RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Noise & Vibration
Occupational Hygiene

RCA ref 9325-201/1

30 April 2014

Upper Hunter Holdings Pty Limited
c/- KMH Environmental
Level 1, 81 Hunter Street
NEWCASTLE NSW 2300

Attention: Mr Adam Bishop

PRELIMINARY RESOURCE ESTIMATE FOR PROPOSED STAGE 1 CONSTRUCTION MATERIALS QUARRY 'DOLWENDEE', GOLDEN HIGHWAY, HOLLYDEEN

1 INTRODUCTION

This report presents a preliminary resource estimate for Stage 1 of a proposed Construction Materials Quarry (herein referred to as proposed quarry - Stage 1) to be located in Lot 2 of the 'Dolwendee' Estate near Hollydeen.

The purpose of this preliminary resource estimate is to determine if a construction materials resource equal to or in excess of 5 million tonnes exists within Lot 2 of the 'Dolwendee' Estate.

This preliminary geotechnical resource estimate of the proposed quarry - Stage 1 was undertaken at the request of Mr Gary Williams, as per email instructions dated 11 February 2013. It is understood that Mr Gary Williams is acting on behalf of Upper Hunter Holdings Pty Limited.

The preliminary resource estimate of Stage 1 of the proposed quarry is based on review and analysis of four cored boreholes drilled on site, preliminary materials testing results and supplied plans of client nominated quarry location and environmentally sensitive areas affecting the proposed quarry area.

2 PREVIOUS INVESTIGATION

As part of the investigation of a potential quarry location, four (4) cored bores were drilled at client specified locations in the vicinity of a proposed quarry area, located within Lot 2 of 'Dolwendee', as shown on **Drawing 1**, attached. The cored boreholes BH1 to BH4 were drilled to depths ranging from 27.15m to 30.1m, as per client nominated depths. Copies of the cored borehole logs and core photographs for BH1 to BH4 are attached.

In brief, BH1 to BH4 encountered a sequence of conglomerate and pebbly sandstone with occasional lithic sandstone. Only BH1 encountered a claystone band and a coal band; which could be used as bedding 'marker' units.

Unfortunately these 'marker' units were not encountered in BH2 to BH4, therefore no estimation of bedding dip could be undertaken.

3 INFERRED GEOLOGY

Reference to NSW Geological Survey (NSW GS) geo-referenced 1: 100,000 Hunter Coalfield Geology Google overlay indicated the client proposed quarry - Stage 1 area traverses the geological boundary between the Wollombi Coal Measures Glen Gallic Sub-group and the overlying Narrabeen Group Widden Brook Conglomerate, as shown on **Drawing 2**, attached. Based on NSW GS mapping it appears BH1 was located within the mapped extent of the Glen Gallic Sub-group and BH2 to BH4 were located within the mapped extent of the overlying Widden Brook Conglomerate.

The rock core recovered from BH1 to BH4 appears to be consistent with the geology shown on the NSW GS 1: 100,000 Hunter Coalfield Geology sheet.

The nearest cross-section on the NSW GS 1: 100,000 Hunter Coalfield Geology sheet indicates the base of the Wollombi Coal Measures dips in a westerly direction at approximately 10º. Reference to NSW DMR notes for the Hunter Coalfield indicates the Widden Brook Conglomerate directly overlies the Greigs Creek Coal Seam (the uppermost coal seam in the Wollombi Coal Measures) with little or no erosion (washout) in many places.

4 PREVIOUS MATERIALS ASSESSMENT

A preliminary assessment of material quality based on tactile appraisal and point load testing of the core recovered from BH1 to BH4 and experience with similar material was presented in RCA Australia (RCA) report 9325-101/0 dated 18 July 2012. In brief, the preliminary material assessment concluded the following:

- Crushed conglomerate/sandstone would not be expected to meet aggregate requirements due to particle durability. The shape and size of the pebbles would also limit the yield of aggregate and size range that can be produced.
- Crushed conglomerate/sandstone would not be expected to meet the RMS pavement material requirements for sealed roads (QA 3051 2011). In particular, the wet/dry strength criteria would be unlikely to be met.

- Crushed conglomerate (blended with minor amounts of sandstone) would be expected to produce pavement material suitable for unsealed rural roads.
- Crushed conglomerate/minor sandstone would be expected to produce a subbase material suitable for sealed rural roads.
- Crushed conglomerate/sandstone would be expected to produce good unsealed hardstand type pavement material.
- It is likely that the finer material produced from crushing of conglomerate/sandstone rock could be processed to meet pipeline trench back fill requirements for drainage works, by removing plastic fines.

The preliminary assessment recommended materials testing of representative sections of the rock core retrieved from cored boreholes be undertaken. As a first pass, material testing could comprise the following:

- Acid rock potential (*not yet undertaken*).
- California Bearing Ratio test after crushing of core and pre-treatment (*four tests completed in Sept-Oct 2012*).
- Plasticity index (*four tests completed in Sept-Oct 2012*).
- Point load strength (*completed in April 2012*).
- Unconfined compressive strength (*not yet undertaken*).
- Wet/dry strength ratio (*not yet undertaken*).

Limited laboratory testing comprising California Bearing Ratio, Plasticity Index and Point Load Strength was undertaken on representative sections of the rock core retrieved from cored boreholes BH1 to BH4. A summary of the limited laboratory materials test results completed to date is presented in **Table 1**.

Table 1 *Summary of Limited Material Test Results*

BH No.	Core Sample		Test Result	
	Depth (m)	Description	CBR (%)	PI (%)
BH 1	8-11	DW-SW Crushed pale brown-grey conglomerate	50/50	6
BH 2	24-26	SW-Fresh Crushed pale grey conglomerate	40/45	3
BH 3	3-5	DW Crushed pale brown conglomerate	50/60	2
BH 4	10-12	DW Crushed pale brown conglomerate	40/40	3

A material assessment based on the results of limited laboratory testing was presented in RCA report 9325/1 dated 13 September 2012. The limited test results supported the preliminary assessment presented in RCA report 9325-101/0 dated 18 July 2012, as summarised above.

5 ADDITIONAL INVESTIGATION RESULTS

5.1 SITE INSPECTION

A site inspection was carried out by an RCA principal engineering geologist in March 2013 to assess the existing surface conditions in the vicinity of the proposed quarry location, including the sandstone cliffs and slopes of a hilltop plateau remnant. A panoramic view of western portion of Lot 2 'Dolwendee' Estate is presented in **Photograph 1** below.

Photograph 1 *Panorama of western portion of Lot 2 'Dolwendee' Estate, note rock outcrop/cliff faces of hilltop plateau remnant in middle-right background.*

No surface expression of deep-seated slope instability was observed within the client proposed quarry location or its immediate environs during site inspection in March 2013.

