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JN1919

COMPANY: Beatons Creek Gold Pty Ltd

ATTENTION: Chris Goti

FROM: Graeme Campbell

SUBJECT: Water-Retention Testing of Oxide-[Surface-Zone]-Waste Samples **BSX083**, **BSX086**, **BSX087**, and **BSX089**

NO. PAGES (including this page): 19 DATE: 7th June 2020

Chris,

The following pages relate to the above samples subjected to water-retention testing as input to the work being undertaken by Mine Earth for the Beatons Creek Project.

The testwork results are shown on Figures 1-4, and the laboratory-testing reports are presented in Attachment I.

A photographic-log of select stages in the testing is presented in the following pages.

Regards,

Dr GD Campbell
Director

1.0 MOULD PACKING AND PRESATURATION

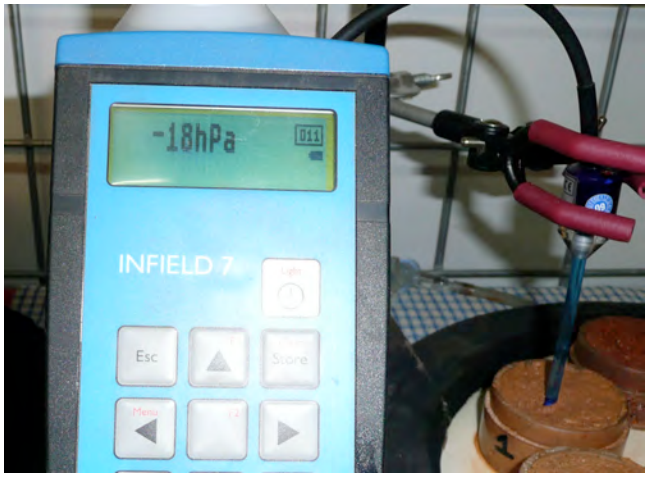
The moulds (30mm height x 50mm i.d.) were packed with the -4.75 mm fractions to the required DBDs, and then pre-saturated via wicking platform using blotting paper (= mineral-water with 'trace-thymol' as biocide).

After correcting for the 'offset' of 9 cm H_2O (= 9 hPa), the matric-suction measured by the UMS T5 microtensiometer was *ca.* 3 cm H_2O (0.3 kPa) as applied via wicking platform.

