REVERB ACOUSTICS
Noise and Vibration Consultants

Revised Noise Impact Assessment
Newcastle Jockey Club
Proposed Stables Development
Corner Chatham Road
& Darling Street
Broadmeadow NSW

May 2022

Prepared for Newcastle Jockey Club Limited
Report No. 20-2564-R3

Building Acoustics-Council/EPA Submissions-Modelling-Compliance-Certification

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Introduction

1.1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a revised noise impact assessment for a proposal to construct new horse stables at the existing racecourse on the corner of Chatham Road and Darling Street, Broadmeadow. This assessment considers noise sources such as mechanical plant, vehicle movements (including unloading, truck movements, etc), horses being walked on public roads, and construction/demolition noise and vibration. Other noise sources include garbage collection and general site noise.

The assessment was requested by Newcastle Jockey Club Limited to form part of and in support of an Environmental Impact Statement for the proposal and to ensure any noise control measures required for the development are incorporated during the design stages.

1.2 TECHNICAL REFERENCE / DOCUMENTS

Beranek, L.L and Istvan, L.V. (1992). *Noise and Vibration Control Engineering.* John Wiley and Sons, Inc.

Bies, D.A. and Hansen, C.H. (1996). *Engineering Noise Control: Theory and Practice*. London, E & F.N. Spon.

Gréhant B. (1996). *Acoustics in Buildings.* Thomas Telford Publishing.

Templeton, D. (1997). *Acoustics in the Built Environment.* Reed Education and Professional Publishing Ltd.

AS 2107-2000 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors"*.

AS 1276.1-1999 *"Acoustics – Rating of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation"*.

NSW Environment Protection Authority (2000). *Industrial Noise Policy*

NSW Environment Protection Authority (2017). *Noise Policy for Industry*

NSW Environment Protection Authority (1999). *Environmental Criteria for Road Traffic Noise*

Office of Environment and Heritage (2010). *NSW Road Noise Policy*

NSW Roads and Maritime Services (2001). *Environmental Noise Management Manual*

NSW Road Rules, NSW (2014)

Seca Solutions Pty Ltd (6 May 2022). *Proposed Stables with Parking – Newcastle Jockey Club, Broadmeadow, NSW*

Plans supplied by EJE Architecture Pty Ltd, Rev A, dated April 2022. Note that variations from the design supplied to us may affect the acoustic recommendations.

Newcastle Jockey Club (April 2022). *Operation and Waste Management plan*

A Glossary of commonly used acoustical terms is presented in Appendix A to aid the reader in understanding the Report.

SECTION 2

Project Description
Existing Acoustic Environment
Assessment Criteria

2.1 PROJECT DESCRIPTION

Newcastle Jockey Club Limited (NJC) seeks approval for a proposal to construct new horse stables at the existing racecourse on the corner of Chatham Road and Darling Street, Broadmeadow. The development will include demolition of the former tie-up stalls, and construction of new stables and associated structures that will cater for up to 480 horses.

