Structural Civil Geo-Environmental



consulting engineers

Plot 7 Science Central, Buckingham Street, Newcastle upon Tyne

Phase II Geo-environmental Assessment

for

Karbon Homes Limited







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Plot 7, Science Central, Newcastle upon Tyne Phase II Geo-Environmental Assessment

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Executive Summary

Site Investigation	 The investigation involved: Inspection of the Phase I Geo-environmental Assessment Report. 3 no. mini-percussion boreholes (WS01 to WS03). 4 no. rotary boreholes (BH1 to BH3, including BH1A). Installation of 3 no. combined gas and groundwater monitoring wells. Geotechnical and contamination related testing. Ground gas and groundwater monitoring.
Ground Conditions	Made ground was recorded below the majority of the site to depths of between 1.0m and 2.0m. Dark grey sand was also noted within WS02 (central east part of site) between 1.8m and 2.0m, which was considered to be potentially attributable to residual grout from previous remedial works. An exception was noted within BH1 and BH1A, sunk within the north-eastern
	corner of the site to target the indicative location of the former open-cast high back wall. Within BH1 made ground comprising gravel and cobbles and sandstone and mudstone was recorded up to >6.4m, which is considered to be associated with engineered fill utilised to backfill the former open-cast.
	Within BH1A mudstone and sandstone colliery spoil was also noted to a depth of 9.00m (or 65.60m AOD) overlying sandstone bedrock. From previous information relating to the former open-cast, as workings included extraction of both the High Main and Metal coal seams, it is understood that this resulted in a basal depth of the open-cast working to between 51.9m to 57.6m AOD.
	Therefore, as made ground within BH1A was only recorded to a depth of 65.60m AOD it is considered this borehole was likely sunk on the high-back wall. This is potentially corroborated by general ground conditions noted this borehole location, which recorded workings and grouted gravel considered to be attributable to the Metal coal seam at depths of between 15.90m to 16.50m, or 58.70m to 58.10m AOD, which concurs with the indicated basal depth of the open-cast workings.
	Natural superficial (drift) deposits were noted to generally limited in thickness where present below the site. In general, these deposits were noted to depths of between 1.80m and 4.00m, generally comprising loose to dense sand, gravel and cobbles of sandstone. Exceptions were noted within WS02 and BH1A where superficial deposits were noted as absent to depths of 1.80m and 9.00m.
	Sandstone bedrock was generally noted at 'rock-head' level below the majority of the site from depths of between 1.80m and 4.00m. An exception to this was noted within BH1A sunk within the north-eastern corner of the site where sandstone bedrock was noted from a depth of 9.00m, with this position considered to be potentially located on the former open-cast high back wall.
	At the locations of BH1A, BH2 and BH3, the initial sandstone bedrock deposits were in-turn underlain by inter-bedded sandstone and mudstone deposits, with evidence of mine workings and/or intact coal recorded considered to be attributable to the High Main, Metal and Five Quarter coal seams.
Groundwater	No groundwater was identified within the exploratory hole locations indicating the absence of a shallow continuous groundwater table (surface) below this site. In addition, during groundwater monitoring all of the wells were noted as being to be dry. It should be noted that groundwater levels vary seasonally and that a higher water table than recorded could occur.



Open-Cast Operations

Boreholes BH1 and BH1A have confirmed that the former open-cast working extends below the north-eastern corner of the site, and within the footprint of the proposed building within this area, with BH1A also considered to have been likely sunk on the high back wall of this feature.

During the investigation works access was prohibited within the north-eastern site area to undertake further investigation works to aid in determining the extent of the former high back wall. However, as indicated on **Drawing G004**, it can be seen that the boundary of the former open-cast working extends below the eastern extent of the proposed building located within the northern site area.

Mining

Shallow coal workings within the High Main and Metal coal seams have been identified below the majority of the site located out-with the extent of the former open-cast working. Within BH2 probable workings within the High Main seam were also noted from 3.0m depth indicating the potential for workings in this seam to have migrated to and/or within close proximity to 'rock-head' level below the central site area.

Within the majority of boreholes which intersected the High Main and Metal coal seams, evidence of grout was identified confirming remedial works have been undertaken to treat these seams below the site. However, for the High Main seam voiding was noted within this grouted seam with loss of flush and limited recovery also evident, indicating that localised voids still remain.

From **Drawing G004** it can also be seen that no remedial grouting works are indicated as having been undertaken for either the High Main or Metal seams along the western boundary of the site. Therefore, stabilisation by drilling and grouting of the mine workings in the High Main and Metal are recommended along the western boundary to facilitate the development.

Due to localised voiding noted within grouted areas of the High Main seam, as part of the recommended remedial works along the western boundary it may also be prudent to undertake further re-grouting of this seam where present below site as a whole to ensure an absence of risk at the surface through localised void migration, and to also negate the risk to future foundations to be sunk down through these materials.

During the investigation works no evidence of intact coal and/or workings considered to be attributable to the Five Quarter seam were identified below majority of the site. However, within BH1A workings considered to be attributable to the Five Quarter seam were noted at depths of between 23.1m to 24.0m below current ground levels, and thickness of 0.90m.

Based on the results of the investigation works a conservative rock cover ratio of 7.3 has been calculated at BH1A. These results indicate that there is insufficient rock cover between the base of the former open-cast working to mitigate against any void migration from the Five Quarter seam.

Therefore, it is considered that workings within the Five Quarter coal seam represent a potential risk to the proposed building within the northern site area through void migration towards the termination depth of proposed piled foundations sunk to the base of the open-cast working. Subsequently, stabilisation by drilling and grouting will be required within the Five Quarter seam for the proposed building across the northern site area.



Gas Monitoring	The results of the ground gas monitoring indicate increased levels of CO ₂ have been recorded up to 8.7% v/v. Therefore, it is considered that as a minimum gas protection measures in accordance with BS8485:2015 Characteristic 2 (CS2) will be required for this site. Radon protection measures are not required for the proposed development.
Contamination	No levels of contaminants have been identified, which exceed current assessment criteria based upon a future residential end use. In addition, due to the low concentrations of determinands, the risk to controlled waters is considered to be negligible. Therefore, no remedial measures are considered necessary for this site with regards human health and/or controlled waters.
Foundations	Due to the nature of the proposed development and variable nature of shallow ground conditions below the site, piled foundations are considered to represent the most viable solution, terminating within competent bedrock deposits. Southern and Central Site Area - For the proposed buildings located within the southern and central site areas, and out-with the extent of the former open-cast working, due to the presence and condition of workings within the High Main seam at shallow depth below these areas, it is recommended that piles be taken
	down through this seam, to be founded within competent bedrock strata at indicative depths of around c.8-10m below ground levels. However, foundations for these areas of the site are subject to completion and review of the information from the recommended remedial (grouting) works outlined within the Mining Assessment.
	Northern Site Area - For the proposed building across the northern site area, to ensure foundations are based wholly within similarly competent strata it is recommended that piled foundations for the eastern extent of the proposed building are taken down to the base of the former open-cast working at an indicative depth of around c.16.5m below current ground levels.
	For western extent of the northern building, located out-with the extent of the former open-cast working, due to the presence of voiding noted within the High Main and Metal coal seams below this area of the site, it is recommended that piled foundations be taken down through both the High Main and Metal coal seams, resulting in piles being based at a similar depth for the northern most building as a whole.
	However, as shallow coal workings within the Five Quarter seam have been identified within influencing distance of the base of the former open-cast working, with this seam not treated as part of previous remedial works, the above solution is subject to the completion and review of the recommended remedial (grouting) works as outlined within the Mining Assessment.
Appraisal	Offsite Disposal of Materials – Generally low levels of contaminants were recorded for made ground samples screened as part of the investigation works indicating these materials could potentially be characterised as Inert for disposal.
	However, due to the nature of these materials, i.e. made ground with demolition related material, with topsoil associated with the capture garden within the southern site area, there is a potential that some of these materials may be classified as either Non-Hazardous or Stable Non-Reactive Hazardous waste.
	Sulphate attack on buried concrete – Buried concrete should be designed to BRE Design Sulphate Class DS-1 with an ACEC classification AC-2z.



1 INTRODUCTION

- 1.1 3e Consulting Engineers Ltd (3e) were commissioned by Karbon Homes Ltd to carry out a Phase II Geo-Environmental Assessment for a proposed development located between Buckingham Street and Corporation Street in Newcastle Upon Tyne. Development proposals include the construction of three new residential apartment blocks, with associated hard and soft landscaping, as indicated on the outline plan included as **Appendix A**.
- 1.2 The objectives of this assessment are:
 - To investigate near surface soil and groundwater conditions.
 - To determine the potential risks posed by any ground or groundwater contamination and provide recommendations on remedial measures to manage such risks.
 - To assess the potential impact of subsurface and open-cast mining operations on the development.
 - To assess the risk posed by hazardous ground gases.
 - To provide advice relating to geotechnical issues associated with the site.
 - To provide foundation recommendations.
- 1.3 Fieldwork was undertaken between 17th and 28th June 2019 and comprised 4 no. rotary open-hole and cored boreholes (referenced as BH1 to BH3, including BH1A) and 3no. mini percussive boreholes (referenced as WS01 to WS03), with associated sampling and testing. In addition, where applicable reference has also been made to a series of exploratory holes sunk on and immediately adjacent to this site by Norwest Holst in 2009.
- 1.4 As part of this assessment a review has also been made of the previous Phase I Geo-Environmental Assessment completed for this site by 3e (Report Ref: P17-262/P1, October 2019), with a summary included in Section 3.
- 1.5 This report presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the scope of works outlined above. It has been assumed in the production of this report that the site is to be redeveloped for a residential end use.



- 1.6 Responsibility cannot be accepted for any conditions not revealed by this investigation and which have not been taken into account by this report. Any diagram or opinion relating to site geology, contamination or other spatially variable features between or beyond investigation positions is conjectural and provided for guidance only. Confirmation of ground conditions between exploratory holes should be undertaken if deemed necessary.
- 1.7 Evaluation of ground gas and groundwater is based on observations made at the time of the investigation and any monitoring visits, but it should be noted that levels may vary due to seasonal effects.
- 1.8 References to possible asbestos containing material made within this report do not constitute an asbestos survey. 3e are not asbestos specialists and cannot provide specific asbestos risk assessment advice, it is recommended that the Client appoints an asbestos consultant to advise on any matters relating to asbestos.
- 1.9 This report has been prepared for Karbon Homes Ltd. No other third party may rely upon or reproduce the contents of this report without the written approval of 3e. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and 3e do not owe them any Duty of Care or Skill.



2 THE SITE

Location and Description

- 2.2 The site, centred on National Grid Reference 423910, 564260, is located to the west of Newcastle upon Tyne city centre and is situated between Buckingham Street to the west and Corporation Street to the south. A site location plan is included as **Drawing G001**.
- 2.3 The site is irregular in shape, occupies an area of approximately 0.44Ha and is currently divided into two separate areas. During the investigation works the northern site area was being utilised for the storage of material for the wider Science Central development area, which included several stockpiles of material comprising topsoil, clay and demolition related materials. In addition, pipe materials, Heras fencing, pallets and electrical equipment were was also present within the northern area of the site, with on-going movement of material to and from the site occurring owing to its on-going usage.
- No permanent structures or hard-standing was present across the majority of the site, with the exception of the western edge of the site which incorporates part of a pedestrian pathway and tarmac hard-standing associated with the adjacent Buckingham Street. In addition, a number of trees and walls are also located within this area, with numerous services present within the pedestrian pathway and road. Due to restrictions associated with the active pathway and road no investigation works were completed within this area of the site. A plan showing the indicative site boundary in relation to existing usage is included as **Drawing G003** (Topographical Survey with Proposed Overlay).
- 2.5 The southern site area is also occupied by a 'Carbon Capture Garden', which comprised an abundance of floral plants and is generally separated from the northern site area by Heras fencing. A track comprising wood chippings leads into the garden from the south-eastern corner of the site and terminates in the west where an open seating area is located comprised a large central wood table surrounded by log benches. Beyond the seating area was noted to be a small planting bed and garden feature.
- 2.6 The southern site area is bounded by mesh fencing. The northern boundary of the site is generally delineated by temporary hoarding, which separates the site from the wider 'Science Central' development area. Heras fencing currently bounds the perimeter of the south-eastern boundary of the site, which is situated adjacent to Oystershell Lane.



During the investigation works site levels were generally noted to reduce gradually to the east, however, a steeper gradient change was noted within the southern extent of the site from west to east. The topographical survey undertaken on the site by Landform Surveys in 2017, recorded the highest elevation of 78.74m Above Ordinance Datum (AOD) within the western extremities of the site, with a lowest elevation of 71.75m AOD noted within the north-eastern corner of the site.

2.8 The adjacent land use is as follows:

- North: Science Central development site (reclaimed former opencast site)
- East: Oystershell Lane leading to Science Central development site (reclaimed former opencast site).
- South Corporation Street leading to mixed commercial properties.
- West: Buckingham Street leading to commercial properties.



3 SUMMARY OF PHASE I GEO-ENVIRONMENTAL ASSESSMENT

3.1 The following section provides a brief summary of the Phase I Geo-Environmental Assessment undertaken by 3e as referenced in Section 1. As part of the Phase I report, reference was also made to previous reports completed for the site and wider Science Central development area along with previous exploratory holes sunk on and immediately adjacent to this site by Norwest Holst (NH) in 2009.

Site History

- 3.2 The earliest recorded history (c.1862) records the site to be occupied by numerous unnamed buildings (possibly mixed residential and commercial properties) located between Buckingham Street and Oystershall Lane. Between c.1921 and 1937 all buildings previously occupying the site have been demolished to make way for residential housing with associated areas of soft landscaping and hard-standing. Between 1970 and 1982, all buildings had been demolished and the land is recorded as cleared.
- 3.3 Within relatively recent history the north-eastern extent of the site has also been subject to opencast coal operations, which occurred across the majority of the wider Science Central development area.

Geology

- 3.4 Geological plans record Glacial Till superficial deposits to underlie the site, with bedrock deposits recorded to comprise Carboniferous Middle Coal Measures formation.
- 3.5 NH carried out extensive previous ground investigation works for the wider Science Central development area in 2009, prior to the open cast operations, which included a number of exploratory positions sunk on and immediately adjacent to this site comprising; 9no. mechanically excavated trial pits (referenced as TP's 125 to 128, TP's 131 to 133, TP136 and TP137) and 3no. cable percussive and rotary boreholes (referenced as BH120, BH121 and BH122A). The locations of the previous exploratory positions sunk by NH can be seen on **Drawing G002** (Exploratory Hole Location Plan) with copies of the record sheets included in **Appendix B**.

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- 3.6 During previous investigation works completed by NH, made ground was recorded below the site to depths of between 0.30m and 2.80m, comprising mixed gravels and clay materials. In addition, an increased thickness of made ground was also noted within TP133 sunk immediately south-east of the site to a depth of 3.80m.
- 3.7 The made ground was recorded to be underlain by natural superficial deposits comprising clayey gravelly sand or sandy clays to depths of between 1.50m and 3.00m, which was in turn generally underlain by sandstone bedrock from depths of between 73.85m AOD and 71.13m AOD. An exception to this was noted within BH122A where a thin 0.20m band of intact coal was recorded at 'rock-head' level. However, it should be noted that previous investigation works completed by NH were undertaken prior to completion of more recent open-cast operations, details of which are summarised further in the following sub-sections.

Coal Mining

- 3.8 Based on BGS and CA data, the High Main seam is recorded to sub-crop beneath the south-eastern site area, trending in a NE-SW direction and dipping in a north-western direction below the site. In addition, the Metal coal seam is recorded to sub-crop around 100m to the south-east, whilst the Five Quarter and Main coal seams are recorded to sub-crop approximately 200m and 310m to the south-east respectively, with all of these seams dipping below the general site area.
- 3.9 Based on BGS data, the Five Quarter and Main coal seams are recorded to be 'impoverished' in the local area. However, previous investigation works completed by NH for the wider Science Central development area recorded the Five Quarter seam as worked around 400-600m south-east of this this site. Where encountered the deeper Main seam was noted to be and intact / unworked in boreholes.
- 3.10 In summary, following a review of desk based information available for this site, the sequence of coal seams (shallowest to deepest) as summarised below, is considered to be generally applicable to this site, with the High Main coal seam potentially absent below the south-western boundary of the site beyond the inferred out-crop location.
 - High Main (E) Extensively worked at shallow depth below the site.
 - Metal (F1) Worked at shallow depth below the site.



- Five Quarter (F2) Recorded as impoverished on BGS plans although workings within this seam are recorded around 400m-600m south-east of the site. If workings are present within this seam they may be located within influencing distance of the surface and/or proposed foundations.
- Main (G) Recorded as impoverished on BGS plans with previous investigation
 works identifying this seam as wholly intact where encountered. Low risk
 considered to the development associated with this seam. In addition, from
 previous investigation data this seam is anticipated to be beyond a depth below
 the site to represent a risk at the surface and/or to future foundations.
- 3.11 In addition to the above, from the CA report obtained for this site as part of the Phase I assessment, workings within the Harvey (N), Brockwell (S) and Three Quarter (R) coal seams are also recorded below the site at depths of between 166m and 224m. However, these are considered to be too deep to represent a risk to the development.
- 3.12 Based on available CA data, the site is also recorded as being within a designated high risk development area of probable unrecorded shallow coal workings, likely associated with unrecorded workings in the High Main, Metal and possibly the Five Quarter coal seams.
- 3.13 As part of the preliminary mining assessment included within the Phase I report a review was made of previous borehole logs completed on this site and as part of the wider Science Central development area, with a summary of the findings provided below specific to the High Main, Metal and Five Quarter coal seams:

High Main Coal Seam

- 3.14 As part of the previous investigation works completed by NH, 3no. cable percussive and rotary boreholes were completed on and immediately adjacent to this site (BH120, BH121 and BH122A). These investigation works recorded sandstone bedrock deposits were recorded at 'rock-head' level below the general site area from depths of between 3.00m and 4.10m. Within all three of the boreholes completed by NH evidence of workings within the High Main seam were recorded in the form of cavities and broken ground, as summarised on the following page.
 - BH120 Cavity and workings considered to be attributable to the High Main seam recorded at depths of between 5.60m and 8.20m (70.65m to 68.05m AOD), and

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thickness of 2.60m.

- BH121 Collapsed workings and non-intact gravel considered to be attributable to the High Main seam recorded at depths of between 6.30m and 9.40m (71.24m to 68.14m AOD), and thickness of 3.10m. In addition, 'open workings' were also noted at this location between 5.10m to 5.30m depth (0.20m in thickness) which are potentially associated with void migration / collapse of workings within the underlying High Main seam.
- BH122A Cavity and collapsed workings considered to be attributable to the High Main seam recorded at depths of between 3.20m and 7.20m (71.65m to 67.65m AOD), and thickness of 4.00m. In addition, a thin band of intact coal was also noted at 'rock-head' level and forming the roof of identified workings within this borehole at depths of between 3.00m and 3.20m (0.20m in thickness).
- 3.15 In addition to the above, reference was also made to boreholes undertaken across the wider Science Central development area which identified significant evidence of historical workings within what is considered to be the High Main coal seam. Historical borehole records within the surrounding area of the site generally record the base of the High Main Coal seam at depths of between 68.81m AOD and 65.48m AOD.

Metal Coal Seam

- 3.16 Based on the previous boreholes undertaken on and immediately adjacent to this site by NH, intact coal was recorded at depths of 18.10m and 18.80m (58.15m to 57.45m AOD), 17.40m to 18.05m (60.14m to 59.48m AOD) and 16.33m to 16.90m (58.52m to 57.95m AOD), ranging in thickness between 0.57m and 0.70m, which were considered to be attributable to the Metal coal seam. The boreholes undertaken across the wider Science Central development indicate evidence of historical workings (e.g. broken ground / voiding) within what was considered to be the Metal coal seam, with nearby historical boreholes recording the base of the Metal seam at depths of between 58.37m AOD and 57.20m AOD.
- 3.17 In summary, from available data it was considered that there was a potential for unrecorded historical workings within the Metal coal seam to extend below the site at shallow depth and as such it was recommended that further investigation works were undertaken within the site to further assess the risk in this regard.



Five Quarter Coal Seam

- 3.18 The Five Quarter seam was not encountered within any of the previous boreholes sunk on and immediately adjacent to this site by NH to depths of between 18.70m to 22.00m; or 54.55m to 56.15m AOD. Therefore, in order to aid in assessing the potential risk to this site from possible unrecorded workings in the Five Quarter seam reference has been made to additional boreholes undertaken by NH across the wider Science Central development area.
- 3.19 In summary, following a review of boreholes undertaken to the east of the site, evidence of historical coal workings within what was considered to be the Five Quarter coal seam were recorded to depths of between 46.57m AOD and 40.93m AOD.
- 3.20 For the remainder of the wider Science Central site where the Five Quarter seam was encountered at depths of between 48.35m AOD to 44.13m AOD, it was generally noted as intact and unworked. However, anecdotal evidence obtained since completion of the Phase I report, relating to the wider Science Central development, indicates that for all buildings located within the extent of the former open-cast working probing and grouting of workings in the Five Quarter seam has been undertaken. It is understood that this is due to Five Quarter seam being present within influencing distance of piled foundations sunk to the base of the former open-cast (i.e. base of the Metal coal seam), although grout uptakes are indicated to have been limited due to this seam being generally thin and sporadically worked. In addition, it is further understood that where encountered workings within the Five Quarter were indicated to have been filled with 'packed waste' thereby limiting grout uptake.
- 3.21 In summary, previous boreholes sunk on and immediately adjacent to this site by NH did not identify the Five Quarter seam, with this seam anticipated to be present beyond their termination depth and as such potentially out-with influencing distance of the surface for the majority of the site. However, for areas of the development which extend onto the location of the former open-cast working should a piled foundation solution be adopted it is considered that there is a possibility that the Five Quarter seam could be located within influencing distance of future foundations. Taking this into account further investigation works were recommended to aid in determining the depth of the Five Quarter seam below the site, specifically targeting the north-eastern site area.



Mine Entries

3.22 Five mine shafts are recorded to the north-east and east, which are considered to be located out-with influencing distance of this Plot 7 site. Based on the CA report obtained as part of the Phase I assessment there are no mine entries recorded on this site.

