PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 1
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 20/08/07-22/08/07
LOGGED BY: FWS/FWS (27/08/07)

LOCATION: Limestone Stockpile
X CO-ORD: +2 867 677.843
Y CO-ORD: +7 836.200
ELEVATION: 1 516.942m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC									0	
NWD4	100	-	0	▼	55				1	
	100	20	0						2	
	70	10	45						3	
	100	12	70						4	
	98	6	100						5	
	100	2	100						6	
	95	7	100						7	
	95	3	100						8	
	95	4	100						9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,70m Ferruginised rock fragments, scattered diabase BOULDERS and GRAVELS in a matrix of red to brown SANDY SILT; pebble marker.

0,70-3,00m Dark red-brown, probably firm to stiff, CLAYEY SILT with scattered sub-rounded GRAVELS; residual Dwyka tillite.

3,00-6,07m Orange-brown, highly weathered (some completely weathered zones), fine grained, thinly bedded, highly fractured, very soft rock DWYKA TILLITE. Fractures are wide, slightly rough and filled with clay-silt and wall rock. Fractures are sub-horizontal.

6,07-8,99m Yellow brown banded red-brown, highly weathered, fine grained, very thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures are narrow to wide, smooth and filled with clay-silt. Fractures dip sub-horizontally.

Stopped at 8,99m

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 2
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 21/08/07-22/08/07
LOGGED BY: FWS/FWS (27/08/07)

LOCATION: Auxiliary Building
X CO-ORD: +2 867 519.432
Y CO-ORD: +7 872.254
ELEVATION: 1 516.366m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	-	0						1	
	23	-	0							
	100	-	0							

CORE DESCRIPTION

0,00-0,22m Abundant GRAVELS in a matrix of bown SANDY SILT; pebble marker.

0,22-1,50m Dark orange-brown, probably stiff to very stiff, CLAYEY SILT; residual Dwyka tillite.

Stopped at 1,50m

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh10
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 28/07/07-02/08/07
LOGGED BY: JFR/JFR (07/08/07)

LOCATION:
X CO-ORD: +2 868 023.017
Y CO-ORD: +8 144.686
ELEVATION: 1497.246m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	>50	-						0	
NXC	100	>50	-						1	
NWD4	100	21	0						2	
NWD4	96	44	0						3	
NWD4	80	>50	0			WP	0 U.L.		4	
NWD4	100	39	0						5	
NWD4	100	35	0						6	
NWD4	87	29	0			WP	0 U.L.		7	
NWD4	100	24	0						8	
NWD4	100	24	9			WP	0 U.L.		9	
NWD4	100	18	15						10	
NWD4	100	23	11			WP	1 U.L. (DIL)		11	
NWD4	100	24	0						12	
NWD4	100	18	0			WP	0 U.L.		13	
NWD4	97	25	0						14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,25m Grey-brown SILTY SAND; hillwash.

0,25-0,55m Abundant red-brown streaked yellowish orange, friable weakly ferruginised, weathered shale GRAVELS in a matrix of yellow-brown SILTY SAND; ferruginised residual Rayton shale.

0,55-3,35m Dark brown banded pinkish brown and orange-brown, highly weathered, very fine grained, laminated and very thinly bedded, highly and very highly fractured, very soft rock, with occasional zones of residual clay-silt up to 50mm wide, RAYTON SHALE. Fractures are very narrow and narrow, slightly and moderately rough, stained red-brown and filled with silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 80-90˚ dips.

3,35-7,68m Orange-brown streaked dark brown, highly weathered, very fine grained, laminated and thinly bedded, highly and very highly fractured, soft rock RAYTON SHALE. Fractures are very narrow to narrow, slightly and moderately rough, stained red-brown and filled with silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 80-90˚ dips.

Note: 200mm core loss from 4,48-5,45m - probably very highly fractured rock.

7,68-11,45m Dark brown banded red-brown and occasionally greenish grey, highly weathered, very fine grained, very thinly bedded and laminated, highly fractured, soft rock to moderately hard rock RAYTON SHALE. Fractures are very narrow, slightly and moderately rough, stained red and black. Fractures dip at 0-20˚ predominantly (bedding separations with occasional 60-70˚ and 80-90 dips.

Note: Core loss of 200mm from 7,8-9,23m owing to grinding during drilling.

11,45-18,04m Khaki banded greenish grey and dark brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow, moderately rough, stained brown and black. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 80-90˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 11
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 15/08/07-20/08/07
LOGGED BY: TCP/SAPJ

LOCATION: Boiler
X CO-ORD: +2 867 527.537
Y CO-ORD: +8 040.795
ELEVATION: 1 513.629m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100									
	88									
	74								1	
NWD4	100			⊤	46					
	96	-	-						2	
				⊤	REF					
									3	
	100					WP	0 U.L.			
									4	
		12-15	57							
				✻	17 MPa				5	
	95	-	-							
	100		41			WP	0 U.L.		6	
	97	6	58	✻	8 MPa					
	100		78						7	
						WP	0 U.L.			
	99		62						8	
	91	8	0							
			68						9	
	100					WP	0 U.L.			
			20						10	
				✻	2 MPa					
	99	-	-						11	
						WP	0,1 U.L. (DIL.)			
	98								12	
			-							
	100					WP	0 U.L.		13	
	98									
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0-0,30m Abundant hard ferruginous CONCRETIONS and ferricrete GRAVELS in a matrix of greyish-brown SILTY SAND; roots; nodular ferricrete.

0,30-0,70m Hardpan ferricrete; consistency probably very dense.

0,70-1,20m Abundant friable ferruginous CONCRETIONS in a matrix of orange-brown CLAYEY SAND; nodular ferricrete.

1,20-2,15m Reddish-brown blotched grey and yellow, probably stiff, slightly CLAYEY SANDY SILT with occasional hard rock GRAVEL size clasts; residual Dwyka tillite.

2,15-5,25m Maroon banded yellowish-brown, probably very stiff, jointed (stained yellow and black) and laminated CLAY-SILT; residual Dwyka shale. Shale has slaking properties.

5,25-6,40m Yellowish-brown blotched grey and maroon, highly weathered, fine grained (but with very coarse clasts), highly fractured, moderately hard rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough to rough, stained yellow and black and filled with yellowish brown clay-silt. Fractures dip mainly sub-horizontally.

6,40-7,12m Residual Dwyka shale as from 2,15-5,25 m.

7,12-11,30m Pale yellowish-brown blotched grey and banded dark brown, highly weathered, fine grained (but with very coarse clasts), locally laminated, highly fractured, soft rock shaley DWYKA TILLITE. Fractures are closed to narrow, moderately rough to rough, stained red and black and filled with yellowish brown clay-silt. Fractures dip sub-horizontally and 20-30˚.

11,30-11,72 Residual Dwyka shale as from 2,15-5,25 m.

11,72-14,50 Pale yellowish-brown banded dark brown and blotched pale and dark grey, highly weathered, fine grained (but with occasional very coarse clasts), locally laminated, highly fractured, soft rock shaley DWYKA TILLITE. Fractures are closed to narrow, slightly rough to rough, stained yellow and black and coated with yellow and grey clay-silt. Fractures dip sub-horizontally, 20-30˚, 45˚, 60˚ and sub-vertically. Contains zone of probably very stiff residual soil from 12,61-12,75 m.

14,50-20,80m Pale yellowish brown blotched pale grey and banded dark grey and maroon, probably very stiff, jointed (stained back) laminated CLAY-SILT with zones up to 600mm wide of very soft shale and a ferruginised interval of moderately hard rock consistency from 15,54-15,76m; residual Dwyka shale.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 11
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 15/08/07-20/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 527.537
Y CO-ORD: -8 040.795
ELEVATION: 1 513.629m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	12	9			WP	0 U.L.		21	
	100	10	39						22	
	96	16	28			WP	0 U.L.		23	
	80	16	28						24	
	88	16	21						25	
	100	19	36	*	110 MPa	WP	8 U.L. DIL.		26	
	100	7	65						27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

4,50-20,80m Pale yellowish brown blotched pale grey and banded dark grey and maroon, probably very stiff, jointed (stained back) laminated CLAY-SILT with zones up to 600mm wide of very soft shale and a ferruginised interval of moderately hard rock consistency from 15,54-15,76m; residual Dwyka shale.

20,80-22,75m Yellowish grey banded grey, highy weathered, very fine grained, thinly bedded, highly fractured, very soft rock RAYTON SHALE with zones of residual clay-silt up to 150mm thick (and comprising approximately 20% of the horizon). Fractures are narrow, slightly rough, stained yellowish orange and filled with silt in places. Fractures dip at 10-20˚ (bedding separations) and 40-50˚.

22,75-27,39m Dark grey banded grey, slightly weathered, very fine grained, thinly bedded, very hard rock RAYTON SHALE. Fractures are very narrow to narrow, slightly to moderately rough and coated with iron oxide. Fractures dip at 10-30˚ (bedding plane separations) with occasional 80-90˚ dips.

Notes: 1. 12-20% core loss from 22,87-25,00m owing to jamming of core spring.
2. Becomes less fractured below 26,00m

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh14
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Driling
MACHINE: XY-2B
DRILLING DATES: 03/08/07-06/08/07
LOGGED BY: JFR/JFR (07/08/07)

LOCATION:
X CO-ORD: + 2 867 873.338
Y CO-ORD: + 8 133.452
ELEVATION: 1503.243m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	10	22						1	
	100	>50	0							
	100	26	34							
NWD4	100	23	0						2	
	100	34	51	*	3 MPa	WP	0 U.L.		3	
									4	
	94	25	0						5	
						WP	0 U.L.		6	
	97	11	53	*	17 MPa				7	
	90	17	35						8	
						WP	0 U.L.		9	
	100	17	24						10	
	96	15	41						11	
						WP	0 U.L.		12	
	100	44	0							
	100	32	15						13	
	100	15	33						14	
						WP	0 U.L.		15	
	100	19	14	*	34 MPa				16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,0-0,25m Grey-brown SILTY SAND; hillwash.

0,25-0,35m Abundant red-brown and black friable ferruginised shale gravels, densely packed in a matrix of yellow-brown SILTY SAND; ferruginised residual Rayton Shale.

0,35-1,16m Pinkish purple banded yellow-brown and orange-brown, highly weathered, very fine grained, very thinly bedded, very highly fractured, very soft rock, RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained orange-brown and black and filled with orange silt. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 80-90˚ dips.

1,16-2,10m Pinkish purple banded red-brown and yellowish orange, highly weathered, very fine grained, very thinly bedded, highly fractured, very soft rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly and moderately rough, stained black and filled with silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 80-90˚ dips.

2,10-6,00m Red-brown banded dark brown and occasionally yellowish orange, highly weathered, very fine grained, very thinly bedded, highly fractured, soft rock, (with zones of very soft rock) RAYTON SHALE. Fractures are very narrow and narrow, slightly and moderately rough, stained black and filled with silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 80-90˚ dips.

6,00-9,50m Khaki banded dark brown and greenish grey, highly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow, slightly rough, stained dark brown. Fractures dip at 0-20˚, 60-70˚ and 80-90˚.

Note: Core loss from 8,92-9,10m - probably residual clayey material.

9,50-11,20m Brownish grey banded dark brown and greenish grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow, moderately rough, stained brown and orange-brown. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70 ˚ and 80-90˚ dips.

11,20-16,67m Greenish grey banded dark brown, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are very narrow, moderately rough, stained dark brown and orange-brown. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 80-90˚ dips.

Note: 1. Core loss from 12,01-12,12m - probably clayey material.
2. Highly to very highly fractured zone from 13,71-13,78m

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh15
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 20/08/07-28/08/07
LOGGED BY: FWS/FWS

LOCATION:
X CO-ORD: +2 867 392.877
Y CO-ORD: +8 049.211
ELEVATION: 1 511.815m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	93								1	
NWD4	83			⊥	REF				2	
	95		0						3	
	90		0						4	
	97	9	44						5	
	100	11	78						6	
	73	7	60						7	
	76	5	20						8	
	77	16	41						9	
	97	13	39						10	
NWD4	96	13	48						11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,90m Abundant angular, ferruginised quartzite GRAVELS in a matrix of fine SAND; pebble marker.

0,90-4,60m Red-brown, probably stiff, CLAY-SILT; residual Dwyka shale.

4,60-9,10m Pale brown to khaki, highly mottled, highly weathered, medium grained with scattered clasts, thickly bedded, highly fractured, very soft rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt and fractured wall rock. Fractures are sub-horizontal. Fracture zone 7,40-7,50m.

9,10-16,60m Pale brown to red-brown on bedding, highly weathered, interbedded, fine grained (Dwyka shale) to medium coarse with clasts (tillite), thinly bedded (shale) to thickly bedded (tillite), highly fractured soft rock, DWYKA SEQUENCE. Fractures narrow to wide, rough, stained with iron oxide and filled with clay-silt. Fractures are generally sub-horizontal. Fracture zones 9,40-9,50m, 10,30-10,60m, 11,00-11,20m, 14,80-15,10m, 15,40-15,50m and 16,40-16,60m.

Note: Poor core recovery due to loss of residual soil material on fracture zones.

16,60-20,70m Pale grey-brown, moderately to slightly weathered, fine grained, laminated, highly fractured, moderately hard rock DWYKA SHALE. Fractures narrow and occasionally wide, smooth, stained with iron oxide and filled with clay-silt and fractured wall rock. Fractures are sub-horizontal (bedding) occasionally sub-vertical. Fracture zone at 19-80-19,90m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 15
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 20/08/07-28/08/07
LOGGED BY: FWS/FWS

LOCATION:
X CO-ORD: +2 867 392.877
Y CO-ORD: +8 049.211
ELEVATION: 1 511.815m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	96	13	48	*	45 MPa				21	
	95	13	60						22	
	90	13	57						23	
	98	10	44	*	30 MPa				24	
	98	12	24						25	
	98	6	69						26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,70-23,75m Pale grey-brown, moderately to slightly weathered, fine grained, laminated, highly fractured, moderately hard rock DWYKA SHALE. Fractures narrow and occasionally wide, smooth, stained with iron oxide and filled with clay-silt and fractured wall rock. Fractures are sub-horizontal (bedding) occasionally sub-vertical.

23,75-25,30m Pale grey, slightly weathered, laminated and false bedded, highly fractured, hard rock, DWYKA SHALE. Fractures narrow, smooth, and stained with iron oxide. Fractures are sub-horizontal (bedded). Highly fractured zone 25,03-25,30m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 21
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 06/07/07-12/07/07
LOGGED BY: JFR/JFR (13/07/07)

LOCATION:
X CO-ORD: +2 867 186.665
Y CO-ORD: +8 080.423
ELEVATION: 1 506.618m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	42								0	
	51									
	100								1	
	100			REF						
	91								2	
	100									
	100								3	
	100	-	-		62				4	
	100									
	100								5	
	100				65					
	100								6	
	100									
	100								7	
	100									
	96								8	
NWD4	100	6	50							
	100	3	81						9	
	100	7	62							
	100	5	73						10	
	100	8	59	UCS	3.3 MPa					
	100	14	44						11	
	100	6	76							
	100	4	88						12	
	100	5	72							
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,60m Dark brown SILTY SAND with scattered coarse, medium and fine quartz/quartzite GRAVELS; pebble marker.

0,60-±1,60m Red-brown mottled orange brown probably dense, ferruginous cemented slightly CLAYEY SILTY SAND with scattered friable ferruginous concretions and very occasional hard GRAVELS up to 50mm in diameter; weakly ferruginised residual tillite.

±1,60-±8,00m Buff blotched and mottled yellowish orange and occasionally red-brown, very stiff (with several zones of stiff up to 200mm wide), slightly CLAYEY SANDY SILT with very occasional hard GRAVELS up to 50mm in diameter; residual Dwyka tillite.

±8.00-10,80m Pale grey to buff blotched and banded yellowish orange and occasionally red-brown, probably very stiff, laminated and slightly jointed CLAYEY SILT; residual Dwyka tillite.

10,80-24,80m Yellowish-orange banded pale grey, highly weathered, very fine grained, very thinly and thinly bedded, highly fractured, very soft rock (with several thin zones of very soft rock to soft rock), DWYKA SHALE, with a 200mm wide zone of fine grained, moderately hard rock sandstone at 17,4m. Fractures are very narrow, slightly rough, stained red-brown and dark brown and filled with silt in places. Fractures dip at 0-15˚ (bedding separations), 30-40˚, 50-60˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES
CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 21
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 06/07/07-12/07/07
LOGGED BY: JFR/JFR (13/07/07)

LOCATION:
X CO-ORD: +2 867 186.665
Y CO-ORD: +8 080.423
ELEVATION: 1 506.618m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	5	72						21	
	100	5	74						22	
	100	7	62						23	
	96	4	85						24	
	100	7	47							
	100	-	-						25	
	92	-	-						26	
	92	7	73						27	
	68	22	18						28	
	89	17	28						29	
	92	16	11						30	
	100	8	73						31	
	100	14	44						32	
	100	7	64						33	
	100	18	26						34	
	100	11	48						35	
	100	9	55						36	
	100	29	25						37	
									38	
									39	
									40	

CORE DESCRIPTION

10,80-24,80m Yellowish-orange banded pale grey, highly weathered, very fine grained, very thinly and thinly bedded, highly fractured, very soft rock (with several thin zones of very soft rock to soft rock), DWYKA SHALE, with a 200mm wide zone of fine grained, moderately hard rock sandstone at 17,40m. Fractures are very narrow, slightly rough, stained red-brown and dark brown and filled with silt in places. Fractures dip at 0-15˚ (bedding separations), 30-40˚, 50-60˚ and 80-90˚.

24,80-27,50m Dark grey banded and blotched yellowish orange and red-brown, probably very stiff, jointed CLAY-SILT; residual carbonaceous Dwyka shale.

27,50-30,25m Orange-brown banded and blotched red-brown and yellowish orange, highly weathered, fine grained, thinly bedded, highly fractured, soft rock, DWYKA SANDSTONE with 150mm wide zone of very soft rock carbonaceous shale at 27,9m and a zone of pale grey very soft rock shale from 28,8-29,35m. Fractures narrow, slightly and moderately rough, stained dark brown and filled with silt in places. Fractures dip at 0-20˚ (bedding separations) and 80-90˚.

30,25-33,00m Yellowish grey and khaki banded orange-brown and yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SHALE. Fractures are narrow, slightly and moderately rough, stained dark brown and filled with silt in places. Fractures dip at 0-20˚ (bedding separations) and 80-90˚.

33,00-36,17m Grey, slightly weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures closed to very narrow, slightly rough, clean or stained brown. Fractures dip at 0-15˚ (bedding separations), 40-50˚ and 60-70˚.

Becomes dark grey to black and carbonaceous below 34,70m with a few thin sandy horizons.

36,17-39,25m Pale brown, orange-brown and yellow-brown, highly weathered, medium grained (with scattered hard clasts up to 50mm in diameter), highly fractured, moderately hard rock, DWYKA TILLITE with a zone of carbonaceous shale (as per 34,70-36,17m) from 36,97-37,50m. Fractuures are very narrow, modertely rough and stained brown. Fractures dip at 0-20˚, 40-50˚ and 80-90˚.

39,25-39,67m Grey-brown banded orange-brown, highly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures very narrow, slightly rough, stained orange-brown and brown. Fractures dip at 10-20˚ (bedding separations).

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 22
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 20/08/07-27/08/07
LOGGED BY: FWS/FWS

LOCATION: Turbine Generator
X CO-ORD: +2 867 399.541
Y CO-ORD: +8 128.247
ELEVATION: 1 511.013m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	70	-	0						0		0,00-0,77m Abundant angular and sub-angular ferruginised quartz GRAVELS in a matrix of CLAYEY SILT; pebble marker.
NWD4	58	-	0						1 2 3		0,77-3,00m Quartz gravel and ferricrete nodules in dark red-brown, probably stiff CLAYEY SILT; residual Dwyka tillite.
	77		0						3 4		3,00-3,98m Dark red-brown, probably very stiff CLAYEY SILT; residual Dwyka tillite.
	100	7	79						4 5 6 7		3,98-7,76m Pale yellow-brown, mottled and banded, highly weathered, medium grained with frequent clasts, jointed, very soft to soft rock DWYKA TILLITE. Fractures are narrow to wide, rough, stained with iron oxide and filled with silt and wall rock. Fractures are sub-horizontal. Fracture zone from 5,40-5,48m.
	80	19	0						8		7,76-9,95m Dark red-brown to olive grey, variably weathered, fine grained, laminated, very highly fractured, soft rock DWYKA SHALE. Fractures are narrow, smooth and stained with iron oxide. Fractures are sub-horizontal (bedding). Fracture zone from 7,76-8,40m.
	100		53						9		
	75		0						10		9,95-14,46m Pale brown, variegated black, dark brown and orange-red, moderately weathered, fine grained, very thinly bedded, highly fractured, moderately hard rock, DWYKA SHALE. Fractures are narrow to wide, smooth to slightly rough and stained with iron oxide and filled with silt. Fractures are sub-horizontal (bedding) and occasionally dip 60-70˚. Fracture zones 10,87-11,48m and 11,48-11,80m.
	95	8	70	*	HORIZ. 13 MPa VERT. 35 MPa				11 12 13 14		
	100	15	55						15 16 17 18 19 20		14,46-20,54m Pale yellow-grey, moderately weathered, fine grained, laminated, highly fractured, soft rock DWYKA SHALE. Fractures narrow to wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are sub-horizontal. Fracture zones 14,90-15,00m, 15,98-16,40m, 16,70-16,85m, 17,48-17,60m, 19,40-19,50m, 20,54-20,68m and 21,05-21,15m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 22
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 20/08/07-27/08/07
LOGGED BY: FWS/FWS

LOCATION: Turbine Generator
X CO-ORD: +2 867 399.541
Y CO-ORD: +8 128.247
ELEVATION: 1 511.013m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NWD4	100	15	55						20		See previous page for description.
	100	20	33						21		20,54-21,15m Dwyka tillite horizon.
	95	12	75	*	HORIZ. 7 MPa VERT. 18 MPa				22		21,15-29,24m Dark grey, slightly weathered, fine grained, laminated/false bedded, highly fractured, moderately hard rock DWYKA SHALE. Fractures narrow to occasionally wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are sub-horizontal and occasionally sub-vertical.
				*	HORIZ. 10 MPa VERT. 18 MPa				23		
									24		
									25		
									26		
									27		
									28		
									29		
	97	8	62						30		29,24-31,82m Dark grey, slightly weathered, fine grained, laminated/false bedded, highly fractured, hard rock DWYKA SHALE. Fractures narrow and occasionally wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are sub-horizontal and occasionally sub-vertical, .
									31		
									32		
									33		
									34		
									35		
									36		
									37		
									38		
									39		
									40		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 28
Sheet:1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 03/07/07-05/07/07
LOGGED BY: TCP/JFR (09/07/07)

LOCATION:
X CO-ORD: +2 868 102,363
Y CO-ORD: +8 325,784
ELEVATION: 1 490,388m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	93								1	
	58									
	100									
	100								2	
	100			↓	36					
	100								3	
	100			↓	27					
	82								4	
	100			↓	REF				5	
NWD4	100	2	91							
	100	±1	100	UCS	394,1 MPa				6	
	100	±1	96			WP	35 U.L. (T.F.)		7	
									8	
	100	<1	100						9	
TNW	100	±1	93			WP	0 U.L.		10	
									11	
	100	±1	95						12	
									13	
	100	2	99						14	
						WP	0,2 U.L. (V.F.)			
	100	2	57						15	
	100	2	90						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,00m Red-brown, SANDY CLAY; hillwash.

±1,00-5,10m Orange-brown speckled yellow and black, probably stiff SANDY CLAY-SILT containing occasional fresh and slightly weathered, very hard rock diabase boulders up to 450mm in diameter; residual diabase.

5,02-5,45m Dark grey, slightly weathered, medium grained, highly fractured, very hard rock DIABASE. Fractures are narrow, moderately rough, stained black and orange-brown. Fractures dip at 0-20˚, 40-50˚, 60-70˚ and 80-90˚.

5,45-5,90m Dark grey, slightly weathered, medium grained, moderately fractured, very hard rock DIABASE with an 80mm wide zone of very dense residual sand at 5,90m. Fractures are narrow, moderately rough and stained black. Fractures dip at 0-20˚.

5,90-14,59m Dark grey, unweathered, medium grained, slightly fractured, very hard rock DIABASE. Fractures are very narrow, moderately rough and rough and clean or cemented with calcite in places. Fractures dip at 0-20˚, 30-40˚ and 60-70˚.

14,59-16,43m Dark bluish grey speckled black, slightly weathered to unweathered, medium grained, moderately fractured, very hard to extremely hard rock DIABASE. Fractures closed, rough and cemented, stained yellow and black and coated with iron oxide or calcite crystals. Fractures dip sub-horizontally, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 29
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 03/07/07-10/07/07
LOGGED BY: TCP/JFR (09/07/07)

LOCATION:
X CO-ORD: + 2 867 190.819
Y CO-ORD: +8 192.308
ELEVATION: 1506.338m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	50									
NWD4	83								2	
	100			SPT	48					
	58								3	
	100									
	100								4	
	100			SPT	REF					
	100								5	
	64									
	100			SPT	REF				6	
	84									
	100								7	
	100								8	
	100			SPT	REF				9	
	100									
	100								10	
	100								11	
	100								12	
	100					WP	0 U.L.		13	
	97	4	88						14	
	100		52							
	100		84						15	
	100		80							
	99		79	UCS	28,4 MPa				16	
	100	3	81						17	
				UCS	1,8 MPa				18	
	100		95			WP	0,4 U.L. (L.F.)		19	
									20	

CORE DESCRIPTION

0,00-1,15m Abundant sub-angular fresh and weathered GRAVELS in a matrix of red-brown SILTY SAND; pebble marker.

1,15-3,75m Orange-brown blotched pinkish purple, yellow and buff, probably stiff CLAYEY SILT with occasional hard GRAVELS and COBBLES up to 100mm in diameter; residual Dwyka tillite.

3,75-13,25m Maroon blotched yellow and purplish pink, probably very stiff, CLAYEY SILT with some more sandy bands and occasional hard GRAVELS and COBBLES up to 100mm in diameter; residual Dwyka tillite.

13,25-15,05m Maroon banded yellow-brown becoming pale yellowish grey with depth, highly weathered, very fine grained, very thinly bedded, moderately fractured, very soft rock DWYKA SHALE. Fractures closed to narrow, slightly rough, stained black, filled with silt . Fractures dip sub-horizontally, 30-40° and sub-vertically.

Note: Material slakes after an hour.

15,05-20,25m Pale yellow brown blotched grey and purple, highly weathered, medium grained (with scattered coarse and very coarse grained clasts), unbedded, moderately fractured, soft rock DWYKA TILLITE. Fractures closed to narrow, slightly rough, stained yellow and black, filled with silt. Fractures dip sub-horizontally and 20-30°. Below 18,71m contains several very soft rock shaley horizons up to 100mm thick.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh29
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 03/07/07-10/07/07
LOGGED BY: TCP/JFR (09/07/07)

LOCATION:
X CO-ORD: + 2 867 190.819
Y CO-ORD: +8 192.308
ELEVATION: 1506.338m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
	100	3	95						20	
	100	7	92						21	
	100		74			WP	0 U.L.		22	
	100	15	65						23	
	100	5	82	UCS	25,5 MPa	WP	0 U.L.		24	
	100		97						25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,25-22,95m Yellow-brown blotched grey and occasionally maroon, highly weathered, fine grained, thinly and medium bedded, highly fractured, soft rock DWYKA TILLITE, with occasional coarse and very coarse grained clasts. Fractures very narrow, slightly and moderately rough, stained dark brown and filled with silt in places. Fractures dip predominantly at 0-10˚ with occasional 20-30˚ and 80-90˚ dips

22,95-24,10m Brownish grey streaked and banded orange-brown, moderately weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures very narrow and narrow, slightly and moderately rough, stained dark brown and occasionally filled with silt. Fractures dip at 0-10˚, 30-40˚ and occasionally 80-90˚.

24,10-27,71m Dark grey banded orange-brown, slightly and moderately weathered, very fine grained, very thinly and thinly bedded, moderately to highly fractured, soft rock DWYKA SHALE with occasional orange-brown, highly weatherd, very soft rock zones up to 50mm thick. fractures very narrow to narrow, smooth and slightly rough, stained dark brown and occasionally filled with silt. Fractures dip at 0-10˚, 30-40˚, 50-60˚ and 70-80˚.

Note: Zone of medium grained soft rock to moderately hard rock sandstone from 26,78-27,30m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 30
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 15/08/07-17/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 374.774
Y CO-ORD: -8 220.608
ELEVATION: 1 509.549m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	51 90 86 36	-	-						1	
NWD4	100 92			⊥	REF				2	
NWD4	100	7	74						3	
NWD4	99		50 89	*	3 MPa				4 5 6	
NWD4	100		66						7 8	
NWD4	93	7	61						9	
NWD4	97		46						10	
NWD4	93		58	*	2 MPa				11 12	
NWD4	100		89						13	
NWD4	98	4	83						14	
NWD4	100	10	49 69	*	4 MPa				15 16 17	
NWD4	83		0						18 19	
NWD4	97	15							20	

CORE DESCRIPTION

0,00-1,70m Abundant sub-angular to sub-rounded, hard ,quartzite GRAVELS and COBBLES and fine ferruginous CONCRETIONS in a matrix of orange-brown CLAYEY SAND; pebble marker.