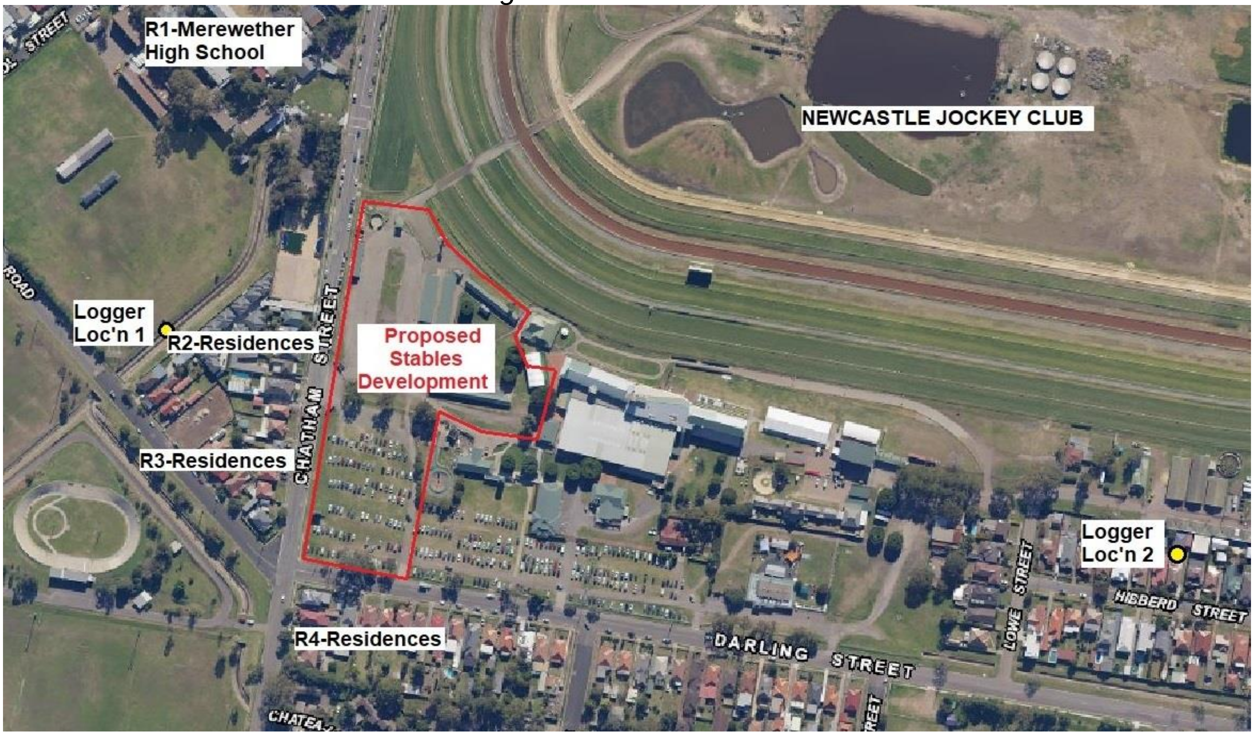
Under the current situation the majority of horses are transported to the racecourse using light rigid single-steer trucks, or horse floats attached to 4WD vehicles in the early hours of the morning prior to commencement of trackwork, which typically occurs from 3.30am-8.30am. The recently approved training/track at the NJC have the capacity to cater for 600 horses, with the current stables being inadequate the new stables with have a capacity for 480 horses. Under the proposed situation, significant reductions in horse transport will occur, in particular with no unloading horses from floats prior to 7am at the new stables. This will result in a positive acoustic impact in the receiver area.

Potential noise sources associated with the new stables include the following:

- Mechanical plant and pressure washers associated with wash bays.
- Vehicle movements at the Drop Off area and carpark.
- Loading and unloading horses from floats.
- Horse movements on ramps, in stables, walkers, etc.
- General site noise associated with care and exercising of horses, waste removal.

This assessment will focus on the noise impact at nearest residential receivers, and it should be acknowledged that compliance with criteria at these locations will ensure satisfactory results at more remote locations. Plans supplied by EJE Architecture Pty Ltd show the layout of the site and the location of nearby land uses.

Figure 1: Location Plan



As referenced in the Newcastle Jockey Club Operation and Waste Management Plan (Aril 2022), the proposed operating hours for the development are as follows:

- Morning Trackwork (3:30am to 8:30am)
- General Daytime (8:30am to 5:00pm)
- Evening (5:00pm to 3:30am)

2.2 EXISTING ACOUSTIC ENVIRONMENT

A background noise level survey was conducted using a Class 1, Svan 977 environmental noise logging monitor, installed along the drainage channel, approximately 50 metres from Melville Road and the rear boundary of nearest residences (R2) (Logger Location 1). The selected location is representative of the acoustic environment in the receiver area and is considered an acceptable location for determination of the background noise in accordance with Appendix B of the NSW Environment Protection Authority's (EPA's) – Noise Policy for Industry (NPfI).

