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REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

THIRSTIN MILL, THIRSTIN ROAD, HONLEY

for

NORTHPARK (GREETLAND) LTD.

CONSULTANTS: BLAND AND SWIFT.

Report No J1842/11/E

June 2011

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1. SYNOPSIS

This investigation has demonstrated that variable made ground was revealed to depths ranging between 0.5m and 5.0m, with typical Millstone grit series mudstone and siltstone beneath the fill. In addition, some contamination was evident within the made ground. Consequently, careful consideration of the discussion of ground conditions should be made and cognisance taken of the section on recommended further investigation.

2. INTRODUCTION

Northpark (Greetland) Ltd propose to develop an area of land off Thirstin Lane, Honley. The site was formerly occupied by Thirstin Mill which was demolished a number of years ago. The area under consideration is located on the west side of the road and occupies a relatively flat area in the base of a valley. Within the southern part of the site the ground level in the valley bottom is significantly higher than the remaining site area. It is understood that the mill pond once occupied this area. The former stream in the valley has been culverted through the site. Additionally, a spring which issues from the western valley side via an inspection chamber also enters the culvert.

The valley side to the west of the site is relatively steep, with a footpath about half way up the slope. Some remedial works have been undertaken in order to stabilise the slope beneath the level of the footpath. This work included the installation of a series of ground anchors, although their suitability has not been established as part of this investigation. The working platform for the installation of the ground anchors was by way of an earth bund situated adjacent to the cut face of the slope. This bund also provides support to the toe of the slope.

It is understood that the proposed development is to include the construction of a number of dwellings together with gardens and access roads. Accordingly, a site investigation has been undertaken in accordance with the information provided by the desk study and subsequently instructed by the client. This work was required in order to determine the nature of the underlying soils, assess their engineering properties and assist in the design of safe and economical foundations for the proposed development and to establish a method of stabilising the valley side below the level of the footpath. Additionally, contamination testing of the made ground has been undertaken to enable an assessment of the levels of contamination at this site.

This report presents the data obtained and discusses the ground conditions in relation to the proposed development.

3. LIMITATIONS

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

4. DESK STUDY

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services Ltd and the results were presented as report number J1842/11/EDS in April 2011. That study has been used extensively during the current intrusive investigation, which was conducted in accordance with the principals outlined in Section 4, Intrusive Investigation, of that report**.** For convenience the salient parts of that section of the desk study are reproduced below.

The desk study was undertaken to:

- Enable the Local Authority to grant outline planning permission with some confidence that the contamination and gas issues are being addressed.
- Provide sufficient data to enable potential 'hot spots' of contamination to be identified.
- Allow if required, a programme of additional investigation to be formulated with greater confidence.
- Assess the potential for landfill gas across the site and in particular in the areas where made ground is known to be present.

The site is to be developed by the construction of a number of residential dwellings which will include access roads, parking, gardens and landscaped areas. On the basis of the above it was recommended that the following testing regime be implemented in the first instance:

- **Metals** – Cd, Cr, Cu, Hg, Ni, Pb, Zn, V.
- **Semi Metals and Non Metals** – As, Se, Free Cyanide and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs) 16 EPA, Total petroleum hydrocarbons (TPH CWG).
- **Others** – pH, Organic Content.
- **PCB's**

If groundwater was encountered at shallow depth then water samples would be taken for chemical analysis.

It was considered that some gas monitoring would be required at this site. In accordance with Table 4.2 of CIRIA C665 *Assessing risks posed by hazardous ground gasses to buildings*, the gas hazard is considered to be moderate and the sensitivity of the end use is high. Therefore the nominal spacing of gas wells should be between 25m and 50m to fully characterise the site. However, in order to provide preliminary guidance it was recommended that a minimum of 3 gas monitoring standpipes be installed in the first instance.

The desk study indicated that the area of the former mill pond may have been in-filled. It should also be appreciated that there may have been some fill activities during the demolition of the mill. Consequently it was considered that the intrusive investigation required to fulfil the environmental issues considered above, as well as provide the required geotechnical data, should include the following.

- A series of trialpits and boreholes across the site following a largely non-targeted sampling method but taking into account that there has been prior construction on the site.
- An initial exploratory examination should be undertaken by testing six samples of the made ground for the range of contaminants listed below.

Depending upon the results of this work further testing may become necessary.

- During the sampling process careful examination of the soil should be made and if there are any signs of asbestos being present then screening should be undertaken.
- Three gas monitoring standpipes should be installed and monitored in accordance with Table 4.2 of CIRIA C665: 2007: *Assessing risks posed by hazardous ground gasses to buildings.*

5. FIELDWORKS

The fieldworks were undertaken during the period 9th to 14th May 2011 and included the following:

- Seven machine dug trial pits.
- Eight windowless sample boreholes.
- Six dynamic probes.
- Seven rotary boreholes with core recovery.
- Four gas monitoring standpipes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report. The major details of this drawing were obtained from a topographical survey plan supplied by the consulting engineers, Bland and Swift Ltd.

5.1 Machine Dug Trialpits

A total of seven trialpits were excavated in order to reveal the nature of the near surface soils using a JCB back acting excavator. The soils were logged on site in general accordance with BS5930: 1999, as amended in 2007, and full descriptions are given on the trialpit records which are presented in Appendix 2. Samples were taken from the trialpits for both geotechnical and chemical testing. The chemical test specimens were retained in the appropriate air tight containers within cool boxes for onward transition to the chemical laboratory.

5.2 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 90mm for the first 1m through 80mm, 70mm and 60mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 1999, as amended in 2007, and full descriptions are given on the window sample records which are presented in Appendix 3. Also included on these records are the core diameters and percentages of core recovered.

5.3 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes and along the bunded working platform in accordance with the procedure given in BS1377: 1990: Part 9, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 4.

5.4 Rotary Cored Boreholes

Seven boreholes were sunk using a Comacchio Geo 205 drilling rig with PWF core barrels and mist flush. Some of the boreholes were undertaken angled back into the slope in order to reveal the material under the footpath. The angles and directions are indicated on the borehole logs. During the boring operations, standard penetration tests (SPT's) were generally taken at 1m depth intervals to rockhead. The SPT's were conducted in accordance with the procedures given in BS1377: 1990: Part 9: 3.3 and the results are summarised on the borehole records.

It should be appreciated that groundwater strikes were masked by the drilling process. However the water level was recorded at the end of the shift. All cores and samples were returned to the laboratory for logging in general accordance with BS5930: 1999 and full descriptions are given on the borehole records, which are presented in Appendix 5. Also included on these records are the water levels, casing details, standard penetration test results and a record of samples/cores taken. The rotary cored borehole 2 also revealed grout that had been injected in to the slope as part of the attempt to install rock anchors. This was logged on a separate log sheet in order to describe the grout.

5.5 Gas Monitoring Standpipes

Gas monitoring standpipes were installed to the full depth of four windowless sample boreholes and the details of the installations are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to between 0.5m and 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal above and the installation was capped with a stop box cover in a concrete surround.

6. GEOLOGY

An examination of the 1: 50 000 scale Geological Survey map of the area[1] indicates the valley bottom is underlain by mudstones and siltstones of the Carboniferous Millstone Grit Series. However, beneath the higher ground immediately to the east, west and south of the site, Rough Rock, a named sandstone unit within the Millstone Grit Series, is shown to outcrop. On the basis of this information it is considered that Rough Rock outcrops in the valley sides, but mudstones and siltstone outcrop in the bed of the valley. The shape of the site virtually mirrors the shape of the outcrop of the mudstone and siltstone, indicating that the bed of the valley is close to the interface between the mudstone/siltstone and Rough Rock.

For the record, the BGS lexicon of named rock units[2] describes the Millstone Grit Group as fine to very coarse grained feldspathic sandstones, interbedded with grey siltstones and mudstones, with subordinate marine shaly mudstone, claystone, coals and seatearths. The Rough Rock is described as cross bedded coarse-grained feldspathic sandstone. The map also indicates that the Upper Meltham Coal outcrops within a river valley, approximately 750m west of the site. An inspection of the generalised vertical section shown on the Geological Survey map indicates that this coal seam will be at a depth of between 40m and 45m beneath this site.

Whilst no alluvial deposits are shown within the immediate area of the site, alluvium is shown to be present in the valley of Hall Dyke a short distance to the north. Furthermore, a northwest-southeast trending fault, with the down-throw to the northeast, is shown approximately 200m north-east.

7. STRATA CONDITIONS

7.1 Lower site

In accordance with the geology of the area, trial pits, windowless samples and rotary cored boreholes R5 and R6, the succession on the lower section of the site has been shown to include the following:

Table 1: *Generalised strata profile*

Depth (m)	Strata type	Groundwater strikes (m)
0.8 – +5.0	Made Ground	2.4 – 3.6
+10m	Carboniferous Millstone Grit Series	

This profile is considered in more detail below.

[1] Sheet 86, solid and drift edition, Glossop.
[2] www.bgs.ac.uk/lexicon/home

7.1.1 Made Ground

The made ground was observed to be variable across the site but generally consisted of medium dense grey brown and yellow brown locally clayey and silty angular to subrounded fine to coarse gravel of fine and medium grained micaceous sandstone. The fill was also observed to contain cobbles and boulders of asphalt, brick, concrete and included much ash. It should be appreciated that the area of the former mill pond revealed large boulder sized fragments of dressed stone, probably from the original mill building.

Trial pits 5 and 7 in the lowest section of the site revealed the presence of a rough finished concrete base. It is possible that this was part of the original floor of the mill and indeed TP7 exposed a section of brick wall insitu.

7.1.2 Carboniferous Millstone Grit Series

On the lower section of the site the trial pits and windowless sample boreholes were unable to penetrate the made ground. Borehole R6 was undertaken on the lower level at the base of the temporary battery which revealed 0.5m of made ground overlying medium strong thickly laminated to thinly bedded yellow-brown fine and medium grained micaceous sandstone with subordinate ripple cross laminated siltstone/silty mudstone to 3.50m.

7.2 Western Banking

In accordance with the geology of the area, rotary cored borehole R7 which was undertaken on the top of the western banking from a neighbour's property and the boreholes R1 to 4 along the line of the temporary batter angled in to the slope, the succession has been shown to include the following:

Table 2: *Generalised strata profile*

Depth (m)	Strata type
0.8	Made Ground
22.2m	Rough Rock Carboniferous Millstone Grit Series
+26m	Mudstone Carboniferous Millstone Grit Series

This profile is considered in more detail below.

7.2.1 Made Ground

Borehole R7, undertaken at the top of the banking, revealed 0.8m of made ground which included ash. It should be appreciated that this fill has no bearing on the development, thus the description was based on the drillers notes.

7.2.2 Rough Rock Carboniferous Millstone Grit Series

On penetrating the made ground from 0.8m to 2.0m the driller reported cobbles of sandstone and weathered sandstone. From 2.0m medium weak and strong yellow-brown medium to very coarse grained feldspathic sandstone was revealed. This was observed to become thickly laminated to thinly bedded with depth. from 19.0m to 20.0m no recovery and no resistance was reported by the driller before achieving core recovery from 20.0m in strong thickly laminated to thinly bedded pale grey occasionally yellow-brown fine and medium grained micaceous sandstone.

7.2.3 Mudstone Carboniferous Millstone Grit Series

From 22.20m to termination of the borehole at 26.0m medium weak and medium strong thickly laminated and very thinly bedded grey silty mudstone was encountered.

7.3 Groundwater

The groundwater conditions entered on the borehole records are those observed at the time of the investigation. The normal rate of boring does not permit the recording of an equilibrium water level for any one strike. Moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

Notwithstanding the above, groundwater strikes were recorded within TP1, 2, 4 and 6 at depths of 3.4m, 3.6m, 2.8m and 2.7m respectively. Groundwater strikes were also recorded in the rotary cored boreholes at 10.5m (R1), 6.5m (R2), 12.8 (R3A), 10.5m (R4) and 3.0m (R5). It is considered that these levels are the same levels as revealed in the trial pits. The water levels within the gas monitoring standpipes were also recorded during the monitoring period.

In addition to the above, there is anecdotal evidence to suggest that significant quantities of groundwater issue from and run down the valley side during periods of high rainfall.

8. INSITU TESTING

8.1 Dynamic Penetration Tests

Dynamic penetration tests were conducted adjacent to the windowless sample boreholes and along the access battery. These results demonstrated that the resistance to penetration was variable within the made ground revealing resistances to penetration of zero to 11 blows/100mm. Also of note are locally stronger blow counts of up to 20 blows/100mm. Effective refusal[3] was recorded at depths of 5.1m, 6.2m, 3.6m, 0.7m, 2.8m, 7.4m, 5.7m and 7.2m in DP's 1 through 7 respectively.

[3] 25 blows/100mm

8.2 Landfill Gas and Water Level Monitoring

The standpipes were monitored between the 16th May and the 7th of June 2011. The results of the gas monitoring undertaken to date are tabulated below.

Table 3: ***Landfill gas monitoring***

Borehole No	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS1	16.05.11	0	1.0	20.4	0.1	1008	3.12	4.0
	23.05.11	0	1.6	19.9	0.1	998	3.20	
	31.05.11	0	1.8	19.8	0.1	1006	3.20	
	7.06.11	0	2.1	19.1	0.1	990	3.30	
WS2	16.05.11	0	0.2	20.8	0.2	1008	3.23	4.0
	23.05.11	0	1.2	13.0	0.2	998	3.27	
	31.05.11	0	0.9	20.4	0.2	1006	3.25	
	7.06.11	0	1.2	11.1	0.1	990	3.25	
WS3	16.05.11	0	0.1	20.8	0.1	1008	2.53	2.8
	23.05.11	0	6.9	5.6	0.3	998	2.61	
	31.05.11	0	7.0	7.8	0.2	1006	2.59	
	7.06.11	0	7.4	8.8	0.3	990	2.55	
WS4	16.05.11	0	0.1	20.7	0.1	1008	-	1.2
	23.05.11	0	2.3	19.0	0.2	998	-	
	31.05.11	0	2.4	18.5	0.2	1006	-	
	7.06.11	0	2.4	18.9	0.2	990	-	

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA2000+ (serial No GA08272) which was last calibrated on the 4th January 2011.

9. LABORATORY TESTING - GEOTECHNICAL

A programme of laboratory testing has been undertaken in accordance with BS1377 unless stated otherwise and the results are presented in Appendix 6. Each type of test is briefly summarised below and the results have been used to assist in the formulation of the discussion of ground conditions.

9.1 Point Load Strength Index Tests (ISRM Suggested Method, 1984)

Point Load Strength Index Tests (ISRM Suggested Method, 1984) were undertaken on the stronger rock encountered during the rotary boring operations. The approximate unconfined compressive strength (UCS) can be found on the test results sheets in Appendix 7, which indicates that the sandstone is present in a moderately strong and strong insitu condition. When using this information the orientation of the test is important. For foundation design the axial results are most useful as the diametral results often reflect the weaker bedding planes within the rock mass.

9.2 Sulphate Content and pH Values

Sulphate content and pH values of selected samples of soil were determined and the results are presented on the chemical test results sheet. Total sulphate contents ranging between 0.027% and 0.072% and soluble sulphate contents ranging from 0.03g/l to 0.10g/l were recorded, these being associated with pH values of between 7.7 and 9.2.

10. LABORATORY TESTING - ENVIRONMENTAL

A suite of testing was undertaken on samples taken from soil samples from across the site and the following testing regime was undertaken on both soil and water samples.

- Metals – Cd, Cr, Cu, Hg, Ni Pb, V and Zn.
- Semi and Non-Metals - As, Se, Free CN^- and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO_4^{2-}.

This testing was undertaken by Envirolab Ltd and the results of all of the chemical testing are presented in Appendix 7 of this report.

Also undertaken are tests for PCB's however these have not been returned from the laboratory and will be addressed in a separate letter.

11. DISCUSSION OF GROUND CONDITIONS - ENVIRONMENTAL

11.1 Discussion of Test Results

As the proposed works are to include the construction of a housing estate with access roads and gardens, the site may be classified as being a residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[4] and these include many local authorities.

