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PLANNING PANELS VICTORIA

SHENSTONE PARK PRECINCT STRUCTURE PLAN
WHITTLESEA AMENDMENT C241

STATEMENT OF EVIDENCE OF TIMOTHY MICHAEL MARKS

Prepared for: 1100 Donnybrook Road Pty Ltd

Instructed by: Hall & Wilcox

Date of last site inspection: Not performed due to current COVID-19 restrictions

Date of Statement of Evidence: 28 October 2020

Document reference: Ev 001 20200825

1.0 NAME AND ADDRESS

1.1 TIMOTHY MICHAEL MARKS

Consultant and former Associate Director of Marshall Day Acoustics Pty Ltd

1.2 6 Gipps Street, Collingwood

Victoria 3066

2.0 AREA OF EXPERTISE

2.1 For the past 36 years I have worked in the field of acoustics, noise and vibration measurement and control as a consulting engineer and as a manufacturer. I am a former Chairman of the Australian Association of Acoustic Consultants (AAAC).

2.2 I am a member of the Australian Acoustical Society (MAAS)

2.3 I am a professionally qualified mechanical engineer who has specialised in acoustics since graduation with Honours from Monash University in 1974. I hold a Master's Degree in Sound and Vibration from Southampton University and have had extensive experience in preparing noise and vibration impact reports for over rail developments, industrial plant, power stations, commercial and mixed use industrial developments and airport, rail and traffic noise studies.

2.4 My qualifications and experience are detailed in Appendix A.

2.5 I am sufficiently expert to make this statement because I have been involved in environmental noise and vibration impact assessments for major projects such as new roads, public infrastructure, residential and mixed use commercial developments, performing arts and music centres and smaller developments such as service stations, childcare centres, restaurants, wineries, pubs and night clubs. I have also conducted rail noise and vibration impact assessments at key infrastructure sites in Victoria and elsewhere, notably for clients or stakeholders impacted by the operation or construction of Metro Melbourne, several Victorian Gold Mines, Montpelier development Hobart. West Gate Freeway Tunnel crossing, the Victorian Desalination Plant, and numerous rail infrastructure projects.

2.6 In the course of my investigations I have:

- Reviewed relevant documentation and reports
- Have not visited the site at the time of preparing this Statement as would normally be required but will do so once applicable COVID 19 restrictions are lifted
- Reviewed the results of vibration assessment calculations
- Reviewed proposed modelling or predictive methodologies
- Prepared a peer review with a general overview of the Relevant sections of the GHD Report (see Clause 3.6 for details)
- Provided additional comments on the project conclusions pertaining to vibration.

3.0 SCOPE

3.1 Amendment C241 to the Whittlesea Planning Scheme (the amendment) involves a review of the Shenstone Precinct Structure Plan dated September 2019 (the PSP).

3.2 1100 Donnybrook Road Pty Ltd (a related entity of Ouson) owns the property at 1100 Donnybrook Road, Donnybrook VIC 3064 which is included within the PSP and is submitter (Submission 20) to the Amendment. This property is referred to herein as the *Ouson land holding*.

3.3 The PSP area contains the existing Woody Hill Quarry and to the south of the PSP area is the proposed Phillips Quarry

3.4 It is noted that 1100 Donnybrook Road Pty Ltd also owns the parcel of land outside the PSP area immediately to the south of the PSP within the Northern Quarries PSP and adjacent to the east boundary of the proposed Phillips Quarry.

3.5 Buffer zones are presented in the PSP around both the existing Woody Hill Quarry and the proposed Phillips Quarry.

3.6 The buffers have been determined based on the findings of the GHD report Ref 313 5311 *Impact Assessment Report for the Shenstone Park Precinct Structure Plan*, dated December 2017 (the GHD Report).

3.7 The Ouson land holding is currently impacted by a number of buffers around the proposed Phillips Quarry and shown in the PSP. The buffers around the Woody Hill Quarry do not impact the Ouson land holding.

3.8 I have been instructed by Hall & Wilcox, on behalf of 1100 Donnybrook Road Pty Ltd to *prepare expert vibration evidence in relation to the merits of the Amendment with a focus on the buffers to the former Phillips Quarry as it impacts the Ouson land holding in the PSP*.

3.9 My instructions are specific to operational vibration and blast related impacts from the proposed Phillips Quarry. Acoustic related impacts are addressed in Christophe Frederic Delaire's witness statement.

3.10 In preparation of my witness statement, I have reviewed relevant sections of the documents listed in Appendix B.

3.11 I prepared this statement of evidence with the assistance of the Marshall Day Acoustics' staff members listed in Table 1.

Table 1: Assisting MDA staff members

Staff member	Title	Tasks	Qualification
Christian Mesa	Consultant	Review of calculations	Ph.D, B. Mech Eng (Spanish Equivalent)
Christophe Delaire	Co-CEO	Review of evidence	M.Eng (French equivalent)

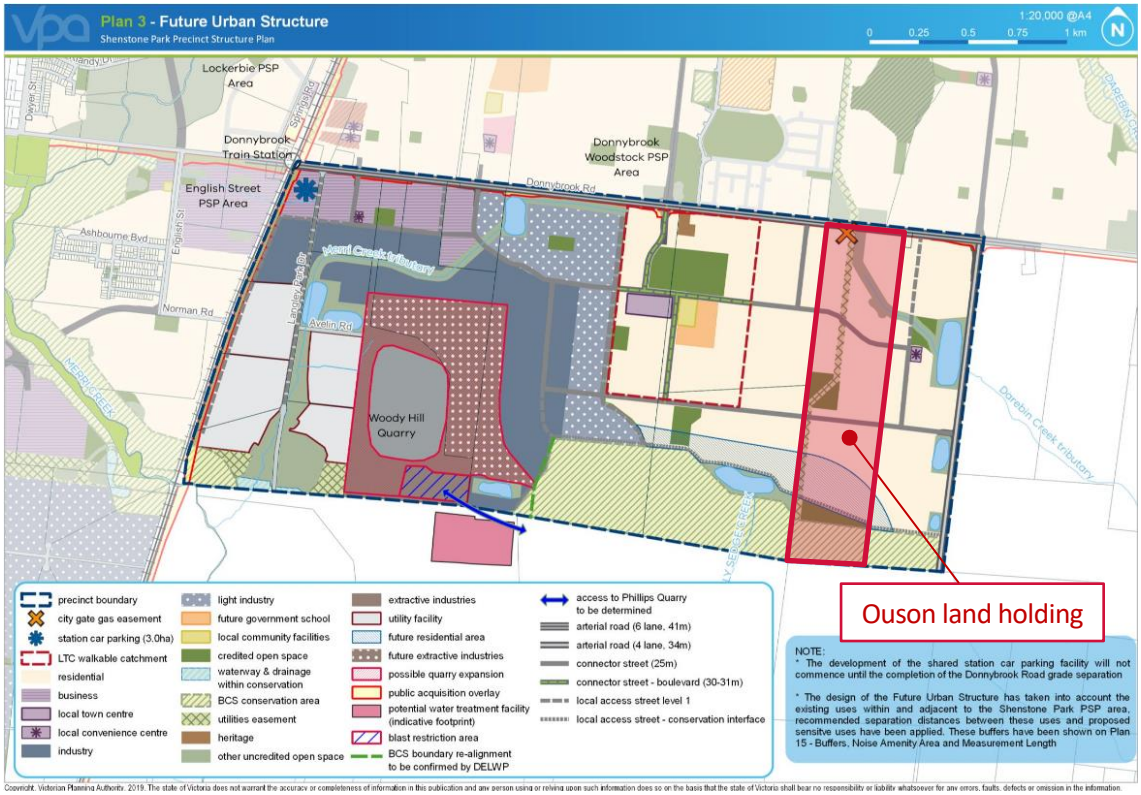
3.12 A glossary of acoustic terminology is provided in Appendix C.

4.0 OUSON LAND HOLDING

4.1 The Ouson land holding is located at 1100 Donnybrook Road, Donnybrook.

4.2 Plan 5 of the PSP presenting the proposed Future Urban Structure is reproduced in Figure 1 with the Ouson land holding highlighted.

Figure 1: Future Urban Structure



4.3 As shown in Figure 1, the Ouson land holding is generally identified as residential with the following:

- A City Gate gas facility to the northwest of the site (marked as an orange cross)
- A gas easement including two APA pipelines running north-south along the western side of the site
- Areas of credited and uncredited open spaces
- A Biodiversity Conservation Strategy (BCS) conservation area along the southern part of the site
- A future residential area to the north of the BCS conservation area.

