

**Environmental
Geotechnical
Specialists**



REPORT

job number	site address
date	
written by	
checked by	issued by

Rogers Geotechnical Services Ltd

Telephone 0843 50 666 87 **Fax** 0843 51 599 30

Email enquiries@rogersgeotech.co.uk

www.rogersgeotech.co.uk

Offices 1 & 2, Barncliffe Business Park, Near Bank, Shelley,
Huddersfield, West Yorkshire HD8 8LU.

GEO-TECH-NI-CAL
ENV-I-RON-MEN-TAL



REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

**MANASHAY, UPPER BROW ROAD, PADDOCK
HUDDERSFIELD HD1 4UP**

for

SHAW & JAGGER

CONSULTANTS: ARC ENGINEERS

Report No J3220/15/E

November 2015

CONTENTS

	Page
1. SYNOPSIS	1
2. INTRODUCTION	2
3. LIMITATIONS	3
4. FIELDWORKS	3
4.1 Machine Excavated Trial Pits	3
4.2 Dynamic Probes	3
4.3 Windowless Sample and Rotary Boreholes with adjacent Dynamic Probes	4
5. HISTORICAL MAPPING	5
6. GEOLOGY	5
7. STRATA CONDITIONS	5
7.1 Made Ground	6
7.2 Concrete	6
7.3 Probable Soliflucted Material	6
7.4 Rough Rock	7
7.5 Groundwater	7
8. INSITU TESTING	8
8.1 Dynamic Probes (Site profiling)	8
8.2 Dynamic Probes (Adjacent to boreholes)	8
8.3 Standard Penetration Tests	9
9. LABORATORY TESTING - GEOTECHNICAL	9
9.1 Moisture Content Determinations	9
9.2 Index Property Tests	9
9.3 Particle Size Distribution	10
9.4 Uniaxial Compressive Strength	10
9.5 Point Load Index Tests	10
9.6 Sulphate Content and pH Values	10
10. HISTORICAL MAPPING	11
11. LABORATORY TESTING – ENVIRONMENTAL	12

12.	DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL	12
12.1	Foundations	13
	12.1.1 Eastern tip of site (Plots 1 to 3)	13
	12.1.2 Northern and central portion of site (Plots 4 to 9)	14
	12.1.3 Comments	14
12.2	Ground Floors	15
12.3	Access Roads and Car Parking	15
	12.3.1 Retaining Structures	16
12.4	Soil Volume Change Potential	19
12.5	Effect of Sulphates	19
13.	DISCUSSION OF GROUND CONDITIONS - ENVIRONMENTAL	20
13.1	Discussion of Test Results	20
	13.1.1 Soil Samples	20
13.2	Site Specific Risk Assessment	22
	13.2.1 Approach	22
	13.2.2 Conceptual Ground Model	22
	13.2.3 Risk assessment	24
13.3	Remediation Strategy	25
	13.3.1 Remediation Objectives	25
	13.3.2 Development Requirements	25
	13.3.3 Strategy	25
13.4	Fill Material Materials	27
13.5	Verification Report	
14.	RECOMMENDATIONS FOR FURTHER WORK	29
15.	REFERENCES	30

APPENDIX 1 – SITE PLAN

APPENDIX 2 – TRAILPIT RECORDS

APPENDIX 3 – DYNAMIC PROBES

APPENDIX 4 – WINDOWLESS SAMPLE AND ROTARY BOREHOLE
RECORDS, AND ADJACENT DYNAMIC PROBES
TESTING RESULTS

APPENDIX 5 – HISTORICAL MAPS

APPENDIX 6 – LABORATORY TESTING – GEOTECHNICAL

APPENDIX 7 – LABORATORY TESTING – ENVIRONMENTAL

REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

**MANASHAY, UPPER BROW ROAD, PADDOCK
HUDDERSFIELD HD1 4UP**

for

SHAW & JAGGER

CONSULTANTS: ARC ENGINEERS

Report No J3220/15/E

November 2015

1. **SYNOPSIS**

This investigation has demonstrated that beneath a capping of made ground, weathered deposits of the Rough Rock are present. In general terms the made ground comprised a heterogeneous mix of soft dark grey clay, clayey silt sand and gravel, and cobble, sized fragments of masonry and concrete. The Rough Rock was found to have a weathered upper surface comprising brown sandy clay/silt, or sand, with sandstone gravel which graded into greyish brown extremely weak and very weak thinly laminated fine and medium sandstone. The trial pits excavated met refusal at depths ranging between 0.9m and 2.4m where the Rough Rock was found to be intact. The dynamic probes however generally met refusal at around 4m to 5m in the east of the site and about 1m to 2m in the western part of the site. Notwithstanding this, a probe undertaken in beyond the original crest of the site, where filling has taken place, met refusal at a depth in excess of 8m. Combined windowless sample and rotary boreholes undertaken along the edge of the site revealed the Rough Rock was present at depths ranging between 1.86m to 5.25m and was seen to the base of the boreholes at 9m below ground level.

As a consequence, it is considered that shallow strip and spread footings could be employed as foundations for the proposed dwellings at the site. However, the stability of the slope on the south-western edge of the site is of concern and careful consideration of the geotechnical discussion is required in regard to an access road for the dwellings.

In addition, chemical testing has demonstrated that some contamination is present at the site, thus some precautionary measures will be required.

2. INTRODUCTION

It is understood that the client proposes to develop the land around Manashay, the existing dwelling, on Upper Brow Road, Paddock, Huddersfield. Plans made available at the time of the investigation indicate that around nine house plots are being considered; three at the front of the site and six on the land to the rear of Manashay.

The site principally comprises a plateau of ground approximately 4m below the level of Upper Brow Road, with properties on the higher ground immediately to the northeast of the site. The plateau represents a narrow strip of land which adjoins Upper Brow Road on the eastern tip of the site, the plateau extends northwest to the mid-length of the site where there is a bend and the site continues north where the tip of the site meets a railway embankment. On the north-eastern and eastern boundary of the site, there is a gabion basket wall which extends from Manashay to the bend in the site. Beyond there is a blue brick and stone wall retaining wall, of some considerable age, which runs from the bend in the site to the rail-line embankment. To the southwest of the site is a steep partially vegetated slope, which is understood to have been steepened with tipped material; this was undertaken to increase the width of the site. At the base of the slope, an approximately 3m high dry stone wall is present along a footpath. A brief inspection of the wall shows some deformation, in the form of bulging, is apparent and there are a number of trees which suggest movement, given the misshaping of the trunk growth. Indeed at one location a tree is tight against the wall which could be as a result of wall movement toward it. Immediately on entering the site there is a plateau of ground, level with the Upper Brow Road, where garages were apparently sited. An area of rough ground slopes down from this plateau to the access road (Johnny Moore Road) which slopes into the site and meets the principal site level where Manashay is located.

It is understood that older properties were once present at the site to the rear of Manashay, in front of where the gabion basket wall is now present, however, these have been demolished. In the time between, a kennels and cattery was located at the site.

As a consequence of the above, a site investigation has been undertaken in accordance with instructions from the consulting engineers with agreement by the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. Contamination testing of the made ground has been undertaken to enable an assessment of the levels of contamination.

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. FIELDWORKS

The fieldworks were undertaken from the 27th June to the 21st October 2015 and included the following:

- Eight machine excavated trialpits.
- Eighteen dynamic probes to profile the sub-surface conditions.
- Four windowless sample and rotary boreholes with adjacent dynamic probes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report. It may be appreciated that this investigation has been conducted in three phases, with the trialpits taking place in June, the dynamic probe profiling in August and the boreholes with adjacent probes in October. After each phase of work, the data obtained was reviewed and discussed with the consulting engineers in order to assist with ensuring the effectiveness of the next phase.

4.1 Machine Excavated Trial Pits

Trialpits were excavated in order to reveal the nature of the near surface soils using the back-acting arm of a JCB 3CX. The soils were logged on site in general accordance with BS5930: 1999, as amended in 2010, and full descriptions are given on the trialpit records which are presented in Appendix 2. At regular intervals throughout the excavation of the pits, samples were taken for chemical testing. The test specimens were retained in the appropriate air tight containers within cool boxes for onward transition to the chemical laboratory.

4.2 Dynamic Probes

Dynamic penetration tests were undertaken in lines across the width of the site in order to profile the ground conditions, in the event, the resulted in four lines of regularly spaced probes along the site length. The probes were carried out 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 3.

4.3 Windowless Sample and Rotary Boreholes with adjacent Dynamic Probes

These boreholes were undertaken using a Dando Terrier tracked drilling rig. Initially a drive-in windowless sampler was employed to progress the borehole through the near surface soils. The windowless sample cores were undertaken in 1m lengths and reduced in diameter from 85mm for the first 1m, through 75mm, 65mm and 55mm for subsequent 1m increments. Standard penetration tests (SPTs) were undertaken at 1m intervals (at the end of each sampler drive) in one of the boreholes. The SPTs were conducted in accordance with the procedures given in BS1377 : 1990 : Part 9 : 3.3, and the results are summarised on the borehole records. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground, the barrel samples were retained in air tight plastic containers. It may be appreciated that the approximate cohesion of clay soils may be obtained by multiplying the equivalent SPT value by approximately 4.5 (after Stroud, 1975). In addition, dynamic probes carried out in accordance with the procedure given in 4.2 *Dynamic Probes* were also undertaken adjacent to three of the boreholes.

On meeting refusal with the windowless sampler, the boreholes were progressed by rotary drilling techniques using air/mist flushing. Beyond refusal it was proposed to extend the boreholes with coring techniques, such that samples could be obtained, however, where the ground could not be successfully recovered, it was necessary to excavate the borehole with open-hole drilling techniques. The open-hole sections of the borehole employed 120mm diameter drag and tricone roller bits. The drill chippings brought to surface in the flush returns were inspected by the driller on a screen which forms part of the re-circulation tanks. Where rotary coring could be utilised successfully, a 92mm diameter barrel, which recovers an 85mm diameter core was employed. Where necessary, a 103mm diameter casing was spun temporarily into the ground in 1.5m lengths to support the bore, with a toothed lead section being utilised to assist with reaming.

The cores recovered from the borehole 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 2010, and full descriptions are given on the boreholes records which are presented in Appendix 4. Also included on these

records are the sample depths, ground water levels, the percentages of *Total Core Recovery* (TCR) and, within rock, the *Solid Core Recovery* (SCR) and *Rock Quality Designation* (RQD). Additionally, the results of the dynamic probes undertaken adjacent to the boreholes are also presented in Appendix 4.

5. **HISTORICAL MAPPING**

As part of a desk study undertaken prior to the commencement of the windowless sample/rotary boreholes, historical maps for the site were obtained. The data shown on these maps, in particular the previous layouts of the site were used in positioning the boreholes and the maps are presented as Appendix 5.

6. **GEOLOGY**

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name ¹	Description ²
Superficial Geology	None indicated.	
Solid Geology	Rough Rock	The Rough Rock Flags are generally fine- to medium-grained, flaggy sandstone.

A marker near the site on the British Geological Survey map sheet suggests that the geology in the area dips at approximately 2° to the south-east.

7. **STRATA CONDITIONS**

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised strata profile

Depth (m)	Strata type	Positions strata was revealed in	Groundwater strikes (m)
0.05 – 5.25	Made Ground	TP1 – TP8, BH1 – BH4	None
0.2	Concrete	TP4	None
3.92 – 5.45	Probable Soliflucted Material	BH1 – BH3	None

¹ Source: British Geological Survey (NERC): Geological Map Sheet 77 – Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [online resource from www.bgs.ac.uk]

² Source: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from www.bgs.ac.uk]

+1.3 – +9.0	Rough Rock	TP1 – TP5, TP7, TP8, BH1 – BH4	None
-------------	------------	-----------------------------------	------

'+' Denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

This profile is considered in more detail below.

7.1 **Made Ground**

The site was found to be capped by a changeable layer of made ground which ranged in thickness between 50mm and 5.25m, and comprised a generally brown mixture of sand gravelly clay/silt, clayey gravelly sand, clayey gravel, with variable amounts of cobbles, and cobbles in a matrix of clay. The cohesive fraction of the made ground comprised very soft ranging to firm dark silty clay and the gravel and cobble fraction of the made ground comprised sub-rounded mudstone and sub-rounded to angular fragments of concrete, brick, sandstone masonry, slate, coal, ceramic pipe, clinker, glass, plastic, foam and asphalt. In addition, plastic food wrappers were present within the made ground seen in borehole BH2.

It may be appreciated that trialpit TP6 terminated within this layer due to the pit side becoming unstable. Moreover, trialpit TP7 was excavated in the rough ground near the site entrance which represents an area of sloping ground. With respect to the very thin layer of made ground found in TP8 at the top of the incline, it is considered that the significant thickness of made ground in TP7, 2.4m, represent fill which makes-up the slope.

It should also be noted that in general terms, the made ground was found to be thinner toward the north-eastern site edge (away from the slope), deepening toward the south-western site edge (at the slope crest). Moreover, along the slope crest running the site length, the made ground appeared to be at maximum thickness toward the centre (in the vicinity of BH2).

7.2 **Concrete**

Below the made ground in TP4, a 150mm thick layer of concrete was observed.

7.3 **Probable Soliflucted Material**

Underlying the made ground in BH1 and BH2, a 200mm to 350mm thick layer of soft yellowish brown slightly sandy silty clay with sandstone gravel was recovered. Similarly, directly below the made ground in BH3, a 520mm thick layer of yellowish brown clayey very sandy gravel of sandstone and coal was present. It should however be appreciated that the gravel fraction of these layers did not have any structure and was generally orientated randomly. As such, it is felt that these layers are unlikely to represent the weathered horizon of the Rough Rock, expected to underlie the site, unless some disturbance has occurred. Moreover, whilst these

layers could represent the base of the made ground, no anthropogenic material was present.

In light of the above, it is reasoned that the above materials most likely characterise material which was deposited on the sloping rockhead below the site through the process of solifluction, prior to the placement of the made ground. Notwithstanding this, it is felt beyond the scope of this investigation to clearly define the precise origin of these layers; therefore, these materials have been considered as probable soliflucted material.

7.4 Rough Rock

On penetrating the made ground (including the concrete in TP4), at all locations except TP2, TP6 and BH1 to BH4, brown and brownish grey slightly sandy slightly gravelly clay/silt, slightly sandy slightly gravelly clay and silty gravelly sand was encountered. The gravel fraction of these soils was fine to coarse sub-angular to angular micaceous sandstone. This layer was full proven to depths of 1.65m in TP1 and present to the termination depths of TP3, TP4, TP5, TP7, and TP8 at between 1.3m to 2.9m below ground. It is felt that this layer characterises the weathered horizon of a sandstone rockhead.

Beneath the weathered Rough Rock in TP1, the probable soliflucted material in BH1 to BH3, and the made ground in TP2 and BH4, extremely weak and very weak dark grey and brown thinly laminated to thinly bedded micaceous rippled bedded fine and medium grained sandstone was present. This material was seen to the termination depth of TP1 and TP2 at 1.6m and 2.2m below ground level. From 4m to 7.5m in boreholes BH1 to BH4, grey and brown sandstone was underlain by medium strong and strong cross-laminated greyish brown striped dark grey fine grained micaceous sandstone with sub-horizontal to 25° dip discontinuities.

With respect to the published geological data for the site, it is considered that the above strata represent the Rough Rock anticipated to be present below the site.

7.5 Groundwater

No groundwater was encountered during the investigation, however, it should be appreciated that the normal rate of excavation 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 and the use of water and mist flushing techniques in the rotary sections of the boreholes may have masked strikes.

8. INSITU TESTING

8.1 Dynamic Probes (Site profiling)

The lines of probing across the site found variable conditions were apparent. The lines of probes in the eastern portion of the site, lines 1 and 2, revealed generally low penetration resistances of between 0 and 3 blows/100mm to depths of around 2m to 3.5m. From these depths in the majority of the probes along line 1, resistances were seen to rapidly increase with effective refusal³ being met at around 4m. With the probes along line 2, from 2m to 3.5m, resistances were seen to gradually increase, albeit with some zones of low blow counts, to about 6m depth where abrupt refusal was met.

Notwithstanding the above, it should be appreciated that the probe DP1 on line 1 was undertaken at the extreme southern edge of the site. This probe recorded 0 to 3 blows/100mm to a depth of 8.3m where abrupt refusal was met. As the location of the probe was at the top of the slope where filling has taken place, it is considered that this probe reflects the condition of the fill material.

Contrastingly, the lines of probes carried out in the western portion of the site, lines 3 and 4, indicated results of 0 to 3 blows/100mm to depths of around 1m to 2m, beyond which resistances rapidly increased with abrupt refusal being met shortly thereafter.

8.2 Dynamic Probes (Adjacent to boreholes)

Probes were also undertaken directly adjacent to three of the boreholes, BH1, BH2 and BH4, and the results typically demonstrated low resistances to penetration of 0 to 3 blows/100mm through the made ground. It may be noted however that in DP1, a zone of higher resistances was apparent in the upper levels.

On encountering the extremely weak thinly laminated to thinly bedded sandstone seen in the boreholes at depths ranging from ≈2m to ≈5m, probes DP2 and DP4 indicated a slight increase in resistances with results ranging between 2 and 5 blows/100mm. In DP1 however, on encountering the extremely weak sandstone at ≈3.5m, results of 0 and 1 blow/100mm were recorded initially recorded, from about ≈5m, an increase to values of 2 to 4 blows/100mm was apparent.

At about 4m to 8m, the probes were expected to have penetrated the strong sandstone revealed at these depths within the boreholes. Resistances were seen to decrease slightly, to 0 to 2 blows/100m, in DP1 on encountering this material but after 0.5m, abrupt refusal was met at 8.5m. In DP2 and DP4, results broadly increased within the upper levels of this material, with variable results of 5 to 22 blows/100mm being observed, and abrupt refusal was met at 8.9m in DP2 and at 4.2m depth in DP3.

³ 25 blows/100mm

8.3 Standard Penetration Tests

In borehole BH3, standard penetration tests were carried out at regular intervals during the windowless sampling. These tests demonstrated variable results through the made ground with results of 8 to 38 blows/300mm being recorded. These results would suggest that the predominately granular (cobbles) made ground is present in a variably loose to dense in-situ condition. However, it must be realised that lower incremental values of the tests are likely to be associated with the cohesive matrix within the made ground, the higher incremental values occurring where cobbles were encountered. As such, it is considered that the SPTs recorded may not be wholly representative of the mass characteristics of the made ground.

9. LABORATORY TESTING - GEOTECHNICAL

A programme of laboratory testing has been undertaken in accordance with BS1377 unless indicated otherwise and the results are provided in Appendix 6. The test results are summarised below and the results have been used to assist in the formulation of the discussion of ground conditions.

9.1 Moisture Content Determinations (Part 2 : 1990 : 3)

Selected samples of the cohesive fraction of the made ground have been subjected to moisture content determinations. The results illustrate that these soils yielded natural water contents ranging between 16% and 19%.

9.2 Index Property Tests (Part 2 : 1990 : 4, 5 and 6.5)

The liquid and plastic limits of the samples of the cohesive made ground have been determined. The results of the testing yielded liquid limits of 32% to 36%, along with plastic limits of 22% and 23%. Therefore, with respect to the associated moisture contents, consistency indices of 1.4 to 1.8 were evaluated. The linear shrinkage test conducted on the sample indicated that this soil exhibits a relatively low shrinkage potential.

These results demonstrate that these cohesive soils may be generally classified as clay of generally low plasticity. Moreover, on the basis of the consistency indices these soils are suggested to have a very stiff consistency⁴. However, it should be appreciated that a significant percentage of material greater than 425µm was present in the samples which will have affected the moisture content phase relationship. Furthermore, it should also be noted that the significant proportion of silt was present within the finer fraction of the soil will have affected the plasticity and thus plastic limit. With this in mind it is considered that the consistency indices determined are likely to be elevated.

⁴ BS EN ISO 14688-2, Table 6 – Consistency index of silts and clays

In addition, the NHBC classification⁵ indicates that the clay revealed at this site possesses a low volume change potential in the most onerous case.

9.3 Particle Size Distribution (Part 2: 1990: 9.2)

A sample of the possible soliflucted material has been subjected to a sieve analysis in order to establish the particle size distribution. The results of these tests indicate that this material may be classified as multi-graded (well-graded) slightly clayey/silty very sandy gravel.

9.4 Uniaxial Compressive Strength (ASTM D2938-95)

Samples of the rock recovered from the rotary coring have been subject to uniaxial compression strength (UCS) testing. The results of these tests, undertaken on rock from 6.7m in BH3 and 7.3m in BH4, yielded UCS values of 44MN/m² and 45MN/m² which indicates medium strong compressive strengths.

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

Point load strength index tests (ISRM Suggested Method, 1984) were also undertaken on the rock recovered from the rotary boring operations. The approximate unconfined compressive strength (UCS) can be found on the test results sheet. When using this information the orientation of the test is important; for foundation design axial results are most useful as the diametral results often reflect the weaker bedding planes within the rock mass.

