AMENDMENT C241 TO THE WHITTLESEA PLANNING SCHEME – SHENSONE PARK PRECINCT STRUCTURE PLAN – EXPERT WITNESS STATEMENT BY TYLAH DROCHMANN

In relation to the regional geology and engineering geoscience, anticipated regional quarry resources and general quarry pit development efficiencies, please see attached the expert witness statement.

This expert witness statement is intended to provide advice from a regional geological perspective only. It is not intended to provide expert technical advice on planning and policy and/or comment on approvals of any specific Work Authorities.

Declaration

I have made all enquiries that I believe are desirable and appropriate and that no matters of significance that I regard as relevant have to my knowledge been withheld from the Panel.

Tylah Drochmann
BSc (adv.) geol; BGeol (hons)

Economic Geologist
Geological Survey of Victoria
Level 17, 1 Spring Street, Melbourne, 3000

1 Qualifications

1.1 Bachelor of Science (Advanced) Majoring in Geology – James Cook University
1.2 Bachelor of Geology (Honours) – James Cook University

2 Industry affiliations

2.1 Associate member of Institute of Quarrying Australia (IQA)

3 Areas of expertise

3.1 Geology
3.2 Resource estimation according JORC and PERC codes
3.3 Quarry pit development
3.4 Quarry operations
3.5 Production testing and specifications of quarry materials

4 Experience

4.1 I have 6 years' experience in various roles within the quarrying industry and government scientific agency.

4.2 I am currently employed as an Economic Geologist to design and implement a technical work program that delivers geoscience data, information and interpretations. This facilitates identification and characterisation of stratigraphic units from which in-demand construction materials can be produced. The responsibilities at the Geological Survey of Victoria (GSV) to date have been: project planning, historical geological data synthesis and analysis through a quarry industry lens, academic geoscience publication writing, state-wide construction material testing initiative coordination, providing geoscience and quarry industry advice to wider departmental groups.

4.3 Experience as a quarry supervisor in day-to-day operational management including: quarry pit development including extraction sequencing, slope stability and stripping campaigns, management and planning of raw materials for production, drill and blast, load and haul, fixed and mobile crushing and screening plant production of a full suite of aggregate and road base products, management of production testing and quality assurance of aggregate and road base products, environmental monitoring (blasting, dust noise and water quality).

4.4 Experience as a Geologist and Mine Planner included managing the geology and pit development for a national portfolio of quarry sites (hard rock and sand). Relevant duties to this expert witness statement include:

- Expert witness for quarry material quality and technical specifications

- Expert witness for quarry site Work Authority applications and variations – quarry pit development and resources
- Short, medium and long-term quarry pit development planning
- Geological mapping, modelling and reporting
- Reserves and resources planning and reporting as per the JORC and PERC standards
- Geotechnical assessment
- Management of drone and surveying data
- Development of exploration and production drilling campaigns including coordination and supervision of drill teams and internal technical teams for resource drilling campaigns
- Greenfields quarry and quarry extension development
- Development of Work Authority/Development Approvals (state specific documentation)
- Planning and submission of State Significant Development Approval documents
- Management of the quarry material certification process – Vicroads specific in Victoria, and state specific authorities interstate

5 Scope of engagement

5.1 I have been instructed in writing by Harwood Andrews to prepare an expert witness statement to present at the Planning Panel hearing regarding Shenstone Park PSP, on behalf of the Victorian Planning Authority and Department of Jobs, Precincts and Regions.

5.2 My instructions are to prepare an expert witness statement addressing:

- Anticipated geology of the area surrounding Woody Hill quarry and Phillips quarry
- Likely extent of resource within and beyond the identified quarry areas
- Advice on the comparative efficiencies (if any) achieved through expansion of an existing quarry compared with the establishment of a new quarry
- Advice on the classes of products and anticipated markets for such products that the quarries could be expected to win

6 Exhibited documents reviewed

6.1 As part of this engagement, I have reviewed the following exhibited documents:

- Shenstone Park Precinct Structure Plan – September 2019
- Shenstone Park Background Report – September 2019
- Whittlesea Planning Scheme – Amendment C241WSEA – Explanatory report
- Whittlesea Planning Scheme – Schedule 7 to clause 37.07 urban growth zone
- Whittlesea Planning Scheme – Schedule to clause 66.04 referral of permit applications under local provisions

- Whittlesea-C241wsea-005znMap04-Exhibition
- Helping Victoria Grow: Extractive resources Strategy
- Melbourne Supply Area – Extractive Industry Interest Areas Review
- Extractive Resources in Victoria: Demand and Supply Study 2015-2050
- The North Growth Corridor Plan 2012
- Shenstone Park PSP assessments – Geomorphology and vegetation values assessment (February 2018)
- Quarry Impact Assessment (2017)
- Quarry Impact Assessment Addendum (2019)
- Shenstone Park PSP submission 27
- Shenstone Park PSP submission 24
- Shenstone Park PSP submission 23
- Whittlesea planning scheme amendment C241WSEA: Shenstone Park PSP – Quarry Statement

7 Previous works referenced in this statement

7.1 All previous works and associated data referenced in this statement are publicly available and discoverable on the GSV catalogue and GeoVic online portal or in hard copy at Geological Survey of Victoria (GSV) office (1 Spring St, Melbourne, 3000).

Table 1: Bibliographic details of documents referenced for this statement

GSV search assist reference ID	Full reference
5219	STEWART, G., 1975. The newer volcanics lava field north of Melbourne: Part 1. Geological Survey of Victoria, Unpublished report 1975/75. Mines Department, Victoria, 170pp.
N/A	Hard copy drill core logs produced by Graeme Stewart prior to completing GSV unpublished report 1975/75 (Stewart, 1975). Interpretations and conclusions based on drill cores are presented in GSV unpublished report 1975/75.
N/A	Hard copy cross-sections routinely drawn as part of the GSV Metro Basalt Survey ca. 1970. Interpolated basalt thickness referenced in GSV unpublished report 1975/75 (Stewart, 1975).
155308	MCHAFFIE, I.W., 1986. Report on an inspection of sedimentary rock resources at Woody Hill, near Donnybrook. Extractive Industry Licence Application 1261. Geological Survey of Victoria, 6 pp.
106616	HIGGINS, D.V., VANDENBERG, A.H.M., MORAND, V.J. & D'ELIA, F., 2014. 1:250,000 Seamless Geology. Geological Survey of Victoria. Department of State Development, Business and Innovation, Victoria.
N/A	JORC CODE, 2012. Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia.

8 Additional works completed to aid this statement

8.1 Drill cores visually inspected to understand the regional geology and determine material quality. Visual inspection included: primary and secondary mineralogy, weathering, alteration and rock texture. Drill hole location map attached as Appendix B.

8.2 Original geology logs (Stewart, 1975) were reviewed and compared with physical drill core. Scanned copies of the original core logs from the metro basalt survey attached as Appendix C.

Table 2: Drill cores visually inspected and geologically logged.

GeoVic site ID	Original name	Drill hole purpose	Drill core type
310871	Kalkallo 2	Metro basalt survey (Stewart, 1975)	Diamond core
310875	Kalkallo 7	Metro basalt survey (Stewart, 1975)	Diamond core
310877	Kalkallo 9	Metro basalt survey (Stewart, 1975)	Diamond core
310878	Kalkallo 10	Metro basalt survey (Stewart, 1975)	Diamond core
310880	Kalkallo 12	Metro basalt survey (Stewart, 1975)	Diamond core
310881	Kalkallo 13	Metro basalt survey (Stewart, 1975)	Diamond core
68750	Kalkallo 15	Groundwater	Percussion cuttings
68791	Kalkallo 10005	Groundwater	Percussion cuttings
68837	Kalkallo 10052	Groundwater	Percussion cuttings

8.3 Sampling of drill core to gather the necessary engineering geoscience data to determine what construction material specifications the basalt can meet. Sampling intervals were dependant on core available at the Geological Survey of Victoria Drill Core Library.