Past rock falls well embedded in soil profile were observed around the base of the rock cliffs that comprise the hill top plateau remnant, as shown in **Photograph 2**. It appears the observed rock falls have resulted from differential weathering of rock outcrop creating rock overhangs that fail once the underside of a natural rock mass defect is exposed and/or 'root jacking' of rock blocks by trees propagating in natural rock mass defect(s).

Photograph 2 *Central southern area of proposed quarry - note several boulders (old rock fall/roll boulders) on right-hand side slope.*

5.2 GROUNDWATER OBSERVATIONS

No groundwater was observed prior to rock coring water recirculation drilling techniques commencing in BH1 to BH4 in April 2012.

At the request of RCA the client dipped the boreholes in June 2013 to determine if there was any standing groundwater in boreholes. The groundwater observations from the client borehole inspection are presented in **Table 2**.

Table 2 *Summary of Client Groundwater Observations in BH1 to BH4 June 2013*

BH No.	Surveyed Collar RL (m AHD)	BH drilled depth (m)	BH inspected to depth (m)	Comments
BH1	216.71	30	16	No free water encountered. BH had collapsed below inspection depth.
BH2	225.61	30.1	25	As above
BH3	211.58	30	11	As above
BH4	221.56	27.15	20	As above

5.3 ROCK CORE DENSITY

To facilitate resource estimation, laboratory core density testing was undertaken on representative sections of rock core retrieved from BH1 to BH4 in March 2013. The test results indicated the mean core density is 2.318 Tonnes/m^3.

6 STAGE 1 QUARRY CONSTRAINTS

Based on the limited drilling and materials testing, it was agreed by the quarry proponents that Stage 1 of the proposed Quarry should be constrained by:

- depth of the existing cored boreholes, nominally 30m;
- Lot 2 boundaries; and
- environmentally sensitive areas identified by regulatory authorities.

RCA advised that Stage 1 of the proposed quarry should be setback from the existing sandstone cliffs and steep slopes to:

- prevent the proposed quarry development affecting the stability of existing hilltop sandstone cliffs, rock formations and steep slopes;
- allow for construction of a safety berm to provide a safety berm around top of quarry walls; and
- allow for construction of a perimeter drain to divert upslope runoff around the proposed quarry safety berm.

KMH Environmental recommended a 20m buffer from the NSW Government Restricted Use of Land (RUL) area to allow for safety berm and diversion drains to constructed between the RUL area and the perimeter of Stage 1 of the proposed quarry.

Based on the limited geotechnical data available at this stage of the planning process the conceptual design adopted for the proposed quarry walls comprises batters up to 10m in height, with 4m wide benches, as discussed in next section of this report.

7 PRELIMINARY RESOURCE ESTIMATION FOR STAGE 1 QUARRY

Based on the development constraints discussed above, RCA plotted a potential plan area for Stage 1 of the proposed quarry in Lot 2 of the 'Dolwendee' Estate, as shown in **Drawing 1**, attached. The proposed plan area for Stage 1 occupies an area of some 10.7 hectares as measured using AutoCAD 2010 software.

Reference to the NSW Geological Survey 1:100,000 Hunter Coalfield Sheet that covers the proposed quarry - Stage 1 area in Lot 2 of the 'Dolwendee' Estate indicates the geological units encountered in the cored boreholes extend to the north of the existing borehole locations, as shown on **Drawing 2**, attached. However, it is likely that the thickness of the Narrabeen Group conglomerate encountered in BH2 to BH4 decreases towards the geological boundary with the Wollombi Coal Measures.

The inferred location of the geological boundary with the Wollombi Coal Measures is located along the proposed northern extent of Stage 1, as shown on **Drawing 2**, attached.

Additional cored boreholes CBH5 and CBH6 as shown on **Drawings 1** and **2** are needed to confirm construction material resource extends north of existing cored borehole locations, within the proposed quarry - Stage 1 area and provide additional data needed for geotechnical stability analysis.

Geotechnical cross-sections of the proposed quarry - Stage 1 conceptual design used for resource estimation are presented in **Drawings 3** and **4**, attached. It should be noted these conceptual cross-sections have been drawn at a 5 to 1 vertical exaggeration.

The conceptual quarry wall arrangements for the proposed quarry - Stage 1 shown on attached **Drawings 3** and **4** have been drawn based on:

- 2H: 1V batter for soil/EW rock where adjacent ground surface slopes towards the proposed quarry;
- 1.5: 1V batter for soil/ EW rock where adjacent ground surface slopes away from the proposed quarry and/or at transition from EW to HW rock;
- benches nominally cut at 5.7H: 1V back into slope, four (4) metres wide and at a maximum vertical interval of ten (10) metres;
- 0.5H: 1V batter for DW to SW competent massive bedrock (as encountered from depths of 4.5 to 7.5m in BH1 to BH4) to a maximum height of ten (10) metres;
- 100H: 1V quarry floor sloping away from high walls to facilitate pit drainage;
- a maximum quarry depth of 32-35m to suit depth of investigation completed to date.

The conceptual benched batter parameters listed above yield an overall quarry high wall slope of approximately1.15H: 1V to 1.3H: 1V, which is considered geotechnically appropriate until further investigation and stability analysis is completed, as discussed in the next section of this report.

Measurements used in calculating the volume of the potential construction materials resource are shown on **Drawings 3** and **4**.

Allowing for conceptual batter arrangements, volumetric calculations indicate the proposed extent of Stage 1 of the proposed quarry as shown in **Drawings 1** to **4** comprises a potential construction materials resource of some 2.8 Million cubic metres.

Based on the results of density testing the average core density is 2.318 Tonnes/m^3. Multiplying the estimated volume of Stage 1 (~2.8 Million cubic metres) by the average core density yields:

- An estimated construction material resource of some **6.5 Million Tonnes** for Stage 1 of the proposed quarry.

8 FURTHER INVESTIGATION

As part of the planning process for Stage 1 of the proposed Quarry it is recommended:

- Proposed cored boreholes CBH5 and CBH6 are drilled to nominal depth of 60m. Nominal locations for CBH5 and CBH6 are shown on **Drawings 1** and **2**.
- CBH5 and CBH6 should be drilled to intersect 'marker' units and BH collar surveyed for estimation of bedding dip within the proposed quarry area for global stability analysis of quarry wall design options.
- Flushing of boreholes after drilling completed, then installation of piezometers to monitor groundwater levels monthly over a one to three year cycle prior to quarry construction.
- Clean out and drill BH2 or BH4 to 60m and install a piezometer as part of the groundwater monitoring programme.
- Additional materials testing as recommended in 9325-101/0 should be completed.
- It may be appropriate to conduct shear box tests on pervasive bedding partings and/or joint sets, if suitable samples are recovered from the additional cored boreholes to be used in global stability analysis of conceptual quarry design.
- Carry out stability analysis on quarry wall options for quarry design and management plan.

