Mining Remediation Authority

User Guide

Gateshead mine water heat living laboratory dataset

January 2025

Version Control

Version	Produced by	Approved by	Comments	Date
1.0	Dan Mallin Martin Fiona Todd	Charlotte Adams Gareth Farr	Initial document	17/04/24
2.0	Dan Mallin Martin Fiona Todd Rebecca Chambers	Gareth Farr	Updated to include Stadium site, new logger details, new ground level information and name changed to Mining Remediation Authority	15/01/25

Key words:

Living lab, mine water heat, mine water level, mine water temperature, mine water quality, monitoring boreholes, Gateshead

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in mining areas

Contents

1 Summary

This document provides information for users of the data generated by the Gateshead mine water heat living laboratory (known as "Gateshead living lab" for short). It outlines why the dataset was created and how it should be used. Technical information regarding how the data was created is described, and details of the data format and how to use the data are also presented.

2 Introduction

The Mining Remediation Authority, the trading name of the Coal Authority since November 2024, ("The Authority") manages the effects of past coal mining, including subsidence damage claims which are not the responsibility of licensed coal mine operators. It deals with mine water pollution and other mining legacy issues. It also owns, on behalf of the country, the majority of the subsurface coal mining infrastructure in Britain, and licenses coal mining and access to our property.

We use our skills to provide services to other government departments and agencies, local governments and commercial partners. We contribute to the delivery of the UK Government's Industrial Strategy and the environmental, social and economic priorities of the UK, Scottish and Welsh Governments.

By sharing our knowledge and expertise we support them, and our partners, to create cleaner, greener nations for us all. Our purpose is to:

- keep people safe and provide peace of mind
- protect and enhance the environment
- use our information and expertise to help people make informed decisions
- create value and minimise cost to the taxpayer

The Mining Remediation Authority is an executive non-departmental public body, sponsored by the Department for Energy Security and Net Zero.

Further information on all the digital data available from the Authority can be found on our website at https://www.gov.uk/government/organisations/mining-remediation-authority or by contacting datasolutions@coal.gov.uk.

3 About the Gateshead living lab dataset

3.1 Background

The Gateshead mine water heat living laboratory (Gateshead living lab) is a flagship part of the Mining Remediation Authority's mine heat R&D programme to improve understanding of how mine heat schemes operate and interact. Data and understanding of thermal and hydraulic interactions between adjacent mine water heat schemes will support ongoing licensing by the Mining Remediation Authority, regulation by environmental agencies and support R&D and development of mine water heat opportunities across Great Britain. It has been funded and designed by the Mining Remediation Authority with the permission of Gateshead Council (landowner) and is located between the Gateshead Energy Company heat network and two other mine water heat schemes developed by Lanchester Wines, at their bonded warehouses in Felling. The Gateshead living lab is Britain's first dedicated borehole monitoring network designed to observe temperatures and water levels as mine heat schemes operate over the long term. The data generated will complement the research work underway at the mine water heat observatory developed in Glasgow by BGS as part of the UKGEOS project by providing insights on the potential for hydraulic, thermal or hydrogeochemical interactions between operational schemes.

A fundamental aspect of the Gateshead living lab is the open access provision of the monitoring data to allow operators, regulators and other interested parties to understand how and if temperatures, water levels and chemistry change within the mine workings, and especially what, if any, interactions are observed when there are two operational heat schemes within the same mine water block.

3.2 Dataset History

Construction of the Gateshead living lab began in 2023 with two monitoring boreholes drilled at the Bede site shown in Figure 1 (formerly known as site A5). The two boreholes are "Bede – Brass Thill" (formerly known as BH5a) and "Bede – High Main" (formerly known as BH5b). Data loggers were installed in these two boreholes in May 2023 with data available from July 2023.

A further two boreholes were drilled in May 2024 at Gateshead Stadium shown in Figure 1 (formerly known as site A4), intersecting the High Main workings (Stadium – High Main), and the Hutton workings (Stadium – Hutton). Data loggers were installed in these boreholes from September 2024.

3.3 Who might use this dataset?

This dataset is suitable for use by a wide range of stakeholders: public and private sector organisations and researchers, mine water heat scheme operators and environmental regulators. The data show the thermal and hydraulic response within the underground mine workings as three mine water heat schemes operate within the Walker mine water block at Gateshead (NB operation will have a seasonal pattern with more heat being supplied during winter months).

3.4 What the dataset includes

The dataset provides time series information for each monitoring borehole including mine water levels, temperatures, electrical conductivities and pore water pressures. The specific data available for each site and monitoring point is given in Section 4, this may differ between sites.

The units for each data type are as follows:

- Mine water levels (depth to water)*
- Manual water levels (m below datum)
- Mine water temperatures (°C)
- Mine water actual and specific electrical conductivities (µS/cm)
- Pore water pressure(s) down the profile of the borehole annulus (mH2O)
- Temperature measurements inside the borehole annulus (°C)
- Barometric pressure (mBar)

A barometric conversion has been undertaken on the raw mine water level data to convert it to depth to water (i.e. m below ground level). Further information on this is available on request.

The drilling contractor’s reports are provided as .pdf files (Appendix A) and a separate activity (events) log provides information on sensor maintenance.

The data are provided in GMT unless otherwise stated. It will be indicated in the file name.

*Note: for the initial data prior to September 2024 (Solinst logger) the water level data were supplied as barometrically compensated m above sensor.

3.5 Coverage

This dataset is limited to the Gateshead area, NE England. Information is available from:

- the Bede site, located on land adjacent to Bede Primary School, Old Fold Rd, Gateshead, NE10 0DJ, and
- Gateshead Stadium, Neilson Rd, Gateshead NE10 0EF, as shown in **Figure 1**.

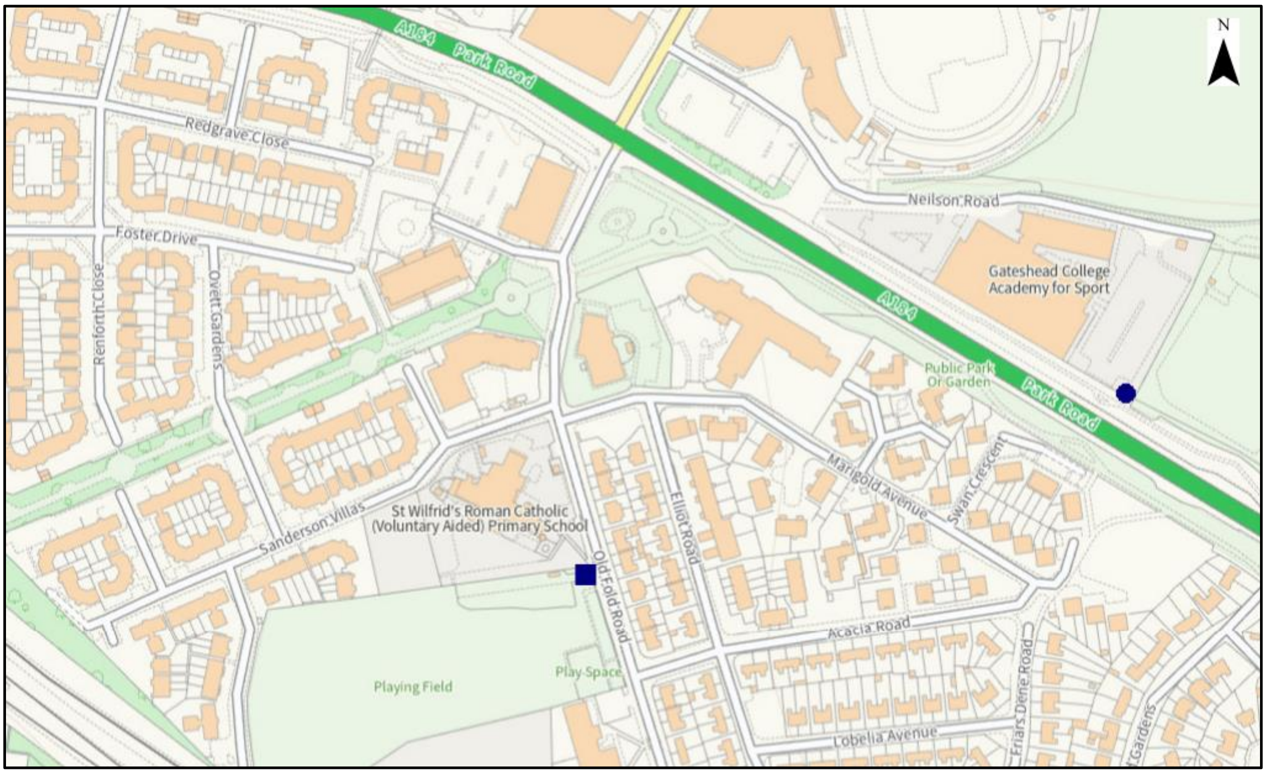

Figure 1: Living Lab Site locations. Bede site (blue square) and Stadium site (blue circle).

4 Living Lab site information

4.1 Bede Monitoring site

Monitoring borehole design

Monitoring began at the first site (Bede) in May 2023 but data are available from July 2023 due to sensor issues. There are two monitoring boreholes on the site:

- Bede – BT (Brass Thill): 136m deep into the Brass Thill seam (Seam K)
- Bede – HM (High Main): 56m deep into the High Main seam (Seam E)

The grid references of the boreholes are [E: 426781, N: 562670] and [E: 426792, N: 562670] for Brass Thill and High Main respectively. The approximate ground elevation at both locations is 33.2 mAOD, this has been obtained from Lidar data from 2021 with a resolution of 1m and supersedes any previously reported elevations. Manual water levels are taken from the top of the 4" plastic casing which is 0.275 mBGL and 0.24 mBGL for High Main and Brass Thill respectively.

Full details of the borehole drilling and construction are provided in the drilling report provided as Appendix A. The borehole construction and sensor installation is shown schematically in Figure 2 and details of the sensors deployed are given in Table 1.