Point load indices (I_{s50}) obtained from the rock in the axial orientation were found to range between 0.6MN/m² and 3.6MN/m² (approximating to equivalent UCS values of 12MN/m² to 72MN/m²), which would suggest the rock may be characterised as weak ranging to strong. Indices obtained from tests conducted on the diametral orientation of the rock were found to range between 0MN/m² and 1.2MN/m² (approximating to equivalent UCS values of 0MN/m² to 24MN/m²), which would suggest in this plane the material is behaving in an extremely weak to weak manner.

Notwithstanding the above, it should be appreciated that a number of tests indicated that the specimen failure was not valid under the ISRM methodology. As such, when considering these results, some caution is advised as an uncharacteristically low result may have been recorded.

9.6 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 0.11% and 0.54% and soluble sulphate contents of 0.075g/l

⁵ NHBC Standards, Chapter 4.2, *Building near trees*, Table 1 – Volume change potential

(75mg/l) to 0.89g/l (890mg/l) were recorded, these being associated with pH values of between 7.7 and 9.2.

10. **HISTORICAL MAPPING**

In order to establish suitable locations for the boreholes, historical maps were obtained for the site with a view to ascertaining locations which would attempt to find the rockhead below the historical built area. In this process, the historical maps were reviewed to determine other details which may assist the investigation and a summary is provided below.

The earliest map sheets available for the site are dated 1893 (1:2500) and 1894 (1:10000). At this time, it can be seen that Johnny Moore's Hill road runs northwest/southeast along the northern edge of the site from the eastern corner where it adjoins Brow Road (later to become Upper and Lower Brow Road). Mid-length along the site the road turns north toward the embankment of the Huddersfield to Manchester railway line. At the base of the railway embankment, the road passes below the railway in an apparent tunnel.

A line of structures (most likely houses) are present along the northern side of Johnny Moore's Hill road where it passes through the site, although no structures are present passed the turn in the road toward the railway. To the south of the road, there are a few scattered structures which presumably sit within the slope present to the south and west of Johnny Moore's Hill Road. There are a number of rows of structures immediately to the north of the site and a pathway runs from Johnny Moore's Hill Road round the base of the slope to the south and west of the site, connecting with another path to the tunnel below the railway.

From the c.1890s to 1918, little appears to change at the site except for the structures to the south of Johnny Moore's Hill Road, where further larger structures appear to be added.

There is a considerable gap in the available 1:2500 scale map data with no mapping being available between c.1918 and c.1960. Notwithstanding this, the 1:10000 scale maps suggest little changes until c.1956. From c.1960 no buildings are present immediately to the north of Johnny Moore's Hill Road and many of the buildings to the north of the site are also no longer there, although the northern most structures are not indicated as 'ruins'. A number of structures have also disappeared to the south of Johnny Moore's Hill Road, although two smaller structures have appeared. Between c.1960 and c.1993 the site and the surrounding area appears to become devoid of any structures except for the two smaller south of Johnny Moore's Hill Road, although Johnny Moore's Hill Road itself is no longer shown. This being said, the linear features shown on the map sheets suggest that the topography of the site does not significantly change.

By c.1995, a structure is present in the eastern end of the site which is indicated to be 'Manashay', further structures are present toward the western end of the site, following the old line of the now removed Johnny Moore's Hill Road, which are demarked as 'kennels'.

11. LABORATORY TESTING - ENVIRONMENTAL

A suite of testing was conducted on samples from across the site and the following regime was undertaken.

- Metals – Cd, Cr^{VI}, 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 SO₄²⁻.
- Asbestos screen.

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

12. DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL

It is understood that the development may comprise the construction of residential dwellings with associated car parking, driveways and an access road. At the time of writing this report the precise construction details have not been finalised, thus the discussion below is of a generalised nature. Notwithstanding this, a proposed site layout indicates that three house plots (plots 1 to 3) may be located on the elevated area where the site adjoins Upper Brow Road, four house plots (plots 4 to 7) are located adjacent to Manashay extending in a line into the site in front of the existing gabion wall and two further plots (plots 8 and 9) will be present beyond the corner in the site at the northern end. In order to provide access to the plots beyond Manashay (plots 4 to 9), the existing road into the site from Upper Brow Road will need to be extended in front of the proposed house plots.

In regard to the retaining walls on the north-eastern and eastern edge of the site i.e. the gabion basket wall and the blue brick and stone retaining wall, it should be appreciated that these structures have been present at the site for a substantial time. Whilst it is noted that no structural distress or movement is obvious with these walls, a detailed assessment of the condition of these structures has not been considered during this investigation.

Furthermore, it appears that the rockhead level from the line of the former houses at the site (similarly to the proposed line of plots 4 to 7) to the crest of the slope along the south-western edge drops from 1m to 2m below ground, to around 4m to 5m.

The dynamic probes, however, do suggest that in general terms the upper surface of the rockhead is dipping at relatively shallow angles until the south-western edge where there is a pronounced drop-off. From the data obtained in this investigation, it is surmised that the rockhead generally represents a cliff of rock, albeit buried below made ground, the upper surface of which dips at $\approx 15^\circ$, although steepens to $\approx 30^\circ$ toward the centre of the site.

12.1 Foundations

It should be appreciated that this investigation has demonstrated that there is a variable capping of made ground present across the site. It cannot be recommended that foundations be constructed directly within the made ground as 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.

Whilst in general terms the Rough Rock was found to be present below the made ground, there were variations in the nature of the rockhead, indicating that the different areas of the site need to be considered discretely.

12.1.1 Eastern tip of site (Plots 1 to 3)

Trialpit TP8 has demonstrated that at the elevated site level in the eastern tip of the site, silty gravelly sand, i.e. weathered rockhead, is present at shallow depths (0.4m) below the made ground capping. It should be noted however, that an older cellar wall impeded the excavation of the trialpit beyond 1.7m. In trialpit TP7, undertaken at the lower level within the eastern tip of the site, a significant thickness of made ground was apparent and it is expected such material represents the slope between the elevated level and the lower level. Below the made ground a thin capping of sandy gravelly silty clay was present above the sandstone rock seen in the base of the trialpit at 2.9m.

As there could be a number of construction options for the proposed dwellings in this area, it is not clear whether the properties will be constructed on the elevated or lower level, or split level. Moreover, it is apparent that some consideration will need to go into the removal of the buried structures seen at this location (TP8). However, it is considered that the sand on the elevated level, from 0.4m in TP8, would make a suitable bearing stratum. Equally, the rock below the made ground and weathered clay horizon seen in TP7 would also make a suitable bearing strata.

Notwithstanding this, depending on the type of construction, some caution will be required as whilst some settlement should be anticipated in the sand, the settlement of foundations on rock would be minimal, thus differential settlement is likely to occur.

On the basis of the above, should the proposed dwellings be located entirely at the elevated level and foundations be constructed wholly within the sand, it is considered that shallow strip and spread footings could be employed for typical house loads. Notwithstanding this, on the basis that old cellars may need to be

removed from the area, it may be prudent to re-assess potential foundation designs once such an operation is complete.

If it transpires that the dwellings in this area are to be split level or constructed wholly at the lower level, then it is considered that foundations be extended to the underlying rockhead.

12.1.2 Northern and central portion of site (Plots 4 to 9)

Aside from the eastern tip of the site, the majority of the site was underlain by rockhead at depths of around 1m to 2m below ground level. It should be noted however that there was some apparent deepening of the rockhead to 2.5m depth toward the south-western site edge, as evidenced by TP3 and TP6. Moreover, whilst there was some weathered horizons above the rockhead, comprising sand and clay, due to the risk of differential settlement, it will be necessary to ensure that foundations are placed directly on to the rockhead, rather than mixing founding strata.

12.1.3 Comments

It is considered that the rockhead will possess a significant bearing capacity, probably being in excess of 250kN/m^2 . Therefore, at a typical foundation load for a house the factor of safety against general shear failure will be high, probably exceeding 10. In addition, it is anticipated that nominal settlements will occur under the action of the proposed increase in load.

Should made ground or any weak zones be revealed in the excavation bases, they should be removed and replaced by suitably compacted granular soil or lean-mixed concrete. Should excavations be required to stand open for any length of time, it will be necessary to place a blinding layer of lean-mixed concrete over the sub-grade. This expedient will reduce loosening or softening of the underling soil due to both physical disturbance and the ingress of surface water.

Should seepages of groundwater be encountered it is considered that they could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

The stability of the excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

12.2 Ground Floors

Due to the nature of the made ground encountered on site it is considered that ground bearing floor slabs could be employed. In this event, however, it is recommended that the sub-grade be proof rolled with a vibrating roller to achieve the required compaction. Any weak soils revealed should be removed and replaced with similarly compacted granular soil.

However, it must be appreciated that the proposed dwellings in the eastern tip of the site (Plot 1 to 3) will need to take into account potential buried structures associated with old cellars. In this case, consideration may be given to the use of suspended ground floor slabs, to bridge over any old walls beneath the site. Alternatively, all of the old structures could be removed during the groundwork phase and the material within the basements replaced with granular fill suitably placed and compacted for a ground bearing slab.

12.3 Access Roads and Car Parking

It should be appreciated that the elevations given on the proposed development plan indicate that there is an approximately 11m height difference between the current site level and the top of the retaining wall at the base of the slope. Given a distance of about 10m from the wall to the edge of the site, this would suggest that the gradient of the slope is currently in the region of $\approx 50^\circ$.

In light of the above, there is concern that the slope to the south-west of the site is currently steeper than inherently safe angles for the composition of the made ground. Indeed, the boreholes suggest that the slope material is made ground principally comprising clay with gravel and cobbles. On the basis of the laboratory testing, in which relatively low plasticity indices were recorded, such a material would be expected to have a long-term friction angle, ϕ' , in the region of 32° . Whilst the slope below the site may appear to be stable at present, this may be as a result of the apparent cohesion of the made ground, however, over time, effective stress conditions will prevail and the slope is likely to become unstable at the current angle. As a consequence, it is considered that the slope material cannot be relied upon to provide support to the access road and car parking areas, particularly as the introduction of load from the pavement on to the slope material is likely to lower the factor of safety on stability and exacerbate slope instability.

It must be realised however, whilst the rockhead may be present in part below the proposed line of the road, unless the road or car parking areas were to be placed directly on the rock, support to these paved areas would be derived from the material within the slope. Notwithstanding this, given the rock is present at depths of around 4m and 5m below the existing ground level, the road being constructed on the rock would seem impracticable. If the made ground were to be dug out and replaced by engineered fill, the fill would still be deriving support from the slope materials.

As a consequence, it is considered that the road and parking areas could not be constructed in accordance with the current plans, unless support was to be given to the materials above the rockhead. Whilst the road and parking areas could be brought into the site, away from the south-western edge, it would still be reliant on the slope material unless it was placed directly on to the rock, which would be a considerable depth below existing ground level. It is therefore recommended that consideration be given to providing a retaining structure along the south-western edge in order to support soils above the rockhead, on to which the access road and car parking could be constructed.

12.3.1 Retaining Structures

As a result of this investigation, it is evident that the soils on the south-western edge of the site will require some remediation to ensure long term stability below the proposed access road and parking area. It is considered that these soils will require some form of stabilisation such that support from the existing slope the southwest of the site is relied upon. In broad terms there are a number of potential solutions which may be considered. These include:

- Gravity or cantilever retaining walls
- Reinforced earth retaining walls
- Embedded pile retaining walls

Gravity or Cantilever Retaining Walls

It may be possible to construct a gravity retaining wall along the south-western edge of the site to provide support to the soils below the access road and car parking. Clearly, made ground present below this edge of the site could not be relied upon to provide founding support or resistance against sliding for such a wall. However, if the wall were to be extended to the edge of the rockhead below the site, the base could be founded in line with the recommendations given in 12.1. Whilst, the base could not be extended out in front of the wall and into the existing slope, it could be widened to the rear such that sufficient sliding resistance was generated at the base. The wall could be constructed using crib walls, mass or reinforced concrete structures or a combination of facing elements backed by no fines concrete.

If a masonry structure were to be considered, the rear would have to be thickened toward the bottom, such that sufficient mass was projecting into the site (toward the northeast) and providing moment and sliding resistance. Moreover, it would be necessary to ensure that the masonry wall has structural continuity to behave as a singular mass.

Alternatively, an 'L' shaped wall could be constructed, with the base projecting back into the site. The base would be required to provide sufficient sliding resistance and soils above the base would need to impose adequate vertical load to the base to

resistance overturning. To construct the wall, concrete could be cast into a temporary form-work along with suitable reinforcement to form.

With the use of a gravity or cantilever wall, it would be necessary to temporarily excavate the made ground along the line of the wall to rockhead. In light of this, the made ground and weathered fraction of the rockhead should be temporarily battered back to an angle of 30° and it is recommended that the level of the existing slope to the front of the wall be reduced to the wall base. Whilst the slope material could be re-placed in front of the wall after construction, it should not be relied upon in the stability calculations for the wall. Once the wall construction is complete, the retained area to the rear of the wall can be filled with well compacted granular material to act as a drainage layer.

Reinforced Earth Retaining Walls

It would also be possible to construct a simple reinforced earth retaining structure along the south-western edge of the site. This method typically involves excavating a significant amount of material behind the wall and replacing it in layers with appropriate reinforcement (i.e. a geo-textile or geo-grid) which connects to the wall. 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. However, if this approach were to be considered further, then it may be possible to temporarily excavate the soils below the site to rockhead, then build the reinforced earth wall and construct the access road and parking on top. Again, it would be necessary to reduce the level of the crest of the slope to the southwest of the site during the construction and again whilst this material could be replaced, its presence should not be attributed to the stability of the wall.

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.

Embedded Pile Retaining Walls

Consideration may also be given to the use of contiguous piles to form the wall. This expedient employs a line of closely spaced piles which cantilever against the soil or rock below the slope in order to support the retained soil. The piles are installed from ground level and once cured, and correctly designed, will provide support to the access road and car parking areas, irrespective of the stability of the slope. One advantage of this wall type is that as the piles are installed from ground level, there is no land-take to the rear of the wall. The advice of a specialist piling contractor should be sought; however, it will be necessary to install the contiguous piles into the underlying rockhead. As such, it is not considered that sheet piles could be employed successfully and the use of drilled piling techniques, such as Odex or Symmetrex, will be necessary. The contiguous piles should be connected at the head by a capping beam and design should consider the stability of the wall in the event of failure of slope to the south-west. Moreover, the slope to the south-west should not be taken to wholly provide passive resistance, traditionally the

design of a slope in front of an embedded wall is achieved by using modified earth pressure values, however, consideration may be directed to modelling the slope as a berm.

As the earth pressure loads and the imposed loads from the access road and car parking are being transmitted to depth, the wall would not necessarily have to be constructed along the line of the rockhead. Indeed, it would be possible to extend the line of the contiguous pile wall out from the existing edge of the site increasing the site width. However, it must be realised that the further out from the existing site edge, the greater the depth to rockhead, particularly in view of the apparent drop-off in the rockhead below ground. As a consequence, the required reinforcement and pile length would increase as depth to rockhead increases, thus it is likely that the cost for the wall construction would rise considerably.

Retaining Wall Comments

It should be appreciated that the upper levels of the rockhead were found to be laminated which represent near horizontal planes of weakness through the rock. As such, some caution will be required in design to ensure that sufficient sliding resistance or passive resistance can be provided without the failing the rock along such planes.

In addition, the efficacy of the retaining wall could be improved by the use of ground anchors angled and drilled into the rock behind the wall or dead-man anchors running horizontally out from the wall gaining sliding resistance from the relatively shallow rockhead in the north-east of the site. Moreover, if the laminations in the rockhead are felt to represent a significant risk to the sliding or passive resistance of the walls, anchors could be employed to reduce the horizontal load on the base of walls or the passive zone of embedded walls.

For provisional costing purposes, the soil parameters given in the table below may be used. Whilst a drainage layer behind the wall could be connected to weep-holes, unless maintenance can be guaranteed throughout the life of the structure, hydrostatic pressure from surface run-off should be considered in design. Moreover, some caution will be required in regard to the outflow from any drainage at the front of the wall into the slope on the south-western site. The addition of water to the slope may induce instability and whilst this should not affect the stability of the retaining wall itself, it could result in problems at the base of the slope. As such, any drainage from the wall should be carefully channelled away from or pipe through the existing slope.

As the wall will represent permanent structure at the site, effective stress parameters should be adopted.

Table 3: Effective Stress Parameters

Description	Bulk unit weight, γ (kN/m ³)	Angle of friction, ϕ' (°)	Effective cohesion c' (kN/m ²)
Made Ground (Cohesive)	18	28	0
Well Compacted Granular Backfill (No clay or silt content)	20	36	0

12.4 Soil Volume Change Potential

It should be appreciated that the cohesive made ground was found to possess low volume change potential under the guidance of the NHBC standards in the most onerous case. It will therefore be necessary to ensure that foundations placed within the cohesive made ground are designed in accordance with the Chapter 4.2 of the standards⁶. The methodology provided in the guidance will require the identification of any trees, still present at or recently removed from the site, and the distance from the proposed foundations. Foundations lying inside the zone of influence of the existing or proposed vegetation should be constructed at minimum depths determined from the guidance.

In this case it has been recommended that the foundations be placed onto the rock-head which will have limited volume change potential. However, there may also be a requirement for heave protection to be employed against the sides of the foundations and below the underside of the floors and beams.

12.5 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 C2⁷, 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-2 requirements. Assuming mobile groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-2.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1⁸, 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-2 is required.

⁶ NHBC Standards, Chapter 4.2, *Building near trees*

⁷ Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brown field sites*

⁸ 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. **DISCUSSION OF GROUND CONDITIONS - ENVIRONMENTAL**

13.1 **Discussion of Test Results**

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

13.1.1 **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 website⁹ and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 7. These results indicate the following:

Table 4: Summary of contaminated areas.

Position	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
TP1	Lead, PAH(chrysene, benzo[b]fluoranthene, benzo[a]pyrene, indeno[1,2,3-c,d]pyrene, dibenz[a,h]anthracene, benzo[g,h,i]perylene).
TP5	None.
TP6	Lead, PAH(pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-c,d]pyrene, dibenz[a,h]anthracene, benzo[g,h,i]perylene).
TP8	Lead, PAH(benzo[a]pyrene).

Concentrations of chromium^{VI}, selenium, free cyanide, phenols and petroleum hydrocarbons (aliphatic C5 to C35 and 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.

It should be appreciated that the soil screening values for the PAHs represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure which is unlikely to significantly affect the combined assessment criterion¹⁰. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion given by CLEA if free product is not observed, the values for which are also provided on the summary of contamination analysis. In this case, no free product was observed with the higher

⁹ <http://www.atrisksoil.co.uk/pages/general/subscribers.asp>

¹⁰ Ref: ATRISK soil, SSVs derived using CLEA v1.04 for 6% SOM, Residential with home grown produce land use, 14.12.09.

results likely to be associated with the clinker observed in the fill, therefore considered that the CLEA criteria should be adopted for the PAHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 5: Summary of areas contaminated by PAHs.

Position	Contaminants found to be exceeding CLEA Criterion (Residential with Plant Uptake)
TP1	PAH(benzo[a]pyrene).
TP5	None.
TP6	PAH(benzo[a]anthracene , benzo[a]pyrene, dibenz[a,h]anthracene).
TP8	PAH(benzo[a]pyrene).

n.b. It should be appreciated that of the chosen set of CLEA screening values does not include limits for benzo[a]anthracene and benzo[a]pyrene, therefore the Atrisk values have been considered.

On the basis of all the information provided above, it is considered that the site is contaminated by lead and some PAHs.

However, it should be appreciated that *benzo[a]pyrene occurs naturally in crude oils, shale oils and coal tars, and is emitted with gasses and fly ash from active volcanoes*¹¹, however, *there is no commercial production of benzo[a]pyrene or known uses for it, it is released into the environment as a product of incomplete combustion of organic materials*¹². Hence, the conclusion that this contaminant is associated with the clinker present within the made ground. Moreover, it may further be appreciated that the extrapolated vapour pressure indicates that, *if released to air, benzo[a]pyrene will exist solely in the particulate phase. Particulate-phase benzo[a]pyrene will be removed from the atmosphere by wet or dry deposition*. In addition, benzo[a]pyrene is expected to have *low to no mobility in soil and volatilisation from moist or dry surfaces is not expected*¹³. In light of the above, whilst the exposure pathway of benzo[a]pyrene may be consider to be likely via the inhalation of dust (and of vapours during the combustion of organic materials), the ingestion of soil and dust, and dermal contact, the pathway for this contaminant via soil bound vapour release and mobile migration may be considered much less likely. This is similarly the case benzo[a]anthracene and dibenz[a,h]anthracene, which are also not believed to represent a significant risk via the vapour pathway.

