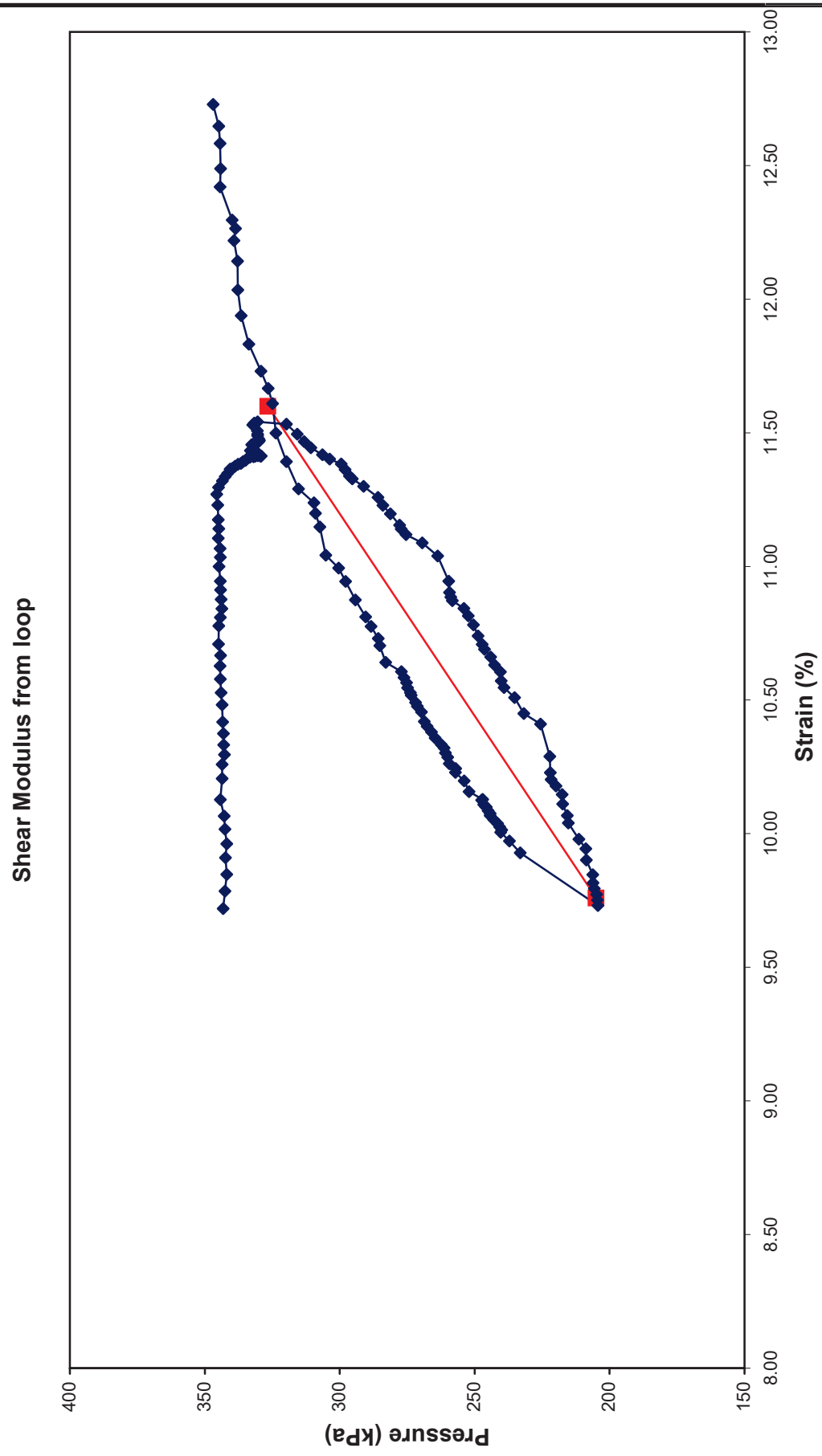
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_02 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
9.76	205
11.60	326.6
1.84 %	122 kPa

Unload reload modulus, Gur **3.3** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

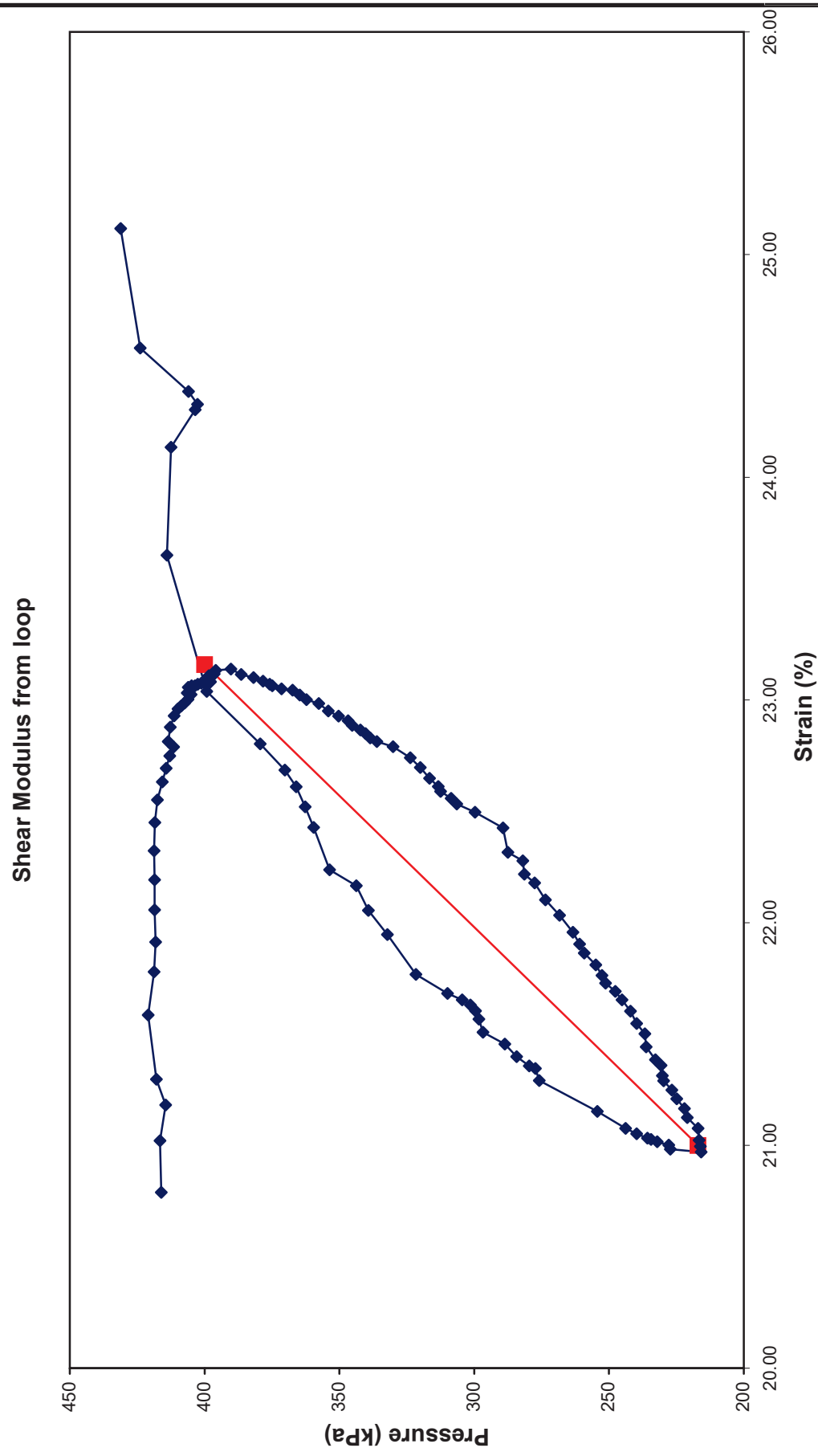
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_02 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 2	
δε	dp
21.00	217
23.16	400
2.16 %	183 kPa

Unload reload modulus, Gur **4.2** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

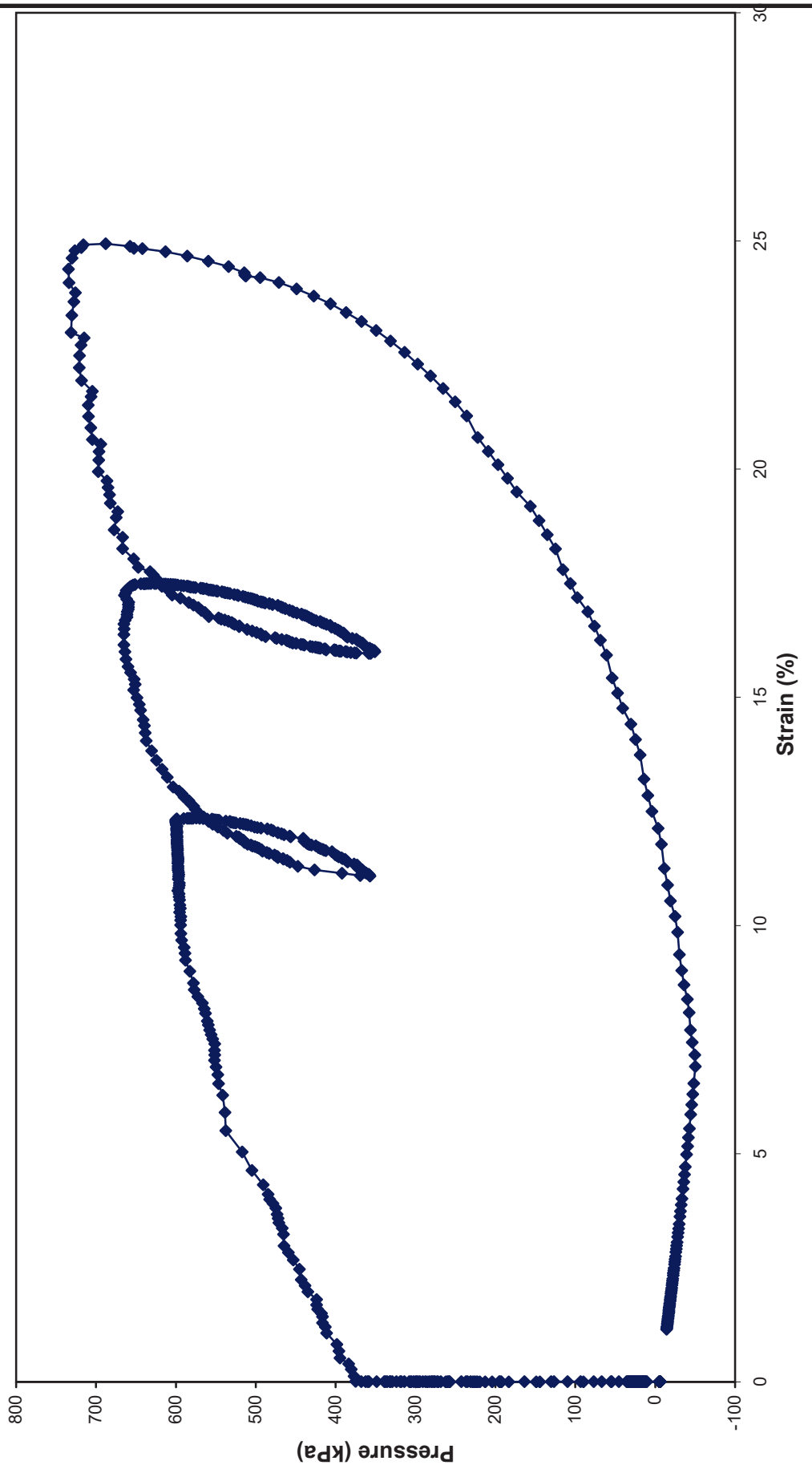
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_02 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	2
Depth(m)	6.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Remarks

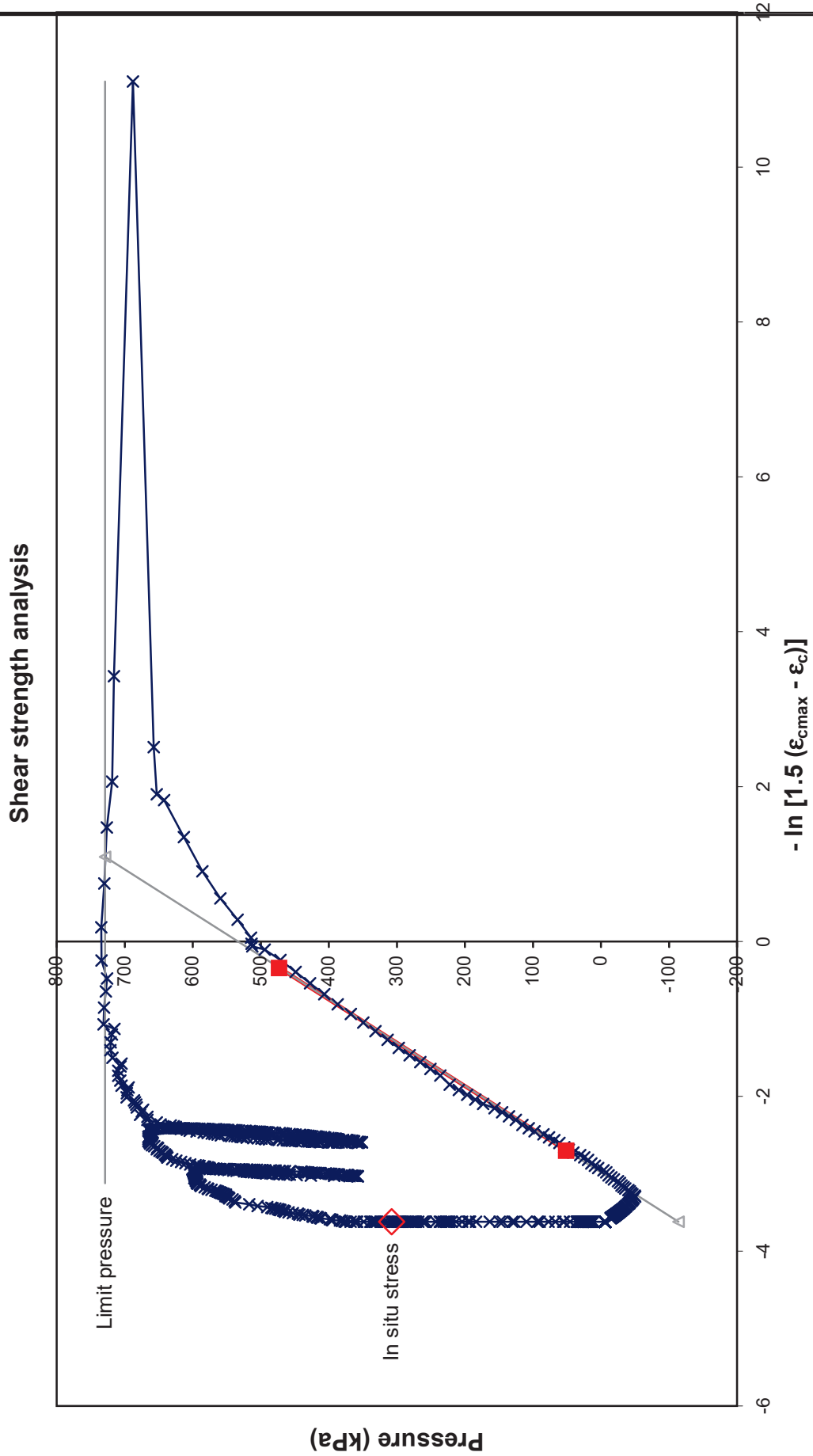
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_02 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	2
Depth(m)	6.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Shear strength analysis		
	δε	δπ
	–0.34	473
	–2.7	51
	Gradient	178.81
	Su (kPa)	**89**

In situ stress analysis		
	δε	P
	-3.62	-113.85
	1.09	729.00
	σm (kPa)	**308**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_02 T2

Driven Pressuremeter Test Results

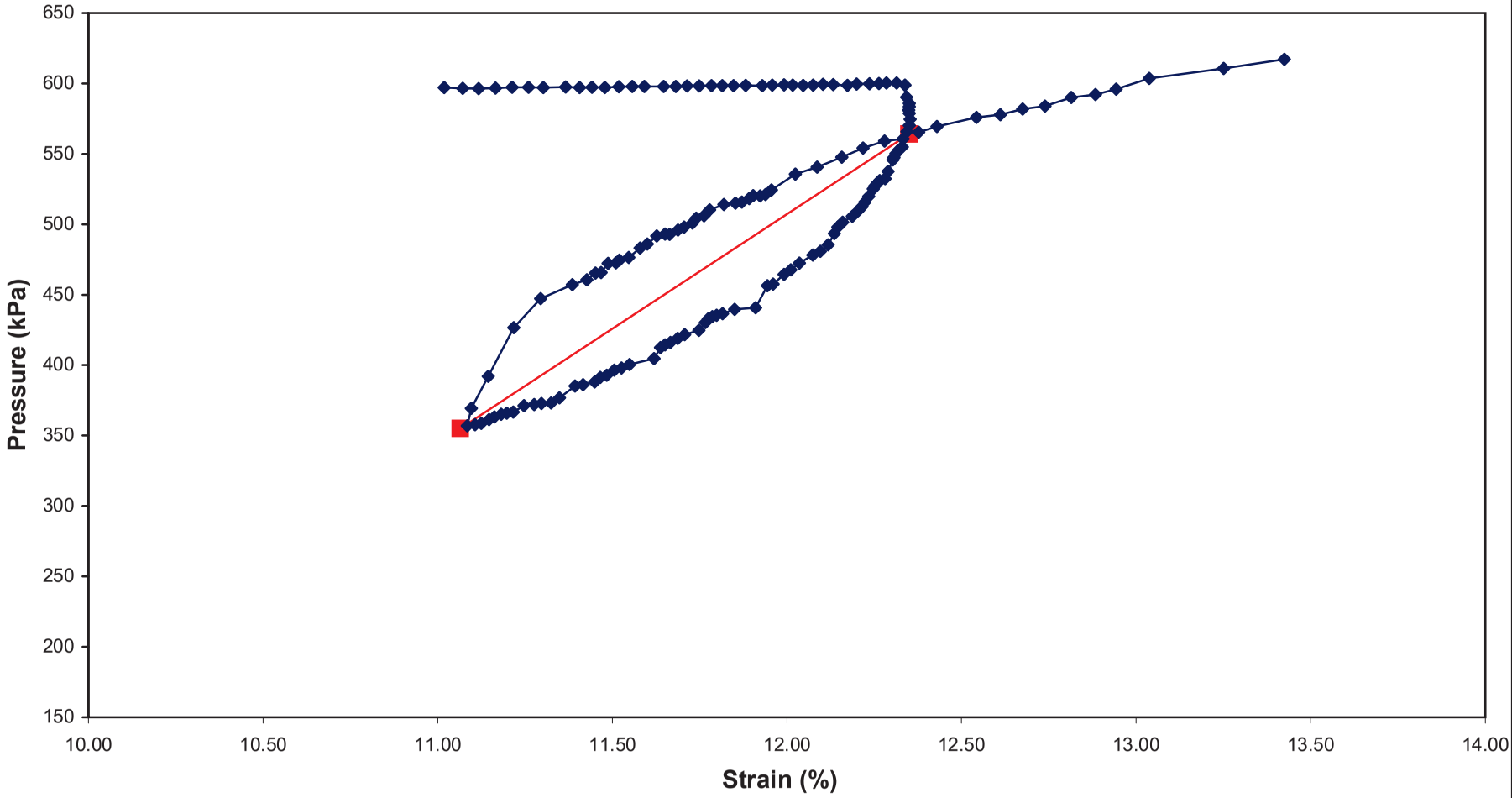
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_02 T2



Borehole Number	cpt_02
Test Number	2
Depth(m)	6.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.07	355
12.35	564
1.29 %	209 kPa

Unload reload modulus, Gur **8.1** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

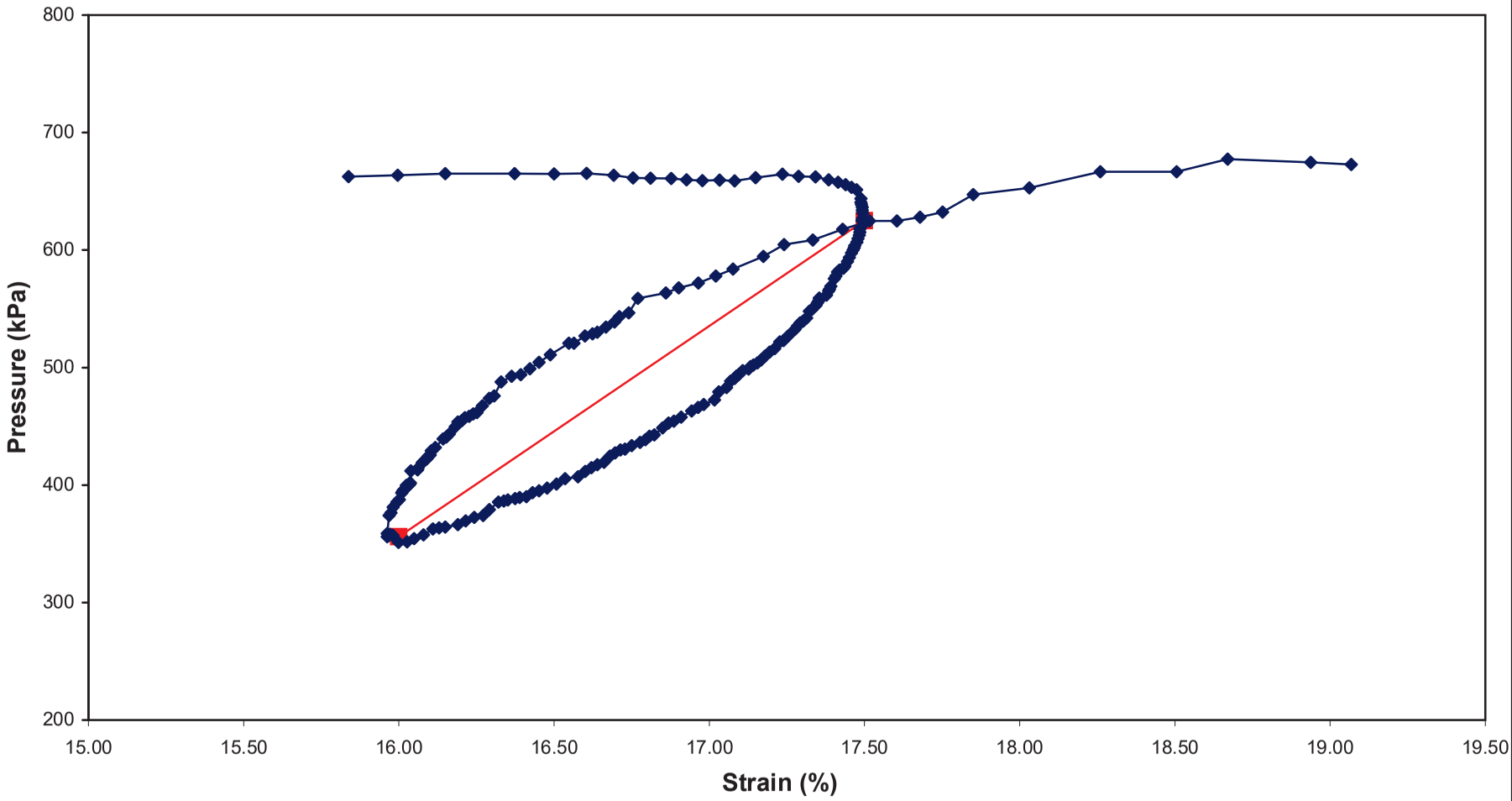
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_02 T2



Borehole Number	cpt_02
Test Number	2
Depth(m)	6.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

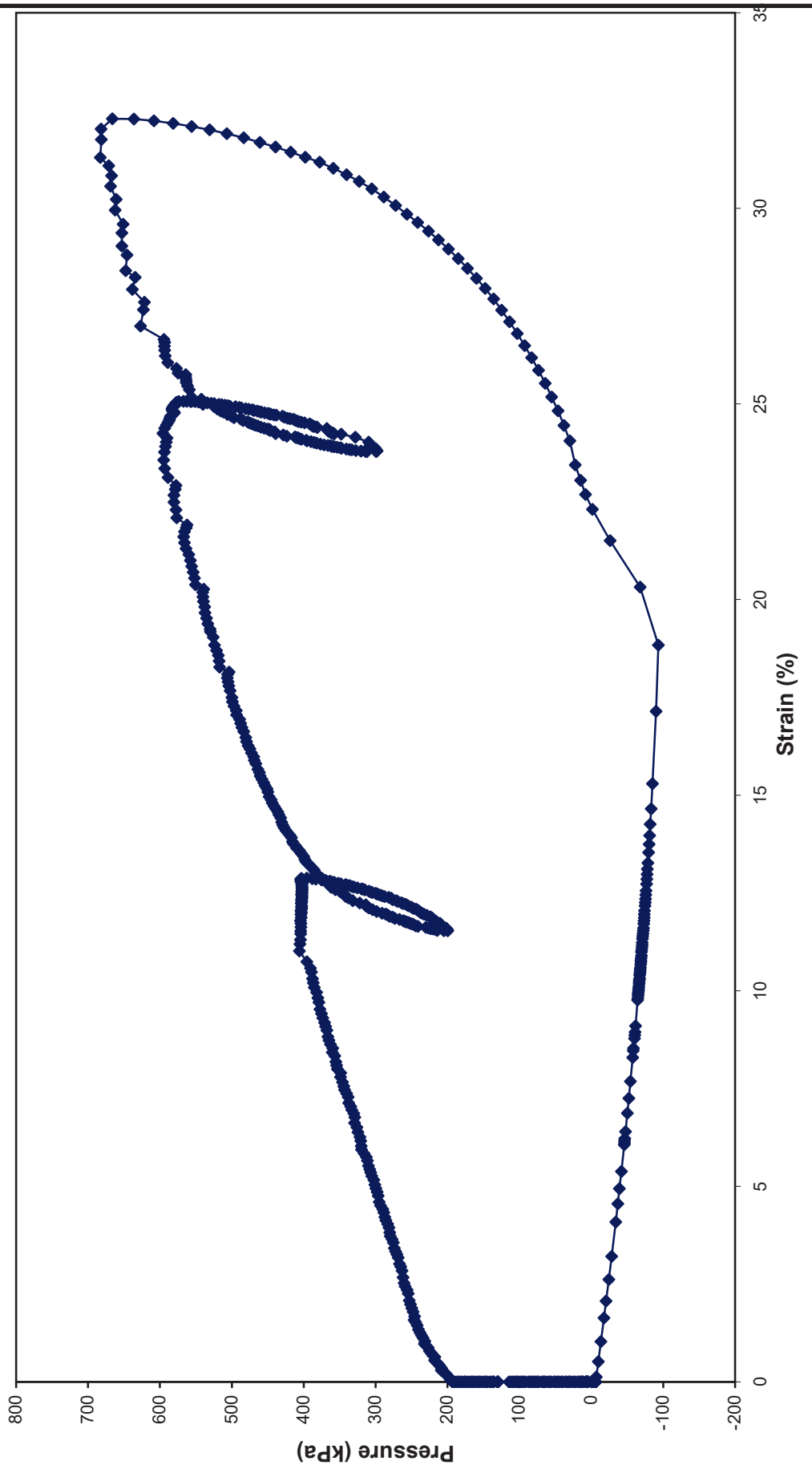
Loop 2	
δε	dp
16.00	356
17.50	625
1.50 %	269 kPa

Unload reload modulus, Gur **9.0** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Remarks

Borehole Number	cpt_03
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	14 April 2009

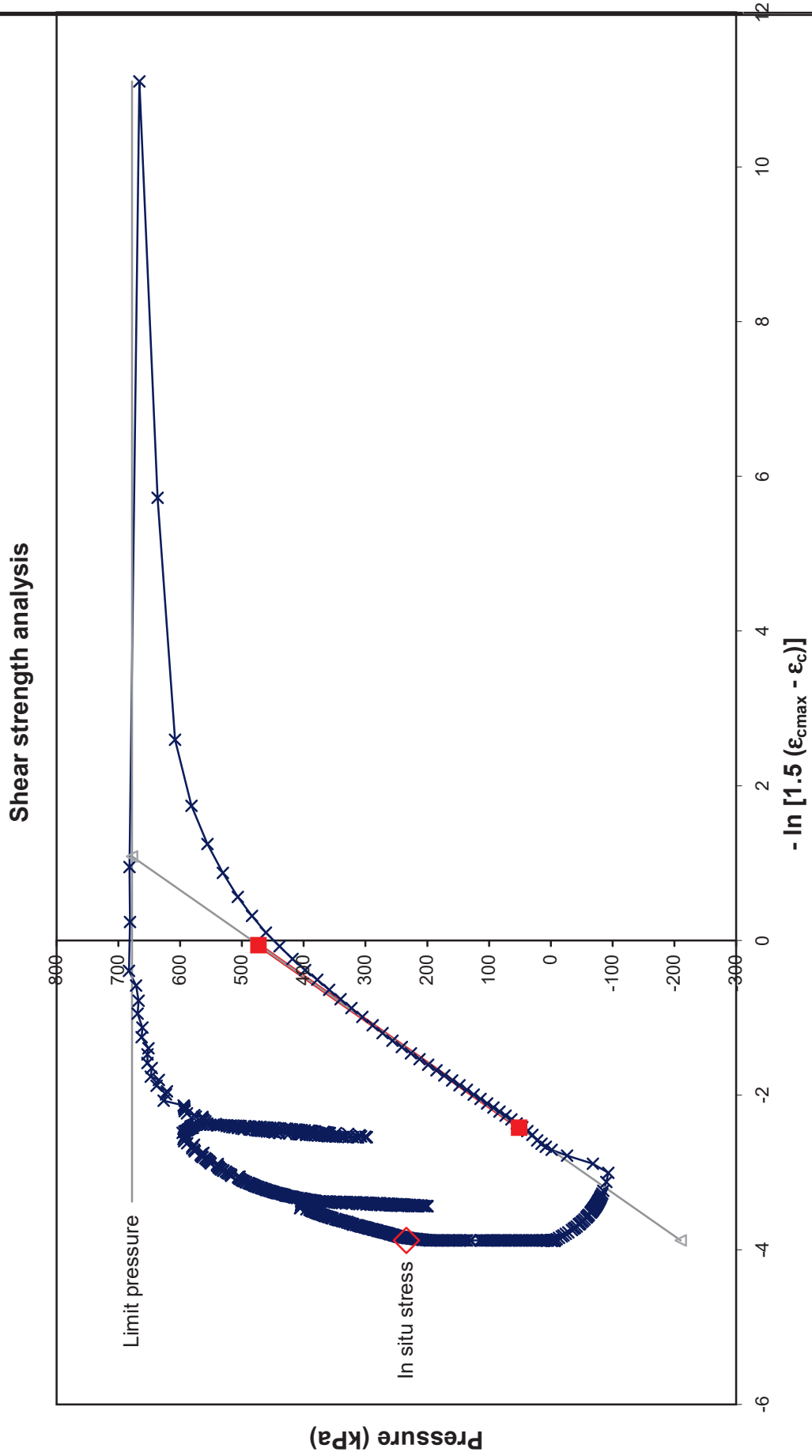
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_03 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_03
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	–0.06	473
	–2.42	51
	Gradient	178.81
	Su (kPa)	**89**

In situ stress analysis		
	δε	P
	-3.88	-210.10
	1.09	678.00
	σm (kPa)	**234**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_03 T1

Driven Pressuremeter Test Results

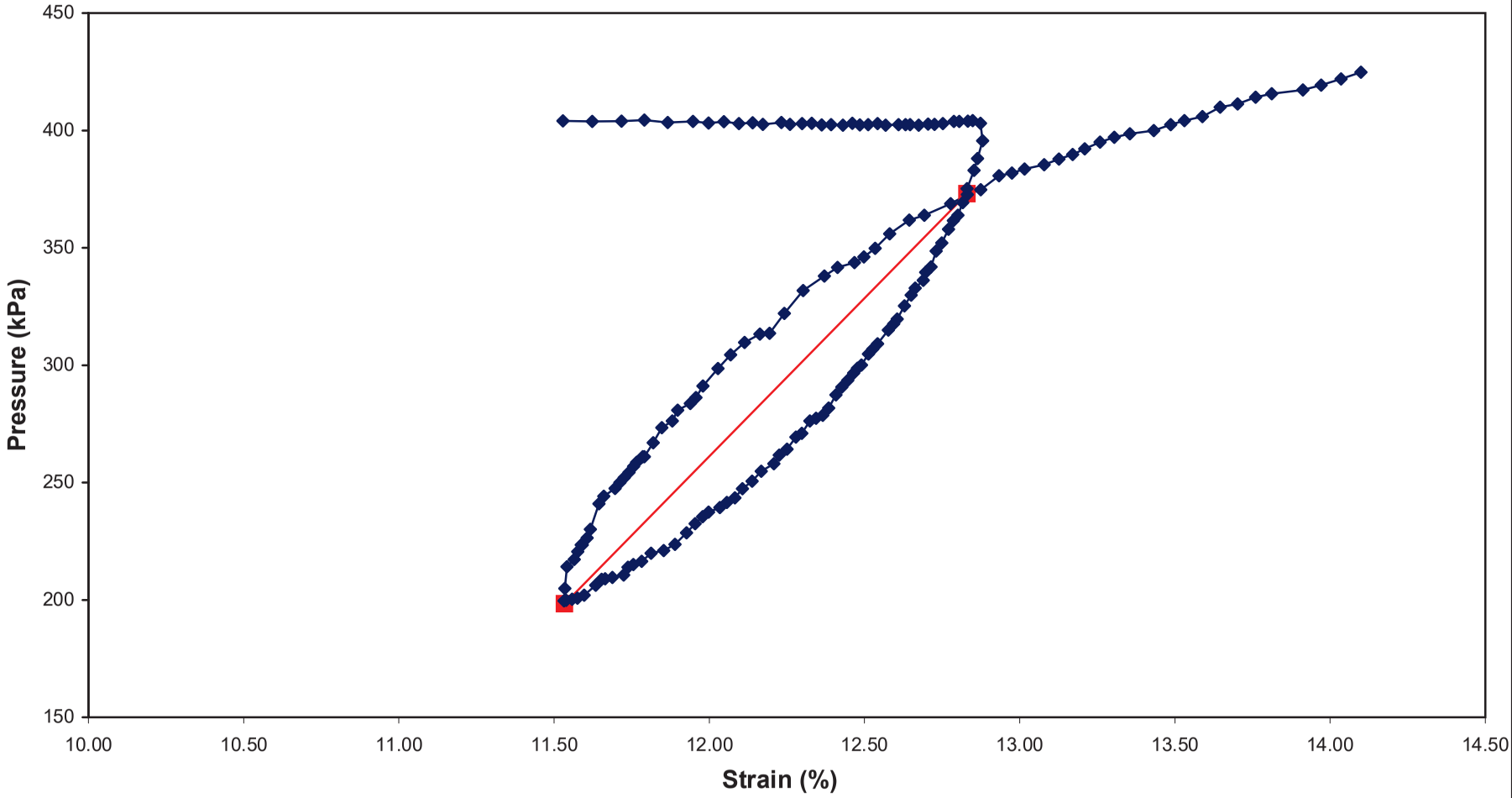
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_03 T1



Borehole Number	cpt_03
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.53	198
12.83	373
1.30 %	175 kPa

Unload reload modulus, Gur **6.7** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

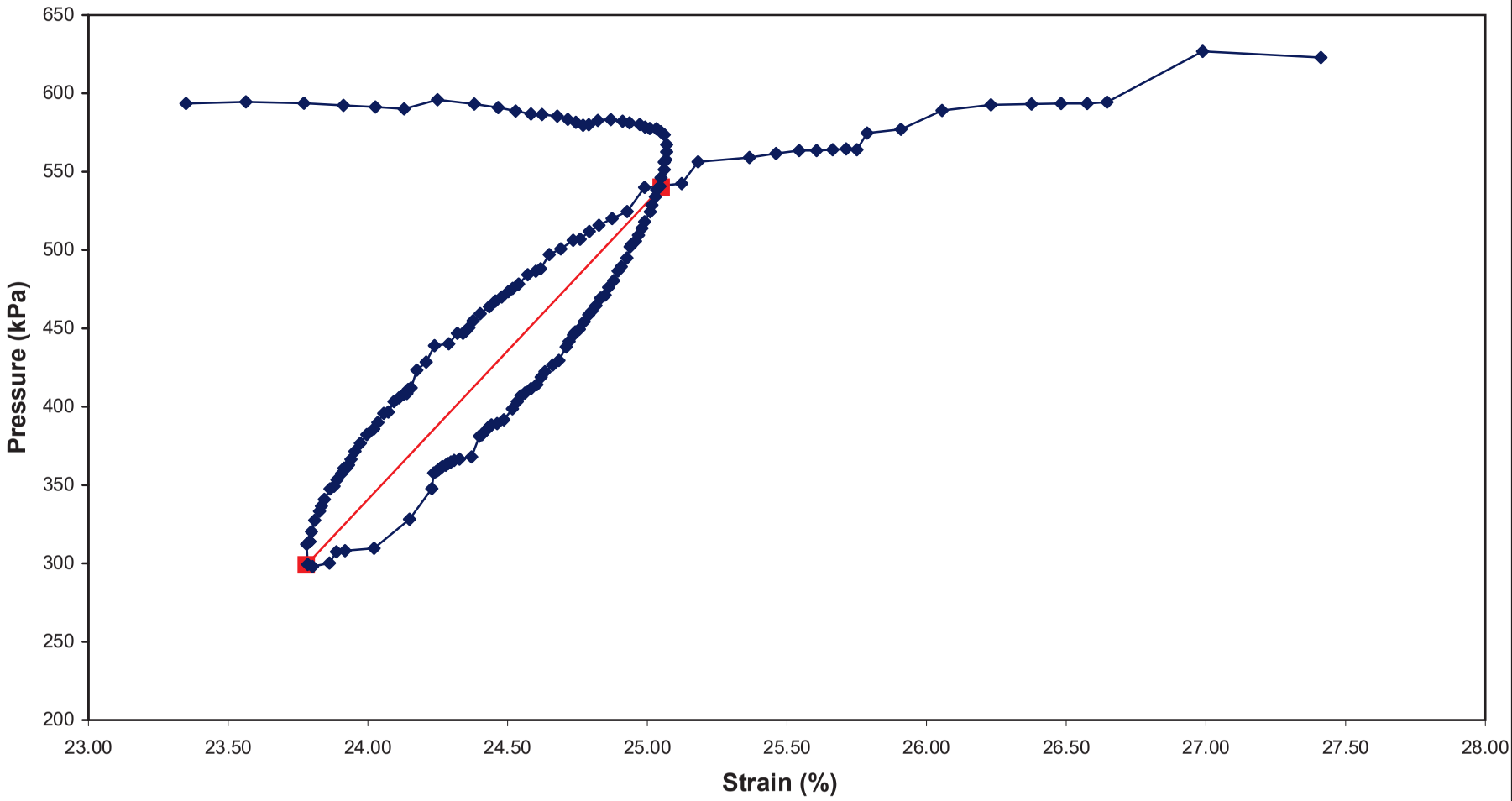
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_03 T1



Borehole Number	cpt_03
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	14 April 2009

Calculating Shear Modulus

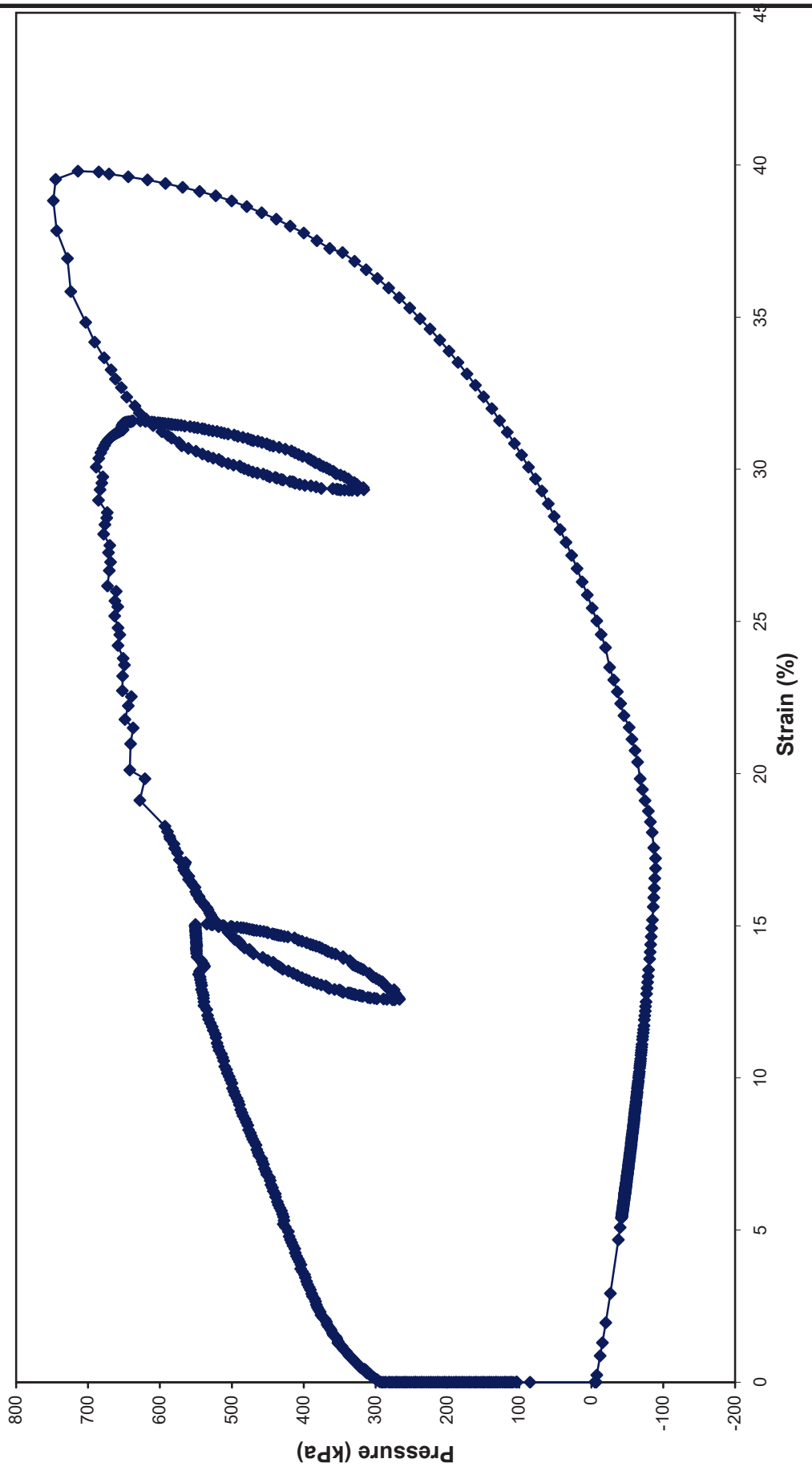
Loop 2	
δε	dp
23.78	299
25.05	540
1.27 %	241 kPa

Unload reload modulus, Gur **9.5** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_03
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Remarks

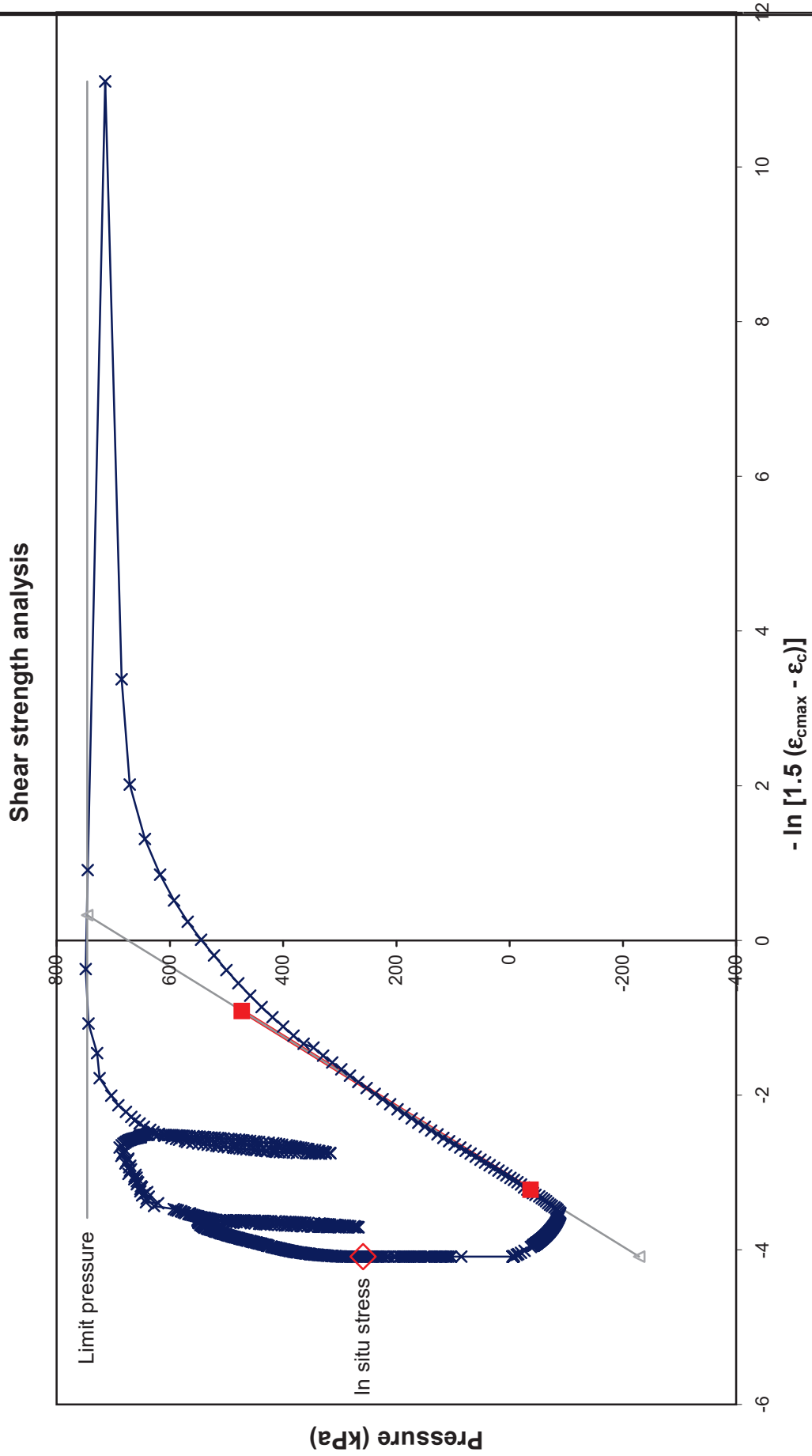
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_03 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_03
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	–0.91	473
	–3.22	–37
	Gradient	220.78
	Su (kPa)	110

In situ stress analysis	
δε	P
-4.09	-228.89
0.33	746.00
σm (kPa)	259

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_03 T2

Driven Pressuremeter Test Results

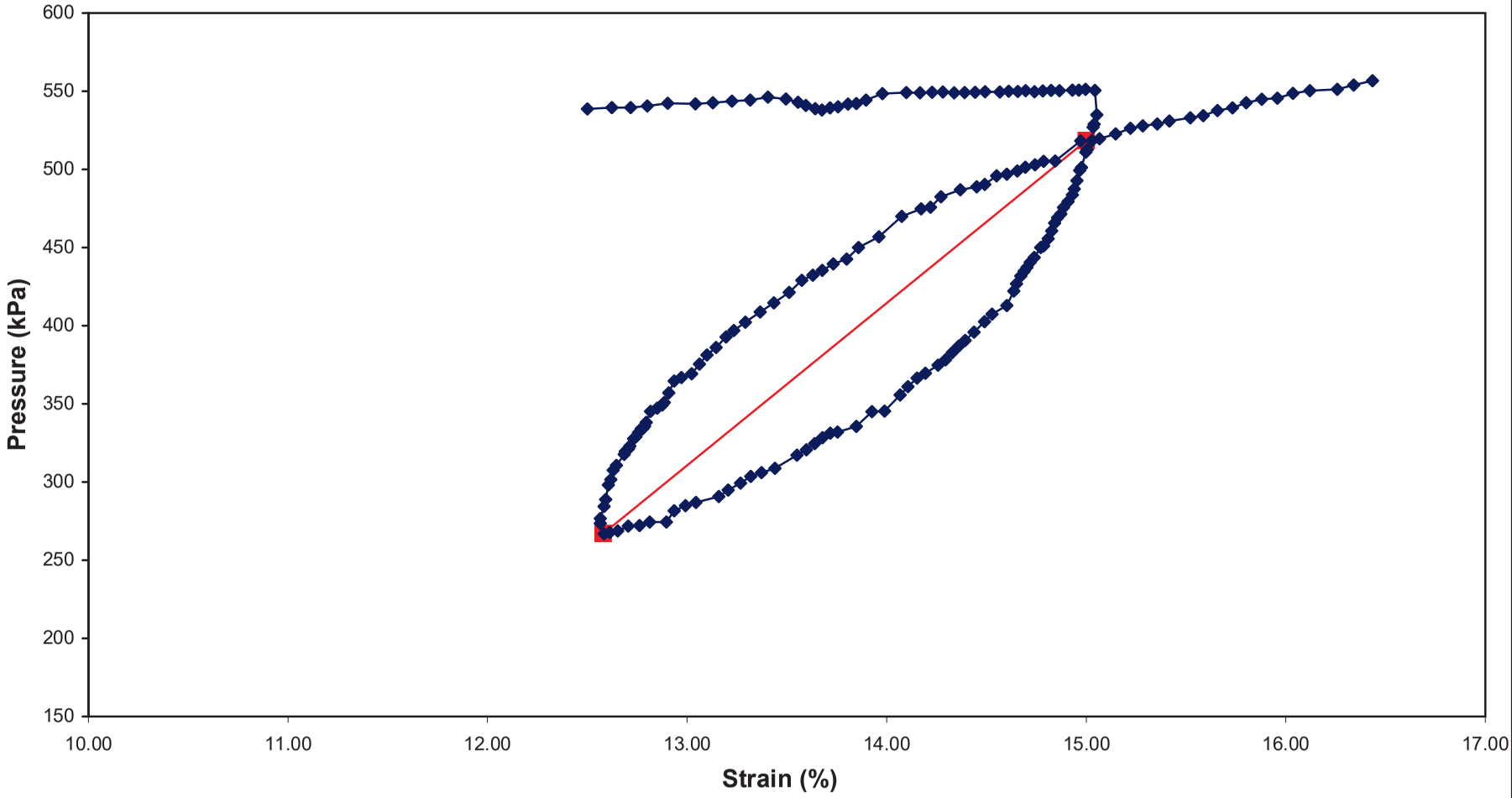
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_03 T2