Table 3: Drill cores sampled and test methods requested for the purpose of this statement.

GeoVic site ID	Original name	Depth interval sampled	Test 1	Test 2	Test 3
310881	Kalkallo 13	24.82m – 33.82m	Degradation factor (AS1141.25.1)	Wet/dry strength variation (AS1141.22)	Particle density and water absorption (AS1141.6.1)
310881	Kalkallo 13	43.54m – 53.70m	Degradation factor (AS1141.25.1)	Wet/dry strength variation (AS1141.22)	Particle density and water absorption (AS1141.6.1)
310881	Kalkallo 13	68.75m – 78.97m	Degradation factor (AS1141.25.1)	Wet/dry strength variation (AS1141.22)	Particle density and water absorption (AS1141.6.1)
310875	Kalkallo 7	41.5m – 47.5m	Degradation factor (AS1141.25.1)	Wet/dry strength variation (AS1141.22)	Particle density and water absorption (AS1141.6.1)
310871	Kalkallo 2	7.01m – 11.2m	Degradation factor (AS1141.25.1)	Wet/dry strength variation (AS1141.22)	Particle density and water absorption (AS1141.6.1)

9 Contributors to this statement

9.1 Drill core testing was completed at the NATA accredited Groundwork Plus laboratory (ABN 13 609 422 791) by Dave Gregson - Business Manager Laboratories.

9.2 Dave Gregson professional qualifications

- Diploma of Frontline Management, Business Administration and Management (General)
- Diploma of Management, Business Administration and Management (General)
- Advance Diploma of Laboratories Operations (Construction Materials Testing), Geotechnical
- Diploma of Laboratories Operations (Construction Materials Testing), Geotechnical
- NATA Technical Assessor
- NATA Internal Audits

9.3 Dave Gregson relevant experience

- 17 years' experience in the construction materials testing industry

- Member of Association of Geotechnical Testing Authorities Inc. (QLD)
- Member of Institute of Quarrying Australia (IQA)
- Comprehensive knowledge of standards and specifications
- Performs and supervises material testing in accordance with Australian Standards and national transport authorities
- Ensures NATA accreditation is maintained for the scope of testing at the Groundwork Plus laboratory

10 Conclusions

10.1 Anticipated geology of the area surrounding Woody Hill quarry and Phillips quarry

10.1.1 See Appendix A for a geological map of the greater Woody Hill-Phillips quarries area. Geological units are mapped from the Geological Survey of Victoria 1:250,000 seamless geology project (Higgins et al., 2014). This map has been generated from GeoVic online portal and includes 1:250,000 geological units, current work authorities and drill holes with an extractive industries purpose.

10.1.2 The current operation at Woody Hill quarry is extracting the sedimentary Melbourne Formation, whereas the area surrounding Woody Hill and Phillips quarries form part of the extensive Newer Volcanic Group basalt province that extensively covers northern and western Victoria. There are three distinct basalt sub-units that form part of the Newer Volcanic Group: basalt flows, stony rises basalt and scoria deposits. The basalt flows and stony rises basalt sub-units are relevant to this statement.

10.1.2.1 The Newer Volcanic Group province exhibits a complex depositional history of eruptions from nine distinct volcanic vents (vents and associated flows are mapped by Stewart, 1975). Relevant to this statement, the basalt flows sub-unit to the west of Woody Hill quarry are attributed to early eruptions from the Mount Ridley South vent and the stony rises basalts around Phillips quarry are attributed to late eruptions from the Mount Fraser vent.

10.1.2.2 The Newer Volcanic Group sub-units relevant to the greater Woody Hill-Phillips quarries area are distinct from each other, in that the basalt flows are generally topographically flat and laterally extensive while the stony rises basalts exhibit topographic highs.

10.1.2.3 Based on primary mineralogy, the Newer Volcanic Group basalts are characterised as olivine basalt with a corresponding sub-classification of iddingsite-basalt where the primary olivine mineralogy is partially or wholly altered to the secondary mineral group termed iddingsite.

10.1.2.4 The basalt flows sub-unit, where the older lava flows filled topographically low valleys and channels, often exhibit weathering and alteration where they are subjected to surface or groundwater for prolonged periods. The younger, topographically high stony rises basalts are generally less weathered and/or altered.

10.1.3 The Woody Hill quarry straddles the mapped boundary between the basalt flows and the stony rises basalt, whereas the Phillips quarry is wholly within the stony rises basalt sub-unit. It would be expected that the Woody Hill extension area to the north of the current operation would exhibit some material inconsistency (i.e. mineralogy, weathering and alteration and texture) immediately adjacent to the boundary between the two mapped basalt units and the boundary with the Melbourne Formation. It is likely that the material around Phillips quarry will be more consistent and is less likely to be extensively weathered and/or altered.

10.1.3.1 At boundaries between geological units there are often structural deformation features such as faults that may impact quarry material extraction. Faults present slope stability risks during quarry development, as well as provide conduits for groundwater to move through the rock which facilitates weathering and alteration. Immediately adjacent to the geological boundaries at Woody Hill quarry (refer Appendix A) it is likely that there will be structural deformation features, weathering and alteration leading to material quality inconsistency. Moving away from the geological boundaries into the stony rises basalt unit (i.e. further north and east) will likely result in greater material consistency.

10.2 Likely extent of resource within and beyond the identified quarry areas

10.2.1 There is no publicly available resource or reserve data for the quarry areas as this information is commercial in confidence to the operation. A JORC (2012) compliant statement of resources is not possible.

10.2.2 The Newer Volcanic Group basalt sub-units relevant to Woody Hill and Phillips quarries have been mapped from Wallan to Broadmeadows-Thomastown (north-south extent) and Mickleham to Yan Yean (east-west extent). Extensive historical drilling across the province (Stewart, 1975) has determined that the average basalt thickness is 38m with range of 5.5m to 79.6m. An interpolated cross section of basalt thickness east-west across the Shenstone Park PSP is shown in Appendix A.

10.2.2.1 Regional scale interpolation of geological data to form conclusions in this way is common practice. The Geological Survey of Victoria seamless geology project (Higgins et al., 2014) incorporated results from widespread drilling, detailed surface outcrop mapping and geological modelling to interpolate the regional geology across the state. The basalt flows of the Newer Volcanic Group province are mapped in detail by Stewart (1975) which means there is a high level of confidence in the geological interpolation in this area.

10.2.3 Historical drilling coupled with unpublished commercial in confidence annual production reporting data (Earth Resources Regulation, 2014-2019) indicate that the stony rises basalt sub-unit is the most suitable for quarrying. There is a total of eight current work authorities and applications (including Woody Hill and Phillips quarries) within the stony rises basalt sub-unit in the immediate geographic area.

10.2.3.1 From FY2014/2015 to FY2019/2020 the total deidentified and aggregated production from the stony rises basalt unit, relevant to Woody Hill and Phillips quarries, represented 10% of total basalt production across Victoria and 5.5% of total quarry production of all rock types across Victoria.

10.3 Advice on the comparative efficiencies (if any) achieved through expansion of an existing quarry compared with the establishment of a new quarry:

10.3.1 Comparison of existing quarry expansions versus development of greenfield sites must include short- and long-term considerations. Efficiencies may be in terms of short- or long-term cost-benefit, production and/or resource development.