1,70-2,81m Yellowish brown blotched reddish brown, probably very stiff, jointed (stained red and black), CLAY-SILT; residual Dwyka shale.

2,81-8,50m Pale yellowish brown blotched buff, highly weathered, fine grained (but with very coarse clasts), highly fractured, soft rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough to rough, stained yellow and black and filled with yellowish brown clay-silt. Fractures dip predominantly sub-horizontally.

8,50-13,00m Pale yellowish brown blotched buff and banded dark brown, highly weathered, very fine grained, laminated, highly fractured, very soft rock DWYKA SHALE with zones of very stiff residual soil up to 200mm wide. Fractures are closed to narrow, slightly rough to rough, stained red and black and filled with reddish brown clay-silt. Fractures dip sub-horizontally, 20-30˚, 60-70˚ and sub-vertically.

13,00-14,55m Pale yellowish brown banded grey and dark brown, highly weathered, very fine grained, thinly laminated, moderately fractured, soft rock DWYKA SHALE. Fractures closed to narrow, slightly rough to rough, stained black and coated with yellow and grey clay-silt. Fractures dip sub-horizontally and sub-vertically.

14,55-19,32m Pale yellowish brown blotched grey and banded dark brown, highly weathered, very fine grained, thinly laminated, highly fractured, very soft rock DWYKA SHALE with zones up to 400mm wide of soft rock and a zone of very stiff clayey residual soil from 18,57-19,15m. Fractures are closed to narrow, slightly rough to rough, stained yellow and black and filled with orange-brown clay-silt. Fractures dip sub-horizontally, 20-30˚, 60-70˚ and sub-vertically.

See description next page

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 30
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 15/08/07-17/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 374.774
Y CO-ORD: +8 220.608
ELEVATION: 1 509.549m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	97								20	
	84		0						21	
	100	15	54						22	
	96		53						23	
	94		68						24	
		30-40							25	
	84		41						26	
	96	10	63						27	
	100		69						28	
	97		32						29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,32-24,40m Greyish brown banded yellowish brown, highly weathered, very fine grained, thinly laminated, highly fractured, soft rock DWYKA SHALE. Fractures are closed to narrow, slightly rough to rough, stained yellow and black and filled with yellow and grey clay-silt. Fractures dip sub-horizontally, 20-30˚, 45˚, 60-70˚ and sub-vertically.

24,40-24,98m Dark grey, highly weathered, very fine grained, thinly laminated, highly fractured, very soft rock carbonaceous DWYKA SHALE. Fractures are closed to narrow, slightly rough to rough, stained yellowish brown and coated with yellow and grey silt. Fractures dip sub-horizontally, 20-30˚ and sub-vertically.

24,98-29,65m Dark bluish grey, slightly weathered, very fine grained, thinly laminated, highly fractured, hard rock RAYTON SHALE. Fractures are closed to narrow, slightly rough, stained yellow and coated with grey silt. Fractures dip 10-15˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 31
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 20/08/07-27/08/07
LOGGED BY: FWS/FWS

LOCATION: Boiler
X CO-ORD: +2 867 482.956
Y CO-ORD: +8 249.674
ELEVATION: 1 509.676m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100		-						1	
	50		-							
NWD4	100		-						2	
									3	
									4	
	100	7	60						5	
	100	9	80						6	
	100	-	0	SPT	68				7	
	100	14	24						8	
	100	10	0						9	
	60	>50	0						10	
	99	>50	0						11	
	100	5	0	*	7 MPa VERT.				12	
	80	16	0						13	
									14	
				*	15 MPa VERT.				15	
									16	
									17	
	100	12	60						18	
									19	
									20	

CORE DESCRIPTION

0,00-1,50m GRAVELS in a matrix of medium brown, probably medium dense, SANDY SILT; pebble marker.

1,50-4,15m Pale orange-brown, probably stiff to very stiff, CLAY-SILT; residual Dwyka shale.

4,15-6,94m Orange-yellow, mottled red-brown, highly weathered, fine grained, laminated, very highly fractured, very soft rock DWYKA SHALE. Fractures are narrow to occasionally wide, smooth, stained with iron oxide and filled with silt. Fractures are sub-horizontal (bedding).

6,94-9,38m Khaki, medium brown, mottled red-brown on bedding, highly weathered, fine grained, laminated, highly fractured, soft rock, DWYKA SHALE.

9,38-12,97m Khaki, banded red-brown, highly weathered with zones of completely weathered, very stiff clay-silt (residual soil), laminated, very highly fractured, very soft rock DWYKA SHALE. Fractures are wide and filled with clay-silt. Fractures are sub-horizontal.

Note: Poor core recovery due to loss of residual soil in fracture zones.

12,97-15,54m Khaki-brown, moderately weathered, fine grained, very thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures are narrow to occasionally wide, smooth, stained with iron oxide and filled with wall rock fragments. Fractures are sub-horizontal. Dwyka tillite zone from 15,00-15,54m.

15,54-19,60m Khaki, banded dark brown, slightly weathered, fine grained, laminated, highly fractured, moderately hard rock DWYKA SHALE. Fractures narrow, smooth and stained with iron oxide. Fractures are sub-horizontal (bedding). Occasional zones of tillite present.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 32
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geothechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 03/07/07-05/07/07
LOGGED BY: TCP/JFR (09/07/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 591.140
Y CO-ORD: +8 278.661
ELEVATION: 1 508.373m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	59								1	
	83									
	82									
NWD4	97								2	
	100	-	-						3	
	100									
	91								4	
	100			SPT	REF					
	100								5	
	100									
	94	15	34						6	
	89		25							
	100		81						7	
	98	10	60	UCS	28,4 MPa	WP	3 U.L. (DIL)		8	
	97		10							
	98	15-20	39			WP	0 U.L.		9	
TNW	100		11						10	
	95		0							
	94	15-20	25			WP	0 U.L.		11	
	100		28	UCS	22,5 MPa				12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,48m Abundant sub-angular coarse medium and fine GRAVELS of weathered quartzite in a matrix of red-brown SILTY SAND; pebble marker.

0,48-1,40m Orange-brown probably firm to stiff, CLAY-SILT with occasional angular GRAVELS; residual Dwyka tillite.

1,40-±4,00m Yellow blotched red-brown, probably stiff, jointed, CLAYEY SILT with occasional hard gravel-sized clasts; residual Dwyka tillite.

±4,00-±6,00m As above but probably very stiff with zones of stiff up to 300mm wide.

±6,00-±8,00m Bright yellow-brown, blotched red and grey, highly weathered, fine grained (but with hard clasts up to 100mm in diameter), highly fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, moderately rough, stained black and filled with orange-brown clay-silt. Fractures dip at 20˚ and 70-80˚.

Note: Core loss totalling 160mm probably residual material.

±8,00-12,47m Pale yellow-brown banded yellowish grey and blotched red and grey, highly weathered, fine grained (but with hard clasts up to 100mm in diameter), highly fractured, soft rock DWYKA TILLITE. Fractures are closed to narrow, moderately rough to rough, stained red and black and filled with orange brown clay-silt and iron oxide. Fractures dip at 20˚, 45˚ and 70-80˚.

Contains zones of very soft rock below 11,35m

12,47-14,65m Greenish grey, moderately weathered, very fine grained, thinly bedded, highly fractured, soft rock RAYTON SHALE. Fractures are narrow, slightly and moderately rough, stained yellow and black and filled with yellow silt and iron oxide. Fractures dip at 20˚ (bedding plane fractures) and 60˚.

14,65-18,20m Grey, moderately weathered, very fine grained, thinly bedded, highly fractured, soft rock to moderately hard rock, RAYTON SHALE. Fractures are narrow, slightly and moderately rough, stained black and filled with yellow silt and iron oxide. Fractures dip at 20˚ (bedding plane fractures) and 60˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 36
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 01/08/07-07/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 359.541
Y CO-ORD: + 8 277.531
ELEVATION: 1 508.624m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	66									
	100									
NWD4	100	-	-						2	
	87									
	93									
	100			▼	REF	WP	0 U.L.		3	
	53									
	94									
	100		29						4	
	100		65							
	98		70						5	
	100	4	28							
	100		46			WP	0 U.L.			
	97		95						6	
	100		71						7	
				*	4 MPa					
	99		63						8	
						WP	0 U.L.		9	
	99		61							
	97		70						10	
				*	2 MPa					
	100	10	36						11	
	97		55			WP	0 U.L.		12	
	95		25						13	
	99		64	*	6 MPa				14	
NWD4										
	94		44			WP	0 U.L.		15	
									16	
	44		0							
	96		38						17	
				I	5,3 MPa				18	
	77	20	0	UCS						
									19	
	78		0							
	100		50						20	

CORE DESCRIPTION

0,00-1,30m Abundant sub-angular and sub-rounded GRAVELS in a matrix of orange-brown SILTY SAND; pebble marker.

1,30-2,40m Yellowish brown mottled orange and black, probably stiff SANDY CLAY-SILT with scattered friable ferruginous CONCRETIONS and stiffer ferruginised zones; ferruginised residual Dwyka tillite.

2,40-4,00m Buff mottled yellowish brown, probably very dense SANDY SILT; residual Dwyka tillite.

4,00-6,70m Buff blotched yellowish brown and orange-brown, highly weathered, fine grained (but with occasional very coarse clasts), moderately fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough to rough, stained black and filled with reddish brown clayey sand. Fractures dip sub-horizontally, 60-70˚ and sub-vertically.

6,70-16,30m Buff banded yellowish brown, grey and occasionally maroon, moderately to highly weathered, fine grained, very thinly bedded, highly fractured soft rock DWYKA SANDSTONE with frequent SILTSTONE bands and occasional gravelly zones. Fractures are narrow to wide, slightly rough to rough, stained orange-brown and black and filled with reddish brown clayey sand and yellow and grey silt. Fractures dip sub-horizontally 20-30˚, 45˚, 60˚ and sub-vertically.

16,30-20,00m Dark grey banded pale grey and blotched yellow and occasionally maroon, highly weathered, very fine grained , very thinly bedded becoming thinly laminated with depth, highly fractured, very soft rock DWYKA SHALE with zones up to 400mm wide (total about 1,0m) of probably very stiff residual material. Fractures are closed to wide, slightly rough and filled with grey and yellowish brown clay-silt. Fractures dip sub-horizontally, 20-30˚, 45˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)
PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 36
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 01/08/07-07/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 359.541
Y CO-ORD: +8 277.531
ELEVATION: 1 508.624m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	99	10-15	66						21	
	99		50						22	
	99		49						23	
	100		52						24	

CORE DESCRIPTION

20,00-23,05m Greyish brown and yellowish brown banded pale grey, moderately weathered, very fine grained, thinly laminated, highly fractured, soft rock DWYKA SHALE. Fractures are closed to narrow, slightly rough, stained yellowish brown and black and coated with iron oxide. Fractures dip sub-horizontally, 20-30 ˚,45˚, 60˚ and sub-vertically.

23.05-24.43m As above, but consistency moderately hard rock.
Note: Dwyka shale below 16,3m has slaking properties.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 37
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 25/07/07-28/07/07
LOGGED BY: TCP/RLP

LOCATION:
X CO-ORD: +2 867 458.065
Y CO-ORD: +8 303.930
ELEVATION: 1508,642m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	85									
NWD4	100			▼	REF				2	
	100									
	43									
	30	-	-	▼	73				3	
									4	
									5	
									6	
	100	15-20	8						7	
			0							
			72						8	
			0							
				*	103.5 MPa				9	
		5	81	UCS	42,3 MPa				10	
			73						11	
			85						12	
NWD4			65						13	
		3							14	
			83						15	
				UCS	42,6 MPa				16	
			91						17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,75m Abundant sub-rounded quartzite gravels and friable ferruginous concretions in a matrix of brown, slightly CLAYEY, SILTY SAND; roots; pebble marker.

0,75-1,60m Orange-brown mottled grey and black, probably stiff, SANDY CLAY-SILT containing abundant friable ferruginous concretions; residual Dwyka tillite.

1,60-6,51m Yellowish brown banded reddish brown and blotched grey, probably very stiff, jointed, slightly CLAYEY SILT with occasional hard gravels; residual Dwka tillite.

6,51-7,80m Yellowish brown banded red and dark grey, highly to completely weathered, fine grained, highly fractured, very soft rock DWYKA TILLITE with zones of up to 200mm wide of residual tillite as above. Fractures are narrow to wide, slightly rough, stained black and filled with yellowish brown silt. Fractures dip sub-horizontally, 20˚, 30˚ and sub-vertically.

7,80-18,09m Bluish grey banded dark grey and mottled dark blue and buff, slightly weathered, fine grained (but with very coarse clasts), moderately fractured, very hard rock DWYKA TILLITE. Fractures are closed to very narrow, stained black, moderately rough and coated with calcite crystals. Fractures dip mainly 20˚, 45˚ and 60˚-70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 38
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 07/08/07-15/08/07
LOGGED BY: FWS/FWS

LOCATION: CCP Building
X CO-ORD: +2 867 556.590
Y CO-ORD: +8 330.930
ELEVATION: 1 507.958
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100		-						1	
	40		-							
	14		-							
	100		-							
	100		-						2	
	100		-							
	100	-	-						3	
	100		-							
	100		48	*	19 MPa				4	
	83		100			WP	0 U.L.		5	
	100	4	64							
	100		100						6	
NWD4	100		59	*	20 MPa				7	
						WP	0 U.L.		8	
	89		64						9	
	100	8	63						10	
				*	25 MPa	WP	0 U.L.		11	
	98		59						12	
				*	33 MPa					
	100		90						13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,14m Abundant ferruginised GRAVEL and soft ferricrete nodules in orange-brown SILTY SAND; mixed transported and residual soil.

1,14-3,90m Frequent ferruginised GRAVEL and rock fragments, in a matrix of mottled orange-brown and red-brown CLAYEY SILTY SAND; residual Dwyka tillite.

3,90-6,60m Pale mauve-grey, moderately to highly weathered, fine grained, very thinly bedded, highly fractured, soft rock RAYTON SHALE. Fractures narrow to occasionally wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are generally sub-horizontal and occasionally 60-70˚. Fracture zone at 5,90-6,25m.

6,60-10,00m Pale grey banded pale brown, with localised iron granules on bedding planes, moderately weathered, fine grained, very thinly bedded, highly fractured, moderately hard rock RAYTON SHALE. Fractures narrow, smooth and stained with iron oxide. Fractures are generally sub-horizontal (bedding).

10,00-14,08m Medium grey, slightly weathered, fine grained, very thinly bedded, moderately to highly fractured, hard rock RAYTON SHALE. Fractures closed to very narrow, slightly rough with black iron staining. Fractures are sub-horizontal.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 41
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 06/08/07-08/08/07
LOGGED BY: FWS/FWS

LOCATION: Transverse Ash Conveyor
X CO-ORD: +2 867 876.311
Y CO-ORD: +8 415.999
ELEVATION: 1 497.649m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
NWD4	100				10				2	
	100								3	
	100				13				4	
	100								5	
	100				27				6	
	100								7	
	100	6	0						8	
	100	11	15						9	
	92	14	36			WP	6 U.L. (W.O.)		10	
	76	>30	0						11	
	70	30	0						12	
	98	38	0						13	
	100	48	0	*	33 MPa	WP	10 U.L. (T.F.)		14	
	100	31	0						15	
	99	40	0			WP	1,7 U.L. (DIL.)		16	
	92	26	0						17	
						WP	1,3 U.L. (V.F.)		18	
				*	42 MPa				19	
									20	

CORE DESCRIPTION

0,00-4,64m Dark, red-brown, firm, CLAY-SILT; residual Diabase.

4,64-9,22m Orange-brown to yellow-brown mottled, stiff, CLAYEY SILT; residual Diabase.

9,22-10,69m Pale brown, mottled red-brown, highly to completely weathered, highly fractured, very soft rock to soft rock DIABASE. Fractures are open and stained.

10,69-12,15m Pale brown, mottled, highly weathered medium grained, highly fractured, medium hard rock DIABASE. Fractures are narrow to wide, medium rough, stained and filled with silt. Fractures have variable orientations.

12,15-13,05m Pale brown, mottled, slightly weathered medium grained, highly fractured, hard rock DIABASE. Fractures narrow to wide, medium rough, stained and filled with silt. Fractures have variable orientations.

13,05-13,60m Pale grey, highly weathered, laminated very highly fractured, soft rock RAYTON SHALE.

13,60-22,10m Khaki-brown, slightly weathered, fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures generally narrow, smooth and stained orange-brown and black. Fractures are generally sub-horizontal and occasionally sub-vertical.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 41
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 06/08/07-08/08/07
LOGGED BY: FWS/FWS

LOCATION: Transverse Ash Conveyor
X CO-ORD: +2 867 876.311
Y CO-ORD: +8 415.999
ELEVATION: 1 497.649m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	85	47	0			WP	5 U.L. (DIL.)		21	
	100	21	43						22	
	98	17	42			WP	0 U.L.		23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

13,60-22,10m Khaki-brown, slightly weathered, fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures generally narrow, smooth and stained orange-brown and black. Fractures are generally sub-horizontal and occasionally sub-vertical.

22,10-26,53m Dark grey, slightly weathered, fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are narrow to wide, stained and filled with secondary calcrete. Fractures are generally sub-horizontal (bedding) and occasionally 60-70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 43
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 06/07/07-12/07/07
LOGGED BY: JFR/JFR (16/07/07)

LOCATION:
X CO-ORD: +2 867 153.175
Y CO-ORD: +8 266.929
ELEVATION: 1 505.312m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	50									
	50									
	100			▼	40				2	
	100									
	100									
	100								3	
	72									
	100								4	
	100								5	
	100								6	
	100								7	
	100								8	
NWD4	100	-	-						9	
	99								10	
	100								11	
	55								12	
	83								13	
	96			UCS	2,9 MPa				14	
	100	5	39						15	
	41	17	0						16	
	100	4	50						17	
	100	5	69						18	
	76	8	13						19	
	100	4	72						20	

CORE DESCRIPTION

0,00-±1,00m Abundant coarse, medium and fine, sub-angular quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker. Matrix becomes red-brown below 0,40m.

±1,00-1,65m Red-brown mottled orange brown, probably firm, ferruginised cemented SANDY CLAYEY SILT, with scattered friable ferruginous concretions and occasional hard GRAVELS up to 50mm in diameter; residual Dwyka tillite.

1,65-3,19m Yellowish orange blotched red-brown, probably stiff, intact SANDY CLAYEY SILT with scattered hard GRAVELS and COBBLES up to 100mm in diameter; residual Dwyka tillite.

3,19-10,10m Brownish purple blotched buff, yellowish orange and red-brown, probably very stiff, jointed CLAYEY SAND with scattered hard fine and medium and occasional coarse, gravel-sized clasts; residual Dwyka tillite.

10,10-15,80m Maroon blotched yellow-brown, probably very stiff, jointed CLAYEY SILT with very occasional hard, coarse medium and fine gravel-sized clasts; residual Dwyka shale (with a few thin tillite horizons). Contains horizons of stiff, clayey silt from 200-400mm thick at 13,00-13,30m, 13,80-14,20m and 14,50-14,80m.

15,80-19,65m Buff blotched pale yellow-brown and pale grey, highly weathered, fine and medium grained (with scattered coarse, medium and fine gravel-sized clasts), moderately and highly fractured, soft rock (but very soft rock from 16,40-17,00m, 17,40-18,15m, 18,35-18,70m and 18,90-19,65m), DWYKA TILLITE. Fractures narrow, moderately rough and rough, stained red and orange-brown and filled with silt in places. Fractures dip at 0-20˚ and 50-60˚.

See next page for descrition.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 43
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 06/07/07-16/07/07
LOGGED BY: JFR/JFR (16/07/07)

LOCATION:
X CO-ORD: +2 867 153.175
Y CO-ORD: +8 266.929
ELEVATION: 1 505.312m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	7	63						21	
	74	7	0							
	76	5	49						22	
	99	8	63						23	
									24	
	100	9	68						25	
	94	9	32						26	
	100	3	85						27	
	93	14	53						28	
	95	14	45							
	93	12	26						29	
									30	
	100	8	50						31	
	100	5	58						32	
	99	3	75						33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,65-21,49m Yellow-brown banded grey-brown and pale grey, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very soft rock, DWYKA SHALE. Fractures are very narrow, slightly rough, stained orange-brown and filed with silt in places. Fractures dip at 0-10˚ (bedding separations) and 20-30˚.

21,49-22,00m Little or no core recovery owing to grinding of tillite gravels. Probably very stiff to very soft rock, TILLITE.

22,00-25,56m Dark grey banded pale grey and occasionally orange-brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA TILLITE. Fractures are closed to very narrow, slightly rough, clean or stained orange-brown. Fractures dip at 0-10˚ (bedding separations) and 70-80˚.

25,56-32,30m Dark grey banded dark brown, orange-brown and greyish brown, moderately weathered, very fine grained, thinly bedded, soft rock, DWYKA SHALE (with zones of fine grained, soft rock sandy tillite from 26,05-26,60m, 28,00-28,42m, 29,10-29,25m and 31,10-31,45m). Fractures are very narrow, slightly and moderately rough, stained orange-brown. Fractures dip at 0-20˚ (bedding separations), 40-50˚, 60-70˚ and 80-90˚.

Zone of residual/highly weathered shale from 29,30-29,70m.

32,30-35,01m Dark grey banded pale grey and occasionally orange-brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA TILLITE. Fractures are closed to very narrow, slightly rough, clean or stained orange-brown. Fractures dip at 0-10˚ (bedding separations) and 70-80˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 44
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechincal Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 06/08/07-14/08/07
LOGGED BY: FWS/FWS (15/08/07)

LOCATION:
X CO-ORD: +2 867 316.318
Y CO-ORD: +8 314.186
ELEVATION: 1 507.875m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	83		-						1	
	71	-	-						2	
	80		-						3	
	73		43						4	
	94		62						5	
	83		0							
	100	9	77						6	
	100		63						7	
	100		58						8	
	100		75						9	
NWD4	50	8	0						10	
	78		25						11	
	88		54	*	2,25 MPa				12	
	99		62						13	
	95		0						14	
	97	17	18	*	5,25 MPa				15	
	96		19						16	
	100		32						17	
	95		47						18	
									19	
									20	

CORE DESCRIPTION

0,00-0,90m Abundant coarse and medium quartzite GRAVEL with ferruginous CONCRETIONS in a matrix of yellow-brown SILTY SAND; pebble marker.

0,90-1,90m Orange-brown, mottled yellow-brown, CLAYEY SAND with scattered coarse, medium and fine hard GRAVELS; residual Dwyka tillite.

1,90-4,00m Maroon, streaked orange-brown and pale grey, probably stiff, laminated and jointed, CLAY-SILT; residual Dwyka shale.

4,00-7,35m Yellow-brown, mottled orange-brown to red brown, highly weathered, fine grained, (with occasional medium and fine gravel clasts), highly fractured, very soft rock DWYKA TILLITE. Zones of soft rock from 5,35-6,10m and 7,00-7,35m. Zones of moderately hard rock from 4,95-5,30m. Fractures very narrow to narrow, slightly rough, stained with iron oxide and filled with silt. Fractures dip at 0-10˚ (bedding) with occasional 40-50˚ dips.

7,35-10,03m Yellow-grey, banded orange-brown, highly weathered, very fine grained, very thinly bedded, highly fractured, soft rock (with occasional bands of very soft rock) DWYKA SHALE. Fractures are very narrow to narrow, slightly rough, stained with iron oxide and locally filled with silt . Fractures dip predominantly at 0-10˚ (bedding) and occasionally at 80-90˚.

10,03-11,65m Pale grey, banded yellow-brown, completely weathered, very fine grained, very highly fractured, probably very stiff CLAY-SILT.
Note: 50% core loss from 10,03 to ±11,00m.

11,65-12,98m Pale grey, banded yellow-brown, moderately weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures are very narrow to narrow, slightly rough,stained with iron oxide and locally filled with silt. Fractures dip predominantly at 0-10˚ (bedding) and occasionally at 80-90˚.

12,98-14,40m Yellow-grey, banded orange-brown, highly weathered, very fine grained, very thinly bedded, highly fractured, soft rock (occasional bands of very soft rock) DWYKA SHALE. Fractures are very narrow to narrow, slightly rough,stained with iron oxide and locally filled with silt. Fractures dip predominantly at 0-10˚ (bedding) and occasionally at 80-90˚. Fracture zone 14,25 to 14,40m.

14,40-15,97m Pale brown, banded brown, moderately weathered, fine grained, very thinly bedded, moderately to highly fractured, soft rock DWYKA SHALE. Fractures are narrow to wide, slightly rough, stained with orange-brown iron oxide and filled with clay. Fractures are predominantly sub-horizontal.

15,97-20,30m Pale to medium grey banded pale orange-brown, moderately to highly weathered, fine grained, thinly bedded, highly fractured, very soft rock DWYKA SHALE. Fractures are narrow to wide,slightly rough, stained with orange-brown iron oxide and filled with clay. Fractures are predominantly sub-horizontal. Fracture zones 17,48-17,60m and 18,80-18,93m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES
CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 44
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechincal Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 06/08/07-14/08/07
LOGGED BY: FWS/FWS (15/08/07)

LOCATION:
X CO-ORD: +2 867 316.318
Y CO-ORD: +8 314.186
ELEVATION: 1 507.875m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100		70						21	
	100	10	70							
	96		82						22	
	98	23	47						23	
	99		53						24	
		9		*	13 MPa				25	
	100		80						26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,30-22,75m Medium grey, moderately weathered, fine grained, thinly bedded, laminated, moderately to highly fractured, soft rock DWYKA SHALE. Fractures narrow, smooth and stained with iron oxide. Fractures are predominantly sub-horizontal with occasionally 45-60˚. Fracture zones 20,30 to 20,40m

22,75-23,87m A more highly weathered and fractured zone in the DWYKA SHALE.

23,87-26,26m Dark grey, slightly weathered, fine grained, laminated, moderately to highly fractured, moderately hard rock DWYKA SHALE. Fractures closed to narrow, clean and smooth. Fractures are predominantly sub-horizontal (bedding) occasionally ±70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES
CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 45
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 30/07/07-01/08/07
LOGGED BY: TCP/RLP

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 424.502
Y CO-ORD: +8 343.173
ELEVATION: 1507.757m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	70								1	
NWD4	100	-	0	↓	49				2	
									3	
				↓	50				4	
			17						5	
		50							6	
	71		0							
				*	15 MPa				7	
	100		44							
		12-15							8	
	71		15							
									9	
	99		61	*	23 MPa					
				I	44,1 MPa				10	
		6-7		UCS						
	95		88						11	
NWD4										
	100		89						12	
									13	
	100		84							
				*	45 MPa				14	
		3-4							15	
	100		79							
									16	
	100		82						17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,00m Abundant weathered quartzite and tillite gravels in a matrix of brown SILTY SAND; roots; pebble marker.

1,00-1,50m Yellowish brown mottled orange and black, probably stiff, slightly CLAYEY SILTY SAND containing abundant friable ferruginous concretions and weathered tillite GRAVELS; roots; residual Dwyka tillite.

1,50-4,90m Pale grey, yellowish brown, orange and dark grey, probably stiff, SANDY CLAY-SILT with occasional hard gravel clasts; residual Dwyka tillite.

4,90-5,60m As above, but probably very stiff.

5,60-6,32m Pale grey banded yellowish brown, very highly weathered, fine grained, very highly fractured, very soft to soft rock DWYKA TILLITE. Fractures are narrow to wide, moderately rough to rough, stained black and filled with yellowish grey silt. Multiple fracture orientations.

6,32-9,20m Pale grey banded yellowish brown and dark brown, highly weathered, fine grained but with very coarse clasts, highly fractured, moderately hard rock DWYKA TILLITE. Fractures are narrow to wide, moderately rough to rough, stained orange black and filled with yellowish grey silty sand. Fractures dip sub-horizontally and 20-30˚.

9,20-12,00m Pale grey banded yellowish brown, moderately weathered, fine grained, but with very coarse clasts, highly fractured, moderately hard to hard rock DWYKA TILLITE. Fractures are narrow to very narrow, slightly rough to rough, stained yellowish brown and black, filled with yellowish brown silty sand and coated with iron oxide. Fractures dip sub-horizontally, 20-30˚ and sub-vertically.

12,00-18,03m Bluish grey blotched pale grey and dark grey, slightly weathered, fine grained but with very coarse clasts, moderately fractured, hard rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough to rough, stained yellowish brown and coated with iron oxide. Fractures dip sub-horizontally and 20-30˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 46
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 14/08/07-16/08/07
LOGGED BY: FWS/FWS

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 532.686
Y CO-ORD: +8 372.161
ELEVATION: 1 507.213m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	83		-						0	
	63		-							
	58		-						1	
NWD4	100		-	⊥	75					
	100		-						2	
	39		-						3	
	72		-	*	3 MPa				4	
	58		-						5	
	91	29	0	*	9 MPa				6	
	100	23	13	*	20 MPa				7	
	96	35	12	*	13 MPa				8	
	100	23	21	*	19 MPa				9	
	100	14	42						10	
	95	30	0						11	
	100	17	32						12	
	100	26	86						13	
	95	17	22						14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,60m Abundant ferruginised rock fragments in SANDY matrix; transported soil.