[4] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

A comparison of the results of the testing, together with the data given above, can be found within Appendix 8. These results indicate the following:

Table 4: ***Summary of contaminated areas.***

Borehole Location	Contaminants found to be exceeding SSVs
TP1	PAH (indeno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).
TP3	PAH (benzo[g,h,i]perylene).
TP5	PAH (benzo[a]pyrene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).
TP7	Lead, PAH (dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).

Concentrations of chromium, selenium, free cyanide, phenols and petroleum hydrocarbons (aliphatic C6 to C8and aromatic C5 to C10) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values.

On the basis of all the information provided above, it would appear that there is general contamination by lead and some poly aromatic hydrocarbons. There is no evidence of 'hot spots' of contamination, although a greater range of poly aromatic hydrocarbons were detected in TP5 and TP7. These locations are in the area occupied by the mill building.

In view of the above comments it is concluded that the whole site should be assumed to be contaminated.

11.1.2 Water Samples

During the course of the fieldworks all water strikes occurred at depths in excess of 2.0m it was decided that chemical testing of water samples was not required in this instance.

11.1.3 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated that there was no methane present. However, concentrations of carbon dioxide were noted to range between 0.1% and 7.4%, in association with oxygen levels of between 5.6% and 20.8%. It was noted that the levels of CO_2 were consistently higher in WS3 than those recorded across the site. It should be appreciated that on non-contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. The maximum flow rate recorded was 0.3 litres per hour in WS3 and this value will be employed in any calculations.
The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure

conditions may be of lesser value. At this site the readings undertaken to date were at atmospheric pressures of 990mb and 1008mb.

11.2 Site Specific Risk Assessment

The presence of contamination hazards on the land has been identified and the risks associated with them have been assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[5] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[6] This method dictates that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'[7]

This advice also states that the effects of a pollution linkage and the groups at risk of harm (receptors) can be identified by the following categorisation:

- Human health – receptors: site personnel, visitors and the general public, and humans on surrounding sites.

- The water environment – receptors: humans, aquatic life and the wider ecosystem, and construction and building materials ie. concrete, cement, rubber and plastic.

- Plants and the wider eco-system – receptors: plants, animals

An appraisal of the sources of contamination, potential and actual, on and in the area of the site has therefore been completed with reference to this pollution linkage.[8] The risk of harm to the receptors has also been evaluated with reference to the following ratings and definitions:

[5] R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.
[6] The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.
[7] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.
[8] This assessment has been based on the information as to the proposed development that has been provided by the client. If the plans should change, the assessment should be re-evaluated.

Low - A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.

Moderate - The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary.

High - The linkage exists and the available data indicates that significant harm may be caused and remedial action will be necessary.

Table 5: *Site specific risk assessment.*

Source	Contaminants	Pathway	Receptor	Risk/likelihood of harm occurring
Made Ground	Lead, PAH (benzo[a]pyrene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).	Ingestion of soil	Site operatives End user Neighbours	Moderate Moderate Low
		Ingestion of dust	Site operatives End user Neighbours	Moderate Moderate Low
		Dermal contact	Site operatives End user Neighbours	Moderate Moderate Low
		Inhalation of dust	Site operative End user Neighbours	Moderate Moderate Moderate
		Inhalation of vapours	Site operative End user Neighbours	Moderate High Low
		Consumption of vegetables and fruit	End user	Moderate
		Uptake via contam. Groundwater	Site operative End user Vegetation	Moderate Moderate Moderate
		Vertical & lateral movement of mobile contam. To surface & groundwater	Vegetation	Moderate
			Controlled waters	High
			Structure and services	Moderate (buried concrete)
			Site operatives End Users	Moderate Moderate
Landfill or mine gas	Ground gas via vadose zone	CH_4, CO_2	Site operatives End Users	Low Low
Ground gas	Made Ground	CO_2	Site operative End user	Moderate Moderate
Solid geology	Radon	Radon gas	Site operative End user	Low Low

It is considered that the site operatives may be at moderate risk of harm due to the ingestion of soil and dust, dermal contact and the inhalation of vapours and dust derived from the made ground. Whilst the end users can come into contact with soil and dust it is considered that they would be at a moderate risk of harm. However, as there are poly aromatic hydrocarbons present, there is considered to be a high risk of harm to occupiers of the dwellings (end users). Whilst it is considered that the neighbours would not be at significant risk of harm due to the ingestion of soil and dust or the inhalation of vapours, there is a moderate risk of harm due to the short term inhalation of dust during the construction period.

As the housing estate is to include gardens, there is considered to be a moderate risk of harm to the end users due to the consumption of home-grown vegetables and fruit. The uptake of contaminants via contaminated groundwater is considered to be of moderate risk as the investigation revealed the presence of groundwater across the site at depths in excess on 2.5m. Consequently there has also been deemed to be a moderate risk of harm due to the vertical and lateral movement of mobile contamination to vegetation, structures and services along with the end user. However a culvert runs through the site and a spring line appears to issue from the western banking on the site. The risk to controlled waters has therefore been considered to be high.

In order to establish the gas screening value (GSV) for CO_2 or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case the maximum gas concentration of 7.4% (0.074) of CO_2 and 0% methane was recorded, in association with a flow detection limit of 0.3l/hr. This resulted in a GSV of 0.0222l/hr for CO_2.

In accordance with Table 8.5, *Modified Wilson and Card classification* of the CIRIA report C665, *Assessing risks posed by ground gasses to building,* the site may be characterised as *Characteristic Situation Level 1*. However, as the worst case levels of carbon dioxide are above 5% the report recommends that the category is increased to *Characteristic Situation Level 2*. It is therefore considered that there is a moderate risk of harm to the end users, but a low risk to site operatives.

On the basis of information provided in the Phase 1 Desk Study it is considered that there is a low risk of harm due to the presence of radon.

11.3 Remediation Strategy

In view of the site specific risk assessment it is considered that remediation will be required at this site. Such a strategy should include the following main elements.

11.3.1 Remediation Objectives

Based on the site specific risk assessment the object of the remediation is likely to be as follows.

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the end user from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the garden plants from the uptake of contamination from the made ground revealed at this site.

- To protect the end user from the elevated levels of carbon dioxide.

11.3.2 Development Requirements

Whilst the precise nature of this development has not been finalised it is understood that it is to be developed by the construction of a housing estate with associated access roads and garden areas. In view of the above a site specific remediation strategy should be undertaken after the proposed development has been finalised. However, for preliminary design and costing the following remediation proposals are offered.

11.3.3 Strategy

In order to fulfil the objectives defined above it is likely that the following remedial strategy could be utilised. It is recommended that a pragmatic approach be undertaken, with observational techniques being employed at each stage of the work.

Ground-works

During the ground-works phase of the development, protection to the site operatives is required. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore the risks to site personnel must be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site specific Method Statements. These documents should include the following main elements.

- Site operatives at all levels should be made aware of the hazards of working with contaminated soils.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- Where vehicles are transferring soil to the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary.

Construction

During the construction phase of the contract the following items are required to protect the end user from the potential contaminants revealed at this site.

- Beneath buildings, pavements and hard-standings clean inert granular sub-base should be employed.
- Due to the levels of CO_2 and in according to Table 8.6, *Typical scope of gas protection measures,* of CIRIA report C665, two levels of protection are considered necessary and should include:
    - Reinforced concrete cast *in situ* floor slab (suspended, non-suspended or raft) with at least 1200g DPM and underfloor venting.
    - Beam and block or pre cast concrete slab and 2000g DPM / reinforced gas membrane and underfloor venting

  Note: All joints and penetrations must be sealed.

  In view of the presence of hydrocarbons it will be necessary to upgrade the barrier to a proprietary vapour resistant membrane.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.

Garden and Landscaped Areas

In view of the potential contamination it is considered that the gardens and landscaped areas will require some remediation. This should include the provision of a capping layer of say 600mm of inert material, which will put the contaminated ground out of the end users' dig range. At the base of this layer a granular capillary break of say 100mm of free draining granular soil should be placed. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

It should be appreciated that this could be achieved by removing 700mm of the soil to a licensed landfill, replacing it with clean inert fill. However, it is considered that this approach would be rather expensive thus it may be financially advantageous to raise the ground level by the appropriate amount

In any event it will be necessary to validate the thickness of the remedial works. This may be undertaken by the excavation of shallow hand auger boreholes through the topsoil and subsoil to the gravel capillary break. These should be undertaken on a random grid giving coverage of one borehole every 25m^2.

Imported Fill Material

It should also be appreciated that any imported fill should be subjected to the following validation testing to assess its suitability.

Table 6: *Validation testing*

Contaminant	Screening Value (mg/kg)	Reference
As	32	Atrisk soil screening values, 6% soil organic matter
Cd	10	Atrisk soil screening values, 6% soil organic matter
Cr	14.7	Atrisk soil screening values, 6% soil organic matter
Cu	4020	Atrisk soil screening values, 6% soil organic matter
Hg	1	Atrisk soil screening values, 6% soil organic matter
Ni	130	Atrisk soil screening values, 6% soil organic matter
Pb	168	Atrisk soil screening values, 6% soil organic matter
V	115	Atrisk soil screening values, 6% soil organic matter
Zn	17200	Atrisk soil screening values, 6% soil organic matter
TPH CWG	-	See Atrisk soil screening values
PAH 16 EPA	-	See Atrisk soil screening values

The frequency of such testing should be sufficient to give statistical confidence for the validation results. For sub-soil the frequency should be 1 per 250m^3 or a minimum of three samples, whichever is the greater.

12. DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL

12.1 Foundations

It is understood that the site is to be developed by the construction of a housing estate with access roads and gardens/landscaped areas. At the time of writing this report the precise layout and building types had not been finalised, thus the discussion below is of a generalised nature.

It cannot be recommended that foundations be constructed directly within the made ground revealed at this site. These soils are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading. In broad terms, therefore, given the amounts of made ground on the site, within the location of the proposed dwellings, it is considered that piled foundations would provide the most appropriate foundation solution.

In view of the thickness of the made ground, consideration may be directed to the use of piles to transfer the foundation loads through the made ground to rock-head. In order to formulate a suitable design it is recommended that the advice of specialist piling contractors be sought. However, for preliminary design and estimating purposes it can be considered that driven piles, which are likely to represent the most economical foundation solution, would penetrate into the

weathered mudstone/siltstone and meet refusal within the top few metres of this layer.

The use of this pile type should be met with some prudence in these ground conditions as the piles are likely to develop the majority of the load capacity in end-bearing and the mudstone was found to be competent and contains siltstone that considerably stronger than the overall rock mass. These siltstone layers are likely to have sufficient strength to prevent piles being driven beyond them. However, once loaded statically by the superstructure, the piles may punch through these thin layers into the underlying weaker material. In view of this, it is recommended that pile design is undertaken on the basis of a static calculation rather than the use of driven 'sets' and the end-bearing portion of this calculation employs the parameters of the weaker mudstone/siltstone rather than the sandstone.

Consideration may also be given to the use of bored cast-in-situ piles, it is likely that this pile type will be able to penetrate further into the underlying rockhead and therefore, generate a greater load carrying capacity in skin friction and hence reduce reliance on end-bearing. This has the advantage of ensuring that punching related issues are minimised, although this should still be checked, and would allow for a greater load capacity of individual piles. It should also be noted that cast-in-situ piles often have the ability to carry greater lateral loads as bespoke reinforcement cages can be installed. In addition, the pile design should include provision for negative skin friction within the made ground soils as these deposits may be subject to collapse compression if not treated.

In view of the relatively weak near surface soils it will be necessary to construct a working platform for the piling rig and any other plant required during the works. Such a design should be undertaken in accordance with the procedures given in the BRE publication entitled *Working platforms for tracked plant.*

12.2 Retaining Structures

It is evident that the slope to the west of the site will require some remediation to ensure its long term stability. It is considered that the slope above the level of the footpath is relatively stable, although the valley side below the footpath will require some form of stabilisation. However, before considering this section of the slope in detail, there are a number of general points which could assist in reducing the extent, hence cost, of these works. For example, it would be advantageous to import and compact fill to raise the site level by as much as is practically possible, which in turn would reduce the slope height. Moreover, if the houses backing onto the slope are say three storeys in height, with the first floor comprising the general living area, it may be possible to further raise the level of the rear gardens, hence further reducing the height of the slope. Before undertaking detailed design work for the slope, these aspects will require careful consideration. Once these details have been finalised the design of the slope stabilising works may be completed. However, in broad terms there are a number of potential solutions which may be considered. These include:

- Ground anchors
- Anchored retaining walls
- Reinforced earth retaining walls
- Gravity retaining wall
- Combination of gravity and reinforced earth walls.

12.2.1 Ground Anchors

It is well understood that there were significant difficulties experienced during the construction of the ground anchors during a previous phase of the work. During construction it is understood that voids were revealed within the rock which resulted in large quantities of grout being injected and lost. Indeed there is some evidence to suggest that the grout found its way to the water course some distance downstream of the site. Whilst it would be possible to simply continue grouting until all voids are sealed and the anchors are fixed in place, it is likely that this approach would be extremely costly. Moreover, grouting up the voids is also likely to adversely affect the drainage of the slope. The result of this could be that the groundwater is unable to escape from the slope face, thus the pore water pressures behind the slope could increase, which would adversely affect stability and could result in slope failure developing over time.

The above comments would suggest that grouted anchors would not be viable at this site. However, there is a body of evidence which suggests that grouting may be possible, using appropriately designed thixotropic grouts in combination with flexible sleeves which could ensure that there is a minimal grout loss. Using this approach it is considered that the overall stability of the slope could be maintained with minimal land take. This will require further background work to establish both the viability and cost implications of this method of construction. Moreover, there will be a need to provide facing elements to enhance the appearance of the slope.

12.2.2 Anchored Retaining Structures

If a method of installing ground anchors can be established then an anchored retaining structure could be utilised which would provide a fair finish and improve the stability of the slope. There are a number of proprietary construction methods which could be considered which use this approach. One such example is a segmental retaining system produced by Aggregate Industries, as well as systems by the Phi Group amongst others.

12.2.3 Reinforced Earth Retaining Walls

It would be possible to construct a simple reinforced earth retaining structure adjacent to the face of the slope. It should be appreciated that the width of such a structure is often about 0.7 times the retained height, thus it would require a significant land take, which may prove detrimental to the development. However, if

this approach were to be considered further, then it may be possible to temporarily re-profile the slope, removing the path, then build the reinforced earth wall and reinstate the path on the top of the wall. It is understood that there is a gas main beneath this footpath which would have to be re-routed if this approach were to be adopted.

It should be appreciated that the face of such a structure can be left to green up, or facing elements could be included to produce a decorative block-work finish.

12.2.4 Gravity Retaining Walls

It may also be possible to construct a gravity retaining wall along the slope, which could include crib walls, gabion basket walls, mass concrete structures or a combination of facing elements backed by no fines concrete. It is probable that these structures would be narrower than the reinforced earth option, but will still require a significant land take, thus the gas main would still have to be re-routed.

12.2.5 Combination of Gravity and Reinforced Earth Walls

A novel approach would be to combine gravity walls with reinforced earth structures. In this approach a gravity wall could be constructed at a lower level, with a reinforced earth wall above. This approach would still require the land take of the gravity retaining wall, however, the upper section would take advantage of a less expensive form of construction. Although, the problems associated with the gas main would remain.

12.3. Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[9], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming mobile groundwater at this site, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[10], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

[9] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brown field sites*
[10] Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*

13. REFERENCES

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- Wilson S, Oliver S, Mallet H, Hutchings H, Card G, *Assessing risks posed by ground gasses to buildings,* CIRIA Report C665.