10.3.2 Expansion of an existing operation generally presents a better short-term cost-benefit alternative to establishing a greenfield site. With an existing site, the high cost associated with stripping of overburden (mobile plant and personnel costs) can be offset by production and sales of materials continuing from the already established quarry pit. Whereas, establishing a greenfield site requires overburden stripping without the benefit of being able to continue production and sales of materials.

10.3.2.1 Further, there is a potential cost-benefit with stripping of a new area at an existing operation and/or a greenfield site where there is an existing market for overburden material sale. It may be appropriate for a quarry site to load overburden material straight into transport trucks to reduce the additional cost of load and haul and stockpiling of material.

10.3.3 Expansion of an existing operation allows existing infrastructure such as fixed and mobile plant, haul roads, utilities etc. to be leveraged. Purchase and building of a full fixed production plant and associated infrastructure can cost in the realm of millions to tens-of-millions of dollars (depending on production capacity needs), so greenfield sites with no existing infrastructure generally incur high up-front capital cost, with return on investment only occurring at a later stage when production and sales can occur consistently.

10.3.4 Establishing a greenfield site as opposed to expansion of an existing operation may incur a higher depreciation cost to an operator where the reasonable extraction life of the site (total resource and expected or demonstrated yearly production) is greater.

10.3.5 From my experience, expansion of an existing operation allows production of a wider suite of products as the generally lower quality material in the upper benches of the expansion area can be blended with the generally higher quality material won from the lower benches as a result of increasing the footprint of the quarry pit. The flexibility of blending materials of varying quality may allow for additional products to be made (e.g. crushed select-fill, high plasticity road base and sub-base etc.) or allow restrictive construction specifications to be met.

10.3.6 Overall resource is an important consideration when comparing greenfield site development with expansion of an exiting operation. Establishing a greenfield site often represents a much larger footprint than would be considered for an expansion of an existing operation. This represents a better long-term proposition.

10.3.6.1 In the case of the Phillips (greenfield) and Woody Hill (expansion) blocks with the following assumptions: 30m quarry depth, material density of 2.8t/m^3 and 30% material loss to account for benching, buffers and waste. The inferred resource estimate for Phillips is 123,700,000t compared with Woody Hill which is 19,000,000t. While this resource estimate is inferred (according to the JORC code 2012) it serves to demonstrate the long-term resource potential of a greenfield site versus expansion of an existing operation.

10.3.7 Regarding resource development, expansion of an existing site may allow for immediate disposal of overburden and unsuitable material. Overburden and unsuitable material may be used for progressive rehabilitation of terminal quarry benches rather than stored on site. Rehabilitation of a 10m high bench to a 1:3 gradient represents 3000m^3 of material placement every 10m on-the-ground distance.

10.3.7.1 In addition, overburden storage is high risk in terms of slope stability safety and long-term resource sterilisation. Over the life of a quarry there is potential to generate a significant amount of overburden that must be transported and stored if there is no suitable use or market for sales. On a site with a small footprint or high-quality resource across the entire site, this may pose a risk to long-term resource sterilisation.

10.4 Advice on the classes of products and anticipated markets for such products that the quarries could be expected to win

10.4.1 To formulate this statement, several drill cores were observed (see table 2), geologically logged, and compared with historical drill logs (Stewart, 1975) to determine the likely construction products that would be possible to produce. See Appendix B for drill hole location map and Appendix C for scanned copies of the available historical drill logs.

10.4.2 Several of the drill cores nominated in table 2 had a suitable amount of core to sample for engineering geoscience test work (see table 3 for requested test methods), and where no core was retained during the historical drilling campaign, or the sample size was insufficient for testing, the historical drill logs were interrogated to formulate conclusions.

10.4.2.1 Results of the drill core testing are presented below in table 4. The corresponding NATA accredited laboratory test certificates for each test result are attached as Appendix D.

Table 4: Drill core test results

GeoVic siteID	Original name	Depth interval sampled	Degradation factor result	Water absorption result	Wet/dry strength variation result
310881	Kalkallo 13	24.82m – 33.82m	16	4.8	Insufficient sample to test
310881	Kalkallo 13	43.54m – 53.70m	43	4.2	38
310881	Kalkallo 13	68.75m – 78.97m	80	2.8	19
310875	Kalkallo 7	41.5m – 47.5m	21	3.9	Insufficient sample to test
310871	Kalkallo 2	7.01m – 11.2m	83	1.6	Insufficient sample to test

10.4.3 Based on test results (refer table 4) and historical drill logs (refer Appendix C) the drill holes situated in the stony rises basalt sub-unit (Kalkallo 7, 9 and 10) indicate that the material quality is widely consistent across the sub-unit. All three holes exhibit high quality material with only minor weathering in the upper section (0 to 30m for Kalkallo 7 and 10; 0 to 21m for Kalkallo 9). The material in this upper section contains low secondary mineral content (approximately 10%). Each of the three holes exhibited an inconsistently weathered section of material below the upper section (30m to 60m), with secondary mineral content up to 20%.

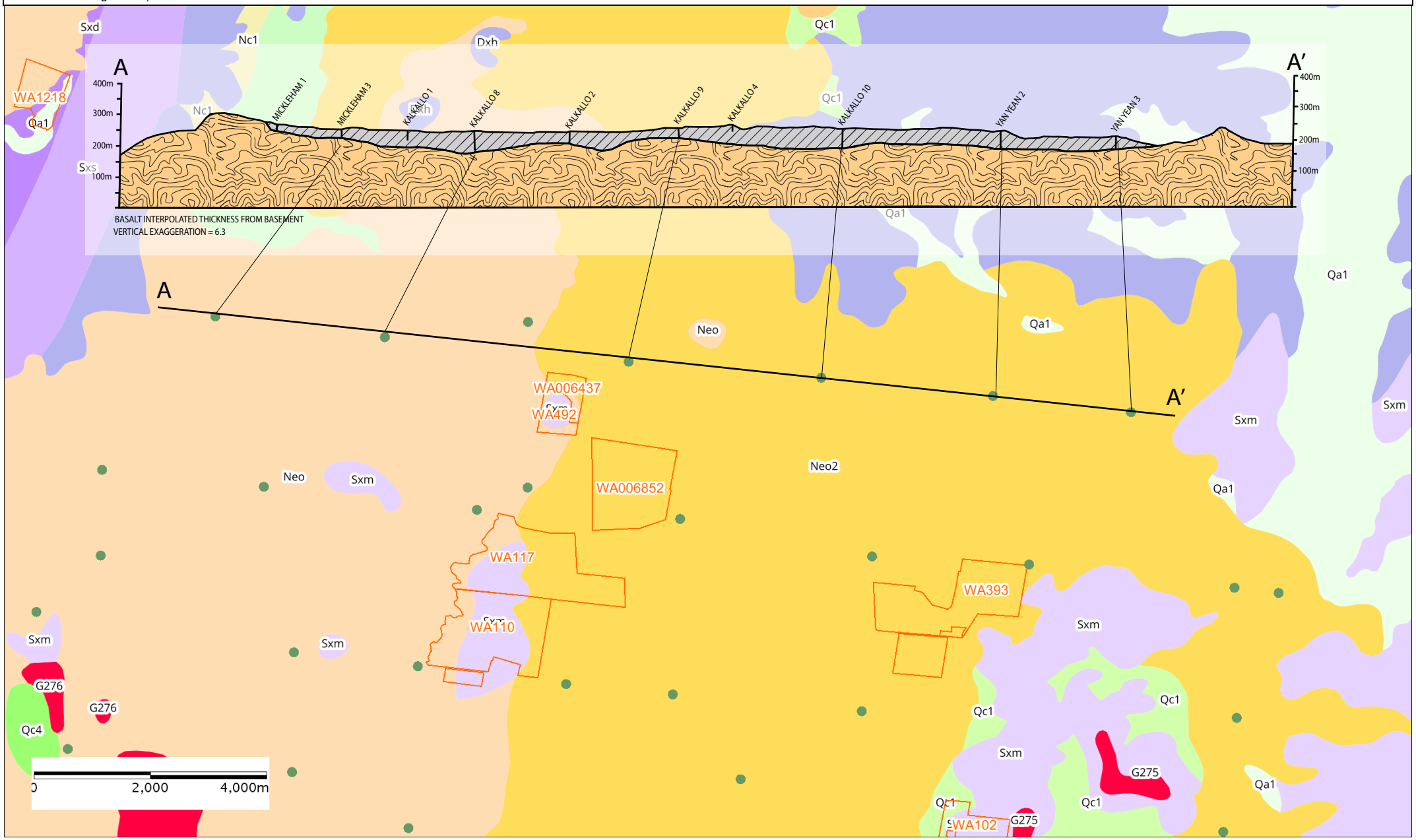
10.4.3.1 The overall characteristics of the material in the upper section of the stony rises sub-unit indicate suitability for production of concrete aggregates (specifically the low secondary mineral content) as the rock is likely to maintain high strength and unlikely to be reactive when used in concrete mixes. The low weathering and alteration indicate suitability for all road base and sub-base classes. Minor weathered sections will likely produce suitable fines to maintain the grading and plasticity requirements for road base specifications.

