27 October 2015

Buttai Gravel Pty Ltd
c/- Daracon Group Pty Ltd
PO Box 299
WALLSEND NSW 2287

Attention: Ashley Smith

Dear Ashley

RE: Martins Creek Quarry Extension Project – Quarry Face Stability Assessment Preliminary Geotechnical Assessment

1 INTRODUCTION

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this preliminary geotechnical assessment report addressing Quarry Face Stability as part of the Martins Creek Quarry Expansion Project, on behalf of Buttai Gravel Pty Ltd and Daracon Group Pty Ltd (Daracon).

This report provides an assessment of the risk of slope instability affecting the site of the proposed Quarry Expansion Project and immediate surrounding area. The report also provides some risk management recommendations for the proposed site developments.

2 SCOPE OF WORK

The preliminary Quarry Face Stability Assessment has included the following activities:

- Site visit by a Principal Geotechnical Engineer from Qualtest on 13 October 2015 to make observations of surface features of the quarry face and in the immediate surrounding area including current site slope stability conditions;
- Review of Extraction Operations Plans (Draft – Interim Report Date 01/10/2015) prepared by VGT Pty Ltd (VGT);
- Review of Martins Creek Quarry Final Pit Design and Cross Sections (5 year, 10year, 15 year, 20 year and 25 years), provided by Daracon.
- Engineering assessment and reporting.

3 SITE CONDITIONS

The site is located at Martins Creek Quarry, Station Street, Martins Creek. Daracon extract Andesite rock types from the quarry to produce aggregates for concrete, road, rail, armour rock and manufactured sand applications.

A summary of the regional and local geological conditions encountered at the site, extracted from the VGT report referenced is presented below.

3.1 Regional Geology

The site is underlain by Carboniferous volcanic and sedimentary sequences. The quarry is underlain by the Martins Creek 'Andesitic Ignimbrite', identified as 'Clnm' on the geology map. This unit terminates in the vicinity of the railway line to the north and the where the overlying sequences of 'Cln' (Newtown Volcanics) and 'Clnv' (Vacy Ignimbrite Member) commence.

3.2 Local Geology

The quarry faces and floor are dominated by the volcanic rock Andesite which is distinguished by large white rhombohedral plagioclase crystals. The Andesite dips toward the west, and extraction to the base of the unit forms a sloping and undulating quarry floor.

There are some exposures of underlying red sandstone and claystone in parts of the quarry floor and these are known as metasediments. This underlying sequence is thought to be 'Cll' the Wallaringar Formation.

The depth of weathering generally defines the rippability of the material. The D9 dozer generally can rip to 0.5 metres below the surface, below which the material is too hard and competent and must be blasted. The yellow surfaces seen in the quarry are very thin iron stains found on the joints and do not compromise the strength of the material.

3.3 Quarry Design Parameters

The quarry face and bench design as outlined by VGT and shown on the Final Pit Design and Cross Sections provided by Daracon, has the following typical features:

- Soil and overburden thickness 1 metre;
- Soil and overburden batter 1V:3H or 18 degrees;
- Face height 12 metres;
- Face angle 80 to 90 degrees, depending upon face formation (geotechnical advice will be sought if required);
- Haul roads minimum 3 times width of largest haul truck (nominally 11.5 metres);
- Haul roads sloped back to the face at 1V:100H;
- Haul roads and faces have safety berms that are half the wheel height of the largest vehicle on site; and
- Haul roads will be mostly graded to 1V:10H but in some circumstances and over short distances could be as steep as 1V:6H.

3.4 Site Visit – 13 October 2015

The site visit conducted by a Principal Geotechnical Engineer from Qualtest on 13 October 2015 generally confirmed the site conditions outlined above, noting the following:

- Whilst bench or face heights of 12m are used for design, in practice they typically range from about 8m to 14m in height;
- Advised by Daracon on site that there are typically about 3 blasts per month under normal quarrying conditions, progressively forming a new face each time.

Selected photographs of the typical quarry face conditions observed are shown below:

Photo 1: Entering quarry from main haul road, looking west.

Photo 2: Old southern quarry face. No extraction works in recent times.

Photo 3: Quarry floor (Bench 5). Western face on left hand side, looking towards the north.

Photo 4: Quarry floor (Bench 5), eastern face.

Photo 5: Eastern face of main pit. Contact between Andesite and underlying Meta-sediments visible.

Photo 6: Northern face (Bench 2). Tension cracks in overburden (soil) material visible.