0,60-2,62m Abundant ferruginised GRAVELS in a matrix of orange-brown, very stiff CLAYEY-SILT; residual Dwyka tillite.

2,62-6,08m Scattered gravel in pale brown mottled, very dense SILTY SAND; residual Dwyka tillite.

6,08-6,65m Brown, banded, highly weathered, highly fractured, soft rock RAYTON SHALE. Fractures are wide and filled with silt.

6,65-8,65m Pale brown mottled dark red-brown and banded khaki, highly weathered, fine grained, thinly bedded, highly fractured, soft to moderately hard rock RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained with iron oxide and filled with silt and wall rock. Fractures are generally sub-horizontal. Fracture zones 6,90-6,95m, 7,42-7,46m, 7,66-7,69m and 8,00-8,35m.

8,65-10,59m Olive-brown, mottled red-brown, highly weathered, fine grained, very thinly bedded, moderately hard rock RAYTON SHALE with zones of very soft rock/ very stiff soil. Fractures are generally wide, rough and filled with clay-silt. Fractures are generally sub-horizontal.

10,59-15,08m Pale grey, moderately weathered, fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures very narrow to wide, slightly rough and stained with iron oxide. Fractures (zones) are generally sub-horizontal.

15,08-18,08m Medium grey, slightly weathered, fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are generally narrow and occasionally wide, slightly rough, stained with iron oxide and filled with clay-silt and wall rock. Fractures are generally sub-horizontal and occasionally 60-70°. Fracture zones 17,50-17,54m, 17,65-17,22m and 17,90-17,94m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 47
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 14/08/07-15/08/07
LOGGED BY: FWS/FWS

LOCATION: CPP Building
X CO-ORD: +2 867 640.885
Y CO-ORD: +8 401.093
ELEVATION: 1 504.511m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	-	-						0	
	84		-							
	89		18						1	
NWD4	100		17	*	15,4 MPa				2	
	100	28	0						3	
	97		0						4	
	100		0						5	
	100		32						6	
	97		30						7	
	97	12	49	*	40 MPa				8	
	74		40						9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,83m Pale orange-brown, gravely SAND; pebble marker.

0,83-1,30m Orange-brown, banded dark brown, mottled black, highly weathered, fine grained, laminated, highly fractured, very soft rock RAYTON SHALE. Fractures are wide and residuum filled. Fractures are sub-horizontal.

1,30-3,20m Pale khaki, moderately weathered, fine grained, very thinly bedded, highly fractured, moderately hard rock RAYTON SHALE. Fractures are narrow to wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are sub-horizontal.

3,20-4,95m Red-brown to pink-brown, highly weathered fine grained, very thinly bedded, highly fractured, moderately hard rock RAYTON SHALE. Fractures are narrow to wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are sub-horizontal. Fracture zone at 3,20-3,75m.

4,95-7,90m Pale to medium grey, moderately weathered, fine grained, very thinly bedded, highly fractured, moderately hard rock RAYTON SHALE. Fractures are narrow and occasionally wide, smooth to slightly rough, stained with iron oxide and filled with silt-clay. Fractures are sub-horizontal and occasionally 70-80˚.

7,90-12,28m Medium to dark grey slightly weathered fine grained thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are narrow to occasionally wide, smooth, stained with iron oxide and filled with clay-silt . Fractures are generally sub-horizontal (bedding) and occasionally 60-80˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 48
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE
DRILLING DATES: 15/08/07-16/08/07
LOGGED BY: FWS/FWS

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 749.068
Y CO-ORD: +8 430.080
ELEVATION: 1 501.176m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100		-						0	
	58		-							
	100	42	0						1	
	100	19	0						2	
	100	23	0						3	
	100	>50	0						4	
	100	20	0						5	
NWD4	100		0						6	
	100		0						7	
	100	22	0	*	4 MPa				8	
	97		0	*	33 MPa				9	
	97		11	*	23 MPa				10	
	100	17	8						11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,20m Abundant angular, hard ferruginised shale GRAVELS in SANDY SILT; pebble marker.

0,20-0,40m Weathered shale fragments in SANDY matrix; residual soil.

0,40-3,67m Pale, orange-brown, highly weathered, fine grained, very thinly bedded to laminated, highly fractured, soft rock with very soft rock zones RAYTON SHALE. Fractures narrow to wide, smooth, stained with iron oxide and filled with clay-silt. Fractures are generally sub-horizontal (bedding) and occasionally dip 60-70˚. Fracture zones at 1,40-1,60m and 2,45-2,55m.

3,67-5,02m Pale, orange-brown, highly weathered, fine grained, very thinly bedded to laminated, highly fractured, soft rock with very soft rock zones RAYTON SHALE. Fractures narrow to wide, smooth, stained with iron oxide and filled with silt. Fractures are generally sub-horizontal (bedding) and occasionally dip 60-70˚.

5,02-9,70m Pale brown, moderately weathered, fine grained, laminated, highly fractured, soft rock RAYTON SHALE. Fractures narrow to wide, smooth to slightly rough, stained with iron oxide and filled with silt. Fractures are generally sub-horizontal (bedding) to 60-70˚. Fracture zones at 5,75-5,85m, 8,30-9,00m and 9,47-9,70m associated with sub-vertical fractures.

9,70-11,60m Pale grey-brown, moderately weathered fine grained, laminated, highly fractured, moderately hard and hard rock RAYTON SHALE. Fractures generally narrow to occasionally wide, slightly rough, stained with iron oxide and filled with silt. Fractures are generally sub-horizontal (bedding) to occasionally sub-vertical.

11,60-13,91m Pale grey-khaki, slightly weathered, fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures narrow to wide, slightly rough, stained with iron oxide and filled with silt and fractured wall rock. Equal number of sub-horizontal (bedding) and sub-vertical fractures.

Note: Frequency of sub-vertical fractures and associated fracturing indicates possible proximity of a fault to bh48.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 50
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 10/07/07-23/07/07
LOGGED BY: JFR/JFR (26/07/07)

LOCATION: H.V. Yard
X CO-ORD: +2 867 056.145
Y CO-ORD: +8 301.894
ELEVATION: 1502.673m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	45								1	
	66									
	100									
NWD4	100				65				2	
	83									
	100	-	-							
	100								3	
	100				58					
	65									
	92								4	
	100				REF					
	78								5	
	100			*	3 MPa					
	100	6	76						6	
	96	7	47	*	3 MPa					
	100	8	27						7	
	54	5	37	*	2 MPa					
	100	7	38						8	
	100	9	38							
	100	5	69	*	3 MPa				9	
									10	
									11	
									12	
									13	
	100	8	42							
						WP	0 U.L.		14	
	100	5	71	*	3 MPa					
									15	
	100	10	34						16	
						WP	0,18 U.L. (DIL)			
	100	8	65						17	
	100	9	34						18	
				*	6 MPa					
									19	
	100	12	56			WP	0,63 U.L. (DIL)			
									20	

CORE DESCRIPTION

0,00-±0,50m Abundant coarse, medium and fine sub-angular to sub-rounded quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±0,50-±1,80m Red-brown mottled orange-brown, probably firm, ferruginous cemented SANDY CLAYEY SILT, with scattered friable ferruginous concretions and occasional hard GRAVELS up to 50mm diameter; residual Dwyka tillite.

±1,80-5,55m Khaki blotched maroon and streaked yellowish orange, probably very stiff, jointed CLAY-SILT; residual Dwyka shale.

5,55-7,10m Buff streaked yellowish orange, highly weathered, fine grained, thinly bedded, moderately to highly fractured, very soft rock DWYKA SANDSTONE. Fractures very narrow to narrow, slightly rough, filled with red clay. Fractures dip at 0-10˚ (bedding separations).

Zone of very soft rock tillite from 5,85-6,05m.

7,10-13,30m Pale grey blotched yellowish orange and red brown, highly weathered, medium grained (with scattered hard clasts up to 50mm diameter), moderately to highly fractured, very soft rock DWYKA TILLITE. Fractures very narrow and narrow, slightly rough, stained red and orange brown. Fractures dip at 0-10˚ and 20-30˚ and 60-70˚.

Becomes weakly ferruginised and soft rock to moderately hard rock below 13,15m.

13,30-15,95m Dark brown blotched buff, yellowish orange and occasionally red brown, highly weathered, fine grained, thinly bedded, moderately to highly fractured, very soft rock to soft rock DWYKA SANDSTONE, (with several thin tillite horizons). Fractures very narrow to narrow, slightly rough,stained red and brown. Fractures dip at 0-10˚ and 20-30˚.

15,95-27,50m Pale yellowish-grey banded yellowish orange and orange-brown, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures narrow, slightly rough and filled with iron oxide. Fractures dip at 0-10˚, 20-30˚ and 70-90˚.

Note: Contains zones of medium grained, moderately hard rock Tillite from 21,10-21,70m, 23,05-23,65m, 24,20-24,75m and 26,40-27,20m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 50
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 10/07/07-23/07/07
LOGGED BY: JFR/JFR (26/07/07)

LOCATION: H.V. Yard
X CO-ORD: +2 867 056.145
Y CO-ORD: +8 301.894
ELEVATION: 1502.673m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	14	60	*	7 MPa	WP	0,63 U.L. (DIL)		21	
	100	11	42	UCS	7,3 MPa				22	
	100	9	43			WP	7,49 U.L. (DIL)		23	
	100	11	45						24	
	100	13	62						25	
	100	8	52						26	
	100	7	54						27	
	100	4	76	* UCS	12 MPa / 13,6 MPa	WP	0 U.L.		28	
	100	5	70						29	
	100	3	71			WP	0 U.L.		30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

15,95-27,50m Pale yellowish-grey banded yellowish orange and orange-brown, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE. Fractures narrow, slightly rough and filled with iron oxides. Fractures dip at 0-10˚, 20-30˚ and 70-90˚.

Note: Contains zones of medium grained, moderately hard rock Tillite from 21,1-21,7m, 23,05-23,65m, 24,20-24,75m and 26,40-27,20m.

27,50-30,65m Dark grey blotched and banded yellowish orange, moderately weathered, very fine grained, thickly bedded, moderately to highly fractured, soft rock to moderately hard rock DWYKA SHALE. Fractures narrow, slightly to moderately rough and filled with iron oxide. Fractures dip at 0-10˚, 50-60˚ and 80-90˚.

30,65-33,37m Dark grey, occasionally banded yellowish orange and maroon, slightly weathered, very fine grained, thickly bedded, moderately fractured, moderately hard rock, DWYKA SHALE. Fractures closed to narrow, slightly rough and clean or filled with iron oxide. Fractures dip at 0-10˚ and 80-90˚.

Note: 50mm wide zone of tillite at 32.60m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 51
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 02/07/07-06/07/07
LOGGED BY: TCP/SAPJ

LOCATION: Generator Transformer
X CO-ORD: +2 867 331.901
Y CO-ORD: +8 380.175
ELEVATION: 1 506.986m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	90								0		0,00-0,46m Abundant friable and hard quartzite GRAVELS and fine ferruginous CONCRETIONS in a matrix of yellowish brown SILTY SAND; pebble marker.
	96										
	87										
	100								1		
	93										0,46-1,25m Yellowish brown mottled orange and grey, probably stiff SANDY CLAY-SILT with abundant friable ferruginous CONCRETIONS; ferruginized residual Dwyka tillite.
	100			T	REF				2		
	92										
	100										
	57										
	100										
	90	-	-						3		1,25-6,25m Yellowish brown blotched orange and grey and occasionally maroon, probably very stiff, jointed (stained black), SANDY CLAY-SILT with occasional friable sandy horizons; residual Dwyka tillite.
	93								4		
	91										
	100 99								5		
	100								6		
NWD4	93	15	19						7		6,25-6,65m Yellowish brown blotched grey, highly weathered, fine grained (but with very coarse clasts), highly fractured very soft rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough, stained black and filled with yellowish brown sandy clay-silt. Fractures dip sub-horizontally and sub-vertically.
	65		0								
	47	-	0						8		6,65-10,35m Residual tillite as from 1,25-6,25m
	97		0						9		
	100		0						10		
	97	12	50	*	1,35 MPa				11		10,35-12,00m Yellowish brown banded grey, highly weathered, fine grained, (but with very coarse clasts), highly fractured very soft rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough to rough, stained black and filled with reddish brown clay-silt. Fractures dip sub-horizontally, 20-30˚, 60-70˚ and sub-vertically.
	98		58						12		12,00m-13,10m Pale yellowish brown blotched dark brown and banded orange, highly weathered, fine grained (but with very coarse clasts), highly fractured soft rock DWYKA TILLITE. Fractures are slightly rough to rough, closed to narrow, stained red and filled with yellowish brown sandy clay-silt. Fractures dip sub-horizontally and sub-vertically.
	100	5	79	*	22 MPa				13		
	94		94	*	29 MPa				14		13,10m-14,20m Pinkish brown banded orange and blotched grey, highly weathered, fine grained (but with very coarse clasts), highly fractured, moderately hard rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough, stained yellowish brown and black and coated with iron oxide. Fractures dip sub-horizontally, 20-30˚ and 60-70˚.
	76	2	85						15		
	100		100						16		14,20m-17,34m Bluish grey blotched dark grey and orange, slightly weathered, moderately fractured, hard rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough to rough, stained yellowish brown and black and coated with yellowish brown silt and iron oxide. Fractures dip sub-horizontally and 20-30˚.
									17		
									18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 52
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 03/08/07-08/08/07
LOGGED BY: TCP/RLP

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 450.265
Y CO-ORD: +8 411.890
ELEVATION: 1 506.582m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	97	-	-		28				1	
	56									
	81								2	
	100									
	71								3	
	42									
NWD4	93	-	49						4	
	33									
	77	>50	0						5	
	78								6	
	100		18						7	
	72		0							
	89								8	
	96		30							
	95		24						9	
	100		22							
	83		0						10	
	68									
	19	10-15	0						11	
	53									
	40								12	
	77		40	*	16,5 MPa					
	57		0						13	
	99		40							
	75								14	
	93		0							
	85		0						15	
	96	15	7							
	100		8						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,20m Abundant sub-angular to sub-rounded, weathered quartzite GRAVELS in a matrix of orange-brown SILTY SAND; roots; pebble marker.

1,20-2,50m Orange-brown mottled yellow and black, stiff, SANDY CLAY-SILT with scattered friable ferruginous concretions and weathered tillite gravels; residual Dwyka tillite.

2,50-2,80m Yellowish brown mottled grey and orange, probably very stiff, jointed (stained reddish brown and black) SANDY SILT with occasional hard rock COBBLES and GRAVELS; residual Dwyka tillite.

2,80-6,87m Greyish brown mottled yellow and orange-brown, highly weathered, fine grained (but with very coarse clasts), very highly fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough to rough, stained reddish brown and black and filled with orange-brown sandy silt. Fractures dip predominantly sub-horizontally and sub-vertically. Contains zones up to 300mm wide (total 0,85m) of stiff or very stiff residual soil as above.

6,87-7,97m Greyish brown blotched orange, highly weathered, fine grained (but with very coarse clasts), highly fractured, soft rock DWYKA TILLITE. Fractures are narrow to wide, slightly rough to rough, stained reddish brown and black and filled with orange-brown sandy silt. Fractures dip predominantly sub-horizontally and sub-vertically. Contains zones of probably stiff to very stiff residual soil up to 200mm wide (total 0,36m).

7,97-15,17m Greyish brown mottled orange, highly weathered, fine grained (with very coarse clasts), highly fractured, moderately hard rock DWYKA TILLITE. Fractures are mostly closed to narrow, moderately rough to rough, stained black and coated with orange-brown silt and iron oxide. Fractures dip sub-horizontally 45˚, 60-70˚ and sub-vertically. Contains zones of residual sandy silt of probably stiff to very stiff consistency from 12,00 to about 12,50m.

15,17-17,30 Greyish brown banded dark brown, moderately weathered, very fine grained, laminated, highly fractured, moderately hard rock RAYTON SHALE. Fractures are closed to narrow, stained orange-brown and black, slightly rough and filled with orange brown clay-silt. Fractures dip sub-horizontally 45˚, 60 -70˚ and sub-vertically.

17,30-21,51m Dark bluish grey, slightly weathered, very fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures closed to narrow, slightly rough and coated with yellowish brown silt and iron oxide. Fractures dip sub-horizontally 18-20˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 52
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 03/08/07-08/08/07
LOGGED BY: TCP/RLP

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 450.265
Y CO-ORD: +8 411.890
ELEVATION: 1 506.582m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	15	46	*	68 MPa				21	

CORE DESCRIPTION

17,30-21,51m Dark bluish grey, slightly weathered, very fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures closed to narrow, slightly rough and coated with yellowish brown silt and iron oxide. Fractures dip sub-horizontally 18-20˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 53
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 17/08/07-20/08/07
LOGGED BY: JFR/JFR (21/08/07)

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 758.340
Y CO-ORD: +8 440.849
ELEVATION: 1 500.709m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	92	-	-						1	
	96	>50	0							
NWD4	100	29	0						2	
	100	>50	0	*	3 MPa				3	
				*	12 MPa				4	
	99	36	0						5	
	99	49	8	*	21 MPa				6	
	100	26	17						7	
	97	41	0						8	
	100	30	13						9	
	100	34	0						10	
	100	35	0	*	31 MPa				11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,20m Yellow-brown SILTY SAND with scattered medium and fine GRAVELS; hillwash.

0,20-±1,20m Abundant coarse, medium and fine angular and platey, weathered, very soft rock and soft rock, shale GRAVELS in a matrix of orange-brown SANDY CLAYEY SILT; residual Rayton shale.

±1,20-3,50m Khaki banded orange-brown and yellow-brown, highly weathered, very fine grained, very thinly bedded, highly and very highly fractured, very soft rock RAYTON SHALE. Fractures are very narrow and narrow, slightly rough, stained black and occasionally red-brown and filled with silt in places. Fractures dip predominantly at 10-15˚ (bedding plane separations) with several prominent 50-60˚ and 70-80˚ dips.

3,50-3,90m Khaki banded orange-brown and dark brown, highly weathered very fine grained, very thinly bedded, very highly fractured, soft to moderately hard rock RAYTON SHALE. Fractures are generally very narrow to narrow (but very wide - 20mm at 3,85m), slightly rough, stained black and red brown and filled with clay-silt in places. Fractures dip predominantly at 10-15˚ with occasional prominent 50-60˚ and 70-80˚ dips.

3,90-9,90m Dark brown banded orange-brown and khaki, highly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard and hard rock, RAYTON SHALE, with zones of highly to very highly fractured, soft rock from 6,10-6,85m and 8,35-9,90m. Fractures generally very narrow to narrow (but occasionally very wide – 10mm), slightly rough, stained black and red brown and filled with clay-silt in places. Fractures dip predominantly at 10-15˚ (bedding separations) with occasional prominent 40-50˚ and 80-90˚ dips.

9,90-13,90m Grey-brown banded orange-brown and dark brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures very narrow and narrow, slightly rough, stained red brown and black and filled with clay-silt in places. Fractures dip at 10-15˚ (bedding separations), 40-50˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 54
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 06/08/07-07/08/07
LOGGED BY: FWS/JFR (08/08/07)

LOCATION: CPP Building
X CO-ORD: +2 867 666.667
Y CO-ORD: +8 469.815
ELEVATION: 1 502.392m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	68									
	93	-	-						1	
	100									
NWD4	100	28	0						2	
	100	25	20						3	
									4	
	100	27	13						5	
				*	9 MPa				6	
	100	8	52						7	
				*	19 MPa				8	
	100	12	43						9	
	100	16	51						10	
									11	
	100	17	26						12	
	100	13	50	*	24 MPa				13	
									14	
	100	11	67						15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,20m Medium brown SILTY SAND, with abundant highly weathered rock fragments; colluvium.

0,20-1,70m Orange-brown CLAYEY SILT, with several zones of highly weathered and fractured, very soft rock shale; residual Rayton shale.

1,70-2,70m Pale khaki, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, RAYTON SHALE. Fractures narrow, slightly rough, stained black and red and with a thin coating of silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 80-90˚ dips.

2,70-5,27m Khaki, banded dark brown, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock RAYTON SHALE, (with zones of very highly fractured very soft rock from 3,15-3,30m and 4,76-5,27m). Fractures are narrow to wide, slightly rough, stained black and red and filled with silt. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 30-40˚ and 80-90˚ dips.

5,27-7,75m Dark brown banded greenish grey, moderately to highly weathered, very fine grained, thinly bedded, highly fractured, soft rock, RAYTON SHALE. Fractures narrow to wide, slightly rough, stained orange-brown and black and filled with silt in places. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 60-70˚ and 70-80˚ dips.

7,75-12,00m Greenish grey banded dark brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures narrow to wide, slightly rough, stained orange-brown and black and occasionally filled with silt. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 70-80˚ dips.

Note: 10cm wide zone of residual silt at 8,65m.

12,00-15,47m Greenish grey banded dark brown, moderately weathered, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures very narrow, moderately rough and stained orange-brown. Fractures dip predominantly at 0-20˚ (bedding separations) with occasional 70-80˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 57
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 13/07/07-27/07/07
LOGGED BY: TCP/RLP

LOCATION: H.V. Yard
X CO-ORD: +2 867 158.883
Y CO-ORD: +8 386.504
ELEVATION: 1 505.005m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	96								0	
	93									
	100								1	
NWD4	57	-	-		47				2	
	100									
	0									
	100									
	71								3	
	100									
	88									
	100								4	
	71									
	100	25								
	86		48						5	
	87	-	0						6	
	100	15-20	78	UCS	31,6 MPa				7	
				*	8 MPa					
	92		0						8	
	100	7	77	*	8 MPa				9	
			69							
			68						10	
				UCS	35,9 MPa				11	
	95		38						12	
	89	10-15	0						13	
	93								14	
	100		76						15	
	97		71	*	7 MPa				16	
	100	9	68	UCS	9,3 MPa				17	
									18	
	93		43						19	
	100		52						20	

CORE DESCRIPTION

0,00-0,60m Abundant sub-angular quartzite GRAVELS in a matrix of brown SILTY SAND; roots; pebble marker.

0,60-2,50m Yellowish brown blotched red and black, stiff to very stiff SANDY CLAY-SILT with scattered friable ferruginous concretions and hard sub-angular quartzite gravels; residual Dwyka tillite.

2,50-3,90m Purplish brown blotched buff and banded yellowish brown, probably very stiff, jointed (stained black), SANDY SILT containing occasional angular hard quartzite GRAVELS; residual Dwyka tillite.

3,90-6,05 Yellowish brown banded purplish brown and blotched pale grey, highly weathered, fine grained (but with gravel sized clasts), highly fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, stained black and filled with yellowish brown silt. Fractures dip sub-horizontally and sub-vertically.

6,05-7,05m Reddish brown and pale grey blotched yellowish brown, probably very stiff, jointed, slightly SANDY SILT; residual Dwyka siltstone.

7,05-9,02 Pale grey speckled and banded yellowish brown and dark brown, moderately to highly weathered, fine grained, very thinly bedded, highly fractured, soft rock FELSPATHIC DWYKA SANDSTONE. Fractures are closed to narrow, slightly rough, stained red and black and filled with reddish brown clay-silt. Fractures are predominantly sub-horizontal and sub-vertical.

9,02-13,50m Yellowish brown banded pale and dark grey, moderately to highly weathered, medium grained, laminated, highly fractured, soft to moderately hard rock FELSPATHIC DWYKA SANDSTONE with zones of probably very soft rock from 10,93-11,03m; 12,40-12,80m and 13,00-13,50m. Fractures are closed to narrow, moderately rough to rough, stained reddish brown and black and filled with red clay-silt. Fractures dip sub-horizontally 45˚ and sub-vertically.

13,50-15,23m Yellowish brown blotched and banded pale grey and red, completely weathered, very fine grained, thinly bedded, highly fractured very soft rock DWYKA SILTSTONE. Fractures are closed to narrow, slightly rough, stained black and filled with reddish brown clay-silt.

15,23-20,75m Pale yellowish brown banded dark brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, soft rock DWYKA SILTSTONE. Fractures are closed to very narrow, slightly rough to rough and coated with iron oxide. Fractures dip sub-horizontally 20-30˚, 60˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 57
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 00/07/07-00/07/07
LOGGED BY: TCP/RLP

LOCATION: H.V. Yard
X CO-ORD: +2 867 158 883
Y CO-ORD: +8 386.504
ELEVATION: 1 505.005m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	9	52						21	
			43						22	
		8	0						23	
	92		80						24	
	0		0							
	99		32						25	
	100		66	UCS	26,5 MPa				26	
	90		0							
	100		28							
			0							
	93		45						27	
	100		46							
	0		0						28	
	97		0							
	93		68						29	
	88	8	34						30	
	70		0						31	
	100		73							
	100		84						32	
									33	
	96		67						34	
	100		63						35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

See previous page for description.

20,75-25,10m Dark grey banded yellowish brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, soft rock CARBONACEOUS DWYKA SHALE. Fractures are closed to very narrow, slightly rough, stained yellow and black and coated with iron oxide. Fractures dip sub-horizontally 20˚,45˚ and sub-vertically. Exhibits slaking properties.

25,10-35,26m Dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock CARBONACEOUS DWYKA SHALE. Fractures are closed to narrow and coated with grey silt or cemented by calcite. Fractures dip sub-horizontally, 20-30˚, 45˚, 60˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 58
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 25/07/07-02/08/07
LOGGED BY: TCP/SAPJ

LOCATION: H.V. Yard
X CO-ORD: +2 867 303.431
Y CO-ORD: +8 486.427
ELEVATION: 1 504.995m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100			SPT	REF				1	
	70									
	100			SPT	REF				2	
	73			SPT	REF					
	100	-	-	SPT	REF				3	
	89								4	
NWD4	100		0						5	
			11	*	3,3 MPa				6	
	97	20	34						7	
				*	13 MPa				8	
	100		54	UCS	50,5 MPa	WP	0 U.L.		9	
	89		71						10	
	96	10	54						11	
	89		34			WP	21,5 U.L. V.F		12	
	90	20	16						13	
	92		34						14	
	99	10	60			WP	1,45 U.L. DIL		15	
	96		63	UCS *	106,1 MPa 50 MPa				16	
									17	
	100	2	88			WP	0 U.L.		18	
									19	
	97		63			WP	0,05 U.L.		20	

CORE DESCRIPTION

0,00-1,20m Abundant sub-angular and sub-rounded GRAVELS and friable ferruginous CONCRETIONS in a matrix of orange-brown SILTY SAND; pebble marker.

1,20-4,75m Buff blotched yellowish brown, jointed (stained black), probably very stiff SANDY SILT with soft rock ferruginized zones and occasional hard rock GRAVELS; residual Dwyka tillite.

4,75-7,20m Pale yellowish brown banded pinkish brown, highly weathered, fine grained (but with very coarse clasts), highly fractured, very soft rock DWYKA TILLITE with zones up to 150mm wide of soft rock. Fractures are narrow to wide, slightly rough to rough, stained black and filled with yellowish brown silt. Fractures dip sub-horizontally and sub-vertically.

7,20-9,90m As above, but moderately hard rock throughout.

9,90-12,00m Pinkish brown banded yellowish brown and blotched grey, moderately weathered, fine grained (but with very coarse clasts), highly fractured soft rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough to rough and filled with yellowish brown silt. Fractures dip predominantly sub-horizontally and 20-30˚.

12,00-13,50m Buff blotched yellowish brown and banded reddish brown, very highly weathered, fine grained (but with very coarse clasts), highly fractured very soft to soft rock DWYKA TILLITE with zones up to 100mm wide (total 300mm) of soft reddish brown clay-silt. Fractures are narrow to very wide, rough, stained orange and filled with reddish brown clay-silt.

13,50-17,00m Yellowish brown banded pinkish brown and grey, moderately weathered, fine grained (but with very coarse clasts), highly fractured, moderately hard rock DWYKA TILLITE. Fractures are closed to narrow, slightly rough, stained dark brown and coated with iron oxide. Fractures dip sub-horizontally and 20-30˚.

17,00-25,16m Bluish grey banded and blotched pale grey, slightly weathered, fine grained (but with very coarse clasts), moderately fractured, hard rock DWYKA TILLITE. Fractures are closed to narrow, rough, stained yellowish brown and coated with iron oxide or cemented by calcite. Fractures dip predominantly sub-horizontally, 20-30 ˚ and 60-70˚.

Contains a zone of moderately weathered, moderately hard rock from 19,26-20,05m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 58
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 25/07/07-02/08/07
LOGGED BY: TCP/SAPJ

LOCATION: H.V. Yard
X CO-ORD: +2 867 303.431
Y CO-ORD: +8 486.427
ELEVATION: 1 504.995m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	97		63						21	
	100		100			WP	0,05 U.L. DIL		22	
	99	2	96						23	
	96					WP	0 U.L.		24	
	99		67						25	
		15							26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

17,00-25,16m Bluish grey banded and blotched pale grey, slightly weathered, fine grained (but with very coarse clasts), moderately fractured, hard rock DWYKA TILLITE. Fractures are closed to narrow, rough, stained yellowish brown and coated with iron oxide or cemented by calcite. Fractures dip predominantly sub-horizontally, 20-30 ˚ and 60-70˚.

