AVON DAM MONITORING BOREHOLES REPORT

September 2015
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Energy and Engineering

S2313 AND S2314 MONITORING BOREHOLES

Avon Dam Hole 1 (S2313) and Avon Dam Hole 2 (S2314) were drilled in Dendrobium Area 3B during the period June-August 2015, for Dams Safety Committee monitoring and reporting purposes.

CONTENTS

INTRODUCTION

The Illawarra Coal *Energy and Engineering* Exploration Team were tasked with drilling, testing & instrumenting two boreholes in Dendrobium Area 3B, for the purpose of characterising & monitoring the geology & hydrogeology of the 'barrier pillar' between Avon Reservoir and the footprint of longwalls in Area 3B. The holes were proposed by Illawarra Coal (IC) as part of the monitoring requirement for Area 3B. The NSW Dams Safety Committee (DSC) confirmed the requirement for monitoring in their letter dated 15 July 2014. DSC Avon Dam Hole 1 (S2313) is located adjacent to the western end of Dendrobium Longwall 12, and DSC Avon Dam Hole 2 (S2314) is located adjacent to the western end of Dendrobium Longwall 13 & 14. Refer to Figure 1 for the location of the DSC Avon holes relative to the Dendrobium Mine plan. At the time of drilling these monitoring holes, Dendrobium Longwall 11 was being extracted. The location of S2313 and S2314 ensures adequate pre-mining data will be obtained from future Dendrobium longwall mining. Additional holes are proposed in the barrier pillar adjacent to Longwalls 15, 16 & 17. Refer Figure 1, green borehole locations. The additional holes will be drilled to ensure there is sufficient baseline data available, prior to extraction.

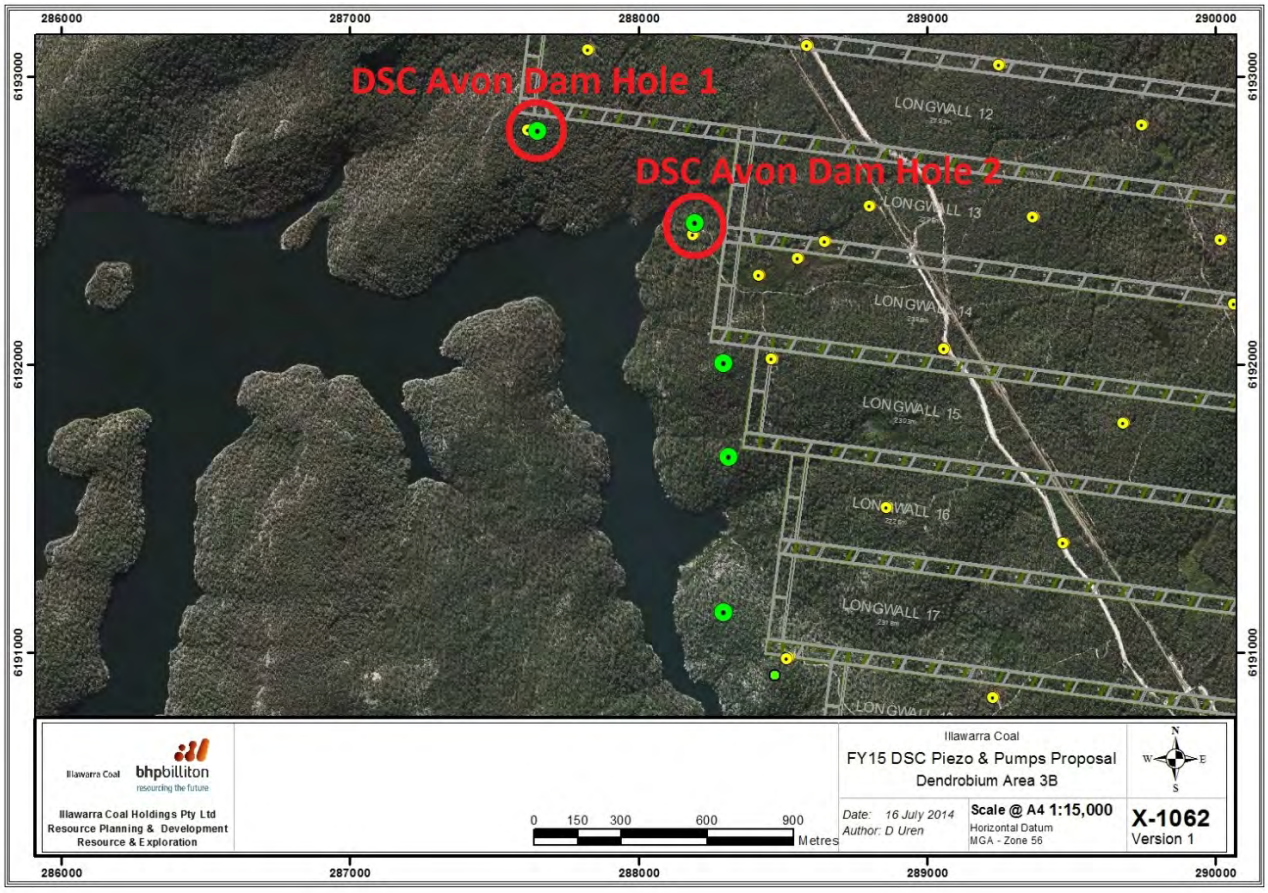

Figure 1: Location of S2313 and S2314 relative to Dendrobium Mine plan.

The two holes were HQ cored from the surface to the top of the Bulgo Sandstone (BGSS). The BGSS is the upper unit of a collective stratigraphic group also referred to as the Colo Vale Sandstone (CVSS). The core was logged by a geologist; noting lithology, geotechnical zones and defects, core recovery and rock-quality designation (RQD). Additional geotechnical testing on core

conducted after drilling included point load testing and UCS testing on core samples. Hydrogeological testing included porosity & permeability testing of core samples, Lugeon packer testing at 6m intervals and hydraulic conductivity analysis of the entire hole and a falling head test of one higher permeability zone identified in S2313. Both holes had a normal suite of geophysical logs completed, including flow logging, optical televiewer and acoustic scanner.

Upon completion of all testing, each borehole was installed with a time-domain reflector (TDR) cable, three piezometers and three water pumps. Two of the pumps and piezometers are set at nominated horizons in the Hawkesbury Sandstone (HBSS), and the third pump and piezometer is installed in the BGSS. The TDR cable enables the hole to be monitored for deformation/shear.

AVON DAM HOLE 1 (S2313)

DRILLING AND TESTING DETAILS

Lucas Drilling mobilised to site on 10/06/2015 with tracked drilling rig DRS096. Coring commenced on 12/06/2015. During coring operations, gradual water loss conditions were experienced, with total water loss occurring at 106m. Coring continued to total depth of 194.8m, completed on 25/06/2015 (delayed due to restricted Catchment access during wet weather).

Packer testing of the hole commenced on 25/06/2015 by Strata Control Technology (SCT). Packer testing was interrupted for geophysical logging from 29/06/2015-30/06/2015 by Weatherford, with packer testing completed on 07/07/2015. At the completion of packer testing, the hole was reamed out to 123mm by Lucas Drilling to enable sufficient room for equipment installation from 07/07/2015-09/07/2015, with drill rig demobilisation occurring on 10/07/2015. Flow and NMR logging was completed on 07/08/2015 by Surtron. The hole was revisited by DRS096 briefly on 09/09/2015 to complete a falling head test on the interval 101-113m, based on analysis of the packer testing data that indicated higher hydraulic conductivity results in this zone.

GEOLOGICAL LOGGING

All core was logged on site for lithology type and geotechnical defects. Detailed data is recorded in Micromine GBIS software package, and available upon request from the *Energy and Engineering* Exploration Team. Normal lithological conditions for the HBSS, Newport Formation (NPFM), Garie Formation (GRFM), Bald Hill Claystone (BACS) and upper BGSS were encountered. Considerable bedding plane and joint fractures were recorded throughout the HBSS as expected, and moderately abundant friable and jointed zones were present in the BACS. Four very minor faults were logged by the geologist, based on polished to slickensided fracture surfaces that indicate small movement. No major shear or faulted zones were present in the core.

For a graphic report illustrating logged lithology and defects against geophysical data, please refer to Appendix 1 - S2313 Lithology, Geotechnical and Geophysical Graphic. To view a compilation of the photographed core, refer to Appendix 2 - S2313 Core Photography(detailed photographs available upon request).

PACKER TESTING AND FALLING HEAD TEST

SCT were engaged to complete Lugeon-style packer testing and hydraulic conductivity analysis. The scope of work involved packer testing from surface to the bottom of the borehole. A 6m straddle packer assembly was used to isolate sections of the borehole, and water injected into these zones to record hydraulic conductivity.

Results of the packer testing indicate that hydraulic conductivity of the strata ranged from less than 1.0^{-11} m/s in the BACS to a maximum of 3.2^{-6} m/s towards the base of the HBSS. The lower

limit of the testing equipment is 1.0^{-11} m/s. Lithology is a principal control on hydraulic conductivity; with zero flow measured in the BACS, and measureable hydraulic conductivities ranging from 2.2^{-10} m/s to 3.2^{-6} m/s in the HBSS and BGSS. A comparison of hydraulic conductivity with logged defects indicates that there is not a strong relationship between fracture frequency and hydraulic conductivity. However, a near vertical joint was identified in the high conductivity zone from 101.25-113.25m towards the lower HBSS. These findings are summarised in the chart prepared by SCT in Figure 2.

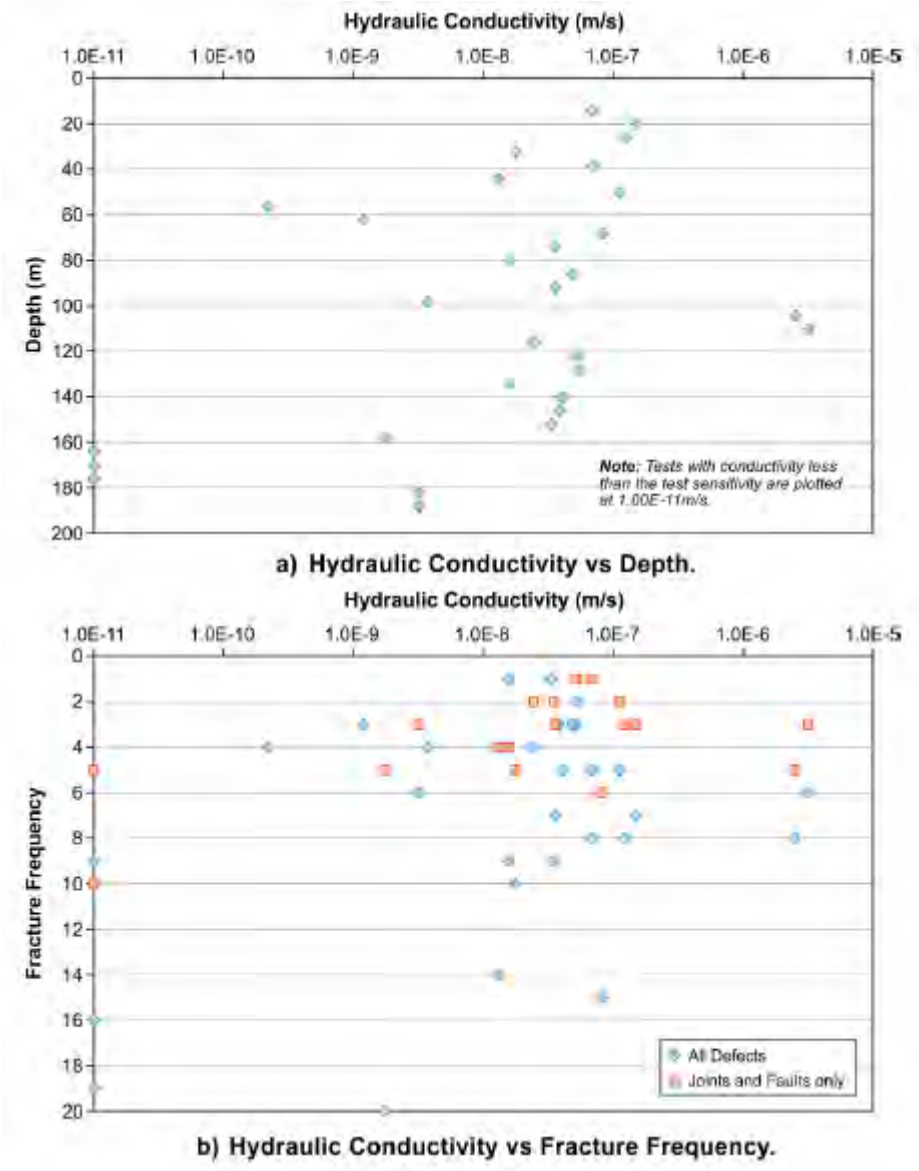

Figure 2: Hydraulic conductivity summary for S2313

The packer test report prepared by SCT is available from the *Energy and Engineering* Exploration Team upon request.

Following the analysis of the hydraulic conductivities, a zone of higher permeability was identified in the lower HBSS from 101.25-113.25m. Based on this, it was decided to investigate the hydraulic conductivity further via a falling head test, conducted by SCT. Falling head tests are performed in a packer isolated interval by charging the rods with water and measuring the resulting water level

decline until a near static condition is observed. Hydraulic conductivity of the interval was calculated via a few different methods, with results that were consistent with each other. SCT have reported a hydraulic conductivity of the interval of $1.0x10^{-6}$ m/s.

The falling head test report prepared by SCT is available from the *Energy and Engineering* Exploration Team upon request.

LABORATORY UCS GEOTECHNICAL TESTING

Eleven geotechnical samples were collated from core and sent to STS for testing of unconfined compressive strength (UCS), elastic and sonic properties. Samples were collected at approximately 10-20m intervals where possible. Results provide point data of the UCS of the intact rock sample, which is the amount of compressive force per unit area applied in a single (uniaxial) direction required to induce failure. Lab UCS results on this borehole widely ranged from a minimum of 11.2 MPa in the upper HBSS, to a maximum of 98.9 MPa in the NPFM.

The results collated by STS are provided as Appendix 3 - S2313 Lab Geotechnical Results

The lab UCS dataset acts as a useful comparison to UCS figures calculated from sonic geophysical data of the entire borehole (refer to Appendix 1 - S2313 Lithology, Geotechnical and Geophysical Graphic for this graphic). The UCS and sonic velocity are geophysical measurement of compression waves travelling through rock and are widely correlated to predict *in situ* rock strength.

PERMEABILITY/POROSITY TESTING OF CORE SAMPLES

Thirteen samples were collated from core and sent to Core Laboratories Australia Pty Ltd for vertical and horizontal permeability and porosity testing. Samples were collected at approximately 10-20m intervals where possible. RPS Australia have been engaged to undertake an analysis of the permeability and porosity results, with the scope including:

- Provision of report that addresses the permeability and porosity results of cored samples;
- Statistical analysis of hydraulic parameters against stratigraphic units, utilising existing bore completion reports; and
- Comparison of core laboratory defined hydraulic parameters against packer testing and geophysical results.

RPS Australia are currently analysing the results of the permeability and porosity sampling, with a report due for completion in early November, 2015. This will be available from the *Energy and Engineering* Exploration Team upon request.

GEOPHYSICAL LOGGING

A geophysical log is a continuous record of measurements made by a probe able to respond to variations in some of the physical property of a rock mass. Weatherford were engaged by Illawarra Coal to compile a full suite of geophysical data, including:

- Gamma.
- Density.
- Multichannel Sonic (90 – 194.9m due to standing water level at 90m).
- Neutron (90 – 194.9m due to standing water level at 90m).
- Resistivity (90 – 194.9m due to standing water level at 90m).
- Verticality.
- Temperature (90 – 194.9m due to standing water level at 90m).
- Acoustic Scanner (90 – 194.9m due to standing water level at 90m).
- Optical Scanner (1-100m due to standing water level at 90m).

Geophysical data is available upon request from the *Energy and Engineering* Exploration Team. For a graphic report illustrating logged lithology and defects against key geophysical data, please refer to Appendix 1 - S2313 Lithology, Geotechnical and Geophysical Graphic

FLOWMETER AND NUCLEAR MAGNETIC (NMR) LOGGING

Surtron were engaged by Illawarra Coal to complete a flowmeter log, using their 9711 Impeller flowmeter. The Impeller flowmeter is a continuous velocity flowmeter log, which measures the fluid flow rates in open and cased wells. Low flow rates of 0.8 litres per second can be detected with the flowmeter. The results do not highlight any areas of significant flow. Complete results are available upon request from the *Energy and Engineering* Exploration Team. For a graphic report illustrating the flow results, refer to Appendix 4 - S2313 Flow Log Graphic.

Whilst conducting the flowmeter log, Surtron offered to trial a new instrument: the nuclear magnetic resonance (NMR) tool. The tool provides a matrix independent porosity, clay and capillary bound fluid and free fluid of the borehole. The results can be used for porosity and permeability calculations, and for characterising fractures. Preliminary results are available for S2313 from the NMR tool in the form of a graphic report that illustrates features including free fluid volume, capillary bound volume, clay bound volume and derived permeability (refer to Appendix 5 - S2313 NMR Log Graphic). Surtron are currently undertaking analysis and preparing a report.

INSTRUMENTATION

Ongoing monitoring of the hole is in the form of a time-domain reflector (TDR) cable, three piezometers and three water pumps. The TDR is a tool which monitors the development of shear movement experienced by the cable, post installation. The vibrating wire piezometers and micropurge pumps are standard equipment for hydrogeological monitoring. Due to the installation of the micropurge pumps for water sampling, muds were not used for drilling and no cement was used in the hole. Instrumentation installation in S2313 was completed on 25/09/2015, according to the array depicted in Figure 3.

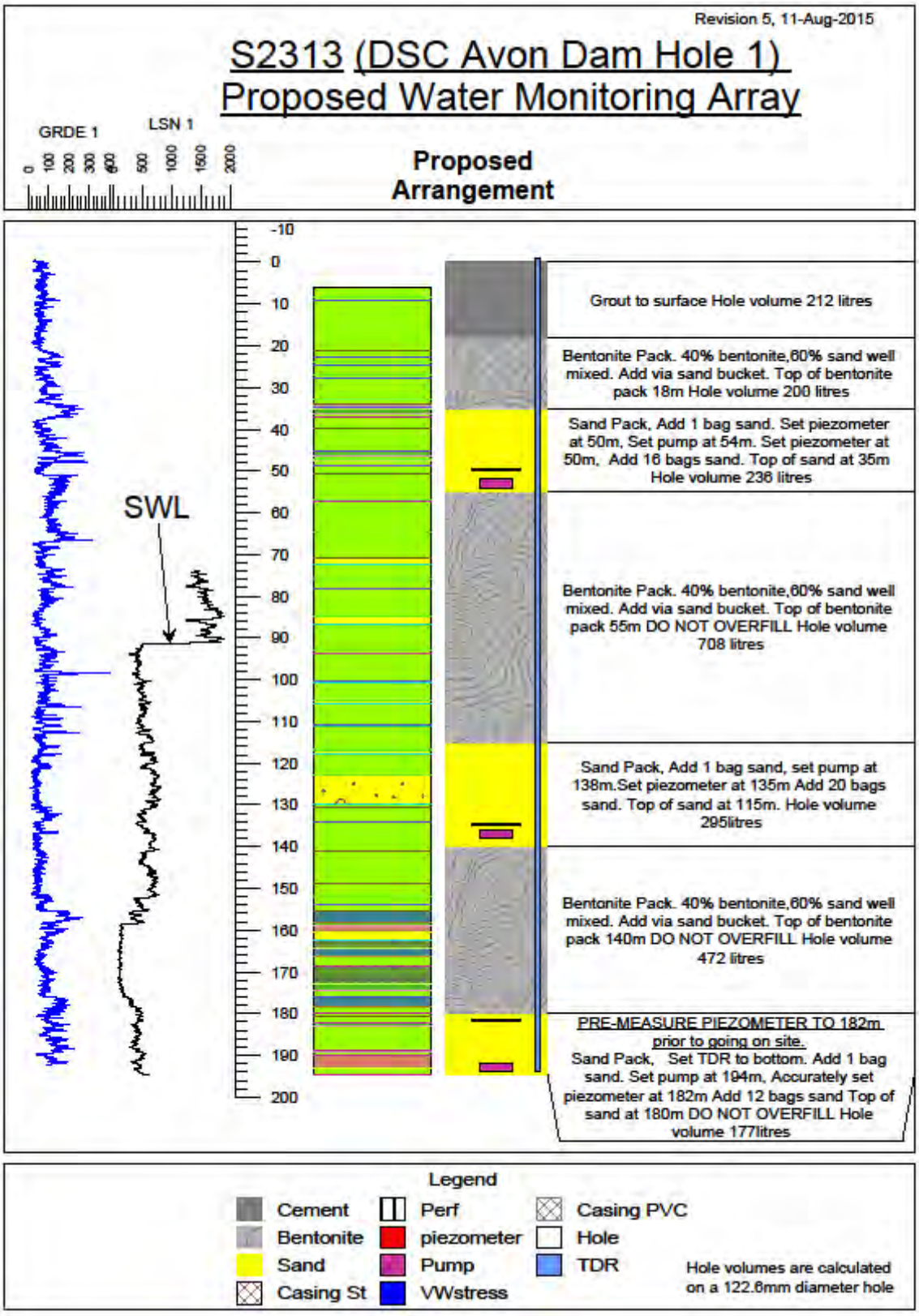

Figure 3: S2313 Instrumentation array.