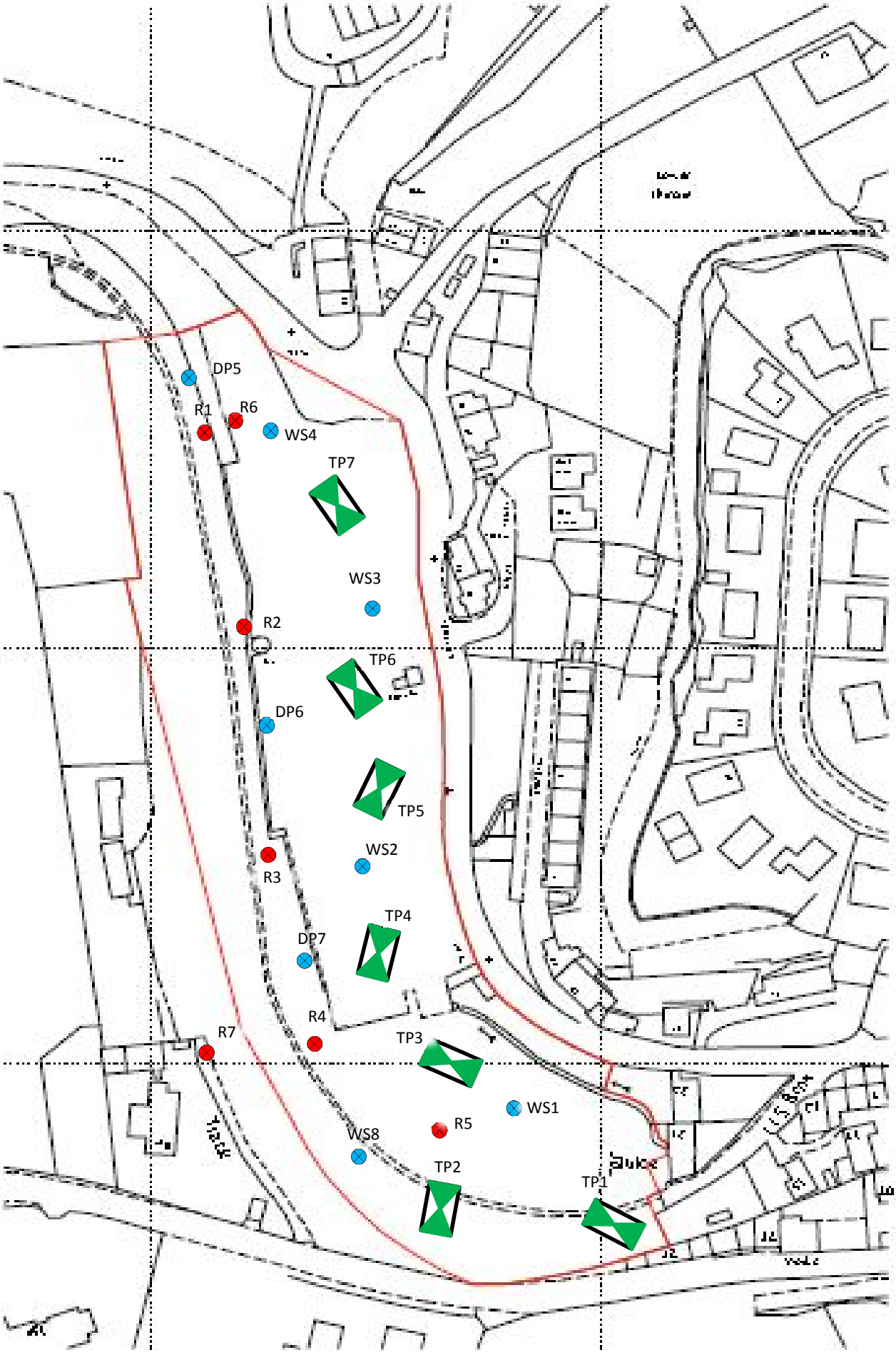
For and on behalf of
Rogers Geotechnical Services Ltd,

R Lewis
Geotechnical Engineer

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

APPENDIX 1

SITE PLAN



Title

Investigation Location Plan

Rogers Geotechnical Services Ltd	**North Park Homes** **Thirstin Mill, Honley**	Contract No: **J1842/11/E**

APPENDIX 2

TRIALPIT RECORDS

RGS

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Trialpit No
TP 1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 3.40m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20			TOPSOIL. (MG)
0.50	D					MADE GROUND (Soft brown locally sandy silty clay with much fine to coarse gravel of sandstone and many cobbles and boulders. Brick, concrete, wood, timber) (MG)
0.75	D					
			2.70			Trialpit Complete at 3.40 m
3.25	D					
3.30	D					

Remarks: Water strike at 3.4m. Vertical excavation faces subject to collapse due to large sandstone cobbles.

Groundwater:

AGS

RGS

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Trialpit No
TP 2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 3.80m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20			TOPSOIL. (MG)
0.35	D					MADE GROUND (Soft orange-brown slightly silty very sandy clay with much fine to coarse gravel of sandstone and many cobbles and boulders. Asphalt, concrete, timber, wood, ash) (MG)
0.80	D		0.80			MADE GROUND (Buff and yellow-brown gravel of limestone) (MG)
			1.60			MADE GROUND (Black sandy ash with brick/concrete) (MG)
1.90	D					
2.40	D					
3.40	D		3.40			MADE GROUND (Orange-brown sandy clay with much fine to coarse gravel of sandstone and many cobbles) (MG)
			3.80			Trialpit Complete at 3.80 m

Remarks: Water seepage at 3.6m.

Groundwater:

AGS

RGS

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Trialpit No
TP 3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 2.50m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20			TOPSOIL. (MG)
0.40	D					MADE GROUND (Soft orange-brown slightly silty very sandy clay with much fine to coarse gravel of sandstone and many cobbles/boulders. Asphalt, concrete, timber, wood, ash) (MG)
1.20	D					
2.20	D					
			2.50			Trialpit Complete at 2.50 m

Remarks:

Groundwater:

AGS

RGS

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Trialpit No
TP 4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: -	Scale 1:50
		Depth 2.80m	
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20			TOPSOIL (MG)
0.40	D					MADE GROUND (Brown-black silty sandy clay with much fine to coarse gravel of sandstone and many cobbles. Brick, concrete, ash, timber) (MG)
0.60	D					
			1.40			
1.50	D					MADE GROUND (Soft yellow-brown sandy clay with much fine to coarse gravel of sandstone and many cobbles) (MG)
2.10	D					
			2.80			Trialpit Complete at 2.80 m

Remarks: Water seepage at 2.8m.

Groundwater:

AGS

RGS

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Trialpit No
TP 5
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 1.20m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.30	D					MADE GROUND (Soft yellow-brown sandy clay with much fine to coarse gravel of sandstone and many cobbles. Brick,concrete,ash) (MG)
0.90	D					
			1.20			CONCRETE. (Probable mill floor) (MG)
			1.20			Trialpit Complete at 1.20 m

Remarks:

Groundwater:

AGS

RGS

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Trialpit No
TP 6
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 2.70m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.20	D					MADE GROUND (Soft yellow-brown sandy clay with much fine to coarse gravel of sandstone and many cobbles. Brick, concrete, ash, timber) (MG)
0.60	D					
1.30	D					
			2.70			Trialpit Complete at 2.70 m

Remarks: Water seepage at 2.7m.

Groundwater:

AGS

RGS

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Trialpit No
TP 7
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Honley	J1842/11/E	Level: -	10/05/2011
Location: Thirstin Mill, Honley		Dimensions: 4.00m, Depth 2.70m, 2.00m	Scale 1:50
Client: North Park (Greetland)			Logged By RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.30	D					MADE GROUND (Soft yellow-brown sandy with much fine to coarse gravel of sandstone and many cobbles. Brick, concrete, ash, timber. Brick wall 1.6 - 2.7m) (MG)
0.30-1.30	D					
2.00	D					
			2.70			CONCRETE. (Possible mill floor) (MG)
			2.70			Trialpit Complete at 2.70 m

Remarks:

Groundwater:

AGS

APPENDIX 3

WINDOW SAMPLE BOREHOLE RECORDS

RGS

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Borehole No
WS 1
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10			Brown clayey TOPSOIL with scattered root remains. (MG)
		0.00-1.00	C					MADE GROUND (Medium dense grey-brown and yellow-brown locally clayey and silty angular to subrounded fine to coarse gravel of fine and medium grained micaceous sandstone/medium and coarse grained feldspathic sandstone. Scattered fine to coarse gravel occasionally cobble sized brick/concrete fragments. Occasional glass/metalwork) (MG)
		1.00-2.00	C					
					2.20			MADE GROUND (Randomly orientated lithorelicts of fine and medium grained micaceous sandstone/medium and coarse grained feldspathic sandstone recovered as medium dense locally loose to medium dense at depth slightly silty sandy angular to subrounded fine to coarse gravel with occasional cobbles) (MG)
		2.00-3.00	C					
		3.00-4.00	C					
					4.00			End of Borehole at 4.00 m
			Type	Results				

1 2 3 4 5 6 7 8 9

Remarks: 0.0 - 1.0m = 95% Recovery 1.0 - 2.0m = 80% Recovery 2.0 - 3.0m = 90% Recovery 3.0 - 4.0m = 50% Recovery

AGS

RGS

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Borehole No
WS 2
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.00-1.00	C					MADE GROUND (Medium dense to dense becoming loose at depth grey-brown and yellow-brown locally clayey and silty angular to subrounded fine to coarse gravel of fine and medium grained micaceous sandstone/medium and coarse grained feldspathic sandstone with many cobbles. Scattered fine to coarse gravel sized brick/concrete fragments) (MG)
		1.00-2.00	C					
					2.00			MADE GROUND (Very loose to loose grey-brown very clayey very silty fine to coarse sand with scattered angular to subrounded fine to coarse lithorelicts (displaying random orientation) of medium and coarse grained feldspathic sandstone) (MG)
		2.00-3.00	C					
		3.00-4.00	C		3.40			MADE GROUND (Dense yellow-brown slightly silty fine to coarse sand with many subangular to rounded medium and coarse lithorelicts (displaying random orientation) of medium to very coarse grained feldspathic sandstone) (MG)
					4.00			End of Borehole at 4.00 m
			Type	Results				

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 75% Recovery 2.0 - 3.0m = 70% Recovery 3.0 - 4.0m = 80% Recovery

AGS

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Borehole No
WS 3
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.00-1.00	C					MADE GROUND (Medium dense locally loose and becoming dense at depth grey-brown and yellow-brown/red and buff speckled locally clayey and silty sandy subangular to rounded fine to coarse gravel of fine and medium grained micaceous sandstone/medium and coarse grained feldspathic sandstone with occasional cobbles. Many fine to coarse gravel often cobble sized brick/concrete fragments. Clinker and ash traces in upper levels. Cobble sized inclusion of dark brown silty plastic amorphous orrganic material at 2.3 - 2.5m) (MG)
		1.00-2.00	C					
		2.00-2.90	C					
					2.90			End of Borehole at 2.90 m
			Type	Results				

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 100% Recovery 2.0 - 2.9m = 100% Recovery

AGS

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Borehole No
WS 4
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.05			Brown sandy gravelly TOPSOIL with scattered root remains. (MG)
		0.00-1.00	C					MADE GROUND (Medium dense locally dense to very dense grey-brown and yellow-brown locally clayey and silty sandy angular to subrounded fine to coarse gravel of medium to very coarse grained feldspathic sandstone with many cobbles. Scattered fine and medium gravel sized brick/clinker/ash/coal fragments) (MG)
		1.00-1.20	C		1.20			End of Borehole at 1.20 m
			Type	Results				

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 1.2m = 100% Recovery

AGS

RGS

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Borehole No
WS 4A
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.00-0.80	C		0.05			Brown sandy gravelly TOPSOIL with scattered root remains. (MG)
					0.80			MADE GROUND (Medium dense becoming dense grey-brown and yellow-brown locally clayey and silty sandy angular to rounded fine to coarse gravel of fine and medium grained micaceous sandstone/medium to very coarse grained feldspathic sandstone with many cobbles. Occasional fine and medium gravel sized brick/clinker/ash fragments) (MG)
								End of Borehole at 0.80 m
			Type	Results				

Remarks: 0.0 - 0.8m = 100% Recovery

AGS

RGS

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Borehole No **WS 8**

Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type WLS
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.00	C					MADE GROUND (Grey-brown and yellow-brown locally clayey and silty sandy angular to subrounded fine to coarse gravel of fine and medium grained micaceous sandstone/medium and coarse grained feldspathic sandstone with many cobbles in upper levels. Scattered fine to coarse gravel sized brick/mortar/clinker/ash fragments) (MG)
		1.00	SPT	N=5 (1,0,1,1,1,2)				
		1.00-1.45	D					
		1.00-2.00	C					
		2.00	SPT	N=3 (1,0,1,0,1,1)	2.00			MADE GROUND (Randomly orientated lithorelicts of medium and coarse grained feldspathic sandstone recovered as yellow-brown slightly silty sandy angular to subrounded fine to coarse gravel with many cobbles) (MG)
		2.00-2.45	D					
		2.00-3.00	C					
		3.00	SPT	N=11 (3,2,5,3,2,1)				
		3.00-3.45	D					
		3.00-4.00	C					
		4.00	SPT	N=18 (2,1,3,4,5,6)				
		4.00-4.45	D					
		4.00-5.00	C					
					5.00			End of Borehole at 5.00 m
			Type	Results				

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 80% Recovery 2.0 - 3.0m = 50% Recovery 3.0 - 4.0m = 50% Recovery 4.0 - 5.0m = 80% Recovery. Driller reported continual collapse of borehole.

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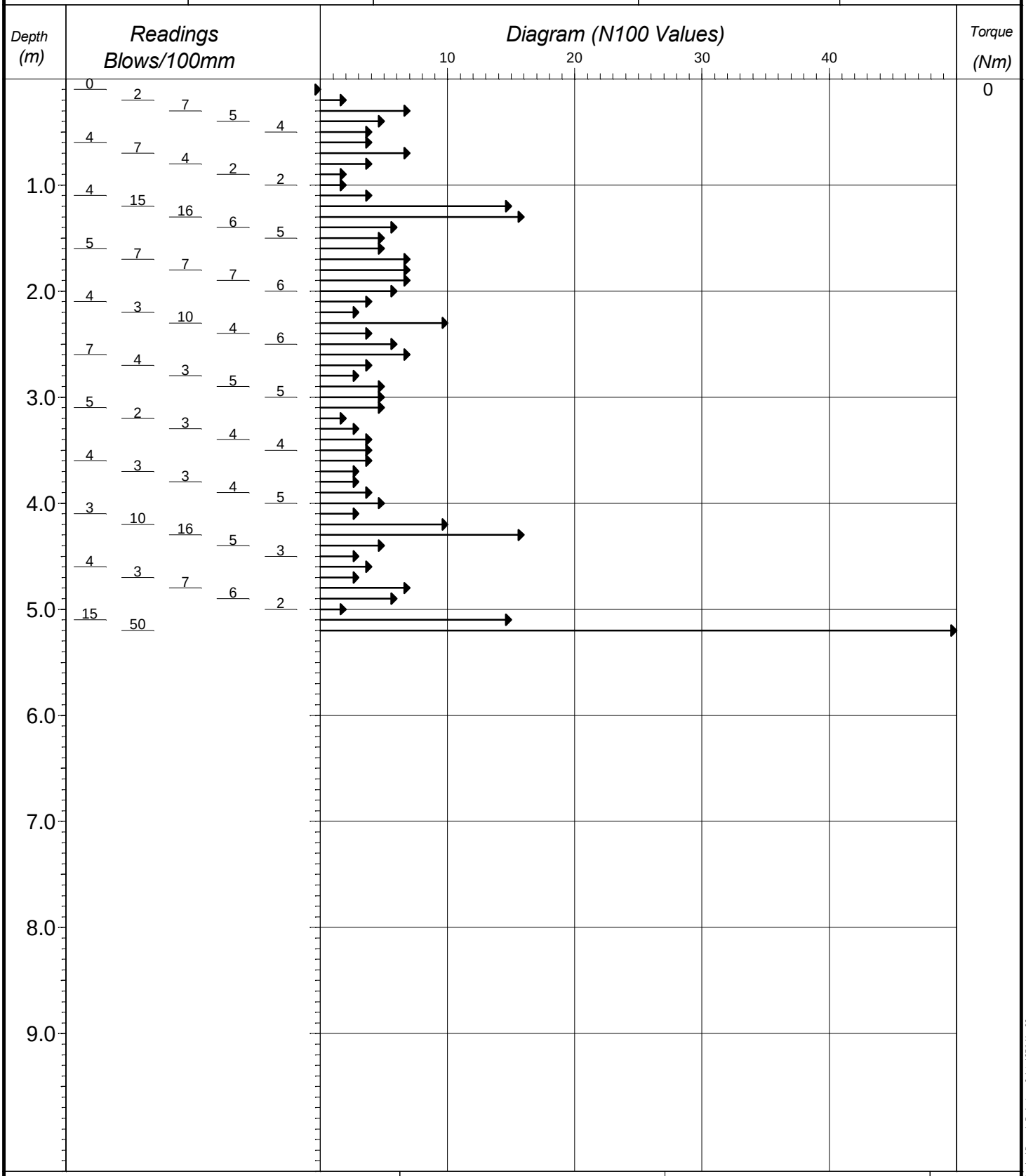
APPENDIX 4