Summary of Previous Remedial Grouting Works and Opencast Operations

- 3.23 Prior to undertaking the opencast mining activities across the Science Central site, it is understood that shallow mine workings located out-with the proposed extent of open-cast operations, which included the extent of the open-cast high back walls, were drilled and grouted to stabilise the surrounding ground, which is understood to have included drilling and grouting of historical workings within the High Main and Metal coal seams.
- 3.24 To aid in determining the extent of remedial grouting works specific to this site reference has been made to the 'Treatment of Mine Workings Drilling and Grouting of Mine Entries Completion Report' produced for this site by Groundshire Limited in 2014 (Report Ref: 11816.H130.001). However, as it is understood that formal reliance cannot be made to the previous grouting completion report produced for this site, at this stage. Where applicable comments relating to remedial grouting operations are provided for information only.

Summary of Remedial Grouting Works

- 3.25 Based on the grouting completion report produced for this site by Groundshire Ltd it is understood that remedial grouting operations for the Science Central site as a whole were undertaken over a number of phases. The primary phase was undertaken between 15th October 2012 and 30th April 2013, which included grouting of the proposed extent of the high-back wall and areas located out-with the open-cast operations. Following completion of these works further phases of remedial works were undertaken to treat mine shafts, although all of these features are shown to be located out-with influencing distance of this Plot 7 site.
- 3.26 During the grouting operations it is understood that grouting of the open-cast high back wall comprised three rows of holes at 3m centres starting 3m from the toe of the high wall. These boreholes were taken to the design base of the open-cast at each location. The main grid of boreholes located out-with the extent of proposed open-cast operations were designed on a 6m five diamond basis, equating to a 4.25m regular grid. These boreholes were



designed to be taken to sufficient depth to ensure that there was rock cover of each seam, typically defined as ten times the thickness of the seam, as rock cover over that seam.

- 3.27 To aid in determine the extent of previous remedial grouting operations undertaken specific to the site, a drawing has been prepared (**Drawing G004**, Grouting Completion Plan Overlay) using the plan included within the grouting completion report, outlining the positions of grout holes (Groundshire Drawing No. 11816/001 Rev A Grout Hole Location Plan), specific to this site is included as, which includes the 'best-fit' indicative proposed site boundary and locations of the proposed buildings. However, as previously highlighted this plan has been provided for information only, at this stage.
- 3.28 The indicative Grouting Completion Plan Overlay drawing indicates that workings within the High Main and Metal coal seams were grouted below the majority of the site. An exception to this is evident along the western boundary of the site, where no remedial grouting works are indicated as having been undertaken within either the High Main or Metal coal seams, likely due to this area being located out-with the general wider Science Central development boundary.
- 3.29 In addition, there also is no distinction shown between the High Main and Metal seams, however it is considered that this is likely due to both of these seams being treated concurrently, where workings were identified.
- 3.30 For the majority of the site both of the High Main and Metal seams are indicated to have been treated on the main grid, equating to a 4.25m regular grid. However, reduced 3m grid spacing is shown within the north-eastern site area associated with the location of the open-cast high back wall. As indicated on the Groundshire grouting completion plans, there appears to be two indicative high back wall locations shown within the northern extent of this site. However, following verbal clarification from the appointed grouting contractor it is understood that the open-cast wall shown furthest east is the actual indicative extent of open-cast operations.
- 3.31 For the second indicative high back wall located to the west of the indicated actual high back wall location, it is understood that proposals were to initially include this area as part of the open-cast operations. However, during working of 'Cut 7', as shown on **Drawing G004**, it is inferred that the extraction rate of High Main seam was in the region of 90-95% thereby rendering removal of coal from below the general northern extent of this site as



uneconomical. Taking this into account, it is understood that an amendment was made to the proposed extent of opencast operations, resulting in the relocation of the high back wall.

3.32 However, as the above information anecdotal and as such can be considered as indicative only, at this stage, it was recommended that further investigation works be completed to target this area of the site and more accurately confirm the extent of the high-back wall, which as a minimum is shown as likely extending below the location of the proposed building within the northern site area.

Summary of Open-Cast Operations

- 3.33 Opencast workings were undertaken between 2011 and 2014 and were excavated in stages (18 cuts) commencing in the south-eastern corner of the Science Central site and extending north and west. From a review of the extent of the completed opencast workings, it appears the opencast boundary extends across the north-eastern portion of the site, details of which are provided in the plan enclosed as **Drawing G004**. In view of this, it is therefore considered the high wall of the former opencast bisects the north-eastern portion of the site with levels to rock-head considered to potentially significantly vary across this extent.
- 3.34 It is understood, in weak rock and superficial strata the benches for the high wall were cut at approximate gradient of 1h:2v at approximately 1m height intervals. In stronger siltstone and sandstone strata it was considered impractical to bench and therefore was excavated at a gradient of 1h:2v. In consideration of this, it is likely significant variation in 'rock-head' level will be present across the high back wall of the opencast adding complications to the mining assessment.
- 3.35 As part of the former opencast mine workings undertaken across the Science Central site, both the High Main and Metal coal seems are understood to have been fully extracted, with the opencast later infilled with engineered fill from ground level to the base of the opencast excavation as part of the restoration works on the site.
- 3.36 The restoration works were designed and validated by WSP for the Science Central site and comprised infilling of the former opencast with engineered fill (i.e. crushed rock, granular made ground, cohesive made ground, recycled aggregate and processed demolition rubble) and brought up to existing site levels.

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3.37 As part of the earthworks it is understood the maximum density of the fill must exceed 90%, with no individual results recording air voids above 10% for the general made ground and 5% for cohesive fill. The fill was placed in 250mm to 500mm layers based on the material type and compacted using a smooth wheeled vibratory roller.

Summary of Environmental Data

Watercourses and Groundwater

3.38 The nearest surface water feature is a boating lake in Leazes Park over 500m to the north. The nearest watercourse is the River Tyne which is located over 1km SE of the site.

Hydrology and Hydrogeology

3.39 The site is recorded as being within a low risk setting of flooding from rivers or seas within sea defences (Flood Zone 1). The underlying superficial drift is recorded as a Secondary (undifferentiated) Aquifer, with the underlying bedrock deposits classified as a Secondary A Aquifer.

Landfill Sites, Pollution Controls and Industrial Land Use

- 3.40 There are no recorded landfill sites within 250m of the site. However, deep made ground / fill is anticipated within the location of the former opencast which is considered to potentially extend across the north-eastern extent of the site.
- 3.41 There is one waste management facility located within 250m of the site. Recorded at the former Tyne Brewery site for the management of inert or extractive waste at mine, considered to be associated with recent opencast activities at 'Science Central'.

Radon

3.42 Inspection of the BRE publication BR211 (2015), 'Radon: Guidance on protective measures for new buildings' indicates that the site lies in an area where radon protection measures are <u>not</u> required and this is confirmed by the Phase I report.



4 METHOD OF INVESTIGATION

Scope of Works

- 4.1 The investigation works were undertaken between 17th and 28th June 2019 and comprised 4no. rotary open-hole and cored boreholes (referenced as BH1 to BH3, including BH1A) and 3no. mini percussive boreholes (referenced as WS01 to WS03), with associated sampling and testing. In addition, where applicable reference has also been made to previous exploratory holes sunk on and immediately adjacent to this site by NH in 2009.
- 4.2 Copies of the exploratory hole records completed as part of these investigation works are included in **Appendix C**, whilst copies of the relevant record sheets completed by NH are included in **Appendix B**. The locations of the NH and 3e boreholes and trial pits completed for this site are also shown on the Exploratory Hole Location Plan, included as **Drawing G002**.
- 4.3 Fieldwork was carried out in general accordance with BS5930:2015 'Code of Practice for Ground Investigations' and BS10175:2011+A2:2017 'Investigation of Potentially Contaminated Sites Code of Practice'. All depths recorded are taken from below existing ground level with the exploratory holes positioned in accordance with the investigation rationale outlined below, whilst also making allowance for buried utilities and areas which were inaccessible during the time of the investigation, as outlined within Section 2.

Investigation Rationale

- 4.4 During the investigation works the mini percussive boreholes (WS01 to WS03) were sunk in order to determine the shallow soil profile across the site and allow ground gas and groundwater monitoring wells to be installed. Disturbed samples were recovered as appropriate for soil descriptions and laboratory testing. Standard penetration tests (SPT's) were carried out to provide an assessment of the in situ strength and density of the made ground and natural deposits present below the site.
- 4.5 The rotary open-hole and cored boreholes (BH1 to BH3, including BH1A) were positioned to provide general coverage across the proposed development area, in order to assess the depth and condition of any coal seams / workings / previous remedial grouting



works (i.e. the High Main, Metal and Five Quarter coal seams) within potential influencing distance of the surface.

- 4.6 In addition, BH1 and BH1A were also targeted within the north-eastern corner of the site to aid in assessing the potential for the former open-cast high back wall to extend below this area of the site. During the investigation works representative samples of made ground were also recovered from the rotary boreholes, referenced as HDP01 to HDP03, which correspond with BH1A to BH3 respectively.
- 4.7 To aid in assessing the level of potential risk to this site from ground gas migration and/or production, combined gas/groundwater monitoring wells, comprising slotted 50mm diameter HDPE pipe set within a granular filter, were also installed at each of the mini percussive borehole locations (WS01 to WS03). The wells were sealed at surface using bentonite and a lockable cover was fitted at the surface.
- 4.8 The wells have been monitored on four occasions for methane, carbon dioxide and oxygen using a portable infra-red gas monitor. The rate of gas flow from the boreholes was also recorded using a portable flow meter and the groundwater levels were recorded using a portable dip meter. The results of the ground gas monitoring are presented in **Appendix D**.

Laboratory Chemical Testing

- 4.9 In order to provide an assessment of potential contamination, representative samples of made ground recovered from across the site as part of the investigation works, were screened for the following range of determinands.
 - 6 no. samples screened for Metals: Arsenic, Boron, Copper, Cadmium, Chromium (total), Chromium (VI), Lead, Mercury, Nickel, Selenium, Zinc and TOC.
 - 6 no. samples screened for Polycyclic Aromatic Hydrocarbons (USEPA 16 PAH's).
 - 6 no. samples screened for the presence of Asbestos.
- 4.10 The results of the chemical analysis completed as part of these investigation works are included as **Appendix E**. All analyses were carried out at an MCERTS registered and UKAS accredited laboratory.



Laboratory Geotechnical Testing

- 4.11 Geotechnical related testing was carried out to determine the physical characteristics of the bedrock deposits and comprised the following:
 - 7 no. Unconfined Compressive Strength Tests (UCS).
 - 13 no. Axial Point Load Tests.
 - 11 no. Diametral Point Load Tests.
- 4.12 In addition to the above, 6 no. samples of made ground and 2 no. samples of the natural superficial deposits were scheduled for water soluble sulphate and pH determinations to assess the potential for sulphate attack on buried concrete. The results of the testing are included in **Appendix E**.



5 RESULTS OF THE INVESTIGATION

Soil Profile

5.1 Detailed descriptions of the materials encountered together with observations of groundwater behaviour, the results of insitu testing and sampling information are given on the exploratory hole records included as **Appendix C**. An interpretation of the ground conditions encountered is presented below:

Made Ground

- 5.2 Made ground was recorded below the majority of the site to depths of between 1.0m and 2.0m below current ground levels (bcgl). In general, these materials comprised an initial thickness of granular surfacing (i.e. sandstone and mudstone, with occasional concrete and brick) over disturbed mudstone, sandstone and re-worked clay. In addition, dark grey sand was also noted within WS02 between 1.8m and 2.0m, which was considered to be potentially attributable to residual grout from previous remedial works.
- 5.3 An exception to the above was noted within the rotary boreholes sunk within the north-eastern corner of the site (BH1 and BH1A) to target the indicative location of the former open-cast high back wall. In summary, at the location of BH1 made ground generally comprising gravel and cobbles and sandstone and mudstone was recorded up to in excess of 6.4m, which is considered to be associated with engineered fill utilised to backfill the former open-cast workings. During the progress of BH1 refusal of sampling equipment occurred at a depth of 6.4m, within the colliery spoil backfill materials. Therefore, this borehole abandoned an additional borehole (BH1A) sunk to aid in determining whether backfill associated with the former open-cast extended further west than BH1.
- However, in borehole BH1A, made ground comprising mudstone and sandstone colliery spoil considered to also be attributable to the former open-cast working was noted to a depth of 9.00m (or 65.60m AOD) overlying sandstone bedrock. Based on previous information relating to the former open-cast site as workings included extraction of both the High Main and Metal coal seams, it is understood that this resulted in a basal depth of the open-cast working to depths of between 51.9m to 57.6m AOD.



Taking this into account, as made ground within BH1A was only recorded to a depth of 65.60m AOD it is considered that BH1A was likely sunk on the high-back wall itself. This is also potentially corroborated by general ground conditions noted this borehole location, which although the High Main seam is recorded as absent below this area (likely removed as part of the open-case operations) the workings and grouted gravel considered to be attributable to the Metal coal seam were noted between 15.90m to 16.50m, or 58.70m to 58.10m AOD, which concurs with the indicated basal depth of the open-cast workings (i.e. workings associated with this seam are still present and as such were not extracted).

Superficial (Drift) Deposits

- 5.6 Natural superficial (drift) deposits were noted to generally limited in thickness where encountered below areas of the site located out-with the extent of the former open-cast working. In general, superficial deposits were noted to depths of between 1.80m and 4.00m, with these materials generally comprising loose to dense sand, gravel and cobbles of sandstone (possible completely weathered bedrock).
- 5.7 These results generally concur with the findings of the previous investigation works completed by NH, which recorded gravelly sand or sandy clay superficial deposits to depths of between 1.50m and 3.00m, although as previously highlighted the investigation works completed by NH were undertaken prior to the more recent open-cast operations.
- 5.8 Exceptions were noted at the locations of WS02 and BH1A where superficial deposits were noted as absent to depths of 1.80m and 9.00m respectively, with made ground immediately overlying suspected sandstone bedrock deposits at these locations. In addition, it is also considered that superficial deposits will be absent within BH1 with this borehole sunk within the extent of the former open-cast working.

Bedrock (Solid) Deposits

5.9 Sandstone bedrock deposits were generally noted at 'rock-head' level below the majority of the site from depths of between 1.80m and 4.00m. An exception to this was noted within BH1A sunk within the north-eastern corner of the site where sandstone bedrock was noted from a depth of 9.00m, with this position considered to be potentially located on the former open-cast high back wall. In addition, bedrock was not encountered within BH1 with this borehole considered to be located within the extent of the former open-cast workings.



5.10 At rotary borehole locations BH1A, BH2 and BH3, the initial sandstone bedrock deposits were in-turn noted to be underlain by inter-bedded sandstone and mudstone deposits, with evidence of mine workings and/or intact coal recorded which are considered to be attributable to the High Main, Metal and Five Quarter coal seams. A more detailed assessment of the findings of the rotary boreholes is included in the sub-section below.

Coal Seams and Coal Workings

- 5.11 Following a review of desk based information workings within High Main and Metal coal seams have been recorded at shallow depth below areas of the site, located out-with the extent of the former open-cast operations. Based on the grouting completion report it is understood that workings within both of these seams were grouted as part of remedial works undertaken for the wider Science Central development in 2013, which also included grouting of the proposed extent of the high-back wall.
- 5.12 To aid in determine the extent of previous remedial grouting operations undertaken specific to the Plot 7 site, the plan included within the grouting completion report, outlining the positions of grout holes specific to this site is included as **Drawing G004** (Grouting Completion Plan Overlay), which includes the 'best-fit' indicative proposed site boundary and locations of the proposed buildings.
- 5.13 In addition to the above, from desk based information it was also considered that there was a potential for workings to be present within the deeper Five Quarter coal seam below areas of the site, with this seam not treated as part of the previous remedial works. In general, for the majority of the site it is considered that if workings are present within the Five Quarter seam, they are likely beyond a depth to represent a risk to the development, which is supported by the findings of the previous investigation and grouting works.
- 5.14 However, for areas extending into the former open-cast workings it is considered that there may be insufficient rock cover present between the Five Quarter seam and the base of the former open-cast working, in consideration that a piled foundation solution will likely need to be adopted for this area.



- 5.15 This is potentially supported by anecdotal evidence obtained since completion of the Phase I report, which indicates that probing and grouting of workings in the Five Quarter seam has been generally undertaken for all buildings constructed as part of the wider Science Central development site, located within the extent of the former open-cast workings. However, grout uptakes are indicated to have been limited due to this seam being generally thin and sporadically worked. In addition, where encountered workings within the Five Quarter were also indicative to have been filled with 'packed waste' thereby further limiting grout uptake.
- 5.16 Within the north-eastern site area the findings of rotary boreholes BH1 and BH1A have also confirmed that the extent of the former open-cast working extends below this area of the site, with BH1A considered to have been likely sunk on the high back wall of this feature. The approximate location of the open-cast high back wall is shown on the plan included within grouting completion report is also indicated on **Drawing G004**.
- 5.17 During the investigation works, 4no. boreholes rotary open-hole and cored boreholes (BH1 to BH3, including BH1A) were positioned across the site in order to assess the depth and condition of any coal seams / workings / previous remedial grouting works (i.e. the High Main, Metal and Five Quarter coal seams). In addition, as previously highlighted BH1 and BH1A were also targeted within the north-eastern corner of the site to aid in assessing the potential for the former open-cast high back wall to extend below this area.
- 5.18 A summary of the rotary boreholes sunk as part of these investigation works is provided in the table on the following page. In addition, to aid in assessing ground conditions at depth below the site the following table also includes a summary of the previous boreholes completed on and immediately adjacent to the site by NH in 2009. However, it should be noted that the boreholes completed by NH were sunk prior to the completion of the remedial grouting works undertaken in 2013 and subsequent opencast operations.



Location	Depth to rock- head (mBGL)	Depth to rock- head (mAOD)	Depth to coal seam, void or grouted workings (mBGL)	Depth to coal seam, void or grouted workings (mAOD)	Thickness of coal seam, void or grouted workings (m)	Comments
BH1	>6.40	>67.30	NA	NA	NA	Sunk within extent of former open-cast working with made ground noted to >6.40m.
BH1A	9.00	65.60	15.60-16.50	59.00-58.10	0.90	Metal Seam - Recorded as grouted gravel to a depth of 15.90m overlying a voiding to 16.50m.
			23.10-24.00	51.50-50.60	0.90	Five Quarter Seam – noted to be filled with soft to firm clay / colliery spoil.
BH2	3.00?	74.80?	3.00-8.70	74.80-69.10	4.20-5.70	High Main Seam – Broken ground in grout matrix.
			19.00-19.60	58.80-58.20	0.60	Metal Seam – intact.
			6.00-9.10	72.20-69.10	3.10	High Main Seam – Broken ground in grout matrix.
BH3	4.00	74.20	18.00-19.07	60.20-59.13	1.07	Metal Seam – intact with grouted band noted between 18.50-18.57m.
BH120	3.00	73.25	5.60-8.20	70.65-68.05	2.60	High Main Seam – recorded as cavity and workings. Borehole completed prior to remedial grouting works.
			18.10-18.80	58.15-57.45	0.70	Metal Seam – intact.
			5.10-5.30	72.44-72.24	0.20	Void; considered to be attributable to void migration for deeper workings in the High Main seam. Borehole completed prior to remedial grouting works.
BH121	4.10	73.44	6.30-9.40	71.24-68.14	3.10	High Main Seam – recorded as collapsed workings with colliery spoil at the base. Borehole completed prior to remedial grouting works.
			17.40-18.06	60.14-59.48	0.66	Metal Seam – intact.
BH122A	3.00	71.85	3.20-7.20	71.65-67.65	4.00	High Main Seam – recorded as cavity and collapsed workings. Borehole completed prior to remedial grouting works.
			15.42-15.70	59.43-59.15	0.28	Unnamed seam – Intact.
			16.33-16.90	58.52-57.95	0.57	Metal Seam – intact.

BGL – Below Ground Level (Existing); AOD – Above Ordnance Datum; NA – Not Applicable.

5.19 Based on the findings of the combined investigation works, sandstone bedrock deposits were generally noted from depths of between 3.00m and 4.10m, or between 71.85m to 74.20m AOD, below the general site area. An exception to this was noted within BH1 and BH1A where an increased thickness of made ground was recorded to depths of 9.00m (BH1A) up to >6.40m (BH1A) associated with the location of the former open-cast working.



5.20 At the location of BH2 'rock-head' level was also unable to be definitively confirmed due to an absence of sample recovery between 3.0m and 4.5m, with these deposits 'scrubbed away' during coring due to the off-set of the sampler within probable grouted workings attributable to the High Main coal seam. However, when comparing the findings of the investigation works as a whole the depth to the underside of the superficial deposits within BH2 is noted to be generally comparable with 'rock-head' levels noted across the remainder of the site. Taking this into account, it is considered that bedrock deposits are likely present a depth of 3.0m below ground level at this location, with grouted workings within the High Main seam present at or close to 'rock-head' level.

5.21 In summary, from the findings of the combined investigation works, shallow coal workings within both the High Main and Metal coal seams have been identified below the site located out-with the extent of the former open-cast working. In addition, workings in the Metal coal seam were also identified within BH1A, which supports the previous assessment of this borehole having been sunk on the high back wall of the open-cast working, as both the High Main and Metal seams were wholly removed as part of previous open-cast operations.

5.22 In addition to the above, workings within the deeper Five Quarter seam were also identified within BH1A sunk within the north-eastern corner of the site and on the inferred high back wall of the former open-cast working.

High Main Coal Seam

5.23 Based on the findings of the rotary investigation works, workings within the High Main seam were identified within all boreholes sunk out-with the extent of the former open-cast working from depths of between 3.2m to 6.3m below ground level (bgl); or 72.20m to 70.65m AOD, ranging in thickness between 2.6m and 4.0m.

5.24 Following a review of the combined investigation works it is considered that the increased thickness of broken ground/workings within this seam is associated with void migration (i.e. migration of collapsed strata/overburden) with the majority of the borehole records noting the High Main seam as 'broken ground'. In addition, at the location of BH2 probable workings within the High Main seam were noted from a depth of 3.0m bgl or 74.80m AOD, to a depth of 8.7m bgl or 69.10m AOD, and increased thickness of up to 5.7m. As previously highlighted the inferred possible top depth of workings within the High Main seam at this location generally concurs with 'rock-head' levels within boreholes sunk across the



remainder of the site. Taking this into account, it is considered that workings in the High Main seam have potentially migrated to and/or within close proximity to 'rock-head' level below the central site area.

5.25 During all boreholes sunk during these investigation works, which intersected workings in the High Main seam, evidence of grout was identified with strata description generally noted as 'broken ground in grout matrix' confirming remedial works have been undertaken to treat this seam below the site. However, it should be noted that during completion of the boreholes, voiding was noted within this grouted seam with loss of flush and limited recovery also evident during coring, indicating that localised voids still remain. This could potentially be a result of the inferred grid spacing of grouting as outlined in the completion report, which indicated the main grid of boreholes were designed on a 6m five diamond basis, equating to a 4.25m regular grid.