From a geotechnical point of view there is scope for expansion and deepening of the proposed Quarry in Lot 2 once Stage 1 is complete. Further investigation would need to include CBH7 to CBH9 to assess feasibility of potential for quarry expansion (Stage 2) and quarry deepening (Stage 3), as shown on **Drawings 3** and **4** attached. Nominal locations for CBH7 to CBH9 are shown on **Drawings 1** and **2**.

Additional boreholes CBH7 to CBH9 are needed to:

- confirm the construction material resource extends north of proposed Stage 1 quarry area into the remainder of Lot 2;
- intersect 'marker' units for estimation of bedding dip within the proposed quarry area;
- provide additional samples for material testing;
- provide additional data for quarry wall stability analysis; and

- assess the potential resource to depth of 60m.

Yours faithfully
RCA AUSTRALIA

Jeremy Everitt
Principal Engineering Geologist

Robert Carr
Principal Geotechnical Engineer

Attachments:

Drawing 1 – Site Plan, Stage 1 – proposed quarry.

Drawing 2 – Inferred Geology, Stage 1 – proposed quarry

Drawing 3 – Conceptual Geotechnical Section A-A through Stage 1 – proposed quarry

Drawing 4 – Conceptual Geotechnical Section B-B through Stage 1 – proposed quarry

BH1 to BH4 Cored Borehole Logs and Photographs.

LEGEND

- Cored borehole location (as surveyed) April 2012
- RCA cored proposed borehole location
- Boardman Peasley plot of ESA
- Boardman Peasley plot of RUL
- Proposed area for Stage 1 CMT Quarry
- Cross section location

0 25 50 75 100
metres

NOTE: Drawing adapted from plan supplied by Boardman Peasley Pty Ltd
Job No. S4953, Plan No. 001, Rev A
Dated February 2013

CBH8
CBH9
CBH7
CBH5
CBH6
BH1
BH2
BH3
BH4

Pt. 1
(8.003ha)

Stage 1 - Area ~107,000m²

5
45.89 ha

2
40 ha

4
40.55 ha

A
A
B
B

Locality Plan
N.T.S.

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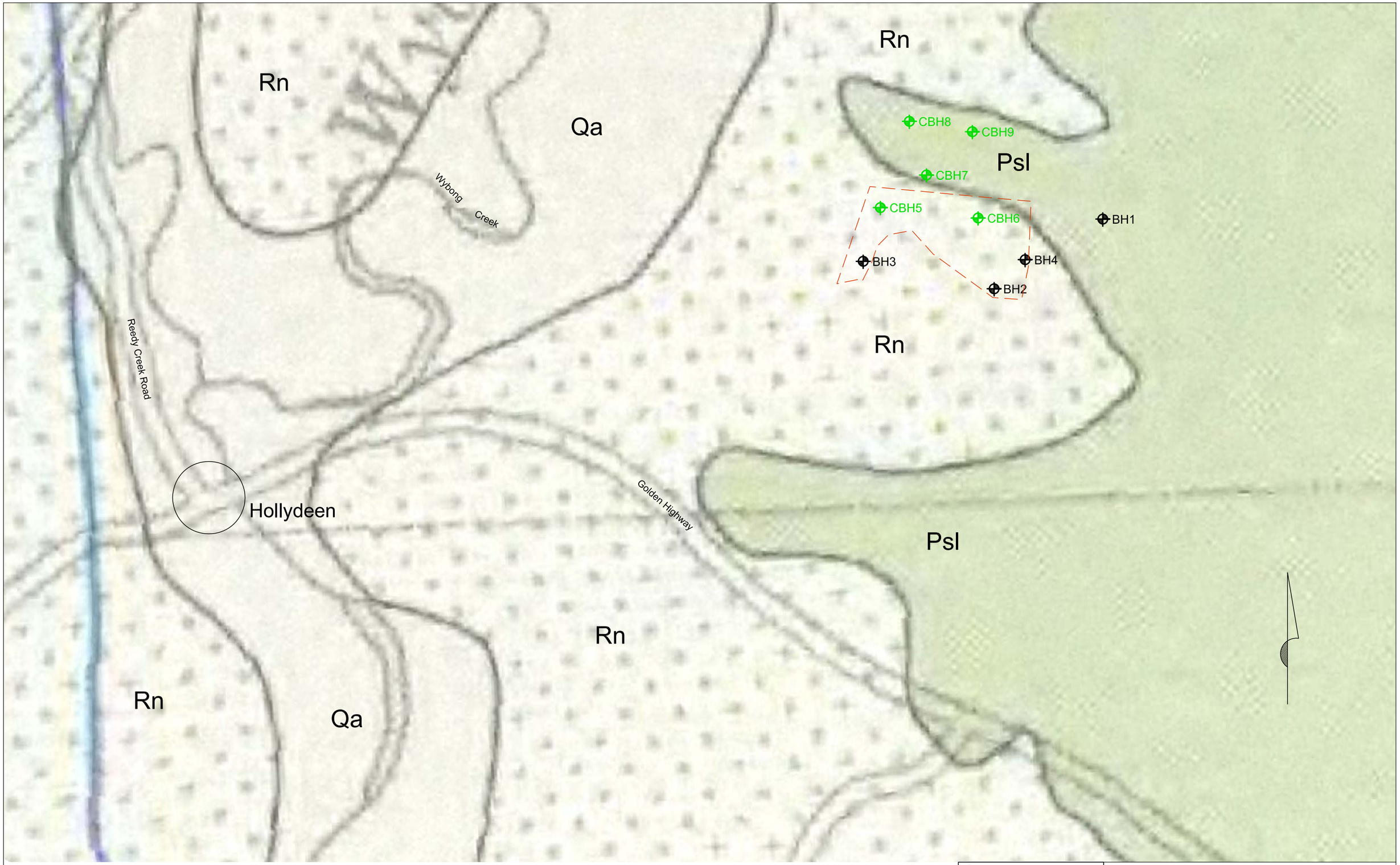
SITE PLAN
STAGE 1 PROPOSED QUARRY
LOT 2 'DOLWENDEE' ESTATE
GOLDEN HIGHWAY
HOLLYDEEN

CLIENT	Upper Hunter Holdings Pty Limited			RCA Ref	9325/201/1
DRAWN BY	JE	SCALE	1 : 2500 (A3)	DRAWING No 1	REV 1
APPROVED BY	RJC	DATE	30/4/2014	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



LEGEND

- Cored boreholes, April 2012
- RCA proposed cored borehole location
- Proposed area for Stage 1 CMT Quarry

0 20 40 60
metres

NSW Geological Survey Geology

Symbol	Name	Description
Qa	Quaternary Alluvium	Silty, sand, gravel
Rn	Narrabeen Group	Conglomerate & Sandstone, with minor siltstone, Claytone
Psl	Wollombi Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate

Geology based on NSW DMR Hunter Coal field Regional Geology, 1 : 100000 (1993)

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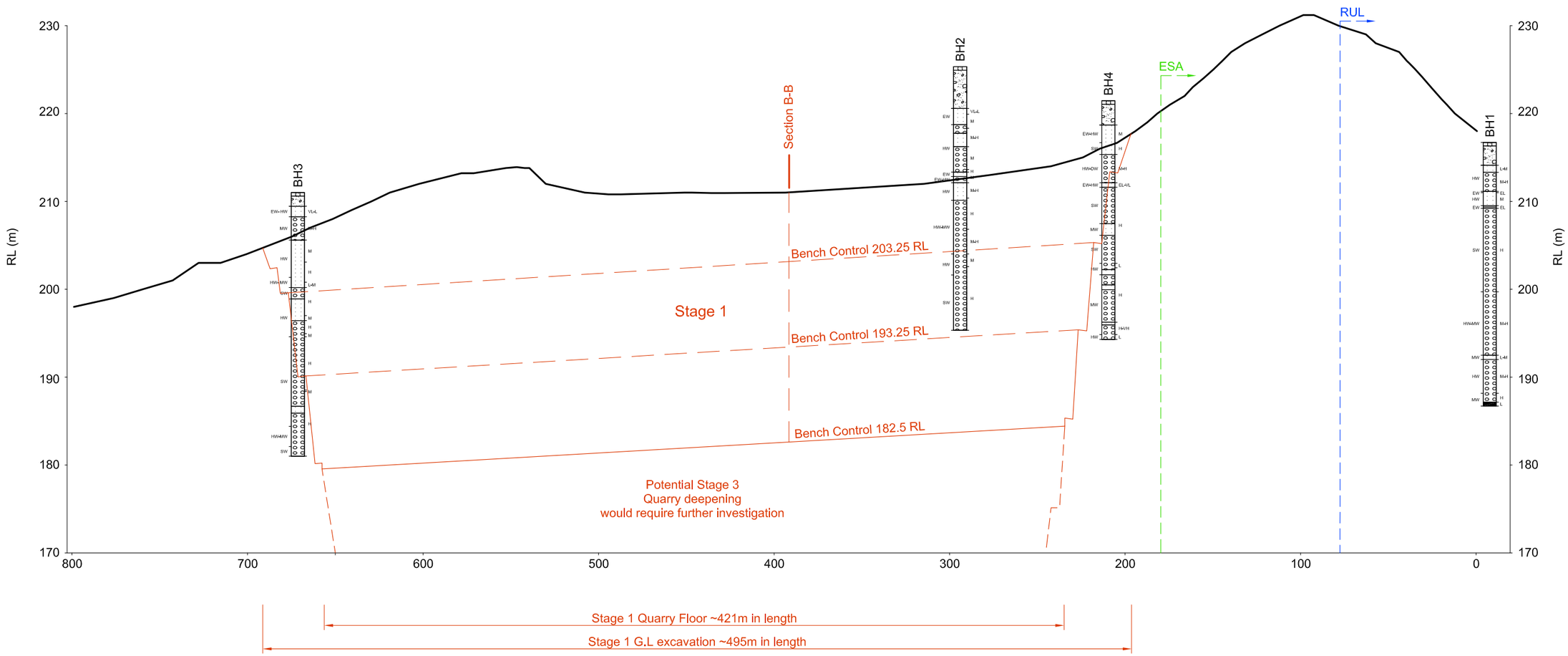
INFERRED GEOLOGY
STAGE 1 PROPOSED QUARRY
LOT 2 'DOLWENDEE' ESTATE
GOLDEN HIGHWAY
HOLLYDEEN

CLIENT	Upper Hunter Holdings Pty Limited			RCA Ref	9325/201/1
DRAWN BY	JE	SCALE	1 : 10000 (A3)	DRAWING No 2	REV 1
APPROVED BY	RJC	DATE	30/4/2014	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



Geotechnical Section A-A Through
Stage 1 CMT Quarry Conceptual Design for Resource Estimation

Conceptual Quarry Design for Resources Estimation Based on:

1. 2H:1V batter for Soil/Extremely weathered rock, where adjacent ground surface slopes towards quarry
2. 1.5H:1V batter for Soil/EW rock, where adjacent ground surface slopes away from quarry
3. 5.7H:1V benches nominally 4m wide at maximum interval of 10m
4. 0.5H:1V batter for HW-SW competent massive bedrock, maximum height of 10m
5. 100H:1V adopted slope of quarry floor to promote drainage
6. Maximum quarry depth of 30m to suit depth of investigation boreholes

Scale

Horizontal = 1 : 2500

Vertical = 1 : 500

Vertical Exaggeration 5 to 1

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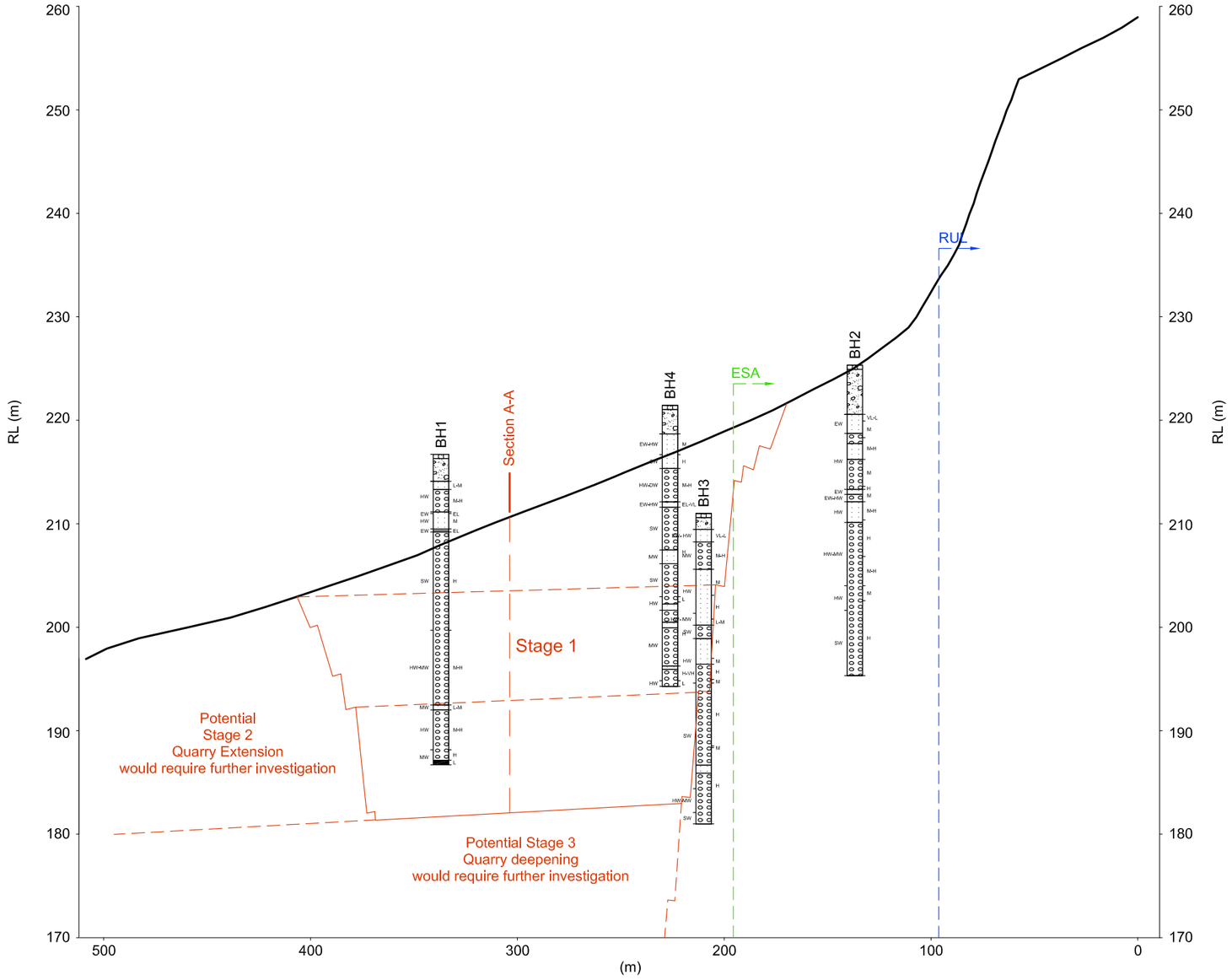
CONCEPTUAL GEOTECHNICAL SECTION A-A
STAGE 1 PROPOSED QUARRY
LOT 2 'DOLWENDEE' ESTATE
GOLDEN HIGHWAY
HOLLYDEEN