DYNAMIC PROBE RESULTS

DYNAMIC PROBING

Probe No **DP 1**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**5.10**
Probe Type	**DPSH**	*Log Scale*	1:50

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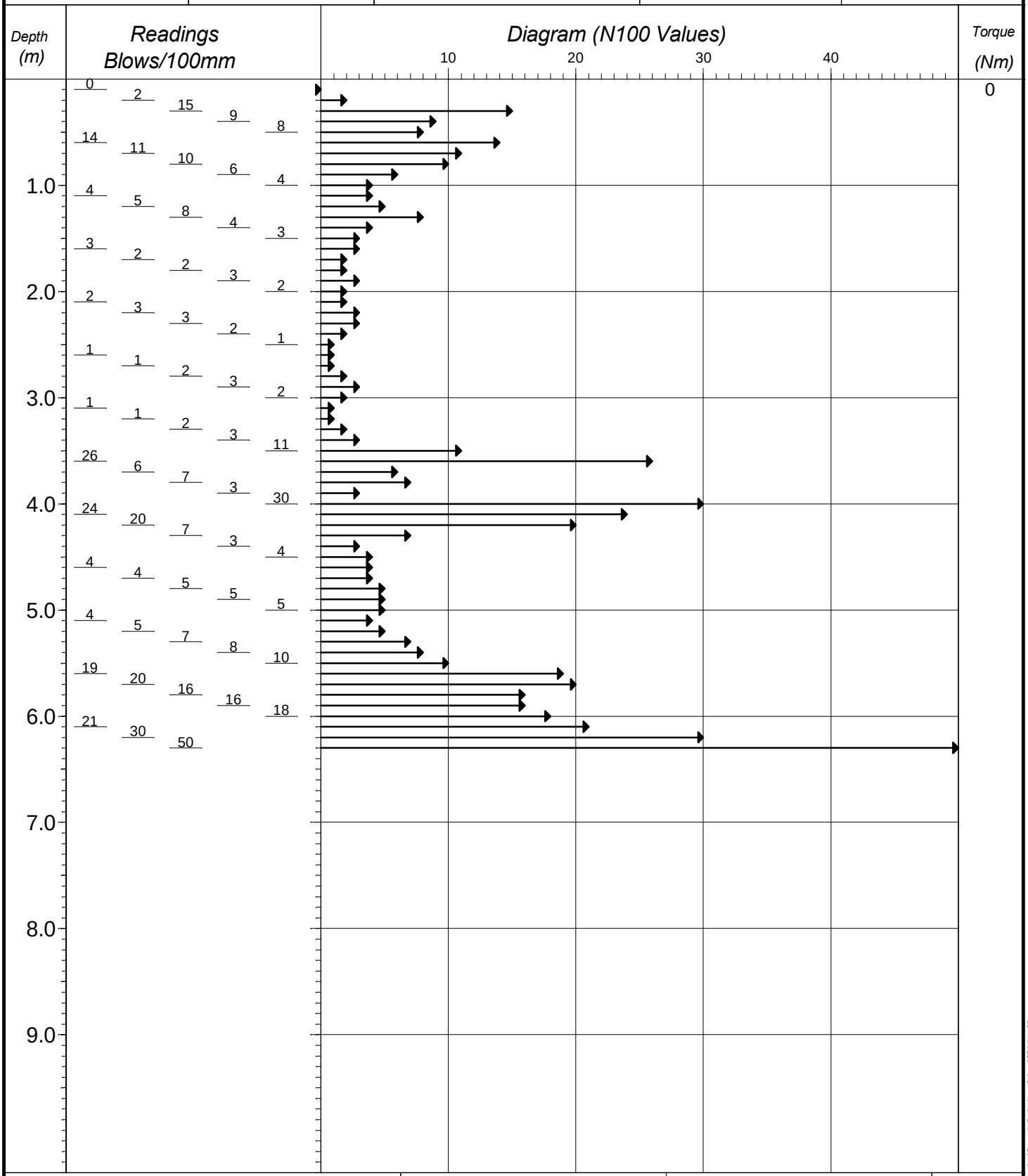
DYNAMIC PROBING

Probe No **DP 2**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**6.20**
Probe Type	**DPSH**	*Log Scale*	1:50

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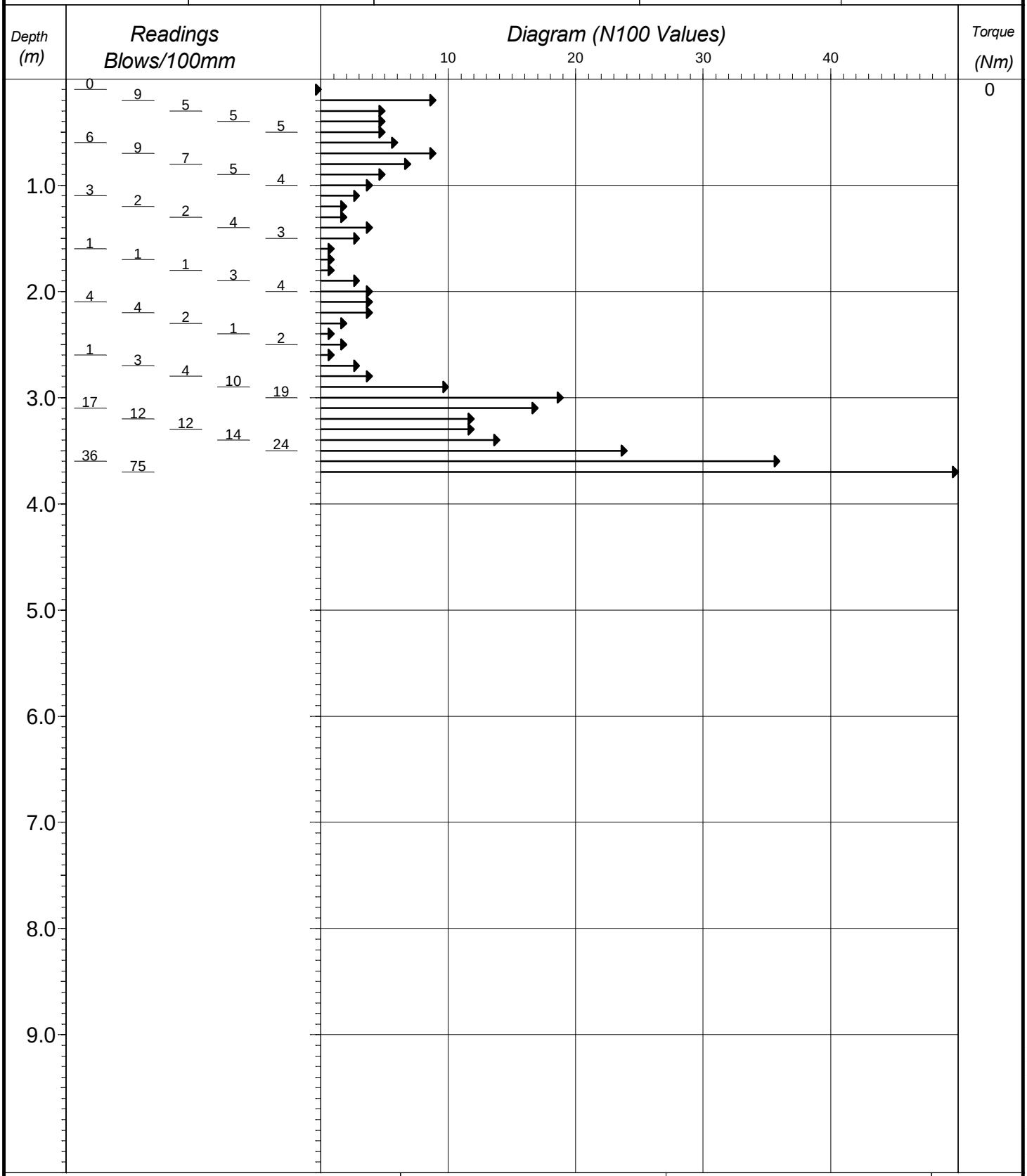
HoleBASE 3.1 (Bld 426.48) Standard Dynamic Probe Log v2 dated 27th Nov 03

DYNAMIC PROBING

Probe No **DP 3**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**3.60**
Probe Type	**DPSH**	*Log Scale*	1:50

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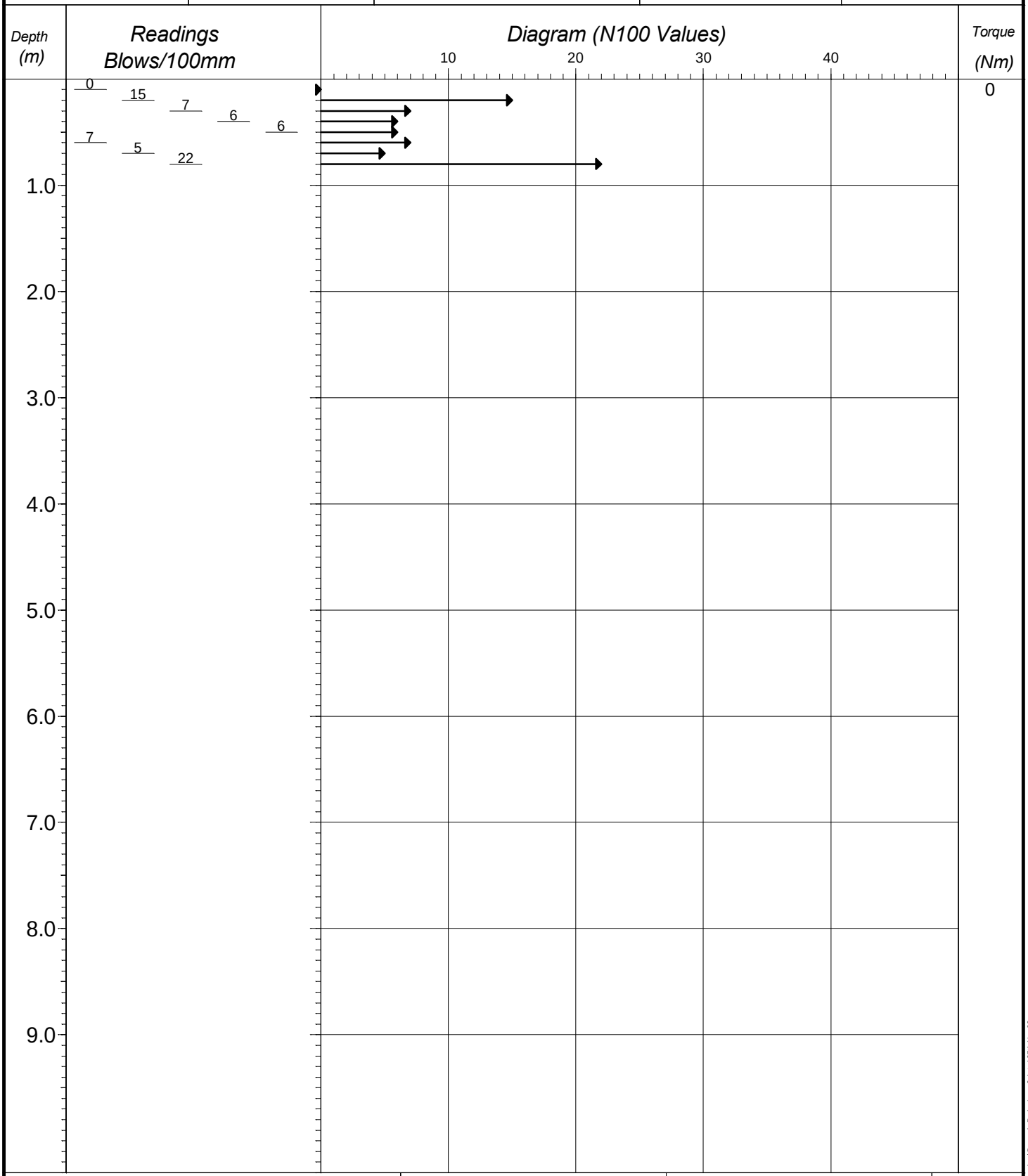
DYNAMIC PROBING

Probe No **DP 4A**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**0.70**
Probe Type	**DPSH**	*Log Scale*	1:50

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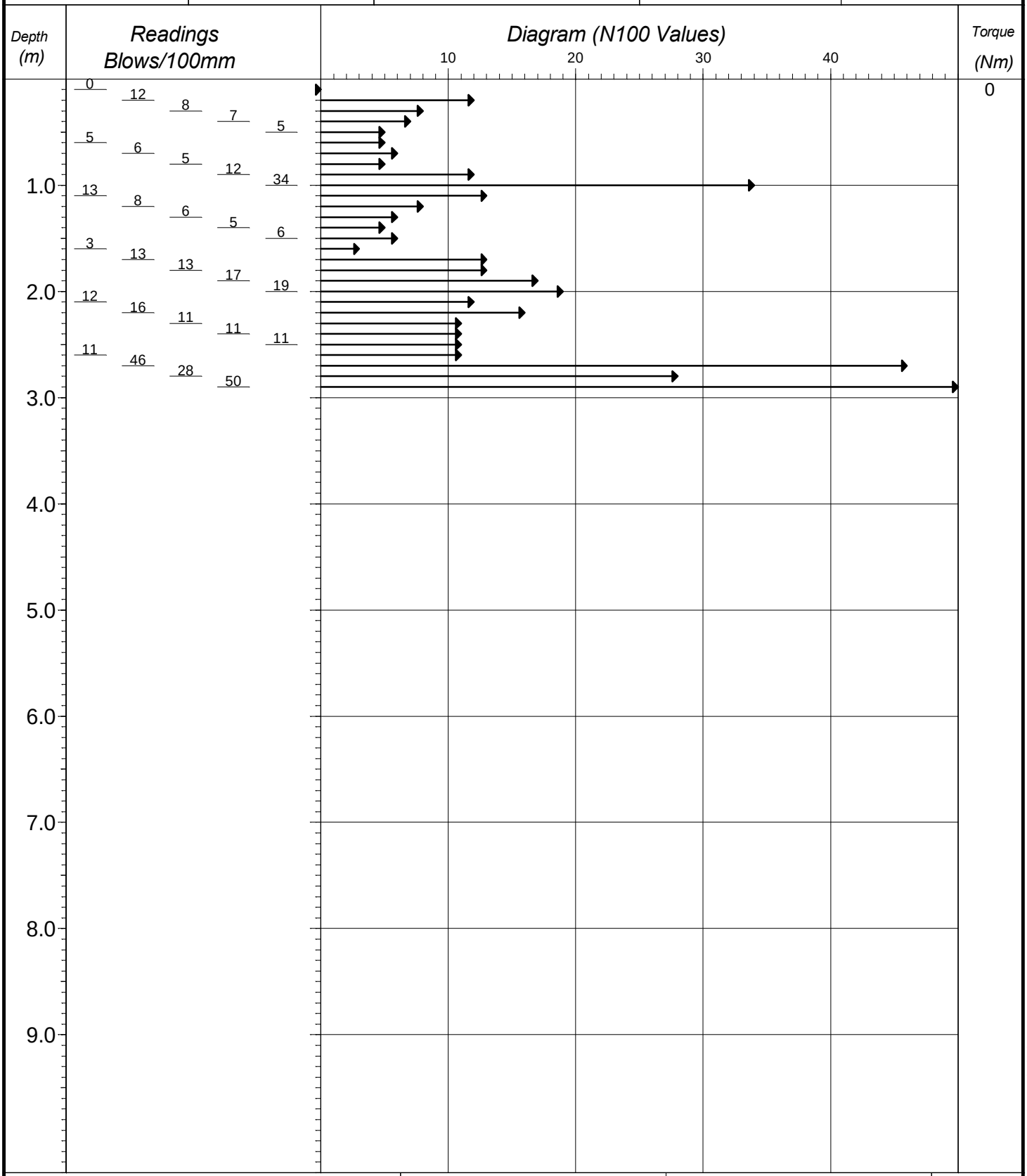
DYNAMIC PROBING