10.4.3.2 The weathering and secondary mineral content of the material in the lower section of the stony rises is unlikely to be of sufficient quality to maintain consistent production of high-quality aggregates but is likely suitable for all road base and sub-base classes. There is some inconsistency in the material quality in the lower section so on a site-by-site basis aggregate production may be achieved with the right production plant. This is evidenced by test results of the 41.5m to 47.5m depth interval of Kalkallo 7 (refer table 4).

10.4.4 Based on test results (refer table 4) and historical drill logs (refer Appendix C) the drill holes situated in the basalt flows sub-unit (Kalkallo 12, 13, 15, 10005 and 10052) indicate widespread material inconsistency. All holes in the basalt flows exhibited a thick profile of weathered material in the upper section (11m to 16m thickness) and consistently high secondary mineral content (approximately 30%). This is evidenced by test results for Kalkallo 2 (refer table 4). This indicates that the basalt flows material has likely been subjected to prolonged exposure to groundwater, leading to an overall lower quality basalt. It is likely that the basalt flows sub-unit will have a higher proportion of overburden and unsuitable material than the stony rises sub-unit. Below the upper section (> 20m depth) there are distinct zones across the area that are of high quality (fresh and very hard) with low secondary mineral content (approximately 10%).

10.4.4.1 The widespread material inconsistency and generally high secondary mineral content indicate that consistent production of high-quality aggregates is unlikely, however on a site-by-site basis aggregate production from the largely unweathered zones may be achieved with the right production plant. The weathered material is likely suitable for production of all road base and sub-base classes. This is evidenced by the test results for Kalkallo 13 (refer table 4).

11 Appendix A – Regional geological map with interpolated cross section



Disclaimer: This map is a snapshot generated from Victoria Government data. This material may be of assistance to you but the State of Victoria does not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for error, loss or damage which may arise from reliance upon it. All persons accessing this information should make appropriate enquiries to assess the currency of the data.

Generated from GeoVic 3

Map Created Wed Oct 21 2020 14:49:39 GMT+1100 (AEDT)

Map scale 1 : 85,842

Projection: GDA94

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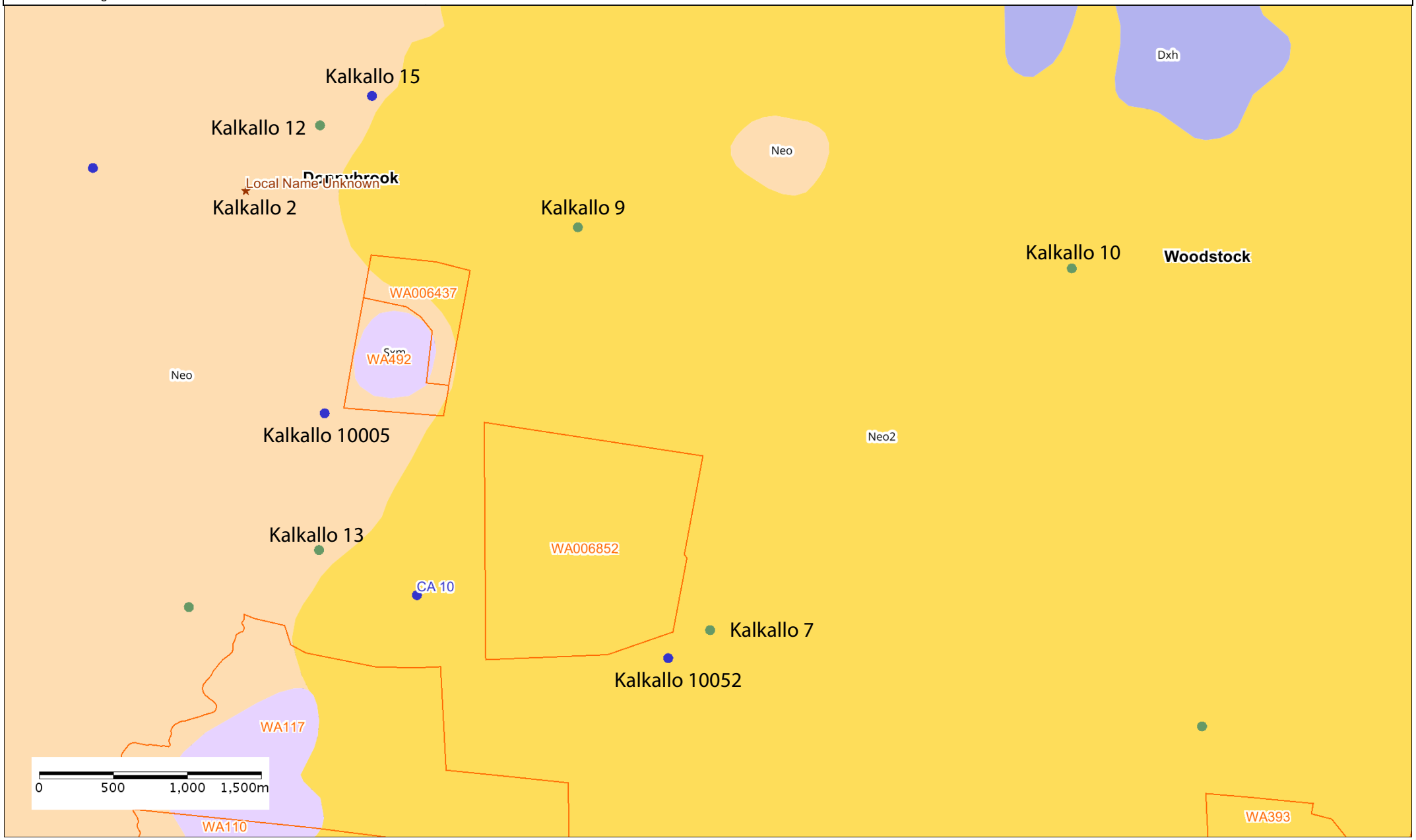
Newer Volcanic Group: stony rises basalt (Neo2)

Newer Volcanic Group: basalt flows (Neo)

Melbourne Formation (Sxm)