5.26 Based on a review of the detail presented on **Drawing G004**, an exception to the above is evident along the western boundary of the site, where no remedial grouting works are indicated as having been undertaken within the High Main seam, likely due to this area being located out-with the general wider Science Central development boundary and proposed opencast high back wall. Taking this into account it is considered that workings within the High Main seam represent a risk within this area of the site through void migration to the surface Therefore, stabilisation by drilling and grouting of the mine workings are recommended to facilitate the proposed development in this area.

5.27 During the investigation works, no evidence of workings in the High Main seam was identified within BH's 1 and 1A sunk within the extent of the former open-cast with this seam removed as part of these works.

Metal Coal Seam

5.28 Based on a review of the combined investigation works, intact coal considered to be attributable to the Metal coal seam was identified from depths of between 16.33m to 19.00m below ground level (bgl); or 60.20m to 58.15m AOD, ranging in thickness between 0.57m and 1.07m. An exception to this was noted within BH1A sunk within the north-eastern corner of the site and likely on the high back wall of the former open-cast working, where workings within the Metal seam were recorded at depths of between 15.60m to 16.50m bgl, or 59.00m to 58.10m AOD, and thickness of 0.90m.

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5.29 When considering the above, although the majority of the boreholes sunk on and within close proximity to the site record the Metal seam as intact, evidence of workings within this seam were noted within BH1A. Therefore, it is considered that this seam is worked below the site although potentially at a reduced extraction rate compared the overlying High Main seam. In addition, evidence of grout was also noted within BH1A, and contained within a fracture identified within the intact coal band noted within BH3, confirming that remedial works have been undertaken to treat this seam below the majority of the site.

5.30 However as previously highlighted and as indicated on **Drawing G004**, an exception to this is evident along the western boundary of the site, where no remedial grouting works are indicated as having been undertaken within the Metal coal seam. Therefore, it is also considered that workings within the Metal coal seam represent a risk within this area of the site through void migration to the surface, and as such stabilisation by drilling and grouting of this seam will also be recommended to facilitate the proposed development.

5.31 During the investigation works no evidence of workings in the Metal coal seam was identified within BH1 sunk within the extent of the former open-cast with this seam removed as part of these works.

Five Quarter Coal Seam

5.32 During the previous investigation works no evidence of intact coal and/or workings considered to be attributable to the Five Quarter seam were identified within boreholes sunk by NH to depths of between 18.70m and 22.00m, or 58.15m to 54.55m AOD. In addition, no evidence of workings within this seam were noted at the locations of BH's 2 and 3, sunk as part of these investigation works, to depth of between 24.0m and 25.0m bgl, or 53.80m to 53.20m AOD.

5.33 However, at the location of BH1A, workings considered to be attributable to the Five Quarter seam were noted at depths of between 23.1m to 24.0m, or 51.50m to 50.60m AOD, and thickness of 0.9m. In view the findings for BH1A, mine workings in the Five Quarter seam were noted to be filled for the full thickness with soft to firm clay containing mudstone, sandstone and coal (colliery spoil), supporting anecdotal evidence of workings within this seam as having been backfilled with 'packed waste'.

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5.34 In summary, when considering the recorded thickness and depth of workings in the Five Quarter at the location of BH1A, it is considered that this seam is beyond a depth below the majority of the site to represent a potential risk to the development. However, for the north-eastern site area, as previously highlighted, should a piled foundation solution be adopted for this area it was considered that there was a possibility that the Five Quarter seam could be located within influencing depth of proposed piled foundations, sunk to the base of the former open-cast working (i.e. base of the Metal seam).

5.35 Based on the results of the investigation works, a conservative rock cover ratio of 7.3 has been calculated at the location of BH1A, with the rock cover ratio considered from the base of the Metal coal seam (i.e. inferred base of the open-cast working). These results indicate that there is insufficient rock cover between the base of the former open-cast working to mitigate against any void migration associated with workings within the Five Quarter seam, using the 'conventional' 10 times seam thickness.

5.36 Therefore, it is considered that workings within the Five Quarter coal seam represent a potential risk to the proposed building within the northern site area through void migration towards the termination depth of proposed piled foundations. Subsequently, stabilisation by drilling and grouting are recommended for buildings extending onto the location of the former open-cast working, in consideration that a piled foundation solution will be required.

Visual and/or Olfactory Evidence of Potential Contamination

5.37 No evidence of potential significant contamination (i.e. hydrocarbons, asbestos containing materials, etc.) was noted during the intrusive site works.

Groundwater

5.38 No groundwater was identified within the exploratory hole locations indicating the absence of a shallow continuous groundwater table (surface) below this site. In addition, during groundwater monitoring all of the wells were noted as being to be dry. The results of the groundwater monitoring are presented in **Appendix D**.

5.39 It should be noted that groundwater levels vary seasonally and that a higher water table than recorded could occur.



In Situ Test Results

Standard Penetration Tests

5.40 The results of the SPT 'N' values undertaken within the made ground, superficial deposits and weathered bedrock are summarised in the table below.

Strata	No. of Tests	Depths Below Ground Level (m)	SPT N Range	SPT N Average
Made Ground	3	1.0	29 - 34	31
	1	2.0	50*	50*
Bedrock Deposits: Sandstone	2	1.8 – 2.0	50*	50*

^{* -} Limited penetration recorded

- 5.41 Within the made ground, SPT 'N' values ranging between 29 and refusal were recorded during the ground investigation works, indicating medium dense to dense granular materials.
- 5.42 SPT tests undertaken within the sandstone bedrock deposits recorded 'N' values in excess of 50 with limited penetration (i.e. 50 blows for less than 300mm penetration).

Geotechnical Related Testing

5.43 The results of the geotechnical testing are presented in **Appendix E**.

Unconfined Compressive Strength (UCS)

5.44 7 no. representative intact samples of bedrock recovered from the rotary boreholes (in excess of the general 120mm minimum length required to complete the test), were sent to the laboratory to determine their Unconfined Compressive Strength value (UCS), the results of which are summarised in the table on the following page.



Position	Depth (m)	Strata Description	UCS Value (MPa)	Strength Term
BH1A	18.72 – 18.92	Sandstone	40.3	Medium strong
BH1A	20.05 – 20.25	Sandstone	18.7	Moderately weak
BH1A	24.10 – 24.35	Mudstone	57.0	Strong
BH02	16.50 – 16.70	Sandstone	45.4	Medium strong
BH02	23.70 – 24.00	Sandstone	84.2	Strong
BH03	16.77 – 17.00	Sandstone	47.2	Medium strong
BH03	24.60 – 24.80	Sandstone	21.5	Moderately weak

Point Load Index

- 5.45 Representative samples of the intact bedrock were scheduled to determine their tensile point load strength ($I_{S(50)}$) for parallel (Diametral) and perpendicular (Axial) orientation, the results of which are summarised in the following tables. In addition, for deposits where the full diameter of core was not recovered, primarily due to zones of increased weathering and fracturing, representative irregular lump sized samples were also sent to the laboratory to determine their indicative tensile point load strength ($I_{S(50)}$), with samples tested at parallel or perpendicular orientations, where applicable.
- 5.46 From a review of these results it is considered that an approximate Unconfined Compressive Strength (UCS) value can be determined utilising the average $I_{S(50)}$ values and an appropriate 'conversion factor'. Due to the nature of the deposits tested a 'conversion factor' (K) of 24 has been utilised for this site (Bieniawski, 1975), as summarised in the table on the following page.



Point Load Tests								
Position	Depth (m)	Test Type	Orientation	Description	Point Load Index (I _{S(50)}) (MPa)	Approximate UCS Value (MPa)	Strength Term	
BH1A	9.85	Α	Perp	Sandstone	2.80	67.2	Strong	
BH1A	9.85	D	Par	Sandstone	1.30	31.2	Medium strong	
BH1A	11.85	Α	Perp	Sandstone	3.03	72.7	Strong	
BH1A	11.85	D	Par	Sandstone	1.54	37.0	Medium Strong	
BH1A	14.30	Α	Perp	Mudstone	0.07	1.68	Very weak	
BH1A	14.30	D	Par	Mudstone	0.15	3.6	Very weak	
BH1A	16.50	Α	Perp	Sandstone	1.91	45.84	Medium strong	
BH02	11.10	Α	Perp	Sandstone	2.17	52.1	Strong	
BH02	11.10	D	Par	Sandstone	1.07	25.7	Medium strong	
BH02	16.10	Α	Perp	Sandstone	2.72	65.3	Strong	
BH02	16.10	D	Par	Sandstone	0.79	19.0	Moderately weak	
BH02	21.70	А	Perp	Mudstone	1.20	28.8	Medium strong	
BH02	21.70	D	Par	Mudstone	0.11	2.6	Very weak	
BH02	23.10	Α	Perp	Sandstone	1.77	42.5	Medium strong	
BH02	23.10	D	Par	Sandstone	0.27	6.5	Weak	
BH03	9.20	Α	Perp	Mudstone	0.18	4.32	Very weak	
BH03	12.60	Α	Perp	Sandstone	2.86	68.6	Strong	
BH03	12.60	D	Par	Sandstone	0.50	12	Weak	
BH03	15.50	Α	Perp	Sandstone	2.93	70.3	Strong	
BH03	15.50	D	Par	Sandstone	1.54	37.0	Medium strong	
BH03	20.20	Α	Perp	Mudstone	0.25	6.0	Weak	
BH03	20.20	D	Par	Mudstone	0.06	1.4	Very weak	
BH03	21.50	Α	Perp	Mudstone	0.50	12.0	Weak	
BH03	21.50	D	Par	Mudstone	0.15	3.6	Very weak	

A = Axial, D = Diametral, I = Irregular, Perp = Perpendicular, Par = Parallel.

Sulphate and pH Determinations

- 5.47 Within the made ground, water soluble sulphate concentrations ranged between 40mg/l and 269mg/l with pH values between 6.2 and 8.6. The results indicate made ground should be designed to a BRE Special Digest 1:2005 Design Sulphate Class DS-1 with an ACEC site classification AC-1.
- 5.48 Within the natural soil samples tested water soluble sulphate concentrations were recorded between 109mg/l and 211mg/l with pH values of ranging between 6.2 and 8.4. This indicates a BRE Special Digest 1:2005 Design Sulphate Class DS-1 with an ACEC site classification AC-2z.



Gas Monitoring

5.49 The results of the ground gas monitoring carried between 13th July and 6th December 2019 are summarised in the following table:

Location	CH₄ (% v/v)	CO₂ (% v/v)	O ₂ (% v/v)	Flow (I/hr)	Barometric Maximum GSV ³ Pressure		m GSV*
					(mb)	CO ₂	CH₄
WS01	0.0	4.1 - 5.2	13.7	<0.1			
WS02	0.0	7.4 – 8.7	6.2 - 8.1	<0.1	1002-1015	<0.07	<0.07
WS03	0.0	0.4 – 4.1	13.7 - 21.1	<0.1			

^{*} CIRIA 665 Gas Screening Value, based on maximum flow and concentration

5.50 In summary, no Methane has been detected whilst Carbon Dioxide has been recorded at a maximum concentration of 8.7%v/v. Oxygen was recorded at a minimum concentration of 6.2%v/v. No flow was detected during the monitoring, resulting in a preliminary CIRIA Gas Screening Value (GSV) of <0.07l/hr being calculated to date.

5.51 However, when considering the generally consistent increased levels of Carbon Dioxide, noted to exceed 5.0%v/v, combined with recorded depleted Oxygen levels, it is considered that as a minimum gas protection measures in accordance with CIRIA C665 and BS8485:2015 Characteristic 2 (CS2) will be required for new developments on this site.

Contamination Related Testing

5.52 The results of the contamination related testing are included in **Appendix D**. Generally, the results have been assessed using the LQM/CIEH Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3170; All rights reserved). Where no S4UL is available, reference is made to published DEFRA, SP1010L Category 4 Screening Levels (C4SL) with the use of these values considered to represent the more conservative approach for assessing the level of potential risk to Human Health. For the purpose of this report, all S4ULs or C4SLs will be referred to as Generic Assessment Criteria (GAC).



5.53 With respect to the assessment, as the site is proposed to be redeveloped as a retail park, the most appropriate values are considered to be the GAC's for a Residential end use. Based on the laboratory results, an SOM of 2.5% has been used in the assessment. A summary of the contamination related testing is presented in the table below.

Determinand	Maximum conc. mg/kg	No of Samples Tested	Generic Assessment Criteria (GAC) ⁽¹⁾ mg/kg	No of Samples Exceeding GAC
Arsenic	4.5	6	40	0
Boron	0.7	6	11000	0
Cadmium	<0.2	6	85	0
Chromium (III)	52	6	910	0
Chromium (VI)	<1	6	6	0
Copper	51	6	7100	0
Lead	19	6	310 ⁽²⁾	0
Mercury	< 0.5	6	56	0
Nickel	31	6	180	0
Selenium	1.0	6	430	0
Zinc	88	6	40000	0
Speciated PAH's				
Naphthalene	0.16	6	5.6	0
Acenaphthylene	< 0.02	6	4600	0
Acenaphthene	0.03	6	4700	0
Fluorene	0.04	6	3800	0
Phenanthrene	0.38	6	1500	0
Anthracene	0.07	6	35000	0
Fluoranthene	0.23	6	1600	0
Pyrene	0.19	6	3800	0
Benzo(a)anthracene	0.08	6	14	0
Chrysene	0.15	6	31	0
Benzo(b)fluoranthene	0.12	6	4	0
Benzo(k)fluoranthene	< 0.03	6	110	0
Benzo(a)pyrene	0.07	6	3.2	0
Indeno(1,2,3-cd)pyrene	0.05	6	46	0
Dibenz(a,h)anthracene	< 0.02	6	0.32	0
Benzo(g,h,i)perylene	0.06	6	360	0

Notes

- (1) LQM/CIEH S4UL for a Residential end use unless otherwise stated
- (2) Category 4 Screening Level (C4SL)

5.54 Based on the results of the chemical analysis, no levels of contaminants have been identified which exceed current assessment criteria based upon a future residential without home grown produce end use. Therefore, these materials are considered suitable for use on without representing a potential risk to human health (i.e. future end users).

Asbestos

5.55 Six samples of made ground were screened for asbestos fibres; none were detected.



Phytotoxic Contaminants

5.56 To assess the potential risks to plants in areas of soft landscaping the results of the soil screening have also been assessed with respect to plant phytotoxicity, as summarised in the table below.

Plant Phytotoxicity							
Determinand Soil pH range Maximum Maximum Permissible Concentration of conc. (mg/kg) TE ⁽¹⁾ in Soil (dependent upon soil pH range) (mg/kg) ⁽²⁾							
			pH<6.0	pH 6.0-7.0	pH>7.0		
Zinc		88	<200	<200	<300		
Copper	6.2 – 8.6	51	<100	<135	<200		
Nickel		31	<60	<75	<110		

Notes

-) PTE Phytotoxic Element
- (2) BS3882:2007 & DoE Code of Practice for Agricultural use of Sewage Sludge, 1996

5.57 In view of the above results, concentrations of Zinc, Copper and Nickel all fall below the maximum permissible concentrations for soils and therefore are not considered to present a risk to future plant growth.

Modified Conceptual Site Model

Sources of Contamination

- 5.58 Based on the findings of the investigation works, no visual and olfactory evidence of potentially significant contamination was encountered within any of the exploratory hole locations. In addition, the chemical analysis did not encounter any elevated concentrations of determinands screened. Due to the low concentrations of determinands recorded during the ground investigation, the risk to controlled waters is considered to be negligible. Therefore, no remedial measures are considered necessary with respect to human health for the intended site end use.
- 5.59 However, from the results of the gas monitoring increased levels elevated levels of Carbon Dioxide have been recorded indicating this site as falling within the CIRIA C665 and BS8485:2015+A1:2019 Characteristic Situation 2 (CS2). Therefore, at present the following are still considered applicable for this site.



Pathways

• Vertical and lateral migration, ingress and accumulation of ground gases into buildings and service entries (manholes).

Receptors

• Human Health – Site end users.

Pollutant Linkage Assessment

5.60 A qualitative risk assessment has been made of the likelihood of any pollutant linkage operating and its potential significance, as summarised in the table below:

Summary Table of Pollutant Linkage Assessment

Contamination source	Pathway	Hazard	Potential receptors	Linkage complete
Ground Gas	Vertical migration into buildings and confined spaces	Human health risk. Fire risk	Human health and property	Increased levels of Carbon Dioxide have been recorded during ground gas monitoring indicating this site as falling within a Characteristic Situation 2 (CS2).



6 DISCUSSION

6.1 Development proposals include the construction of three new residential apartment blocks, with associated hard and soft landscaping. This investigation was carried out to provide geotechnical information with respect to foundations for the proposed developments and contamination related testing to outline potential constraints.

Contamination Assessment

- 6.2 In view of the results of the chemical analysis with no levels of contaminants have been identified which exceed current assessment criteria based upon a future residential end use. Therefore, these materials are considered suitable for use within a residential setting without representing a potential risk to human health (i.e. future end users).
- 6.3 In addition, when comparing the results of the soil screening undertaken by Norwest Holst in 2009, none of the levels of contaminants recorded during these works exceed current assessment criteria for Human Health based upon a residential end use, further confirming an absence of significant risk in this regard.
- 6.4 In addition, due to the low concentrations of determinands recorded during the combined investigation works, the risk to controlled waters is considered to be negligible. Therefore, no remedial measures are considered necessary for this site with regards human health and/or controlled waters.

Remediation

6.5 In view of the results and assessment of the contamination analysis carried out, no remediation is considered necessary to facilitate development, with regards human health and/or controlled waters.

Disposal of Materials

6.6 Waste classification testing has not been carried out. However, the results of the chemical analyses can allow an initial assessment to be made.

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6.7 Following a review of the soil screening results, generally low levels of contaminants were recorded for made ground samples screened as part of the investigation works indicating these materials could potentially be characterised as Inert for disposal. However, due to the nature of these materials, i.e. made ground with demolition related material, with soft landscaping/topsoil associated with the Carbon Capture Garden also present within the southern site area, there is a potential that some of these materials may be classified as either Non-Hazardous or Stable Non-Reactive Hazardous waste.

6.8 Where offsite disposal of waste soils is required, the results of the investigation should be made available to the waste carrier/receiver in order to determine the waste classification, costs for disposal and the requirement for further testing. Sufficient time should be allowed in the site programme to effectively segregate soils based on material type, including the time allowed for any further laboratory classification analysis as required.

Mining Assessment

6.9 The following provides a summary of the rotary investigation works completed for the site as part of this assessment along with previous rotary boreholes undertaken on and within close proximity to this site by Norwest Holst (NH) in 2009. In addition, where applicable reference has also been made to 'Treatment of Mine Workings Drilling and Grouting of Mine Entries Completion Report' produced for this site by Groundshire Limited in 2014, but as discussed previous. where applicable comments relating to the previous remedial works undertaken by Groundshire Ltd are provided for information only.

Open-Cast Operations

6.10 Based on the findings of the investigation works rotary boreholes BH1 and BH1A have confirmed that the former open-cast working extends below the north-eastern corner of the site, and within the footprint of the proposed building within this area, with BH1A also considered to have been likely sunk on the high back wall of this feature.

6.11 During the investigation works access was prohibited within the north-eastern site area to undertake further investigation works to aid in determining the extent of the former high back wall. However, as indicated on **Drawing G004**, it can be seen that the boundary of the former open-cast working extends below the eastern extent of the proposed building located within the northern site area, with the high back wall of this feature defined by the



tighter spaced grout holes coloured black and green. In view of this, it is considered that as the high back wall of the former opencast bisects the north-eastern portion of the site, levels to rock-head are considered to vary significantly across this part of the site.

High Main and Metal Coal Seams

- 6.12 Based on the findings of the investigation works and review of available information, shallow coal workings within the High Main and Metal coal seams have been identified below the majority of the site located out-with the extent of the former open-cast working. At the location of BH2 probable workings within the High Main seam were also noted from a depth of 3.0m indicating the potential for workings in the High Main seam to have migrated to and/or within close proximity to 'rock-head' level below this area.
- 6.13 Within the majority of boreholes sunk as part of these investigation works, which intersected workings in the High Main and Metal coal seams, evidence of grout was identified confirming remedial works have been undertaken to treat these seams below the site. However, for the High Main seam voiding was noted within this grouted seam with loss of flush and limited recovery also evident during coring, indicating that localised voids still remain. This could potentially be a result of the inferred grid spacing of grouting as outlined in the completion report, which indicated the main grid of boreholes were designed on a 6m five diamond basis, equating to a 4.25m regular grid.
- 6.14 In addition, from **Drawing G004** it can be seen that no remedial grouting works are indicated as having been undertaken for either the High Main or Metal seams along the western boundary of the site. Therefore, it is considered that workings within both of these seams represent a risk across this area of the site through void migration to the surface, and as such stabilisation by drilling and grouting of the mine workings are recommended to facilitate the development.
- 6.15 Due to localised voiding noted within grouted areas of the High Main seam below the site, as part of the recommended remedial works along the western boundary of the site, as a precautionary measure it may also be prudent to undertake further re-grouting of this seam where present below site as a whole to ensure an absence of risk at the surface through localised void migration, and to also negate the risk to future foundations to be sunk down through these materials, particularly as no reliance can be made of the previous grouting report.



Five Quarter Coal Seam

6.16 During the investigation works no evidence of intact coal and/or workings considered to be attributable to the Five Quarter seam were identified within BH's 2 and 3 sunk as part of these investigation works, to a maximum depth of 25.0m. However, at the location of BH1A workings considered to be attributable to the Five Quarter seam were noted at depths of between 23.1m to 24.0m below current ground levels, and thickness of 0.90m.

6.17 Within BH1A workings in the Five Quarter were noted to be filled for the full thickness with soft to firm clay containing mudstone, sandstone and coal (colliery spoil), supporting anecdotal evidence of workings within this seam as having been backfilled with 'packed waste'. However, based on the results of the investigation works a conservative rock cover ratio of 7.3 has been calculated at BH1A, with the rock cover ratio considered from the base of the Metal coal seam (i.e. inferred base of the open-cast working). These results indicate that there is insufficient rock cover between the base of the former open-cast working to mitigate against any void migration associated with workings within the Five Quarter seam, using the 'conventional' 10 times seam thickness.