Probe No **DP 4**				
Client **North Park (Greetland)**			Sheet 1 of 1	
Site **Honley**			*Project No* **J1842/11/E**	
E -	*N* -	*Level* -	*Date* **10/05/2011**	*Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**2.80**
Probe Type	**DPSH**	*Log Scale*	1:50

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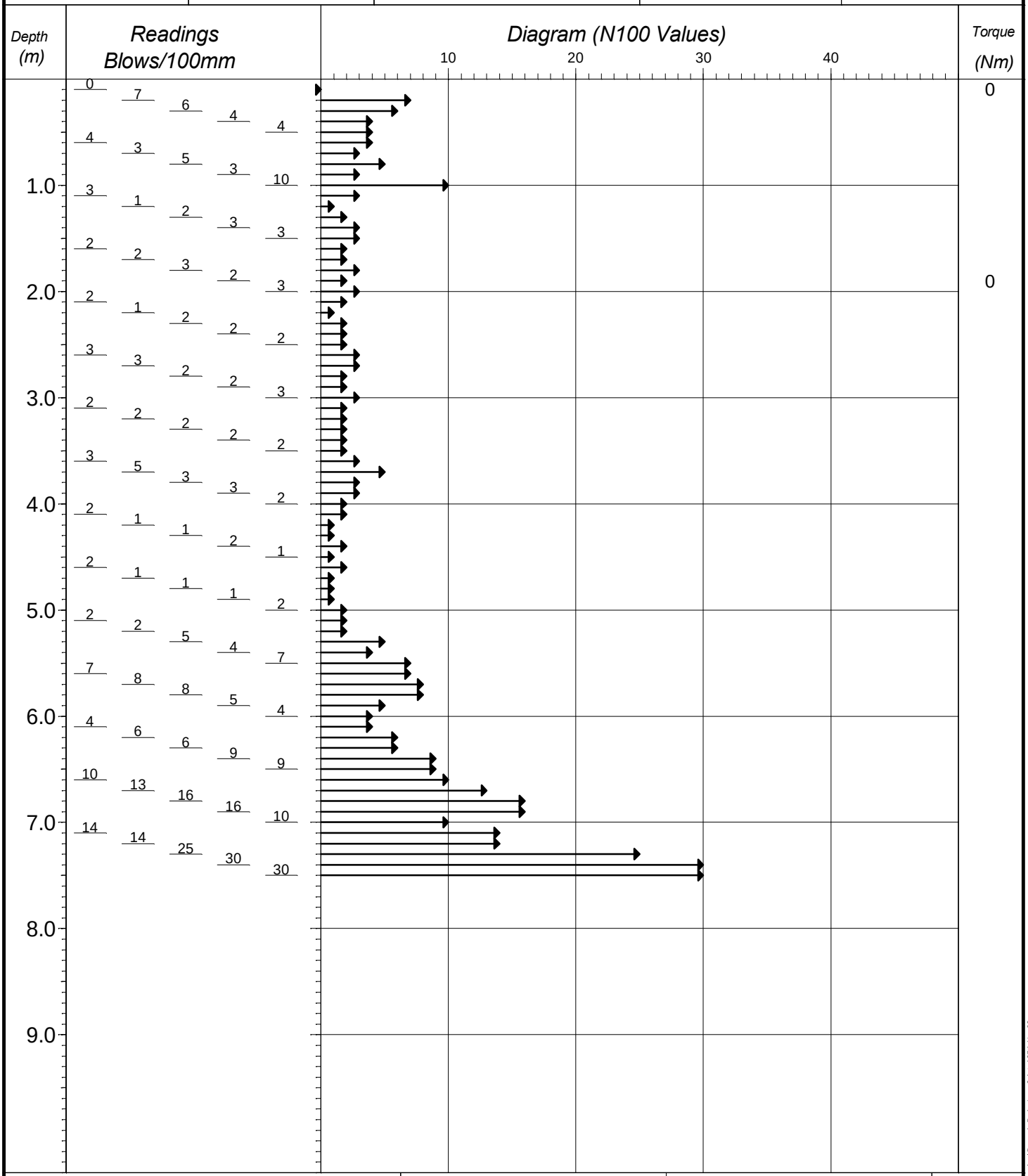
DYNAMIC PROBING

Probe No **DP 5**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**7.40**
Probe Type	**DPSH**	*Log Scale*	1:50

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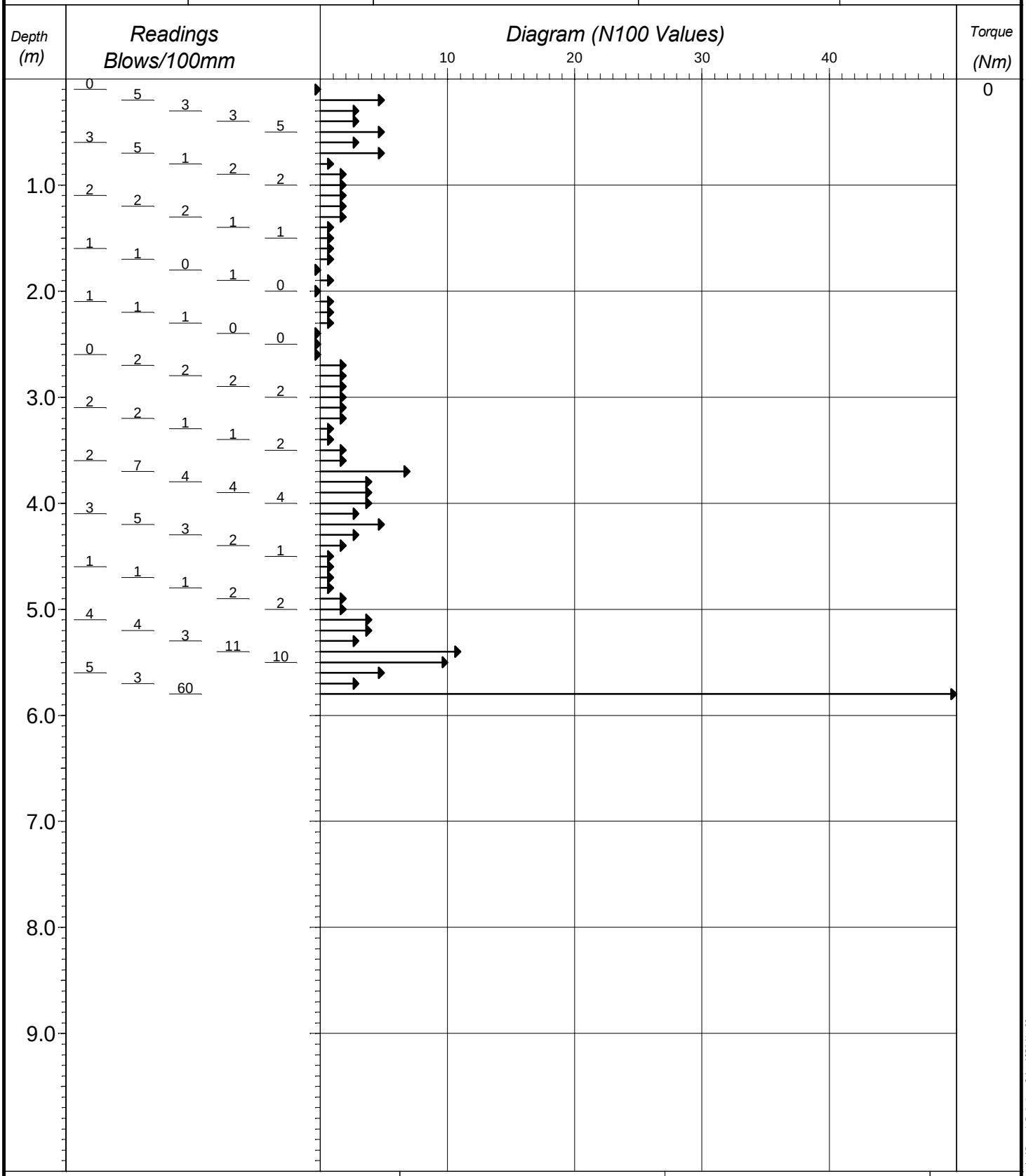
DYNAMIC PROBING

Probe No **DP 6**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**5.70**
Probe Type	**DPSH**	*Log Scale*	1:50

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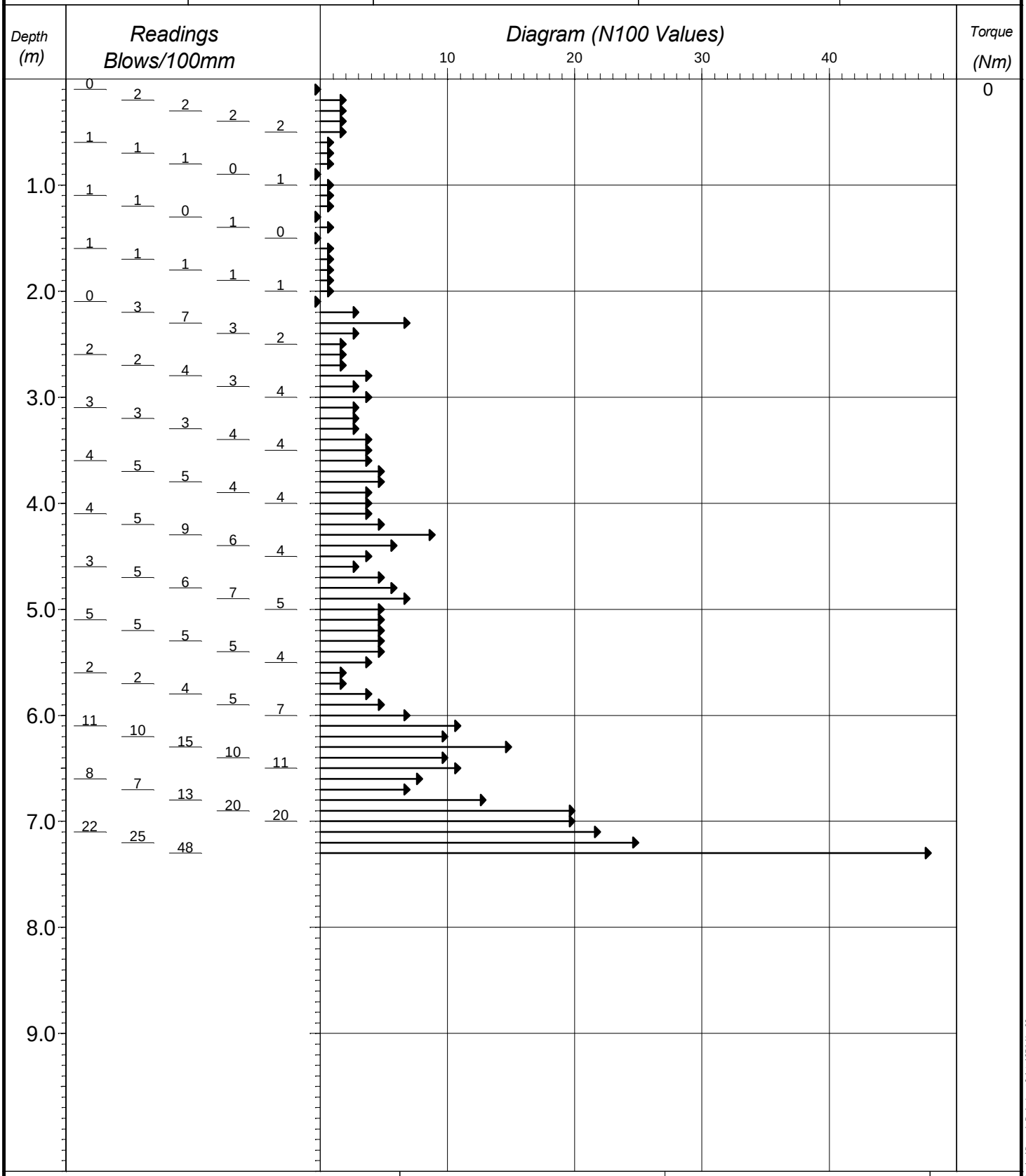
DYNAMIC PROBING

Probe No **DP 7**	
Client **North Park (Greetland)**	Sheet 1 of 1
Site **Honley**	*Project No* **J1842/11/E**
E - *N* - *Level* -	*Date* **10/05/2011** *Logged by* **AG**



Fall Height	**760**	*Cone Base Diameter*	**50**
Hammer Wt	**63.50**	*Final Depth*	**7.20**
Probe Type	**DPSH**	*Log Scale*	1:50

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APPENDIX 5

ROTARY BOREHOLE RECORDS

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Borehole No **R 1**
Sheet 1 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Sandy COBBLES of gritstone. (Driller's notes)
					2.00			Weathered MUDSTONE. (Driller's notes)
					5.80			MUDSTONE. (Driller's notes)
		7.00-7.50		TCR 15 SCR 0 RQD FI	7.00			Medium weak and medium strong thinly laminated to very thinly bedded dark grey silty MUDSTONE/ripple cross laminated SILTSTONE/subordinate fine grained micaceous SANDSTONE. Occasional very thin and thin seams of mudstone/siltstone/sandstone recovered as angular to subrounded fine to coarse gravel. Occasional very thin seams of friable silty clay with extremely weakly cemented angular fine and medium lithorelicts of silty shaly mudstone. Frequent bedding and induced joints/fractures. Occasional 30, 40, 50 and 70 angle joints/fractures. Planar smooth occasionally undulating rough, very weak friable up to 3mm penetration, tight and moderately open, local strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. Occasional randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/SILTSTONE/subordinate SANDSTONE (CLASS C))
		7.00-7.50	C 100					
		7.50-9.00		TCR 69 SCR 26 RQD FI				
		7.50-9.00	C 97					
		9.00-10.50		TCR 77 SCR 43 RQD FI				
		9.00-10.50	C					

Continued next sheet

Remarks: Borehole undertaken at angle of 26 degrees (bearing 238 degrees north). Driller reported lost flush at 11.5m and no flush at 12 - 13m.

AGS

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Borehole No
R 1
Sheet 2 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
			94							Medium weak and medium strong thinly laminated to very thinly bedded dark grey silty MUDSTONE/ripple cross laminated SILTSTONE/subordinate fine grained micaceous SANDSTONE. Occasional very thin and thin seams of mudstone/siltstone/sandstone recovered as angular to subrounded fine to coarse gravel. Occasional very thin seams of friable silty clay with extremely weakly cemented angular fine and medium lithorelicts of silty shaly mudstone. Frequent bedding and induced joints/fractures. Occasional 30, 40, 50 and 70 angle joints/fractures. Planar smooth occasionally undulating rougth, very weak friable up to 3mm penetration, tight and moderately open, local strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. Occasional randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/SILTSTONE/subordinate SANDSTONE (CLASS C))
	▽	10.50-12.00		43	22					
		10.50-12.00	C 97				11.60			
		12.00-13.00		74	43					Medium strong and strong thinly laminated to very thinly bedded pale grey fine grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many bedding and induced joints/fractures. Occasional 30 angle joints/fractures. Undulating rough, weak friable up to 1mm penetration, tight and moderately open, local slight discolouration, clean. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		12.00-13.00	C 97				13.00			End of Borehole at 13.00 m
			TCR	SCR	RQD	FI				

Remarks: Borehole undertaken at angle of 26 degrees (bearing 238 degrees north). Driller reported lost flush at 11.5m and no flush at 12 - 13m.