¹¹ National Center for Biotechnology Information (NCBI); Compound Summary for CID 2336 (Benzo(a)pyrene); 11.2.3 *Naturally occurring sources [online resource from <https://pubchem.ncbi.nlm.nih.gov>]*

¹² National Center for Biotechnology Information (NCBI); Compound Summary for CID 2336 (Benzo(a)pyrene); 11.2.2 *Environmental Fate/Exposure Summary [online resource from <https://pubchem.ncbi.nlm.nih.gov>]*

¹³ National Center for Biotechnology Information (NCBI); Compound Summary for CID 2336 (Benzo(a)pyrene); 11.2.5 *Environmental Fate [online resource from <https://pubchem.ncbi.nlm.nih.gov>]*

13.2 Site Specific Risk Assessment

13.2.1 Approach

The presence of contamination hazards and the risks associated with them should be 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 Agency¹⁴ advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.¹⁵ 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.'¹⁶

13.2.2 Conceptual Ground Model

In view of the results of the chemical testing undertaken a conceptual site model has been produced. On the basis that no obvious signs of contamination from off-site sources were observed during the fieldworks, the source for any contamination at the site has been considered to be the made ground on-site.

Table 6: Potential Harm to Humans and Animals (fauna)

SOURCES: MADE GROUND CONTAMINATION: LEAD, PAHS		
Pathways	Receptor	Linkage Present?
Direct contact/dermal absorption/soil ingestion	Operative	Yes – contamination found to be present at the site and contact with soil likely during works.
	End User	Yes – contamination found to be present at the site and site to be developed into residential housing with garden areas.
	Neighbours	Yes – contamination found to be present at the site and a populated residential area adjoins the site.

¹⁴ 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'.

¹⁵ 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.

¹⁶ See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils, although the contamination found is unlikely to represent a significant vapour risk.
	End User	Yes – dust may be derived from contaminated soils, although the contamination found is unlikely to represent a significant vapour risk.
	Neighbours	Yes – contamination found to be present at the site and residential properties located within 250m radius of the site and possible inhalation of dust during the works.
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or water sources seen in the area of the proposed new works during the fieldworks.
	End User	Yes – contamination found to be present at the site and site to be developed into residential housing with garden areas.
	Neighbours	Yes – contamination found to be present at the site and densely populated residential area adjoins the site.

Table 7: Potential Harm to Controlled Waters and Groundwater

SOURCES: MADE GROUND CONTAMINATION: LEAD, PAHS		
Pathways	Receptor	Linkage Present?
Spillage/loss/run off direct to receiving water	Controlled Waters	No – no surface sources of contamination observed during the fieldworks.
Migration via permeable unsaturated strata	Controlled Waters	No – the contamination is not anticipated to be significantly mobile.
Run off via drainage/sewers etc	Controlled Waters	No – contamination is not anticipated to be significantly mobile.

Table 8: Potential Harm to Plants (flora)

SOURCES: MADE GROUND CONTAMINATION: LEAD, PAHS		
Pathways	Receptor	Linkage Present?
Direct contact with contaminated soils	Plants	Yes – significant contamination present at the site which may be phototoxic.
Uptake via root system	Plants	Yes – significant contamination present at the site which may be phototoxic.

Table 9: Potential Harm to Buildings/Structures

SOURCES: MADE GROUND CONTAMINATION: LEAD, PAHS		
Pathways	Receptor	Linkage Present?
Direct contact with contaminated soils	Building Materials	Yes – whilst contamination revealed at the site is not considered to represent a significant risk to building materials or plastic water pipes, testing indicates that the aggressive chemical environment for concrete classification is AC-2.
Direct contact with contaminated groundwater	Building Materials	Yes – whilst contamination revealed at the site is not considered to represent a significant risk to building materials or plastic water pipes, testing indicates that the aggressive chemical environment for concrete classification is AC-2.

13.2.3 Risk Assessment

The risk assessment has been evaluated with reference to the following ratings and definitions:

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 could be necessary.

Table 10: Site Specific Risk Assessment

SOURCES: MADE GROUND CONTAMINATION: LEAD, PAHS			
Pathways	Receptor	Risk Rating	Notes
Direct contact/dermal absorption/soil ingestion	Operative	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User		
	Neighbour		
Inhalation of Dust/Vapours	Operative	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User		
	Neighbours		
Ingestion of fruit/vegetables and/or waters	End User	High	Some contamination is present underlying the site. Precautionary measures will be required in gardens and landscaped areas during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	Neighbour	Moderate	
Direct contact with contaminated soil	Plants	High	Contamination is present underlying the site. Remediation will be required to either remove contamination sources or break pathways.
Uptake via root system	Plants		

Direct contact with contaminated soils	Building Materials	Moderate (Plastic services)	Contamination is not expected to represent a significant risk to buried plastic water services; however, it may be necessary to carry out further testing and a risk assessment to satisfy statutory undertakers.
Direct contact with contaminated groundwater	Building Materials	High (Concrete)	Some concentrations of sulphates noted. Concrete class AC-2.

13.3 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.

13.3.1 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.
- To protect the end user and neighbours from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect the garden plants from contaminated ground and to protect the end user from the ingestion of contaminated fruit and vegetables.
- To protect buried concrete from elevated levels of sulphates.

13.3.2 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 residential properties with gardens. 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.

13.3.3 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.
- Plastic services should be constructed in a surround of clean inert material and should be placed at the site in accordance with the United Kingdom Water Industry Research (UKWIR) website under Report Ref. No. 10/WM/03/21 - 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-2.

Soft Landscaped and Garden 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 a minimum 500mm of inert material, which provide a suitable

growing media for vegetation. At the base of this layer a granular capillary break of a minimum 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 600mm of the soil to an appropriate landfill, replacing it with clean inert fill. It should be appreciated that the landfill operator may require Waste Acceptance Criteria (WAC) testing to be undertaken, prior to accepting the material. Alternatively, the site level could be raised by the same amount using inert material, as described above.

Comments

Where the construction requirements and final development plans suit, the above approach may be employed as a finalised site specific strategy. Should it be necessary to tailor the strategy to suit the construction requirements, it is recommended that the above be employed as an initial basis.

13.4 Fill Materials

It should also be appreciated that any fill material, either site-won or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

Fill materials should be initially screened, by a suitably qualified engineer, for the following.

- It is a suitable growing medium where is to be employed as such, including compliance with BS3883 (2007)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YAHPAC¹⁷ documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

¹⁷ Sampling & Testing Matrix of Yorkshire and Humberside Pollution Advisory Council, 2013, YAHPAC *Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems v2.1*, Appendix 1a.

Table 11: Validation sampling and testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr ^{VI} , Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m ³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m ³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m ³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

The screening values for the above regime should also be agreed with any regulatory bodies; however, the following is recommended in the first instance.

Table 12: Fill screening values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)	Reference
As	32	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Cd	10	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Cr ^{VI}	14.7	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Cu	4020	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Hg	1	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Ni	130	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Pb	168	Atrisk ^{SOIL} SSVs, 6% soil organic matter
V	115	Atrisk ^{SOIL} SSVs, 6% soil organic matter
Zn	17200	Atrisk ^{SOIL} SSVs, 6% soil organic matter
TPH CWG	See contamination analysis sheet	Atrisk ^{SOIL} SSVs, 6% soil organic matter
PAH 16 USEPA	See contamination analysis sheet	Atrisk ^{SOIL} SSVs, 6% soil organic matter

Testing should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP should be obtained. However, it will be necessary to ensure that this documentation specifically related to the material being imported, it is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials should be either placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

13.5 Verification Report

In order to demonstrate that the remedial works and provision of clean cover has been sufficiently carried out where applicable, it will be necessary to produce a verification report for submission to any statutory authorities.

It will be necessary for this report to include the following:

- Characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.
- Photographic and logged evidence the clean material has been handled on site and placed in a sufficient thickness over areas where made ground remains. This may be either at the time of placement or after placement by means of hand excavated trial pits. Photographs should include visual site references or reference boards to prove the location and date taken. A measurement reference should be visible in the photographs to substantiate the thickness of material placed. Please note that it may also be necessary to undertake a topographical survey and the requirement for which should be checked with any statutory authorities.

The report detailed above should be produced by a suitably qualified engineer. The number of verification areas for the development should be confirmed with any statutory authorities for the site.

14. RECOMMENDATIONS FOR FURTHER WORK

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with contractors regarding their method for constructing the retaining wall at the site. This may need to include piling contractors as well as retaining wall specialists.
- Discussions with service providers regard the materials suitable for pipework etc.
- Detailed design of the sub-structure.
- Produce a validation report to demonstrate that the geo-environmental risks discussed in this report have been mitigated.

Clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

15. REFERENCES

- British Geological Survey (NERC) (2015), BGS, Keyworth.
Geology of Britain Viewer:
(http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)
Lexicon of Named Rock Units:
(<http://www.bgs.ac.uk/lexicon/>)
- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes*, B.S.I., London.
- British Standards Institution (1999) BS5930: *Code of practice for site investigations, incorporating amendment no.1 (2007) and no.2 (2010)*, B.S.I., London.
- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: *Concrete in aggressive ground*, BRE Press, Garston.
Part C: *Assessing the aggressive chemical environment*.
Part D: *Specifying concrete for general cast-in-situ use*.
- Building Research Establishment. 1999. *Radon: Guidance on protective measures for new dwellings*.
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – SC050021/SR3, *Updated technical background to the CLEA model*. Environment Agency, Bristol.

For and on behalf of
Rogers Geotechnical Services Ltd,

J. Farnsworth BEng, FGS
Senior Geotechnical Engineer

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

APPENDIX 1
SITE PLAN



Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**

 **Rogers Geotechnical Services Ltd**

Site Name:
**Land to the rear of Manashay
Upper Brow Rd, Paddock**

Job No:
J3220/15/E

APPENDIX 2
TRIALPIT RECORDS



Trial Pit Log

Trialpit No

TP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

2.4

Scale
1:50

Client: Shaw & Jagger

Depth
2.20

0.7

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.00 - 0.60	D		0.30			MADE GROUND (Brownish grey, clayey fine to coarse, sub-rounded to angular GRAVEL with cobbles. Gravel and cobbles are of concrete, brick, masonry sandstone, mudstone and ceramic pipe).
				0.75			MADE GROUND (Dark grey, sandy gravelly CLAY/SILT with brick, ceramic pipe and frequent roots).
	1.25	D					Brown, slightly sandy, slightly gravelly CLAY/SILT. Gravel is fine to coarse, sub-angular to angular of sandstone.
	1.65	D		1.65			Extremely weak and very weak, dark grey and brown, thickly laminated to thinly bedded micaceous, rippled bedded SANDSTONE.
	2.00 - 2.10	B		2.20			End of pit at 2.20 m

Remarks: Pipe running north to south on west side of pit at 0.8m depth. Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

2.4

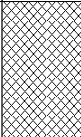

Scale
1:50

Client: Shaw & Jagger

Depth
1.60

0.7

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.70	D		0.90			MADE GROUND (Dark brown and grey, slightly sandy gravelly CLAY/SILT with cobbles and small boulders of masonry sandstone, mudstone and concrete slabs. Gravel is fine to coarse of sandstone, brick, mudstone and clinker).
	1.35	D		1.60			Very weak and extremely weak, thickly laminated micaceous SANDSTONE.
	1.55 - 1.60	B					End of pit at 1.60 m



Remarks: Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

2.2

Scale




1:50

Client: Shaw & Jagger

Depth
2.40

0.7

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.40	D		0.25			MADE GROUND (Brown and light brown, silty slightly gravelly fine to medium SAND. Gravel is fine to coarse, sub-angular to angular of masonry sandstone).
	1.90	D		1.85			MADE GROUND (Dark grey, clayey silty fine SAND with gravel and cobbles of masonry sandstone and brick).
	2.20 - 2.40	B		2.40			Brownish grey, silty gravelly SAND with micaceous sandstone cobbles. Gravel is fine to coarse, sub-angular to angular of micaceous sandstone.
							End of pit at 2.40 m

Remarks: Becomes red-stained at 1.3m. Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

1.95

Scale

1:50

Client: Shaw & Jagger

Depth

1.30

0.7

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.50	D		0.05 0.20			MADE GROUND (Dark grey and brownish grey silty sandy fine to coarse, sub-rounded to angular GRAVEL of brick, concrete, sandstone and mixed lithologies). CONCRETE
	1.25 - 1.30	B		1.30			Brownish grey, very thinly bedded, silty gravelly SAND with rare cobbles. Cobbles are of micaceous sandstone. Gravel is fine to coarse, sub-angular to angular of micaceous sandstone. End of pit at 1.30 m

1
2
3
4
5
6
7
8
9
10

Remarks: Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP5

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):


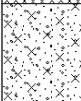
2.2

0.7

Scale
1:50

Client: Shaw & Jagger

Depth
1.95Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.00 - 0.45	D					MADE GROUND (Greyish brown, slightly sandy gravelly CLAY/SILT with cobbles. Cobbles are of brick and sandstone. Gravel is fine to coarse, sub-angular to angular of concrete, brick and sandstone).
				0.55			Greyish brown, very thinly bedded, silty gravelly SAND with cobbles. Cobbles are of micaceous sandstone. Gravel is fine to coarse, sub-angular to angular(tabular) of micaceous sandstone.
	1.45	D					
	1.95	D		1.95			End of pit at 1.95 m

Remarks: Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

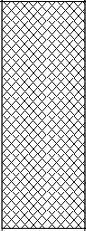
2.5

Depth
1.50

0.7

Scale
1:50Logged
RAP

Client: Shaw & Jagger

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.00 - 0.40	D					
				1.50			MADE GROUND (Dark grey and greyish brown, sandy gravelly CLAY/SILT with cobbles and boulders of masonry sandstone and concrete. Gravel is fine to coarse, sub-angular to angular of sandstone, brick, concrete, glass, plastic, foam, asphalt). <i>Becoming more cobbly and bouldery with masonry sandstone and concrete breeze blocks.</i>
							End of pit at 1.50 m

1
2
3
4
5
6
7
8
9
10

Remarks: Trial pit terminated at 1.5m due to unstable sides of the pit. From 1.3m cobble and boulder sized fragments of sandstone masonry and concrete falling in when material removed below this depth.

Stability: Pit sides unstable from 1.3m.





Trial Pit Log

Trialpit No

TP7

Sheet 1 of 1

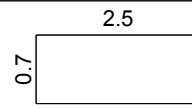
Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

Scale
1:50

Client: Shaw & Jagger

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.35	D		0.35			MADE GROUND (Dark grey and dark brown, silty gravelly fine to coarse SAND with cobbles. Cobbles are of masonry sandstone, brick and concrete).
	0.75	D					MADE GROUND (Light brown, silty gravelly fine and medium SAND with rare cobbles. Cobbles are of sandstone. Gravel is fine to coarse of sandstone, clinker, concrete, brick and coal).
	2.15	D		2.05			MADE GROUND (Brown and greyish brown, silty gravelly SAND with cobbles. Cobbles are of sandstone. Gravel is fine to coarse, sub-angular to angular of sandstone and rare brick and clinker).
	2.55	B		2.40			Brown, silty sandy slightly gravelly CLAY with rare cobbles and boulders of micaceous sandstone. Gravel is fine to coarse, sub-angular to angular sandstone.
				2.90			End of pit at 2.90 m

Remarks: Old ceramic pipe at 0.55m. Refusal due to bedrock in base of trial pit.

Stability:





Trial Pit Log

Trialpit No

TP8

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No. J3220/15/E

Co-ords: -
Level:Date
27/07/2015

Location: Paddock, Huddersfield

Dimensions (m):

3.8

Scale


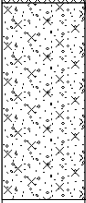
1:50

Client: Shaw & Jagger

Depth
1.70

0.7

Logged
RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.00 - 0.25	D					
	0.45 - 0.60	D		0.40			MADE GROUND (Dark grey and dark brown, clayey sand gravelly SILT with frequent roots and rootlets and cobbles. Cobbles are of brick and masonry sandstone. Gravel is fine to coarse, sub-angular to angular of sandstone, brick, pottery and glass).
	1.45 - 1.50	B					<i>Micaceous sandstone paving with brick layer underneath.</i> Light brown and brown, silty gravelly SAND with occasional rootlets. Gravel is fine to coarse, sub-angular to angular of sandstone.
	1.70	D		1.70			End of pit at 1.70 m

Remarks: Old water pipe at 0.3m. Old electric cable in wooden box at 0.3m and 0.65m. Old cellar wall and ceramic pipe at 0.6m. Refusal at 1.7m due to old cellar walls and pipe.

Stability:



APPENDIX 3

DYNAMIC PROBES



Probe Log

Probe No.

L1 DP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

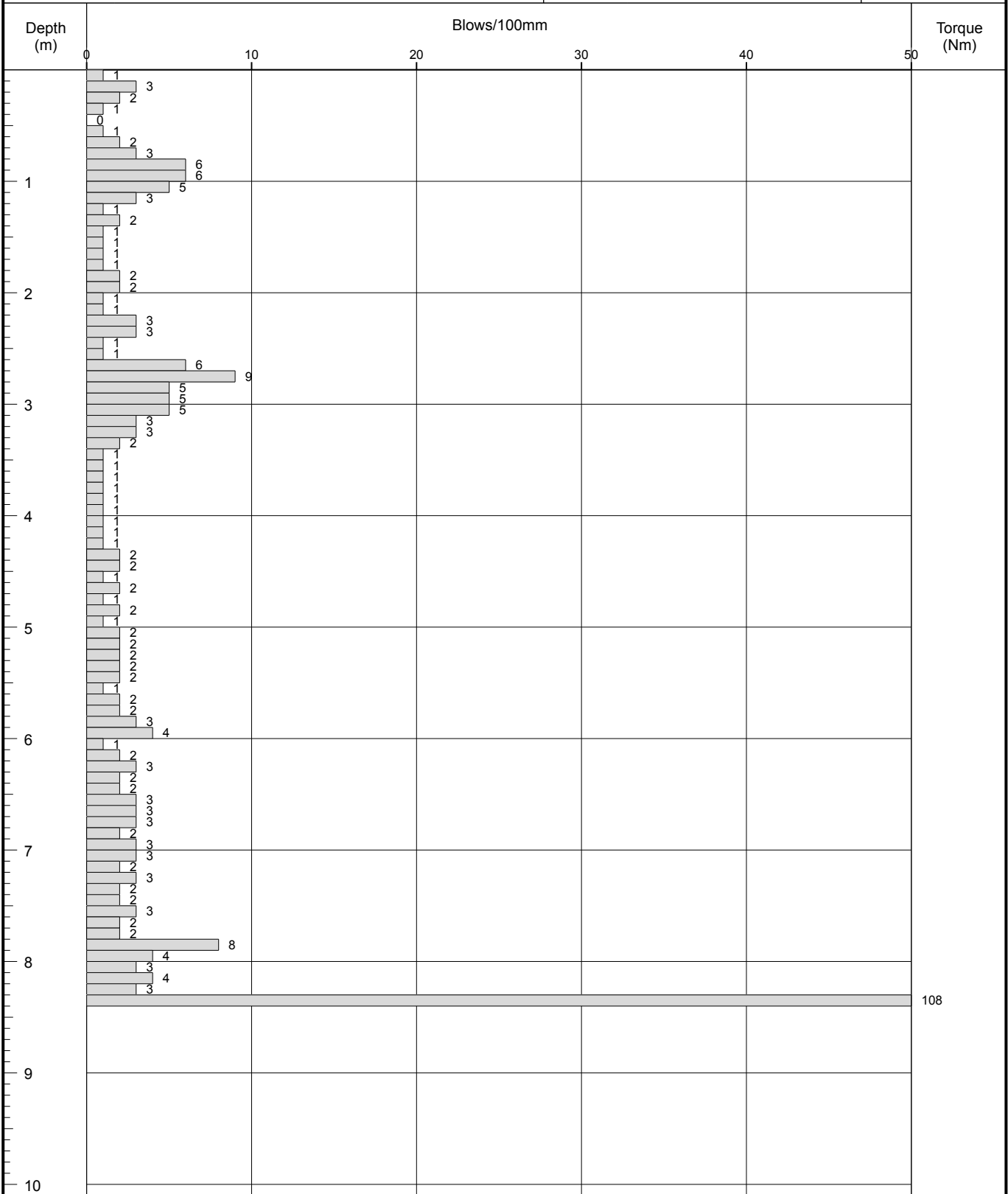
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



108

Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 8.3m

Probe Type DPSH-B





Probe Log

Probe No.

