

A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.7 Environmental Statement – Appendix 11.4 Coal Mining Risk Assessment

Part A

APFP Regulation 5(2)(a)

Planning Act 2008

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



Infrastructure Planning

Planning Act 2008

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

The A1 in Northumberland: Morpeth to Ellingham

Development Consent Order 20[xx]

Environmental Statement - Appendix

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Highways England

A1 IN NORTHUMBERLAND: MORPETH TO FELTON SCHEME

Coal Mining Risk Assessment

MAY 2019 PUBLIC



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Highways England

1. INTRODUCTION

1.1. SCOPE AND OBJECTIVE OF THE REPORT

WSP has been commissioned by Highways England to undertake an assessment of the risks posed by historical coal mining to the A1 in Northumberland: Morpeth to Felton; to be known thereafter as 'the Scheme', which forms part of the Department for Transport's (DfT) Roads Investment Strategy (RIS).

In accordance with HD22/08 [1], a Ground Investigation Report (GIR) [2] has been produced for the scheme as a whole. As set out in the GIR report, the vast majority of the proposed scheme is not considered at risk from hazards associated with coal mining. However, two short sections of the scheme footprint pass over areas where such hazards may be present, these areas are classified as a Development High Risk Area (DHRA) by the Coal Authority (CA). The aforementioned GIR presents the information obtained and reviewed to assess the mining hazard, the associated risks to the scheme and potential mitigation measures which may be required. The two areas are referred to as Causey Park where CA information indicates shallow mine workings to be present and, a second section (associated with the valley of the River Coquet) associated with coal outcropping at the surface in this area.

This report presents the information in the GIR pertinent to mining risk and provides an assessment of the potential coal mining related land stability risks.

The format of this document broadly follows the model report template provided within the CA's 'Risk based approach to development management' [3].

The scope of the works undertaken is as follows:

- Collate and review readily available information including geological, Coal Authority and site investigation data,
- Produce a ground model for the scheme focussing on the distribution of coal seams and recorded coal workings likely to affect the proposed improvement works,
- Assess the risks posed to the improvement works by historical coal mine working; and,
- Identify potential mitigation measures to reduce the risks to acceptable levels.

It is anticipated that the findings of this report will be utilised by the scheme Design and Build Contractor when developing the detailed design and construction methodology.

1.2. SITE DESCRIPTION AND LOCATION

A description of the scheme as a whole is included in the GIR [2].

The Causey Park section of the scheme where potential coal mining hazards have been identified is located to the east of the village of Causey Park and currently comprises an area of agricultural fields. A drawing showing the proposed scheme layout overlying the DHRA is included in Appendix A. The section of road through the area of potential mining risk is approximately 250m long (CH17850 to CH18100) and will be in cutting of around 3m deep at the southernmost end of the area of interest, rising to approximately grade the northernmost end.

The section of the site around the River Coquet valley which is designated as DHRA comprises the valley slopes and bed of the River Coquet. The slopes of this valley vary from near vertical to around

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45° near the crest, reducing in angle toward the river at the toe. The slopes are heavily vegetated in places. An existing bridge carrying the A1 over the river valley, with abutments at the crest of the valley and two piers located within the valley, one each side of the river. At this location a new bridge, with abutments on piled or caisson foundations, is proposed alongside the existing structure.



2. SOURCES OF INFORMATION

The WSP GIR for the scheme brought together information from numerous historical Preliminary Sources Study Reports (PSSRs) and ground investigation Factual Reports produced as part of the ongoing scheme development, as well as recent scheme specific ground investigation information. In summary, the following information, contained in these reports, has been reviewed in connection with the mining risk to the site:

- BGS 1:63,360 (solid geology) Geological Map Sheet 9 1966.
- BGS 1:50,000 (solid and drift) Geological Map Sheet 9, Rothbury, 2009.
- A set of historical mapping.
- A Coal Authority Mine Abandonment Plan (NC536).
- A geophysical survey of the subject section of the route specifically to investigate mining features.
- Historical and recent ground investigation undertaken for scheme development.

A fuller discussion of these references is in included in the GIR, however the relevant extracts have been included as appendices to this report. In addition to the information detailed above, the following additional information was obtained by WSP to aid the coal mining risk assessment.

- A site walkover was undertaken with the landowner of the area around the proposed route and surrounding to obtain local knowledge of recent potential mining related events. A note detailing the information obtained in included as Appendix C.
- Additional ground investigation specifically to investigate the mining risk at the location of the road. The Factual Report [4] for this investigation is included in Appendix D.



3. IDENTIFICATION AND ASSESSMENT OF SITE SPECIFIC COAL MINING

3.1. FEATURES IDENTIFIED

CAUSEY PARK

The information detailed in Section 2 of this report was reviewed and compiled to create a Geohazard Plan and Geological Long Section for the site, which are presented in Appendix A. It should be noted that the geological long section was produced prior to the investigation detailed in Reference 4, therefore this ground investigation data is not shown on the associated plan, however these holes confirmed the ground conditions shown on the section.

The ground conditions comprise around 5 to 7 m of Glacial Till comprising firm to stiff clay overlying Pennine Lower Coal Measures which comprise a sequence of mudstones, shales, siltstones, sandstones and coal. The geological mapping shows an unnamed coal seam outcropping across the route, trending roughly east west.

The Causey Park Dyke is a tholeitic intrusion which crosses the proposed route west to east to the south of the areas of potential mining risk (approximate CH17830). The dyke was formed by an igneous intrusion along a fault.

The following potential mining hazards were identified which are further assessed in this report:

- Adits are evident on the historical mapping and Coal Authority's Online Interactive Viewer, which
 are within the site boundary (Scheme red line boundary) but to the west of the proposed route of
 the road.
- The mine abandonment plan shows workings extend beneath the site at approximately 72 to 74m
 OD beneath the route, approximately 8 to 10m below the finished carriageway levels.
- Anecdotal evidence from the landowner would indicate voids have formed to the east of west of the site boundary causing depressions at ground level and an area of backfilled opencast mining is located to the west of the route.
- Zone of core loss in a historical borehole (BH1046) formed to the south of area of interest.

RIVER COQUET VALLEY

Highways England

Although this area has been designated as a DHRA, the CA interactive mapper does not designate this area as an area of identified or probable shallow coal mine workings. No information has been identified to indicate mining (such as abandonment plans, historic mapping or anecdotal) has taken place in this area.

A walkover and geomorphological mapping exercise undertaken as part of the bridge design did not identify any mining related features. It is considered likely that any such features would have been obliterated during construction of the existing river bridge in the late 1970s.

The BGS mapping indicates the DHRA corresponds with two unnamed coal seams, one above and one below the Corbridge Limestone within the Stainmore Formation (see Appendix B for extract from BGS mapping) which outcrop on the valley slopes due to cutting of the valley through these deposits.

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A geological section based on the ground investigation information has been produced for the section of the route and is included in Appendix A. The upper of the two coal seams is intermittently encountered at levels of around 57mOD to the south of the river but absent to the north, it was found to be intact and around 0.15m thick. This seam is roughly coincident with the proposed road level and will likely be dug out at part of formation of the road cutting and bridge foundations.

The lower seam was encountered at depths of around 29m OD to the south of the river and in one hole to the north of the river at around 38mOD, it varied from 0.2 to 0.5 m thick and was found to be intact.

3.2. ASSESSMENT

CAUSEY PARK

ADITS

The location of the adits is relatively consistent on the mining plans and historical maps. From the anecdotal evidence from the landowner it is likely that they have been either dug out as part of open cast operations or buried when the area of opencast was backfilled.

SHALLOW MINING

Given the mining abandonment plan appears to show that workings extended beneath the proposed route of the road, additional ground investigation undertaken on the route alignment to further investigate this hazard was undertaken.

The GI did not encounter any voids, broken ground or loss of flush and where coal was encountered it was thin (around 0.20m), and likely to have been unworkable. This corresponded to similar thicknesses of coal encountered in other historical boreholes.

Though some zones of no recovery are shown on historical borehole logs in the vicinity (BH1046), these occurred outside the area where mine workings were anticipated based on the abandonment plans and generally correspond to depths where very weak mudstone (recovered as mudstone gravel) are recorded on nearby logs. It is therefore considered that the lack of recovery is due to core loss due to the drilling fragmenting and washing out the very weak mudstone gravel (possibly associated with disturbance from faulting and the igneous intrusion).

It is considered that none of the boreholes have provided conclusive evidence of coal workings in the documented mining areas, including those formed recently specifically to investigate this risk.

However, it is clear that near-surface mining has taken place in the vicinity of the route and has caused localised settlement/collapse in the vicinity of the route (evidence of which was potentially picked up on the geophysics survey to the west of the proposed route).

Based on the coal mining plan and the anecdotal evidence, there remains a risk of shallow coal workings within the vicinity of the route.