AGS

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Borehole No
R 2
Sheet 1 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011-12/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Sandy COBBLES of gritstone. (Driller's notes)
		2.50	CPT	75 mm - Abandoned	2.50			
		2.50-4.00 2.50-4.00	C 89	55 / 24				Medium strong locally medium weak thickly laminated to thinly bedded yellow-brown fine and medium grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE/coarse and very coarse grained feldspathic SANDSTONE and GRITSTONE. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical joints and rare 60 angle joints. Undulating rough, weak friable up to 2mm penetration, tight to very open, local slight discolouration, often clean often with grout infilling*. Occasional randomly orientated partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		4.00-5.50 4.00-5.50	C 92	33 / 8				
	▽	5.50-7.00 5.50-7.00	C 97	15 / 0	5.85			Extremely weak poorly and thickly laminated brown silty MUDSTONE recovered as clayey silty angular and subangular fine to coarse gravel. Bedding planes display local strong discolouration. (DESTRUCTURED MUDSTONE (CLASS D))
		7.00-8.50 7.00-8.50	C 100	69 / 13	6.55			Medium weak and medium strong thickly laminated and very thinly bedded grey silty MUDSTONE/subordinate SILTSTONE/very fine grained micaceous SANDSTONE. Occasional very thin to medium seams of mudstone/siltstone recovered as clayey silty angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical, 70 and 80 angle joints. Planar smooth occasionally undulating rough, very weak friable up to 8mm penetration, tight to open, local srong discolouration, generally clean occasionally infilled with up to 2mm silty clay. Rare randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		8.50-10.00 8.50-10.00	C 94	62 / 10				
			TCR	SCR / RQD / FI				

Continued next sheet

Remarks: *See log R 2 GROUT.

AGS

RGS

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Borehole No
R 2
Sheet 2 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011-12/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
		10.00-11.50 10.00-11.50	C 90	31	23					Medium weak and medium strong thickly laminated and very thinly bedded grey silty MUDSTONE/subordinate SILTSTONE/very fine grained micaceous SANDSTONE. Occasional very thin to medium seams of mudstone/siltstone recovered as clayey silty angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical, 70 and 80 angle joints. Planar smooth occasionally undulating rough, very weak friable up to 8mm penetration, tight to open, local srong discolouration, generally clean occasionally infilled with up to 2mm silty clay. Rare randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		11.50-13.00 11.50-13.00	C 89	75	32		12.60			Medium strong and strong (bedding origin uncertain) pale grey locally dark grey fine grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Occasional locally many subhorizontal bedding and induced joints/fractures. Occasional prominent subvertical and 80 angle joints. Undulating rough, medium weak friable up to 2mm penetration, tight to open, local strong discolouration, clean. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		13.00-14.50 13.00-14.50	C 95	85	70					
		14.50-16.00 14.50-16.00	C 97	85	71					
							16.00			End of Borehole at 16.00 m
			TCR	SCR	RQD	FI				

Remarks: *See log R 2 GROUT.

AGS

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Borehole No **R 3A**
Sheet 1 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 12/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								MADE GROUND (Cobbles of sandstone and brick fill) (Driller's notes) (MG)
		2.50-4.00 2.50-4.00	C 100	92 64	2.50			Medium strong and strong thickly laminated to thinly bedded yellow-brown and pale grey fine grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many subhorizontal bedding and induced joints/fractures. Prominent 80 angle joint at 4.8 - 4.9m. Undulating rough, medium weak friable up to 1mm penetration, tight to open, local slight discolouration, clean. Occasional randomly orientated very narrow partially cemented incipient joints/fractures at depth. (DISTINCTLY WEATHERED SANDSTONE/subordinate SILTSTONE (CLASS C))
		4.00-5.50 4.00-5.50	C 57	19 8	4.90			Very weak thinly and thickly laminated dark brown silty MUDSTONE. Frequent very thin and thin to medium seams of mudstone recovered as clayey silty angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Many subvertical, 30, 40, 70 and 80 angle joints. Planar smooth occasionally undulating rough, very weak friable up to 10mm penetration, tight and moderately open, pervasive strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. (DESTRUCTURED MUDSTONE (CLASS D))
		5.50	SPT	12 50/180mm 180mm (4,8,17,21,12)				
		5.50-7.00 5.50-7.00	C 95	39 11	7.50			Very weak to medium strong thickly laminated and very thinly bedded grey silty MUDSTONE with subordinate SILTSTONE/very fine grained micaceous SANDSTONE at depth. Occasional narrow and very thin seams of mudstone/siltstone recovered as clayey silty angular to subrounded fine to coarse gravel in upper levels. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical, 70 and 80 angle joints. Planar smooth occasionally undulating rough, weak friable up to 6mm penetration, tight to open, local strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		7.00-8.50 7.00-8.50	C 100	60 8				
		8.50-10.00 8.50-10.00	C 96	61 27				
			TCR	SCR RQD FI				

Continued next sheet

Remarks: Driller reported lost flush at 4.5m.

AGS

RGS

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Borehole No
R 3A
Sheet 2 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 12/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
							10.40			Very weak to medium strong thickly laminated and very thinly bedded grey silty MUDSTONE with subordinate SILTSTONE/very fine grained micaceous SANDSTONE at depth. Occasional narrow and very thin seams of mudstone/siltstone recovered as clayey silty angular to subrounded fine to coarse gravel in upper levels. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical, 70 and 80 angle joints. Planar smooth occasionally undulating rough, weak friable up to 6mm penetration, tight to open, local strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		10.00-11.50 10.00-11.50	C 95	85	51					
	▽	11.50-13.00 11.50-13.00	C 95	83	57					Medium weak and medium strong thickly laminated and very thinly bedded grey SILTSTONE/subordinate very fine grained micaceous SANDSTONE. Occasional narrow and very thin seams of siltstone/sandstone recovered as clayey silty angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical, 70 and 80 angle joints. Planar smooth occasionally undulating rough, weak friable up to 6mm penetration, tight to open, local strong discolouration, generally clean occasionally infilled with up to 2mm silty clay. (DISTINCTLY WEATHERED INTERBEDDED SILTSTONE/subordinate SANDSTONE (CLASS C))
		13.00-14.50 13.00-14.50	C 81	74	46					
							14.50			End of Borehole at 14.50 m
			TCR	SCR	RQD	FI				

Remarks: Driller reported lost flush at 4.5m.

AGS

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Borehole No
R 3
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 12/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Depth (m)	Level (m AOD)	Legend	Stratum Description
										COBBLES of sandstone. (Driller's notes)
		2.00-3.00 2.00-3.00	C 0	0	0					
							3.00			Medium strong to very strong thickly laminated to thinly bedded yellow-brown and pale grey fine and medium grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Occasional bedding and induced joints/fractures. Occasional prominent 70 and 80 angle joints. Undulating rough, weak friable up to 2mm penetration, tight to open, local strong discolouration, clean. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		3.00-4.00 3.00-4.00	C 80	30	18					
							4.00			End of Borehole at 4.00 m
			TCR	SCR	RQD	FI				

Remarks: Borehole undertaken at angle of 30 degrees (bearing 194 degrees north).

AGS

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Borehole No
R 4
Sheet 1 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 13/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.25			Brown gravelly TOPSOIL with scattered root remains. (MG)
		0.00-1.00	C		0.70			Brown slightly clayey fine to coarse SAND with scattered subangular to rounded fine to coarse lithorelicts of medium to very coarse grained feldspathic sandstone. Many fine/medium/coarse closed rootlets. (RESIDUAL SANDSTONE (CLASS E))
		1.00	SPT	N=21 (3,7,5,5,3,8)				
		1.00-1.80	C					Medium dense yellow-brown fine to coarse SAND with many subangular to rounded fine to coarse often cobble sized lithorelicts of medium to very coarse grained feldspathic sandstone. (RESIDUAL SANDSTONE (CLASS E))
		1.80	SPT	24 50/110mm 110mm (7,17,29,21)	1.80			COBBLES of sandstone. (Driller's notes)
					4.50			Medium weak and medium strong yellow-brown medium to very coarse grained feldspathic SANDSTONE recovered as slightly sandy angular to rounded medium and coarse gravel with many cobbles. (DESTRUCTURED SANDSTONE (CLASS D))
		4.50-6.00	C	23 2	5.80			
		4.50-6.00	99					
		6.00-7.50	C	63 27				Strong thickly laminated to thinly bedded yellow-brown and pale grey fine to coarse grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many subhorizontal bedding and induced joints/fractures. Occasional prominent subvertical and 60 angle joints. Undulating rough, weak friable up to 2mm penetration, tight to open, local strong discolouration, clean. Occasional subhoizontal very narrow partially cemented incipient bedding joints retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		6.00-7.50	95					
		7.50-9.00	C	90 70				
		7.50-9.00	97					
		9.00-10.50	C	75 40				
		9.00-10.50						
			TCR	SCR RQD FI				

Continued next sheet

Remarks:

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Borehole No
R 4
Sheet 2 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 13/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
	▽		100							
		10.50-12.00 10.50-12.00	C 97	59	15		10.70			Strong thickly laminated to thinly bedded yellow-brown and pale grey fine to coarse grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many subhorizontal bedding and induced joints/fractures. Occasional prominent subvertical and 60 angle joints. Undulating rough, weak friable up to 2mm penetration, tight to open, local strong discolouration, clean. Occasional subhoizontal very narrow partially cemented incipient bedding joints retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		12.00-13.50 12.00-13.50	C 99	80	35		12.50			Medium weak to medium strong thickly laminated and very thinly bedded grey silty MUDSTONE/subordinate SILTSTONE/very fine grained SANDSTONE. Occasional narrow to thin seams of mudstone recovered as clayey silty angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Occasional subvertical and many 30, 40, 60 and 80 angle joints. Undulating rough occasionally planar smooth, very weak friable up to 5mm penetration, tight and moderately open, local strong discolouration, generally clean occasionally infilled with up to 1mm silty clay. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		13.50-15.00 13.50-15.00	C 100	87	72					Medium strong thickly laminated and very thinly bedded grey SILTSTONE/subordinate silty MUDSTONE/very fine grained micaceous SANDSTONE. Rare very thin seams of siltstone recovered as clayey silty angular to subrounded fine and medium gravel. Many becoming occasional subhorizontal bedding and induced joints/fractures. Occasional 70 and 80 angle joints. Planar smooth occasionally undulating rough, weak friable up to 3mm penetration, tight to open, local strong discolouration, clean. (DISTINCTLY WEATHERED INTERBEDDED SILTSTONE/subordinate MUDSTONE/SANDSTONE (CLASS C))
							15.00			End of Borehole at 15.00 m
			TCR	SCR	RQD	FI				

Remarks:

AGS

RGS

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Borehole No
R 5
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 13/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								MADE GROUND (Driller's notes) (MG)
	▽				4.00			No recovery 4.0 - 5.5m.
		4.00-5.50 4.00-5.50	C 0	0 0				
					5.50			Medium weak to strong thickly laminated to thinly bedded yellow-brown and pale grey fine and medium grained micaceous SANDSTONE/subordinate silty MUDSTONE/ripple cross laminated SILTSTONE. Occasional narrow and very thin seams of sandstone/mudstone/siltstone recovered as clayey silty sandy angular to subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Occasional prominent 80 angle joints. Undulating rough, medium weak friable up to 1mm penetration, tight to open, local strong discolouration, clean. Occasional subhorizontal very narrow partially cemented incipient bedding joints retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate MUDSTONE/SILTSTONE (CLASS C))
		5.50-7.00 5.50-7.00	C 60	27 19				
		7.00-8.50 7.00-8.50	C 99	77 43				
					8.50			End of Borehole at 8.50 m
			TCR	SCR RQD FI				

Remarks:

AGS

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Borehole No
R 6
Sheet 1 of 1

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 13/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Depth (m)	Level (m AOD)	Legend	Stratum Description
										MADE GROUND (Driller's notes) (MG)
							0.50			Medium strong thickly laminated to thinly bedded yellow-brown and pale grey fine and medium grained micaceous SANDSTONE /subordinate ripple cross laminated SILTSTONE/silty MUDSTONE. Occasional narrow to thin seams of sandstone recovered as sandy subangular and subrounded fine to coarse gravel. Many subhorizontal bedding and induced joints/fractures. Many prominent subvertical and 80 angle joints. Undulating rough, medium weak friable up to 1mm penetration, tight to open, local occasionally pervasive strong discolouration, clean. Occasional randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE/MUDSTONE (CLASS C))
		0.50-2.00 0.50-2.00	C 93	60	45					
		2.00-3.50 2.00-3.50	C 98	73	49					
							3.50			End of Borehole at 3.50 m
			TCR	SCR	RQD	FI				

Remarks:

AGS

RGS

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Borehole No
R 7
Sheet 1 of 3

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing					Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	TCR	SCR	RQD	FI			
										MADE GROUND (Ash) (Driller's notes) (MG)
							0.80			COBBLES of sandstone. (Driller's notes)
							1.50			Weathered SANDSTONE. (Driller's notes)
		2.00-3.00 2.00-3.00	C 60	0	0		2.00			Medium weak and medium strong yellow-brown medium to very coarse grained feldspathic SANDSTONE recovered as slightly sandy subangular and subrounded medium and coarse gravel with many cobbles.
		4.00-5.50 4.00-5.50	C 68	33	20		4.40			Strong (bedding origin uncertain) yellow-brown medium to very coarse grained feldspathic SANDSTONE. Occasional 30, 60 and 70 angle joints in upper levels. Undulating rough, medium weak friable up to 4mm penetration, tight to open, local strong discolouration, clean. Occasional randomly orientated very narrow partially cemented incipient joints/fractures retaining some tensile strength in upper levels. (PARTIALLY WEATHERED SANDSTONE (CLASS B))
		5.50-7.00 5.50-7.00	C 95	90	90		7.00			Medium weak and medium strong yellow-brown medium to very coarse grained feldspathic SANDSTONE recovered as slightly sandy subangular and subrounded medium and coarse gravel with many cobbles.
		7.00-8.50 7.00-8.50	C 33	0	0		8.50			Strong thickly laminated and very thinly bedded yellow-brown fine and medium grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE/silty MUDSTONE. Frequent narrow to medium seams of sandstone/siltstone recovered as slightly silty sandy angular to subrounded fine to coarse gravel with occasional cobbles at depth. Occasional becoming many subhorizontal bedding and induced joints/fractures. Rare prominent subvertical joints. Undulating rough occasionally planar smooth, weak friable up to 5mm penetration, tight and
		8.50-10.00 8.50-10.00	C 71	50	43					

Continued next sheet

Remarks: Driller reported fractured ground 19.0 - 19.5m and no resistance 19.5 - 20.0 m.

AGS

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
		10.00-11.50		37	7					moderately open, local strong discolouration, generally clean occasionally infilled with up to 1mm silty clay. Occasional randomly orientated very narrow partially cemented incipient joints retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE/MUDSTONE (CLASS C))
		10.00-11.50	C 96				10.90			
							11.50			Very weak thickly laminated and very thinly bedded grey-brown silty MUDSTONE. Many subhorizontal bedding and induced joints/fractures and much randomly orientated very narrow jointing in upper levels. Undulating rough, very weak friable up to 8mm penetration, tight and moderately open, local strong discolouration, clean. Many randomly orientated very narrow partially cemented incipient joints retaining some tensile strength. (DESTRUCTURED MUDSTONE (CLASS D))
		11.50-13.00		92	77					Strong thickly laminated to thinly bedded yellow-brown fine to coarse grained micaceous and feldspathic SANDSTONE. Occasional very thin and thin to medium seams of sandstone recovered as slightly silty sandy subangular and subrounded fine to coarse gravel. Occasional locally many subhorizontal bedding and induced joints/fractures. Occasional locally frequent prominent subvertical and 80 angle joints. Undulating rough occasionally planar smooth, weak friable up to 2mm penetration, tight to open, local occasionally pervasive strong discolouration, clean. (DISTINCTLY WEATHERED SANDSTONE (CLASS C))
		11.50-13.00	C 100							
		13.00-15.00		56	46					
		13.00-15.00	C 97							
		15.00-17.00		62	45					
		15.00-17.00	C 94							
							17.00			Strong thickly laminated to thinly bedded pale grey occasionally yellow-brown fine and medium grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many subhorizontal bedding and induced joints/fractures. Undulating rough, weak friable up to 2mm penetration, tight to open, local occasionally pervasive strong discolouration, clean. (DISTINCTLY WEATHERED SANDSTONE/subordinate SILTSTONE (CLASS C))
		17.00-18.50		81	67					
		17.00-18.50	C 95							
							19.00			No recovery 19.0 - 20.0m.
		18.50-20.00		25	13					
		18.50-20.00	C 33							
			TCR	SCR	RQD	FI				Continued next sheet

Remarks: Driller reported fractured ground 19.0 - 19.5m and no resistance 19.5 - 20.0 m.