CLIENT	Upper Hunter Holdings Pty Limited			RCA Ref	9325-201/1
DRAWN BY	JE	SCALE	As Shown	DRAWING No 3	REV 1
APPROVED BY	RJC	DATE	29/4/2014	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



Geotechnical Section B-B Through
Stage 1 CMT Quarry Conceptual Design for Resource Estimation

Conceptual Quarry Design for Resources Estimation Based on:

1. 2H:1V batter for Soil/Extremely weathered rock, where adjacent ground surface slopes towards quarry
2. 1.5H:1V batter for Soil/EW rock, where adjacent ground surface slopes away from quarry
3. 5.7H:1V benches nominally 4m wide at maximum interval of 10m
4. 0.5H:1V batter for HW-SW competent massive bedrock, maximum height of 10m
5. 100H:1V adopted slope of quarry floor to promote drainage
6. Maximum quarry depth of 30m to suit depth of investigation boreholes

Scale

Horizontal = 1 : 2500

Vertical = 1 : 500

Vertical Exaggeration 5 to 1

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CONCEPTUAL GEOTECHNICAL SECTION B-B
STAGE 1 PROPOSED QUARRY
LOT 2 'DOLWENDEE' ESTATE
GOLDEN HIGHWAY
HOLLYDEEN

CLIENT	Upper Hunter Holdings Pty Limited			RCA Ref	9325-201/1
DRAWN BY	JE	SCALE	As Shown	DRAWING No 4	REV 1
APPROVED BY	RJC	DATE	29/4/2014	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

GEOTECHNICAL BOREHOLE LOG

BH1

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PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 17/04/2012
DATE COMPLETED: 17/04/2012
SURFACE RL: 216.71 m AHD
COORDS: 278865.51 m E 6421097.58 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered)			216.5	0.40		ML	Sandy SILT, low plasticity, grey-brown, fine to coarse grained sand, with gravel, trace of clay	D - M		RESIDUAL
					0.5		GP-GM	Silty Sandy GRAVEL, fine to medium, brown-red-grey, fine to coarse grained sand			
				216.0	1.0						
				215.5	1.5						
				215.0	2.0						
				214.5	2.5						
								CONTINUED AS CORED BOREHOLE			
				214.0	3.0						
				213.5	3.5						
				213.0	4.0						
				212.5	4.5						
				212.0							

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH1

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Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				216.5	0.5						
				216.0	1.0						
				215.5	1.5						
				215.0	2.0						
				214.5	2.5		START CORING AT 2.60m				
NMLC		100	99	214.0	3.0		SANDSTONE/CONGLOMERATE, fine to coarse grained lithic sand, pale brown, rounded gravel up to 10mm	HW			DZ 0°
		100	96	213.5	3.5		CONGLOMERATE, fine to coarse up to 20mm, pale grey-pale brown, fine to coarse grained lithic sand matrix, with pebbly sandstone bands				
				213.0	4.0						
				212.5	4.5						
				212.0							

2.60
3.40

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
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NMLC		100	96	211.5	5.5		CONGLOMERATE, fine to coarse up to 20mm, pale grey-pale brown, fine to coarse grained lithic sand matrix, with pebbly sandstone bands	HW			
					5.57		Pebbly SANDSTONE, fine to medium grained, dark brown-red, lithic, rounded gravel up to 20mm, with clay laminations	EW			DZ/FZ
				211.0				HW			
					6.0						
				210.5							
					6.5						
				210.0							
					7.0						
				209.5	7.20		CLAYSTONE, pale brown	EW			DZ
					7.50		CONGLOMERATE, fine to coarse gravel up to 20mm, pale grey-orange-brown, rounded, fine to medium grained lithic sand matrix	SW			
		100	100	209.0							
					8.0						
				208.5							
					8.5						
				208.0							
					9.0						
				207.5							
					9.5						
				207.0							

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

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NMLC		100	100	206.5	10.5		CONGLOMERATE, fine to coarse gravel up to 20mm, pale grey-orange-brown, rounded, fine to medium grained lithic sand matrix	SW			
				206.0	11.0						
					11.17						
		100	100	205.5	11.5		CONGLOMERATE, fine to coarse gravel up to 25mm, grey-brown, rounded-sub rounded, fine to coarse grained quartoze/lithic sand matrix				BP 0° CN PR RF
				205.0	12.0						
				204.5	12.5						
				204.0	13.0						
				203.5	13.5						
				203.0	14.0						
				202.5	14.5						
				202.0							

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
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SURFACE RL: 216.71 m AHD
COORDS: 278865.51 m E 6421097.58 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	100	201.5	15.5		CONGLOMERATE, fine to coarse gravel up to 25mm, grey-brown, rounded-sub rounded, fine to coarse grained quartoze/lithic sand matrix	SW			
				201.0	16.0						
				200.5	16.5						
				200.0	17.00						
		100	100	199.5	17.5		CONGLOMERATE, fine to coarse gravel up to 40mm, grey-red-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with pebbly sandstone bands	HW - MW			BP 0° SN PR RF
				199.0	18.0						
				198.5	18.5						
				198.0	19.0						
				197.5	19.5						
				197.0							