4 QUARRY FACE SLOPE STABILITY ASSESSMENT

4.1 Basis of Assessment

The risk of slope instability has been assessed from the observed site conditions using methods consistent with those presented in the Australian Geomechanics Society (AGS) publication "*Practice Note Guidelines for Landslide Risk Management, 2007*". Based on those methods, the risks associated with slope instability on the subject area have been assessed using the terms presented in AGS 2007, *Landslide Risk Assessment Qualitative Terminology for Use in Assessing Risk to Property*, extracts of which are attached.

The report provides an assessment of the risk of slope instability on the proposed development area. The report also recommends some geotechnical constraints for the site development in light of the slope instability assessment. The assessed risk to the proposed development is based on the geotechnical constraints and recommendations provided in this report being implemented. The onus is on the owner, potential owner, or interested party to decide whether the assessed level of risk is acceptable taking into account the likely consequences of the risk and the recommended geotechnical constraints.

4.2 Principal Site Features and Evidence of Instability

The assessment of the risk of slope instability for the existing Quarry Face has been based on the site observations recorded in Section 3 and the principal site features summarised below:

- Soil and overburden thickness 1 metre;
- Soil and overburden batter 1V:3H or 18 degrees;
- Face height generally of about 12 metres, (in practice they typically range from about 8m to 14m in height);
- Face angle 80 to 90 degrees, depending upon face formation;
- Existing quarry faces have no known history of major failures. The stability of the quarry faces revealed no large scale wedge, planar or toppling instability evident;
- Some localised toppling and block instability is noted within several areas of the existing benches (e.g. Photo 2 & 4) due to localised unfavourable joint orientation and loosening due to blasting;
- Little to no seepage was observed and it is assessed that the proposed future quarry expansion will exhibit similar 'dry' quarrying conditions;
- No obvious evidence of overall slope instability was observed on the site during the site visit.

4.3 Hazard Identification

The following hazards that could potentially impact on plant or personnel working on the site are assessed as follows:

H1. Large scale (>10m^3) rock fall caused by spalling or toppling of rock masses along adversely orientated rock defects;

H2. Localised rock falls. Rock blocks or boulders (up to 1m^3) becoming dislodged from the face due to slope deterioration or wet weather;

H3. Failure of overburden (the upper soil profile of up to 1m depth) due to unsuitable batters, or subject to erosion by concentrated surface water flows. This may occur as rotational slides, shallow ground 'creep' movements or slumping.

4.4 Risk Evaluation for the Proposed Development

Elements at risk for the identified hazards are plant and personnel working within the quarry.

The matrix below evaluates the hazards outlined above and their likelihood of occurring based on the proposed development of the site, and assuming the geotechnical constraints and recommendations of this report are implemented. If these recommendations are not followed, the likelihood of hazards occurring may increase and the level of risk may change. Further advice should be sought where necessary.

Hazard	Location	Consequence	Likelihood	Risk
H1	Quarry Area	Minor	Unlikely	Low
H2	Quarry Area	Minor	Unlikely	Low
H3	Quarry Area	Minor	Unlikely	Low

The following assessment of consequence and likelihood of a hazard occurring and impacting on plant or personnel was made from a risk management perspective:

Consequence:

Assessed to be 'Minor' (*limited damage to part of structure, and/or part of the site requiring some reinstatement stabilisation works*), assuming the geotechnical constraints and recommendations of this report are implemented.

The consequence of any of the identified hazards occurring would likely result in rock fall or slumping of overburden material, typically expected to fall and impact on the ground within 5m to 10m of the toe of the quarry face. This area is only likely to be accessed by plant with protection for personnel inside cabins, and would only be accessed by personnel on foot under rare circumstances.

Any such access should be carried out in accordance with Daracon quarry site safety management plans, and site specific safe work method statements and procedures.

Likelihood:

Assessed to be 'Unlikely' (*the event might occur under very adverse circumstances over the design life*) assuming the geotechnical constraints and recommendations of this report are implemented.

Whilst the likelihood of rock falls from the quarry face outlined in potential hazards is 'likely' to occur (*the event will probably occur under adverse conditions over the design life*), the likelihood of these falls impacting on plant is considered 'unlikely' (*the event might occur under very adverse circumstances over the design life*) and the likelihood of impacting on personnel is considered 'rare' (*the event is conceivable but only under exceptional circumstances over the design life*).