L1 DP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

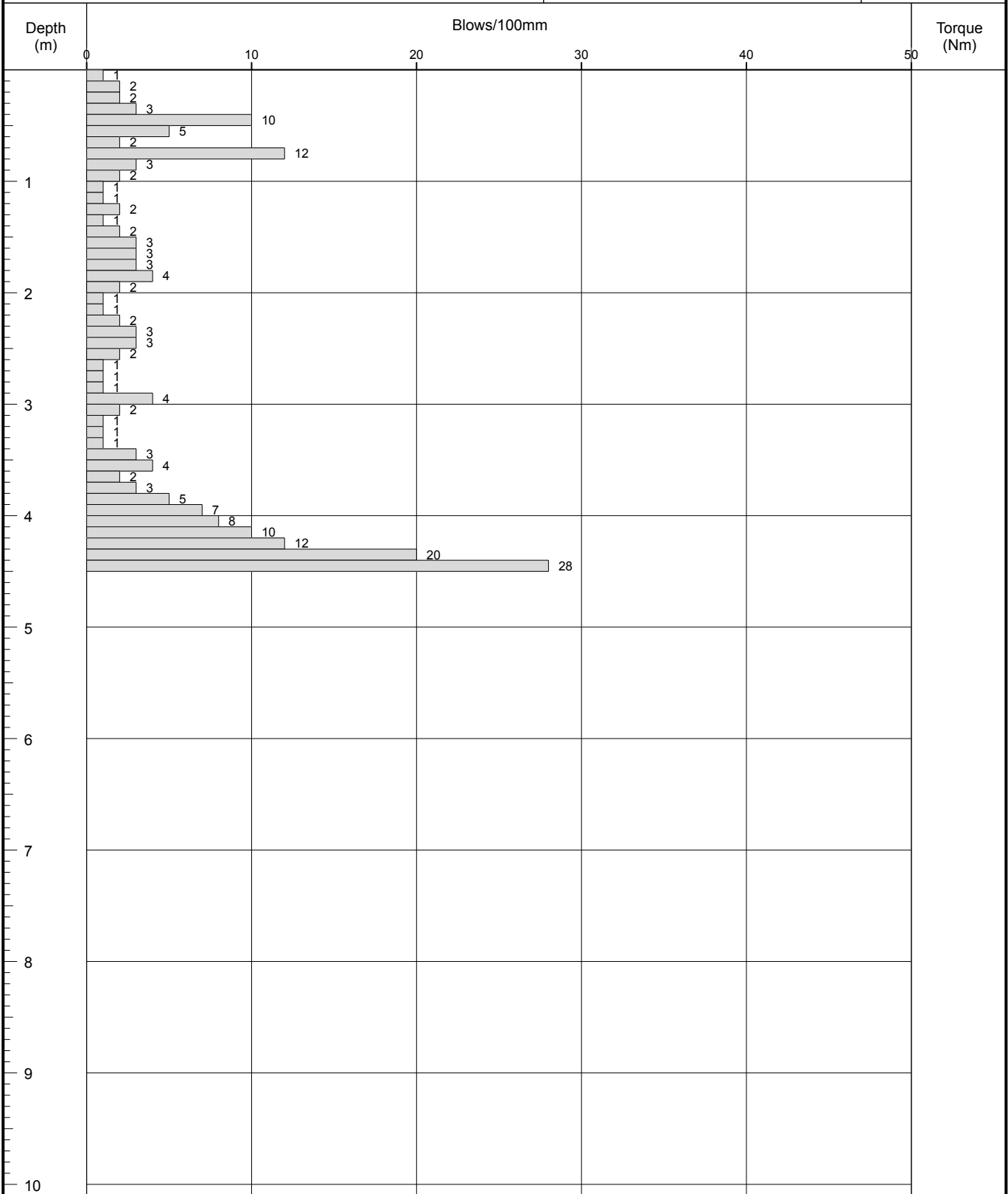
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 4.4m

Probe Type DPSH-B





Probe Log

Probe No.

L1 DP3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

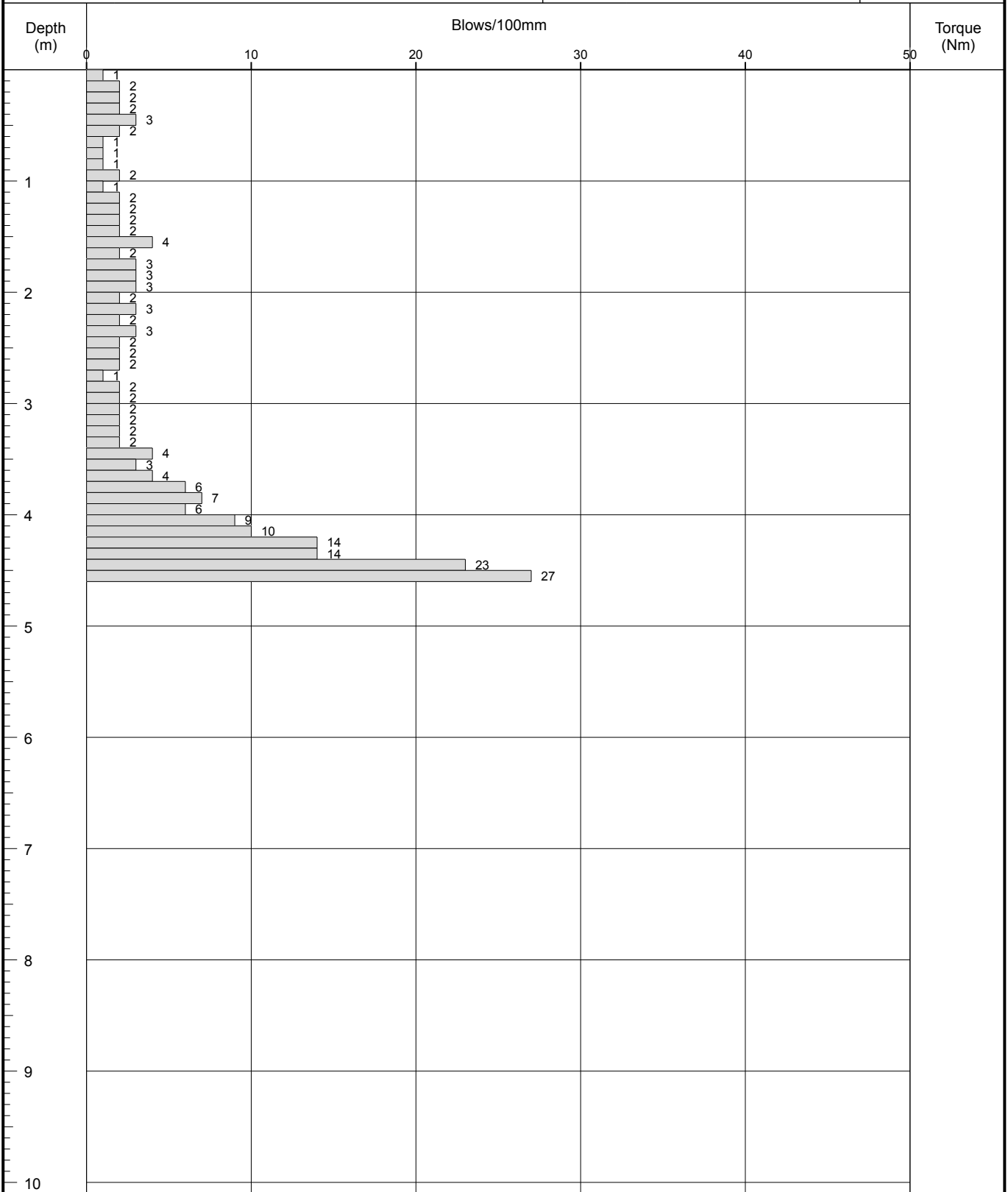
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 4.5m

Probe Type DPSH-B





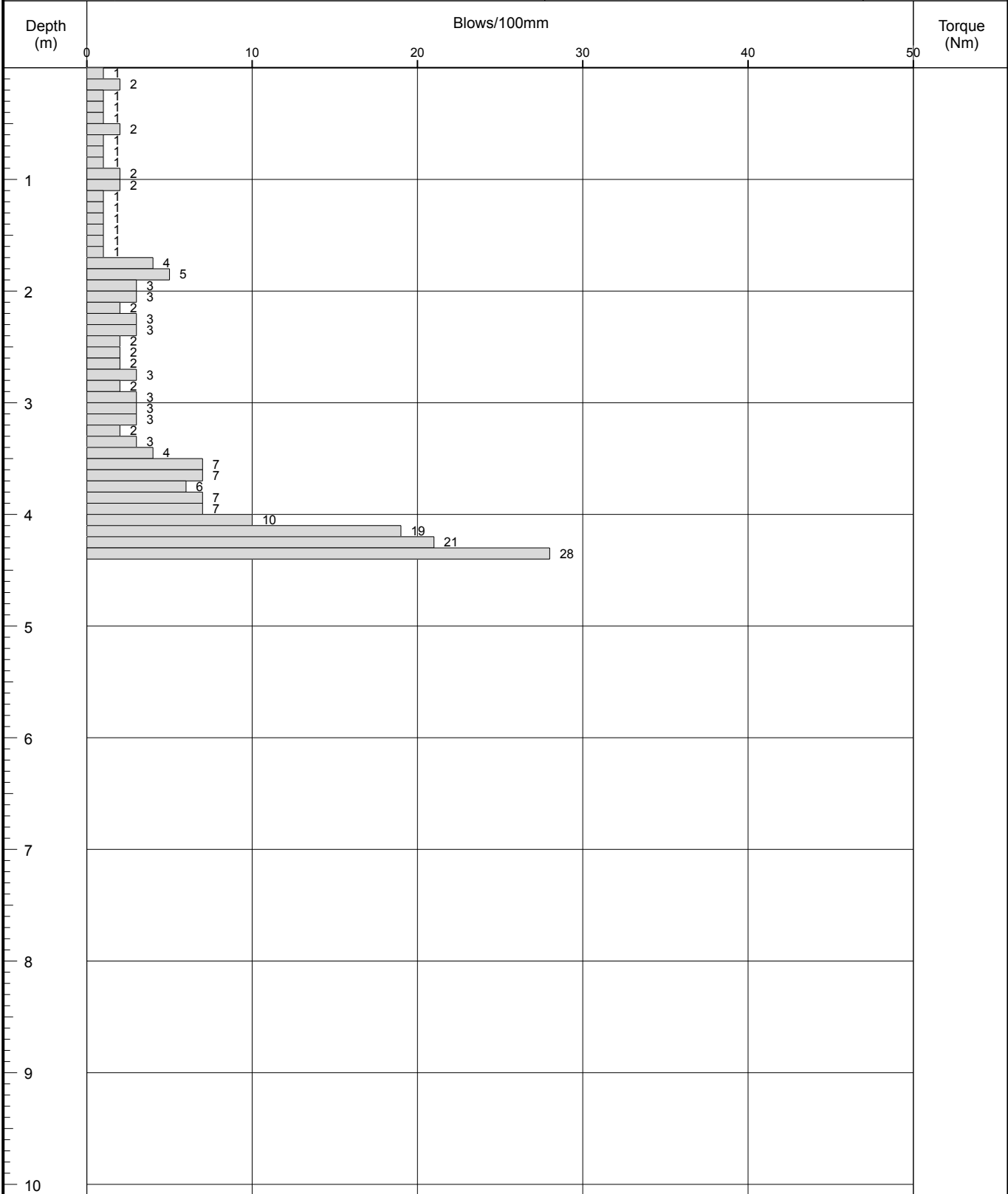
Probe Log

Probe No.

L1 DP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	4.3m
	Probe Type	DPSH-B		





Probe Log

Probe No.

L2 DP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

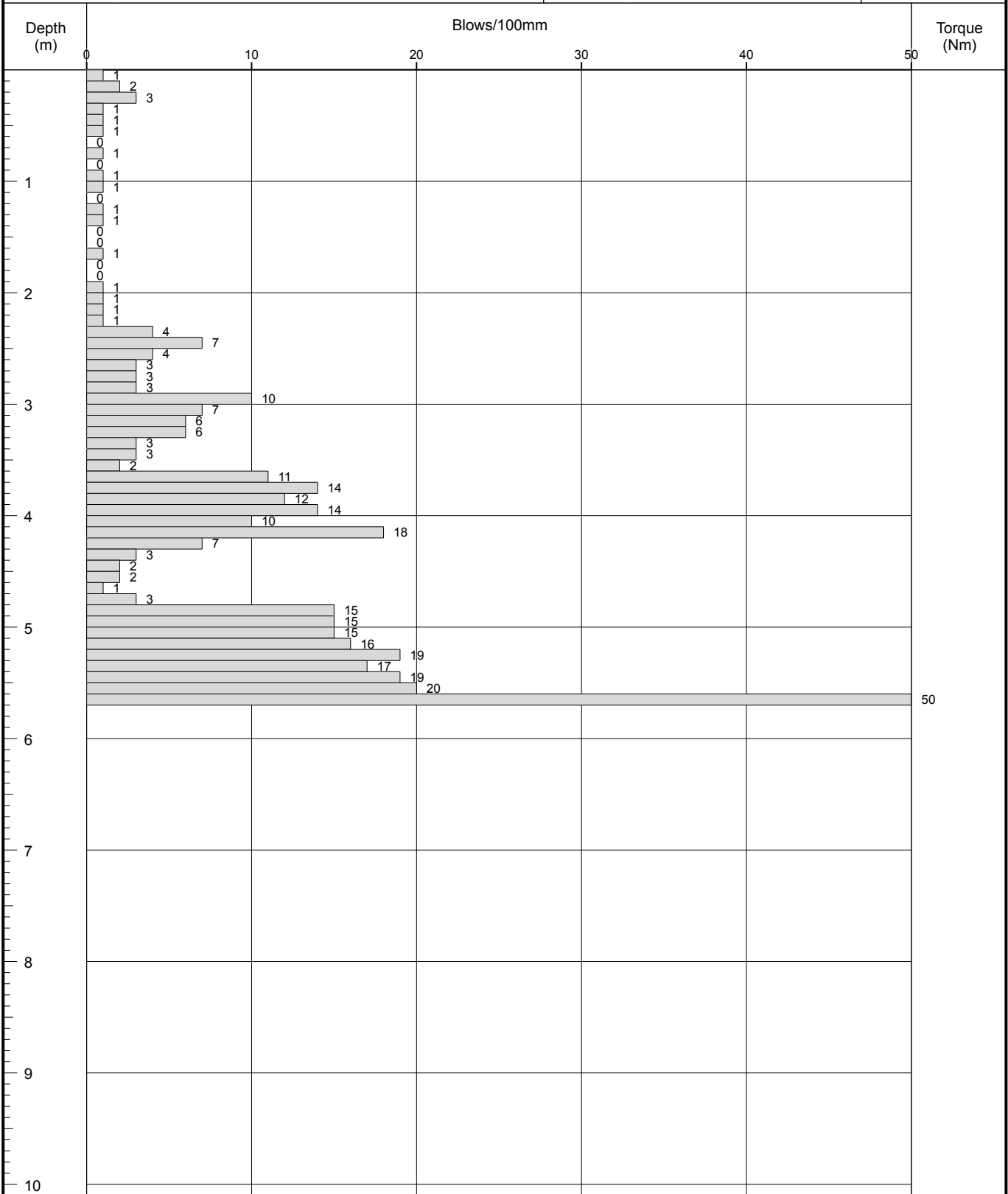
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 5.6m

Probe Type DPSH-B





Probe Log

Probe No.

L2 DP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

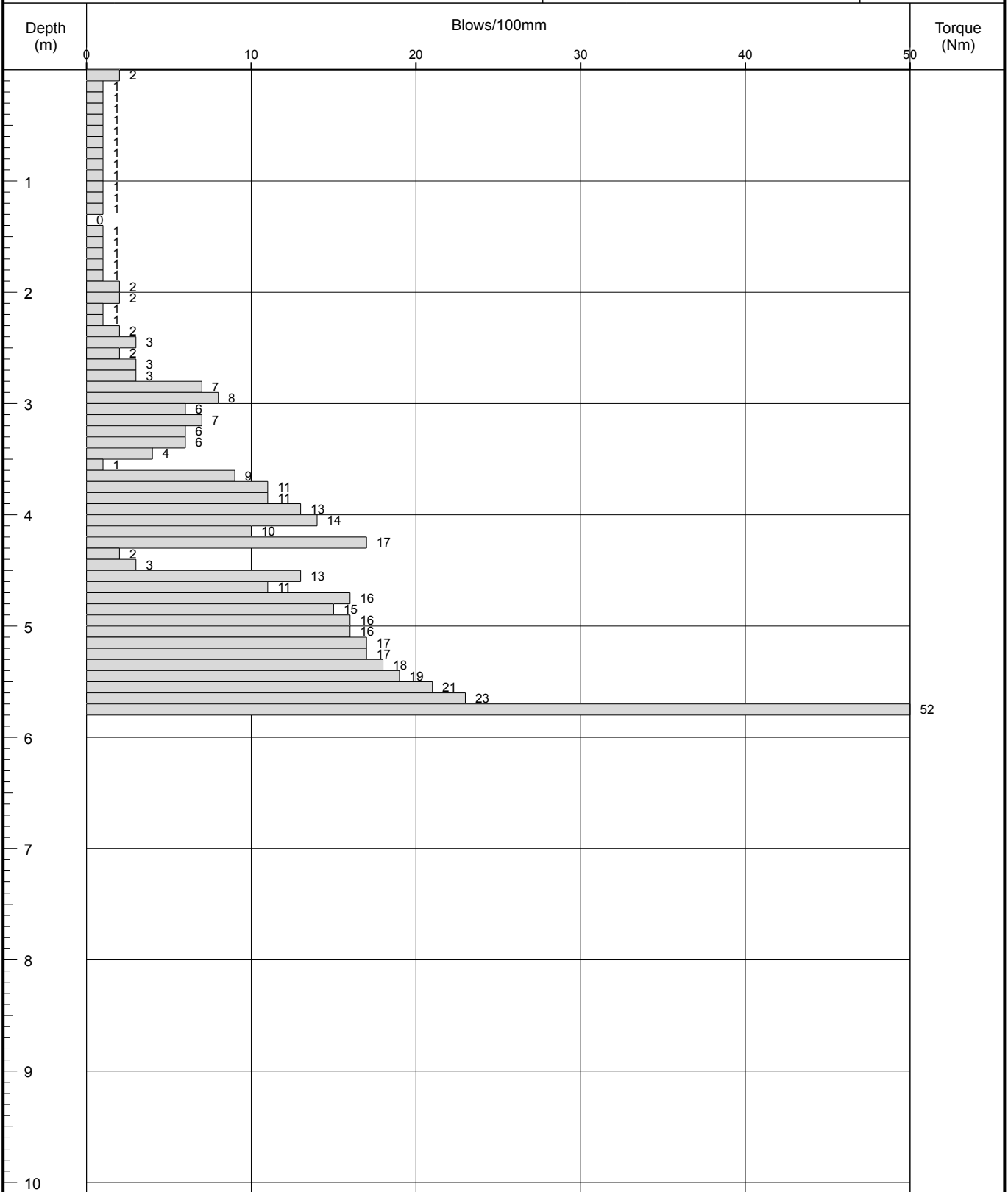
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 5.7m

Probe Type DPSH-B





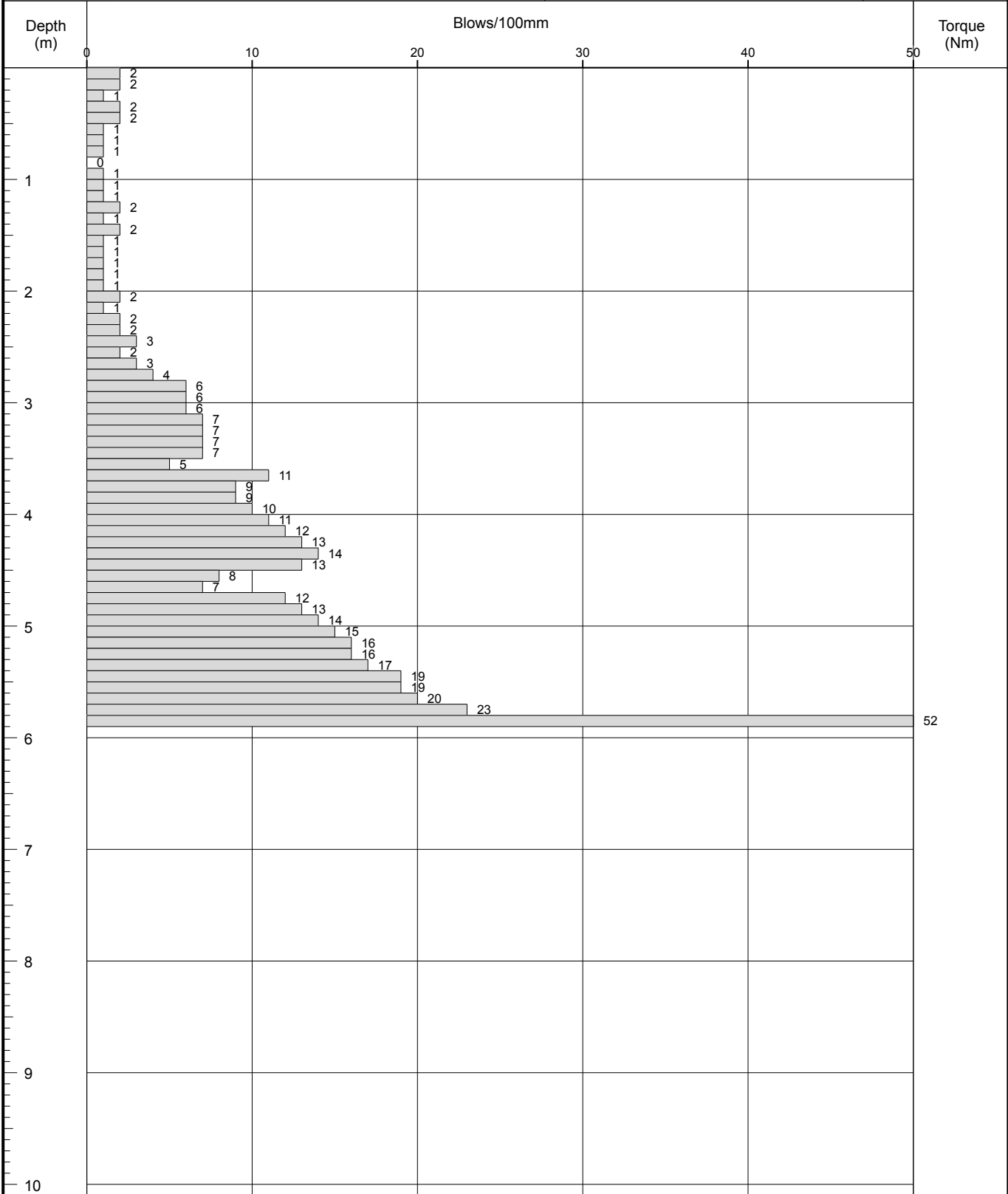
Probe Log

Probe No.