RIVER COQUET

No desk study of ground investigation information has identified mining hazards at this location. The risk is considered to be negligible and no further consideration is considered necessary.

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4. MITIGATION STRATEGY

GENERAL

Any assessment of appropriate mitigation measures is dependent on the risk owner's attitude toward risk. It needs to balance the probability of a risk being realised and the likely impact of it should it occur (including financial, health and safety, reputational, social) against the cost and practicality of removing or reducing the probability of the risk being realised.

Potential mitigation measures have been suggested within the scheme GIR, which are considered proportionate to the perceived risk and the impact it would have should it be realised. However, other options may be available which offer a greater degree of certainty but are associated with increased cost or construction / programme impacts.

Based on the available information obtained to date, it is considered there are two mining related risks to the subject section of the route; adits and shallow workings.

ADITS

Based on the available information, taking into account their position away from the proposed construction and that they have most likely been excavated/backfilled as part of the opencast operations, no further investigation or treatment of the adits is considered necessary for the permanent works. In order to minimise risk further, it would be prudent for the Contractor to avoid this area as much as is practicable during construction and avoid locating haul roads or stockpiling material in these areas.

SHALLOW MINING

Given the lack of positive evidence of workings (i.e. voids, broken ground, loss of flush) below the proposed route of the scheme, it is considered that there is a low risk of historical coal workings affecting the site. Therefore, no specific mitigation measures have been included in the preliminary scheme for design development for DCO and the risk is noted in the Risk Register.

In consideration of the mining history of the subject section of the scheme, there is a residual risk that unknown mining features may be encountered during construction and a risk allowance has been included within the scheme budget to allow for the need to treat unexpected voids or mining features.

It is highlighted that no structures are proposed within the subject section of the scheme so any treatment of unexpected mining features would relate to the management of the risk to the carriageway and any associated road infrastructure (drainage, etc.). Given the road is in cutting, any treatment areas are anticipated to be localised and would be limited to the footprint of the road and cutting slopes.

The information from the mining plans and exploratory hole logs indicate the coal seam is approximately 72 to 74m OD beneath the route, approximately 8 to 10m below the finished carriageway levels.

The seam would generally be around 3m below rockhead with around 5 to 7m of Glacial Deposits overlying the solid deposits.

Where drift is very thin, voids may express at the surface as a crown hole whereas, where drift is particularly thick, any subsidence would most likely propagate through the drift and result in a wider shallow settlement trough.

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It is suggested that if during excavation of the proposed cutting, evidence of shallow workings (crown hole, subsidence troughs, etc) is encountered then a grid of grouted probe holes to infill any voids or broken ground would be used. The probes would likely be drilled to 2 m below the anticipated seam depth and if required, a 'grout curtain' could be used to prevent the migration of grout to areas outside the footprint of the earthworks or the site boundary. A high strength geogrid beneath the road pavement foundation to control settlement in the case of surface movement due to the collapse of any unrecorded workings could also be utilised as required.

It is expected that the Design and Build Contractor would provide full details of any required remedial measures as part of the CA's permitting system prior to any treatment. Records of any treatment would be detailed in the scheme Geotechnical Feedback Report as set out in HD22/08.