5.0 PHILLIPS QUARRY

5.1 The proposed Phillips Quarry is located at 430 Summerhill Road, Donnybrook, to the southwest of the Ouson land holding.

5.2 At the time of preparing the GHD Report, limited information was available to assess vibration from the Phillips Quarry. As such only preliminary vibration estimates were made by GHD.

5.3 Hours of operation for the Phillips Quarry as detailed in Section 4.1.2 of the GHD Report as:

- 0700 to 1800 hrs Monday to Friday
- 0700 to 1300 hrs Saturdays.

5.4 As directed by Planning Panels Victoria on 4 September 2020, the following documents detailing key factual information about the Phillips Quarry have been issued:

- Letter dated 2 October 2020 prepared by Barro Group Pty Ltd (the *Barro Letter*)
- *Quarry Statement* prepared by the Victorian Planning Authority.

5.5 Neither documents provide any additional information to more accurately predict vibration from the Phillips Quarry.

5.6 The planning permit (TPP7049001) granted in 1999 has recently been extended specifying that operation must commence no later than 8 July 2024.

5.7 A new application for work authority (WA006852) has not yet been submitted. The Quarry staged plan is shown in Appendix D.

5.8 With respect to the proposed quarrying operations within the Phillips Quarry, the Barro Letter states the following:

> *Attached and marked Annexure 6 (e) (ii) is the current proposed initial staging plan for WA 6852.*
>
> *WA 6852 is expected to commence as soon as the necessary approvals are obtained.*
>
> *The north eastern portion of WA 6852 (represented generally by the perimeter of stages 1A and 1B) is currently intended to be fully extracted first, while the north western portion (represented generally by the perimeter of Stages 1C and 1D) will initially be extracted to a level on which to site the fixed processing plant.*

6.0 RELEVANT VIBRATION STANDARDS

6.1 Section 9 of the GHD Report presents vibration criteria for non-blasting activities in terms of human comfort and structural damage. The human comfort criteria are taken from BS 6472.1:2008[1] and the structural damage criteria are taken from DIN 4150-3:1999[2].

6.2 I consider these standards are suitable for assessing Quarry operational vibration from when interpreted correctly. Although they each use differing criteria, that is VDV (Vibration Dose Value) for evaluating human comfort and Peak Particle velocity (PPV) for evaluating structural vibration, these standards are commonly applied in Australia.

6.3 Section 12 of the GHD Report presents vibration criteria for blasting activities in terms of residential limits and structural damage to buildings. This Section also provides criteria for buried pipework, that would apply to the APA pipelines nearby that pass North South through the subject land and then along the eastern Boundary of the Phillips Quarry to the Wollert Compressor Station.

6.4 The residential limits criteria for blasting are taken from the ANZEC Guideline[3] and the structural damage criteria for blasting on buildings and the buried pipelines are taken from DIN 4150:1999.

6.5 Except as discussed in this Statement, I consider this Guideline and Standard when interpreted correctly are each suitable for assessing quarry blasting vibration and although these codes use the same criteria, that is Peak Particle velocity (PPV), they can be used for evaluating both structural and piping vibration. Both are commonly applied in Australia.

6.6 The nominated criteria and vibration assessment by GHD are summarized in the following sections.

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1 BS 7385.2:1993 *Evaluation and Measurement of vibration in Buildings, Part 2- Guide to Damage levels from Ground Borne Vibration*

2 DIN 4150-3:1999 *Structural Vibration - Part 3: Effects of Vibration on Structures*

3 ANZEC *Technical basis for Guidelines to minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)*

7.0 RELEVANT ASSESSMENT CRITERIA - NON-BLASTING

Non blasting human comfort

7.1 For non-blasting activities the GHD report nominates a criterion of VDV 0.2-0.4 for human comfort in residential buildings ("low probability of adverse comment") which is taken from BS 6472.1. However, since vibration from mechanical mining or quarrying equipment is usually measured in PPV, then the relevant criteria for consideration should be based on the PPV metric. In the GHD Report these are obtained from continuous and intermittent vibration criteria presented in Appendix C of the NSW Department of Environment and Conservation (DEC) *Assessing Vibration – A Technical Guideline* (NSW DEC Guideline), an extract of which is enclosed as Appendix E.

7.2 Appendix E is a consolidated set of criteria from several codes and standards, especially from ISO 10137:2007[4] and contains both Root Mean Square (RMS) acceleration and velocity, and converts these to the equivalent PPV, assuming a Crest Factor (CF) of 1.4.

7.3 The NSW DEC Guideline presents two sets of criteria which depend on the type of vibration:

- One set of criteria for continuous or intermittent vibration; and
- One set of criteria for impulsive or transient vibration which is 30 times higher (e.g. a vibration velocity of 0.28 mm/s PPV vs 8.6 mm/s PPV in residences during daytime).

7.4 Crest factors of 1.4 are rare in construction and mining equipment vibration, this parameter can usually vary from 1.4 to 6.0 times the RMS vibration velocity, so the correct criterion can be a range of numbers and difficult to establish with certainty.

7.5 The use of a crest factor of 1.4 is very conservative and its use will provide a considerable safety factor, that in this case does not become material to the GHD analysis and conclusions.

Non blasting structural damage

7.6 The GHD Report nominates frequency dependent PPV values of 5 mm/s (1-10 Hz), 5-15 mm/s (10-50 Hz) and 15-20 mm/s (50-100 Hz) which would be applicable for excavation and mining equipment operating at Phillips Quarry. These targets are taken from DIN 4150-3:1999, which is internationally recognised and widely used for most types of vibration assessment, including blasting and non-blasting events, and is applicable to buildings and dwellings with occupants.

7.7 Given the assessment in the GHD Report is based on representative vibration levels at 10 m from construction and quarry mining equipment, the risk of operational vibration causing structural damage to nearby residences is low. In this assessment I have considered equipment principally located in the Stage 1B area of the Quarry.

7.8 The methodology employed by GHD to predict the operational vibration at distances greater than 10 m from each item of quarry equipment is based on a distance attenuation exponent of 1.5 which is consistent with other references[5] and provides satisfactory forecasts of vibration at distances greater than 10 m.

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[4] ISO 10137:2007 *Bases for design of structures - Serviceability of buildings and walkways against vibrations*

[5] FTA Handbook *Transit Noise and Vibration Impact Assessment,* Chapter 12 Noise and Vibration during Construction

7.9 I agree with the statement made in the GHD Report that (operational) vibration impacts from equipment such as graders or excavators on-site at Phillips Quarry would not be perceptible beyond a distance of approximately 100 m from the Stage 1B(i) or Stage 1B(ii) work sites of the Quarry (that is, those work areas closest to the subject land), unless excavation and quarrying was conducted right to the extreme limits of the boundary.

7.10 By definition then, given the distances involved from the Stage 1B(i)and Stage 1B(ii) areas to the nearest residences on the Ouson land holding, this would mean that no structural damage would be expected from operational activities and this matter would not be an issue for these dwellings. The APA pipelines would not be adversely affected but some parts of the land holding to the east of the pipeline easement and outside the PSP area may require a buffer zone.

8.0 RELEVANT ASSESSMENT CRITERIA -BLASTING

8.1 The GHD Report uses the ANZEC Guideline to establish vibration limits for residences of 5 mm/s (maximum level) and 2 mm/s (long term regulatory goal). This Guideline also provides for an "allowance to exceed 5 mm/s on up to 5 % of all blasts over any 12-month period, but never over 10 mm/s".

8.2 Most blasting vibration has a spectrum with a range of maximum vibration from 0-80 Hz with maximum values typically occurring at 20-30 Hz.

8.3 The ANZEC Guideline targets apply to occupied residences since the allowable limits for minimizing structural damage are much higher, e.g. BS 7385.2:1993 sets guide values for transient damage of 15 mm/s above 4 Hz, 20 mm/s at 15 Hz, increasing to 50 mm/s at 40 Hz.

8.4 BS 6472.2:2008[6] sets permissible limits for human comfort with "*probability of adverse comment being low*", of 6-10 mm/s as a limit for up to three events per day, as indicated in the extract from this standard presented in Appendix F.

8.5 DIN 4150.3:1999 sets permissible limits of 5 mm/s as a limit for long term vibration, as indicated in the extract from this standard presented in in Appendix F.