L2 DP3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	5.8m
	Probe Type	DPSH-B		





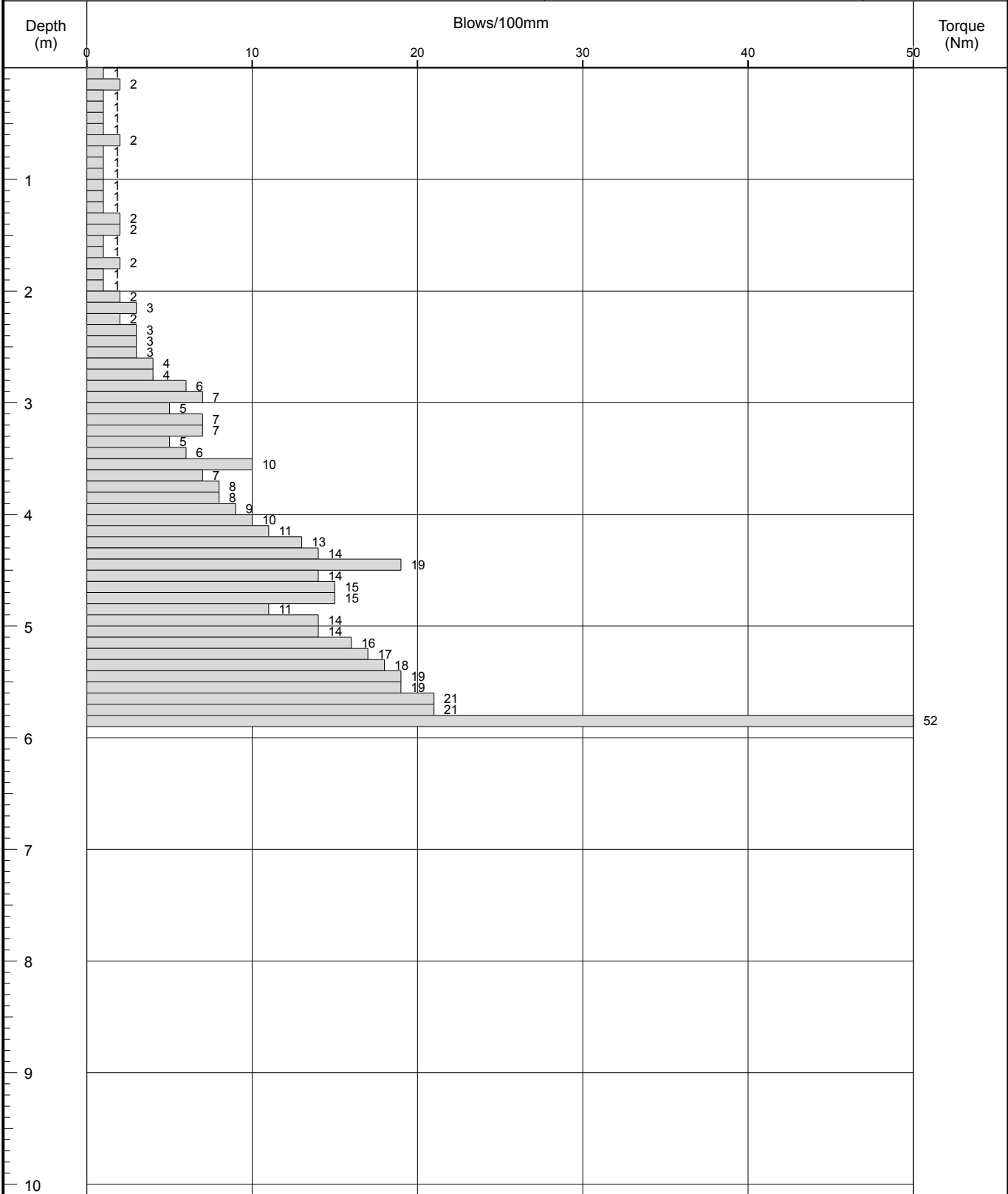
Probe Log

Probe No.

L2 DP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield	Level:		Scale 1:50
Client: Shaw & Jagger	Dates: 17/08/2015		Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	5.8m
	Probe Type	DPSH-B		





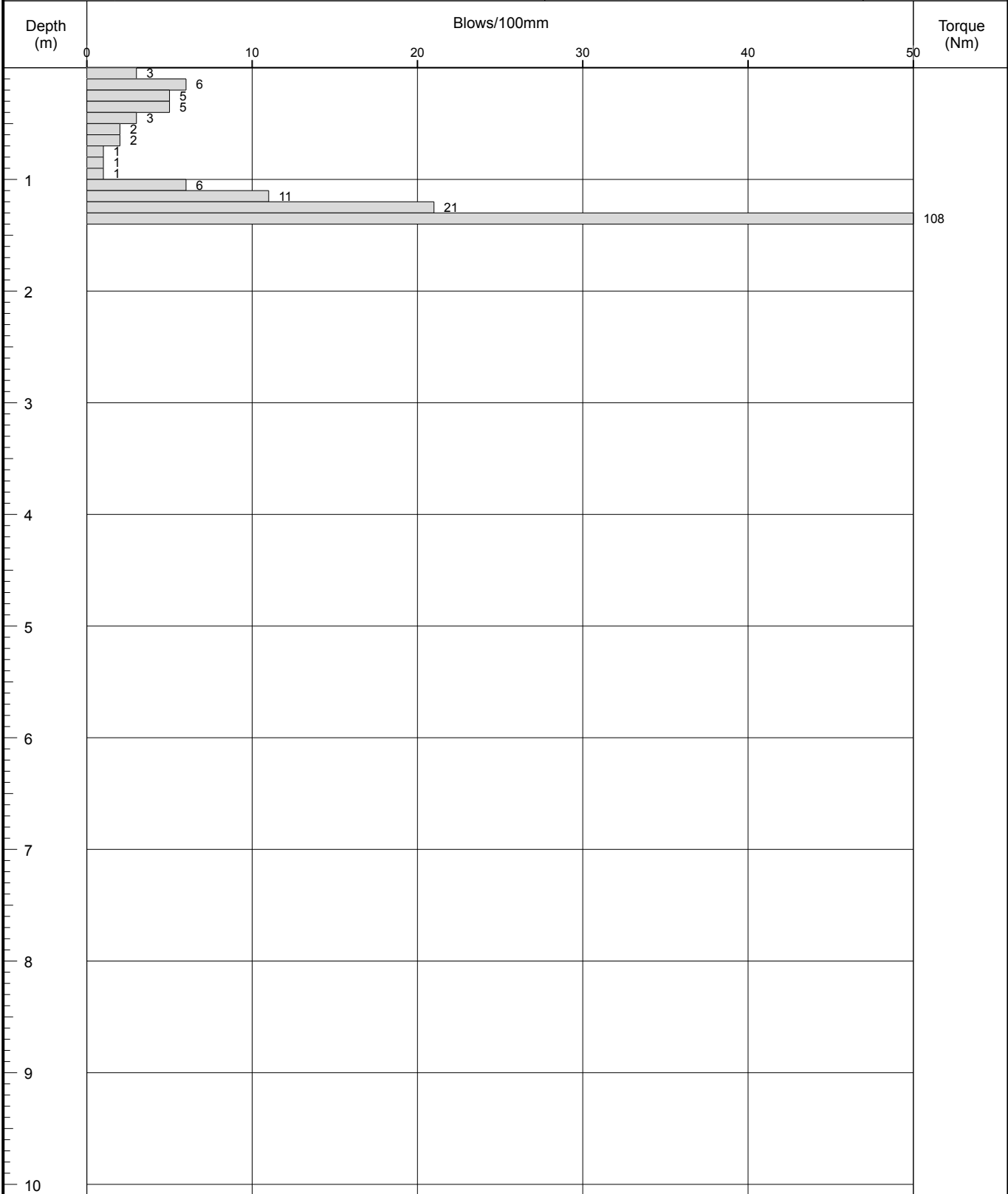
Probe Log

Probe No.

L3 DP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield	Level:		Scale 1:50
Client: Shaw & Jagger	Dates: 17/08/2015		Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.3m
	Probe Type	DPSH-B		





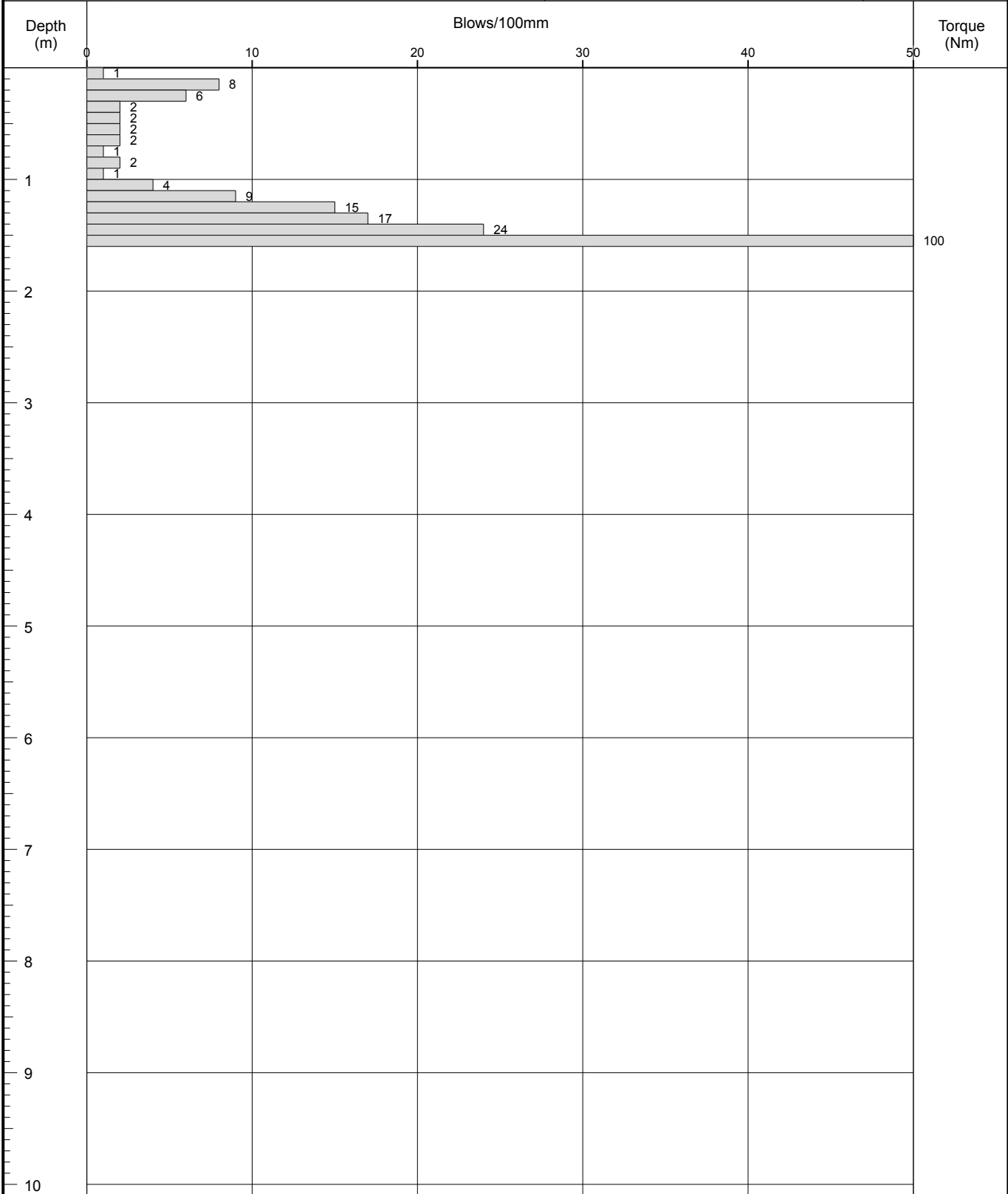
Probe Log

Probe No.

L3 DP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.5m
	Probe Type	DPSH-B		





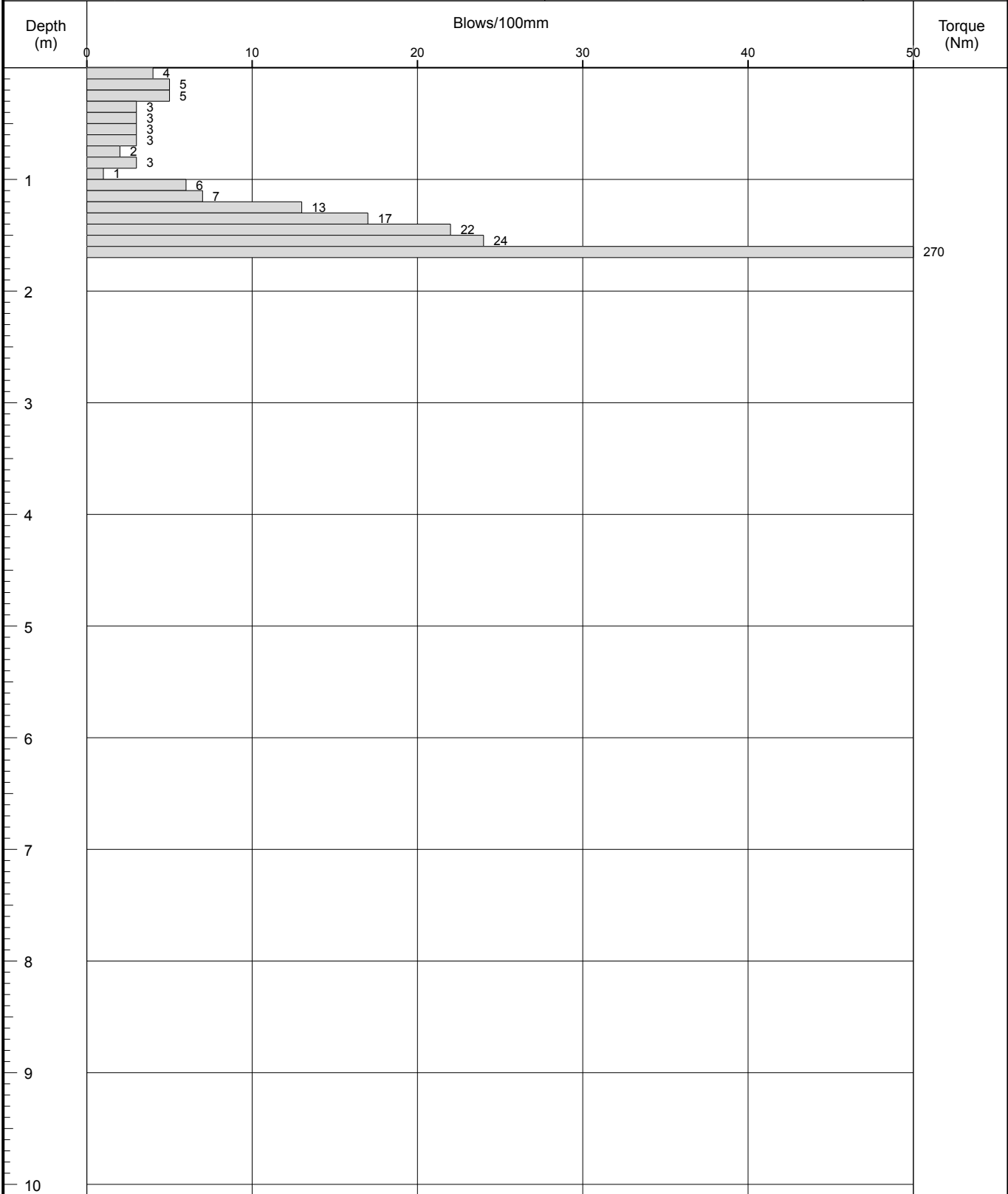
Probe Log

Probe No.

L3 DP3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.6m
	Probe Type	DPSH-B		





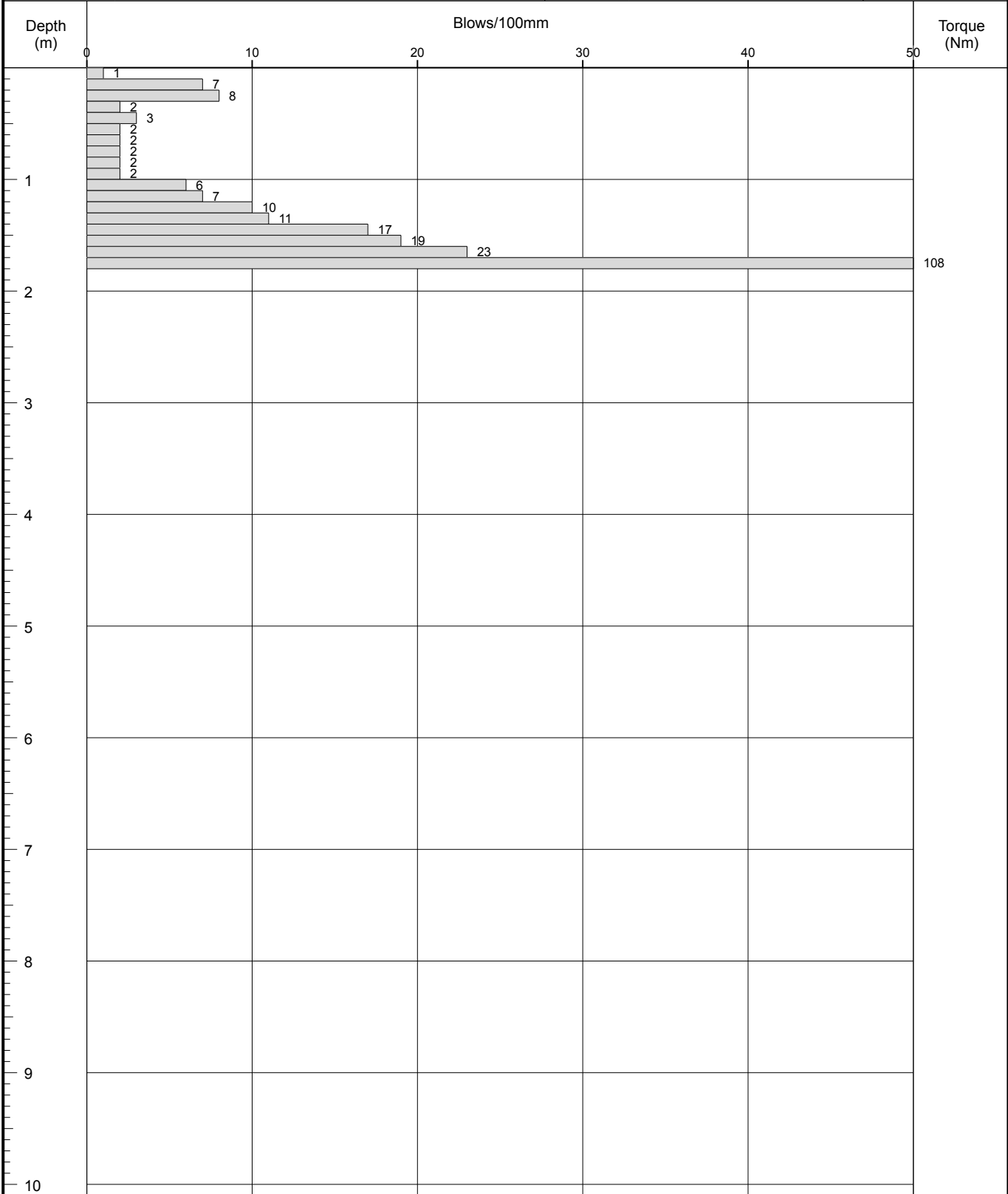
Probe Log

Probe No.

L3 DP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.7m
	Probe Type	DPSH-B		





Probe Log

Probe No.