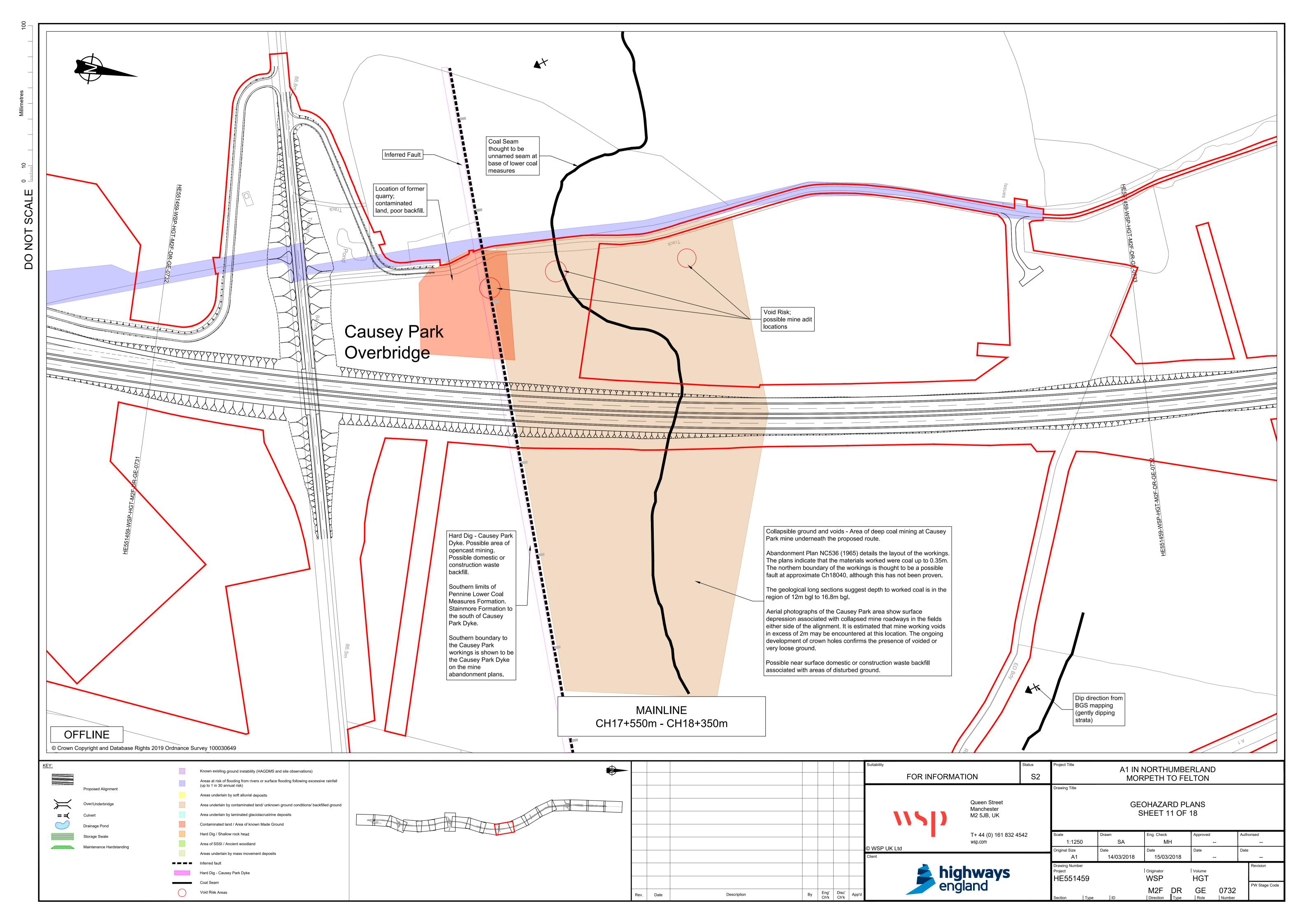
5. REFERENCES

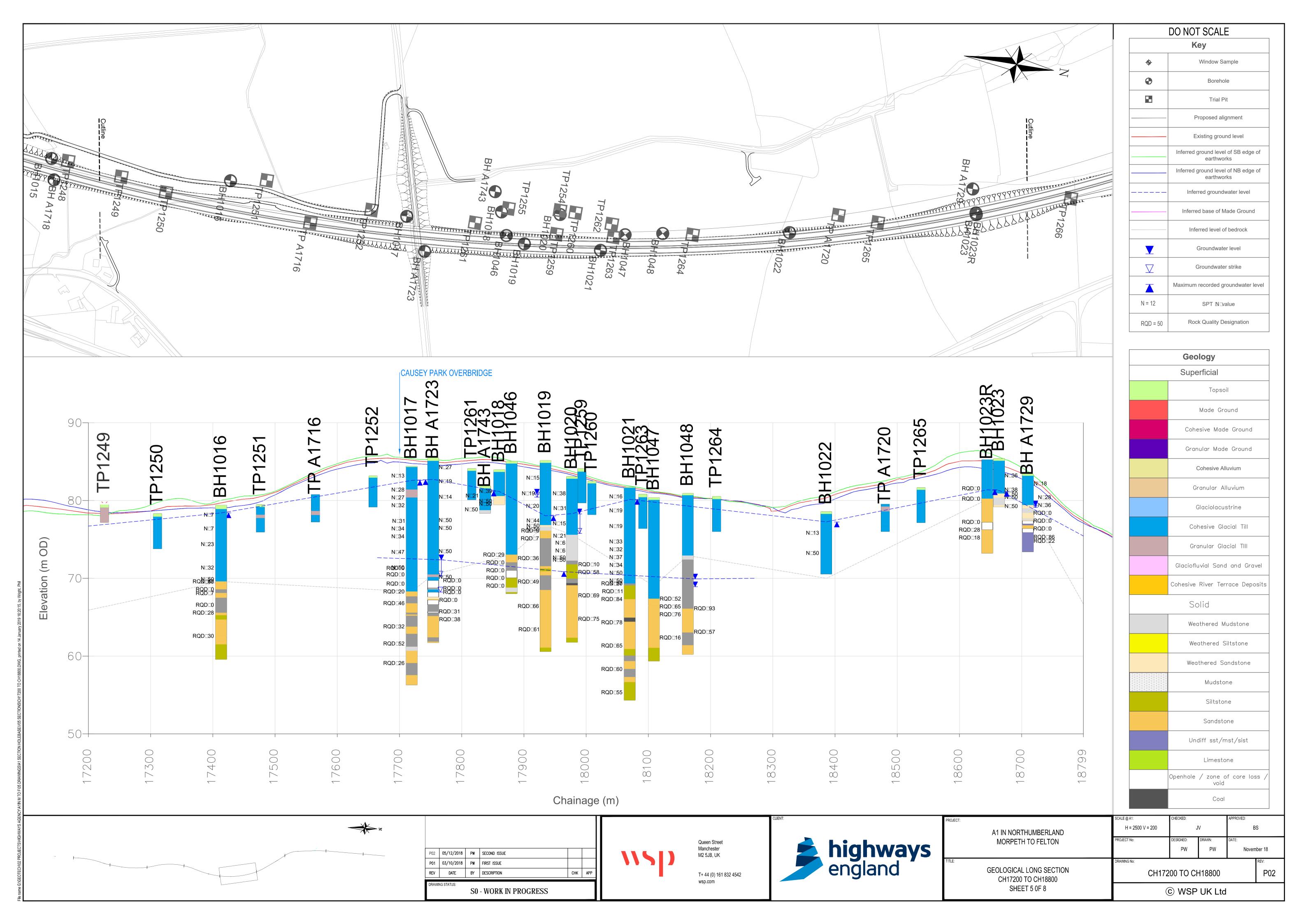
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- 2. WSP, February 2019, A1 in Northumberland: Morpeth to Felton Scheme Ground Investigation Report, ref HE551459-WSP-HGT-M2F-RP-CE-518.
- 3. The Coal Authority, 2017, Risk based approach to development management' Version 4.
- 4. Socotec UK Ltd, July 2018, A1in Morpeth To Felton & Alnwick To Ellingham Factual Report On Ground Investigation: Morpeth To Felton Causey Park, Report No A8013-18/Cp.

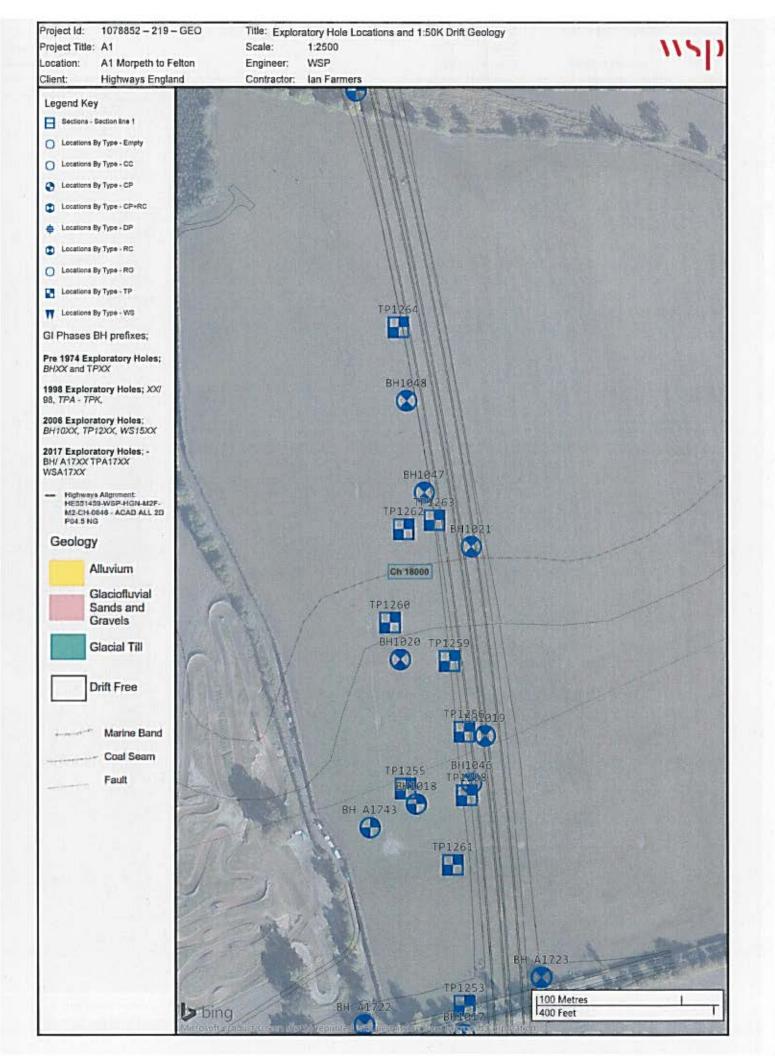
Appendix A

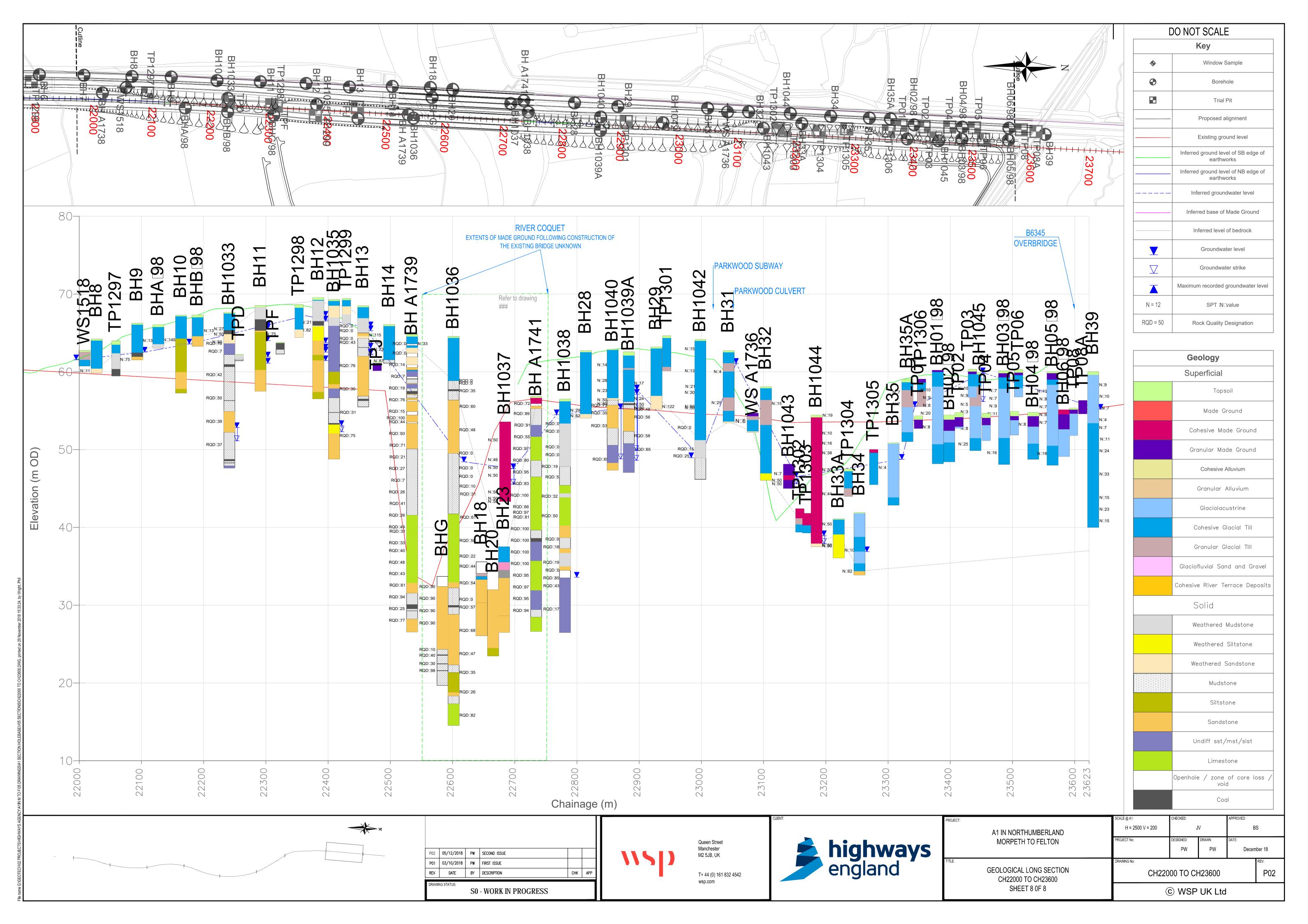
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DRAWINGS