8.6 The United States Bureau of Mines (USBM)[7] analyzed the impact of blasting vibration and similar vibrations on people, finding that when the peak particle velocity (PPV) of vibration reaches 5 mm/s, the complaint rate can reach 5 %; when the PPV reaches 10 mm/s, the complaint rate can reach 10 %.

8.7 In my view the use of maximum 2 mm/s vibration limits as a basis for establishing buffer zones that limit residential development within the subject site is too conservative and inappropriate.

8.8 Although BS 5228.2:2009[8] (referenced in Table 28 of the GHD Report), states that a vibration of 1 mm/s PPV "will cause complaint, but can be tolerated" this is not consistent with my experience. Previous research in the field notably Wiss[9], states that transient vibration of 1 mm/s is barely perceptible and that a vibration of 5 mm/s is distinctly perceptible. An extract from Wiss is provided in Appendix G.

8.9 The above Codes or Standards (BS6472.2, DIN4150 and USBM) all nominate vibration levels (PPV) of 5-10mm/s as being acceptable for up to three blast events per day and long-term exposure. Further, AS 2187-2:2006[10] nominates an allowance of 5 m/s for operations longer than 12 months or more than 20 blasts. See Appendix H for an extract from this Standard.

8.10 At Shenstone Park and in particular at the Ouson land holding it is my view that the buffer zones where needed to protect residential amenity, should be set at a vibration limit determined on the basis of 5 mm/s PPV.

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6 BS 6472.2:2008 *Guide to evaluation of human exposure to vibration in buildings, Part 2-Blast induced vibrations*

7 Siskind, Stagg, Kopp et al, *Structure Response and Damage produced by Ground Vibration from surface blasting*, RI 8507, US Bureau of Mines 1980

8 BS 5228.2:2009 *Code of Practice for Noise and Vibration on Construction and Open Sites-Part 2: Vibration*

9 Wiss J. F., Parmelee R. A. *Human perception of transient vibration*, Journal of the Structural Division, ASCE 1974

10 AS 2187.2:2006 *Explosives-Storage and Use of Explosives*

9.0 BLASTING VIBRATION ASSESMENT

9.1 In Table 37 of Section 12.2 of the GHD Report, a vibration assessment is undertaken which uses a well-known "site law" relationships to calculate the predicted PPV vibration, for a given blast charge size, at given distances (in this case from 50 m to 1,000 m) to establish distance ranges where certain vibration targets are met.

9.2 This set of results is then used to determine the distances at which certain PPV criteria are met for given charge sizes (Refer to Table 38 of the GHD Report).

9.3 Both tables use the site law provided in AS 2187.2:2006 with a site constant, K, of 1140 and a site exponent, B, of 1.6 both of which are dependent on the ground or rock type . The GHD Report notes that these terms apply to the 50th percentile of exceedance, and that when using K = 1140 and B = 1.6, actual vibration levels may vary from 40 to 400 % of the predicted value.

9.4 Most site law determinations require that the 95th percentile of blasts (top 5 % of all blasts) comply with the requirements of AS 2187.2:2006. Hence knowledge of the 95th percentile vibration distances are required at Phillips Quarry before any relevant buffer zones can be established.

9.5 Phillips Quarry is not in operation and site tests cannot yet be performed to determine site-specific values for K and B, but some indication of their appropriateness for use can be made from other example projects.

9.6 In 2016, I was involved with a project in Hobart called the Montpelier Development that required substantial blasting in weathered and hard rock called Dolerite, which is a volcanic Basalt with density of 2,750-2,900 kg/m^3, C_P (primary vibration wave speed) of 6,300-6,700 m/s and C_S (secondary vibration wave speed) of 3,650-3,800 m/s)

9.7 The actual values for the rock parameters at Phillips Quarry have not been provided by the proponent but can be confirmed by a geotechnical engineer and being a Basalt quarry, I would expect similar properties. As such, I consider that site law tests at the Montpelier Development could give a reasonable guide as to the validity of the buffer distances calculated by GHD.

9.8 The results of site law tests conducted at the Montpelier Development are provided in Appendix I , which shows that the actual values for K and B may vary significantly from that determined using the guidance in AS 2187.2:2006. The following examples are provided:

- In weathered ("surface") rock, the values of K and B (50th percentile) are 1,202 and 1.67 respectively and for the 95th percentile the values of K and B are 3,513 and 1.67 respectively
- For hard ("deep") rock, the values of K and B (50th percentile) were 2,390 and 1.73 respectively and for the 95th percentile were 4,919 and 1.73 respectively.

9.9 The impact of higher values in situ at Phillips Quarry for K and B is that the calculated distances to meet the required vibration limit for a given blast changes will increase significantly

9.10 Appendix J provides the summary of the distances at which vibration targets of 2 mm/s, 5 mm/s, 10 mm/s and 50 mm/s can be met in weathered and hard dolerite that may be comparable or at least a guide to the likely results at Phillips Quarry.

9.11 Compared to Table 37 of the GHD Report, using values for a 100 kg charge to meet 2 mm/s, the actual buffer distance could be up to 60-65 % greater than 550 m forecast by GHD (viz. 876-912 m) - if their compliance target was to be adopted.

9.12 However because I recommend a different compliance limit of 5 mm/s, and in accordance with the recommendations of AS 2187.2:2006, DIN 4150-3:1999 and BS 6472.2:2008, the required buffer distance need only be about 334-360 m not 550 m.

10.0 EFFECT OF BLASTING ON APA PIPELINES

10.1 The GHD Report discusses short term blasting vibration impacts on buried pipelines by reference to BS 5228.2.2:2009 and DIN 4150-3:1999. Table 3 of DIN 4150-3:1999 suggests vibration limits of 100 mm/s PPV which can be reduced by 50 % when assessing long term vibration, that is 50 mm/s. BS 5228.2:2009 recommends limits of 30 mm/s for steel or concrete pipelines.

10.2 The GHD Report states that past experience indicates that gas utility companies may require a 20 m/s limits for vibration at the pipeline.

10.3 This is consistent with previous EES studies namely Melbourne Metro Project where the limit for buried utility services was set at 20 mm/s[11].

10.4 No other advice has been received from APA regarding formal limits for their assets including pipelines, so the above 20 mm/s PPV criterion has been taken as approved for this assessment.

10.5 APA's advice should be sought to confirm their requirements.

10.6 The two existing pipelines in the reservation through the Ouson land holding are T74 (300/600 mm dia. Wollert-Wodonga)and T119 (400 mm dia. Wollert - Barnewatha), which both lie within the 35 m easement corridor and are separated by a distance of 7.0 m.

10.7 A future Pipeline, the Western Outer Ring Main (WORM), is also expected to be laid within the corridor at some time in the future but in any event will lie within the corridor.

10.8 All pipelines including the WORM pass to the east of the Phillips Quarry site with some minor deviations as shown in Appendix K. The pipeline easement is with 120m of the Phillips Quarry

10.9 Appendix J provides the estimated buffer distances required to meet the nominated APA pipeline target of 20 mm/s in basalt rock, which is up to 241 m for a 100 kg blast charge

10.10 As a result there will be constraints on the ability of the future operator to conduct blasting within about 240m of the APA pipelines Appendix J.

10.11 Field measured site constants and exponents must be determined for the actual Philips Quarry for the forecast buffer 241m distance to be confirmed.

[11] Table B.4, Appendix B, Part 1, Melbourne Metro EES, 2015

11.0 VIBRATION CONTROL RECOMMENDATIONS

11.1 The buffer zone from operational equipment at the Quarry , required to protect residential development within the Ouson land holding to vibration levels within recommended limits, should be a minimum of 100 m.

11.2 The buffer zone, to control blasting vibration to within recommended limits (5 mm/s) , should be at least 360 m, measured from the nearest dwellings north of the BCS on the Ouson land Holding.