Borehole Number	cpt_03
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
12.58	267
15.00	518.4
2.42 %	251 kPa

Unload reload modulus, Gur **5.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

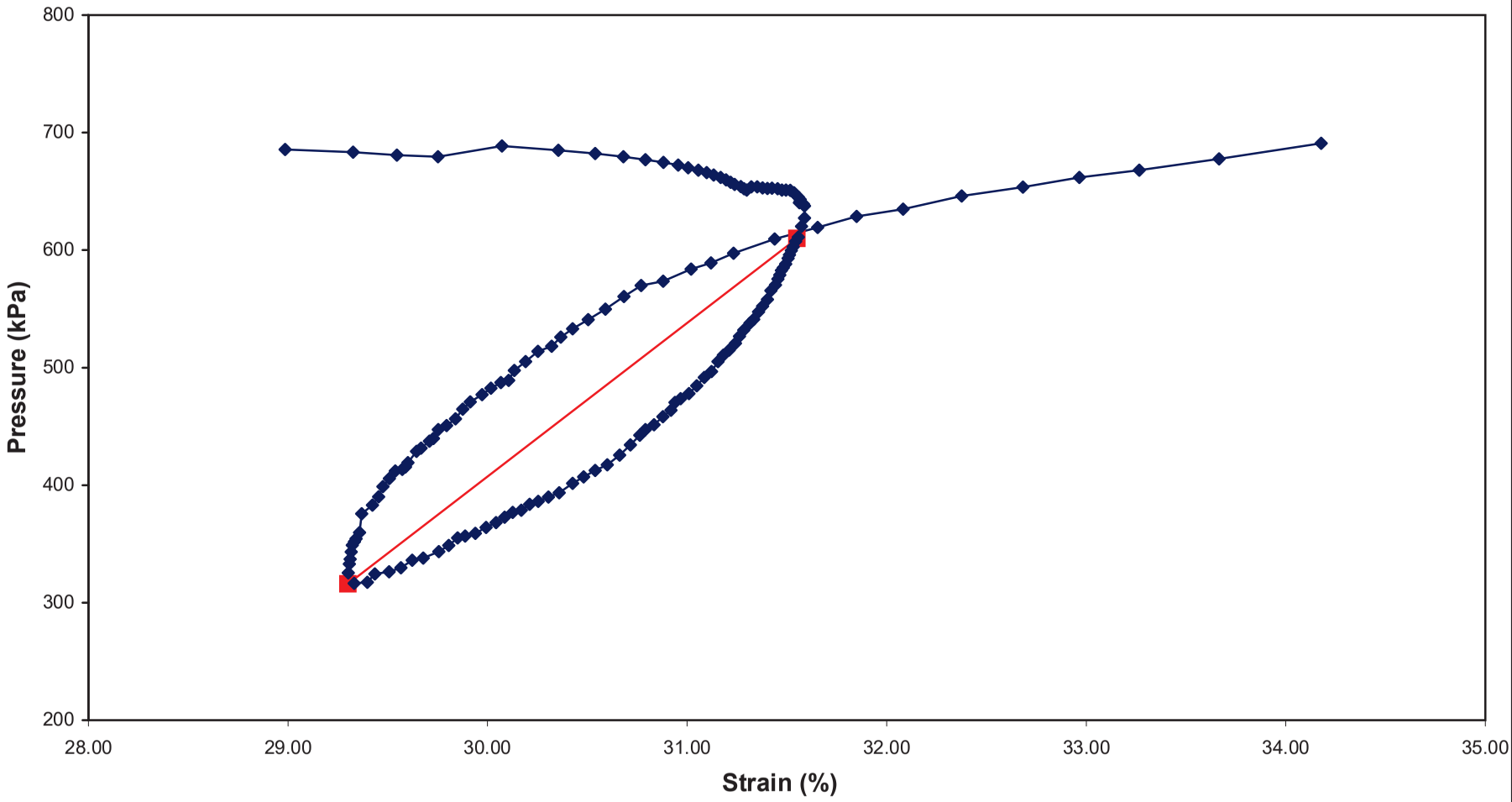
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_03 T2



Borehole Number	cpt_03
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

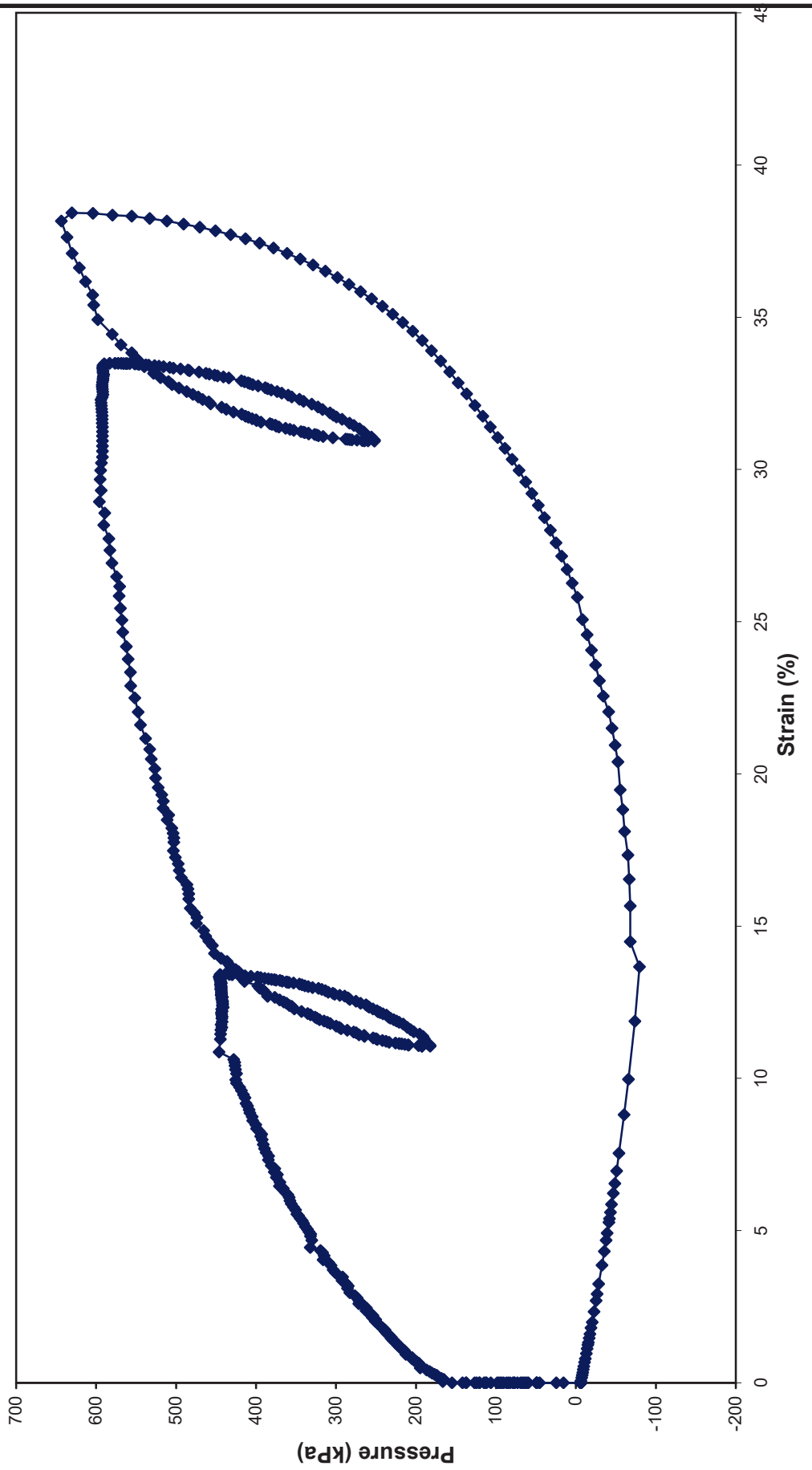
Loop 2	
δε	dp
29.30	316
31.55	610
2.25 %	294 kPa

Unload reload modulus, Gur **6.5** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_04
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Remarks

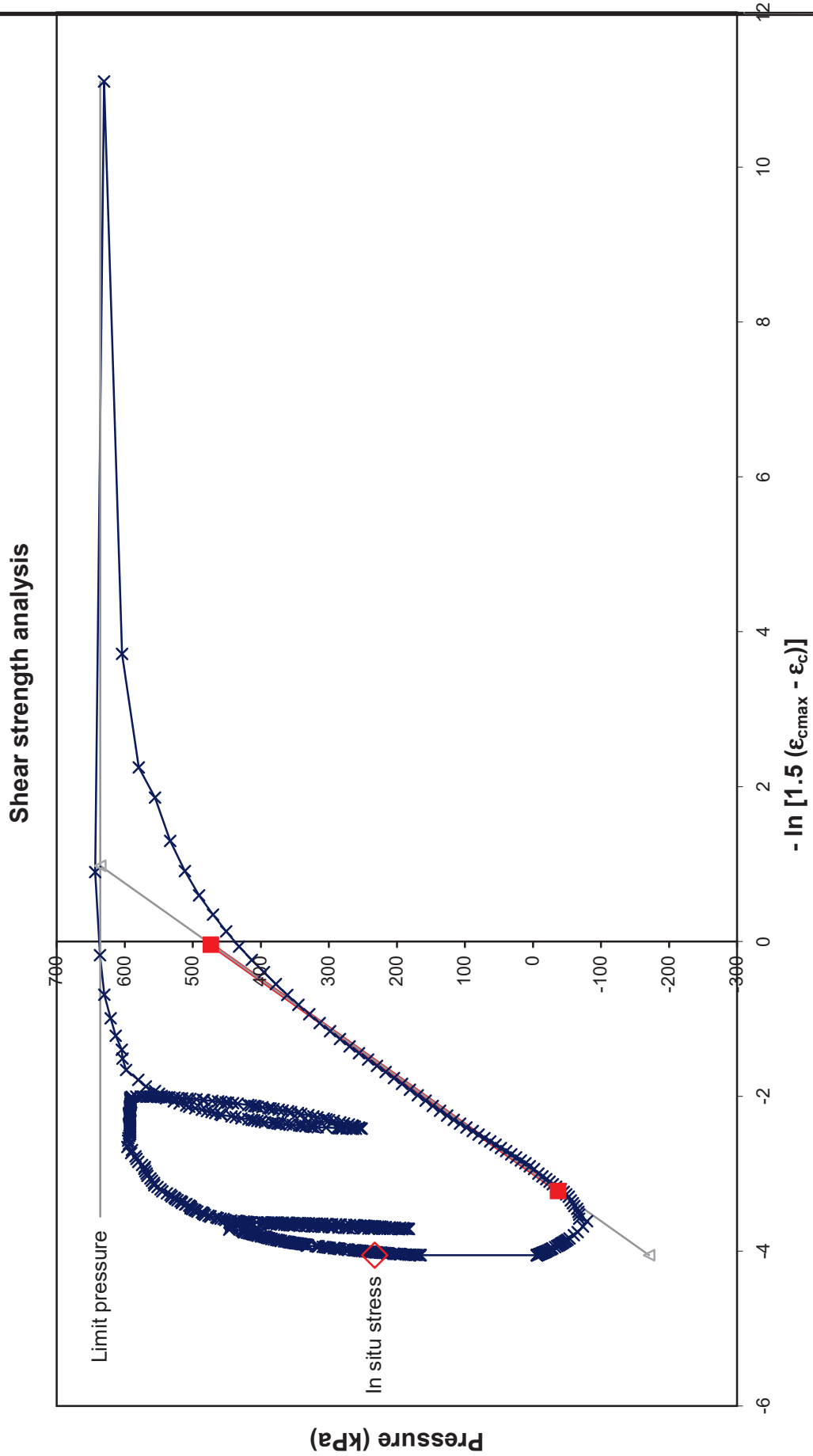
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_04
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	–0.04	473
	–3.22	–37
	Gradient	160.38
	Su (kPa)	**80**

In situ stress analysis		
	δε	P
	-4.05	-170.79
	0.98	636.00
	σm (kPa)	**233**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T1

Driven Pressuremeter Test Results

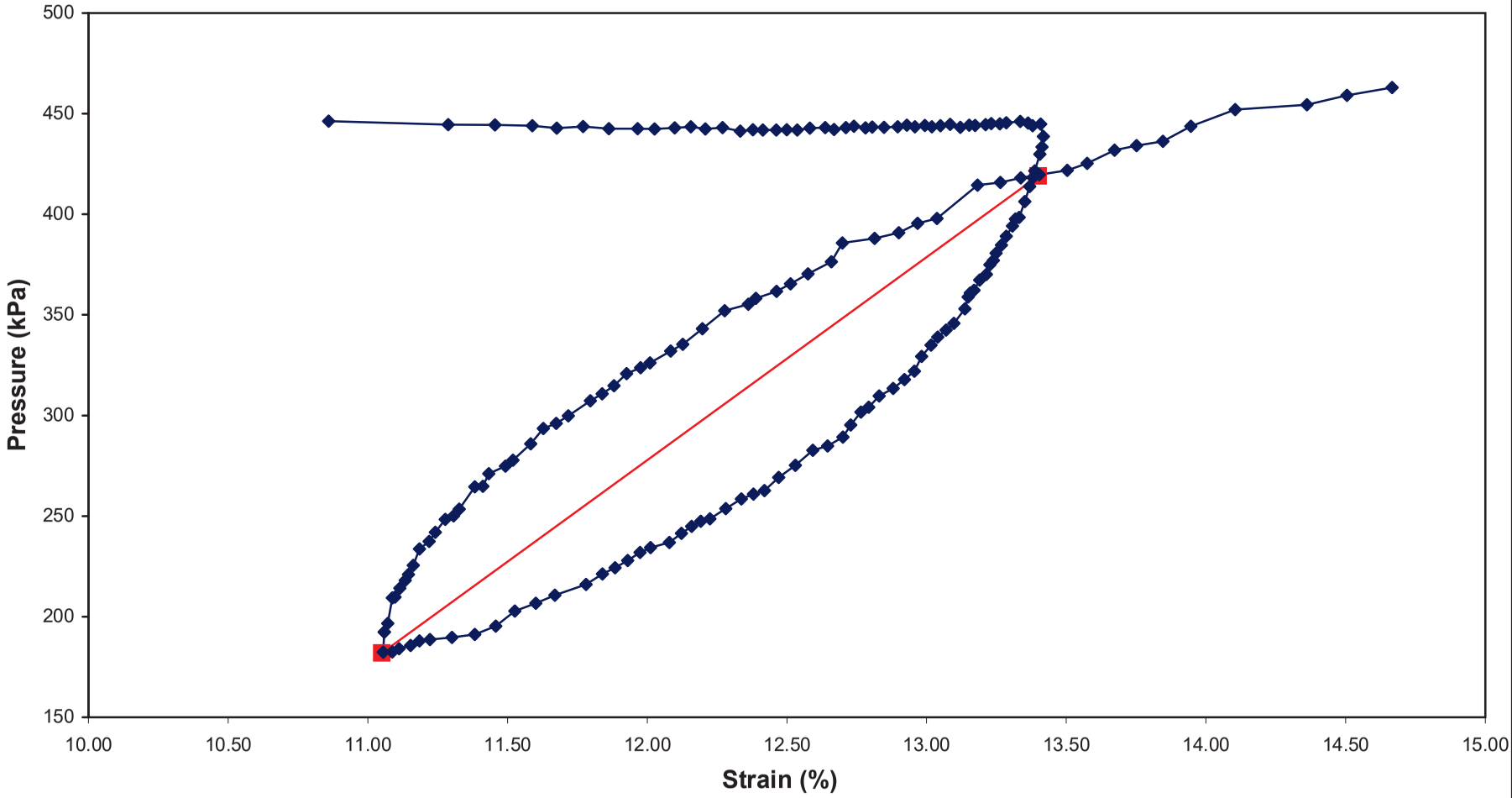
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_04 T1



Borehole Number	cpt_04
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.05	182
13.40	419
2.35 %	237 kPa

Unload reload modulus, Gur **5.0** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

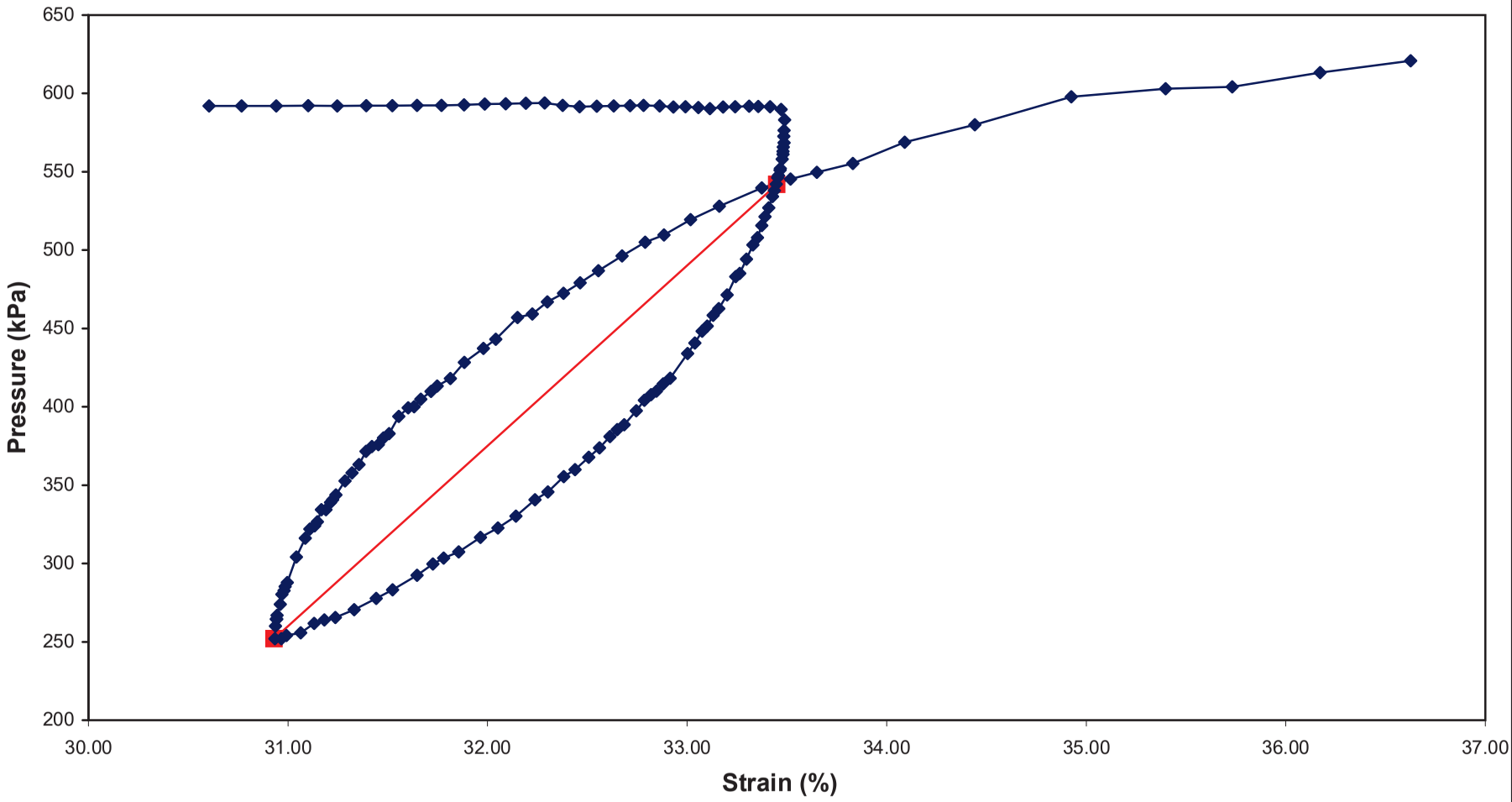
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_04 T1



Borehole Number	cpt_04
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

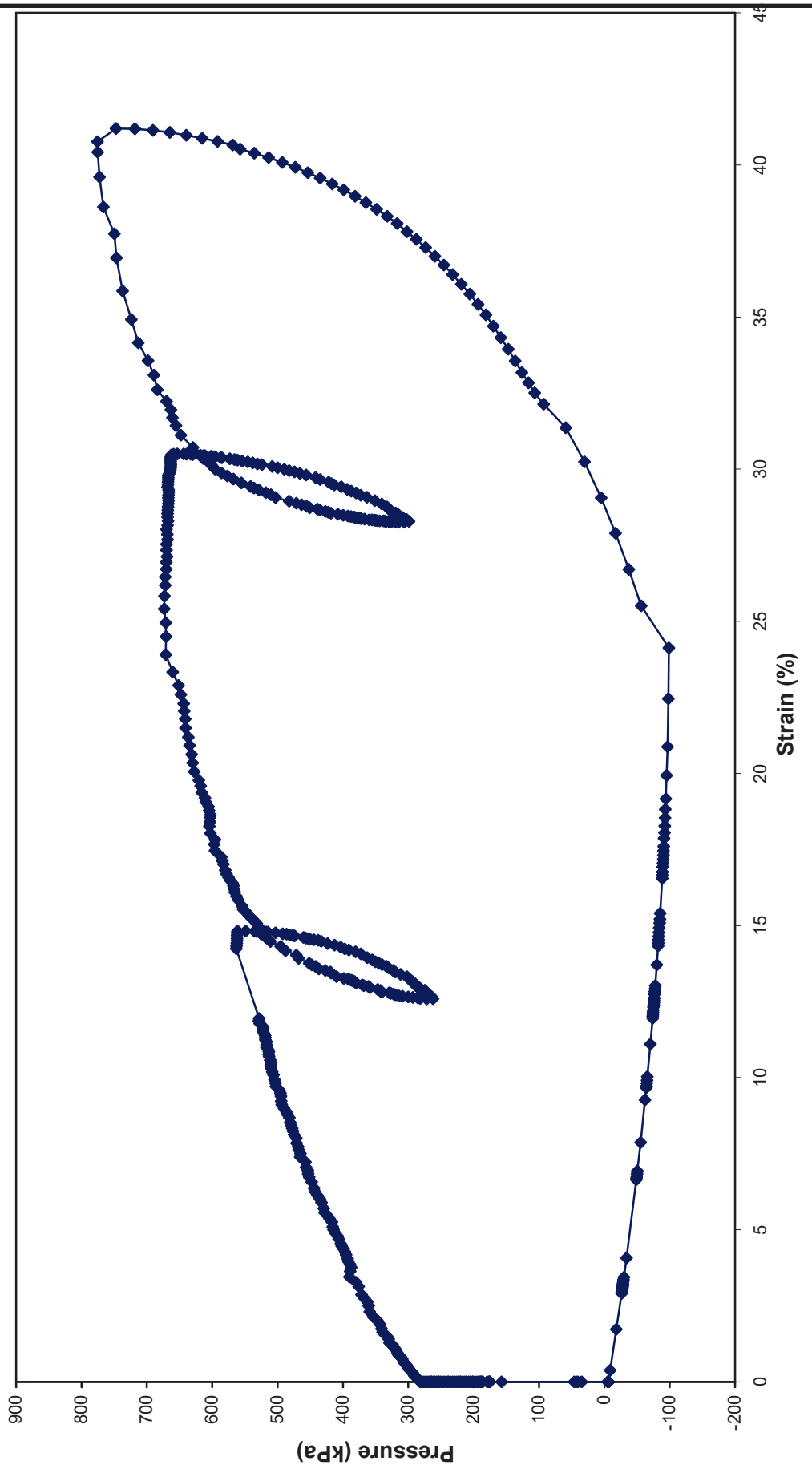
Loop 2	
δε	dp
30.93	252
33.45	542
2.52 %	290 kPa

Unload reload modulus, Gur **5.8** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Remarks

Borehole Number	cpt_04
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

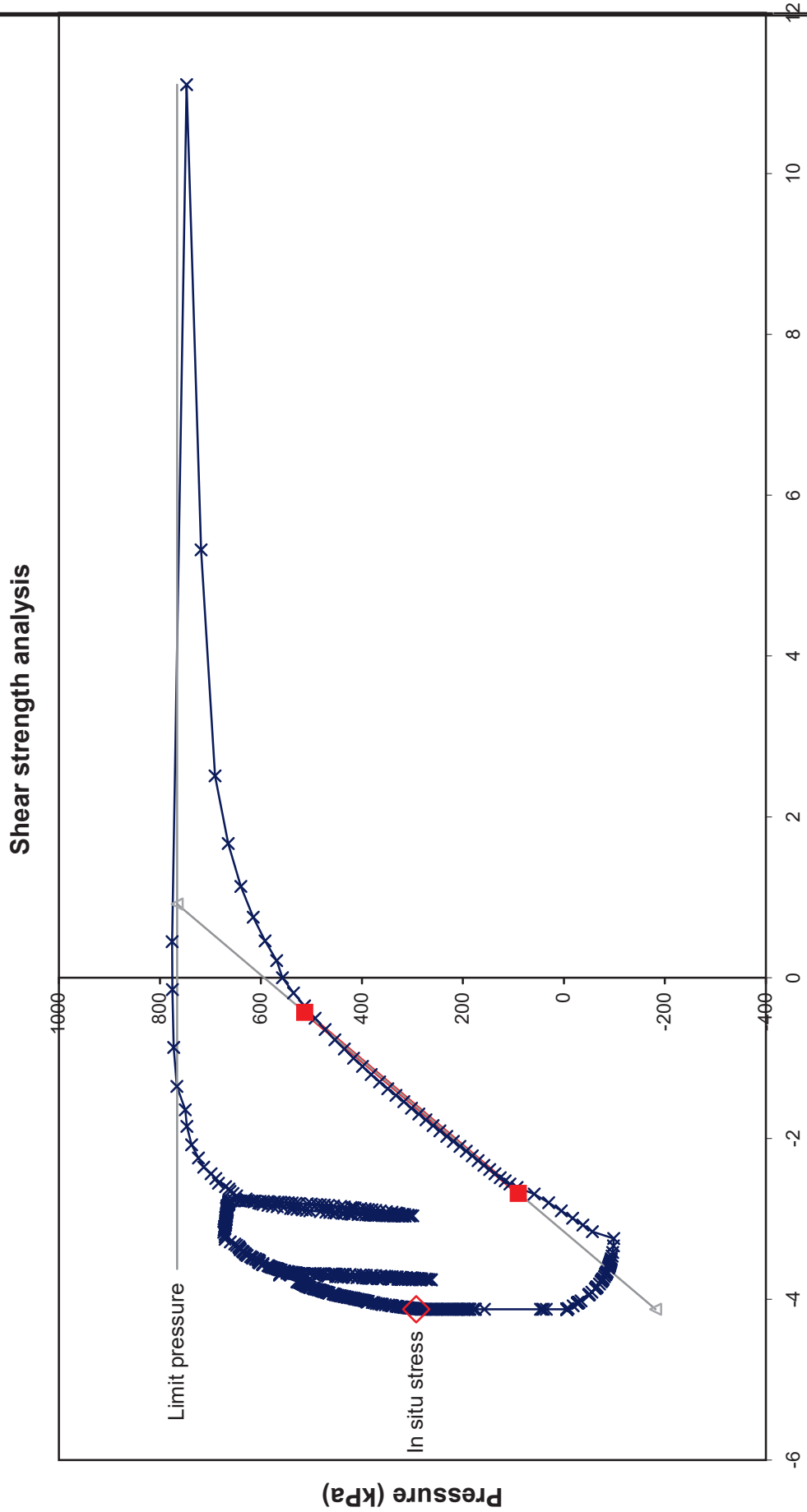
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_04
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	–0.43	513
	–2.68	90
	Gradient	188.00
	Su (kPa)	94

In situ stress analysis		
	δε	P
	-4.12	-181.42
	0.92	766.00
	σm (kPa)	292

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T2

Driven Pressuremeter Test Results

x strain

GEOCONE

Borehole Number	cpt_04
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
12.60	262
14.80	525
2.20 %	263 kPa

Unload reload modulus, Gur **6.0** **MPa**

Notes:	**Project**	TWEEN BRIDGE WIND FARM, PHASE 2	**Figure**
	Project No.	M9015	**DPM cpt_04 T2**
	Carried out for	Morrison Construction	

Driven Pressuremeter Test Results

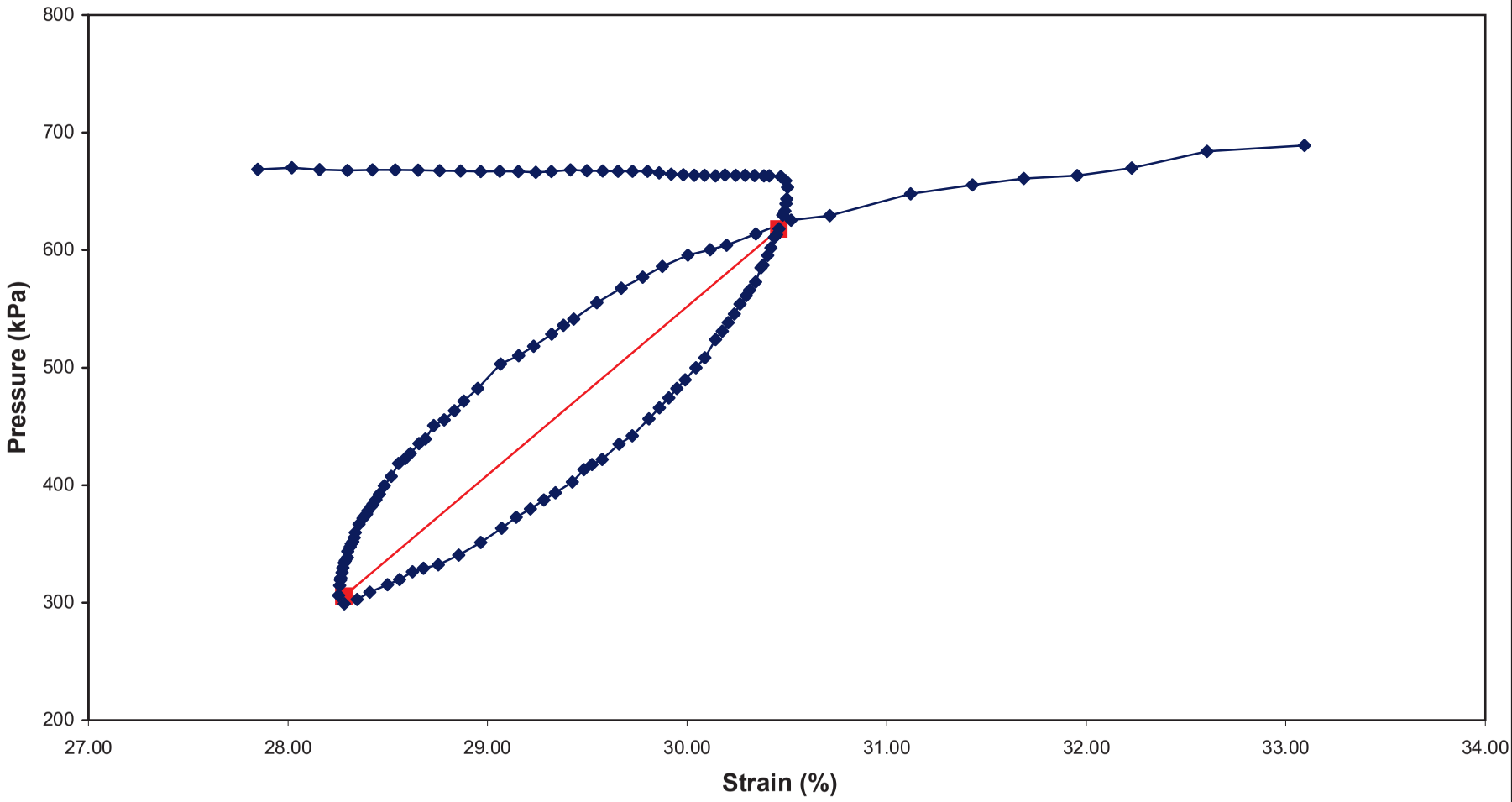
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_04 T2



Borehole Number	cpt_04
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

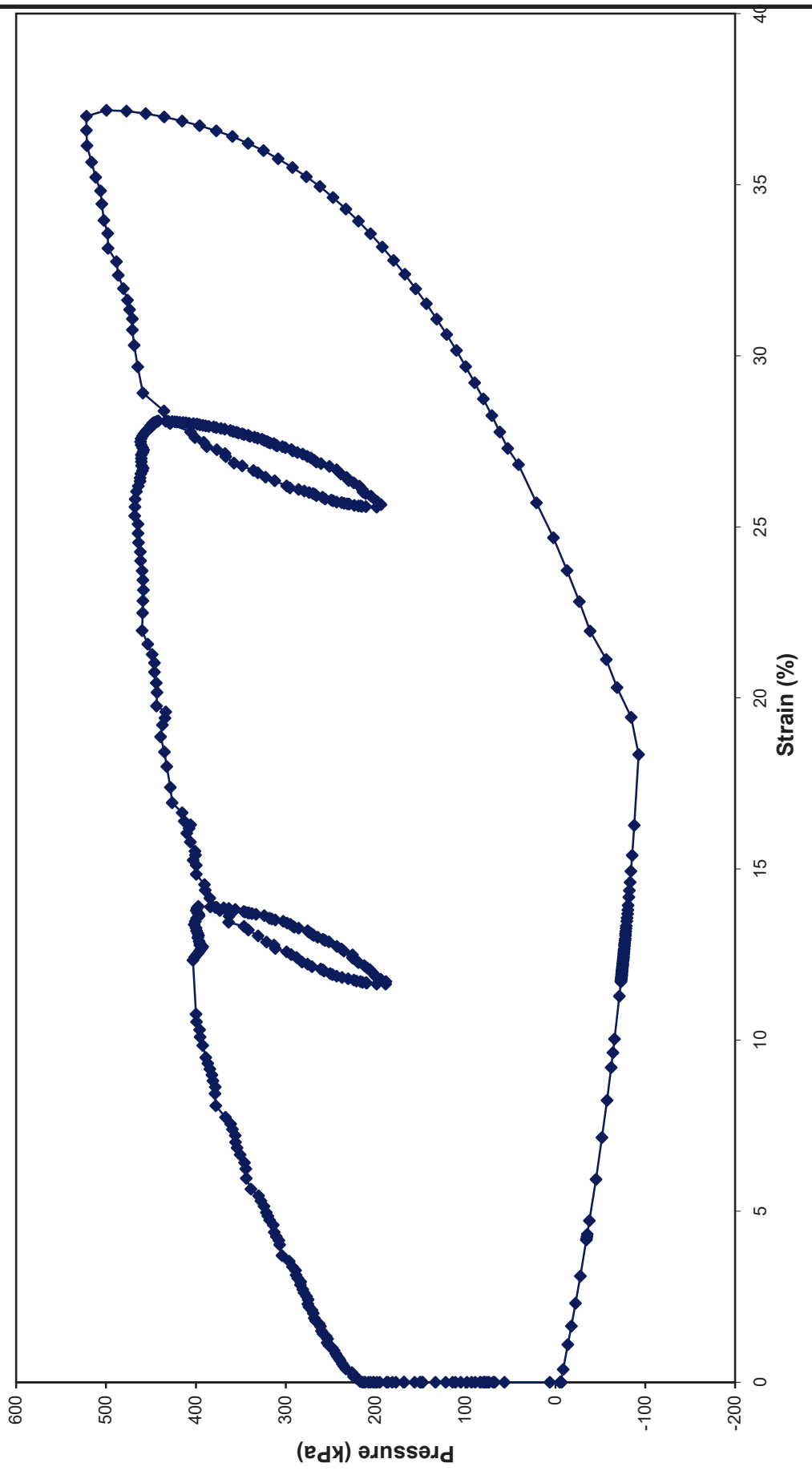
Loop 2	
δε	dp
28.28	306
30.46	618
2.18 %	313 kPa

Unload reload modulus, Gur **7.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_09
Test Number	1
Depth(m)	3.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Remarks

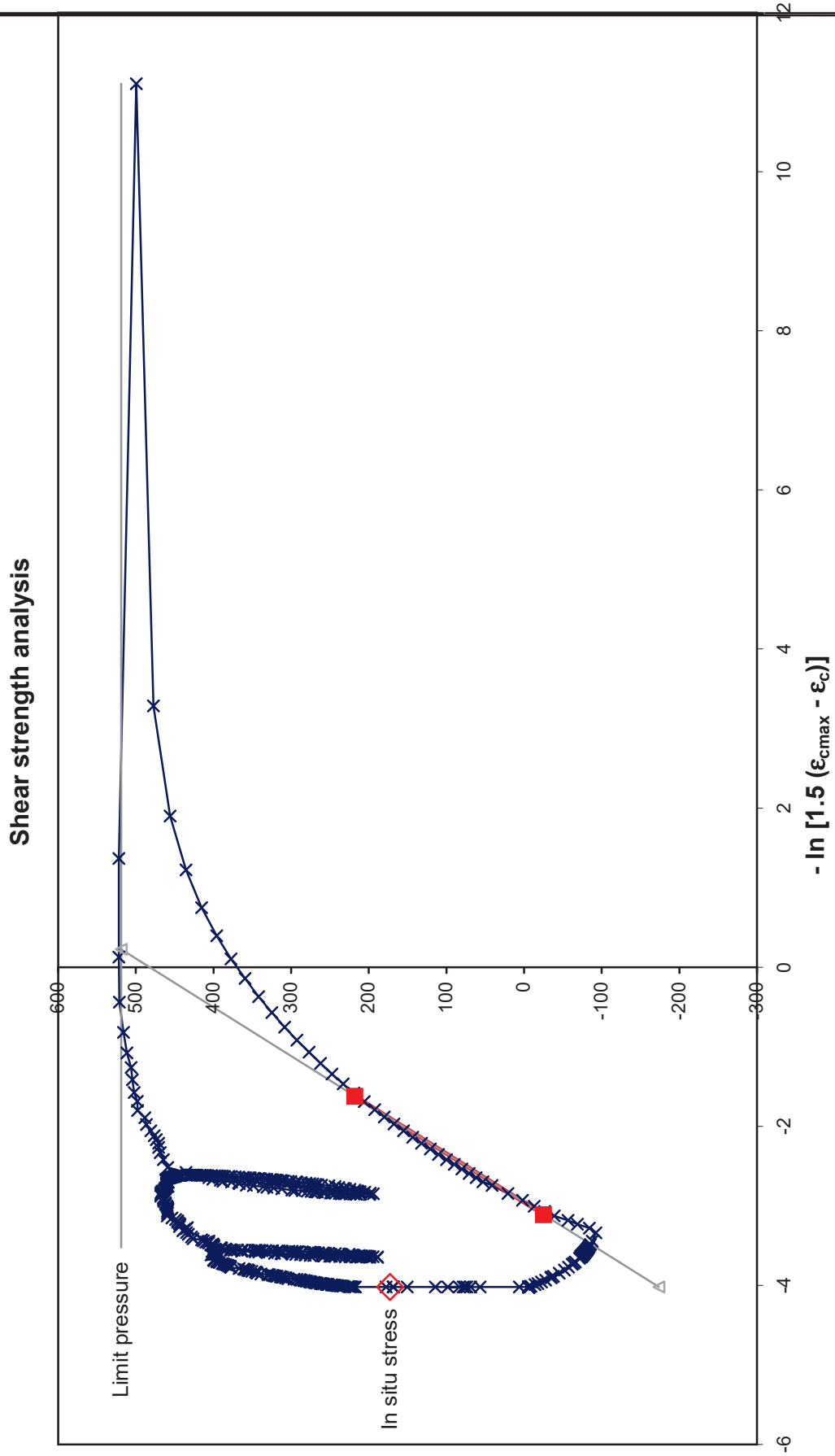
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_09 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_09
Test Number	1
Depth(m)	3.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	–1.62	218
	–3.11	–25
	Gradient	163.09
	Su (kPa)	82

In situ stress analysis	
δε	P
-4.02	-173.58
0.23	519.00
σm (kPa)	173

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_09 T1

Driven Pressuremeter Test Results

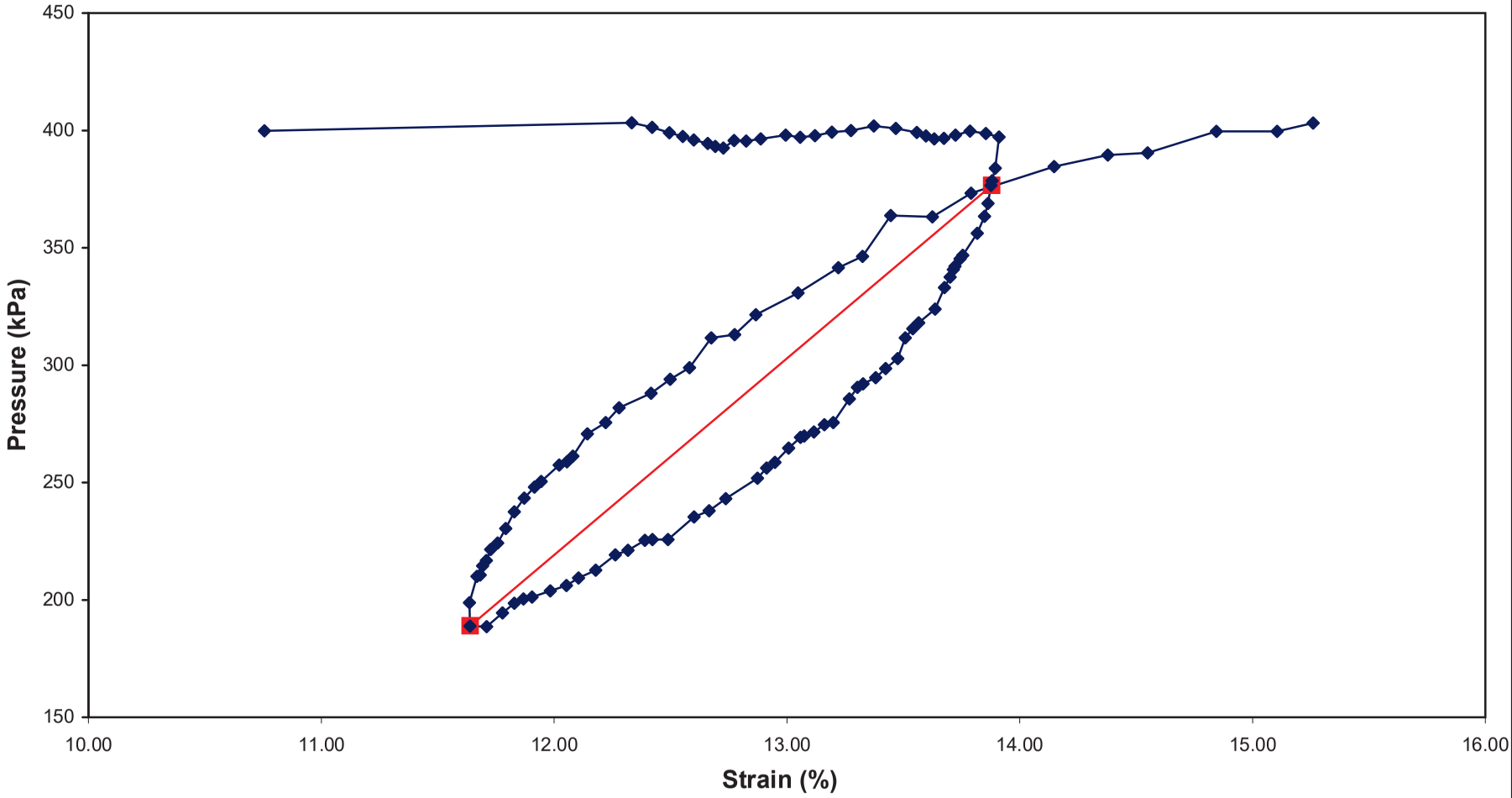
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_09 T1



Borehole Number	cpt_09
Test Number	1
Depth(m)	3.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.64	189
13.88	376.6
2.24 %	188 kPa

Unload reload modulus, Gur **4.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

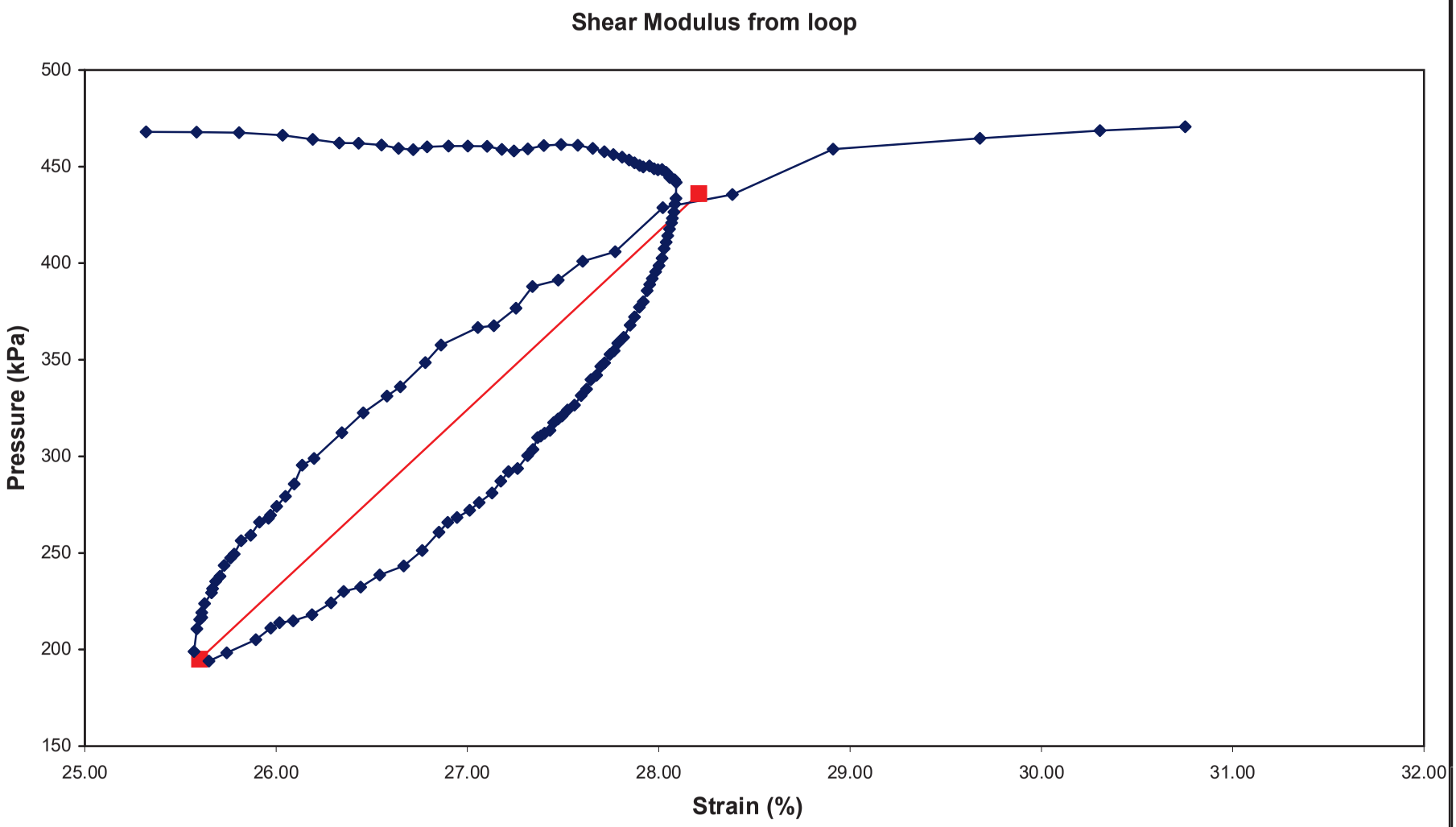
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_09 T1