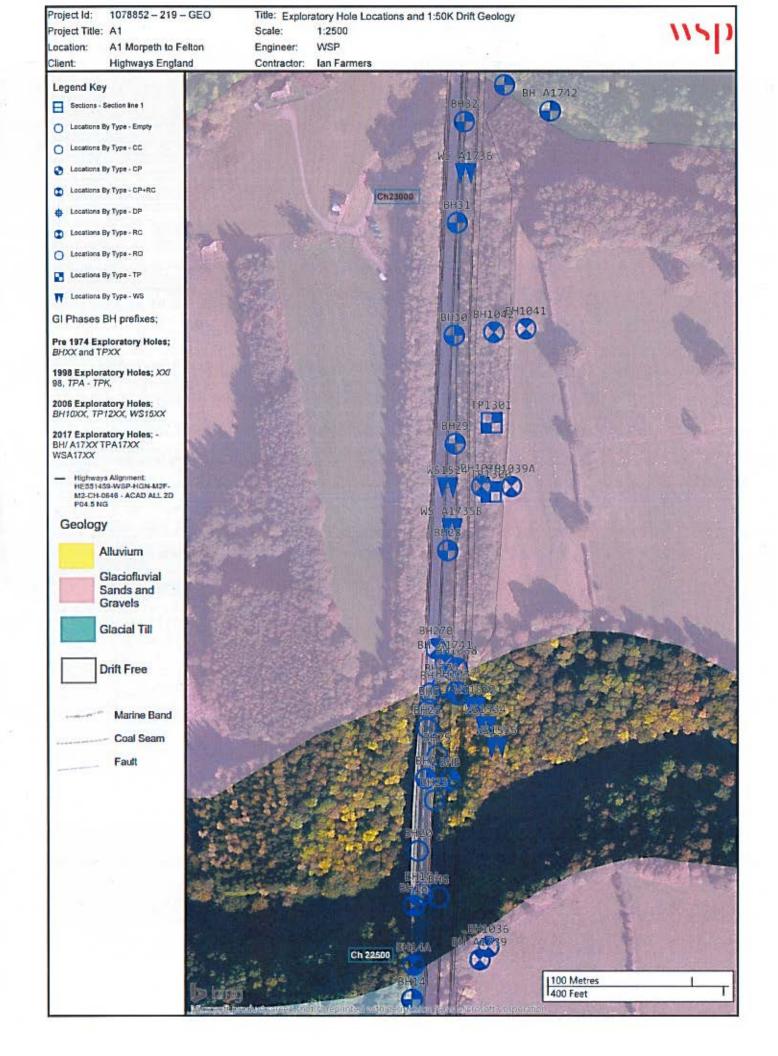








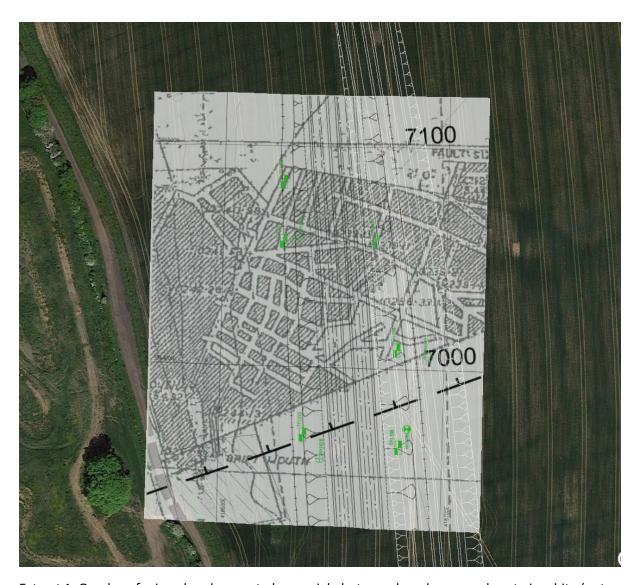




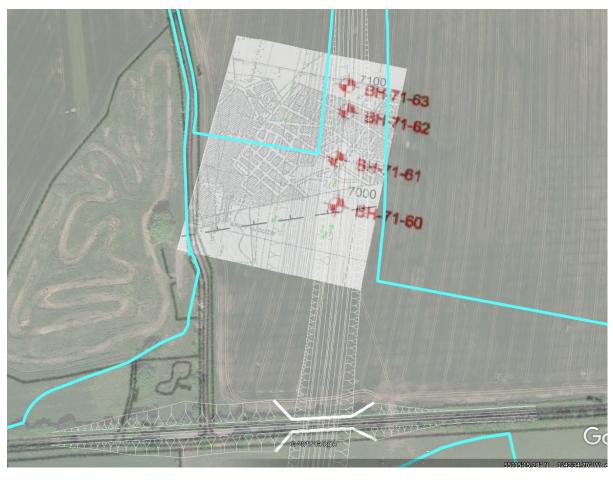
Appendix B

WSD

EXTRACTS



Extract 1. Overlay of mine abandonment plan, aerial photograph and proposed route in white (note the extract abandonment plan is taken from a historic report with a superseded route overlain in black, this route alignment should be ignored).



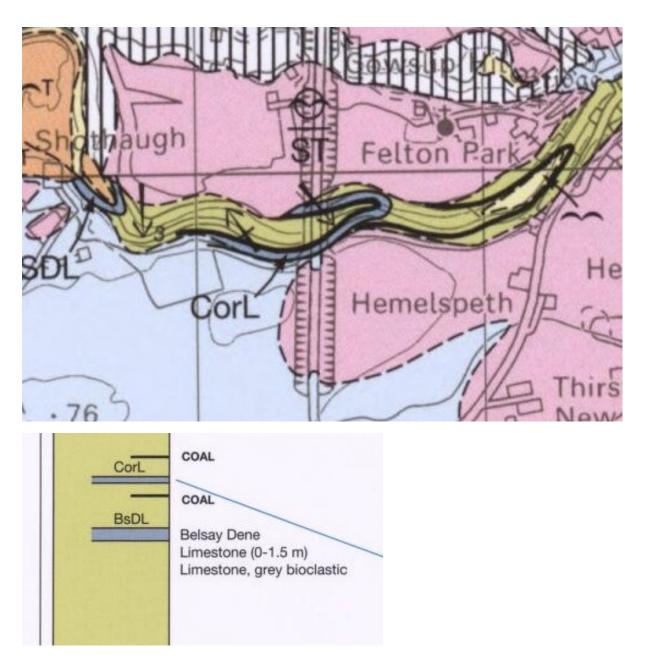
Extract 2: Overlay of Mining Abandonment Plan, aerial photography, proposed route of scheme and location of recent holes from mining investigation.



Extract 3: Overlay of geophysical survey, aerial photograph and proposed route in white (note the extract geophysical survey is taken from a historic report with a superseded route overlain in black, this route alignment should be ignored).



Extract 4. Overlay of historic mapping, aerial photograph and proposed route in white.



Extract 5: BGS mapping at location of River Coquet DHRA (Reproduced with the permission of British Geological Society ©NERC. All rights reserved)

Appendix C

WSD

MINING WALKOVER



MEMO

то	Matt Howard/ Jim Harbord/ Gary Hugill	FROM	Olivia McBarnet	
DATE	29 November 2018	CONFIDENTIALITY	Confidential	
SUBJECT	Mining-Causey Park			

At 1100 Wednesday 18th April Ben Jackson (Osborne) and Olivia McBarnet (WSP) met Mr Hogg, the Landowner, at Causey Park to observe any historic mining features on his land which may impact on works for the A1.

The following memo provides a summary of the meeting and photographs of the area.

1. MINING LOCATIONS



Figure 1-1 Location of historic mine features. Google Earth Imagery 2018



- Opencast mining was located where the concerned field slopes to the west, west of the telegraph poles. Following closure of the works, the area was bull-dozed and infilled. When enquired how the works were infilled Mr Hogg suggested that it was done using excess soil (Figure 1-2;1-3).
- To the west of the proposed boreholes Mr Hogg pointed out undulations in the fields, where previous mining voids have appeared. He indicated that the historic mine works were carried out in a 'diamond shaped geometry', spanning towards the eastern extent of the field.
- These voids have since been infilled or left to settle. The voids which were left have only settled a few inches (from what has been seen), which may indicate that the voids are much deeper in this area. No new voids have appeared in the field for the past 5/6 years (Figure 1-5;1-6).
- To the west of the Site area, Mr Hogg pointed out a large void in the far field. This void opened suddenly in March 2018 (Figure 1-4).