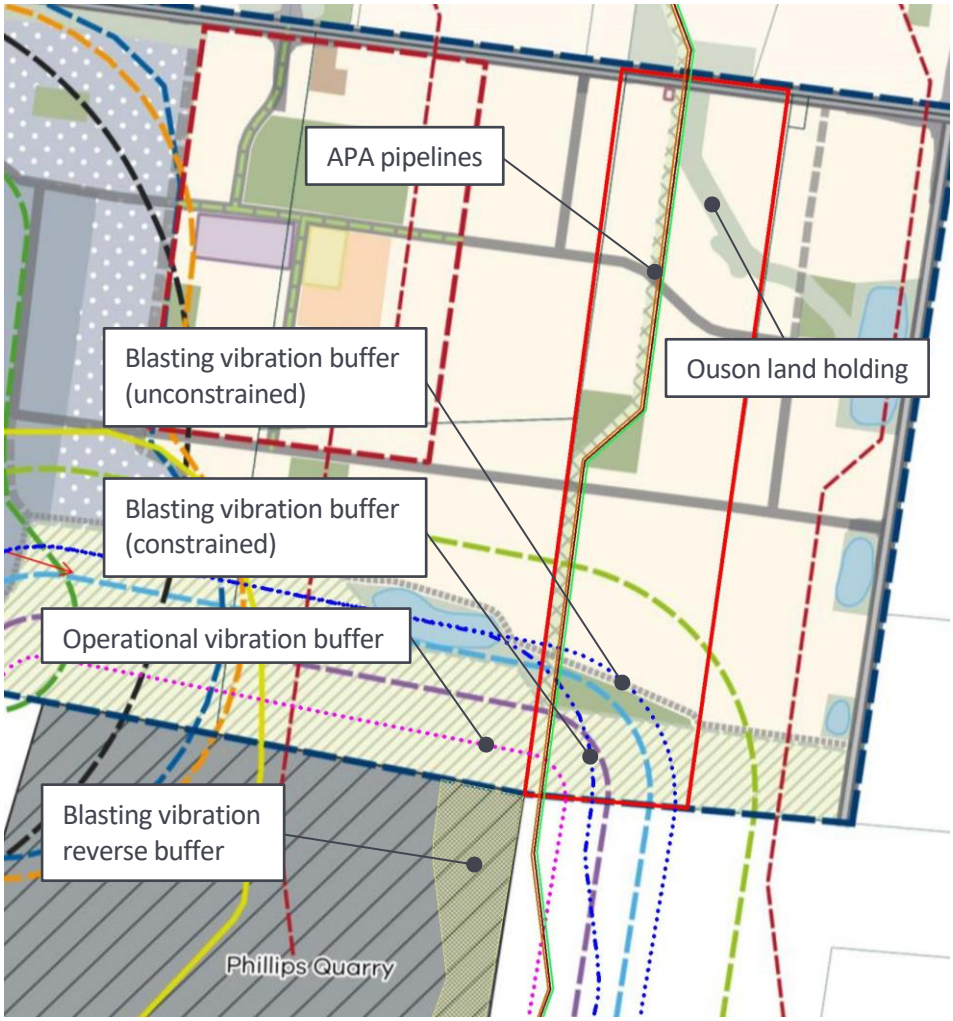
11.3 Once site factors are confirmed, the buffer zone, to minimise blasting vibration and protect the APA pipelines within the easement through the Ouson land holding, should be at least 240 m from the pipeline alignment.

11.4 Since the APA pipeline alignment cannot be altered, then a reverse buffer is recommended so that no blasting on the Phillips Quarry site takes place within 240 m of the APA pipelines

11.5 In some key directions (eg. northeast from the Phillips Quarry) the reverse pipeline buffer and residential development buffer may overlap in which case the residential buffer may be reduced and extend a lesser distance (as low as 120 m in the extreme case) onto the Ouson land holding as this reverse buffer should prevent blasting works and therefore result in the Work Authority area being moved away from the Quarry boundary.

11.6 The proposed buffers are presented in Figure 2.

Figure 2: Proposed buffers



12.0 DECLARATION

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

Signed .....  ...

Dated 28 October 2020

APPENDIX A CURRICULUM VITAE – TIMOTHY MICHAEL MARKS

TIMOTHY MARKS

Associate Director, Marshall Day Acoustics, Melbourne, Australia

B.Eng(Hons) Bachelor of Engineering, Mechanical Engineering
Monash University, Melbourne (1974)

M.Sc Master of Science, Southampton University, U.K. (1979)

Membership

MIE Aust Member Institution of Engineers, Australia
CPEng Chartered Professional Engineer, Reg No 144303
MAAS Member of the Australian Acoustical Society
AAAC MDA representative (Former Chairman)

Recent Work

Responsible for the design, specifications and commissioning for noise control, sound insulation and building services systems, including:

- Victorian Desalination Plant
- Numerous Gas Turbine Power Stations
- Department of Defence JSF Acoustic Impact Assessment
- Montpelier Development Salamanca Place, Hobart
- Metro Melbourne EES IAC hearings
- RMIT University Consultant for CYP Construction of CBD North Station

Project Experience

Active in all areas of industrial noise assessment (process plants, power stations and general industry), vibration assessment and control (structural, human and dynamic) and a wide range of environmental acoustics, including road and rail EIS, planning noise impact assessment, panel and tribunal hearings and presenting expert Evidence Statements .

Additional details

Tim is the MDA specialist for rail noise and vibration control and often acts as an expert witness at VCAT and in Panel Hearings

Employment

2019-2020	Manager MDA Hong Kong (temporary), acting as external consultant since official retirement in July 2019
1996 - 2018	Director & Associate Director, Marshall Day Acoustics, Melbourne, Australia.
1986 - 1995	Managing Director NAP (Australia) Pty Ltd, trading as NAP Silentflo. The company manufactured and supplied noise control products for engineering, architectural, building, commercial and industrial projects. Extensive experience in project management, design, field work and practical noise and vibration control in Australia, Hong Kong and Singapore.
1981 - 1986	General Manager BTR Nylex Group, BTR Silentflo Pty Ltd.
1979-1980	Postgraduate degree M.Sc Southampton University
1975 - 1978	Associate Director of Vipac and Partners. Worked as a consulting engineer conducting noise surveys, project noise control, design work, laboratory and NATA testing of automotive, industrial and mechanical services components, feasibility studies, town planning, expert witness, lecturing and other general acoustic, aerodynamic, thermodynamic and vibration consulting activities
1971 - 1974	Graduate Mechanical Engineer, Honours Degree, Monash University, Victoria.

APPENDIX B DOCUMENTS TAKEN INTO ACCOUNT

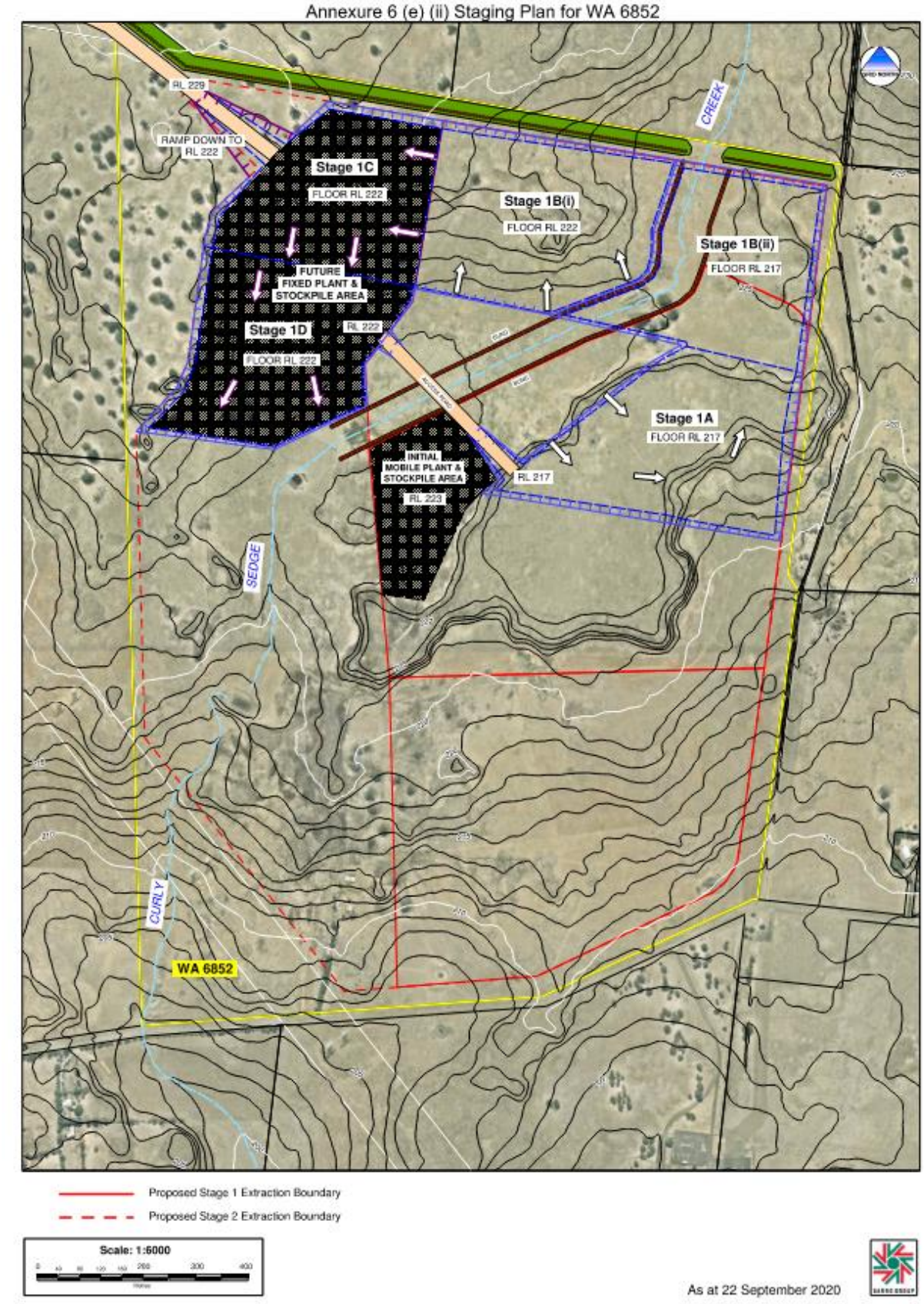
I have reviewed the following documents to the extent necessary to prepare this statement of evidence:

- *Shenstone Park Precinct Structure Plan* dated September 2019
- GHD report Ref 313 5311 *Impact Assessment Report for the Shenstone Park Precinct Structure Plan*, dated December 2017
- GHD report *Shenstone Park Impact Assessment Woody Hill Addendum*, dated September 2019
- Letter dated 2 October 2020 prepared by Barro Group Pty Ltd
- *Quarry Statement* prepared by the Victorian Planning Authority
- BS 6472.1:2008 *Guide to evaluation of human exposure to vibration in buildings, Part 1-Vibration sources other than blasting*
- NSW Department of Environment and Conservation *Assessing Vibration, a Technical Guideline*, dated 2006
- ISO 10137:2007 *Basis for design of Structures: Serviceability of buildings and walkways against vibration*
- DIN 4150-3:1999 *Structural Vibration - Part 3: Effects of Vibration on Structures*
- FTA Handbook *Transit Noise and Vibration Impact Assessment*, Chapter 12 Noise and Vibration during Construction
- ANZEC *Technical basis for Guidelines to minimise Annoyance due to Blasting Overpressure and Ground Vibration*, dated 1990
- BS 7385.2:1993 *Evaluation and Measurement of vibration in Buildings, Part 2- Guide to Damage levels from Ground Borne Vibration*
- BS 6472.2:2008 *Guide to evaluation of human exposure to vibration in buildings, Part 2-Blast induced vibrations*
- Siskind, Stagg, Kopp et al, *Structure Response and Damage produced by Ground Vibration from surface blasting*, RI 8507, US Bureau of Mines 1980
- BS 5228.2:2009 *Code of Practice for Noise and Vibration on Construction and Open Sites-Part 2: Vibration*
- Wiss J. F., Parmelee R. A. *Human perception of transient vibration*, Journal of the Structural Division, ASCE 1974
- AS 2187.2:2006 *Explosives-Storage and Use of Explosives*

APPENDIX C GLOSSARY OF TERMINOLOGY

dB	Decibel The unit of sound or vibration level.
Vibration	Ground or solid body movement that can be measured as acceleration or velocity and displacement
Hertz (Hz)	Frequency of vibration, cycles per second
RMS	Root Mean square is the mean value of a sine wave signal such as vibration
Crest Factor	The ratio of the RMS to maximum (peak value) of a signal. For a pure sine wave the CF is 1.414
mm/s	Unit of Vibration Velocity
m/s^2	Unit of Vibration Acceleration
PPV	Peak particle velocity, united of measurement
VDV	Vibration Dose value measure of vibration energy received by a subject

APPENDIX D CURRENT PROPOSED INITIAL STAGING PLAN FOR WA 6852



APPENDIX E EXTRACT FROM NSW DEC GUIDELINE

Appendix C
Vibration criteria presented in different units

C1 Criteria for exposure to continuous and impulsive vibration

The criteria presented in Table C1.1 for continuous vibration relate to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity.

The criteria presented in Table C1.1 for impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment.

Table C1.1 Criteria for exposure to continuous and impulsive vibration

		Assessment criteria					
		[1]rms acceleration (m/s^2) (& vib. accel. value) (dB re 10^{-6} m/s^2)		[2]rms velocity (mm/s) (& vib. velocity value) (dB re 10^{-6} mm/s)		[2]Peak velocity (mm/s)	
Place	**Time**	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous vibration							
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day- or night-time	0.0050 (74 dB)	0.010 (80 dB)	0.10 (100 dB)	0.20 (106 dB)	0.14	0.28
Residences	Daytime[3]	0.010 (80 dB)	0.020 (86 dB)	0.20 (106 dB)	0.40 (112 dB)	0.28	0.56
	Night-time	0.0070 (77 dB)	0.014 (83 dB)	0.14 (103 dB)	0.28 (109 dB)	0.20	0.40
Offices	Day- or night-time	0.020 (86 dB)	0.040 (92 dB)	0.40 (112 dB)	0.80 (118 dB)	0.56	1.1
Workshops	Day- or night-time	0.040 (92 dB)	0.080 (98 dB)	0.80 (118 dB)	1.6 (124 dB)	1.1	2.2
Impulsive vibration							
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day- or night-time	0.0050 (74 dB)	0.010 (80 dB)	0.10 (100 dB)	0.20 (106 dB)	0.14	0.28
Residences	Daytime[3]	0.30 (110 dB)	0.60 (113 dB)	6.0 (136 dB)	12.0 (142 dB)	8.6	17.0
	Night-time	0.10 (100 dB)	0.20 (106 dB)	2.0 (126 dB)	4.0 (132 dB)	2.8	5.6
Offices	Day- or night-time	0.64 (116 dB)	1.28 (122 dB)	13.0 (142 dB)	26.0 (148 dB)	18.0	36.0
Workshops	Day- or night-time	0.64 (116 dB)	1.28 (122 dB)	13.0 (142 dB)	26.0 (148 dB)	18.0	36.0

1 Values derived from z-axis critical frequency range 4–8 Hz. Where required, a more detailed analysis can be conducted as per BS 6472–1992.
2 Values given for the most critical frequency range >8 Hz assuming sinusoidal motion. Where required, a more detailed analysis can be conducted as per AS 2670.2–1990. Sufficient justification should accompany the use of a peak velocity approach if used in an assessment.
3 Specific values depend on social and cultural factors, psychological attitudes and expected degree of intrusion.

APPENDIX F BLASTING LIMITS FROM VARIOUS CODES

BS 6472-2:2008

Table 1 **Maximum satisfactory magnitudes of vibration with respect to human response for up to three blast vibration events per day**

Place	Time	Satisfactory magnitude [A] ppv mm·s^{-1}
Residential	Day [D]	6.0 to 10.0 [C]
	Night [D]	2.0
	Other times [D]	4.5
Offices [B]	Any time	14.0
Workshops [B]	Any time	14.0

NOTE 1 This table recommends magnitudes of vibration below which the probability of adverse comment is low (noise caused by any structural vibration is not considered).

NOTE 2 Doubling the suggested vibration magnitudes could result in adverse comment and this will increase significantly if the magnitudes are quadrupled.

*NOTE 3 For more than three occurrences of vibrations per day see the further multiplication factor in **5.2**.*

[A] The satisfactory magnitudes are the same for the working day and the rest of the day unless stated otherwise.

[B] Critical working areas where delicate tasks impose more stringent criteria than human comfort are outside the scope of this standard.

[C] Within residential properties people exhibit a wide variation of tolerance to vibration. Specific values are dependent upon social and cultural factors, psychological attitudes and the expected degree of intrusion. In practice the lower satisfactory magnitude should be used with the higher magnitude being justified on a case-by-case basis.