Borehole Number	cpt_09
Test Number	1
Depth(m)	3.00
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

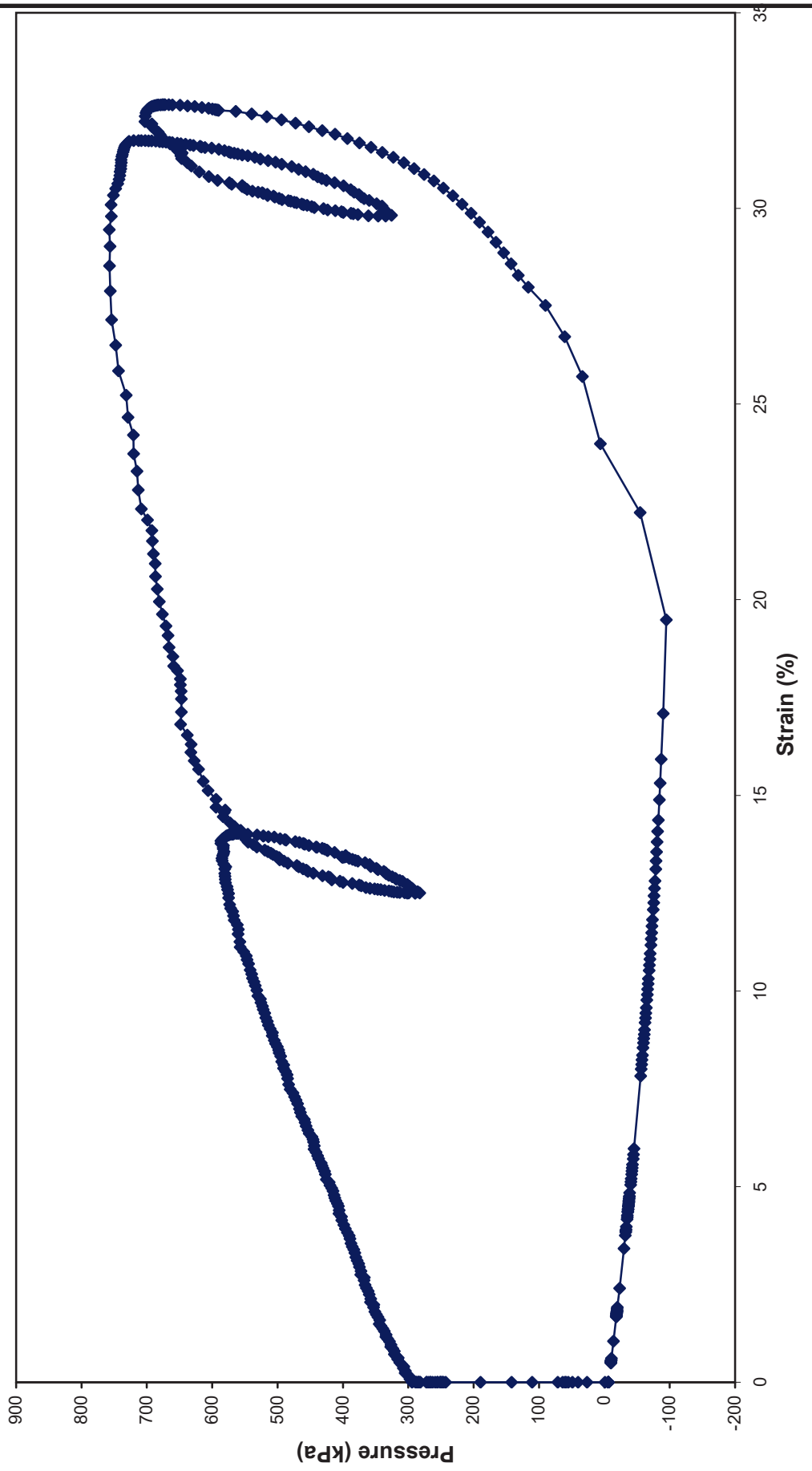
Loop 2	
δε	dp
25.60	195
28.21	436
2.61 %	241 kPa

Unload reload modulus, Gur **4.6** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_09
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Remarks

Notes:

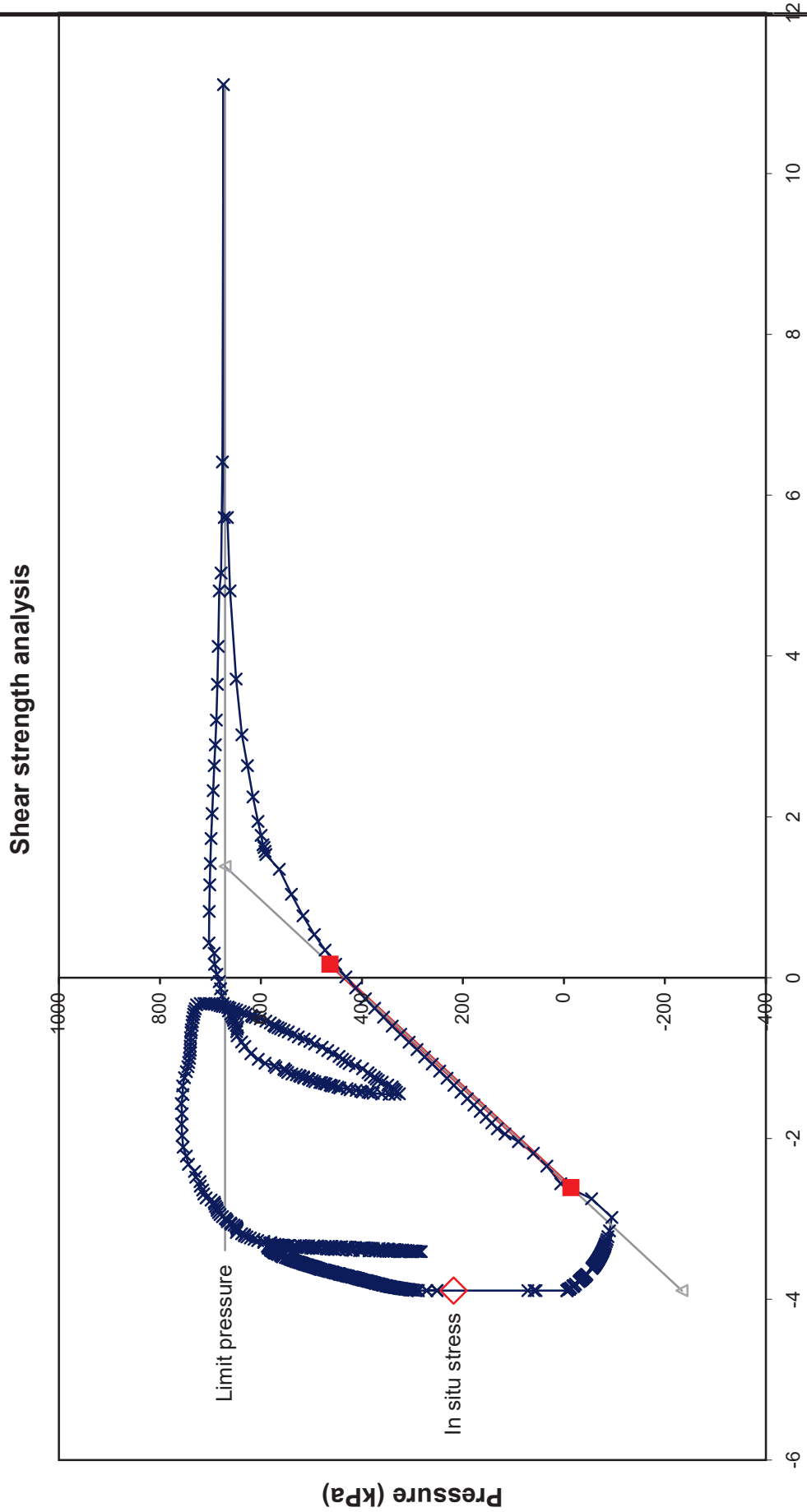
Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_09 T2

Driven Pressuremeter Test Results

GEOCONE



Borehole Number	cpt_09
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Shear strength analysis		
	δε	δπ
	0.17	463
	−2.61	−14
	Gradient	171.58
	Su (kPa)	**86**

In situ stress analysis		
	δε	P
	-3.89	-233.86
	1.38	671.00
	σm (kPa)	**219**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_09 T2

Driven Pressuremeter Test Results

x strain

GEOCONE

Borehole Number	cpt_09
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
12.50	283
14.02	554
1.52 %	271 kPa

Unload reload modulus, Gur **8.9** **MPa**

Notes:	**Project**	TWEEN BRIDGE WIND FARM, PHASE 2	**Figure**
	Project No.	M9015	**DPM cpt_09 T2**
	Carried out for	Morrison Construction	

Driven Pressuremeter Test Results

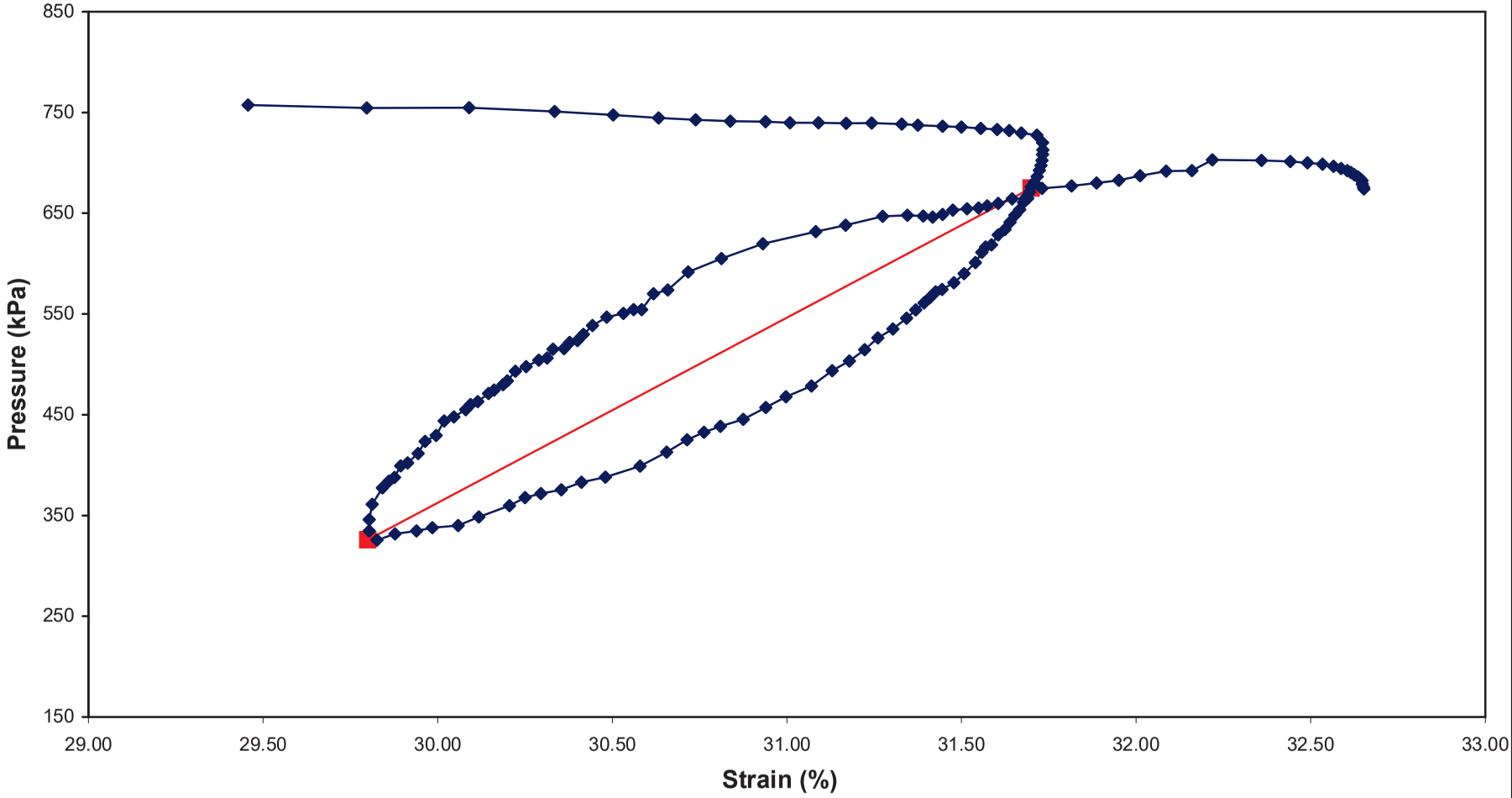
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_09 T2



Borehole Number	cpt_09
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th Db
Test Date	14 April 2009

Calculating Shear Modulus

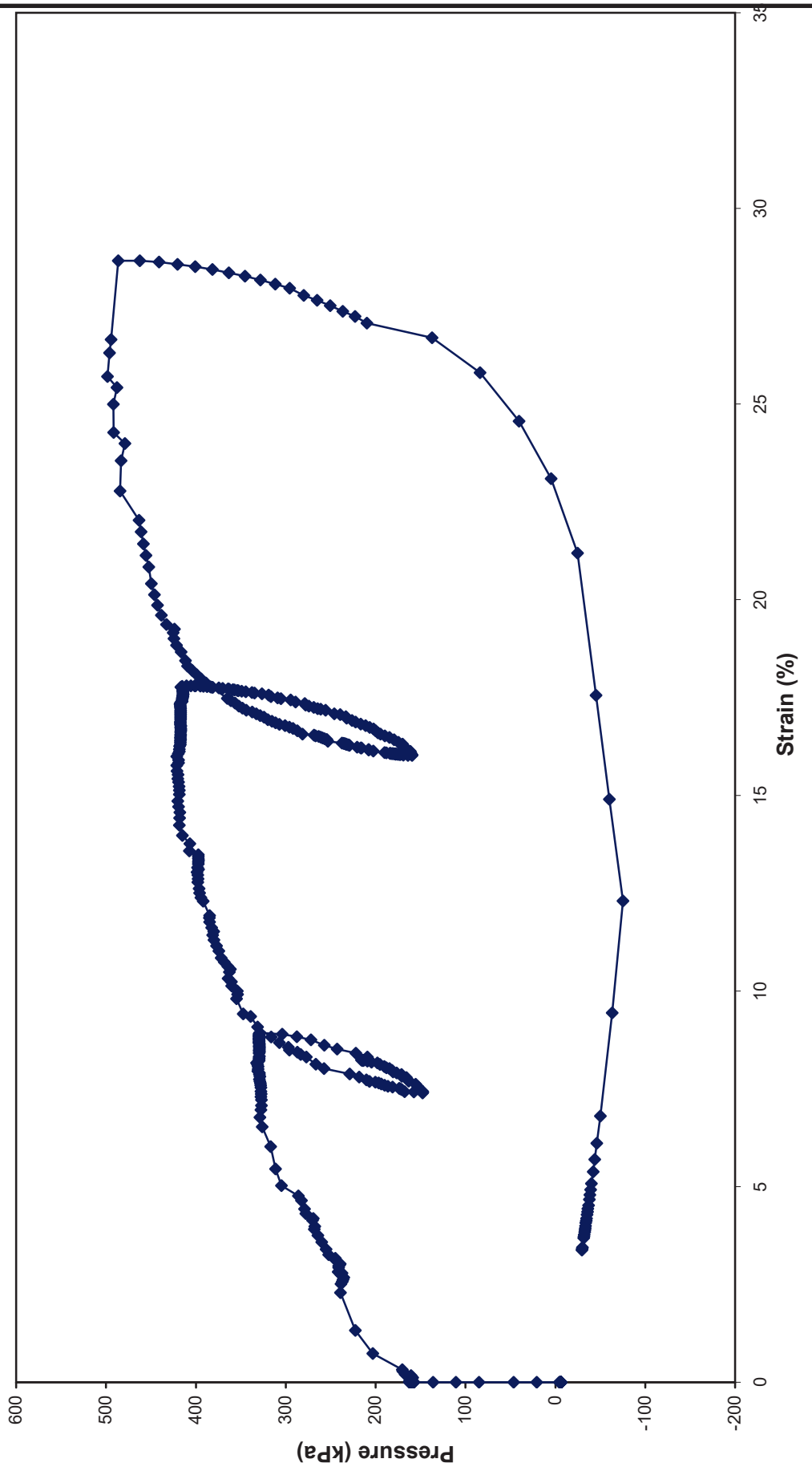
Loop 2	
δε	dp
29.80	326
31.70	675
1.90 %	349 kPa

Unload reload modulus, Gur **9.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_17
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Remarks

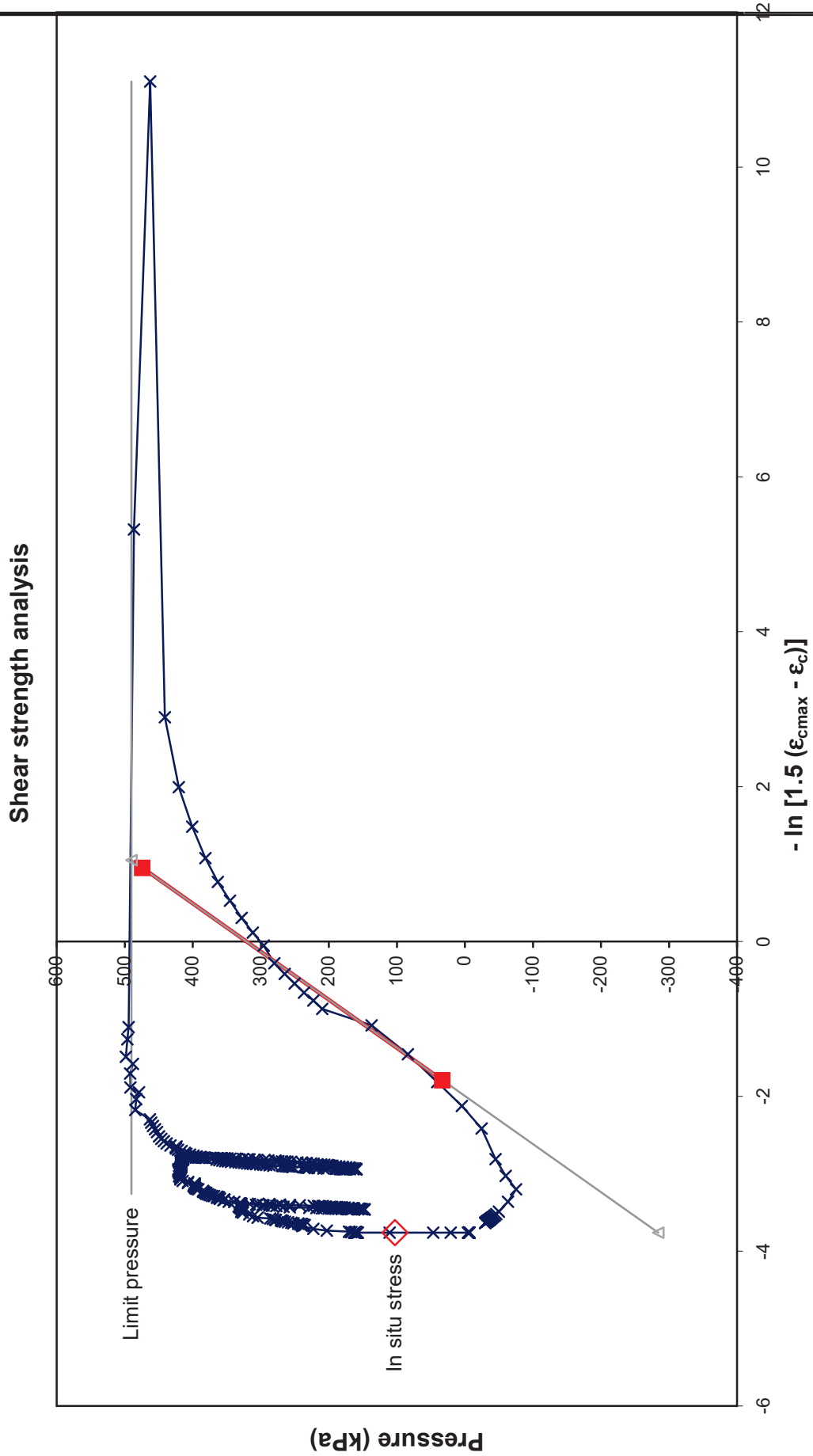
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_17 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_17
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Shear strength analysis		
	δε	δπ
	0.95	474
	–1.79	33
	Gradient	160.95
	Su (kPa)	**80**

In situ stress analysis		
	δε	P
	-3.76	-284.25
	1.05	490.00
	σm (kPa)	**103**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_17 T1

Driven Pressuremeter Test Results

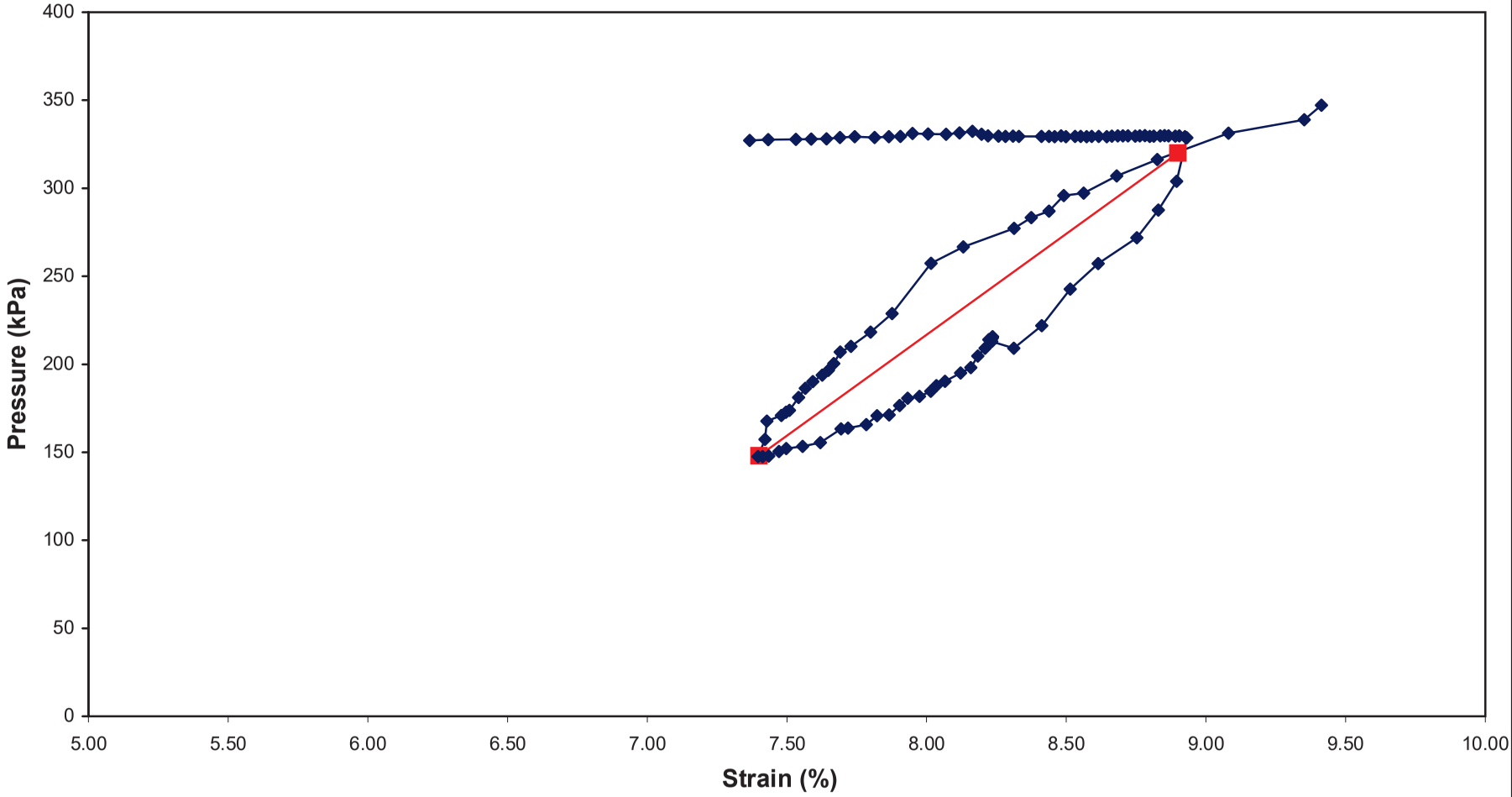
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_17 T1



Borehole Number	cpt_17
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
7.40	148
8.90	320
1.50 %	172 kPa

Unload reload modulus, Gur **5.7** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

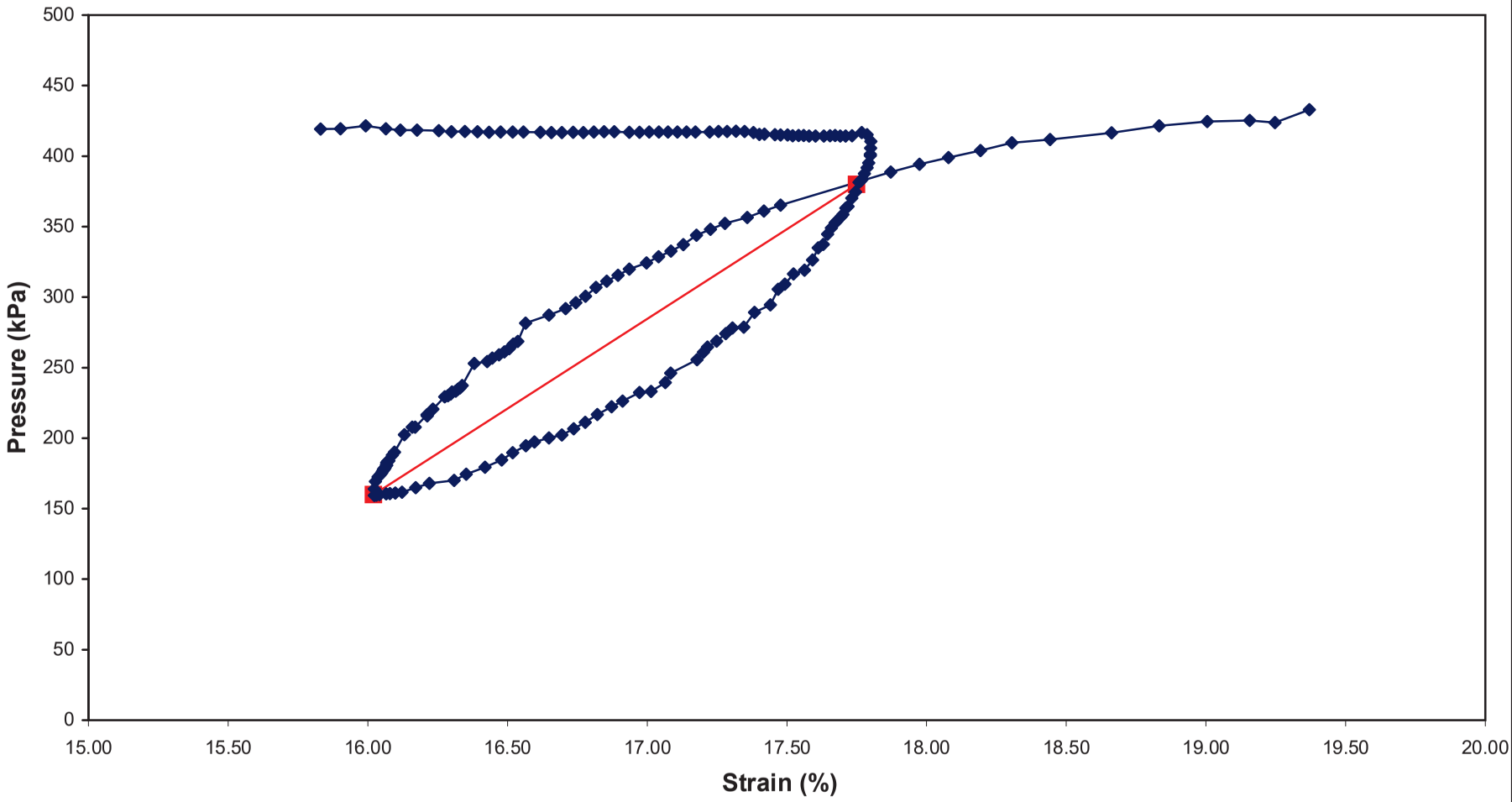
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure: DPM cpt_17 T1



Borehole Number	cpt_17
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Calculating Shear Modulus

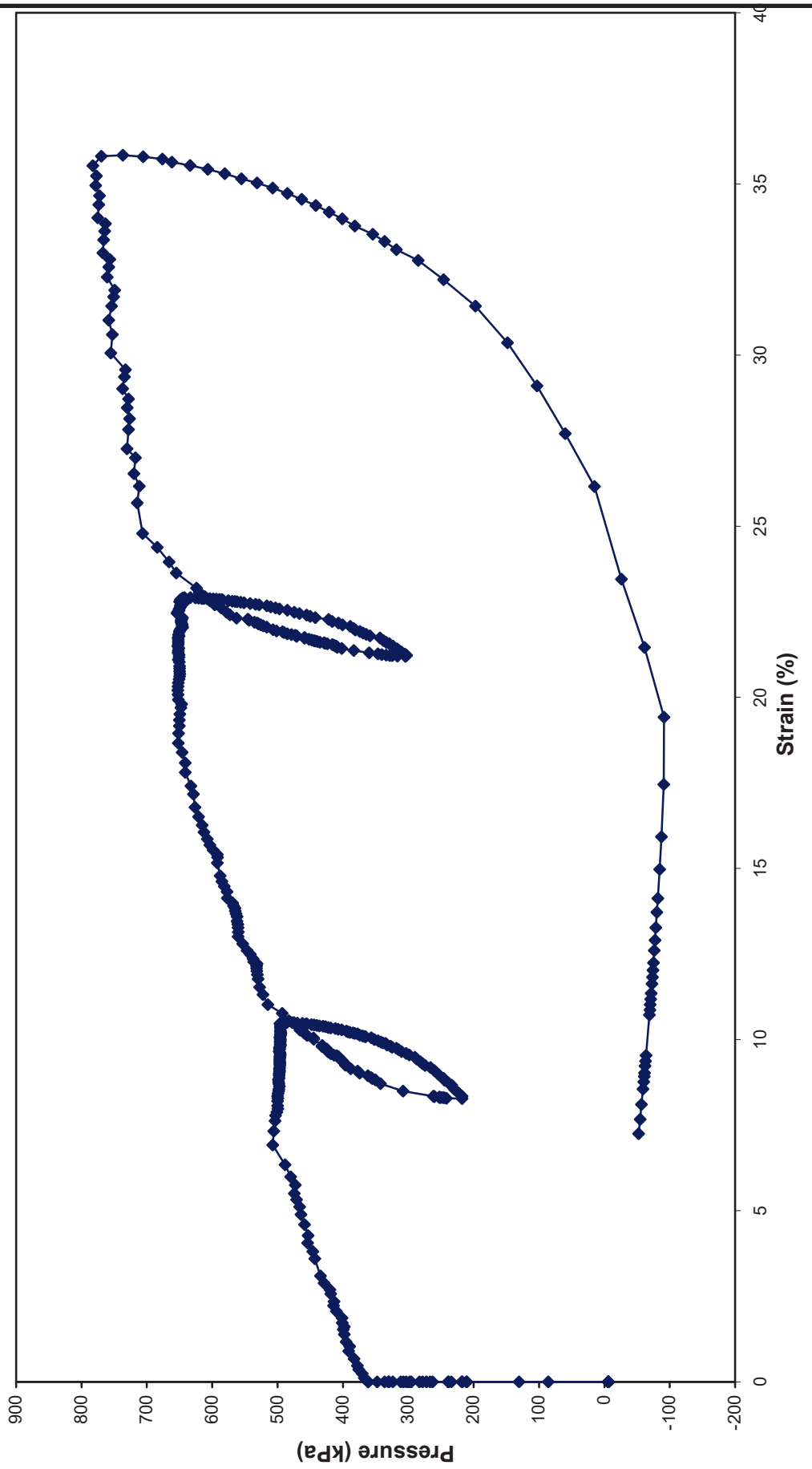
Loop 2	
δε	dp
16.02	160
17.75	380
1.73 %	220 kPa

Unload reload modulus, Gur **6.4** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_17
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Remarks

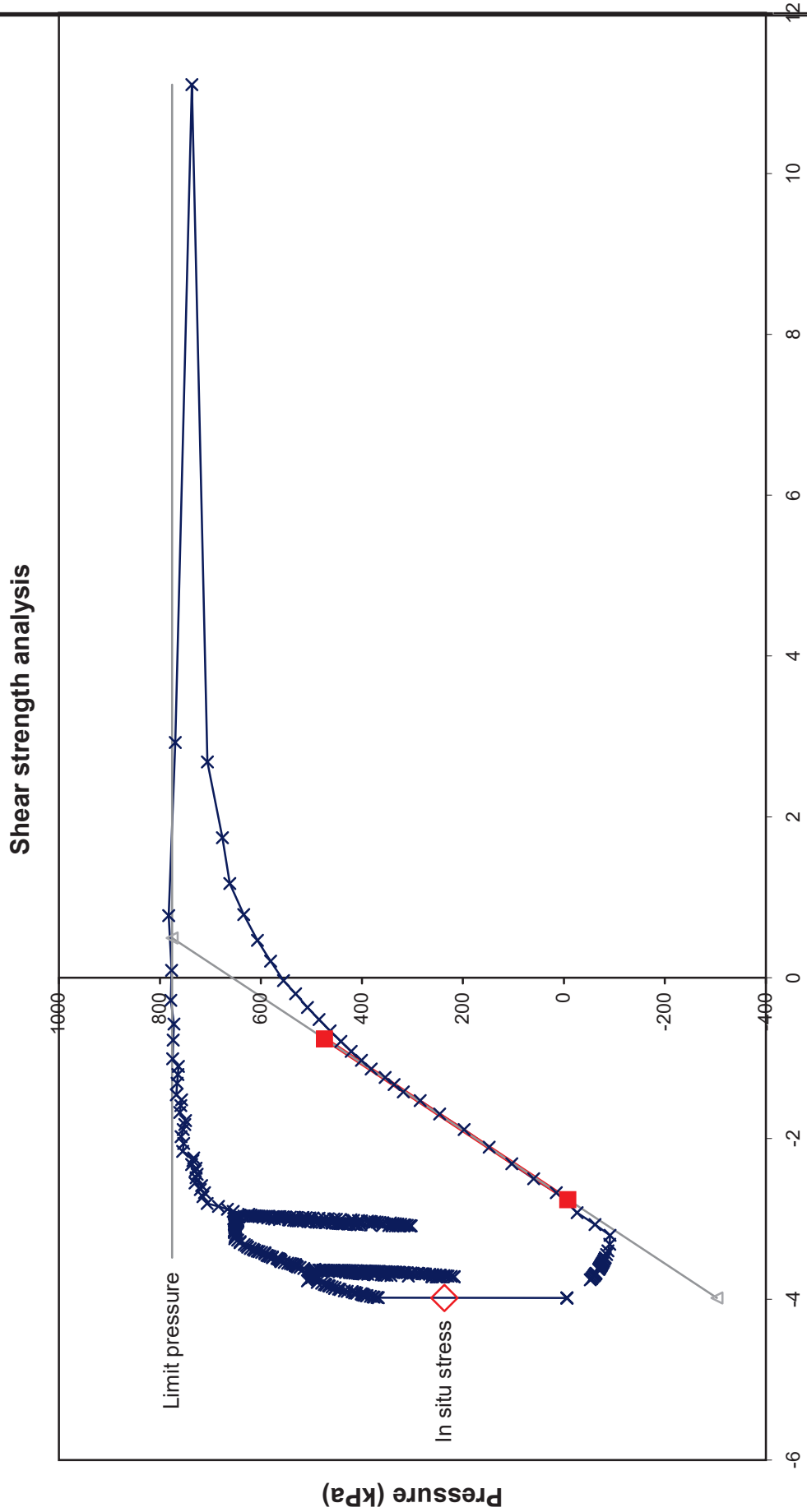
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_17 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_17
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Shear strength analysis		
	δε	δπ
	–0.76	474
	–2.76	–8
	Gradient	241.00
	Su (kPa)	**121**

In situ stress analysis		
	δε	P
	-3.98	-303.13
	0.49	776.00
	σm (kPa)	**236**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_17 T2

Driven Pressuremeter Test Results

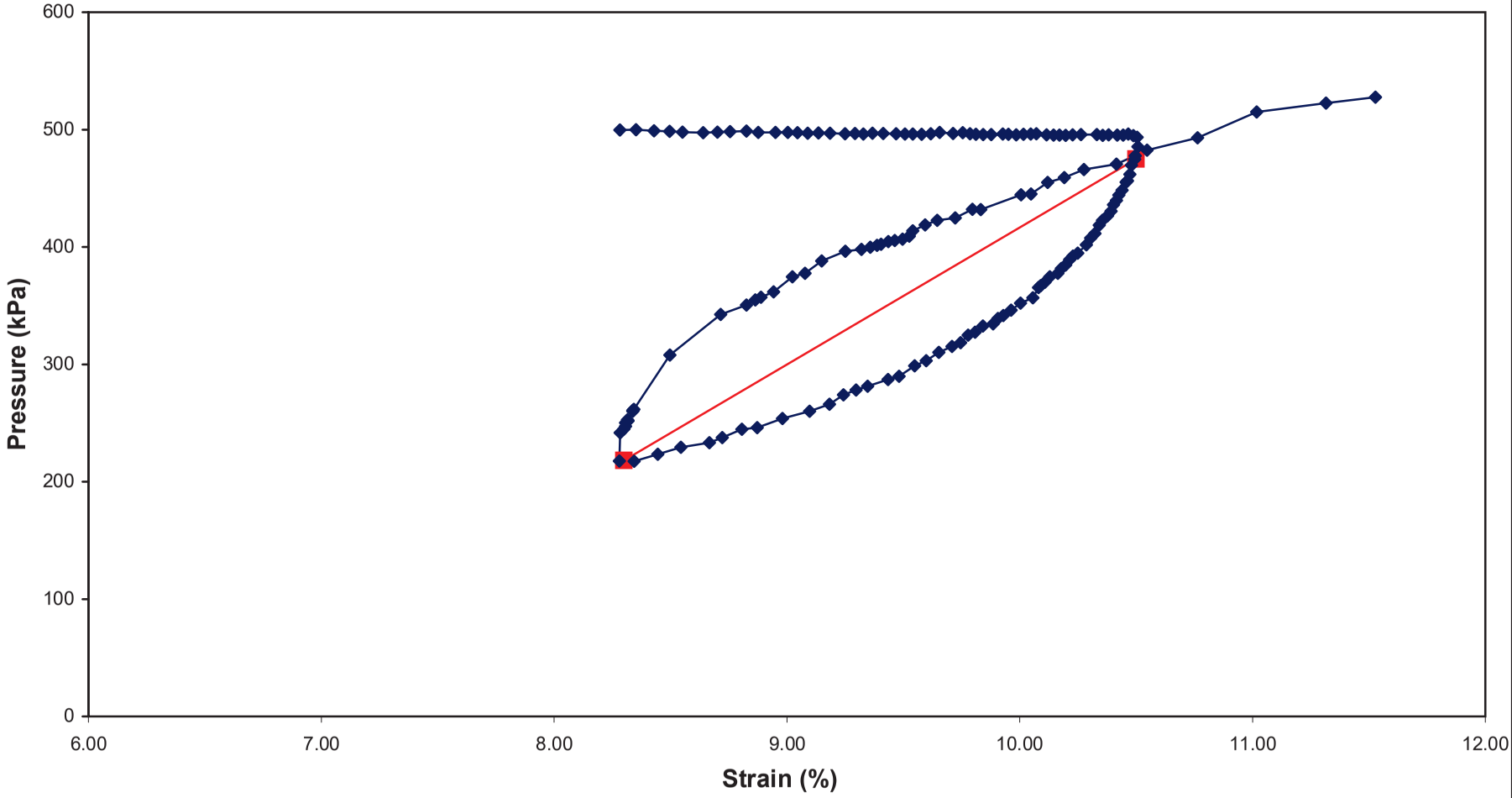
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_17 T2



Borehole Number	cpt_17
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
8.30	218
10.50	475
2.20 %	257 kPa

Unload reload modulus, Gur **5.8** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

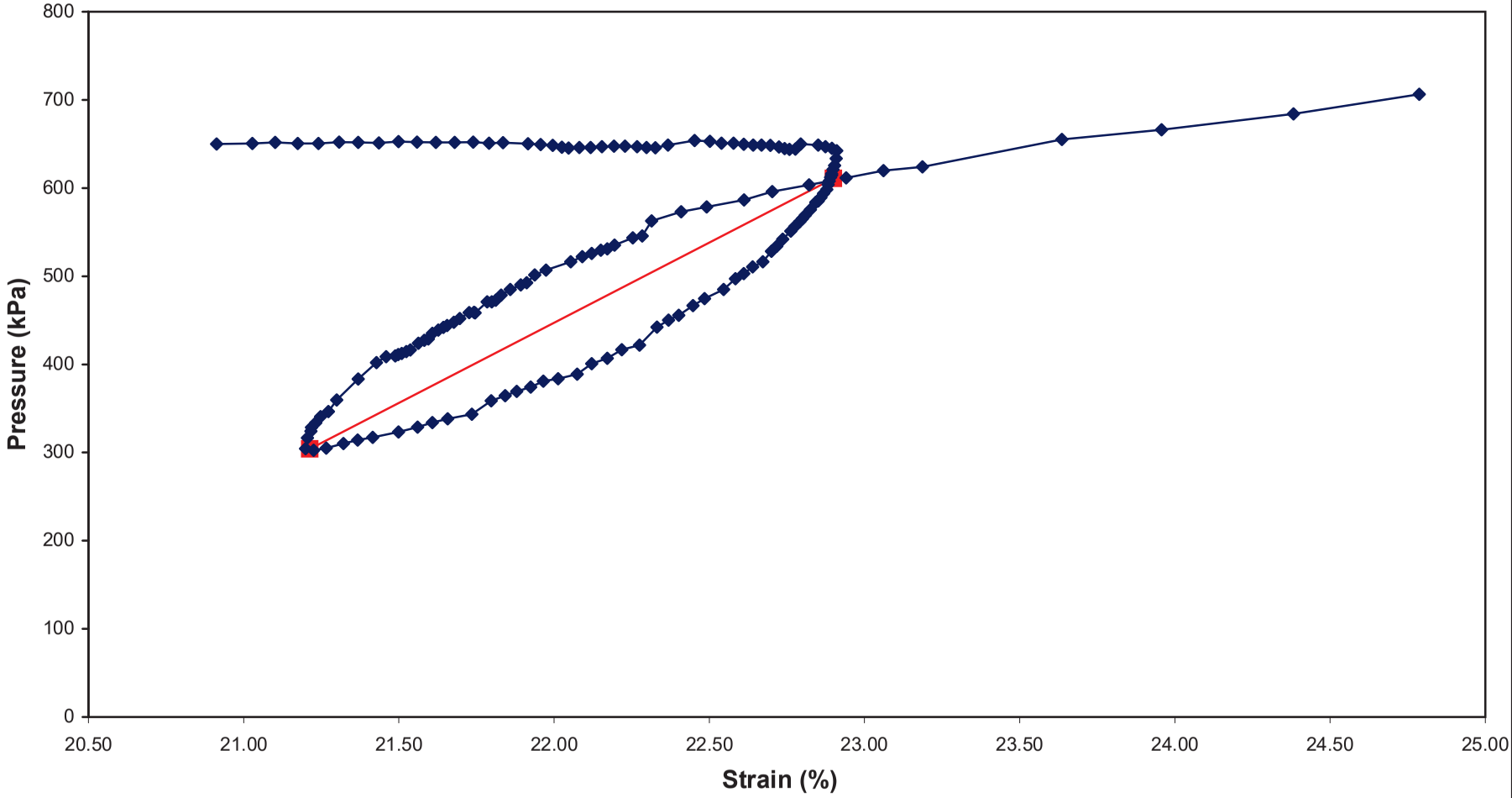
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_17 T2



Borehole Number	cpt_17
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	TH DB
Test Date	02 April 2009

Calculating Shear Modulus

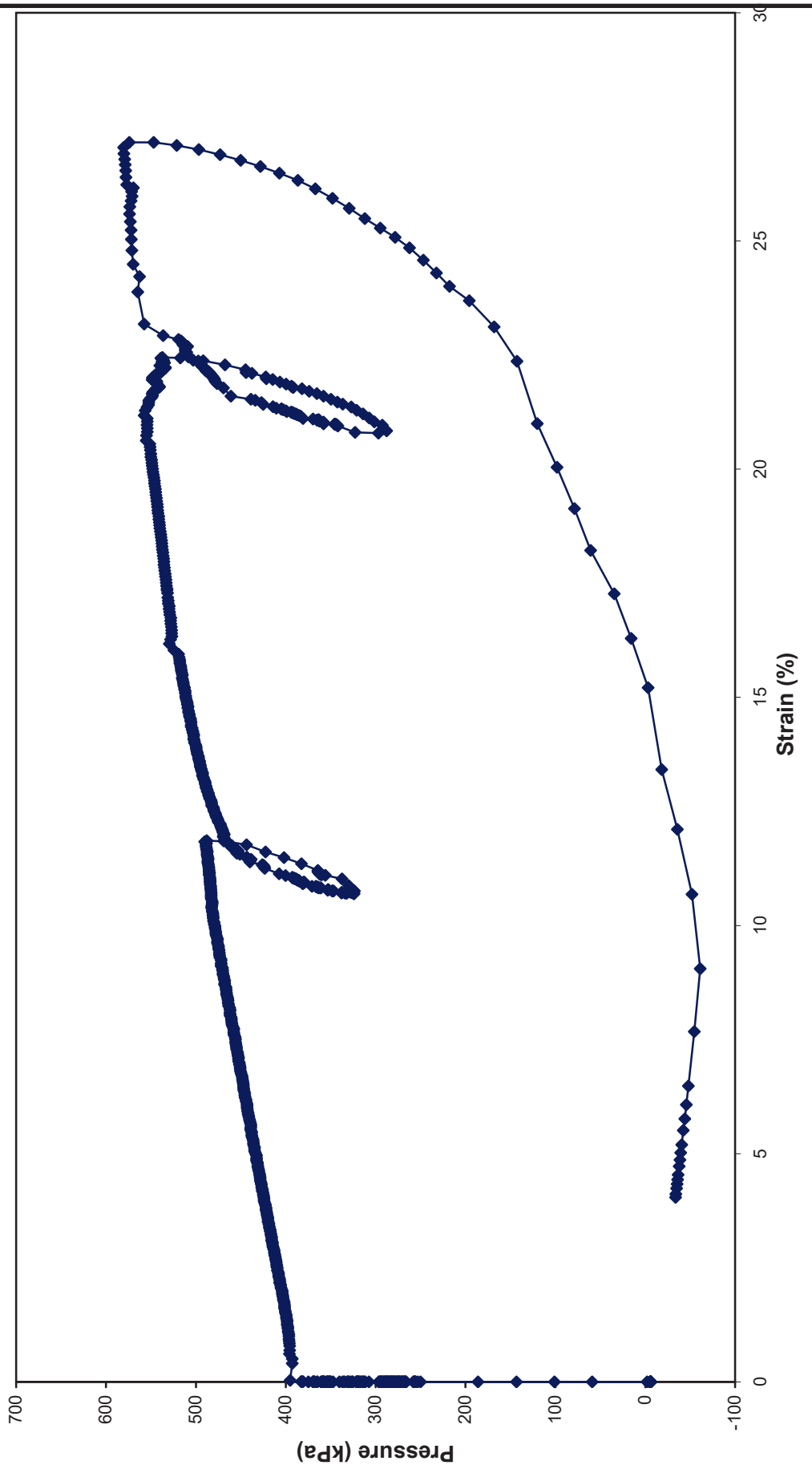
Loop 2	
δε	dp
21.21	304
22.90	611
1.69 %	307 kPa

Unload reload modulus, Gur **9.1** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Remarks

Borehole Number	cpt_19
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	TH DB
Test Date	01 April 2009