Therefore from a qualitative perspective, the risk to plant and personnel has been assessed as 'Unlikely'. This is based on the assumption that all work within the quarry environment is carried out in accordance with approved quarry extraction operation plans, safety management plans, and site specific safe work method statements and procedures, and exposure of plant and personnel to the area of potential hazards (i.e. at the toe of the quarry face, or above the quarry face) is limited.

Risk Assessment:

Based on the above factors, the existing quarry and proposed future quarry expansion is assessed as having a **"Low"** risk of slope instability.

Existing quarry faces have no known history of major failures and appear to have stood up reasonably well over time. The stability of the quarry faces observed was assessed to be adequate, with no large scale wedge, planar or toppling instability evident. Future proposed quarry expansion operations are understood to follow similar operating procedures, and are therefore assessed likely to perform in a similar manner.

The assessed risk to the existing quarry face and proposed quarry expansion is based on the geotechnical constraints and recommendations provided in this report being implemented. If these recommendations are not followed, the likelihood of hazards occurring may increase and the level of risk may change. Further advice should be sought where necessary.

It would be normal practice in an operating quarry environment for operations to proceed on a site with this risk level classification. Future management of the quarry face should be carried out in accordance with sound engineering principles, approved quarry extraction operation plans, quarry operation safety management plans, site specific safe work method statements, and the geotechnical constraints outlined in this report.

4.5 Recommended Geotechnical Constraints for Residential Development

It is recommended that potential localised instability risk within and of the quarry face be controlled by:

- Access within 5m to 10m of the quarry face should be limited, preferably only entering if inside plant / machine with cabin protection for personnel;
- If personnel on foot are required to access within 5m to 10m of the quarry face, they should be aware of the risks involved, assess the stability of the quarry face before entering the area, have a spotter present for any works, and obtain specific geotechnical assessment if entering the potential hazard area for a prolonged period;
- Scaling loose blocks back to the hard intact wall surface with excavators during quarrying;
- Blasting behind any inferred dyke or fault structure to reduce poor face stability conditions related to the relatively weak nature of these features;
- Standing off waiting dump trucks a minimum of 10m from the toe of end and high walls (quarry faces) during loading;
- Incorporating a risk analysis and safety management plan for personnel beneath high and end walls (quarry faces), including regular inspections by the quarry manger and periodic assessment by a geotechnical professional of quarry wall stability and incorporating an awareness of the geotechnical hazards within the quarry to site staff during induction and toolbox safety meetings;
- It is assessed that the current design quarry bench height of 12m (in practice they typically range from about 8m to 14m in height) is performing adequately with regard to stability and it is assessed that the variable bench heights may be incorporated into the proposed quarry;
- Drainage measures should be implemented above and behind the quarry face to avoid concentrated water flows on the quarry face or infiltration into the soil/rock profile behind the quarry face;

- Surface water flows from upslope areas should be diverted away from the quarry face;
- Little to no seepage was observed and it is assessed that the proposed future quarry expansion will exhibit similar 'dry' quarrying conditions. It is recommended that benches and the pit floor be graded to promote positive drainage conditions;
- Minor seepage and ponding water from excessive rainfall is likely to be manageable by conventional drainage measures within the proposed quarry such as periodic pumping out to the surrounding drainage controls;
- Final quarry design, including batters, benching, heights and extraction by others;
- All work to be carried out in accordance with approved quarry extraction operation plans, safety management plans, and site specific safe work method statements and procedures;
- If any signs of future instability, large scale wedge, planar or toppling instability are observed, further geotechnical advice should be sought without delay.

5 LIMITATIONS

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practices and standards. To our knowledge, they represent a reasonable interpretation of the general conditions of the site.

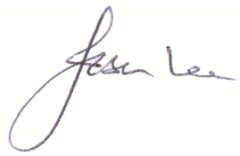
The extent of testing associated with this assessment is limited to a site walkover and visual assessment of site conditions only. It should be noted that subsurface conditions following future blasting and quarry expansion may be different to those observed and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during construction or ongoing quarry operations differ from those given in this report further advice should be sought without delay.

Data and opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement by Qualtest. If this report is reproduced, it must be in full.

If you have any questions regarding this report please do not hesitate to contact Alan Cullen or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd.



Jason Lee
Principal Geotechnical Engineer

Attachments:
Selected Excerpts from AGS 2007 - Practice Note Guidelines for Landslide Risk Management

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	**1: CATASTROPHIC 200%**	**2: MAJOR 60%**	**3: MEDIUM 20%**	**4: MINOR 5%**	**5: INSIGNIFICANT 0.5%**
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		**Example Implications** (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.