L3 DP5

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

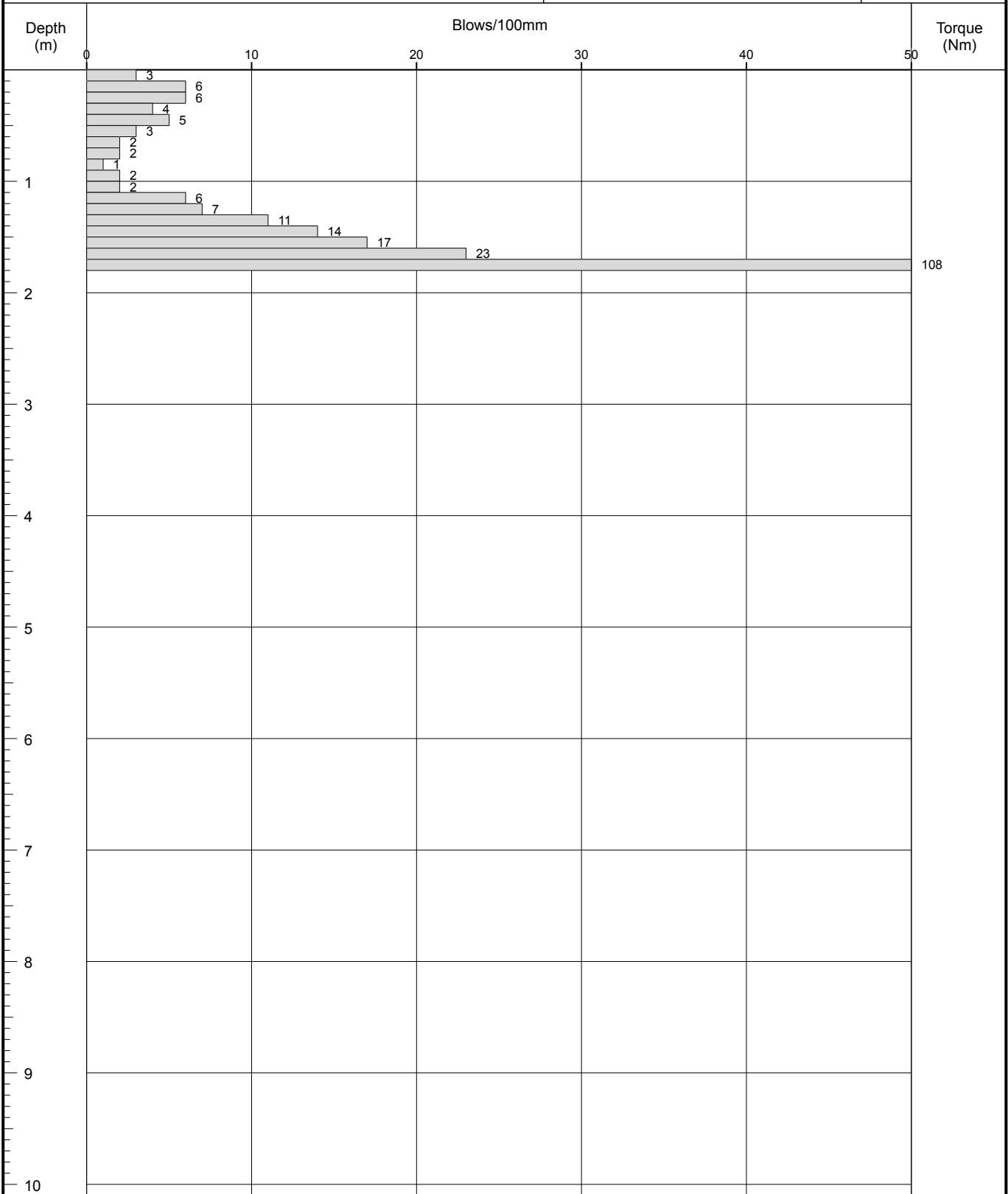
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 17/08/2015

Logged By



Remarks:

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 1.7m

Probe Type DPSH-B





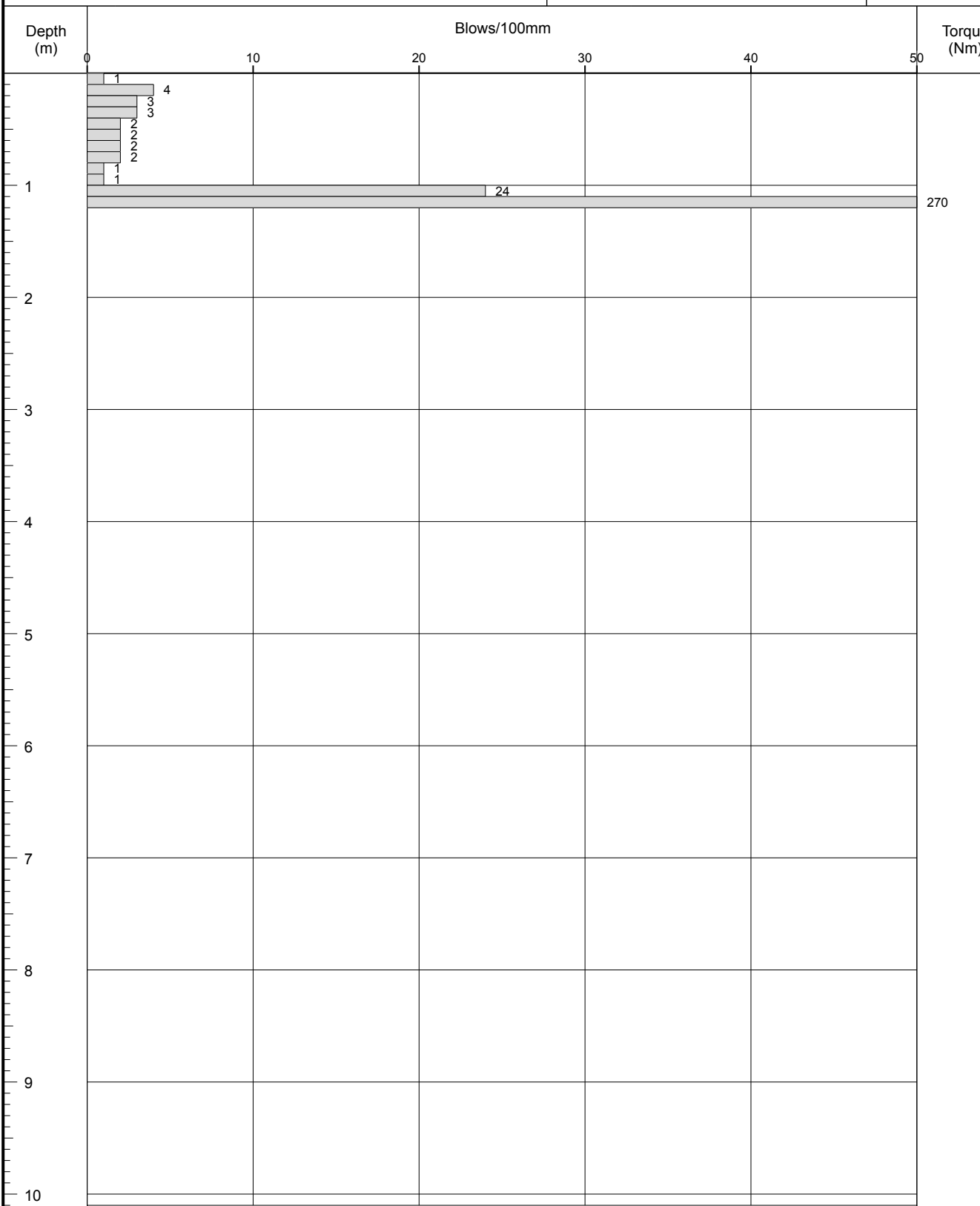
Probe Log

Probe No.

L4 DP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.1m
	Probe Type	DPSH-B		





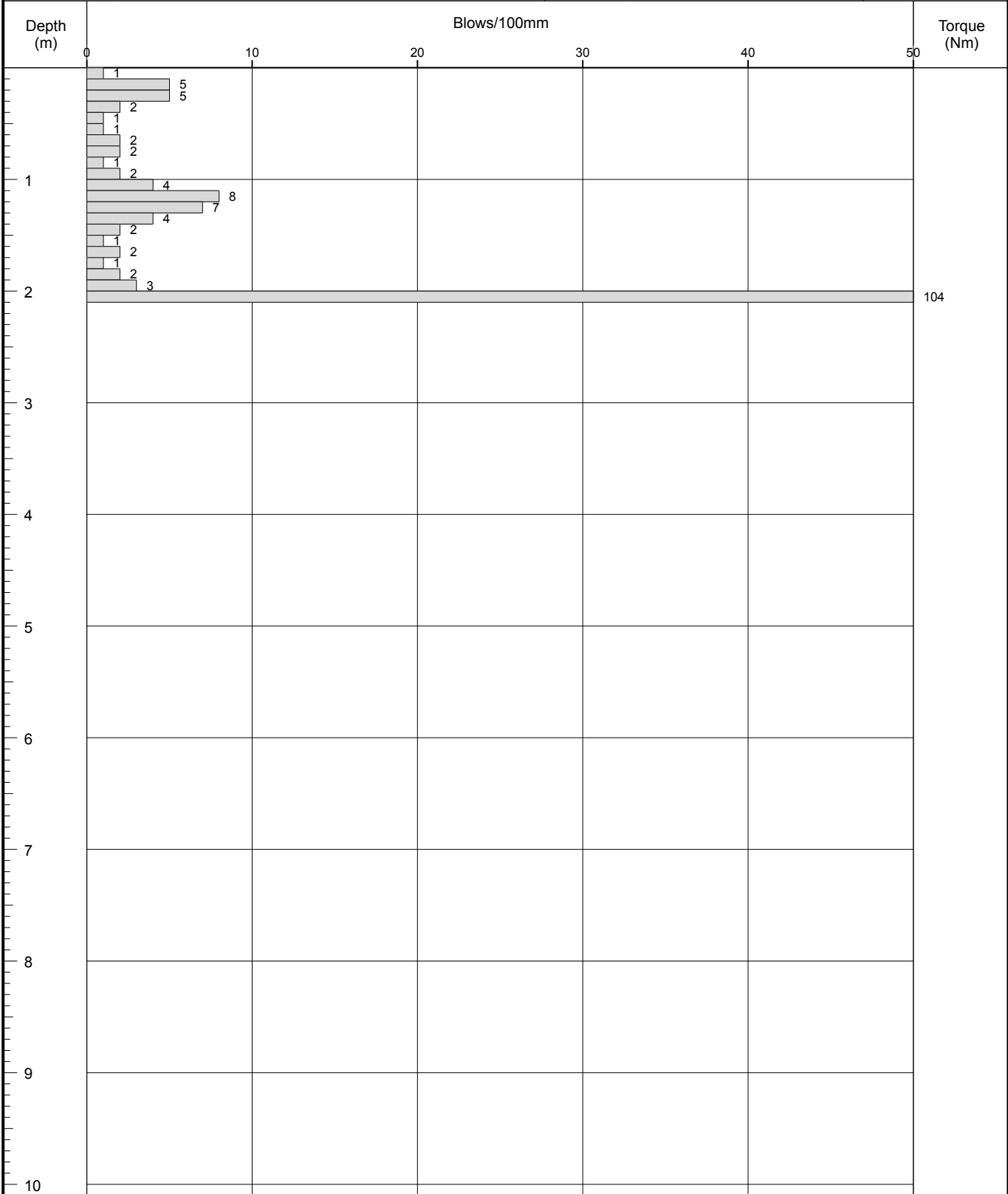
Probe Log

Probe No.

L4 DP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield	Level:		Scale 1:50
Client: Shaw & Jagger	Dates: 17/08/2015		Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	2m
	Probe Type	DPSH-B		





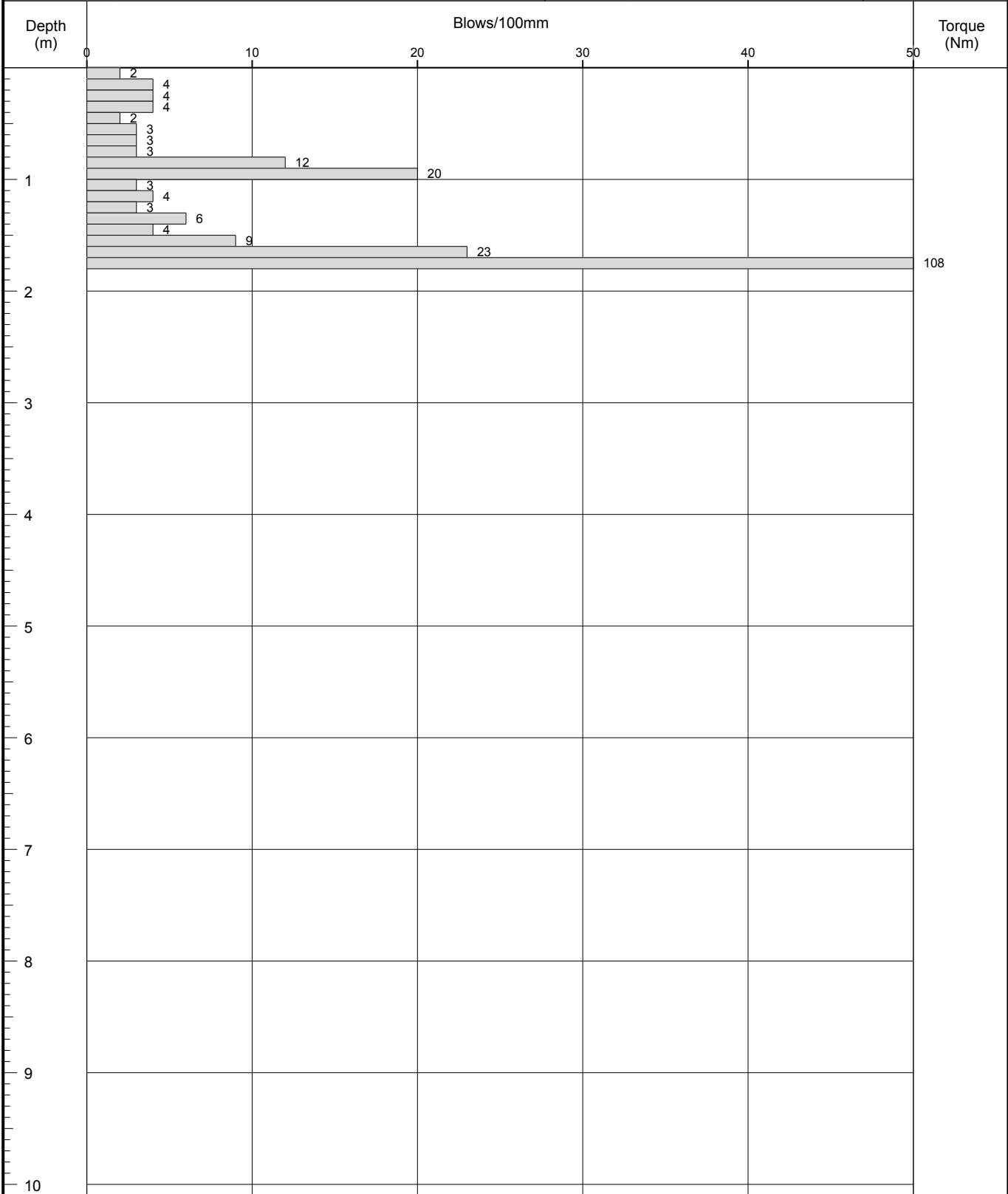
Probe Log

Probe No.

L4 DP3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.7m
	Probe Type	DPSH-B		





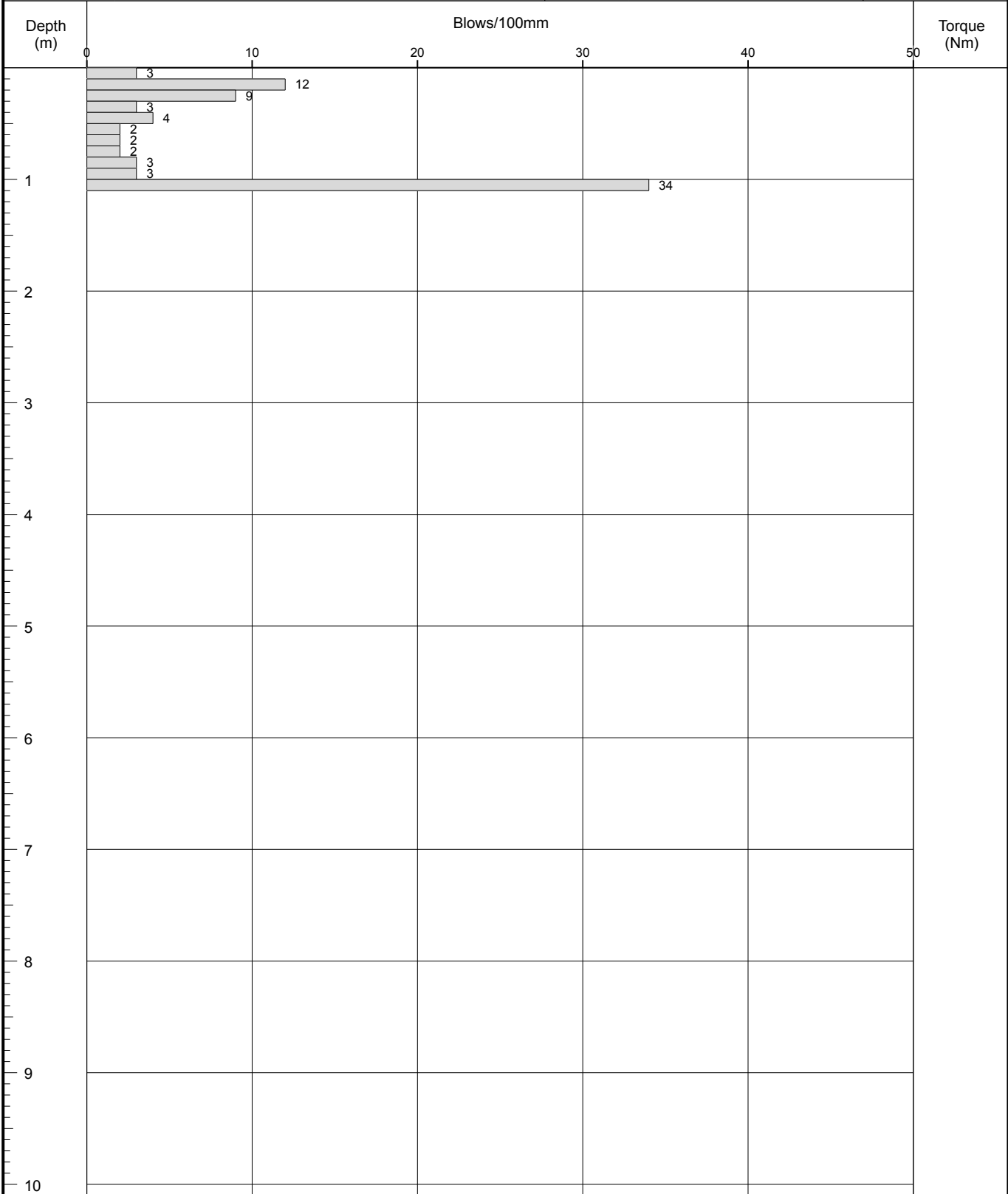
Probe Log

Probe No.

L4 DP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield		Level:	Scale 1:50
Client: Shaw & Jagger		Dates: 17/08/2015	Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1m
	Probe Type	DPSH-B		





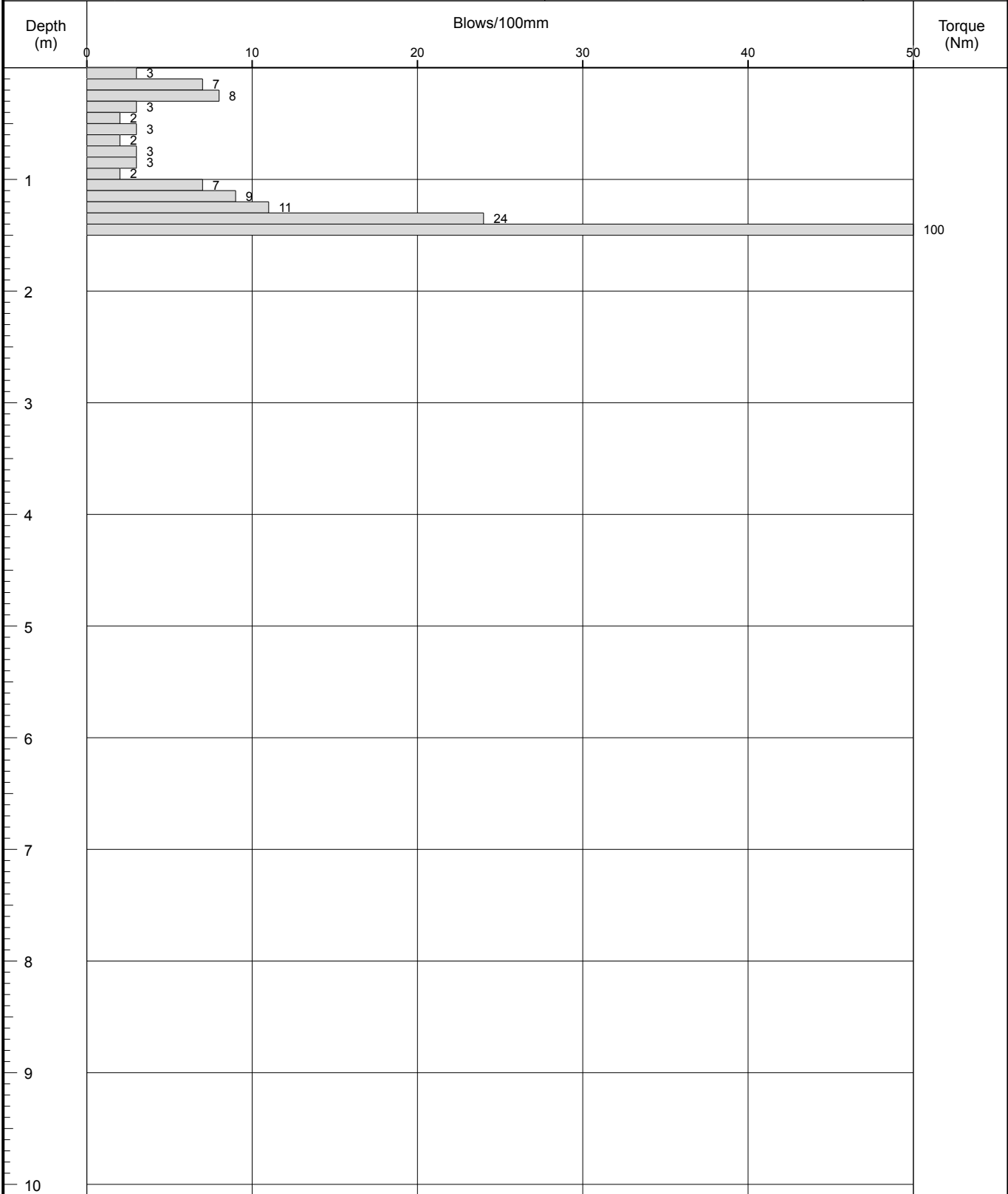
Probe Log

Probe No.