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 17/04/2012
DATE COMPLETED: 17/04/2012
SURFACE RL: 216.71 m AHD
COORDS: 278865.51 m E 6421097.58 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	100	196.5	20.5		CONGLOMERATE, fine to coarse gravel up to 40mm, grey-red-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with pebbly sandstone bands	HW - MW			
				196.0	21.0						
				195.5	21.5						
				195.0	22.0						
				194.5	22.5						
				194.0	23.0						
				193.5	23.5						
				193.0	24.0						
				192.5	24.22						
		100	95		24.5		Pebbly SANDSTONE, fine to coarse grained, brown, lithic, rounded-sub rounded gravel up to 15mm	MW			BP 0° CN PR RF
				192.0	24.70		CONGLOMERATE, fine to coarse gravel up to 50mm, grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with sandstone layers/bands	HW			

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 17/04/2012
DATE COMPLETED: 17/04/2012
SURFACE RL: 216.71 m AHD
COORDS: 278865.51 m E 6421097.58 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	95	191.5	25.5		CONGLOMERATE, fine to coarse gravel up to 50mm, grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with sandstone layers/bands	HW			BP 0° SN PR RF
				191.0	26.0						
				190.5	26.5						
				190.0	27.0						BP 10° Clay IR RF
				189.5							CZ 0°
											BP 0° CN PR RF
				189.0	27.5						
					28.0						
				188.5							
					28.5						
					28.55		CONGLOMERATE, fine to coarse gravel up to 60mm, pale grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matric, with pebbly sandstone bands	MW			
				188.0							
					29.0						
				187.5							
					29.5						
					29.56		COAL, black, thinly laminated				CZ 0°
				187.0							BP 10° CN PR S
											BP 10° CN PR S
											BP 0° CN PR S

CORED BOREHOLE BH1 TERMINATED AT 30.00 m

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH1	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH1	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH1	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH1	**RCA ref:** 9325

GEOTECHNICAL BOREHOLE LOG

BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered)			255.5	0.40		ML	Sandy SILT, grey-brown, fine to coarse grained sand, with gravel, trace of clay	M		RESIDUAL
				255.0	0.5		GP-GM	Silty Sandy GRAVEL, fine to medium, brown-grey, fine to coarse grained sand			
				254.5	1.0						
				254.0	1.5						
				253.5	2.0						
				253.0	2.5						
				252.5	3.0						
				252.0	3.5						
				251.5	4.0						
				251.0	4.5						
								CONTINUED AS CORED BOREHOLE			

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				255.5	0.5						
				255.0	1.0						
				254.5	1.5						
				254.0	2.0						
				253.5	2.5						
				253.0	3.0						
				252.5	3.5						
				252.0	4.0						
				251.5	4.5						
				251.0			START CORING AT 4.75m				
NMLC		100	87		4.75		Gravelly Pebbly SANDSTONE, fine to coarse grained, brown-grey, lithic, rounded-sub rounded gravel up to 40mm, interbedded with clay	EW			CZ/DZ 0°

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	87	250.5	5.5		Gravelly Pebbly SANDSTONE, fine to coarse grained, brown-grey, lithic, rounded-sub rounded gravel up to 40mm, interbedded with clay	EW			BP 20° SN PR RF
				250.0	6.0						CZ/DZ
				249.5	6.5						DZ 5° BP/DZ 5° SN IR RF
				249.0	6.59						BP 5 - 10° SN PR RF
					7.0		CONGLOMERATE, fine to coarse gravel up to 45mm, pale grey-pale brown, rounded-sub rounded, fine to coarse grained lithic sand matrix	HW			
				248.5	7.5						BP 0° CN IR RF
		100	98	248.0	7.57		SANDSTONE, fine to medium grained, pale grey-orange-brown, lithic, with fine gravel, with clay bands up to 100mm thick				BP 10° CN PR S
					8.0						BP 10° SN PR S
				247.5							
					8.5						
				247.0							
					9.0						
				246.5	9.10		CONGLOMERATE, fine to coarse gravel up to 30mm, pale grey-pale brown, rounded-sub rounded, fine to coarse grained lithic sand matrix				
		100	98		9.5						BP 5° CN IR RF
				246.0							BP 0° CN PR RF

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	98	245.5	10.5		CONGLOMERATE, fine to coarse gravel up to 30mm, pale grey-pale brown, rounded-sub rounded, fine to coarse grained lithic sand matrix	HW			
				245.0							
				244.5	11.0						
				244.0	11.5						BP 0° CN IR RF
					12.00						BP 0° CN IR RF
				243.5			SANDSTONE, fine to coarse grained, grey-brown, lithic, with fine to medium rounded-sub rounded gravel	EW			BP 0° CN IR RF
					12.45						BP 0° CN IR RF
				243.0			CONGLOMERATE, fine to medium gravel, pale brown, fine to medium grained lithic sand matrix	EW - HW			
					13.0						
				242.5							BP 0° SN IR RF
					13.20						BP 0° SN PR RF
		100	85		13.5		Pebbly Gravelly SANDSTONE, fine to medium grained, lithic, pale brown, fine to coarse rounded-sub rounded gravel up to 25mm	HW			DZ
				242.0							IS Fe PR S
					14.0						
				241.5							CZ 0°
											FZ/DZ 0°
					14.5						
				241.0							JT 70 - 80° SN PR RF
					14.95						JT 60° CN PR RF

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	85	240.5			SANDSTONE/CONGLOMERATE, fine to coarse grained lithic sand, fine to coarse rounded-sub rounded gravel, pale grey	HW			
					15.20		CONGLOMERATE, fine to coarse gravel, pale grey-pale brown, sub rounded, fine to coarse grained lithic sand matrix, with pebbly sandstone bands	HW - MW			DZ/BP 0° CN
		100	96	240.0	15.5						JT 50 - 60° Clay PR RF
				239.5	16.0						BP 10° CN PR RF JT 60° Clay PR RF
				239.0	16.5						BP 20° VNR PR RF
				238.5	17.0						
				238.0	17.5						
				237.5	18.0						
				237.0	18.5						
				236.5	19.0						
				236.0	19.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	96	235.5	20.5		CONGLOMERATE, fine to coarse gravel, pale grey-pale brown, sub rounded, fine to coarse grained lithic sand matrix, with pebbly sandstone bands	HW - MW			
				235.0	21.0						
				234.5	21.5		Becoming grey-brown-red at 21.31m	HW			
				234.0	22.0						BP 5 - 10° SN PR RF BP 0° SN IR RF
				233.5	22.5						
				233.0	23.0						
				232.5	23.5						
				232.0	23.70						
		100	100	231.5	24.0		CONGLOMERATE, fine to coarse gravel up to 20mm, pale grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with coarse grained sandstone bands	SW			
				231.0	24.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 18/04/2012
DATE COMPLETED: 18/04/2012
SURFACE RL: 255.61 m AHD
COORDS: 278554.16 m E 6420898.05 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	100	230.5	25.5		CONGLOMERATE, fine to coarse gravel up to 20mm, pale grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix, with coarse grained sandstone bands	SW			
				230.0	26.0						
				229.5	26.5						
				229.0	27.0						
				228.5	27.5						
				228.0	28.0						
				227.5	28.5						
				227.0	29.0						
				226.5	29.5						
				226.0							