Additional monitoring was carried out by Spectrum Acoustics for the Tie Up Stalls, Stage 1 of the development, in the rear yard of No. 36 Hibberd Street (Logger Location 2). However, monitoring at this location is well removed from the stables development and was taken in 2012. Therefore, Logger Location 2 data has been discarded and not considered further.

Noise levels at Logger Location 1 were continuously monitored from 7 December to 14 December 2020, to determine the existing background and ambient noise levels for the area. The instrument was programmed to accumulate environmental noise data continuously and store results in internal memory. The data were then analysed to determine 15 minute Leq and statistical noise levels using dedicated software supplied with the instrument. The instrument was calibrated with a Brüel and Kjaer 4230 sound level calibrator producing 94dB at 1kHz before and after the monitoring period, as part of the instrument's programming and downloading procedure, and showed an error less than 0.5dB.

Table 1 shows a summary of our noise survey, including the Assessment Background Levels (ABL's), for the day, evening and night periods. From these ABL's the Rating Background Level (RBL) has been calculated, according to the procedures described in the EPA's NPfI and by following the procedures and guidelines detailed in Australian Standard AS1055-1997, "Acoustics - Description and Measurement of Environmental Noise, Part 1 General Procedures". A complete set of logger results is not shown, but available on request.

Table 1: Summary of Noise Logger Results, dB(A)

Time Period	Background L90			Ambient Leq		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
7-8 Dec	40.2	39.8	34.6	53.8	52.4	44.5
8-9 Dec	36.2	35.0	34.8	54.9	50.5	48.1
9-10 Dec	38.2	35.8	34.6	58.5	52.0	48.0
10-11 Dec	39.6	35.1	34.6	57.8	49.3	45.3
11-12 Dec	38.8	35.5	34.1	56.6	50.5	46.7
12-13 Dec	38.4	36.2	36.1	58.3	49.8	43.6
13-14 Dec	38.2	-	-	56.6	-	-
RBL	**38**	**36**	**35**	**--**	**--**	**--**
LAeq	**--**	**--**	**--**	**57**	**51**	**46**

Site, weather and measuring conditions were all satisfactory during the noise survey. We therefore see no serious reason to modify the results because of influencing factors related to the site, weather or our measuring techniques. A summary of the measured noise environment at the site appears in Table 2, taken from our logger results.

Table 2: Existing Source Noise levels

Time Period	Leq		Lmax		L10		L90	
	Range	Average	Range	Average	Range	Average	Range	Average
Day	46-73	56	65-97	75	48-64	56	37-53	42
Evening	36-67	49	42-95	70	37-60	45	35-45	38
Night	35-68	42	36-85	56	35-64	41	34-48	37

2.3 CRITERIA

2.3.1 Road Traffic Noise

The Roads and Maritime Services (RMS) base their assessment criteria on those outlined by EPA. Reference to Page 160 of the Environmental Noise Management Manual released in December 2001, indicates that noise reduction measures for new and existing developments should endeavour to meet the noise level targets set out in the EPA's Environmental Criteria for Road Traffic Noise (ECRTN). The ECRTN has been superceded by the NSW Road Noise Policy (RNP) which contains a number of criteria applied to a variety of road categories (freeway, arterial, sub-arterial and local roads) and situations (new, upgraded roads and new developments affected by road traffic). Table 4 shows the relevant categories, taken from Table 3 of the RNP:

Table 3: - Extract from Table 3 of RNP Showing Relevant Criteria.