Contains a zone of moderately weathered, moderately hard rock from 19,26-20,05m

25,16-25,50m Dark grey and pale grey, slightly weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock DWYKA SHALE. Fractures are closed to very narrow, stained dark grey and coated with manganese oxide or cemented by calcite. Fractures dip sub-horizontally and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 59
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 02/08/07-04/08/07
LOGGED BY: TCP/SAPJ

LOCATION: H.V. Yard
X CO-ORD: +2 867 421.795
Y CO-ORD: + 8 518.142
ELEVATION: 1 504.276m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	82								1	
	76									
	94									
NWD4	41								2	
	82		-						3	
	100	-		⊣	REF				4	
									5	
									6	
	100		51	*	1,8 MPa				7	
	85		22							
NWD4	71		0						8	
	96		7						9	
									10	
					48,0 MPa				11	
		20	31	UCS *	31 MPa				12	
			19						13	
			0						14	
TNW	100		33						15	
			20						16	
		20-30							17	
			7						18	
			0						19	
									20	

CORE DESCRIPTION

0,00-0,80m Abundant sub-angular to sub-rounded GRAVEL in a matrix of orange-brown SILTY SAND; roots; pebble marker.

0,80 –2,90m Orange-brown mottled yellow and black, probably stiff SANDY CLAY-SILT with abundant friable ferruginous CONCRETIONS; residual Dwyka tillite.

2,90-5,12m Yellowish brown blotched orange, probably very stiff, jointed (stained black) SANDY CLAY-SILT with occasional more sandy zones and infrequent soft to hard rock gravel clasts; residual Dwyka tillite.

5,12-6,53m As above, but consistency very stiff to very soft rock.

6,53-7,20m Greyish brown banded yellowish brown, highly weathered, fine grained, highly fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, rough, stained black and filled with yellowish brown sandy clay-silt. Fractures mostly dip sub-horizontally.

7,20-8,02 Residual tillite as per 5,12-6,53m.

8,02-10,90m Greyish brown banded dark grey, moderately weathered, very fine grained, laminated, highly fractured, soft rock RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained red and black and filled with orange-brown clay-silt. Fractures dip 20-30˚ and 60˚. Zone of reddish brown clay-silt from 9,4-9,95m marks change in dip of shale from about 60˚ above to 20˚ below.

10,90-15,23m Dark brownish grey banded yellowish brown, slightly weathered, very fine grained, laminated, highly fractured, moderately hard to hard rock RAYTON SHALE. Fractures are closed to wide, slightly rough, stained black and occasionally filled with reddish brown clay-silt. Fractures dip 20-30˚ and 60-70˚.

15,23-18,43m Dark grey banded pale grey, slightly weathered, very fine grained, laminated, highly fractured, hard rock RAYTON SHALE. Fractures are closed to wide, slightly rough, stained yellow and black and coated with reddish brown clay-silt and iron oxide. Fractures dip 20-30˚, 45˚ and 60-70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 60
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 07/08/07-08/08/07
LOGGED BY: TCP/SAPJ

LOCATION:
X CO-ORD: +2 867 529.870
Y CO-ORD: +8 547.101
ELEVATION: 1 502.488m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	95								0	
	83		0							
	87								1	
		>50								
	99		15						2	
	100		34	UCS	21,3 MPa				3	
			85						4	
NWD4									5	
	99	8	55	✻ UCS	24 MPa 24,5 MPa				6	
			38						7	
			66						8	
				✻	27 MPa				9	
	67		71						10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,20m Abundant angular shale GRAVELS in a matrix of yellowish brown SILTY SAND; roots; pebble marker.

0,20-3,50m Reddish brown streaked yellowish brown, highly weathered, very fine grained, thinly laminated, very highly fractured, very soft rock RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained black and filled with orange-brown clay-silt. Fractures dip 20–30˚, 45˚, 60-70˚ and sub-vertically.

3,50-12,60m Greyish brown banded yellowish brown, moderately weathered, very fine grained, thinly laminated, highly fractured, hard rock RAYTON SHALE. Fractures are closed to narrow, slightly rough to rough, stained orange and black and filled with orange-brown clay-silt. Fractures dip 20-30˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 61
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D45R
DRILLING DATES: 30/07/07-31/07/07
LOGGED BY: TCP/RLP

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 638.197
Y CO-ORD: +8 576.067
ELEVATION: 1 500.185m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	95								0	
	76									
	97									
	88								1	
	81	-	-	↓	48				2	
	100									
	100			↓	70				3	
									4	
NWD4	100	>50	0						5	
			7						6	
	99	50	0						7	
									8	
			8						9	
									10	
			0						11	
									12	
	100	30	7						13	
									14	
			17						15	
									16	
NWD4			14	*	84 MPa				17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,50m Brown SILTY SAND containing scattered fine angular weathered shale and quartzite GRAVELS; roots; hillwash.

0,50-2,40m Abundant fine, friable, weathered shale GRAVELS in a matrix of orange-brown mottled yellow and black, probably stiff, jointed, CLAY-SILT; residual Rayton shale.

2,40-4,25m Yellowish brown banded orange and dark brown, probably very stiff, jointed (stained black), CLAY-SILT; residual Rayton shale.

4,25-6,26m Yellowish brown banded dark brown and orange, very highly weathered, very fine grained, laminated, very highly fractured, very soft rock RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained black and filled with yellowish brown clay-silt. Fractures dip predominantly 15-20˚ and sub-vertically.

6,26-8,40m Yellowish brown, banded dark grey, highly weathered, very fine grained, laminated, very highly fractured, soft rock RAYTON SHALE. Fractures are closed to narrow, slightly rough, stained orange and black and filled with orange brown clay-silt. Fractures mainly dip 15-20˚ (bedding plane partings) and sub-vertically but several other orientations present.

8,40-12,90m Yellowish brown banded dark grey, moderately weathered, very fine grained, laminated, highly fractured, moderately hard rock RAYTON SHALE. Fractures are closed to narrow, stained orange and black and filled with orange-brown clay silt or coated with iron oxide. Fractures dip 15-20˚, 45˚, 60˚, 70˚ and sub-vertically.

12,90-17,10m Dark brown banded yellowish brown and dark grey, slightly to moderately weathered, very fine grained, laminated highly fractured, hard rock RAYTON SHALE. Fractures are closed to very narrow, slightly rough to rough, stained orange and black and coated with orange brown silt and iron oxide. Fractures dip 15-20˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 63
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 17/08/07-27/08/07
LOGGED BY: FWS/FWS

LOCATION: CPP Building
X CO-ORD: +2 867 854.436
Y CO-ORD: +8 634.008
ELEVATION: 1 495.620m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	98								1	
	38									
NWD4	80			⊥	56				2	
	90	15	0			WP	28 U.L. (W.O.)		3	
		2							4	
		14		✻	10 MPa				5	
	100	11	43	✻	60 MPa				6	
	100	7	76						7	
	100	20	71						8	
	94	1	92			WP	10 U.L. (T.F.)		9	
	100	15	47						10	
	86	4	87	✻	>200 MPa	WP	0,5 U.L. (V.F.)		11	
									12	
	97		40						13	
	100		100						14	
	100	3	86			WP	0,2 U.L. (L.F.)		15	
									16	
	100		100						17	
						WP	0 U.L.		18	
									19	
									20	

CORE DESCRIPTION

0,00-1,56m Red-brown, probably dense, SILTY SAND; no observed pebble marker; transported soil.

1,56-2,94m Pale brown, mottled dark red and black, probably very dense, SANDY SILT; residual diabase.

2,94-5,86m Orange-brown, mottled dark red-brown to black, highly weathered to unweathered, medium grained, jointed, highly fractured, soft rock DIABASE. Fractures narrow to wide, rough,stained and filled with silt and wall rock. Fractures are generally sub-horizontal to occasionally 60-70˚.

5,86-7,72m Grey-green, highly weathered, medium grained, jointed, highly fractured, hard rock DIABASE. Fractures narrow, rough and stained with iron oxide. Fractures are generally sub-horizontal to occasionally 60-70˚ .

7,72-9,20m Grey-green, slightly to unweathered, medium grained, jointed, highly fractured, hard rock DIABASE. Fractures narrow, rough and stained with iron oxide. Fractures are generally sub-horizontal to occasionally 60-70˚. Fracture zones at 7,40-7,48m and 7,98-8,07m.

9,20-12,03m Grey-green, highly weathered, medium grained, jointed, highly fractured, extremely hard rock DIABASE. Fractures narrow, rough and stained with iron oxide. Fractures are generally sub-horizontal to occasionally 60-70˚.

12,03-18,35m Grey-green, unweathered, medium grained, jointed, moderately fractured, extremely hard rock DIABASE. Fractures narrow, rough and stained with iron oxide. Fractures are generally sub-horizontal with occasional major fractures at 60-70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 64
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechical Drilling
MACHINE: XY-2B
DRILLING DATES: 21/07/07-25/07/07
LOGGED BY: JFR/JFR (26/07/07)

LOCATION: H.V. Tower
X CO-ORD: +2 867 050.805
Y CO-ORD: +8 524.976
ELEVATION: 1 502.240m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	70								0	
	100									
	74								1	
NWD4	96									
	100								2	
	100									
	100			I	22				3	
	100	-	-							
	94								4	
	100									
	100								5	
	100								6	
	100	10	51							
	98	6	79	*	4 MPa				7	
	100	8	60							
	100	8	61	*	5 MPa				8	
	98	9	32							
	97	6	18						9	
NWD4	100	9	66							
	100	8	55						10	
	100	13	27	*	7 MPa					
	100	11	79						11	
	100	10	41							
	100	8	75	*	3 MPa				12	
	100	9	34							
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,57m Abundant coarse medium and fine, sub-angular and sub-rounded, weathered quartzite GRAVELS, in a matrix of brown SILTY SAND; pebble marker.

0,57-±1,90m Red-brown mottled orange-brown probably firm, ferruginous cemented CLAYEY SAND with scattered friable ferruginous CONCRETIONS and occasional hard GRAVELS up to 50mm in diameter; residual Dwyka tillite.

±1,90-±5,70m Red-brown mottled yellowish orange and orange-brown, probably firm CLAYEY SAND, with occasional hard gravels up to 50mm in diameter; residual Dwyka tillite.

Notes: 1. Zone of buff silty sand (residual sandstone) from 2,30-2,70m.
2. Becomes probably stiff in consistency below ±4,50m.
3. Contains several thin zones of clayey silt (residual shale).

±5,70-7,80m Yellowish grey blotched yellowish orange, probably very stiff, jointed (stained black and orange) CLAYEY SILT; residual Dwyka shale.

7,80-8,08m Dark brown and orange-brown, highly weathered, medium grained (with several hard clasts up to 50mm in diameter), highly fractured, soft rock to moderately hard rock, DWYKA TILLITE. Fractures wide, slightly rough and filled with clay. Fractures dip at 0-10˚ and 60-70˚.

8,08-13,15m Orange-brown banded dark brown and pale grey, highly weathered, very fine grained, very thinly and thinly bedded, highly fractured, very soft rock to soft rock DWYKA SHALE with very occasional fine hard gravel inclusions. Fractures very narrow and narrow, slightly rough and filled with iron oxide. Fractures dip at 0-10˚ (bedding separations) and 30-40˚.

13,15-19,10m As from 8,08-13,15m but with several zones up to 50mm thick (and comprising a total of 400 mm) of grey probably very stiff clay-silt (residual shale).

19,10-20,85m Dark grey streaked orange-brown and dark brown, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 64
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 21/07/07-25/07/07
LOGGED BY: JFR/JFR (26/07/07)

LOCATION: H.V. Tower
X CO-ORD: +2 867 050.805
Y CO-ORD: +8 524.976
ELEVATION: 1 502.240m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	9	34						21	
	98	>50 / 10	24						22	
	100	9	52						23	
	93	>50	0						24	
	100	>50 / 11	19						25	
	100	15	35						26	
	98	8	65						27	
	100	6	80	*	9 MPa				28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,10-20,85m Dark grey streaked orange-brown and dark brown, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.

20,85-21,90m Dark grey streaked and banded maroon and orange-brown, moderately weathered, very fine grained, thinly bedded, very highly fractured, very soft rock to soft rock, DWYKA SHALE with very occasional fine gravel inclusions. Fractures narrow to wide, slightly rough and filled with clay. Fractures have multiple dip angles.

21,90-27,10m Dark grey slightly weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SHALE with very occasional fine gravel inclusions. Fractures very narrow to narrow, slightly rough and filled with clay in places. Fractures dip at 0-10˚ (bedding separations) with occasional 40-50˚ and 70-90˚ dips.

Note: 1. Very highly fractured horizon (with zones of residual clay-silt comprising ± 50% of horizon) from 23,95-25,25m.
2. 50mm thick horizon of residual clay-silt at 25,4m.
3. 100mm thick very highly fractured horizons at 26,0m and 27,0m.

27,10-29,30m Dark grey unweathered, very fine grained, thickly bedded, moderately to highly fractured, soft rock DWYKA SHALE. Fractures closed, slightly rough and clean. Fractures dip at 0-10˚.

Note: 5cm wide very highly fractured zone at 29,3m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 65
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 28/07/07-01/08/07
LOGGED BY: TCP/RLP

LOCATION: H.V. Yard
X CO-ORD: +2 867 266.208
Y CO-ORD: +8 640.275
ELEVATION: 1 502.175m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	80 55 30	-	-						1	
NWD4	100			⊣	REF					
	97								2	
	98	5-6	40							
	87		45						3	
	91		38						4	
	99		60						5	
	98		70	*	5.6 MPa				6	
	100		59						7	
	65		0						8	
	94	10	54						9	
	100		75	*	7 MPa				10	
	100		59							
	77		54						11	
	0		0							
	100		0						12	
	99		79						13	
	100	8-9	70	*	24 MPa				14	
	100		73						15	
	100		38							
	100		72						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,10m Abundant sub-angular weathered quartzite GRAVELS and fine ferruginous CONCRETIONS in a matrix of brown SILTY SAND; roots; pebble marker.

0,10-1,50m Orange-brown mottled yellow and black, probably stiff, CLAYEY SAND with scattered hard quartzite GRAVELS and friable ferruginous CONCRETIONS; residual Dwyka tillite.

1,50-2,60m Purplish brown banded buff, probably very dense, SANDY SILT with occasional hard rock GRAVELS; residual Dwyka tillite.

2,60-6,15m Pale grey banded yellowish brown, orange and purplish brown, very highly weathered, fine grained, highly fractured, very soft rock DWYKA TILLITE with zones up to 100mm wide of very dense material as above. Fractures are narrow to wide, slightly rough, stained orange-brown and filled with yellowish grey silt. Fractures dip sub-horizontally, 20-30˚ and 45˚.

6,15-8,25m Pale grey banded yellowish brown and purplish brown, slightly weathered, fine gravel, highly fractured, soft rock DWYKA TILLITE. Fractures are narrow to wide, moderately rough to rough, stained yellow and black and filled with orange brown silt. Fractures dip sub-horizontally 20˚,30˚ and 45˚.

8,25-12,20m Pale yellowish grey banded purplish brown, very highly weathered, fine grained, highly fractured, soft rock DWYKA TILLITE with core losses of up to 470mm in places and zones of probably stiff clay up to 150mm thick. Fractures are narrow to wide, slightly rough to rough, stained yellow and black and filled with orange and purplish silt. Fractures dip 20-30˚, 45˚ and 60˚.

12,20-16,74m Pale grey blotched yellow brown and occasionally purplish brown, moderately weathered, fine grained, highly fractured moderately hard to hard rock DWYKA TILLITE. Fractures are closed to narrow, stained yellow and black and filled with yellowish brown silt. Fractures dip sub-horizontally, 20-30˚ and 45˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 67
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D45R
DRILLING DATES: 24/07/07-28/07/07
LOGGED BY: TCP/RLP

LOCATION: H. V. Yard
X CO-ORD: +2 867 462.537
Y CO-ORD: +8 785.538
ELEVATION: 1 496.856m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	-	-						0	
	51									
	78									
	100								1	
	58									
NWD4	100									
	96	>50	0						2	
	100								3	
	85								4	
									5	
			7	*	17 MPa				6	
									7	
			49						8	
			32						9	
									10	
			47						11	
NWD4	100	10-15	0						12	
									13	
			17						14	
									15	
			0						16	
									17	
									18	
									19	
		10	35						20	

CORE DESCRIPTION

0,00-0,60 Abundant fine angular shale GRAVELS in a matrix of yellowish brown SILTY SAND; roots; hillwash.

0,60-1,00m Abundant coarse medium and fine angular shale GRAVELS in a matrix of brown CLAY-SILT; residual Rayton shale.

1,00-3,35m Yellowish brown, highly weathered, very fine grained, very thinly bedded, very highly fractured, very soft rock RAYTON SHALE. Fractures are narrow to wide, slightly rough, stained black and filled with yellowish brown clay-silt. Fractures dip mainly sub-horizontally and sub-vertically.

3,35-13,25m Yellowish brown banded dark grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock RAYTON SHALE. Fractures are closed to narrow, slightly rough, stained black and coated with orange-brown clay-silt and iron oxide. Fractures dip 20˚, 45˚, 60-70˚ and sub-vertically.

Contains zones of very soft to soft rock, highly weathered material up to 100mm thick.

13,25-19,00m Brown banded dark grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock to hard rock RAYTON SHALE. Fractures are closed to very narrow, stained orange and black and coated with yellowish grey silt and iron oxide. Fractures dip 45˚, 60-70˚ and sub-vertically.

Contains zones of very soft and soft rock, highly weathered material up to 50mm wide.

19,00-23,80m Dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are slightly rough, stained yellowish brown and black and coated with iron oxide.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 67
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D45R
DRILLING DATES: 24/07/07-28/07/07
LOGGED BY: TCP/RLP

LOCATION: H. V. Yard
X CO-ORD: +2 867 462.537
Y CO-ORD: +8 785.538
ELEVATION: 1 496.856m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	10	35 7 0 23 0						21 22 23 24 25 26 27 28 29 30 31 32 33 34 15 36 37 38 39 40	

CORE DESCRIPTION

19,00-23,80m Dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock RAYTON SHALE. Fractures are slightly rough, stained yellowish brown and black and coated with iron oxide.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 68
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 26/07/07-01/08/07
LOGGED BY: TCP/RLP

LOCATION: Quarry
X CO-ORD: +2 865 191.000
Y CO-ORD: +86 565.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	62								0	
	100								1	
	42								2	
	100								3	
	29								4	
	18	-	-						5	
	38								6	
	99								7	
	36								8	
	32								9	
	67								10	
	90									
	60								11	
	65								12	
	17								13	
	50								14	
	43	>50	0						15	
TNW	73								16	
	100								17	
	100								18	
	25								19	
	100								20	

CORE DESCRIPTION

0,00-0,50m Brown silty fine SAND containing scattered hard quartzite GRAVELS; colluvial gravel.

0,50-3,00m Orange-brown mottled yellowish brown, probably dense, slightly CLAYEY SILT; residual Rayton quartzite.

3,00-9,80m Orange-brown and pinkish brown mottled yellowish brown, probably dense, SANDY SILT with frequent more clayey horizons; residual Rayton quartzite.

9,80-12,00m Scattered sub-angular quartzite COBBLES and GRAVELS in a matrix of buff mottled and streaked yellowish brown and orange, fine SANDY SILT; residual Rayton quartzite.

12,00-22,05m Pale greenish grey streaked grey and buff, moderately weathered, fine grained, very thinly bedded, very highly fractured, hard rock, RAYTON QUARTZITE with frequent zones up to 1,2m wide of silty residual quartzite as above (fractured quartzite makes up about 40% of total core length). Fractures are closed to wide, slightly rough, stained black with manganese dendrites and filled with yellowish brown silt. Multiple fracture orientations.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 68
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 26/07/07-01/08/07
LOGGED BY: TCP/RLP

LOCATION: Quarry
X CO-ORD: +2 865 191.000
Y CO-ORD: +86 565.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
TNW	57	>50	45						21	
	93		50							
	70		0						22	
	100		25							
	94		65						23	
	100		39	*	189 MPa					
	89		17						24	
	51									
	90	30							25	
	67									
	85		0						26	
TNW	28									
	84		25						27	
	100		0							
			37						28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

12,00-22,05m Pale greenish grey streaked grey and buff, moderately weathered, fine grained, very thinly bedded, very highly fractured, hard rock, RAYTON QUARTZITE with frequent zones up to 1,2m wide of silty residual quartzite as above (fractured quartzite makes up about 40% of total core length). Fractures are closed to wide, slightly rough, stained black with manganese dendrites and filled with yellowish brown silt. Multiple fracture orientations.

22,05-30,01m Pale greenish grey banded dark grey and buff, slightly weathered, fine grained, very thinly bedded, highly fractured, very hard rock RAYTON QUARTZITE. Fractures are closed to narrow, slightly rough, stained with manganese dendrites and coated with yellowish brown iron oxide. Fractures dip 20˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 69
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 03/08/07-06/08/07
LOGGED BY: FWS/FWS

LOCATION: Quarry
X CO-ORD: +2 864 749.000
Y CO-ORD: +6 565.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	92		-						1	
	92		52							
	26		-						2	
	28	26	-						3	
	56		-							
	90		-						4	
	88		70							
	68		-						5	
	94		34							
	100		34						6	
	100	9	74							
	89		79						7	
	92		42							
	100		60						8	
	84		-							
TNW	100		81						9	
	100		33							
	89		18	*	263 MPa				10	
	92	10	78							
	100		36						11	
	100		47							
	100		50						12	
	93	7	70	*	233 MPa					
	100		62						13	
	100		0							
	89	23	0						14	
	100		0							
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-4,56m White, slightly weathered, medium grained, highly fractured, extremely hard rock QUARTZITE. Fractures are narrow to wide, rough, stained with orange-brown iron oxide and locally waxy. Fractures dip at 10-20˚ and 70˚.

4,56-14,06m Pale grey, slightly weathered, medium grained, highly fractured, extremely hard rock, QUARTZITE. Fractures narrow to wide, rough, stained with orange-brown iron oxide and filled with clay-silt. Fractures dip at 10-20˚ and 70˚. Recrystalised coarse quartz and mica locally developed on fracture surfaces.

Note: Core loss 4,97-5,46m due to residual filling being washed out.

14,06-17,35m Grey, unweathered, medium grained, generally highly fractured, (with zones of moderately fractured) extremely hard rock QUARTZITE. Fractures very narrow to narrow, rough and stained with iron oxide. Dips 10-20˚ and 70˚.

17,35-20,26m Grey, slightly to moderately weathered, medium grained, moderately to highly fractured, very hard rock QUARTZITE. Fractures narrow to wide, rough and stained with iron oxide and filled with clay-silt . Fractures dip 20-40˚ and ± 70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 69
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 03/08/07-06/08/07
LOGGED BY: FWS/FWS

LOCATION:
X CO-ORD: +2 864 749.000
Y CO-ORD: +6 565.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
TNW	100		89						20	
	66		60						21	
	93		86						22	
	44		38						23	
	100		96						24	
	100		85						25	
	100		34						26	
	100		86						27	
	100		69						28	
	97		35						29	
	88		0						30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,26-29,93m Pale grey, unweathered, medium grained, moderately to highly fractured, extremely hard rock QUARTZITE. Fractures are narrow, rough and stained with iron oxide. Fractures dip at 20-40˚ and ± 70˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 70
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 08/08/07-20/08/07
LOGGED BY: TCP/SAPJ

LOCATION: Quarry
X CO-ORD: +2 864 380.000
Y CO-ORD: +6 803.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	17								1	
	70									
	63									
NWD4	27								2	
	37									
	57								3	
	15									
	54	-	-						4	
	100								5	
									6	
									7	
	88									
TNW	100		37						8	
	97		14						9	
	99		43	*	304 MPa				10	
	100		54						11	
	96		96							
			9						12	
	100	10-12	96						13	
			78						14	
	92		14						15	
			17						16	
			40							
TNW	100		39						17	
			52						18	
									19	
	96		52 43						20	

CORE DESCRIPTION

0,00-2,90 Abundant sub-angular, fresh and partially weathered quartzite GRAVELS and COBBLES in a matrix of orange-brown SILTY SAND; colluvial gravel.

2,90-7,85 Buff blotched yellowish brown and orange, probably dense to very dense, jointed (stained yellow and black), SILTY FINE SAND; residual Rayton quartzite.

7,85-21,30 Pale grey banded dark bluish grey, slightly weathered, fine grained, thinly bedded, highly fractured, extremely hard rock RAYTON QUARTZITE. Fractures are closed to very wide, slightly rough to rough, stained yellowish brown and filled with sericite, mica flakes pale grey silty sand and fine gravel. Fractures dip 20-30˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: bh 70
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 08/08/07-20/08/07
LOGGED BY: TCP/SAPJ

LOCATION: Quarry
X CO-ORD: +2 864 380.000
Y CO-ORD: -6 803.000
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
TNW	96	10-12	43						21	
	100		96							
	91		44						22	
			60							
	100		0						23	
			29							
			32						24	
	92	10	60						25	
	100		73							
	94		84	*	358 MPa				26	
			86						27	
	100								28	
			45							
	93		55						29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

7,85-21,30 Pale grey banded dark bluish grey, slightly weathered, fine grained, thinly bedded, highly fractured, extremely hard rock RAYTON QUARTZITE. Fractures are closed to very wide, slightly rough to rough, stained yellowish brown and filled with sericite, mica flakes pale grey silty sand and fine gravel. Fractures dip 20-30˚, 45˚, 60-70˚ and sub-vertically.

21,30-29,88 Brownish grey, glassy, slightly weathered to unweathered, fine grained, thinly bedded, highly fractured, extremely hard rock RAYTON QUARTZITE. Fractures are closed to narrow, slightly rough to rough, stained yellowish brown and coated with sericite, mica flakes and iron oxide, with some cemented by secondary quartz. Fractures dip 20-30˚, 45˚, 60-70˚, and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 1
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 07/09/07-12/09/07
LOGGED BY: JFR/JFR (13/09/07)

LOCATION: Workshop and Stores
X CO-ORD: +2 867 928.300
Y CO-ORD: +7 928.950
ELEVATION: 1 507.385
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100								1	
	100			⊣	REF				2	
	100									
	100								3	
	100									
	100								4	
	100					WP	0 U.L.			
	84								5	
	100									
	77								6	
						WP	0 U.L.			
	100	6	76	✻	14 MPa				7	
	100	3	81							
	100	<1	100						8	
						WP	0 U.L.			
	100	3	86						9	
	98	4	69	✻	6 MPa				10	
						WP	2 U.L. (DIL.)			
	98	5	0						11	
	100	8	77	✻	32 MPa					
	100	9	67						12	
						WP	0,9 U.L. (L.F.)		13	
	100	14	28							
	100	13	37						14	
NWD4	100	13	54			WP	0 U.L.		15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,60m Abundant hard, coarse, medium and fine quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±0,60-±2,00m Red-brown mottled orange-brown and yellow-brown, probably very stiff, weakly ferruginised CLAYEY SANDY SILT with occasional medium and fine hard GRAVELS (clasts); weakly ferruginised residual Dwyka tillite.

±2,00-7,90m Yellowish orange blotched yellow brown and orange-brown, probably very stiff CLAYEY SANDY SILT, with scattered hard GRAVELS (clasts) up to 60mm diameter; residual Dwyka tillite.

7,90-13,85m Pale yellow-brown mottled yellowish orange and blotched red-brown and grey, highly weathered, fine grained (with scattered hard clasts up to 150mm in diameter), moderately fractured, moderately hard rock, DWYKA TILLITE. Fractures are narrow, slightly rough, stained red and orange and filled with silt in places. Fractures dip at 10-20˚ and 40-50˚.

Becomes soft rock below 11,75m.

Becomes very soft rock below 13,25m.

13,85-19,15m Greenish grey banded dark grey, slightly weathered, very fine grained, thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow and narrow, slightly and moderately rough, stained with iron oxide and filled with calcite in places. Fractures dip predominantly at 10-20˚ (bedding plane separations), with occasional 70-80˚ dips.

Becomes very hard rock below 16m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 2
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechincal Drilling
MACHINE: TONE TAS
DRILLING DATES: 12/09/07-17/09/07
LOGGED BY: JFR/JFR (20/09/07)

LOCATION:
X CO-ORD: +2 867 773.100
Y CO-ORD: +7 880.970
ELEVATION: 1 514.494m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100									
	100								2	
	100			↧	N19					
	100									
	100								3	
	100									
	100								4	
	100									
	84								5	
									6	
NWD4	100	3	86							
									7	
	95	5	79	✻	5 MPa					
									8	
	100	5	97							
									9	
	100	10	50						10	
									11	
	100	8	13							
									12	
	87	7	35							
									13	
	99	9	72	✻	3 MPa					
									14	
	99	11	54							
									15	
	90	8	38							
									16	
	100	4	90	✻	5 MPa					
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,30m Abundant coarse, medium and fine hard, quartzite GRAVELS in a matrix of brown and orange-brown SILTY and CLAYEY SAND; pebble marker.

±1,30-6,50m Yellowish orange-brown banded orange-brown, yellow-brown and pale grey probably firm, laminated, jointed, SANDY CLAYEY SILT with occasional hard clasts up to 50mm in diameter; residual Dwyka shale/tillite. Becomes stiff below 2,20m and very stiff below 4,35m.

6,50-7,70m Yellowish orange banded yellow-brown and yellowish grey, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SILTSTONE, with a 100mm thick, ferruginised medium hard rock zone at 6,50m. Fractures are very narrow to narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ and 20-30˚.