[D] For the purpose of blasting, daytime is considered to be 08h00 to 18h00 Monday to Friday and 08h00 to 13h00 Saturday. Routine blasting would not normally be considered on Sundays or Public Holidays. Other times cover the period outside of the working day but exclude night-time, which is defined as 23h00 to 07h00.

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subclause 4.4. In the case of multi-storey frame structures, the dynamic stress component can also be determined from the relative displacement of the ends of the vertical members.

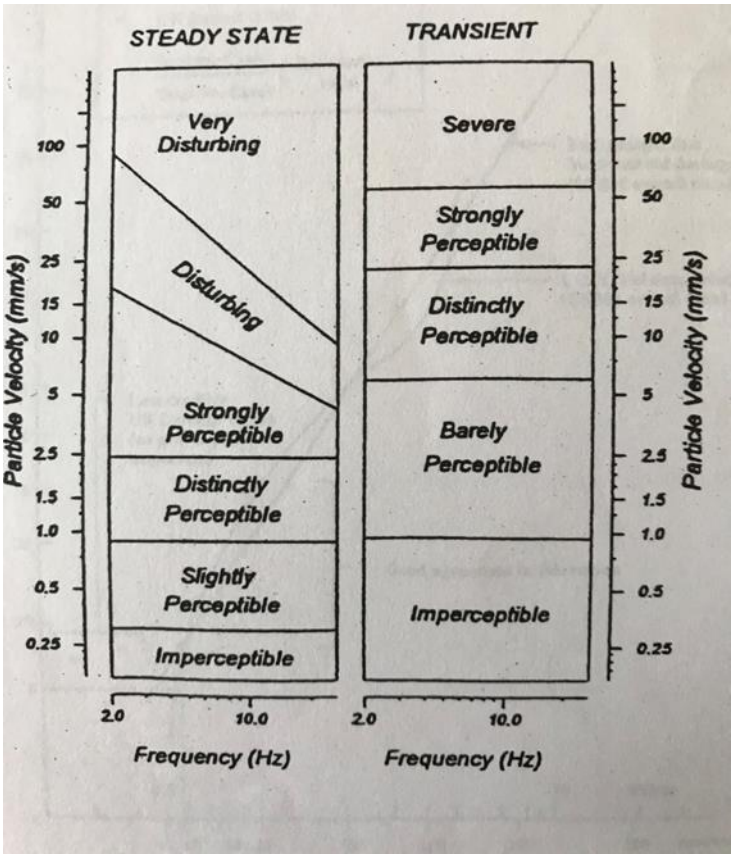
If a building is subjected to harmonic vibration, then the maximum values can also occur in floors other than the top floor, or in the foundation. The values given in table 3 also apply in these cases.

When other points of reference are used, separate analysis is required.

Table 3: Guideline values for vibration velocity to be used when evaluating the effects of long-term vibration on structures

Line	Type of structure	Guideline values for velocity, v_i, in mm/s, of vibration in horizontal plane of highest floor, at all frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
2	Dwellings and buildings of similar design and/or occupancy	5
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	2,5

APPENDIX G HUMAN RESPONSE TO VIBRATION (WISS)



APPENDIX H BLASTING LIMITS FROM AS 2187.2:2006

TABLE J4.5(A)

GROUND VIBRATION LIMITS FOR HUMAN COMFORT CHOSEN BY SOME REGULATORY AUTHORITIES (see Note to Table J4.5(B))

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Sensitive site*	Operations lasting for less than 12 months or less than 20 blasts	10 mm/s maximum unless agreement is reached with occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely effect the equipment operation

*A sensitive site includes houses and low rise residential buildings, theatres, schools, and other similar buildings occupied by people.

NOTE: The recommendations in Table J4.5(A) are intended to be informative and do not override statutory requirements with respect to human comfort limits set by various authorities. They should be read in conjunction with any such statutory requirements and with regard to their respective jurisdictions.

APPENDIX I TYPICAL BLASTING VIBRATION SITE ASSESSMENT

Montpelier Project – Site Law Assessment

3.1.2 Regression analysis

The regression of the 104 data point is presented in Figure 3.

The values on the Y axis indicate the measured vibration level (ppV). The values on the X axis represent the value of the scaled distance (distance scaled by the charge weight)

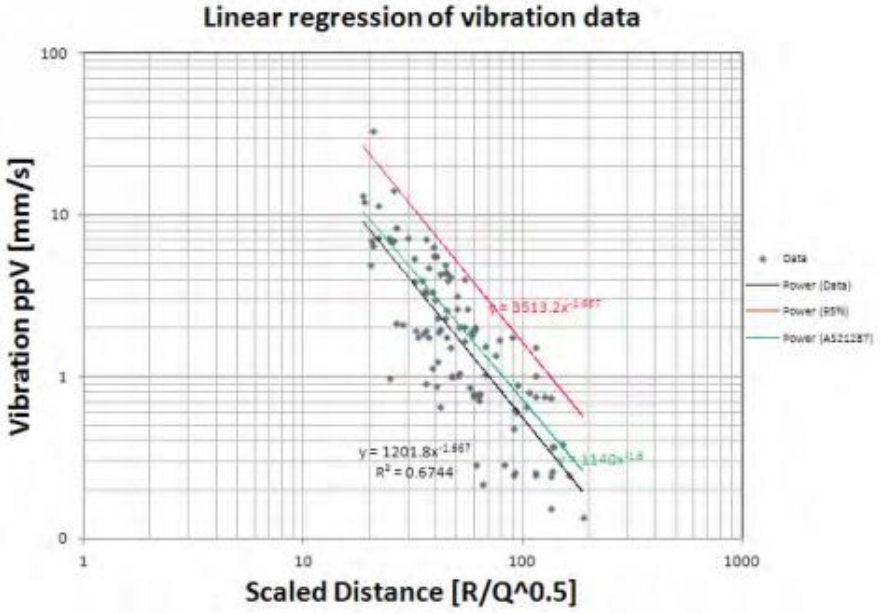


Figure 3: Graph of Scaled Distance vs. ppV for all data points.

The regressed equation for the 50% confidence level (black line) is as follows:

$$ppV_{50} = 1202(SD)^{-1.67}$$

However, it is considered best practice to use a 95% confidence level as legislative requirements usually stipulate 95% of blasts to be below the required limit. The regressed equation for the 95% confidence level (red line) is as follows:

$$ppV_{95} = 3513(SD)^{-1.67}$$

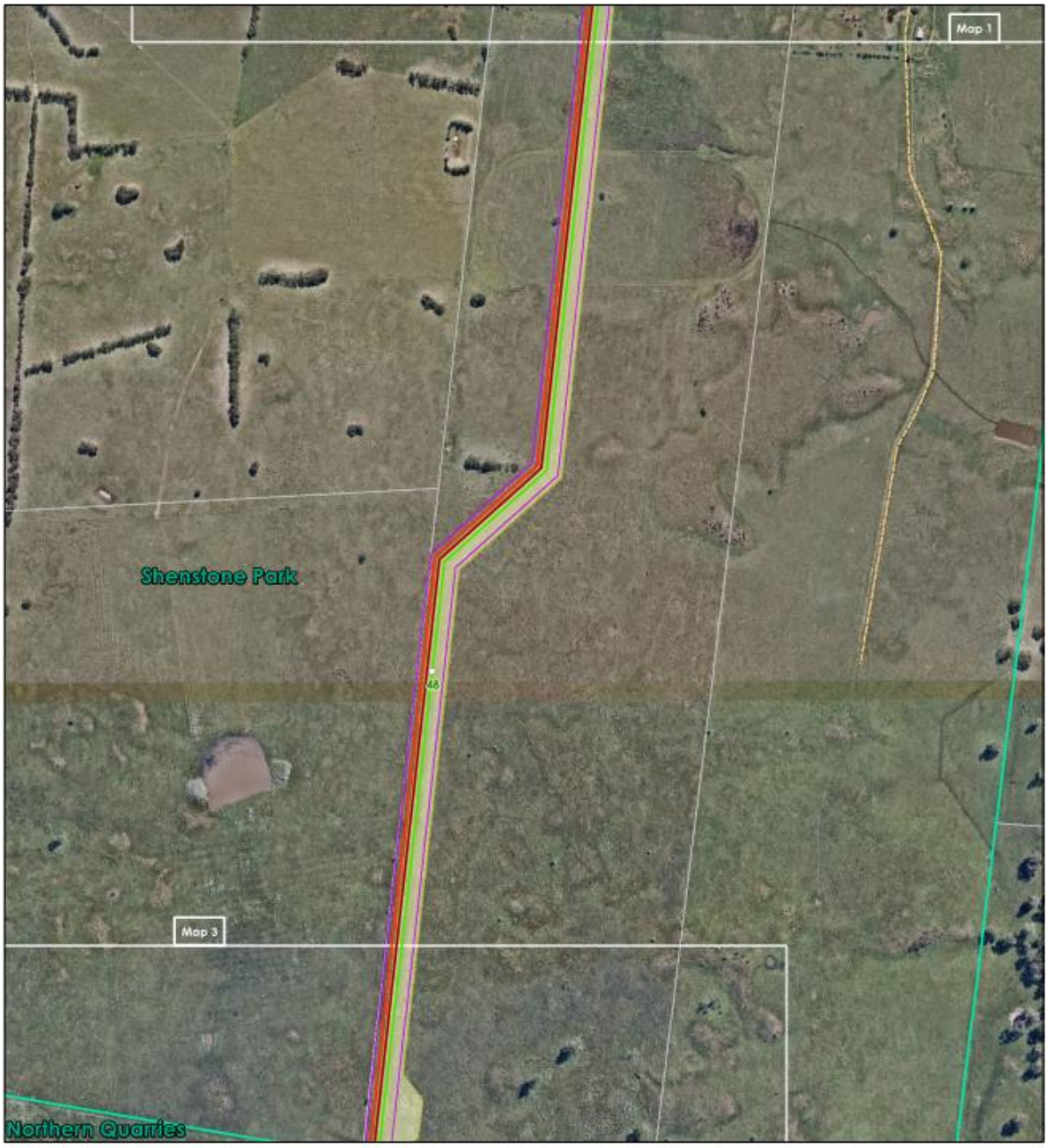
Source: Orica Mining Services

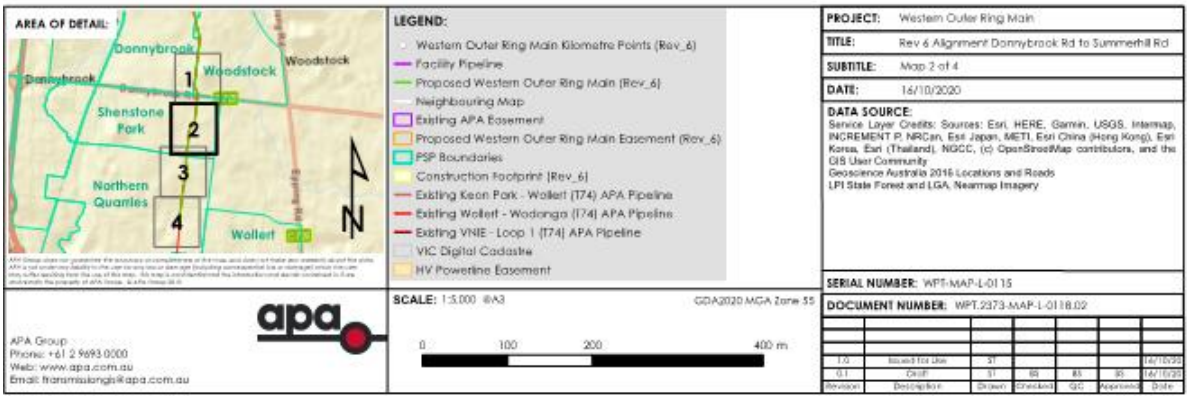
APPENDIX J CALCULATED V95 DISTANCES FOR VOLCANIC BASALT (DOLERITE)

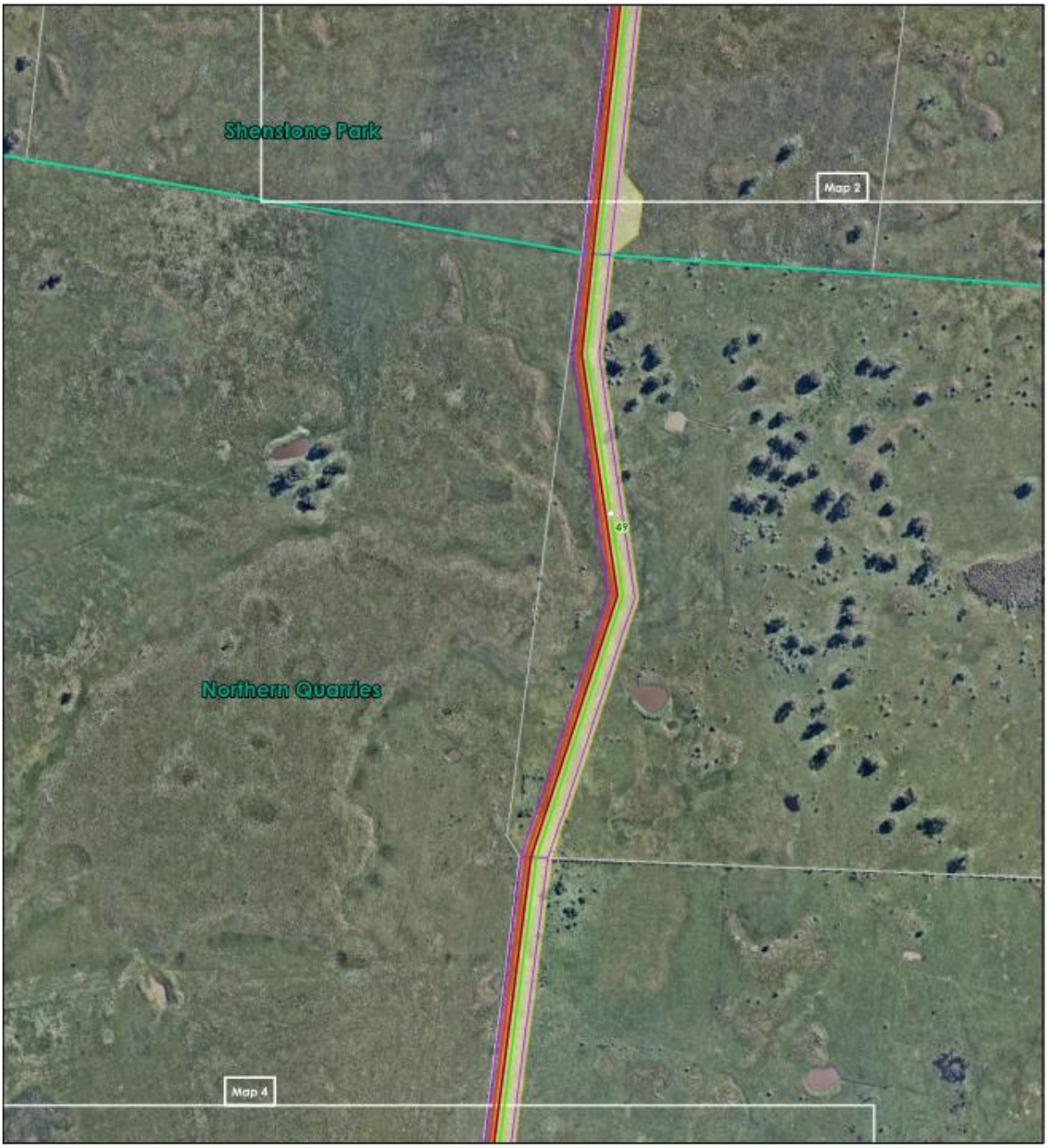
		Charge, kg					
Vibration level	**Ground type**	**10**	**20**	**50**	**75**	**100**	**120**
50 mm/s	weathered rock	40	57	90	110	128	140
	deep rock, compacted	45	63	100	123	142	155
20 mm/s	weathered rock	70	99	156	191	221	242
	deep rock, compacted	76	108	170	209	241	264
10 mm/s	weathered rock	106	150	236	290	334	366
	deep rock, compacted	114	161	254	312	360	394
2 mm/s	weathered rock	277	392	620	759	876	960
	deep rock, compacted	288	408	645	790	912	999