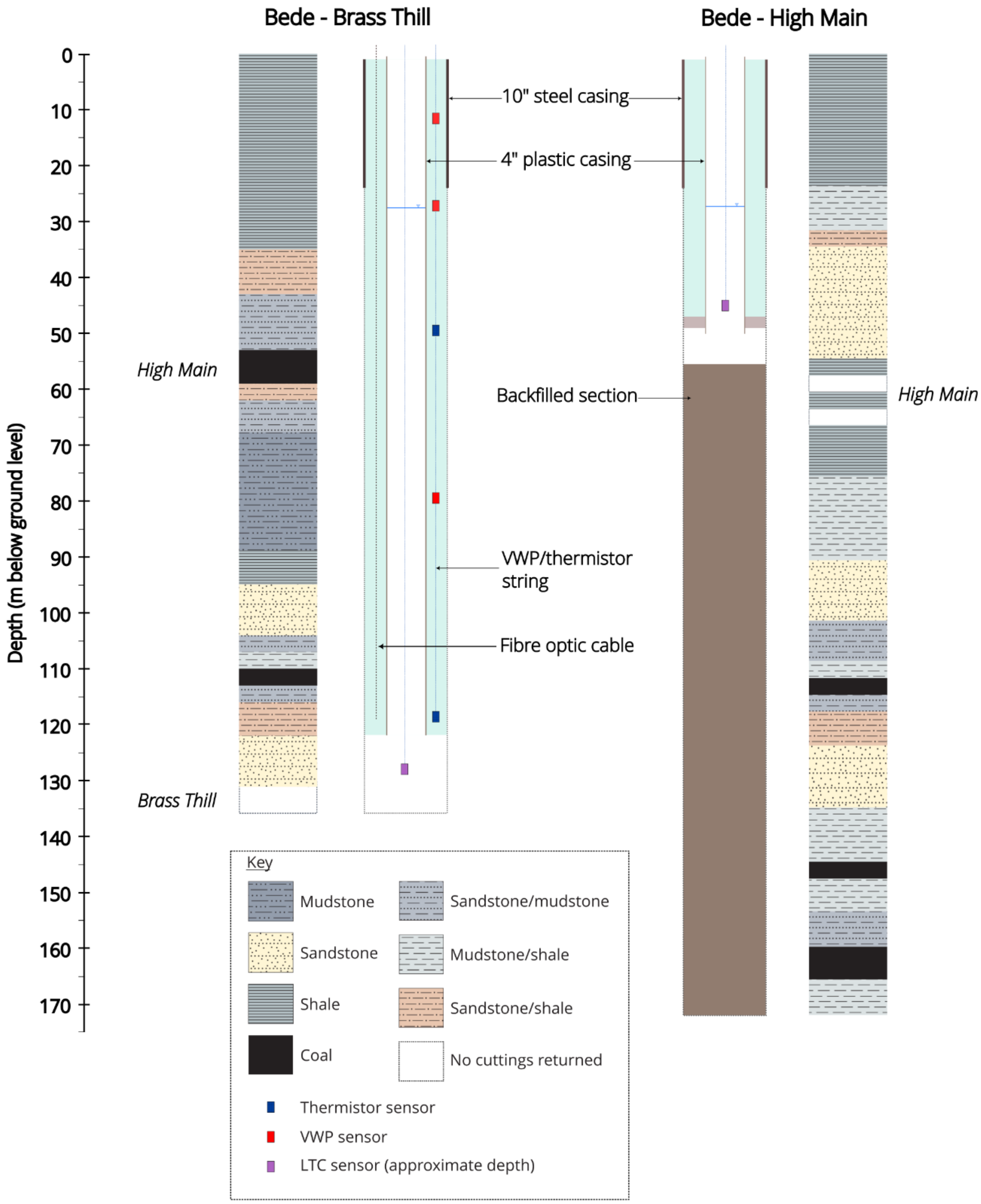

Figure 2: Bede site monitoring borehole construction and geological logs

Sensor information

Table 1: Bede site sensor information

Borehole	Sensor	Details
Bede–BT	Aqua Troll 200 non-vented (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 132 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Insitu
Bede–BT	Levelogger 5 LTC logger (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 128 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Solinst **Note: this was replaced in Sept 2024 by the Insitu Aqua Troll logger**
Bede–BT	Thermistor	Two thermistor sensors deployed outside 4” casing at 49.16 mBGL and 119.67 mBGL (on same string as VWP). Manufacturer: Geosense
Bede–BT	VWP-3000 (vibrating wire piezometer)	Three vibrating wire piezometer sensors deployed outside 4” casing at 11.56 mBGL, 27.29 mBGL and 79.70 mBGL. A calibration file for this is provided in Appendix B. Manufacturer: Geosense
Bede–BT	Fibre optic cable, single-mode and multi-mode fibres	Fibre optic cable installed outside 4” casing (grouted in place) to 119.67 mBGL. Note: no data logger installed with this cable, spot measurements only. Manufacturer: Silixa
Bede–HM	Aqua Troll 200 non-vented (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 50 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Insitu
Bede–HM	Levelogger 5 LTC logger (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 50 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Solinst **Note: this was replaced in Sept 2024 by the Insitu Aqua Troll logger**

4.2 Gateshead Stadium site

Monitoring borehole design

Monitoring began at the Gateshead Stadium site in September 2024. There are two monitoring boreholes on the site:

- Stadium – H (Hutton): 188 m deep into the Hutton seam (Seam L)
- Stadium – HM (High Main): 82m deep into the High Main seam (Seam E)

The grid references of the boreholes are [E: 427129, N: 562774 and [E: 427125 N: 562786 for Hutton and High Main respectively. The approximate ground elevation at both locations is 27.2 mAOD, this has been obtained from Lidar data from 2021 with a resolution of 1m. Manual water levels are taken from the top of the 4” plastic casing which is 0.28 m and 0.24 m above ground level for High Main and Hutton respectively.

Full details of the borehole drilling and construction are provided in the drilling report provided as Appendix A. The borehole construction and sensor installation is shown schematically in Figure 2 and details of the sensors deployed are given in Table 2.

Due to complications encountered while drilling the pore water pressure sensors in Stadium-H cannot be used to provide accurate data as they are installed within external steel casing.

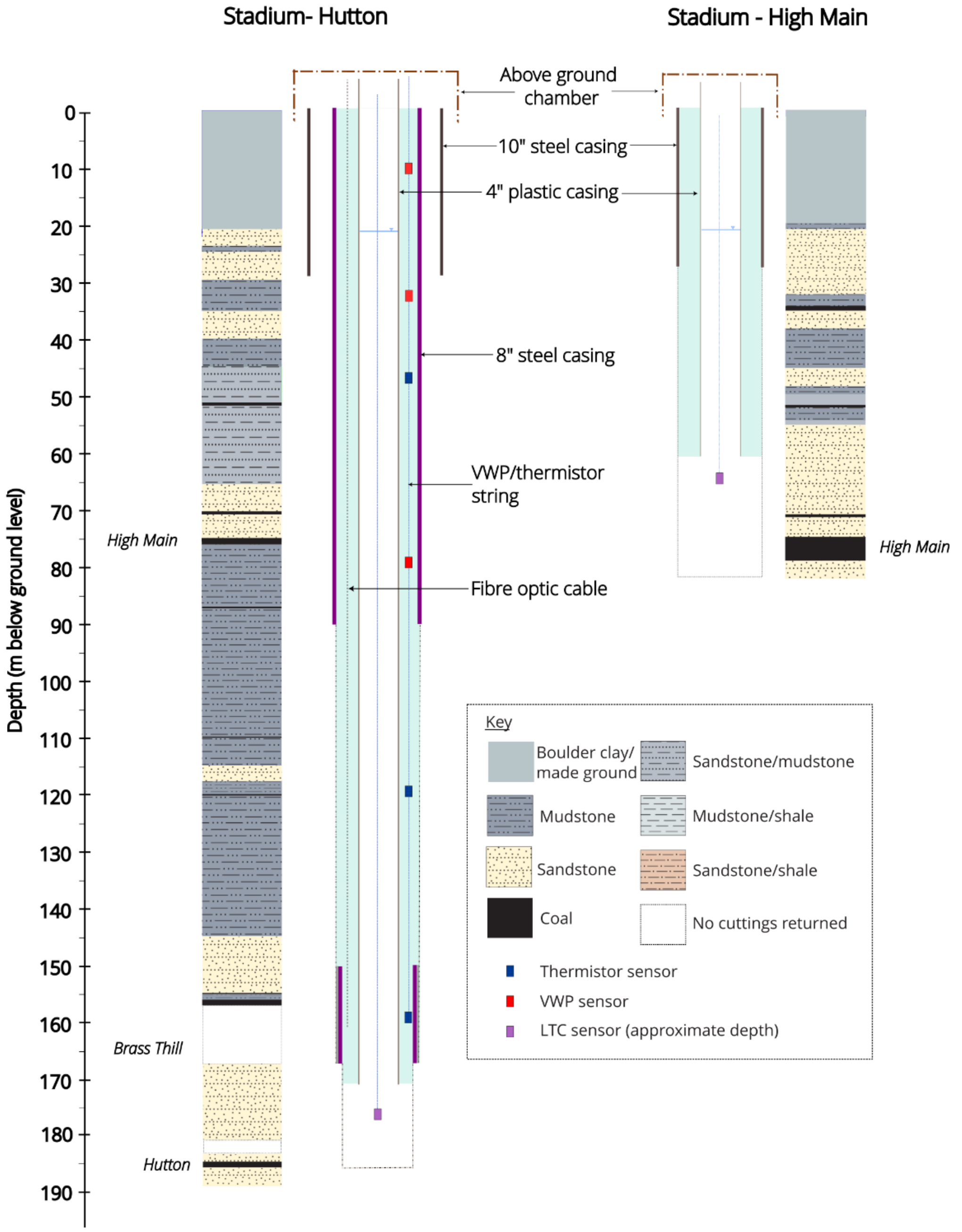

Figure 3: Stadium site monitoring borehole construction and geological logs

Sensor information

Table 2: Stadium site sensor information

Borehole	Sensor	Details
Stadium-H	Aqua Troll 200 non-vented (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 180 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Insitu
Stadium-H	Thermistor	Three thermistor sensors deployed outside 4" casing at 47.86 mBGL 120.45 mBGL and 160.00 mBGL (on same string as VWP). Manufacturer: Geosense
Stadium-H	VWP-3000 (vibrating wire piezometer)	Three vibrating wire piezometer sensors deployed outside 4" casing at 10.27 mBGL, 30.28mBGL and 80.22 mBGL. A calibration file for this is provided in Appendix B. Manufacturer: Geosense **Note:** The VWP sensors here cannot be used for accurate pore water pressures due to being installed within external steel casing
Stadium-H	Fibre optic cable, single-mode and multi-mode fibres	Fibre optic cable installed outside 4" casing (grouted in place) to 160.00 mBGL. Note: no data logger installed with this cable, spot measurements only. Manufacturer: Silixa
Stadium-HM	Aqua Troll 200 non-vented (level, temperature and conductivity)	Logger installed inside casing at an approximate depth of 73 mBGL. Data from this logger has been compensated for barometric pressure. Manufacturer: Insitu

5 Technical Information

5.1 Definitions

Mine water blocks are a set of flooded collieries which are interconnected and exhibit a continuous gradient of water level across their area

Mine water level – the position of elevation of the mine water in the workings, relative to a known point. Reported in either in metres above sensor (mAS), metres below ground level (mBGL) or metres above Ordnance Datum (mAOD).