6.18 Therefore, it is considered that workings within the Five Quarter coal seam represent a potential risk to the proposed building within the northern site area through void migration towards the termination depth of proposed piled foundations sunk to the base of the open-cast working. Subsequently, stabilisation by drilling and grouting will be required within the Five Quarter seam for buildings extending onto the location of the former open-cast working, in consideration that a piled foundation solution will be required.

Foundations

6.19 When considering the nature of the proposed development and in consideration of the variable nature of shallow ground conditions below the site, piled foundations are considered to represent the most viable solution, terminating within competent bedrock deposits.

6.20 During the investigation works as anticipated shallow coal workings have been identified below the majority of the site located out-with the extent of the former open-cast working, within the High Main and Metal coal seams. From the grouting completion report it is understood that both the shallower High Main and Metal coals seams have been grouted below the majority of the site, which is supported by the findings of the investigation which

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also recovered grout at the various seam horizons. However, evidence of voiding was noted within the shallower grouted High Main seam with loss of flush and limited recovery also evident. In addition, from **Drawing G004** it can be seen that no remedial grouting works are indicated as having been undertaken within either the High Main or Metal seams below the western edge of the site.

6.21 Based on the investigation works the former open-cast working and associated high back wall has been also been confirmed as extending below the north-eastern site area, resulting in significant variations in rock-head level. Therefore, recommendations relating to piled foundations for the building within the northern site area have been considered separately to buildings proposed within the southern and central site areas, as summarised below:

Southern and Central Site Areas

6.22 For the proposed buildings located within the southern and central site areas and outwith the extent of the former open-cast working, due to the presence and condition of workings within the High Main seam at shallow depth below these areas, it is recommended that piled foundations be taken down through this seam, to be founded within competent bedrock strata at indicative depths of around c.8-10m below current ground levels.

6.23 However, foundations for these areas of the site are subject to completion and review of the information from the recommended remedial (grouting) works outlined within the Mining Assessment.

Northern Site Area

6.24 During the investigation works, an increased thickness of made ground has been identified associated with the location of the former open-cast working and associated high back wall, which has been confirmed as extending below the eastern extent of the northern most building. From the available information, it is understood that both the High Main and Metal coal seems were fully extracted as part of the former open-cast operations, resulting in the basal depth of the open-cast generally concurring with the base of the Metal coal seam, which was identified at a depth of 16.50m bgl or 58.10m AOD within BH1A.

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6.25 Therefore, to ensure foundations within this area of the site are based wholly within similarly competent strata it is recommended that piled foundations for the eastern extent of the proposed building are taken down to the base of the former open-cast working at an indicative depth of around c.16.5m below current ground levels.

6.26 For western extent of the northern building, located out-with the extent of the former open-cast working, due to the presence of voiding noted within the High Main and Metal coal seams below this area of the site, it is recommended that piled foundations be taken down through both the High Main and Metal coal seams, resulting in piles being based at a similar depth for the northern most building as a whole.

6.27 However, as shallow coal workings within the Five Quarter seam have been identified within influencing distance of the base of the former open-cast working, with this seam not treated as part of previous remedial works, the above solution is subject to the completion and review of the recommended remedial (grouting) works as outlined within the Mining Assessment.

6.28 If a piled foundation design is to be considered for this site, the advice of a specialist contractor should be sought, to determine and appropriate design and method of installation.

Gas Protection Measures

6.29 Radon protection measures are not required for the proposed development.

6.30 Based on results of the ground gas monitoring, increased levels of Carbon Dioxide have been recorded up to a maximum of 8.7%, which corresponds with recorded levels of depleted Oxygen. Therefore, it is considered that gas protection measures in accordance with CIRIA C665 and BS8485:2015 Characteristic 2 (CS2) will be required for any future developments on this site.

Excavations and Dewatering

6.31 If man entry is proposed into excavations the use of support to excavation sides is recommended, in line with health and safety guidelines. Significant groundwater ingress into excavations are not anticipated, however any that do occur, particularly within deeper



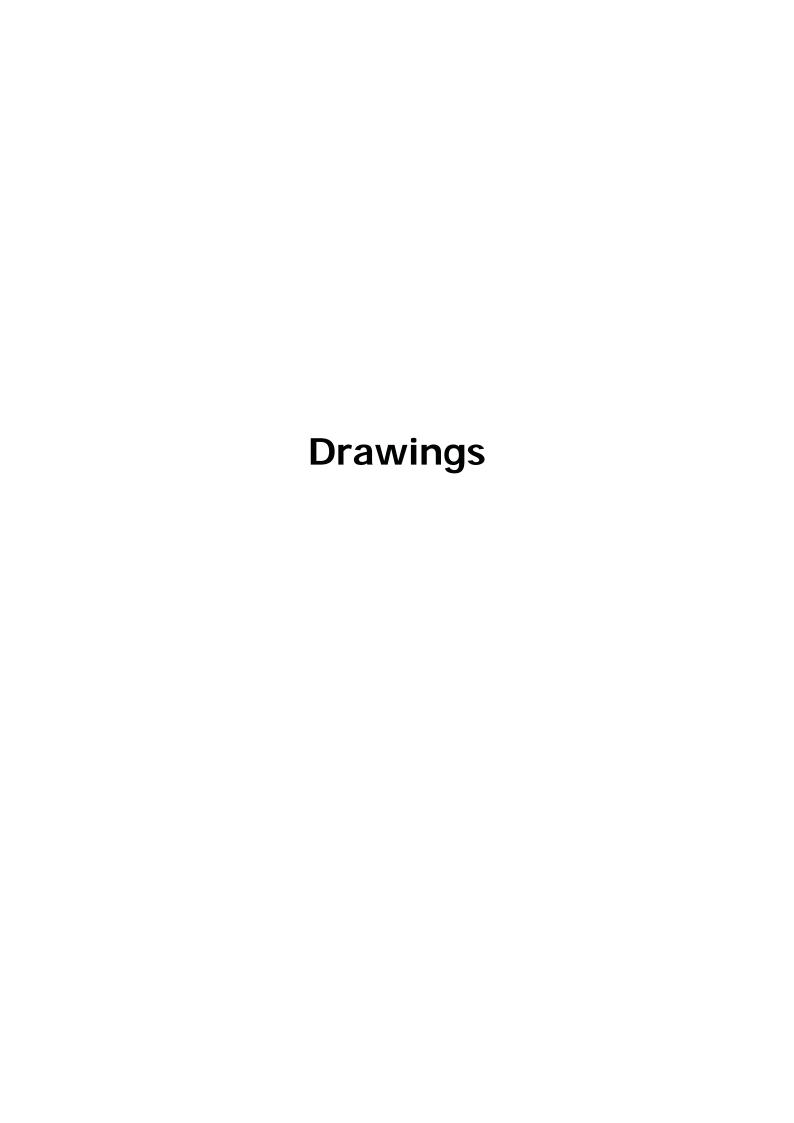
excavations, should be controlled adequately by localised pumping from sumps within excavations.

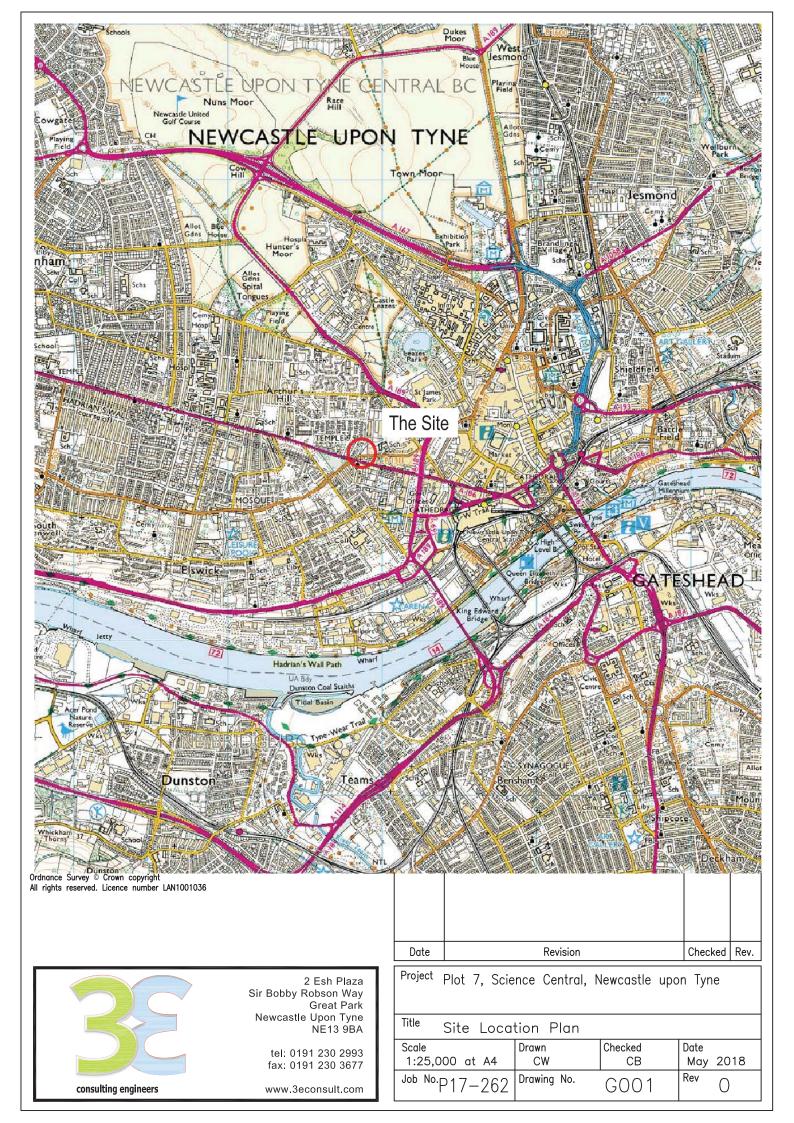
External Hard-Standing

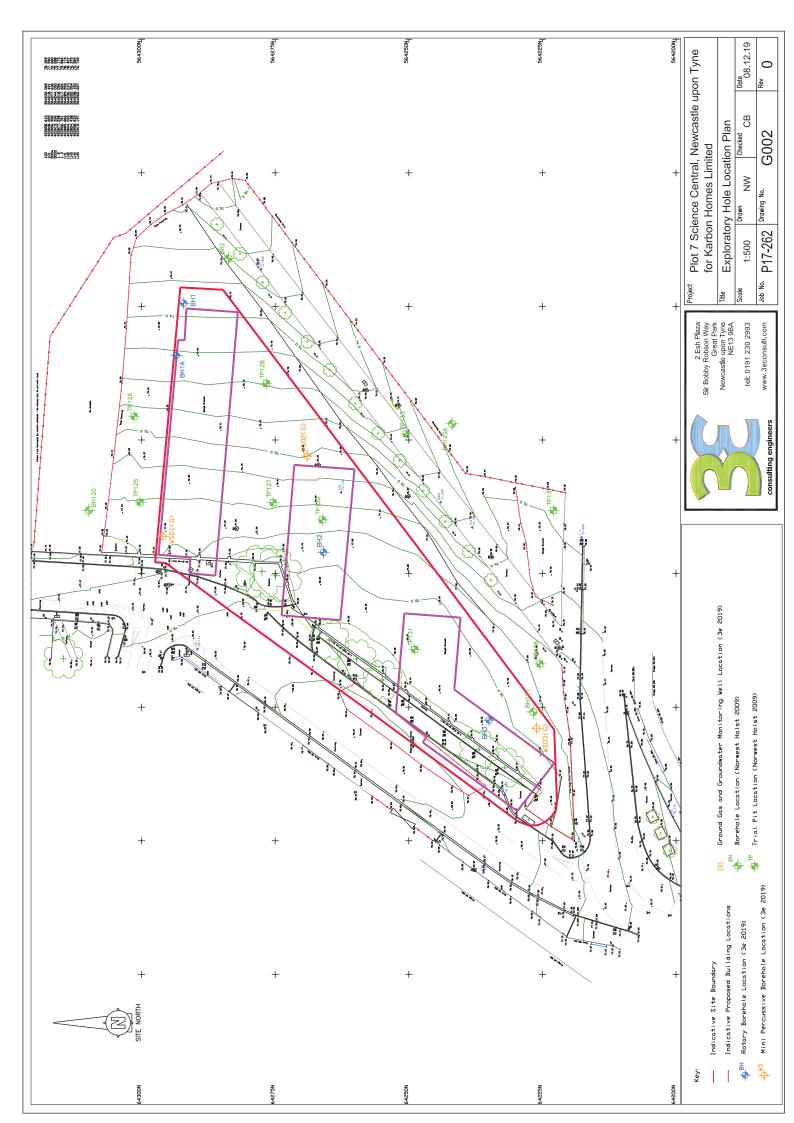
6.32 Due to the variable and generally loose nature of the granular made ground it is recommended that a conservative CBR value of 2% be initially adopted, at this stage, for these materials, subject to the completion of in-situ plate bearing tests at formation level during the development works.

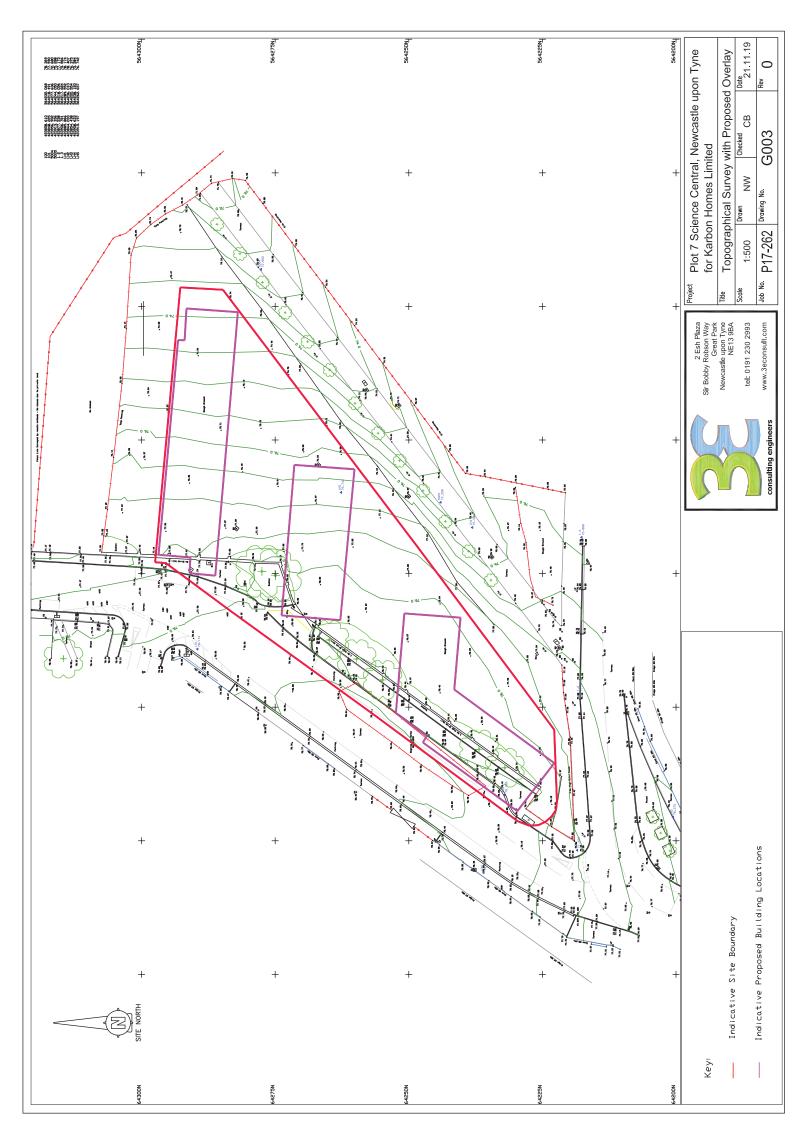
Sulphate Attack on Buried Concrete

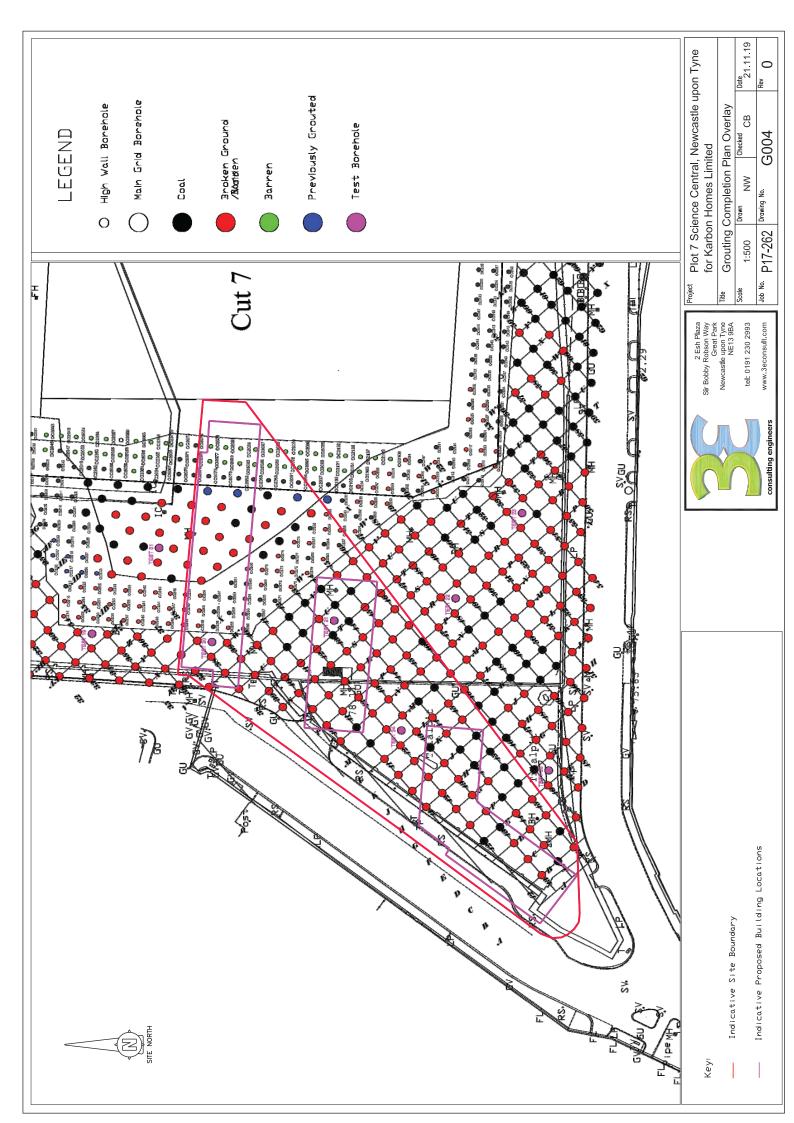
6.33 The results of the chemical analyses indicate a BRE Special Digest 1:2005 Design Sulphate Class DS-1 with an ACEC classification AC-2z; buried concrete should be designed accordingly.











Appendix A

Proposed Development Plan

The use of the date by the welface in the man system, by the indentity opposition and the state of the state

Site Boundary
Newcastle Helik
Masterplan Boundary
Existing Buildings
Newcastle Helik
Proposed Buildings

73400

Meeting Space

Opcle

^{કુનુનાર} m^{erighish}u⁸

Gurdwara Singh Sabha

Bin

The Oaks

Abinger Street

۵

Bin

Number of units	19	31	80	Ŋ	63
GIFA	mbs06	46sqm	141sqm	91sqm	
Type	284P	1B2P	487P	284P	er of units
Unit	æ	o	Q	ш	Total number of units

The company of the co	Nemersta DASS DASS Proposed Plon Project ID FH Ryder Project Syder Project
Other Halts days to the state of the state o	Corporation Street

owing the right of the following the sees hunder right of the right of Ryder

Appendix B

Previous Exploratory Hole Record Sheets (Norwest Holst 2009)



Hole ID. TP131 Sheet 1 of 1

Contract No.

F15481

Method

Logged by

Machine Excavated

Coordinates

423885.81 E 564248.89 N

Project

Former Tyne Brewery

Equipment JCB 3CX

PS

Ground Level

77.80m AOD

Client

Newcastle City Council

Date Started Date Completed

19/03/2009 19/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	Depth Below G.L.	Datum Level	S	Sampling	Remarks
MADE GROUND: Tarmacadam.	13333		- 77.70			
MADE GROUND: Light brown slightly clayey sandy subangular fine to coarse gravel sized fragments of sandstone. Sand sized fragments are fine to coarse.		0.60	77.20	ES1	0.60	-
MADE GROUND: Dark brown slightly sandy slightly gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are angular fine to coarse of brick and sandstone.		1,00	76.80	ES2	1.00	
Light brown slightly clayey gravelly fine to coarse SAND with high cobble content. Gravel is subangular fine to coarse of sandstone. Cobbles are subangular of sandstone. (Weathered Sandstone)						
Weak light brown fine grained SANDSTONE. Trial pit complete at 3.05 m.	The control of	3.00	74.80			

Stability

Unstable from 1.00m to 3.00m

Shoring

None used

Groundwater

None encountered during excavation

A 4.00m D 0.60m ₿ C → 343. Bearing

Sketch Plan of Trial Pit

Remarks

Trial pit complete at 3.05m.
 Trial pit backfilled upon completion.

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

Form	ARIAL TP LOG	_
Version	3.08	
Revised	17/12/2007	



Hole ID. **TP132** Sheet 1 of 1

Contract No. Project

F15481

Logged by

Machine Excavated

Coordinates

423910.05 E 564266.20 N

Equipment

JCB 3CX

Ground Level Date Started

75.35m AOD

Client

Newcastle City Council

Former Tyne Brewery

17/03/2009 Date Completed 17/03/2009

Consultant

Mott MacDonald

The state of the s						
Description of Strata	Legend	Depth Below G.L.	Datum Level	S	Sampling	Remarks
MADE GROUND: Brown sandy subangular fine to coarse gravel sized fragments of concrete and brick with low cobble content. Sand sized fragments are fine to coarse. Cobble sized fragments are subangular of concrete and brick.	\$\$\$\$ \$\ \\$	0.30	75.05 74.85	ES1	0.50	-
MADE GROUND: Light brown slightly clayey gravelly fine to coarse sand. Gravel sized fragments are subangular fine to coarse of sandstone and brick.		1.50	73.85	ES2	1.50	
Light brown gravelly fine to coarse SAND. Gravel is angular of sandstone.		1,60	73.75			
Weak light brown fine grained SANDSTONE. (Recovered as subangular fine to coarse gravel). Trial pit complete at 1.60 m.						

Stability

Unstable from GL to 0.30m

Shoring

None used

Groundwater

None encountered during excavation

Sketch Plan of Trial Pit Α 2.50m D 0.60m В → 310* C Bearing

Remarks

All bearings given relate to magnetic North

Trial pit complete at 1.60m.
 Trial pit backfilled upon completion.