L4 DP5

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road	Project No. J3220/15/E	Co-ords:	Hole Type DCP
Location: Paddock, Huddersfield	Level:		Scale 1:50
Client: Shaw & Jagger	Dates: 17/08/2015		Logged By



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.4m
	Probe Type	DPSH-B		



APPENDIX 4
WINDOWLESS SAMPLE AND ROTARY BOREHOLE RECORDS
AND
ADJACENT DYNAMIC PROBE TESTING RESULTS



Borehole Log

Borehole No.

BH1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
WLS+RO+RC

Location: Paddock, Huddersfield

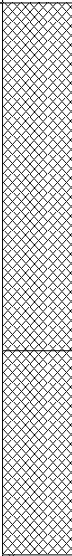
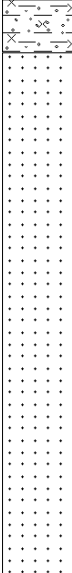
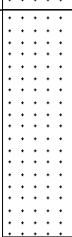
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 16/10/2015

Logged By
JRF

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.50	D	85	60				 <p>Firm becoming soft yellowish brown locally dark grey gravelly silty CLAY with medium cobble content and locally with layers of ash. Gravel is sub-rounded to sub-angular fine to coarse brick, concrete, sandstone masonry, mortar and rare asphalt. Cobbles are sub-rounded to sub-angular concrete.</p>	1	
		1.67	D	85	80					2	
		2.75	D	75	100		2.30			3	
		3.80	D	65	100		3.65			4	
							4.00	 <p>Soft yellowish brown slightly sandy gravelly silty CLAY. Sand is fine. Gravel is randomly orientated sub-angular to sub-rounded fine to coarse sandstone. (Reworked material?) Extremely weak thinly laminated greyish brown fine and medium grained SANDSTONE. (Inferred from open-hole flush returns)</p>	5		
							7.50		 <p>Medium strong to strong cross-laminated greyish brown striped dark grey fine grained micaceous SANDSTONE with very closely to closely spaced sub-horizontal smooth planar discontinuities with a tight to open aperture. Laminations are very tight clean smooth undulating stained dark brown.</p>	8	
							9.00			9	
										10	
				Dia. (mm)	TCR (%)	SCR (%)	RQD (%)	FI			

Remarks

Rotary coring attempted at 4m, 5m and 7m; coring failed to make any progress nor recovery any material. Therefore rotary open-hole drilling techniques employed between 4m and 7.5m depth.





Probe Log

Probe No.

DP1

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

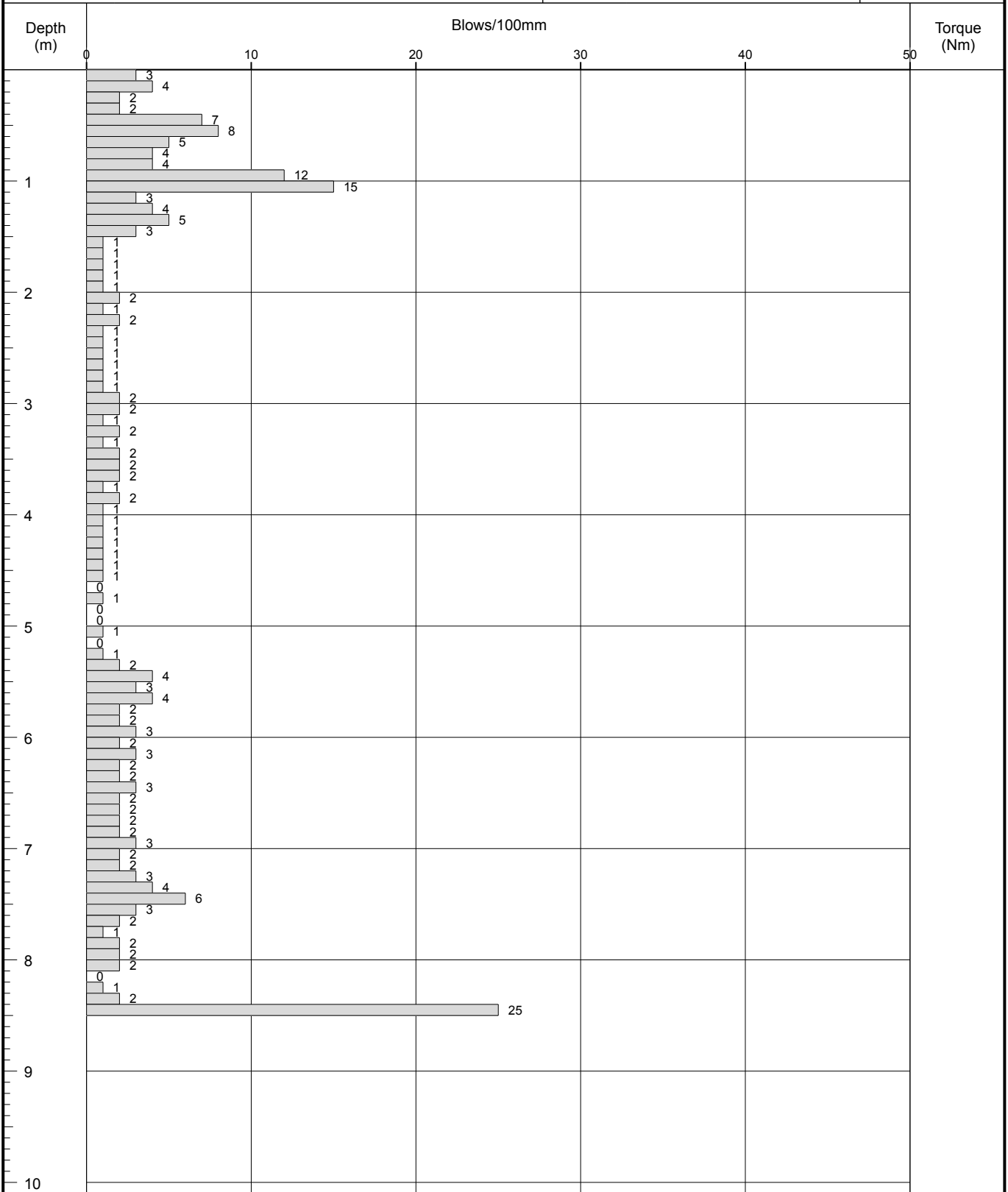
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 13/10/2015

Logged By

Remarks:
Abrupt Refusal at 8.50m.

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 8.4m

Probe Type DPSH-B





Probe Log

Probe No.

DP2

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

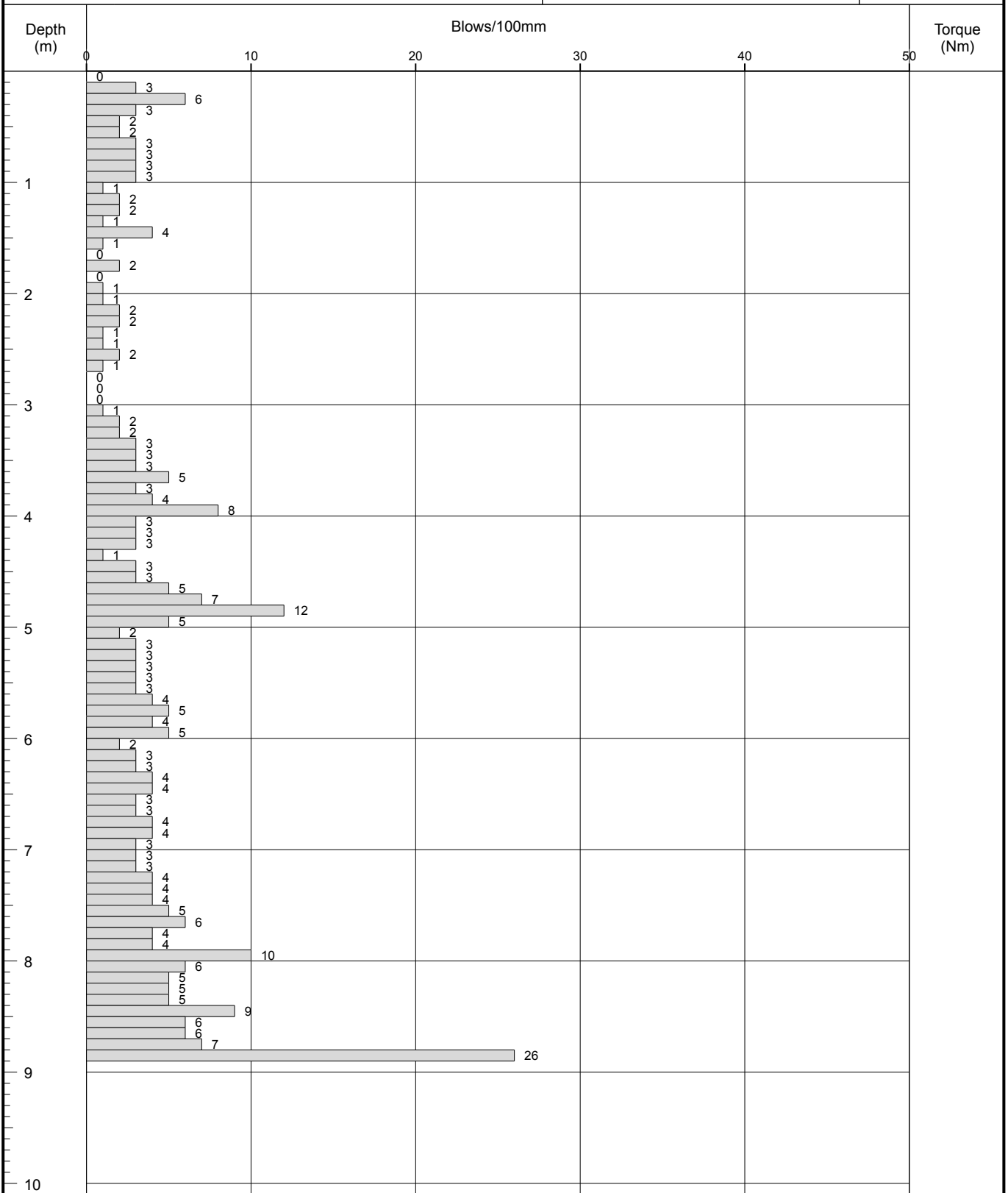
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 13/10/2015

Logged By



Remarks:
25 blows for 95mm shown as 26 blows for 100mm.
Abrupt refusal.

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 8.8m

Probe Type DPSH-B





Borehole Log

Borehole No.

BH3

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
WLS+RO+RC

Location: Paddock, Huddersfield

Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 20/10/2015

Logged By
JRF

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		1.00	SPT	85	100	N=38 (1,0/7,9,12,10)				MADE GROUND (Angular COBBLES of concrete, sandstone masonry and brick, with slate, in a matrix of very soft dark grey becoming brownish grey gravelly silty CLAY. Gravel fraction of matrix is sub-rounded to angular concrete, sandstone masonry, brick, slate and mortar).	1
		2.00	SPT	85	5		N=8 (2,2/1,2,2,3)				
		3.00	SPT	65	70	N=25 (1,2/2,4,6,13)					3
		3.50 - 3.70	D	55	70		3.40				4
							3.92			Loose becoming medium dense yellowish brown silty clayey sandy randomly orientated sub-angular to sub-rounded fine to coarse	
				85	66	39	24	4.50		GRAVEL of sandstone and fine and medium coal. Sand is fine. (Probable Soliflucted Material)	4
				85	66	26	23			Extremely weak thinly laminated greyish brown fine and medium grained SANDSTONE. (Between 4m - 4.5m; inferred from limited core recovery)	5
				85	95	95	55			Strong cross-laminated greyish brown striped dark grey fine grained micaceous SANDSTONE with very closely to closely spaced sub-horizontal to 25° smooth planar and rough undulating discontinuities, tight to open aperture. Laminations are very tight clean smooth undulating stained dark brown, occasionally broken by worm casts.	6
				85	84	82	42			4.5m - 4.63m: Heavily fractured zone. 5.5m - 6m: Heavily fractured zone; inferred from limited core recovery. 6.07m - 6.28m: Heavily fractured zone. 6.18m - 6.45m: Discontinuity; 80° dark brown staining rough planar. 6.54m - 6.66m: Heavily fractured zone. 6.74m - 7.01m: Becomes dark grey, laminations become faint and terminate within core.	7
										7.64m - 7.98m: Becomes dark grey, laminations become faint and terminate within core.	8
										8.6m - 8.85m: Laminations become horizontal and planar.	9
							9.00			End of Borehole at 9.00m	10

Remarks





Borehole Log

Borehole No.

BH4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
WLS+RO+RC

Location: Paddock, Huddersfield

Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 21/10/2015

Logged By
JRF

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results				
		1.50	D	85	90		0.65		MADE GROUND (Very soft dark grey gravelly silty CLAY with medium cobble content. Gravel is sub-rounded to sub-angular fine to coarse concrete and sandstone masonry. Cobbles are sub-rounded to sub-angular concrete and sandstone masonry). MADE GROUND (Light yellow sandy angular COBBLES of medium grained sandstone). MADE GROUND (Very soft greyish brown sandy gravelly CLAY/SILT. Gravel is randomly orientated sub-rounded to sub-angular fine to coarse fine and medium grained sandstone). (Reworked material) Extremely weak thinly laminated greyish brown fine and medium grained SANDSTONE.	
	85			100	1.86					
	75			70						
				85	99	68	37	4.00		Medium strong to strong cross-laminated greyish brown striped dark grey fine grained micaceous SANDSTONE with very closely to closely spaced sub-horizontal smooth planar and rough undulating discontinuities, tight to open aperture. Laminations are very tight clean smooth undulating stained dark brown, occasionally broken by worm casts. <i>4.7m - 4.8m: Heavily fractured zone.</i> <i>4.97m - 5.03m: Heavily fractured zone.</i> <i>5.3m - 5.7m: Becomes dark brown medium grained. Discontinuity present through layer; 80° dark brown staining rough planar.</i>
		85	100	100	61	6				
		85	100	90	38	7				
		85	100	20	0	8				
						9				
						9.00			End of Borehole at 9.00m	
										10

Remarks





Probe Log

Probe No.

DP4

Sheet 1 of 1

Project Name: Manashay, Upper Brow Road

Project No.
J3220/15/E

Co-ords:

Hole Type
DCP

Location: Paddock, Huddersfield

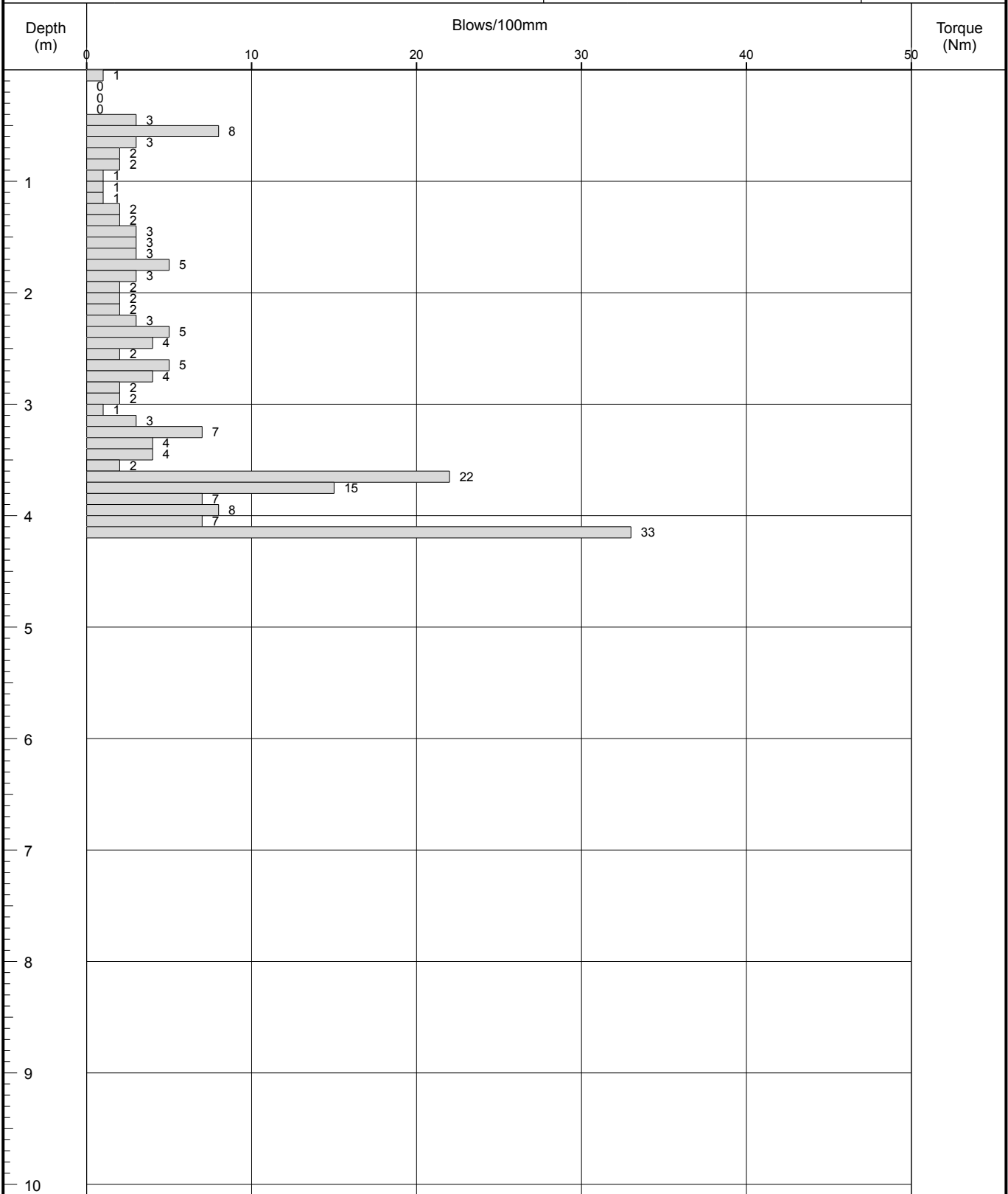
Level:

Scale
1:50

Client: Shaw & Jagger

Dates: 13/10/2015

Logged By



Remarks:
25 blows for 75mm shows as 33 blows for 100mm.
Abrupt refusal.