Mine water temperature – the temperature of the mine water in the workings (in °C), or the temperature of the mine water at the sensor position.

Mine water conductivity – the specific electrical conductivity (SEC) at 25°C for the mine water in the workings, or at the sensor position. This is a representation of the concentration of dissolved ions in the mine water. The more ions dissolved, the higher the conductivity. It should be noted that brackish/saline waters are present within the mine workings due some influence from the adjacent River Tyne which is tidal in the Gateshead area.

Pore water pressures – measured by a vibrating wire piezometer, this represents the water pressure in the rock mass around borehole. The piezometers have been installed with the fully grouted method and therefore measure the pore water pressure adjacent to their installation position. These are recorded as a Frequency by the sensor (as Hz, or Engineering Units (Hz^2/1000), which is then converted to kPa, PSI or mH_2O by sensor-specific linear conversion factors to provide an equivalent "level" above the piezometer.

Annular temperatures – these are the temperatures (in °C) measured by the thermistors installed on the outside of the borehole casing, and are influenced by the groundwater/mine water and rock mass around the borehole.

5.2 Data Format

The data are presented in a number of .csv files for each sensor. Each .csv relates to a specific sensor in each borehole. Each csv contains a number of header rows from the data logger which display units, attributes, and any corrections applied at time of logging.

5.3 Field Descriptions

Table 3: Attribute table field descriptions (Insitu LTC logger data). Used from Sept 2024

Data Field	Explanation of Data Field
Header file fields	
Report Date:	Date data barometrically compensated
Report User Name:	Removed for confidentiality
Report Computer Name:	Removed for confidentiality
Application:	Download software
Application Version:	Download software version
Log file properties	File name and date of WinSitu file (e.g. converted from Vu Situ to WinSitu file)
Device properties	Properties of logging device which is installed in borehole
Log configuration	Information on configuration of log file. Created by and computer name have been removed for confidentiality.
Level reference settings at log creation	This is the manual dip data used to convert the water level recorded above sensor to depth to water (conversion done in logger)
Other log settings	Standard values used in logger
Log notes	Notes on compensation. All user data removed for confidentiality
Log Data	Data logger information
Time Zone	Time zone
Data fields	
Date Time	Date and time of reading
Elapsed time (sec)	Time since log started
Corrected Pressure (bar)	Barometrically compensated pressure of water above sensor at date and time
Temperature (°C)	Measured temperature data at sensor depth at date and time
Corrected Level Depth to Water (m)	Barometrically compensated water level in m below ground level at date and time
Actual conductivity (μS/cm)	Measured conductivity at sensor depth at date and time
Specific conductivity (μS/cm)	Conductivity at sensor depth at date and time standardised to 25°C
Barometric Pressure (Bar)	Barometric pressure recorded on baro logger at date and time and used for conversion

Table 4: Attribute table field descriptions (Solinst LTC logger data). Discontinued use after Sept 2024

Data Field	Explanation of Data Field
Header file fields	
Serial_number	Logger serial number
Project ID	Site reference
Location	Monitoring point location
LEVEL UNIT	Units for level measurements
Offset	Offset applied to level data
TEMPERATURE UNIT	Units for temperature measurements
CONDUCTIVITY UNIT	Units for conductivity measurements
Data fields	
Date	Date of reading
Time	Time of reading
ms	miliseconds
LEVEL	Barometrically compensated water level in m above sensor at date and time
TEMPERATURE	Measured temperature data at sensor depth at date and time
CONDUCTIVITY	Measured conductivity at sensor depth at date and time

Table 5: Attribute table field descriptions (VWP and thermistor data)

NB: The following fields apply to each channel on the data logger

Data Field	Explanation of Data Field
Header file fields	
Sensorname	Depth of installed sensor and site name
Model	Product name for sensor (VWP or Thermistor)
Serial	Serial number for sensor (if provided by manufacturer)
Baro	Barometric pressure at time of calibration (See Appendix B)
Tempatcal	Temperature at time of calibration
LinFactor	Linear conversion factor for VWP sensors only. Default linear conversion factor is for (Digits) to mH2O.
ZeroRdg	Zero reading at time of calibration (no applied hydrostatic pressure) (See Appendix B)
ZeroT	Temperature taken at time of zero reading during calibration (See Appendix B)
Data fields	
Date/Time	Date-time of reading taken
VBatt	Battery voltage in data logger at date-time
Temp.	Temperature measured by the data logger at surface at date-time
Channel # (mH2O)	Measured pressure at sensor point for Channel #. Reported in mH2O, at date-time. Not av. Value for thermistor only channels
Channel # (°C)	Temperature measured by VWP or Thermistor on data logger channel # at date-time.
CH# Raw (Digits)	Unconverted Linear Digits (Hz^2x100) recorded by each channel at date-time.

5.4 Data update frequency

Data will be collected from the sensors ideally on a half yearly basis, and uploaded to the website/data access point. The frequency is dependent on staff availability and other project commitments.

6 Licensing Information

The data is accessible under the Open Government Licence (OGL v3). Full details of the conditions of the OGL v3 licence can be found at: https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

7 Limitations and exclusion of liability

- The data represented in this dataset is relevant only to the Gateshead area
- The Gateshead living lab data are supplied 'as is' without filtering or cleansing apart from barometric compensation of the Insitu and Levelogger LTC data. Dataloggers may malfunction or provide erroneous data therefore we cannot guarantee data continuity or accuracy.
- If users are uncertain about the use of particular data they should seek professional advice.
- The Mining Remediation Authority has used reasonable endeavours to verify the quality of the data, but gives no warranty and makes no representation that the data is complete, accurate, up-to-date, reliable or exhaustive.
- The Mining Remediation Authority makes no warranties or representations as to the suitability of the data for any particular use or purpose or as to the value or utility of the data.

Appendix A: Drilling reports for Bede and Stadium

DRILCORP

REPORT

BOREHOLE ENGINEERING SERVICES

Contract:	BC23025
Client:	Coal Authority
Site:	A5, Gateshead Living Lab
Boreholes:	BH1, BH2 (BH5b), BH2 (BH5a)
Operations:	1. BH1: mobilisation 2. BH1: site-setup 3. BH1: trial pit 4. BH1: drilling ops 5. BH1: decommissioning 6. BH2: Mobilisation 7. BH2: site set-up 8. BH2: Trial Pit 9. BH2: Drilling ops 10. BH2: Installation of 4" pipe 11. BH2: chamber installation 12. BH3: mobilisation 13. BH3: Site-setup 14. BH3: Trial pit 15. BH3: Drilling ops 16. BH3: Installation of 4" pipe 17. BH3: Chamber installation 18. Site Re-instatement 19. Demobilisation

Version	Date	Modification(s) to previous version	Issued by
1	04-July-2023	N/A	J. M. Killeen
2	25-July-2023	After revision from client more information was required	J. M. Killeen
3	11-August-2023	After revision from client more information was required	J. M. Killeen
4	11-October-2023	After revision from client more information was required	J. M. Killeen
5	03-january-2024	After revision from client more information was required	J. M. Killeen

Tab. 1: Document history

Overview of operations at Site 5A, Gateshead living lab

The following report has been prepared by Drilcorp for the Coal Authority,
This report will cover the drilling operations carried out at site A5 of the Gateshead living lab project,
This details how Drilcorp drilled and completed two monitoring Boreholes down to the abandoned mine workings below Gateshead, the document will also cover the decommissioning process of BH1 (failed borehole) from TD (total depth) to Ground level.

The two designations of the Boreholes are as follows:

- BH2 now known as (BH5b)
- BH3 now known as (BH5a)

Designation of the Decommissioned Borehole:

- BH1

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BOREHOLE LOCATIONS

Fig. 1: Aerial view of site A5, Gateshead living labs, and locations of BH1, BH2 (BH5b) and BH3 (BH5a)

Grid reference:

- BH1: 426768 562668
- BH2 (BH5b): 426792 562670
- BH3 (BH5a): 426781 562670

1. BOREHOLE 1 COMPLETION DIAGRAM (20-06-23)

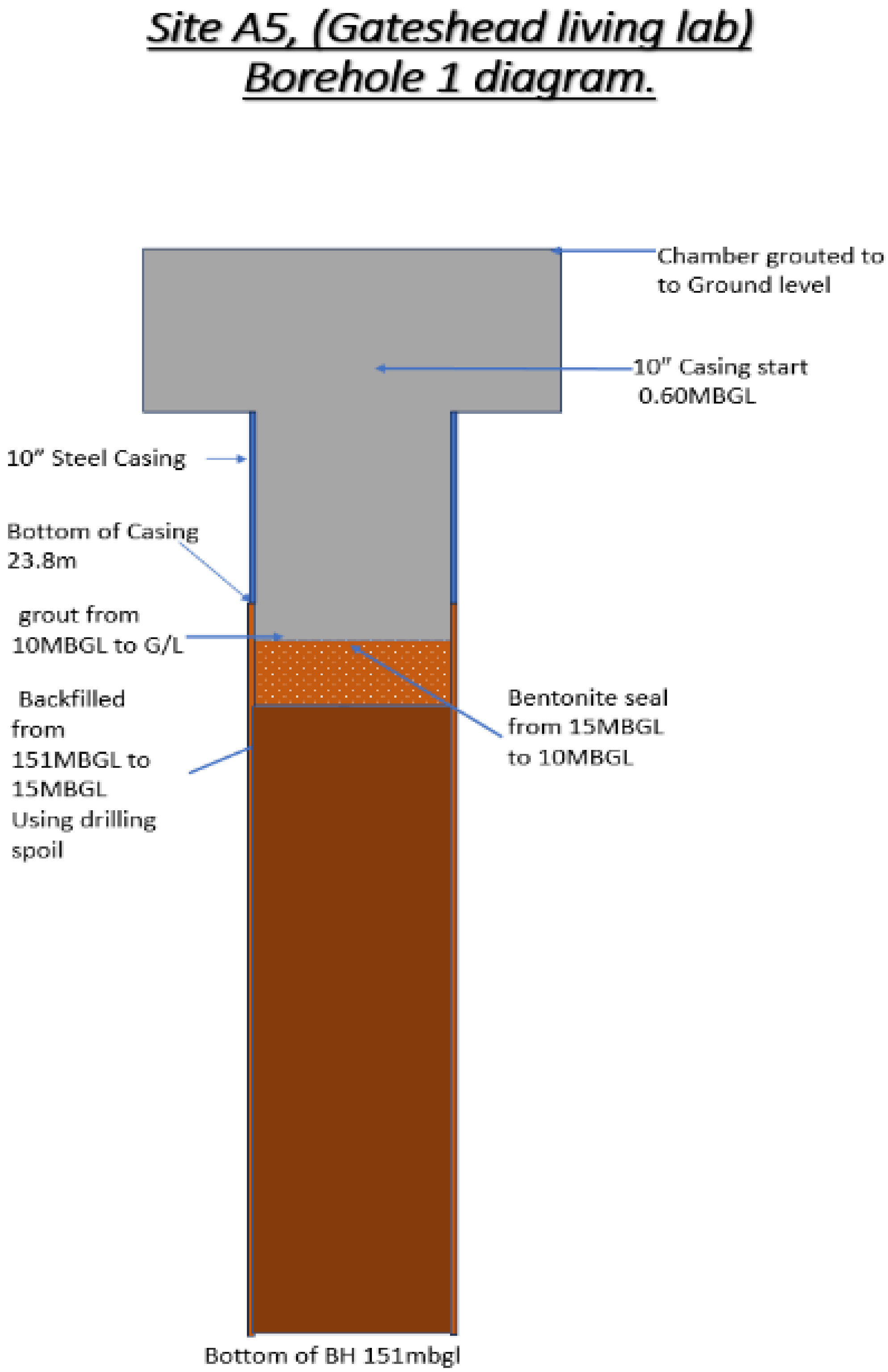

Fig. 2: Diagram of BH1 decommissioning performed in June-2023

2. BOREHOLE 2 (BH5B) COMPLETION DIAGRAM (17-06-23)

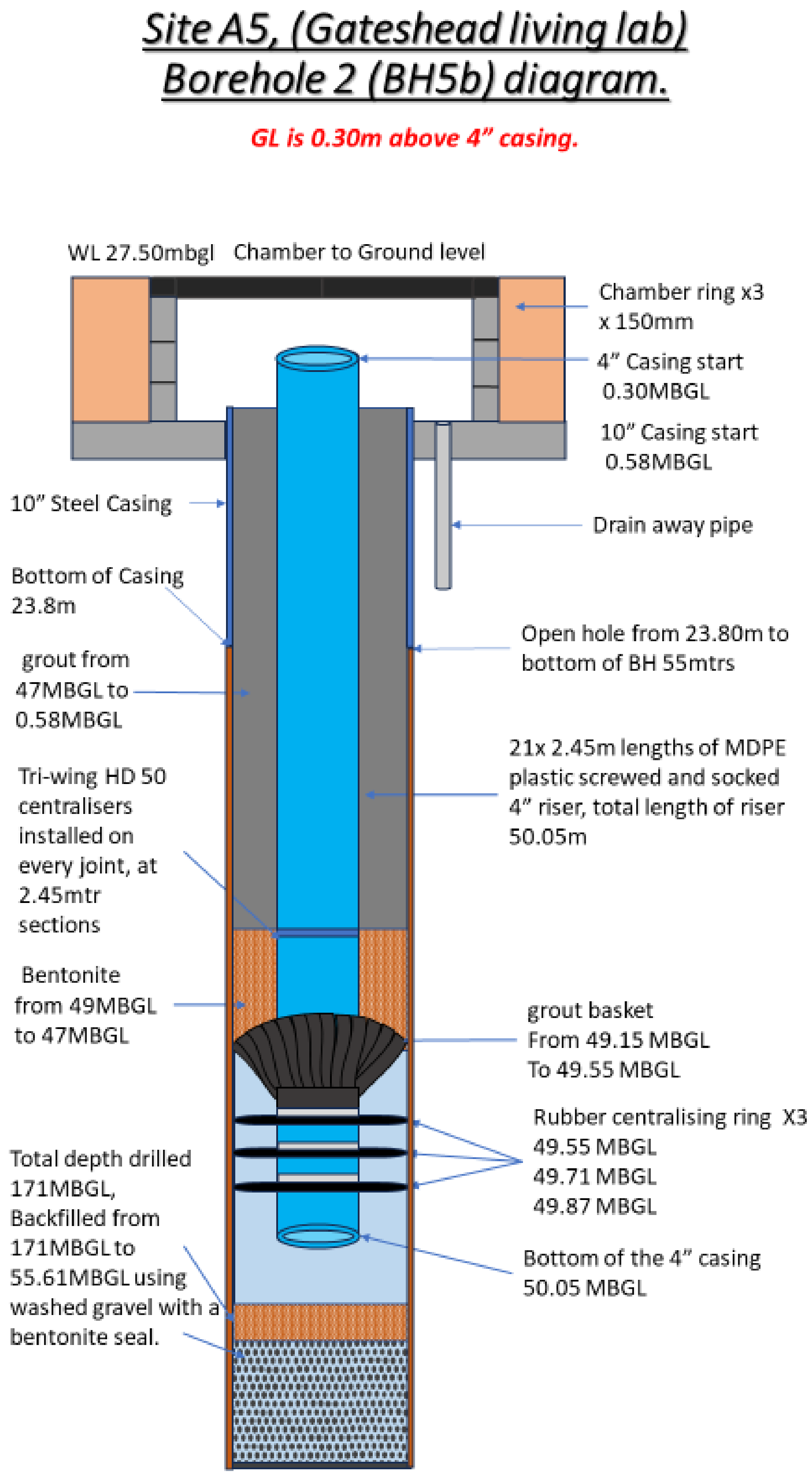

Fig.3: Diagram of BH2 and casing installation performed in June-2023

3. BOREHOLE 3 (BH5A) COMPLETION DIAGRAM (09-06-23)

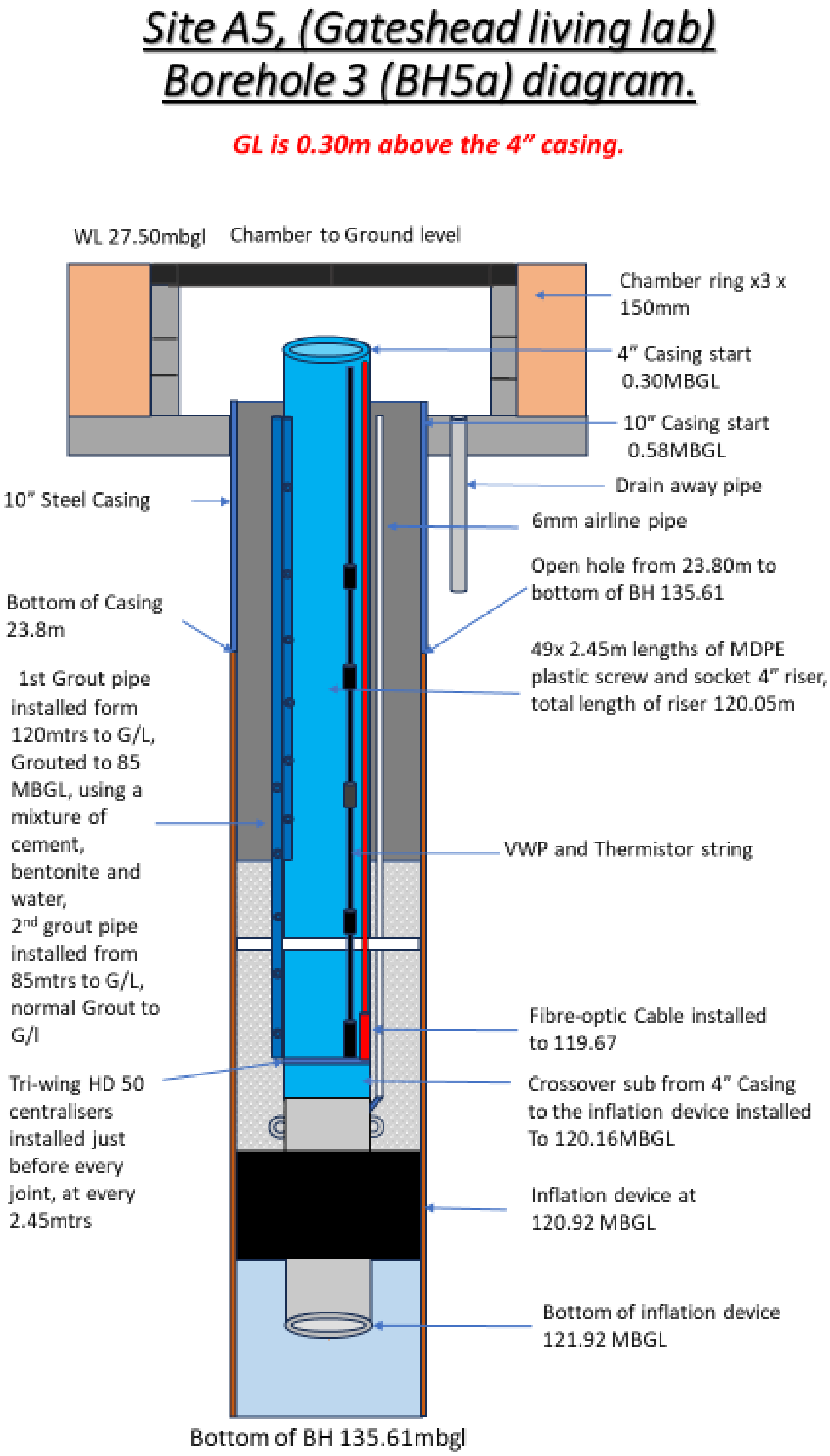

Fig.4: Diagram of BH3 after the installation of the casing and cables, performed in June-2023

4. SEQUENCE OF OPERATIONS

Tab. 2: Sequence of operations for drilling performed at BH1, BH2 and BH3 in June-2023

Start	End	Borehole(s)	Operation	Performed by
20-02-23	21-02-23	BH1	Mobilisation	Drilling division
21-02-23	21-02-23	BH1	Setup of site. Trial pit, rig setup	
22-02-23	23-02-23	BH1	Drilling to casing depth 23.80mtrs	
24-02-23	27-02-23	BH1	Casing install + grout	
27-02-23	28-02-23	BH1	Prep for drilling phase	
28-02-23	08-03-23	BH1	Drilling to 106.98mtrs	
08-03-23	14-03-23	BH1	Flush loss	
14-03-23	17-03-23	BH1	Grouting ops	
17-03-23	23-03-23	BH1	Drilling ops	
23-03-23	24-03-23	BH1	Grouting ops	
27-03-23	28-03-23	BH1	Drilling ops to 151MBGL	
28-03-23	29-03-23	BH1	Rod removal	
30-03-23	31-03-23	BH1	Back filing	
15-06-23	15-06-23	BH1	Back filling	
19-06-23	20-06-23	BH1	Back filling	
20-06-23	20-06-23	BH1	Decommissioning	
31-03-23	31-03-23	BH2	Trial pit	
04-04-23	04-04-23	BH2	Move equipment to BH2 location	
05-04-23	05-04-23	BH2	Drilling to casing depth 23.80mtrs	
06-04-23	11-04-23	BH2	Casing installation, flushing in + grout	
12-04-23	12-04-23	BH2	Drilling + lost flush	
13-04-23	13-04-23	BH2	Installing 7” casing	