2.0 SUCTION-PLATE DETERMINATIONS

General Testing Setup: Hanging Water-column Initially

1 kPa

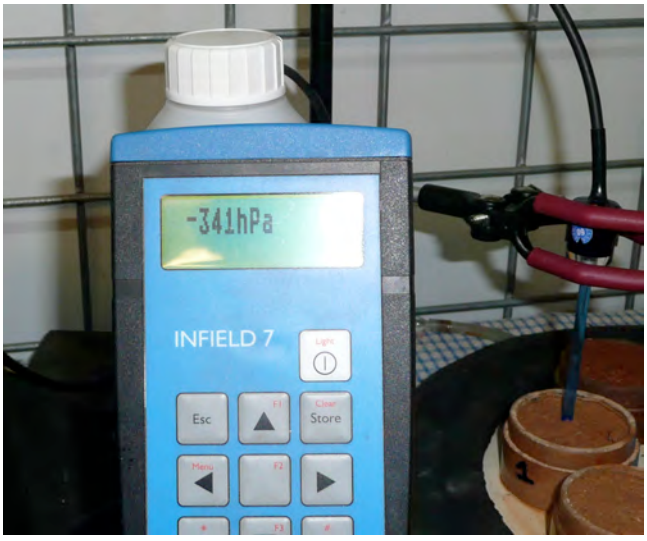


3 kPa

10 kPa

General Testing Setup: Vacuum-Line

33 kPa



2.0 PRESSURE-CHAMBERS

General Pressure-Chamber Arrangement

Closeup of Pre-Saturated Moulds on 1 bar Plate in Pressure-Chamber

FIGURES

Figure 1

Water-Retention Results for Sample_ID BSX083

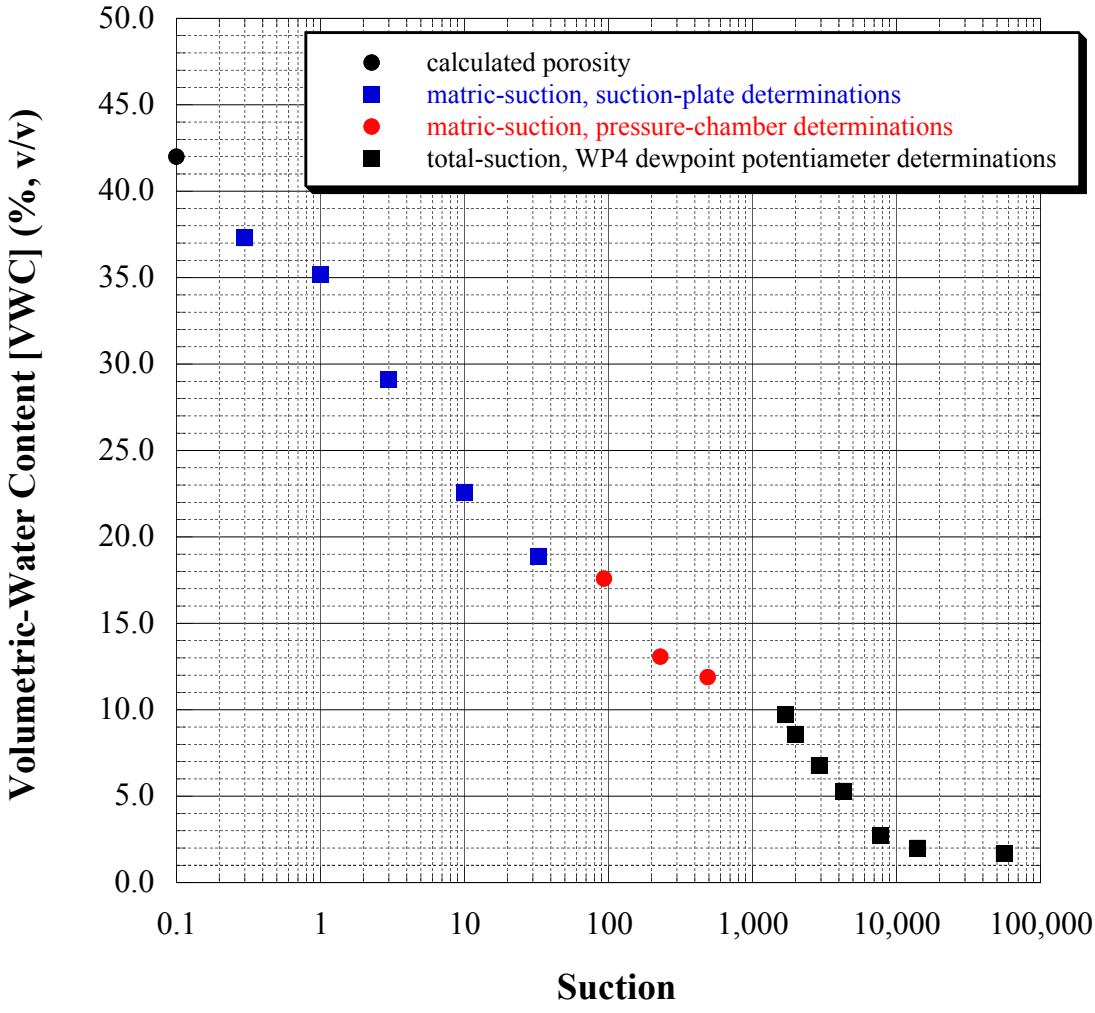


Figure 2

Water-Retention Results for Sample_ID BSX086