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations.

Form	ARIAL TP LOG
Version	3 05
Revised	17/12/2007



Hole ID. **TP133** Sheet 1 of 1

Contract No.

F15481

Method

Logged by

Machine Excavated

Coordinates

423926.14 E

Project Former Tyne Brewery

Equipment JCB 3CX

PS

Ground Level

Date Completed

564250.51 N 74.93m AOD

Client

Newcastle City Council

Date Started

17/03/2009 17/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	Depth Below G.L.	Datum Level	5	Sampling	Remarks
MADE GROUND: Brown sandy subangular fine to coarse gravel sized fragments of concrete and brick with low cobble content. Sand sized fragments are fine to coarse. Cobble sized fragments are subangular of concrete and brick.		0.60	74.33	ES1	0.60	
MADE GROUND: Light brown slightly gravelly sandy clay with low cobble content. Sand sized fragments are fine to coarse. Gravel sized fragments are subangular fine to coarse of sandstone. Cobble sized fragments are subangular of sandstone and brick.						
from 2.00m with high boulder content. Boulder sized fragments are subangular of sandstone						
Weak light brown fine grained SANDSTONE. (Recovered as angular fine to coarse gravel). Trial pit complete at 3.85 m.		3.85 3.85	71.13	ES2	3,80	
		:				

Stability

Unstable from GL to 0.60m

Shoring

None used

Groundwater

None encountered during excavation

С

D 0.60m

Sketch Plan of Trial Pit Α 5.00m

Remarks

Trial pit complete at 3.85m.
 Trial pit backfilled upon completion.

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.08
Revoted	17/12/2007

В

→ 200°

Bearing



JCB 3CX

PS

Hole ID. **TP136** Sheet 1 of 1

Contract No.

F15481

Method

Machine Excavated

Coordinates

423883.10 E 564225 46 N

Project

Former Tyne Brewery

Equipment

Logged by

Ground Level

76,96m AOD

Client

Newcastle City Council

Date Started Date Completed 19/03/2009 19/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	Depth Below G.L.	Datum Level	S	ampling	Remarks
MADE GROUND: Tarmacadam.	10000	0 10	76.86			E
MADE GROUND: Light brown slightly clayey sandy subangular fine to coarse gravel sized fragments of sandstone. Sand sized fragments are fine to coarse.		0.40	76.56	ES1	0.40	
MADE GROUND: Dark brown slightly sandy slightly gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are subangular fine to coarse of brick and sandstone.		0.80	70.00	E32	0.50	
Light brown slightly clayey gravelly fine to coarse SAND with high cobble content. Gravel is subangular fine to coarse of sandstone. Cobbles are subangular of sandstone. (Weathered Sandstone)		2.40	74.56			
Weak light brown fine grained SANDSTONE. Trial pit complete at 2.45 m.		2.45	74.51			
			-			

Stability

Unstable from 0.90m to 2.40m

Shoring

None used

Groundwater

None encountered during excavation

Remarks

Trial pit complete at 2.45m.
 Trial pit backfilled upon completion.

Α	
◀ 4.00m ➤	
A	
D 0.60m	
٧	
C Bearing 288°	

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

١	Form	ARIAL TP LOG	
	Version	3.08	
1	Revised	17/12/2007	



Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
TP137
Sheet 1 of 1

Contract No.

F15481

Method

Equipment

Logged by

Machine Excavated

Coordinates

423911,83 E 564222,94 N

Project

Former Tyne Brewery

JCB 3CX

PS

Ground Level

74.64m AOD

Client

Newcastle City Council

Date Started

Date Completed

17/03/2009 17/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	Depth Below G.L.	Datum Level	S	Sampling	Remarks
MADE GROUND: Light brown sandy subangular fine to coarse gravel sized fragments of concrete and brick with low cobble content. Sand sized fragments are fine to coarse. Cobble sized fragments are subangular of concrete and brick.			74.34	ES1	0.30	
\ MADE GROUND: Light brown gravelly fine to coarse \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \						
						-
			-			
			F			r -

Stability Unstable from GL to 0.30m

Shoring

None used

Groundwater

None encountered during excavation

Remarks

 Trial pit complete at 0.60m. Unable to excavate further (concrete foundations across base of pit).

2. Trial pit backfilled upon completion.

Sketch Plan of Trial Pit

A

5.00m

D 0.80m

C

Bearing

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North



Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole ID. **BH120** Header

Contract No. F15481

Project

Cable Percussion & Rotary

Coordinates

423911 85 E 564309.90 N

Former Tyne Brewery

Dando/Boart Longyear 520 Drilling Rig

Ground Level

76:25m AOD

Client

Newcastle City Council

Drillers LC/TF

Method

Orientation

Vertical 11/03/2009

Consultant

Mott MacDonald

FJP Logged by T6116 Date Started

Core barrel Core bit Impregnated Date Completed

13/03/2009

	_		PROGRESS			CABLE PERCUSSION DETAILS
Dale	Time	Hole depth	Casing depth	Water depth	Remarks	Hard Strata Hard Strata Chiselling Remarks Hours
11/03/2009 11/03/2009 11/03/2009 13/03/2009 13/03/2009	1200 1200 1730 0730 1730	3.10 3.10 9.70 9.70 21.70	2.90 2.90 8.20 8.20 8.20	DRY DRY DRY DRY DRY	End of CP Start of Rotary End of Shift Start of Shift End of Hole	

	CAS	ING		WATER STRIKES										
Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.	Date	Time	Strike at depth	Rise todepth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow			
150 125	3.10 21.70	150 125	2.90 8.20			The political and the second s	was pivi	30,1100			10.5301 1101			

RO	TARY DRILLING	DETAILS				SPT DETAILS
From To depth depth	Flush type	Flush return	Core diameter	Depth	Type	incremental blow count/penetration in mm
3.20 5.20 5.20 8.20 8.20 21,70	Air/Mist Air/Mist Air/Mist	100% 0% 100%	92 92 92	1.50 2.50 3.00	S S S	N=2 (1,0.0,1,1.0) N=36 (7,9,9,8,10,9) 50/0mm (25/60,50/0)

GENERAL NOTES

- 1. Inspection pit hand excavated from GL to 1,20m.
- Cable Percussive boring complete at 3.10m.
 Rotary Coring complete at 21.70m.
- 4. 1 No 50mm diameter standpipe installed, with slotted
- section from 0.50m to 3.50m.
 5. 19mm diameter piezometer installed, with tip at 20.20m.

·		,	
	* Seating blows only.		

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, hard strata time in hours

	Form	ARIAL COMBINED HEADER	
Į	Version	3.04	
1	Revised	17/12/2007	

Casing NR

NR

NR

DRY

DRY

DRY

NORWEST •

NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water

strikes. See legend sheet for key to symbols,

Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID. BH120 Sheet 1 of 3

ARIAL COMBINED LOG

3.10

17/12/2007

Contract No. F15481 Cable Percussion & 423911.85 E Method Coordinates Rotary Project Former Tyne Brewery 564309,90 N Drilling Rig Dando/Boart Longyear 520 Ground Level 76.25m AOD Drillers LC/TF Client **Newcastle City Council** Orientation Vertical Logged by FJP Date Started 11/03/2009 Consultant Mott MacDonald Core Barrel T6116 Date Completed 13/03/2009 Core Bit Impregnated

Description of Strata	Legend	Depth Below	Datum		Sampling			Count		SPT type, I	
<u> </u>		G.L.	Level		& coring	TCF	SCR	ROD	則	& depth	atio
MADE GROUND: Brown slightly sandy gravelly clay. Sand is fine to coarse of ash. Gravel sized fragments are angular to subangular fine to coarse of coal, brick and sandstone.		0.30	75.95	D1 82	0 30 0.50-1.00						
MADE GROUND: Brown and black slightly gravelly sandy clay. Sand is fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of sandstone, tile and mudstone.		1.00	75.25	D3	1.00						
MADE GROUND: Black and grey slightly gravelly sandy clay. Sand is fine to coarse of ash. Gravel sized fragments are angular to subangular fine to coarse of brick and sandstone.		2.00	74.25	D4 B5	1.50-1.95 1.50-2 00					\$2 1.50 1.95	
Dense brown clayey SAND and angular to subangular fine to coarse GRAVEL of sandstone. (Reworked/Weathered Sandstone)				D7 D8 B9	2.50 2.50-2.95 2.50-3.00					\$38 250 256	
Medium strong yellowish brown coarse grained		3.00	─73.25 	D10	300					\$50/0mm 3.00 3.06	3 11
micaceous SANDSTONE. Discontinuities: 1) 0-10 deg planar rough with sand infill.					3 20 4.	20 100	100	100			
			-		43544	-			50 150 500		
from 4.80m darker brown with orange stainingat 5.10m black staining					420 5	20 100	93	67			
			-								
CAVITY (Driller's description)	12010	5.60	- 70.65 -								
Zone of core loss. WORKINGS (Driller's description) (The 'High Main'?)	~	6.60	69.65		5.20 8.	20 0	0	0	NR		
Very weak grey MUDSTONE with plant fossils Recovered as angular fine to coarse gravel sized fragments. (seat earth) Weak to medium strong black carbonaceous MUDSTONE with local pyrite growth. Discontinuities: 1) very closely to closely		8.20 8.34	68.05		820 9.	70 99	14	0	NI NI NI 150		
spaced 0-10 deg planar smooth with clay infill. 2) closely to widely spaced 80-90 deg planar smooth with clay infillfrom 8.53m to 8.78m and 8.84m to 9.03m		9,70 9,90	- 66.55 - 68.35			6-	1		NI NI		



NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID. BH120 Sheet 2 of 3

ARIAL COMBINED LOG

17/12/2007

Cable Percussion & Contract No. F15481 Method Coordinates 423911.85 E Rotary Former Tyne Brewery Project 564309,90 N Dando/Boart Longyear 520 Ground Level 76.25m AOD **Drilling Rig** Client **Newcastle City Council** Drillers Orientation Vertical Logged by FJP Date Started 11/03/2009 Consultant Mott MacDonald Core Barrel T6116 Date Completed 13/03/2009 Impregnated Core Bit

Description of Strata	Legend	Depth Below	Datum	Sampling	ļ	,	Count	_	SPT type, N Install
		G.L.	Level	& coring	TCR	SCR	ROD	=	& depth ation
8.34m - 9.70m : Remaining Detail : 8.53m - 8.78m : recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)		10.48	C 65.77	970 11.20	100	76	41	NI 50 100	
Defail 9.20m - 9.26m :from 9.20m to 9.26m and 9.31m to 9.70m recovered as non intact core (angular to subangular fine to coarse									
gravel sized fragments)									
9.70m - 9.90m : Probable SEAT EARTH with plant fossils. Recovered as angular to subangular fine to coarse gravel and cobble sized fragments.				11.20 12.70	97	85	74		
9.90m - 10.48m : Weak dark grey MUDSTONE, Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth with local clay infill.									
Detail 10.01m - 10.01m :from 9.45m to 9.48m recovered as non intact core (slightly clayey angular to subangular fine to medium gravel sized fragments)from 9.45m to 9.48m recovered as non intact core (slightly clayey angular to subangular				12.70 14 20	95	94	66	NI 150 300	
fine to medium gravel sized fragments)			-						
Weak to medium strong grey fine grained SANDSTONE with very closely spaced thin laminations to very thin beds of mudstone. Discontinuities: 1) very closely to closely locally medium spaced (0-10 deg) planar smooth. from 11.57m to 11.61m recovered as non				14 20 15.70	100	96	71		
intact core (angular coarse gravel sized fragments)from 13.35m to 13.38m recovered as non intact core (angular to subangular fine to medium gravel sized fragments)									
from 15.42m to 15.62m 1 No 80-90 deg planar rough discontinuity with purple stainingfrom 16.32m to 16.55m 2 No discontinuities 60-70 deg planar rough with black and orange staining and local clay infill		16.62	59.63	15 70 17.20	95	42	39		
Very weak to weak dark grey MUDSTONE. Discontinuities: 1) closely spaced 0-10 deg planar smooth locally clay infilled.		17,42	58.83					100 140	
Weak black COAL with pyrite. Recovered as angular to subangular fine to coarse gravel sized fragments.		17.59	58.66	17.20 18.70	100	34	a	NI NA	
Very weak to weak black and grey MUDSTONE with plant fossils and slip planes. (Seat Earth)		18.10	58.15						
Very weak to weak black COAL with pyrite. Recovered as angular fine to coarse gravel sized fragments. (The 'Metal'?)	1	18.80	57.45					IN .	
Very weak to weak black and grey MUDSTONE with plant fossils and slip planes. (Possible Seat Earth). Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth. —from 19.05m to 19.17m, 19.40m to 19.57m and				18.70 20 20	82	13	0	NI NI 100	1 1 1 1 1 1 1 1



Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole ID. **BH120** Sheet 3 of 3

Contract No.

F15481

Cable Percussion &

423911,85 E

Project

Former Tyne Brewery

Rotary

T6116

Dando/Boart Longyear 520 Ground Level

564309.90 N 76.25m AOD

Client

Newcastle City Council

Drilling Rig LC/TF Drillers FJP

Orientation

Vertical

Consultant

Mott MacDonald

Logged by Core Barrel

Method

Date Started

11/03/2009

Date Completed

Core Bit Impregnated

13/03/2009

Description of Strata	Lanand	Depth Below	Datum	Sampli		Blow Count				SPT type, N	
	Lagerio	G.L.	Level	& corin	g	TCR	SCR	RQD	IF	& depth	at
Remaining Detail: 19.05m - 19.17m: 19.80m to 20.65m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)		20.65	55.60	- #			e velige agine				
Weak grey MUDSTONE. Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth locally clay infilledfrom 20.77m to 20.81m and 20.92m to 21.07m recovered as non Intact core (angular fine to coarse gravel sized fragments)			33.00	2 0 20	21.70	100	54	38	NI 50 150		
Borehole complete at 21.70 m.		21.70	- 54.55								

NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

ARIAL COMBINED LOG Version 3.10 17/12/2007



Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole iD. **BH121** Header

Water Depth

DRY

DRY DRY

DRY

Casing

NR

NR

NR

Contract No. F15481

Former Tyne Brewery

Cable Percussion & Rotary

Coordinates

423874,12 E

Project

Drilling Rig Dando/Knebel H179

564226.66 N

Client

Newcastle City Council

Drillers

Ground Level

77.54m AOD

AL/PT Logged by FJP

Orientation Date Started Vertical 16/03/2009

Consultant Mott MacDonald

Core barrel PWF Core bit PCD

Date Completed

19/03/2009

			PROGRESS				CABLE PE	RCUSSIO	N DETAILS
Date	Time	Hole depth	Casing depth	Water depth	Remarks	Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Remarks
16/03/2009 19/03/2009 19/03/2009	1730 0730 1730	4.10 4.10 22.00	3.50 3.50 9.00	DRY DRY NR	End of CP Start of Rotary End of Hote	2.30 3.50	2.40 3.80	0.50	Chiselling Chiselling

	CAS	SING						WATER STR	RIKES		
Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.	Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
						Geptit	_ deptit	10 1156		at stirke tille	TO Seal HOW
150 121	4.10 9.00	150 121	3.50 9.00			ļ					
92	22.00										:
											1

Туре

	RC	TARY DRILLING	DETAILS		
From depth	To depth	Flush type	Flush return	Core diameter	Depth
4.10 4.40 5.90	4.40 5.90 22.00	Air/Mist Air/Mist Air/Mist	100% 0% NR	92 92 92	1.20 2.00 3.00 3.80

GENERAL NOTES

- Inspection pit hand excavated from GL to 1.20m.
 Cable Percussive boring complete at 4.10m.
 Rotary Coring complete at 22.00m.
 50mm diameter standpipe installed, with slotted section from 9.00m to 3.00m.

=		
\dashv		
	* Seating blows only.	

SPT DETAILS

Incremental blow count/penetration in mm

N=27 (3,4,6.6,7,8)

N=38 (4,5.9,12,10,7) N=45 (3,6,7,8,13,17)

50/180mm (15,10/5,18,22,10/30)

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, hard strata time in hours

Form	ARIAL COMBINED HEADER
Version	3.04
Revised	17/12/2007

NORWEST **?** HOLST

Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID.

BH121
Sheet 1 of 3

Cable Percussion & 423874.12 E Contract No. F15481 Method Coordinates Rotary 564226.66 N Project Former Tyne Brewery Ground Level **Drilling Rig** Dando/Knebel H179 77.54m AOD AL/PT Orientation Client Newcastle City Council Drillers Vertical Logged by FJP Date Started 16/03/2009 PWF Consultant Mott MacDonald Core Barrel Date Completed 19/03/2009 Core Bit PCD

Core Bit	PC	D											
Description of Strata	Legend	Depth Below G.L.	Datum Level		Sampling & coring	- 1			Count		SPT typ		Insta atio
MADE GROUND: Tarmacadam.	**************************************	0,10	- 77,44									-	
MADE GROUND: Light brown slightly clayey sandy angular to subangular fine to coarse gravel sized fragments of sandstone and mudstone.		0 30	- 77.24 -	D1 B2	0.30 0.50-1.00								
MADE GROUND: Light brown mottled dark brown sandy gravelly clay with low cobble content. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of brick, sandstone and mudstone. Cobble sized fragments are angular of sandstone.		1.00	76.54	D3 B4	1.20-1.65 1.20-1.70						527 120	165	
Medium dense to dense light brown clayey very gravelly fine to coarse SAND with low cobble content. Gravel is angular to subangular fine to coarse of sandstone with low cobble content. Cobble sized fragments are angular of				05 86	2.00-2 45 2.00-2.50						538 2.00	2 45	
sandstone.	74.57			D7	2.60							- 1	
				89 D8	3.00-3 45 3.00-3 50						545 3.00	3 45 -	
Dense light brown sandy angular to subangular fine to coarse GRAVEL of sandstone.		3.50	74.04	D10 D11	3.70 3.80-4 10						\$50/180m 3 80	1m - 4 08 -	
Medium strong to strong light brown coarse grained SANDSTONE. Discontinuities: 1) very		4.10	- 73.44 - -		4.10	4.40	83	36	(0)				E
closely to closely spaced 0-10 deg planar rough. 2) medium spaced 80-90 deg planar rough local orange staining and clay infilfrom 4.50m to 4.67m and 5.90m to 6.00m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)		5.10 5.30	72.44 72.24		4 40	5.90	46	14	0	NI 40 80 NR			
Open workings. (Driller's description)			-							NI		-	
Medium strong to strong light brown coarse grained SANDSTONE. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. 2) medium spaced 80-90 deg planar rough local orange staining and clay infillfrom 5.90m to 6.00m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)		6.30	71.24		5 90	7.80	17	0	0	40 70			
COLLAPSED WORKINGS (Driller's description) (The 'High Main'?)										NR		-	
				1	7.80	8 90	0	0	o	NR		-	
Recovered as non intact core (angular to subangular fine to coarse GRAVEL of mudstone and sandstone). (Collapsed Workings)		8.90	68.64		8 90	9.20	100	0	0	พเ		-	
Thinly interlaminated weak to medium strong dark grey MUDSTONE and fine grained		9 40	68.14		920 1	10 40	100	62	36	NI 20			
IOTES: All depths in metres, all diameters in millimetres.		1			·			F	опп		LAL COMBIN	ED LOG	1

NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.



Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID, BH121 Sheet 2 of 3

Contract No. F15481 Cable Percussion & Method Coordinates 423874,12 E Rotary Project Former Tyne Brewery 564226.66 N Drilling Rig Dando/Knebel H179 Ground Level 77.54m AOD Client Newcastle City Council Drillers AL/PT Orientation Vertical FJP Logged by Date Started 16/03/2009 Consultant Mott MacDonald Core Barrel PWF Date Completed 19/03/2009 Core Bit PCD

SANDSTONE. Discontinuities: 1) very closely to nedium spaced C-10 deg planar smooth in-from 9-40m to 9-46m recovered as non intact ore (angular fine to course in-from 9-40m to 9-46m recovered as non intact ore (angular to subangular fine to course in-from 9-50m to 9-56m black cathonaceous in-from 10.21m to 10.27m recovered as non intact core (angular to subangular fine in a	Dennistan of Maria	Lagrand	Depth	Datum	Sampling		Blow	Count	SPT type,	N Insta
SANDSTONE Discontinuities: 1) very closely to needium spaced of 10 deg plans are mooth.	Description of Strata	Legena		Level	& coring	TCR	SCR	ROD	F & depth	atio
Neak to medium strong grey MUDSTONE with page 3 to 1,340 strong staining and clay infiti. 2) medium to didely spaced value of planar smooth with boat range staining and clay infit. 2) medium to didely spaced value of the planar smooth with range staining and clay infit. 2) medium to didely spaced value of the planar rough with range staining and clay infit. 2) medium to didely spaced value of the planar rough with range staining and clay infit. 2) medium to didely spaced value of the planar rough with range staining. Neak to medium strong grey MUDSTONE with boat spaced fine to be didely spaced value. The planar rough with range staining and clay infit. 2) medium to didely spaced value of the planar rough with range staining and clay infit. 2 medium to didely spaced value of the planar rough classification of the planar rough. The planar rough classification of the planar rough classification of the planar rough. The Medium space of the planar rough. The Medium space is spaced fragments of the planar rough. The Medium space is spaced regiments of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough. The Medium spaced clay classification of the planar rough classification of the planar rough. The Medium spaced classification of the planar rough classification of the planar rough. The medium spaced classification of the planar rough classification of the	SANDSTONE. Discontinuities: 1) very closely to medium spaced 0-10 deg planar smoothfrom 9.40m to 9.48m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)from 9.50m to 9.68m black carbonaceousfrom 10.21m to 10.27m recovered as non intact core (clayey angular to subangular fine to medium gravel sized fragments)			67 14					200	
Veak to medium strong grey MUDSTONE with losely spaced thick laminations to thin beds (grey siltstone. Discontinuities: 1) very losely to closely spaced planar smooth coally cally infilled. —from 16.56m to 16.52m recovered as non natact core (angular to subangular fine to oarse gravel sized fragments) Veak black COAL with pryite. Discontinuities:) very closely to closely spaced 0-10 deg lanar rough. (The "Metal"?) Veak grey MUDSTONE with plant fossils. Secontinuities: 1) very closely to closely paced 0-10 deg lanar rough. (The "Metal"?) Veak grey MUDSTONE with plant fossils. Secontinuities: 1) very closely to closely paced 0-10 deg lanar rough. (The "Metal"?) Ferm MIDSTONE with plant fossils. Secontinuities: 1) very closely to closely paced 0-10 deg lanar rough. (The Shelat"?)	Medium strong to strong grey fine grained SANDSTONE with very closely spaced to closely spaced thin laminations of mudstone. Discontinuities: 1) closely to medium locally spaced 0-10 deg planar smooth with local orange staining and clay infill, 2) medium to widely spaced 40-50 deg planar rough with orange staining.				10.40 13.40	99	91	77		
Weak to medium strong grey MUDSTONE with losely spaced thick laminations to thin beds (grey sitistone. Discontinuities: 1) very losely spaced spanar smooth ocally clay infilled. If the space of thick laminations to thin beds (grey sitistone. Discontinuities: 1) very losely to closely spaced spanar smooth ocally clay infilled. If the space of thick laminations in the space of th									50	3
Veak to medium strong grey MUDSTONE with losely spaced thick laminations to thin beds of grey silistone. Discontinuities: 1) very losely to closely spaced planar smooth scally clay infilled. —from 15.56m to 16.62m recovered as non neact core (angular to subangular fine to oarse gravel sized fragments) Test Nak black COAL with pyrite. Discontinuities:) very closely to closely spaced 0-10 deg illanar rough. (The 'Metal'?) Veak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. (The 'Metal'?) Veak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely paced 0-10 deg planar rough. (The 'Metal'?) Test All depths in metres, all diameters in millimetres.									400	
Veak to medium strong grey MUDSTONE with losely spaced thick laminations to thin beds of grey siltstone. Discontinuities: 1) very losely to closely spaced planar smooth ocally clay infilled. —from 16.56m to 16.62m recovered as non near to core (angular to subangular fine to oarse gravel sized fragments) —from 17.07m to 17.09m recovered as non neart core (angular to subangular fine to nearly sized fragments) Veak black COAL with pyrite. Discontinuities: 18.06 59.48 18.06 59.48 18.07 19.40					13,40 16.40	99	80	50		
-from 16.56m to 16.62m recovered as non hact core (angular to subangular fine to obarse gravel sized fragments) -from 17.07m to 17.09m recovered as non hact core (angular to subangular fine to hedium gravel sized fragments) Veak black COAL with pyrite. Discontinuities:) very closely to closely spaced 0-10 deg illanar rough. (The 'Metal'?) Veak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core	Weak to medium strong grey MUDSTONE with closely spaced thick laminations to thin beds of grey siltstone. Discontinuities: 1) very closely to closely spaced planar smooth		16.40	61.14					80	
) very closely to closely spaced 0-10 deg lanar rough. (The 'Metal'?) Veak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core coss TES: All depths in metres, all diameters in millimetres.	Intercept of the subangular fine to subangular fine to coarse gravel sized fragments) Intercept of the subangular fine to coarse gravel sized fragments) Intercept of the subangular fine to subangular fine to medium gravel sized fragments)				16.40 10.40	74	55	16	20 100 150	
Discontinuities: 1) very closely to closely paced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core poss TES: All depths in metres, all diameters in millimetres.	Weak black COAL with pyrite. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. (The 'Metal'?)									
I ES: All depths in metres, all diameters in minimetres.	Weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar roughfrom 18.59m to 19.40m assumed zone of core oss								NI 50 100	
I ES: All depths in metres, all diameters in minimetres.				F 8						-
See header sheet for details of boring, progress and water varies 2.10				ELL			-			1



NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID. BH121 Sheet 3 of 3

Form

ARIAL COMBINED LOG

Contract No. F15481 Cable Percussion & 423874.12 E Method Coordinates Rolary Project Former Tyne Brewery 564226 66 N Drilling Rig Dando/Knebel H179 Ground Level 77.54m AOD Client Newcastle City Council Drillers AL/PT Orientation Vertical Logged by FJP Date Started 16/03/2009 PWF Consultant Mott MacDonald Core Barrel Date Completed 19/03/2009 Core Bit PCD

Description of Strata Legend Below Level Below Level Sampling & Blow Count SPT type & depti Weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. from 20.40m to 20.45m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)from 20.67m and 20.86m to 20.98m recovered as non intact core (clayey angular	- 1	Ins
Description of Strata Legend Below G.t. Weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. from 20.40m to 20.45m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) from 20.63m to 20.67m and 20.86m to 20.98m recovered as non intact core (clayey angular	- 1	l.
Weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar rough. —from 20.40m to 20.45m recovered as non inlact core (angular to subangular fine to coarse gravel sized fragments) —from 20.63m to 20.67m and 20.86m to 20.98m recovered as non intact core (clavey angular		
to subangular fine to coarse gravel sizad (fragments) Weak to medium strong grey MUDSTONE with very closely to closely spaced thick taminations to thin beds of fine grained sandstone. Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth. —from 21.65m to 21.70m recovered as non intact core (angular to subangular fine to coarse gravel sizad fragments) Borehole complete at 22.00 m.		



Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole ID. **BH122A** Header

Remarks

Water Depth

DRY

DRY

Casing

1.50

2.50

Contract No. F15481

Former Tyne Brewery

Cable Percussion & Method Rotary

Coordinates

423928.03 E

Project

Drilling Rig Dando 2000/BL 520 Ground Level 74.85m AOD

564241.88 N

Client

Newcastle City Council

Drillers MH/TF Orientation

Vertical

Consultant

Date

Mott MacDonald

FJP Logged by

Date Started

11/03/2009

Time

T6116 Core barrel

Date Completed

Seating blows only.

17/03/2009

Core bit Impregnated

	PROGRESS					CABLE PE	RCUSSION	N DETAILS
Hole depth	Casing depth	Water depth	Remarks		Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Rem
5.65 5.65	5.15 5.15	DRY DRY	End of CP Start of Rotary		1 30 1 70	1 50 1 80	0,75 0.75	Chiselling Chiselling
15.70	7.20	l nev	End of Chift	ш	2.30	2.50	1.00	Chinollina

11/03/2009 1730 Chiselling 16/03/2009 0730 Chiselling 16/03/2009 1730 Chiselling 7.20 17/03/2009 0730 15.70 DRY Start of Shift 17/03/2009 1730 7.20 DRY End of Hole

L		<u> </u>									
	CAS	SING					1	WATER STR	RIKES		
Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.	Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow_
150	3.40	150	3.40								
121 92	7.20 18.70	121	7.20								

	RC	DTARY DRILLING	DETAILS				SPT DETAILS
From depth	To depth	Flush type	Flush return	Core diameter	Depth	Тура	Incremental blow count/penetration in mm
5.65 7.20	7.20 18.70	Air/Mist Air/Mist	0% 100%	0° 92	1,50 2.50	SS	50/135mm (20,5/40,22,28/60) 50/200mm (3,8,10,22,18/50)
r'						1	

GENERAL NOTES

- 1. Inspection pit hand excavated from GL to 1.20m.
- Cable Percussive boring complete at 3.40m.
 Rotary Coring complete at 18.70m.
- 1 No 19mm piezometer installed, with tip at 18.50m.
- 5. 50mm standpipe installed, with slotted section from
- 7.00m to 1.00m.

NOTES: All depths in metres, all diameters in millimetres,	
water strike rise time in minutes, hard strata time in hours	

Form	ARIAL COMBINED HEADER	_
Version	3.04	_
Revised	17/12/2007	

NORWEST HOLST

Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole ID. **BH122A** Sheet 1 of 2

Contract No. Project

F15481

Method

Cable Percussion &

Rotary

FJP

Coordinates

423928.03 E

Former Tyne Brewery

Drilling Rig Dando 2000/BL 520

Ground Level

564241.88 N

Client

Newcastle City Council

Drillers

Orientation

74.85m AOD

Consultant

Mott MacDonald

Logged by Core Barrel

MH/TF Date Started T6116

11/03/2009

Core Bit

Date Completed

17/03/2009

Impregnated

Core Bit	lm	pregnate	ed									
Description of Strata	Legend	Depth Below G.L.	Datum Level	-	Sampling & coring				Count		SPT type, N & depth	Install ation
MADE GROUND: Brown slightly clayey sandy angular fine to coarse gravel sized fragments of sandstone and brick. Sand sized fragments are fine to coarse.	,,	0.20	74.65	D1 D2 B3	0.20 0.50 0.50-1.20						-	
Very dense orangish brown clayey very gravelly fine to coarse SAND with low cobble content, Gravel is angular fine to coarse of sandstone. Cobbles are angular of sandstone.				D4	1.20							
				D5 86	1.50-1.95 1.50-2.00						\$50/135mm - 1.75 -	
				D7 D8 B9	2 30 2 50-2 95 2 50-3 00						\$50/200mm 2.50 2.85	
Black COAL. Recovered as sandy angular fine to coarse gravel sized fragments. CAVITY		3.00	71.85	Dto	3.20							
Zone of core loss. COLLAPSED WORKINGS. (Driller's description) (The 'High Main'?)		5.65	69.20		5 65	7.20	G	٥	0	NR		
Very weak to weak thinly laminated dark grey MUDSTONE. Discontinuities: 1) very closely spaced 0-10 deg planar smooth locally clay infilledfrom 7.20m to 7.72m recovered as non intact core (slightly clayey angular to subangular fine to coarse gravel sized fragments)		7.20	67.65		7.20	6.20	96	15	0	NI NI NI 30		
from 7,92m to 8.35m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) from 8.95m to 8.98m recovered as non intact core (clayey angular to subangular fine gravel sized fragments) Medium strong grey fine grained micaceous SANDSTONE with very thin laminations of		8.98	65.87		820	9.70	100	64	26			
NOTES: All depths in metres, all diameters in millimetres.	1-1					!	!	F	Otton	AR	IAL COMBINED LOG	
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.								_	ersion	3.1		
								14	evited	17/	12/2007	

NORWEST HOLST

Norwest Holst Soil Engineering Ltd. BOREHOLE LOG - CABLE & ROTARY

Hole ID. BH122A Sheet 2 of 2

Contract No. Project

F15481

Former Tyne Brewery

Method

Cable Percussion &

Coordinates

423928.03 E 564241.88 N

Client

Newcastle City Council

NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Drilling Rig Drillers Logged by

Dando 2000/BL 520 Ground Level Orientation

74.85m AOD Vertical 11/03/2009

Consultant

Mott MacDonald

Core Barrel

FJP T6116

Rotary

MH/TF

Date Started Date Completed

17/03/2009

ARIAL COMBINED LOG

Version

Core Bit Impregnated

Description of Strata	Legend	Depth	Datum	Sampling	11		Count		SPT type, N	200
Description of Strata	Legend	G.L.	Level	& coring	TCR	SCR	ROD	lk.	& depth	ati
mudstone. Discontinuities: 1) closely to medium locally very closely spaced 0-10 deg planar smooth with local clay infill and orange staining. 2) widely spaced 80-90 deg planar smooth stained orange. Detail 9.10m - 9.10m :at 9.10m 1 No 60-70 deg planar rough discontinuity with clay				970 1120	100	100	82			
infill and orange staining Defail 9.48m - 9.65m : —from 9.48m to 9.65m and 11.20m to 11.30m orange staining							57		1	
from 11.70m to 11.79m orange and purple staining				11 20 12 70	84	85	54	Ni 150 300		
from 12.50m to 12.60m recovered as non intact core (clayey angular to subangular fine to coarse gravel sized fragments)from 12.70m to 12.90m recovered as non										
intact core (sandy angular to subangular fine to coarse gravel and cobble sized fragments) from 12.90m to 13.24m highly fractured stained orange				12.70 14.20	100	84	\$2	TOTAL DESIGNATION OF THE PERSON OF THE PERSO	:	
								2000 E		
Weak to medium strong thinly laminated grey MUDSTONE. Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth with local orange staining		14.68	60.17	14 20 15 70	97	30	71	NI 40 100		
ntact core (angular to subangular fine to coarse gravel sized fragments)		15.70	59.15					40 40 100		
Very weak black COAL with pyrite. // Discontinuities: 1) very closely to closely // spaced 0-10 deg planar smooth. //	1000	16.33	58 52					NI 20 100		
Weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to closely spaced 0-10 deg planar smooth. (Seat Earth)from 15.70m to 15.83m and 15.90m to 15.96m recovered as non infact core (angular to		16.90	57.95	15.70 17.20	100	47	23	NI 80 100		
subangular fine to coarse gravel sized fragments) —from 16.13m to 16.33m 1 No thin bed of very weak to weak grey very thinly laminated mudstone —from 16.21m to 16.33m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)				17.20 18.70	76	45	14	NI 100 150		
Very weak black COAL with pyrite. Discontinuities: 1) closely spaced planar rough 0-10 deg. (The 'Metal?)from 16.53m to 16.70m recovered as non intact core (angular fine to coarse gravel sized (ragments)		18.70	56.15							
Very weak to weak grey MUDSTONE with plant fossils. Discontinuities: 1) very closely to	1								-	



Norwest Holst Soil Engineering Ltd. **BOREHOLE LOG - CABLE & ROTARY**

Hole ID. **BH122A** Sheet 2+ of 2

Contract No.

F15481

Former Tyne Brewery

Cable Percussion & Method Rotary

Coordinates

423928.03 E

Project

Dando 2000/BL 520 Drilling Rig

MH/TF

T6116

FJP

Ground Level

564241.88 N

Client

Newcastle City Council

74.85m AOD

Drillers Logged by Orientation Date Started Vertical 11/03/2009

Consultant

Mott MacDonald

Core Barrel

Date Completed

Core Bit Impregnated 17/03/2009

		Depth	Datum	C!:		Diam	Count		COTA N	11
D		Dopar				DIOM	Count		SPT type, N	Insta
Description of Strata	Legend	Relow	Level	& coring	TCR	SCR	ROD	IF	& depth	atio
		G.L.	20701		701	1			a copiii	200
closely spaced 0-10 deg planar smooth. ;;;			~							
16.04m 17.07m ((mm. 16.00m to 17.07m			-						-	
16.91m - 17.07m :from 16.90m to 17.07m			-						-	
predominantly recovered as non intact core;;;			-						"	
17.70m - 18.15m :from 17.70m to 18.15m 1			Γ.						1 1	
No 80-90 deg discontinuity undulating rough;;;		l i	Γ :							
40 04-5 deg discontinuity disculating rough,,			- !						4	
18.31m - 18.43m :from 18.31m to 18.43m									-	
recovered as non-intact core (angular to			-						35	
subangular fine to coarse gravel sized			-						-	
fromonio):: 19 /2m - 19 70m : - from 19 /2m									1 1	
(hagiteris),, 10.45iii - 10.70iii ,iioni 10.45iii			_						-	
subangular fine to coarse gravel sized fragments);;; 18.43m - 18.70m :from 18.43m to 18.70m assumed zone of core loss			-						-	
Borehole complete at 18.70 m.			-						-	
borchoid dompiete at 10.10 fft.										
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NOTES: All depths in metres, all diameters in millimetres. See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form ARIAL COMBINED LOG Version



Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID. TP125 Sheet 1 of 1

Contract No.

F15481

Method

Equipment

Logged by

Machine Excavated

Depth

Below

G.L.

0,10

Legend

Coordinates

423913.29 E 564300.27 N

Project

Former Tyne Brewery

JCB 3CX

Ground Level

Sampling

76.28m AOD 17/03/2009

Client

Newcastle City Council

Description of Strata

Date Started

Datum

76.18

Consultant

Mott MacDonald

Date Completed

17/03/2009

Remarks

MADE GROUND: Grey subangular fine to coarse gravel sized fragments of limestone. -at 0.10m plastic sheet

MADE GROUND: Brown slightly gravelly sandy clay. Sand sized fragments are fine to coarse. Gravel sized fragments are subangular fine to coarse of sandstone and brick.

Firm light brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of sandstone.

Weak light brown fine grained SANDSTONE. (Recovered as subangular fine to coarse gravel sized fragments).

Trial pit complete at 2.65 m.

		E51	0.50		
1 30	74.98	ES2	1.30		
2 60 2.65	73.68 73.63	ES3	2.60		
	V.				
	t t			t and the second	

Stability

Unstable from GL to 0.10m

Shoring

None used

Groundwater

None encountered during excavation

Remarks

- 1. Trial pit complete at 2.65m.
- 2. Trial pit backfilled upon completion.

Sketch Plan of Trial Pit 2.50m D 0.60m В c

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3 08
Revised	17/12/2007



Hole ID. **TP126** Sheet 1 of 1

Contract No.

F15481

Method

Equipment

Machine Excavated

Coordinates

423929.49 E 564301.38 N

Project

Former Tyne Brewery

JCB 3CX

Ground Level

75.08m AOD 17/03/2009

Client

Newcastle City Council

Logged by PS Date Started Date Completed

17/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	G.L.	Datum Level	S	ampling	Remarks
MADE GROUND: Grey subangular fine to coarse gravel sized fragments of limestoneat 0.10m plastic sheet		0.10	74.98	ES1	0.40	
MADE GROUND: Black slightly clayey gravelly fine to coarse sand sized fragments of ash. Gravel sized fragments are subangular fine to coarse of sandstone.		0.80	74.28	ES2	0.80	
MADE GROUND: Brown slightly gravelly sandy clay. Sand sized fragments are fine to coarse. Gravel sized fragments are subangular fine to coarse of sandstone and brick.						
Light brown gravelly fine to coarse SAND. Gravel is subangular fine to coarse of sandstone.		2.80 2.95 3.00	72.28 72.13 72.08			
Weak light grey fine grained SANDSTONE. Trial pit complete at 3.00 m.						
			70 70 70 70 70 70 70			* 30

Stability

Unstable from GL to 0.80m

Shoring

None used

Groundwater

None encountered during excavation

Remarks

Trial pit complete at 3.00m.
 Trial pit backfilled upon completion.

Sket	ch Plan of Trial A	Pit
~	2.50m	>
A		
D 0.60m		В
٧		
	C	Bearing 358*

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

		_
Form	ARIAL TP LOG	
Version	3.06	
Revised	17/12/2007	



Hole ID.
TP127
Sheet 1 of 1

Contract No.

F15481

Method

Logged by

Machine Excavated

Coordinates

423913.29 E 564275.39 N

Project

Former Tyne Brewery

Equipment JCB 3CX

Ground Level

75,32m AOD 17/03/2009

Version

17/12/2007

Client

Newcastle City Council

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North PS

Date Started

Date Completed

17/03/2009

Consultant

Mott MacDonald

Description of Strata	Legend	Depth Below G.L.	Datum Level	S	Sampling	Remarks
MADE GROUND: Brown sandy subangular fine to coarse gravel sized fragments of concrete and brick with low cobble content, Sand sized fragments are fine to coarse. Cobble sized fragments are subangular of concrete and brick.			74.92	ES1	0.40	74
Light brown slightly clayey gravelly fine to coarse SAND. Gravel is subangular fine to coarse of sandstone.						
Weak light brown fine grained SANDSTONE. Trial pit complete at 1.80 m.		1,75 1.80	73.57			

Stability	Unstable from GL to 0.40m	Sketch Plan of Trial Pit A
Shoring	None used	5.00m
Groundwater	None encountered during excavation	C Bearing 270°
Remarks	Trial pit complete at 1.80m. Trial pit backfilled upon completion.	



Norwest Holst Soil Engineering Ltd. TRIAL PIT LOG

Hole ID.
TP128
Sheet 1 of 1

Contract No.

F15481

Method

Equipment

Machine Excavated

Coordinates 423935.58 E

423935.58 E 564276.65 N

Project

Former Tyne Brewery

JCB 3CX

Ground Level

74.76m AOD 16/03/2009

Client

Newcastle City Council

Logged by PS

Date Started Date Completed

16/03/2009

Consultant

Mott MacDonald

· · · · · · · · · · · · · · · · · · ·						
Description of Strata	Legend	Depth Below G.L.		8	Sampling	Remarks
MADE GROUND: Brown sandy subangular fine to coarse gravel sized fragments of concrete and brick with low cobble content. Sand sized fragments are fine to coarse. Cobble sized fragments are subangular of concrete and brick. Light brown slightly clayey gravelly fine to coarse SAND. Gravel is subangular fine to coarse of sandstone. (Possible Made Ground)		0.30			0.30	
Weak light grey fine grained SANDSTONE. Trial pit complete at 1.85 m.		1 80 1.85	72.96	ES2	1.80	

Stability

Unstable from GL to 0.30m

Shoring

None used

Groundwater

None encountered during excavation

Remarks

1. Trial pit complete at 1.85m.

Trial pit backfilled upon completion.

	Sket	ch Plan of Trial P A	it
	⋖	2.50m	>
A			
D 0.60m			В
Y			
		C	Bearing 180°

NOTES: All depths in metres, all soil strengths in kPa. See legend sheet for key to symbols and abbreviations. All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3 06
Revised	17/12/2007

Appendix C

Exploratory Hole Record Sheets

					Borehole No.				
5					Bo	reho	ole Log	WS01	
consulting engineer	rs					_		Sheet 1 of	
Project Name:	: Plot 7 - Sc	ience	Central	Project No. P17-262A		Co-ords:	423950.00 - 564299.00	Hole Type WLS	
Location:	Newcastle	Upon	Tyne			Level:	77.40	Scale 1:50	
Client:						Dates:	19-06-2019 - 19-06-2019	Logged B CB	у
Water	Samples	s and	In Situ Testing	Depth	Level		Otractions December 4		
Strikes	Depth (m)	Туре	Results	(m)	(m)	Legend	Stratum Description	1	
				0.70 1.00 1.25 1.75 1.80		Legend	Stratum Description MADE GROUND: Grey silty very sicoarse angular GRAVEL and COBI sandstone, mudstone and occasion MADE GROUND: Grey and brown sandy fine to coarse angular GRAV mudstone. MADE GROUND: Grey clayey sancoarse angular GRAVEL of sandstomudstone. MADE GROUND: Stiff brown silty si	clayey silty EL of dy fine to one, brick and sandy gravelly ular to and brick. ar GRAVEL of eathered	1 2 3 4 5 6 7 8
									9



Remarks

1. No groundwater encountered.

2. Refusal of sampling equipment at 1.8m bgl on possible bedrock.

- No groundwater encountered.
 Refusal of sampling equipment at 2.0m bgl on possible bedrock. or large cobble/boulder.