Road Category	Day	Night
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	60 LAeq,15hr (external)	55 LAeq,9hr (external
Existing residences affected by additional traffic on existing local roads generated by land use developments.	55 LAeq,1hr (external)	50 LAeq,1hr (external)

Road categories are defined in the RNP are as follows:

Freeway/arterial	Support major regional and inter-regional traffic movement. Freeways and motorways usually feature strict access control via grade separated interchanges.
Sub-arterial	Provide connection between arterial roads and local roads. May provide a support role to arterial roads during peak periods. May have been designed as local streets but can serve major traffic generators or non-local traffic functions. Previously designated as "collector" roads in ECRTN.
Local Road	Provide vehicular access to abutting property and surrounding streets. Provide a network for the movement of pedestrians and cyclists and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.

Based on the above definitions, Chatham Road and Darling Street are classified as sub-arterial roads.

2.3.2 Site Activities/Mechanical Plant Noise

Noise from industrial noise sources scheduled under the Protection of Environment Operations Act is assessed using the EPA's NPfI. However, local Councils and Government Departments may also apply the criteria for land use planning, compliance and complaints management. The NPfI specifies two separate criteria designed to ensure existing and future developments meet environmental noise objectives. The first limits intrusive noise to 5dB(A) above the background noise level and the other is based on the total industrial noise in an area in relation to the noise levels from the development to be assessed. Project Noise Trigger Levels are established for new developments by applying both criteria to the situation and adopting the more stringent of the two.

The existing L(A)eq for the receiver areas is dominated by traffic on nearby roads, some commercial activity and neighbourhood noise during the day, evening and night. Reference to Table 2.2 of the NPfI shows that the receiver areas are classified as suburban. The Project Amenity Level is derived by subtracting 5dB(A) from the recommended amenity level shown in Table 2.2. A further +3dB(A) adjustment is required to standardise the time periods to LAeq,15 minute. The adjustments are carried out as follows:

Recommended Amenity Noise Level (Table 2.2) – 5dB(A) +3dB(A)

Table 4 below specifies the applicable project intrusiveness and amenity noise trigger levels for the proposed redevelopment.

Table 4: - Intrusiveness and Amenity Noise levels

Period	Intrusiveness Criteria	Amenity Criteria
Day	43 (38+5)	53 (55-5+3)
Evening	41 (36+5)	43 (45-5+3)
Night	40 (35+5)	38 (40-5+3)
Receiver Type: Suburban (See EPA's NPfI - Table 2.1)		

Project Noise Trigger Levels, determined as the more stringent of the intrusiveness criteria and the amenity / high traffic criteria, are as follows:

Day	**43dB LAeq,15 Minute**	7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
Evening	**41dB LAeq,15 Minute**	6pm to 10pm
Night	**38dB LAeq,15 Minute**	10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

School Classrooms
35dB LAeq (internal) when in use

2.3.3 Maximum Noise Level Event Assessment - Sleep Arousal

Section 2.5 of EPA's NPfI requires a detailed maximum noise level event assessment to be undertaken where the subject development/premises night-time noise levels exceed the following:

- LAeq (15 minute) 40dB(A) or the prevailing RBL plus 5dB whichever is greater, and/or
- LAFmax 52dB(A) or the prevailing RBL plus 15dB, whichever is greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night period.

2.3.4 Construction Noise – Residential Receivers

Various authorities have set maximum limits on allowable levels of construction noise in different situations. Arguably the most universally acceptable criteria, and those which will be used in this Report, are taken from the NSW Environment Protection Authority's (EPA's) Interim NSW Construction Noise Guideline (ICNG). Since the project involves a significant period of construction activity, a "quantitative assessment" is required, i.e. comparison of predicted construction noise levels with relevant criteria. For assessment of noise impacts at residential receivers Table 3 of the ICNG is reproduced below in Table 5:

Table 5: - Table 3 of ICNG Showing Relevant Criteria at Residences

Time of Day	Management Level Leq (15min)	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public holidays	Noise affected RBL +10dB(A) i.e**. 48dB(A) day**	- The noise affected level represents the point above which there may be some community reaction to noise. - Where the predicted or measured LAEQ (15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. - The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75dB(A)	- The highly noise affected level represents the point above which there may be strong community reaction to noise. - Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. - If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended Standard hours	Noise affected RBL +5dB(A)	- A strong justification would typically be required for works outside the recommended standard hours. - Proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. - For guidance on negotiating agreements see Section 7.2.2

Section 4.1.2 of the ICNG also specifies the following internal noise level limits for school classrooms.