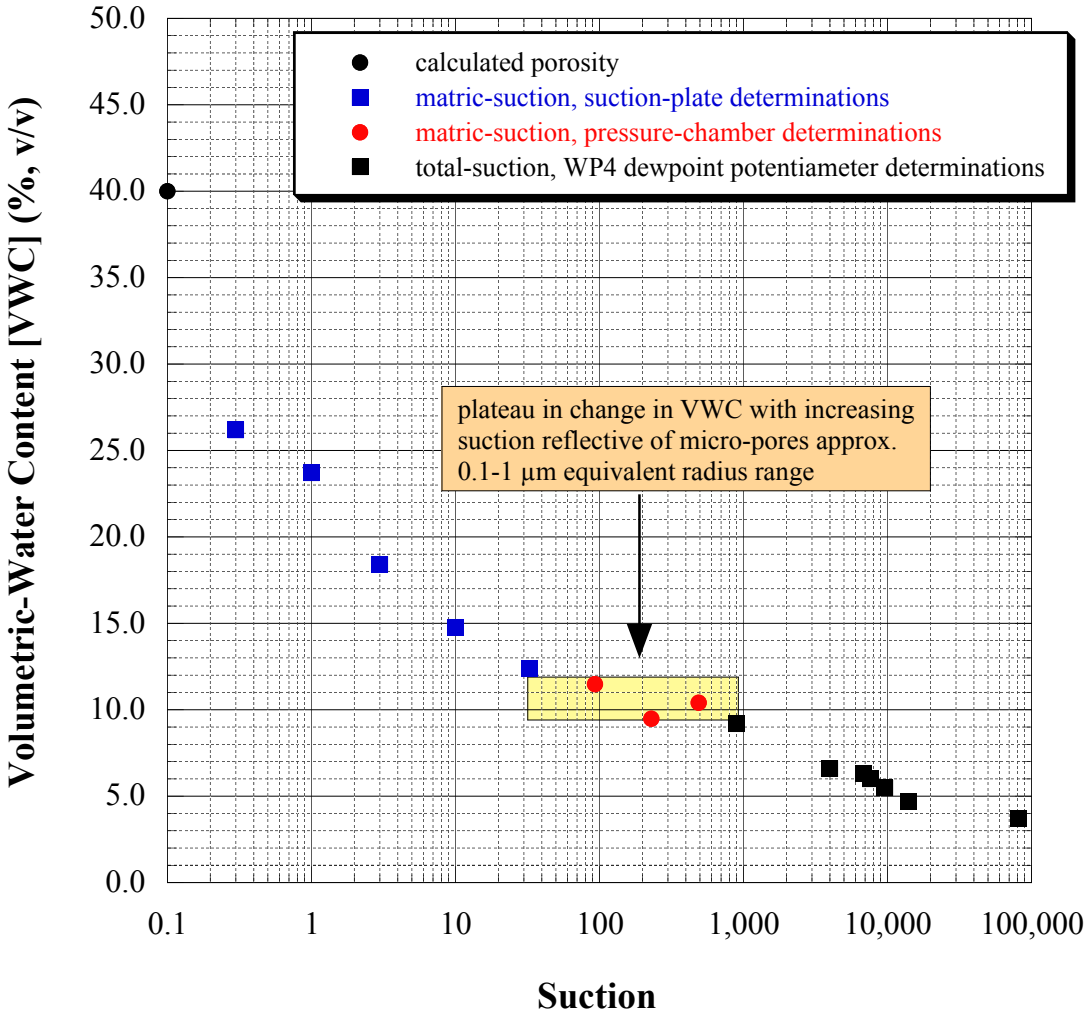


Figure 3

Water-Retention Results for Sample_ID BSX087

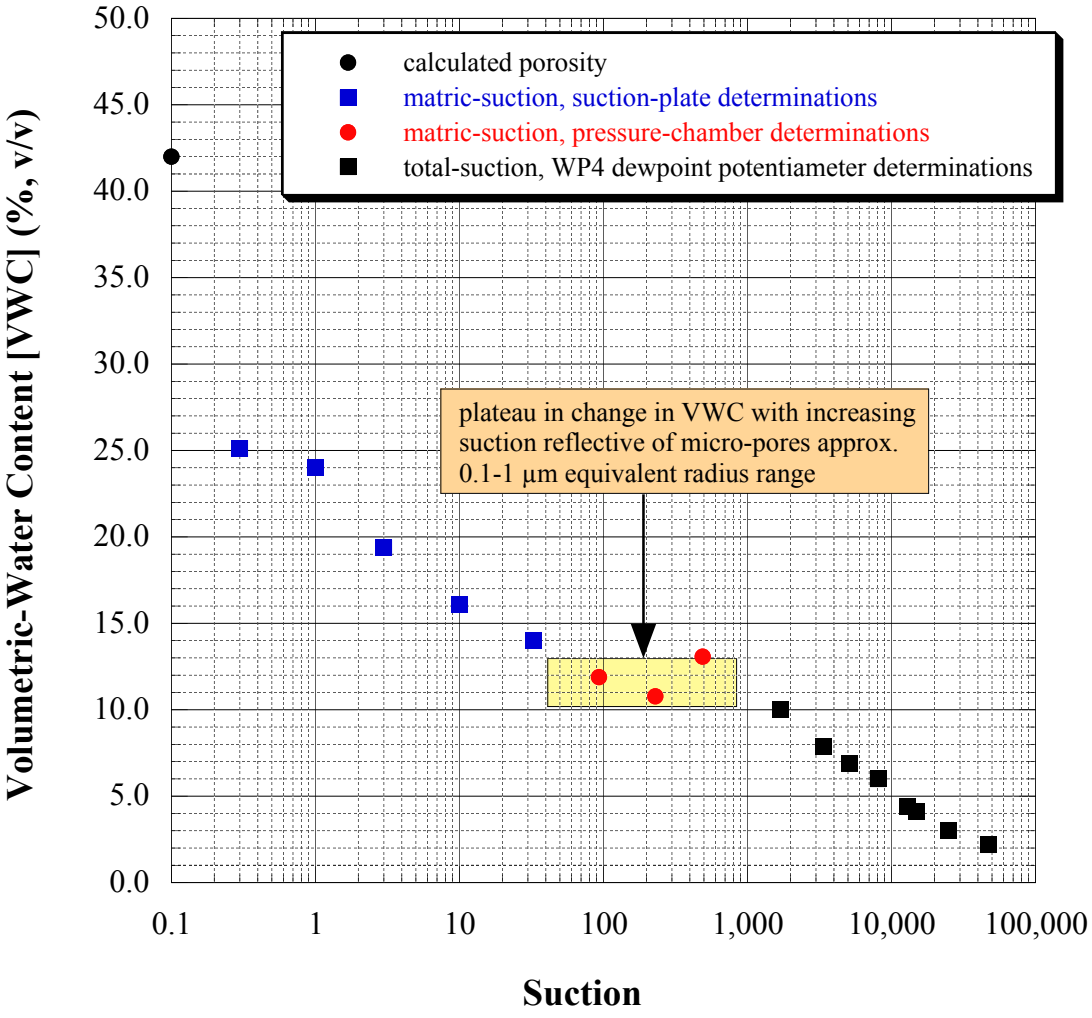
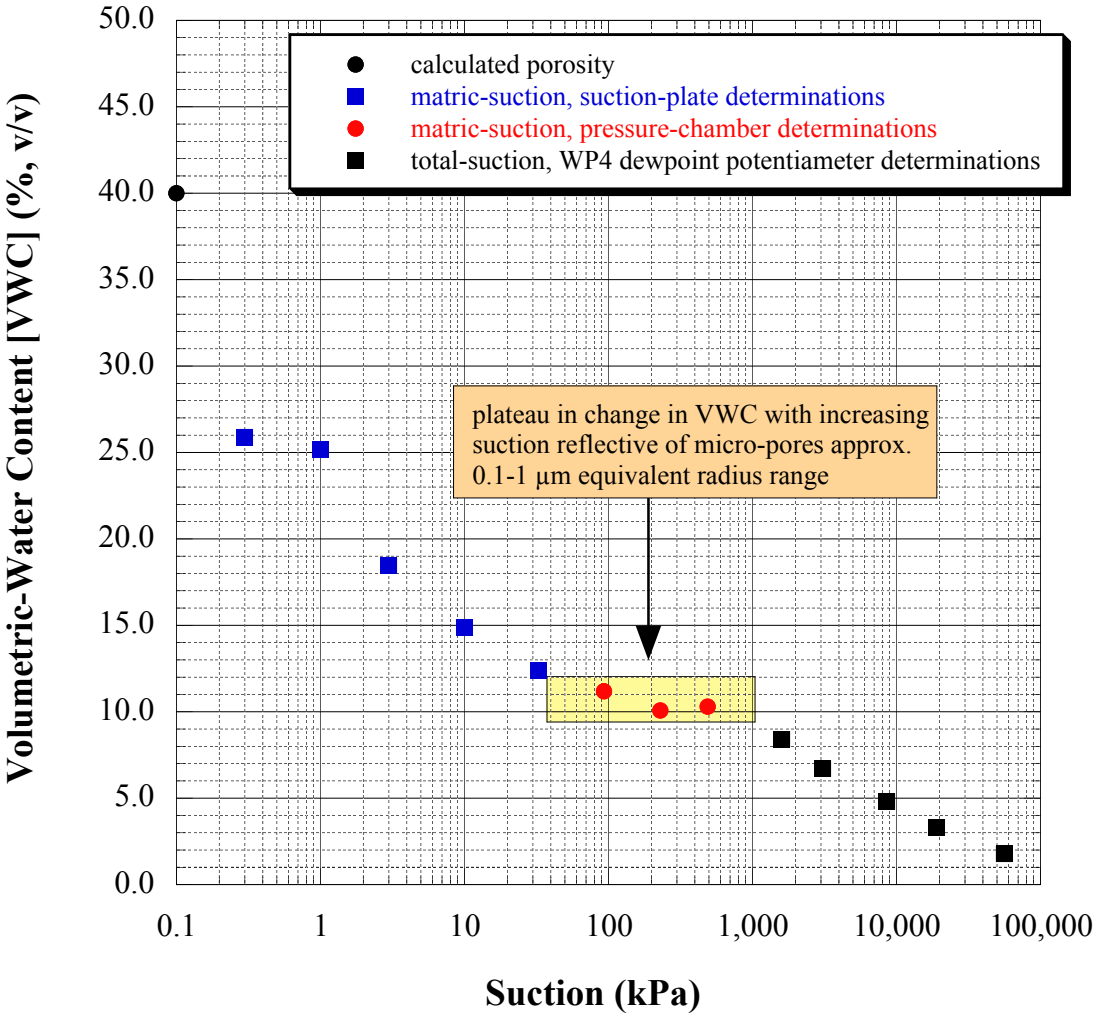


Figure 4

Water-Retention Results for Sample_ID BSX089



ATTACHMENT I

LABORATORY-TESTING REPORTS

WATER-RETENTION TESTING (BEATONS CREEK GOLD PTY LTD)

Sample_ID BSX083

Job No.: 1919

1.0 Suction-Plate and Pressure-Chambers

The following testing employed the **-4.75 mm** fraction.