7,70-12,80m Buff banded dark brown and orange-brown, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock, DWYKA SILTSTONE, with 100mm wide, moderately hard rock, ferruginised zone at 7,70m. Fractures are very narrow to narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ and 20-30˚.

12,80-13,65m Yellowish orange mottled pale grey, probably very stiff, CLAY-SILT; residual Dwyka shale.

13,65-16,05m Yellowish grey, banded yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SILTSTONE, with 200mm wide soft rock ferruginous zones at 13,65-15,10m. Fractures are very narrow to narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ and 20-30˚.

16,05-18,15m Yellowish grey and buff, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock, DWYKA SILTSTONE, with a zone of soft rock carbonaceous shale from 16,90-17,05m and 30-50mm wide residual clayey silt zones at 16,55m, 16,90m, 17,10m and 17,30m. Fractures are very narrow to narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ and 20-30˚.

18,15-19,40m Yellowish grey banded orange-brown, highly weathered, medium grained (with clasts up to 100mm diameter of hard rock Rayton shale), highly fractured, hard rock, DWYKA TILLITE, which is ferruginised towards the base. Fractures are narrow to wide, slightly rough and filled with silt. Fractures dip at 0-15˚ and 20-30˚.

19,40-19,65m Orange-brown, probably stiff, residual CLAY-SILT.
Note: Mostly not recovered

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 2
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 12/09/07-17/09/07
LOGGED BY: JFR/JFR(20/09/07)

LOCATION:
X CO-ORD: +2 867 773.100
Y CO-ORD: +7 880.970
ELEVATION: 1 514.494m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	4	90						21	
	100	8	61						22	
	100	12	46						23	
	100	10	59	*	38 MPa				24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,40-25,17m Greenish grey banded dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are narrow, slightly rough, stained black and filled with cemented iron oxide or silt. Fractures dip at 10-15˚ (bedding plane separations) with occasional 40-50˚ and 80-90˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 3
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 18/09/07-19/09/07
LOGGED BY: TCP/TCP (20/09/07)

LOCATION: Coal conveyor
X CO-ORD: +2 867 931.400
Y CO-ORD: +8 039.270
ELEVATION: 1 503.730m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	95								0	
	100									
	100								1	
	84	3	44	*	13 MPa				2	
	100	12	21							
				*	26 MPa				3	
	100		71						4	
NWD4	100	10	33						5	
				*	12 MPa				6	
	100		27						7	
	100		40						8	
		10							9	
	99		9						10	
	94		31						11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,40m Abundant sub-angular weathered shale GRAVELS in a matrix of orange-brown CLAYEY SAND; pebble marker.

0,40-1,47m Abundant sub-angular weathered shale GRAVELS and COBBLES and a matrix of pinkish brown and orange-brown CLAY-SILT; residual Rayton shale.

1,47-1,75m Yellowish brown streaked maroon, probably stiff to very stiff, jointed (stained black) CLAY-SILT with scattered sub-angular weathered shale GRAVELS; residual Rayton shale.

1,75-2,40m Pinkish brown, highly weathered, very fine grained, laminated, moderately fractured, very soft rock, RAYTON SHALE. Fractures are narrow to very wide, slightly to moderately rough, stained red and yellow and filled with yellowish brown clay-silt. Fractures dip sub-horizontally.

2,40-3,50m Pinkish brown banded dark brown, highly weathered, very fine grained, thinly laminated, highly fractured, soft rock RAYTON SHALE. Fractures are narrow to wide, slightly to moderately rough, stained orange and black and filled with orange-brown clay-silt. Fractures dip 15-20˚, 60-70˚ and sub-vertically.

3,50-6,90m Yellowish brown banded dark brown, moderately weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock RAYTON SHALE. Fractures are closed to wide, moderately rough to rough, stained black and orangeand filled with orange-brown CLAY-SILT.

6,90-12,15m Bluish grey banded dark grey, slightly to moderately weathered, very fine grained, thinly laminated, highly fractured, hard rock, RAYTON SHALE. Fractures are closed to narrow, moderately rough, stained orange and black and coated with silt and iron oxide. Fractures dip 10-15˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 4
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 07/09/07-10/09/07
LOGGED BY: JFR/JFR (12/09/07)

LOCATION:
X CO-ORD: +2 868 089.800
Y CO-ORD: +8 197.660
ELEVATION: 1 493.144
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100								2	
	100									
	96	32	0						3	
NWD4	100	>50	0						4	
	100	>50	0						5	
	100	41	0	*	30 MPa				6	
	100	43	0						7	
	100	33	0						8	
	100	36	7	*	21 MPa				9	
	100	36	0						10	
	100	49	0						11	
	100	38	0						12	
	100	43	0						13	
	100	>50	0						14	
	100	28	0						15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,60m Abundant red-brown streaked yellowish orange, medium and fine friable soft rock and very soft rock, weakly ferruginised, weathered shale GRAVELS, in a matrix of yellow brown SILTY SAND; ferruginised residual Rayton shale.

±0,60-3,95m Khaki banded yellowish orange and red- brown, very stiff to very soft rock, laminated, highly jointed (stained black and red), CLAYEY SILT; residual Rayton shale.

3,95-4,65m Khaki banded yellowish orange and red-brown, highly weathered, very fine grained, very thinly bedded, very soft rock (with numerous thin zones of soft rock) RAYTON SHALE. Fractures are very narrow to wide, slightly rough, stained red and black and filled with silt in places. Fractures dip predominantly at 0-10˚ (bedding plane separations) with occasional 50-70˚ dips.

4,65-8,20m Khaki banded red-brown and yellowish grey, highly weathered, very fine grained, thinly bedded to thinly laminated, very highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly rough, stained red and black and filled with silt in places. Fractures dip predominantly at 0-10˚ (bedding plane separations) with occasional 60-70˚ and 80-90˚ dips.

Note: 100mm wide zone of residual clayey silt at 6,50m.

8,20-19,70m Dark brown banded khaki and yellowish grey, moderately to highly weathered, very fine grained, very thinly bedded and laminated, highly fractured, hard rock, RAYTON SHALE, with zones of highly weathered very highly fractured, very soft rock/soft rock (with some residual silt) from 13,90-14,10m, 15,45-16,05m, 18,50-18,90m and 19,30-19,50m. Fractures are very narrow and narrow, slightly rough, stained black and red and filled with silt in places. Fractures dip predominantly at 10-15˚ (bedding plane separations) with occasional 50-60˚ and 70-90˚ dips.

19,70-27,04m Dark grey occasionally banded khaki and dark brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured (becomes less fractured with depth), very hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough, stained with iron oxide or cemented with calcite in places . Fractures dip at 20-30˚ (bedding plane separations), 50-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 4
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 07/09/07-10/09/07
LOGGED BY: JFR/JFR (12/09/07)

LOCATION:
X CO-ORD: +2 868 089.800
Y CO-ORD: +8 197.660
ELEVATION: 1 493.144
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	28	0						21	
	100	20	27						22	
	100	23	12						23	
	100	44	0						24	
	100	18	37						25	
	100	8	69	*	73 MPa				26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,70-27,04m Dark grey occasionally banded khaki and dark brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured (becomes less fractured with depth), very hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough, stained with iron oxide or cemented with calcite in places . Fractures dip at 20-30˚ (bedding plane separations), 50-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 5
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 28/08/07-03/09/07
LOGGED BY: JFR/JFR (05/09/07)

LOCATION: De-watering Plant
X CO-ORD: +2 867 611.290
Y CO-ORD: +7 906.980
ELEVATION: 1 516.160m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	81									
	100									
	100			⊥	43				2	
	100									
	93									
	40								3	
	39									
	90								4	
	49									
	69								5	
NWD4	100									
	100								6	
	100									
	100								7	
	100									
	100								8	
	100	8	52							
									9	
	100	5	33	*	4 MPa					
									10	
	100	4	81	*	4 MPa					
									11	
	100	7	52			WP	1 U.L. (V.F)			
									12	
	100	11	29							
									13	
	100	7	29	*	8 MPa					
									14	
	100	7	52			WP	1 U.L. (DIL.)			
									15	
	100	10	23							
									16	
	100	10	47							
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,84m Abundant coarse, medium and fine, hard gravels, in a matrix of brown SILTY SAND; pebble marker.

±0,84-±2,43m Red-brown mottled yellow and orange-brown probably stiff, weakly ferruginised CLAYEY SANDY SILT, with occasional medium and fine gravels and ferruginous concretions; weakly ferruginised residual Dwyka tillite.

±2,43-5,60m Yellowish orange blotched red-brown, probably stiff, CLAYEY SANDY SILT with occasional coarse, medium and fine, hard GRAVELS; residual Dwyka tillite.

5,60-10,20m Maroon blotched and banded yellow-brown, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.
Becomes clayey silt below 9,40m.

10,20-12,25m Buff, banded and blotched orange-brown, highly weathered, medium grained (with numerous hard clasts up to 50mm in diameter), moderately fractured, very soft rock, DWYKA TILLITE. Fractures are narrow, slightly rough and filled with red silt. Fractures dip at 30-40˚ and 80-90˚.

12,25-22,30m Orange-brown banded grey, dark brown and yellow-brown, highly weathered, very fine grained thinly and very thinly bedded, highly fractured very soft rock to soft rock DWYKA SHALE with 50-100mm thick ferruginised moderately hard rock horizons at 13,85m, 15,5m and 20,45m. Very highly fractured zones from 15,16-15,45m and 15,70-16,10m. Zones of refusal clay-silt from 18,25-18,65m and 18,9-19,35m. Fractures are narrow, slightly rough and stained with iron oxide. Fractures dip at 0-10˚ (bedding separations), 30-40˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 5
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 28/08/07-03/09/07
LOGGED BY: JFR/JFR (05/09/07)

LOCATION: De-watering Plant
X CO-ORD: +2 867 611.290
Y CO-ORD: +7 906.980
ELEVATION: 1 516.160m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	10	47	*	4 MPa	WP	18 U.L. (L.F.)		21	
	100	12	43						22	
	100	12	48							
	100	18	18	*	5 MPa				23	
	100	12	30			WP	0 U.L. (DIL.)		24	
	100	19	13						25	
				*	10 MPa					
	100	21	7			WP	8 U.L. (L.F.)		26	
	100	17	51						27	
									28	
	100	>50	0						29	
	100	10	26	*	15 MPa	WP	0,06 U.L. (DIL.)		30	
	100	2	96						31	
	100	10	56						32	
						WP	0,50 U.L. (DIL.)		33	
	100	5	74							
	100	6	75						34	
						WP	0 U.L.		35	
									36	
	100	5	92						37	
									38	
									39	
									40	

CORE DESCRIPTION

12,25-22,30m Orange-brown banded grey, dark brown and yellow-brown, highly weathered, very fine grained thinly and very thinly bedded, highly fractured very soft rock to soft rock DWYKA SHALE with 50-100mm thick ferruginised moderately hard rock horizons at 13,85m, 15,5m and 20,45m. Very highly fractured zones from 15,16-15,45m and 15,70-16,10m. Zones of refusal clay-silt from 18,25-18,65m and 18,9-19,35m. Fractures are narrow, slightly rough and stained with iron oxide. Fractures dip at 0-10˚ (bedding separations), 30-40˚ and 80-90˚.

22,30-29,59m Dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured (but with several very highly fractured zones from 24,00-24,50m, 25,75-26,00m, 26,30-26,60m, 26,80-27,16m and 27,80-29,50m), soft rock, DWYKA SHALE. Fractures are closed to narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-10˚ (bedding separations), 50-60˚ and 80-90˚.

29,59-31,95m Dark grey, slightly weathered, very fine grained, very thinly bedded, moderately and highly fractured, moderately hard rock DWYKA SHALE. Fractures are closed, slightly rough and clean. Fractures dip at 0-10˚ (bedding separations).

31,95-33,75m Pale grey banded dark grey, slightly weathered, very fine grained, very thinly bedded, moderately and highly fractured, hard rock, DWYKA SHALE, with hard rock granite clast from 32,90-33,60m. Fractures are closed to narrow, slightly rough and cemented with calcite. Fractures dip at 10-15˚ (bedding separations).

33,75-37,55m Greenish grey banded dark grey, unweathered, very fine grained, very thinly bedded, moderately and highly fractured, very hard rock, RAYTON SHALE. Fractures are closed to very narrow, slightly and moderately rough and cemented with calcite. Fractures dip at 15-20˚ (bedding plane separations).

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 6
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 30/09/07-03/09/07
LOGGED BY: JFR/JFR (04/09/07)

LOCATION: Limestone Silo
X CO-ORD: +2 867 667.800
Y CO-ORD: +7 956.470
ELEVATION: 1 514.679m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								0		0,00-±0,75m Abundant coarse, medium and fine hard GRAVELS, in a matrix of red-brown CLAYEY SANDY SILT; residual Dwyka tillite.
	100										
	100								1		±0,75-±1,63m Red-brown mottled yellowish orange, probably stiff CLAYEY SILT; residual Dwyka tillite.
	100			⊣	50				2		±1,63-±2,90m Yellowish orange blotched red-brown, probably stiff CLAYEY SANDY SILT, with occasional medium and fine GRAVELS; residual Dwyka tillite.
	100										
	100								3		±2,90-6,20m Yellowish brown banded maroon and yellowish grey, probably very stiff, laminated and jointed CLAYEY SILT; residual Dwyka shale.
	100								4		
	100								5		
	100								6		
NWD4	96	6	48	*	4 MPa				7		6,20-6,55m Yellow-brown speckled yellowish orange, probably very dense, SILTY SAND, with scattered hard, coarse medium and fine GRAVELS; residual Dwyka tillite.
	100	7	49						8		6,55-6,70m Buff blotched red-brown, moderately weathered, medium and fine grained (with numerous hard clasts up to 50mm in diameter), hard rock, DWYKA TILLITE. No fractures to describe.
	100	7	45	*	2 MPa				9		6,70-10,90m Yellowish orange banded pale grey and yellowish grey, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SILTSTONE. Fractures are very narrow, slightly rough and stained red and black. Fractures dip at 0-10˚, 40-50˚ and 80-90˚.
	100	6	63						10		
	100	8	54						11		10,90-15,55m Grey-brown banded yellowish orange, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very soft rock, DWYKA SHALE, with several zones of residual very stiff clay-silt with a total length of 950mm. Fractures are very narrow, slightly rough and stained red and black. Fractures dip at 0-10˚, 40-50˚ and 80-90˚.
	100	14	26						12		
	100	7	47						13		
	95	5	44						14		
	100	7	70	*	2 MPa				15		15,55-18,63m Greenish grey banded yellowish orange, maroon and dark grey, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured very soft rock, DWYKA SHALE. Fractures are very narrow, slightly rough and stained red and black. Fractures dip at 0-10˚, 40-50˚ and 80-90˚.
	100	7	67						16		Becomes soft rock below 18,05m.
	98	11	42						17		18,63-18,95m Yellowish orange banded pale grey, probably very stiff, laminated, jointed CLAYEY SILT; residual Dwyka shale.
									18		18,95-19,35m Buff blotched pale grey and dark grey, highly weathered medium and fine grained (with numerous hard clasts up to 50mm diameter), highly fractured, very soft rock, DWYKA TILLITE. Fractures are narrow, slightly and moderately rough, stained orange-brown and filled with silt in places. Fractures dip at 10-20˚ and 40-50˚.
									19		19,35-22,00m See next page for description.
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 6
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 30/08/07-03/09/07
LOGGED BY: JFR/JFR (04/09/07)

LOCATION: Limestone Silo
X CO-ORD: +2 867 667.800
Y CO-ORD: +7 956.470
ELEVATION: 1 514.679m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	7	69	*	25 MPa				21	
	100	13	26						22	
	100	9	60	*	44 MPa				24	
	100	10	50						26	

CORE DESCRIPTION

19,35-22,00m Buff blotched dark grey and red, slightly weathered, medium and fine grained (with numerous hard clasts up to 100mm in diameter) highly fractured, hard rock DWYKA TILLITE. Fractures are narrow, slightly and moderately rough and stained orange-brown and dark brown. Fractures dip at 10-20˚, 40-50˚ and 80-90˚.

22,00-26,17m Greenish grey banded dark grey, slightly weathered, very fine grained, very thinly bedded, hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 10-20˚ (bedding plane separations), 60-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 7
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 19/09/07-20/09/07
LOGGED BY: JFR/JFR (21/09/07)

LOCATION: Auxiliary Building
X CO-ORD: +2 867 820.050
Y CO-ORD: +8 118.580
ELEVATION: 1 505.432m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	-	-						0	
	71	16	0							
	100	13	38	*	20 MPa				1	
	100	12	42	*	24 MPa				2	
	92	20	24						3	
	100	13	40							
	100	10	49	*	23 MPa				4	
	100	15	37						5	
	100	17	27						6	
	100	12	53						7	
	100	5	81						8	
	100	9	55	*	41 MPa				9	
	100	9	71						10	
NWD4	100	19	9	*	28 MPa				11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,24m Abundant coarse, medium and fine hard quartzite GRAVELS, in a matrix of yellow-brown SILTY SAND; pebble marker.

0,24-1,50m Pinkish purple banded yellowish orange, highly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are wide, slightly and moderately rough and filled with clayey silt. Fractures dip at 10-15˚ and 20-30˚.

1,50-3,35m Maroon banded khaki, highly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are wide (but very wide in places - up to 100mm) and filled with clayey silt. Fractures dip at 15-20˚ (bedding plane separations), 40-50˚ and 70-80˚.

3,35-9,45m Dark brown banded yellowish orange and maroon, moderately weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are generally narrow to very narrow (but very occasionally very wide - 10mm- and filled with clayey silt), slightly rough to rough and stained black and orange. Fractures dip at 10-20˚ (bedding plane separations), 60-70˚ and 80-90˚.

9,45-16,54m Greenish grey banded greyish green and maroon, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 10-20˚ (bedding plane separations), 60-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 9
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 11/09/07-13/09/07
LOGGED BY: JFR/JFR (14/09/07)

LOCATION: Limestone Silo
X CO-ORD: +2 868 023. 520
Y CO-ORD: +8 312.130
ELEVATION: 1 493.874m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								0		0,00-0,60m Orange-brown CLAYEY SAND; hillwash.
	87								1		0,60-±5,00m Red-brown mottled orange and yellow brown, probably firm CLAY-SILT with occasional weathering spheroids of very hard rock diabase up to 400mm in diameter; residual diabase.
	100										
	100			SPT	23				2		
	100										
	100			SPT	9				3		
	100										
	100			SPT	16				4		
	100										
	34								5		±5,00-8,50m Yellowish orange speckled buff and black, probably dense, jointed (stained red and black) SANDY SILT; residual diabase.
	70								6		
	100										
	100			SPT	34				7		
	45								8		
NWD4	100	15	0								
	100	15	64						9		8,50-11,40m Dark brown speckled buff and yellowish orange, highly weathered, medium grained, highly fractured, very soft rock DIABASE, with a number of thin horizons (up to 100mm thick and comprising up to 10% by volume) of residual sandy clay and several hard rock corestones from 50-200mm in diameter. Fractures very narrow to wide, moderately rough, stained black and filled with silt in places. Fractures dip at 0-20˚, 30-40˚ and 70-80˚.
	94	32	0						10		
	76	24	0								
	100	30	13						11		11,40-14,90m Dark grey mottled dark brown and orange-brown, moderately weathered, medium grained, highly fractured, hard rock and very hard rock, DIABASE, with several zones up to 200mm thick (and comprising ±20% by volume) of highly weathered soft rock and moderately hard rock diabase. Fractures very narrow to wide, moderately rough, stained black and filled with silt in places. Fractures dip at 0-20˚, 30-40˚ and 70-80˚.
	100	32	0						12		
	90	19	0								
	100	18	0						13		
	100	15	14						14		
	100	15	50						15		14,90-16,90m Dark grey occasionally mottled dark brown and orange-brown, slightly weathered, medium grained, highly fractured, very hard rock to extremely hard rock DIABASE. Fractures very narrow and narrow, slightly and moderately rough, stained orange and black and filled with silt in places. Fractures dip at 0-20˚, 30-40˚ and 80-90˚.
	100	12	0						16		
	100	>50	0						17		16,90-22,50m Dark brown banded khaki and yellowish grey, moderately to highly weathered, very fine grained, laminated, very highly fractured, hard rock, RAYTON SHALE. Fractures very narrow and narrow, slightly and moderately rough, stained with iron oxide and filled with silt in places . Fractures dip predominantly at 10-15˚ (bedding plane separations) with occasional 50-60˚ and 80-90˚ dips.
	100	>50	0						18		
									19		Becomes highly fractured below 21,10m.
	100	>50	0						20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 9
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 11/09/07-13/09/07
LOGGED BY: JFR/JFR (14/09/07)

LOCATION: Limestone Siloß
X CO-ORD: +2 868 023. 520
Y CO-ORD: +8 312.130
ELEVATION: 1 493.874m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	>50	0						21	
	100	>50	0							
	100	18	10						22	
	100	17	21						23	
	100	14	43						24	
				*	106 MPa				25	
	100	15	34						26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

16,90-22,50m Dark brown banded khaki and yellowish grey, moderately to highly weathered, very fine grained, laminated, very highly fractured, hard rock, RAYTON SHALE. Fractures very narrow and narrow, slightly and moderately rough, stained with iron oxide and filled with silt in places . Fractures dip predominantly at 10-15˚ (bedding plane separations) with occasional 50-60˚ and 80-90˚ dips.

Becomes highly fractured below 21,10m.

22,50-27,06m Dark grey banded greenish grey, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very hard rock, RAYTON SHALE. Fractures very narrow to narrow, slightly to moderately rough, stained with iron oxide and cemented with calcite in places. Fractures dip predominantly at 10-15˚ (bedding separations), with occasional 80-90˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 10
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 14/09/07-15/09/07
LOGGED BY: TCP/TCP (19/09/07)

LOCATION: Water tank
X CO-ORD: +2 868 073.010
Y CO-ORD: +8 368.700
ELEVATION: 1 491.020m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	92								0		0,00-0,73m Orange-brown, probably stiff, CLAYEY SAND with scattered fine ferruginous CONCRETIONS; hillwash.
	43								1		0,73-3,10m Orange-brown speckled yellow and black, probably stiff SANDY CLAY-SILT with scattered fine ferruginous CONCRETIONS; residual diabase.
	100										
	100			↓	N20				2		
	32										
	100								3		
	100										3,10-5,70m Yellowish brown speckled buff and black, jointed (stained black), probably dense, micaceous SILTY SAND with zones up to 30cm wide of clayey residuum as above; residual diabase.
	100			↓	N40				4		
	13										
	100										
	100			↓	N43				5		
	61										
NWD4	100		100	✻	206 MPa				6		5,70-11,82m Dark bluish grey speckled dark grey, slightly weathered, medium textured, highly fractured, extremely hard rock, DIABASE. Fractures are closed to narrow, slightly rough to rough, stained black and coated with chlorophaeite or cemented by calcite. Fractures dip sub-horizontally, 20-30˚, 60˚ and sub-vertically.
	100		100								
	100	6	63						7		
	100		24						8		
	100		57	✻	197 MPa				9		
									10		
									11		
									12		
									13		
									14		
									15		
									16		
									17		
									18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 11
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 18/09/07-20/09/07
LOGGED BY: TCP/TCP (21/09/07)

LOCATION: Chimney
X CO-ORD: +2 867 740.309
Y CO-ORD: +8 002.103
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								1		0,00-1,00m Abundant sub-rounded weathered GRAVELS and ferruginous CONCRETIONS in a matrix of reddish brown CLAYEY SAND; pebble marker.
	93										1,00-4,50m Orange-brown blotched maroon and speckled black, probably stiff to very stiff, SANDY CLAY-SILT; residual Dwyka siltstone.
	79										
	100								2		
	100			⊥	N49						
	100								3		
	92										
	100								4		
NWD4	98	4	92						5		4,50-12,19m Yellowish brown banded dark brown and blotched grey, highly weathered, very fine grained, laminated, moderately fractured, very soft rock, DWYKA SILTSTONE. Fractures are narrow to wide, moderately rough, stained black and filled with grey and reddish brown clay-silt. Fractures dip sub-horizontally, 15-20˚, and 60-70˚. Contains a few very wide fractures (up to 60mm wide) containing residual soil.
	100		83						6		
	100		64						7		
	100		50						8		
	97		65						9		
	100	-	53						10		
	100		43						11		
	100	6	25						12		12,19-12,59m Pale grey blotched dark grey and yellowish brown, probably very stiff, CLAYEY SILT; residual Dwyka siltstone.
	100		53						13		12,59-16,80m Yellowish brown blotched maroon and grey, highly weathered, very fine grained, laminated, highly fractured, very soft rock and soft rock DWYKA SILTSTONE. Fractures are narrow to wide, stained orange and black and filled with orange and grey clayey silt. Fractures dip sub-horizontally, 15-20˚, 45˚ and 60-70˚. Zone of probably very stiff residual soil from 14,45-14,87m.
	100		91	* ⊥ UCS	13 MPa 19 MPa				14		
	99	9	47						15		
	100		79						16		
									17		16,80-20,07m Pale grey banded grey and yellowish brown, moderately weathered, fine grained, highly fractured, moderately hard rock, DWYKA SILTSTONE. Fractures are closed to narrow, moderately rough, stained orange and black and coated with yellow-grey silt and iron oxide. Fractures dip 15-20˚, 45˚ and sub-vertically.
									18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 11
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 18/09/07-20/09/07
LOGGED BY: TCP/TCP (21/09/07)

LOCATION: Chimney
X CO-ORD: +2 867 740.309
Y CO-ORD: +8 002.103
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	5	79	*	71 MPa				21	
	100		55						22	
	100		77	UCS	55,0 MPa				23	
	100		56						24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,07-25,42m Pale grey blotched dark grey and pink, slightly weathered, fine grained (but with very coarse clasts), highly fractured, hard to very hard rock, DWYKA TILLITE. Fractures are closed to narrow, stained orange and black, rough and crated with silt and iron oxide. Fractures dip 15-20° and 45°.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 12
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 04/09/07-07/09/07
LOGGED BY: JFR/JFR (10/09/07)

LOCATION: Chimney
X CO-ORD: +2 867 711.420
Y CO-ORD: +8 046.540
ELEVATION: 1 511.305m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100									
	100									
	100								1	
	100			⊣	37					
	100								2	
	100									
	100								3	
	100									
	100								4	
	100									
	100								5	
	100									
	100								6	
	100									
	100								7	
	100									
	100								8	
	100									
	100								9	
	100									
	100								10	
	100									
	100								11	
	100									
	100								12	
	100	7	100							
	100	11	39	*	2 MPa				13	
	100	6	60							
	100	14	29	*	17 MPa				14	
	100	7	62	*	13 MPa					
	100	9	54						15	
									16	
									17	
									18	
									19	
									20	

NWD4

CORE DESCRIPTION

0,00-±0,62m Abundant coarse, medium and fine, soft to hard rock quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±0,62-2,30m Red-brown mottled orange-brown and yellow-brown, probably stiff, SANDY CLAYEY SILT, with occasional friable ferruginous CONCRETIONS and coarse medium and fine hard GRAVELS; residual Dwyka tillite.

2,30-8,60m Yellowish orange banded buff and pale grey, probably very stiff, laminated and jointed, CLAYEY SILT, with zones of red-brown ferruginised soft rock to moderately hard rock from 4,50-4,70m and 7,05-7,20m; residual Dwyka siltstone.

Becomes very stiff to very soft rock below 5,00m.

8,60-13,05m Yellowish orange banded maroon and grey, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.

13,05-15,90m Grey-brown banded yellowish orange, dark grey and maroon, highly weathered, very fine grained, thinly bedded, highly fractured very soft rock DWYKA SHALE with a zone of residual silty sand (tillite) from 15,25-15,55m and 50mm wide zones of ferruginised moderately hard rock at 13,05m, 13,40m and 14,95m. Fractures are very narrow, slightly rough and stained orange and red. Fractures dip at 0-10˚ (bedding plane separations), 20-30˚ and 40-50˚.

15,90-16,80m Yellowish grey banded yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, moderately hard rock, DWYKA SILTSTONE, with 50mm wide ferruginised hard rock zone at 16,25m. Fractures are very narrow and narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-10˚ and 20-30˚.

16,80-20,80m Yellow-brown blotched, dark grey, pale grey, greyish green and maroon, moderately to highly weathered, medium grained (with numerous hard clasts up to 60mm diameter), highly fractured, moderately hard rock DWYKA TILLITE, with zones of highly weathered, very highly fractured soft rock from 18,45-18,70m and 19,05-19,20m. Fractures very narrow and narrow, moderately rough and rough and stained with iron oxide. Fractures dip at 0-10˚, 20-30˚, 50-60˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 12
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 04/04/07-07/09/07
LOGGED BY: JFR/JFR (10/09/07)

LOCATION: Chimney
X CO-ORD: +2 867 711.420
Y CO-ORD: +8 046.540
ELEVATION: 1 511.305m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	5	66	*	14 MPa				21	
	100	2	93						22	
	100	<1	95						23	
	100	7	58						24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

See previous page for description.