12 Appendix B – Drill hole location map

Department of Jobs,
Precincts and Regions



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Map Created Tue Oct 27 2020 11:58:11 GMT+1100 (AEDT)

Map Scale: 1:33,481

Projection: Geographic GDA94

GDA

VICTORIA State Government

13 Appendix C – Metro basalt survey drill core logs (Stewart, 1975)

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground 195.4 m

Location From junction of W boundary c.a. 9 and Summerhill Rd. 1.7 m E then 7.6 m S into road reserve

Hole No. KALKALLO 7 Angle of Hole from Horizontal vertical Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vel. Diagr.	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per foot	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
							0 6 12 18			
No core				0						
Basalt Slightly to highly weathered	Dark grey to yellow brown Hard to soft	10%		2 4		93		Fragments laminar		
		10%		6		94				AS ABOVE BUT APPEARS FRESHER OK ✓ Sample Slide No. 10461
Fresh to slightly weathered	Dark grey Hard			8						
		10%				96		Olivine phenocrysts abundant		
Slightly to moderately weathered	Brown grey	20%		10				Base of flow		
Soil	Yellow orange brown			12				Soil derived from weathered basalt Clayey		
Basalt Fresh to moderately weathered	Yellow brown to medium grey	10%		14		95		Non-vesicular Fractures lined with clay		
		20%		16		93				
Slightly weathered	Dark grey Very hard			18		96		minor streaming of vesicles		
				20						

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged R.T.P.
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs = 1 m

Sheet 1 of 3

Drawing No.

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY — R.L. Ground _____

Location _____

Hole No. KALKALLO 7 — Angle of Hole from Horizontal _____ — Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vein Dip	Log	Depth and Size of Core	Casing Lift and Core Recovery (%)	Fractures per 6 inch	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
						0 6 12 18			
Basalt Slightly weathered				20					
Slightly to moderately weathered	Dark grey Very hard	from 0°		22	89		Fragments laminar, lined with clays and carbonates		OLIVINE TO A LARGE EXTENT CONVERTED TO IDDINGSITE — WITH MUCH CALCITE Sample OK ✓ Slide No. 10462
				24					
Slightly to highly weathered	Dark grey to grey red Hard to soft	20°			93		Scoriaceous Vesicle infill: clay and blue-grey material Fractures, randomly oriented		
				26					
Moderately weathered	Dark grey to red grey	10°		28	94		Vesicle infill: as above		
Slightly to moderately weathered	Brown grey Hard to soft	20°		30			Vesicle infill: as above		
					97				LITTLE FRESH OLIVINE LEFT Green (CLAY) material fills vesicles & replaces FERROMAGS (—) Sample Slide No. 10463
Slightly weathered	Dark grey Very hard	from 7°		32			as above		
				34			Base		of flow
Basaltic soil completely weathered	Dark red brown Soft				95				
Moderately to slightly weathered	Red grey to dark grey Soft to hard	20°		36	98		Vesicles infilled with grey clay and carbonates		
				38					
Fresh to slightly weathered	Dark grey Very hard	10°			95		as above		
				40					

Drill Type _____
Core Barrel Type _____
Driller _____
Commenced _____
Completed _____

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged _____
Date _____
Checked _____
Approved _____
Drawn _____
Map Ref. _____

Vertical Scale 5 ins = 1 m
Sheet 2 of 3
Drawing No. _____

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground _____

Location _____

Hole No. KALKALLO 7 Angle of Hole from Horizontal _____ Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Log	Depth and Size of Core Casing	Lift and Core Recovery (%)	Fractures per foot (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water level	
Basalt			40	95		Vesicles infilled with clay and carbonates		HIGHLY weathered Greenish/yellow/brown CLAY material replaces olivine & fills the vesicles (—) Sample Slide No. 10464
Fresh to slightly weathered	Dark grey Very hard	for 7%	42 4" core	+				
				95				
			44			Vesicles infilled with carbonates.		
Slightly weathered	as above	10%						
Fresh to slightly weathered	Dark grey Very hard	10%	46	96		Vesicles infilled with grey blue material		
			48					
Slightly weathered	Dark grey to grey brown Very hard	10%		92		Of uniform appearance		GREENISH-YELLOW AS ABOVE + MORE WEATHERED (—) Sample Slide No. 10465
			50	100 +			Base	of flow
Soil	Pale red yellow		52			Lateritic soil, ironstone nodules		
Mudstone			84			Inferred Silurian age bedrock		
			96			End		of bore

Drill Type _____

Core Barrel Type _____

Driller _____

Commenced _____

Completed _____

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged _____

Date _____

Checked _____

Approved _____

Drawn _____

Map Ref. _____

Vertical Scale 5 divs. = 1 m

Sheet 3 of 3

Drawing No. _____

28/9/00010

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY

Location From NW corner 2.9.17, 465.2 m E along fence then 2.2 m N into road reserve

R.L. Ground 226.5 m

Hole No. KALKALLO 10 Angle of Hole from Horizontal _____ Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vac Bipp	Log	Depth and Size of Core	Casing Lift and Core Recovery (%)	Fractures per foot	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
						0 6 12 18			
No core				0					
Basalt				2					
Fresh to slightly weathered	Medium grey Very hard	10%		4	90		Some vesicles filled with carbonates Some fractures filled with clay		Grey / medium grained fresh, little Idingsite - Calcite OK ✓ Sample Slide No. 10476
		20%		6	95		as above		
Slightly weathered	as above			8					
		20%		10	90		as above		Vesicular, corroded + Idingsitized olivine little clay OK ✓
Slightly weathered moderately to highly weathered in places	Medium grey to grey brown Hard to soft	10%		12	90		Some vesicles infilled with carbonates		Sample Slide No. 10477 Sample Slide No. 10478 Fine grained Grey to brown + carbonate + little cl OK ✓
Moderately weathered	Brown grey Hard	10%		14	95		Vesicles infilled with red brown clay		
				16					
Slightly weathered	Medium grey Very hard	10%		18	86		Fractures infilled with yellow clay		
				20					

Drill Type _____
Core Barrel Type _____
Driller _____
Commenced _____
Completed _____

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged R.J.P.
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 dia. = 1 m
Sheet 1 of 4
Drawing No. _____

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY
Location _____ R.L. Ground _____
Hole No. KALKALLO 10 Angle of Hole from Horizontal _____ Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vesicularity	Log	Depth and Size of Core / Casing	Lift and Core Recovery (%)	Fractures per foot (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water level	
Basalt				20					COARSE GRAINED VESICULAR
Slightly weathered	Medium grey Very hard	20%		22	95				OK ✓ Sample Slide No. 10479
Moderately to highly weathered	Brown grey Hard	10%		24	97		Vesicles infilled with clay		
Slightly weathered	Dark grey Very hard	few %		26 28	86		Some vesicles filled with carbonates		Sample Slide No. 10480 VESICULAR, VESICLES FILLED WITH CALCITE + GREENISH CLAY Ferromag (olivine) appears to be completely altered to iddingsite (?) to (- at flat
Soil horizon	light yellow brown			30	93		Ironstone nodules Base		
Basalt Slightly weathered	Dark grey	few %		32			Porphyritic texture		
		few %			96		Fractures lined with iron-stained clay		
Fresh to slightly weathered	Dark grey Very hard	few %		34 36	96		Fractures lined with carbonates		AS ABOVE Sample Slide No. 10481
Moderately to highly weathered	Brown grey to dark grey Hard to soft	few %		38 40	61		laminar fragments Fine carbonate veins in the border fragments		

Drill Type _____
Core Barrel Type _____
Driller _____
Commenced _____
Completed _____

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m
Sheet 2 of 4
Drawing No. _____