1.1 Mould-Packing and Pre-saturation

Target-DBD = approx. 1.57 g/cm3	Suction-Plate [100 kPa Plate]		Pressure-Chamber [100 kPa Plate]		Pressure-Chamber [300 kPa Plate]	
Mould No.	**1**	**2**	**3**	**4**	**5**	**6**
Mould-Volume (cm3)	58.9	58.9	58.9	58.9	58.9	58.9
Wt Mould (g)	27.37	26.85	26.07	26.41	26.44	26.81
Wt [Moist-Sample + Mould] (g)	125.29	124.61	124.43	124.88	124.68	125.15
Wt Moist-Sample (g)	97.92	97.76	98.36	98.47	98.24	98.34
GWC (%, w/w)	6.2	6.2	6.2	6.2	6.2	6.2
Wt Dry-Solids (g)	92.20	92.05	92.62	92.72	92.50	92.60
DBD (g/cm3)	**1.57**	**1.56**	**1.57**	**1.57**	**1.57**	**1.57**
Sample-Bed Porosity (%, v/v)	41.6	41.7	41.3	41.3	41.4	41.3

Notes:

GWC = Gravimetric-Water Content; DBD = Dry-Bulk Density.

Target-DBD corresponds to 80 % of Maximum-Dry-Density (MDD) value of 1.96 t/m3, as provided by Mine Earth.

Sample-Bed Porosity based on Particle-Density (PD) value of 2.68 g/cm3, as provided by Mine Earth.

The GWC value corresponds to pre-moistening -4.75 mm fraction with mineral-water.

Pre-moistened soil allowed to age for a few days in a sealed plastic-container in a CT-room at 18-20 oC.

GWC corresponds to oven-drying at 105 oC for approx. 24 hrs.

Moulds (machined from acrylic tube) have an i.d. of 50 mm and a height of 30 mm.

Moulds packed using a rammer similar to that employed in soil-mechanics for compaction testing. However, compactive effort was 'modest'.

The packed-moulds were pre-saturated by wetting-up on a wicking-platform via blotting-paper strips, and corresponding to a matric-suction of approx. 0.4 kPa (i.e. 4 hPa [= 4 cm H2O]).

Wicking occurred over *ca.* 3 days. Glistening of soil-surface indicated attainment of near-saturated state.

Non-aerated, mineral-water employed for setting-up with a 'dash' of thymol as biocide.

No swelling of slumping occurred upon wetting-up to near-saturation.

All suction determinations were undertaken in a CT-room at 18-20 oC.

Initial Pre-Saturation Step

N.B. VWC = Volumetric-Water Content

Mould No.	**1**	**2**
0.003 bar or 0.3 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	140.85	141.55
Wt Moist-Sample (g)	113.48	114.70
GWC (%, w/w)	23.1	24.6
VWC (%, v/v)	36.1	38.5
Mean-VWC (%, v/v)	**37.3**	
Relative-Saturation (%)	87	92

Comment:
The wetted-up sample-bed in the mould had a "soft" surface, and porewater separated when gently pressed with finger-tip. Care was required when transferring wetted-up-mould for weighing and placement on suction-plate, due to 'sliding' of 'soft' sample-bed out of mould.

1.2 Dewatering on Suction-Plate

N.B. No contact material employed for packed-moulds placed on suction-plate.

Mould No.	**1**	**2**
0.01 bar or 1 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	-	139.66
Wt Moist-Sample (g)	-	112.81
GWC (%, w/w)	-	22.5
VWC (%, v/v)	-	**35.2**
0.03 bar or 3 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	-	136.02
Wt Moist-Sample (g)	-	109.17
GWC (%, w/w)	-	18.6
VWC (%, v/v)	-	**29.1**

Comment:
When transferring Mould-No.-1 loss of solids occurred which rendered further tetsing with this mould invalid.
However, this mould was used for checking values of matric-suction via the UMS T5 Microtensiometer, as shown on accompanying photographs in GCA-report.
For Sample_ID BSX083, the water-retention results corresponding to suction-plate testing were therefore those obtained for Mould-No.-2 (i.e. single determination, and not a mean of two determinations.

0.10 bar or 10 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	-	132.19
Wt Moist-Sample (g)	-	105.34
GWC (%, w/w)	-	14.4
VWC (%, v/v)	-	**22.6**
Now Connect-up Vaccum-line (i.e. change from hanging-water-column).		
0.33 bars or 33 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	-	130.04
Wt Moist-Sample (g)	-	103.19
GWC (%, w/w)	-	12.1
VWC (%, v/v)	-	**18.9**

1.3 Dewatering in Pressure-Chamber [100 kPa Plate]

Mould No.	**3**	**4**
0.93 bars or 93 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	128.87	129.71
Wt Moist-Sample (g)	102.80	103.30
GWC (%, w/w)	11.0	11.4
VWC (%, v/v)	17.3	18.0
Mean-VWC (%, v/v)	**17.6**	

1.4 Dewatering in Pressure-Chamber [300 kPa Plate]

Mould No.	**5**	**6**
2.3 bars or 230 kPa (approx. 10 days)		
Wt [Mould + Fittings] + Moist-Sample (g)	126.84	126.96
Wt Moist-Sample (g)	100.40	100.15
GWC (%, w/w)	8.5	8.2
VWC (%, v/v)	13.4	12.7
Mean-VWC (%, v/v)	**13.1**	

1.5 Dewatering in Pressure-Chamber [500 kPa Plate]

This determination is based on the approach of Cresswell *et al.* (2008) employing the **-2 mm** fraction in PVC-rings 10 mm in height.
Triplicate rings were run for this determination.
After saturating with demineralised-water on the ceramic plate in pressure-chamber, the GWC is determined after 5 days at approx. 5 bars.
(Reference: Cresswell HP, Green TW and McKenzie NJ, 2008, "The Adequacy of Pressure Plate Apparatus for Determining Soil Water Retention", *Soil Science Society of America Journal,* 72:41-49).