20,80-24,99m Pale brownish grey, blotched dark grey, dark brown, maroon and greyish green, slightly weathered, medium grained (with numerous hard clasts up to 60mm diameter), slightly and moderately fractured, moderately hard rock DWYKA TILLITE. Fractures very narrow and narrow, moderately rough and rough and stained with iron oxides. Fractures dip at 0-10˚, 20-30˚, 50-60˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 13
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 15/09/07-18/09/07
LOGGED BY: JFR/JFR (21/09/07)

LOCATION: Chimney
X CO-ORD: +2 867 977.899
Y CO-ORD: +8 239.691
ELEVATION: 1 498.247m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100	-	-							
NWD4	100	>50	0						1	
	100	>50	0						2	
	100	>50	0						3	
	100	>50	0						4	
	100	>50	0						5	
	100	>50	0						6	
	100	>50	0						7	
	100	>50	0						8	
	100	>50	0						9	
	100	>50	0	✻	18 MPa				10	
	100	>50	0						11	
	100	>50	7						12	
	100	>50	0	✻	13 MPa				13	
	100	>50	0						14	
	100	>50	0	✻	20 MPa				15	
	100	>50	0						16	
	100	>50	0						17	
	100	26	12	✻	24 MPa				18	
	100	28	0						19	
	98	24	0	✻	50 MPa				20	

CORE DESCRIPTION

0,00-±0,30m Grey-brown SILTY SAND; hillwash.

±0,30-5,80m Yellowish orange banded dark brown and yellow-brown, highly weathered, very fine grained, laminated, very highly fractured, very soft rock, RAYTON SHALE. Fractures wide and very wide (up to 2cm), slightly rough and filled with residual clayey silt. Fractures dip at 5-15˚ (bedding plane separations), with several prominent 70-90˚ dips.

5,80-9,52m Khaki banded brown and yellow-brown, highly weathered, very fine grained, laminated, very highly fractured (with a few thin highly fractured zones), soft rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly rough, stained red and black and filled with clayey silt. Fractures dip at 5-15˚ (bedding plane separations) with several prominent 70-90˚ dips.

9,52-17,12m Khaki banded dark brown and greenish grey, highly weathered, very fine grained, laminated, very highly fractured (with several thin highly fractured zones), moderately hard rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly rough, stained red and black and filled with clayey silt. Fractures dip at 5-15˚ (bedding plane separations) with several prominent 70-90˚ dips.

17,12-25,53m Greenish grey banded dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained orange and black with iron oxide. Fractures dip at 10-15˚ (bedding plane separations) with occasional 60-70˚ and 80-90˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 13
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 15/09/07-18/09/07
LOGGED BY: JFR/JFR (21/09/07)

LOCATION: Chimney
X CO-ORD: +2867977.899
Y CO-ORD: +8239.691
ELEVATION: 1 498.247m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	98	24	0	*	32 MPa				21	
	100	17	7						22	
	95	19	10						23	
	100	22	17						24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

17,12-25,53m Greenish grey banded dark grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough, stained orange and black with iron oxide. Fractures dip at 10-15° (bedding plane separations) with occasional 60-70° and 80-90° dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 14
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 05/09/07-06/09/07
LOGGED BY: JFR/JFR (07/09/2007)

LOCATION: Chimney
X CO-ORD: +2 867 949.010
Y CO-ORD: +8 284.130
ELEVATION: 1 497.367m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100	>50	0							
NWD4	100	38	0						2	
	81	32	0						3	
	100	35	0						4	
	100	23	7	*	9 MPa				5	
	100	32	0						6	
	100	32	0	*	15 MPa				7	
	100	24	0						8	
	87	19	0						9	
	100	22	19	*	16 MPa				10	
	100	27	0						11	
	100	29	0						12	
	100	31	0	*	57 MPa				13	
	100	42	8						14	
	100	33	9						15	
	94	28	11	*	113 MPa				16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,12m Abundant coarse, medium and fine, angular, friable, weathered, very soft rock and soft rock shale GRAVELS in a matrix of yellow brown SANDY SILT; overall consistency probably dense; residual Rayton shale.

1,12-±2,10m Yellowish orange banded yellow-brown and orange-brown, highly weathered, very fine grained, laminated, very highly fractured, very soft rock, RAYTON SHALE. Fractures are very narrow and narrow, slightly rough and stained red and black. Fractures dip at 10-25˚ (bedding separations), 50-70˚ and 80-90˚.

±2,10-6,80m Khaki banded yellowish orange, highly weathered, very fine grained, very thinly bedded, highly fractured (with very highly fractured zones from 2,90-3,20m, 4,50-4,80m and 6,25-6,50m), soft rock (with several thin very soft rock zones) RAYTON SHALE. Fractures are very narrow and narrow, slightly rough and stained red and black. Fractures dip at 10-25˚ (bedding separations), 50-70˚ and 80-90˚.

No zones of very soft rock below 4,80m.

6,80-13,50m Dark brown banded khaki, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured (with very highly fractured zones from 10,30-10,80m and 12,75-12,90m), moderately hard rock RAYTON SHALE. Fractures very narrow and narrow, slightly and moderately rough, stained red and black and filled with red silt or cemented iron oxide. Fractures dip at 10-15˚ (bedding separations) and 70-90˚.

13,50-17,40m Dark brown banded yellowish grey, moderately weathered, very fine grained, thinly and very thinly bedded, highly fractured (with very highly fractured zones from 14,90-15,10m and 15,55-15,80m) hard rock, RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-15˚ (bedding separations) and 70-80˚.

17,40-22,45m Dark grey occasionally banded yellowish grey and dark brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very hard rock RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-15˚ (bedding separations) and 70-80˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 14
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 05/09/07-06/09/07
LOGGED BY: JFR/JFR (07/09/2007)

LOCATION: Chimney
X CO-ORD: +2 867 949.010
Y CO-ORD: +8 284.130
ELEVATION: 1 497.367m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	94	28	11						21	
	100	22	13						22	
	100	19	17						23	

CORE DESCRIPTION

17,40-22,45m Dark grey occasionally banded yellowish grey and dark brown, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very hard rock RAYTON SHALE. Fractures are very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-15˚ (bedding separations) and 70-80˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 21
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 04/09/07-11/09/07
LOGGED BY: JFR/JFR (12/09/07)

LOCATION: Fly Ash Cond. Plant S
X CO-ORD: -2 867 381
Y CO-ORD: -7 895
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	96									
NWD4	100			⊣	72				2	
	95									
	100								3	
	100									
	100								4	
	100									
	100								5	
	100									
	100								6	
	100									
	100								7	
	100									
	100								8	
	100									
	100								9	
	100	±1	92	*	4 MPa				10	
	100	3	62						11	
	100	3	71						12	
	100	3	71						13	
	100	4	82						14	
	100	5	66	*	5 MPa				15	
	100	7	61						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,50m Abundant coarse, medium and fine, hard, quartzite GRAVELS, in a matrix of brown SILTY SAND; pebble marker.

±1,50-2,70m Red-brown mottled yellowish orange, probably very dense, weakly ferruginised, slightly CLAYEY SANDY SILT, with occasional medium and fine soft rock GRAVELS; weakly ferruginised residual Dwyka tillite.

2,70-4,55m Maroon blotched yellow-brown, probably very stiff CLAY-SILT; residual Dwyka shale.

4,55-9,35m Yellowish orange and buff, probably very dense (with a few 100-200mm thick zones of very soft rock and soft rock), SILTY SAND, with occasional hard GRAVELS (clasts) up to 60mm diameter; residual Dwyka tillite.

9,35-14,65m Buff mottled yellowish orange and blotched pale grey and red brown, highly weathered, fine grained (with scattered hard clasts up to 60mm in diameter), moderately fractured, very soft rock, DWYKA TILLITE. Fractures are very narrow, slightly rough and filled with silt. Fractures dip at 0-15˚ and 50-70˚.

14,65-26,25m Yellowish orange banded yellow-brown, dark brown, pale grey and maroon, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA SILTSTONE with a 200mm thick moderately hard rock ferruginised zone at 20,70m. Fractures are very narrow and narrow, slightly and moderately rough, stained with iron oxide or filled with cemented iron oxide. Fractures dip at 10-20˚ (bedding plane separations), 40-50˚ and 70-80˚.

Note: Becomes very soft rock below 20,85m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 21
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 04/09/07-11/09/07
LOGGED BY: JFR/JFR (12/09/07)

LOCATION: Fly Ash Cond. Plant S
X CO-ORD: -2 867 381
Y CO-ORD: +7 895
ELEVATION: -
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	12	22	*	3 MPa				21	
	100	3	79						22	
	100	5	82						23	
	100	9	34						24	
	100	5	86						25	
	100	10	41						26	
	100	8	53						27	
	100	6	66						28	
	100	5	68						29	
	100	11	36						30	
	100	13	7						31	
	100	4	80						32	
	100	5	53						33	
	100	12	35						34	
	100	12	39						35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

14,65-26,25m Yellowish orange banded yellow-brown, dark brown, pale grey and maroon, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA SILTSTONE with 200mm thick moderately hard rock ferruginised zone at 20,70m. Fractures are very narrow and narrow, slightly and moderately rough, stained with iron oxide or filled with cemented iron oxide. Fractures dip at 10-20˚ (bedding plane separations), 40-50˚ and 70-80˚.

Note: Becomes very soft rock below 20,85m.

26,25-31,20m Pale grey banded orange brown and maroon, probably very stiff, bedded and jointed, CLAY-SILT; residual Dwyka shale.

31,20-34,60m Yellowish grey, occasionally banded orange-brown, moderately weathered, very fine grained, very thinly and thinly bedded, highly fractured, soft rock, DWYKA SHALE. Fractures are very narrow and narrow, slightly and moderately rough, stained with iron oxide and filled with silt in places. Fractures dip at 10-15˚ (bedding separations) and 40-60˚.

Note: 200mm wide, moderately hard rock, ferruginised zone at 32,30m.

34,60-36,35m Dark grey, slightly weathered, fine grained, medium bedded, moderately fractured, moderately hard rock, DWYKA SANDSTONE. Fractures are closed, moderately rough and clean. Fractures dip at 0-10˚ and 20-30˚.

36,35-38,30m Dark grey to black, slightly weathered, very fine grained, thinly bedded, highly fractured, soft rock, carbonaceous DWYKA SHALE. Fractures are closed, slightly rough and clean. Fractures dip at 0-10˚ and 40-50˚.

38,30-40,62m Greenish grey banded yellow and orange-brown, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE, with a zone of moderately hard rock Dwyka tillite from 39,90-40,40m. Fractures are very narrow, slightly rough and stained with iron oxide. Fractures dip at 20-30˚ (bedding plane separations) and 40-50˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 23
Sheet 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 13/09/07-15/09/07
LOGGED BY: TCP/TCP (20/09/07)

LOCATION: Precipitator
X CO-ORD: +2 867 620.700
Y CO-ORD: +8 121.710
ELEVATION: 1 511.598m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	97								1	
	73									
	66									
NWD4	100								2	
	100			↓	33					
	92								3	
	90									
	100								4	
	99		13	*	4 MPa				5	
	100	6	88						6	
	99		41						7	
	93	-	-						8	
	97		-	UCS	2,5 MPa				9	
	99	7	49						10	
	97		63	*	2 MPa				11	
	100	3	88						12	
	99		88						13	
	100	4	58						14	
	100		94	*	150 MPa				15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,50m Abundant sub-rounded weathered quartzite GRAVELS and ferruginous CONCRETIONS in a matrix of reddish brown SILTY SAND; pebble marker.

1,50-2,60m Orange-brown, probably stiff, SANDY CLAY-SILT with occasional ferruginous CONCRETIONS and gravel-sized clasts; residual Dwyka tillite.

2,60-5,66m Yellowish brown blotched pale grey and maroon, probably very stiff, CLAY-SILT with zones up to 200mm wide of sandy silt and occasional hard rock gravel-sized weathered quartzite clasts; residual Dwyka tillite. Exhibits slaking properties.

5,66-8,88m Pale yellowish brown blotched pale and dark grey, highly weathered, very fine grained (but with occasional very coarse clasts), highly fractured, very soft rock, DWYKA TILLITE. Fractures are narrow to wide, rough, stained orange and black and filled with yellow and grey clay-silt. Fractures dip mainly sub-horizontally. Exhibits slaking properties.

8,88-11,90m Pale grey banded dark grey and blotched orange and maroon, probably very stiff, jointed (stained orange and black), CLAY-SILT; residual Dwyka shale.

11,90-14,00m Pale yellowish brown blotched pale and dark grey, highly weathered, very fine grained (but with occasional very coarse clasts), highly fractured, very soft rock, DWYKA TILLITE. Fractures are narrow to wide, rough, stained orange and black and filled with yellow and grey CLAY-SILT. Fractures dip mainly sub-horizontally. Exhibits slaking properties. Includes 60˚ fracture set.

14,00-16,80m Yellowish brown and pale grey blotched dark grey, moderately weathered, fine grained (but with very coarse clasts), moderately fractured, hard rock, DWYKA TILLITE. Fractures are closed to narrow, rough, stained black and orange and coated with iron oxide. Fractures dip sub-horizontally and 30˚.

16,80-20,94m Pale grey blotched dark grey and pink, slightly weathered, fine grained (but with very coarse clasts), moderately fractured, very hard rock, DWYKA TILLITE. Fractures are closed to narrow, rough, stained orange and black and coated with iron oxide. Fractures dip 20-30˚, 60˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 24
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 10/09/07-12/09/07
LOGGED BY: JFR/JFR (13/09/07)

LOCATION: Precipitator
X CO-ORD: +2 867 699.890
Y CO-ORD: +8 200.900
ELEVATION: 1 507.164m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100 / 73								0	
	85	13	18						1	
NWD4	100	17	0						2	
	100	17	27						3	
	100	17	37	*	15 MPa				4	
	100	21	0						5	
	100	16	30						6	
	100	12	56						7	
	100	9	58	*	17 MPa				8	
	100	18	28						9	
	100	14	45						10	
	100	22	22	*	26 MPa				11	
	100	19	20						12	
	100 / 100	50 / 16	0 / 21	*	37 MPa				13	
	100	18	46						14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,80m Abundant, hard, coarse, medium and fine quartzite GRAVELS in a matrix of yellow-brown SILTY SAND; pebble marker.

±0,80-2,20m Maroon banded yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock, RAYTON SHALE. Fractures are very narrow to wide, slightly and moderately rough, stained red and black and filled with silt in places. Fractures dip at 15-20˚ and 80-90˚.

2,20-4,45m Maroon banded grey brown, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow and narrow, slightly and moderately rough, stained red and black and filled with silt in places. Fractures dip at 15-20˚ (bedding plane separations), with occasional 80-90˚ dips.

4,45-12,36m Grey brown and khaki banded maroon, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly and moderately rough, stained brown and black and filled with silt in places. Fractures dip at 15-20˚ (bedding plane separations) with occasional 60-70˚ and 80-90˚ dips.

12,36-18,10m Greenish grey banded dark grey and occasionally maroon and khaki, slightly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow to narrow, slightly and moderately rough, stained brown and black and filled with silt in places. Fractures dip at 15-20˚ (bedding plane separations) with occasional 60-70˚ and 80-90˚ dips.

Note: Very highly fractured zone from 15,38-15,50m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 25
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 18/09/07-19/09/07
LOGGED BY: TCP/TCP (20/09/07)

LOCATION: Precipitator
X CO-ORD: +2 867 778.880
Y CO-ORD: +8 280.300
ELEVATION: 1 503.434m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	95								1	
	83									
	100									
	83									
NWD4	90	10	24						2	
	100	8	55							
	100		16						3	
									4	
	100		87	*	15 MPa				5	
									6	
	100		65						7	
	100	15 to 20	8	*	18 MPa				8	
									9	
	94		0						10	
	100		22						11	
	99		0						12	
									13	
	100	15 to 20	9						14	
	97		59						15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,15m Abundant sub-angular weathered shale GRAVELS densely packed in a matrix of yellowish brown SILTY SAND; pebble marker.

1,15-1,50m Scattered deeply weathered GRAVELS and COBBLES of soft rock Rayton shale in a matrix of reddish brown SANDY CLAY-SILT; residual Rayton shale.

1,50-2,60m Pinkish brown, highly weathered, very fine grained, laminated, highly fractured, very soft rock, RAYTON SHALE. Fractures are closed to wide, slightly and moderately rough, stained yellow and black and filled with orange-brown clay-silt. Fractures dip sub-horizontally and sub-vertically.

2,60-5,80m Pale pinkish brown banded dark brown, highly weathered, very fine grained, thinly laminated, highly fractured, soft rock, RAYTON SHALE. Fractures are closed to wide, slightly to moderately rough, stained yellow and black and filled with orange-brown clay-silt. Fractures dip sub-horizontally, 60˚ and sub-vertically.

5,80-11,30m Greyish brown banded dark grey, moderately weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are closed to narrow (occasionally wide), stained orange and black, slightly to moderately rough and coated with grey clay-silt and iron oxide. Fractures dip 20-30˚, 60˚ and sub-vertically.

11,30-15,81m Bluish grey banded dark grey, slightly weathered, very fine grained, thinly laminated, highly fractured, hard rock, RAYTON SHALE. Fractures are closed to narrow, slightly to moderately rough, stained yellow and black and coated with silt and iron oxide. Fractures dip 20-30˚, 60˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 26
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 20/09/07-21/09/07
LOGGED BY: JFR/JFR (24/09/07)

LOCATION: Precipitator
X CO-ORD: +2 867 858.070
Y CO-ORD: +8 359.500
ELEVATION: 1 499.394m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	92								1	
	100									
	98	>50	0						2	
	98	>50	0							
	100	32	0						3	
	100	38	0							
	88	>50	0						4	
	100	42	0							
NWD4	100	25	0	*	35 MPa				5	
	99	33	0						6	
	100	35	0							
	100	34	7						7	
	100	25	0	*	23 MPa				8	
	100	19	9							
	100	32	0						9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,00m Abundant coarse, medium and fine, angular weathered soft rock shale GRAVELS in a matrix of yellowish orange CLAYEY SILT; residual Rayton shale.

±1,00-±2,10m Yellowish orange banded orange and yellow-brown, highly weathered, very fine grained, very thinly bedded, very highly fractured, very soft rock, RAYTON SHALE, with several zones up to 200mm wide of residual clayey silt. Fractures are narrow, slightly rough and filled with silt. Fractures dip at 15-20˚ (bedding plane separations) with occasional 80-90˚ dips.

±2,10-3,65m Yellowish orange banded orange and yellow-brown, highly weathered, very fine grained, very thinly bedded, highly fractured (very highly fractured below 3,55m), very soft rock to soft rock, RAYTON SHALE. Fractures are narrow, slightly rough and filled with silt. Fractures dip at 15-20˚ (bedding plane separations) with occasional 80-90˚ dips.

3,65-4,60m Yellowish orange banded dark brown, highly weathered, very fine grained, very thinly bedded, very highly fractured (highly fractured below 4,00m), soft rock, RAYTON SHALE. Fractures narrow, slightly rough, stained black and filled with clay-silt in places. Fractures dip at 15-20° (bedding plane separations) with occasional 80-90° dips.

4,60-10,60m Yellowish orange banded dark brown and grey-brown, highly weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are narrow to wide, slightly and moderately rough, stained black and filled with clay-silt. Fractures dip at predominantly at 15-20˚ (bedding plane separations) with several prominent 70-90˚ dipping fractures.

10,60-15,13m Khaki banded yellowish grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures narrow to wide, slightly and moderately rough, stained black and filled with clay-silt. Fractures dip at predominantly at 15-20˚ (bedding plane separations) with several prominent 70-90˚ dipping fractures.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 27
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drillimg
MACHINE: XY-42
DRILLING DATES: 21/09/07
LOGGED BY: TCP/TCP (24/09/07)

LOCATION: Precipitator
X CO-ORD: +2 867 937.270
Y CO-ORD: +8 438.700
ELEVATION: 1 495.229
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	80								1	
	100									
	91									
	100			⊣	N19				2	
	78									
	100								3	
	99		10							
	100	20 to 15	17						4	
	100		47						5	
	100		84	✻	281 MPa				6	
	100		95						7	
NWD4	99	3	81						8	
	98		46						9	
	100		82						10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-2,00 Reddish brown, probably firm, intact, CLAY-SILT; residual diabase.

2,00-4,25m Yellowish and olive-brown speckled orange and black, probably dense to very dense, SILTY SAND containing boulders up to 0,60m in diameter of very soft/soft rock diabase; residual diabase.

4,25-7,02 Bluish grey speckled dark grey and blotched yellowish grey, moderately weathered, medium textured, highly fractured, very hard rock DIABASE. Fractures are closed to wide, rough, stained yellow and black and filled with orange-brown sandy clay. Fractures dip sub-horizontally, 45˚, 60-70˚ and sub-vertically.

7,02-13,40m Bluish grey speckled dark grey, unweathered, medium textured, moderately fractured, extremely hard rock DIABASE. Fractures are closed to narrow (but one very wide and filled with orange-brown sandy clay at 7,92 -7,98m), moderately rough, stained yellow and black and coated with chlorophaeite and calcite crystals. Fractures dip sub-horizontally, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 28
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-2B
DRILLING DATES: 28/08/07-04/09/07
LOGGED BY: JFR/JFR (06/09/07)

LOCATION: Fly Ash Con. Plant
X CO-ORD: +2 868 051.180
Y CO-ORD: +8 565.200
ELEVATION: 1 490.604m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	89								0	
	100									
	100								1	
	100			⊥	50					
	100								2	
	100									
	73								3	
NWD4	91	9	18							
	92	16	0						4	
	94	16	29							
	67	16	0						5	
	93	8	64							
	93	6	61						6	
				*	241 MPa					
	100	±1	95						7	
	100	<1	97							
	100	<1	100						8	
	100	<1	97							
	100	2	100						9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,40m Red-brown SANDY CLAY, with occasional hard diabase BOULDERS up to 200mm diameter; hillwash.

±0,40-±1,00m Red-brown mottled orange-brown and occasionally black, probably stiff, SANDY CLAY-SILT, with scattered fine friable ferruginous CONCRETIONS; reworked residual Diabase.

±1,00-±2,00m Orange-brown speckled yellow-brown and black, probably dense, jointed SANDY SILT; residual Diabase.

±2,00-3,50m Orange-brown speckled yellow-brown and black, probably very dense, jointed (stained red and black), SILTY SAND; residual diabase.

3,50-7,00m Dark brown speckled black and khaki, highly weathered, medium grained, highly fractured, very soft rock, DIABASE, with several 50 to 600mm diameter corestones of very hard rock diabase, comprising a total length of 1,30m. Fractures are very narrow and narrow, slightly and moderately rough, stained orange and black and filled with silt in places. Fractures have multiple dip angles.

7,00-13,33m Dark grey speckled pale grey and black, unweathered, medium grained, very slightly and slightly fractured, very hard rock to extremely hard rock DIABASE. Fractures are closed to very narrow, moderately rough and rough and cemented with calcite. Fractures dip at 0-15˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 29
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 04/09/07-08/09/07
LOGGED BY: JFR/JFR (10/09/07)

LOCATION:
X CO-ORD: +2 867 328.500
Y CO-ORD: +7 993.840
ELEVATION: 1 510.777m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100									
	87								1	
	100			I	53				2	
	85								3	
	90								4	
	82								5	
	100								6	
NWD4	100								7	
	100								8	
	85								9	
	66								10	
	82								11	
	100	3	79	*	2 MPa				12	
	100	8	69						13	
	100	7	71						14	
	100	5	81						15	
	100	7	59	*	3 MPa				16	
	100	7	58						17	
	100	4	62	*	3 MPa				18	
	100	7	66						19	
									20	

CORE DESCRIPTION

0,00-±0,70m Abundant coarse, medium and fine hard quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±0,70-±2,30m Red-brown mottled yellowish orange and orange-brown, probably stiff to very stiff, weakly ferruginised, CLAYEY SANDY SILT, with occasional coarse medium and fine hard GRAVELS (clasts); weakly ferruginised residual Dwyka tillite.

±2,30-11,00m Purplish brown blotched yellow-brown, probably very stiff, CLAYEY SILTY SAND, with scattered coarse medium and fine hard gravels (clasts); residual Dwyka tillite.
Becomes yellowish orange mottled red-brown and below 10,50m.

11,00-14,85m Yellow-brown banded maroon, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SHALE. Fractures very narrow and narrow, slightly rough and stained with iron oxide. Fractures dip at 0-10˚ (bedding plane separations), 40-50˚ and 70-80˚.

14,85-21,00m Buff banded yellowish orange, highly weathered, medium grained (with numerous hard clasts up to 60mm in diameter), highly fractured, very soft rock (but soft rock to medium hard rock from 14,85-15,25m, 19,25-19,45m and 19,85-20,10m) DWYKA TILLITE, with zones of very fine grained, very soft rock, siltstone, up to 600mm thick below 18,00m. Fractures very narrow to narrow, slightly and moderately rough and filled with cemented iron oxide. Fractures dip at 0-10˚ (bedding plane separations); 40-50˚ and 70-80˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 29
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 04/09/07-08/09/07
LOGGED BY: JFR/JFR (10/09/07)

LOCATION:
X CO-ORD: +2 867 328.500
Y CO-ORD: +7 993.840
ELEVATION: 1 510.777m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	7	66						21	
	98	9	44	*	6 MPa				22	
	100	6	58						23	
	100	9	57						24	
	100	10	57	*	5 MPa				25	
	100	8	63						26	
	100	9	63						27	
	100	6	73	*	8 MPa				28	
	100	7	68						29	
	100	8	66						30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

See previous page for description

21,00-29,25m Orange-brown banded yellow-brown, dark brown and pale grey, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA SILTSTONE, with zones of medium to fine grained, soft rock to medium hard rock sandstone from 21,70-22,15m and 23,95-24,90m. Fractures very narrow to narrow, slightly and moderately rough and filled with cemented iron oxide. Fractures dip at 0-10˚ (bedding plane separations), 40-50˚ and 70-80˚.

29,25-34,54m Dark grey banded yellowish orange and dark brown, moderately weathered, very fine grained, thinly and very thinly bedded, moderately fractured, soft rock DWYKA SHALE. Fractures very narrow to narrow, slightly and moderately rough and filled with cemented iron oxide. Fractures dip at 0-10˚ (bedding plane separations), 20-30˚, 50-60˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 30
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 28/08/07-03/09/07
LOGGED BY: JFR/JFR (04/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 473.660
Y CO-ORD: +8 110.320
ELEVATION: 1 512.049m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100								1	
NWD4	100			⊥	52				2	
	100									
	100								3	
	77									
	90								4	
	100									
	100								5	
	100									
	100	7	30						6	
	100	3	73	*	2 MPa				7	
	88	10	32							
	90	7	79						8	
	100	7	76							
	100	-	-						9	
	100	11	24	*	2 MPa					
	100	10	53						10	
NWD4	85	12	17							
	100	9	43						11	
	88	33	22							
	100	9	41						12	
	95	15	46	*	4 MPa					
	100	14	35						13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,60m Abundant coarse, medium and fine, hard quartzite GRAVELS in a matrix of orange-brown SILTY SAND; pebble marker.

0,60-±1,40m Red-brown mottled yellowish orange, probably stiff, CLAYEY SANDY SILT, with scattered fine and medium ferruginous concretions and miscellaneous gravels; weakly ferruginised residual Dwyka tillite.

±1,40-5,07m Red-brown blotched yellow-brown and yellowish orange, probably very stiff, CLAYEY SANDY SILT with scattered hard gravels up to 50mm in diameter; residual Dwyka tillite.

5,07-7,00m Maroon banded yellow-brown and yellowish grey, very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.

7,00-7,80m Buff blotched yellowish orange, highly weathered, medium grained (with scattered hard clasts up to 50mm in diameter), highly fractured, very soft rock (but moderately hard rock from 7,00-7,20m) DWYKA TILLITE. Fractures are narrow to wide, moderately rough and filled with red clayey sand. Fractures dip at 40-50˚ and 70-80˚.

7,80-12,10m Yellowish grey banded yellow-brown, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA SHALE with several thin zones (up to 100mm thick) of very soft rock tillite and a 100mm wide zone of ferruginised moderately hard rock at 11,25m. Fractures are narrow, slightly and moderately rough and stained orange-brown. Fractures dip at 50-60˚ and 80-90˚.

12,10-13,05m Khaki banded yellowish orange and pale grey, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.

13,05-19,50m Yellowish orange banded yellowish grey and dark grey, highly weathered, very fine grained, thinly bedded, highly fractured very soft rock DWYKA SHALE, with occasional thin zones of very stiff clay-silt with a total length of 300mm. Fractures are narrow, slightly rough and stained with iron oxide. Fractures dip at 0-10˚ and 40-50˚.

19,50-20,34m See next page for description.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 30
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 28/08/07-03/09/07
LOGGED BY: JFR/JFR (04/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 473.660
Y CO-ORD: +8 110.320
ELEVATION: 1 512.049m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	21	0						21	
	97	13	43						22	
	97	11	26	*	5 MPa				23	
	95	12	41						24	
	90	14	32						25	
	100	13	25						26	
	100	19	27						27	
	100	10	60	*	31 MPa				28	
	100	10	49						29	
	100	17	32	*	75 MPa				30	
	100	10	59						31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

19,50-20,34m Dark grey banded yellowish orange, probably very stiff, laminated and jointed (stained yellowish orange) CLAY-SILT; residual Dwyka carbonaceous shale.

20,34-22,15m Dark grey occasionally banded yellowish orange and red-brown, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock, DWYKA CARBONACEOUS SHALE, with several 50mm wide ferruginised soft rock zones. Fractures are narrow, moderately rough and stained with iron oxide. Fractures dip at 0-10˚ and 20-30˚.