AVON DAM HOLE 2 (S2314)

DRILLING AND TESTING DETAILS

Lucas Drilling mobilised to site and commenced coring on 14/07/2015 with tracked drilling rig DRS096. During drilling operations, slight water loss occurred. Approximately 50% water loss was recorded around 50m, with water loss continuing throughout drilling at 50% water return rate. Coring continued to total depth of 131.7m, completed on 29/07/2015 (delayed due to wet weather).

Packer testing of the hole commenced on 30/07/2015 by Strata Control Technology (SCT), and completed on 03/08/2015. Geophysical logging of S2314 occurred from 03/08/2015-04/08/2015 by Weatherford. At the completion of logging, the hole was reamed out to 123mm by Lucas Drilling to enable sufficient room for equipment installation from 04/08/2015-07/08/2015, with drill rig demobilisation occurring on 07/08/2015. Flow and NMR logging was completed on 11/08/2015 by Surtron.

GEOLOGICAL LOGGING

All core was logged on site for lithology type and geotechnical defects. Detailed data is recorded in Micromine GBIS software package, and available upon request from the *Energy and Engineering* Exploration Team. Normal lithological conditions for the Hawkesbury Sandstone (HBSS), Newport Formation (NPFM), Garie Formation (GRFM), Bald Hill Claystone (BACS) and upper Bulgo Sandstone (BGSS) were encountered. Considerable bedding plane and joint fractures were recorded throughout the HBSS as expected, and were also moderately abundant in the BGSS. Several bedding planes were recorded in the BACS, although generally the core was less puggy and contained less jointed zones than the BACS observed in S2313. No faulting or major shearing was present in the core. A small defect zone logged as shear towards the base of the borehole is a very mechanically coherent unit.

For a graphic report illustrating logged lithology and defects against geophysical data, please refer to Appendix 6 - S2314 Lithology, Geotechnical and Geophysical Graphic. To view photography of the core, refer to Appendix 7 - S2314 Core Photography

PACKER TESTING AND FALLING HEAD TEST

SCT were engaged to complete Lugeon-style packer testing and hydraulic conductivity analysis on S2314. The scope of work involved packer testing from surface to the bottom of the borehole. A 6m straddle packer assembly was used to isolate sections of the borehole, and water injected into these zones to record hydraulic conductivity.

Results of the packer testing indicate that hydraulic conductivity of the strata ranged from less than 1.0^{-11} m/s in the BACS and BGSS to a maximum of 1.3^{-6} m/s in the uppermost weathered section of the HBSS. The lower limit of the testing equipment is 1.0^{-11} m/s. The results show a generally good correlation of decreasing hydraulic connectivity with increasing depth, particularly in the HBSS. This is a common result observed in packer testing as increasing confining stress acts on the strata.

A comparison of hydraulic conductivity with logged defects indicates that there is a good relationship between hydraulic conductivity and defects logged as joints (although there are some outliers present). Conductivity is notably higher in joints than those defects logged as bedding plane fractures. Furthermore, a significant number of joints and fractures were recorded in the two slightly higher conductivity zones in the BGSS from 118-130m (hydraulic conductivities of 2.6^{-7} m/s and 8.0^{-8} m/s). Lithology remains a principal control on hydraulic conductivity, with zero flow measured in the BACS. Zero flow was also recorded at the top of the BGSS, which corresponded with a fine-grained lithology and zero jointing/faulting.

These findings are summarised in the chart prepared by SCT in Figure 4.

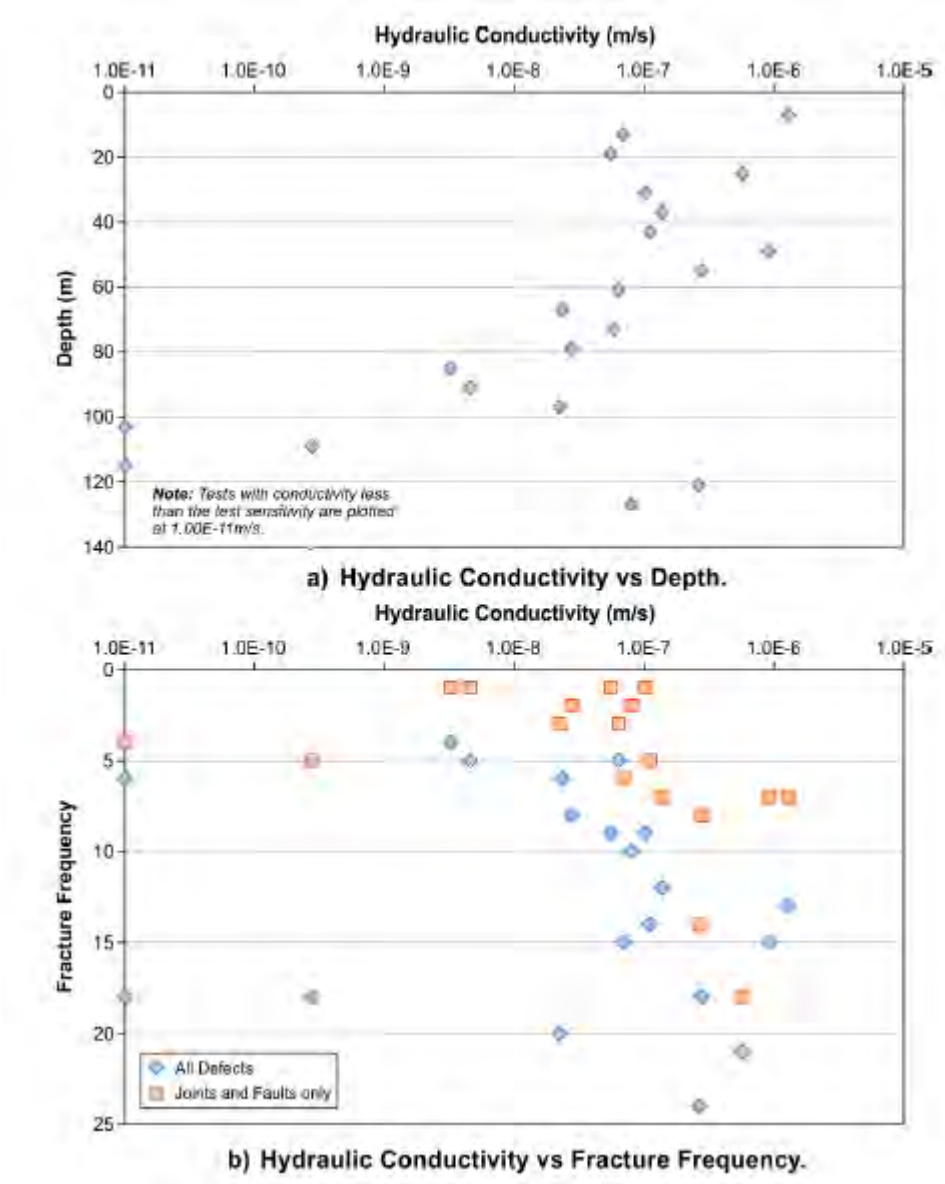

Figure 4: Hydraulic conductivity summary for S2314.

The packer test report prepared by SCT is available from the *Energy and Engineering* Exploration Team upon request.

LABORATORY UCS GEOTECHNICAL TESTING

Twelve geotechnical samples were collated from core and sent to STS for testing of uniaxial, elastic and sonic properties. Samples were collected at approximately 10-20m intervals where possible, particularly concentrated around the BACSS and BGSS/CVSS. Results provide point data of the the UCS of the intact rock sample, which is the amount of compressive force per unit area applied in a single (uniaxial) direction required to induce failure. Lab UCS results on this borehole ranged widely from a minimum of 46.2 MPa in the upper weathered HBSS, to a maximum of 125.1 MPa at the base of the NPFM.

The results collated by STS are provided as Appendix 8 - S2314 Lab Geotechnical Results.

The lab UCS dataset acts as a useful comparison to UCS figures calculated from sonic geophysical data of the entire borehole (refer to Appendix 6 - S2314 Lithology, Geotechnical and Geophysical Graphic for this graphic). The UCS and sonic velocity are geophysical measurement of compression waves travelling through rock and are widely correlated to predict *in situ* rock strength.

PERMEABILITY/POROSITY TESTING OF CORE SAMPLES

Twelve samples were collated from core and sent to Core Laboratories Australia Pty Ltd for vertical and horizontal permeability and porosity testing. Samples were collected at approximately 10-20m intervals where possible, particularly concentrated around the BACSS and BGSS/CVSS. RPS Australia have been engaged to undertake an analysis of the permeability and porosity results, with the scope including:

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Weatherford were engaged by Illawarra Coal to compile a full suite of geophysical data, including:

- Gamma.
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- Resistivity (21 – 131.6m due to standing water level at 21m).
- Verticality.
- Temperature (23 – 131.6m due to standing water level at 21m).
- Acoustic Scanner (23 – 131.6m due to standing water level at 21m).
- Optical Scanner (1-30m due to standing water level at 21m).

Geophysical data is available upon request from the *Energy and Engineering* Exploration Team. For a graphic report illustrating logged lithology and defects against key geophysical data, please refer to Appendix 6 - S2314 Lithology, Geotechnical and Geophysical Graphic

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Whilst conducting the flowmeter log, Surtron offered to trial a new instrument: the nuclear magnetic resonance (NMR) tool. The tool provides a matrix independent porosity, clay and capillary bound fluid and free fluid of the borehole. The results can be used for porosity and permeability calculations, and for characterising fractures. Preliminary results are available for S2314 from the NMR tool in the form of graphic report that illustrates features including free fluid volume, capillary bound volume, clay bound volume and derived permeability (refer to Appendix 10 - S2314 NMR Log GraphicArrangements for Surtron to complete additional analysis and a report summarising key results are currently underway.

INSTRUMENTATION

Ongoing monitoring of the hole is in the form of a time-domain reflector (TDR) cable, three piezometers and three water pumps. The piezometers and pumps are set in sand packs, with piezometer/pump intervals separated by a bentonite and sand mixture. Instrumentation installation in S2314 commenced on 28/09/2015 and was completed on 06/10/2015, according to the array depicted in Figure 5.

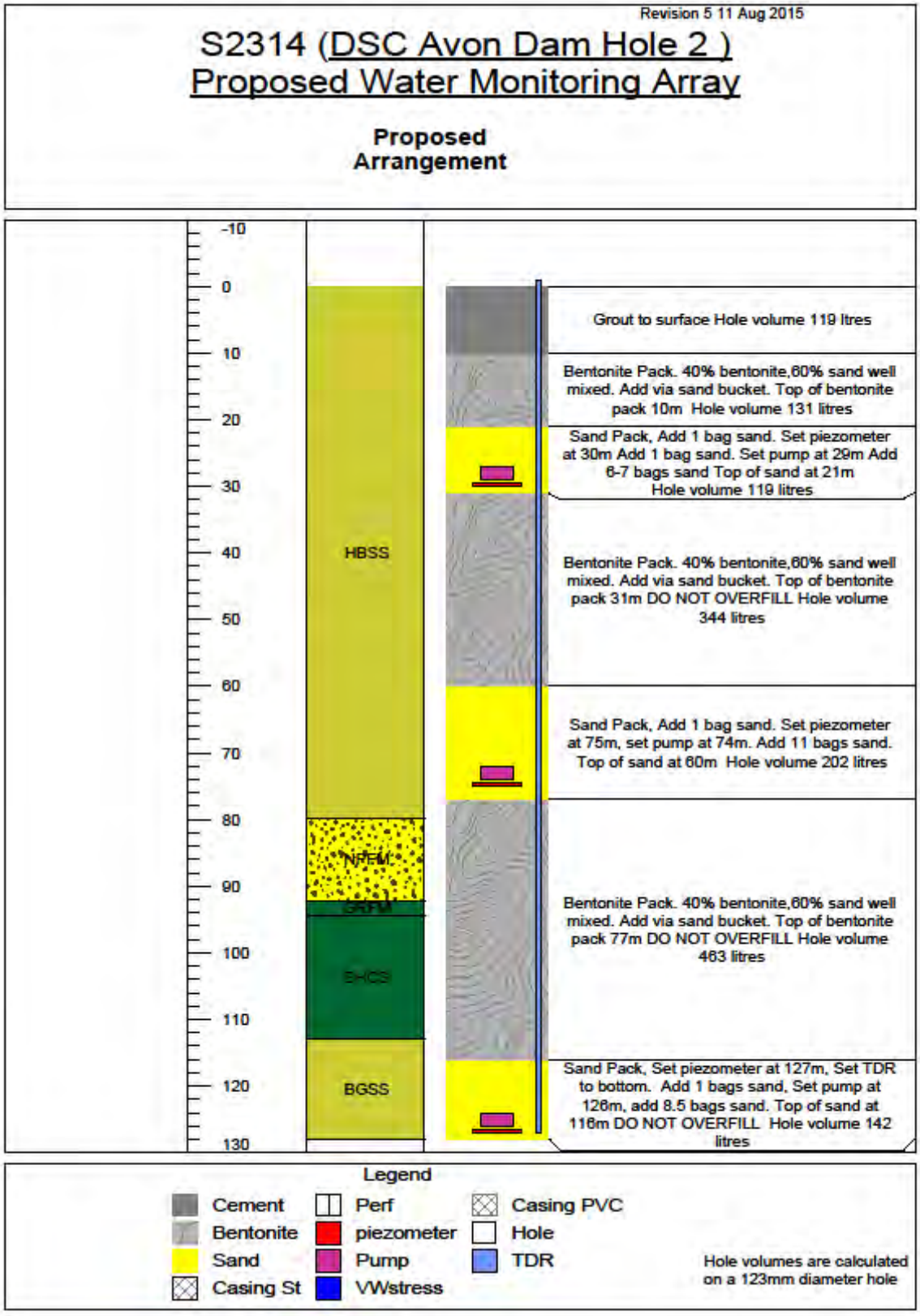
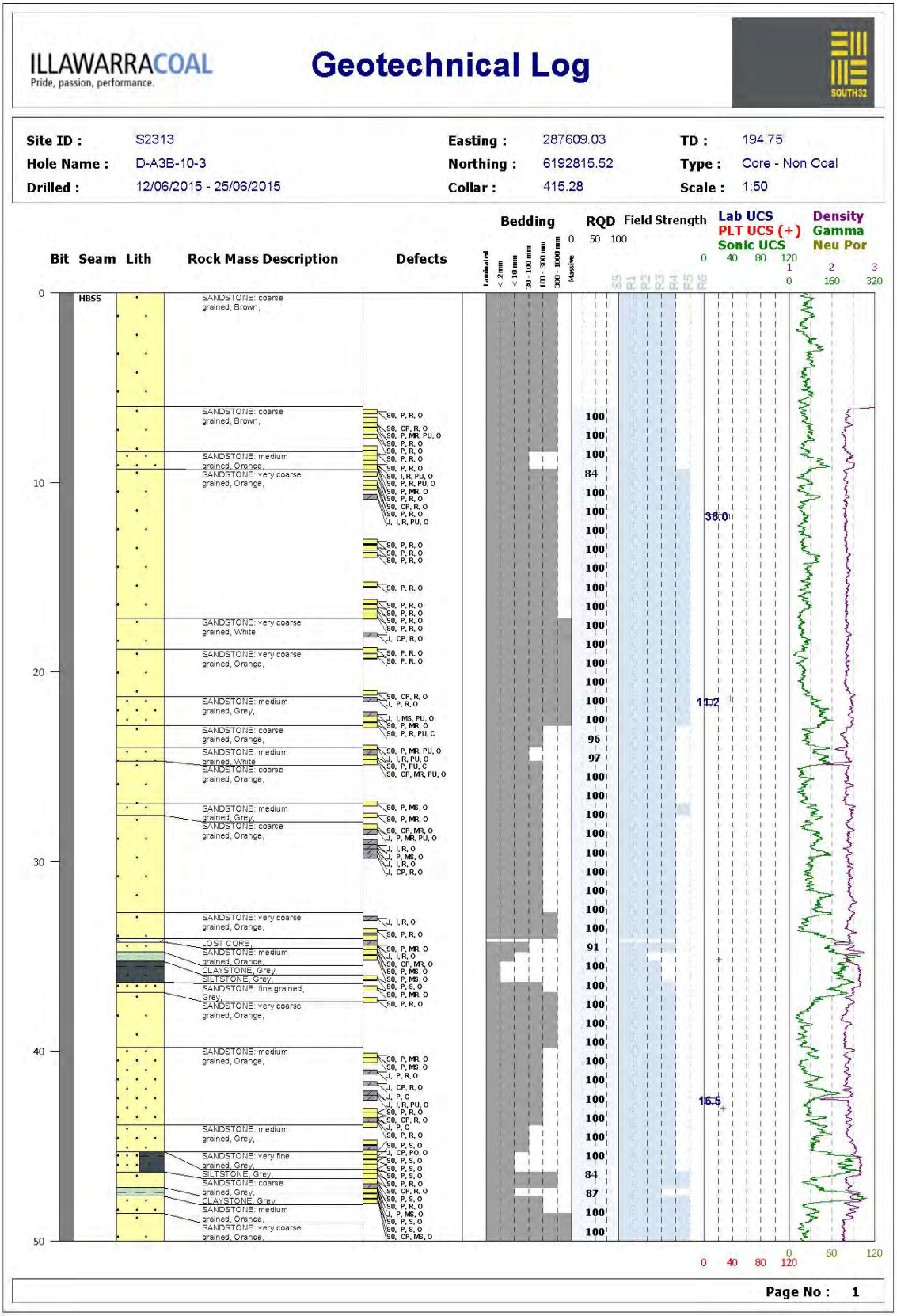


Figure 5: S2314 Instrumentation array.

APPENDIX

APPENDIX 1 - S2313 LITHOLOGY, GEOTECHNICAL AND GEOPHYSICAL GRAPHIC

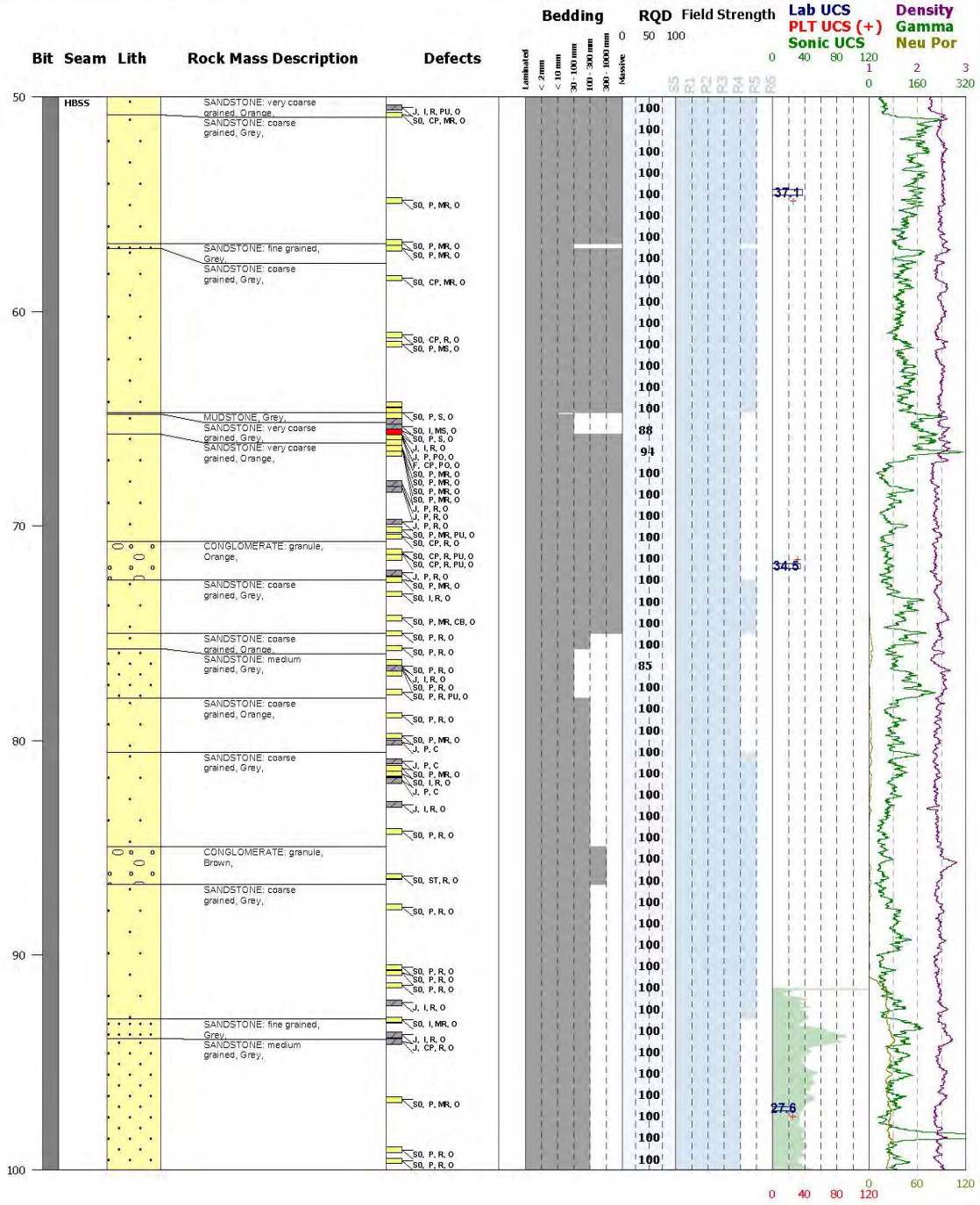


ILLAWARRACOAL
Pride, passion, performance.