Start	End	Borehole(s)	Operation	Performed by
14-04-23	18-04-23	BH2	Installed 7" casing to final depth of 54mtrs + drilling wit 6" bit + adding more casing.	Drilling division
19-04-23	20-04-23	BH2	Drilling	
21-04-23	21-04-23	BH2	Viability testing, target not hit, high main viable	
24-04-23	25-04-23	BH2	Casing removal	
07-06-23	07-06-23	BH2	Backfilled to 55mtrs	
08-06-23	08-06-23	BH2	4" casing installed	
12-06-23	17-06-23	BH2	Chamber installation ops	
15-06-23	15-06-23	BH2	Airlifting ops	
26-04-23	26-04-23	BH3	Mobilisation	
27-04-23	27-04-23	BH3	Trial pit	
28-04-23	02-05-23	BH3	Drilled to casing depth, 23.80mtrs	
02-05-23	04-05-23	BH3	Casing installed	
09-05-23	10-05-23	BH3	Drilling ops	
11-05-23	24-05-23	BH3	Grouting ops	
25-05-23	26-05-23	BH3	Drilling ops to a final depth of 135.61MBGL	
30-05-23	01-06-23	BH3	Install of the 4" casing and adjoining cables to 120MBGL	
02-06-23	05-06-23	BH3	Grouting ops	
06-06-23	06-06-23	BH3	Waggon collection	
07-06-23	07-06-23	BH3	Casing cut, pit extension	
08-06-23	08-06-23	BH3	Trial pit excavated, shuttering complete and plinth grouted	
09-06-23	09-06-23	BH3	Chamber rings installed and trial pit grouted,	
14-06-23	14-06-23	BH3	Airlifting ops	
19-06-23	26-06-23	BH3	Demobilisation + re-instatement ops	

5. PRE-DRILLING OPS: (FEB-2023)

Mobilisation

The team arrived on site Monday the 20th of February 2023, once on site, the team assessed the situation keeping in mind determining factors such as, where the plant and equipment will be placed and if initial plans are still viable for permanent placement.

Site-setup

The team employed good traffic control techniques while escorting waggons during peak school times and general hours, while keeping spatial awareness in mind the plant and equipment delivered on site was manoeuvred in place ready for the next phase of the plan.

Fig. 5: Image taken of the site-setup completed in February 2023

Along with plant movement and equipment setup, the site was secured using Heras fencing, this reached around the entirety of site, safety signs were then attached to the fencing, the office was setup and more health and safety information was displayed and attached to the appropriate areas, muster points and gas detection zones where also marked out, and the team briefed.

Fig. 6: Image taken of the site-setup completed in February 2023

GPR

A GPR (Ground Penetrating Radar) survey was conducted on the 20th Feb 2023, the GPR team carried out a full site survey, identifying any hidden and buried services, this includes, water, gas and electrical utilities, the survey revealed the two known utilities running parallel with site under the walkway, the GPR team also mapped out and geo-tagged the BH drilling locations, marking them with both a crossed symbol and ID Number, with nothing found and the BH locations marked out the team proceeded with the next phase.

Trial Pit

With the BH locations marked out and the area giving the all clear for buried services, the team will begin marking out the trial pit, this entails, measuring the trial pit to the dimensions of 1.2mtrs X 1.2mtrs X 1.2mtrs. Once measured out the team will, using the aid of the CAT and Genny, Breaker pack and insulated digging tools, begin to dig out the trial pit to the previously mentioned dimensions, checking for any buried services not found by the GPR Survey. The process was repeated throughout the job for the three trial pits, the pit serves two functions,

Function 1: to serve as the base for the later chamber installation,

Function 2: to provide a suction point for the drilling flush.

Fig. 7: Image taken of a trial pit being dug completed February 2023

Rig-Setup

With the trial pit dug and the area safe for drilling completed, the team tracked the rig over to the pit, set the rig up over the pit, jacking the rig up and using the built in spirit levels to calibrate the correct angle of the mast for drilling.

The rig is jacked and levelled so that when the drilling operations start the drilling angle will remain true and minimise the chances of the rods going offline. With the rig jacked up and levelled the rig can also utilise its full pullback weight with the jacks distributing the weight of the rig evenly.

Drilling flush

Before drilling ops can begin, the team will mix and weigh the correct amount of bentonite or Polymer to water, the reason we add these substances to the drilling flush is so that when we begin the drilling operations and throughout the job, we can maintain the structural integrity of the borehole walls and allow for the debris produced by the drilling process to clear the hole and rise to the surface to be collected in the trial pit. Both of the LCM (Loss Circulation Material) utilise the same delivery and mixing techniques into the drilling tanks.

6. DRILLING OPPERATIONS (FEB-JUNE-2023)

BH1

The team using a 14 ¾" BHA (Bottom Hole Assembly) drilled to a depth of 23.80MBGL (Metres Below Ground Level) the 10" permanent casing was installed in the BH, this left a 20cm lip above ground level and was grouted in place. The 14 ¾" BHA was removed and replaced with a 9 5/8" BHA, the drilling operation continued to a final depth of 151MBGL. Loss of flush and grouting operations not producing results, led to the decision to abandon the BH and move onto the next location, with decommissioning operations to take place later.

BH2

The team using a 14 ¾" BHA drilled to a depth of 23.80MBGL the 10" permanent casing was be installed in the BH, this left a 20cm lip above ground level and was grouted in place. The 14 ¾" BHA was removed and replaced with a 9 5/8" BHA, the drilling operation continued to a depth of 54MBGL, 7" Casing was installed to 54mbgl and the 9 5/8" BHA Was replaced with a 6" BHA and drilled to a final depth of 171MBGL, an electrical conductivity test was carried out by a member of the Coal Authority, the results of which led to the realisation that we likely hit a pillar of unworked coal in the Hutton seam, however the tests did confirm that the High Main Seam connection was above expectations and a decision was then made to retain this borehole as the High Main Seam monitoring borehole .

BH3

The team using a 14 ¾" BHA drilled to a depth of 23.80MBGL the 10" permanent casing was installed in the BH, this left a 20cm lip above ground level and was grouted in place, The 14 ¾" BHA was removed and replaced with a 9 5/8" BHA, the drilling operation continued to a final depth of 134MBGL. Loss of flush and grouting operations not producing results with the added time and budgetary constraints led to the decision of changing the final install depth to 134MBGL, in the Brass Thill Seam rather than the Hutton Seam.

7. INSTALLATION (JUNE-2023)

BH2

Casing

Before the installation of the 4" casing in BH2 the team backfilled the BH to a Depth of 55.61MBGL With Gravel and Bentonite pellets to create a good seal. The team then assembled and moved the grout basket in place over the BH location. From there the team lowered the first section of the casing in place in the BH, the section was clamped before the end of the pipe towards the join and from there the team loosened the lifting head and moved towards the next section. The team connected the next section of the 4" casing and moved it into place over the grout basket section, the 4" casing was then connected and the joint taped to prevent grout from leaking into the casing during the later grouting stage. After the joint was taped a HD50 Centraliser was then attached to the join, this process was then repeated till the 4" casing was installed to depth. Once the casing was installed to depth, the team introduced two bags of bentonite pellets down the anulus of the BH and casing, with the grout basket catching the bentonite pellets and ensuring a good seal. A small amount of grout was ran in, creating a good solid foundation ready for the remaining grout introduction which the team later introduced and completed.

Fig. 8: Image taken of the installation of BH2 completed June-2023

<u>Chamber</u>

The installation of the chamber rings and completion of the chamber began with the team extending the trial pit outwards, giving the team room to get in and cut the casing down. The team completed the shuttering around the base of the chamber making sure that the pit was dug to 80cm deep and backfilling the outer edges of the trail pit with the removed debris from the pit extension measuring the top of the shuttering so that it was 60cm exact from G/L.

Once the shuttering was done, the team mixed up concrete and poured it into the shuttering, smoothing the surface and measuring levels to maintain the 60cm from G/L to the top of the shuttering. From this point the team allowed the concrete to harden. Once the concrete had gone off the team marked out the 10” and 4” casing, cutting both to the correct depths before the team moved the chamber rings into position using a mortar mixture to fix the rings to the base of the concrete plinth, ensuring the chamber rings were level and the correct height from G/L. The exterior of the trial pit was then filled in with concrete to just below the top of the chamber rings. Once set off the team installed the chamber lid to the top of the chamber with mortar and concrete around the whole lid so that the top of the lid is flush to G/L.

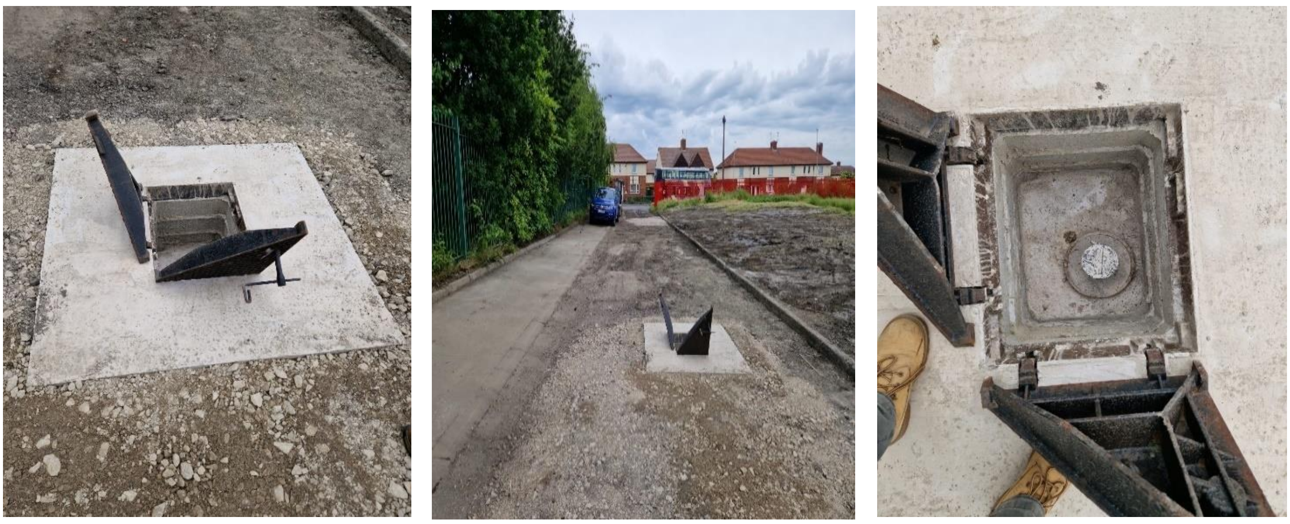

Fig. 9: Image taken of the chamber before and after photos, completed in June-2023

BH3

Casing

Before the installation of the 4" riser, the team prepped and installed the crossover thread from 4" bsp to the casing pipe thread. They then attached the first section of casing to the packer and moved the packer in place over the BH location with the aid of the drilling rig's winch. The team then assembled the nitrogen bottle and airline hose, running the hose from the packer to the nitrogen bottle ready to inflate the device when final depth was reached. The join was then taped and a HD50 Centraliser attached to the Casing section above the join, the Coal Authority and Silixa then attached their cables to the 4" casing just above the join and top of the packer, with both cables on drums attached to trestles and fed over a roller being suspended by the telehandler. This allowed for a clean installation of both the cables, Drilcorp also attached the first grout pipe to the HD50 Centraliser. From there the team lowered the first section of the casing in place in the BH, the section was clamped before the end of the pipe towards the join and from there the team loosened the lifting head and moved towards the next section. The team connected the next section of the 4" casing and moved it into place over the casing join, the 4" casing was then connected and the joint taped to prevent grout from leaking into the casing at a later stage. After the joint was taped a HD50 Centraliser was then attached to the join and the Fibre optic cable and piezo wire taped and secured to the 4" casing with the second grout pipe taped on at 85MBGL, this process was then repeated till the 4" casing was installed to depth.