CORED BOREHOLE BH2 TERMINATED AT 30.00 m

LOGGED: ML/JH
CHECKED: JE
DATE: 20/03/2013

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH2	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH2	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH2	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH2	**RCA ref:** 9325

GEOTECHNICAL BOREHOLE LOG

BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered)			211.5	0.40		ML	Sandy SILT, low plasticity, grey-brown, fine to coarse grained sand, with some gravel	D - M		RESIDUAL
				211.0	0.5			Silty Sandy GRAVEL, fine to medium, brown-red-grey, fine to coarse grained sand			
				210.5	1.0						
				210.0	1.5			CONTINUED AS CORED BOREHOLE			
				209.5	2.0						
				209.0	2.5						
				208.5	3.0						
				208.0	3.5						
				207.5	4.0						
				207.0	4.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				211.5	0.5						
				211.0	1.0						
				210.5	1.5		START CORING AT 1.55m				
NMLC		100	93	210.0	1.55		Pebbly SANDSTONE, fine to coarse grained, brown-grey, lithic, fine to coarse rounded-sub rounded gravel up to 20mm	EW - HW			DZ 0°
				209.5	2.0						BP 10° SN IR RF
				209.0	2.5						BP 0° CN IR RF
				208.5	2.75		CONGLOMERATE, fine to medium gravel up to 10mm, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix	MW			DZ/FZ 0°
				208.0	3.0						JT 30° CN PR RF
				207.5	3.5						
				207.0	4.0						
					4.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	93	206.5			CONGLOMERATE, fine to medium gravel up to 10mm, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix	MW			
					5.40						
					5.5		SANDSTONE, fine to medium grained, pale grey-brown, lithic, with fine to coarse rounded-sub rounded gravel, with pebbly sandstone bands	HW			
				206.0							
					6.0						
				205.5							BP 10° CN IR RF
					6.5						
				205.0							BP 5° CN PR RF
											BP 10 - 20° CN PR RF
					7.0						
				204.5							
		100	100								BP 0° CN PR RF
					7.5						BP 0° CN PR S
				204.0							
											BP 0° CN IR RF
					8.0						
				203.5							
					8.5						
				203.0							
					9.0						
				202.5							
					9.5						
				202.0							
					9.65						
		100	95				SANDSTONE, fine to medium grained, pale grey brown-grey, lithic, with fine to coarse gravel, with some extremely weathered extremely low strength clay bands	HW - MW			

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	95	201.5	10.5		SANDSTONE, fine to medium grained, pale grey brown-grey, lithic, with fine to coarse gravel, with some extremely weathered extremely low strength clay bands	HW - MW			DZ
				201.0							BP 10° CN PR RF
					10.80		CONGLOMERATE, fine to coarse gravel, grey-brown, sub rounded, fine to coarse grained lithic sand matrix, trace of pebbles	SW			
				200.5	11.0						
					11.5						
				200.0							
					12.0						
				199.5	*12.10*		Gravelly SANDSTONE, fine to medium grained, pale brown-grey, lithic, fine to coarse sub rounded gravel, with conglomerate bands	HW			
					12.5						
				199.0							
					13.0						FZ/CZ SN
				198.5							
		100	86		13.5						JT 70° CN PR RF
				198.0							BP 10° CN PR RF
					14.0						
				197.5							BP 20° SN PR RF
					14.5						
				197.0	*14.57*		CONGLOMERATE, fine to coarse gravel up to 25mm, brown-grey, rounded-sub rounded, fine to medium grained lithic sand matrix				JT 70 - 80° SN PR RF

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	86	196.5	15.5		CONGLOMERATE, fine to coarse gravel up to 25mm, brown-grey, rounded-sub rounded, fine to medium grained lithic sand matrix	HW			BP 15° SN PR RF BP 0° SN IR RF
				196.0							
				195.5	16.0						
					16.40						CZ/DZ
		100	100	195.0	16.5		CONGLOMERATE, fine to coarse gravel up to 30mm, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix	SW			
					17.0						
				194.5							
					17.5						
				194.0							
					18.0						
				193.5							
					18.5						
				193.0							BP 20° SN PR RF
					19.0						
				192.5							
					19.5						
				192.0							

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	100	191.5	20.5		CONGLOMERATE, fine to coarse gravel up to 30mm, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix	SW			
				191.0	21.0						
				190.5	21.5						
				190.0	22.0						
				189.5	22.5						BP 0° CN PR RF
				189.0	23.0						BP 0° CN PR RF
				188.5	23.5						
				188.0	24.0						
				187.5	24.32						
		100	100	187.0	24.5		Gravelly SANDSTONE, fine to medium grained, brown, lithic, fine sub rounded gravel				

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 211.58 m AHD
COORDS: 278178.86 m E 6420976.85 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC		100	100	186.5	25.10			SW			
							CONGLOMERATE, fine to coarse gravel up to 35mm, brown-grey, rounded-sub rounded, fine to medium grained lithic sand matrix				
				186.0	25.5						
					26.0						
				185.5							
					26.5						
				185.0	26.60						
							CONGLOMERATE, fine to medium gravel, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix, with sandstone bands, trace of claystone bands	HW - MW			
					27.0						
				184.5							
					27.5						BP 5 - 10° CN PR RF
				184.0							
					28.0						
				183.5							BP 20° CN PR RF
					28.5						
				183.0							BP 10° CN ST RF
					28.90						
					29.0		CONGLOMERATE, fine to medium gravel, grey-brown, rounded-sub rounded, fine to medium grained lithic sand matrix	SW			
				182.5							
					29.5						
				182.0							

CORED BOREHOLE BH3 TERMINATED AT 30.00 m

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH3	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH3	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH3	**RCA ref:** 9325

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH3	**RCA ref:** 9325

GEOTECHNICAL BOREHOLE LOG

BH4

SHEET 1 OF 7

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 221.56 m AHD
COORDS: 278642.80 m E 640981.57 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				221.5			ML	Sandy SILT, low plasticity, grey-brown, fine to coarse grained sand, with gravel, trace of clay	M		RESIDUAL
					0.40						
				221.0	0.5			Silty Sandy GRAVEL, fine to medium, brown-grey, fine to coarse grained sand			
				220.5	1.0						
				220.0	1.5						
				219.5	2.0						
				219.0	2.5						
								CONTINUED AS CORED BOREHOLE			
				218.5	3.0						
				218.0	3.5						
				217.5	4.0						
				217.0	4.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