Geotechnical Log

SOUTH32

Site ID :	S2313	**Easting :**	287609.03	**TD :**	194.75
Hole Name :	D-A3B-10-3	**Northing :**	6192815.52	**Type :**	Core - Non Coal
Drilled :	12/06/2015 - 25/06/2015	**Collar :**	415.28	**Scale :**	1:50



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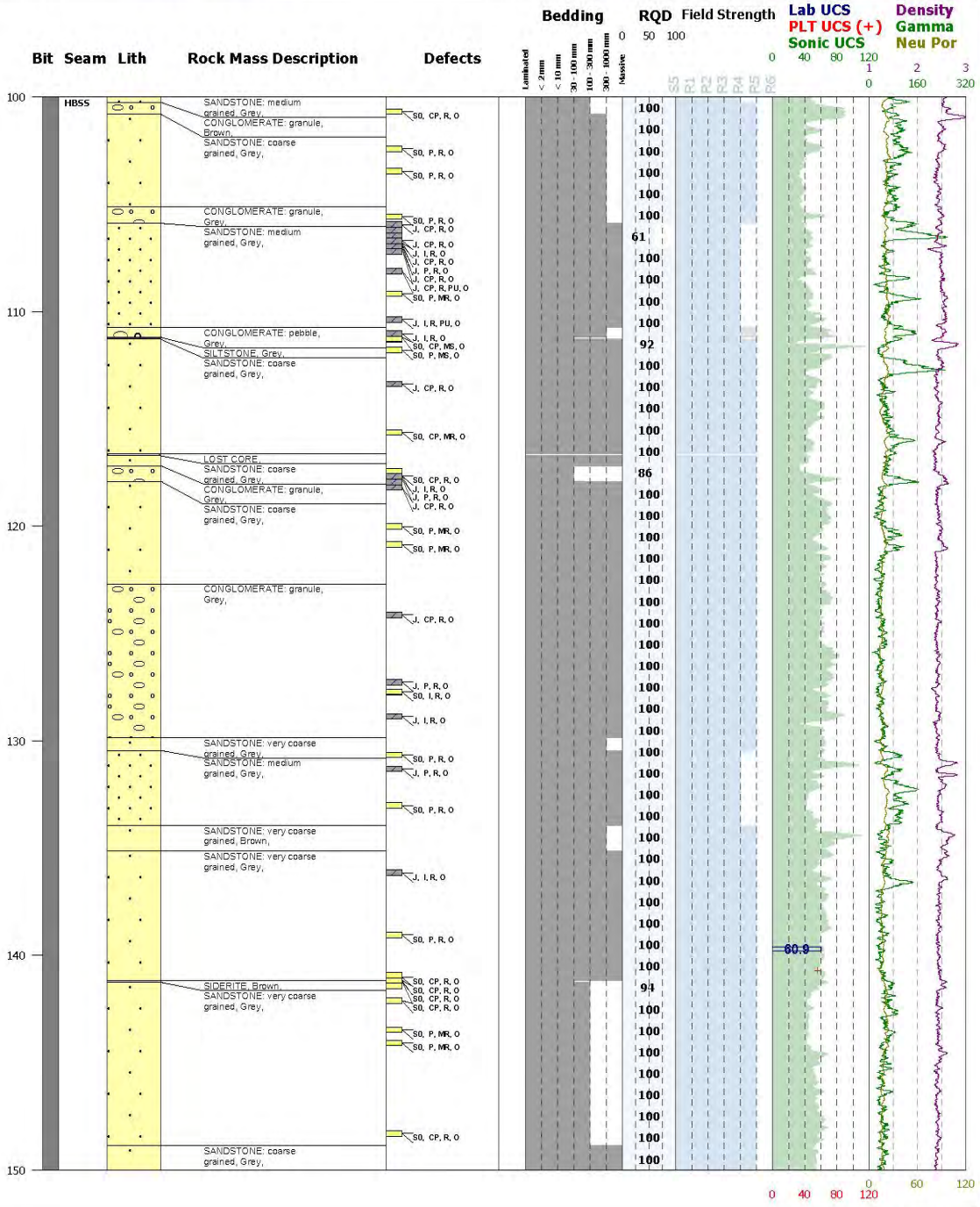

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Geotechnical Log

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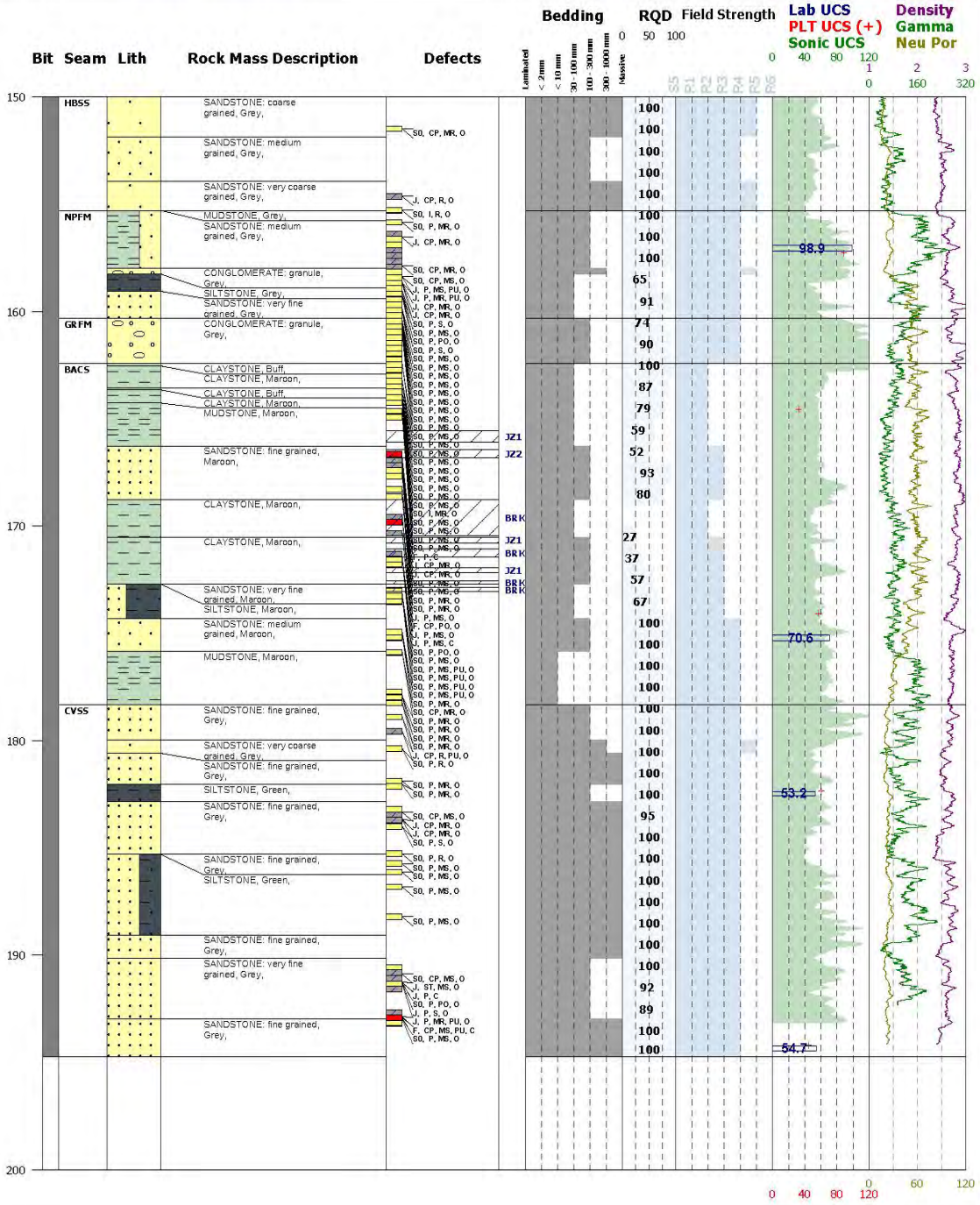
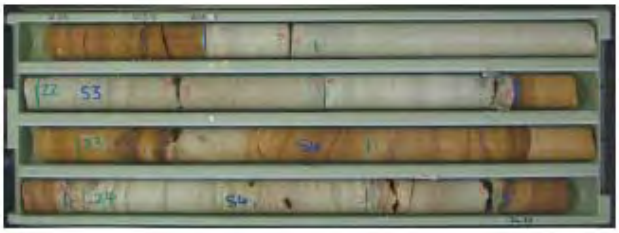
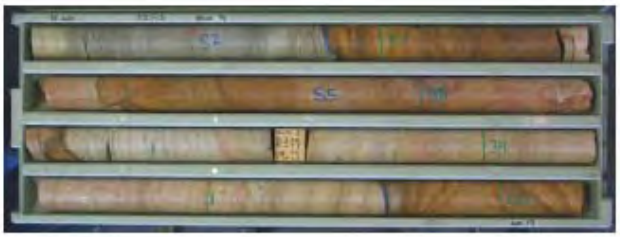
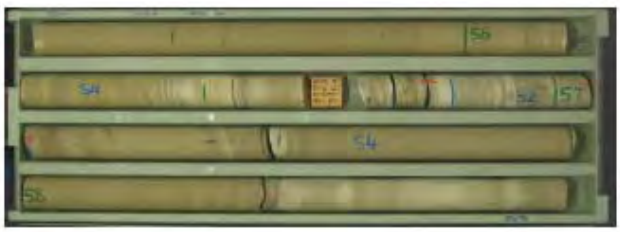
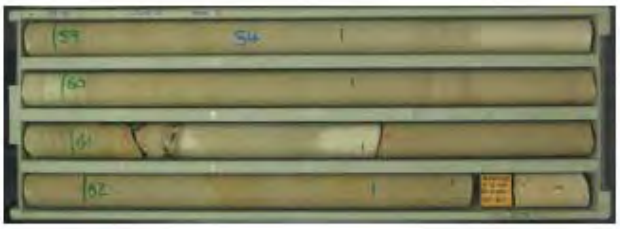


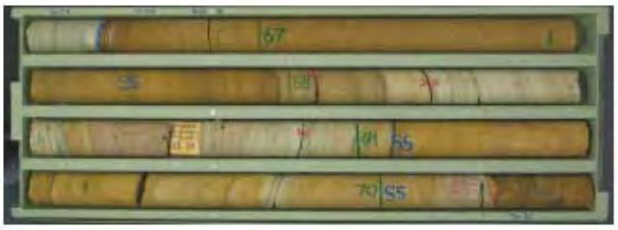
APPENDIX 2 - S2313 CORE PHOTOGRAPHY

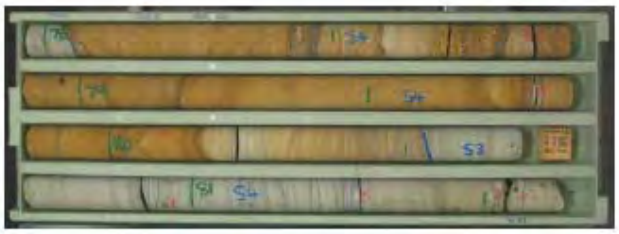


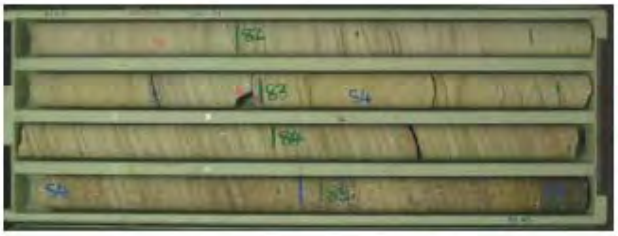


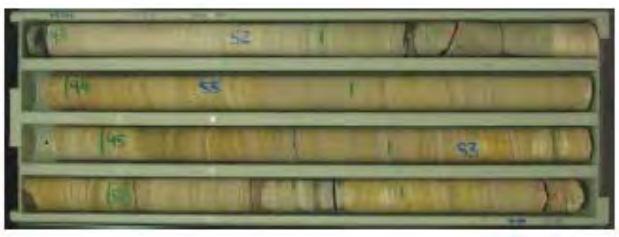


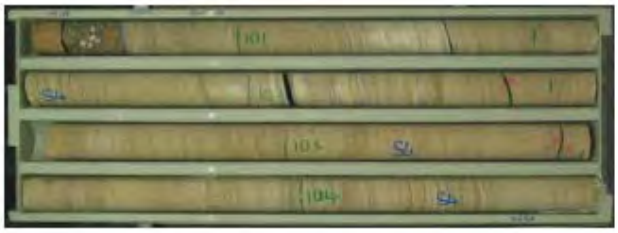


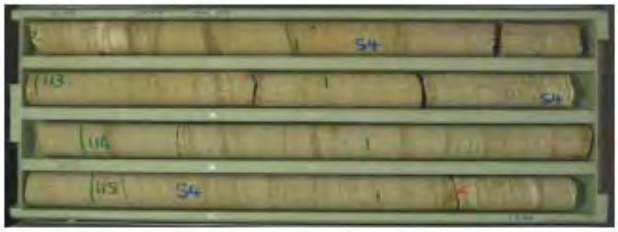


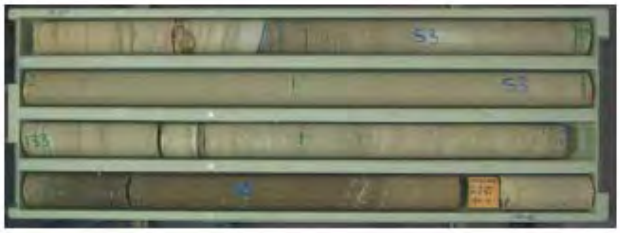


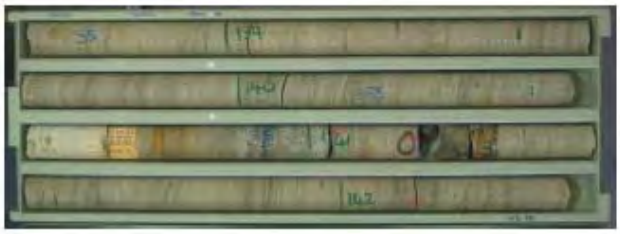


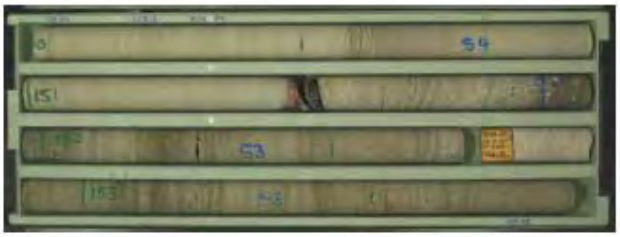


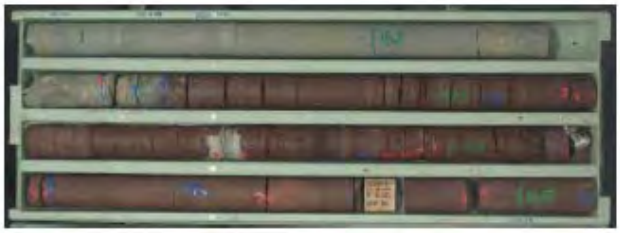
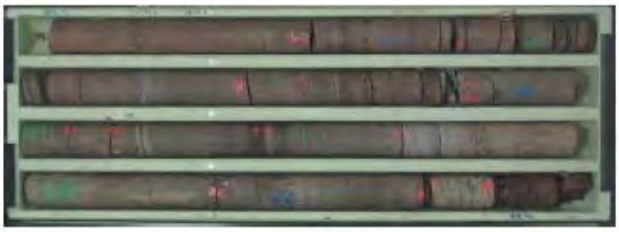


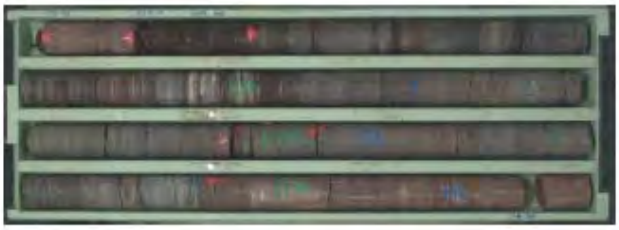
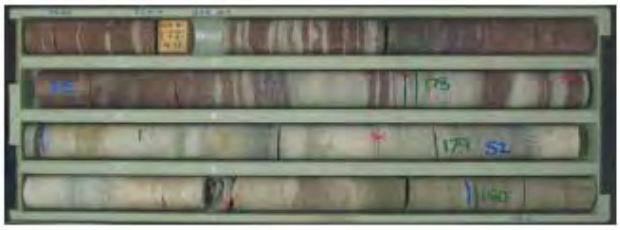






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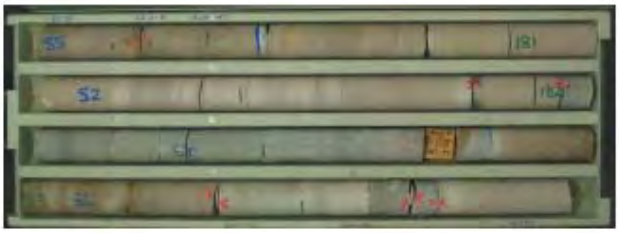
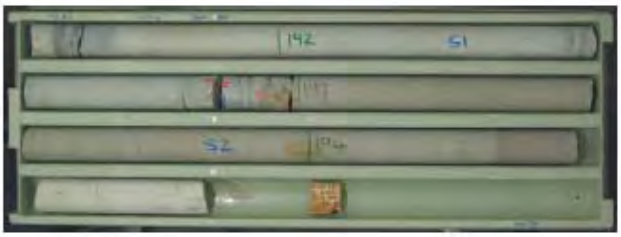


S2
S2



APPENDIX 3 - S2313 LAB GEOTECHNICAL RESULTS

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

REPORT NUMBER: L2710
REPORT DATE: 10 Aug 2015

GEOTECHNICAL LABORATORY TEST REPORT

BHPBIC
Resource & Exploration

S2313

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015
PAGE: 1 of 11

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-01
Rock Type: S5
ID/Mark/Depth: GT1, 11.680 - 11.910
Storage: Plastic wrapped, tested as received

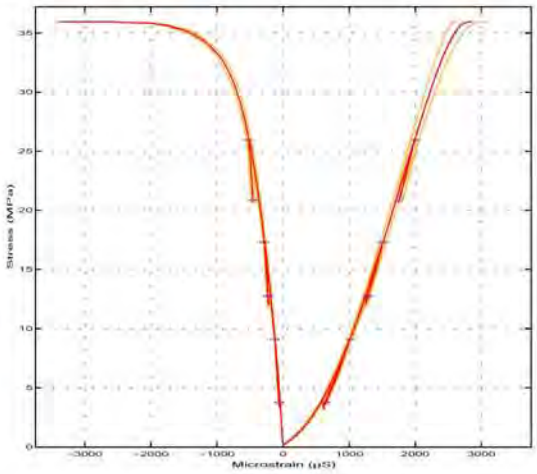
TEST

Date: 5 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 09:22 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.8	152.0	2.267	5.1	**36.0**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
3.75 - 9.13	**14.2**	**0.17**
12.7 - 17.3	**19.7**	**0.24**
20.9 - 26.0	**21.3**	**0.28**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**2724**	**111.9**
2.0 / 2.0	**3220**	**94.7**
5.0 / 5.0	**3518**	**86.6**
10.0 / 10.0	**3752**	**81.2**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT1

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-03
Rock Type: S3
ID/Mark/Depth: GT11, 175.090 - 175.330
Storage: Plastic wrapped, tested as received