Cable depths:

Tab. 3: Table of cable install depths

Thermistor Depths	Piezo Depths	Fibre Optic Cable
49.16mbgl	11.56mbgl	119.67mbgl
119.67mbgl	27.29mbgl	
	79.70mbgl	

Once the casing was installed to depth, the team introduced grout into the casing annulus from 120MBGL to 85MBGL, and then a special mixture of grout and bentonite with a ratio of (cement x 1, water x 2, bentonite x 0.36) was introduced from 85MBGL TO 10MBGL. The remaining 10m was topped up with normal grout.

Fig. 10: Image acquired during the installation of the 4" casing and adjoining cables completed in June-2023

Chamber

The installation of the chamber rings and completion of the chamber began with the team extending the trial pit outwards, giving the team room to get in and cut the casing down, the team completed the shuttering around the base of the chamber making sure that the pit was dug to 80cm deep and backfilling the outer edges of the trail pit with the removed debris from the pit extension measuring the top of the shuttering so that it was 60cm exact from G/L.

Once the shuttering was done the team mixed up concrete and poured it into the shuttering, smoothing the surface and measuring to maintain the 60cm from G/L to the top of the shuttering, from this point the team allowed the concrete to harden. Once the concrete had gone off, the team marked out the 10” and 4” casing, cutting both to the correct depths before the team moved the chamber rings into position using a mortar mixture to fix the rings to the base of the concrete plinth, ensuring the chamber rings are level and the correct height from G/L. The exterior of the trial pit was then filled in with concrete to just below the top of the chamber rings. Once set off the team installed the chamber lid to the top of the chamber with mortar and concrete around the whole lid so that the top of the lid is flush to G/L.

Fig. 11: Image taken of the chamber before and after photos, completed in June-2023

8. RE-INSTATEMENT (JUNE-2023)

Due to the small site footprint, the state of the ground and the plant being utilised on site, the condition of the ground had been compromised. The wet and rainy conditions throughout the project contributed towards the state of the ground on site, with the project moving into the warmer months, the condition of site improved to the point that a final re-instatement date could be planned and carried out.

With the aid of a mini-digger and telehandler, the team cleaned the roadway, path and the field section, and smoothed and filled in any holes and uneven patches of ground. They used either the pre-existing ground or bags of gravel / ballast to achieve the ideal ground condition. The team used ballast to fill in the holes on the roadway whilst the soil was used to fill in the grass way.

Fig. 12: Images acquired after the re-instatement operations carried out in June-2023

9. BH1: DECOMMISSIONING

Along with the re-instatement works being carried out, the team decommissioned BH1, they excavated the trial pit, then proceeded to backfill and then grout the BH to the bottom of the trial pit (***Fig. 3)*** reference. The team then cut the casing down to size. They then filled the excavated pit with concrete to G/L, creating a concrete cap, and sealing the BH from the public and re-instating the roadway for safe use.

10. DEMOBILISATION

With all operations complete on site, the team loaded all equipment and materials on either the vans or the waggons that arrived on site. All plant was off-hired and collected, and all materials brought back to Drilcorp's base, the team completed a final walk round on site before signing out and leaving.

DRILCORP

REPORT

BOREHOLE ENGINEERING SERVICES

Contract:	BC23025
Client:	Coal Authority
Site:	A4, Gateshead Living Lab
Boreholes:	BH4a-01A Stadium Hutton, BH4b-01 Stadium High Main
Operations:	1. BH4a-01A: Mobilisation 2. BH4a-01A site set-up 3. BH4a-01A Trial Pit 4. BH4a-01A Drilling ops 5. BH4a-01A Installation of 8” Dropset casing 6. BH4a-01A Installation of 4” pipe 7. BH4a-01A chamber installation 8. BH4b-01 Mobilisation 9. BH4b-01 Site-setup 10. BH4b-01 Trial pit 11. BH4b-01 Drilling ops 12. BH4b-01 Installation of 8” casing 13. BH4b-01 Installation of 4” pipe 14. BH4b-01 Chamber installation

Version	Date	Modification(s) to previous version	Issued by
1	20-August-2024	N/A	J. M. Killeen
2	21-October-2024	More information required	J.M. Killeen
3	15-November-2024	Morne information required	J.M. Killeen

Tab. 1: Document history

Overview of operations at Site 4A, Gateshead living lab

The following report has been prepared by Drilcorp for the Coal Authority.
This report will cover the drilling operations carried out at site A4 of the Gateshead living lab project, this details how Drilcorp drilled and completed two monitoring Boreholes down to the abandoned mine workings below Gateshead.

The two designations of the Boreholes are as follows:

- BH4a-01A: Stadium - Hutton
- BH4b-01: Stadium – High Main

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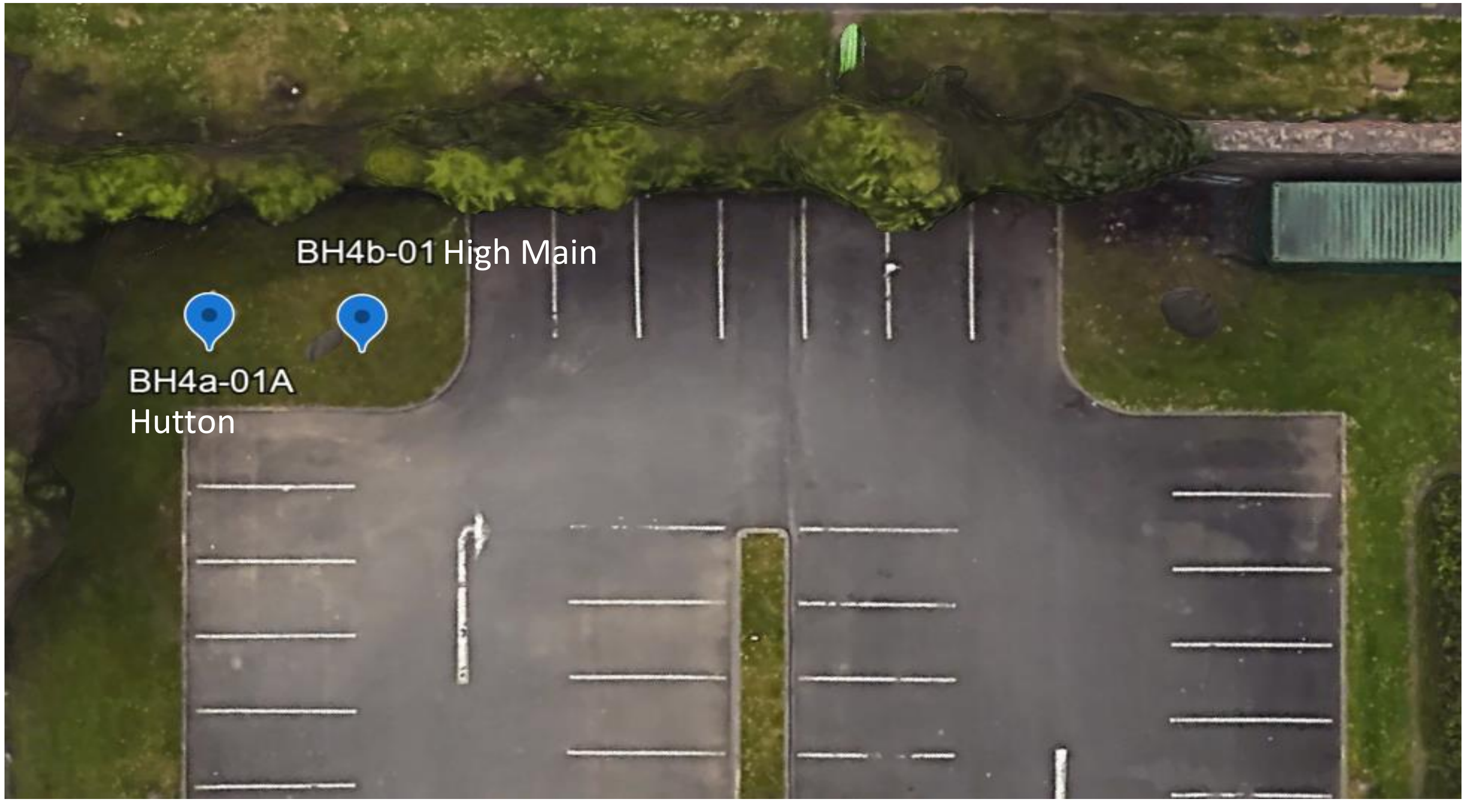
BOREHOLE LOCATIONS

Fig. 1: Aerial view of site A4, Gateshead living labs, and locations of BH4a-01A Hutton and BH4b-01 High Main



	Grid reference:	**What 3 Words:**
• BH4a-01A (Stadium – Hutton):	NZ 27129 62786	///giving.boom.found
• BH4b-01 (Stadium – High Main):	NZ 27127 62788	///puzzle.page.budget