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

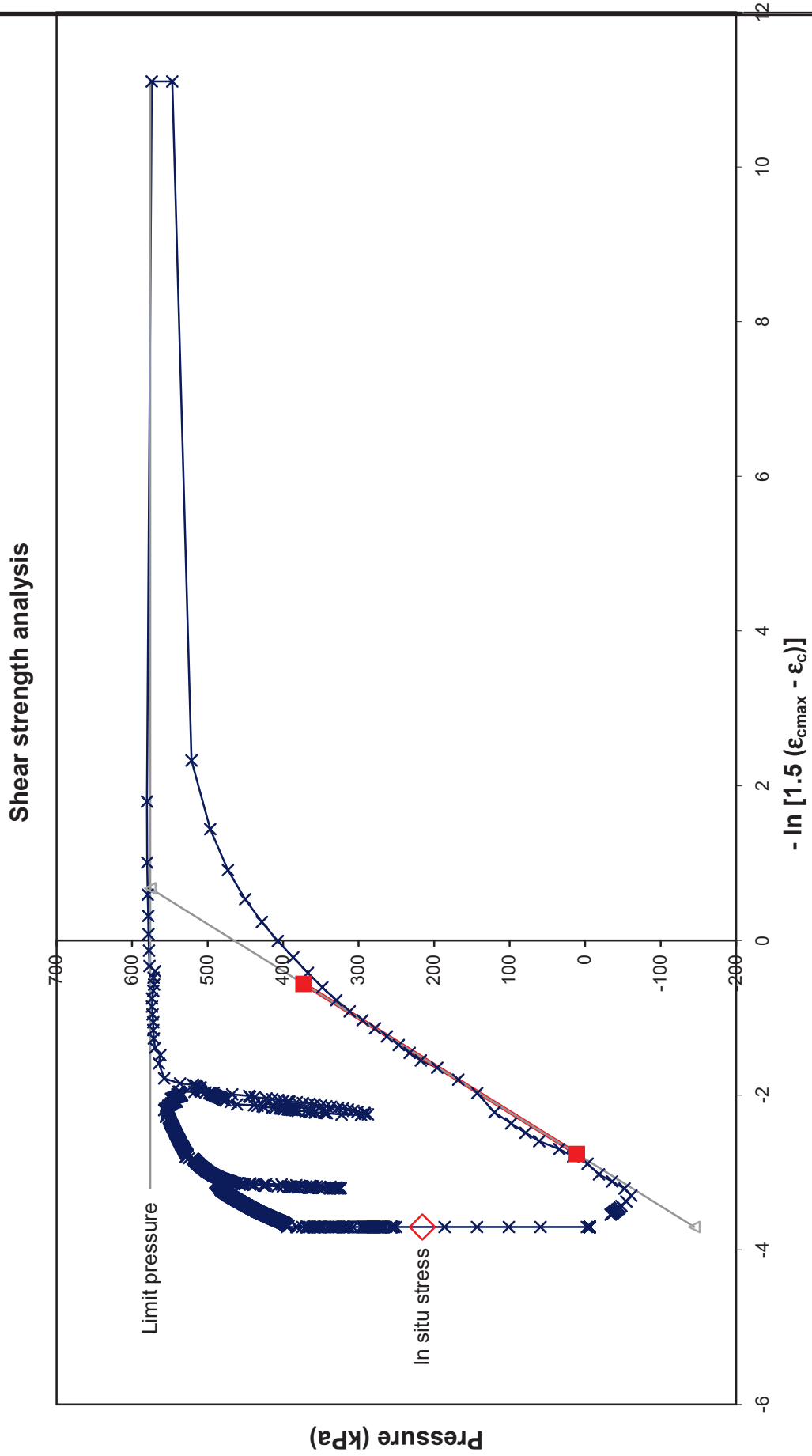
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_19 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_19
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	TH DB
Test Date	01 April 2009

Shear strength analysis		
	δε	δπ
	–0.56	373
	–2.76	11
	Gradient	164.55
	Su (kPa)	82

In situ stress analysis	
δε	P
-3.71	-144.85
0.67	576.00
σm (kPa)	216

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_19 T1

Driven Pressuremeter Test Results

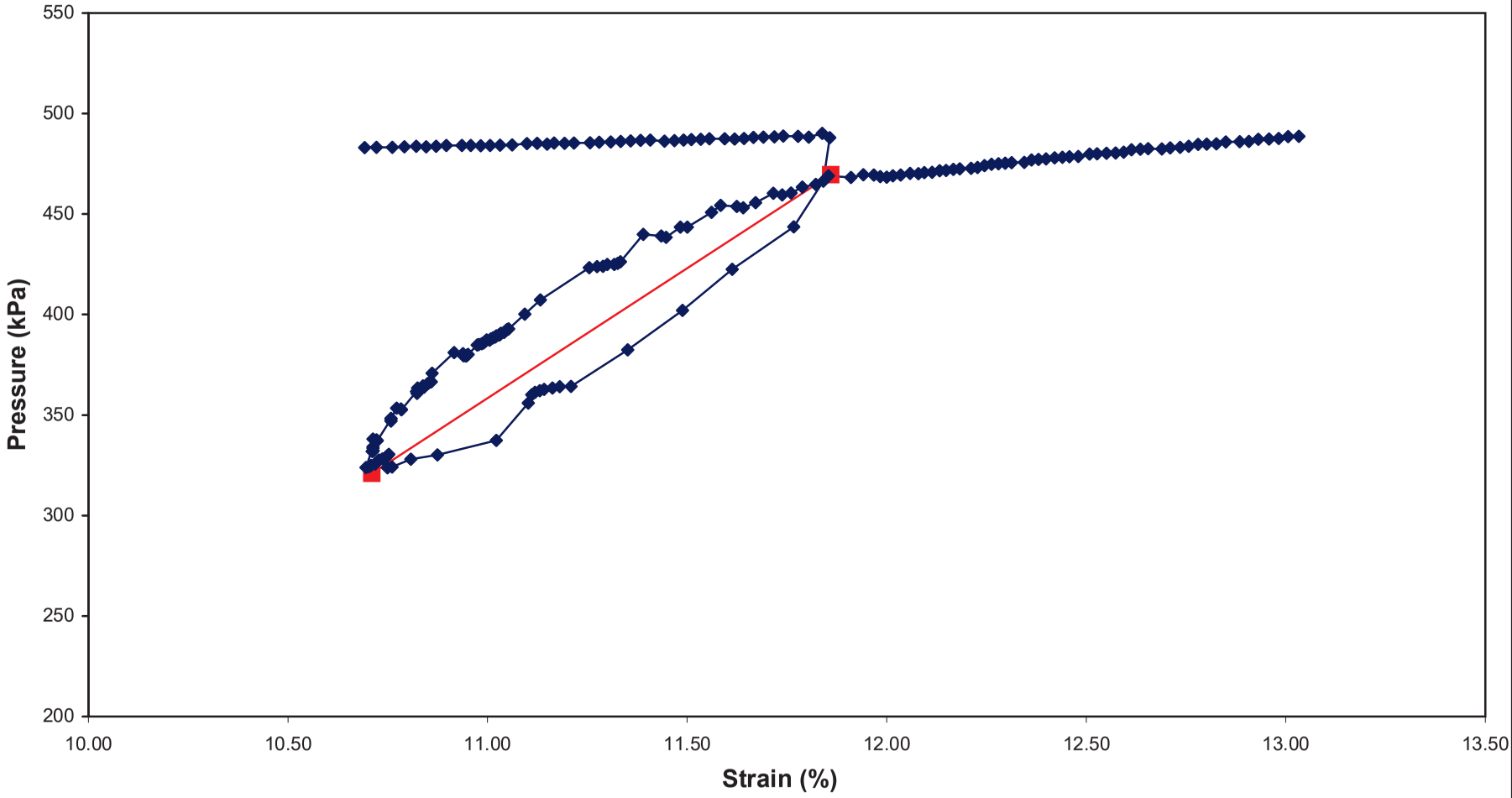
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_19 T1



Borehole Number	cpt_19
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	TH DB
Test Date	01 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
10.71	321
11.86	469.5
1.15 %	149 kPa

Unload reload modulus, Gur **6.5** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

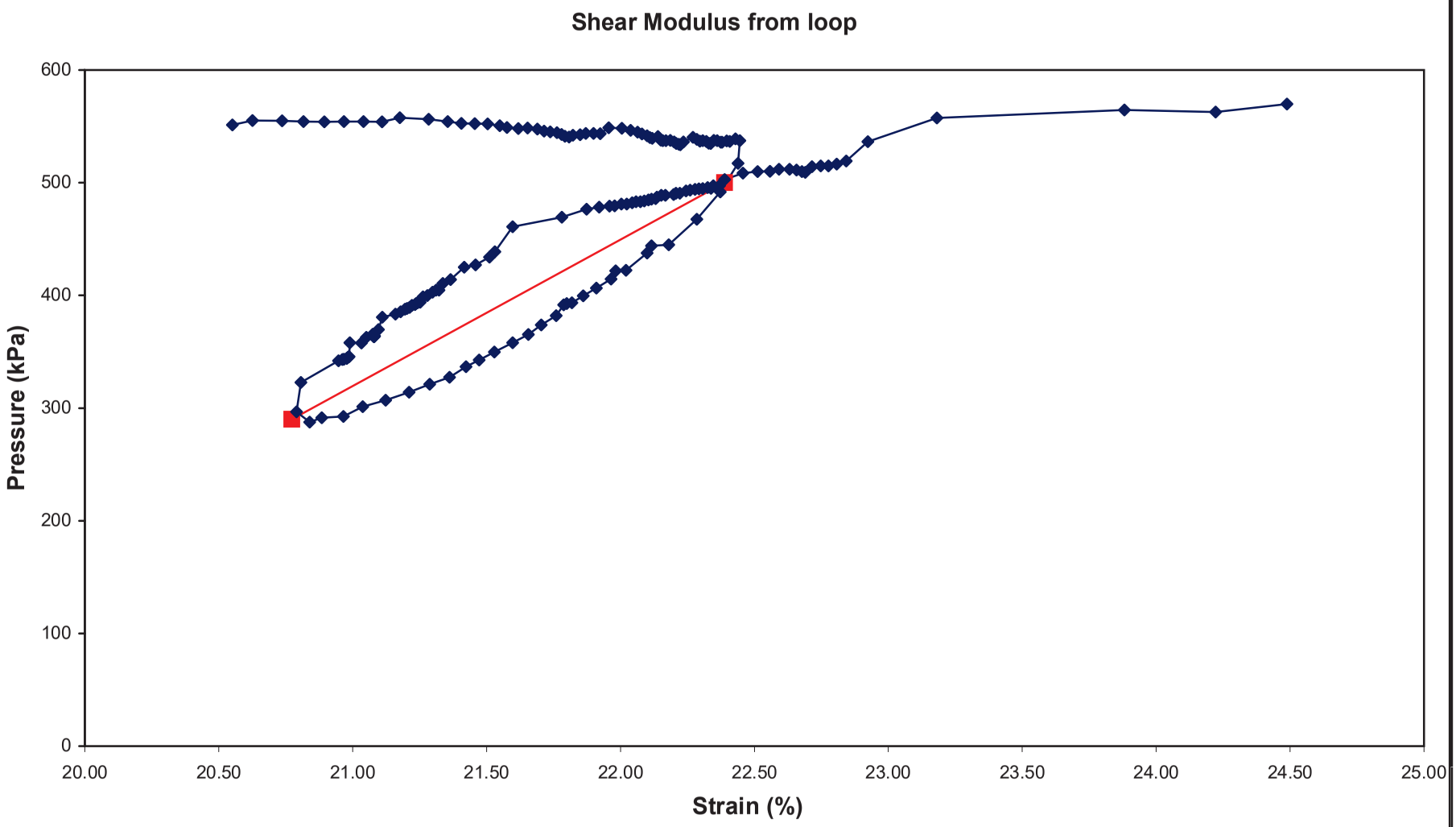
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_19 T1



Borehole Number	cpt_19
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	TH DB
Test Date	01 April 2009

Calculating Shear Modulus

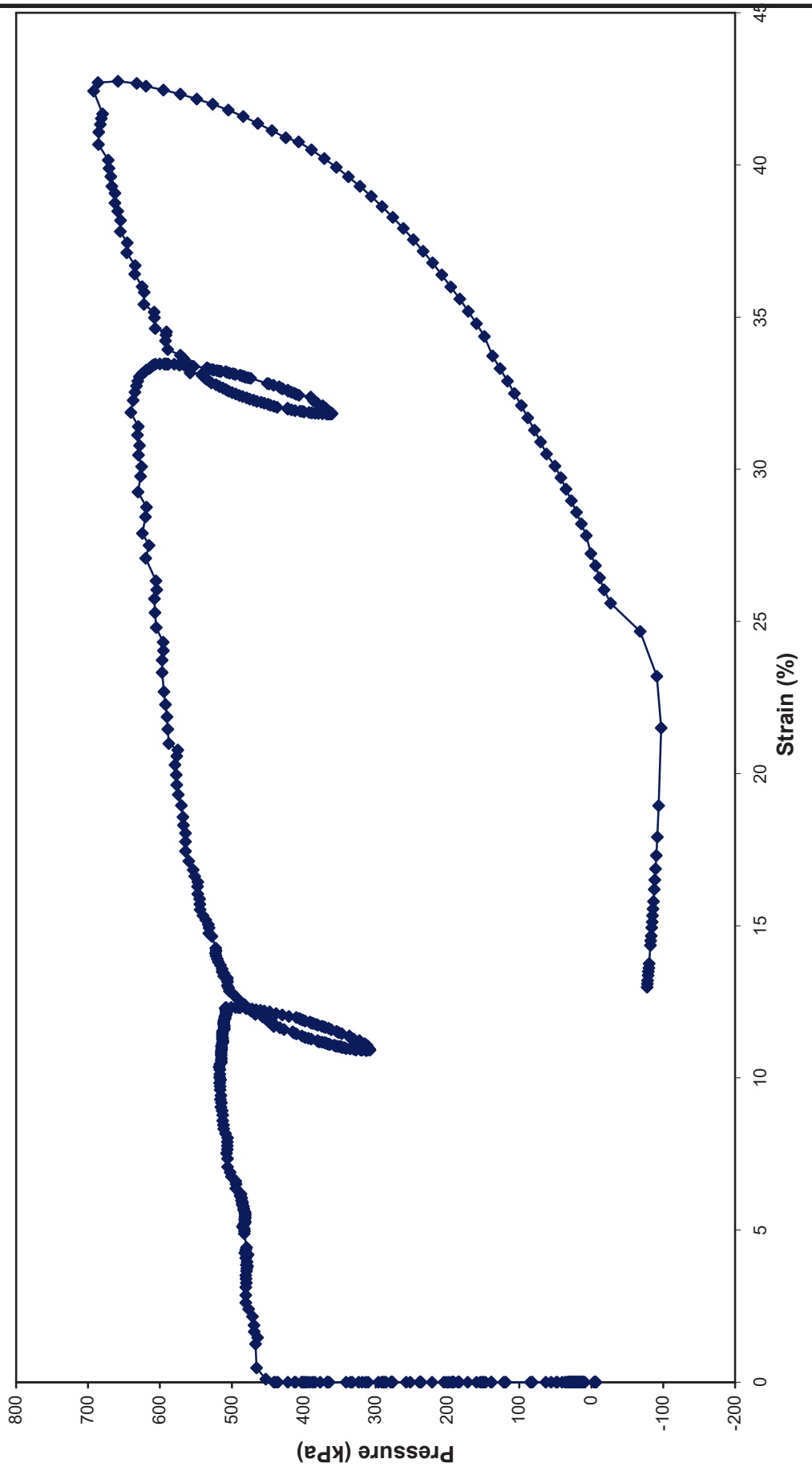
Loop 2	
δε	dp
20.77	290
22.39	500
1.62 %	210 kPa

Unload reload modulus, Gur **6.5** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_19
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	Th DB
Test Date	01 April 2009

Remarks

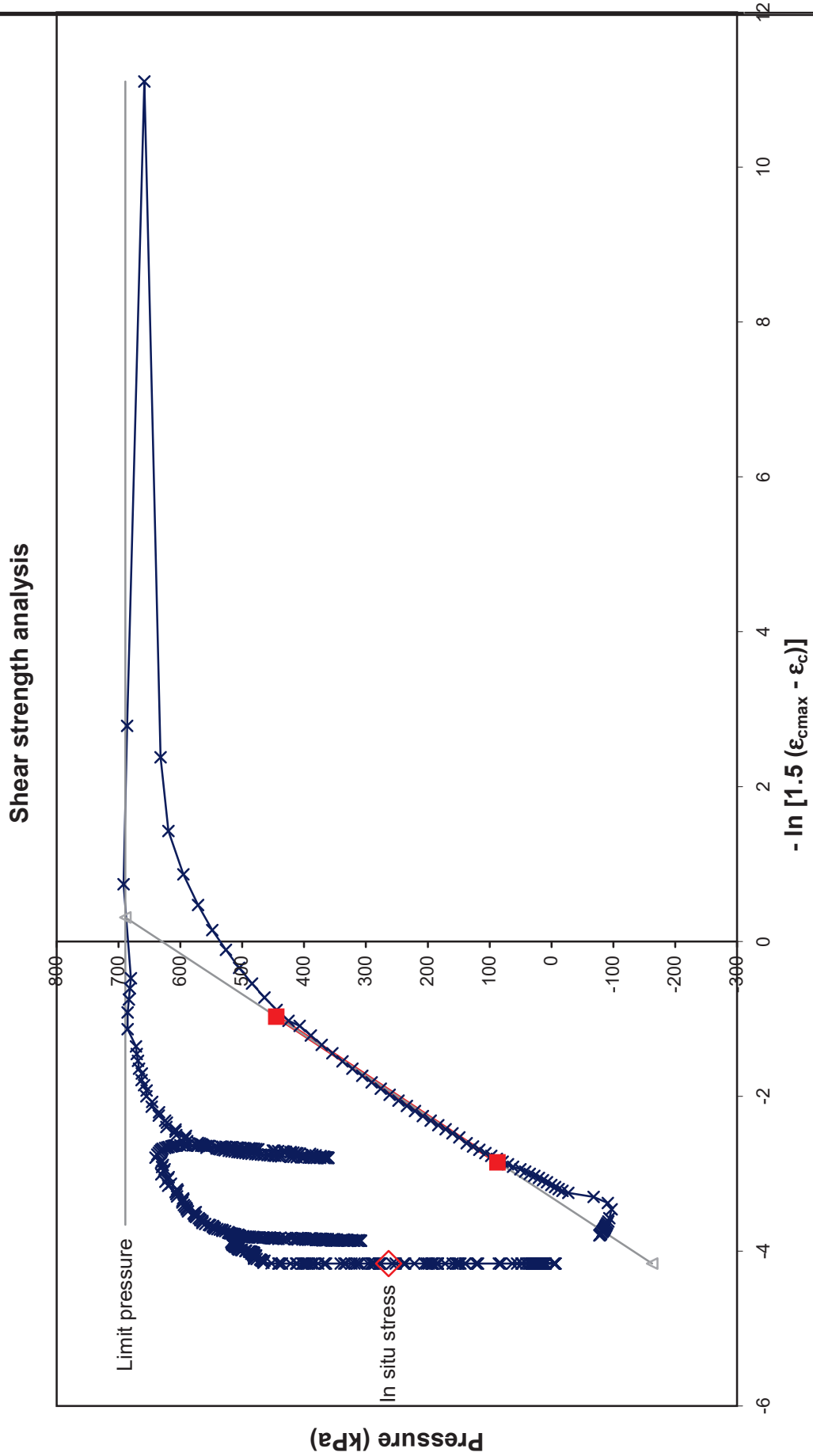
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_19 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_19
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	Th DB
Test Date	01 April 2009

Shear strength analysis		
	δε	δπ
	–0.97	445
	–2.85	87
	Gradient	190.43
	Su (kPa)	**95**

In situ stress analysis		
	δε	P
	-4.16	-162.59
	0.31	689.00
	σm (kPa)	**263**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_19 T2

Driven Pressuremeter Test Results

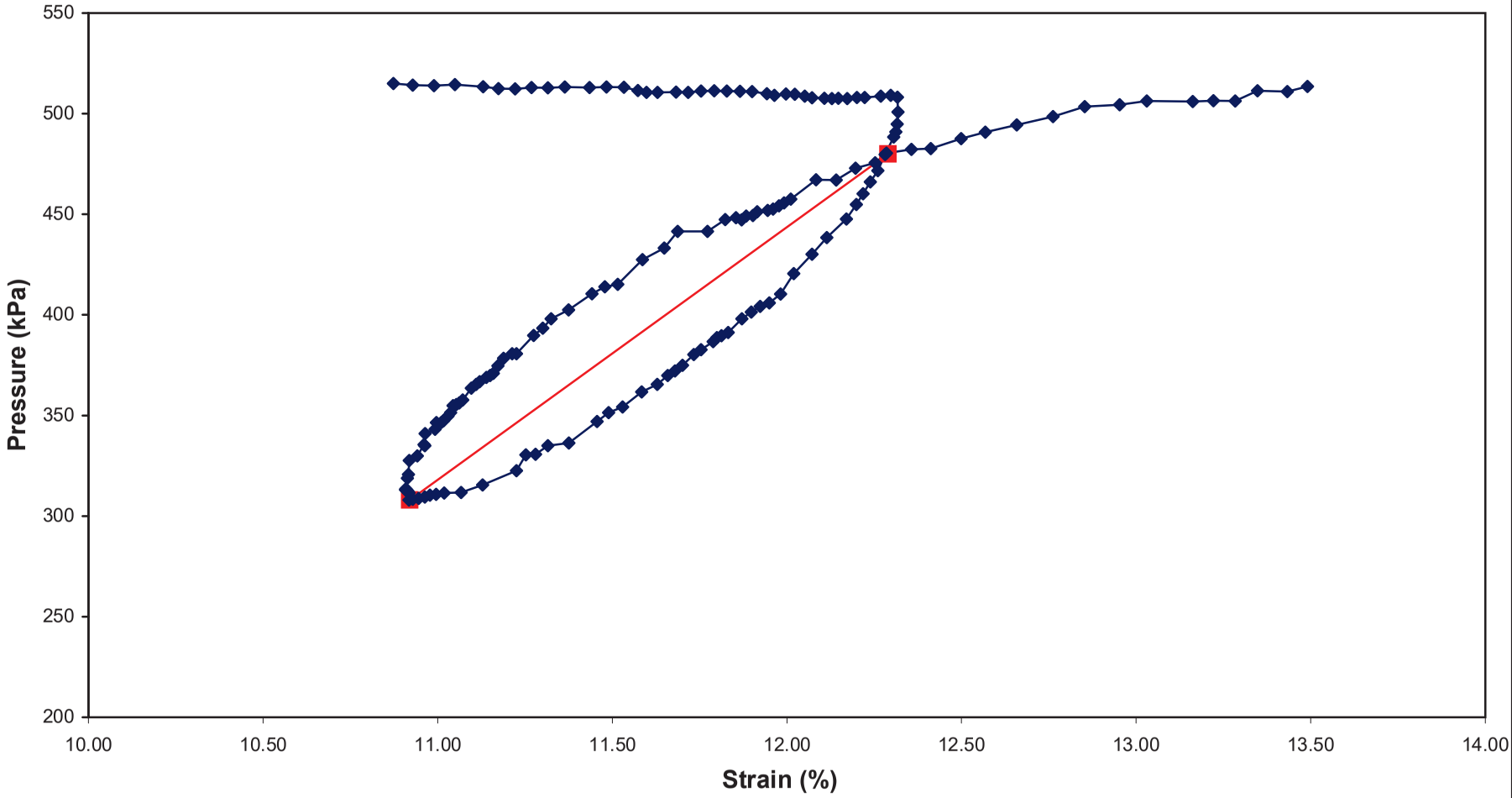
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_19 T2



Borehole Number	cpt_19
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	Th DB
Test Date	01 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
10.92	308
12.29	480
1.37 %	172 kPa

Unload reload modulus, Gur **6.3** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

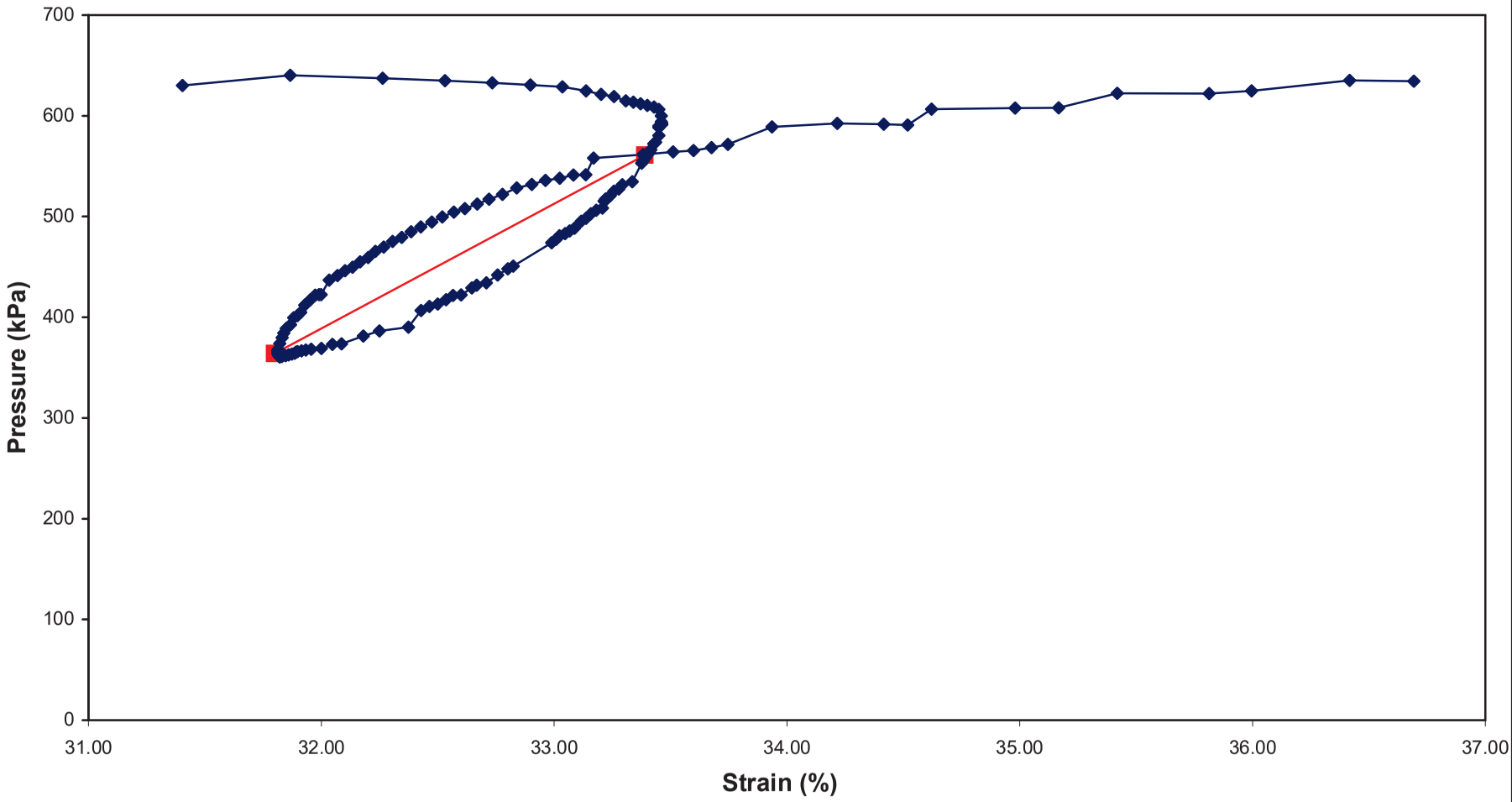
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_19 T2



Borehole Number	cpt_19
Test Number	2
Depth(m)	6.50
Installation Method	CPT
Operator	Th DB
Test Date	01 April 2009

Calculating Shear Modulus

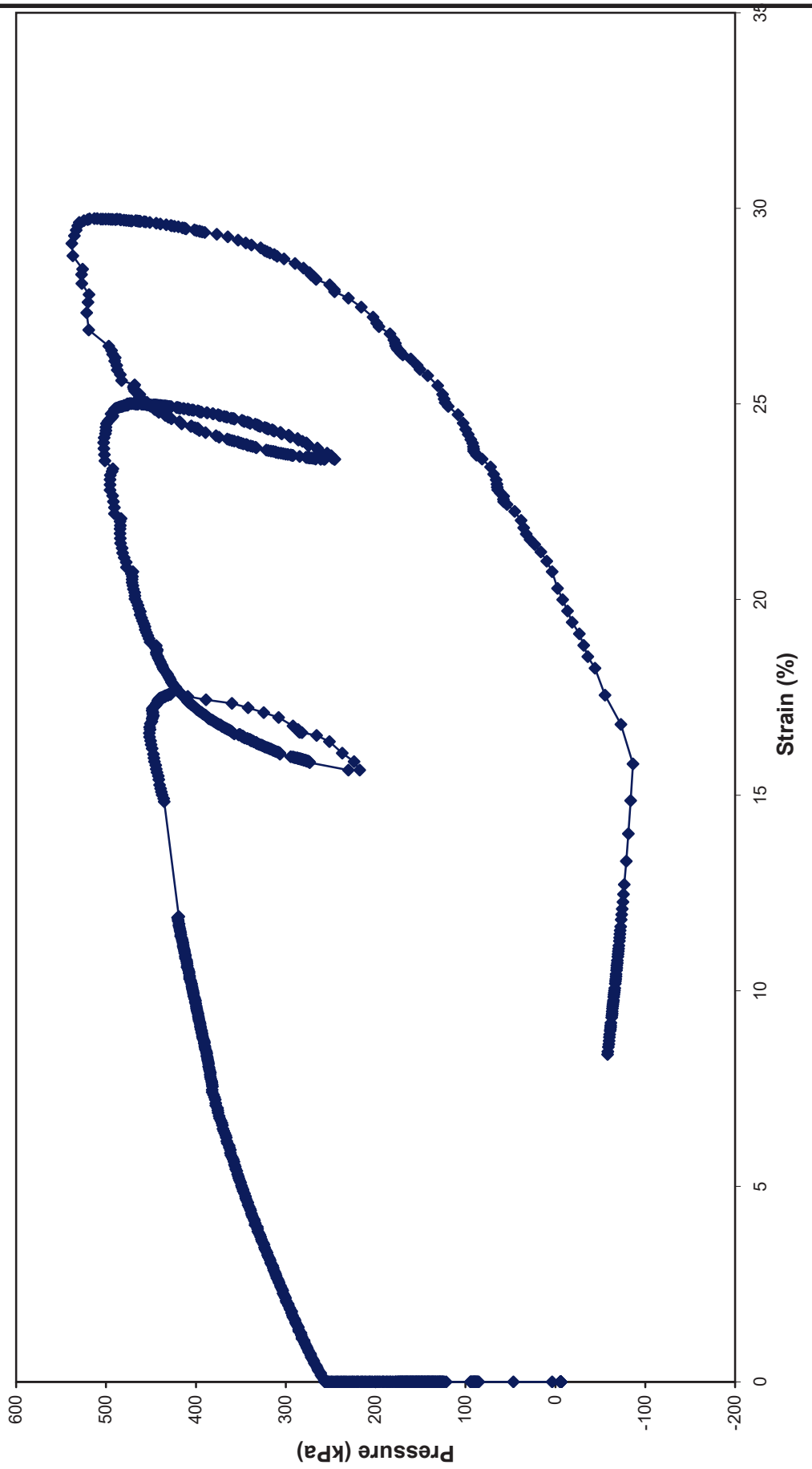
Loop 2	
δε	dp
31.80	364
33.39	561
1.59 %	197 kPa

Unload reload modulus, Gur **6.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_20
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Remarks

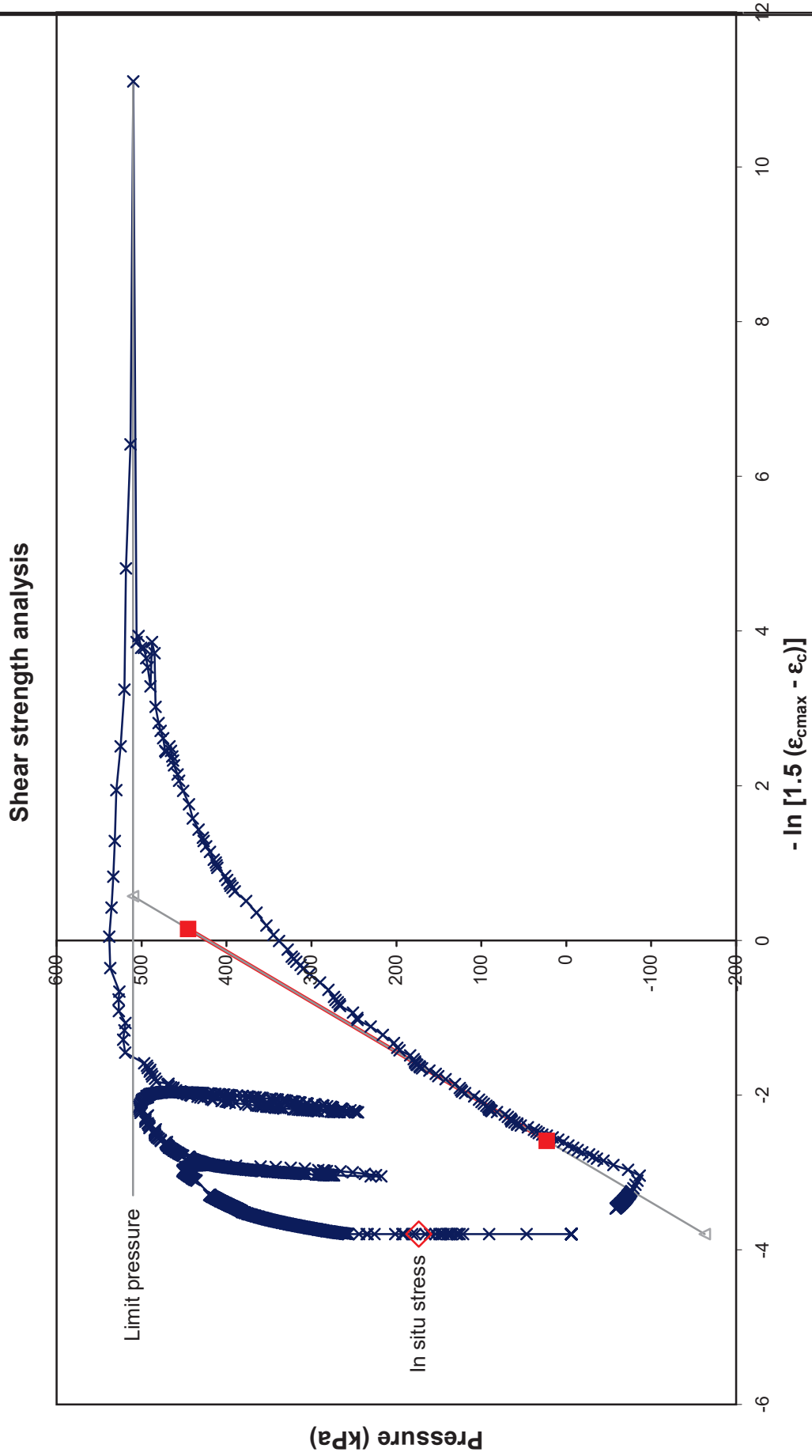
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_20 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_20
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Shear strength analysis		
	δε	δπ
	0.15	445
	–2.59	23
	Gradient	154.01
	Su (kPa)	**77**

In situ stress analysis		
	δε	P
	-3.80	-163.03
	0.57	510.00
	σm (kPa)	**173**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_20 T1

Driven Pressuremeter Test Results

x strain

GEOCONE

Borehole Number	cpt_20
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
15.65	218
17.55	415
1.90 %	197 kPa

Unload reload modulus, Gur **5.2** **MPa**

Notes:	**Project**	TWEEN BRIDGE WIND FARM, PHASE 2
	Project No.	M9015
	Carried out for	Morrison Construction
	Figure	**DPM cpt_20 T1**

Driven Pressuremeter Test Results

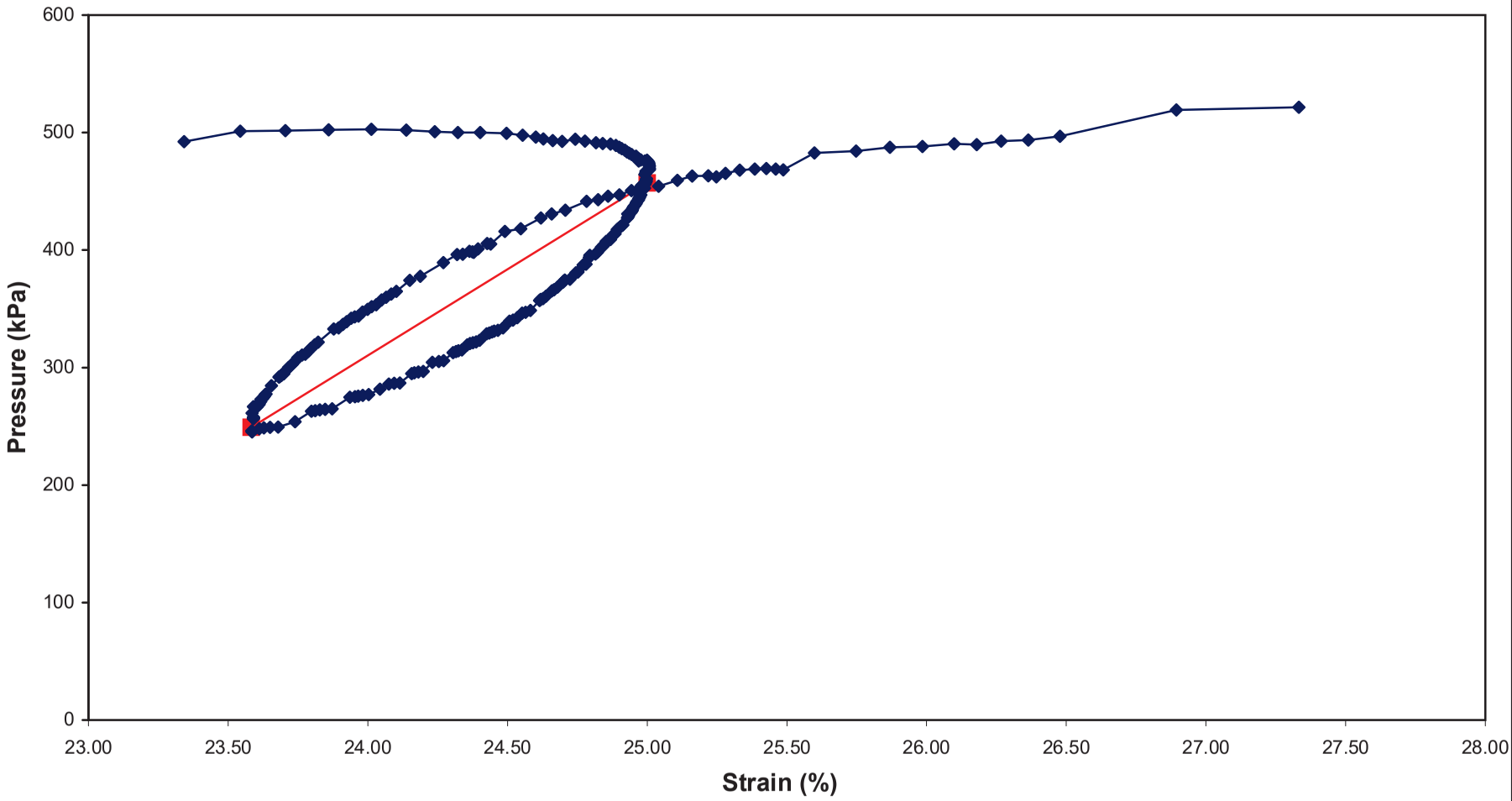
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_20 T1



Borehole Number	cpt_20
Test Number	1
Depth(m)	4.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Calculating Shear Modulus

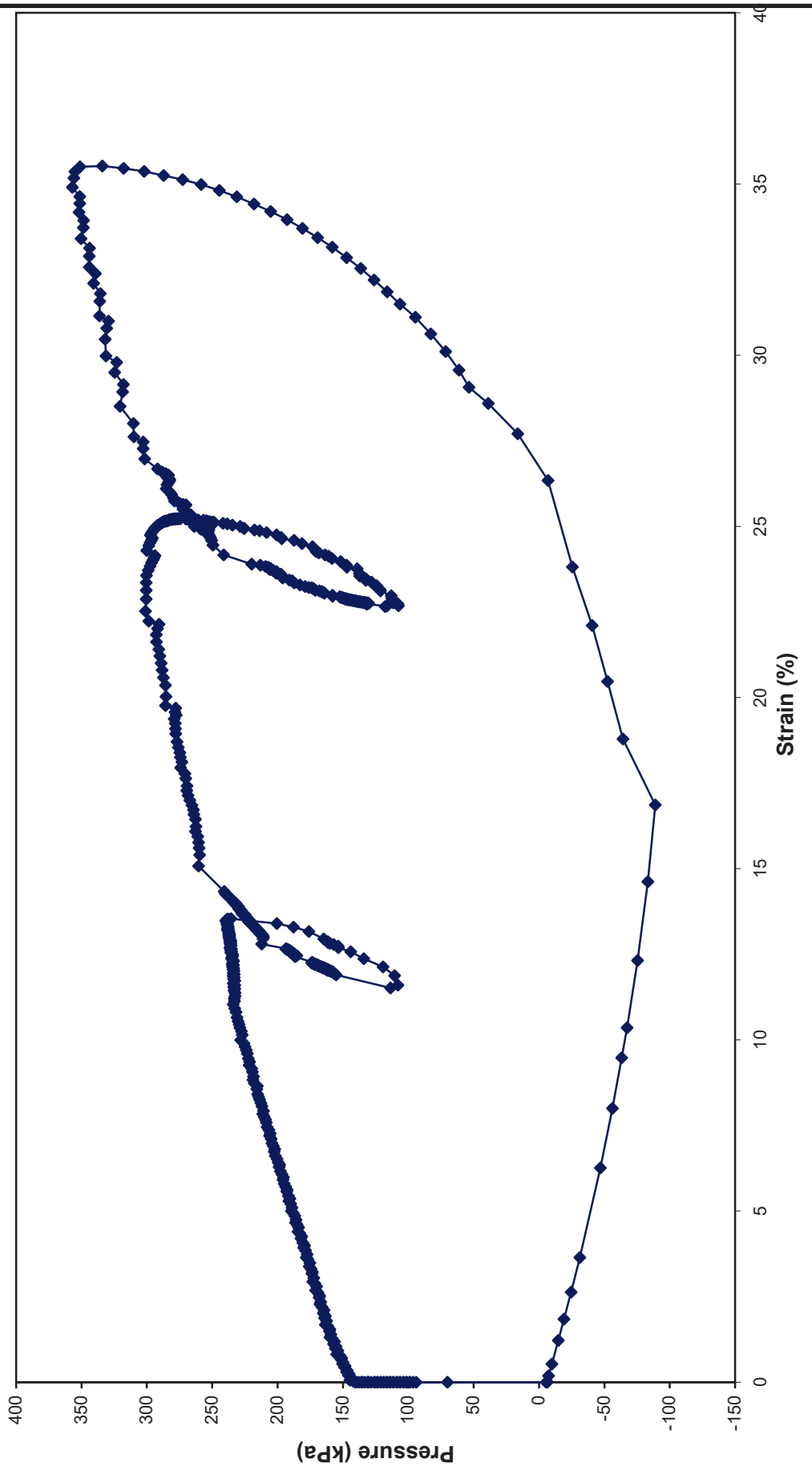
Loop 2	
δε	dp
23.58	249
25.00	457
1.42 %	208 kPa

Unload reload modulus, Gur **7.3** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_20
Test Number	2
Depth(m)	7.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Remarks

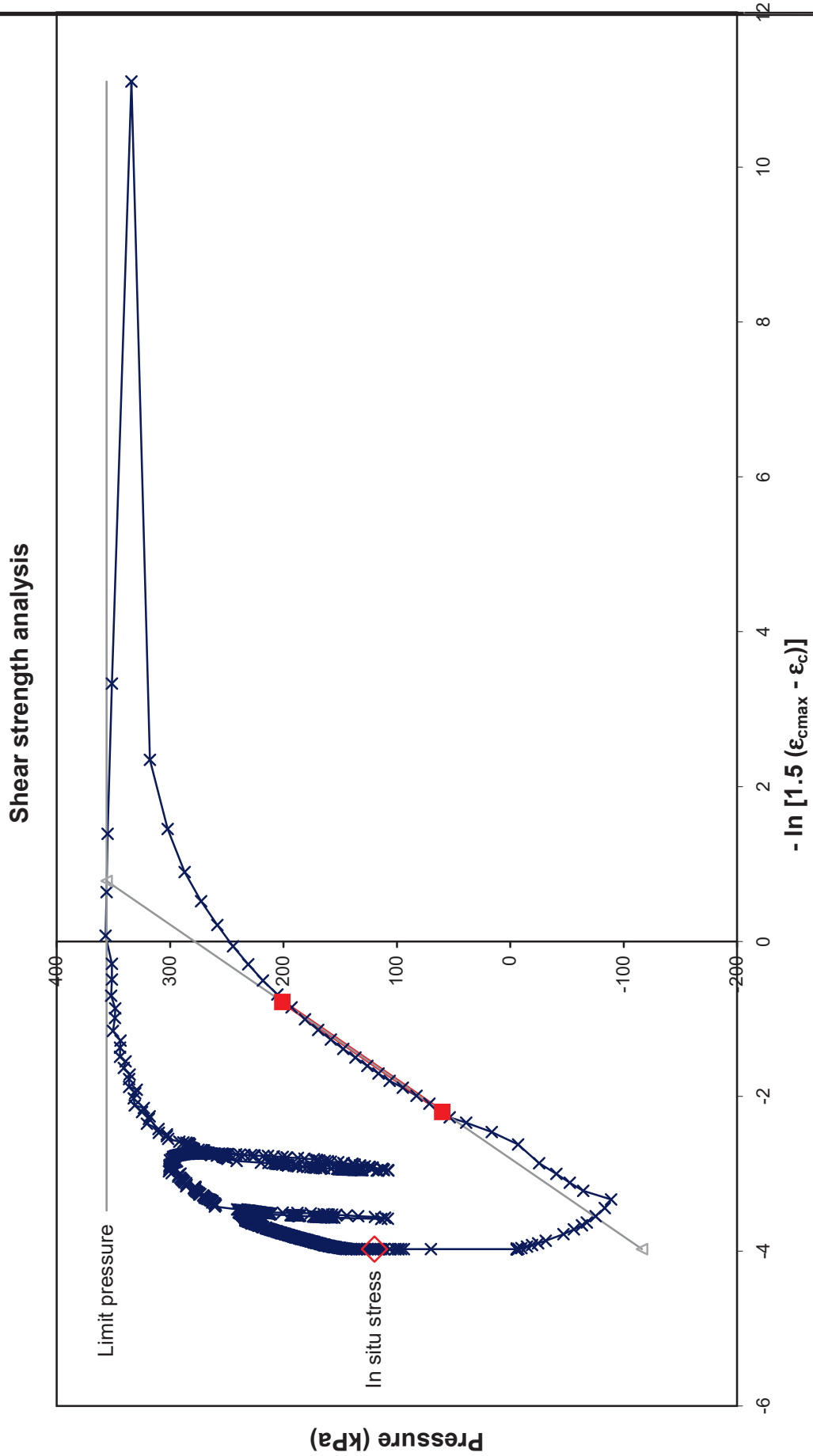
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_20 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_20
Test Number	2
Depth(m)	7.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Shear strength analysis		
	δε	δπ
	–0.78	201
	–2.2	60
	Gradient	99.30
	Su (kPa)	**50**