10 -

		>							Borehole N	No.
	3	1				Bo	reho	ole Log	WS03	
со	nsulting engineer	s			Project No.				Sheet 1 of Hole Type	
Projed	t Name:	Plot 7 - Sc	ience		P17-262A		Co-ords:	423871.00 - 564226.00	WLS	
Locati	on:	Newcastle	Upon	Tyne			Level:	78.10	Scale	
									1:50 Logged B	Sv.
Client	:						Dates:	19-06-2019 - 19-06-2019	CB	
Well	Water	-	and	In Situ Testing	Depth	Level	Legend	Stratum Description	1	
11011	Strikes	Dopui (iii)	Туре	Results	(m)	(m)	Logona	·		
		0.10 0.40	ES ES		0.20	77.90		MADE GROUND: Vegetation over of silty gravelly fine to medium SAND Gravel is fine to coarse angular mu MADE GROUND: Grey brown silty	with roots. dstone. /	
	0.70 ES 0.90 ES 1.00 N=34			N=34 (9,10/11,13,5,5)	0.80	77.30		coarse angular GRAVEL and COBE mudstone, sandstone and brick. MADE GROUND: Stiff brown silty v CLAY. Gravel is fine to coarse angu subrounded sandstone and mudsto	BLES of ery gravelly lar to	1 -
		1.80 D		50 (25 for 145mm/	1.60	76.50		Yellow orange slightly clayey sandy coarse angular GRAVEL and COBE sandstone (possible sandstone bec	BLES of	2 —
		2.20	D	ioi roomini)	2.30	75.80	***************************************	End of borehole at 2.30 m		
										3 -
										4 —
										5 —
										6 —
										7 —
										8 —
										9 —

- Remarks

 1. No groundwater encountered.

 2. Refusal of sampling equipment at 2.3m bgl on possible bedrock.



1	35						R	ota	rv (Core Log	Borehole No.	
co	nsulting engineer	s							-)		Sheet 1 of	1
Projec	t Name:	Plot 7 - Sc	cience	Centra	l		oject No. 7-262A		Co-ords:	423951.00 - 564292.00	Hole Type RC	е
Locati	on:	Newcastle	Upon	Tyne		FI	1-202A		Level:	73.70	Scale	
O!! 1									D (1:50 Logged B	V
Client	:	Karbon Ho	omes L				Ι	ı	Dates:	17-06-2019 - 18-06-2019	NW	,
Well	Water Strikes	Depth (m)	Type / FI	TCR	Coring SCR	RQD	Depth (m)	Level (m)	Legend	Stratum Description		
										MADE GROUND: Grey and brown COBBLES of sandstone, mudstone occasional concrete with occasional pockets.	and	1 -
							1.80	71.90		MADE GROUND: Brown GRAVEL of (driller description)	of mudstone	2 -
	_	1.80 - 3.20	NI	66	0	0	3.20	70.50		MADE GROUND: No recovery, con as above.	sidered to be	3 -
		3.20 - 4.70	NI	0	0	0						4 -
		4.70 - 6.20	NI	0	0	0	4.70	69.00		MADE GROUND: Yellow brown GR COBBLES of sandstone (drillers de		5
												6 -
		6.20 - 6.40	NI	0	0	0	6.40	67.30		End of borehole at 6.40 m		-
												7 -
												8 -
												9 -
												10



NEITIAINS

1. Rotary open holed to 1.80m bgl.

2. Coring commenced at 1.80m bgl.

3. Borehole refused at 6.40m bgl.

4. Full flush returns noted to 5.80m bgl.

5. Slight loss of flush from 5.80m bgl.

6. NI - Non-intact.

		>									Borehole N	lo.
ı	5	1					R	ota	ry C	Core Log	BH1A	
cor	nsulting engineer	s				Dr	oject No.				Sheet 1 of Hole Typ	
Projec	t Name:	Plot 7 - Sc	ience	Centra]		7-262A		Co-ords: 423941.00 - 564293.00		RC	E .
Locati	on:	Newcastle	Upon	Tyne					Level: 74.60		Scale 1:50	
Client:		Karbon Ho	omes L	.td					Dates:	18-06-2019 - 19-06-2019	Logged B EM	Ву
Well	Water	Depth	Туре		Coring	l	Depth	Level	Legend	Stratum Description		
vveii	Strikes	(m)	/FI	TCR	SCR	RQD	(m)	(m)	Legend	·		
							1.50	73.10		MADE GROUND: CLAY FILL (driller description).		1 —
		1.50 - 3.00	NI	0	0	0	1.50	73.10		MADE GROUND: No recovery. Muci jamming in end of core barrel - scrul Probable colliery spoil opencast bac	bbed away.	2 —
		3.00 - 4.50	NI	10	0	0	3.00	71.60		MADE GROUND: Grey brown claye of mudstone and sandstone colliery occasional brick fragments. (Probab backfill material).	spoil with	4 —
							4.50	70.10		MADE GROUND: Grey brown claye of mudstone and sandstone colliery occasional brick fragments. (Probab backfill material).	spoil with	5 6 1
												7
		9.00 - 10.00	12	100	89	50	9.00	65.60		Weak to strong light grey SANDSTC Discontinuities are medium spaced sub-horizontal clean. Continued on next sheet	ONE. rough planar	9 -
						l	l	1		Continued on next sheet		



Remarks

1. Coring commenced at 1..50m with loss of returns in made ground.

2. Borehole sunk using open-hole techniques to 9.0m

3. Coring commenced from 9.0m upon encountering competent bedrock.

4. NI - Non-intact.

con	sulting engineer	775					R	ota	ry C	Core Log	Borehole No BH1A Sheet 2 of	\
Projec	t Name:	Plot 7 - Sc	ience (Central			oject No. 7-262A		Co-ords:	423941.00 - 564293.00	Hole Type RC	
Locatio	on:	Newcastle	Upon	Tyne					Level: 74.60		Scale 1:50	
Client:		Karbon Ho	mes L	td					Dates:	18-06-2019 - 19-06-2019	Logged By EM	
Well	Water Strikes	Depth (m)	Type / FI	TCR	Coring SCR	RQD	Depth (m)	Level (m)	Legend	Stratum Description		
		10.00 - 11.00	AZCL	77	75	71	10.50	64.10		Medium strong to strong light grey SANDSTONE. Discontinuities are n spaced rough planar sub-horizontal		11 -
		11.00 - 12.00		100	98	80						12 -
		12.00 - 13.00	38	96	88	68						13 -
		13.00 - 14.00		99	96	72		60.55				
		14.00 - 15.00	10	100	8	0	14.05			Very weak grey highly fractured MU Discontinuities are closely spaced o closed rough planar sub-horizontal is silty gravel.	pen and	14 -
		15.00 - 16.00	10 NI	90	32	0	15.60 15.90	59.00 58.70	* X * X X X X X X X X X X X X X X X X X	MADE GROUND: Grouted gravel of and coal.		15 -
		16.00 - 17.00	AZCL	50	8	0	16.50	58.10	:::::::	VOID. Possible mine workings in Meseam. Medium strong light grey SANDSTO	DNE.	16 -
		17.00 - 18.00		100	56	43				Discontinuities are medium spaced sub-horizontal clean.	rougn planar	17 -
		18.00 - 19.00	54	100	92	68						18 -
		19.00 - 20.00		100	76	47	19.60	55.00		Weak grey highly fractured MUDST Discontinuities are closely spaced o	ONE. pen and	19 -

- Remarks

 1. Coring commenced at 1..50m with loss of returns in made ground.

 2. Borehole sunk using open-hole techniques to 9.0m

 3. Coring commenced from 9.0m upon encountering competent bedrock.

 4. NI Non-intact.



	36						R	ota	ry (Core Log	Borehole N	١
con	sulting enginee	rs				Pro	oject No.		<u> </u>		Sheet 3 of Hole Type	
Projec	t Name	: Plot 7 - Sc	ience	Centra	-		7-262A		Co-ords: 423941.00 - 564293.00		RC	
Location	on:	Newcastle	Upon	Tyne					Level:	74.60	Scale 1:50	
Client:		Karbon Ho	mes L	.td					Dates:	18-06-2019 - 19-06-2019	Logged B EM	у
	Water	Depth	Туре		Coring	J	Depth	Level				
Well	Strikes	(m)	/FI	TCR	SCR	RQD	(m)	(m)	Legend	Stratum Description		
		20.00 - 21.00		100	59	55	20.05	54.55 54.00		closed rough planar sub-horizontal is silty gravel. Weak light grey SANDSTONE. Discare medium spaced rough planar su	ontinuities	-
			NI							∖ clean. Weak grey highly fractured MUDST		
		21.00 - 22.00	38	94	4	0				Discontinuities are closely spaced or closed rough planar sub-horizontal isilty gravel.		21 —
												22 —
		22.00 - 23.00		70	0	0						-
		23.00 - 24.00	NI	100	0	0	23.10	51.50	**************************************	MADE GROUND: Soft to firm brown black gravelly sand clay. Gravel is a coarse of mudstone, sandstone and spoil). Possible mine workings in Fix coal seam.	ngular fine to coal (colliery	23 —
		24.00 - 25.00	8	100	10	0	24.00	50.60	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Strong grey highly fractured MUDS Discontinuities are closely spaced or closed rough planar sub-horizontal isilty gravel.	pen and	-24 — - - - - - -
							25.00	49.60		End of borehole at 25.00 m		25 —
												27 —
												28 —
												-
												29 -

- Remarks

 1. Coring commenced at 1..50m with loss of returns in made ground.

 2. Borehole sunk using open-hole techniques to 9.0m

 3. Coring commenced from 9.0m upon encountering competent bedrock.

 4. NI Non-intact.



Project Name Plot 7 - Science Central Project No. P17-262A Co-ords: 423904.00 - 564266.00 Hole Type Co-ords: 423904.00 - 564266.00 RC Scale	cor	sulting engineers						R	ota	ry C	Core Log	Borehole No BH2 Sheet 1 of a	
Depth Type Coring Depth Strikes Coring Depth Depth Coring Depth	Projec	t Name:	Plot 7 - Sc	ience (Centra	ıl				Co-ords: 423904.00 - 564266.00			
Well Water Strikes Per (m) Type Coring Strikes Per (m) Typ	_ocati	on:	Newcastle	Upon	Tyne		<u>'</u>			Level:	77.80		
Well Strikes Depth (m) Type TCR SCR ROD TC	Client:		Karbon Ho	omes L	td					Dates:	20-06-2019 - 21-06-2019		у
1.00 76.80	Well	Water Strikes		Type / FI						Legend	Stratum Description		
8.70 69.10 8.70 - 9.70 95 5 0 8.70 69.10			1.50 - 3.00	NI	0	0	0	1.00	76.80 76.30	mage image image image water planting and a second planting and a	Light brown gravelly SAND. Gravel is coarse angular sandstone. Light brown SAND and GRAVEL of sa (Possible sandstone bedrock) No recovery. Scrubbed away due to c sampler and casing within possible gr workings within the possible High Mai seam.	fine to andstone. offset of outed in coal	2 - 3 - 4 - 5 - 5 -
8.70 - 9.70 95 5 0 and closed rough planar sub-nonzontal infilled with silty gravel.				10				8.70	69.10	Assist yourselves and selection of the s	Discontinuities are close to medium s	paced open	8 -
			8.70 - 9.70	NI	95	5	0				and closed rough planar sub-horizont		9 -

- Remarks

 1. Coring commenced at 1..50m with loss of returns in made ground.

 2. Borehole sunk using open-hole techniques to indicative base of old workings in High Main coal seam.

 3. Loss of flush between 3.00m and 8.70m bgl.

 4. Coring commenced upon encountering competent bedrock.

 5. NI Non-intact.



con	sulting engineers						R	ota	ry C	Core Log	Borehole No BH2 Sheet 2 of	
Projec	Name:	Plot 7 - Sci	ience (Centra	I		oject No. 7-262A		Co-ords:	423904.00 - 564266.00	Hole Type RC	
ocatio	n:	Newcastle	Upon	Tyne		·			Level: 77.80		Scale 1:50	
Client:		Karbon Ho	mes L	td					Dates: 20-06-2019 - 21-06-2019		Logged B	у
Well	Water	Depth	Туре		Coring		Depth	Level	Legend	Stratum Description		
	Strikes	(m)	/FI	TCR	SCR	RQD	(m)	(m)	3	'		_
		9.70 - 10.70		100	11	0						- - - - -
		10.70 - 11.70	11	100	56	31	10.90 11.30	66.90 66.50		Medium strong light grey SANDSTO Discontinuities are medium spaced sub-horizontal occasional infill of so Medium strong to strong light grey SANDSTONE. Discontinuities are m	rough planar ft clay. nedium	11 -
		11.70 - 12.70		100	75	59				spaced rough planar sub-horizontal infill of soft clay.	occasional	12 -
		12.70 - 13.70		100	79	72						13 -
		13.70 - 14.70	48	100	95	37						14 —
		14.70 - 15.70		100	72	20						15 -
		15.70 - 16.70		100	95	83	15.70 15.80	62.10 62.00		Medium Strong MUDSTONE recove slightly silty gravel. Gravel is subrou Weak to strong light grey SANDSTO Discontinuities are medium spaced sub-horizontal occasional infill of so	nded coarse. / DNE. rough planar	16 -
		16.70 - 17.70	AZCL	90	85	40	16.80 17.20	61.00 60.60		Medium strong light grey SANDSTO Discontinuities are medium spaced sub-horizontal occasional infill of so Weak to medium strong dark grey N	rough planar ft clay. IUDSTONE.	17 -
		17.70 - 18.70	28	98	24	0	18.20	59.60		Discontinuities are close to medium and closed rough planar sub-horizo with grey sandy clay .	ntal infilled	18 —
		17.70 - 18.70		98	24	U	10.ZU	59.00		Weak dark grey MUDSTONE, high! Discontinuities are very close to closinfilled with clay and gravel of coal.	y weathered. sely spaced	- - - - -
		18.70 - 19.70	NI	100	0	0	19.00	58.80		Weak black COAL. Possible Metal of	coal seam.	19 -
							19.60	58.20		Weak to medium strong dark grey M Discontinuities are close to medium Continued on next sheet		20 —

- NOTITIALIS.

 1. Coring commenced at 1.50m with loss of returns in made ground.

 2. Borehole sunk using open-hole techniques to indicative base of old workings in High Main coal seam.

 3. Loss of flush between 3.00m and 8.70m bgl.

 4. Coring commenced upon encountering competent bedrock.

 5. NI Non-intact.



		>									Borehole N	0.
	5	1					R	ota	ry (Core Log	BH2	
cor	nsulting enginee	rs				-					Sheet 3 of	
Projec	t Name	Plot 7 - Sc	ience (Central			oject No. 7-262A		Co-ords:	423904.00 - 564266.00	Hole Type RC	е
Location	on:	Newcastle	Upon	Tyne					Level:	77.80	Scale 1:50	
Client:		Karbon Ho	mes L	.td					Dates:	20-06-2019 - 21-06-2019	Logged B EM	у
Well	Water Strikes	Depth (m)	Type / FI		Coring		Depth (m)	Level (m)	Legend	Stratum Description		
	Otrikes	(111)	7	TCR	SCR	RQD	(111)	(111)		and closed rough planar sub-horizo	ntal infilled	
		19.70 - 20.70	AZCL	90	14	0	20.40	57.40		with silty gravel. Weak to medium strong dark grey N Discontinuities are close to medium and closed rough planar sub-horizo	spaced open	- - - - - -
		20.70 - 21.70		100	0	0	21.10	56.70		with silty gravel. Very weak to strong grey MUDSTOI Discontinuities are close to medium	NE.	21 -
										and closed rough planar clean.		22 —
		21.70 - 22.70	41	100	38	12						-
		22.70 - 23.20		100	56	0	22.70	55.10		Weak to strong to strong light grey SANDSTONE. Discontinuities are n spaced rough planar sub-horizontal		23 —
		23.20 - 24.00		100	69	69						- - - - - - -
							24.00	53.80		End of borehole at 24.00 m		24 -
												25 —
												26 —
												27 —
												28 —
												29 —
Remai												30 —

- Remarks

 1. Coring commenced at 1..50m with loss of returns in made ground.

 2. Borehole sunk using open-hole techniques to indicative base of old workings in High Main coal seam.

 3. Loss of flush between 3.00m and 8.70m bgl.

 4. Coring commenced upon encountering competent bedrock.

 5. NI Non-intact.



	200							21-		Sava Las	Borehole N	0.
							R	ota	ry C	Core Log	ВН3	
	nsulting engineers					Pr	oject No.		Ī		Sheet 1 of Hole Type	
Projec	t Name:	Plot 7 - Sc	ience (Centra			7-262A		Co-ords:	423873.00 - 564245.00	RC	
Locati	on:	Newcastle	Upon	Tyne					Level:	78.20	Scale 1:50	
Client		Karbon Ho	mes L	td					Dates:	27-06-2019 - 28-06-2019	Logged B CB	У
Well	Water Strikes	Depth (m)	Type / FI	TCR	Coring SCR	RQD	Depth (m)	Level (m)	Legend	Stratum Description		
										MADE GROUND: CLAY FILL (drillers description).		-
							1.50	76.70		Yellowish brown SAND and GRAVEL description). (Possible completely we bedrock).	(drillers athered	1
							4.00	74.20		SANDSTONE (drillers description).		3
							6.00	72.20	Image Image Image Awator/wator/ Image Imag	BROKEN GROUND with grout mix. F mine workings in High Main coal sear	Possible n.	6 - 7 - 7
		8.00 - 9.10		18	7	0	- 8.00	70.20		MUDSTONE and GROUT mix. (Poss working within High Main coal seam).	sible mine	8
		9.10 - 9.50	NI	29	3	0	9.10	69.10		Very weak highly fractured dark grey bedded MUDSTONE. Discontinuities	are closely	9 —
		9.50 - 9.80		70	10	0	1			spaced open and closed rough plana horizontal	r sub-	
							9.80	68.40		Weak black carbonaceous MUDSTO	NE.	10
Rema	rke									Continued on next sheet		1,0

- 1. Borehole sunk using open-hole techniques to 8.0m bgl.
 2. Loss of flush between 6.0m and 8.0m bgl.
 3. Coring commenced from 8.0m upon encountering competent bedrock.
 4. NI Non-intact.



		>									Borehole N	lo.
i	5						R	ota	rv (Core Log	ВН3	
cor	nsulting engineer	rs							.)	20.0 _09	Sheet 2 of	3
Projec	t Name:	: Plot 7 - Sc	ience (Centra	l		oject No.		Co-ords:	423873.00 - 564245.00	Hole Typ	е
<u> </u>						P1	7-262A				RC Scale	
Locati	on:	Newcastle	Upon	Tyne					Level:	78.20	1:50	
Client:	:	Karbon Ho	mes L	td					Dates:	27-06-2019 - 28-06-2019	Logged B CB	Ву
Well	Water Strikes	Depth (m)	Type / FI	TCR	Coring SCR		Depth (m)	Level (m)	Legend	Stratum Description		
		9.80 - 10.40		100	67	0		, ,		Discontinuities are closely spaced o closed rough planar sub-horizontal.	pen and	
							10.40	67.80		Moderately weak grey MUDSTONE Discontinuities are closely spaced o	non and	
		10.40 - 11.00		100	73	42	44.00	07.00		closed rough planar sub-horizontal.	pen and	
		11.00 - 12.50		100	94	87	11.00	67.20		Weak to strong weathered light grey SANDSTONE. Discontinuities are cl spaced open and closed rough plan horizontal	osely	11 —
		12.50 - 13.50		97	87	89						13 —
		13.50 - 15.50	67	96	77	65						14 —
		15.50 - 17.00		98	83	75						16 -
		17.00 - 18.00		100	66	54	17.00	61.20		Moderately weak slightly weathered MUDSTONE with sandstone beds. Discontinuities are closely spaced o closed rough planar sub-horizontal		17 -
		18.00 - 18.50		60	26	0	18.00 18.50	60.20 59.70		Very weak black COAL. (Metal?)		18 -
		18.57 - 19.07	NI	56	0	0	18.57	59.63	*********	COAL and GROUT mix. (Fracture in Very weak black COAL. (Metal?)	ı Metal?)	
		19.07 - 20.00		100	41	0	19.07	59.13		Very weak to weak dark grey MUDS Discontinuities are closely spaced o closed rough planar sub-horizontal.		19 -
							20.00	58.20		Continued on next sheet		20
Rema	rke											



^{1.} Borehole sunk using open-hole techniques to 8.0m bgl.
2. Loss of flush between 6.0m and 8.0m bgl.
3. Coring commenced from 8.0m upon encountering competent bedrock.
4. NI - Non-intact.

con	nsulting enginee	irs						ota	ry (Core Log	Borehole N BH3 Sheet 3 of	3
Projec	t Name	: Plot 7 - Sc	ience	Centra	I		oject No. 7-262A		Co-ords:	423873.00 - 564245.00	Hole Type RC	е
Locati	on:	Newcastle	Upon	Tyne					Level:	78.20	Scale 1:50	
Client:		Karbon Ho	mes L	.td					Dates:	27-06-2019 - 28-06-2019	Logged B CB	у
Well	Water Strikes	Depth (m)	Type / FI	TCR	Coring SCR	RQD	Depth (m)	Level (m)	Legend	Stratum Description		
		20.00 - 21.50		81	63	0				Very weak grey MUDSTONE with or sandstone beds. Discontinuities are spaced open and closed rough plan horizontal.	closely	21 -
		21.50 - 23.50	55	98	51	8						22 -
		23.50 - 25.00		100	65	47	23.50	54.70		Weak grey SANDSTONE with muds Discontinuities are closely spaced o closed rough planar sub-horizontal	stone bands. pen and	24 -
							25.00	53.20		End of borehole at 25.00 m		25 -
												26
												27 -
												28 -
												29 -
												30 -

- Remarks

 1. Borehole sunk using open-hole techniques to 8.0m bgl.

 2. Loss of flush between 6.0m and 8.0m bgl.

 3. Coring commenced from 8.0m upon encountering competent bedrock.

 4. NI Non-intact.



Appendix D

Gas and Groundwater Monitoring Results



Site: Plot 7, Science Central Project No. P17-262 Date: 13.06.2019

Borehole	Gas Flow	Time	Borehole Pressure	Methan	Methane (%v/v)	Methane (% LEL*)	(% LEL*)	Carbon Dio (%v/v)	Carbon Dioxide (%v/v)	Оху (%)	Oxygen (%v/v)		Other Gases (ppm)	s	Depth to Water
	(/		(Pa)	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	DID	SZH	00	(mBGL)
WS01	<0.1	2	1015	0.0	0.0	000	000	4.1	4.1	13.7	13.7	2	0.0	0.0	Dry
WS02	<0.1	5	1015	0.0	0.0	000	000	7.5	7.5	8.1	8.1	3	0.0	0.0	Dry
WS03	<0.1	2	1015	0.0	0.0	000	000	0.4	0.4	20.5	20.5	3	0.0	0.0	Dry
	Notes: Monitoring sl * LEL = Lower	hould be for Explosive L	Notes: Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes * LEL = Lower Explosive Limit = 5%v/v. mBGL = metres Below Ground Level.	າ 3 minutes. mBGL = me	However, i tres Below G	if high concei	ntrations of	gases initial	ly recorded,	monitoring	should be f	or up to 10	minutes		