Photographs of the locations of historic mining are located below; the locations of the photos are indicated in Figure 1-1.



Figure 1-2 Looking north from L1. Area of former opencast mining, now infilled.





Figure 1-3 Looking south from L1. Area of former opencast mining, now infilled.



Figure 1-4 Looking West from L2





Figure 1-5 Looking north-east from L3. Undulations in the field may indicate locations of possible historic mining voids.



Figure 1-6 Looking east from L3. Undulations in the field may indicate locations of possible historic mining voids



Figure 1-7 below, highlights the Causey Park dyke and mining voids at Causey Park. Some of the undulations visible on Google Map imagery have been identified on the Geophysical survey below.



Figure 1-7 GeophysicalSurvey. Location of voids. Laing O'Rourke, Preliminary Geotechnical Report. 2006. Google Imagery 2018

Appendix D

FACTUAL REPORT





A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM

FACTUAL REPORT ON GROUND INVESTIGATION: MORPETH TO FELTON – CAUSEY PARK

Report No A8013-18/CP

July 2018

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Report No A8013-18/CP

July 2018

Issue No Date	Status	Prepared by	Checked by	Approved by
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APPENDIX A FIGURES AND DRAWINGS
APPENDIX B EXPLORATORY HOLE RECORDS



1 INTRODUCTION

In April 2018 SOCOTEC UK Limited (SOCOTEC) was commissioned by Geoffrey Osborne Ltd (Osborne), on behalf of Highways England, to carry out a ground investigation associated with a proposed realignment and upgrade of the A1 between Morpeth and Ellingham, Northumberland. The Investigation Supervisor, on behalf of Highways England, was WPS.

The proposed realignment route is split into five sections, as below:

- Alnwick to Ellingham
- Morpeth to Felton River Coquet
- Morpeth to Felton National Grid
- Morpeth to Felton Northern Gas Networks
- Morpeth to Felton Causey Park

This report presents the finding of the ground investigation for the *Morpeth to Felton – Causey Park* section of the route. The investigation works in this section are required to identify any mining related features such as voids, broken ground or coal seams.

The scope of the investigation was specified by WSP and comprised rotary (open-hole) boreholes. The investigation was performed in accordance with the general requirements of BS 5930 (2015), BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and other relevant related standards identified below. The fieldwork was carried out between 24 and 26 April 2018.

This report presents the factual records of the fieldwork, the information is also presented as digital data as defined in AGS4 (2017).

2 SITE SETTING

2.1 Location and Description

The site is located to the west of the A1 trunk road, about 9 km north of Morpeth town centre, Northumberland, see Site Location Plan in Appendix A. The National Grid reference for the site is NZ 186 954.

The general area is known as Causey Park and the site comprises arable farmland, with a series of fields separated by hedges and fences. Causey Park Farm is at the south west corner of the site.

2.2 Published Geology

The published geological map for the area, BGS Sheet 9 (2009) and the BGS Geology of Britain Viewer (2018) show the site located on Glacial Till. The underlying bedrock is the Stainmore Formation, comprising sandstones, siltstones, mudstones, thin limestones and some coals.

3 FIELDWORK

3.1 General

The exploratory hole locations were selected by WSP and set out by Osborne. The co-ordinates and reduced levels of the as dug locations were surveyed by SOCOTEC to National Grid and Ordnance Datum. The exploratory hole locations are shown on the Site Plan in Appendix A.

3.2 Exploratory Holes

Details of the exploratory holes are summarised in the table below:

TABLE 1: SUMMARY OF EXPLORATORY HOLES

Hole ID	Hole Type	Hole Depth, (m)
BH/17/60	Rotary Open-Hole	35.00
BH/17/61	Rotary Open-Hole	35.00
BH/17/62	Rotary Open-Hole	35.00
BH/17/63	Rotary Open-Hole	35.00



The exploratory logs are presented in Appendix B. These provide information including the equipment and methods used, samples taken, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records in Appendix B, together with other explanatory information. The logging of soil is in accordance with BS 5930 (2015).

On completion of the fieldwork geotechnical samples were transported to the Doncaster laboratory of SOCOTEC for testing and temporary retention. Geoenvironmental samples were transported from site directly to the SOCOTEC laboratory at Bretby, Burton-on-Trent.



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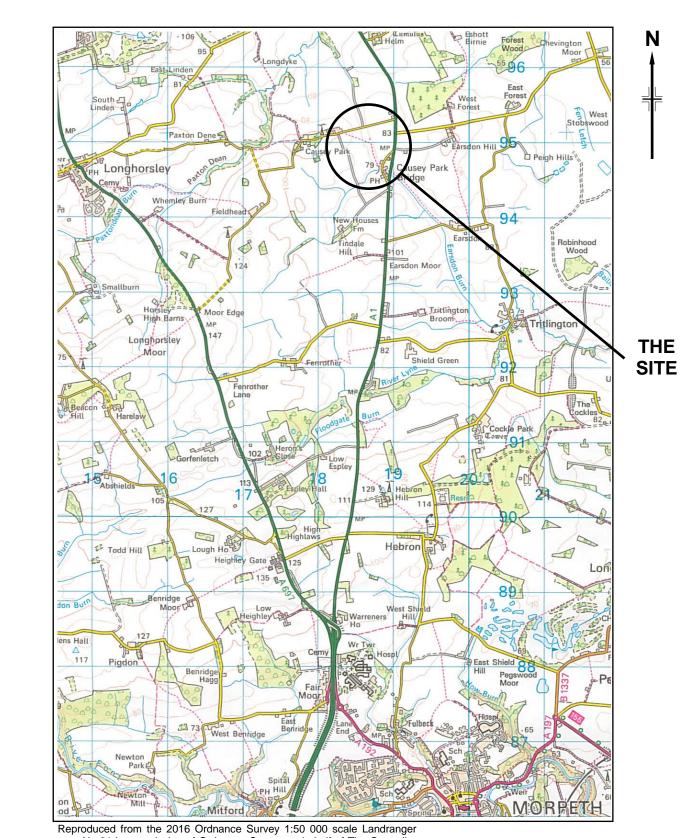


APPENDIX A FIGURES AND DRAWINGS

Site Location Plan	A1
Site Plan	A2

Site Location Plan





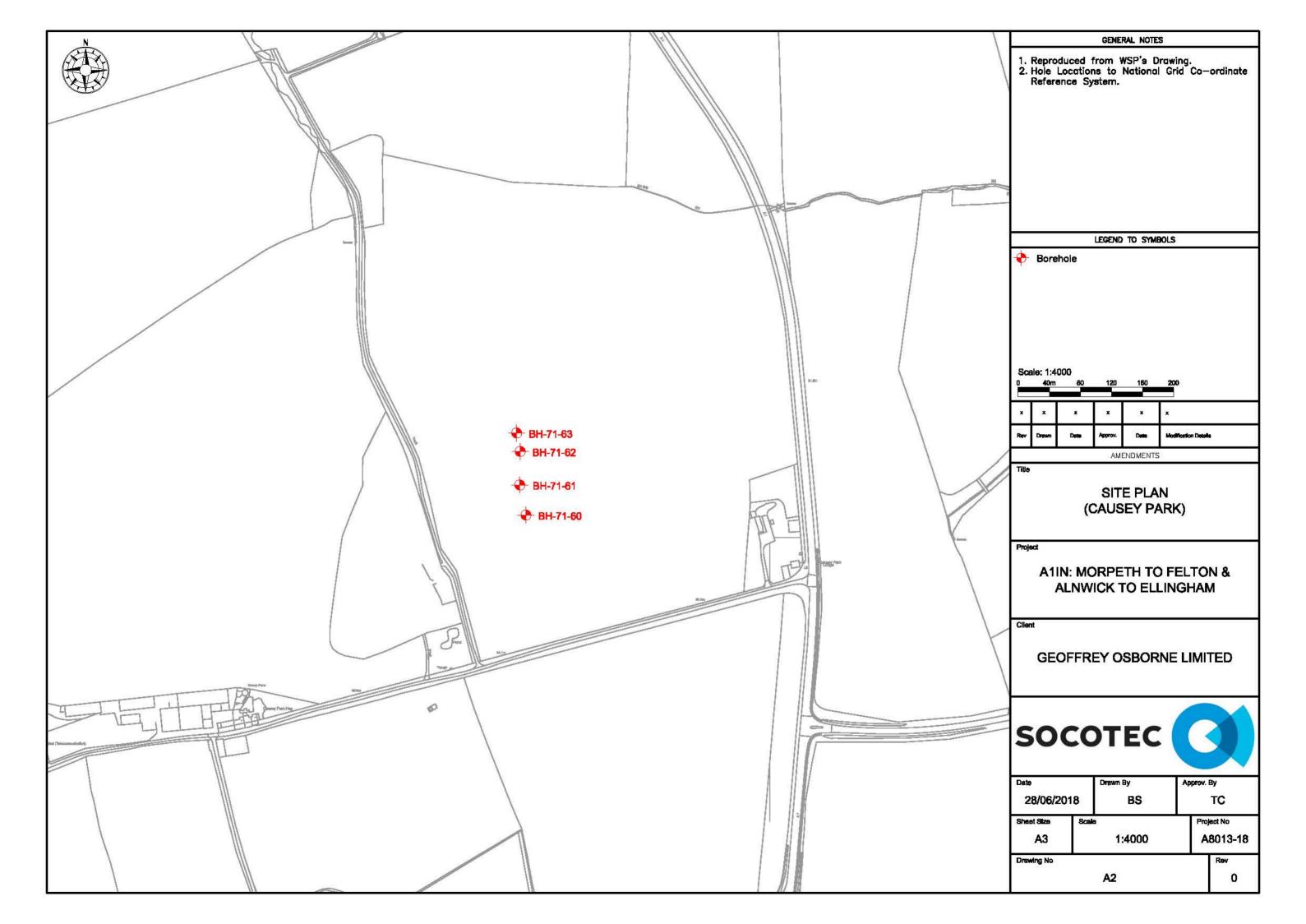
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Scale 1:50 000