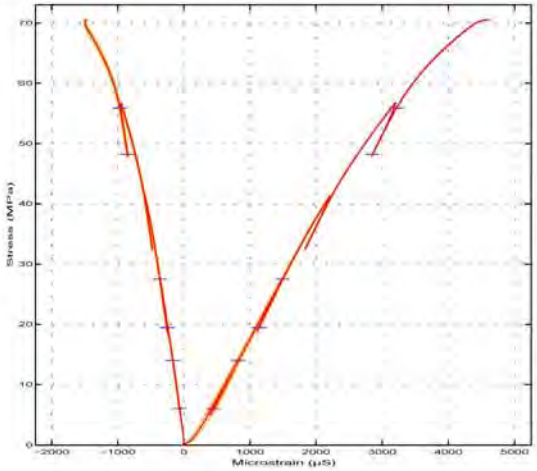
TEST

Date: 5 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 13:12 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	156.3	2.634	2.2	**70.6**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.06 - 14.0	**21.1**	**0.27**
19.5 - 27.5	**22.3**	**0.29**
48.2 - 55.9	**21.2**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3877**	**78.6**
2.0 / 2.0	**3986**	**76.5**
5.0 / 5.0	**4069**	**74.9**
10.0 / 10.0	**4123**	**73.9**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT11

StrataLab 5.6.02 – May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-04
Rock Type: ST
ID/Mark/Depth: GT12, 182.370 - 182.570
Storage: Plastic wrapped, tested as received

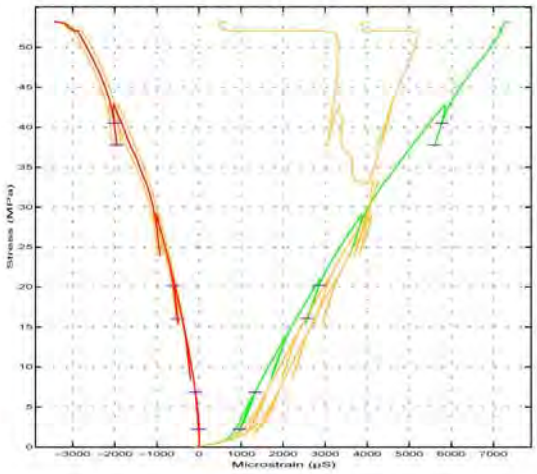
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 15:34 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	152.6	2.722	1.6	**53.2**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
2.26 - 6.84	**12.2**	**0.21**
16.1 - 20.2	**14.5**	**0.34**
37.8 - 40.5	**16.2**	**0.38**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3952**	**77.1**
2.0 / 2.0	**4004**	**76.1**
5.0 / 5.0	**4047**	**75.3**
10.0 / 10.0	**4079**	**74.7**

Single Data Sets Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT12

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-05
Rock Type: S2
ID/Mark/Depth: GT13, 194.220 - 194.460
Storage: Plastic wrapped, tested as received

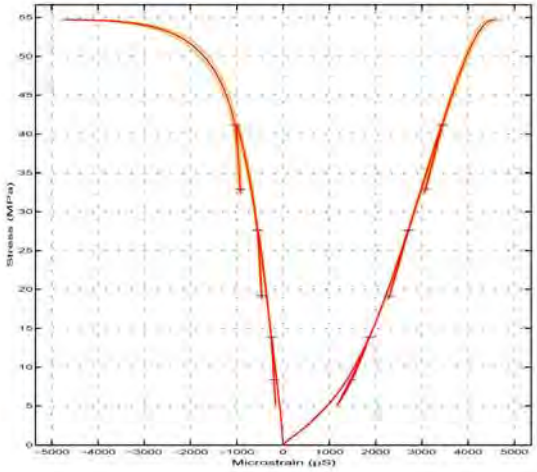
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 10:45 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	156.7	2.338	6.9	**54.7**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
8.38 - 13.9	**13.3**	**0.15**
19.2 - 27.6	**20.3**	**0.22**
32.9 - 41.2	**22.6**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3230**	**94.4**
2.0 / 2.0	**3340**	**91.2**
5.0 / 5.0	**3497**	**87.2**
10.0 / 10.0	**3775**	**80.7**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT13

StrataLab 5.6.02 – May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-06
Rock Type: S3
ID/Mark/Depth: GT2, 21.460 - 21.710
Storage: Plastic wrapped, tested as received

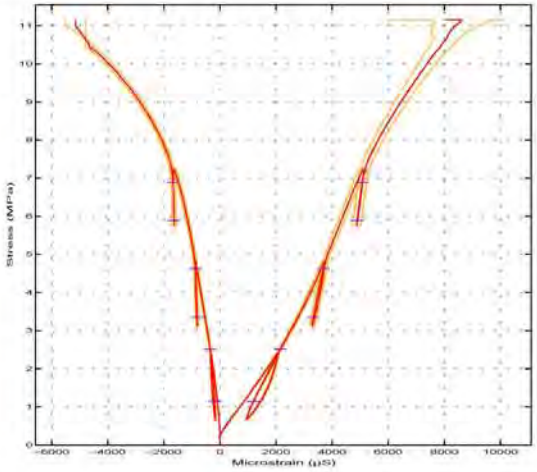
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 10:51 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.8	154.2	2.466	3.4	**11.2**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
1.14 - 2.51	**1.45**	**0.17**
3.34 - 4.62	**3.56**	**0.19**
5.89 - 6.89	**5.52**	**0.23**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3179**	**95.9**
2.0 / 2.0	**3337**	**91.3**
5.0 / 5.0	**3472**	**87.8**
10.0 / 10.0	**3610**	**84.4**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT2

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-08
Rock Type: S3
ID/Mark/Depth: GT4, 42.490 - 42.740
Storage: Plastic wrapped, tested as received

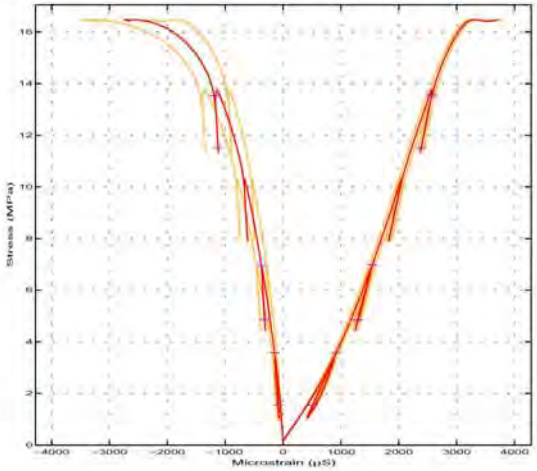
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 20:06 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.9	151.3	2.326	7.4	**16.5**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
1.54 - 3.57	**4.95**	**0.17**
4.84 - 6.97	**8.31**	**0.25**
11.5 - 13.5	**11.0**	**0.39**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3056**	**99.7**
2.0 / 2.0	**3212**	**94.9**
5.0 / 5.0	**3325**	**91.7**
10.0 / 10.0	**3461**	**88.1**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT4

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-09
Rock Type: S4
ID/Mark/Depth: GT5, 54.320 - 54.570
Storage: Plastic wrapped, tested as received

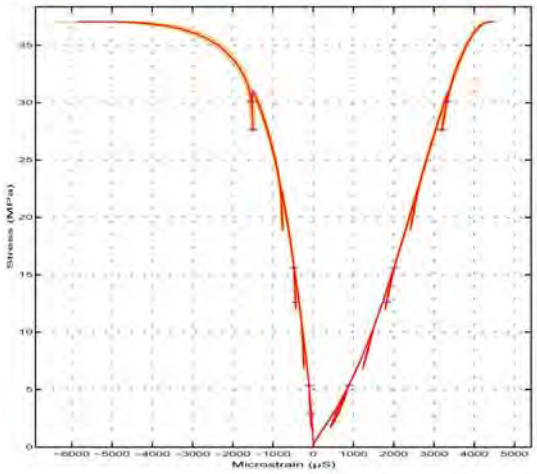
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 29:18 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.8	154.8	2.507	3.4	**37.1**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
2.96 - 5.34	**7.74**	**0.13**
12.6 - 15.6	**15.5**	**0.22**
27.7 - 30.1	**19.1**	**0.34**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3550**	**85.9**
2.0 / 2.0	**3676**	**82.9**
5.0 / 5.0	**3793**	**80.4**
10.0 / 10.0	**3918**	**77.8**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT5

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015
PAGE: 8 of 11

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-10
Rock Type: G1
ID/Mark/Depth: GT6, 71.750 - 71.980
Storage: Plastic wrapped, tested as received

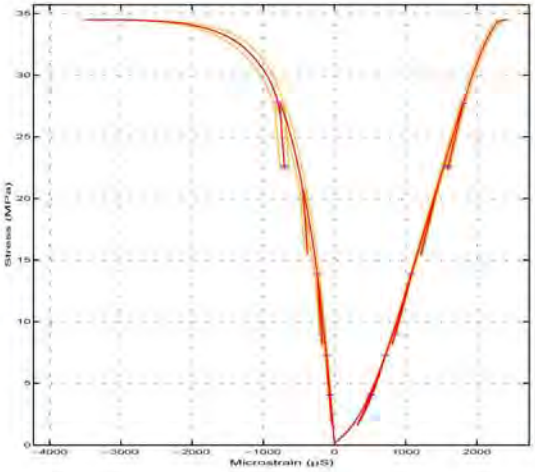
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 12:57 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.8	153.1	2.355	5.7	**34.5**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
4.06 - 7.27	**15.7**	**0.24**
8.99 - 13.9	**21.0**	**0.27**
22.6 - 27.8	**24.0**	**0.41**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3593**	**84.8**
2.0 / 2.0	**3855**	**79.1**
5.0 / 5.0	**4039**	**75.5**
10.0 / 10.0	**4216**	**72.3**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT6

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-11
Rock Type: S3
ID/Mark/Depth: GT7, 97.050 - 97.260
Storage: Plastic wrapped, tested as received

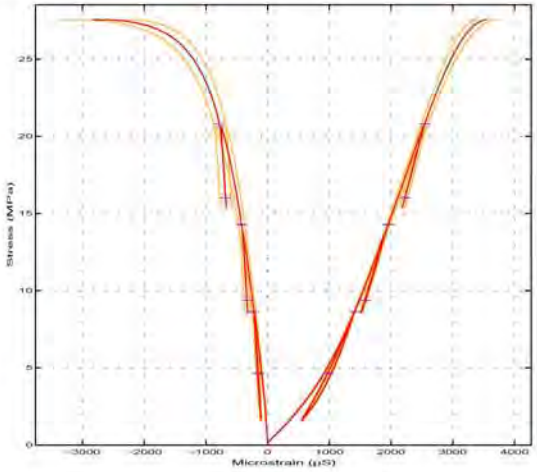
TEST

Date: 6 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 10:31 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.9	158.3	2.330	7.3	**27.6**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
4.63 - 8.65	**9.19**	**0.17**
9.37 - 14.3	**13.0**	**0.23**
16.0 - 20.8	**14.7**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3055**	**99.8**
2.0 / 2.0	**3097**	**98.4**
5.0 / 5.0	**3311**	**92.1**
10.0 / 10.0	**3486**	**87.4**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015
PAGE: 10 of 11

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-12
Rock Type: S5
ID/Mark/Depth: GT8, 139.610 - 139.820
Storage: Plastic wrapped, tested as received

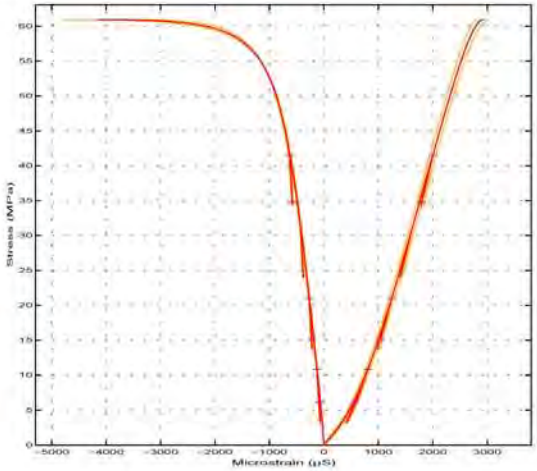
TEST

Date: 7 Aug 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 19:56 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.9	158.2	2.411	4.6	**60.9**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.11 - 10.9	**20.1**	**0.17**
15.2 - 21.0	**27.7**	**0.21**
34.7 - 41.6	**32.1**	**0.26**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3721**	**81.9**
2.0 / 2.0	**3877**	**78.6**
5.0 / 5.0	**4076**	**74.8**
10.0 / 10.0	**4275**	**71.3**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT8

StrataLab 5.6.02 - May 2015

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2710-YP
REPORT DATE: 10 Aug 2015
PAGE: 11 of 11

CLIENT: BHPBIC
Resource & Exploration
Project: S2313

SAMPLE

Specimen: 2710-13
Rock Type: MS
ID/Mark/Depth: GT9, 156.900 – 157.190
Storage: Plastic wrapped, tested as received

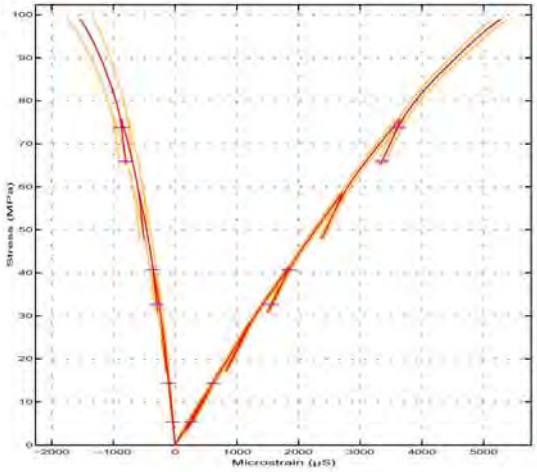
TEST

Date: 7 Aug 2015
Methods: AS 4133.4.3.1 – 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 19:27 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.9	154.7	2.639	1.1	**98.9**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
5.42 – 14.4	**24.9**	**0.17**
32.6 – 40.7	**28.7**	**0.22**
65.9 – 73.8	**30.1**	**0.25**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**4261**	**71.5**
2.0 / 2.0	**4308**	**70.8**
5.0 / 5.0	**4332**	**70.4**
10.0 / 10.0	**4357**	**70.0**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228
Accredited for compliance with ISO/IEC 17025.

Approved Signatory: Peter Fulko

Sample ID: GT9

StrataLab 5.6.02 – May 2015

APPENDIX 4 - S2313 FLOW LOG GRAPHIC

SURTRON WIRELINE SERVICES

TOOL: 9710A

TOOL S/N: 211

WELL: S2313

COMPANY	BHP	LOCATION	DSC AVON 1	COUNTY	ILLAWARRA
FIELD	SOUTH 32	STATE	NSW	LOGGING CO.	SURTRON
DATE	08/07/15	DRILL DEPTH	194.75	FIRST READING	97.70
TIME	15:22:	BIT SIZE	12.3	LOG BOTTOM	194.60
LOGGING UNIT	V034	LOG FROM		CASING TYPE	STEEL
FIELD ENGINEER	MLJ1	DRILL FROM		CASING SIZE	
WITNESSED BY		LATITUDE	207521	CASING BOTT.	6
RIG NUMBER		LONGITUDE	6192619	COUNTRY	

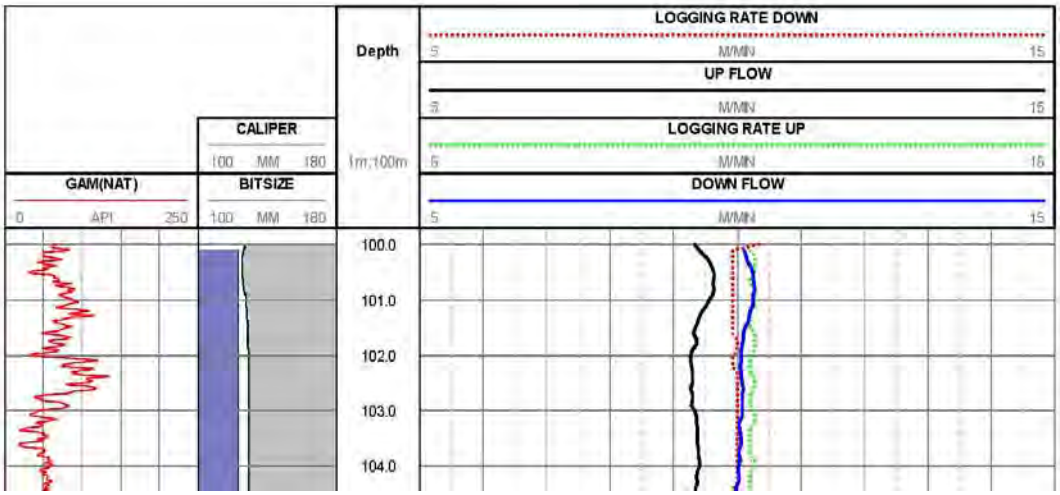
LICENSE	SECTION	TOWNSHIP	RANGE	PERMANENT DATUM ELEV. PERM. DATUM	ELEVATIONS KB DF GL

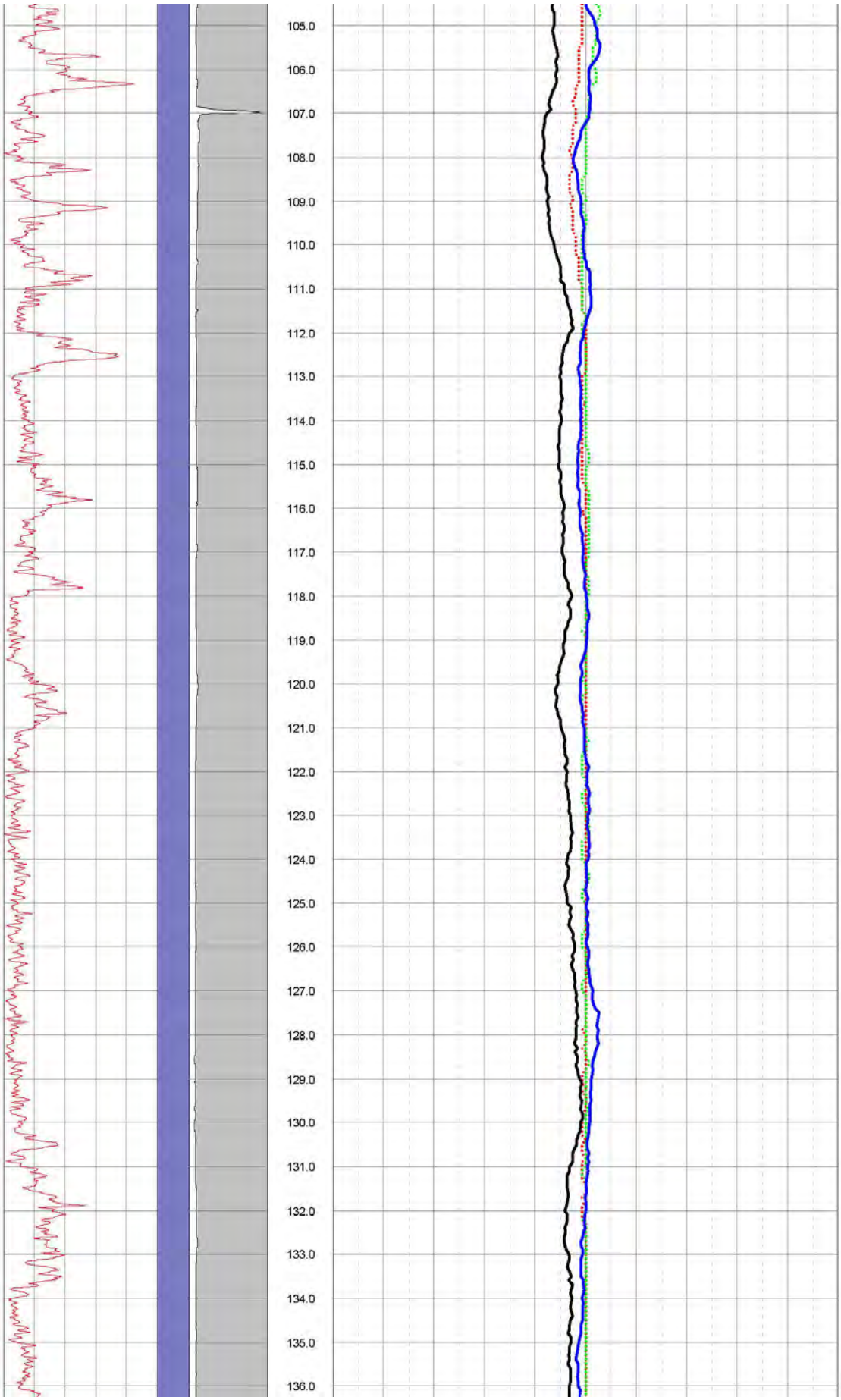
RUN NUMBER		ENCODER CAL	0.09788	OTHER SERVICES 1. 2. 3.	
SAMPLE INT.	.10	SOTWARE VER	3.60E		
LOG DIRECTION	D	SYS SERIAL	1		
DEPTH UNIT	M	WELL EXT.			
ENG OR CPS	E	LOGGER TD			
ELECT CUTOFF	99999	ARRIVAL		REMARKS 1. 2.	
API NO		DEPART			
CASING OD	14	MAG DECL.	8.28		
FLUID TYPE	0	FILE TYPE	PROCESSED		
UWI		CASING THICK	0		

AVE SURF TEMP		MUD SAMPLE SCE	0	RES MUD CAKE	0
TEMP GRADIENT	0	MUD RES	0	TEMP MUD CAKE	
DENSITY MATRIX	2.65	MUD TEMP	0	FLUID VISCOSITY	
NEUTRON MATRIX	SANDSTONE	RES MUD FILT.		FLUID DENSITY	1.0
DELTAT MATRIX	177	TEMP MUD FILT.		FLUID PH	
DELTAT FLUID		TIME CIRC. STOP			

IMPORTANT NOTE

The following interpretations are opinions based upon inferences from borehole logs, Surtron Technologies (Australia) Pty Ltd cannot and does not guarantee the correctness or accuracy of any interpretations. Therefore Surtron Technologies (Australia) Pty Ltd shall not be liable or responsible for any loss, damage, cost or expense incurred or sustained by anyone resulting from any interpretations.