1. BH4a-01A DIAGRAM

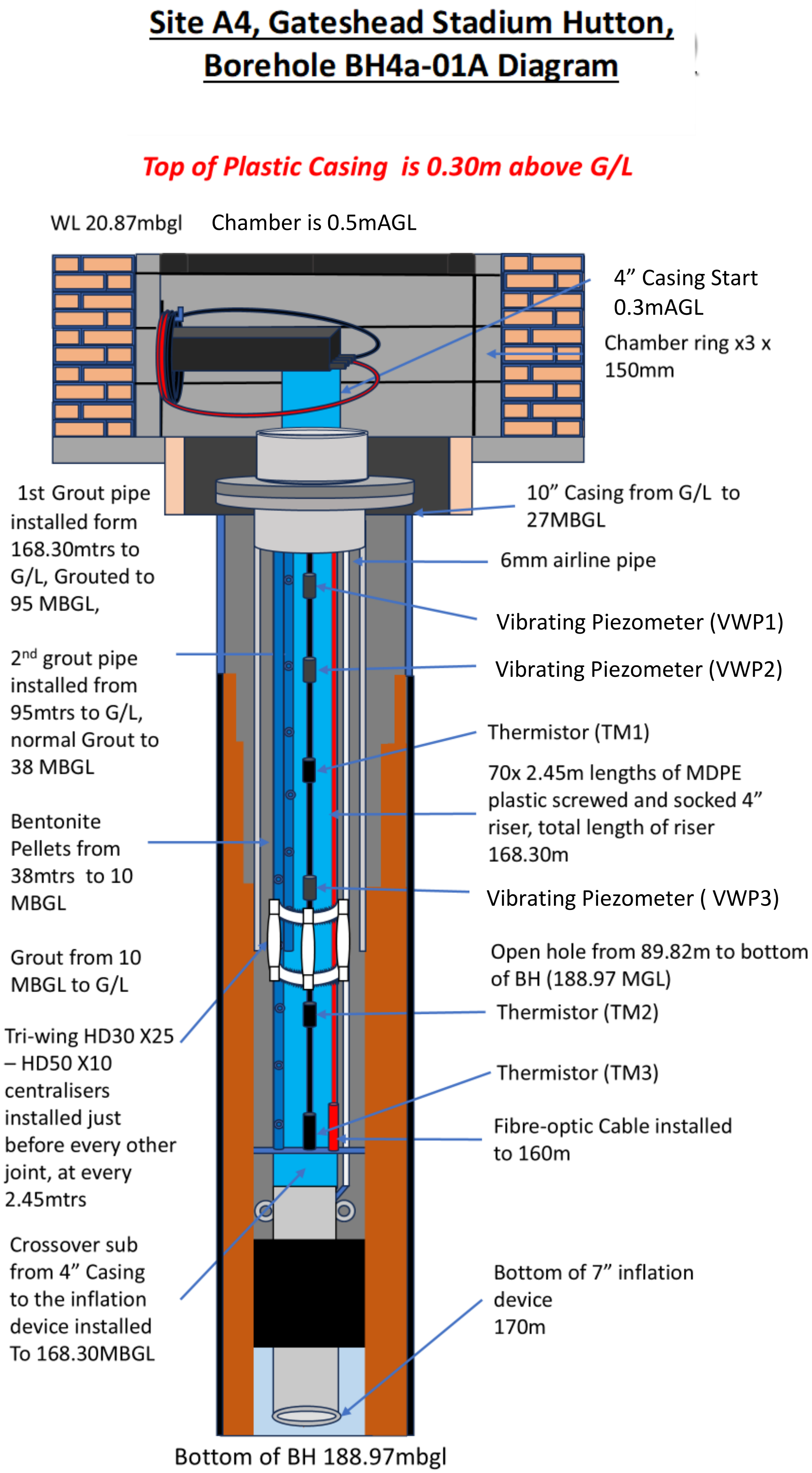


Fig. 2: Diagram of BH4a-01A Hutton

2. BH4b-01 DIAGRAM

Site A4, (Gateshead Stadium High Main BH4b-01 Diagram

GL is 0.30m above 4" casing.

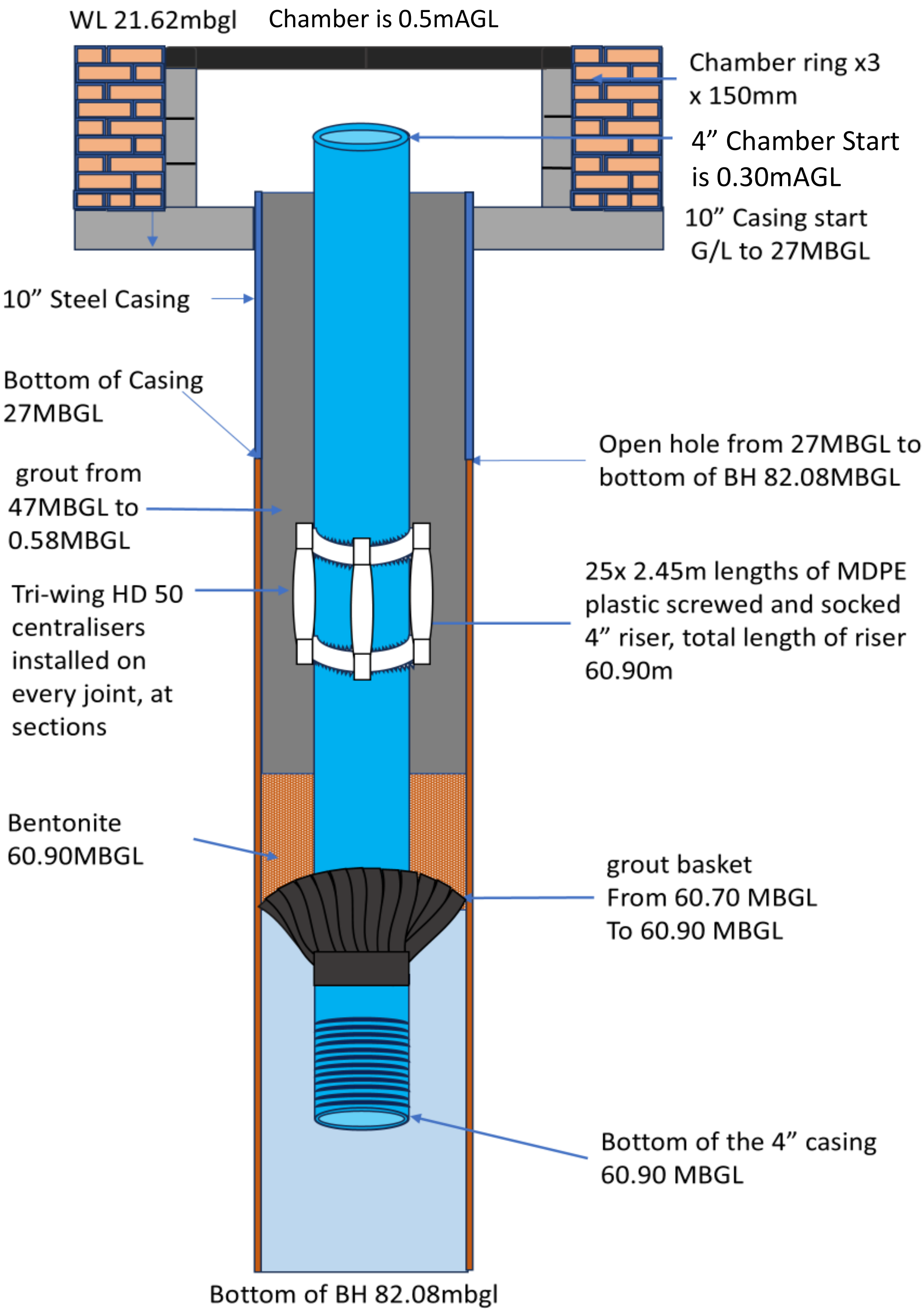


Fig.3: Diagram of BH4b-01 Stadium High Main

3. SEQUENCE OF OPERATIONS

Tab. 2: Sequence of operations for drilling performed at BH4a-01A and BH4b-01

Start	End	Borehole(s)	Operation	Performed by
02/05/2024	03/05/2024	BH4a-01A	Mobilisation	Drilling division
07/05/2024	07/05/2024	BH4a-01A	Setup of site. Trial pit, rig setup	
08/05/2024	08/05/2024	BH4a-01A	Drill to 25m at 14" 3/4 and prepare to run casing	
09/05/2024	10/05/2024	BH4a-01A	Install 25m of 10" casing and grout annulus	
10/05/2024	04/06/2024	BH4a-01A	Drill from 25m to 180m	
29/05/2024	31/05/2024	BH4a-01A	Install 8" dropset for flush lost in workings then grout.	
04/06/2024	05/05/2024	BH4a-01A	Flush BH clean and complete verticality test	
06/06/2024	06/06/2024	BH4b-01	Set up on BH4b-01 Trail pit, Rig Setup	
07/06/2024	07/06/2024	BH4b-01	Drill to 25m at 14" 3/4 and prepare to run casing	
10/06/2024	11/06/2024	BH4b-01	Install 25m of 10" casing and grout annulus	
11/06/2024	17/06/2024	BH4b-01	Drill from 25m to 70m	
18/06/2024	18/06/2024	BH4b-01	Flush BH clean and complete verticality test	
18/06/2024	20/06/2024	BH4b-01	Install PVC liner, seal and first grout pass	
10/07/2024	12/07/2024	BH4b-01	Complete chamber and top off grout	
21/06/2024	21/06/2024	BH4a-01A	Set back up on BH4a-01A then flush b/h before install	
27/06/2024	27/06/2024	BH4a-01A	Install 8" casing into BH4a-01A from G.L to 90.0m	
28/06/2024	28/06/2024	BH4a-01A	Run rods into b/h and flush to base of b/h to 188.97m	
01/07/2024	02/07/2024	BH4a-01A	Install PVC liner and instruments, inflate packer and check for seal	
03/07/2024	05/07/2024	BH4a-01A	Run first grout pass into BH then run 2nd pass into b/h,	
10/07/2027	11/07/2024	BH4a-01A	Complete chamber and top off grout	
09/07/2024	12/07/2024	BH4a-01A -BH4b-01	Demobilise	

4. PRE-DRILLING OPS

Mobilisation

Drilcorp arrived on site Monday the 02nd of May 2024, two wagons shortly arrived on site ready to be unloaded and the site setup ready for the planned operations.

Site-setup

The team employed good traffic control techniques while escorting wagons during peak and general hours, through the Stadium and college. Whilst keeping spatial awareness in mind, the plant and equipment delivered on site where then maneuvered into place ready for the next phase of the plan, within the agreed borders of site.

Safety and informational signs were secured at appropriate sections of the fencing. Additional H&S (Health and Safety) documentation along with the Rams and job program were located in the welfare unit.

Along with plant movement and equipment setup, the site was secured using Heras fencing. This enclosed the entirety of the site, with safety signs attached to the fencing at appropriate intervals. A site office was set up, which contained the health and safety and construction information. This information detailed the muster points and gas detection zones throughout site, as well as the induction point to access site.