Project A1iN MORPETH TO FELTON & ALNWICK TO ELLINGHAM
Project No. A8013-18
Carried out for Geoffrey Osbourne Limited

Figure

A1





APPENDIX B EXPLORATORY HOLE RECORDS

Key to Exploratory Hole Records

Key

Borehole Logs

BH/17/60 to BH/17/63

Key to Exploratory Hole Records



SAMPLES

Undisturbed

Driven tube sample

nominally 100 mm diameter and full recovery unless otherwise stated LIT Driven thin wall tube sample

TW Pushed thin wall tube sample Pushed piston sample

Liner sample from dynamic (windowless) sampling. Full recovery unless otherwise stated

CBR CBR mould sample BLK Block sample

Core sample (from rotary core) taken for laboratory testing. C/CS

AMAL Amalgamated sample

Disturbed

Small sample D В Bulk sample

Other

Water sample W G Gas sample

Environmental chemistry samples (in more than one container where appropriate)

ES Soil sample EW Water sample

Comments Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that, while an

attempt was made to take a tube sample, there was no recovery.

Samples taken from borehole installations (ie water or gas) after hole construction are not shown on the exploratory

hole logs.

Specimens for point load testing undertaken on site (or other non-lab location) are not shown on the log.

IN SITU TESTS

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

The Standard Penetration Test is defined in BS EN ISO 22476-3:2005+A1:2011.

The incremental blow counts are given in the Field Records column; each increment is 75 mm unless stated otherwise and any penetration under self-weight in mm (SW) is noted. Where the full 300 mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 the

total blow count beyond the seating drive is given (without the N = prefix).

I٧ in situ vane shear strength, peak (p) and remoulded (r) HV Hand vane shear strength, peak (p) and remoulded (r) Pocket penetrometer test, converted to shear strength

KFH, KRH, KPI Permeability tests (KFH = falling head, KRH = rising head; KPI = packer inflow);

results provided in Field Records column (one value per stage for packer tests)

DRILLING RECORDS

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930:2015

TCR Total Core Recovery, % SCR Solid Core Recovery, % RQD Rock Quality Designation, %

If Fracture spacing, mm. Minimum, typical and maximum spacing measurements are presented.

The term non-intact (NI) is used where the core is fragmented. NI

Used where a measurement is not applicable (eg. If, SCR and RQD in non-rock materials). NA

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

CRF Core recovered (length in m) in the following run

AZCL Assessed zone of core loss

GROUNDWATER

Updated October 2017

Groundwater entry

Depth to groundwater after standing period

Notes: Project A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM

See report text for full references of standards. Project No. A8013-18

Carried out for **Geoffrey Osborne Limited** Key

Sheet 1 of 3

Key to Exploratory Hole Records



INSTALLATION

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

Standpipe/ piezometer

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

The type of instrument installed is indicated by a code in the Legend column at the base of the tubing:

Standpipe

SPIE PPIE **EPIE** Standpipe piezometer Pneumatic piezometer Electronic piezometer

Pipe

Slotted

Piezometer qiT

Inclinometer or Slip Indicator

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

column.

ICE

Biaxial inclinometer

ICM SLIP Inclinometer tubing for use with probe Slip indicator

Settlement Points or **Pressure Cells** The installation of single point instruments is indicated on the Record. The location of the measuring device is shown in the

Legend column.

The type of instrument installed is indicated by a code in the Legend column:

ESET Electronic settlement cell/gauge

ETM Magnetic extensometer settlement point **EPCE** Electronic embedment pressure cell **PPCE** Electronic push in pressure cell

INSTALLATION / BACKFILL LEGENDS

A legend describing the installation is shown in the rightmost column. Legend symbols used to describe the backfill materials are indicated below.







Topsoil









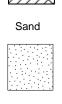
STRATUM LEGENDS

The legend symbols used for graphical representation of soils, rocks and other materials on the borehole logs are shown below. For soils with significant proportions of secondary soil types, a combination of two or more symbols may be used.

Macadam
簽
Clay
Mudstone



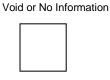
Concrete





Made Ground / Fill







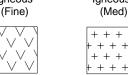


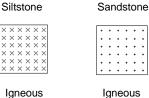
Breccia



Limestone

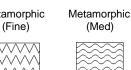


























Notes:

See report text for full references of standards.

Updated October 2017

Project

A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM

A8013-18 Project No.

Carried out for **Geoffrey Osborne Limited**

Key

Key to Exploratory Hole Records



	SOCOTEC
NOTES	
1	Soils and rocks are described in accordance with BS EN ISO 14688-1:2002+A1:2013 and 14689-1:2003 respectively as amplified by BS 5930:2015.
2	For fine soils, consistency determined during description is reported for those strata where undisturbed samples are available. Where the logger considers that the sample may not be representative of the condition in situ, for whatever reason, the reported consistency is given in brackets. The reliability of the sample is indicated by Probably or Possibly as appropriate. Hence (Probably firm) indicates the logger is reasonably confident of the assessment, but (Possibly firm) means less certainty. Where the samples available are too disturbed to allow a reasonable assessment of the in situ condition, no consistency is given.
3	Evidence of the occurrence of very coarse particles (cobbles and boulders) is presented on the logs. However, because of their size in relation to the exploratory hole these records may not be fully representative of their size and frequency in the ground mass.
4	The declination of bedding and joints is given with respect to the normal to the core axis. Thus in a vertical borehole this will be the dip.
5	The assessment of SCR, RQD and Fracture Spacing excludes artificial fractures.
6	Observations of discernible groundwater entries during the advancement of the exploratory hole are given at the foot of the log and in the Legend column. The absence of a recorded groundwater entry should not, however, be interpreted as a groundwater level below the base of the borehole. Under certain conditions groundwater entry may not be observed, for instance, drilling with water flush or overwater, or boring at a rate faster than water can accumulate in the borehole. Similarly, where water entry observations do exist, groundwater may also be present at higher elevations in the ground than where recorded in the borehole. In addition, where appropriate, water levels in the hole at the time of recovering individual samples or carrying out in situ tests and at shift changes are given in the Records column.
7	The borehole logs present the results of Standard Penetration Tests recorded in the field without correction or interpretation. However, in certain ground conditions (eg high hydraulic head or where very coarse particles are present) some judgement may be necessary in considering whether the results are representative of in situ mass conditions.
REFERENCES	
1	BS EN ISO 14688-1:2002+A1: 2013: Geotechnical investigation and testing - Identification and classification of soil. Part 1 Identification and description. British Standards Institution
2	BS EN ISO 14689-1 : 2003 : Geotechnical investigation and testing - Identification and classification of rock. Part 1 Identification and description. British Standards Institution
3	BS EN ISO 22476-3:2005+A1 : 2011 : Geotechnical investigation and testing - Field testing. Part 3 Standard penetration test. British Standards Institution

Notes:	Project	A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM
See report text for full references of standards.	Project No.	A8013-18