School Classrooms **45dB(A),Leq (15 min)** **Internal**

Construction will only occur during standard construction hours, i.e. 7am to 6pm Monday to Friday and 8am to 1pm on Saturday, with no construction permitted on Sundays or public holidays. Table 6 details relevant criteria for potentially affected receivers (also see Figure 1).

2.3.5 Construction Vibration

Personal Comfort

The majority of maximum limits on allowable ground and building vibration in different circumstances and situations are directed at personal comfort rather than building damage. This usually leads, in virtually every situation, to people who interpret the effects of a vibration to ultimately determine its acceptability. The ICNG recommends that the EPA guideline, *Assessing Vibration: A Technical Guideline (2006),* should be used for assessing construction vibration. Limits set out in the Guideline are for vibration in buildings, and are directed at personal comfort for continuous, impulsive and intermittent vibrations. Table 6 shows the Vibration Dose Values for intermittent vibration activities such as pile driving and use of vibrating rollers etc, taken from Table 2.4 of the Guideline, above which various degrees of adverse comment may be expected.

Table 6: Acceptable Vibration Dose Values ($m/s^{1.75}$)
Above which Degrees of Adverse Comment are Possible

Location	Day (7am-10pm)		Night (10pm-7am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas #	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Hospital operating theatres, precision laboratories, etc.

Building Safety:

Other criteria specifically dealing with Building Safety Criteria include Australian Standard AS2187.2-1993, dealing specifically with blasting vibration, specifies a maximum peak particle velocity of 10mm/sec for houses and a preferred limit of 5mm/sec where site specific studies have not been undertaken.

German Standard DIN 4150 - 1986, Part 3 Page 2, specifies a maximum vibration velocity of 5 to 15 mm/sec in the foundations for dwellings and 3 to 8 mm/sec for historical and sensitive buildings, for the range 10 to 50Hz. British Standard BS 7385 Part 2, specifies a maximum vibration velocity of 15mm/sec at 4Hz increasing to 20mm/sec at 15Hz increasing to 50mm/sec at 40Hz and above, measured at the base of the building.

Additionally, The Australian and New Zealand Environment Conservation Council (ANZECC) guideline *"Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration"* limit peak particle velocities from blasting to below 5mm/sec at residential receivers, with a long term regulatory goal of 2mm/sec.

The above listed criteria vary from 3mm/sec up to 15mm/sec, therefore, the more conservative limit of **3mm/sec** will be adopted for the purposes of Building Safety Criteria. It should be acknowledged, however, that intermittent ground vibration velocities at 5mm/sec are generally considered the threshold at which architectural (cosmetic) damage to normal dwellings may occur and velocities at 10mm/sec should not cause any significant structural damage, with the exception of the most fragile and brittle of buildings.

SECTION 3
Noise Impact Assessment

3.1 METHODOLOGY

3.1.1 Road Traffic Noise

Due to the non-continuous nature of traffic flow to and from the site, noise generated by traffic associated with the development, on public roads, is assessed using the EPA approved US Environment Protection Agency's Intermittent Traffic Noise guidelines.

Equation 1 outlines the mathematical formula used in calculating the Leq,T noise level for intermittent traffic noise.