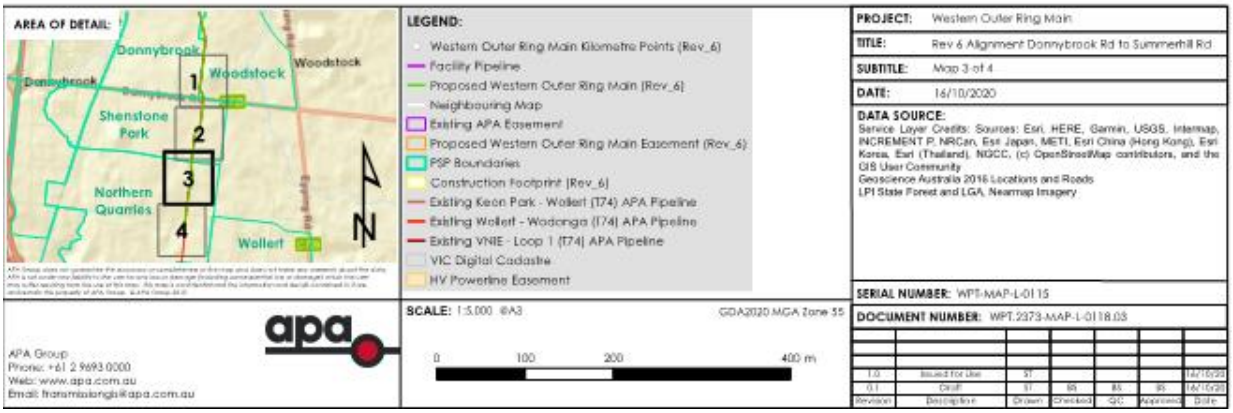
Note: Distances to V95 that is 95 % of all blasts are below the nominated PPV value

APPENDIX K APA PIPELINE ALIGNMENT






Shenstone Park
Map 2
Northern Quarries
Map 4


AREA OF DETAIL:
Donnybrook
Woodstock
Shenstone Park
Northern Quarries
Wollert
1
2
3
4
LEGEND:
Western Outer Ring Main Kilometre Points (Rev_6)
Facility Pipeline
Proposed Western Outer Ring Main (Rev_6)
Neighbouring Map
Existing APA Easement
Proposed Western Outer Ring Main Easement (Rev_6)
PSP Boundaries
Construction Footprint (Rev_6)
Existing Keon Park - Wollert (T74) APA Pipeline
Existing Wollert - Wodonga (T74) APA Pipeline
Existing VNIE - Loop 1 (T74) APA Pipeline
VIC Digital Cadastre
HV Powerline Easement
PROJECT: Western Outer Ring Main
TITLE: Rev 6 Alignment Donnybrook Rd to Summerhill Rd
SUBTITLE: Map 3 of 4
DATE: 16/10/2020
DATA SOURCE:
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Geoscience Australia 2016 Locations and Roads
LPI State Forest and LGA, Nearmap Imagery
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DOCUMENT NUMBER: WPT-2373-MAP-L-0118.03
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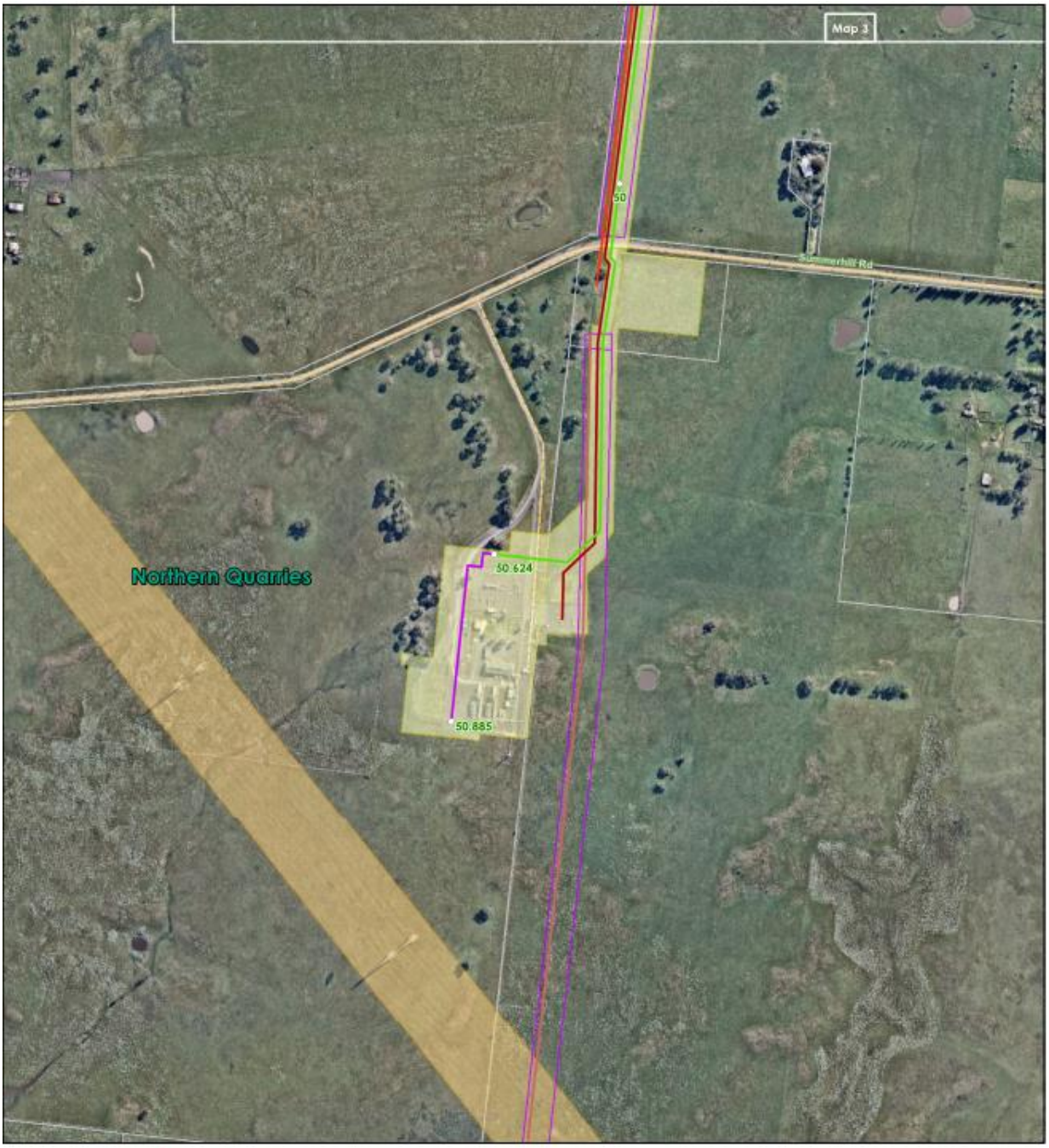
APA Group
Phone: +61 2 9693 0000
Web: www.apa.com.au
Email: transmissionglis@apa.com.au


Map 3
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Summerhill Rd
Northern Quarries
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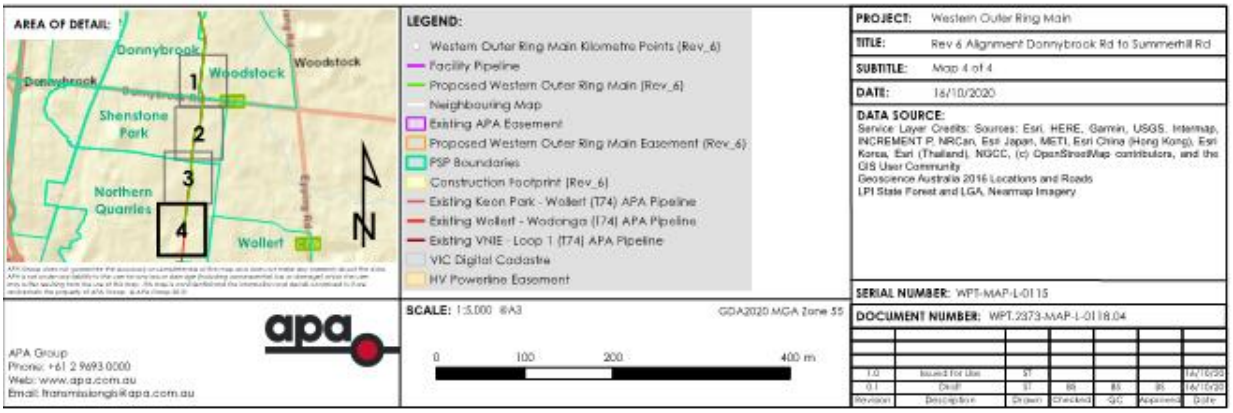
AREA OF DETAIL:
Donnybrook
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DOCUMENT NUMBER: WPT-2373-MAP-L-0118.04
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