In situ stress analysis		
	δε	P
	-3.98	-116.31
	0.78	356.00
	σm (kPa)	**120**

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_20 T2

Driven Pressuremeter Test Results

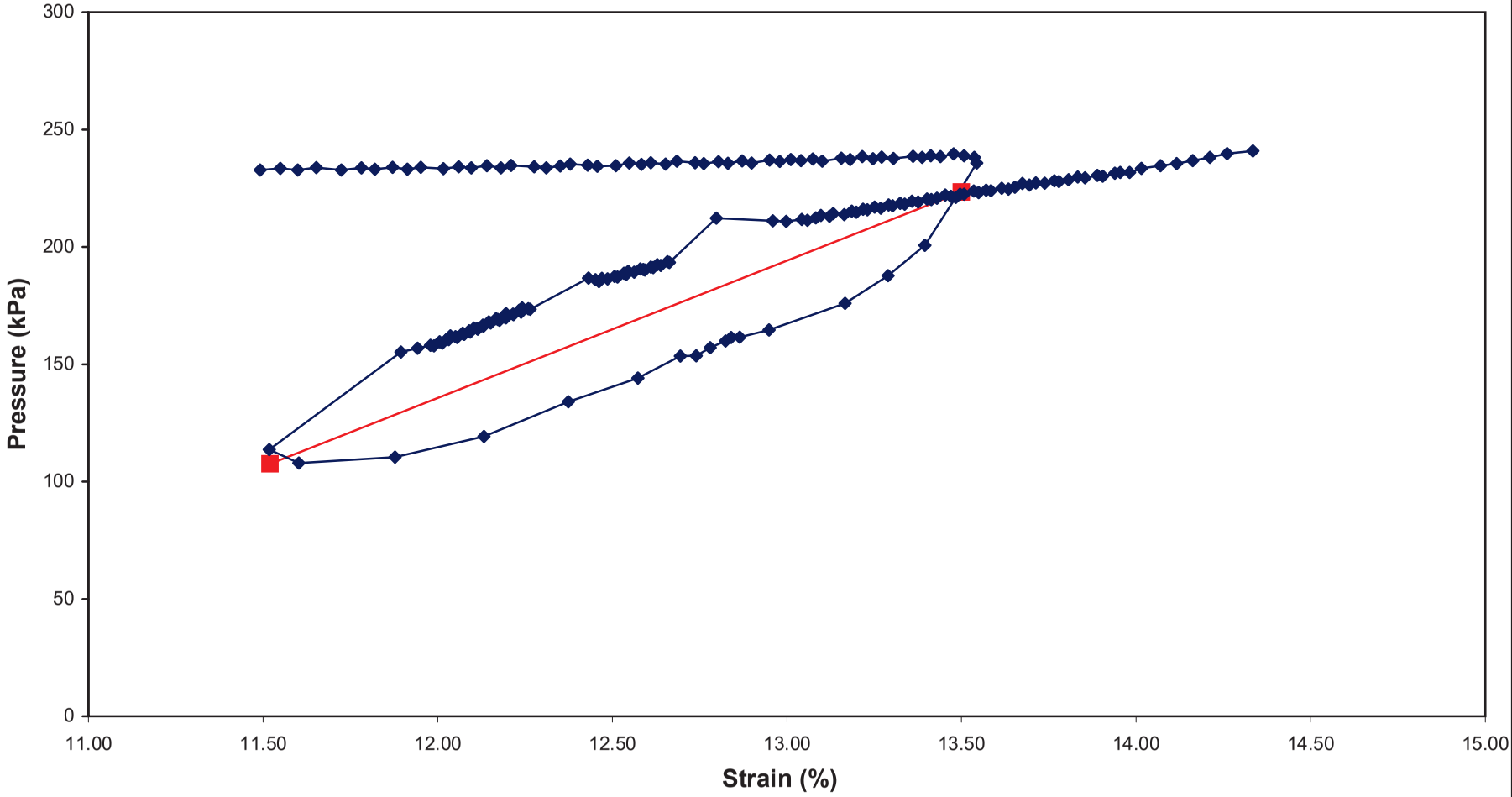
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_20 T2



Borehole Number	cpt_20
Test Number	2
Depth(m)	7.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.52	108
13.50	223.4
1.98 %	116 kPa

Unload reload modulus, Gur **2.9** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

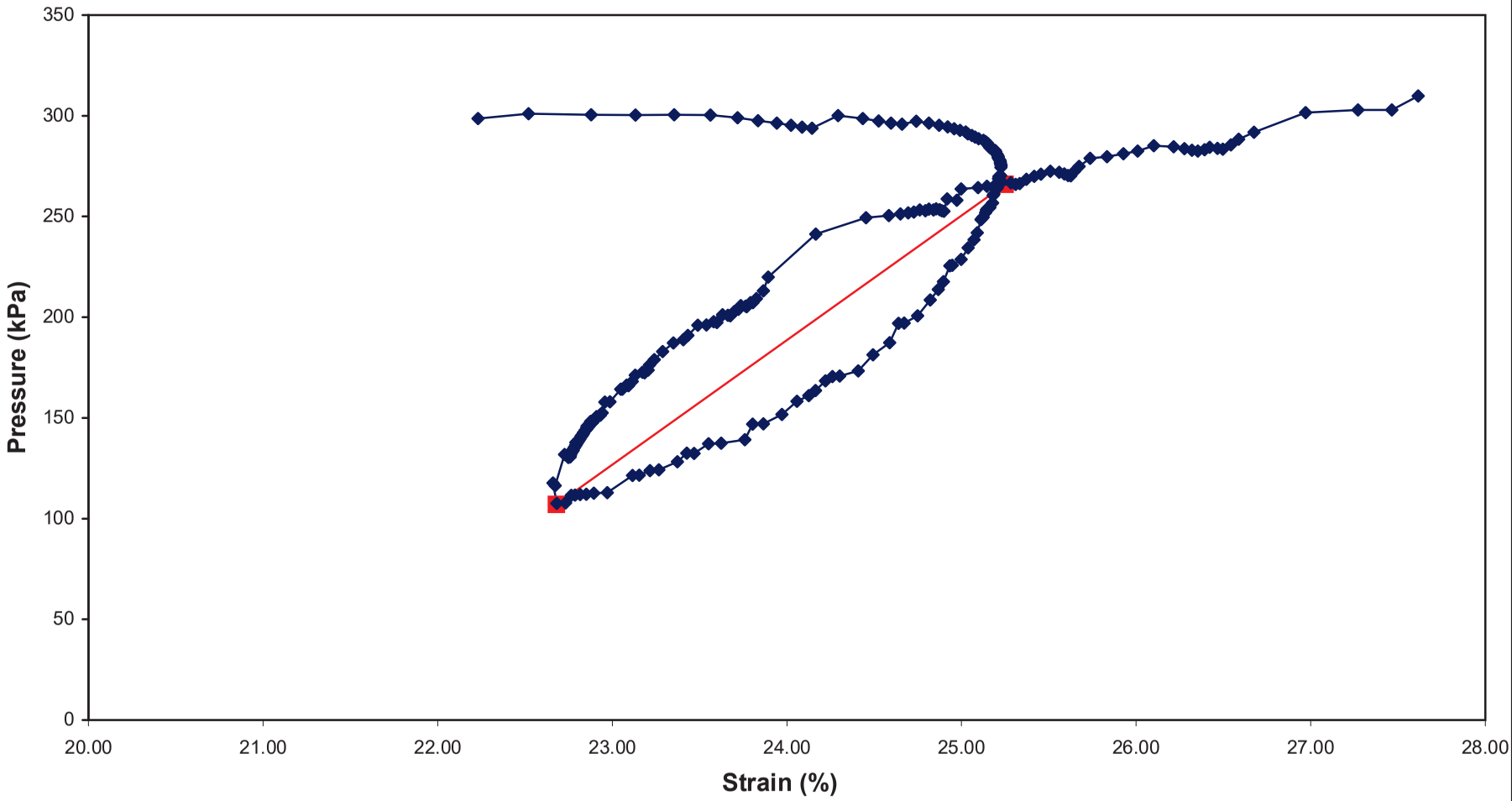
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_20 T2



Borehole Number	cpt_20
Test Number	2
Depth(m)	7.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Calculating Shear Modulus

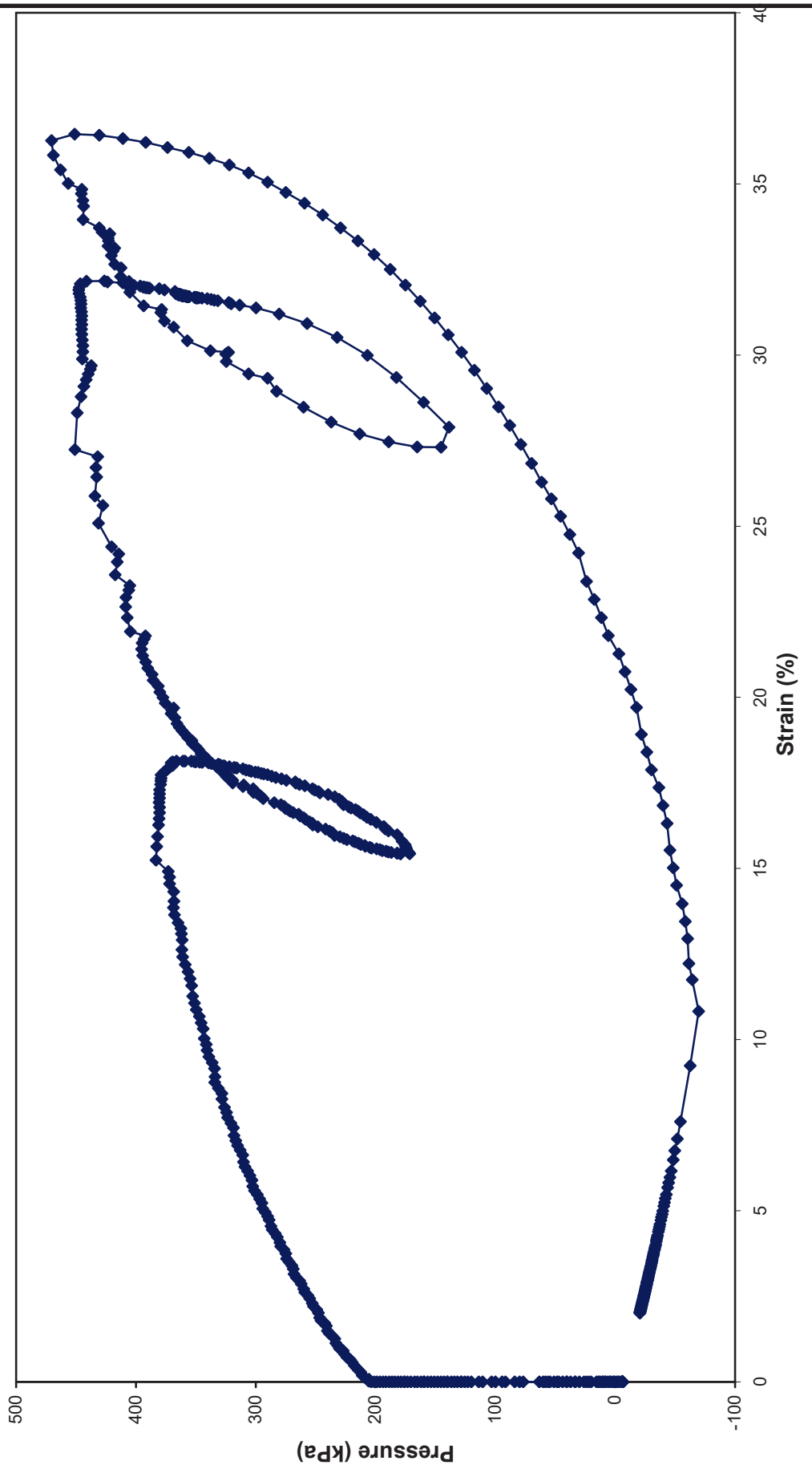
Loop 2	
δε	dp
22.68	107
25.25	266
2.57 %	159 kPa

Unload reload modulus, Gur **3.1** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_22
Test Number	1
Depth(m)	3.50
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Remarks

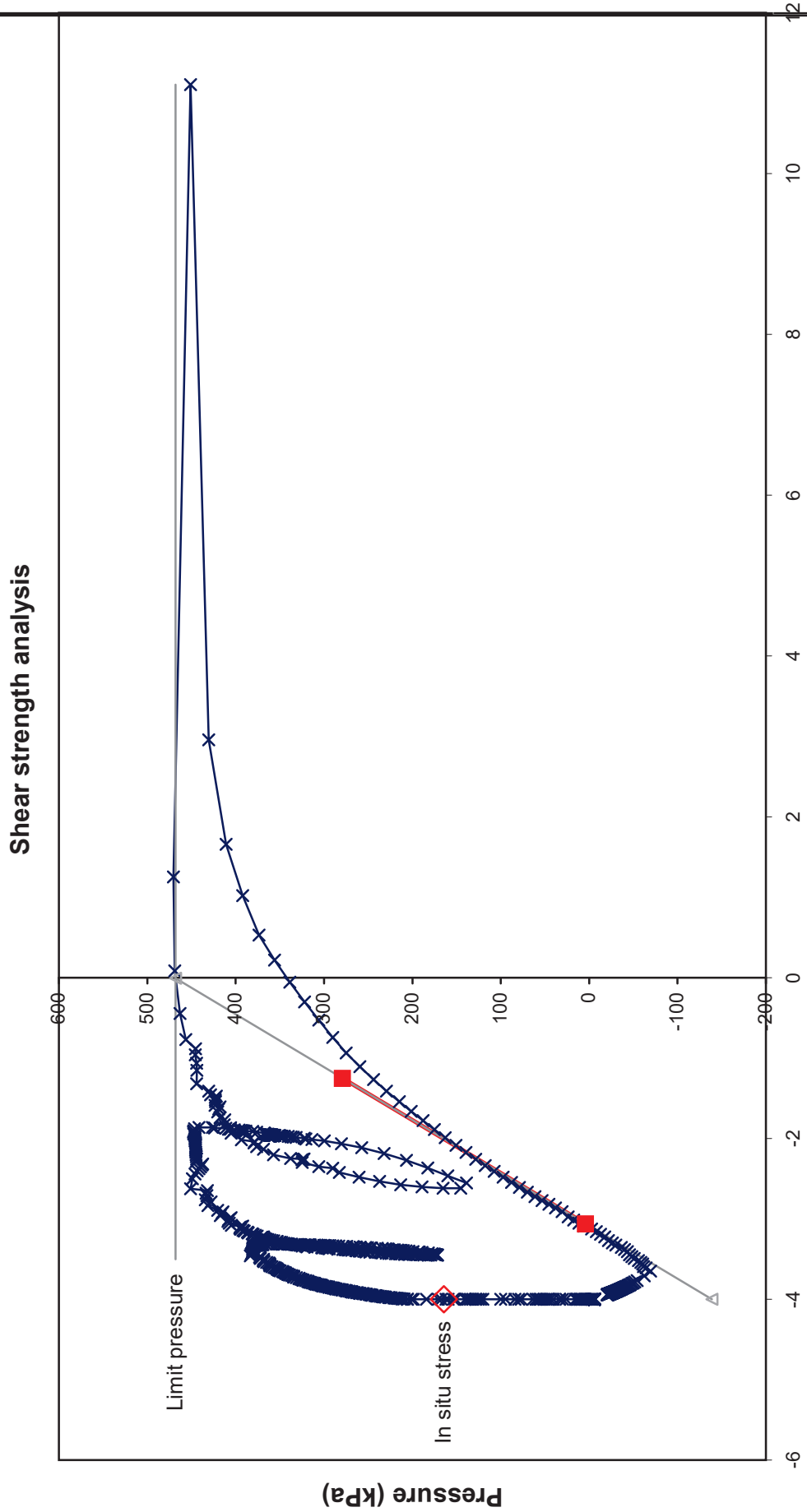
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_22 T1

Driven Pressuremeter Test Results



Borehole Number	cpt_22
Test Number	1
Depth(m)	3.50
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Shear strength analysis		
	δε	δπ
	–1.25	279
	–3.06	4
	Gradient	151.93
	Su (kPa)	76

In situ stress analysis	
δε	P
-4.00	-139.05
-0.01	468.00
σm (kPa)	164

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_22 T1

Driven Pressuremeter Test Results

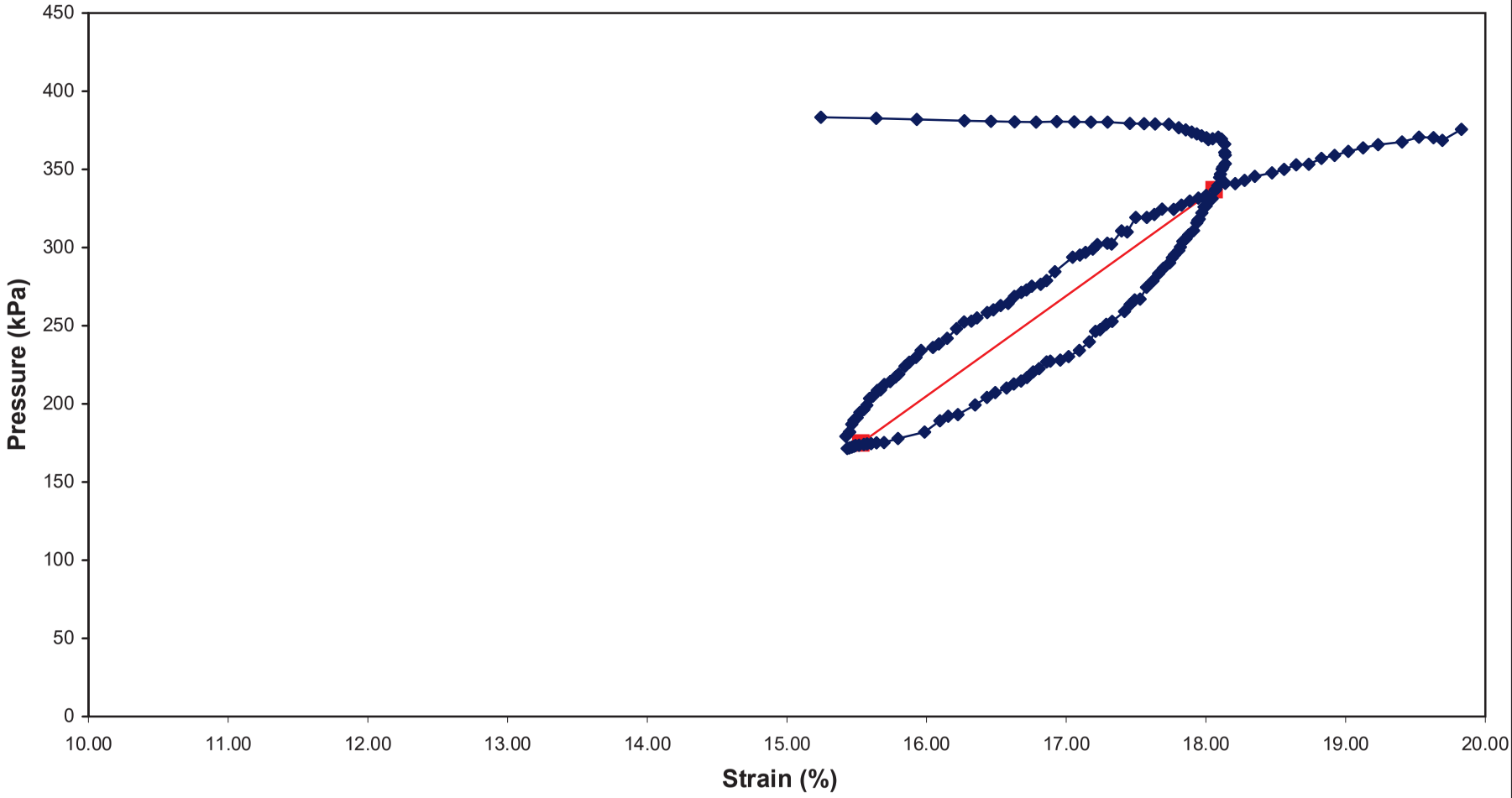
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_22 T1



Borehole Number	cpt_22
Test Number	1
Depth(m)	3.50
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
15.53	175
18.06	337
2.53 %	162 kPa

Unload reload modulus, Gur **3.2** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results

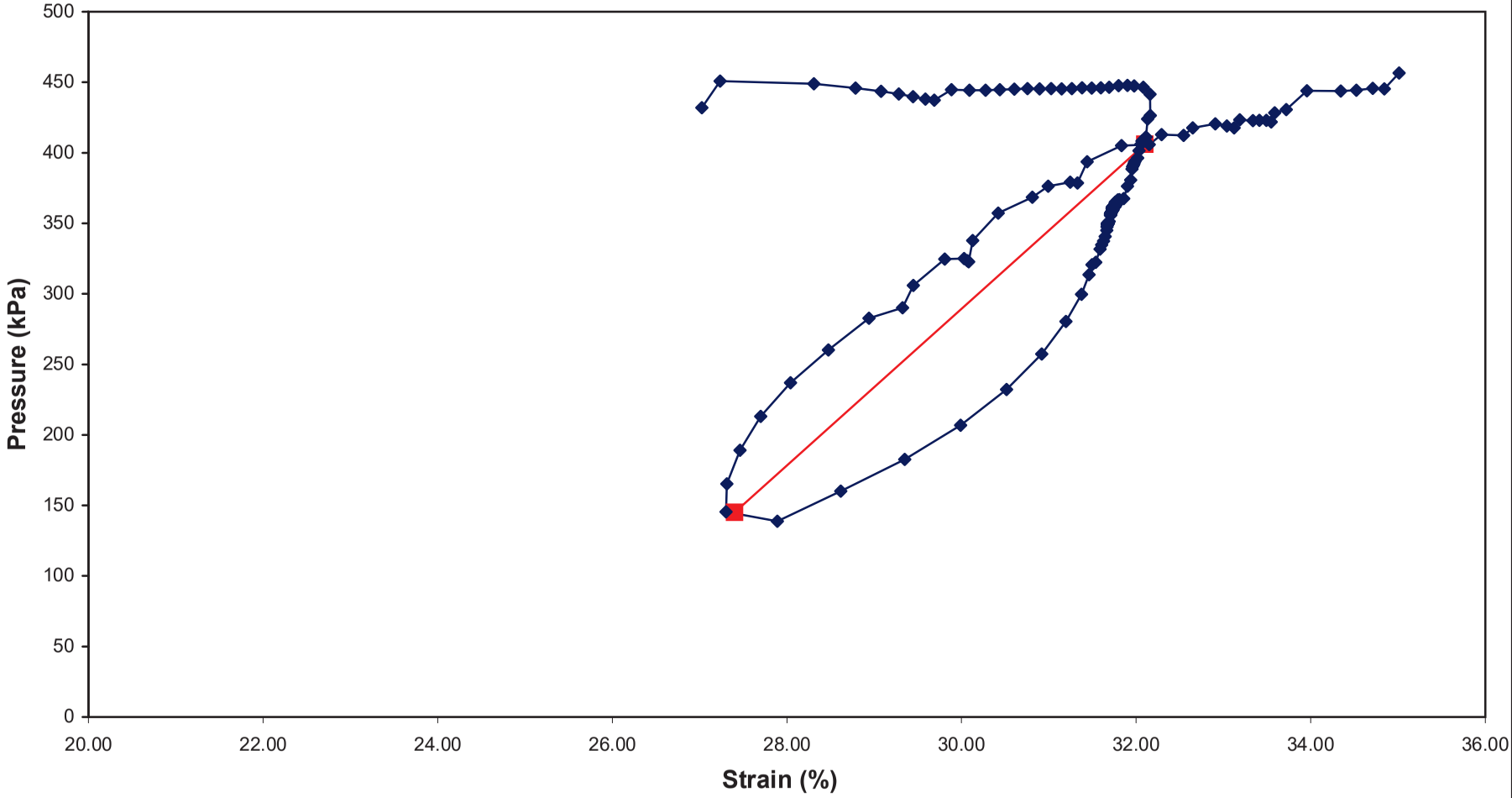
Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No.: M9015

Carried out for: Morrison Construction

Figure: DPM cpt_22 T1



Borehole Number	cpt_22
Test Number	1
Depth(m)	3.50
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

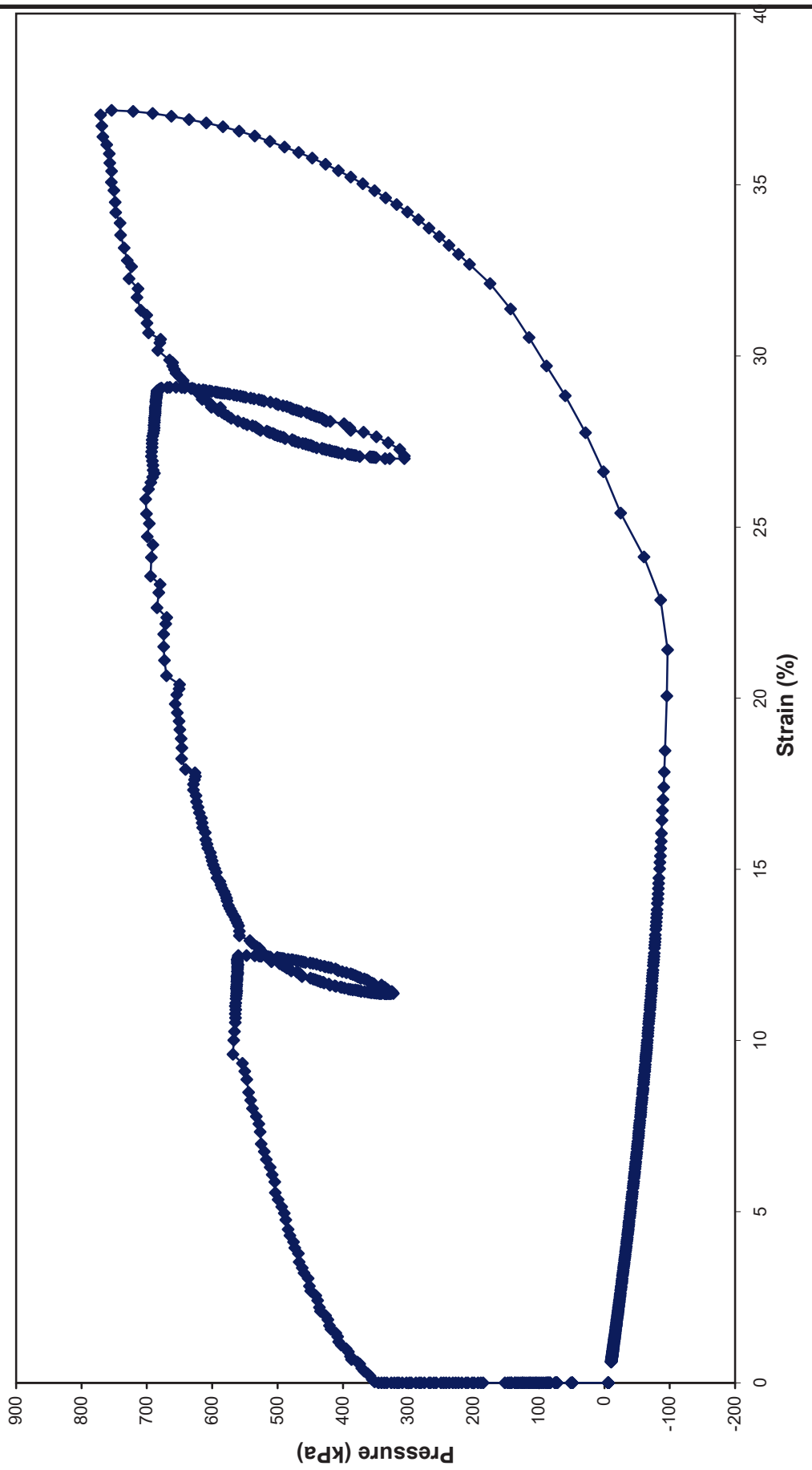
Loop 2	
δε	dp
27.40	145
32.10	406
4.70 %	261 kPa

Unload reload modulus, Gur **2.8** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_22
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th DB
Test Date	09 April 2009

Remarks

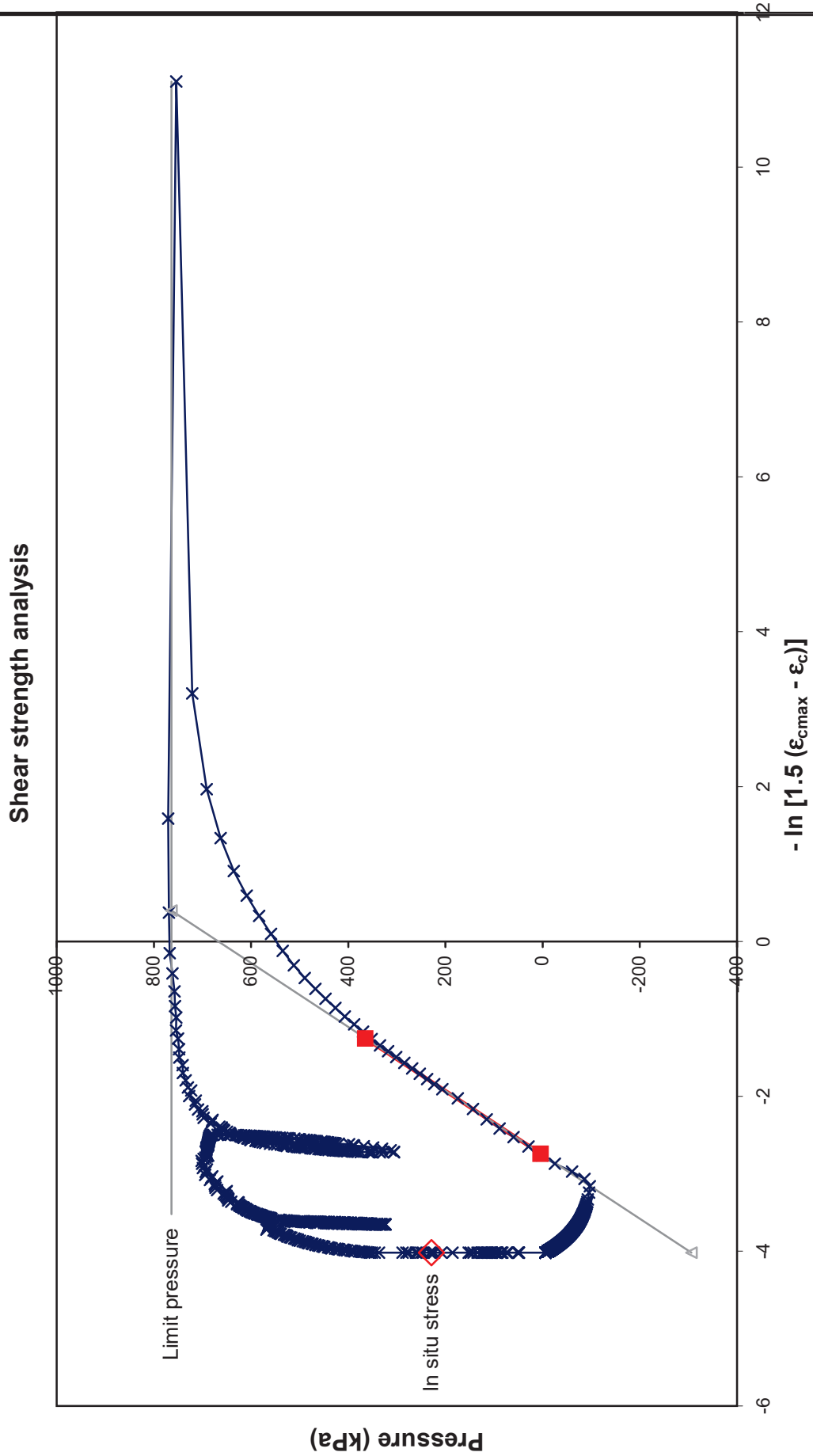
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_22 T2

Driven Pressuremeter Test Results



Borehole Number	cpt_22
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th DB
Test Date	09 April 2009

Shear strength analysis		
	δε	δπ
	–1.25	365
	–2.74	4
	Gradient	242.28
	Su (kPa)	121

In situ stress analysis	
δε	P
-4.02	-306.38
0.40	764.00
σm (kPa)	229

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_22 T2

Driven Pressuremeter Test Results

x strain

GEOCONE

Borehole Number	cpt_22
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 1	
δε	dp
11.38	327
12.50	523
1.12 %	196 kPa

Unload reload modulus, Gur **8.8** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_22 T2

Driven Pressuremeter Test Results

x strain

GEOCONE

Calculating Shear Modulus

Loop 2	
δε	dp
26.99	300
29.05	639
2.06 %	339 kPa

Unload reload modulus, Gur **8.2** **MPa**

Borehole Number	cpt_22
Test Number	2
Depth(m)	5.50
Installation Method	CPT
Operator	Th DB
Test Date	09 April 2009

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_22 T2

Soil Mechanics

UKAS TESTING
4330

CERTIFICATE OF TEST

Authorised signatories:
[redacted] Operations Manager[✓]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

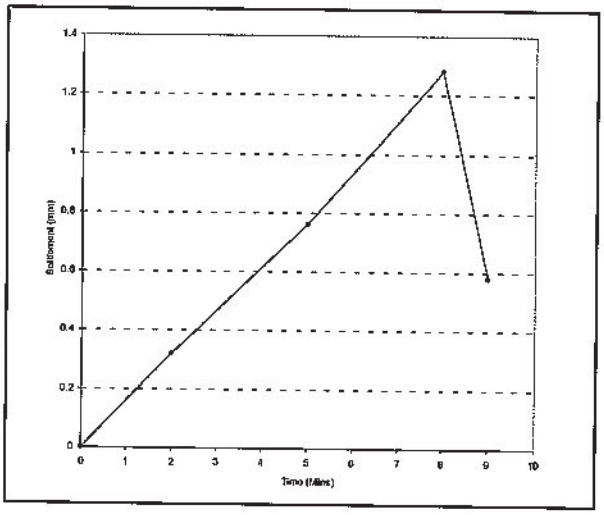
Date 08/04/2009
Report Ref: 09FW0331

Lab Ref No.	**09FW0331.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**1**	Client Reference	**1**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish brown sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**29.8**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
30	2	0.32
60	5	0.76
90	8	1.28
0	9	0.58



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.28	**54.7**	**3.8**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
Remarks:

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Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.
Results reported herein relate solely to the sample tested and are not necessarily representative of a larger sample population.
The results herein relate solely to the location tested. The Client should ensure that the material tested is representative of material on site.
This test certificate shall not be reproduced, except in full, without the written approval of the issuing laboratory.

Client Name
Soil Mechanics
Askern Road
Carcroft
Doncaster
South Yorkshire
DN5 8DG

FAO [redacted]

Issuing laboratory:
Soil Mechanics

Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
Tel: 0114 240 1901
Fax: 0114 240 1744

Authorised By: [redacted]

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:
[redacted] Operations Manager[ ]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

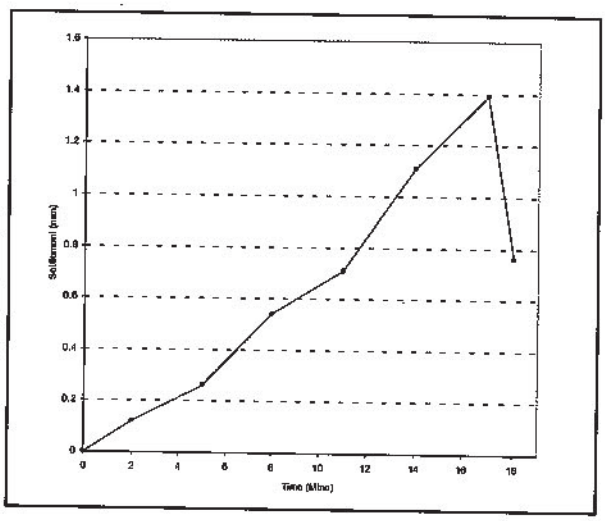
Date 08/04/2009
Report Ref: 09FW0332

Lab Ref No.	**09FW0332.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**2**	Client Reference	**2**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**26.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.26
45	8	0.54
60	11	0.71
75	14	1.11
90	17	1.39
0	18	0.76



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.39	**45.3**	**3.3**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
Remarks:

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Issuing laboratory:
Soil Mechanics

Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
Tel: 0114 240 1901
Fax: 0114 240 1744

Client Name
Soil Mechanics
Askern Road
Carcroft
Doncaster
South Yorkshire
DN5 8DG

FAO [redacted]

Authorised By: [redacted]

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:
[redacted] Operations Manager[ ]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

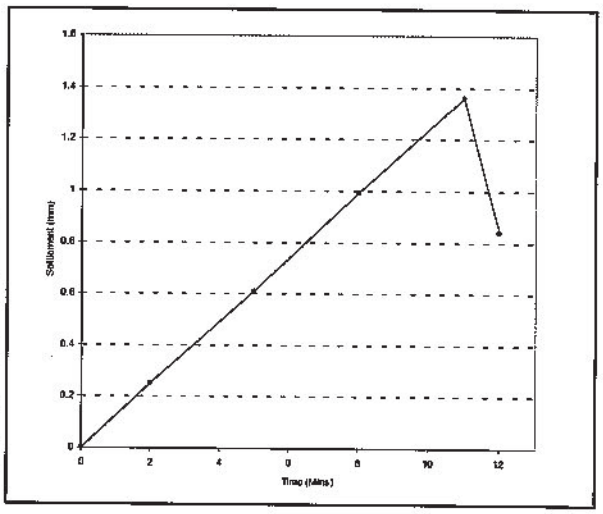
Date 08/04/2009
Report Ref: 09FW0333

Lab Ref No.	**09FW0333.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**3**	Client Reference	**3**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
20	2	0.25
40	5	0.61
60	8	0.99
80	11	1.36
0	12	0.84



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.36	**38.2**	**2.7**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
Remarks:

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Issuing laboratory:
Soil Mechanics

Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
Tel: 0114 240 1901
Fax: 0114 240 1744

Client Name
Soil Mechanics
Askern Road
Carcroft
Doncaster
South Yorkshire
DN5 8DG

FAO [redacted]

Authorised By: [redacted]

Soil Mechanics

UKAS TESTING 4330

CERTIFICATE OF TEST

Authorised signatories:
[redacted] Operations Manager[✓]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

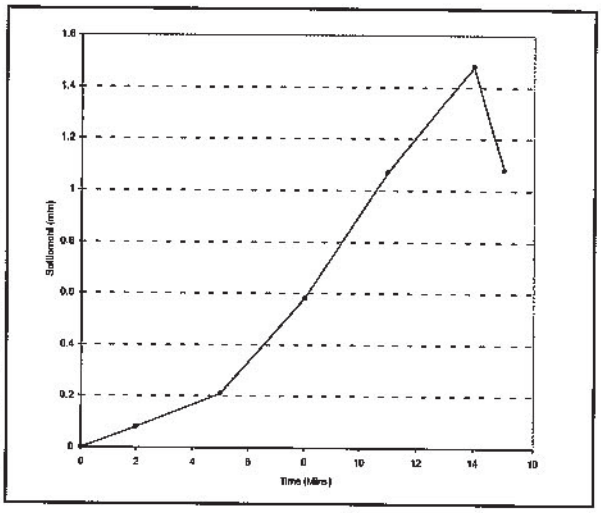
Date 08/04/2009
Report Ref: 09FW0334

Lab Ref No.	**09FW0334.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location		Client Reference	**4**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**31.0**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.08
30	5	0.21
45	8	0.58
60	11	1.07
75	14	1.48
0	15	1.08



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.48	**27.0**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
Remarks:

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Issuing laboratory:
Soil Mechanics

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Tel: 0114 240 1901
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FAO [redacted]

Authorised By: [redacted]

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:
[redacted] Operations Manager[ ]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

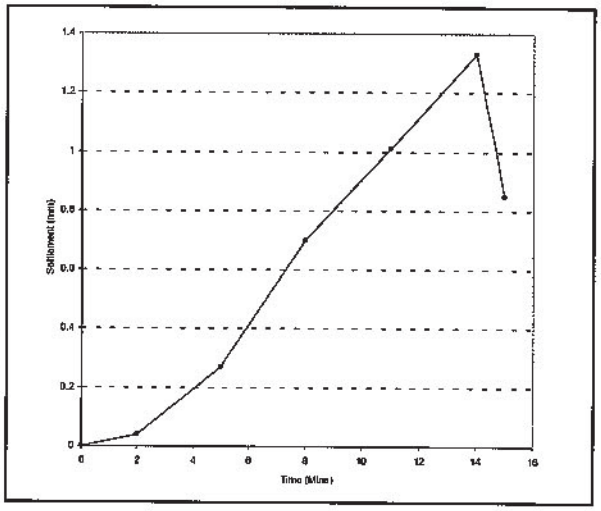
Date 08/04/2009
Report Ref: 09FW0335

Lab Ref No.	**09FW0335.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**5**	Client Reference	**5**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**17.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.04
30	5	0.27
45	8	0.70
60	11	1.01
75	14	1.33
0	15	0.85



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.33	**36.1**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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BS 1377: Part 9: 1990

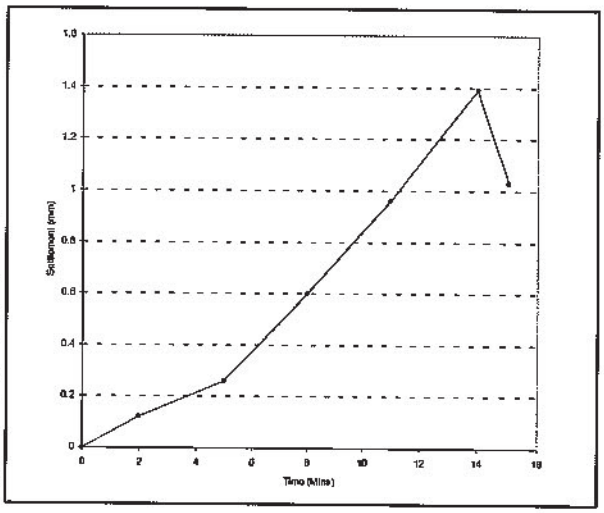
Date 08/04/2009
Report Ref: 09FW0336

Lab Ref No.	**09FW0336.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**6**	Client Reference	**6**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**22.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.26
45	8	0.60
60	11	0.96
75	14	1.39
0	15	1.03



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.39	**25.9**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Lab Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

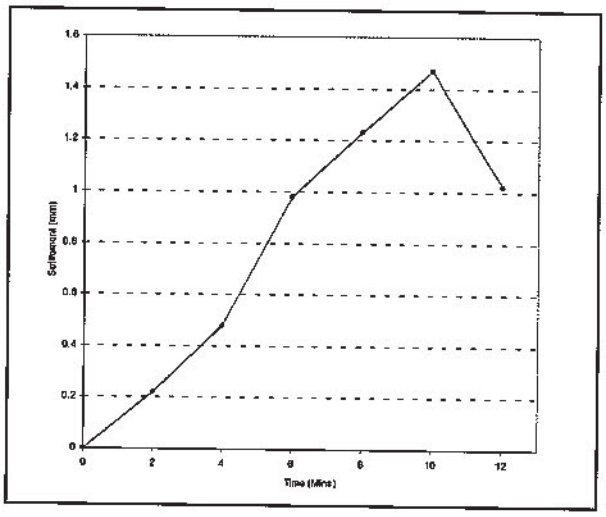
Date 07/04/2009
Report Ref: 09FW0338

Lab Ref No.	**09FW0338.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**7**	Client Reference	**CBR 7**
Technician	**JF**	Weather	**Dry**
Soil Description	**Brown slightly silty sandy CLAY with streak inclusions**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**19.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.22
20	4	0.48
30	6	0.98
40	8	1.23
50	10	1.47
0	12	1.02



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.47	**30.6**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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BS 1377: Part 9: 1990

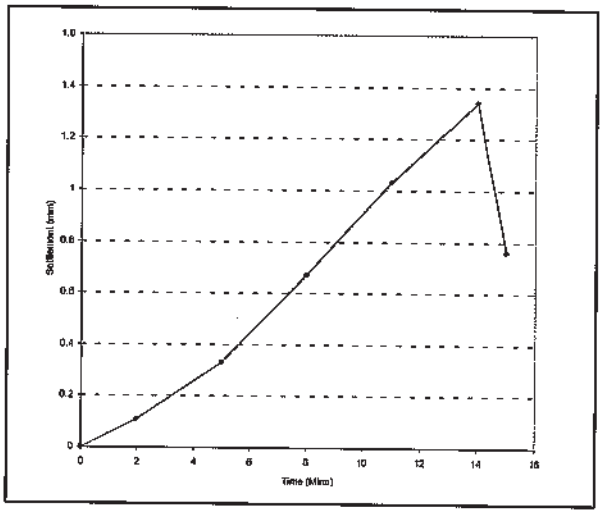
Date 08/04/2009
Report Ref: 09FW0346

Lab Ref No.	**09FW0346.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**8**	Client Reference	**8**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**20.8**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.11
30	5	0.33
45	8	0.67
60	11	1.03
75	14	1.34
0	15	0.76



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.34	**43.3**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Operations Manager[ ]
Lab Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

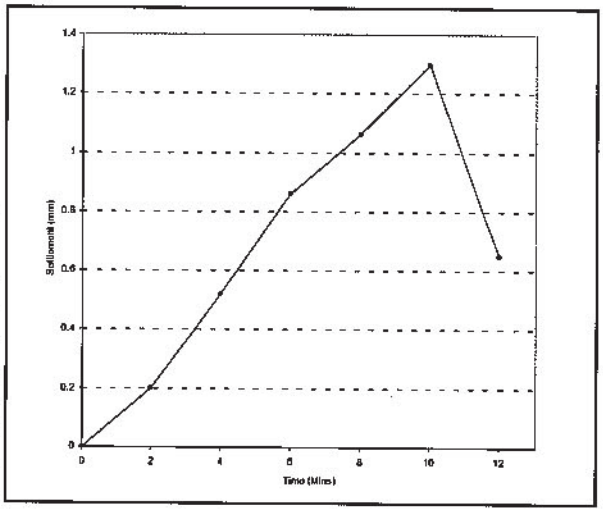
Date 07/04/2009
Report Ref: 09FW0339

Lab Ref No.	**09FW0339.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**9**	Client Reference	**CBR 9**
Technician	**JF**	Weather	**Dry**
Soil Description	**Brown slightly silty sandy CLAY with streak inclusions**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**19.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.20
20	4	0.52
30	6	0.86
40	8	1.06
50	10	1.30
0	12	0.65



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.30	**50.0**	**1.3**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

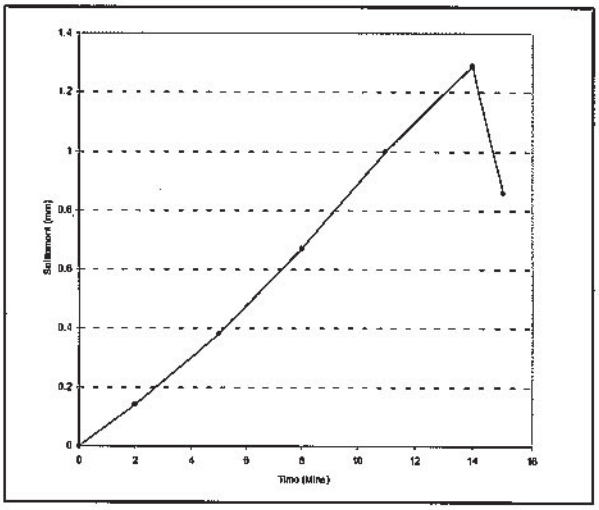
Date 08/04/2009
Report Ref: 09FW0337

Lab Ref No.	**09FW0337.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**10**	Client Reference	**10**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**24.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.14
30	5	0.38
45	8	0.67
60	11	1.00
75	14	1.29
0	15	0.86



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.29	**33.3**	**2.6**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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UKAS TESTING 4330

CERTIFICATE OF TEST

Authorised signatories:

[redacted] Operations Manager[ ]
Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

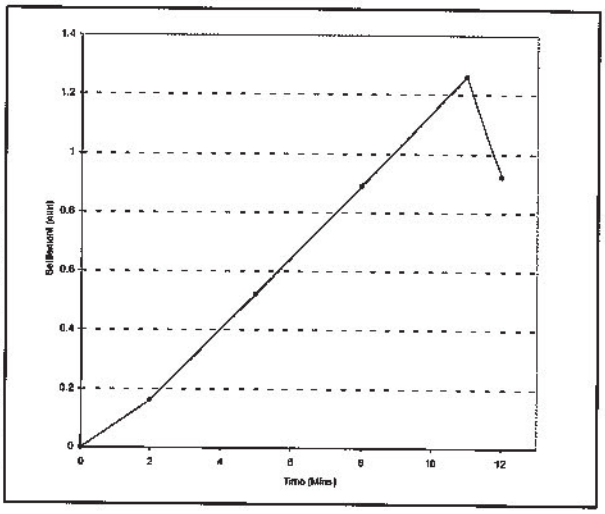
Date 08/04/2009
Report Ref: 09FW0347

Lab Ref No.	**09FW0347.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**11**	Client Reference	**11**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish Brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**21.7**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.16
30	5	0.52
45	8	0.89
60	11	1.26
0	12	0.92



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.26	**27.0**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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[redacted] Lab Team Leader[✓]

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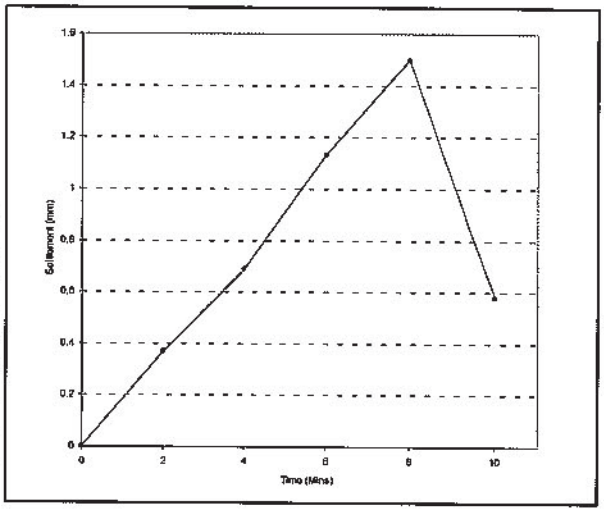
Date 07/04/2009
Report Ref: 09FW0340

Lab Ref No.	**09FW0340.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**12**	Client Reference	**CBR 12**
Technician	**JF**	Weather	**Dry**
Soil Description	**Dark brown sandy CLAY with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**35.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.37
20	4	0.69
30	6	1.13
40	8	1.50
0	10	0.58