Drilled BJ Start quipment, Methods and Remarks Depth from Casing Depth Ground Level (m) 35.00 (m) 8.00 RT Coordinates (m) .oaaed 24/04/2018 E 418686.10 TC National Grid N 595393.80 Checked End Approved TC 24/04/2018 Samples and Tests Strata Description Depth, Level (Thickness) Backfill Legend Records/Samples Detail Casing Wate irm brown slightly sandy CLAY with occasiona 0.20 0.20 0.40 0.50 - 1.00 rootlets and pockets of orange fine sand. Rare subangular to subrounded fine to coarse gravel of 0.30 medium grained sandstone. (TOPSOIL) Firm brown, mottled orangish brown and grey, (0.90)slightly sandy CLAY with occasional pockets (<10mm) of orange fine to medium sand.
Occasional subangular to subrounded fine to 1.00 ES 4 coarse gravel of mudstone grained sandstone and hard grey mudstone.
(GLACIAL TILL)
Firm brownish grey CLAY with cobbles. 1.20 (Driller's description) (Probable GLACIAL TILL) (6.60)7.80 SANDSTONE. (Driller's description)
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1:50 Project No. A8013-18 Carried out for **Geoffrey Osborne Limited** Sheet 1 of 4



Drilled BJ	Start	Equipment,	Methods and Rem	arks			Depth from	to		r Casing Depth	Ground Level		85.10 mOD
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© Copyright SOCOTEC UK Limited Scale 1:50 04/07/2018 12:21:41 A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Borehole Project BH/17/60 Project No. A8013-18 Carried out for Geoffrey Osborne Limited



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Drilled BJ Start quipment, Methods and Remarks Ground Level Depth from Casing Depth (m) 35.00 RT Coordinates (m) E 418678.18 .oaaed 25/04/2018 TC National Grid N 595432.45 Checked End Approved TC 25/04/2018 Strata Description Samples and Tests Depth, Level (Thickness) Backfill Legend Records/Samples Detail Casing Wate Firm brown slightly sandy CLAY with frequent 0.20 0.20 0.40 0.50 - 1.00 rootlets and occasional pockets of orange fine to medium sand. (TOPSOIL) 0.30 Firm brown, mottled orangish brown and grey, CLAY with occasional rootlets and pockets of (0.90)orange fine to medium sand and rare subangular to subrounded fine to coarse gravel of medium 1.00 ES 5 grained sandstone. D 6 Firm brown grey CLAY with cobbles. (Driller's description) (Probable GLACIAL TILL) (5.70)(Driller's description) (Probable STAINMORE FORMATION) (4.10) Depth Related Remarks Chiselling Details Depth Sealed Duration (mins) Tools used Depth Strike Remarks Depths (m) Remarks Depths (m) Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Borehole Project BH/17/61 in depth column.
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1:50 Project No. A8013-18 Carried out for **Geoffrey Osborne Limited** Sheet 1 of 4



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otes: For explanation of symbols and abbreviations	No. Depth Strike			Depth Seale								ns) Tools used
ee Key to Exploratory Hole Records. All depths and	.5.00											
te ney to Exploratory more Records. All depths and	otes: For explanation	of symbols and	l abbreviations	Project	A1IN MORPETH TO I	FELTON & ALNWICK TO EL	LINGHAM			Borehole		
duced levels in metres. Stratum thickness given in	duced levels in metre	es. Stratum thick	kness given in	L						D	山/ 47/4	31
ackets in depth column. Project No. A8013-18 DIT/11/OI	ackets in depth colum	nn.	C UK Limited AGS							l 📴	11/1//) I
Scale 1:50 Geoffrey Osborne Limited Scale 1:50 Geoffrey Osborne Limited Sheet 2 of 4	Scale 1:50			Carried out for	Geoffrey Osborne Li	mited				<u> </u>	Sheet 2 of 4	



Drilled BJ	Start	Equ	ipment, Methods and Rema	arks			Depth from	to	Diameter	Casing Depth	Ground Level		84.61 mOD
Logged RT	25/04/2018	Mas	ssenza MI3.				(m) 1.20	(m) 35.00	(mm) 121	(m) 7.00	Coordinates (m)		E 418678.18
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Approved TC	25/04/2018					0					ł		
Samples and			1	Date	Time	Strata Description	1					T	5
Depth	TCR SCR RQD	If	Records/Samples	Casing	Water	Ma	ain			Detail	Depth, Level (Thickness)	Legend	Backfill
-						SANDSTONE with occas	ional mudstor	ne bands.					
<u>=</u> -						(Driller's description)	ODMATION			=			
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roundwater Entries	 S			1		Depth Related Remarks					Chiselling Detail	s	
No. Depth Strike				Depth Se	aled	Depths (m) Remarks						Duration (mins)	Tools used
otes: For explanation	of symbols a	nd abb	reviations Project		A1ii	N MORPETH TO FELTON & AL	NWICK TO ELL	INGHAM			Borehole		
e Key to Exploratory	Hole Records	s. All de	epths and		A111	A							
duced levels in metre ackets in depth colur	mn.		Project	No.	A80	13-18					j Bi	H/17/6′	1
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Drilled BJ	Start	Equ	ipment, Methods and Rem	arks			Depth from	to	Diameter	Casing Depth	Ground Level		84.61 mOD
Logged RT	25/04/2018	Mas	ssenza MI3.				(m) 1.20	(m) 35.00	(mm) 121	(m) 7.00	Coordinates (m)		E 418678.18
Checked TC	End	Rota	ary open hole drilling.				1.20	00.00		7.55	National Grid		N 595432.45
											National Grid		14 333432.43
Approved TC	25/04/2018					a. . a.					4		
Samples and			1	Date	Time	Strata Description	1						
Depth	TCR SCR RQD	If	Records/Samples	Casing	Water	M	ain			Detail	Depth, Level (Thickness)	Legend	Backfill
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Groundwater Entries						Depth Related Remarks					Chiselling Detail		
No. Depth Strike	e Remarks			Depth Se	ealed	Depths (m) Remarks					Depths (m)	Duration (mins) Tools used
otes: For explanation	of symbols a	nd ahh	reviations Project		Δ1:1	N MORPETH TO FELTON & AL	NWICK TO FIT	INGHAM			Borehole		
ee Key to Exploratory	Hole Record	s. All de	epths and		Aill	TIMORE LITTIO FELIUN & AL	THE ELL	TG: IAIVI					_
duced levels in metre ackets in depth colur	es. Stratum th	ickness	s given in	No.	A80	13-18					l B	H/17/6	1
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Drilled Start quipment, Methods and Remarks BJ Depth from Casing Depth Ground Level (m) 35.00 (m) 8.00 RT Coordinates (m) .oaaed 25/04/2018 E 418678.70 TC National Grid N 595475.56 Checked End Approved TC 25/04/2018 Strata Description Samples and Tests Depth, Level (Thickness) Backfill Legend Records/Samples Detail Casing Wate Firm brown slightly sandy CLAY with frequent (0.30)rootlets and occasional pockets of orange fine sand. (TOPSOIL) 0.30 +83.77 0.20) +83.57 Firm greyish brown slightly sandy slightly gravelly Firm greyisn brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of medium grained sandstone.

((GLACIAL TILL)

Firm orangish brown, mottled brown and grey slightly sandy CLAY with rare subangular to subrounded fine to coarse gravel of medium grained sandstone 0.75 ES 5 (0.70) D 6 1.20 grained sandstone.
(GLACIAL TILL)
Firm brown grey CLAY with cobbles.
(Driller's description)
(Probable GLACIAL TILL) (6.60)7.80 +76.27 SANDSTONE (Driller's description)
(Probable STAINMORE FORMATION) (3.40)Groundwater Entries Depth Related Remarks Chiselling Details Depth Sealed Duration (mins) Tools used Depth Strike Remarks Depths (m) Remarks Depths (m) Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Borehole Project BH/17/62 © Copyright SOCOTEC UK Limited AGS Project No. A8013-18 Carried out for **Geoffrey Osborne Limited** Sheet 1 of 4



Drilled BJ	Start	Equipment, Method	ds and Rema	ırks		(m) (m)	ameter Casing Depth (mm) (m) 121 8.00			84.07 mOD
Logged RT	25/04/2018	Massenza MI3. Rotary open hole dri	illing.			1.20 35.00	121 8.00	Coordinates (m		E 418678.70
Checked TC	End							National Grid		N 595475.56
Approved TC	25/04/2018									
Samples and						Strata Description				
Depth	TCR SCR RQD	If Records/S	Samples	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
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_						(Driller's description)	<i>l</i> =	11.30 +72.7	7	$\perp / / \downarrow$
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_						(Driller's Description)	_	_		-1///
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Groundwater Entries		•				Depth Related Remarks		Chiselling Deta		_
No. Depth Strike	Remarks			Depth Sea	aled	Depths (m) Remarks		Depths (m)	Duration (mins)	Tools used
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Notes: E		Labbani C	le :			MARRIET TO FELTOWA		Barrel :		
Notes: For explanation see Key to Exploratory	Hole Records.	All depths and	Project		A1il	MORPETH TO FELTON & ALNWICK TO ELLINGHAM		Borehole		
see Key to Exploratory reduced levels in metro brackets in depth colur	Hole Records. es. Stratum thic	All depths and kness given in	Project I	No.		I MORPETH TO FELTON & ALNWICK TO ELLINGHAM			BH/17/62	2