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY — R.L. Ground _____

Location _____

Hole No. KALKALLO 10 — Angle of Hole from Horizontal _____ — Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vein	Log	Depth and Size of Core / Casing	Lift and Core Recovery (%)	Fractures per ft. (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Basalt Moderately to highly weathered	Brown grey to dark grey Hard to soft	few		40 42	61				
Slightly to moderately weathered	Dark grey, brown grey near fractures	few		44 46	92 90		Fine fractures lined with green material and carbonates Porphyritic		
		few		48 50	92		Films of limonite and carbonate on fractures		Sample Slide No. 10482 Brown/grey Compact in place About all olivine converted to iddingsite and in part to brown/greenish clay? (+) to (-)
Fresh	Dark grey Very hard	few		52 54	95		as above		
		few		56 58	90				AS ABOVE but with less clay Fresh? Sample Slide No. 10483 (+) to (+)
		10%		60			as above Base		of flow
Soil	Red brown clay mottled red and cream clay						Lateritic soil ironstone nodules		

Drill Type _____
Core Barrel Type _____
Driller _____
Commenced _____
Completed _____

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m

Sheet 3
of 4
Drawing No. _____

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground _____

Location _____

Hole No. KALKALLO 12 Angle of Hole from Horizontal _____ Direction _____

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vis. Strip	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per ~~foot~~ 6" (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Fine grained micaceous siltstone	Red brown and grey			60				Bedding dips approximately 30°		
				62				End		of bore
				84						

Drill Type _____

Core Barrel Type _____

Driller _____

Commenced _____

Completed _____

NOTES

Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged _____

Date _____

Checked _____

Approved _____

Drawn _____

Map Ref. _____

Vertical Scale 5 ins. = 1 mm

Sheet 4 of 4

Drawing No. _____

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

2219000009

Project: METROPOLITAN BASALT SURVEY
Location:
R.L. Ground: 237·4 m
Hole No.: KALKALLO 9 Angle of Hole from Horizontal: vertical Direction:

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vesicularity	Log	Depth and Size of Core	Lift and Core Recovery (%)	Fractures per foot	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water level	
						0 6 12 18			
Soil				0					
				2					
Basalt									
Slightly weathered	Dark grey Very hard			4	95		Fractures obliquely oriented		
Fresh	Very hard								
Slightly weathered	light grey grading to a pinkish brown	10%		6	96		Vesicles infilled with brown clay		OK ✓ Sample Slide No. 10471
Slightly to moderately weathered	Grey-pink to grey-red Hard	25%		8					
				10	97		Vesicles infilled with carbonates, clay and grey matter.		
Fresh	Medium grey Hard						Few vesicles		COARSE GRAINED VESICULAR FRESH ~ LITTLE ALTERATION OK ✓ Sample Slide No. 10472
				12					
Slightly weathered	Medium grey Very hard	10%			91		Fractures and vesicles infilled with carbonate and clay		Sample Slide No. 10473
				14					AS ABOVE ~ SLIGHTLY FINER GRAINED AND LITTLE MORE SECONDARY MINERALS OK ✓ to (+)
							large fracture infilled with laminated, swelling clay		
				16	96				
Fresh to slightly weathered moderately weathered in places	Dark grey Hard	20%							AS ABOVE Sample Slide No. 10474
				18					
					96%		Vesicles infilled with clay		
		20%		20					

Drill Type:
Core Barrel Type:
Driller:
Commenced:
Completed:

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged:
Date:
Checked:
Approved:
Drawn:
Map Ref.:

Vertical Scale: 5 divs = 1 m

Sheet 1 of 2
Drawing No.:

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground

Location

Hole No. KALKALLO 9 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vein Dip	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per foot / m (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Basalt				20				Base		of flow
Soil	light yellow brown							Baked upper surface Abundant ironstone gravel		
Basalt				22		95%				
Moderately to highly weathered	Brown grey grading to medium grey grading to pink grey with depth Hard to soft	10°		24				Fractures randomly oriented Intensity of fracturing has reduced core to rubble.		
				26		85				
Moderately weathered	Pinkish grey Hard	20°		28				Vesicles and fractures infilled with clay and light grey matter		
Highly weathered	Pinkish grey Soft	20°		30				Rubble		GREEN / GREY weathered (—)
Slightly weathered	Dark grey Hard to soft			32		+		As above		Sample Slide No. 10475
								Base		of flow
Soil	Red-orange							Ironstone gravel		
Shale possibly Silurian bedrock	Yellow brown to yellow grey Soft			34				Extensive network of fine fractures coated with limonite		
				36						
				36.6				End of		bore

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES

Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged RJP

Date

Checked

Approved

Drawn

Map Ref.

Vertical Scale 5 divs = 1 m

Sheet 2

of 2

Drawing No.

2819000.3

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY — R.L. Ground 211.7 m

Location 261.518 m W from the NW corner c.a. 3C then 489.59 m N on 17° 45' Lilla bearing

Hole No. KALKALLO 13 — Angle of Hole from Horizontal vertical — Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vesicularity	Log	Depth and Size of Core	Lost Core	Lift and Core Recovery (%)	Fractures per 300 mm (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Clay	Grey brown			0				Contains some quartz grains		Alluvium and basaltic soil
Basalt Slightly weathered	Medium grey Hard	20%		2		95		Vesicles large and small minor vesicle streaming		
Clay	Brown							Infilling completely weathered basalt		
Basalt	Medium grey Soft to hard	30%		4		100		Fractures lined with yellow brown clays		
		10%		6				Olivine phenocrysts iddingsitized.		
	as above	10%				100		Fractures lined with clays		
		30%		8						
	as above	10%		10		100		Phenocrysts completely weathered		
Slightly to moderately weathered	Brown grey Soft to hard	20%		12				Vesicles lined with grey material. Fractures lined with carbonate and clays		
	Grey brown Soft to hard	20%		14		100		Vesicles lined with both grey and yellow material		
	as above	20%		16		97		Vesicles lined with grey material		
		30%		18				Olivine phenocrysts iddingsitized		
Slightly weathered	Grey brown Hard	20%		20				Vesicles lined with grey material		

Drill Type
Core Barrel Type
Driller
Commenced
Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged G.S.
Date Feb '75
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m

Sheet 1 of 5

Drawing No.

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project: METROPOLITAN BASALT SURVEY — R.L. Ground:

Location:

Hole No.: KALKALLO 13 — Angle of Hole from Horizontal: — Direction:

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Ves	Log	Depth and Size of Core (Casing)	Lift and Core Recovery (%)	Fractures per 6" (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level
Basalt				20	100		Minor vesicle streaming	
Slightly weathered	Grey brown Hard	20%		22			Some vesicles lined with grey and white material	
		30%			100		Other vesicles infilled with white material	
Fresh	Medium grey Very hard	few %		24				
		30%		26	100		Some vesicles lined with clays	
Fresh to slightly weathered	Brown grey Very hard	30%		28			Vesicles lined with grey and some white material	
		few %		30	100			
Slightly weathered	Medium grey Very hard	30%		32			Some vesicles lined with dark grey material, others infilled with olive green material	
		few %			100			
		10%		34				
Fresh to slightly weathered	as above	few %			100		Vesicles lined with grey material, carbonates and olive green clays	
		20%		36				
	Grey grading to brown with depth						Possible flow boundary Thin layer of yellow brown clay	
Slightly weathered		20%		38	100			
				40				

Drill Type:
Core Barrel Type:
Driller:
Commenced:
Completed:

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged:
Date:
Checked:
Approved:
Drawn:
Map Ref.:

Vertical Scale: 5 divs. = 1 m

Sheet 2 of 5

Drawing No.:

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project: METROPOLITAN BASALT SURVEY — R.L. Ground:

Location:

Hole No.: KALKALLO 13 — Angle of Hole from Horizontal: — Direction:

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vesicles	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per m (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level
Basalt	Alternating brown-grey and brown Very hard	10%		40				Vesicles lined with grey material	
Fresh to slightly weathered						100			
		30%		42					
	Medium grey Very hard							as above	
		10%		44		100		Fractures and vesicles infilled with olive green clay	
		30%		46					
Slightly weathered	Medium grey Hard					100		Some fractures lined with brown clay	
		20%		48					
				50		100		larger vesicles lined with grey material	
Fresh to slightly weathered	Medium grey Very hard	few							
				52				Base of flow	
		10%							
Clay	Orange brown			54		75		Inferred completely weathered scoria	
Basalt slightly weathered	Medium grey Hard	30%		56				Vesicles lined with grey material	
Fresh to slightly weathered	Medium to dark grey Very hard					100			
		10%		58				as above, some vesicles lined with carbonates	
				60					

Drill Type:
Core Barrel Type:
Driller:
Commenced:
Completed:

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged:
Date:
Checked:
Approved:
Drawn:
Map Ref.:

Vertical Scale: 5 divs. = 1 m

Sheet 3 of 5

Drawing No.:

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground
Location
Hole No. KALKALLO 13 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Log	Depth and Size of Core	Lift and Core Loss	Recovery (%)	Fractures per 6" (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level
Basalt			60					
Fresh to slightly weathered	Dark grey Very hard	few		100			Vesicles lined with olive green material	
			62				Fractures lined with carbonates	
							Minor vesicle streaming	
Highly weathered	Soft	few	64					
				80			Base of flow	
Quartz sand and clay	Brown grey						Partly silicified Ironstone granules	
Basalt			66				Soil profile	
Moderately weathered grading to fresh with depth	Medium grey Soft to hard	30%					Some fractures lined with clays	
			68	80				
		10%					Some vesicles lined with blue grey material	
			70					
	Blue grey Very hard	10%		100			Vesicles lined with blue grey material and minor carbonate	
			72					
Fresh							as above	
	Medium grey Very hard	10%	74	100			Fractures lined with black material	
			76					
				100			Vesicles and fractures lined with carbonates	
Slightly weathered	Light grey Hard	few	78					
							Base of flow	
Sandy clay	Dark brown		80					

Drill Type
Core Barrel Type
Driller
Commenced
Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m

Sheet 4
of 5
Drawing No.

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground

Location

Hole No. KALKALLO 13 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per ft. (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Sandy clay	Dark brown		80				Slightly micaceitic carbonized plant material		Inferred alluvial origin
	light brown								
			82		35		Inferred weathered bedrock		
	Yellow brown								
Sandstone Highly weathered	Yellow brown		84				Weathered bedrock		
							End		of bore
			86						
			88						
			90						

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged

Date

Checked

Approved

Drawn

Map Ref.

Vertical Scale 5 divs. = 1 m

Sheet 5 of 5

Drawing No.

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY — R.L. Ground 221·3 m

Location From the SW corner Lot 1 Vol 4149 Fol. 711, 471·28 m N

Hole No. KALKALLO 12 — Angle of Hole from Horizontal vertical — Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vein Sym.	Log	Depth and Size of Core	Casing	Lift and Core Recovery (%)	Fractures per	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level
							0 6 12 18		
Clay	Medium grey-brown			0				Quartz free	
Clayey very fine sand	Medium grey-brown			2		100		Contains minor muscovite	
				4		97		Seemingly devoid of sedimentary structure	
	light to medium grey-brown			6				Some small heavily ferruginized pellets	
Basalt									
Highly weathered	Brown grey Soft	20%		8		86		Vesicles lined with clays and carbonates	
Moderately weathered	as above	30%		10		97		Some fractures lined with carbonates	
Highly to completely weathered	Dark grey, yellow brown Soft	few %		12				Core composed of platelike fragments	
				14		100			
Slightly to moderately weathered	Dark grey Hard	few %		16		97 +		Fractures lined with carbonates	
Fresh to slightly weathered	Grey to grey brown Very hard	20%		18					
				20					

Drill Type
Core Barrel Type
Driller
Commenced
Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged G.S.
Date Dec. '74
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m

Sheet 1 of 5

Drawing No.

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground

Location

Hole No. KALKALLO 12 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Log	Depth and Size of Core / Casing	Lift and Core Recovery (%)	Fractures per ft. (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level
Basalt		30%	20	100		Vesicles lined with grey and light grey material	
Fresh to slightly weathered	Grey to brown grey Very hard	few 2%	22	97		Fractures lined with clays	
		20%	24			Vesicles lined with green material	
		20%				Minor vesicle streaming	
	Light to medium grey Very hard	10%	26	100		Some vesicles lined with green material	
Fresh			28				
	Medium grey Very hard	10%		97+		Coarsely crystalline groundmass	
			30				
	Medium grey Very hard		32				
Fresh to slightly weathered	Brown grey Very hard	few 2%		100		as above	
			34				
Slightly weathered	Medium grey Very hard	30%				Vesicles and fractures lined with white material	
			36	100			
Fresh	as above	few 2%				Medium to coarse crystalline groundmass	
			38				
Moderately weathered	Hard to soft Grey			100		Vesicles lined with grey material	
Fresh	Very hard	30%	40			Vesicles filled with brown clay	

Section Vertical Scale 5 divs. = 1 m

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Logged

Date

Checked

Approved

Drawn

Map Ref.

Sheet 2 of 5

Drawing No.

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY — R.L. Ground

Location

Hole No. KALKALLO 12 — Angle of Hole from Horizontal — Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vug.	Log	Depth and Size of Core / Casing	Lift and Core Recovery (%)	Fractures per ft. (0 6 12 18)	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
Basalt		10%		40					
					97		Vesicles lined with light grey and green grey material		
		from 2%		42					
Fresh	Brown grey Very hard								
				44	+ 100		Vesicles lined with light grey material		
		from 1%							
				46					
Slightly weathered	Brown grey	20%					Some vesicles infilled with white material, others lined with light grey, medium grey and black material		
				48	97				
Fresh		10%							
		30%					Base of basalt		
Clay	light grey brown			50			Ironstone nodules . Quartz free		
NO RECOVERY, FLUSHED FROM CORE BARREL DURING DRILLING				52	46				
Clayey sand	Light grey			54			Slightly muscovitic		
	as above			56					
Muscovitic sandstone Completely weathered	Dark grey			58	58		Very fine grained Fractures lined with limonitic material		
				60					

Section — Vertical Scale 5 divs. = 1 m

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Logged

Date

Checked

Approved

Drawn

Map Ref.

Sheet 3 of 5

Drawing No.

MINES DEPARTMENT, VICTORIA
GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground
Location
Hole No. KALKALLO 12 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vein Symbols	Log	Depth and Size of Core / Casing	Lift and Core Recovery (%)	Fractures per	Structures Joints, Veins, Seams, Faults, Crushed Zones	Weathering Level
						0 6 12 18		
Muscovitic sandstone	Dark grey Soft			60			Very fine grained	
							Fractures lined with limonitic material	
Moderately to highly weathered	Patchy dark grey and grey-brown			62	75		Fractures dip at approximately 30°	
							Colour change due to change in colour of matrix	
				64				
Slightly weathered	Dark grey Hard			66	86		Fractures lined with limonitic material	
				68			First appearance of disseminated sulphides	
					90			
				70				
							Fractures lined with limonitic material	
				72				
					97			
Fresh to slightly weathered	Medium grey Hard			74				
							Intercalated laminae of light brown to white sandstone	
				76	97		Sulphides are concentrated on bedding planes	
				78				
					100		as above	
				80				

Drill Type
Core Barrel Type
Driller
Commenced
Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section
Logged
Date
Checked
Approved
Drawn
Map Ref.