The mean-GWC value was 7.6 % (w/w) for 490 kPa.
The corresponding VWC value for **490 kPa** was therefore **11.9 % (v/v)** based on a DBD value of 1.57 g/cm3.

2.0 WP4 Dewpoint PotentiaMeter

GWC (%, w/w)	**VWC (% v/v)**	**Total-Suction (kPa)**
6.2	**9.7**	**1,700**
5.5	**8.6**	**2,000**
4.3	**6.8**	**2,900**
3.4	**5.3**	**4,300**
1.7	**2.7**	**7,800**
1.3	**2.0**	**14,000**
1.1	**1.7**	**56,000**

Notes:
The **-2 mm** fractions were moistened using mineral-water (+ 'trace-thymol' as biocide), and left to age for approx. 2 days in sealed plastic-containers in a CT-room at 18-20 oC.
The WP4 Dewpoint PotentiaMeter was checked using the 0.5 molal KCl solution (viz. total-suction near 20 oC of approx. 2,100 kPa) provided by the manufacturer. Agreement within approx. 100 kPa which is within the tolerance limit of the instrument in this total-suction range.
GWCs correspond to oven-drying at 105 oC for approx. 24 hrs.
The VWCs are based on a DBD of 1.57 g/cm3.

Dr GD Campbell
6th June 2020

GRAEME CAMPBELL & ASSOCIATES PTY LTD

WATER-RETENTION TESTING (BEATONS CREEK GOLD PTY LTD)

Sample_ID BSX086

Job No.: 1919

1.0 Suction-Plate and Pressure-Chambers

The following testing employed the **-4.75 mm** fraction.

1.1 Mould-Packing and Pre-saturation

Target-DBD = approx. 1.62 g/cm3	Suction-Plate [100 kPa Plate]		Pressure-Chamber [100 kPa Plate]		Pressure-Chamber [300 kPa Plate]	
Mould No.	**7**	**8**	**9**	**10**	**11**	**12**
Mould-Volume (cm3)	58.9	58.9	58.9	58.9	58.9	58.9
Wt Mould (g)	25.45	26.52	27.07	26.79	26.42	26.72
Wt [Moist-Sample + Mould] (g)	126.31	127.57	128.23	127.76	127.52	128.30
Wt Moist-Sample (g)	100.86	101.05	101.16	100.97	101.10	101.58
GWC (%, w/w)	5.7	5.7	5.7	5.7	5.7	5.7
Wt Dry-Solids (g)	95.42	95.60	95.70	95.53	95.65	96.10
DBD (g/cm3)	**1.62**	**1.62**	**1.62**	**1.62**	**1.62**	**1.63**
Sample-Bed Porosity (%, v/v)	40.2	40.1	40.0	40.2	40.1	39.8

Notes:

GWC = Gravimetric-Water Content; DBD = Dry-Bulk Density.

Target-DBD corresponds to 80 % of Maximum-Dry-Density (MDD) value of 2.03 t/m3, as provided by Mine Earth.

Sample-Bed Porosity based on Particle-Density (PD) value of 2.71 g/cm3, as provided by Mine Earth.

The GWC value corresponds to pre-moistening -4.75 mm fraction with mineral-water.

Pre-moistened soil allowed to age for a few days in a sealed plastic-container in a CT-room at 18-20 oC.

GWC corresponds to oven-drying at 105 oC for approx. 24 hrs.

Moulds (machined from acrylic tube) have an i.d. of 50 mm and a height of 30 mm.

Moulds packed using a rammer similar to that employed in soil-mechanics for compaction testing. However, compactive effort was 'modest'.

The packed-moulds were pre-saturated by wetting-up on a wicking-platform via blotting-paper strips, and corresponding to a matric-suction of approx. 0.4 kPa (i.e. 4 hPa [= 4 cm H2O]).

Wicking occurred over *ca.* 3 days. Glistening of soil-surface indicated attainment of near-saturated state.

Non-aerated, mineral-water employed for setting-up with a 'dash' of thymol as biocide.

No swelling of slumping occurred upon wetting-up to near-saturation.

All suction determinations were undertaken in a CT-room at 18-20 oC.

Initial Pre-Saturation Step

N.B. VWC = Volumetric-Water Content

Mould No.	**7**	**8**
0.003 bar or 0.3 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	136.01	137.80
Wt Moist-Sample (g)	110.56	111.28
GWC (%, w/w)	15.9	16.4
VWC (%, v/v)	25.7	26.6
Mean-VWC (%, v/v)	**26.2**	
Relative-Saturation (%)	64	66

Comment:
The wetted-up sample-bed in the mould had a slight tendency to 'slip' when transferred for weighing and placement on suction-plate. Surface of sample-bed quite 'gritty'.

1.2 Dewatering on Suction-Plate

N.B. No contact material employed for packed-moulds placed on suction-plate.

Mould No.	**7**	**8**
0.01 bar or 1 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	134.71	136.24
Wt Moist-Sample (g)	109.26	109.72
GWC (%, w/w)	14.5	14.8
VWC (%, v/v)	23.5	24.0
Mean-VWC (%, v/v)	**23.7**	
0.03 bar or 3 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	131.64	132.98
Wt Moist-Sample (g)	106.19	106.46
GWC (%, w/w)	11.3	11.4
VWC (%, v/v)	18.3	18.4
Mean-VWC (%, v/v)	**18.4**	
0.10 bar or 10 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	129.52	130.92
Wt Moist-Sample (g)	104.07	104.40
GWC (%, w/w)	9.1	9.2
VWC (%, v/v)	14.7	14.9
Mean-VWC (%, v/v)	**14.8**	

Now Connect-up Vaccum-line (i.e. change from hanging-water-column).