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Borehole No
R 7
Sheet 3 of 3

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 11/05/2011	Logged By RB

Well	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	FI	Depth (m)	Level (m AOD)	Legend	Stratum Description
							20.00			Strong thickly laminated to thinly bedded pale grey occasionally yellow-brown fine and medium grained micaceous SANDSTONE/subordinate ripple cross laminated SILTSTONE. Many subhorizontal bedding and induced joints/fractures. Undulating rough, weak friable up tp 2mm penetration, tight to open, local occasionally pervasive strong discolouration, clean. (DISTINCTLY WEATHERED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS C))
		20.00-21.50 20.00-21.50	C 100	83	51					
		21.50-23.00 21.50-23.00	C 100	83	58		22.20			Medium weak and medium strong thickly laminated and very thinly bedded grey silty MUDSTONE/subordinate SILTSTONE/very fine grained SANDSTONE. Occasional narrow and very thin seams of mudstone recovered as clayey silty angular and subangular fine and medium gravel. Many subhorizontal bedding and induced joints/fractures. Occasional locally many subverical, 60, 70 and 80 angle joints. Undulating rough and planar smooth, very weak friable up to 5mm penetration, tight to open, local strong discolouration, clean. Occasional very narrow randomly orientated partially cemented incipient joints retaining some tensile strength. (DISTINCTLY WEATHERED INTERBEDDED MUDSTONE/subordinate SILTSTONE/SANDSTONE (CLASS C))
		23.00-24.50 23.00-24.50	C 98	55	27					
		24.50-26.00 24.50-26.00	C 100	91	73					
							26.00			End of Borehole at 26.00 m
			TCR	SCR	RQD	FI				

Remarks: Driller reported fractured ground 19.0 - 19.5m and no resistance 19.5 - 20.0 m.

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Borehole No
R2 GROUT
Sheet 1 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								COBBLES. (Driller's notes)
					2.50			Medium strong SANDSTONE and GRITSTONE/subordinate SILTSTONE. Frequent grout filled open and very open subhorizontal joints. Occasional grout filled very open subvertical joints. Grout filled very open 60 angle joint at depth.
					5.85			Extremely weak MUDSTONE.
					6.55			Medium weak and medium strong MUDSTONE/subordinate SILTSTONE/SANDSTONE.
			Type	Results				

Continued next sheet

Remarks: Grout comprises very weak friable light grey/white speckled paf/cement matrix with locally much angular to rounded fine and medium (up to 20mm) aggregate of mixed lithology (mudstone/siltstone/fine grained sandstone/limestone/chert)

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Borehole No
R2 GROUT
Sheet 2 of 2

Project Name: Honley	Project No. J1842/11/E	Co-ords: -	Hole Type Rotary
Location: Thirstin Mill, Honley		Level: -	Scale 1:50
Client: North Park (Greetland)		Dates: 10/05/2011	Logged By RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Medium weak and medium strong MUDSTONE/subordinate SILTSTONE/SANDSTONE.
					12.60			Medium strong and strong SANDSTONE/subordinate SILTSTONE.
					16.00			End of Borehole at 16.00 m
			Type	Results				

Remarks: Grout comprises very weak friable light grey/white speckled paf/cement matrix with locally much angular to rounded fine and medium (up to 20mm) aggregate of mixed lithology (mudstone/siltstone/fine grained sandstone/limestone/chert)

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APPENDIX 6

LABORATORY TESTING – GEOTECHNICAL

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 1	R 1	R 1	R 1	R 1	R 1	R 1	R 1		
	Depth (m)	8.2	8.2	9.2	9.2	10.8	10.8	12.2	12.2		
	Sample Type / No.	Core 2	Core 2	Core 3	Core 3	Core 4	Core 4	Core 5	Core 5		
	Rock Description	Medium weak to strong interbedded MUDSTONE/SILTSTONE/SANDSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A		
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86		
L	Specimen Length (mm)	155	86	130	86	110	86	210	86		
D	Platen Separation (mm)	86	71	86	70	86	65	86	90		
P	Failure Load (kN)	1.4	3.0	1.0	2.1	2.6	5.2	6.6	14.2		
D_e	Equivalent Dia. (mm)	86.0	78.1	86.0	77.6	86.0	74.8	86.0	88.0		
I_s	Point Load (MN/m^2)	0.2	0.6	0.2	0.4	0.4	1.2	1.1	2.3		
F	Size Factor	1.3	1.2	1.3	1.2	1.3	1.2	1.3	1.3		
$I_{s(50)}$	Point Load Index (MN/m^2)	**0.31**	**0.76**	**0.22**	**0.54**	**0.57**	**1.42**	**1.45**	**3.01**		
	Equivalent UCS (MN/m^2)	6.2	15.3	4.4	10.8	11.4	28.4	29.0	60.2		

	Borehole No.										
	Depth (m)										
	Sample Type / No.										
	Rock Description										
	Test Type / Orientation										
	Moisture Condition										
W	Specimen Width (mm)										
L	Specimen Length (mm)										
D	Platen Separation (mm)										
P	Failure Load (kN)										
D_e	Equivalent Dia. (mm)										
I_s	Point Load (MN/m^2)										
F	Size Factor										
$I_{s(50)}$	Point Load Index (MN/m^2)										
	Equivalent UCS (MN/m^2)										

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 1
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 2	R 2	R 2	R 2	R 2	R 2	R 2	R 2	R 2	R 2
	Depth (m)	3.0	3.0	4.5	4.5	8.0	8.0	10.5	10.5	12.7	12.7
	Sample Type / No.	Core 1	Core 1	Core 2	Core 2	Core 4	Core 4	Core 6	Core 6	Core 7	Core 7
	Rock Description	Medium weak (locally very weak) to strong interbedded MUDSTONE/ SILTSTONE//SANDSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A	D	A
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86	86	86
L	Specimen Length (mm)	142	86	115	86	114	86	125	86	125	86
D	Platen Separation (mm)	86	85	86	85	86	70	86	74	86	80
P	Failure Load (kN)	1.0	10.0	2.5	7.0	0.5	4.6	1.9	5.8	10.0	13.5
D_e	Equivalent Dia. (mm)	86.0	85.5	86.0	85.5	86.0	77.6	86.0	79.8	86.0	82.9
I_s	Point Load (MN/m^2)	0.2	1.7	0.4	1.2	0.1	1.0	0.3	1.2	1.7	2.5
F	Size Factor	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.3	1.3
$I_{s(50)}$	Point Load Index (MN/m^2)	**0.22**	**2.22**	**0.55**	**1.55**	**0.11**	**1.19**	**0.42**	**1.43**	**2.20**	**3.14**
	Equivalent UCS (MN/m^2)	4.4	44.3	11.0	31.0	2.2	23.7	8.3	28.6	43.9	62.7

	Borehole No.	R 2	R 2								
	Depth (m)	15.0	15.0								
	Sample Type / No.	Core 9	Core 9								
	Rock Description	Medium weak (locally very weak) to strong interbedded MUDSTONE/ SILTSTONE/SANDSTONE									
	Test Type / Orientation	D	A								
	Moisture Condition										
W	Specimen Width (mm)	86	86								
L	Specimen Length (mm)	125	86								
D	Platen Separation (mm)	86	70								
P	Failure Load (kN)	9.7	21.0								
D_e	Equivalent Dia. (mm)	86.0	77.6								
I_s	Point Load (MN/m^2)	1.7	4.4								
F	Size Factor	1.3	1.2								
$I_{s(50)}$	Point Load Index (MN/m^2)	**2.1**	**5.4**								
	Equivalent UCS (MN/m^2)	42.6	108.3								

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 2
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 3	R 3								
	Depth (m)	3.3	3.3								
	Sample Type / No.	Core 2	Core 2								
	Rock Description	Medium strong to very strong SANDSTONE									
	Test Type / Orientation	D	A								
	Moisture Condition										
W	Specimen Width (mm)	86	86								
L	Specimen Length (mm)	220	86								
D	Platen Separation (mm)	86	60								
P	Failure Load (kN)	3.0	22.0								
D_e	Equivalent Dia. (mm)	86.0	71.8								
I_s	Point Load (MN/m^2)	0.5	5.4								
F	Size Factor	1.3	1.2								
$I_{s(50)}$	Point Load Index (MN/m^2)	**0.66**	**6.39**								
	Equivalent UCS (MN/m^2)	13.2	127.8								

	Borehole No.										
	Depth (m)										
	Sample Type / No.										
	Rock Description										
	Test Type / Orientation										
	Moisture Condition										
W	Specimen Width (mm)										
L	Specimen Length (mm)										
D	Platen Separation (mm)										
P	Failure Load (kN)										
D_e	Equivalent Dia. (mm)										
I_s	Point Load (MN/m^2)										
F	Size Factor										
$I_{s(50)}$	Point Load Index (MN/m^2)										
	Equivalent UCS (MN/m^2)										

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 3
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 3A	R 3A	R 3A	R 3A	R 3A	R 3A	R 3A	R 3A	R 3A	R 3A
	Depth (m)	3.1	3.1	3.7	3.7	7.9	7.9	9.5	9.5	10.4	10.4
	Sample Type / No.	Core 1	Core 1	Core 1	Core 1	Core 4	Core 4	Core 5	Core 5	Core 6	Core 6
	Rock Description	Medium weak (locally very weak) to strong interbedded MUDSTONE/ SILTSTONE/SANDSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A	D	A
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86	86	86
L	Specimen Length (mm)	180	86	160	86	110	86	100	86	150	86
D	Platen Separation (mm)	86	84	86	78	86	84	86	70	86	91
P	Failure Load (kN)	1.3	12.7	6.5	16.9	0.5	2.4	0.3	3.4	1.8	4.9
D_e	Equivalent Dia. (mm)	86.0	85.0	86.0	81.9	86.0	85.0	86.0	77.6	86.0	88.5
I_s	Point Load (MN/m^2)	0.2	2.2	1.1	3.2	0.1	0.4	0.1	0.7	0.3	0.8
F	Size Factor	1.3	1.3	1.3	1.2	1.3	1.3	1.3	1.2	1.3	1.3
$I_{s(50)}$	Point Load Index (MN/m^2)	**0.29**	**2.84**	**1.43**	**4.01**	**0.11**	**0.54**	**0.07**	**0.88**	**0.40**	**1.03**
	Equivalent UCS (MN/m^2)	5.7	56.8	28.6	80.1	2.2	10.7	1.3	17.5	7.9	20.6

	Borehole No.	R 3A	R 3A	R 3A	R 3A						
	Depth (m)	11.5	11.5	13.2	13.2						
	Sample Type / No.	Core 7	Core 7	Core 8	Core 8						
	Rock Description	Medium weak (locally very weak) to strong interbedded MUDSTONE/ SILTSTONE/SANDSTONE									
	Test Type / Orientation	D	A	D	A						
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86						
L	Specimen Length (mm)	140	86	135	86.00						
D	Platen Separation (mm)	86	78	86	74.00						
P	Failure Load (kN)	2.1	7.5	1.200	5.00						
D_e	Equivalent Dia. (mm)	86.0	81.9	86.0	79.8						
I_s	Point Load (MN/m^2)	0.4	1.4	0.2	1.0						
F	Size Factor	1.3	1.2	1.3	1.2						
$I_{s(50)}$	Point Load Index (MN/m^2)	**0.5**	**1.8**	**0.3**	**1.2**						
	Equivalent UCS (MN/m^2)	9.2	35.6	5.3	24.7						

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 4
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 4	R 4	R 4	R 4	R 4	R 4	R 4	R 4	R 4	R 4
	Depth (m)	6.6	6.6	7.3	7.3	11.0	11.0	13.7	13.7	14.5	14.5
	Sample Type / No.	Core 4	Core 4	Core 4	Core 4	Core 7	Core 7	Core 9	Core 9	Core 9	Core 9
	Rock Description	Medium strong to stong (locally medium weak) interbedded SANDSTONE/ subordinate MUDSTONE/SILTSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A	D	A
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86	86	86
L	Specimen Length (mm)	122	86	120	86	100	86	120	86	135	86
D	Platen Separation (mm)	86	64	86	75	86	80	86	78	86	74
P	Failure Load (kN)	6.4	11.7	17.0	15.5	2.5	3.0	3.6	6.1	2.3	7.6
D_e	Equivalent Dia. (mm)	86.0	74.2	86.0	80.3	86.0	82.9	86.0	81.9	86.0	79.8
I_s	Point Load (MN/m^2)	1.1	2.7	2.9	3.1	0.4	0.6	0.6	1.2	0.4	1.5
F	Size Factor	1.3	1.2	1.3	1.2	1.3	1.3	1.3	1.2	1.3	1.2
$I_{s(50)}$	Point Load Index (MN/m^2)	**1.41**	**3.23**	**3.74**	**3.79**	**0.55**	**0.70**	**0.79**	**1.45**	**0.51**	**1.88**
	Equivalent UCS (MN/m^2)	28.1	64.6	74.7	75.7	11.0	13.9	15.8	28.9	10.1	37.5

	Borehole No.										
	Depth (m)										
	Sample Type / No.										
	Rock Description										
	Test Type / Orientation										
	Moisture Condition										
W	Specimen Width (mm)										
L	Specimen Length (mm)										
D	Platen Separation (mm)										
P	Failure Load (kN)										
D_e	Equivalent Dia. (mm)										
I_s	Point Load (MN/m^2)										
F	Size Factor										
$I_{s(50)}$	Point Load Index (MN/m^2)										
	Equivalent UCS (MN/m^2)										

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 5
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 5	R 5	R 5	R 5	R 5					
	Depth (m)	6.3	6.3	7.4	7.4	8.0					
	Sample Type / No.	Core 2	Core 2	Core 3	Core 3	Core 3					
	Rock Description	Medium weak to strong interbedded SANDSTONE/subordinate MUDSTONE/ SILTSTONE									
	Test Type / Orientation	D	A	D	A	A					
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86					
L	Specimen Length (mm)	160	86	142	86	86					
D	Platen Separation (mm)	86	62	86	90	89					
P	Failure Load (kN)	7.9	11.1	2.0	2.0	22.4					
D_e	Equivalent Dia. (mm)	86.0	73.0	86.0	88.0	87.5					
I_s	Point Load (MN/m^2)	1.4	2.7	0.3	0.3	3.7					
F	Size Factor	1.3	1.2	1.3	1.3	1.3					
$I_{s(50)}$	Point Load Index (MN/m^2)	**1.74**	**3.14**	**0.44**	**0.42**	**4.79**					
	Equivalent UCS (MN/m^2)	34.7	62.9	8.8	8.5	95.9					

	Borehole No.										
	Depth (m)										
	Sample Type / No.										
	Rock Description										
	Test Type / Orientation										
	Moisture Condition										
W	Specimen Width (mm)										
L	Specimen Length (mm)										
D	Platen Separation (mm)										
P	Failure Load (kN)										
D_e	Equivalent Dia. (mm)										
I_s	Point Load (MN/m^2)										
F	Size Factor										
$I_{s(50)}$	Point Load Index (MN/m^2)										
	Equivalent UCS (MN/m^2)										