Fig. 4: Image taken of the site- setup

GPR

A GPR (Ground Penetrating Radar) survey was conducted on the 01st Sep 2022 by an independent organization on behalf of Drilcorp. The GPR team carried out a full site survey, identifying any hidden and buried services throughout site, this includes: water, gas and electrical utilities. The survey revealed the surrounding utilities on site, with no utilities identified on or around the Drilling location.

The GPR team mapped out and geo-tagged the BH drilling locations, marking them with both a crossed symbol and ID Number. With nothing found and the BH locations marked out, The High Main borehole location was moved away from its original surveyed location due to proximity to the fence line, and was brought more in line with the initial Hutton Borehole.

Trial Pit

BH locations marked out and the area free from buried services, the team marked out the trial pit, to the dimensions of 1.2mtrs X 1.2mtrs X 1.2mtrs. Using the aid of the CAT and Genny and insulated digging tools, the team excavated the trial pit, checking for any buried services not identified by the GPR Survey. The first Trial Pit found an obstruction, and so was then moved and carried out again to find no obstruction. As a result, drilling proceeded on High Main borehole. This process was then repeated for the second BH on site.

Rig-Setup

The rig was tracked over the pit and setup, jacking the rig up using hydraulic legs and using the built in spirit levels to calibrate the correct angle of the mast for drilling.
The rig is jacked and levelled so that when drilling operations start, the drilling angle will remain true and minimise the chances of the rods going offline. With the rig jacked up and levelled, the full potential of the rig can be used and, in turn, its full pullback weight with the jacks distributing the weight of the rig evenly.

Drilling flush

The team mixed and weighed the correct amount of bentonite and Polymer to water ratio. The reason these substances were added to the flush is to aid in drilling operations and, throughout the job, flush can maintain the structural integrity of the borehole walls. This also allows for debris produced by the drilling process to clear the hole and rise to the surface to be collected in the trial pit. This is then transferred through the mud treatment system. Water for site was supplied via a hydrant on site.

Fig. 5: Image taken of the mud treatment and shaker plant

5. DRILLING OPERATIONS

BH4a-01A- Stadium Hutton

The team using a 14 ¾” BHA (Bottom Hole Assembly) drilled to a depth of 27MBGL (Metres Below Ground Level). The 10” permanent casing was installed in the BH and was grouted in place. The 14 ¾” BHA was removed and replaced with a 9 5/8” BHA, with the drilling operation continuing to a depth of 167.36MBGL. An 8” dropset casing was then installed from 152.36MBGL to 167.36MBGL and grouted in place. Drilling continued at 7 5/8” to a total depth of 188.97 mBGL. Following completion, the top section of the borehole was found to be collapsing, and was redrilled to 89.42 mBGL, before a permanent 8” casing string was installed, and hung off the 10” surface casing.

BH4b-01- Stadium High Main

The team using a 14 ¾” BHA drilled to a depth of 27MBGL. The 10” permanent casing was installed in the BH and grouted in place. The 14 ¾” BHA was removed and replaced with a 9 5/8” BHA, and the drilling operation continued to a depth of 82.08MBGL.

6. INSTALLATION

BH4b-01 Stadium High Main

Casing

The team assembled and moved the grout basket in place over the BH location. From there the team lowered the first section of the casing in place over the BH, which was clamped before the end of the join. From there the team loosened the lifting head and moved towards the next section. The team connected the next section of the 4” casing and moved it into place over the grout basket section. The 4” casing was then connected and the joint taped to prevent grout from leaking into the casing during the later grouting stage. After the joint was taped a HD50 Centraliser was then attached to the join, this process was then repeated till the 4” casing was installed to depth. Once the casing was installed to depth, the team introduced two bags of bentonite pellets down the annulus of the BH and casing, with the grout basket catching the bentonite pellets and ensuring a good seal. A small amount of grout was ran in, creating a good solid foundation ready for the remaining grout which the team later introduced and completed.

Fig. 6: Image taken of the installation of BH4b-01 Stadium High Main

Chamber

Shuttering was built up around the casing allowing for grout to be poured to G/L and be leveled off.

Once the shuttering was done, the team mixed up concrete and poured it into the trial pit surrounding the shuttering, smoothing the surface and measuring levels to maintain an even finish to G/L. From this point the team allowed the concrete to harden. Once the concrete had gone off the team marked out the 10” and 4” casing, cutting both to the correct depths, before the team moved the chamber rings into position using a mortar mixture to fix the rings to the base of the concrete plinth. They ensured the chamber rings were level and the correct height from G/L. Once set off the team installed the lid to the top of the chamber with mortar and concrete. This was installed around the whole lid so that the top of the lid is flush to the surface of the chamber.

From there the team built up the exterior of the chamber using bricks to achieve a professional finish and to secure the chamber.

Fig. 7: Image taken of the chamber before and after photos

BH4a-01A Stadium Hutton

Casing

Before the installation of the 4” riser, the team prepped and installed the crossover thread from 4” bsp to the casing pipe thread. They then attached the first section of casing to the packer and moved the packer in place over the BH location with the aid of the drilling rig’s winch. The team then assembled the nitrogen bottle and airline hose, running the hose from the packer to the nitrogen bottle ready to inflate the device when final depth was reached. The join was then taped and a set of HD30 centralisers were attached above the join. Drilcorp also attached the first grout pipe to the HD30 Centraliser. Lengths of casing were added and the process of taping and adding a centralizer were repeated, until the 160 mBGL mark on the casing. The Coal Authority and Silixa then attached their cables to the 4” casing from the 160 mBGL mark, with both cables on drums attached to trestles and fed over a roller being suspended by the telehandler. This allowed for a clean installation of both the cables. From there the team lowered the casing in place in the BH, the section was clamped before the end of the pipe towards the join and from there the team loosened the lifting head and moved towards the next section. The team connected the next section of the 4” casing and moved it into place over the casing join. The 4” casing was then connected and the joint taped to prevent grout from leaking into the casing at a later stage. After the joint was taped a HD30 Centraliser was then attached to the join and the Fibre optic cable and piezo wire were taped and secured to the 4” casing with the second grout pipe attached. This process was then repeated till the 4” casing was installed to depth. Towards the top of the casing install, HD50 centralizers were used with two fins removed in order to fit inside the 8" steel casing.

Cable depths:

Tab. 3: Table of cable install depths

Thermistor Depths	Piezo Depths	Fibre Optic Cable
47.86mbgl	**10.27mbgl**	**160mbgl**
120.45mbgl	**30.28mbgl**	
160mbgl	**80.22mbgl**	

Once the casing was installed to depth, the team introduced grout into the casing annulus from 160MBGL to 95MBGL, and then grout was introduced from 95MBGL TO 10MBGL. The remaining 10m was topped up with normal grout.

Fig. 8: Image taken of the installation of BH4b-01 Stadium Hutton

Chamber

Shuttering was built up around the casing allowing for grout to be poured to G/L and be leveled off.

Once the shuttering was done, the team mixed up concrete and poured it into the trial pit surrounding the shuttering, smoothing the surface and measuring levels to maintain an even finish to G/L. From this point the team allowed the concrete to harden. Once the concrete had gone off the team marked out the 10" and 4" casing, cutting both to the correct depths before the team moved the chamber rings into position using a mortar mixture to fix the rings to the base of the concrete plinth. This ensured the chamber rings were level and the correct height from G/L. Once set off the team installed the lid to the top of the chamber with mortar and concrete. This was installed around the whole lid so that the top of the lid is flush to the surface of the chamber.

From there the team built up the exterior of the chamber using bricks to achieve a professional finish and to secure the chamber.

Fig.9: Image taken of the chamber before and after photos,

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Appendix B: VWP calibration file – Bede

Site	*Bede*
BH ID	Bede – BT
Target	Brass Thill
Zero Baro (kPa)	103.2
Zero Temp (°C)	11

VWP – BedeBT_11.56m			
SN	361271		
Install depth	11.56m		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9302.4	9302.4	9302.4
A constant	-4.23E-07	-7.70E-08	-4.31E-08
B constant	-9.09E-02	-1.35E-02	-9.27E-03
C constant	881.95	131.98	89.93
Thermal	2.18E-01	4.07E-02	2.22E-02
Linear (K)	-9.73E-02	1.41E-02	-9.92E-03

VWP – BedeBT_27.29m			
SN	334698		
Install depth	27.29m		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9304.8	9304.8	9304.8
A constant	-6.44E-07	-9.35E-08	-6.57E-08
B constant	-1.09E-01	-1.59E-02	-1.12E-02
C constant	1074.01	155.77	109.52
Thermal	-2.52E-02	-3.66E-03	-2.57E-03
Linear (K)	-1.19E-01	-1.72E-02	-1.21E-02

VWP – BedeBT_79.7m			
SN	361418		
Install depth	79.7m		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9645	9645	9645
A constant	-1.79E-06	-2.59E-07	-1.82E-07
B constant	-3.18E-01	-4.61E-02	-3.24E-02
C constant	3230.94	468.59	329.47
Thermal	5.78E-01	8.38E-02	5.89E-02
Linear (K)	-3.47E-01	-5.03E-02	-3.54E-02

Appendix C: VWP calibration file – Stadium

Site	*Stadium*
BH ID	Stadium – H
Target	Hutton
Zero Baro (kPa)	101.2
Zero Temp (°C)	17

VWP_10.27m			
SN	361273		
Install depth	10.27 mBGL		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9066.9	9066.9	9066.9
A constant	-6.06E-07	-8.78E-08	-6.72E-08
B constant	-9.57E-02	-1.39E-02	-9.76E-03
C constant	917.58	133.08	94.01
Thermal	2.34E-01	3.39E-02	2.39E-02
Linear (K)	-1.05E-01	-1.52E-02	-1.05E-01

VWP_30.28			
SN	334659		
Install depth	30.28 mBGL		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9390.1	9390.1	9390.1
A constant	-6.54E-07	-9.49E-08	-6.67E-08
B constant	-1.81E-01	-1.58E-02	-1.11E-02
C constant	1756.17	156.55	110.07
Thermal	2.36E-01	3.42E-02	2.40E-02
Linear (K)	-1.18E-01	-1.71E-02	-1.21E-02

VWP_80.22m			
SN	361419		
Install depth	80.22 mBGL		
	kPa per digit	PSI per digit	mH2O per digit
Avg. Site Zero	9802.9	9802.9	9802.9
A constant	-1.03E-06	-1.50E-07	-1.05E-07
B constant	-2.73E-01	3.96E-02	-2.78E-02
C constant	2775.26	-373.74	283.00
Thermal	4.58E-01	6.64E-02	4.67E-02
Linear (K)	-2.90E-01	-4.20E-02	-2.95E-02