22,15-28,30m Dark grey, slightly weathered, very fine grained, thinly bedded, highly fractured, soft rock, DWYKA SHALE, with several zones of residual clay-silt up to 200mm thick and with a total length of 500mm. Fractures are closed, slightly rough and clean. Fractures dip at 0-10˚ and 40-50˚.

28,30-33,44m Greenish grey banded pale and dark grey, slightly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very hard rock RAYTON SHALE with zones of hard rock DWYKA TILLITE from 28,65-30,05m and 31,20-31,55m. Fractures are very narrow to closed, slightly rough to rough and cemented with calcite. Fractures dip at 10-15˚; 40-50˚ and 70-80˚.

Note: Although the Rayton Shale predomnates it actually comprises large inclusions within the Dwyka Tillite

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 31
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 06/09/07-10/09/07
LOGGED BY: JFR/JFR (11/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 552.800
Y CO-ORD: +8 189.590
ELEVATION: 1 510.732m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	78								1	
	83									
	100			▼	37				2	
	100									
	100								3	
	100								4	
NWD4	100	4	44	*	2 MPa				5	
	100	7	50						6	
	100	6	39						7	
	100	6	50						8	
	100	4	84						9	
				*	2 MPa				10	
	100	3	86	UCS	3,9 MPa				11	
	100	13	22						12	
	100	9	42	*	11 MPa				13	
	100	5	58						14	
	100	10	52	*	94 MPa				15	
	100	16	27						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,50m Abundant coarse, medium and fine, hard quartzite GRAVELS, in a matrix of brown SILTY SAND; pebble marker.

±1,50-2,80m Red-brown blotched yellowish orange, probably stiff, CLAYEY SILT; residual Dwyka shale.
Probably becomes very stiff below 2,70m.

2,80-4,55m Yellowish orange blotched buff red-brown and dark brown, probably very dense, jointed SANDY SILT with occasional hard GRAVELS up to 60mm diameter; residual Dwyka tillite.

4,55-5,15m Pale yellow-brown banded orange-brown and pale grey, probably very stiff, laminated, jointed (stained red and black) CLAY-SILT; residual Dwyka shale.

5,15-8,15m Yellowish orange banded orange-brown and pale grey, highly weathered, very fine grained, thinly bedded, highly fractured, very soft to hard rock DWYKA SHALE, with very occasional soft to hard rock clasts up to 60mm diameter. Fractures are very narrow to narrow, slightly rough, stained with iron oxide and filled with cemented iron oxide in places. Fractures dip at 0-10˚ (bedding plane separations), 30-40˚ and 60-70˚.

8,15-9,35m Pale grey blotched and banded yellowish orange and maroon, probably very stiff, laminated, jointed, CLAY-SILT; residual Dwyka shale.

9,35-15,05m Yellow-brown banded dark brown, grey-brown and pale grey, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very soft rock, DWYKA SHALE, with 50-200mm wide ferruginised soft rock to moderately hard rock zones at 9,35m, 10,00m and 12,50m. Zone of residual clay-silt from 13,95-14,35m. Fractures are generally very narrow to narrow (but wide in places), slightly rough, stained with iron oxide and filled with clay-silt in places. Fractures dip at 0-10˚ (bedding separations), 40-50˚ and 70-80˚.

15,05-15,75m Pale yellow-brown to khaki, banded yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock DWYKA SILTSTONE, with a zone of very highly fractured very stiff to very soft rock siltstone from 15,20-15,45m. Fractures are generally very narrow (but 5mm wide and filled with silt at 15,60m) slightly rough and stained black and orange-brown. Fractures dip at 0-10˚ (bedding separations), 40-50˚ and 70-80˚.

15,75-20,45m Orange-brown banded pale yellow-brown and dark brown, with dark grey, pale grey and red-brown blotches, highly weathered, medium grained (with scattered hard clasts up to 60mm diameter), highly fractured, soft rock to moderately hard rock, DWYKA TILLITE with 50-100mm wide zones of residual gravelly sand at 16,20m, 16,95m, 17,60m, 19,15m and 19,40m. Fractures very narrow and narrow, slightly and moderately rough, stained with iron oxide or filled with cemented iron oxide. Fractures dip at 0-15˚ and 40-50˚.
Becomes a very hard rock below 18,1m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)
PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 31
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 06/09/07-10/09/07
LOGGED BY: JFR/JFR (11/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 552.800
Y CO-ORD: +8 189.590
ELEVATION: 1 510.732m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NWD4	100	6	79	*	36 MPa				21		See previous page for description.
	100	2	80						22		20,45-25,59m Pale grey blotched red-brown, dark grey and greyish green, slightly weathered, fine grained (with scattered hard clasts up to 100mm diameter), moderately fractured, hard rock, DWYKA TILLITE. Fractures closed to very narrow, moderately rough and rough, clean or stained yellowish orange. Fractures dip at 0-10° and 40-50°.
	100	3	76	*	34 MPa				23		
	100	3	89						24		
									25		
									26		
									27		
									28		
									29		
									30		
									31		
									32		
									33		
									34		
									35		
									36		
									37		
									38		
									39		
									40		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 32
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 12/09/07-15/09/07
LOGGED BY: TCP/TCP (19/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 632.010
Y CO-ORD: +8 268.780
ELEVATION: 1 507.625m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	81								1	
	82									
	100			⊣	REF				2	
	100									
	100								3	
	100									
	100	20	26						4	
	100		15						5	
NWD4	100		25	✻	13 MPa				6	
	100		9						7	
	99	20	16						8	
	98		6						9	
	100		11						10	
	98	10 to 15	17						11	
	99		41						12	
	100		37						13	
	99	10	35						14	
	99		29						15	
	100		35						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,85m Abundant sub-angular to sub-rounded quartzite GRAVELS and fine ferruginous CONCRETIONS in a matrix of yellowish brown CLAYEY SAND; pebble marker.

0,85-3,46m Scattered sub-rounded quartzite clasts in a matrix of yellowish and pinkish brown, probably very stiff, CLAY-SILT containing a few more sandy zones; residual Dwyka tillite.

3,46-5,85m Brown banded yellowish brown, moderately to highly weathered, very fine grained, highly fractured, thinly laminated, very soft rock RAYTON SHALE. Fractures are narrow to wide, slightly rough to rough, stained black and filled with yellow-grey clay-silt. Fractures dip mainly sub-horizontally and sub-vertically.

5,85-12,54m Greyish brown banded dark brown, moderately weathered, very fine grained, thinly laminated, highly fractured, soft rock, RAYTON SHALE with zones of very highly fractured very soft rock from 9,67-9,92m, 10,83-11,60m and 12,32-12,53m. Fractures are closed to narrow, slightly and moderately rough, stained black and orange and filled with reddish brown clay-silt. Fractures dip predominantly sub-horizontally and sub-vertically.

12,54-15,08m Greyish brown banded dark brown, moderately weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock, RAYTON SHALE with zones of very highly fractured very soft rock. Fractures are closed to narrow, slightly and moderately rough, stained black and orange and filled with reddish brown clay-silt. Fractures dip predominantly sub-horizontally and sub-vertically.

15,08-20,27m Bluish grey banded dark grey, slightly weathered, very fine grained, thinly laminated, highly fractured, hard rock RAYTON SHALE. Fractures are closed to narrow, slightly to moderately rough, stained orange and coated with clay-silt and iron oxide. Fractures dip sub-horizontally, 20-30˚ (bedding plane separations), 60˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 33
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 17/09/07-17/09/07
LOGGED BY: JFR/JFR (20/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 711.210
Y CO-ORD: +8 347.980
ELEVATION: 1 504.005m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	82									
NWD4	65	33	0							
	100	30	0						2	
	100	15	36	*	10 MPa					
	100	23	0						3	
	100	19	39	*	20 MPa				4	
	100	10	71						5	
				*	34 MPa				6	
	100	18	38						7	
	100	14	20	*	23 MPa				8	
									9	
	100	17	19						10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,25m Abundant red-brown and yellowish orange, medium and fine, friable, very soft rock and soft rock, weakly ferruginised, highly weathered, Rayton shale GRAVELS, in a matrix of yellow-brown SILTY SAND; weakly ferruginised residual Rayton shale.

±1,25-2,05m Maroon banded yellowish orange, highly weathered, very fine grained, very thinly bedded, highly fractured, very soft rock, RAYTON SHALE, with several zones of residual clay-silt up to 50mm thick. Fractures are narrow, slightly rough,stained orange and black and filled with silt in places. Fractures dip at 10-15˚ (bedding plane separations) with occasional 60-70˚ dips.

2,05-3,10m Maroon banded dark brown and greenish grey, highly weathered, very fine grained, very thinly bedded, highly fractured, soft rock, RAYTON SHALE. Fractures are narrow, slightly rough, stained orange and black and filled with silt in places. Fractures dip at 10-15˚ (bedding plane separations) with occasional 60-70˚ dips.

3,10-6,05m Khaki banded dark brown and maroon, moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are very narrow and narrow, slightly rough, stained orange-brown and black and filled with silt in places. Fractures dip at 10-15˚ (bedding plane separations) with occasional 70-80˚ dips.

6,05-10,51m Khaki banded maroon and greenish grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are very narrow and narrow, slightly rough, stained orange-brown and black and filled with silt in places. Fractures dip at 10-15˚ (bedding plane separations) with occasional 70-80˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 34
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnocal Drilling
MACHINE: XY-44
DRILLING DATES: 21/09/07-25/09/07
LOGGED BY: JFR/JFR (26/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 790.400
Y CO-ORD: +8 427.180
ELEVATION: 1 500.077m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	94								1	
	100	>50	0							
	100	45	0							
	100	31	0						2	
NWD4	100	24	21							
	100	28	0						3	
	100	28	0						4	
	97	39	0						5	
	96	40	0						6	
	99	37	0						7	
	100	36	0						8	
	100	23	0						9	
	100	29	0	*	114 MPa				10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,90m Abundant, angular, coarse, medium and fine, weathered, very soft rock shale GRAVELS, in a matrix of yellow brown SILTY SAND; pebble marker/residual Rayton shale.

±0,90-5,90m Yellowish orange banded dark brown and grey-brown, highly weathered, very fine grained, very thinly bedded, highly and very highly fractured, soft rock, RAYTON SHALE. Fractures are narrow and wide, slightly rough, stained red and black and frequently filled with clay-silt. Fractures dip at 10-20˚ (bedding plane separations), 40-50˚ and 70-80˚.

Below 2,45m becomes very soft rock and contains a number 50-200mm thick (with a total length of 650mm) horizons of clay-silt.

5,90-12,00mm Dark brown banded orange-brown, yellow-brown and yellowish grey, highly weathered, very fine grained, very thinly bedded, highly to very highly fractured, moderately hard rock RAYTON SHALE with a number of zones of friable very soft rock and soft rock (up to 50mm thick, very highly fractured with a total length of 400mm) to a depth of 10,60m. Fractures dip at 10-20˚ (bedding plane separations), 40-50˚ and 70-80˚.

Below 2,45m becomes very soft rock and contains a number of 50-200mm thick (with a total length of 650mm) horizons of clay-silt.

12,00-13,80m Dark brown banded yellowish grey, moderately weathered, very fine grained, very thinly bedded, highly fractured (very highly fractured from13,50-13,85m), hard rock, RAYTON SHALE. Fractures are very narrow and narrow, moderately rough, stained black and filled with silt in places. Fractures dip at 10-20˚ (bedding plane separations), 40-50˚ and 70-90˚.

13,80-14,62m Dark greenish grey, occasionally banded yellowish grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, very hard rock, RAYTON SHALE. Fractures are very narrow, slightly rough and stained with iron oxide. Fractures dip at 10-20˚, 40-50˚ and 70-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 35
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 07/09/07-10/09/07
LOGGED BY: JFR/JFR (11/09/07)

LOCATION: Boiler
X CO-ORD: +2 867 869.600
Y CO-ORD: +8 506.370
ELEVATION: 1 496.511m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100									
	100			▼	REF				2	
	100									
	100								3	
	78	>50	0							
NWD4	95	17	0						4	
	99	15	21						5	
	94	18	0						6	
	100	13	0						7	
	100	16	16						8	
	100	9	16						9	
	100	5	66						10	
	100	5	75						11	
	100	15	0	✻	203 MPa				12	
	100	6	97						13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,10m Red-brown, probably stiff, fissured, SANDY CLAY, with occasional hard GRAVELS; hillwash.

±1,10-±1,80m Red-brown mottled yellow-brown, probably stiff, jointed, CLAYEY SAND; residual diabase.

±1,80-2,30m Yellow-brown speckled orange brown and black, probably very dense, jointed (stained black)SILTY SAND; residual diabase.

2,30-3,20m Corestones up to 200mm diameter of soft rock to very hard rock diabase in a matrix of yellow and orange-brown, probably very dense, SILTY SAND; residual diabase.

3,20-9,55m Dark grey speckled pale grey and black, slightly weathered, medium grained, highly fractured, very hard rock to extremely hard rock, DIABASE, with zones of moderately or highly weathered, very highly fractured soft rock to hard rock diabase from 3,55-3,77m, 4,90-5,10m, 6,90-7,45m, 8,45-8,55m and 9,25-9,45m. Fractures very narrow to wide, moderately rough, stained red-brown and black and filled with sandy silt in places. Fractures dip at 0-20˚, 30-40˚, 50-60˚ and 70-80˚.

9,55-13,29m Dark grey speckled pale grey and black, slightly weathered, medium grained, moderately and highly fractured, very hard rock to extremely hard rock DIABASE. Fractures very narrow to narrow, moderately rough and rough and stained red and black . Fractures dip at 10-20˚, 30-40˚, 50-60˚ and 70-80˚ .

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 36
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D 90R
DRILLING DATES: 31/08/07-05/09/07
LOGGED BY: JFR/JFR (06/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 432.010
Y CO-ORD: +8 152.010
ELEVATION: 1 510.994m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	79								1		0,00-±1,20m Abundant coarse, medium and fine quartzite GRAVELS in a matrix of brown and orange- brown SILTY SAND; pebble marker.
	87										
	100			I	50				2		±1,20-5,60m Orange-brown banded and blotched red-brown, probably stiff, intact, SANDY CLAYEY SILT, with occasional hard GRAVELS (clasts) up to 50mm diameter; residual Dwyka tillite. Probably very stiff below 3,5m
	80										
	100								3		
	100								4		
	100								5		
	100								6		5,60-6,90m Maroon banded and blotched yellow-brown, probably very stiff, laminated and jointed CLAY-SILT; residual Dwyka shale.
	100								7		6,90-12,80m Yellow-brown banded yellowish grey and maroon, highly weathered, very fine grained, thinly bedded, highly fractured, very soft rock DWYKA SHALE with a zone of soft rock and moderately hard rock tillite from 8,85-9,50m and a zone of very highly fractured, moderately hard rock ferruginised tillite from 10,70-11,00m. Fractures are narrow, slightly rough and filled with silt in places. Fractures dip at 0-10˚ and 20-30˚.
	93	5	85	*	3 MPa				8		
	100	20	30						9		
NWD4	100	6	80						10		
	100	>50	0						11		
	100	6	66						12		
	100	10	21	*	4 MPa				13		12,80-16,97m Yellowish grey banded dark brown and orange-brown, highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, very soft rock to soft rock DWYKA SILTSTONE. Fractures are narrow, slightly rough and filled with cemented iron oxide. Fractures dip at 0-10˚ (bedding separations) and 20-30˚ and 50-60˚.
	100	8	54						14		
				*	6 MPa				15		
	100	11	44						16		
	100	16	0						17		16,97-20,15m Pale grey banded orange-brown and dark brown, probably very stiff, laminated, jointed (up to 2mm wide and filled with cemented iron oxides), CLAY-SILT, with a few thin zones of very soft shale, comprising a total of 600mm in length; residual Dwyka shale.
	100	12	0						18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES
CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 36
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D 90R
DRILLING DATES: 31/08/07-05/09/07
LOGGED BY: JFR/JFR (06/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 432.010
Y CO-ORD: +8 152.010
ELEVATION: 1 510.994m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	14	0							
	100	24	11						21	
	100	29	11						22	
	100	±1	100	*	10 MPa				23	
	100	12	20	*	84 MPa				24	
	100	7	67						25	
	100	13	40						26	
	100	6	77						27	
	100	9	66						28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

20,15-23,90m Khaki banded grey, moderately to highly weathered, very fine grained, thinly and very thinly bedded, highly fractured, soft rock, DWYKA SHALE, with 100mm wide, zone of very highly fractured, moderately hard rock tillite at 22,80m. Fractures are narrow, slightly rough and stained with iron oxide. Fractures dip at 10-20˚ (bedding separations).

23,90-24,20m Dark grey banded yellow-brown, probably very stiff to very soft rock, laminated, jointed clay-silt; residual/highly weathered Dwyka carbonaceous shale.

24,20-30,56m Greenish grey banded dark grey, unweathered, thinly and very thinly bedded, highly fractured, very hard rock, RAYTON SHALE. Fractures are closed to very narrow, slightly rough and stained with iron oxide. Fractures dip at 0-10˚ (bedding plane separations).

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 37
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 10/09/07-12/09/07
LOGGED BY: JFR/JFR (14/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 504.130
Y CO-ORD: +8 224.130
ELEVATION: 1 510.202m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								0		0,00-±0,85m Abundant, hard, coarse, medium and fine quartzite GRAVELS, in a matrix of brown SILTY SAND; pebble marker.
	100										
	100								1		±0,85-2,55m Red-brown mottled yellowish orange, probably firm, weakly ferruginised SANDY CLAYEY SILT with scattered hard, coarse, medium and fine GRAVELS; residual Dwyka tillite.
	100			SPT	23				2		
	96										2,55-5,45m Yellowish orange blotched and mottled maroon, probably very stiff, jointed, CLAYEY SILT, with several thin zones of sandy gravel; residual Dwyka shale with a few thin horizons of residual Dwyka tillite.
	100								3		
									4		
	89								5		
NWD4	100	6	40	*	2 MPa				6		5,45-10,90m Yellowish orange banded pale grey and maroon, highly weathered, very fine grained, thinly bedded, very soft rock DWYKA SHALE. Fractures very narrow to narrow, slightly rough, stained orange and red and filled with silt in places. Fractures dip at 0-10˚ (bedding plane separations) with occasional 30-40˚ and 50-60˚ dips.
	100	5	77	UCS	1,8 MPa				7		Note: Zones of very stiff residual clay-silt from 9,60-9,90m and 10,10-10,40m.
	100	10	21						8		
	100	9	37						9		
									10		
	100	10	51						11		10,90-15,65m Khaki banded grey-brown and occasionally yellowish orange, highly weathered, very fine grained, thinly bedded, highly fractured, soft rock, DWYKA SHALE. Fractures very narrow, slightly rough and stained black. Fractures dip at 0-10˚ (bedding plane separations), with occasional 30-40˚ and 50-60˚ dips.
	100	12	40	*	3 MPa				12		
	100	8	69						13		
									14		
	100	15	33	*	28 MPa				15		15,65-20,30m Yellowish brown and yellowish grey, blotched grey and red, highly weathered, medium grained (with numerous hard clasts up to 150mm diameter), highly fractured, hard rock, DWYKA TILLITE. Fractures very narrow to narrow, stained with iron oxide or filled with cemented iron oxide. Fractures dip at 0-20˚ and 30-40˚.
	100	8	69						16		Note: Zones of pale brownish grey, slightly weathered, hard rock to very hard rock tillite from 17,00-19,15m.
				*	64 MPa				17		
	100	3	85						18		
									19		
	100	14	59						20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES
CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 37
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-44
DRILLING DATES: 10/09/07-12/09/07
LOGGED BY: JFR/JFR (14/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 504.130
Y CO-ORD: -8 224.130
ELEVATION: 1 510.202m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	14	59						21	
	100	9	43						22	
	100	5	75						23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

See previous page for description

20,30-24,01m Brownish grey blotched dark grey and red, slightly weathered, medium grained, highly fractured, hard rock to very hard rock, DWYKA TILLITE. Fractures closed to very narrow, moderately rough and clean. Fractures dip at 0-20˚ and 30-40˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 38
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 15/09/07-17/09/07
LOGGED BY: TCP/TCP (19/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 575.960
Y CO-ORD: +8 296.770
ELEVATION: 1 508.177m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								1		0,00-1,50m Abundant sub-rounded, weathered quartzite GRAVELS and friable ferruginous CONCRETIONS in a matrix of brown, becoming orange-brown with depth, SILTY SAND; pebble marker.
	94										
	84										
	100								2		1,50-5,22m Orange-brown becoming yellowish brown and blotched grey with depth, probably very dense, SANDY SILT containing occasional sub-rounded hard rock GRAVELS and COBBLES with localized more clayey zones; residual Dwyka tillite.
	100								3		
	99								4		
	99	10	19						5		
	100		44	*	4,5 MPa				6		5,22-6,78m Yellowish brown blotched grey, highly weathered, fine grained (but with very coarse clasts), highly fractured, very soft rock DWYKA TILLITE. Fractures are narrow to wide, rough, stained orange and black and filled with yellowish brown silt. Fractures dip predominantly sub-horizontally.
	100	10	24						7		6,78-9,05m Grey banded dark brown and purple, highly weathered, fined grained (but with very coarse clasts), highly fractured, soft rock DWYKA TILLITE with zones up to 40mm wide (total about 160mm) of residual soil as above. Fractures are narrow to wide, rough, stained black and filled with orange and grey silt. Fractures dip horizontally, 20-30˚, 45˚ and 60˚.
NWD4	99		67	*	18 MPa				8		
	99	4	82						9		9,05-13,05m Pale grey blotched yellow, moderately weathered, fine grained (but with very coarse clasts), moderately fractured, moderately hard to hard rock DWYKA TILLITE. Fractures are closed to narrow, rough, stained orange and black and coated with silt and iron oxide. Fractures dip sub-horizontally and 45˚.
	99		47	*	93 MPa				10		
		20							11		
									12		13,05-13,80m Brown banded dark brown, moderately weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock RAYTON SHALE. Fractures are closed to narrow, slightly rough, stained yellow and black and coated with iron oxide and dendrites. Fractures dip at 20-30˚ and sub-vertically.
									13		
									14		
									15		
									16		
									17		
									18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 39
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: XY-42
DRILLING DATES: 22/09/07-25/09/07
LOGGED BY: JFR/JFR (26/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 666.060
Y CO-ORD: +8 386.060
ELEVATION: 1 504.267m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	81									
	81	13	57							
	100	17	27	*	20 MPa				2	
	100	16	38	*	17 MPa				3	
									4	
	100	17	35						5	
	100	13	67	*	10 MPa				6	
									7	
	100	13	44	*	16 MPa				8	
	100	17	25						9	
									10	
	100	9	83	*	29 MPa				11	
									12	
	100	9	69						13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,00m Abundant weathered soft rock and very soft rock shale GRAVELS and COBBLES (up to 150mm in diameter), in a matrix of yellow brown SILTY SAND; pebble marker/residual Rayton shale.

±1,00-8,80m Maroon banded greenish grey, moderately to highly weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE. Fractures are generally very narrow to narrow (but with occasional wide fractures in places), slightly rough to moderately rough and stained with iron oxide or filled with cemented iron oxide and occasionally silt. Fractures dip at 10-20˚ (bedding plane separations), 65-75˚ and 80-90˚.

8,80-13,38m Dark brown banded greenish grey, moderately weathered, very fine grained, very thinly bedded, highly fractured, hard rock, RAYTON SHALE. Fractures are generally very narrow to narrow (but with occasional wide fractures in places), slightly rough to moderately rough, stained with iron oxide or filled with cemented iron oxide and occasionally silt. Fractures dip at 10-20˚ (bedding plane separations), 65-75˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)
PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 40
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 20/09/07-21/09/07
LOGGED BY: TCP/TCP (24/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 738.280
Y CO-ORD: +8 458.280
ELEVATION: 1 500.812m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100		-							
	100	30 - 40	0							
	100		0	*	29 MPa				1	
	100		0						2	
	92		0						3	
	100		14						4	
	100		0						5	
	100		0						6	
NWD4	100	20	12						7	
	98		0						8	
	96		29						9	
	99		16	*	34 MPa				10	
	100		0						11	
	100		9						12	
	100		0						13	
	100	20	14						14	
	99		48						15	
				*	60 MPa				16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,42m Abundant angular weathered shale GRAVELS in a matrix of yellowish brown SILTY SAND; pebble marker.

0,42-6,29m Yellowish brown banded dark brown, highly weathered, very fine grained, thinly laminated, highly fractured, moderately hard rock to hard rock, RAYTON SHALE. Fractures are narrow to wide, slightly to moderately rough, stained orange and black and filled with orange-brown clay-silt. Fractures dip sub-horizontally, 15-20˚, 45˚ and sub-vertically. Contains zone of very soft to soft rock from 4,60-4,92m.

6,29-16,10m Brown banded yellowish brown and dark grey, moderately weathered, very fine grained, thinly laminated, highly fractured, hard rock, RAYTON SHALE. Fractures are narrow to very wide (25mm), slightly to moderately rough, stained orange and black and filled with orange-brown clay-silt. Fractures dip sub-horizontally, 15-20˚, 45˚, 60-70˚ and sub-vertically.

16,10-18,39m Dark grey banded brown, slightly weathered, very fine grained, thinly laminated, highly fractured, hard rock, RAYTON SHALE. Fractures are closed to narrow, slightly to moderately rough, stained yellow and black and coated with iron oxide. Fractures dip sub-horizontally, 15-20˚ and 45˚,

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 41
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 05/09/07-07/09/07
LOGGED BY: JFR/JFR (07/09/07)

LOCATION: Auxiliary Bay
X CO-ORD: +2 867 810.300
Y CO-ORD: +8 530.300
ELEVATION: 1 497.728m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100								2	
	100			▼	15					
	90								3	
	100									
	100			▼	21				4	
	80									
	100								5	
									6	
	100	15	0						7	
	100	24	0						8	
NWD4	100	14	10						9	
	100	14	50						10	
									11	
	100	14	23						12	
	100	20	17						13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,50m Red-brown, probably firm, SANDY CLAYEY SILT; probably reworked residual diabase.

±1,50-±4,70m Orange-brown speckled yellow-brown and black, probably firm, jointed (stained red and black) CLAYEY SILT; residual diabase.

±4,70-7,50m Yellow brown speckled orange-brown and black, probably dense, jointed (stained red and black) SILTY SAND, with occasional weathering spheroids of very soft rock and soft rock up to 150mm in diameter; residual diabase.

7,50-8,35m Grey-brown speckled and blotched dark brown and grey, moderately weathered, medium grained, highly fractured, hard rock DIABASE. Fractures very narrow to narrow, moderately rough and rough, stained red-brown, orange-brown and black and filled with silty sand in places. Fractures dip at 0-20˚, 40-60˚ and 80-90˚.

8,35-13,87m Dark grey, occasionally blotched yellowish grey, slightly weathered, medium grained, highly fractured, very hard rock and extremely hard rock, DIABASE, with a zone of moderately weathered hard rock from 12,50-12,70m. Fractures are very narrow to narrow, moderately rough and rough, stained red-brown, orange-brown and black and filled with silty sand in places. Fractures dip at 0-20˚, 40-60˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 42
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 13/09/07-13/09/07
LOGGED BY: JFR/JFR (14/09/07)

LOCATION: Workshop and Stores
X CO-ORD: +2 867 939.900
Y CO-ORD: +8 677.170
ELEVATION: 1 493.508m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								0	
	100									
	100								1	
	80									
NWD4	100	15	0						2	
	100	10	35							
	95	9	24						3	
	100	3	84						4	
	100	2	100	*	206 MPa				5	
	100	2	90						6	
	100	2	100						7	
									8	
									9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,50m Red-brown SANDY CLAY; hillwash.

0,50-±1,00m Red-brown mottled orange-brown, probably stiff, SANDY CLAY-SILT, with scattered fine ferruginous CONCRETIONS; reworked residual diabase.

±1,00-1,65m Yellow-brown speckled black and orange-brown, probably very dense, jointed (stained red), SILTY SAND; residual diabase.

1,65-3,30m Dark grey speckled pale grey, slightly weathered, medium grained, highly fractured, very hard rock DIABASE with several zones of residual silty sand, up to 150mm thick and comprising up to 30% by volume. Fractures narrow to very wide (up to 8mm), moderately rough and filled with clay. Fractures dip at 0-10˚, 40-50˚ and 70-90˚.

3,30-8,78m Dark grey speckled pale grey, slightly weathered, medium grained, moderately fractured, extremely hard rock DIABASE. Fractures very narrow, moderately rough and rough and stained with iron oxide. Fractures dip at 0-10˚, 40-50˚ and 70-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 43
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 31/08/07-04/09/07
LOGGED BY: JFR/JFR (05/09/07)

LOCATION: Workshop and Stores
X CO-ORD: +2 867 258.590
Y CO-ORD: +8 039.640
ELEVATION: 1 508.666m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	88								0	
	92								1	
	100			⊣	68				2	
	79								3	
	95								4	
	100								5	
	100								6	
	100								7	
	100								8	
NWD4	100	4	49	*	6 MPa				9	
	100	3	51						10	
	100	5	54						11	
	100	3	60						12	
	100	±1	91	*	7 MPa				13	
	100	3	70						14	
	100	4	66						15	
	99	4	75						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,75m Abundant hard quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±0,75-3,25m Red-brown mottled orange-brown, probably very stiff, weakly ferruginised CLAYEY SANDY SILT, with scattered fine ferruginous concretions and occasional coarse, medium and fine, hard, miscellaneous gravels; weakly ferruginised residual Dwyka tillite.