Relev	Relevant Information At Time Of Monitoring	oring		
Monitored by: Alex Middleton	Alex Middleton			
Atmospheric Pressure (mB): 1015	1015			
Weather:	Weather: Sunny, Dry			
Atmospheric Pressure Trend: Falling	Falling			
Equipment Used:	Equipment Used: Infra-red Gas Analyser	Yes	Last calibrated:	01.05.19
	Mass Balance Transducer	2	Last calibrated:	3
	Tiger PID	5	Last calibrated:	\$
Visible Signs of Vegetation Stress: None of significance noted.	None of significance noted.			
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:	\$			



Site: Plot 7, Science Central Project No. P17-262 Date: 19.07.2019

Borehole	Gas Flow	Time	Borehole Pressure	Methan	Methane (%v/v)	Methane	Methane (% LEL*)	Carbon Dio (%v/v)	Carbon Dioxide (%v/v)	Oxygen (%/v)	/v)		Other Gases (ppm)	S	Depth to Water
	(III /II		(Pa)	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	DID	H2S	00	(mBGL)
WS01	<0.1	2	1005	0.0	0.0	000	000	5.2	5.2	13.2	13.2	2	0.0	0.0	Dry
WS02	<0.1	~	1005	0.0	0.0	000	000	8.7	8.7	7.6	9.7	3	0.0	0.0	Dry
WS03	<0.1	~	1005	0.0	0.0	000	000	0.7	0.7	21.1	21.1	3	0.0	0.0	Dry
	Notes: Monitoring sl * LEL = Lower	hould be for r Explosive L	Notes: Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes * LEL = Lower Explosive Limit = 5%v/v. mBGL = metres Below Ground Level.	າ 3 minutes. . mBGL = me	However, i tres Below G	if high conce sround Level.	ntrations of	gases initial	ly recorded,	monitoring	should be f	or up to 10	minutes		

Relev	Relevant Information At Time Of Monitoring	toring		
Monitored by: Alex Middleton	Alex Middleton			
Atmospheric Pressure (mB): 1005	1005			
Weather: Overcast	Overcast			
Atmospheric Pressure Trend: Falling	Falling			
Equipment Used:	Equipment Used: Infra-red Gas Analyser	Yes	Last calibrated:	01.05.19
	Mass Balance Transducer	2	Last calibrated:	2
	Tiger PID	2	Last calibrated:	2
Visible Signs of Vegetation Stress: None of significance noted.	None of significance noted.			
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:	₹			



Site: Plot 7, Science Central Project No. P17-262 Date: 19.07.2019

Borehole	9	Time	Borehole Pressure	Methan	Methane (%v/v)	Methane	Methane (% LEL*)	Carbon (%v	Carbon Dioxide (%v/v)	Oxygen (%/v)	gen /v)		Other Gases (ppm)		Depth to Water
	(Jul/i)		(Pa)	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	DID	H ₂ S	CO	(mBGL)
WS01	2	3	2	2	3	2	2	3	2	2	2	2	2	3	3
WS02	<0.1	2	1004	0.0	0.0	000	000	8.0	8.0	8.0	8.0	3	0.0	0.0	Dry
WS03	<0.1	2	1004	0.0	0.0	000	000	3.7	3.7	14.1	14.1	2	0.0	0.0	Dry
	Notes: Monitoring sl * LEL = Lower	hould be for r Explosive L	Notes: Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes * LEL = Lower Explosive Limit = 5%v/v. mBGL = metres Below Ground Level.	າ 3 minutes. . mBGL = me	However, i	if high conce sround Level.	ntrations of	gases initial	lly recorded,	monitoring	should be f	or up to 10	minutes		

Relev	Relevant Information At Time Of Monitoring	oring		
Monitored by: Alex Middleton	Alex Middleton			
Atmospheric Pressure (mB): 1005	1005			
Weather: Overcast	Overcast			
Atmospheric Pressure Trend: Rising	Rising			
Equipment Used:	Equipment Used: Infra-red Gas Analyser	Yes	Last calibrated:	01.05.19
	Mass Balance Transducer	2	Last calibrated:	2
	Tiger PID	2	Last calibrated:	2
Visible Signs of Vegetation Stress: None of significance noted.	None of significance noted.			
Other Comments / Observations:	Other Comments / Observations: WS01 buried under stockpiled materials.	als.		
Boreholes Sampled For Laboratory Analysis: 🖰	2			



Site: Plot 7, Science Central Project No. P17-262 Date: 06.12.2019

Borehole	Gas Flow	Time	Borehole Pressure	Methan	Methane (%v/v)	Methane (% LEL*)	; (% LEL*)	Carbon (%v	Carbon Dioxide (%v/v)	0xy (%)	Oxygen (%v/v)		Other Gases (ppm)	S	Depth to Water
	(", "",		(Pa)	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	DID	Н25	00	(mBGL)
WS01	2	~	2	2	\$	2	2	2	2	2	2	2	2	2	3
WS02	<0.1	~	1002	0.0	0.0	000	000	7.4	7.4	6.2	6.2	5	0.0	0.0	Dry
WS03	<0.1	2	1002	0.0	0.0	000	000	4.1	4.1	13.7	13.7	5	0.0	0.0	Dry
	Notes: Monitoring s * LEL = Lowel	hould be for r Explosive L	Notes: Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes * LEL = Lower Explosive Limit = 5%v/v. mBGL = metres Below Ground Level.	າ 3 minutes. . mBGL = me	However, i tres Below G	if high conce iround Level.	ntrations of	gases initial	ly recorded,	monitoring	should be f	or up to 10	minutes		

Relev	Relevant Information At Time Of Monitoring	oring		
Monitored by:	Monitored by: Alex Middleton			
Atmospheric Pressure (mB): 1002	1002			
Weather: Overcast	Overcast			
Atmospheric Pressure Trend: Falling	Falling			
Equipment Used:	Equipment Used: Infra-red Gas Analyser	Yes	Last calibrated:	01.05.19
	Mass Balance Transducer	5	Last calibrated:	5
	Tiger PID	5	Last calibrated:	5
Visible Signs of Vegetation Stress: None of significance noted.	None of significance noted.			
Other Comments / Observations:	Other Comments / Observations: WS01 buried under stockpiled materials.	als.		
Boreholes Sampled For Laboratory Analysis:	2			

Appendix E

Laboratory Test Results







ANALYTICAL TEST REPORT

Contract no: 79592(1)

Contract name: Plot 7 - Science Central, Newcastle Upon Tyne

Client reference: P17-262

Clients name: 3E Consulting Engineers

Clients address: 2 Esh Plaza

Sir Bobby Robson Way Great Park, Newcastle

NE13 9BA

Samples received: 25 June 2019

Analysis started: 25 June 2019

Analysis completed: 01 July 2019

Report issued: 07 November 2019

This is a supplementary report to report number 79592 issued 02 July 2019.

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test

M MCERTS & UKAS accredited test

\$ Test carried out by an approved subcontractor

I/S Insufficient sample to carry out test N/S Sample not suitable for testing

NAD No Asbestos Detected

Approved by:

Dave Bowerbank Customer Support Hero

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet. Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
79592-1	WS01	0.50	Clayey Sand with Gravel	-	-	6.5
79592-2	WS02	0.80	Sandy Clay with Gravel	-	-	7.8
79592-3	WS02	1.80	Clayey Sand with Gravel	-	-	7.2
79592-4	WS03	0.10	Sand with Gravel	-	-	7.6
79592-5	WS03	0.90	Clay with Gravel	-	-	7.9
79592-6	WS03	1.90	Clayey Sand with Gravel	-	-	11.5

SOILS

Lab number			79592-1	79592-2	79592-3	79592-4	79592-5	79592-6
Sample id			WS01	WS02	WS02	WS03	WS03	WS03
Depth (m)			0.50	0.80	1.80	0.10	0.90	1.90
Date sampled			20/06/2019	20/06/2019	20/06/2019	20/06/2019	20/06/2019	20/06/2019
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	3.9	5.7	-	1.4	4.5	-
Boron (water soluble)	CE063 ^M	mg/kg B	0.7	0.6	-	<0.5	0.5	-
Cadmium (total)	CE127 ^M	mg/kg Cd	<0.2	<0.2	-	<0.2	<0.2	-
Chromium (total)	CE127 ^M	mg/kg Cr	52	28	-	24	33	-
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	-	<1	<1	-
Copper (total)	CE127 ^M	mg/kg Cu	13	21	-	51	15	-
Lead (total)	CE127 ^M	mg/kg Pb	18	18	-	2.8	13	-
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	-	<0.5	<0.5	-
Nickel (total)	CE127 ^M	mg/kg Ni	21	31	-	19	27	-
Selenium (total)	CE127 ^M	mg/kg Se	0.7	0.8	-	1.0	0.7	-
Zinc (total)	CE127 ^M	mg/kg Zn	68	75	-	71	73	1
рН	CE004 ^M	units	8.2	8.5	8.4	8.6	8.2	6.2
Sulphate (2:1 water soluble)	CE061 ^M	mg/I SO ₄	269	169	211	40	137	109
Total Organic Carbon (TOC)	CE072 ^M	% w/w C	1.4	1.8	-	0.1	1.4	-
Estimate of OMC (calculated from TOC)	CE072 ^M	% w/w	2.4	3.1	-	0.2	2.3	-
РАН	•	•		•	•		•	•
Naphthalene	CE087 ^M	mg/kg	0.16	0.08	-	<0.02	0.08	-
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Acenaphthene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Fluorene	CE087 ^U	mg/kg	<0.02	0.02	-	<0.02	<0.02	-
Phenanthrene	CE087 ^M	mg/kg	0.38	0.36	-	<0.02	0.25	-
Anthracene	CE087 ^U	mg/kg	<0.02	0.06	-	<0.02	<0.02	-
Fluoranthene	CE087 ^M	mg/kg	0.09	0.17	-	<0.02	0.05	-
Pyrene	CE087 ^M	mg/kg	0.08	0.18	-	<0.02	0.05	-
Benzo(a)anthracene	CE087 ^U	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Chrysene	CE087 ^M	mg/kg	<0.03	<0.03	-	< 0.03	< 0.03	-
Benzo(b)fluoranthene	CE087 ^M	mg/kg	<0.02	0.02	-	<0.02	<0.02	-
Benzo(k)fluoranthene	CE087 ^M	mg/kg	<0.03	<0.03	-	<0.03	< 0.03	-
Benzo(a)pyrene	CE087 ^U	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Indeno(123cd)pyrene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
Benzo(ghi)perylene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	-
PAH (total of USEPA 16)	CE087	mg/kg	0.71	0.91	-	<0.34	0.43	-
Subcontracted analysis	•	•						
Asbestos (qualitative)	\$	-	NAD	NAD	-	NAD	NAD	-

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	М	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	М	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Cr
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	М	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	М	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	М	5	mg/kg Zn
CE004	рН	Based on BS 1377, pH Meter	As received	М	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	М	10	mg/I SO ₄
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	М	0.1	% w/w C
CE072	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry	М	0.1	% w/w
CE087	Naphthalene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	М	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	М	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N No (not deviating sample)Y Yes (deviating sample)NSD Sampling date not provided

NST Sampling time not provided (waters only)

EHT Sample exceeded holding time(s)

IC Sample not received in appropriate containers HP Headspace present in sample container

NCF Sample not chemically fixed (where appropriate)

OR Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
79592-1	WS01	0.50	N	
79592-2	WS02	0.80	N	
79592-3	WS02	1.80	N	
79592-4	WS03	0.10	N	
79592-5	WS03	0.90	N	
79592-6	WS03	1.90	N	

TEST REPORT REVISIONS

The table below identifies ammendments that have been made to this test report for each revision.

Test Report Reference	Details of amendments to test report	Issue Date
79592	Original report issued	02 July 2019
79592(1)	Chromium VI results amended	07 November 2019







ANALYTICAL TEST REPORT

Contract no: 80175

Contract name: Plot 7 - Science Central, Newcastle Upon Tyne

Client reference: P17-262

Clients name: 3E Consulting Engineers

Clients address: 2 Esh Plaza

Sir Bobby Robson Way Great Park, Newcastle

NE13 9BA

Samples received: 22 July 2019

Analysis started: 22 July 2019

Analysis completed: 29 July 2019

Report issued: 29 July 2019

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test

M MCERTS & UKAS accredited test

\$ Test carried out by an approved subcontractor

I/S Insufficient sample to carry out test N/S Sample not suitable for testing

NAD No Asbestos Detected

Approved by:

Dave Bowerbank Customer Support Hero

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet. Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
80175-1	HP01	0.10	Clayey Sand with Gravel	-	-	5.3
80175-2	HP03	0.30	Sandy Clay with Gravel	-	-	13.4

SOILS

Lab number Sample id			80175-1 HP01	80175-2 HP03
Depth (m)			0.10	0.30
Date sampled	Method	Units	19/07/2019	19/07/2019
Test Arsenic (total)	CE127 M	mg/kg As	4.0	3.6
Boron (water soluble)	CE063 M	mg/kg B	0.7	0.8
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	<0.2
Chromium (total)	CE127 M	mg/kg Cr	39	37
Chromium (VI)	CE146	mg/kg CrVI	<1	<1
Copper (total)	CE127 M	mg/kg Cu	16	18
Lead (total)	CE127 M	mg/kg Pb	19	16
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	30	28
Selenium (total)	CE127 M	mg/kg Zn	0.6	0.6
Zinc (total)	CE127 M	mg/kg Se	88	81
pH	CE004 M	units	7.0	7.2
Sulphate (2:1 water soluble)	CE061 M	mg/I SO ₄	240	93
Total Organic Carbon (TOC)	CE072 M	% w/w C	1.6	2.6
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	2.8	4.5
PAH	02072			
Naphthalene	CE087 ^M	mg/kg	0.09	0.03
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02
Acenaphthene	CE087 ^M	mg/kg	0.03	<0.02
Fluorene	CE087 ^U	mg/kg	0.04	<0.02
Phenanthrene	CE087 ^M	mg/kg	0.33	0.09
Anthracene	CE087 ^U	mg/kg	0.07	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.23	0.07
Pyrene	CE087 ^M	mg/kg	0.19	0.06
Benzo(a)anthracene	CE087 ^U	mg/kg	0.08	<0.02
Chrysene	CE087 ^M	mg/kg	0.15	0.06
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.12	<0.02
Benzo(k)fluoranthene	CE087 ^M	mg/kg	<0.03	<0.03
Benzo(a)pyrene	CE087 ^U	mg/kg	0.07	<0.02
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.05	<0.02
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02	<0.02
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.06	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	1.49	< 0.34
Subcontracted analysis				
Asbestos (qualitative)	\$	-	NAD	NAD

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	М	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	М	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Cr
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	М	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	М	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	М	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	М	5	mg/kg Zn
CE004	рН	Based on BS 1377, pH Meter	As received	М	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	М	10	mg/I SO₄
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	М	0.1	% w/w C
CE072	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry	М	0.1	% w/w
CE087	Naphthalene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	М	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	М	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	М	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N No (not deviating sample)Y Yes (deviating sample)NSD Sampling date not provided

NST Sampling time not provided (waters only)

EHT Sample exceeded holding time(s)

IC Sample not received in appropriate containers
HP Headspace present in sample container

NCF Sample not chemically fixed (where appropriate)

OR Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
80175-1	HP01	0.10	N	
80175-2	HP03	0.30	N	



LABORATORY REPORT



4043

Contract Number: PSL19/5007

Report Date: 29 August 2019

Client's Reference: P17-262

Client Name: 3E Consulting Engineers Ltd

1st Floor, Block C Holland Park Holland Drive

Newcastle Upon Tyne

NE2 4LD

For the attention of: Chris Brewster

Contract Title: Plot 7, Science Central, Newcastle Upon Tyne

Date Received: 19/8/2019
Date Commenced: 19/8/2019
Date Completed: 29/8/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson A Watkins R Berriman (Director) (Director) (Quality Manager)

L Knight S Eyre R Cowles (Senior Technician) (Senior Technician) (Senior Technician)

Page 1 of

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DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111-116, 1981.

Remarks														
Date Tested	28/08/19	28/08/19	28/08/19	28/08/19	28/08/19	28/08/19	28/08/19							
Failure Mode	Brittle	Brittle	Brittle	Brittle	Brittle	Brittle	Brittle							
ncs	(MPa) 57.0	40.3	18.7	45.4	84.2	47.2	21.5							
Load Failure	(KIN) 323.5	233.9	105.9	263.6	489.1	274.4	122.1							
Dry Density	(Mg/m) 2.61	2.56	2.61	2.45	2.52	2.43	2.58							
Moisture Content	1.8	1.8	1.9	1.6	1.1	1.5	2.2							
_	(Mg/m) 2.66	2.61	2.65	2.49	2.55	2.46	2.64							
Initial	(g) 3006	2998	2998	2919	2949	2803	2922							
Height Ratio	2.3	2.3	2.3	2.3	2.3	2.3	2.3							
Sample Length	(mm) 199	198	199	202	199	196	195							
1	(mm) 85	98	85	98	98	98	85							
Base Depth	(m) 24.35	18.92	20.25	16.70	24.00	17.00	24.80							
Top Depth	(m) 24.10	18.72	20.00	16.50	23.70	16.77	24.60							
Sample Type	Core	Core	Core	Core	Core	Core	Core							
Sample Number														
Hole	BH1A	BH1A	BH1A	BH02	BH02	BH03	BH03							



Plot 7, Science Central, Newcastle Upon Tyne

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods: 2007

Borchole I	Depth (m)	Sample	Test	Orientation	II)	(mm)	Area	D_e^2	De	Failure	Failure Load (P)	ľ	Corr Fac	I_{s50}	Failure Tyne	Remarks
			2461	Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Adr.	
BH1A	9.85		A	Perp	98	70	6020	7664.90	87.55	•	16.66	2.17	1.287	2.80	Valid	
BH1A	11.85		A	Perp	85	59	5015	6385.30	16.67		15.68	2.46	1.235	3.03	Valid	
BH1A	14.30		A	Perp	82	89	08/5	7359.32	62.28	•	0.41	90.0	1.275	0.07	Valid	
BH1A	16.50		A	Perp	85	47	3668	5086.59	71.32	,	8.29	1.63	1.173	1.91	Valid	
BH02	16.10		A	Perp	82	64	5440	6926.42	83.23		14.97	2.16	1.258	2.72	Valid	
BH02	21.70		A	Perp	85	41	3485	4437.24	19'99	٠	4.67	1.05	1.138	1.20	Valid	
BH02	23.10		A	Perp	85	43	3655	4653.69	68.22	٠	7.16	1.54	1.150	1.77	Valid	
BH02	11.10		A	Perp	82	71	9035	7684.00	99''	•	12.98	1.69	1.287	2.17	Valid	
BH03	12.60		A	Perp	85	48	4080	5194.82	72.08	,	12.60	2.43	1.179	2.86	Valid	
BH03	15.50		A	Perp	98	89	5848	7445.90	86.29	,	17.05	2.29	1.278	2.93	Valid	
BH03	20.20		A	Perp	85	41	3485	4437.24	19.99	,	96.0	0.22	1.138	0.25	Valid	
BH03	21.50		A	Perp	82	61	2185	6601.75	81.25	•	2.64	0.40	1.244	0.50	Valid	
BH03	9.20		A	Perp	82	32	2720	3463.21	58.85	'	0.59	0.17	1.076	0.18	Valid	
							_		_							

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular

UKAS UKAS 4043 Professional Soils Laboratory

Plot 7, Science Central, Newcastle Upon Tyne

Contract No: PSL19/5007	Client Ref:	P17-262
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SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods: 2007

Remarks																		
Failure	7 J.P.C	Valid																
I_{s50}	(MPa)	1.30	1.54	0.15	0.79	0.11	0.27	1.07	0.50	1.54	90.0	0.15						
Corr Fac	F	1.276	1.270	1.270	1.270	1.270	1.270	1.270	1.270	1.276	1.270	1.270						mopu
\mathbf{I}_{s}	(MPa)	1.018	1.210	0.120	0.621	0.087	0.212	0.844	0.393	1.205	0.050	0.116						tular, U = Ra
Load	(kN)	7.53	8.74	0.87	4.49	0.63	1.53	6.10	2.84	8.91	0.36	0.84						= perpendic
Failure Load	(Mpa)	-	-	-	-	1	1	1	ı	1	1	1						Par = parallel, Perp = perpendicular, $U = Random$
De	(mm)	86.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	86.00	85.00	85.00						Par=1
D _e ²		7396	7225	7225	7225	7225	7225	7225	7225	7396	7225	7225						
sions n)	D	86	85	85	85	85	85	85	85	98	85	85						nt
Dimensions (mm)	Г	-	-	-	-		,											ter conte
Orientation	Par / Perp	Par						All testing carried out on samples at as received water content										
Test	13 pc	D	D	D	D	D	D	D	D	D	D	D						samples at
Sample																		sarried out on
Depth (m)		9.85	11.85	14.30	16.10	21.70	23.10	11.10	12.60	15.50	20.20	21.50						All testing o
Borehole		BH1A	BH1A	BH1A	BH02	BH02	BH02	BH02	BH03	BH03	BH03	BH03						*Note

Contract No: PSL19/5007 Client Ref: P17-262

Plot 7, Science Central, Newcastle Upon Tyne

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Professional Soils Laboratory 4043

Appendix F



BH1A - 9.00m to 14.00m



BH1A - 14.00m to 18.00m



Client: Karbon Date: 12.08.19 Homes Limited Job No: P17-262



BH1A - 18.00m to 23.00m



BH1A - 23.00m to 25.00m



Client: Karbon Date: 12.08.19 Homes Limited Job No: P17-262



BH2 - 8.70m to 12.70m



BH2 - 12.70m to 18.70m



Client: Karbon Date: 12.08.19 Homes Limited Job No: P17-262



BH2 - 18.70m to 22.70m



BH2 - 22.70m to 24.00m



Site: Plot 7 Science Central,	Job No: P17-262
Newcastle upon Tyne	

Client: Karbon Date: 12.08.19 Core Photographs
Homes Limited



BH3 - 8.00m to 13.50m



BH3 - 18.50m to 23.50m



Client: Karbon Date: 12.08.19 Homes Limited

Job No: P17-262



BH3 - 23.50m to 25.00m



Client: Karbon Date: 12.08.19

Homes Limited

Job No: P17-262

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