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 4.1m

Probe Type DPSH-B



APPENDIX 5
HISTORICAL MAPS

Historical Mapping Legends

Ordnance Survey County Series 1:10,560

- Gravel Pit
- Sand Pit
- Other Pits
- Quarry
- Shingle
- Orchard
- Osiers
- Reeds
- Marsh
- Mixed Wood
- Deciduous
- Brushwood
- Fir
- Furze
- Rough Pasture
- Arrow denotes flow of water
- Trigonometrical Station
- Site of Antiquities
- Bench Mark
- Pump, Guide Post, Signal Post
- Well, Spring, Boundary Post
- 285** Surface Level
- Sketched Contour
- Instrumental Contour
- Main Roads
- Minor Roads
- Sunken Road
- Raised Road
- Road over Railway
- Railway over River
- Railway over Road
- Level Crossing
- Road over River or Canal
- Road over Stream
- Road over Stream
- County Boundary (Geographical)
- County & Civil Parish Boundary
- Administrative County & Civil Parish Boundary
- County Borough Boundary (England)
- County Burgh Boundary (Scotland)
- Rural District Boundary
- Civil Parish Boundary

Ordnance Survey Plan 1:10,000

- Chalk Pit, Clay Pit or Quarry
- Gravel Pit
- Sand Pit
- Disused Pit or Quarry
- Refuse or Slag Heap
- Lake, Loch or Pond
- Dunes
- Boulders
- Coniferous Trees
- Non-Coniferous Trees
- Orchard
- Scrub
- Coppice
- Bracken
- Heath
- Rough Grassland
- Marsh
- Reeds
- Saltings
- Building
- Glasshouse
- Sloping Masonry
- Pylon
- Electricity Transmission Line
- Pole
- Cutting
- Embankment
- Standard Gauge Multiple Track
- Standard Gauge Single Track
- Siding, Tramway or Mineral Line
- Narrow Gauge
- Geographical County
- Administrative County, County Borough or County of City
- Municipal Borough, Urban or Rural District, Burgh or District Council
- Borough, Burgh or County Constituency
Shown only when not coincident with other boundaries
- Civil Parish
Shown alternately when coincidence of boundaries occurs
- BP, BS Boundary Post or Stone
- Ch Church
- CH Club House
- F E Sta Fire Engine Station
- FB Foot Bridge
- Fn Fountain
- GP Guide Post
- MP Mile Post
- MS Mile Stone
- Pol Sta Police Station
- PO Post Office
- PC Public Convenience
- PH Public House
- SB Signal Box
- Spr Spring
- TCB Telephone Call Box
- TCP Telephone Call Post
- W Well

1:10,000 Raster Mapping

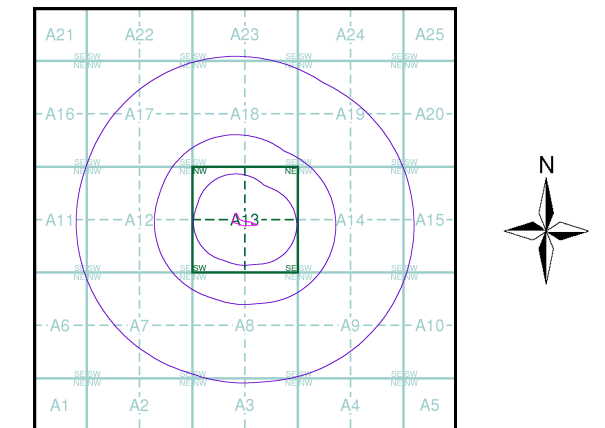
- Gravel Pit
- Rock
- Boulders
- Shingle
- Sand
- Slopes
- General detail
- Overhead detail
- Multi-track railway
- County boundary (England only)
- District, Unitary, Metropolitan, London Borough boundary
- Area of wooded vegetation
- Non-coniferous trees (scattered)
- Coniferous trees (scattered)
- Orchard
- Rough Grassland
- Scrub
- Water feature
- MHW(S) Mean high water (springs)
- Bench mark (where shown)
- Point feature (e.g. Guide Post or Mile Stone)
- Site of (antiquity)
- General Building
- Refuse tip or slag heap
- Rock (scattered)
- Boulders (scattered)
- Mud
- Sand Pit
- Top of cliff
- Underground detail
- Narrow gauge railway
- Single track railway
- Civil, parish or community boundary
- Constituency boundary
- Non-coniferous trees
- Coniferous trees
- Positioned tree
- Coppice or Osiers
- Heath
- Marsh, Salt Marsh or Reeds
- Flow arrows
- MLW(S) Mean low water (springs)
- Triangulation station
- Pylon, flare stack or lighting tower
- Glasshouse
- Important Building



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:10,560	1854	3
Yorkshire	1:10,560	1894	4
Yorkshire	1:10,560	1908	5
Yorkshire	1:10,560	1930	6
Yorkshire	1:10,560	1938	7
Yorkshire	1:10,560	1948	8
Ordnance Survey Plan	1:10,000	1956	9
Ordnance Survey Plan	1:10,000	1966 - 1969	10
Ordnance Survey Plan	1:10,000	1978	11
Ordnance Survey Plan	1:10,000	1984 - 1987	12
Huddersfield	1:10,000	1984	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2015	15

Historical Map - Slice A



Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

Russian Military Mapping Legends

1:5,000 and 1:10,000 mapping

a. Not drawn to scale b. Drawn to scale

	Government and Administrative Buildings		Military and Industrial Buildings
	Military and Communication Areas		Subway Entrance
	Fireproof Building		Prominent Fireproof Building
	Non-fireproof Building		Non-fireproof Building (non-dwelling)
	Factory, mill, and flour mill, with chimneys		Factory, mill, and flour mill, without chimneys
	Power Station, drawn to scale		Hydroelectric Power Station
	Radio Station, drawn to scale		Telephone Station, drawn to scale
	Abandoned Open-pit Mine or Quarry		Open-pit Salt Mine
	Pit		Oil Deposit or Well
	Oil Seepage		Natural Gas Tank
	Tailings Pile		Fuel Storage Tanks
	Bench Mark		Drill Hole
	Burial Mound		Triangulation Point on Burial Mound
	Single-track Railroad		Double-track Railroad
	Railroad and Station Building		Small Bridge
	Pipe (Culvert)		Tunnel
	Coniferous Forest		Deciduous Forest
	Mixed Forest		Lawns
	Citrus Orchard		Wet Ground
	Scattered Vegetation		

243,8 Values for prominent elevations
186.0 Numbers for spot elevations, depth soundings, contour lines, etc.
0,2 Velocity of the current, width of river bed, depth of river
180/12 Fractional terms: length and capacity of bridges; depth of fords and condition of the river bottom; height of forest and the diameter of trees

Russian Alphabet (For reference and phonetic interpretation of map text)

А а (A)	З з (Z)	П п (P)	Ч ч (CH)
Б б (B)	И и (I)	Р р (R)	Ш ш (SH)
В в (V)	Й й (Y)	С с (S)	Щ щ (SHCH)
Г г (G)	К к (K)	Т т (T)	Ъ (-)
Д д (D)	Л л (L)	У у (U)	Ы (Y)
Е е (E)	М м (M)	Ф ф (F)	Ь (')
Ё ё (YO)	Н н (N)	Х х (KH)	Э э (E)
Ж ж (ZH)	О о (O)	Ц ц (TS)	Ю ю (YU or IU)
			Я я (YA or IA)

1:25,000 mapping

a. Not drawn to scale b. Drawn to scale

	Government and Administrative Buildings		Military and Industrial Buildings
	Military and Communication Areas		Subway Entrance
	Partly Demolished Buildings		Demolished Buildings
	Built-Up Area with Fireproof Buildings Predominant		Built-Up Area with Non-Fireproof Buildings Predominant
	Individual Fireproof Building		Prominent Industrial Building
	Individual Dwelling, Fireproof		Ruins of an Individual Dwelling
	Factory or Mill Chimney		Factory or Mill with Chimney
	Factory or Mill without Chimney		Mine or Open Pit Mine
	Operating Shaft or Mine		Non-Operating Shaft or Mine
	Salt Mine		Tailings Pile
	Pit		Stone Quarry
	Gas Pump or Service Station		Fuel Storage or Natural Gas Tank
	Oil or Natural Gas Derrick		Small Hydroelectric Power Station
	Power Station		Transformer Station
	Cemetery		Burial Mound (height in metres)
	Triangulation Point on Burial Mound		Triangulation Point
	Bench Mark		Bench Mark (monumented)
	Telegraph Office		Telephone Station
	Radio Station		Radio Tower
	Airfield or Seaplane Base		Landing Strip
	Cut		Fill
	Main Highway		Highway under Construction
	Improved Dirt Road (former truck road)		Steep Grade
	Small Bridge		Pipe (Culvert)
	Tunnel		Dismantled Railroad
	Double-track Railroad with First Class Station		Railroad Under Construction
	Shore Embankment		River or Ditch with Embankment
	Water Reservoir or Rain Water Pit		Spring
	Isobath with value		Water Gauge
	Direction and velocity of current		Water Level Mark
	Well		Spot Elevation Value
	Heavy (Index) Contour Line		Half Contour Line
	Contour Line and Value		Spot Elevation Value
	Coniferous		Deciduous
	Mixed		Scrub

Key to Numbers on Mapping

SE11NW_Huddersfield

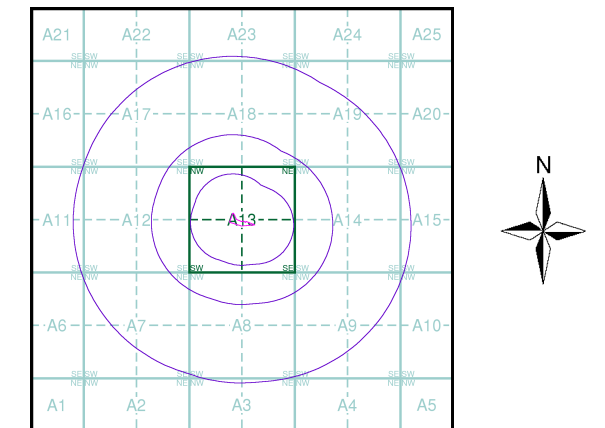
No.	Description
4	Factory (Machinery)
6	Factory (Machinery)
12	Chemical Plant
56	Factories (Use Unknown)



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:10,560	1854	3
Yorkshire	1:10,560	1894	4
Yorkshire	1:10,560	1908	5
Yorkshire	1:10,560	1930	6
Yorkshire	1:10,560	1938	7
Yorkshire	1:10,560	1948	8
Ordnance Survey Plan	1:10,000	1956	9
Ordnance Survey Plan	1:10,000	1966 - 1969	10
Ordnance Survey Plan	1:10,000	1978	11
Ordnance Survey Plan	1:10,000	1984 - 1987	12
Huddersfield	1:10,000	1984	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2015	15

Russian Map - Slice A



Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

Yorkshire

Published 1854

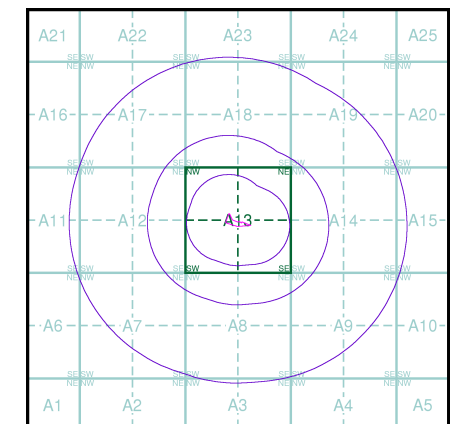
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

24600	1854	1:10,560
26000	1854	1:10,560

Historical Map - Slice A

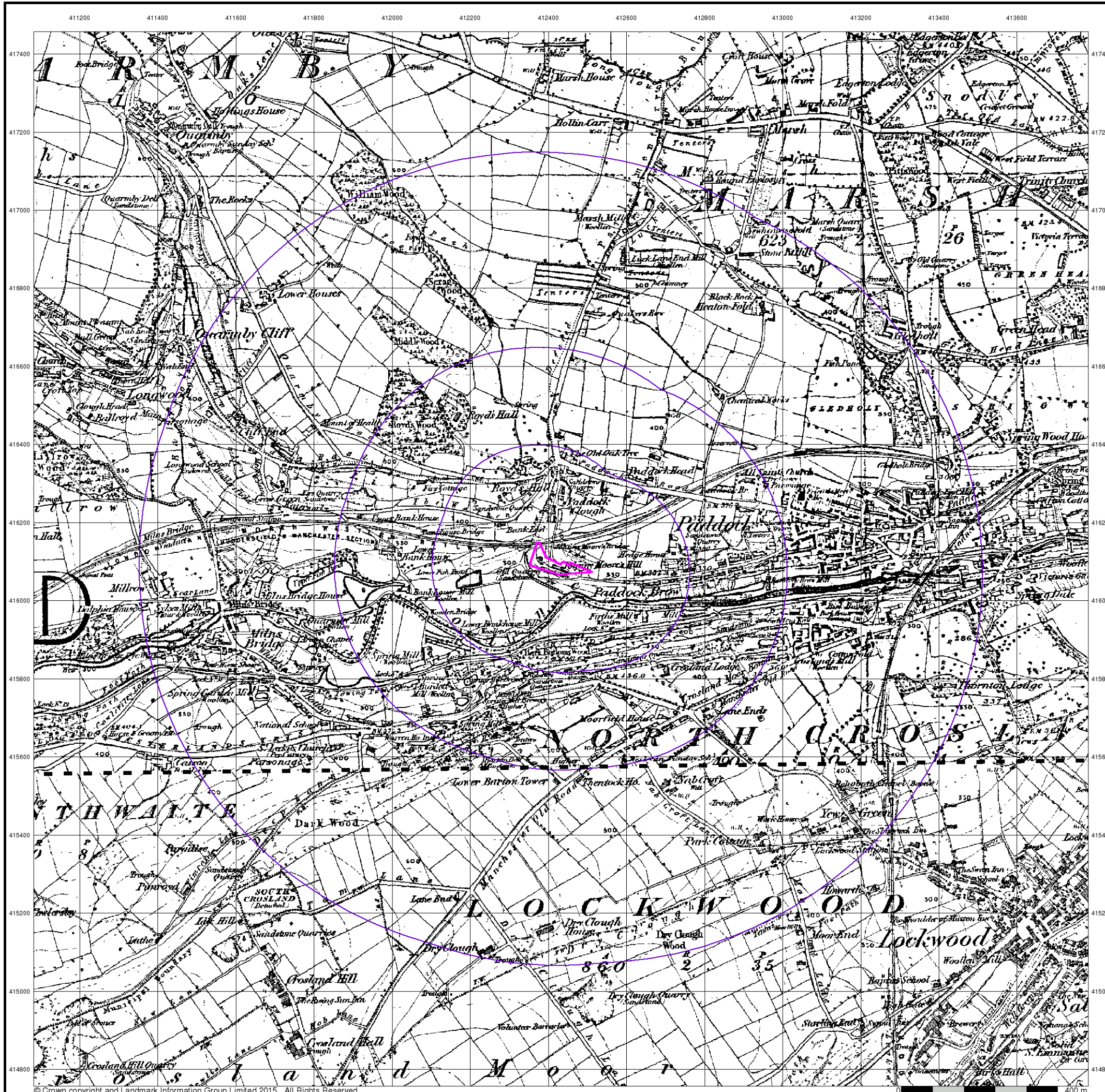


Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP



Yorkshire

Published 1894

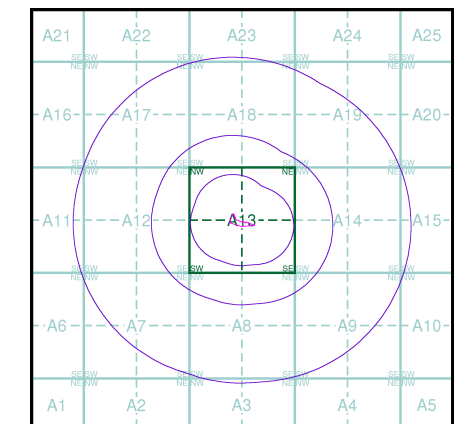
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

246SW 1894 1:10,560	246SE 1894 1:10,560
260NW 1894 1:10,560	260NE 1894 1:10,560

Historical Map - Slice A

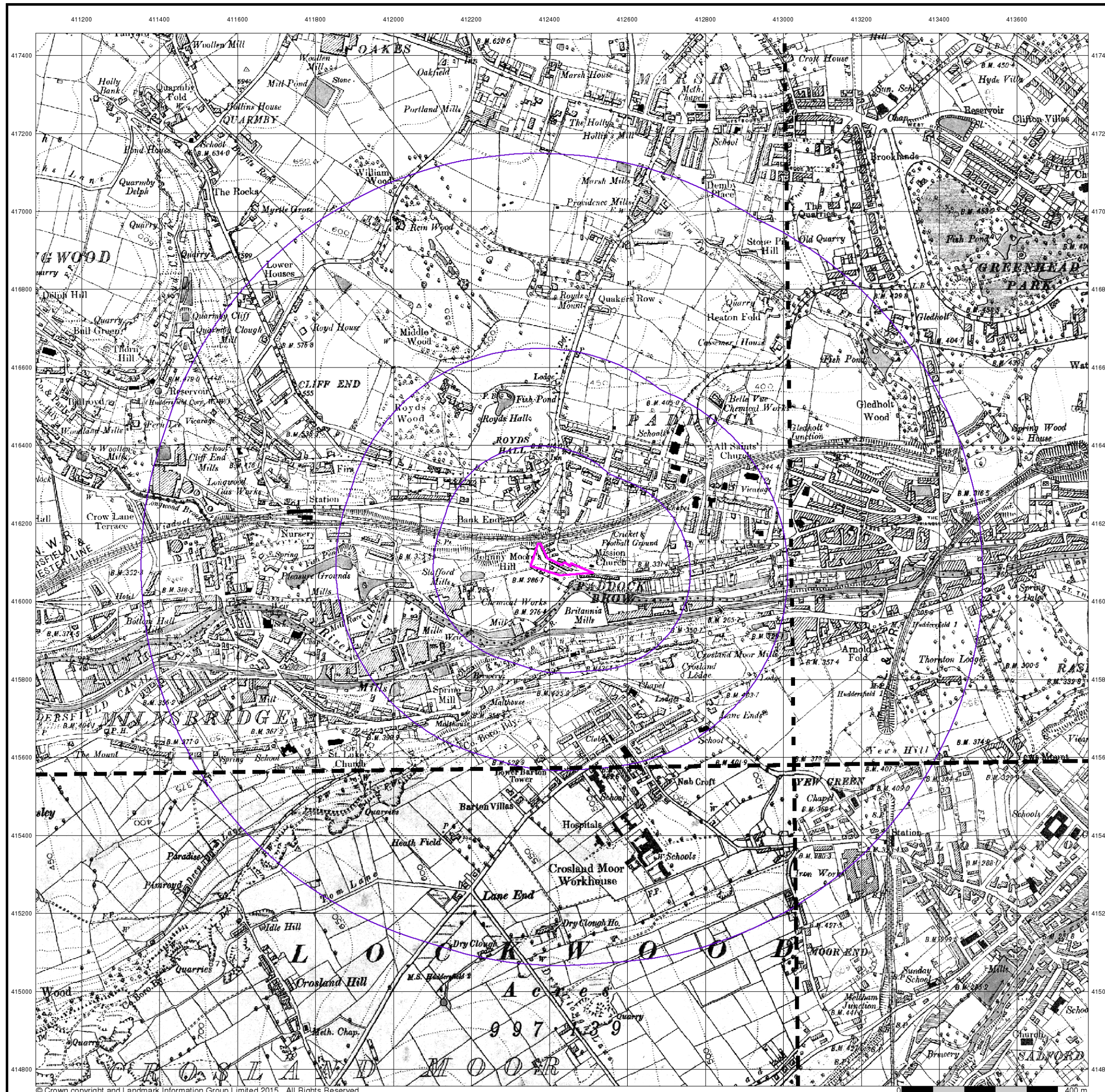


Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP



Yorkshire

Published 1908

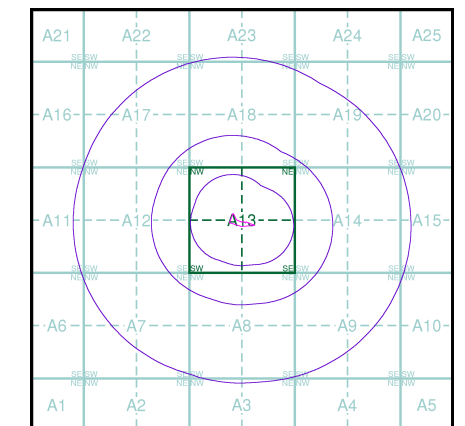
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

246SW 1908 1:10,560	246SE 1908 1:10,560
260NW 1908 1:10,560	260NE 1908 1:10,560

Historical Map - Slice A



Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP



Yorkshire

Published 1930

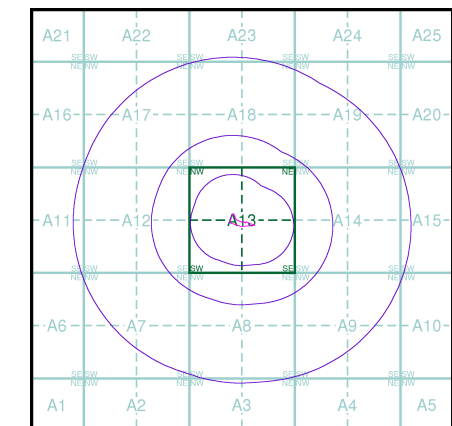
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

246SW 1930 1:10,560	246SE 1930 1:10,560
260NW 1930 1:10,560	260NE 1930 1:10,560

Historical Map - Slice A



Order Details

Order Number: 73050248_1_1
 Customer Ref: J3220/15/E
 National Grid Reference: 412430, 416100
 Slice: A
 Site Area (Ha): 0.45
 Search Buffer (m): 1000

Site Details

Upper Brow Road, HUDDERSFIELD, HD1 4UP