3,25-7,70m Yellow brown blotched brownish purple and orange-brown, probably very stiff, slightly CLAYEY SANDY-SILT with occasional hard, coarse, medium and fine GRAVELS (clasts); residual Dwyka tillite.

Note: Zone of red-brown mottled yellowish orange clayey silt from 4,00-4,36m.

7,70-10,25m Maroon banded khaki and yellow-brown probably very stiff, laminated, jointed (stained red-brown), CLAY-SILT; residual Dwyka shale.

Note 10cm wide zone of residual tillite (as from 3,25-7,70m) at 8,60m.

10,25-15,40m Buff banded yellowish orange and speckled and blotched red-brown, highly weathered, moderately fractured, soft rock, DWYKA TILLITE with scattered hard clasts generally up to 100mm diameter (but with 550mm diameter granite clast at 12,60m). Fractures are narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 40-50˚ and 70-80˚.

15,40-17,10m Buff banded yellowish orange and occasionally blotched red-brown, highly weathered, very fine grained, medium bedded, slightly fractured, soft rock, DWYKA SILTSTONE, with a 100mm wide ferruginised moderately hard rock zone at 16,45m. Fractures narrow, slightly rough and stained red-brown. Fractures dip at 20-30˚ and 40-50˚.

17,10-23,08m Orange-brown banded pale grey, dark brown and yellow-brown, highly weathered, very fine grained, thinly and very thinly bedded, moderately fractured, soft rock, DWYKA SHALE, with zones of fine grained soft rock Dwyka sandstone from 18,80-19,05m, 20,45-20,65m and 22,55-22,85m. Fractures are narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-10˚, 30-40˚, 60-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 43
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 31/08/07-04/09/07
LOGGED BY: JFR/JFR (05/09/07)

LOCATION: Workshop and Stores
X CO-ORD: +2 867 258.590
Y CO-ORD: +8 039.640
ELEVATION: 1 508.666m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	5	77	*	6 MPa				21	
	100	5	58	*	9 MPa				22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

17,10-23,08m Orange-brown banded pale grey, dark brown and yellow-brown, highly weathered, very fine grained, thinly and very thinly bedded, moderately fractured, soft rock, DWYKA SHALE, with zones of fine grained soft rock Dwyka sandstone from 18,80-19,05m, 20,45-20,65m and 22,55-22,85m. Fractures are narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 0-10˚, 30-40˚, 60-70˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)
PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 44
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 28/08/07-30/08/07
LOGGED BY: FWS/FWS (31/08/07)

LOCATION: Turbine Generator
X CO-ORD: +2 867 376.250
Y CO-ORD: +8 162.140
ELEVATION: 1 510.313m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100		-						1		0,00-1,20m Abundant ferruginised angular and sub-angular GRAVELS, in dark red-brown, SANDY SILT; pebble marker.
	100		-								
	100		-	⊢	74				2		1,20-3,75m Abundant mixed gravels in a matrix of orange-brown to red-brown, probably stiff to very stiff, CLAYEY SILT; residual Dwyka tillite.
	95		-						3		
NWD4	100	7	91						4		3,75-6,66m Yellow-brown banded red-brown, highly weathered, coarse grained, jointed, highly fractured, soft rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal.
									5		
									6		
	100	>30	0						7		6,66-12,98m Pale brown, moderately weathered, medium grained with clasts, jointed, highly fractured, soft becoming moderately hard rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal. Fracture zones 7,50-8,00m, 8,75-9,00m and 11,40-11,60m.
									8		
	100	10	70						9		
									10		
									11		
	100	10	85						12		
	100	-	0						13		12,98-13,34m Orange, probably very stiff CLAYEY SILT; fracture filling.
	93	10	60						14		13,34-14,90m Pale brown, moderately weathered, medium grained with clasts, jointed, highly fractured, soft becoming moderately hard rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal.
	100	-	0						15		14,90-15,60m Orange-yellow, probably very stiff CLAYEY SILT; fracture filling.
	98	18	93	*	10 MPa				16		15,60-18,40m Pale brown, moderately weathered, medium grained with clasts, jointed, highly fractured, soft becoming moderately hard rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal.
									17		
	95	6	84						18		18,40-18,98m Khaki-grey, very highly fractured, very soft rock DWYKA SHALE.
	100	14	22						19		18,98-20,48m Pale brown, moderately weathered, medium grained with clasts, jointed, highly fractured, soft becoming moderately hard rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal.
	100	14	65						20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 44
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 28/08/07-30/08/07
LOGGED BY: FWS/FWS (31/08/07)

LOCATION: Turbine Generator
X CO-ORD: +2 867 376.250
Y CO-ORD: +8 162.140
ELEVATION: 1 510.313m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	98	8	81						21	
	96	13	12						22	
									23	
									24	
	100	10	50						25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

18,98-20,48m Pale brown, moderately weathered, medium grained with clasts, jointed, highly fractured, soft becoming moderately hard rock DWYKA TILLITE. Fractures are generally wide, rough and filled with clay-silt. Fractures are sub-horizontal.

20,48-24,98m Pale to dark grey, slightly weathered, fine grained, laminated, highly fractured, moderately hard rock DWYKA SHALE. Fractures are generally narrow to occasionally wide, smooth, stained with iron oxide and filled with clay-silt. Fractues are generally sub-horizontal to occasionally sub-vertical.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 45
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D 90R
DRILLING DATES: 28/08/07-30/08/07
LOGGED BY: FWS/FWS (31/08/07)

LOCATION: Turbine Generator
X CO-ORD: +2 867 455.400
Y CO-ORD: +8 241.330
ELEVATION: 1 509.681m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								1		0,00-1,50m Abundant subrounded GRAVELS in a matrix of SILTY SAND; pebble marker.
	95										
NWD4	85			SPT	59				2		1,50-3,57m Red-brown, probably very stiff, CLAYEY-SILT with occasional clasts; residual Dwyka tillite.
	100	6	65						3		
									4		3,57-5,15m Pale red-brown to khaki, highly weathered, fine grained, laminated, moderately to highly fractured, very soft rock DWYKA SHALE. Fractures are narrow, smooth and stained. Fractures are generally sub-horizontal.
	100	7	75						5		5,15-6,65m Pale brown to khaki, highly weathered, fine grained, laminated, moderately to highly fractured, soft rock DWYKA SHALE. Fractures are narrow, smooth and stained. Fractures are generally sub-horizontal.
	100	7	67						6		6,66-13,53m Pale brown to khaki, highly weathered, fine grained, laminated, moderately to highly fractured, soft rock DWYKA SHALE. Fractures are generally narrow to occasionally wide, slightly rough, stained with iron oxide and filled with clay-silt. Fractures are generally sub-horizontal, occasionally sub-vertical with wide separations. Fracture zone 11,82-12,00m associated with sub-vertical fracture.
	100	7	89						7		
									8		
									9		
	100	7	80	*	4 MPa				10		
	93	10	82						11		
									12		
									13		
	100	7	68						14		13,53-18,31m Khaki-pale brown to red-brown (variation on bedding) variably weathered, fine grained, laminated, highly to very highly fractured, soft rock (with very soft rock zones) DWYKA SHALE. Fractures are generally narrow, occasionally very wide, slightly rough, stained with iron oxide and filled with clay-silt. Fractures are mainly sub-horizontal and occasionally 60-70˚.
	100	>50	24						15		
									16		
									17		
	96	18	23						18		18,31-20,50m Khaki-pale brown to red-brown (variation on bedding) variably weathered, fine grained, laminated, highly to very highly fractured, soft to moderately hard rock (with very soft rock zones) DWYKA SHALE. Fractures are generally narrow to occasionally very wide, slightly rough, stained with iron oxide and filled with clay-silt. Fracture mainly sub-horizontal and occasionally 60-70˚. Fracture zones from 18,30-18,50m and 19,10-19,30m.
	100	>50	0	*	HORIZ. 20 MPa VERT. 23 MPa				19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 45
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D 90R
DRILLING DATES: 28/08/07-30/08/07
LOGGED BY: FWS/FWS (31/08/07)

LOCATION: Turbine Generator
X CO-ORD: +2 867 455.400
Y CO-ORD: +8 241.330
ELEVATION: 1 509.681m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	>50	0						21	
	100	8	82						22	
	100	5	88	*	HORIZ. 60 MPa VERT. 82 MPa				23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	
									34	
									35	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

18,31-20,50m Khaki-pale brown to red-brown (variation on bedding) variably weathered, fine grained, laminated, highly to very highly fractured, soft rock (with very soft rock zones) DWYKA SHALE. Fractures are generally narrow to occasionally very wide, slightly rough, stained with iron oxide and filled with clay-silt. Fractures (zones) mainly sub-horizontal and occasionally 60-70˚. Fracture zones from 18,30-18,50m and 19,10-19,30m.

20,50-25,97m Pale brown to khaki, slightly weathered, fine grained (Dwyka shale) to moderately coarse (Dwyka tillite), laminated to jointed, moderately fractured, moderately hard rock (shale) to hard rock (tillite), DWYKA TILLITE/SHALE sequence. Fractures are narrow, slightly rough to rough and stained with iron oxide. Fractures are generally sub-horizontal.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 49
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 11/09/07-12/09/07
LOGGED BY: JFR/JFR (13/09/07)

LOCATION: Turbine Generator
X CO-ORD: +2 867 772.270
Y CO-ORD: +8 558.080
ELEVATION: 1 498.107m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100			↧	33				2	
	100									
	100	10	27						3	
	100	20	0						4	
NWD4	100	16	0							
	100	17	0						5	
	100	16	0						6	
	100	7	32						7	
	100	11	43						8	
	100	9	47	✻	76 MPa				9	
	100	8	63						10	
	100	10	33						11	
	100	11	33						12	
	100	23	25						13	
	100	42	0						14	
	100	48	0						15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-0,98m Red-brown, probably stiff, fissured SANDY CLAY with occasional hard, coarse, medium and fine GRAVELS; hillwash.

0,98-2,35m Red-brown mottled orange-brown and speckled black, probably stiff, jointed, SANDY CLAYEY SILT; residual diabase.

2,35-2,80m Orange-brown speckled yellow-brown and black, probably very dense, jointed (stained red and black), SILTY SAND; residual diabase.

2,80-4,40m Yellow-brown speckled orange-brown and black, highly weathered, medium grained, highly fractured, soft rock, DIABASE. Fractures very narrow to wide, slightly rough and filled with clayey silt. Fractures dip at 0-10˚ and 80-90˚.

4,40-8,20m Dark brown speckled orange-brown and black, highly weathered, medium grained, highly fractured, moderately hard rock DIABASE, with zones of residual silty sand from 4,85-4,93m, 7,77-7,90m, 7,34-7,47m and 7,92-8,02m. Fractures are very narrow to narrow, slightly and moderately rough, stained red and black and filled with silt in places. Fractures dip at 0-20˚, 40-50˚, 60-70˚ and 80-90˚.

8,20-15,20m Dark grey and occasionally yellowish grey, slightly weathered, medium grained, highly fractured, very hard rock, DIABASE. Fractures very narrow to narrow, slightly and moderately rough, stained red and black and filled with silt in places. Fractures dip at 0-20˚, 40-50˚, 60-70˚ and 80-90˚.

15,20-16,50m Dark grey, occasionally banded dark brown, slightly weathered, very fine grained, very thinly bedded, highly fractured, very hard rock, indurated RAYTON SHALE. Fractures very narrow and narrow, slightly rough to rough, stained orange and brown and filled with silt in places. Fractures dip at 15-20˚ (bedding plane separations), with occasional 60-70˚ dips.

16,50-18,37m Dark brown banded yellow brown, moderately to highly weathered, very fine grained, very thinly bedded, highly to very highly fractured, hard rock RAYTON SHALE. Fractures narrow to wide, slightly rough, stained black and frequently filled with silt. Fractures dip at 15-20˚ (bedding plane separations), with numerous 60-70˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 50
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 11/09/07-19/09/07
LOGGED BY: TCP/TCP (21/09/07)

LOCATION: Demin storage tank
X CO-ORD: +2 867 157.080
Y CO-ORD: +8 021.410
ELEVATION: 1 505.890m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	93								1	
	89									
	90									
	94									
	60									
NWD4	100			↧	REF				2	
	100									
	99								3	
	98								4	
	99	5 to 6	56						5	
	99		61						6	
	100		67	✻	1 MPa				7	
	99	10 to 12	26	✻	5 MPa				8	
	100		52						9	
	99	-	62						10	
	99		42						11	
	99	10	39						12	
	100		85						13	
	99		13						14	
	99	20	8	✻	19 MPa				15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-1,10m Abundant weathered sub-rounded quartzite GRAVELS and ferruginous CONCRETIONS in a matrix or orange-brown CLAYEY SAND; pebble marker.

1,10-1,90m Orange-brown SANDY CLAY-SILT with scattered friable siltstone GRAVELS and ferruginous CONCRETIONS; residual Dwyka siltstone.

1,90-2,70m Yellowish brown mottled red, probably very stiff CLAYEY fine SANDY SILT; residual Dwyka siltstone.

2,70-5,33m Yellowish brown blotched grey and orange, probably very stiff, jointed (stained black), slightly CLAYEY SANDY SILT; residual Dwyka siltstone.

5,33-8,80m Pale grey banded yellow, red and dark grey, highly weathered, very fine grained, laminated, highly fractured, very soft rock, SILTSTONE. Fractures are narrow to wide, moderately rough to rough, stained orange and black and filled with clayey silt. Fractures dip sub-horizontally, 15-20˚ and 60-70˚.

8,80-9,75m Yellowish brown banded grey, medium grained, very thinly bedded, highly fractured, moderately hard rock, DWYKA SANDSTONE. Fractures are closed to narrow, rough, stained black and orange and filled with orange-brown silt. Fractures dip 15-20˚, 60-70˚ and sub-vertically.

9,75-10,70m Yellowish brown blotched grey, probably very stiff, jointed (stained reddish brown), CLAY-SILT; residual Dwyka siltstone.

10,70-15,15m Yellowish brown and grey banded dark brown and maroon, highly weathered, very fine grained, thinly laminated, highly fractured, very soft rock, CLAYEY SILTSTONE. Fractures are closed to narrow, moderately rough, stained black and filled with clay-silt. Fractures dip 15-20˚, 45˚ and 60-70˚. Contains sandier zones up to 300mm wide of soft rock consistency.

15,15-24,75m Yellowish brown blotched and banded pale grey and dark brown, highly weathered, very fine grained, laminated, highly fractured, moderately hard rock, DWYKA SILTSTONE with some very highly fractured soft rock zones. Fractures are closed to wide, moderately rough, stained orange and black and filled with reddish brown clay-silt. Fractures dip 15-20˚, 45˚, 60-70˚ and sub-vertically.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
✻ UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 50
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Technical Drilling
MACHINE: TROUTSTIHL
DRILLING DATES: 11/09/0719/09/07
LOGGED BY: TCP/TCP (21/09/07)

LOCATION: Demin storage tank
X CO-ORD: +2 867 157.080
Y CO-ORD: -8 021.410
ELEVATION: 1 505.890m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NWD4	100	20	0						21	
	99		19						22	
	100		24						23	
	100		7						24	
	100	50	40						25	
	98		0						26	
	99	-	16						27	
	100	12	53						28	
									29	
									30	
									31	
									32	
									33	
									34	
									15	
									36	
									37	
									38	
									39	
									40	

CORE DESCRIPTION

15,15-24,75m Yellowish brown blotched and banded pale grey and dark brown, highly weathered, very fine grained, laminated, highly fractured, moderately hard rock, DWYKA SILTSTONE with some very highly fractured soft rock zones. Fractures are closed to wide, moderately rough, stained orange and black and filled with reddish brown clay-silt. Fractures dip 15-20˚, 45˚, 60-70˚ and sub-vertically.

24,75-28,06m Yellowish brown banded grey and dark brown, highly weathered, very fine grained, laminated, very highly fractured, very soft rock DWYKA SILTSTONE with some soft rock zones. Fractures are narrow to wide, slightly rough, stained orange and black and filled with grey-brown clay-silt. Fractures dip15-20˚, 45˚, 60-70˚ and sub-vertically.

28,06-28,50m Brown, probably very stiff, CLAY-SILT; residual Dwyka clayey siltstone.

28,50-29,83m Brown banded yellowish brown and dark brown, highly weathered, very fine grained, laminated, highly fractured, soft rock, DWYKA SILTSTONE. Fractures are closed to narrow, slightly to moderately rough, stained orange and black, and coated with iron oxide. Fractures dip 20-25˚ and 45˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 55
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 18/09/07-20/09/07
LOGGED BY: JFR/JFR (21/09/07)

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 681.020
Y CO-ORD: +8 551.270
ELEVATION: 1 500.004m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100								2	
	100									
	100								3	
NWD4	100	28	0						4	
	93	21	18	*	4 MPa				5	
	100	33	0						6	
	100	31	0	*	24 MPa				7	
	100	32	0						8	
	98	35	0						9	
									10	
	96	25	0						11	
	100	30	7						12	
	100	19	22						13	
	100	25	22	*	96 MPa				14	
	100	16	39						15	
	100	15	55						16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,70m Abundant coarse, medium and fine friable, weathered, weakly ferruginised shale GRAVELS in a matrix or orange-brown CLAYEY SAND; residual Rayton shale.

±0,70-3,48m Orange-brown mottled red-brown, yellowish orange and yellowish grey, probably stiff (becoming very stiff with depth), jointed, stained red and black, CLAYEY SILT; residual Rayton shale.

3,48-6,50m Yellowish orange banded red-brown, highly weathered, very fine grained, very thinly bedded, highly fractured, very soft rock, RAYTON SHALE. Fractures are narrow, slightly rough, stained red and black and filled with silt. Fractures dip 10-15˚ (bedding plane separations), 50-60˚ and 70-90˚. Becomes soft rock below 5,00m.

Note: Zones of residual clayey shale from 4,75-4,85m and 5,80-6,00m.

6,50-7,45m Yellowish orange banded dark brown, highly weathered, very fine grained, very thinly bedded, highly fractured (very highly fractured from 7,10-7,40m), moderately hard rock, RAYTON SHALE. Fractures are narrow, slightly rough, stained red and black and filled with silt. Fractures dip 10-15˚ (bedding plane separations), 50-60˚ and 70-90˚. Becomes soft rock below 5,00m.

Note: Zones of residual clayey from 4,75-4,85m and 5,80-6,00m.

7,45-14,30m Yellowish orange banded dark brown and yellowish grey, moderately to highly weathered, very fine grained, very thinly bedded, highly fractured (but very highly fractured from 9,31-9,60m, 10,00-10,51m and 11,5m and 11,70m), hard rock, RAYTON SHALE. Fractures are narrow to very narrow, slightly and moderately rough, stained red and black and filled with silt in places. Fractures dip at 0-15˚ (bedding plane separations) with occasional 50-60˚ and 70-90˚ dips.

14,30-20,19m Dark grey occasionally banded, yellowish grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, very hard rock, RAYTON SHALE. Fractures are narrow and very narrow, moderately rough and rough and stained with iron oxide. Fractures dip at 10-15˚ (bedding plane separations), 40-50˚ and 80-90˚.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 56
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 14/09/07-15/09/07
LOGGED BY: TCP/TCP (19/09/07)

LOCATION: Air Cooled Condensors
X CO-ORD: +2 867 760.140
Y CO-ORD: +8 630.390
ELEVATION: 1 497.688m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NXC	100								0		0,00-1,00m Reddish brown, probably firm to stiff SANDY CLAY-SILT with scattered sub-angular quartzite GRAVELS at base; hillwash.
	100								1		1,00-1,60m Orange-brown, probably firm to stiff, micaceous SANDY CLAY-SILT; residual diabase.
	100			I	26						1,60-2,59m Yellowish brown speckled buff, orange and black, probably dense, micaceous SILTY SAND with zones of clayey residuum as above up to 250mm thick; residual diabase.
	87								2		
	92		0								2,59-5,40m Bluish grey speckled dark grey, moderately weathered, medium textured, highly fractured, hard rock, DIABASE with zones of sandy and clayey residual soil up to 120mm thick (total 300mm). Fractures are narrow to very wide, slightly rough to rough, stained orange and black and filled with orange-brown clay-silt and silty sand. Fractures dip 20-30˚, 45˚, 60-70˚ and sub-vertically.
	100	30	0						3		
									4		
									5		
	99		62								5,40-10,87m Dark bluish grey speckled black, slightly weathered, medium textured, moderately fractured, extremely hard rock , DIABASE. Fractures are closed to narrow, slightly rough to rough, stained red, yellow and black and coated with iron oxide, calcite crystals and chlorophaeite. Fractures dip sub- horizontally, 20˚, 60˚ and sub-vertically.
NWD4									6		
	99	4 to 5	84	*	301 MPa				7		
									8		
	100		100						9		
				*	243 MPa						
	100		56						10		
									11		
									12		
									13		
									14		
									15		
									16		
									17		
									18		
									19		
									20		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 62
SHeet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 20/09/07-25/09/07
LOGGED BY: JFR/JFR (26/09/07)

LOCATION: Generator Transformer
X CO-ORD: +2 867 603.240
Y CO-ORD: +8 629.050
ELEVATION: 1 499.416m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100								2	
	100									
	100								3	
	100									
	100								4	
	100									
	100								5	
	100									
	100								6	
	100									
	100								7	
NWD4	100	22	0							
	100	18	13						8	
	99	25	0							
	99	24	0						9	
	99	22	7							
	99	29	0						10	
	99	14	42							
	99	24	0						11	
	97	21	13							
	100	23	0						12	
	100	26	13							
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±0,70m Orange-brown SANDY CLAY, with occasional medium and fine GRAVELS; hillwash.

±0,70-7,55m Orange-brown banded yellowish orange and red-brown, probably stiff, jointed (stained red and black) CLAYEY SILT; residual Rayton shale.

Becomes very stiff below ±5,70m.

7,55-8,35m Yellowish orange banded dark brown, highly weathered, very fine grained, very thinly bedded, highly fractured, soft rock, RAYTON SHALE. Fractures are narrow and wide, slightly rough, stained red and black and frequently filled with clayey silt. Fractures dip at 15-25˚ (bedding plane separations).

8,35-18,10m Dark brown banded yellowish orange and occasionally yellowish grey, highly to moderately weathered, very fine grained, very thinly bedded, highly fractured, moderately hard rock, RAYTON SHALE, with zones of residual clayey silt from 8,75-9,20m, 11,00-11,60m and 16,20-16,30m. Fractures are very narrow to wide, slightly and moderately rough, stained red and black and frequently filled with silt. Fractures dip at 15-25˚ (bedding plane separations), with several prominent 60-70˚ and 80-90˚ dipping fractures.

Becomes hard rock below 15,15m.

18,10-20,07m Dark greenish grey occasionally banded yellowish grey, slightly weathered, very fine grained, very thinly bedded, highly fractured, very hard rock, RAYTON SHALE. Fractures very narrow, slightly and moderately rough and stained with iron oxide. Fractures dip at 15-25˚ (bedding plane separations), with occasional 60-70˚ and 80-90˚ dips.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 63
Sheet: 1 of 1

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: TONE TAS
DRILLING DATES: 15/09/07-18/09/07
LOGGED BY: JFR/JFR (20/09/07)

LOCATION: Generator Transformer
X CO-ORD: +2 867 682.360
Y CO-ORD: +8 708.170
ELEVATION: 1 496.950m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	100									
	100									
	100									
	100			⊣	30				2	
	100									
	100									
	100			*	3 MPa				3	
	99	8	59						4	
				*	5 MPa				5	
	100	17	14						6	
NWD4	100	>5	0							
	100	24	10						7	
	100	7	58						8	
	100	12	34						9	
									10	
	100	7	69						11	
									12	
	100	5	56						13	
	100	<1	100						14	
	100	2	86						15	
									16	
									17	
									18	
									19	
									20	

CORE DESCRIPTION

0,00-±1,20m Red-brown probably stiff, fissured SANDY CLAY, with occasional GRAVELS and COBBLES of hard quartzite and shale; hillwash.

±1,20-2,40m Red-brown mottled yellowish orange, firm to stiff, SANDY CLAYEY SILT; residual diabase.

2,40-6,35m Dark brown speckled yellow and orange-brown, highly weathered, medium grained, highly fractured, very soft rock, DIABASE. Fractures are very narrow and narrow, slightly rough, stained red and black and filled with silt in places. Fractures dip 10-20˚, 40-50˚ and 70-80˚.

Becomes soft rock below 4,20m.

Becomes very highly fractured, very soft rock, below 5,90m.

6,35-7,70m Yellowish grey mottled dark brown and dark grey, moderately weathered, medium grained, very highly fractured, hard rock (with a few thin zones of soft rock and moderately hard rock), DIABASE. Fractures are narrow and very narrow, slightly rough, stained orange and dark brown and filled with silt in places. Fractures dip at 10-20˚, 40-50˚ and 70-80˚.

Becomes highly fractured below 6,80m.

7,70-15,76m Dark grey speckled pale grey, slightly weathered, medium grained, highly fractured, very hard rock, DIABASE. Fractures are very narrow to narrow, slightly to moderately rough, stained black and orange-brown and filled with silt (chlorophaeite) or calcite in places. Fractures dip at 10-20˚, 40-50˚ and 70-80˚.

Becomes slightly and very slightly fractured below 13,30m.

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
* UCS DERIVED FROM POINT LOAD TEST

L.F. LAMINAR FLOW
T.F. TURBULENT FLOW
DIL. DILATION
W.O. WASH-OUT
V.F. VOID FILLING
U.L. UNIT LUGEON

PARTRIDGE, MAUD AND ASSOCIATES

CONSULTANTS IN THE EARTH SCIENCES

BOREHOLE LOG

Borehole No.: BH 64
Sheet: 1 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 20/09/07-22/09/07
LOGGED BY: JFR/JFR (24/09/07)

LOCATION: Waste Water Treat. Plant
X CO-ORD: +2 867 040.900
Y CO-ORD: +8 211.930
ELEVATION: 1 502.069m
INCLINATION: Vertical
DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG
NXC	100								1	
	67									
	93								2	
	100									
	100								3	
	100								4	
									5	
NWD4	100	2	100						6	
	100	3	100	*	4 MPa				7	
	96	14	32						8	
	96	15	30						9	
				*	2 MPa				10	
	97	7	60						11	
	100	6	70						12	
									13	
	100	6	69	*	8 MPa				14	
									15	
	100	6	70						16	
									17	
	100	4	92						18	
									19	
	100	3	92						20	

CORE DESCRIPTION

0,00-±2,10m Abundant coarse medium and fine quartzite GRAVELS in a matrix of brown SILTY SAND; pebble marker.

±2,10-5,65m Orange-brown mottled buff and dark brown, probably dense, jointed, SILTY SAND, with scattered fine (up to 10mm diameter) hard, GRAVELS (clasts); residual Dwyka tillite.

5,65-13,70m Buff banded yellowish orange and pale grey, highly weathered, very fine grained, thinly bedded, moderately to highly fractured (but highly fractured from 8,20-9,30m and 9,80-10,50m), very soft rock, DWYKA SHALE with 10-30cm wide zones of soft rock or moderately hard rock at 6,00m, 12,20m and 13,10m. Fractures are very narrow and narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ (bedding plane separations), 50-60˚ and 80-90˚.

13,70-19,65m Dark brown banded grey-brown and yellowish orange, highly weathered, very fine grained, thinly bedded, moderately to highly fractured, soft rock, DWYKA SHALE, with a number of thin siltstone/sandstone horizons. Fractures are very narrow and narrow, slightly rough, stained red-brown and filled with silt in places. Fractures dip at 0-10˚ (bedding plane separations), 50-60˚ and 80-90˚.

See next page for description

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)
PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
UNCONFINED COMPRESSIVE STRENGTH (UCS)/TRIAXIAL (TR)/ SHEAR BOX (SB)
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BOREHOLE LOG

Borehole No.: BH 64
Sheet: 2 of 2

PROJECT: BRAVO
CONTRACTOR: RWBE Geotechnical Drilling
MACHINE: YWE D90R
DRILLING DATES: 20/09/07-22/09/07
LOGGED BY: JFR/JFR (24/09/07)

LOCATION: Waste Water Treat. Plant
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DIRECTION: -

DRILLING METHOD AND SIZE	CORE RECOVERY (%)	FRACTURE FREQUENCY (No/m)	RQD	STRENGTH TESTS TYPE	STRENGTH TESTS VALUE	WATER TESTS TYPE	WATER TESTS VALUE	WATER DETAILS	DEPTH (m)	SYMBOLIZED LOG	CORE DESCRIPTION
NWD4	100	-	-						21		19,65-21,39m Orange-brown banded yellowish grey, dark grey and red-brown, probably very stiff, laminated, jointed, CLAY-SILT; residual Dwyka shale.
									22		
									23		
									24		
									25		
									26		
									27		
									28		
									29		
									30		
									31		
									32		
									33		
									34		
									15		
									36		
									37		
									38		
									39		
									40		

CASING
WATER REST LEVEL
WATER LOSS
STANDARD PENETRATION TEST (SPT) WITH N-VALUE (BLOWS/300mm)

PERMEABILITY (PT)/WATER PRESSURE TEST (WP)
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