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 6
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 6	R 6	R 6	R 6						
	Depth (m)	1.0	1.0	3.4	3.4						
	Sample Type / No.	Core 1	Core 1	Core 2	Core 2						
	Rock Description	Medium strong interbedded SANDSTONE/subordinate MUDSTONE/ SILTSTONE									
	Test Type / Orientation	D	A	D	A						
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86						
L	Specimen Length (mm)	160	86	150	86						
D	Platen Separation (mm)	86	78	86	82						
P	Failure Load (kN)	6.0	9.9	0.3	11.6						
D_e	Equivalent Dia. (mm)	86.0	81.9	86.0	84.0						
I_s	Point Load (MN/m^2)	1.0	1.9	0.1	2.1						
F	Size Factor	1.3	1.2	1.3	1.3						
$I_{s(50)}$	Point Load Index (MN/m^2)	**1.32**	**2.35**	**0.07**	**2.64**						
	Equivalent UCS (MN/m^2)	26.4	46.9	1.3	52.9						

	Borehole No.										
	Depth (m)										
	Sample Type / No.										
	Rock Description										
	Test Type / Orientation										
	Moisture Condition										
W	Specimen Width (mm)										
L	Specimen Length (mm)										
D	Platen Separation (mm)										
P	Failure Load (kN)										
D_e	Equivalent Dia. (mm)										
I_s	Point Load (MN/m^2)										
F	Size Factor										
$I_{s(50)}$	Point Load Index (MN/m^2)										
	Equivalent UCS (MN/m^2)										

Remarks : Diametral test result of 1.3 MN/m at 3.4m represents a test undertaken on an incipient joint/fracture

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 7
I - Irregular	O - Oblique	AD - Air Dried			

Rogers Geotechnical Services Ltd.
POINT LOAD STRENGTH INDEX TEST
I.S.R.M. Suggested Method, 1984

Client: North Park (Greetland)
Site: Thirstin Mill, Honley

Tested by: RB **Chkd by :** RB

Date: 19.05.11 **Date:** 19.05.11

	Borehole No.	R 7	R 7	R 7	R 7	R 7	R 7	R 7	R 7	R 7	R 7
	Depth (m)	5.4	5.4	8.7	8.7	9.8	9.8	13.3	13.3	16.0	16.0
	Sample Type / No.	Core 2	Core 2	Core 5	Core 5	Core 5	Core 5	Core 8	Core 8	Core 9	Core 9
	Rock Description	Medium strong and strong (locally medium weak at depth) interbedded SANDSTONE/subordinate MUDSTONE/SILTSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A	D	A
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86	86	86
L	Specimen Length (mm)	240	86	126	86	200	86	230	86	100	86
D	Platen Separation (mm)	86	86	86	100	86	80	86	90	86	74
P	Failure Load (kN)	14.5	22.5	8.9	24.0	13.0	18.0	19.2	22.0	14.0	16.9
D_e	Equivalent Dia. (mm)	86.0	86.0	86.0	92.7	86.0	82.9	86.0	88.0	86.0	79.8
I_s	Point Load (MN/m^2)	2.5	3.9	1.5	3.6	2.2	3.3	3.3	3.6	2.4	3.4
F	Size Factor	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2
$I_{s(50)}$	Point Load Index (MN/m^2)	**3.19**	**4.94**	**1.96**	**4.69**	**2.86**	**4.18**	**4.22**	**4.67**	**3.08**	**4.17**
	Equivalent UCS (MN/m^2)	63.7	98.9	39.1	93.8	57.1	83.7	84.4	93.3	61.5	83.4

	Borehole No.	R 7	R 7	R 7	R 7	R 7	R 7	R 7	R 7		
	Depth (m)	18.4	18.4	23.0	23.0	24.5	24.5	26.0	26.0		
	Sample Type / No.	Core10	Core10	Core14	Core14	Core15	Core15	Core15	Core15		
	Rock Description	Medium strong and strong (locally medium weak at depth) interbedded SANDSTONE/subordinate MUDSTONE/SILTSTONE									
	Test Type / Orientation	D	A	D	A	D	A	D	A		
	Moisture Condition										
W	Specimen Width (mm)	86	86	86	86	86	86	86	86		
L	Specimen Length (mm)	130	86	100	86	120	86	185	86		
D	Platen Separation (mm)	86	92	86	71	86	78	86	79		
P	Failure Load (kN)	15.0	24.5	2.0	3.8	2.9	5.5	3.7	5.7		
D_e	Equivalent Dia. (mm)	86.0	88.9	86.0	78.1	86.0	81.9	86.0	82.4		
I_s	Point Load (MN/m^2)	2.6	3.9	0.3	0.8	0.5	1.0	0.6	1.1		
F	Size Factor	1.3	1.3	1.3	1.2	1.3	1.2	1.3	1.3		
$I_{s(50)}$	Point Load Index (MN/m^2)	**3.3**	**5.1**	**0.4**	**1.0**	**0.6**	**1.3**	**0.8**	**1.3**		
	Equivalent UCS (MN/m^2)	65.9	102.2	8.8	19.4	12.7	26.1	16.3	26.8		

Remarks :

Test Type	Orientation	Moisture Condition			Job No.
D - Diametral	X - Perpendicular	N - Natural	$De = \sqrt{4WD/\pi}$	$Is = (P/\pi D_e^2/4) \times 1000$	J1842/11/E
A - Axial	Y - Parallel	S - Saturated	$F = (De/50)0.45$	$Is(50) = Is \times F$	Figure 8
I - Irregular	O - Oblique	AD - Air Dried			

APPENDIX 7

LABORATORY TESTING – ENVIRONMENTAL

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS

Client: Northpark (Greetland) Job Number: J1842/11/E
Site: Thirstin Mill Date: 10.6.11

Tox Data Report No.	Compound	Range of Values Found (mg/kg)		Residential with Plant Uptake Development Values (mg/kg)	Reference
	Metals	*Min*	Max		
3	Cadmium	<0.5	0.7	10	A
4	Chromium	<1		14.7	A
	Copper	27	78	4020	A
7	Mercury	<0.17	0.38	1.00	A
8	Nickel	16	43	130	A
	Lead	47	379	168	A
	Zinc	59	404	17200	A
	Vanadium	21	34	115	A
	Semi and Non Metals				
1	Arsenic	6	10	32	A
10	Selenium	<1		350	A
	Free Cyanide	<1		34	A
9	Phenols (total)	<0.2		420	A
	Poly Aromatic Hydrocarbons				
20	Napthalene	0.05	0.47	8.71	A
	Acenaphthene	0.04	0.45	937	A
	Fluorene	0.08	0.32	746	A
	Anthracene	0.35	0.77	20.9	A
	Fluoranthene	0.83	2.75	113	A
	Pyrene	0.73	2.6	13.2	A
	Benzo(a)anthracene	0.19	1.62	8.54	A
2	Chrysene	0.48	2.49	2.64	A
2	Benzo(b)fluoranthene	0.25	1.18	7.29	A
2	Benzo(k)fluoranthene	0.24	0.79	4.12	A
2	Benzo(a)pyrene	0.32	1.6	0.998	A
2	Dibenzo(a,h)anthracene	<0.01	0.32	0.0236	A
2	Indeno(1,2,3-cd)pyrene	0.1	0.57	0.368	A
2	Benzo(g,h,i)perylene	0.23	0.99	0.112	A
	Petroluem Hydrocarbons				
	Aliphatic C5-C6	<0.01		26.1	A
	Aliphatic C6-C8	<0.01		87.8	A
	Aliphatic C8-C10	<0.01		14.5	A
	Aliphatic C10-C12	<0.01	2.5	87.7	A
	Aliphatic C12-C16	<0.01	8.7	126	A
	Aliphatic C16-C21	<0.01	31.5	88200	A
	Aliphatic C21-C35	<0.01	130		A
	Aromatic C5-C7 (Benzene)	<0.01		0.33	A*
	Aromatic C7-C8 (Toluene)	<0.01		610	A
	Aromatic C8-C10	<0.1		23.7	A
	Aromatic C10-C12	<0.1	3.1	132	A
	Aromatic C12-C16	<0.1	4.6	452	A
	Aromatic C16-C21	<0.1	13.2	804	A
	Aromatic C21-C35	<0.1	61.3	1220	A
	Others				
	pH	7.7	9.2	-	-
	Organic Content (%)	2.6	4	-	-
	Soluble Sulphate (g/l)	0.03	0.1	-	-
	Total Sulphate (%)	0.027	0.072	-	-

A = WS ATKINS PLC, ATRISK SOIL SCREENING VALUES BASED ON 6% SOIL ORGANIC MATTER

A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 11/02106
Issue Number: 1 **Date:** 25 May, 2011

Client:
Rogers Geotechnical Services
Unit 12
Emley Business Park
Leys Lane
Emley
Huddersfield
UK
HD8 9QY

Project Manager: Steve Rogers / Rob Lewis
Project Name: Thirstin Mill, Honley
Project Ref: J1842/11/E
Order No: 0511-4
Date Samples Received: 17/05/11
Date Instructions Received: 17/05/11
Date Analysis Completed: 25/05/11

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

John Gustafson
Director

Notes - Soil analysis
All results are reported as dry weight (<40°C).
Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General
For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.
Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.
Superscript # indicates method accredited to ISO 17025.
Accreditation for TPH (C6-C40) applies to the range C6-C36 only.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

MCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 1247

Envirolab Job Number: 11/02106

Client Project Name: Thirstin Mill, Honley

Client Project Ref: J1842/11/E

Lab Sample ID	11/02106/1	11/02106/2	11/02106/3	11/02106/4	11/02106/5	11/02106/6	11/02106/7	11/02106/8	Units	Method ref
Client Sample No										
Client Sample ID	WS3	WS4A	WS8	TP4	TP1	TP3	TP5	TP7		
Depth to Top	0.40	0.80	0.60	0.60	0.75	0.40	0.30	1.30		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	4AB	4AB	4AB	4ABE	6A	5A	4AB	4AB		
% Moisture~$_A^{\#}$	-	-	-	-	16.1	18.3	10.6	11.2	% w/w	A-T-044
% Stones >10mm~$_A^{\#}$	-	-	-	-	24.9	7.2	17.6	19.9	% w/w	A-T-044
pH$_D^{M\#}$	9.2	7.7	8.8	9.1	8.1	8.4	8.8	9.1	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.05	0.06	0.03	0.04	0.06	0.05	0.09	0.10	g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	-	-	-	-	400	270	650	720	mg/kg	A-T-028
Cyanide (free)$_A^{M\#}$	-	-	-	-	<1	<1	<1	<1	mg/kg	A-T-042sFCN
Phenols - Total by HPLC$_A$	-	-	-	-	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-050s
Organic matter$_D^{M\#}$	-	-	-	-	2.6	3.3	4.0	3.8	% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	-	-	-	-	8	7	10	6	mg/kg	A-T-024
Cadmium$_D^{M\#}$	-	-	-	-	0.7	<0.5	<0.5	<0.5	mg/kg	A-T-024
Copper$_D^{M\#}$	-	-	-	-	44	32	27	78	mg/kg	A-T-024
Chromium (hexavalent)$_D$	-	-	-	-	<1	<1	<1	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	-	-	-	-	47	72	104	379	mg/kg	A-T-024
Mercury$_D$	-	-	-	-	<0.17	<0.17	0.17	0.38	mg/kg	A-T-024
Nickel$_D^{M\#}$	-	-	-	-	43	34	16	18	mg/kg	A-T-024
Selenium$_D^{M\#}$	-	-	-	-	<1	<1	<1	<1	mg/kg	A-T-024
Vanadium$_D^{M\#}$	-	-	-	-	23	34	21	22	mg/kg	A-T-024
Zinc$_D^{M\#}$	-	-	-	-	77	84	59	404	mg/kg	A-T-024

Envirolab Job Number: 11/02106

Client Project Name: Thirstin Mill, Honley

Client Project Ref: J1842/11/E

Lab Sample ID	11/02106/1	11/02106/2	11/02106/3	11/02106/4	11/02106/5	11/02106/6	11/02106/7	11/02106/8	Units	Method ref
Client Sample No										
Client Sample ID	WS3	WS4A	WS8	TP4	TP1	TP3	TP5	TP7		
Depth to Top	0.40	0.80	0.60	0.60	0.75	0.40	0.30	1.30		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	4AB	4AB	4AB	4ABE	6A	5A	4AB	4AB		
TPH CWG										
Ali >C5-C6$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A$	-	-	-	-	<0.1	<0.1	<0.1	2.5	mg/kg	A-T-023s
Ali >C12-C16$_A$	-	-	-	-	<0.1	<0.1	<0.1	8.7	mg/kg	A-T-023s
Ali >C16-C21$_A$	-	-	-	-	<0.1	<0.1	<0.1	31.5	mg/kg	A-T-023s
Ali >C21-C35$_A$	-	-	-	-	<0.1	<0.1	<0.1	130	mg/kg	A-T-023s
Total Aliphatics$_A$#	-	-	-	-	<0.1	<0.1	<0.1	172	mg/kg	A-T-022+23s
Aro >C5-C7$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C9-C10$_A$	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A$	-	-	-	-	<0.1	<0.1	<0.1	3.1	mg/kg	A-T-023s
Aro >C12-C16$_A$	-	-	-	-	<0.1	<0.1	2.6	4.6	mg/kg	A-T-023s
Aro >C16-C21$_A$	-	-	-	-	<0.1	<0.1	17.1	13.2	mg/kg	A-T-023s
Aro >C21-C35$_A$	-	-	-	-	<0.1	<0.1	45.0	61.3	mg/kg	A-T-023s
Total Aromatics$_A$#	-	-	-	-	<0.1	<0.1	64.6	82.1	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$#	-	-	-	-	<0.1	<0.1	64.6	254	mg/kg	A-T-022+23s
BTEX - Benzene$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A$#	-	-	-	-	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 11/02106

Client Project Name: Thirstin Mill, Honley

Client Project Ref: J1842/11/E

Lab Sample ID	11/02106/1	11/02106/2	11/02106/3	11/02106/4	11/02106/5	11/02106/6	11/02106/7	11/02106/8	Units	Method ref
Client Sample No										
Client Sample ID	WS3	WS4A	WS8	TP4	TP1	TP3	TP5	TP7		
Depth to Top	0.40	0.80	0.60	0.60	0.75	0.40	0.30	1.30		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	4AB	4AB	4AB	4ABE	6A	5A	4AB	4AB		
PAH 16										
Acenapthene$_A$	-	-	-	-	0.45	0.25	0.04	0.14	mg/kg	A-T-019s
Acenapthylene$_A$	-	-	-	-	<0.01	<0.01	0.12	0.02	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	-	-	-	-	0.35	0.60	0.77	0.48	mg/kg	A-T-019s
Benzo(a)anthracene$_A$	-	-	-	-	0.19	0.34	1.62	0.32	mg/kg	A-T-019s
Benzo(a)pyrene$_A$	-	-	-	-	0.32	0.39	1.60	0.45	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A$	-	-	-	-	0.25	0.25	1.18	0.34	mg/kg	A-T-019s
Benzo(ghi)perylene$_A$	-	-	-	-	0.28	0.23	0.99	0.38	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	-	-	-	-	0.24	0.28	0.79	0.28	mg/kg	A-T-019s
Chrysene$_A$	-	-	-	-	0.48	0.92	2.49	0.77	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A$	-	-	-	-	<0.01	<0.01	0.32	0.04	mg/kg	A-T-019s
Fluoranthene$_A$	-	-	-	-	0.83	1.40	2.75	0.93	mg/kg	A-T-019s
Fluorene$_A$	-	-	-	-	0.32	0.17	0.08	0.10	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A$	-	-	-	-	0.13	0.10	0.57	0.17	mg/kg	A-T-019s
Napthalene$_A$	-	-	-	-	0.13	0.47	0.05	0.14	mg/kg	A-T-019s
Phenanthrene$_A$	-	-	-	-	0.85	1.41	0.96	0.64	mg/kg	A-T-019s
Pyrene$_A$	-	-	-	-	0.73	1.43	2.60	0.87	mg/kg	A-T-019s
Total PAH$_A$	-	-	-	-	5.57	8.24	16.9	6.06	mg/kg	A-T-019s