Equation 1:

$$L_{eq},T = L_b + 10\log\left[1 + \frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10} - 1}{2.3} - \frac{(L_{\max} - L_b)}{10}\right)\right]$$

Where L_b background noise level (dB(A))
T is the time for each group of vehicles (min)
D is duration of noise of each vehicle (min)
L_{MAX} is vehicle noise (dB(A))
N is number of vehicle trips

Typical vehicle noise levels were sourced from our library of technical data, while background noise levels are those described in Section 2.2. The Lmax vehicle noise levels used in Equation 1 are the maximum predicted noise levels produced at the facade of the residence by vehicles entering and departing the site.

3.1.2 Site Equipment/Activities

Future noise sources on the site cannot be measured at this time, consequently noise levels produced by customer's vehicles, delivery trucks, mechanical plant and site activities have been sourced from manufacturers' data and/or our library of technical data. This library has been accumulated from measurements taken in many similar situations on other sites, and allows predictions of future environmental noise at each receiver and recommendations concerning noise control measures most likely to be required on this site.

All noise level measurements were taken with a Svan 912AE Sound and Vibration Analyser. This instrument is Class 1 accuracy, in accordance with the requirements of IEC 61672, and has the capability to measure steady, fluctuating, intermittent and/or impulsive sound, and to compute and display percentile noise levels for the measuring period. A calibration signal was used to align the instrument train prior to measuring and checked at the conclusion. Difference in the two measurements was less than 0.5dB. Each measurement was taken over a representative time period to include all aspects of machine/process operation, including additional start-up noise where applicable. Items of equipment, which produced a brief burst of noise, were measured for a similarly brief time period to ensure the results were not influenced by long periods of inactivity between operations. Sound measurements were generally made around all sides of each machine, to enable the acoustic sound power (dB re 1pW) to be calculated. The sound power level of each item is then theoretically propagated to each receiver with allowances made for spherical spreading, directivity, molecular absorption, intervening topography or barriers and ground effects giving the received noise level at the receiver from that particular plant item.

Addition of the received Sound Pressure Level (SPL) for each of the individual operating sources gives the total SPL at each receiver, which is then compared to the relevant criteria. Where noise impacts above the criterion are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels.

The theoretical assessment is based on a worst-case scenario, where all fixed plant items are operating simultaneously and vehicles entering and leaving in a location most exposed to the surrounding residences. In reality, many items will not always be operating in the most exposed areas, so actual received noise levels are expected to be less than the predictions shown in this report, or at worst equal to the predicted noise levels for only part of the time.

Due to the non-continuous nature of some site activities (i.e. car/truck movements, etc), adjustments for duration have been made using the following formula. Note that fixed plant items such as air conditioning/exhaust plant will be continuous over the entire assessment period and no duration adjustment is necessary.

Equation 2:

$$L_{eq},T = Lw - 10 \log (2 \pi r^2) + 10 \log \frac{(D \times N)}{T}$$

Where Lw is sound power level of source (dB(A))
R distance to receiver (m)
D is duration of noise for each event (sec)
N is number of events
T is total assessment period (sec)

The Sound Pressure Level's (SPL's) of noise sources identified during our site visits are listed below:

Item	*SPL dB(A)*	*Comments*
Car movements (S1)	64	passby at 3m
Car/4WD with float (S2)	66	passby at 3m
LR truck movements (S3)	69	passby at 3m
Pressure washer (S4)	68	@ 3m
Air compressor (S5)	65	@ 3m
Unload horse float (S6)	62	@ 3m
Pool pumps (S7)	55	@ 3m
Horses in horse walker (S8)	52	@ 3m
Horses on asphalt/concrete (S9)	68	@ 3m
Horses in pool (S10)	62	@ 3m
Waste/manure removal (S11)	79	@ 3m
Horses in stables (S12)	56	@ 3m
Stable cleaning (S13)	65	@ 3m
Maintenance activities/unloading (S14)	38	@ 20m

3.2 ANALYSIS

3.2.1 Received Noise Levels - Road Traffic

Traffic due to the proposal travelling on nearby public roads is assessed separate to site noise and is subject to the criteria described in Section 2.3.1 of this Report. Cars and trucks will enter and exit the site via the main entry/exit points on Darling Street and Chatham Road.