Casing Depth Drilled BJ Start quipment, Methods and Remarks Depth from Ground Level to (m) 35.00 (m) 8.00 RT 25/04/2018 Coordinates (m) E 418678.70 .oaaed National Grid Checked TC N 595475.56 End Approved TC 25/04/2018 Samples and Tests Strata Description Depth, Level (Thickness) Backfill Legend Records/Samples Detail Casing Wate (Driller's description) (Probable STAINMORE FORMATION) (19.00) Depth Related Remarks Chiselling Details Depth Strike Remarks Depth Sealed Duration (mins) Tools used Depths (m) Depths (m) Remarks Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

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Scale 1:50 04/07/2018 12:21:42 A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Borehole Project BH/17/62 Project No. A8013-18 Carried out for Geoffrey Osborne Limited



Drilled BJ	Start	Equ	ipment, Methods and Rem	arks			Depth from	to		Casing Depth	Ground Level		84.07 mOD
Logged RT	25/04/2018	Mas	ssenza MI3.				(m) 1.20	(m) 35.00	(mm) 121	(m) 8.00	Coordinates (m)		E 418678.70
Checked TC	End	Rota	ary open hole drilling.								National Grid		N 595475.56
Approved TC	25/04/2018	.									National Ona		14 000+7 0.00
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Samples and			I	Date	Time	Strata Description	1				Depth, Level	Legend	Backfill
Depth	TCR SCR RQD	If	Records/Samples	Casing	Water	Ma	iin			Detail	(Thickness)	Legenu	Dackiiii
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Groundwater Entries	<u> </u>			l		Depth Related Remarks					Chiselling Detail	s	
No. Depth Strike		3		Depth Se	aled	Depths (m) Remarks) Tools used
lotae: For ovalench	of cumbala -	and abl	revistione Dest4		A 4 **	MODDETH TO EE! TON 9 A1	NWICK TO ELL	INGU A BA			Rorobala		
Notes: For explanation ee Key to Exploratory	Hole Record	ls. All de	epths and		A1il	N MORPETH TO FELTON & AL	NWICK 10 ELL	INGHAM			Borehole		
educed levels in metre rackets in depth colur	es. Stratum th	nickness	s given in	No.	A80	13-18					l B	H/17/6	2
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Scale 1:50		04/07/20	18 12:21:42		360	J Codo. No Emilitor					<u> </u>	Sheet 4 of 4	



Drilled BJ	Start	Equ	uipment, Methods and Rema	rks			Depth from	to		Casing Depth	Ground Le	vel		83.98 mOD
Logged RT	26/04/2018	₃ Ma	ssenze MI3.				(m) 1.20	(m) 35.00	(mm) 121	(m) 9.50	Coordinate	s (m)		E 418674.16
Checked TC	End	Rot	tary open hole drilling.								National G			N 595499.30
Approved TC	26/04/2018	,									National C			14 000400.00
		,				011. D					4			
Samples and				Date	Time	Strata Description	1		_		Don'th I		1	D Leftill
Depth	TCR SCR RQD	If	Records/Samples	Casing	Water	Ma	ain			Detail	Depth, L (Thickness)	evei	Legend	Backfill
_	<u> </u>		0.00-1.20 Hand excavated			Soft to firm dark brown sl	ightly sandy C	CLAY with			(0.20)		XXXXX	
- 0.20 - 0.20	ES 1 D 2		inspection pit.			frequent rootlets. (TOPSOIL)				=	(0.30)	+83.68		
-			-			Firm to stiff brown, mottle	d orangish bro	own and	-1	-	- 0.00	-00.00		
- 0.50 - 0.50	ES 3 D 4					bluish grey, slightly sandy	CLAY with or	ccasional		=				1//
_						pockets of light grey fine subangular to subrounde	to coarse sand	id and rare se gravel d	of	_	(0.90)			
<u>-</u>						medium grained sandsto	ne. Rare lignit	te (<5mm).	.	1.00-1.20 no—				
=						(GLACIAL TILL)				orangish brown -	1.00	+82.78		1//
						Firm brown grey CLAY w (Driller's description)	ith cobbles.			mottling -	1.20	+02.70		
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_ _	1					Dark grey SANDSTONE (Driller's description)	with mudstone	e bands.		-	1		[:::::	
_	1					(Probable STAINMORE F	ORMATION))		=	+			
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Groundwater Entries	5		1			Depth Related Remarks					Chiselling	Details	s	
No. Depth Strike	e Remarks	s		Depth Sea	aled	Depths (m) Remarks					Depths (m		Duration (mins)	Tools used
Noton: For our land	of or met -1:	and ch.	provintions Provi			MODDETH TO FELTON 8	NIMICK TO E.	INCUA			Porch -1-			
Notes: For explanation see Key to Exploratory	Hole Record	ds. All d	lepths and		A1il	N MORPETH TO FELTON & AL	NWICK 10 ELL	LINGHAM			Borehole			
educed levels in metre rackets in depth colur	es. Stratum t	hicknes	s given in	No.	A80	13-18					BH/17/63			
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Drilled BJ		Equipment, Method	s and Remai	rks			(m)	(m) (m	neter Casing Depth nm) (m) 121 9.50			83.98 mOD	
Logged RT	26/04/2018	Massenze MI3. Rotary open hole dril	ling.				1.20 3	35.00	121 9.50	Coordinates (m)		E 418674.16	
Checked TC	End									National Grid	1	N 595499.30	
Approved TC	26/04/2018									1			
Samples and						Strata Description	1			<u> </u>			
Depth	TCR SCR POD	If Records/S	amples			Ma	iin		Detail		Legend	Backfill	
Groundwater Entries	TCR SCR RAD	if Records/S	amples	Date Casing Depth Seal	Time Water	Dark grey SANDSTONE (Driller's description) (Probable STAINMORE Formal States of the Control of	with mudstone become the comment of	pands.	Detail	Depth, Level (Thickness) (4.90) (4.90) Chiselling Detai Depths (m)		Tools used	
										1			
										<u> </u>			
Notes: For explanation	of symbols and	l abbreviations	Project		A1iN	MORPETH TO FELTON & AL	NWICK TO ELLING	GHAM		Borehole			
see Key to Exploratory reduced levels in metro	es. Stratum thick	kness given in	Project N	lo.	٨٥٥٠	13.18				P	H/17/63	1	
brackets in depth column. © Copyright SOCOTEC UK Limited AGS Project No. A8013-18									ו י				
© Copyright SOCOTEC UK Limited AGS Scale 1:50 04/07/2018 12:21:43 Carried out for Geoffrey Osborne Limited									Sheet 2 of 4				



Casing Depth Drilled BJ Start quipment, Methods and Remarks Depth from Ground Level to (m) 35.00 (m) 9.50 RT 26/04/2018 Coordinates (m) E 418674.16 .oaaed National Grid Checked TC N 595499.30 End Approved TC 26/04/2018 Samples and Tests Strata Description Depth, Level (Thickness) Backfill Legend Records/Samples Detail Casing Wate Light grey SANDSTONE with occasional mudstone bands. (Driller's description)
(Probable STAINMORE FORMATION) (20.60) Depth Related Remarks Chiselling Details Depth Strike Remarks Depth Sealed Duration (mins) Tools used Depths (m) Depths (m) Remarks Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

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Scale 1:50 04/07/2018 12:21:43 A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Borehole Project BH/17/63 Project No. A8013-18 Carried out for Geoffrey Osborne Limited



Drilled BJ Logged RT Checked TC	Start 26/04/2018 End	Equipment, Methods Massenze MI3. Rotary open hole drilli			Depth from (m) to (m) Dia (m) 1.20 35.00 (m)		Ground Level Coordinates (m) National Grid		83.98 mOD E 418674.16 N 595499.30			
Approved TC	26/04/2018				Strata Dagarin tian							
Samples and			Date	Time	Strata Description		Depth, Level	Legend	Backfill			
Depth	SCR RQD	If Records/Sa	mples Casing	Water		Detail	(Thickness)	····				
Depth	TCR	If Records/Sa		Time	Main Light grey SANDSTONE with occasional mudstone bands. (Driller's description) (Probable STAINMORE FORMATION)	Detail	Depth, Level (Thickness)	Legend	Backfill			
Groundwater Entries No. Depth Strike	S Remarks		Depth Sc	ealed	Depth Related Remarks Depths (m) Remarks		Chiselling Details Depths (m)	s Duration (mins)	Tools used			
Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. © Copyright SOCOTEC UK Limited Scale 1:50 04/07/2018 12:21:43 Output Project A1IN MORPETH TO FELTON & ALNWICK TO ELLINGHAM Project No. A8013-18 Carried out for Geoffrey Osborne Limited								H/17/63 Sheet 4 of 4				

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