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106.0
107.0
108.0
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110.0
111.0
112.0
113.0
114.0
115.0
116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
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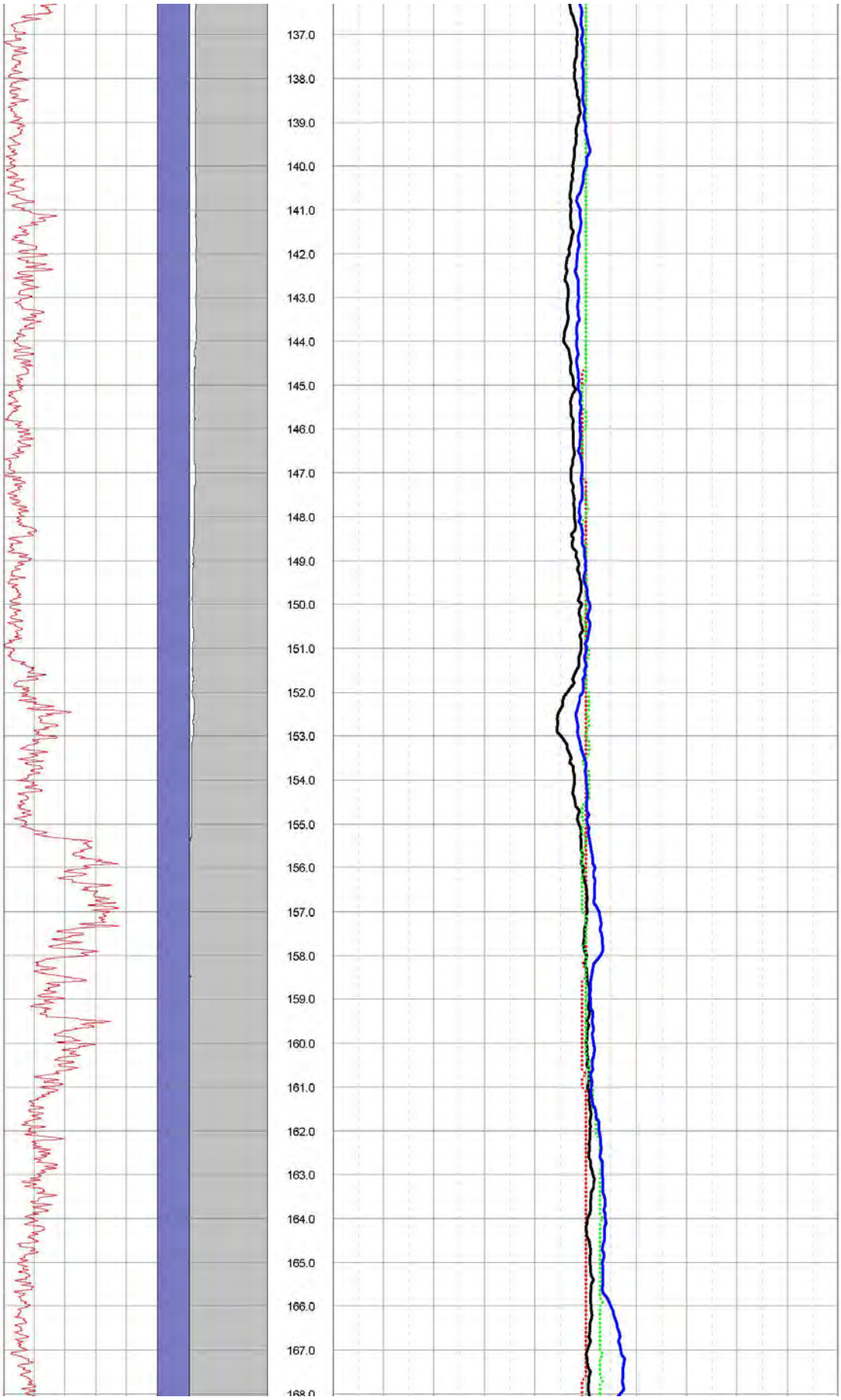
127.0
128.0
129.0
130.0
131.0
132.0
133.0
134.0
135.0
136.0


137.0
138.0
139.0
140.0
141.0
142.0
143.0
144.0
145.0
146.0
147.0
148.0
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150.0
151.0
152.0
153.0
154.0
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163.0
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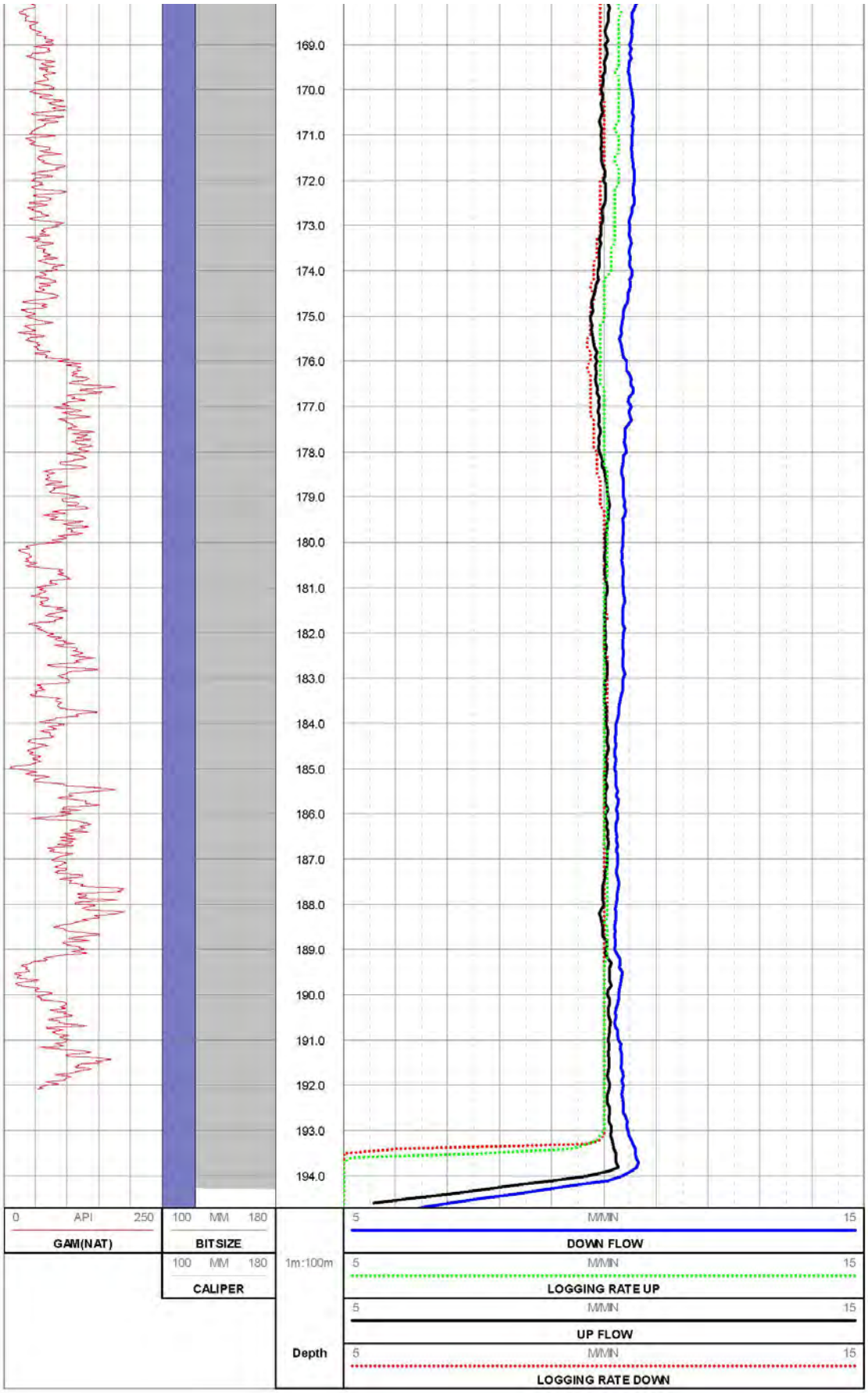
165.0
166.0
167.0


169.0
170.0
171.0
172.0
173.0
174.0
175.0
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177.0
178.0
179.0
180.0
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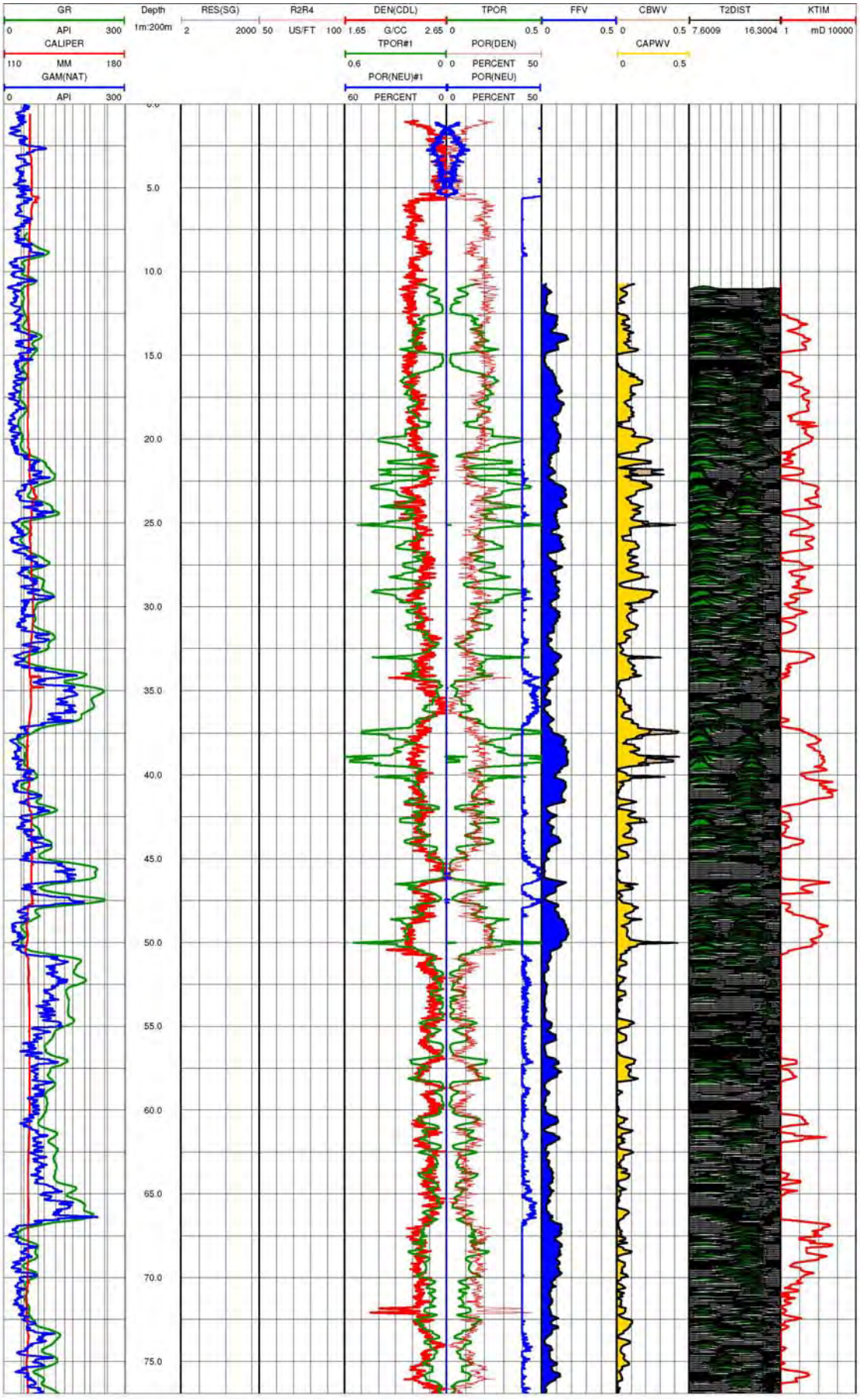
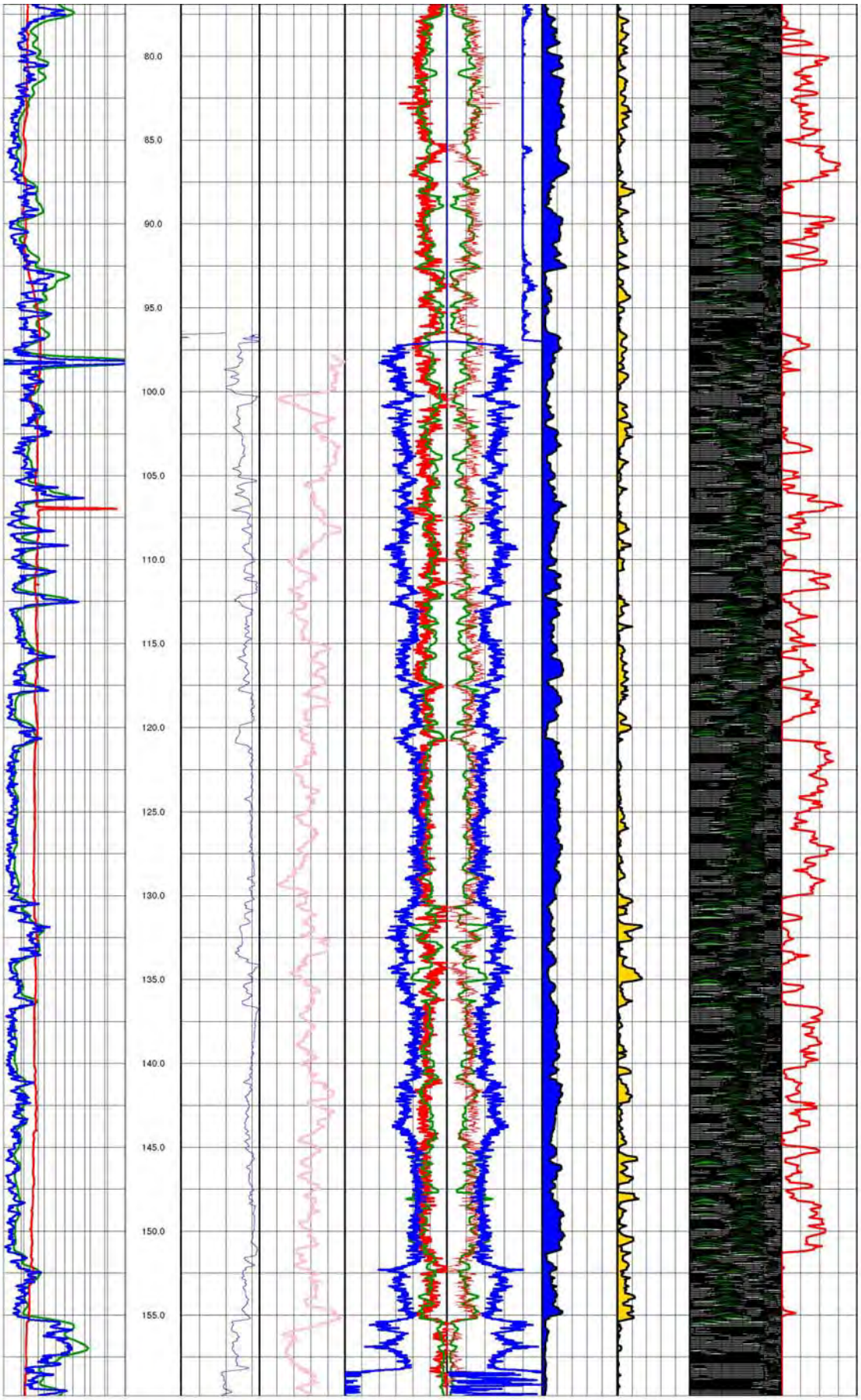
182.0
183.0
184.0
185.0
186.0
187.0
188.0
189.0
190.0
191.0
192.0
193.0
194.0
0 API 250
GAM(NAT)
100 MM 180
BITSIZE
100 MM 180
CALIPER
1m:100m
Depth
5 M/MIN 15
DOWN FLOW
5 M/MIN 15
LOGGING RATE UP
5 M/MIN 15
UP FLOW
5 M/MIN 15
LOGGING RATE DOWN

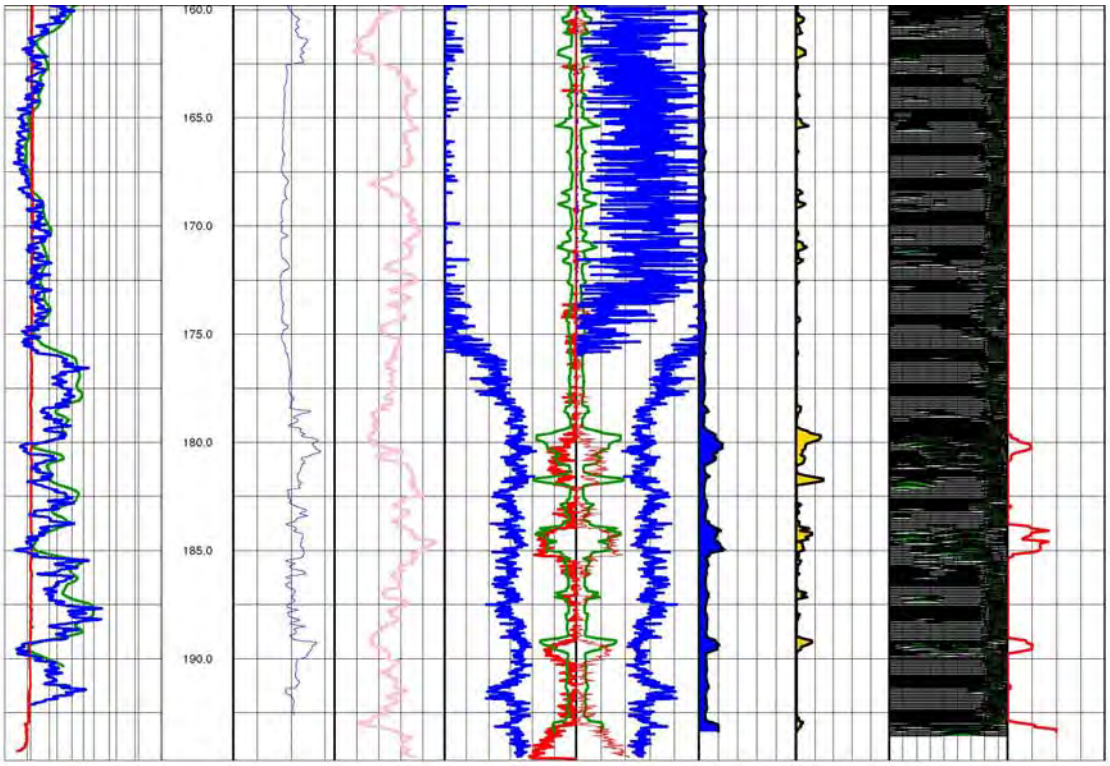
APPENDIX 5 - S2313 NMR LOG GRAPHIC



Page 1


80.0
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
155.0

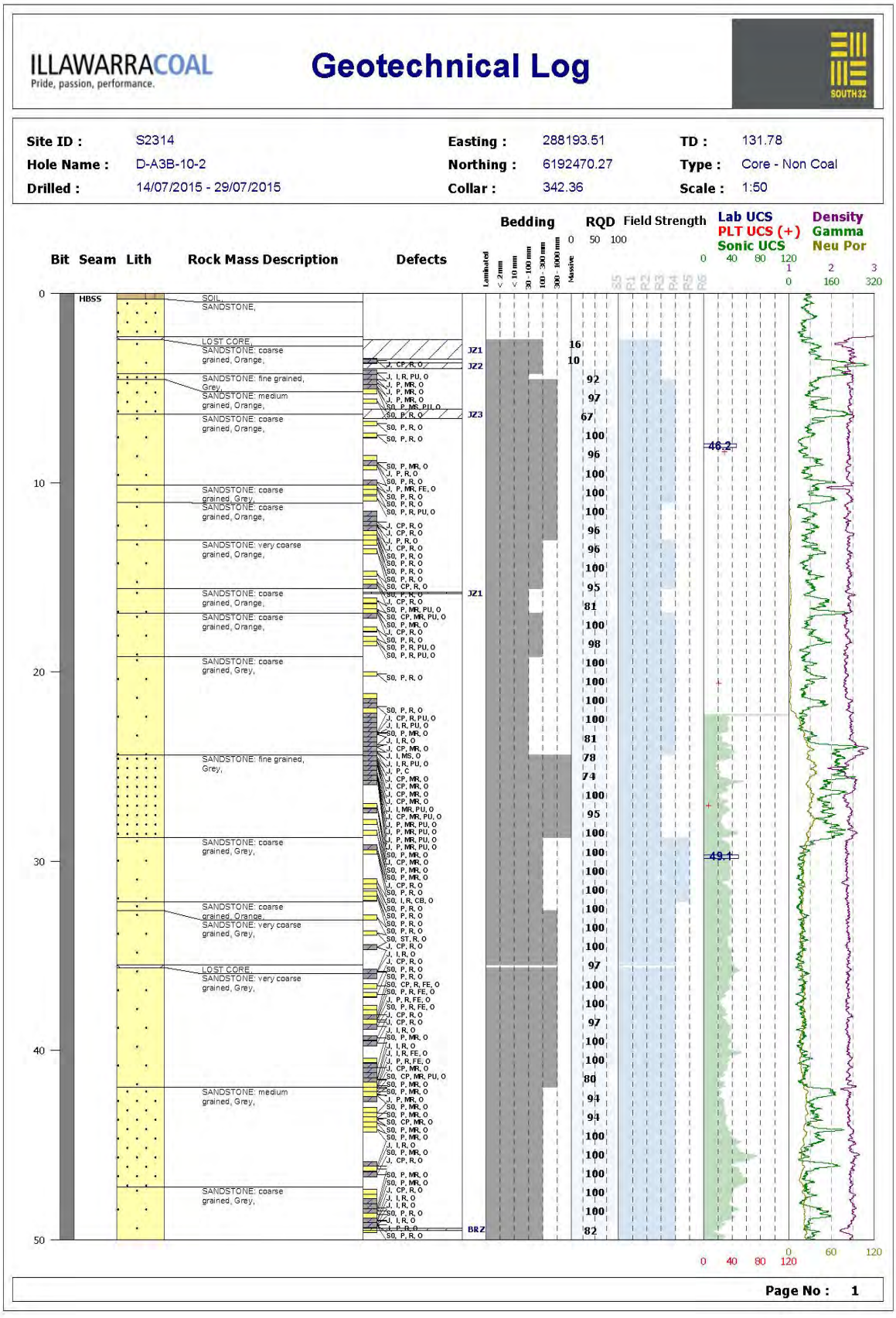
Page 2



NB: Explanation of codes on NMR graphic:

GR/ GAM – Gamma Ray measurements
Caliper – Hole size (from the density caliper)
Res – Medium Guard Resistivity (from the density tool)
R2R4 – Compressional Slowness from the sonic tool
DEN – Compensated Density
POR(NEU) – Neutron Porosity (Sandstone Matrix)
TPOR – Total porosity from the NMR tool
POR(DEN) – Calculated density porosity using a sandstone matrix.
FFV – Free Fluid Volume from the NMR (the fluid which will flow)
CAPW – Capiliary Bound Volume from the NMR
CBWV – Clay Bound Volume from the NMR
T2DIST – The NMR T2 distribution from the NMR – this is the distribution the NMR measures that is then used to produce the other curves.
KTIM – Permeability derived from the NMR data with the Timor-Coates equation.

APPENDIX 6 - S2314 LITHOLOGY, GEOTECHNICAL AND GEOPHYSICAL GRAPHIC

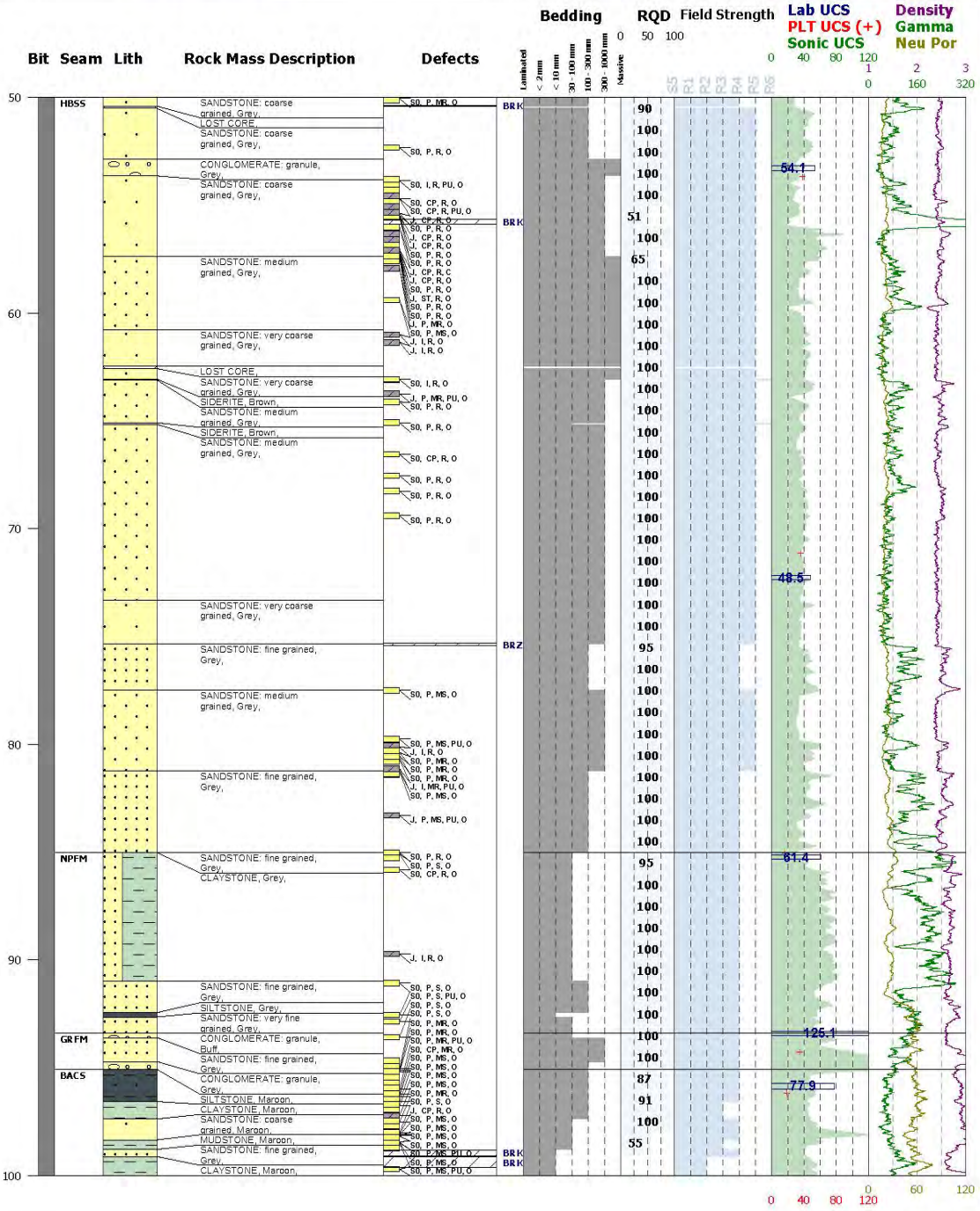


ILLAWARRACOAL
Pride, passion, performance.

Geotechnical Log

SOUTH32

Site ID :	S2314	**Easting :**	288193.51	**TD :**	131.78
Hole Name :	D-A3B-10-2	**Northing :**	6192470.27	**Type :**	Core - Non Coal
Drilled :	14/07/2015 - 29/07/2015	**Collar :**	342.36	**Scale :**	1:50

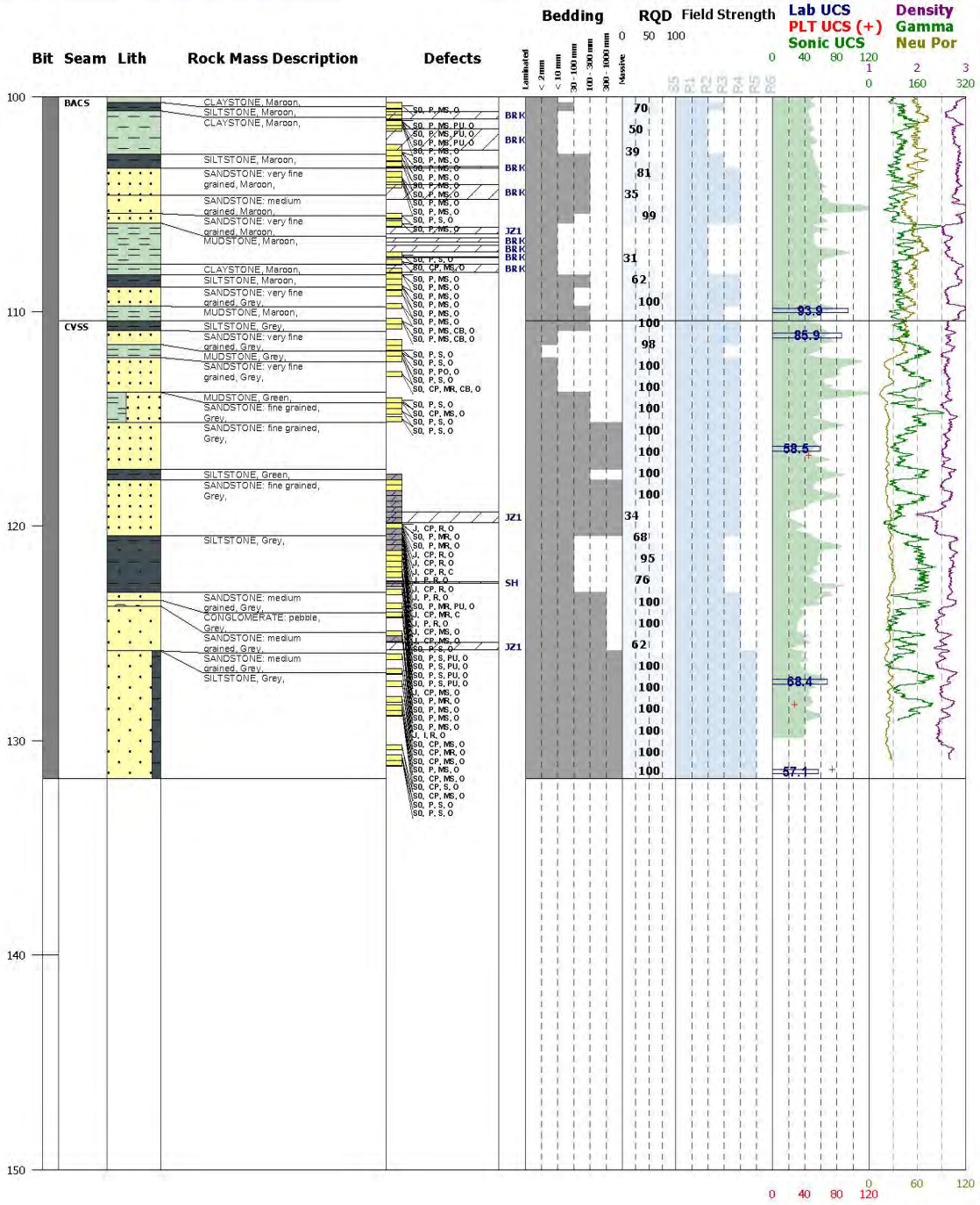


ILLAWARRACOAL
Pride, passion, performance.

Geotechnical Log

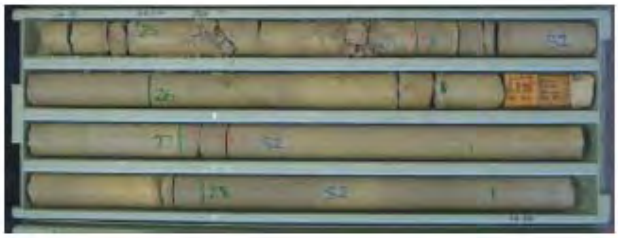
SOUTH32

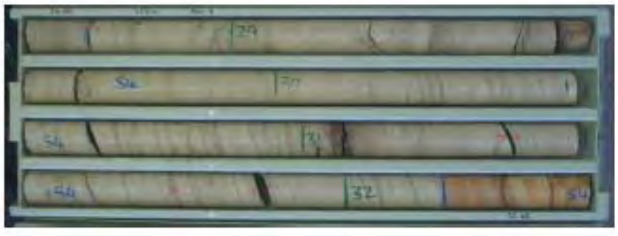
Site ID :	S2314	**Easting :**	288193.51	**TD :**	131.78
Hole Name :	D-A3B-10-2	**Northing :**	6192470.27	**Type :**	Core - Non Coal
Drilled :	14/07/2015 - 29/07/2015	**Collar :**	342.36	**Scale :**	1:50

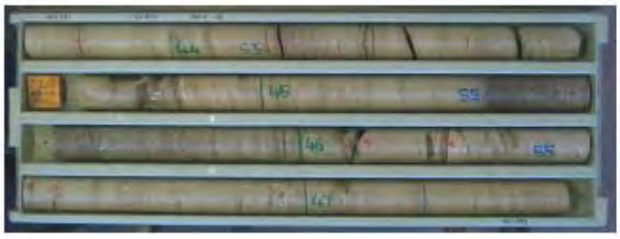


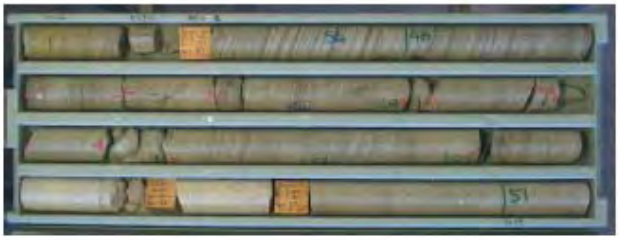
Page No : 3

APPENDIX 7 - S2314 CORE PHOTOGRAPHY



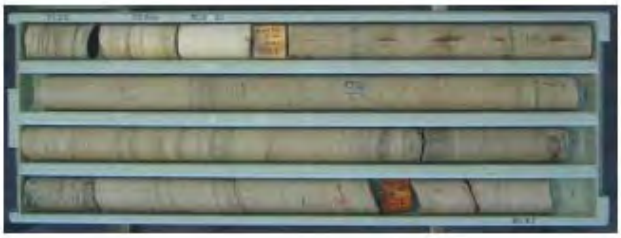


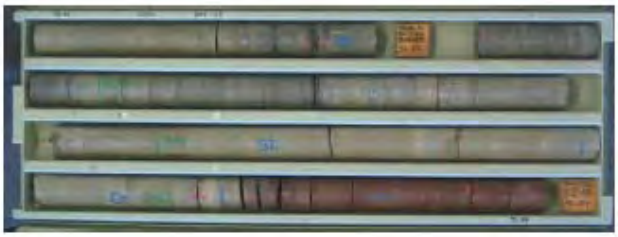




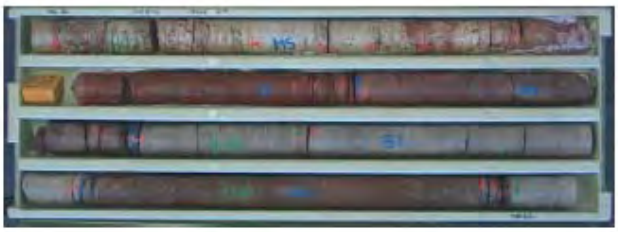











APPENDIX 8 - S2314 LAB GEOTECHNICAL RESULTS

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

REPORT NUMBER: L2737
REPORT DATE: 22 Sep 2015

GEOTECHNICAL LABORATORY TEST REPORT

South32 IC
Resource & Exploration

Geotechnical Testing – BH: S2314

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-01
Rock Type: S4
ID/Mark/Depth: GT1, 7.950 - 8.150
Storage: Plastic wrapped, tested as received

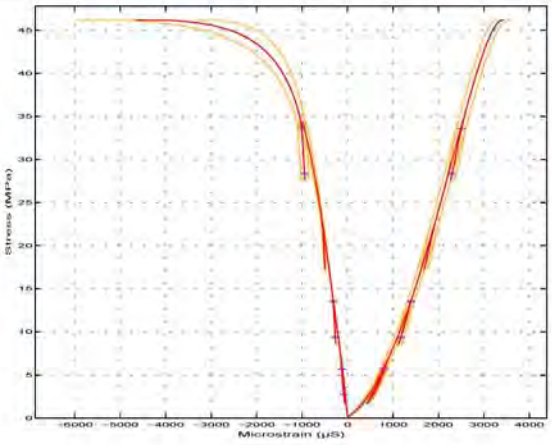
TEST

Date: 18 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 20:39 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
60.8	152.2	2.352	3.6	**46.2**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
2.79 - 5.68	**11.2**	**0.18**
9.37 - 13.5	**18.4**	**0.22**
28.3 - 33.6	**24.7**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3389**	**89.9**
2.0 / 2.0	**3589**	**84.9**
5.0 / 5.0	**3842**	**79.3**
10.0 / 10.0	**4004**	**76.1**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT1

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-02
Rock Type: S2
ID/Mark/Depth: GT10, 116.280 - 116.500
Storage: Plastic wrapped, tested as received

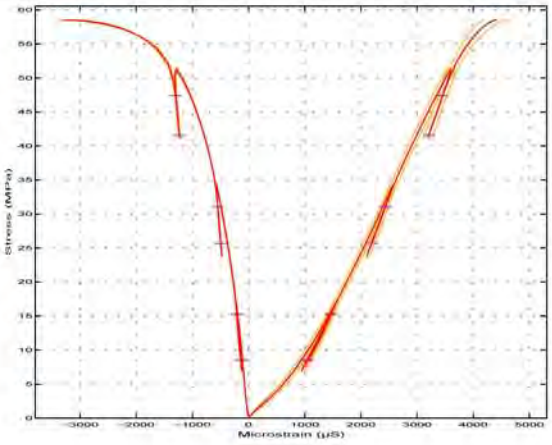
TEST

Date: 11 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 08:46 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.1	153.2	2.522	4.3	**58.5**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
8.56 - 15.3	**16.0**	**0.17**
25.7 - 31.0	**21.9**	**0.21**
41.5 - 47.4	**23.9**	**0.28**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3629**	**84.0**
2.0 / 2.0	**3709**	**82.2**
5.0 / 5.0	**3791**	**80.4**
10.0 / 10.0	**3887**	**78.4**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT10

StrataLab 5.6.02 - May 2015

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-03
Rock Type: S3
ID/Mark/Depth: GT11, 127.150 - 127.370
Storage: Plastic wrapped, tested as received

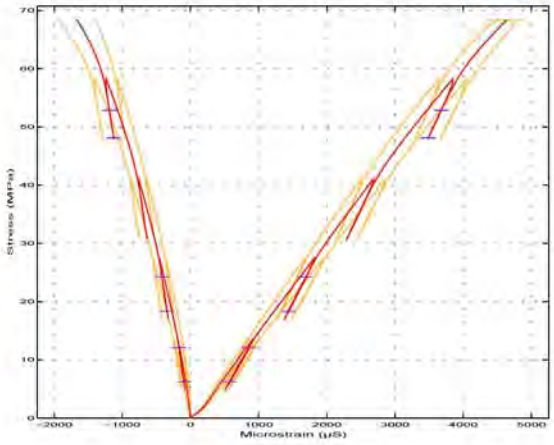
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 14:41 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	152.0	2.654	1.5	**68.4**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.30 - 12.1	**20.5**	**0.26**
18.4 - 24.2	**23.0**	**0.30**
48.1 - 52.9	**25.2**	**0.34**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**4107**	**74.2**
2.0 / 2.0	**4152**	**73.4**
5.0 / 5.0	**4175**	**73.0**
10.0 / 10.0	**4209**	**72.4**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT11

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-04
Rock Type: S3
ID/Mark/Depth: GT12, 131.370 - 131.550
Storage: Plastic wrapped, tested as received

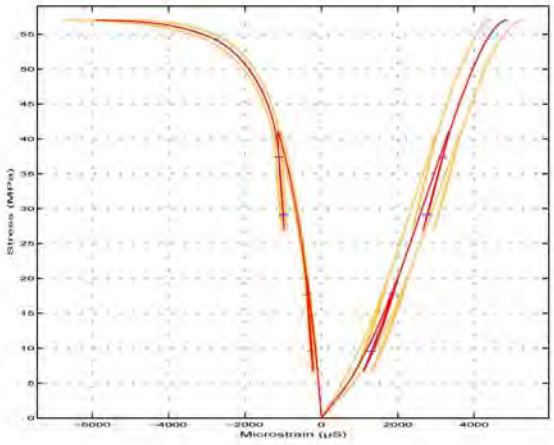
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 08:37 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.1	150.9	2.499	3.6	**57.1**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
9.58 - 17.7	**14.8**	**0.20**
29.1 - 37.4	**20.4**	**0.29**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3662**	**83.2**
2.0 / 2.0	**3698**	**82.4**
5.0 / 5.0	**3800**	**80.2**
10.0 / 10.0	**3918**	**77.8**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT12

StrataLab 5.6.02 - May 2015

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015
PAGE: 5 of 12

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-05
Rock Type: S4
ID/Mark/Depth: GT2, 29.650 - 29.860
Storage: Plastic wrapped, tested as received