0.33 bars or 33 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	128.11	129.53
Wt Moist-Sample (g)	102.66	103.01
GWC (%, w/w)	7.6	7.8
VWC (%, v/v)	12.3	12.6
Mean-VWC (%, v/v)	**12.4**	

1.3 Dewatering in Pressure-Chamber [100 kPa Plate]

Mould No.	**9**	**10**
0.93 bars or 93 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	129.55	129.14
Wt Moist-Sample (g)	102.48	102.35
GWC (%, w/w)	7.1	7.1
VWC (%, v/v)	11.5	11.6
Mean-VWC (%, v/v)	**11.5**	

1.4 Dewatering in Pressure-Chamber [300 kPa Plate]

Mould No.	**11**	**12**
2.3 bars or 230 kPa (approx. 10 days)		
Wt [Mould + Fittings] + Moist-Sample (g)	127.38	128.79
Wt Moist-Sample (g)	100.96	102.07
GWC (%, w/w)	5.6	6.2
VWC (%, v/v)	9.0	10.1
Mean-VWC (%, v/v)	**9.5**	

1.5 Dewatering in Pressure-Chamber [500 kPa Plate]

This determination is based on the approach of Cresswell *et al.* (2008) employing the **-2 mm** fraction in PVC-rings 10 mm in height.
Triplicate rings were run for this determination.
After saturating with demineralised-water on the ceramic plate in pressure-chamber, the GWC is determined after 5 days at a pressure of approx. 5 bars.
(Reference: Cresswell HP, Green TW and McKenzie NJ, 2008, "The Adequacy of Pressure Plate Apparatus for Determining Soil Water Retention", *Soil Science Society of America Journal,* 72:41-49).

The mean-GWC value was 6.4 % (w/w) for 490 kPa.
The corresponding VWC value for **490 kPa** was therefore **10.4 % (v/v)** based on a DBD value of 1.62 g/cm3.

2.0 WP4 Dewpoint PotentiaMeter

GWC (%, w/w)	**VWC (% v/v)**	**Total-Suction (kPa)**
5.7	**9.2**	**900**
4.1	**6.6**	**4,000**
3.9	**6.3**	**6,800**
3.7	**6.0**	**7,600**
3.4	**5.5**	**9,600**
2.9	**4.7**	**14,000**
2.3	**3.7**	**82,000**

Notes:
The **-2 mm** fractions were moistened using mineral-water (+ 'trace-thymol' as biocide), and left to age for approx. 2 days in sealed plastic-containers in a CT-room at 18-20 oC.
The WP4 Dewpoint PotentiaMeter was checked using the 0.5 molal KCl solution (viz. total-suction near 20 oC of approx. 2,100 kPa) provided by the manufacturer. Agreement within approx. 100 kPa which is within the tolerance limit of the instrument in this total-suction range.
GWCs correspond to oven-drying at 105 oC for approx. 24 hrs.
The VWCs are based on a DBD of 1.62 g/cm3.

Dr GD Campbell
6th June 2020

WATER-RETENTION TESTING (BEATONS CREEK GOLD PTY LTD)

Sample_ID BSX087

Job No.: 1919

1.0 Suction-Plate and Pressure-Chambers

The following testing employed the **-4.75 mm** fraction.

1.1 Mould-Packing and Pre-saturation

Target-DBD = approx. 1.57 g/cm3	Suction-Plate [100 kPa Plate]		Pressure-Chamber [100 kPa Plate]		Pressure-Chamber [300 kPa Plate]	
Mould No.	**13**	**14**	**15**	**16**	**17**	**18**
Mould-Volume (cm3)	58.9	58.9	58.9	58.9	58.9	58.9
Wt Mould (g)	26.90	26.69	26.16	26.31	25.78	26.29
Wt [Moist-Sample + Mould] (g)	126.34	125.93	125.21	125.60	125.15	125.76
Wt Moist-Sample (g)	99.44	99.24	99.05	99.29	99.37	99.47
GWC (%, w/w)	7.2	7.2	7.2	7.2	7.2	7.2
Wt Dry-Solids (g)	92.76	92.57	92.40	92.62	92.70	92.79
DBD (g/cm3)	**1.57**	**1.57**	**1.57**	**1.57**	**1.57**	**1.58**
Sample-Bed Porosity (%, v/v)	41.9	42.0	42.1	42.0	41.9	41.9

Notes:

GWC = Gravimetric-Water Content; DBD = Dry-Bulk Density.

Target-DBD corresponds to 80 % of Maximum-Dry-Density (MDD) value of 1.96 t/m3, as provided by Mine Earth.

Sample-Bed Porosity based on Particle-Density (PD) value of 2.71 g/cm3, as provided by Mine Earth.

The GWC value corresponds to pre-moistening -4.75 mm fraction with mineral-water.

Pre-moistened soil allowed to age for a few days in a sealed plastic-container in a CT-room at 18-20 oC.

GWC corresponds to oven-drying at 105 oC for approx. 24 hrs.

Moulds (machined from acrylic tube) have an i.d. of 50 mm and a height of 30 mm.

Moulds packed using a rammer similar to that employed in soil-mechanics for compaction testing. However, compactive effort was 'modest'.

The packed-moulds were pre-saturated by wetting-up on a wicking-platform via blotting-paper strips, and corresponding to a matric-suction of approx. 0.4 kPa (i.e. 4 hPa [= 4 cm H2O]).

Wicking occurred over *ca.* 3 days. Glistening of soil-surface indicated attainment of near-saturated state.

Non-aerated, mineral-water employed for setting-up with a 'dash' of thymol as biocide.

No swelling of slumping occurred upon wetting-up to near-saturation.

All suction determinations were undertaken in a CT-room at 18-20 oC.