CORED BOREHOLE LOG

BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
DATE COMPLETED: 19/04/2012
SURFACE RL: 221.56 m AHD
COORDS: 278642.80 m E 640981.57 m N MGA94 56
DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				221.5	0.5						
				221.0	1.0						
				220.5	1.5						
				220.0	2.0						
				219.5	2.5						
				219.0	2.75		START CORING AT 2.75m				
		100	99	218.5	3.0		Gravelly SANDSTONE, fine to medium grained, grey-brown, lithic, fine to medium rounded-sub rounded gravel up to 10mm, trace of pebbly sandstone bands	EW - HW			BP 0° CN PR RF CZ BP 0° CN PR RF
				218.0	3.5						
				217.5	4.0						BP 0° SN PR RF BP 0 - 5° CN PR RF
				217.0	4.5						BP 0° CN PR RF
					4.76			SW			BP 0° CN PR RF BP 0° CN PR RF

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CORED BOREHOLE LOG
BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
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SURFACE RL: 221.56 m AHD
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DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
		100	99	216.5	5.5		Gravelly SANDSTONE, fine to coarse grained, grey-brown, lithic, fine to medium rounded-sub rounded gravel up to 10mm, with conglomerate bands	SW			
				216.0							
				215.5	6.0						
					6.10		CONGLOMERATE, fine to coarse gravel up to 30mm, grey-brown, rounded-sub rounded, fine to coarse grained lithic sand matrix	HW - DW			
				215.0	6.5						
				214.5	7.0						
				214.0	7.5						BP Clay PR RF
		100	97	213.5	8.0						
				213.0	8.5						
				212.5	9.0						BP 0° CN PR RF
					9.32						BP 0° CN PR RF
							SANDSTONE, fine to medium grained, grey-brown-red, lithic, trace of gravel	EW - HW			
				212.0	9.5						BP/DZ 0° SN PR RF
											BP 0° SN PR RF
					9.84						JT 20 - 30° SN IR RF
		100	99					SW			BP 0° SN PR RF
											BP 0° CN PR RF

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CORED BOREHOLE LOG
BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

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PROJECT: Proposed Quarry
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DATE COMMENCED: 19/04/2012
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DRILL MODEL:

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
		100	99	211.5	10.5		CONGLOMERATE, fine to medium gravel up to 15mm, grey-brown, rounded-sub rounded, fine to coarse lithic sand matrix	SW			
				211.0							
				210.5	11.0						
				210.0	11.5						
				209.5	12.0						BP 0° CN PR RF
				209.0	12.5						
				208.5	13.0						
				208.0	13.5						
					13.97						
		100	90	207.5	14.0		Gravelly SANDSTONE, fine to coarse grained, grey-brown, lithic, fine sub rounded gravel, with pebbly sandstone bands	MW			
				207.0	14.5						

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CORED BOREHOLE LOG
BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

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Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				206.5			Gravelly SANDSTONE, fine to coarse grained, grey-brown, lithic, fine sub rounded gravel, with pebbly sandstone bands	MW			BP 0° SN PR RF
					15.30						
					15.5		CONGLOMERATE, fine to coarse gravel up to 30mm, grey-brown-red, rounded-sub rounded, fine to coarse grained lithic sand matrix, trace of iron oxide fissures	SW			
				206.0							
					16.0						
				205.5							
					16.5						
				205.0							BP 5° CN PR S
											BP 0° CN PR RF
		100	90		17.0						
				204.5							
					17.5						
				204.0							
					18.0						BP 0° CN PR RF
				203.5							
					18.49		CONGLOMERATE, fine to medium gravel, brown-grey-red, rounded-sub rounded, fine to coarse grained lithic sand matrix, highly fractured	HW			BP 0° SN PR RF
				203.0							FZ/SZ SN
					19.0						BP 0° CN PR RF
				202.5							
					19.20		SANDSTONE, fine to medium grained, brown-red				
		100	100		19.5						
				202.0							
					19.80		CONGLOMERATE, fine to coarse gravel up to 30mm, brown-grey, rounded-sub rounded, fine to coarse grained lithic sand matrix	MW			

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CORED BOREHOLE LOG
BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

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CLIENT: Upper Hunter Holdings
PROJECT: Proposed Quarry
LOCATION: Hollydeen

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Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
		100	100	201.5	20.5		CONGLOMERATE, fine to coarse gravel up to 30mm, brown-grey, rounded-sub rounded, fine to coarse grained lithic sand matrix	MW			
				201.0							
					20.95						
				200.5	21.0		Gravelly SANDSTONE, fine to coarse grained, lithic, brown-grey, fine to coarse rounded-sub rounded gravel				
					21.50						
				200.0			CONGLOMERATE, fine to coarse gravel up to 30mm, brown-grey, rounded-sub rounded, fine to coarse grained lithic sand matrix, with gravelly sandstone bands				
				199.5	22.0						
				199.0	22.5						
				198.5	23.0						
				198.0	23.5						
				197.5	24.0						
				197.0	24.5						BP 20° CN PR S

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CORED BOREHOLE LOG
BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 9325
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PROJECT: Proposed Quarry
LOCATION: Hollydeen

DATE COMMENCED: 19/04/2012
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Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
		100	100	196.5	25.19			MW			
					25.50		SANDSTONE, fine to coarse grained, lithic, brown-grey				
		100	72	196.0	25.5		CONGLOMERATE, fine to coarse gravel up to 30mm, brown-grey, rounded-sub rounded, fine to coarse grained lithic sand matrix, with gravelly sandstone bands				BP 10° CN PR RF
				195.5	26.0						
				195.0	26.5						
					26.60		CONGLOMERATE, fine to medium gravel up to 20mm, brown-grey, rounded-sub rounded, fine to coarse grained lithic sand matrix, trace of rootlets at 26.9m	HW			FZ/CZ
				194.5	27.0						
					27.15		CORED BOREHOLE BH4 TERMINATED AT 27.15 m				
				194.0	27.5						
				193.5	28.0						
				193.0	28.5						
				192.5	29.0						
				192.0	29.5						

LOGGED: ML/JH | CHECKED: JE | DATE: 20/03/2013

Client:	Upper Hunter Holdings	**RCA Australia**
Project:	Proposed Quarry	
Location:	BH4	**RCA ref:** 9325

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Project:	Proposed Quarry	
Location:	BH4	**RCA ref:** 9325

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Project:	Proposed Quarry	
Location:	BH4	**RCA ref:** 9325

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Project:	Proposed Quarry	
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