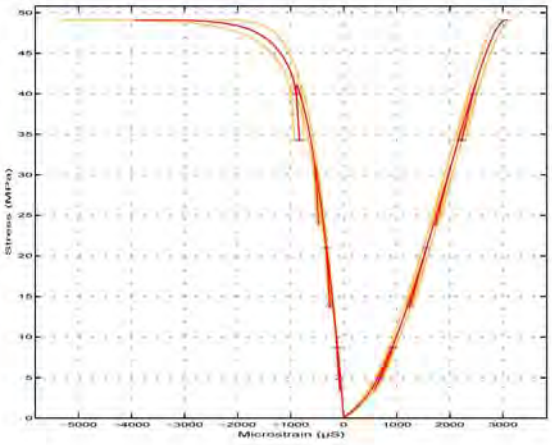
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 11:46 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	152.3	2.303	6.3	**49.1**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
4.86 - 8.66	**15.9**	**0.16**
13.9 - 20.9	**22.7**	**0.22**
34.3 - 40.0	**25.8**	**0.29**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3339**	**91.3**
2.0 / 2.0	**3445**	**88.5**
5.0 / 5.0	**3741**	**81.5**
10.0 / 10.0	**3955**	**77.1**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT2

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015
PAGE: 6 of 12

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-06
Rock Type: G1
ID/Mark/Depth: GT3, 53.160 - 53.410
Storage: Plastic wrapped, tested as received

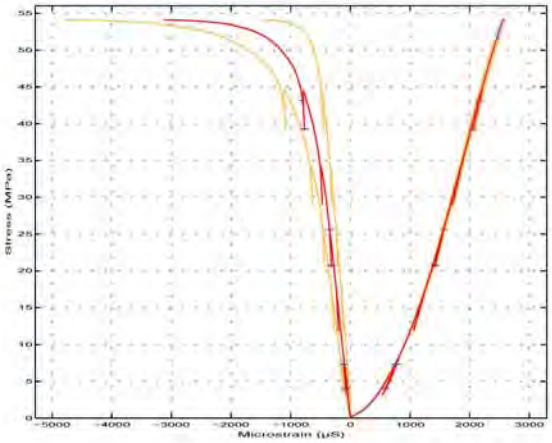
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 13:33 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	154.6	2.418	3.3	**54.1**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
4.00 - 7.32	**18.4**	**0.16**
20.7 - 25.7	**33.3**	**0.21**
39.3 - 43.1	**37.2**	**0.31**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3826**	**79.7**
2.0 / 2.0	**4046**	**75.3**
5.0 / 5.0	**4293**	**71.0**
10.0 / 10.0	**4467**	**68.2**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Sample ID: GT3

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-07
Rock Type: S3
ID/Mark/Depth: GT4, 72.170 - 72.380
Storage: Plastic wrapped, tested as received

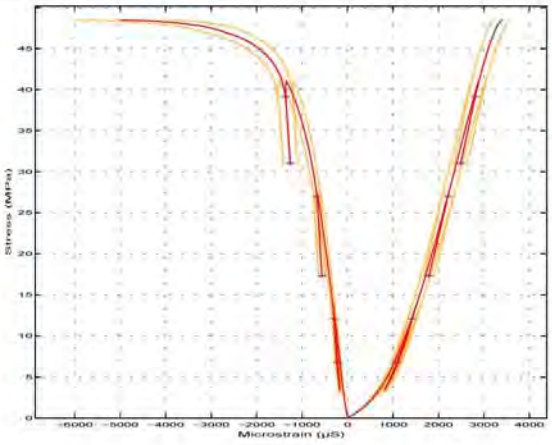
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 08:00 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	152.4	2.379	4.6	**48.5**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.78 - 12.1	**15.7**	**0.23**
17.3 - 27.0	**23.0**	**0.26**
31.1 - 39.2	**25.3**	**0.34**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**3503**	**87.0**
2.0 / 2.0	**3707**	**82.2**
5.0 / 5.0	**3927**	**77.6**
10.0 / 10.0	**4096**	**74.4**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT4

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015
PAGE: 8 of 12

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-08
Rock Type: YS
ID/Mark/Depth: GT5, 85.130 - 85.320
Storage: Plastic wrapped, tested as received

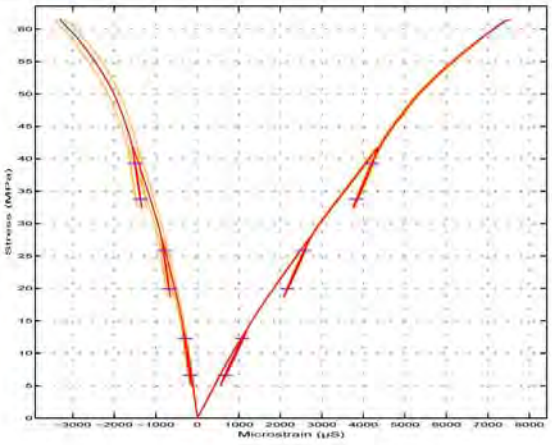
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 09:14 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	150.2	2.674	1.4	**61.4**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.64 - 12.2	**13.2**	**0.29**
19.9 - 25.8	**14.4**	**0.33**
33.8 - 39.2	**15.0**	**0.36**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3671**	**83.0**
2.0 / 2.0	**3690**	**82.6**
5.0 / 5.0	**3708**	**82.2**
10.0 / 10.0	**3735**	**81.6**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT5

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing – BH: S2314

SAMPLE

Specimen: 2737-09
Rock Type: G1
ID/Mark/Depth: GT6, 93.300 – 93.510
Storage: Plastic wrapped, tested as received

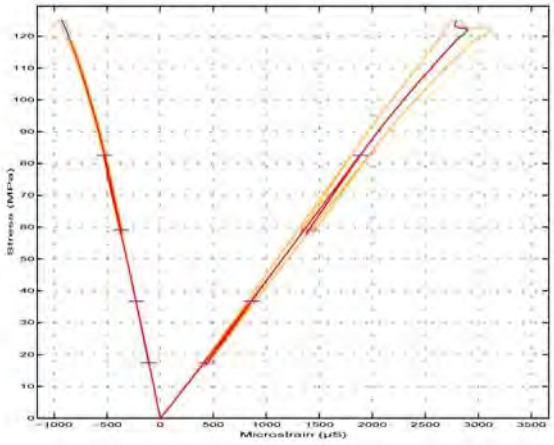
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 – 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 06:17 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	152.6	3.045	0.9	**125.1**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
17.4 – 36.7	**46.2**	**0.29**
59.2 – 82.6	**48.4**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**5242**	**58.1**
2.0 / 2.0	**5260**	**57.9**
5.0 / 5.0	**5278**	**57.7**
10.0 / 10.0	**5297**	**57.5**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT6

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-10
Rock Type: ST
ID/Mark/Depth: GT7, 95.720 - 95.980
Storage: Plastic wrapped, tested as received

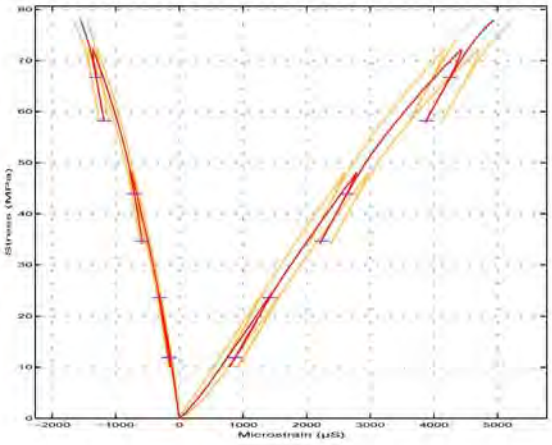
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 06:34 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	151.3	2.839	2.1	**77.9**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
11.9 - 23.6	**21.5**	**0.27**
34.7 - 43.9	**23.1**	**0.31**
58.2 - 66.7	**22.7**	**0.32**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (μS/ft)
0.0 / 0.0	**3929**	**77.6**
2.0 / 2.0	**3960**	**77.0**
5.0 / 5.0	**3981**	**76.6**
10.0 / 10.0	**4012**	**76.0**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT7

StrataLab 5.6.02 - May 2015

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-11
Rock Type: MS
ID/Mark/Depth: GT8, 109.860 - 110.050
Storage: Plastic wrapped, tested as received

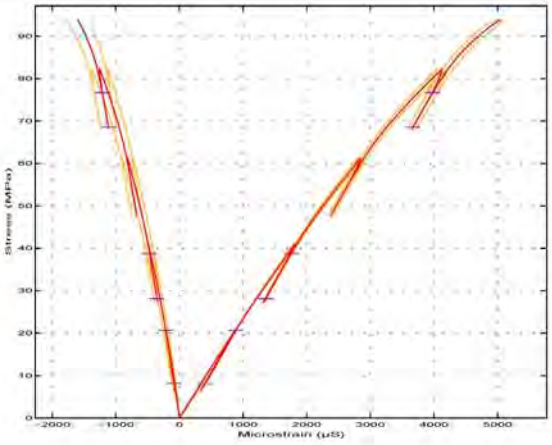
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 11:24 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	154.0	2.870	1.7	**93.9**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
8.18 - 20.7	**25.8**	**0.26**
28.1 - 38.8	**26.6**	**0.29**
68.6 - 76.7	**26.0**	**0.31**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**4277**	**71.3**
2.0 / 2.0	**4288**	**71.1**
5.0 / 5.0	**4325**	**70.5**
10.0 / 10.0	**4337**	**70.3**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

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Sample ID: GT8

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GEOTECHNICAL LABORATORY TEST REPORT

UNIAXIAL PROPERTIES

REPORT NUMBER: 2737-YP-1
REPORT DATE: 22 Sep 2015

CLIENT: South32 IC
Resource & Exploration
Project: Geotechnical Testing - BH: S2314

SAMPLE

Specimen: 2737-12
Rock Type: S1
ID/Mark/Depth: GT9, 111.010 - 111.230
Storage: Plastic wrapped, tested as received

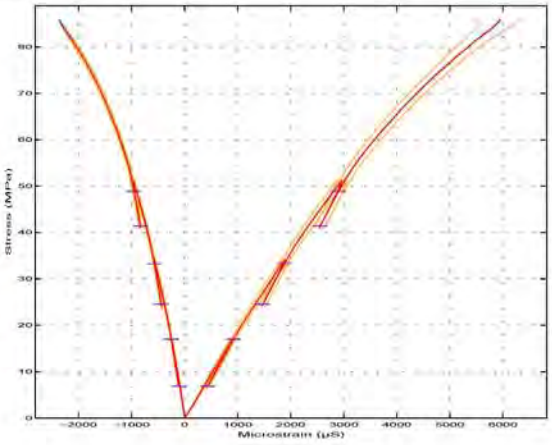
TEST

Date: 14 Sep 2015
Methods: AS 4133.4.3.1 - 2009
RTA Test Method T224
Test Machine: CMA & CONTROLS & Celtron LCD100k
Measurement: Electrical Strain Gauges
Duration: 15:45 (mm:ss)

RESULTS

Diameter (mm)	Length (mm)	Density (t/m³)	Moisture Content (%)	UCS (MPa)
61.0	151.7	2.638	1.7	**85.9**

Failure Mode



Elastic Properties

Stress Range (MPa)	Young's Modulus (GPa)	Poisson's Ratio
6.88 - 17.0	**21.0**	**0.29**
24.6 - 33.3	**21.6**	**0.32**
41.4 - 48.9	**21.8**	**0.33**

Sonic Properties

Axial/Confining Pressures (MPa)	P-Wave	
	Velocity (m/s)	Travel Time (µS/ft)
0.0 / 0.0	**4189**	**72.8**
2.0 / 2.0	**4213**	**72.4**
5.0 / 5.0	**4219**	**72.3**
10.0 / 10.0	**4242**	**71.9**

Mean Data

COMMENTS

NATA Accredited Laboratory Number 2228

Accredited for compliance with ISO/IEC 17025.

Julio Miranda

Approved Signatory.....

Sample ID: GT9

StrataLab 5.6.02 - May 2015

APPENDIX 9 - S2314 FLOW LOG GRAPHIC

SURTRON WIRELINE SERVICES

TOOL: 9710A

TOOL S/N: 211

WELL: S2314

COMPANY	BHP	LOCATION	DSC AVON 2	COUNTY	ILLAWARRA
FIELD	SOUTH 32	STATE	NSW	LOGGING CO.	SURTRON
DATE	08/11/15	DRILL DEPTH	131.8	FIRST READING	22.20
TIME	10:02:	BIT SIZE	12.3	LOG BOTTOM	131.10
LOGGING UNIT	V034	LOG FROM		CASING TYPE	STEEL
FIELD ENGINEER	MLJ1	DRILL FROM		CASING SIZE	
WITNESSED BY		LATITUDE		CASING BOTT.	2.3
RIG NUMBER		LONGITUDE		COUNTRY	

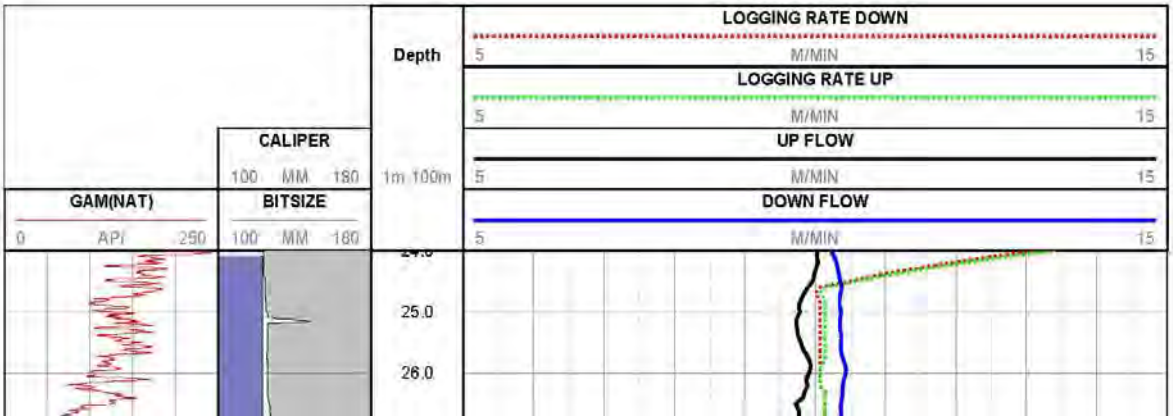
LICENSE	SECTION	TOWNSHIP	RANGE	PERMANENT DATUM ELEV. PERM. DATUM	ELEVATIONS KB DF GL

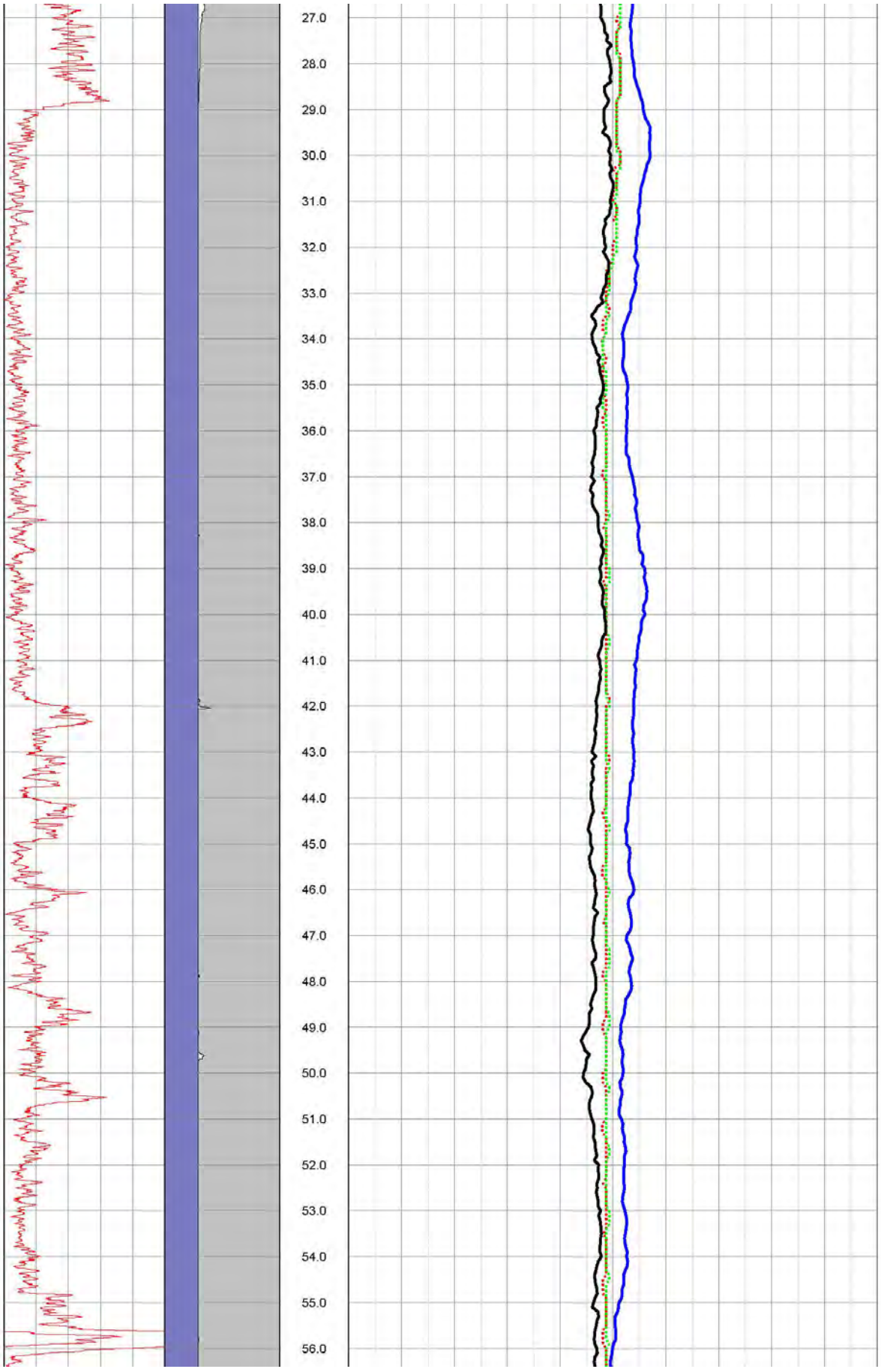
RUN NUMBER		ENCODER CAL	0.09788	OTHER SERVICES
SAMPLE INT.	.10	SOTWARE VER	3.60E	1.
LOG DIRECTION	D	SYS SERIAL	1	2.
DEPTH UNIT	M	WELL EXT.		3.
ENG OR CPS	E	LOGGER TD		
ELECT CUTOFF	99999	ARRIVAL		REMARKS
API NO		DEPART		1. S/U=0.02CM
CASING OD	14	MAG DECL.	8.28	
FLUID TYPE	0	FILE TYPE	PROCESSED	2. DOWN RUN
UWI		CASING THICK	0	

AVE SURF TEMP		MUD SAMPLE SCE	0	RES MUD CAKE	0
TEMP GRADIENT	0	MUD RES	0	TEMP MUD CAKE	
DENSITY MATRIX	2.65	MUD TEMP	0	FLUID VISCOSITY	
NEUTRON MATRIX	SANDSTONE	RES MUD FILT.		FLUID DENSITY	1.0
DELTAT MATRIX	177	TEMP MUD FILT.		FLUID PH	
DELTAT FLUID		TIME CIRC. STOP			

IMPORTANT NOTE

The following interpretations are opinions based upon inferences from borehole logs, Surtron Technologies (Australia) Pty Ltd cannot and does not guarantee the correctness or accuracy of any interpretations. Therefore Surtron Technologies (Australia) Pty Ltd shall not be liable or responsible for any loss, damage, cost or expense incurred or sustained by anyone resulting from any interpretations.