Initial Pre-Saturation Step

N.B. VWC = Volumetric-Water Content

Mould No.	**13**	**14**
0.003 bar or 0.3 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	134.72	133.77
Wt Moist-Sample (g)	107.82	107.08
GWC (%, w/w)	16.2	15.7
VWC (%, v/v)	25.6	24.6
Mean-VWC (%, v/v)	**25.1**	
Relative-Saturation (%)	61	59

Comment:
The wetted-up sample-bed in the mould had a slight tendency to 'slip' when transferred for weighing and placement on suction-plate. Surface of sample-bed quite 'gritty'.

1.2 Dewatering on Suction-Plate

N.B. No contact material employed for packed-moulds placed on suction-plate.

Mould No.	**13**	**14**
0.01 bar or 1 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	134.02	133.18
Wt Moist-Sample (g)	107.12	106.49
GWC (%, w/w)	15.5	15.0
VWC (%, v/v)	24.4	23.6
Mean-VWC (%, v/v)	**24.0**	
0.03 bar or 3 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	131.14	130.59
Wt Moist-Sample (g)	104.24	103.90
GWC (%, w/w)	12.4	12.2
VWC (%, v/v)	19.5	19.2
Mean-VWC (%, v/v)	**19.4**	
0.10 bar or 10 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	129.16	128.76
Wt Moist-Sample (g)	102.26	102.07
GWC (%, w/w)	10.2	10.3
VWC (%, v/v)	16.1	16.1
Mean-VWC (%, v/v)	**16.1**	

Now Connect-up Vaccum-line (i.e. change from hanging-water-column).		
0.33 bars or 33 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	127.92	127.48
Wt Moist-Sample (g)	101.02	100.79
GWC (%, w/w)	8.9	8.9
VWC (%, v/v)	14.0	13.9
Mean-VWC (%, v/v)	**14.0**	

1.3 Dewatering in Pressure-Chamber [100 kPa Plate]

Mould No.	**15**	**16**
0.93 bars or 93 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	125.78	125.76
Wt Moist-Sample (g)	99.62	99.45
GWC (%, w/w)	7.8	7.4
VWC (%, v/v)	12.3	11.6
Mean-VWC (%, v/v)	**11.9**	

1.4 Dewatering in Pressure-Chamber [300 kPa Plate]

Mould No.	**17**	**18**
2.5 bars or 230 kPa (approx. 10 days)		
Wt [Mould + Fittings] + Moist-Sample (g)	125.22	125.08
Wt Moist-Sample (g)	99.44	98.79
GWC (%, w/w)	7.3	6.5
VWC (%, v/v)	11.5	10.2
Mean-VWC (%, v/v)	**10.8**	

1.5 Dewatering in Pressure-Chamber [500 kPa Plate]

This determination is based on the approach of Cresswell *et al.* (2008) employing the **-2 mm** fraction in PVC-rings 10 mm in height.
Triplicate rings were run for this determination.
After saturating with demineralised-water on the ceramic plate in pressure-chamber, the GWC is determined after 5 days at a pressure of approx. 5 bars.
(Reference: Cresswell HP, Green TW and McKenzie NJ, 2008, "The Adequacy of Pressure Plate Apparatus for Determining Soil Water Retention", *Soil Science Society of America Journal,* 72:41-49).

The mean-GWC value was 8.4 % (w/w) for 490 kPa.
The corresponding VWC value for **490 kPa** was therefore **13.1 % (v/v)** based on a DBD value of 1.57 g/cm3.

2.0 WP4 Dewpoint PotentiaMeter

GWC (%, w/w)	**VWC (% v/v)**	**Total-Suction (kPa)**
6.4	**10.0**	**1,700**
5.0	**7.9**	**3,400**
4.4	**6.9**	**5,100**
3.8	**6.0**	**8,100**
2.8	**4.4**	**13,000**
2.6	**4.1**	**15,000**
1.9	**3.0**	**25,000**
1.4	**2.2**	**47,000**

Notes:
The **-2 mm** fractions were moistened using mineral-water (+ 'trace-thymol' as biocide), and left to age for approx. 2 days in sealed plastic-containers in a CT-room at 18-20 oC.
The WP4 Dewpoint PotentiaMeter was checked using the 0.5 molal KCl solution (viz. total-suction near 20 oC of approx. 2,100 kPa) provided by the manufacturer. Agreement within approx. 100 kPa which is within the tolerance limit of the instrument in this total-suction range.
GWCs correspond to oven-drying at 105 oC for approx. 24 hrs.
The VWCs are based on a DBD of 1.57 g/cm3.

Dr GD Campbell
6th June 2020

GRAEME CAMPBELL & ASSOCIATES PTY LTD

WATER-RETENTION TESTING (BEATONS CREEK GOLD PTY LTD)

Sample_ID BSX089

Job No.: 1919

1.0 Suction-Plate and Pressure-Chambers

The following testing employed the **-4.75 mm** fraction.

1.1 Mould-Packing and Pre-saturation

Target-DBD = approx. 1.64 g/cm3	Suction-Plate [100 kPa Plate]		Pressure-Chamber [100 kPa Plate]		Pressure-Chamber [300 kPa Plate]	
Mould No.	**19**	**20**	**21**	**22**	**23**	**24**
Mould-Volume (cm3)	58.9	58.9	58.9	58.9	58.9	58.9
Wt Mould (g)	25.84	26.04	25.86	25.83	25.97	25.90
Wt [Moist-Sample + Mould] (g)	128.58	128.54	127.78	128.94	128.91	128.80
Wt Moist-Sample (g)	102.74	102.50	101.92	103.11	102.94	102.90
GWC (%, w/w)	6.2	6.2	6.2	6.2	6.2	6.2
Wt Dry-Solids (g)	96.74	96.52	95.97	97.09	96.93	96.89
DBD (g/cm3)	**1.64**	**1.64**	**1.63**	**1.65**	**1.65**	**1.65**
Sample-Bed Porosity (%, v/v)	39.6	39.8	40.1	39.4	39.5	39.5

Notes:

GWC = Gravimetric-Water Content; DBD = Dry-Bulk Density.