The Seca Solutions Pty Ltd Traffic Report suggests that the new stables development will generate 98-176 light vehicle or vehicle/float movements each day and 12 heavy vehicle movements each day. Approximately 50% of light vehicle movements, i.e 69 movements are expected to occur before 7am, while all heavy vehicle movements will occur during the day after 7am. The majority of traffic movements are expected prior to and at completion of trackwork.

LR truck noise varies from one machine to another, with more modern larger vehicles consistently producing a sound power in the range 96 to 102 dB(A) at full power. This assessment assumes a typical truck sound power of 100dB(A), as full engine power is not typically required to approach and depart the site at low speed. An additional 50 vehicle movements and 5 heavy vehicle movements are expected each day for maintenance, produce deliveries, waste removal, etc.

Cars typically produce an average sound power of 92dB(A), however wide variations are noted particularly with smaller modern cars and larger V8 or diesel powered vehicles. Our calculations present the worst case for the situation, as the noise produced by a typical car accelerating at full power is used to determine the received noise level. In reality, many people will not leave the site at full acceleration but will depart more sedately.

The following Table shows calculations to determine received traffic noise levels at typical residential receivers along Chatham Road and Darling Street for peak day and night periods.

Table 7: Traffic Noise Calculations Chatham Road/Darling Street - dB(A)Leq (T)

Traffic and Receiver	Peak Day		Peak Night	
Vehicle Type	Cars	Trucks	Cars	Trucks
Movements per day/night	100	25	100	2
Vehicle Sound Power	92	100	92	100
Average Distance to Rec, m	10	10	10	10
Rec Noise Level dB(A),Leq	39.4	42.4	41.6	33.6
Total Received	**44.1**		**42.3**	
Criteria	**60dB(A),Leq 15hr**		**55dB(A),Leq 9hr**	
Impact	**0**		**0**	

The above Tables show the noise impact from traffic movements on public roads, associated with the new development are predicted to compliant with the criteria during the peak day and night periods at all residential receivers and is considered acceptable.

3.2.2 Received Noise – Site Operation (Activities/Equipment)

The Acoustic Power Levels (Lw's) of plant and machinery expected for the site which were input into our computer model, are shown in the following Table for peak day, and night periods. The Table gives the A-weighted sound power levels for each listed plant item, principally based on manufacturers' data and our library of technical data. Also shown is the number of items expected at the site during a 15 minute assessment period.

Table 8: Equipment/Activities (15 minute Assessment Period)

Item/Activity	Lw dB(A)	Staff Cpark	Dr Off Zone	Walker	Promenade	Ramp	Stables	Maint Shed
				DAY				
Cars[1]	81	20						
4WD float[2]	83		5					
LR Truck[3]	86		3					
Pr Washer[4]	85						4	
Air compressor[5]	82						4	
Unload[6]	85		8					
Pool pumps[7]	72						2	
Horses[8,9,10,12]	69/79			5x10				
Waste remove[11]	96							1
Pool[10]	79						10	
Cleaning[13]	82						6	
Maint Act[14]	72							1
				NIGHT				
Cars[1]	81	20						
4WD float[2]	83		5					
LR Truck[3]	86		3					
Pr Washer[4]	85						2	
Air compressor[5]	82						2	
Unload[6]	85		8					
Pool pumps[7]	72						2	
Horses[8,9,10,12]	69/79			5x5				
Waste remove[11]	96							
Pool[10]	79						10	
Cleaning[13]	82						4	
Maint Act[14]	72							1

NOTES:
1. Cars manoeuvring in carpark.
2. 4WD with float at Drop-Off Zone.
3. LR truck with float at Drop-Off Zone.
4. Washing out stables.
5. Air compressor running in conjunction with pressure washers.
6. Unload horses at Drop-Off Zone.
7. Pool pumps in pool services plant room.
8. Horses exercising in Walker.
9. Horses walking on ramps, promenade, passageways, etc.
10. Horses in pool.
11. Waste/manure bins removal by trucks.
12. Horses in stables.
13. Removal of waste/manure, etc.
14. Maintenance activities at Maintenance Shed and Equipment Shed

Figure 2: Site Plan

Table 9 shows calculations to predict the cumulative noise impact during day and evening periods (7am-10pm) at the nearest residential boundaries west of the site (R3).