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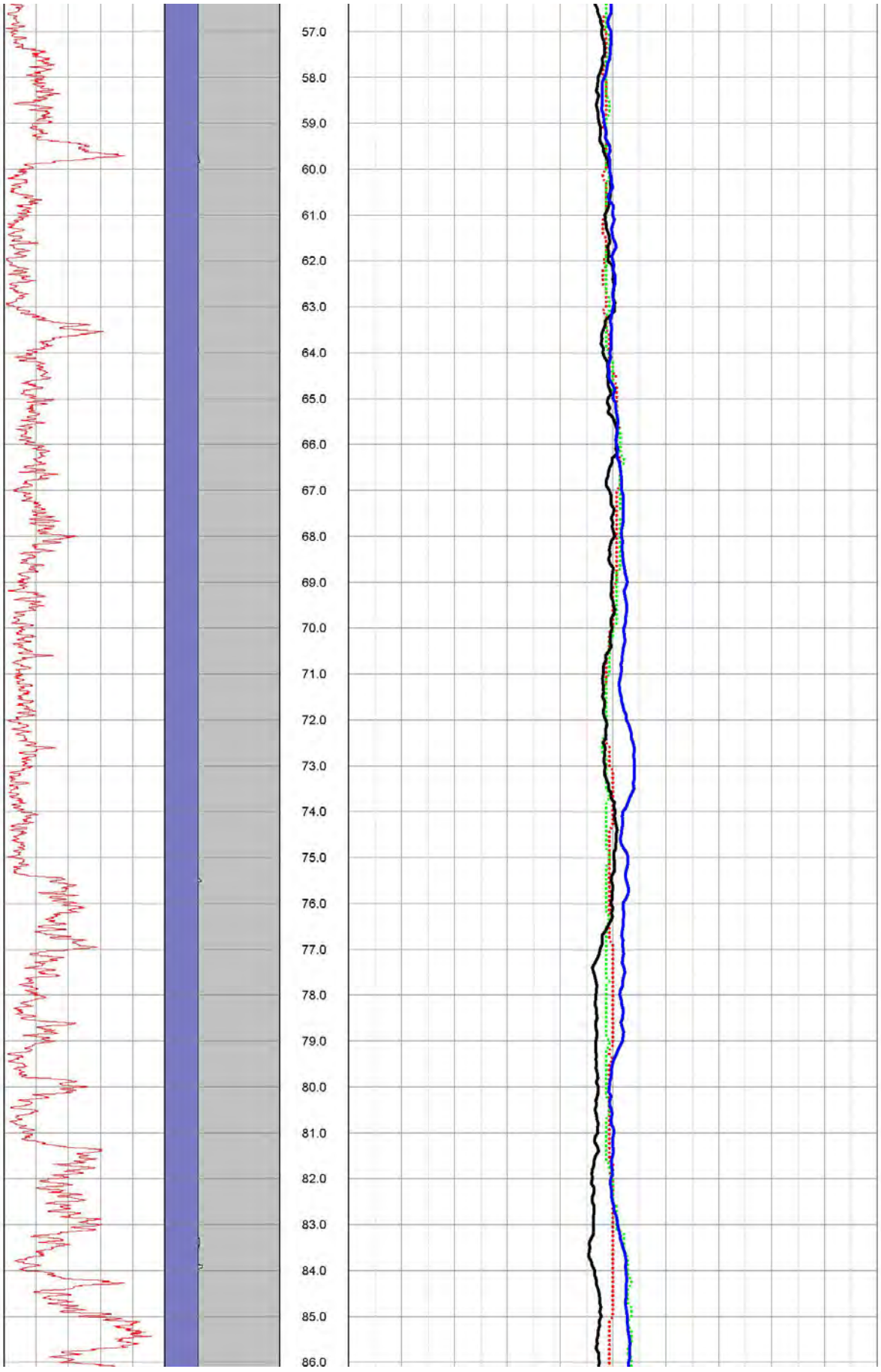
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0


57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
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70.0
71.0
72.0
73.0
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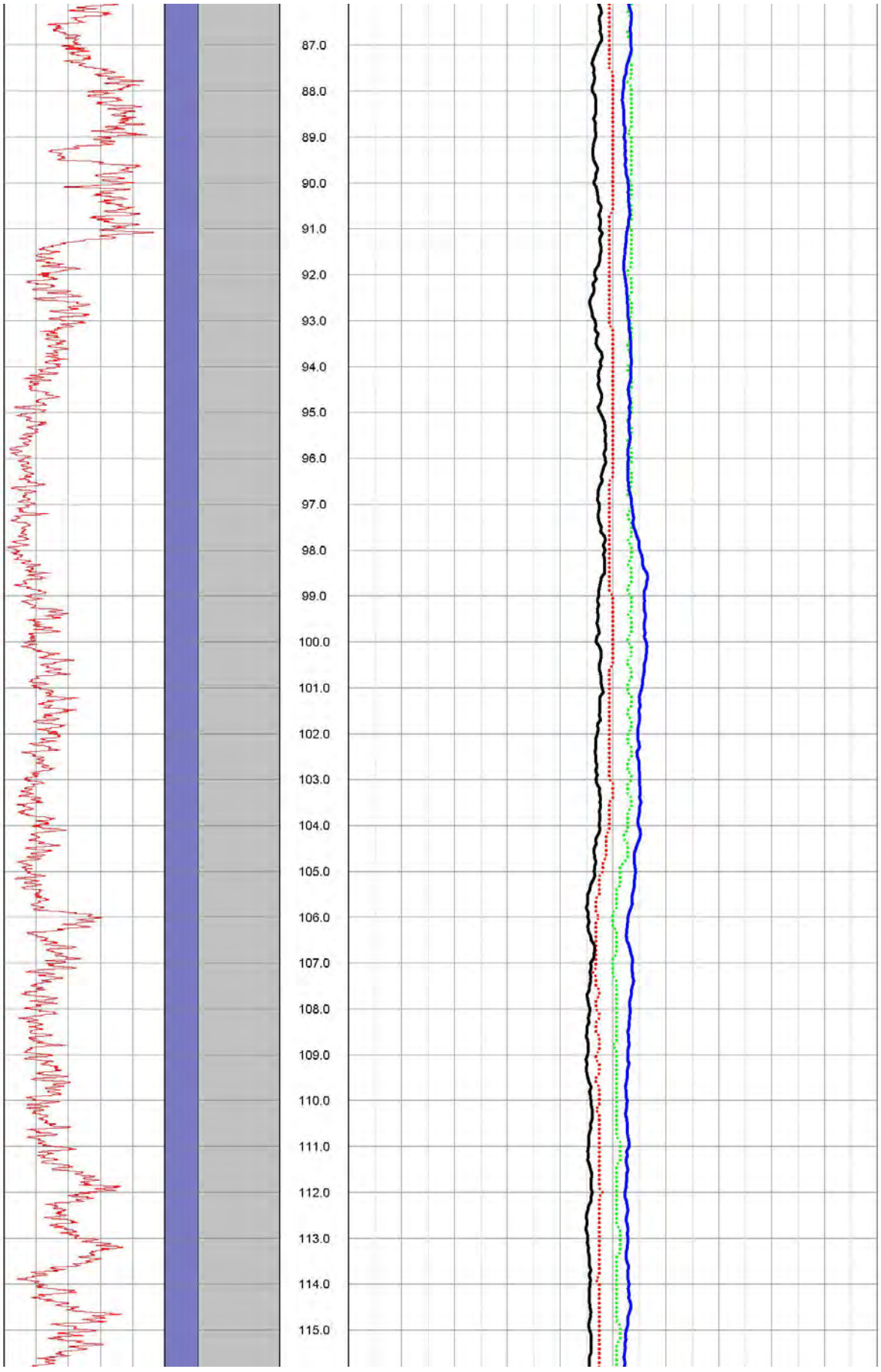
81.0
82.0
83.0
84.0
85.0
86.0


87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
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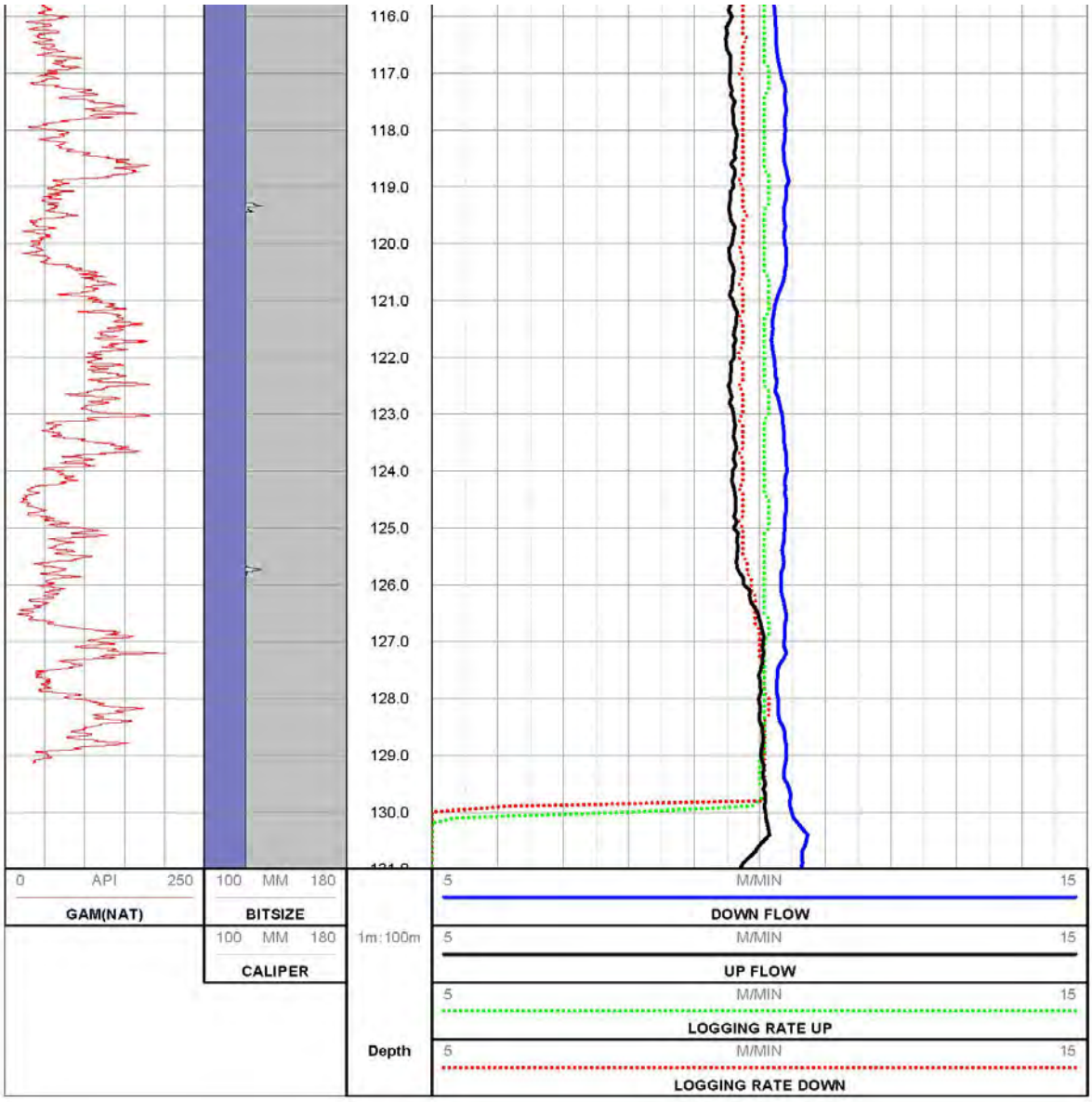
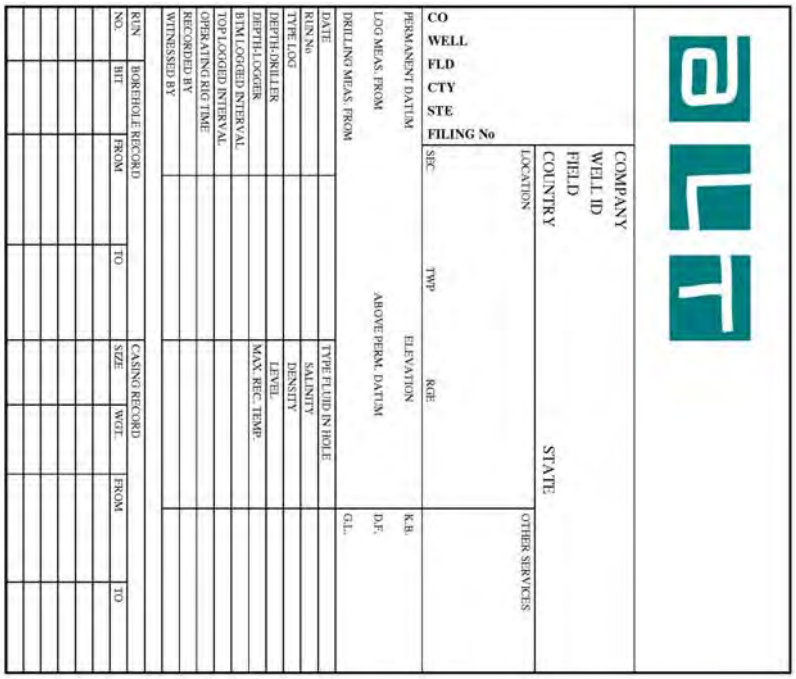
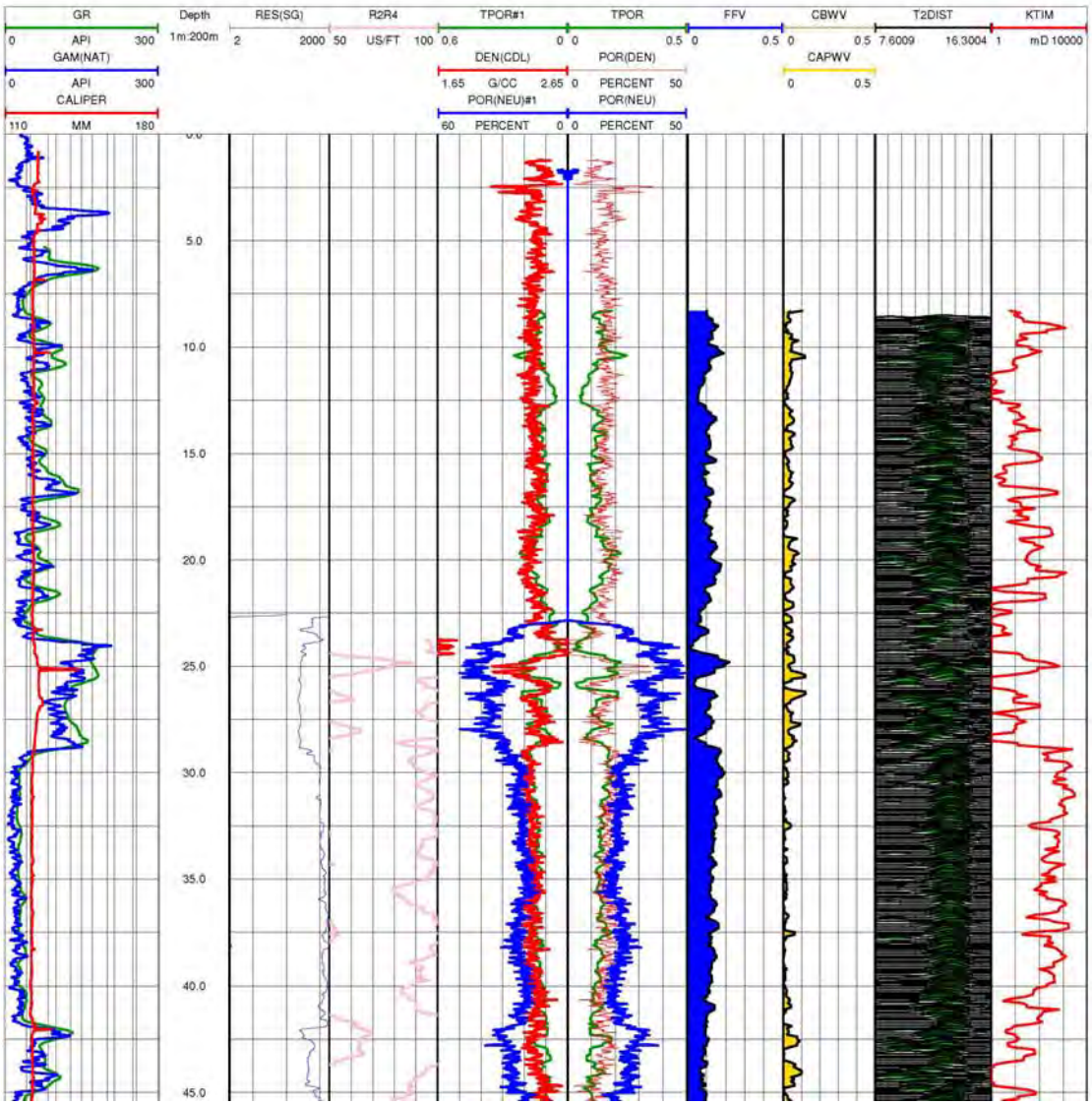
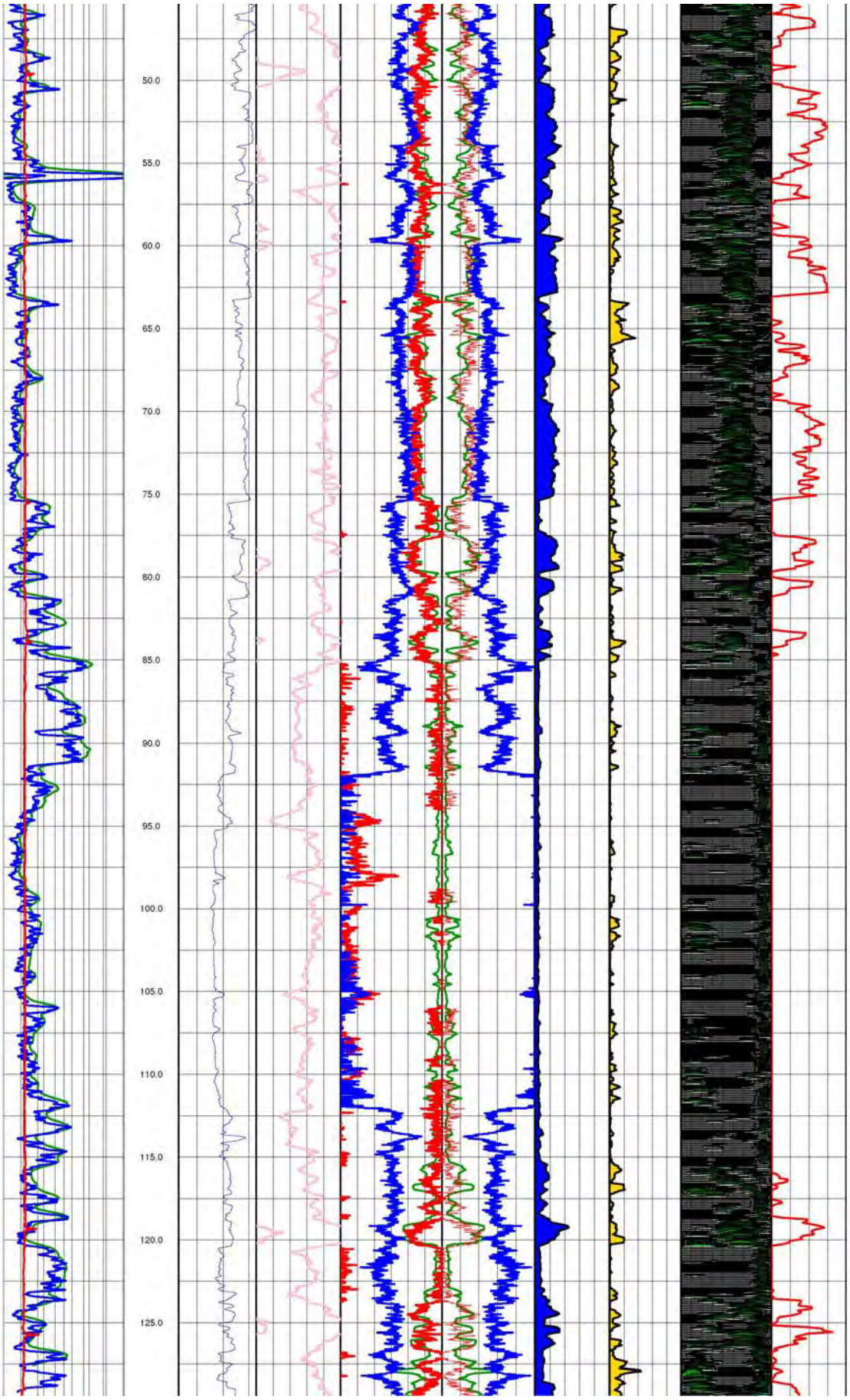
110.0
111.0
112.0
113.0
114.0
115.0


116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
130.0
0
API
250
GAM(NAT)
100
MM
180
BITSIZE
100
MM
180
CALIPER
1m:100m
Depth
5
M/MIN
15
DOWN FLOW
5
M/MIN
15
UP FLOW
5
M/MIN
15
LOGGING RATE UP
5
M/MIN
15
LOGGING RATE DOWN

APPENDIX 10 - S2314 NMR LOG GRAPHIC






50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0

NB: Explanation of codes on NMR graphic:

GR/ GAM – Gamma Ray measurements
Caliper – Hole size (from the density caliper)
Res – Medium Guard Resistivity (from the density tool)
R2R4 – Compressional Slowness from the sonic tool
DEN – Compensated Density
POR(NEU) – Neutron Porosity (Sandstone Matrix)
TPOR – Total porosity from the NMR tool
POR(DEN) – Calculated density porosity using a sandstone matrix.
FFV – Free Fluid Volume from the NMR (the fluid which will flow)
CAPW – Capiliary Bound Volume from the NMR
CBWV – Clay Bound Volume from the NMR
T2DIST – The NMR T2 distribution from the NMR – this is the distribution the NMR measures that is then used to produce the other curves.
KTIM – Permeability derived from the NMR data with the Timor-Coates equation.