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.50	**61.3**	**1.1**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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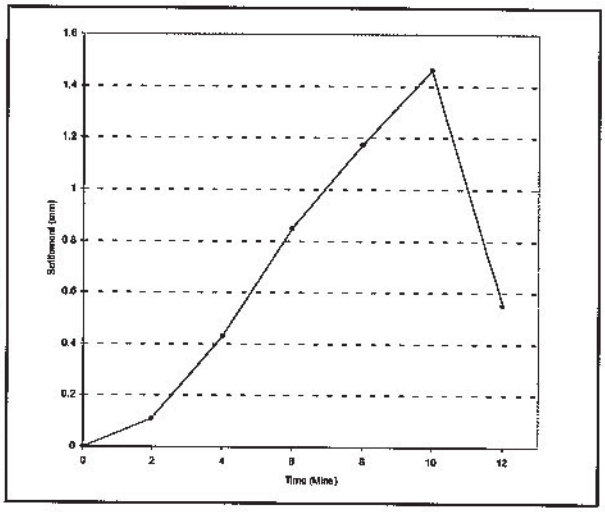
Date 07/04/2009
Report Ref: 09FW0341

Lab Ref No.	**09FW0341.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**13**	Client Reference	**CBR 13**
Technician	**JF**	Weather	**Dry**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**345.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.11
20	4	0.43
30	6	0.85
40	8	1.17
50	10	1.46
0	12	0.55



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.46	**62.3**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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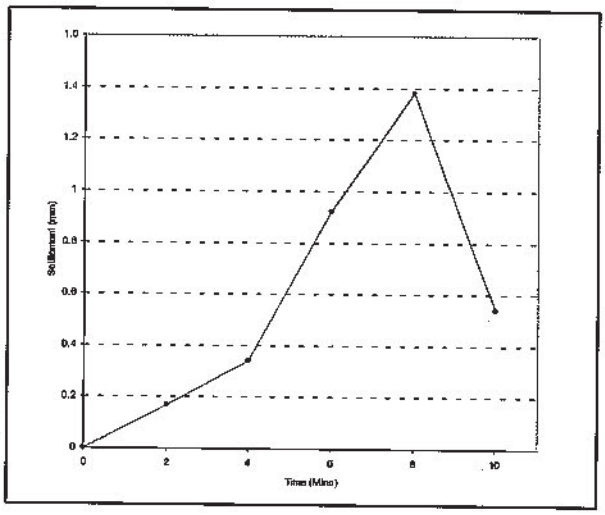
Date 07/04/2009
Report Ref: 09FW0342

Lab Ref No.	**09FW0342.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**14**	Client Reference	**CBR 14**
Technician	**JF**	Weather	**Dry**
Soil Description	**Light brown slightly silty SAND with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**17.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.17
20	4	0.34
30	6	0.92
40	8	1.38
0	10	0.54



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.38	**60.9**	**0.8**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Client Name
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Askern Road
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DN5 8DG

FAO [redacted]

Authorised By [redacted]

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:
[redacted] Operations Manager[ ]
Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

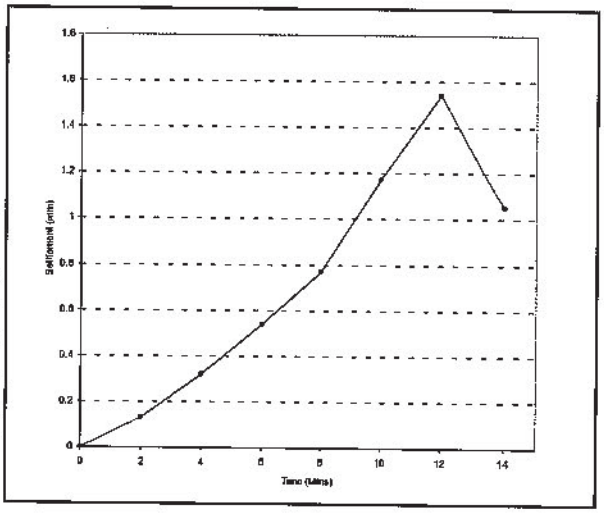
Date 07/04/2009
Report Ref: 09FW0343

Lab Ref No.	**09FW0343.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**15**	Client Reference	**CBR 15**
Technician	**JF**	Weather	**Dry**
Soil Description	**Greyish brown sandy CLAY with fine gravel**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**12.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.13
20	4	0.32
30	6	0.54
40	8	0.77
50	10	1.17
60	12	1.54
0	14	1.05



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.54	**31.8**	**1.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
Remarks:

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Lab Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

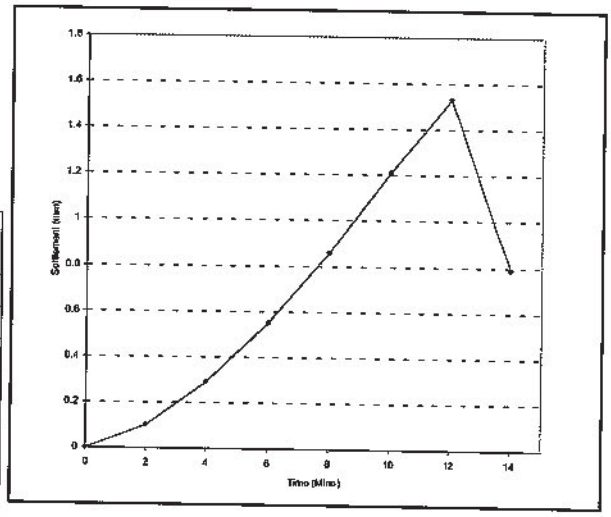
Date 07/04/2009
Report Ref: 09FW0344

Lab Ref No.	**09FW0344.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**16**	Client Reference	**CBR 16**
Technician	**JF**	Weather	**Dry**
Soil Description	**Brown clayey SAND with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**18.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.10
20	4	0.29
30	6	0.55
40	8	0.86
50	10	1.21
60	12	1.53
0	14	0.79



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.53	**48.4**	**1.4**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

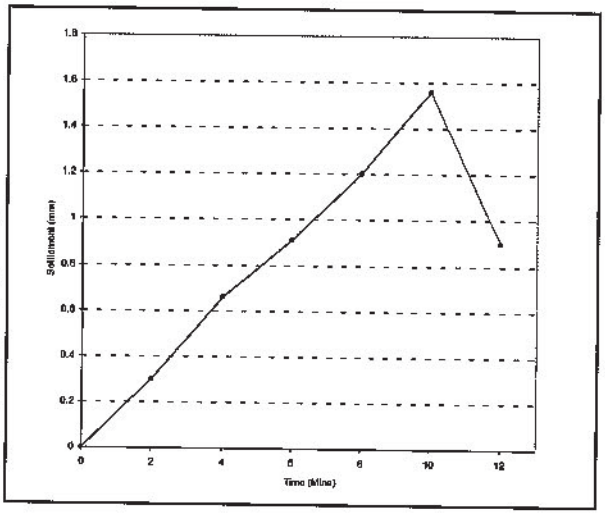
Date 07/04/2009
Report Ref: 09FW0345

Lab Ref No.	**09FW0345.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**17**	Client Reference	**CBR 17**
Technician	**JF**	Weather	**Dry**
Soil Description	**Greyish brown sandy CLAY with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**21.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.30
20	4	0.66
30	6	0.91
40	8	1.20
50	10	1.56
0	12	0.90



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.56	**42.3**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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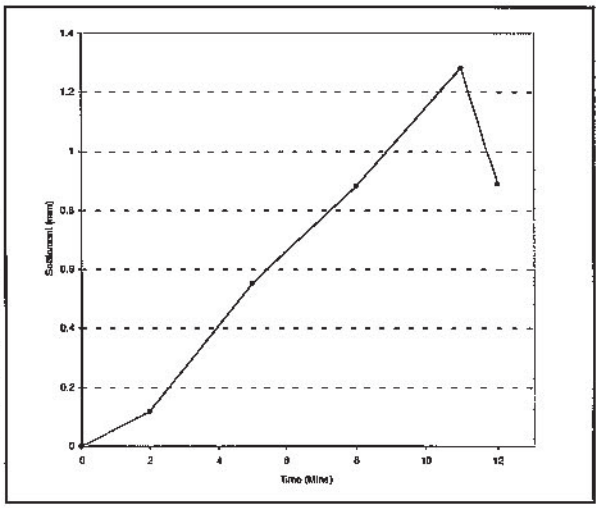
Date 08/04/2009
Report Ref: 09FW0348

Lab Ref No.	**09FW0348.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**18**	Client Reference	**18**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**39.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.55
45	8	0.88
60	11	1.28
0	12	0.89



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.28	**30.5**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

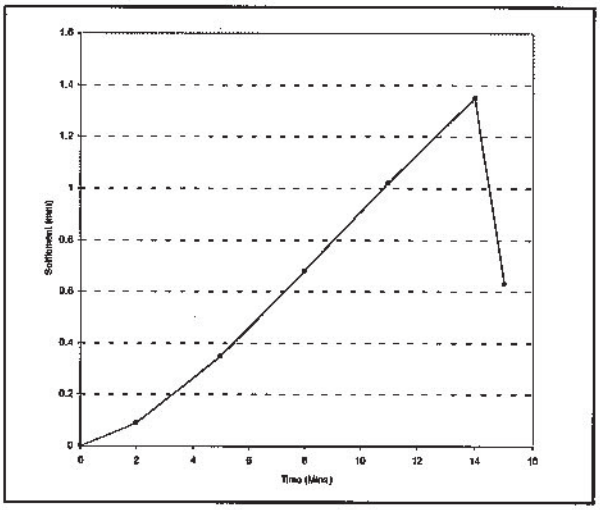
Date 08/04/2009
Report Ref: 09FW0349

Lab Ref No.	**09FW0349.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**19**	Client Reference	**19**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY mixed with black peat**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.09
30	5	0.35
45	8	0.68
60	11	1.02
75	14	1.35
0	15	0.63



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.35	**53.3**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.
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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

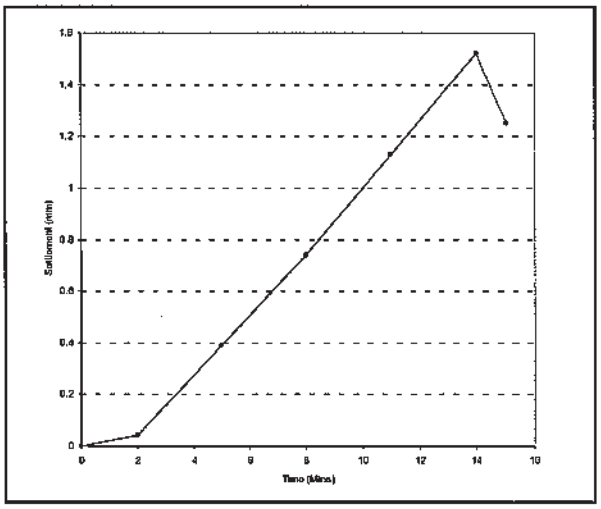
Date 08/04/2009
Report Ref: 09FW0350

Lab Ref No.	**09FW0350.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**20**	Client Reference	**20**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Light brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.04
30	5	0.39
45	8	0.74
60	11	1.13
75	14	1.52
0	15	1.25



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.52	**17.8**	**2.2**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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Vertical Deformation of Soil by Plate Load Test
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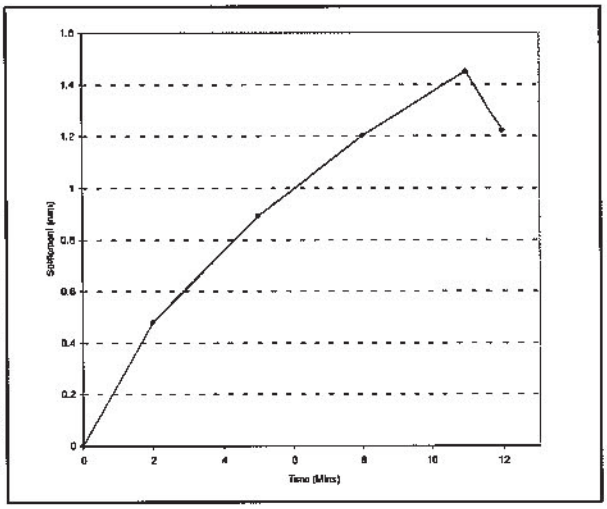
Date 08/04/2009
Report Ref: 09FW0351

Lab Ref No.	**09FW0351.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**21**	Client Reference	**21**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY mixed with black peat**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**40.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.48
30	5	0.89
45	8	1.20
60	11	1.45
0	12	1.22



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.45	**15.9**	**2.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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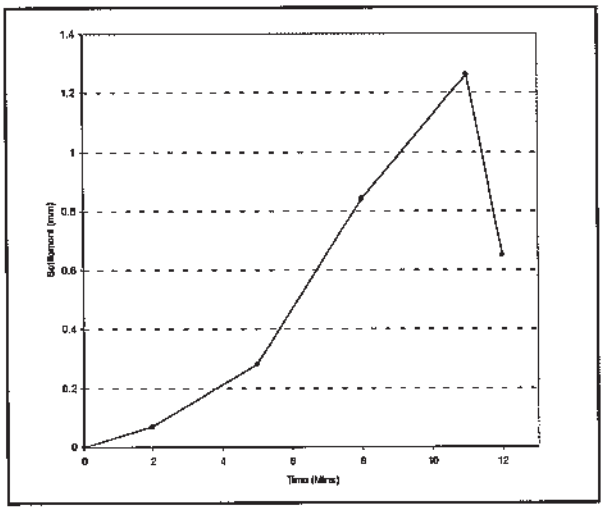
Date 08/04/2009
Report Ref: 09FW0352

Lab Ref No.	**09FW0352.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**22**	Client Reference	**22**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**500**
Distance from excavation wall (mm)	**400**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**36.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.07
30	5	0.28
45	8	0.84
60	11	1.26
0	12	0.65



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.26	**48.4**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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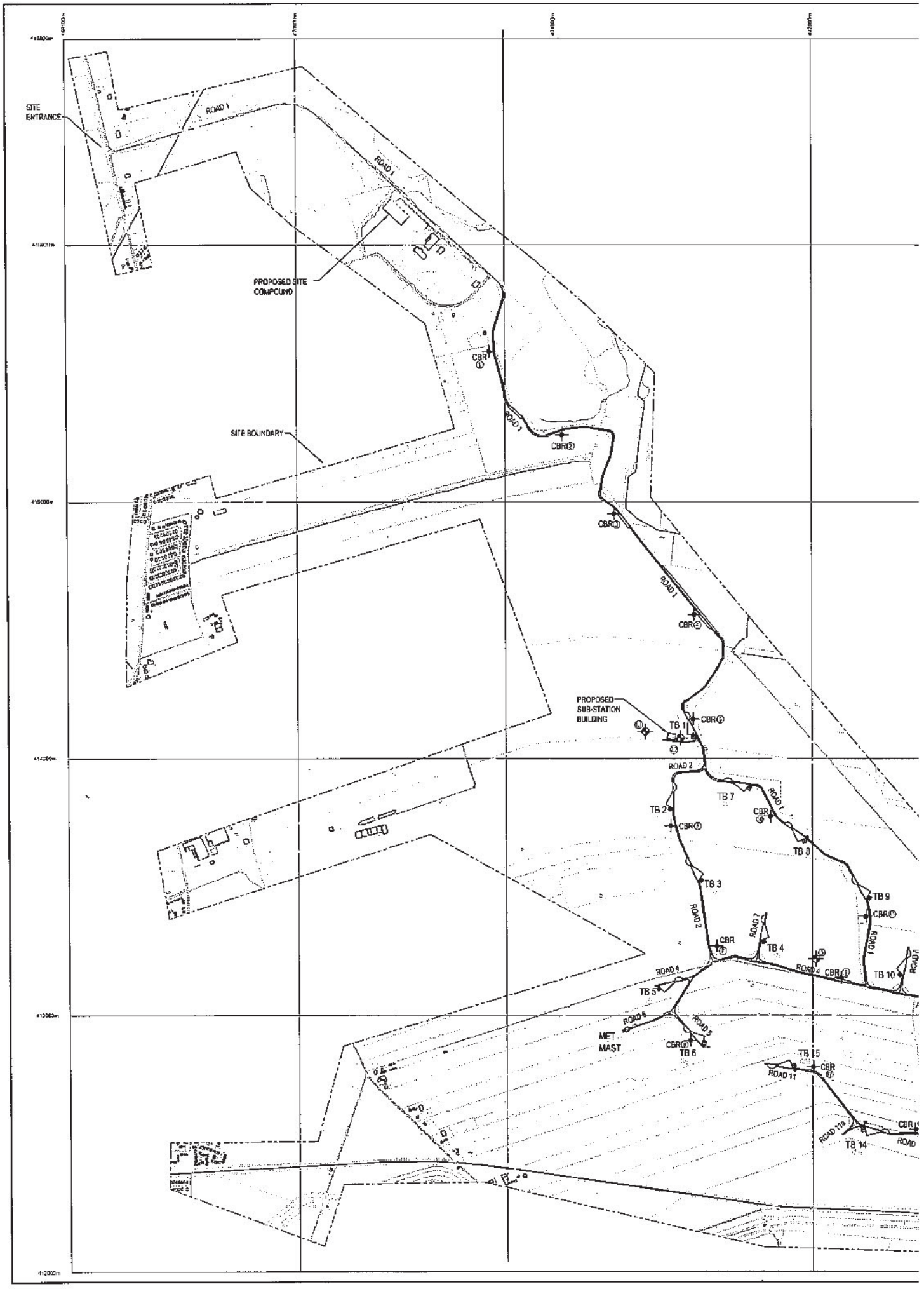
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FAO [redacted]

Authorised By [redacted]


SITE ENTRANCE
ROAD 1
PROPOSED SITE COMPOUND
SITE BOUNDARY
CBR①
CBR②
CBR③
CBR④
CBR⑤
PROPOSED SUB-STATION BUILDING
TB 1
TB 2
TB 3
TB 4
TB 5
TB 6
TB 7
TB 8
TB 9
TB 10
TB 14
ROAD 2
ROAD 4
ROAD 5
ROAD 7
ROAD 11
MET MAST

INDEX PROPERTIES - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ Mg/m³	ρ_d Mg/m³	w %	< 425 µm sieve %	w_L %	w_P %	I_P	ρ_s Mg/m³	Remarks
BH3	1	0.10	0.40	B	Greyish brown slightly sandy CLAY.			21	100 n	45 a	23	22		
BH3	8	4.00	4.45	D	Brown slightly sandy CLAY.			17	100 s	48 b	21	27		
BH3	11	6.00	6.45	D	Brown slightly sandy CLAY.			19	100 n	54 a	21	33		
BH5	1	0.10	0.40	B	Brownish grey clayey sandy SILT.			22	99 n	30 a	20	10		
BH5	11	5.05	5.05	D	Brown silty CLAY.			27	100 n	49 a	22	27		
BH5	14	7.50	7.95	D	Brown silty SAND.			21	94 s	22 b	NP			
BH8	8	4.65	5.10	D	Brown silty CLAY.			22	100 n	42 a	20	22		
BH10	1	0.10	0.50	B	Brown and light brown slightly sandy clayey SILT.			17	100 n	30 a	20	10		
BH13	11	6.00	6.45	D	Light brown SAND with occasional pockets of clay.			19	100 n	24 b	NP			
BH16	1	0.10	1.00	B	Brown slightly sandy CLAY.			37	100 n	58 a	24	34		
BH16	9	4.50	4.95	D	Brown slightly sandy CLAY.			19	100 n	47 a	22	25		
BH16	13	7.50	7.95	D	Brown CLAY.			26	100 n	43 a	21	22		
BH18	9	4.50	4.95	D	Brown slightly sandy CLAY.			32	100 n	44 a	19	25		
BH22	9	4.60	5.05	D	Greyish brown silty CLAY.			28	100 s	50 b	22	28		

General notes: All above tests carried out to BS1377 : 1990 definitive method in all cases unless annotated otherwise. See individual test reports for further details.

Key :

ρ	bulk density, linear	W_L Liquid limit	W_P	Plastic limit	<425um preparation	ρ_s	particle density
ρ_d	dry density	a 4 point cone test	NP	non - plastic	n from natural soil	-g = gas jar	
w	moisture content	b 1 point cone test	I_P	Plasticity Index	s sieved specimen	-p = small pyknometer	

CHEMICAL TESTS - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Org %	LOI %	pH	Sulphate as SO_4 Preparation/test *	Sulphate as SO_4 2:1 water sol. g/L	Sulphate as SO_4 ground water g/L	Sulphate as SO_4 acid sol. %	SD1 options TS %	SD1 options Mg mg/L NO_3 mg/L NH_4	CO_2 %	Chloride, Cl water sol. %	Chloride, Cl acid sol. %	<2 mm %	Remarks
BH3	6	2.50	3.00	B	Greyish brown silty CLAY.			7.2	1+3	0.07								100	
BH3	14	7.50	8.00	B	Greyish brown very sandy SILT.			7.3	1+3	0.07								100	
BH3	20	12.00	13.00	B	Dark brownish grey slightly gravelly SAND.			7.3	1+3	0.26								100	
BH5	9	3.50	4.00	B	Greyish brown slightly sandy CLAY.			7.3	1+3	0.10								100	
BH5	15	7.50	8.00	B	Greyish brown silty SAND.			7.4	1+3	0.09								100	
BH5	21	12.00	13.00	B	Brown SAND.			7.5	1+3	0.07								100	
BH8	9	4.65	5.10	B	Greyish brown slightly sandy CLAY.			7.6	1+3	0.16								100	
BH8	15	7.60	8.05	B	Greyish brown slightly sandy SILT.			7.5	1+3	0.04								100	
BH8	21	11.20	11.60	B	Greyish brown slightly sandy SILT.			7.4	1+3	0.08								100	
BH10	6	2.50	3.00	B	Greyish brown slightly sandy CLAY.			7.5	1+3	0.09								100	
BH10	12	6.00	7.00	B	Greyish brown silty SAND.			7.6	1+3	0.11								100	
BH10	19	10.50	11.00	B	Greyish brown slightly sandy SILT.			7.3	1+3	0.07								100	
BH13	7	3.60	4.05	B	Greyish brown SAND with rare clay pockets.			5.3	1+3	0.12								100	
BH13	12	6.00	6.45	B	Light brown and light grey clayey SAND.			7.1	1+3	0.11								100	
BH13	19	9.00	9.40	B	Light brown clayey SAND.			7.2	1+3	0.09								100	
BH16	14	7.50	8.00	B	Brown slightly sandy CLAY.			7.7	1+3	0.09								100	
BH16	18	10.50	11.00	B	Brown SAND.			7.8	1+3	0.07								100	
BH16	25	15.60	16.00	B	Brown slightly gravelly SAND.			8.0	1+3	0.07								100	
BH18	10	4.50	5.00	B	Brown slightly sandy CLAY.			7.7	1+3	0.02								100	

BS 1377 : definitive method unless stated :

Org Organic matter content (s-sulphides, c-chlorides identified)

LOI Mass loss on ignition at 440°C

CO_2 Carbonate content (rapid titration)

Cl Chloride content

* Sulphate tests preparation / test methods :

1. BS 1377:Part 3:1990:clause 5.3
2. BS 1377:Part 3:1990:clause 5.4
3. BS 1377:Part 3:1990:clause 5.5
4. TRL447 - 1 water soluble sulphate
5. TRL447 - 2 acid soluble sulphate
6. BR279 - groundwater sulphate

< 2mm material passing 2mm sieve

BRE Special Digest SD1, dependent options :

TS Total Sulphur to BR279 / EN ISO15178

Mg Soluble Magnesium to BR279, colorimetric

NO3 Soluble Nitrate to BR279, colorimetric

NH_4 qualitative

CHEMICAL TESTS - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Org %	LOI %	pH	Sulphate as SO_4 Preparation/test *	Sulphate as SO_4 2:1 water sol. g/L	Sulphate as SO_4 ground water g/L	Sulphate as SO_4 acid sol. %	SD1 options TS %	SD1 options Mg mg/L NO_3 mg/L NH_4	CO_2 %	Chloride, Cl water sol. %	Chloride, Cl acid sol. %	<2 mm %	Remarks
BH18	14	7.50	8.00	B	Brown silty SAND.			7.9	1+3	0.07								100	
BH18	20	12.00	13.00	B	Brown SAND.			7.7	1+3	0.02								100	
BH22	10	4.60	5.05	B	Greyish brown slightly sandy CLAY.			7.2	1+3	0.03								100	
BH22	16	7.50	7.95	B	Greyish brown silty very gravelly SAND.			7.6	1+3	0.07								75	
BH22	26	12.80	13.10	B	Brown sandy CLAY.			7.7	1+3	0.05								100	

BS 1377 : definitive method unless stated :

Org Organic matter content (s-sulphides, c-chlorides identified)

LOI Mass loss on ignition at 440°C

CO_2 Carbonate content (rapid titration)

Cl Chloride content

* Sulphate tests preparation / test methods :

1. BS 1377:Part 3:1990:clause 5.3
2. BS 1377:Part 3:1990:clause 5.4
3. BS 1377:Part 3:1990:clause 5.5
4. TRL447 - 1 water soluble sulphate
5. TRL447 - 2 acid soluble sulphate
6. BR279 - groundwater sulphate

< 2mm material passing 2mm sieve

BRE Special Digest SD1, dependent options :

TS Total Sulphur to BR279 / EN ISO15178

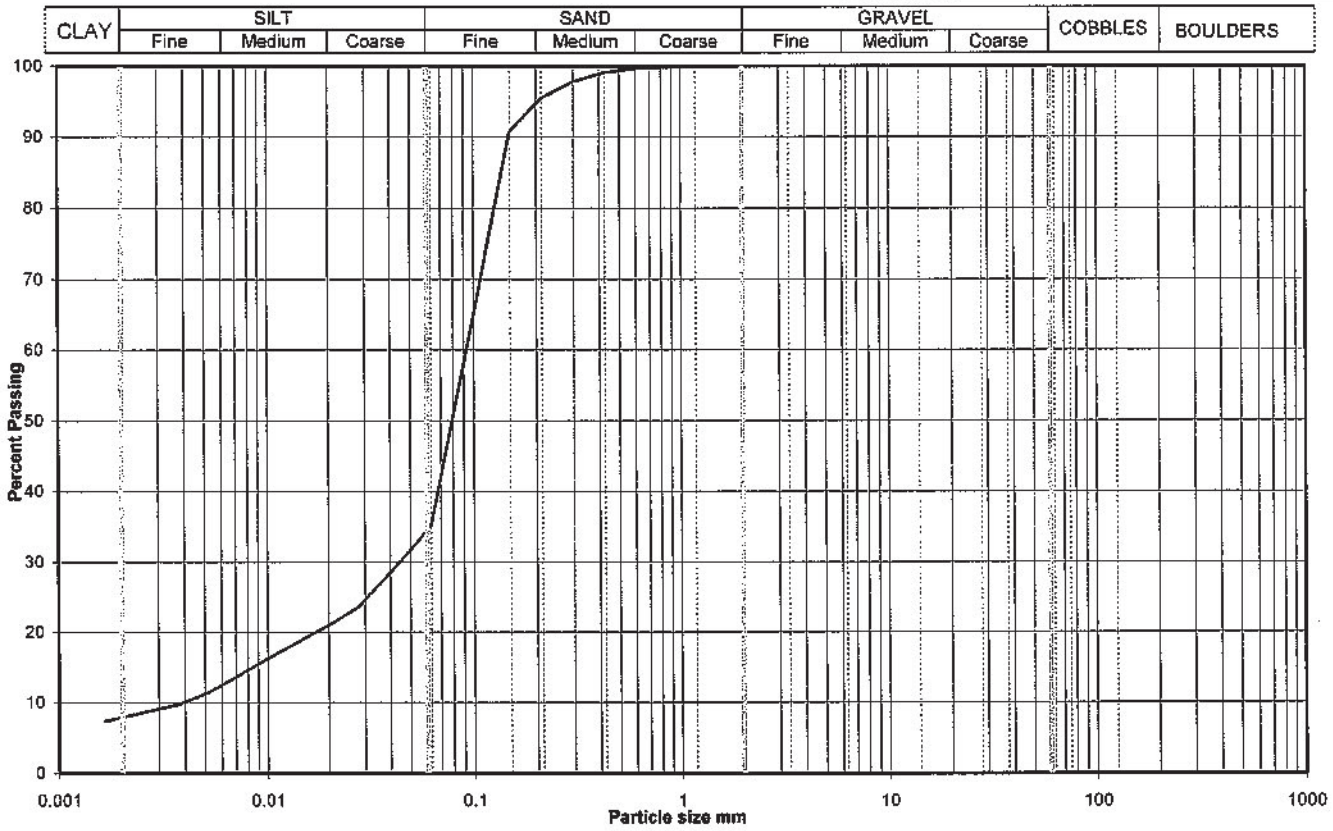
Mg Soluble Magnesium to BR279, colorimetric

NO3 Soluble Nitrate to BR279, colorimetric

NH_4 qualitative

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH3		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50		
			Samp No	14	Type	B
			ID	ESGA90572009041400000000162		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	35
90	100	0.0534	33
75	100	0.0384	28
63	100	0.0276	23
50	100	0.0197	21
37.5	100	0.0103	16
28	100	0.0052	11
20	100	0.0037	10
14	100	0.0017	7
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100		
0.425	99	2.65 assumed	
0.300	98	Dry mass of sample, kg	
0.212	95		
0.150	91	13.1	
0.063	35		

Soil description	Greyish brown very sandy SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
	Silt	27	27
	Clay	8	8

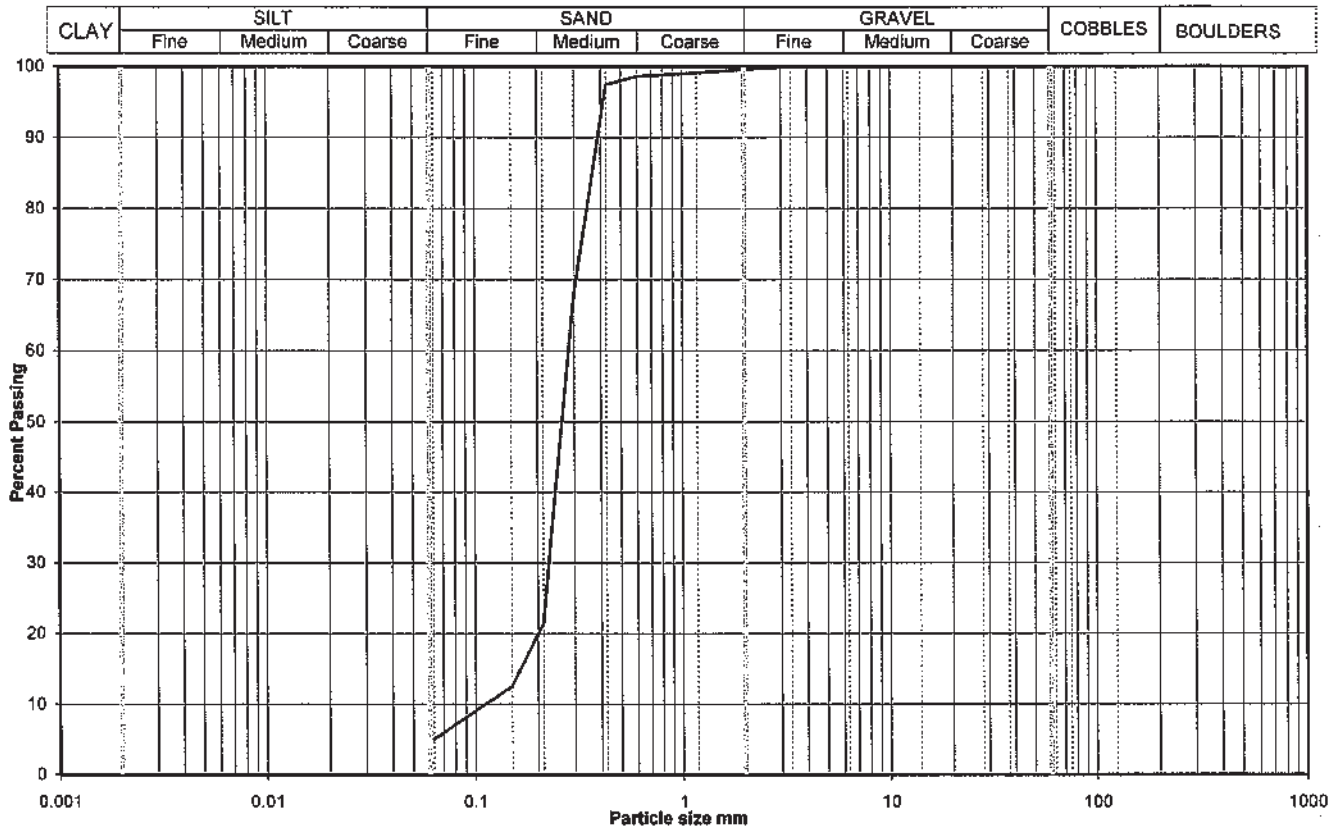
Uniformity Coefficient	D_{60} / D_{10}	23

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS 1157	Printed:22/06/2009 12:10	**Figure** **PSD 1**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH3		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	10.50		
			Samp No	18	Type	B
			ID	ESGA90572009041400000000166		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	99		
0.600	99		
0.425	97		
0.300	68	Dry mass of sample, kg	
0.212	21		
0.150	12	10.2	
0.063	5		

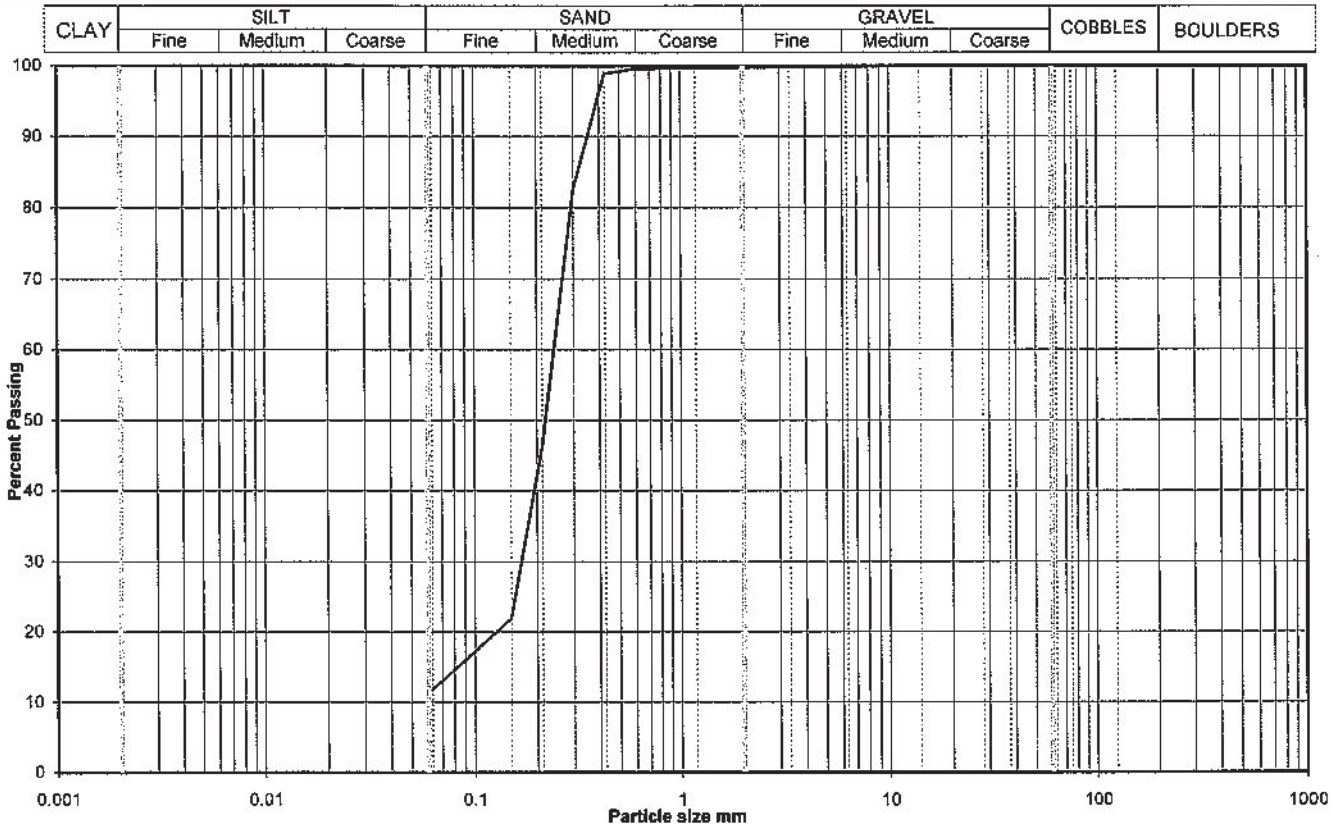
Soil description	Greyish brown SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	95	95
	Silt	silt+clay =	
	Clay	5	5

Uniformity Coefficient	D_{60} / D_{10}	3

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH5		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	12.00		
			Samp No	21	Type	B
			ID	ESGA905720090408000000142		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	99		
0.300	82	Dry mass of sample, kg	
0.212	46		
0.150	22	10.4	
0.063	12		

Soil description	Brown SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	88	88
	Silt	silt+clay =	
	Clay	12	12

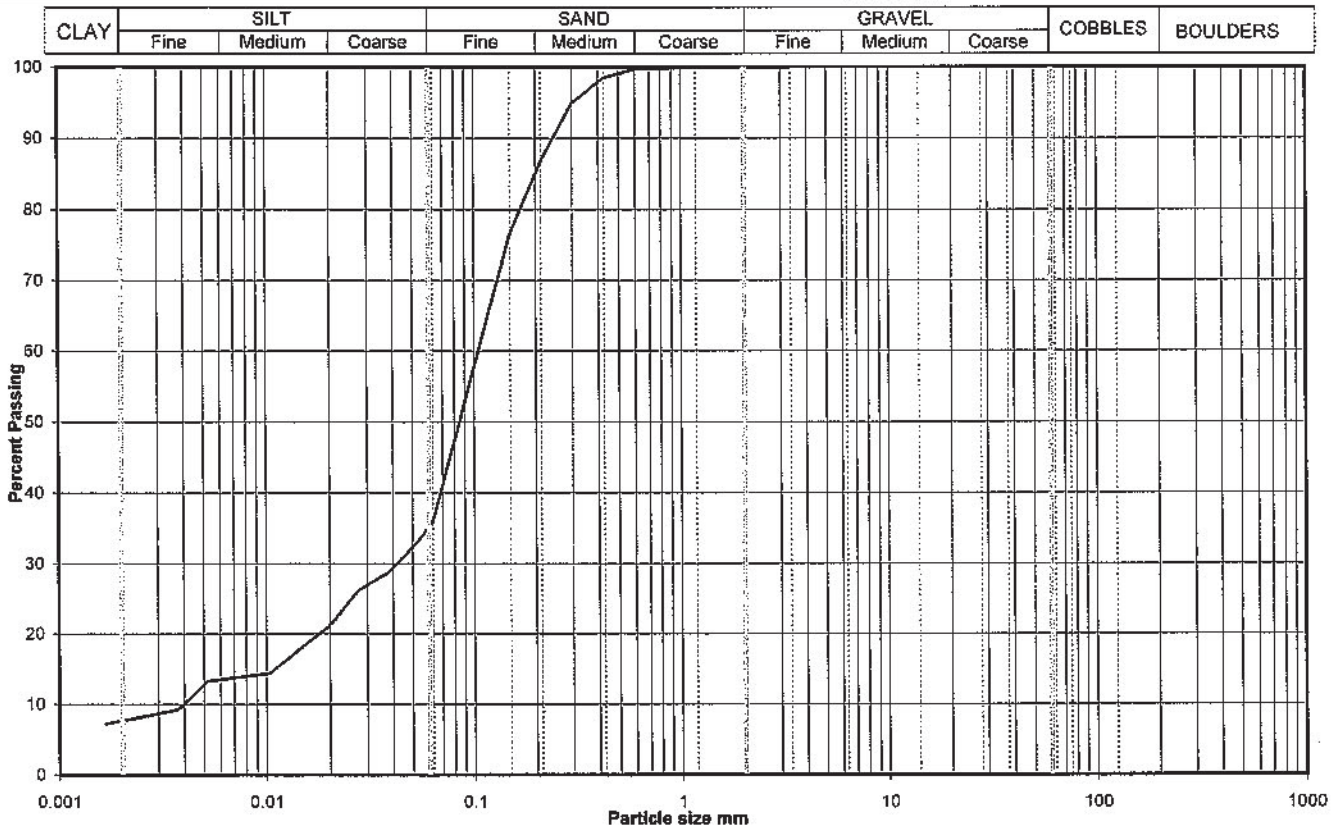
Uniformity Coefficient	D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS TESTING 1187	Printed:22/06/2009 12:10	**Figure** **PSD 3**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH8		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.10		
			Samp No	17	Type	B
			ID	ESGA905720090414000000188		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	36
90	100	0.0531	33
75	100	0.0382	29
63	100	0.0273	26
50	100	0.0197	21
37.5	100	0.0104	14
28	100	0.0052	13
20	100	0.0037	9
14	100	0.0017	7
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100		
0.425	98	2.65 assumed	
0.300	95	Dry mass of sample, kg	
0.212	87		
0.150	76	10.4	
0.063	36		

Soil description	Greyish brown very sandy SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
	Silt	27	27
	Clay	8	8

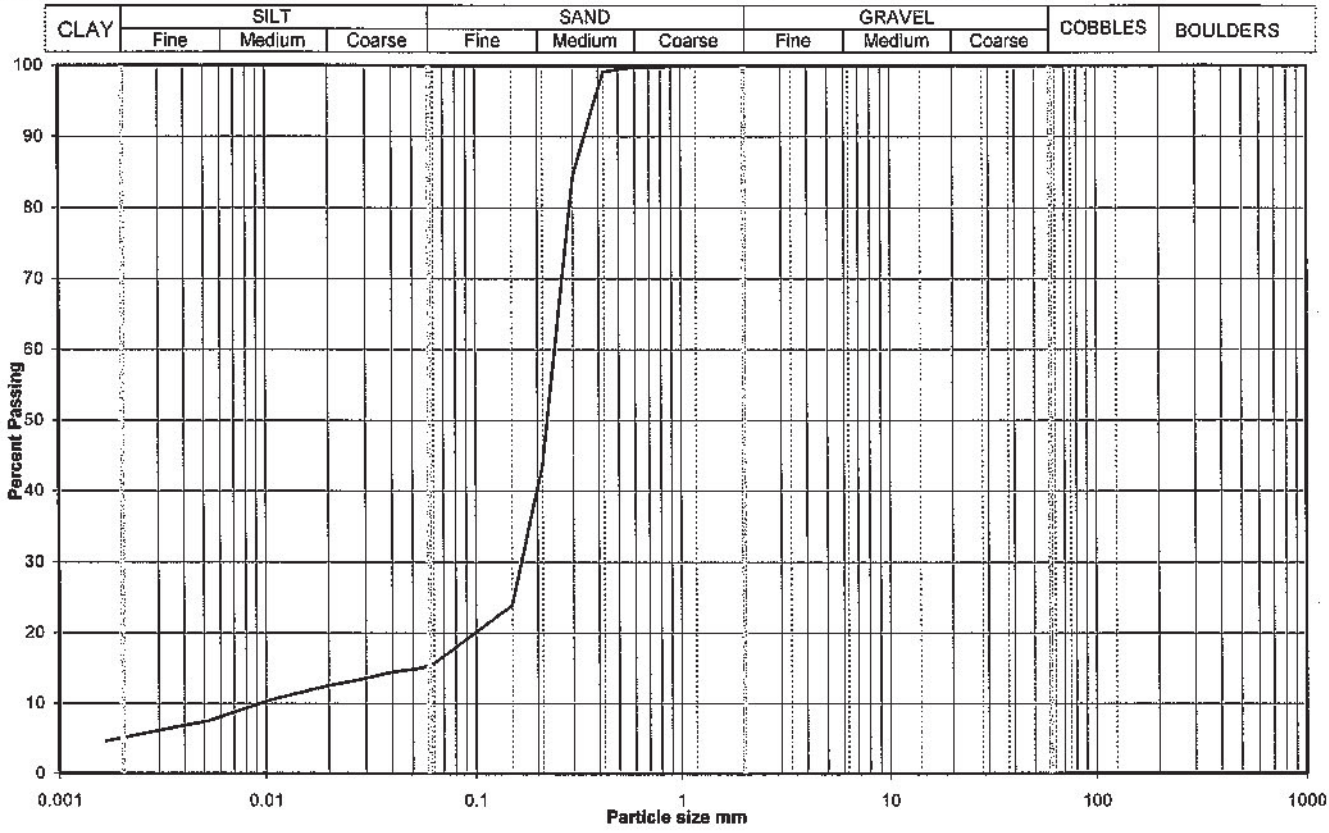
Uniformity Coefficient	D_{60} / D_{10}	26

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:11	**Figure** **PSD 4**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH10		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	12	Type	B
			ID	ESGA90572009040800000000013		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	16
90	100	0.0556	15
75	100	0.0395	14
63	100	0.0280	13
50	100	0.0199	13
37.5	100	0.0104	10
28	100	0.0053	8
20	100	0.0037	7
14	100	0.0017	5
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100	2.65 assumed	
0.425	99		
0.300	84	Dry mass of sample, kg	
0.212	44	9.0	
0.150	24		
0.063	16		

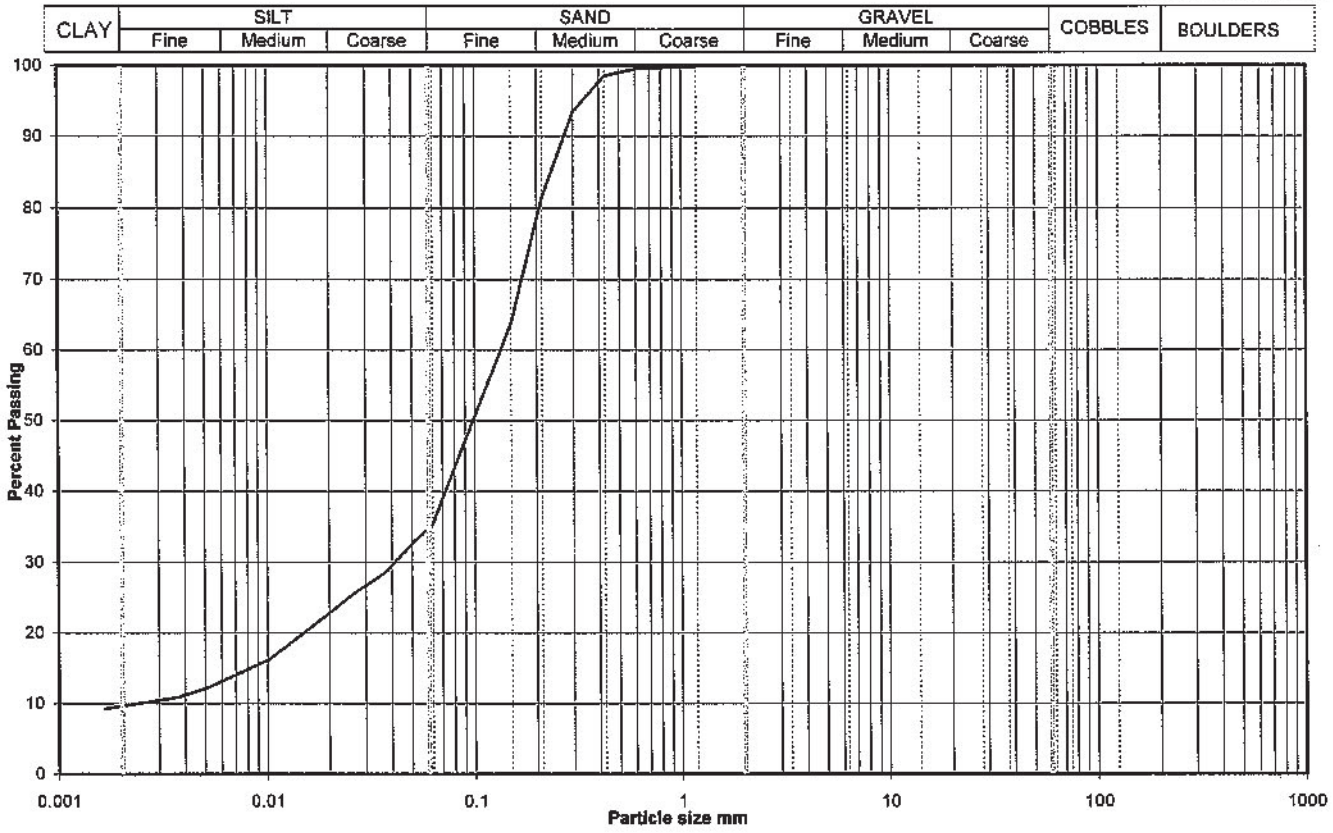
Soil description	Greyish brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	85	85
	Silt	10	10
	Clay	5	5