Vertical Scale 5 divs. = 1 m
Sheet 4 of 5
Drawing No.

MINES DEPARTMENT, VICTORIA

GEOLOGICAL LOG OF DRILL HOLE

Project METROPOLITAN BASALT SURVEY R.L. Ground

Location

Hole No. KALKALLO 12 Angle of Hole from Horizontal Direction

Rock type and Degree of Weathering	Description Colour, Hardness, etc.	Vis. Core	Log	Depth and Size of Core Casing	Lift and Core Recovery (%)	Fractures per 6"	Structures Joints, Veins, Seams, Faults, Crushed Zones	Water Level	
						0 6 12 18			
Very fine grained sandstone Fresh to slightly weathered	Medium grey Hard			80 82 84 86 88 90	97		Fractures lined with limonitic material containing rounded pebble clasts Granulated interval		Metallographic mount 731 Metallographic mount 732 End of bore

Drill Type

Core Barrel Type

Driller

Commenced

Completed

NOTES
Bedding and Joint Planes: Angles are measured relative to a plane normal to the core axis.

Section

Logged

Date

Checked

Approved

Drawn

Map Ref.

Vertical Scale 5 ins. : 1 in.

Sheet 5 of 5

Drawing No.

14 Appendix D – Laboratory test certificates

GROUNDWORK plus

TEST CERTIFICATE

Groundwork Plus
78 / 109 Leitchs Road, Brendale,
QLD 4500 Australia

Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001056
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310871-001
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Degradation Factor

Method:	AS1141.25.1
Wash water after 500ml:	Cloudy
Description of Sample Source:	Laboratory Crushed Material
Crusher type used and source:	Laboratory Jaw Crusher / Cores
Scalping screen size:	19mm
Description of Deleterious material removed:	Nil
Degradation Factor:	83

Approved Signatory: _____ (Dave Gregson, Business Manager - Laboratories) Date: 21/10/2020

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Form No.: GWB-FMR-055 v.2.0 08.10.2019

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001052
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2003
		Sample Method:	Sampled by Client
		Tested Date:	22/10/2020

Particle Density & Water Absorption - Fine Aggregate

Method:	AS1141.5
Particle Density	
Apparent (t/m³):	2.92
Dry Basis (t/m³):	2.59
Surface Saturated Dry (t/m³):	2.70
Water Absorption (%):	4.2

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 27/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001054
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-006
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Degradation Factor

Method:	AS1141.25.1
Wash water after 500ml:	Clear
Description of Sample Source:	Laboratory Crushed Material
Crusher type used and source:	Laboratory Jaw Crusher / Cores
Scalping screen size:	19mm
Description of Deleterious material removed:	Nil
Degradation Factor:	16

Approved Signatory: _____ (Dave Gregson, Business Manager - Laboratories) Date: 21/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001055
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310875-001
		Sample Method:	Sampled by Client
		Tested Date:	22/10/2020

Particle Density & Water Absorption - Fine Aggregate

Method:	AS1141.5
Particle Density	
Apparent (t/m³):	2.92
Dry Basis (t/m³):	2.62
Surface Saturated Dry (t/m³):	2.73
Water Absorption (%):	3.9

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 27/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001056
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310871-001
		Sample Method:	Sampled by Client
		Tested Date:	22/10/2020

Particle Density & Water Absorption - Fine Aggregate

Method:	AS1141.5
Particle Density	
Apparent (t/m³):	2.91
Dry Basis (t/m³):	2.78
Surface Saturated Dry (t/m³):	2.82
Water Absorption (%):	1.6

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001054
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-006
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Wet / Dry Strength Variation

Method:	AS1141.22
Nature of Bulk Sample:	Core
Nominal Size of Bulk Sample (mm):	5
Fraction Size of Test Portion (mm):	4.75-3.35
Size of Test Cylinder (mm):	75
Occurrence of Breakdown:	Yes
Ten Percent Fines - Dry (kN):	337
Ten Percent Fines - Wet (kN):	213
Wet / Dry Variation (%):	37

Note: Laboratory crushed material

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 28/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001055
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310875-001
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Degradation Factor

Method:	AS1141.25.1
Wash water after 500ml:	Clear
Description of Sample Source:	Laboratory Crushed Material
Crusher type used and source:	Laboratory Jaw Crusher / Cores
Scalping screen size:	19mm
Description of Deleterious material removed:	Nil
Degradation Factor:	21

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001054
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-006
		Sample Method:	Sampled by Client
		Tested Date:	22/10/2020

Particle Density & Water Absorption - Fine Aggregate

Method:	AS1141.5
Particle Density	
Apparent (t/m³):	2.91
Dry Basis (t/m³):	2.56
Surface Saturated Dry (t/m³):	2.68
Water Absorption (%):	4.8

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 27/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001052
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2003
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Degradation Factor

Method:	AS1141.25.1
Wash water after 500ml:	Clear
Description of Sample Source:	Laboratory Crushed Material
Crusher type used and source:	Laboratory Jaw Crusher / Cores
Scalping screen size:	19mm
Description of Deleterious material removed:	Nil
Degradation Factor:	43

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001052
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2003
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Wet / Dry Strength Variation

Method:	AS1141.22
Nature of Bulk Sample:	Core
Nominal Size of Bulk Sample (mm):	5
Fraction Size of Test Portion (mm):	4.75-2.36
Size of Test Cylinder (mm):	75
Occurrence of Breakdown:	Yes
Ten Percent Fines - Dry (kN):	334
Ten Percent Fines - Wet (kN):	209
Wet / Dry Variation (%):	38

Note: Laboratory crushed material

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 28/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001053
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2004
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Degradation Factor

Method:	AS1141.25.1
Wash water after 500ml:	Clear
Description of Sample Source:	Laboratory Crushed Material
Crusher type used and source:	Laboratory Jaw Crusher / Cores
Scalping screen size:	19mm
Description of Deleterious material removed:	Nil
Degradation Factor:	80

Approved Signatory: _____ (Dave Gregson, Business Manager - Laboratories) Date: 21/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001053
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2004
		Sample Method:	Sampled by Client
		Tested Date:	22/10/2020

Particle Density & Water Absorption - Fine Aggregate

Method:	AS1141.5
Particle Density	
Apparent (t/m³):	2.93
Dry Basis (t/m³):	2.71
Surface Saturated Dry (t/m³):	2.78
Water Absorption (%):	2.8

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 27/10/2020

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Client:	Geological Survey of Victoria	Job Number:	000279
Project:	Aggregate Testing	Order No:	PO 361790
Location:	Geological Survey of Victoria	Sample ID:	00001053
Address:	Level 17, 1 Spring Street, Melbourne, Victoria Australia 3000	Client Sample ID:	310881-2004
		Sample Method:	Sampled by Client
		Tested Date:	21/10/2020

Wet / Dry Strength Variation

Method:	AS1141.22
Nature of Bulk Sample:	Core
Nominal Size of Bulk Sample (mm):	5
Fraction Size of Test Portion (mm):	4.75-3.35
Size of Test Cylinder (mm):	75
Occurrence of Breakdown:	No
Ten Percent Fines - Dry (kN):	358
Ten Percent Fines - Wet (kN):	289
Wet / Dry Variation (%):	19

Note: Laboratory crushed material

Approved Signatory: _____ (Steve Bird, Laboratory Manager) Date: 28/10/2020

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