Target-DBD corresponds to 80 % of Maximum-Dry-Density (MDD) value of 2.05 t/m3, as provided by Mine Earth.

Sample-Bed Porosity based on Particle-Density (PD) value of 2.72 g/cm3, as provided by Mine Earth.

The GWC value corresponds to pre-moistening -4.75 mm fraction with mineral-water.

Pre-moistened soil allowed to age for a few days in a sealed plastic-container in a CT-room at 18-20 oC.

GWC corresponds to oven-drying at 105 oC for approx. 24 hrs.

Moulds (machined from acrylic tube) have an i.d. of 50 mm and a height of 30 mm.

Moulds packed using a rammer similar to that employed in soil-mechanics for compaction testing. However, compactive effort was 'modest'.

The packed-moulds were pre-saturated by wetting-up on a wicking-platform via blotting-paper strips, and corresponding to a matric-suction of approx. 0.4 kPa (i.e. 4 hPa [= 4 cm H2O]).

Wicking occurred over *ca.* 3 days. Glistening of soil-surface indicated attainment of near-saturated state.

Non-aerated, mineral-water employed for setting-up with a 'dash' of thymol as biocide.

No swelling of slumping occurred upon wetting-up to near-saturation.

All suction determinations were undertaken in a CT-room at 18-20 oC.

Initial Pre-Saturation Step

N.B. VWC = Volumetric-Water Content

Mould No.	**19**	**20**
0.003 bar or 0.3 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	138.02	137.65
Wt Moist-Sample (g)	112.18	111.61
GWC (%, w/w)	16.0	15.6
VWC (%, v/v)	26.2	25.6
Mean-VWC (%, v/v)	**25.9**	
Relative-Saturation (%)	66	64

Comment:
The wetted-up sample-bed in the mould had a slight tendency to 'slip' when transferred for weighing and placement on suction-plate. Surface of sample-bed quite 'gritty'.

1.2 Dewatering on Suction-Plate

N.B. No contact material employed for packed-moulds placed on suction-plate.

Mould No.	**19**	**20**
0.01 bar or 1 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	137.89	136.94
Wt Moist-Sample (g)	112.05	110.90
GWC (%, w/w)	15.8	14.9
VWC (%, v/v)	26.0	24.4
Mean-VWC (%, v/v)	**25.2**	
0.03 bar or 3 kPa (approx. 2 days)		
Wt [Mould] + Moist-Sample (g)	133.53	133.45
Wt Moist-Sample (g)	107.69	107.41
GWC (%, w/w)	11.3	11.3
VWC (%, v/v)	18.6	18.5
Mean-VWC (%, v/v)	**18.5**	
0.10 bar or 10 kPa (approx. 3 days)		
Wt [Mould] + Moist-Sample (g)	131.40	131.30
Wt Moist-Sample (g)	105.56	105.26
GWC (%, w/w)	9.1	9.1
VWC (%, v/v)	15.0	14.8
Mean-VWC (%, v/v)	**14.9**	

Now Connect-up Vaccum-line (i.e. change from hanging-water-column).		
0.33 bars or 33 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	129.99	129.77
Wt Moist-Sample (g)	104.15	103.73
GWC (%, w/w)	7.7	7.5
VWC (%, v/v)	12.6	12.2
Mean-VWC (%, v/v)	**12.4**	

1.3 Dewatering in Pressure-Chamber [100 kPa Plate]

Mould No.	**21**	**22**
0.93 bars or 93 kPa (approx. 5 days)		
Wt [Mould] + Moist-Sample (g)	128.52	129.41
Wt Moist-Sample (g)	102.66	103.58
GWC (%, w/w)	7.0	6.7
VWC (%, v/v)	11.4	11.0
Mean-VWC (%, v/v)	**11.2**	

1.4 Dewatering in Pressure-Chamber [300 kPa Plate]

Mould No.	**23**	**24**
2.3 bars or 230 kPa (approx. 10 days)		
Wt [Mould + Fittings] + Moist-Sample (g)	128.96	128.63
Wt Moist-Sample (g)	102.99	102.73
GWC (%, w/w)	6.3	6.0
VWC (%, v/v)	10.3	9.9
Mean-VWC (%, v/v)	**10.1**	

1.5 Dewatering in Pressure-Chamber [500 kPa Plate]

This determination is based on the approach of Cresswell *et al.* (2008) employing the **-2 mm** fraction in PVC-rings 10 mm in height.
Triplicate rings were run for this determination.
After saturating with demineralised-water on the ceramic plate in pressure-chamber, the GWC is determined after 5 days at a pressure of approx. 5 bars.
(Reference: Cresswell HP, Green TW and McKenzie NJ, 2008, "The Adequacy of Pressure Plate Apparatus for Determining Soil Water Retention", *Soil Science Society of America Journal,* 72:41-49).

The mean-GWC value was 6.3 % (w/w) for 490 kPa.
The corresponding VWC value for **490 kPa** (was therefore **10.3 % (v/v)** based on a DBD value of 1.64 g/cm3.

2.0 WP4 Dewpoint PotentiaMeter

GWC (%, w/w)	**VWC (% v/v)**	**Total-Suction (kPa)**
5.1	**8.4**	**1,600**
4.1	**6.7**	**3,100**
2.9	**4.8**	**8,600**
2.0	**3.3**	**19,000**
1.1	**1.8**	**56,000**

Notes:
The **-2 mm** fractions were moistened using mineral-water (+ 'trace-thymol' as biocide), and left to age for approx. 2 days in sealed plastic-containers in a CT-room at 18-20 oC.
The WP4 Dewpoint PotentiaMeter was checked using the 0.5 molal KCl solution (viz. total-suction near 20 oC of approx. 2,100 kPa) provided by the manufacturer. Agreement within approx. 100 kPa which is within the tolerance limit of the instrument in this total-suction range.
GWCs correspond to oven-drying at 105 oC for approx. 24 hrs.
The VWCs are based on a DBD of 1.64 g/cm3.

Dr GD Campbell
6th June 2020