Uniformity Coefficient	D_{60} / D_{10}	26

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH10		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.00		
			Samp No	17	Type	B
			ID	ESGA90572009040800000000018		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	35
90	100	0.0516	33
75	100	0.0373	29
63	100	0.0267	26
50	100	0.0192	22
37.5	100	0.0102	16
28	100	0.0052	12
20	100	0.0037	11
14	100	0.0016	9
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	99		
0.425	98	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	81		
0.150	64	10.5	
0.063	35		

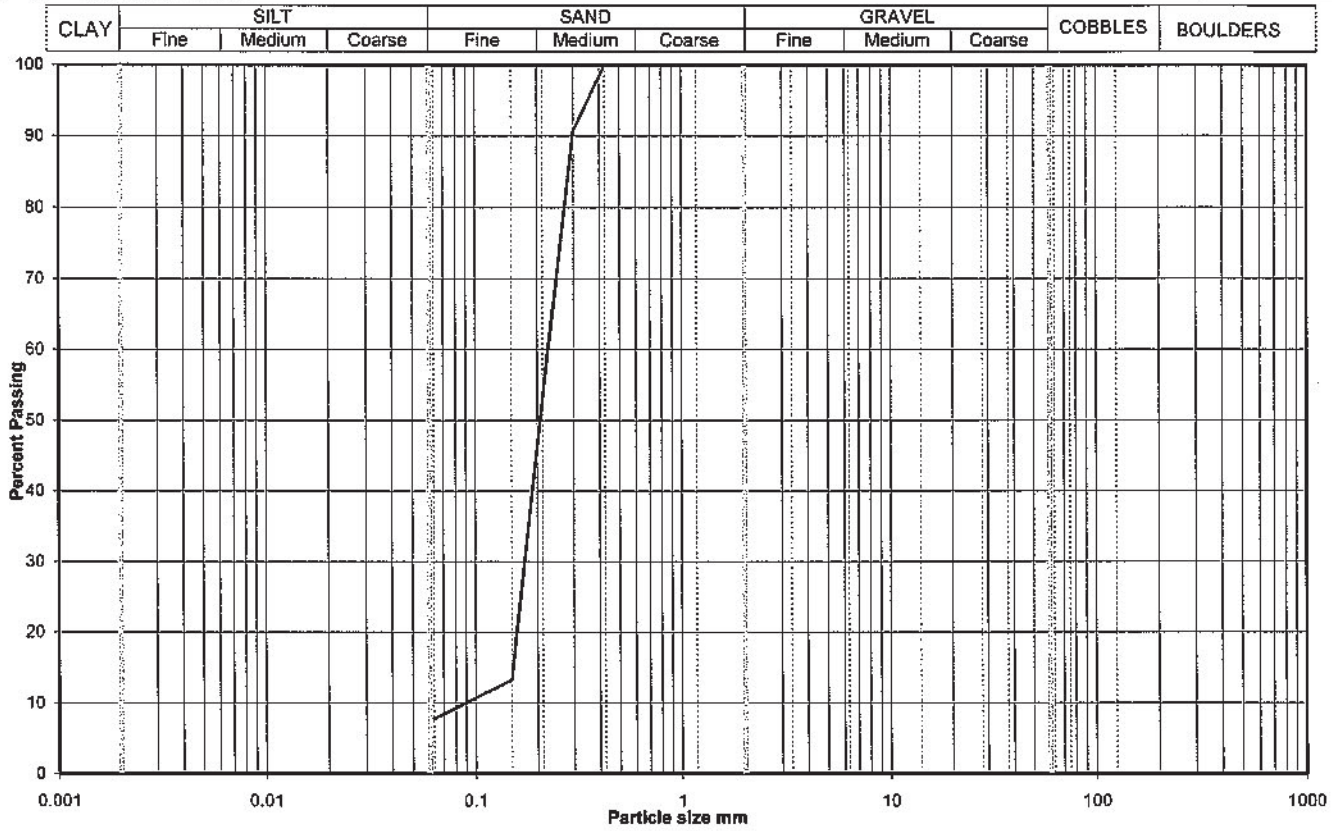
Soil description	Greyish brown very sandy SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
	Silt	25	25
	Clay	10	10

Uniformity Coefficient	D_{60} / D_{10}	55

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH13		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60		
			Samp No	7	Type	B
			ID	ESGA90572009040800000000027		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	100		
0.300	91	Dry mass of sample, kg	
0.212	53		
0.150	13	12.9	
0.063	8		

Soil description	Greyish brown SAND with rare clay pockets.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	92	92
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	8	8

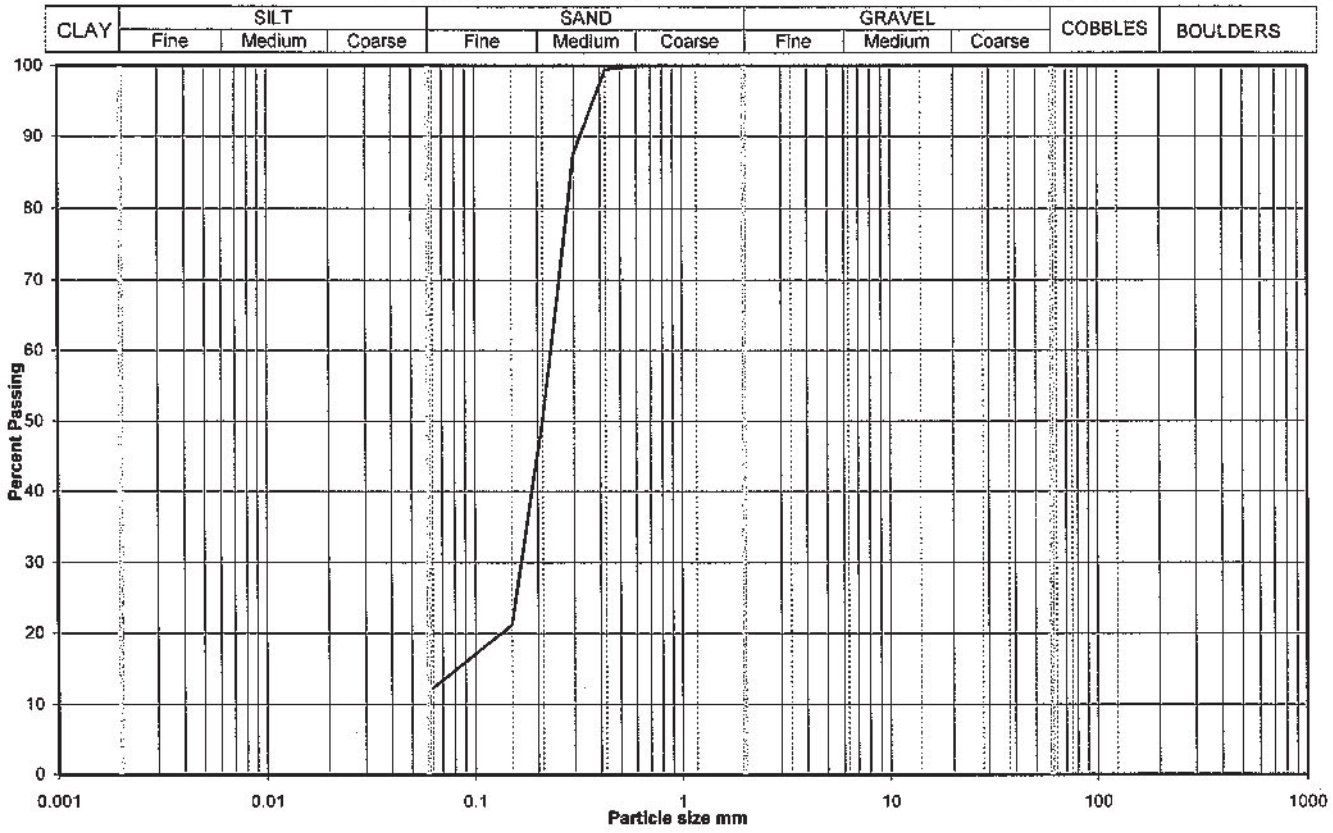
Uniformity Coefficient	D_{60} / D_{10}	3

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:11	**Figure** **PSD 7**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH13		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.00		
			Samp No	19	Type	B
			ID	ESGA90572009040800000000039		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	99		
0.300	88	Dry mass of sample, kg	
0.212	50		
0.150	21	11.4	
0.063	12		

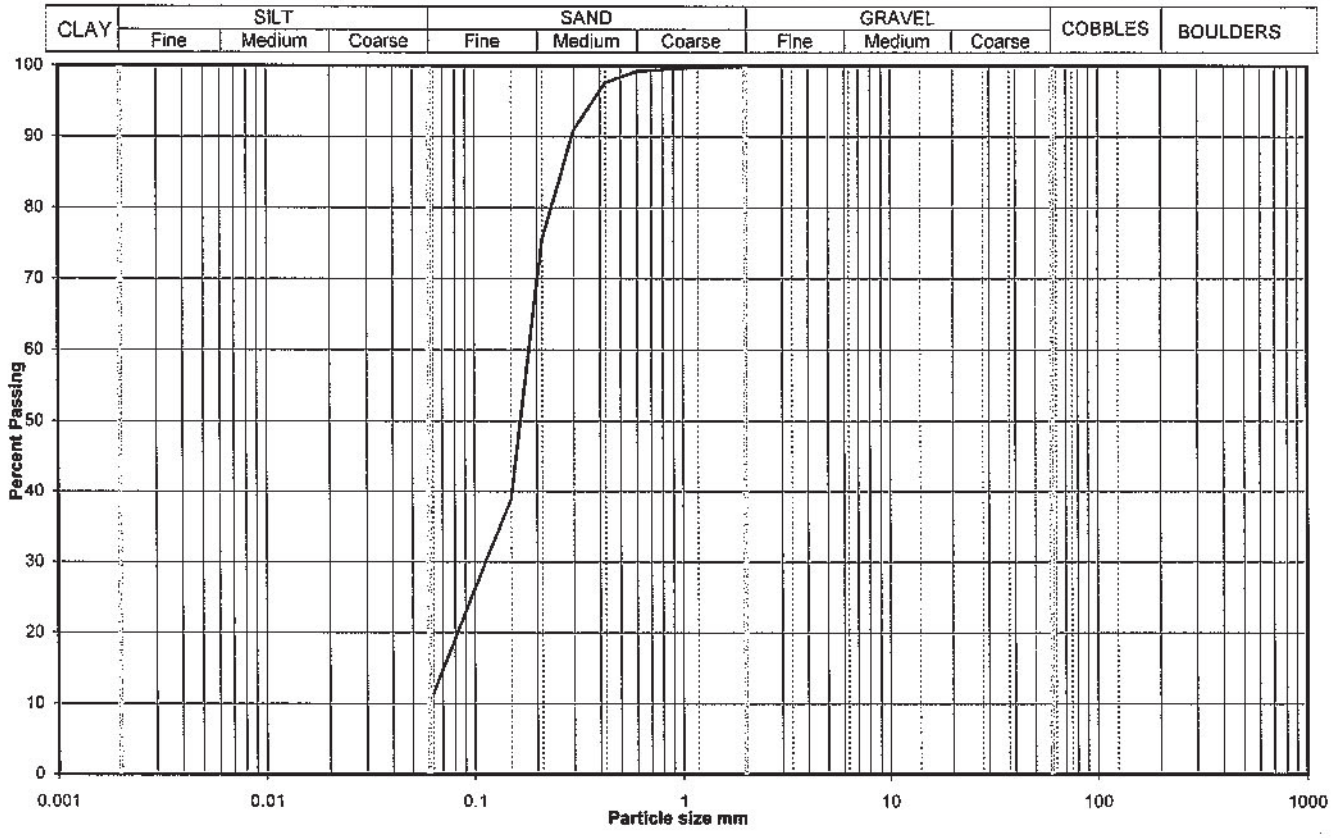
Soil description	Light brown clayey SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	88	88
	Silt	silt+clay =	
	Clay	12	12

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

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.00		
			Samp No	16	Type	B
			ID	ESGA905720090408000000060		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	91	Dry mass of sample, kg	
0.212	76		
0.150	39	12.4	
0.063	11		

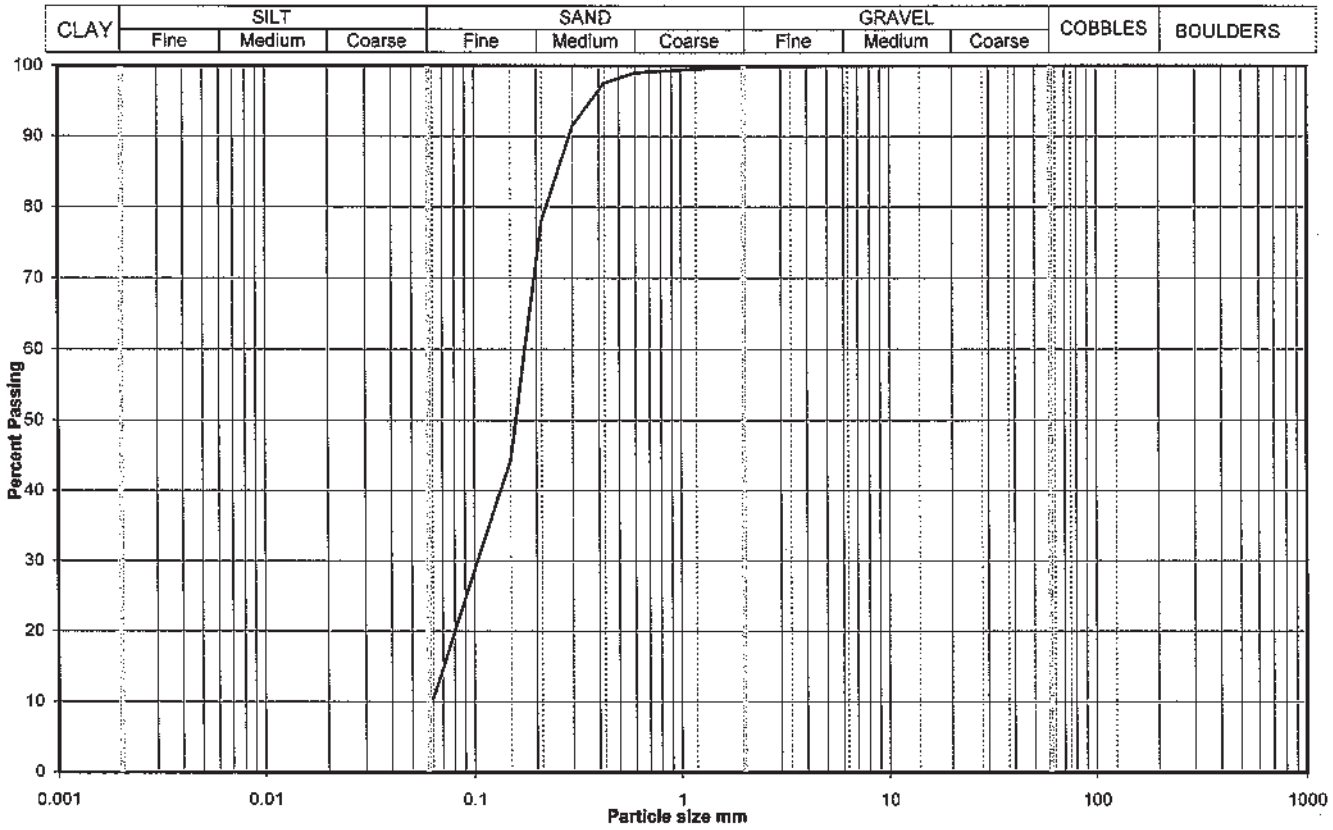
Soil description	Brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only	Cobbles / boulders	Whole	*<60mm
		0	0
	Gravel	0	0
	Sand	89	89
	Silt	silt+clay =	
	Clay	11	11

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

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	12.00		
			Samp No	20	Type	B
			ID	ESGA90572009040800000000064		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	91	Dry mass of sample, kg	
0.212	78		
0.150	44	14.5	
0.063	10		

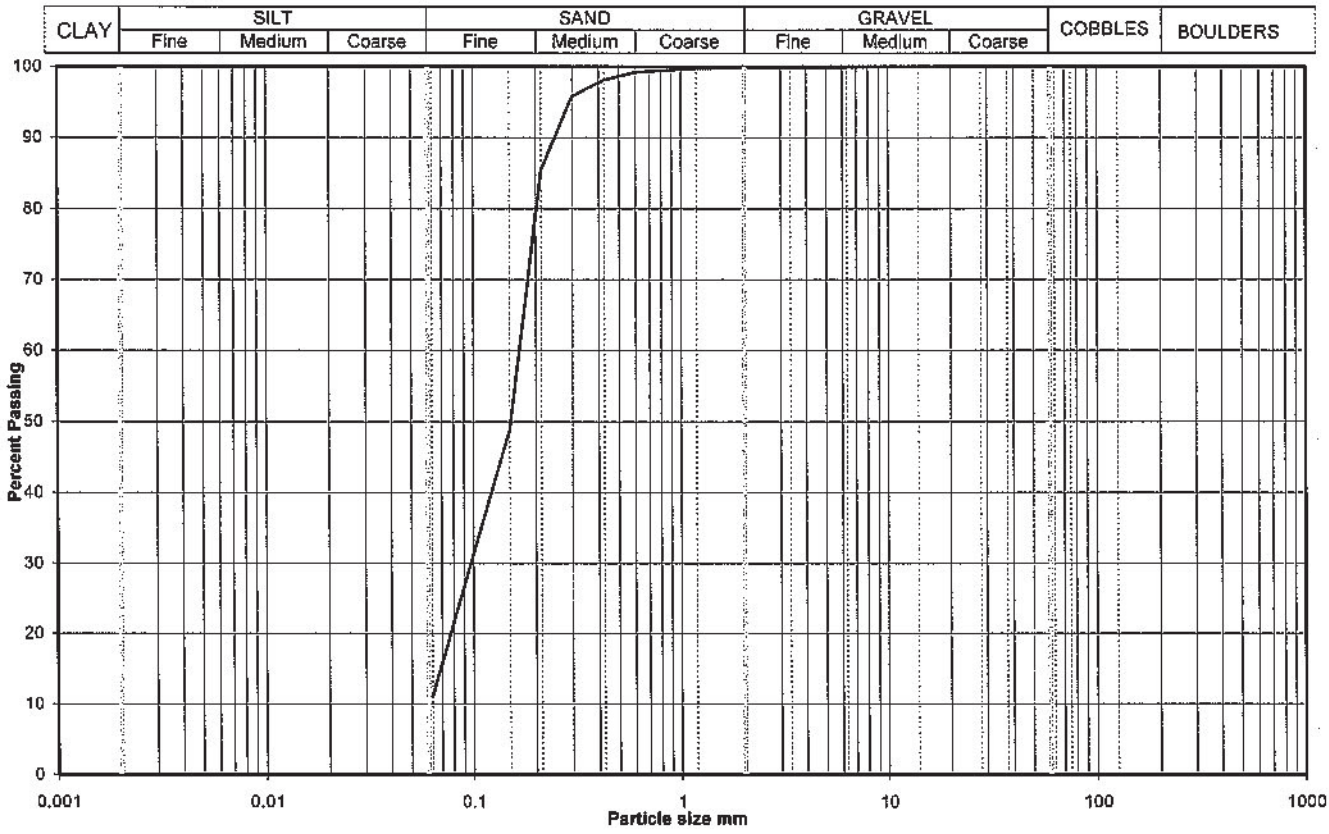
Soil description	Brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only	Cobbles / boulders	Whole	*<60mm
		0	0
	Gravel	0	0
	Sand	89	89
	Silt	silt+clay =	
	Clay	11	11

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

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH18		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50		
			Samp No	14	Type	B
			ID	ESGA90572009040800000000085		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	96	Dry mass of sample, kg	
0.212	85		
0.150	49	11.8	
0.063	11		

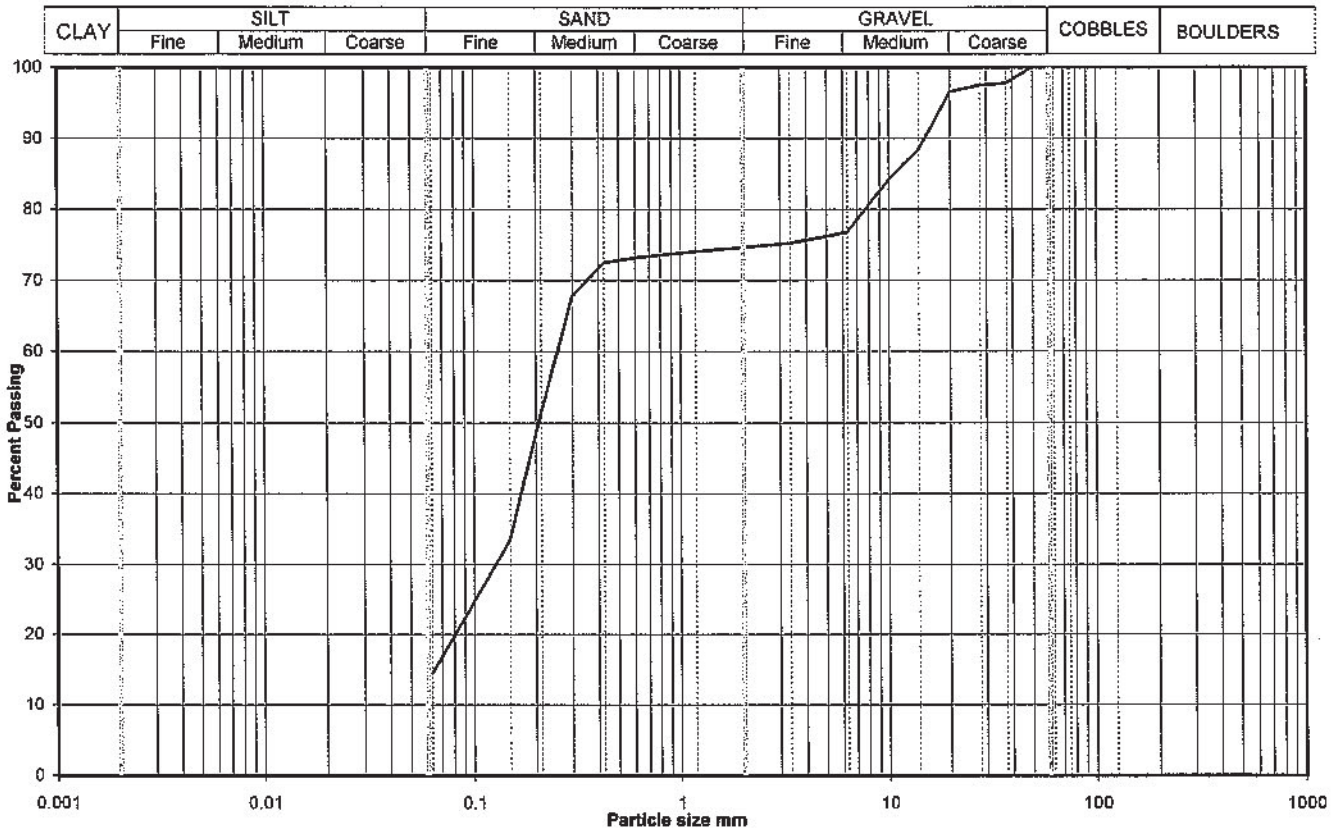
Soil description	Brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	89	89
	Silt	silt+clay =	
	Clay	11	11

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

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH22		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50		
			Samp No	16	Type	B
			ID	ESGA90572009040800000000108		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	98		
28	97		
20	97		
14	88		
10	84		
6.3	77		
5.0	76		
3.35	75		
2.00	75		
1.18	74		
0.600	73		
0.425	72		
0.300	68	Dry mass of sample, kg	
0.212	52		
0.150	33	11.6	
0.063	14		

Soil description	Greyish brown silty very gravelly SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	25	25
	Sand	60	60
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	15	15

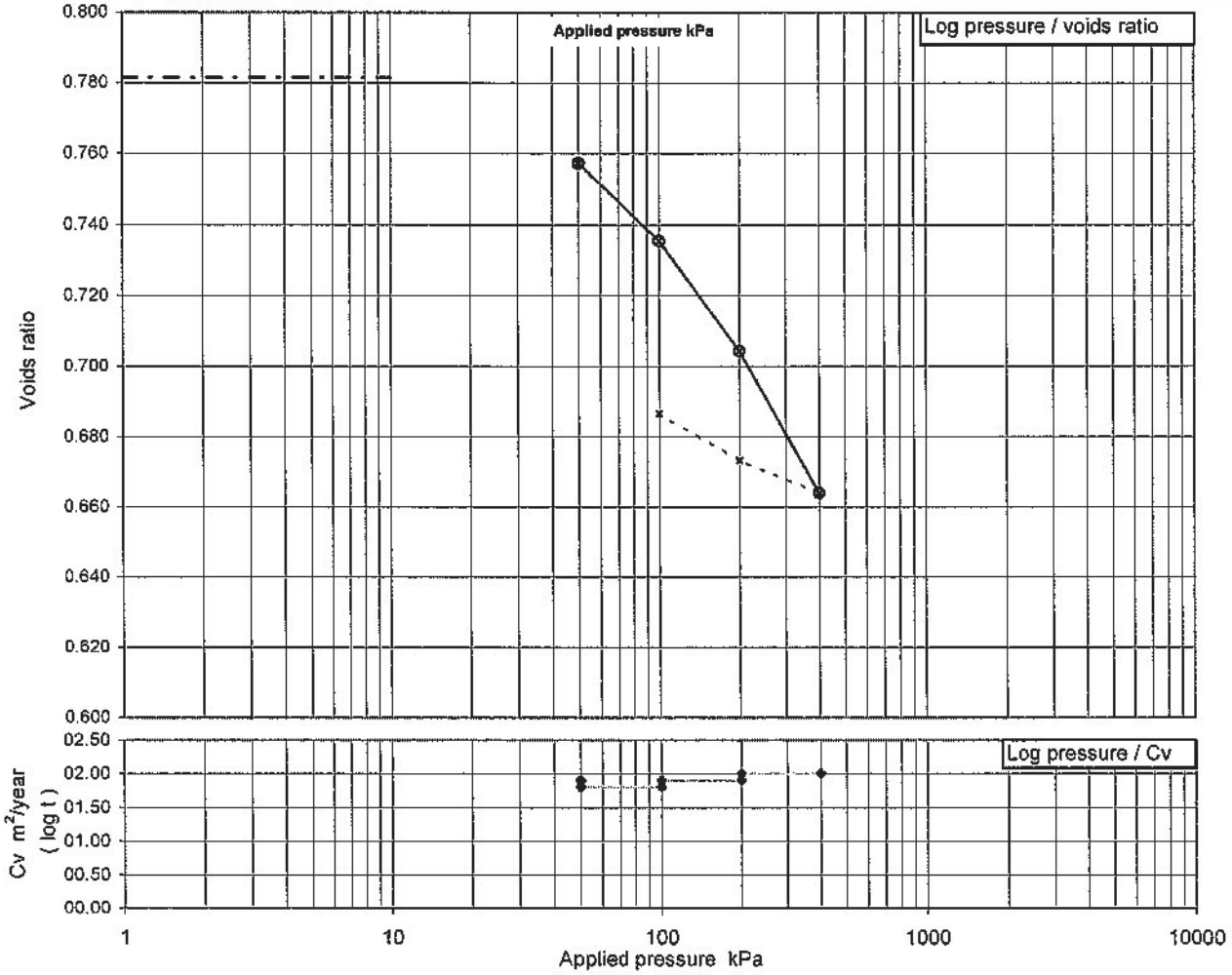
Uniformity Coefficient	D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:11	**Figure** **PSD 12**

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH5		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	4.50		
			Samp No	10	Type	U
			ID	ESGA90572009040800000000130		
			Spec Ref			



Soil description	Firm brown laminated CLAY with occasional silt pockets.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % | Plastic limit %

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m³
Diameter	74.85		mm
Height	19.05	18.04	mm
Voids ratio	0.781	0.687	
Moisture content	30	27	%
Bulk density	1.97	2.03	Mg/m³
Dry density	1.52	1.60	Mg/m³
Saturation	103	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

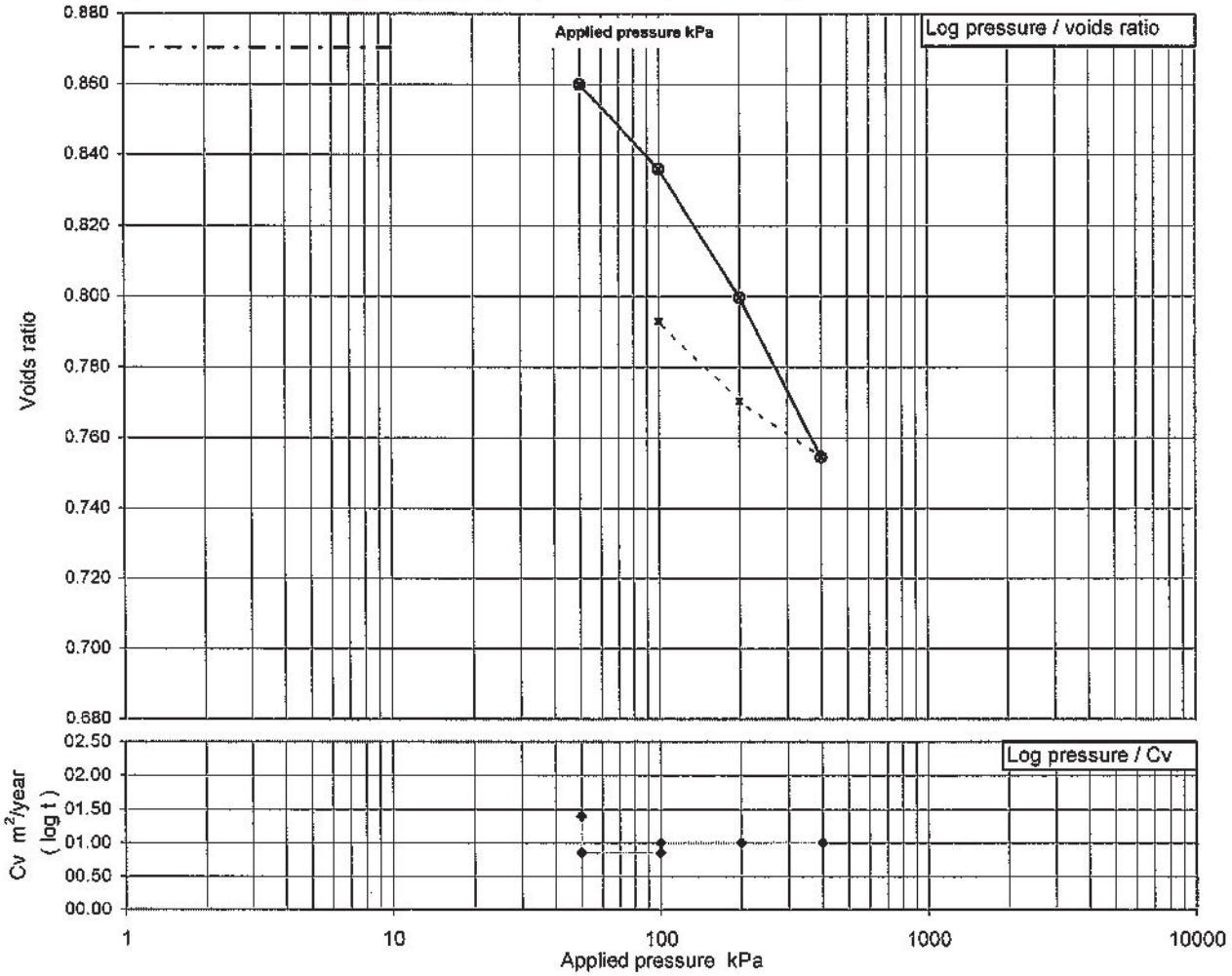
Notes :

Specimen taken 80 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.7815				
50	0.7572	0.273	1.9	1.9	
100	0.7355	0.247	1.8	1.8	
200	0.7042	0.180	1.9	2	
400	0.6639	0.118	2	2.1	
200	0.6732	0.028	-	-	
100	0.6866	0.080	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH8		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60		
			Samp No	6	Type	U
			ID	ESGA90572009041400000000177		
			Spec Ref			



Soil description	Soft brown silty CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % : Plastic limit % :

Specimen details	Initial	Final	
Particle density	2.75	assumed	Mg/m³
Diameter	74.62		mm
Height	19.06	18.27	mm
Voids ratio	0.870	0.793	
Moisture content	33	30	%
Bulk density	1.95	2.00	Mg/m³
Dry density	1.47	1.53	Mg/m³
Saturation	103	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

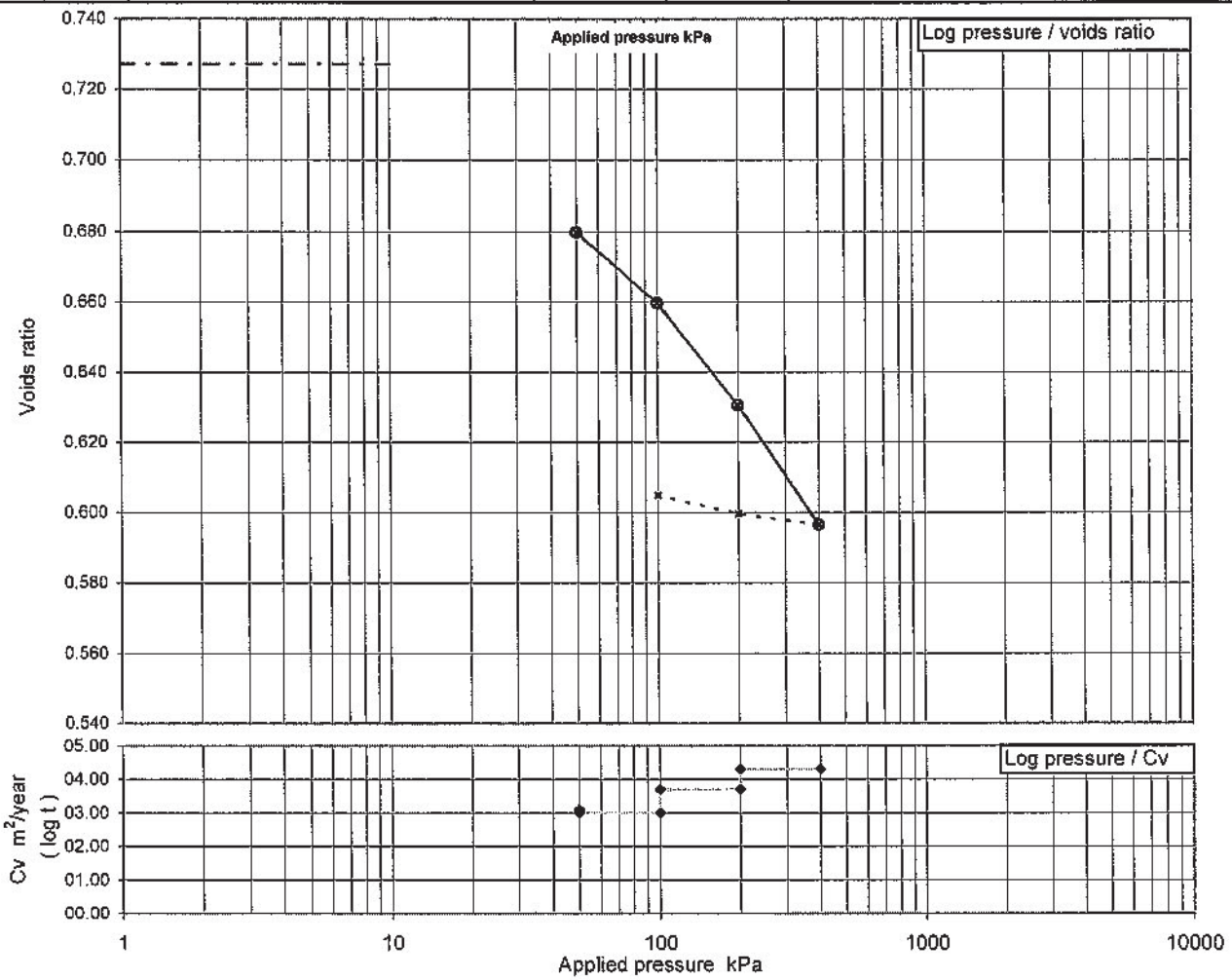
Notes :

Specimen taken 100 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.8704				
50	0.8599	0.112	1.4	1.7	
100	0.8359	0.257	0.85	0.88	
200	0.7996	0.198	1	1.1	
400	0.7545	0.125	1	1.1	
200	0.7704	0.045	-	-	
100	0.7929	0.127	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH10	
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.50	
			Samp No	7	Type U
			ID	ESGA90572009040800000000007	
			Spec Ref		



Soil description: Soft brown sandy CLAY.

Preparation: Undisturbed

Index properties (if available): Liquid limit % | Plastic limit %

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m³
Diameter	74.90		mm
Height	19.17	17.81	mm
Voids ratio	0.727	0.605	
Moisture content	27	24	%
Bulk density	1.99	2.08	Mg/m³
Dry density	1.56	1.68	Mg/m³
Saturation	101	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

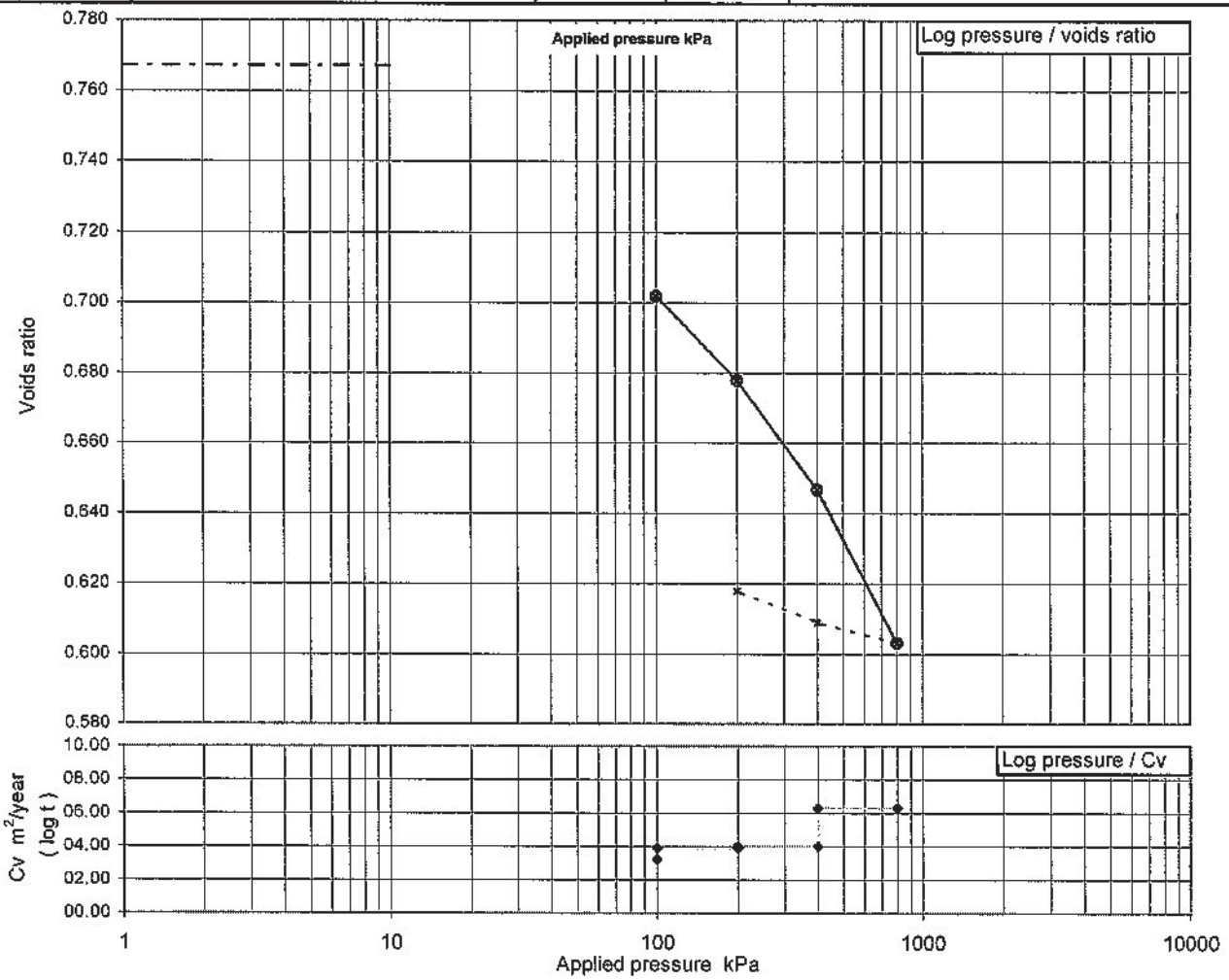
Notes :

Specimen taken 340 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.7271				
50	0.6798	0.548	3.1	3.3	
100	0.6597	0.239	3	3.2	
200	0.6305	0.176	3.7	4	
400	0.5965	0.104	4.3	4.2	
200	0.5995	0.009	-	-	
100	0.6048	0.033	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	11	Type	U
			ID	ESGA90572009040800000000054		
			Spec Ref			



Soil description: Firm to stiff greyish brown thinly laminated CLAY with silt and sand dusting on laminae.

Preparation: Undisturbed

Index properties (if available): Liquid limit % | Plastic limit %

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m³
Diameter	75.00		mm
Height	19.12	17.50	mm
Voids ratio	0.767	0.618	
Moisture content	29	24	%
Bulk density	1.97	2.07	Mg/m³
Dry density	1.53	1.67	Mg/m³
Saturation	101	104	%
Average temperature for test	22		°C

Swelling pressure: not measured kPa

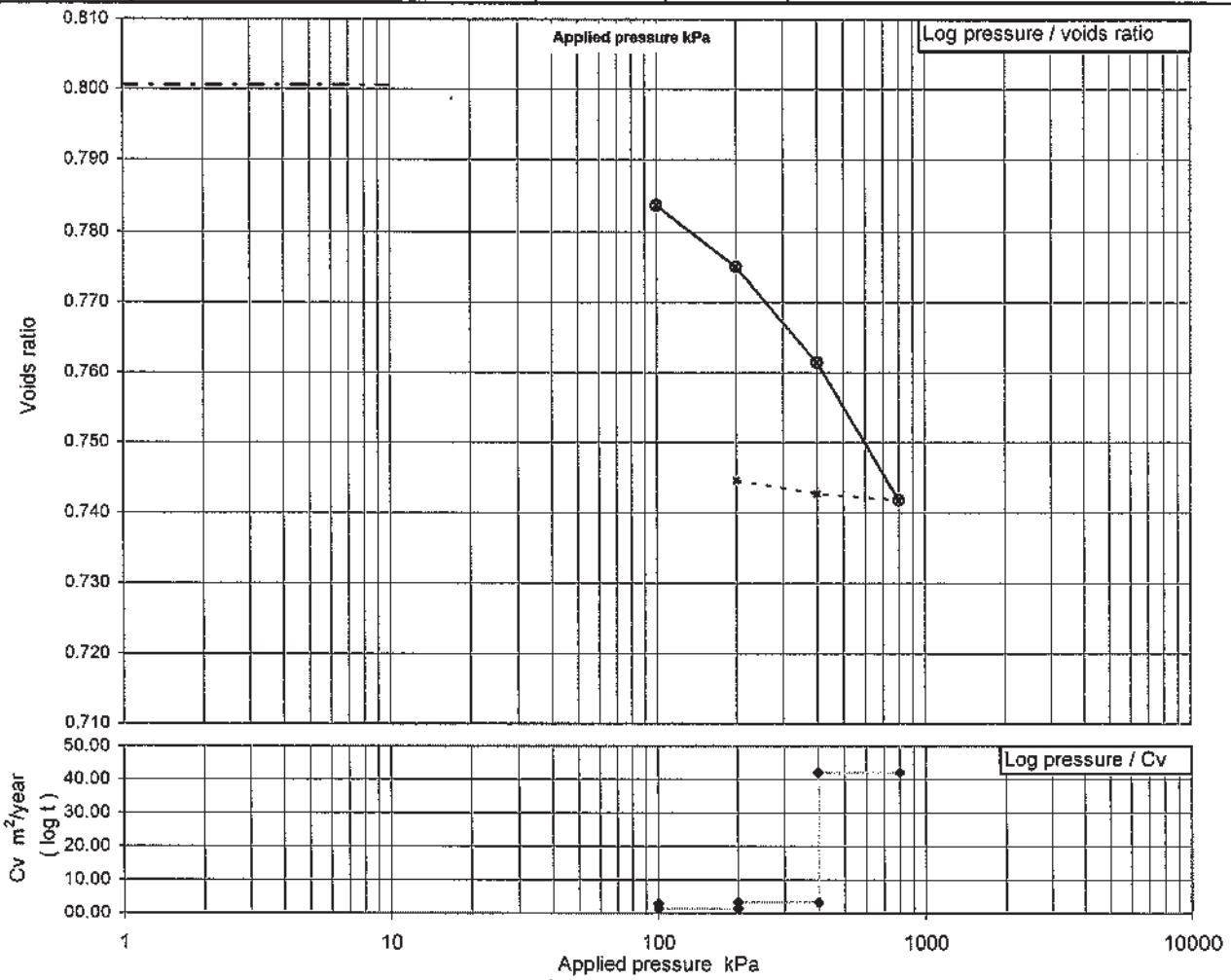
Notes :

Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.7672				
100	0.7019	0.370	3.2	3.5	
200	0.6778	0.141	3.9	4.3	
400	0.6466	0.093	4	4.2	
800	0.6031	0.066	6.3	6.8	
400	0.6090	0.009	-	-	
200	0.6179	0.028	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH18		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	11	Type	U
			ID	ESGA90572009040800000000081		
			Spec Ref			



Soil description	Greyish brown very silty SAND with occasional gravel sized clay pockets.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % : Plastic limit % :

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m³
Diameter	74.96		mm
Height	19.02	18.42	mm
Voids ratio	0.801	0.745	
Moisture content	31	29	%
Bulk density	1.92	1.97	Mg/m³
Dry density	1.47	1.52	Mg/m³
Saturation	102	105	%
Average temperature for test	22		°C

Swelling pressure: not measured kPa

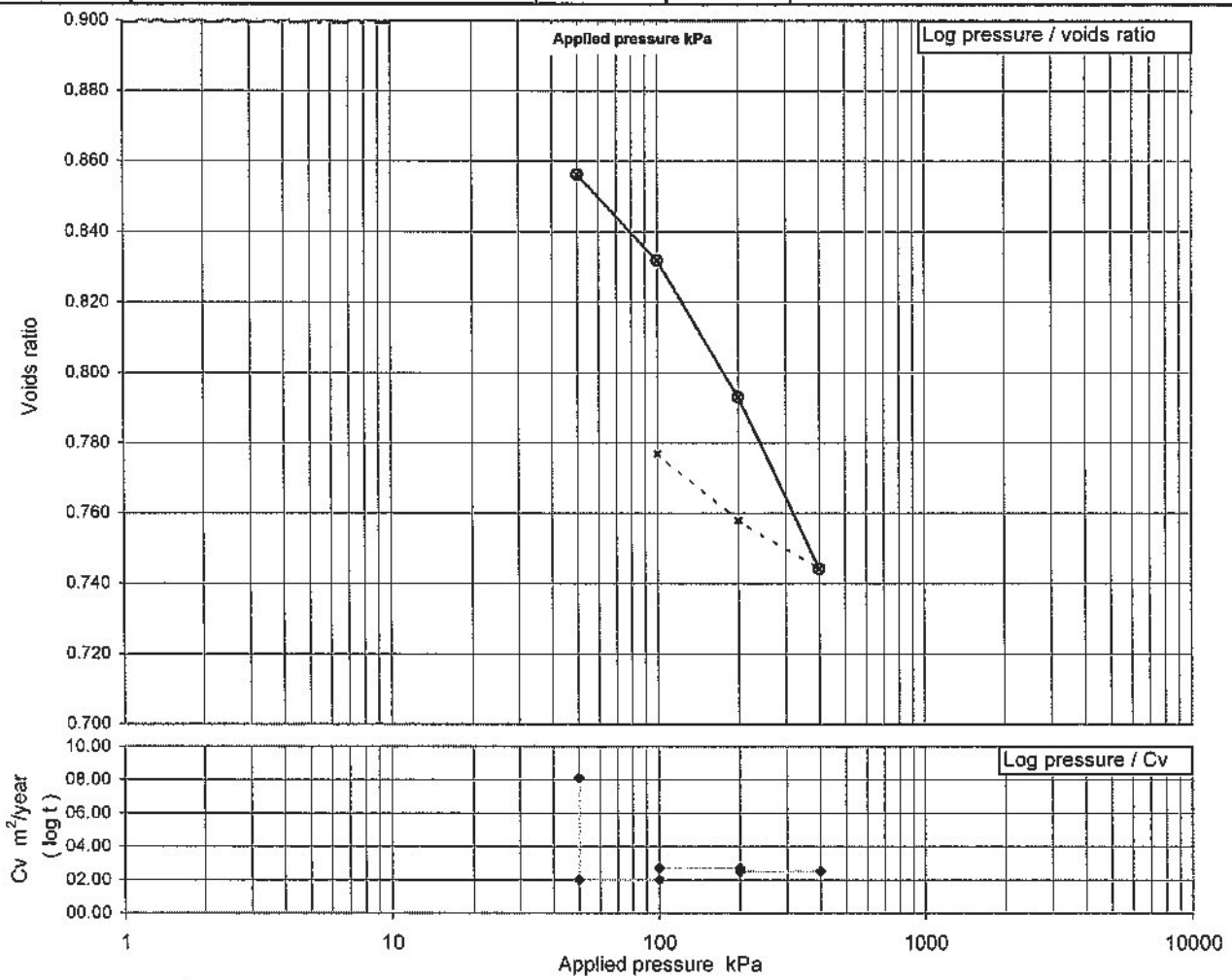
Notes :

Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.8005				
100	0.7837	0.094	2.8	2.9	
200	0.7751	0.048	1.4	1.5	
400	0.7614	0.038	3.3	3.6	
800	0.7417	0.028	42	45	
400	0.7427	0.001	-	-	
200	0.7446	0.005	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH22	
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60	
			Samp No	7	Type U
			ID	ESGA90572009040800000000099	
			Spec Ref		



Soil description	Firm brown CLAY with silt laminations.
Preparation	Undisturbed
Index properties (If available)	Liquid limit % / Plastic limit %

Specimen details	Initial	Final	
Particle density	2.75	assumed	Mg/m³
Diameter	74.87		mm
Height	19.23	17.99	mm
Voids ratio	0.899	0.777	
Moisture content	33	30	%
Bulk density	1.92	2.01	Mg/m³
Dry density	1.45	1.55	Mg/m³
Saturation	100	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

Notes :

Specimen taken 80 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.8994				
50	0.8562	0.455	8.1	8.6	
100	0.8317	0.264	2	2.2	
200	0.7931	0.211	2.7	2.9	
400	0.7441	0.137	2.5	2.7	
200	0.7578	0.039	-	-	
100	0.7768	0.108	-	-	

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS WITHOUT MEASUREMENT OF PORE PRESSURE - SUMMARY OF RESULTS

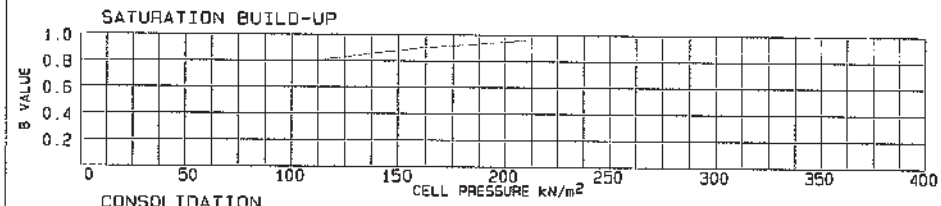
Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

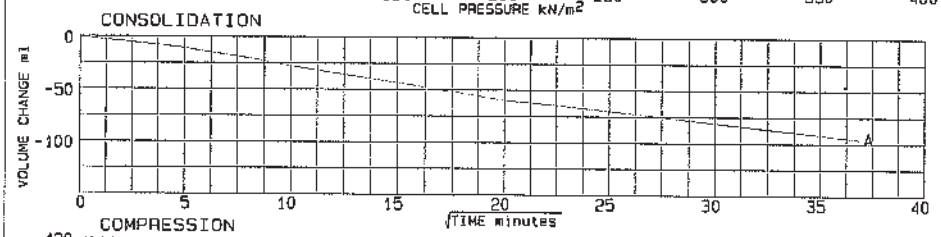
Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Density bulk Mg/m³	Density dry Mg/m³	w %	Test type	Dia. mm	$\acute{o}_3$ kPa	At failure / end of stage: Axial strain %	$\acute{o}_1 - \acute{o}_3$ kPa	C_u kPa	MODE	Remarks
BH3	3	1.50	1.95	U	Firm brown CLAY with silt partings.	1.97	1.55	27	UU	103.3	30	19.6	106	53	P	
BH5	10	4.50	4.95	U	Firm brown laminated CLAY with occasional silt pockets.	1.98	1.53	29	UU	103.1	90	11.3	102	51	B	
BH8	11	6.10	6.55	U	Firm brown CLAY with sand partings.	1.91	1.45	31	UU	103.4	120	19.7	70	35	P	
BH22	7	3.60	4.05	U	Firm brown CLAY with silt laminations.	1.95	1.51	29	UU	103.3	70	18.2	80	40	C	

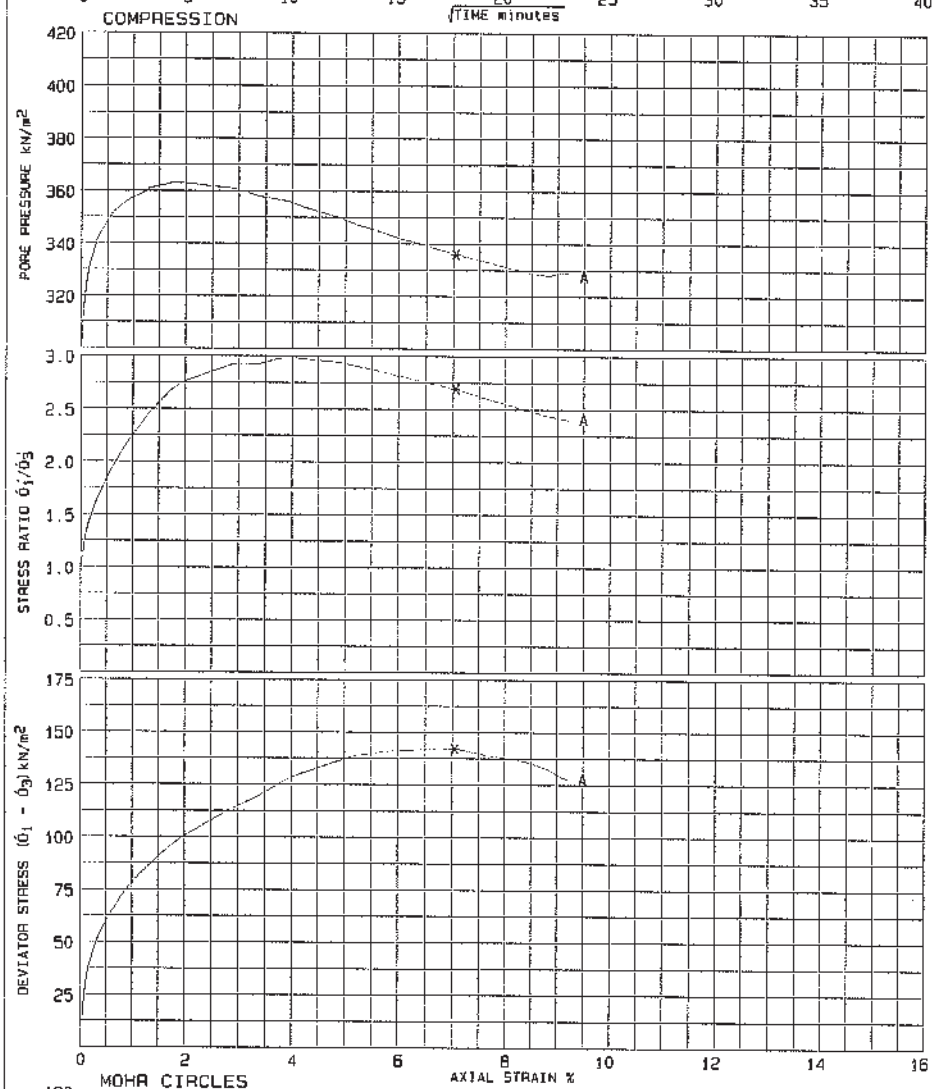
General notes: Tests carried out in accordance with BS1377: Part 7: 1990, clause 8 for single stage, clause 9 for multistage tests. Specimens nominally 2:1 height diameter ratio and tested at a rate of strain of 2%/minute, unless annotated otherwise. See individual test reports for further details.

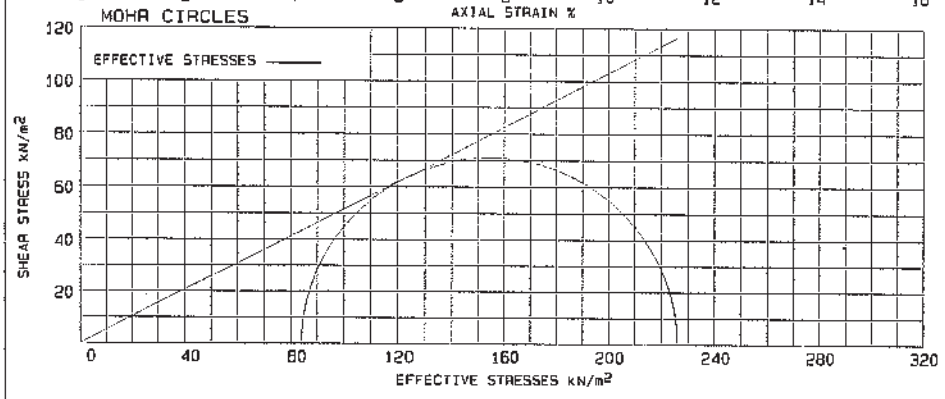
Legend

UU - single stage test (may be in sets of specimens)	$\acute{o}_3$	cell pressure	Mode of failure	P	plastic
UUM - multistage test on a single specimen	$\acute{o}_1 - \acute{o}_3$	deviator stress		B	brittle
suffix R - remoulded or recompacted	C_u	undrained shear strength		C	compound









SPECIMEN			A	B	C
INITIAL	Density Mg/m³		2.03		
	Moisture %		29		
	Dry Density Mg/m³		1.58		
AFTER CONSOLIDATION	Density Mg/m³		2.08		
	Moisture %		26		
	Dry Density Mg/m³		1.65		
SATURATION STAGE	Initial pwp	kN/m²	0		
	Saturated pwp		150		
	Final cell pressure		210		
	B value		0.96		
CONSOLIDATION STAGE	Cell Pressure	kN/m²	420		
	Back Pressure		300		
	Initial pwp		410		
	Final pwp		303		
	$\acute{o}_3'$		120		
	pwp dissipation %		97		
COMPRESSION STAGE	Cell Pressure	kN/m²	420		
	Initial pwp		300		
	Inital $\acute{o}_3'$		120		
	Rate of strain % per hour		0.35		
FAILURE CONDITIONS AT PEAK DEVIATOR STRESS	Axial Strain %		7.0		
	$(\acute{o}_1 - \acute{o}_3)_f$	kN/m²	142		
	u_f		336		
	$\acute{o}_{3f}'$		84		
	$\acute{o}_{1f}'$		226		
	A_f		0.23		
	$(\acute{o}_1' / \acute{o}_3')$		2.692		
	MODE OF FAILURE				

SHEAR STRENGTH PARAMETERS C' ASSUMED ZERO	C'	Ø'
	0 kN/m²	27½°

NOTES

Saturation by application of cell/back pressure increments of 50 kN/m2 with a differential of 10 kN/m2.

Drainage during consolidation to top with Vertical Side drains fitted

Stress/strain curves corrected for area change, side drains and .45 mm thick membrane

SOIL DESCRIPTION

Firm to stiff greyish brown thinly laminated CLAY with silt and sand dusting on laminae.

TYPE OF SPECIMEN: UNDISTURBED

SPECIMEN DIMENSIONS: 102.3mm dia x 203.1 mm long

Test carried out to BS 1377 : Part 8 : 1990 : Test 7

Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

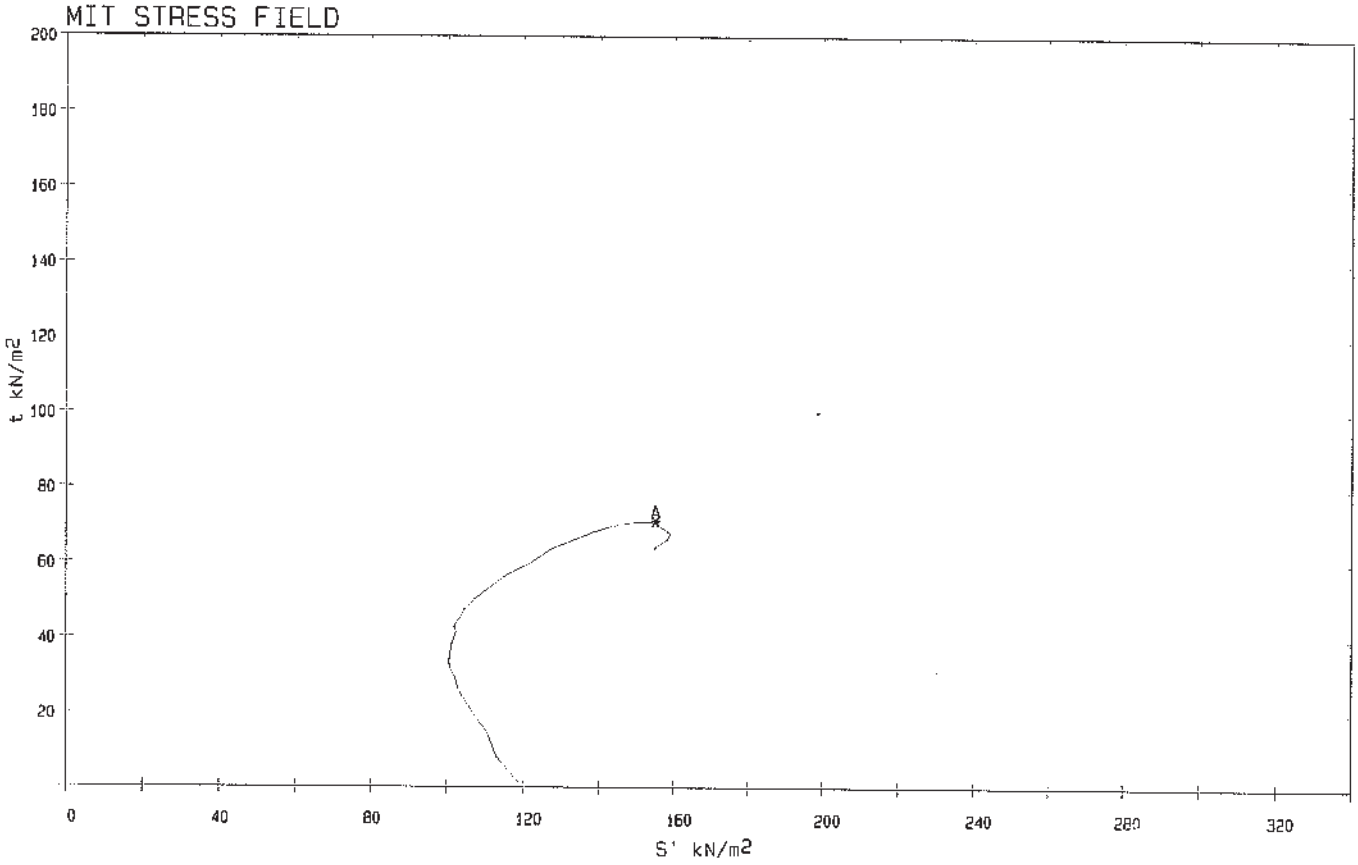
Borehole No. BH16 Depth 6.00-6.45m

Sample No. U11

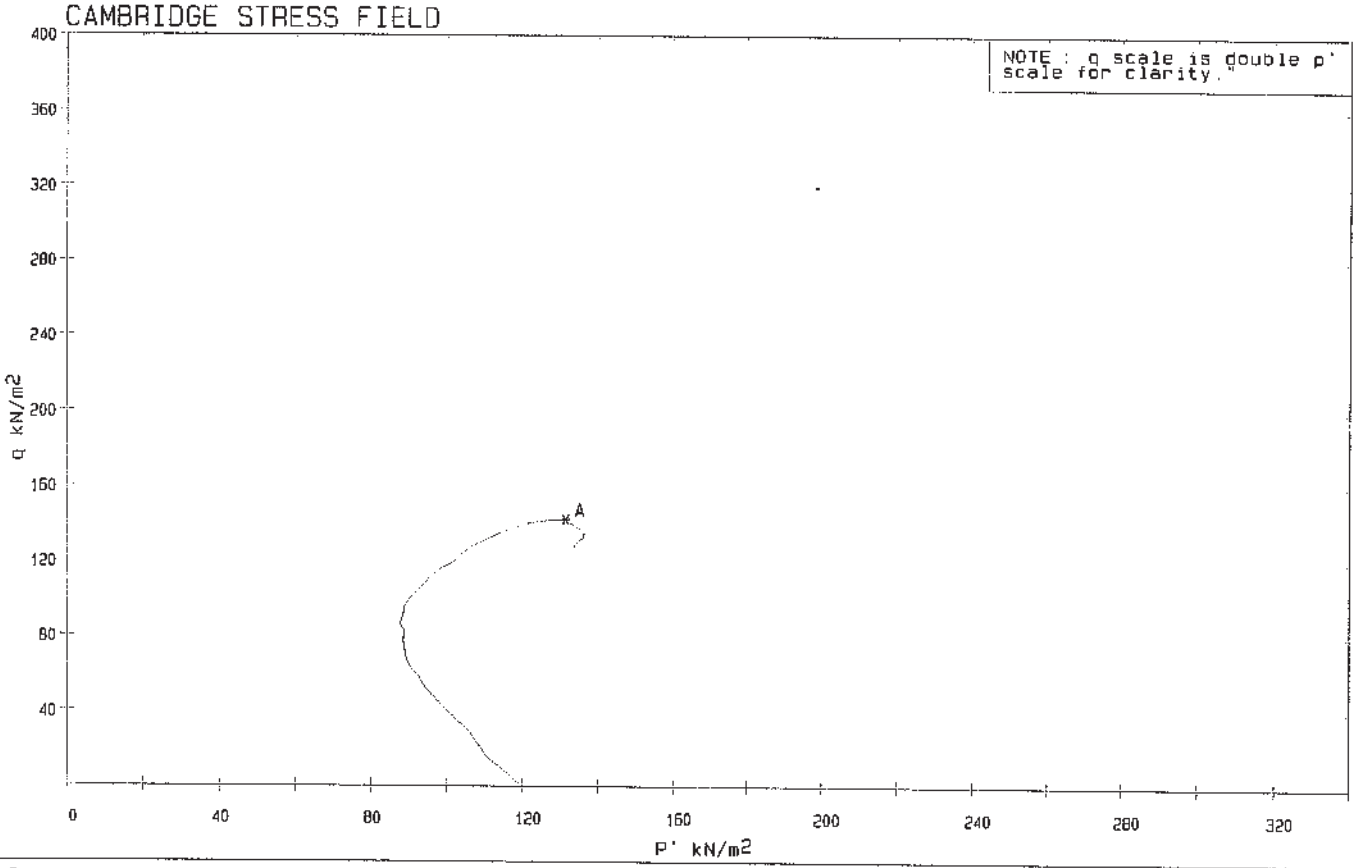
SLR 8.7A	Soil Mechanics	Location: TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

NOTE : Tested at a rate of strain based on pore pressure equalisation at failure only

MIT STRESS FIELD



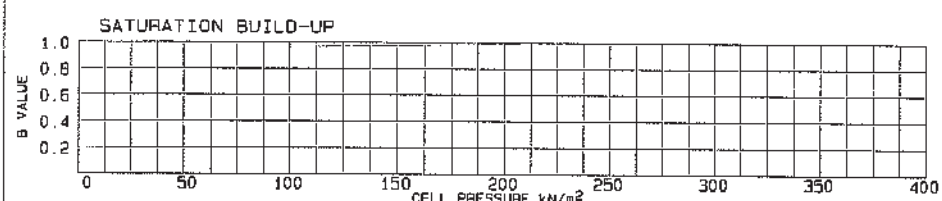
CAMBRIDGE STRESS FIELD

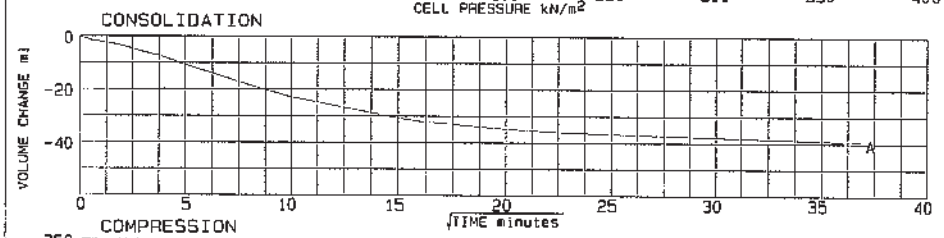


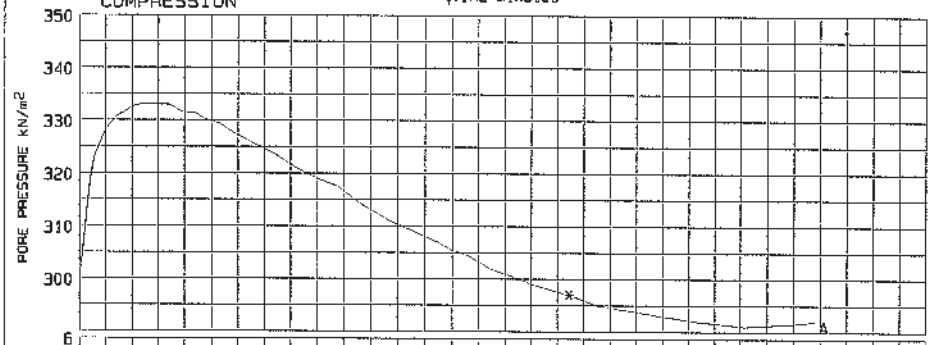
Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

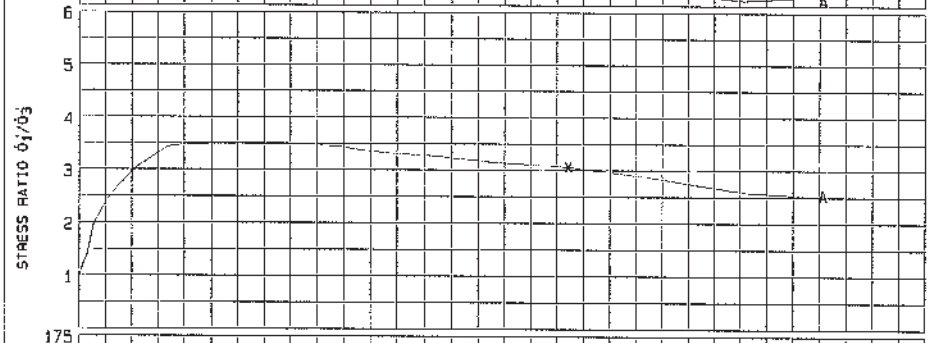
Borehole No. BH16 Depth 6.00-6.45m
Sample No. U11

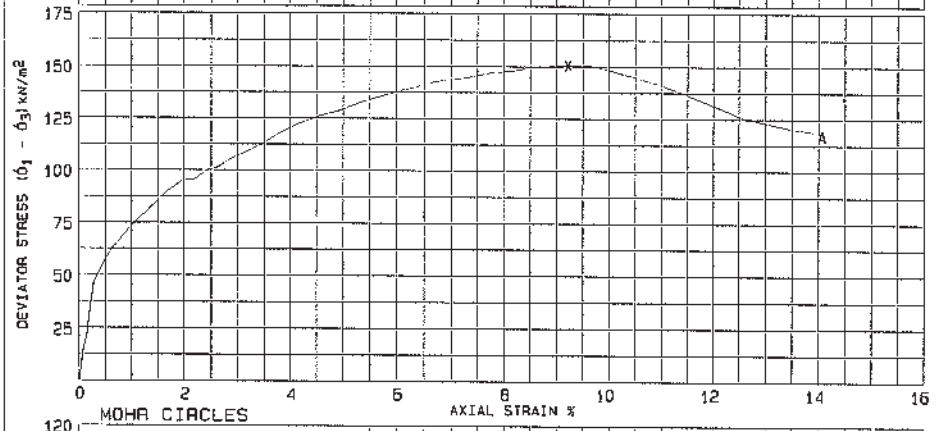
SLR 8.7B	Soil Mechanics	Location	TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

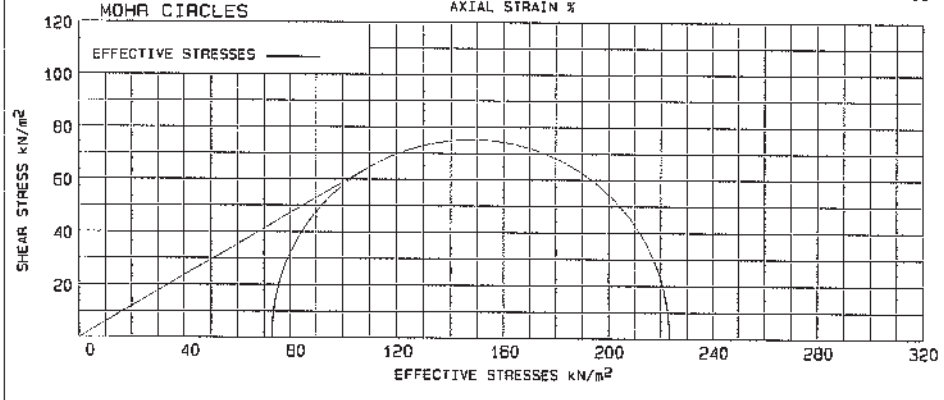












SPECIMEN			A	B	C
INITIAL	Density Mg/m³		2.03		
	Moisture %		26		
	Dry Density Mg/m³		1.61		
AFTER CONSOLIDATION	Density Mg/m³		2.04		
	Moisture %		25		
	Dry Density Mg/m³		1.64		
SATURATION STAGE	Initial pwp	kN/m²	0		
	Saturated pwp		150		
	Final cell pressure		210		
	B value		1.00		
CONSOLIDATION STAGE	Cell Pressure	kN/m²	370		
	Back Pressure		300		
	Initial pwp		356		
	Final pwp		300		
	$\acute{\sigma}_3$'		70		
	pwp dissipation %		100		
COMPRESSION STAGE	Cell Pressure	kN/m²	370		
	Initial pwp		300		
	Inital $\acute{\sigma}_3$'		70		
	Rate of strain % per hour		1.27		
FAILURE CONDITIONS AT PEAK DEVIATOR STRESS	Axial Strain %		9.2		
	($\acute{\sigma}_1$ - $\acute{\sigma}_3$)f	kN/m²	150		
	u_f		297		
	$\acute{\sigma}_3$'f		73		
	$\acute{\sigma}_1$'f		223		
	A_f		-0.02		
	[$\acute{\sigma}_1$' / $\acute{\sigma}_3$']		3.060		
	MODE OF FAILURE				

SHEAR STRENGTH PARAMETERS C' ASSUMED ZERO	C'	Ø'
	0 kN/m²	30½°

NOTES

Saturation by application of cell/back pressure increments of 50 kN/m2 with a differential of 10 kN/m2.

Drainage during consolidation to top with Vertical Side drains fitted

Stress/strain curves corrected for area change, side drains and .45 mm thick membrane

SOIL DESCRIPTION

Firm greyish brown thinly laminated CLAY with silt and sand dusting on laminae.

TYPE OF SPECIMEN: UNDISTURBED

SPECIMEN DIMENSIONS: 103.1 mm dia x 202.8 mm long

Test carried out to BS 1377 : Part 8 : 1990 : Test 7

Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

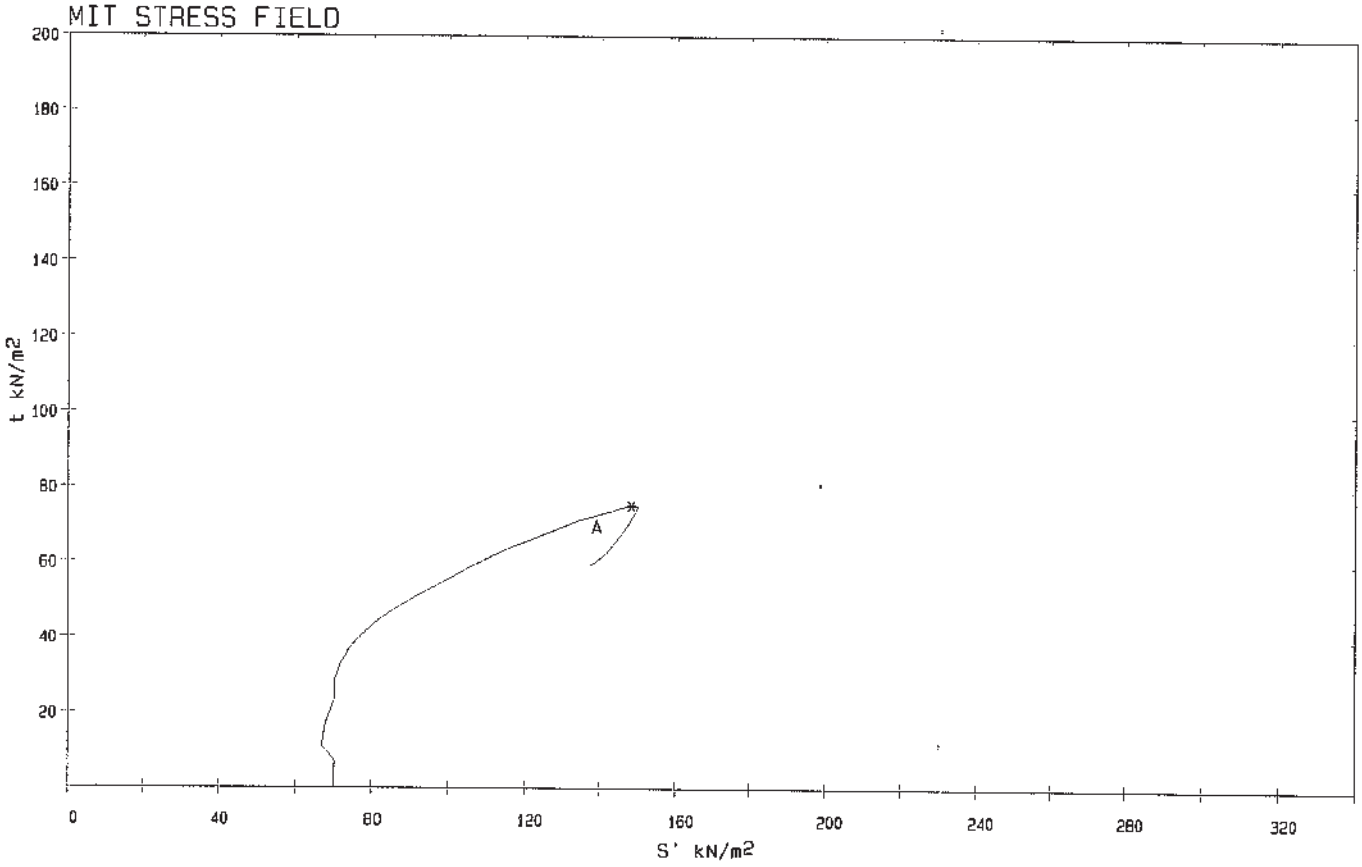
Borehole No. BH18 Depth 3.50-3.95m

Sample No. U7

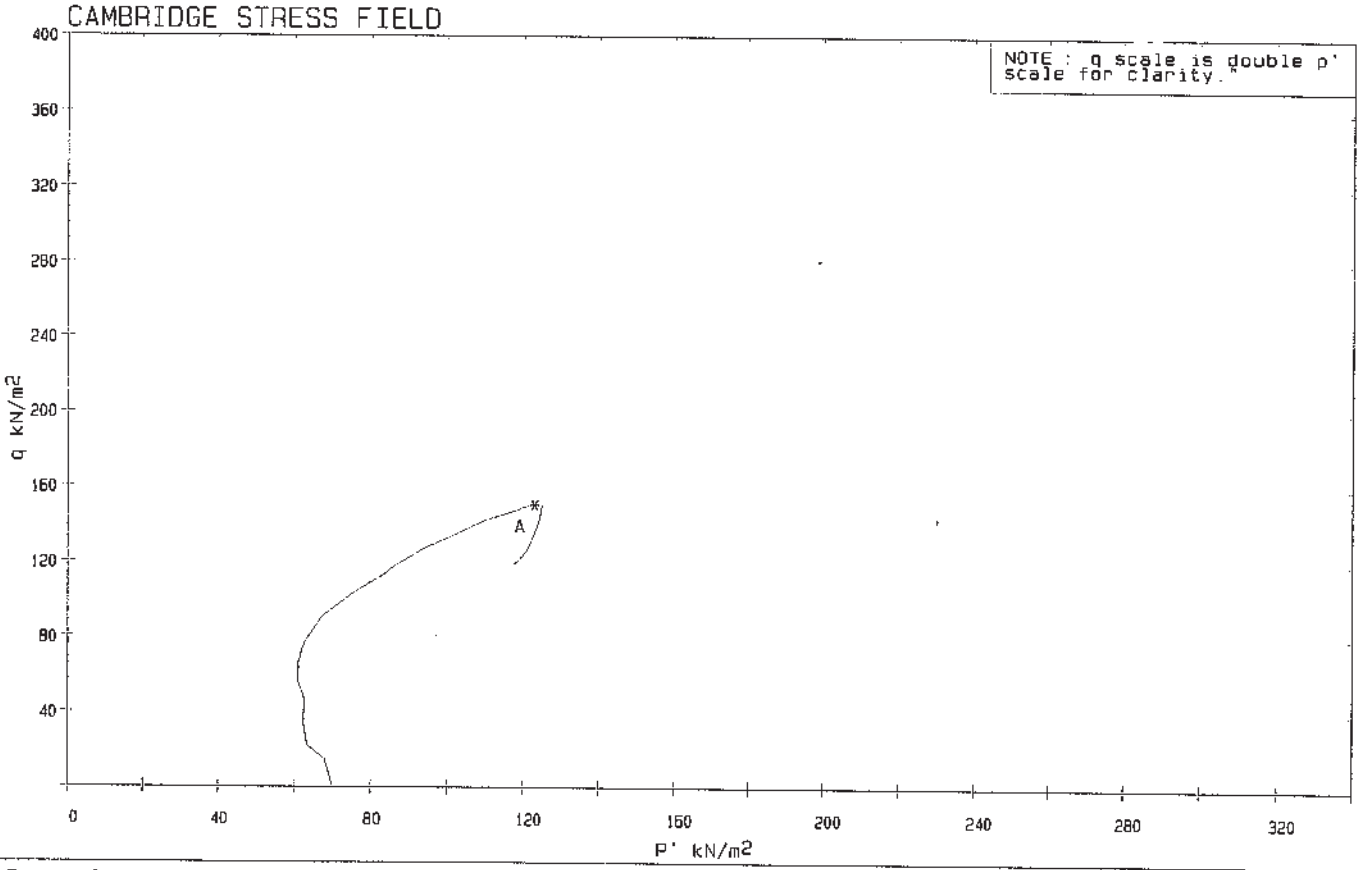
SLR 8.7A	Soil Mechanics	Location: TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

NOTE : Tested at a rate of strain based on pore pressure equalisation at failure only

MIT STRESS FIELD



CAMBRIDGE STRESS FIELD



Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

Borehole No. BH18 Depth 3.50-3.95m
Sample No. U7

SLR 8.7B	Soil Mechanics	Location	TWEEN BRIDGE WIND FARM, -PHASE 2	Loc. No. A9057	Fig.

Soil Mechanics

Point Load Test Results

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No: A9057

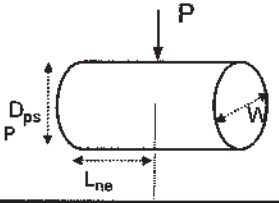
Carried out by: EM

Date: 06 May 2009

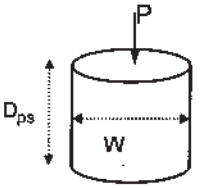
Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
L - parallel to planes of weakness
P - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2 14.426

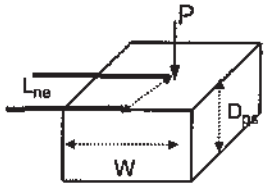
Diametral



Axial



Block/irregular lump



Borehole	Top, m BGL	Ref	Type	Test No	Test Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, MPa	P Failure Load, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
							Type (D, A, I)	Direction (L/P)		L mm	Dps', mm	W mm							
BH8	14.46	25	CS	1	14.54	SANDSTONE	D	L	Y	35	97	100	0.48	0.69		98.5	0.07	0.10	
BH8	14.46	25	CS	2	14.51	SANDSTONE	A	P	Y		38	100	0.51	0.74		69.6	0.15	0.18	
BH8	15.22	27	CS	1	15.31	SANDSTONE	D	L	Y	40	97	100	0.52	0.75		98.5	0.08	0.10	
BH8	15.22	27	CS	2	15.27	SANDSTONE	A	P	Y		31	100	0.56	0.81		62.8	0.20	0.23	
BH10	13.33	22	CS	1	13.43	SANDSTONE	D	L	Y	50	100	100	0.08	0.12		100.0	0.01	0.02	
BH10	13.33	22	CS	2	13.37	SANDSTONE	A	P	Y		54	100	0.29	0.42		82.9	0.06	0.08	
BH10	15.23	23	CS	1	15.30	SANDSTONE	D	L	Y	40	100	100	0.44	0.63		100.0	0.06	0.09	
BH10	15.23	23	CS	2	15.27	SANDSTONE	A	P	Y		36	100	0.67	0.97		67.7	0.21	0.24	
BH13	12.11	24	CS	1	12.20	SANDSTONE	D	L	Y	50	99	100	0.28	0.40		99.5	0.04	0.06	
BH13	12.11	24	CS	2	12.15	SANDSTONE	A	P	Y		40	100	0.80	1.15		71.4	0.23	0.27	
BH13	14.00	25	CS	1	14.09	SANDSTONE	D	L	Y	45	99	100	0.44	0.63		99.5	0.06	0.09	
BH13	14.00	25	CS	2	14.04	SANDSTONE	A	P	Y		47	100	0.52	0.75		77.4	0.13	0.15	
BH16	17.78	27	CS	1	17.88	SANDSTONE	D	L	Y	50	95	100	0.26	0.38		97.5	0.04	0.05	
BH16	17.78	27	CS	2	17.83	SANDSTONE	A	P	Y		42	100	0.60	0.87		73.1	0.16	0.19	
BH16	18.54	28	CS	1	18.65	SANDSTONE	D	L	Y	50	98	100	0.42	0.61		99.0	0.06	0.08	
BH16	18.54	28	CS	2	18.62	SANDSTONE	A	P	Y		31	100	0.64	0.92		62.8	0.23	0.26	
BH18	19.70	22	CS	1	19.80	SANDSTONE	D	L	Y	50	99	100	0.20	0.29		99.5	0.03	0.04	
BH18	19.70	22	CS	2	19.75	SANDSTONE	A	P	Y		46	100	0.68	0.98		76.5	0.17	0.20	
BH18	20.75	23	CS	1	20.85	SANDSTONE	D	L	Y	55	100	100	0.22	0.32		100.0	0.03	0.04	
BH18	20.75	23	CS	2	20.80	SANDSTONE	A	P	Y		34	100	1.60	2.31		65.8	0.53	0.60	
BH22	14.46	29	CS	1	14.58	SANDSTONE	D	L	Y	60	100	100	0.24	0.35		100.0	0.03	0.05	
BH22	14.46	29	CS	2	14.52	SANDSTONE	A	P	Y		69	100	0.56	0.81		93.7	0.09	0.12	
BH22	17.53	30	CS	1	17.63	SANDSTONE	D	L	Y	50	100	100	0.20	0.29		100.0	0.03	0.04	
BH22	17.53	30	CS	2	17.58	SANDSTONE	A	P	Y		41	100	0.36	0.52		72.3	0.10	0.12	

Soil Mechanics

Point Load Test Results

Project: **TWEEN BRIDGE WIND FARM, PHASE 2**

Project No: A9057

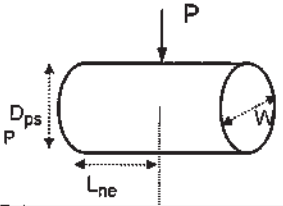
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Date: 07 May 2009

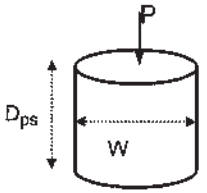
Test Type
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Machine Ram Area, cm^2 14.426

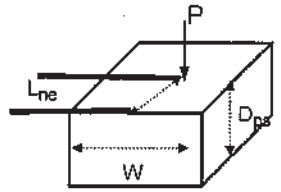
Diametral



Axial

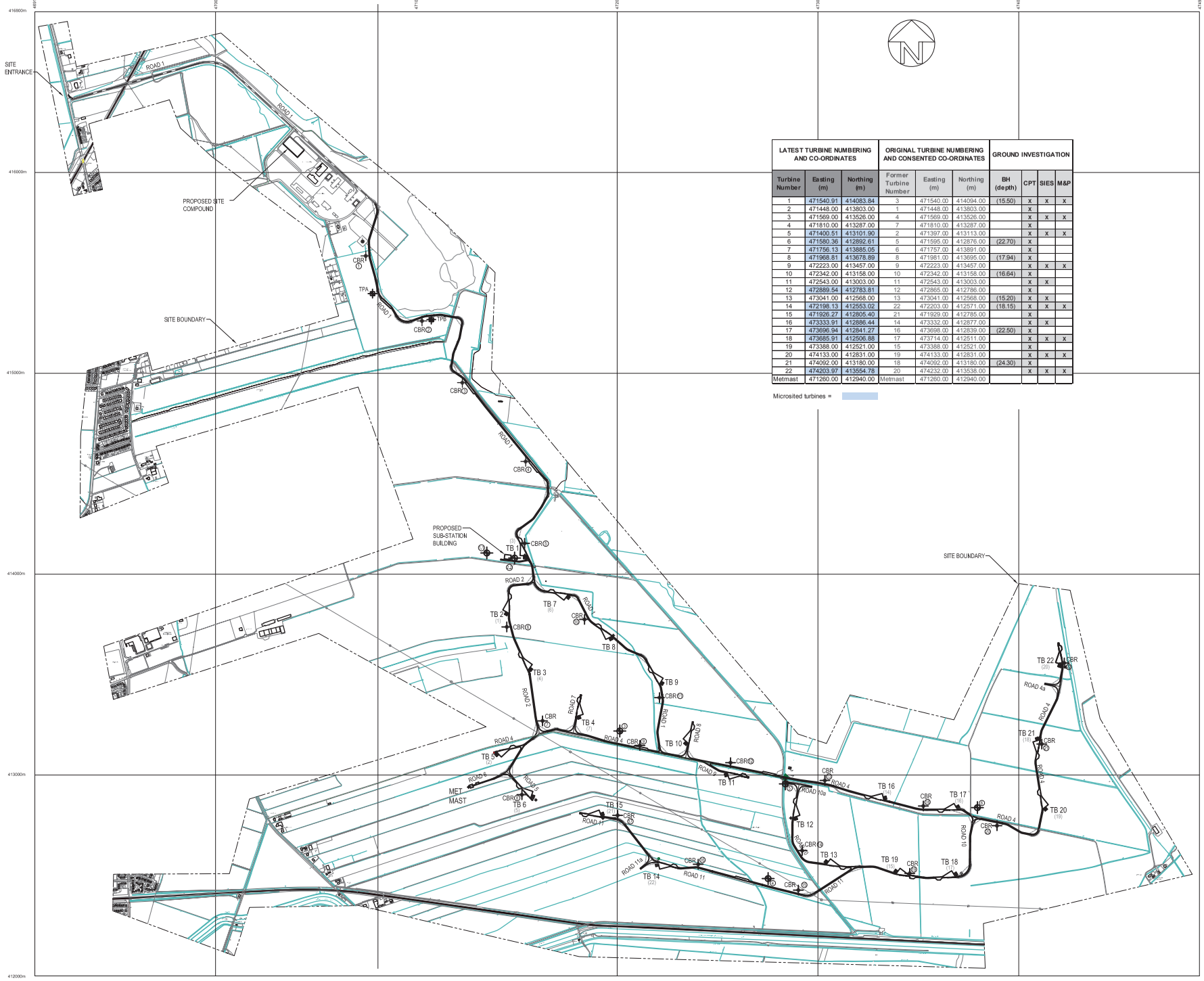


Block/irregular lump



Borehole	Top, m BGL	Ref	Type	Test No	Test Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, MPa	P Failure Load, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
							Type (D, A, I)	Direction (L/P)		L mm	Dps', mm	W mm							
BH10	13.58	CS24		1	13.67	SANDSTONE	D	L	Y	40	74	100	0.29	0.42		86.0	0.06	0.07	
BH10	13.58	CS24		2	13.63	SANDSTONE	A	P	Y		15	100	0.32	0.46		43.7	0.24	0.23	
BH13	13.50	CS26		1	13.62	SANDSTONE	D	L	Y	60	98	100	0.28	0.40		99.0	0.04	0.06	
BH13	13.50	CS26		2	13.54	SANDSTONE	A	P	Y		64	100	0.30	0.43		90.3	0.05	0.07	
BH16	17.00	CS29		1	17.10	SANDSTONE	D	L	Y	40	100	100	0.24	0.35		100.0	0.03	0.05	
BH16	17.00	CS29		2	17.05	SANDSTONE	A	P	Y		41	100	0.80	1.15		72.3	0.22	0.26	
BH18	19.52	CS24		1	19.62	SANDSTONE	D	L	Y	50	97	100	0.20	0.29		98.5	0.03	0.04	
BH18	19.52	CS24		2	19.59	SANDSTONE	A	P	Y		28	100	0.67	0.97		59.7	0.27	0.29	
BH22	16.35	CS31		1	16.47	SANDSTONE	D	L	Y	60	99	100	0.36	0.52		99.5	0.05	0.07	
BH22	16.35	CS31		2	16.41	SANDSTONE	A	P	Y		44	100	0.51	0.74		74.8	0.13	0.16	

APPENDIX C: GROUND INVESTIGATION AND ROAD LAYOUT PLAN



LATEST TURBINE NUMBERING AND CO-ORDINATES			ORIGINAL TURBINE NUMBERING AND CONSENTED CO-ORDINATES			GROUND INVESTIGATION			
Turbine Number	Easting (m)	Northing (m)	Former Turbine Number	Easting (m)	Northing (m)	BH (depth)	CPT	SIES	M&P
1	471540.91	414083.84	3	471540.00	414094.00	(15.50)	x	x	x
2	471448.00	413803.00	1	471448.00	413803.00		x		
3	471569.00	413526.00	4	471569.00	413526.00		x	x	x
4	471810.00	413287.00	7	471810.00	413287.00		x		
5	471400.51	413101.90	2	471397.00	413113.00		x	x	x
6	471580.36	412892.61	5	471595.00	412876.00	(22.70)	x		
7	471756.13	413885.05	6	471757.00	413891.00		x		
8	471968.81	413678.89	8	471981.00	413695.00	(17.94)	x		
9	472223.00	413457.00	9	472223.00	413457.00		x	x	x
10	472342.00	413158.00	10	472342.00	413158.00	(16.64)	x		
11	472543.00	413003.00	11	472543.00	413003.00		x	x	
12	472889.54	412783.81	12	472865.00	412786.00		x		
13	473041.00	412568.00	13	473041.00	412568.00	(15.20)	x	x	
14	472198.13	412553.02	22	472203.00	412571.00	(18.15)	x	x	x
15	471926.27	412805.40	21	471929.00	412785.00		x		
16	473333.91	412886.44	14	473332.00	412877.00		x	x	
17	473696.94	412841.27	16	473698.00	412839.00	(22.50)	x		
18	473685.91	412506.88	17	473714.00	412511.00		x	x	x
19	473388.00	412521.00	15	473388.00	412521.00		x		
20	474133.00	412831.00	19	474133.00	412831.00		x	x	x
21	474092.00	413180.00	18	474092.00	413180.00	(24.30)	x		
22	474203.97	413554.78	20	474232.00	413538.00		x	x	x
Metmast	471260.00	412940.00	Metmast	471260.00	412940.00				

Microsited turbines =

TURBINE LOCATION GROUND INVESTIGATION KEY

BH	BOREHOLE
CPT	CONE PENETRATION TEST
SIES	SEISMIC CONE TEST
M&P	MOSTAP SAMPLE & PRESSUREMETER TEST

OTHER GROUND INVESTIGATION LOCATIONS

- WINDOW SAMPLE BOREHOLE WITH GAS MONITORING INSTALLATION
- CBR① CALIFORNIA BEARING RATIO TEST LOCATION
- TB 20 (19) CURRENT WTG POSITION (FORMER WTG REFERENCE No.)
- TPA TRIAL PIT LOCATIONS

Rev.	Revision Description	Drn	Chkd	Appd	Date
A	ISSUED FOR TENDER PURPOSES	RD	DJL	WT	12/6/09

Status:

FOR TENDER PURPOSES

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Website: www.donaldsonassociates.com

Client: e·on Climate & Renewables

Project: TWEEN BRIDGE WINDFARM ECI STAGE 1

Title: GROUND INVESTIGATION & SITE TRACK LAYOUT

Drawn by:	Designed by:	Checked:
RD	DJL	DJL
Date: 12.06.09	Original Sheet Size A1	Approved: WT
Scales: N.T.S.		

Drawing No: J1087 - 013 Revision A