Table 9: Received Noise - Site Activities dB(A),Leq (Day/Evening)
Propagated W to Nearest Residential Boundaries R3 (NO NOISE CONTROL)

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/TL	Received dB(A)
Cars E/L staff carpark	81	110	10	20	18	8
4WD E/L Drop-Off Zone	83	30	10	5	12	21
LR Tr E/L Drop-Off Zone	86	30	10	3	10	24
Pr washer west stables	85	35	180	4	14	31
Pr washer SE stables	85	80	180	2	18	17
Air comp west stables	82	35	180	4	14	28
Air comp SE stables	82	80	180	2	18	14
Unload floats Drop-Off Z	79	40	300	8	14	29
Pool pumps Bl D pl room	72	90	900	4	24	7
Horses SW walker	69	50	900	10	2	25
Horses NW walker	69	70	900	10	2	22
Horses NE walker	69	100	900	10	12	9
Horses south ramp	85	50	30	5	6	29
Horses Drop-Off Zone	85	40	20	10	16	22
Horses north ramp	85	70	30	5	4	28
Horses south pr'nade	85	60	120	5	12	27
Horses north pr'nade	85	80	120	5	14	23
Horses north passage	85	100	30	5	24	5
Waste remove NW	88	20	300	1	4	45
Horses W stables	73	50	900	2x3	12	28
Horses E stables	73	80	900	2x4	18	18
Waste remove W stables	82	50	300	8	12	26
Waste remove S stables	82	80	300	4	18	16
Maintenance S shed	72	40	300	1	6	31
Maintenance N shed	72	80	300	1	8	23
				Combined		**46**
				Criteria (Day/Even)		**43/41**
				Impact		**3/5**

As can be seen by the results in Table 9, the cumulative noise impact from activities associated with the site are predicted to exceed the criteria at nearest residential boundaries west of the site (R3) by up to 7dB(A) during the day. Furthermore, additional preliminary calculations reveal that short-term noise events are also predicted to exceed the Sleep Arousal Criterion at night. Reference to our calculations reveal that the following noise control modifications will be necessary to achieve compliance.

1. No horse delivery pickup prior to 7am at Equine Drop-Off Zone.
2. Waste manure removal from the site must be restricted to day only (7am-6pm).
3. A 2400mm high acoustic fence will need to be erected along the west site boundary adjacent to the Maintenance Drop-Off Zone.
4. Solid balustrade 1200mm above FFL is required on ramps.

Table 10 shows recalculation to predict the cumulative noise impact during day and evening periods at the nearest residential receiver west of the site (R3), with the above noise control modifications in place.

Table 10: Received Noise - Site Activities dB(A),Leq (Day/Evening)
Propagated W to Nearest Residential Boundaries R3 (NOISE CONTROL IN PLACE)

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/TL	Received dB(A)
Cars E/L staff carpark	81	110	10	20	18	8
4WD E/L Drop-Off Zone	83	30	10	5	12	21
LR Tr E/L Drop-Off Zone	86	30	10	3	10	24
Pr washer west stables	85	35	180	4	14	31
Pr washer SE stables	85	80	180	2	18	17
Air comp west stables	82	35	180	4	14	28
Air comp SE stables	82	80	180	2	18	14
Unload floats Drop-Off Z	79	40	300	8	14	29
Pool pumps Bl D pl room	72	90	900	4	24	7
Horses SW walker	69	50	900	10	4	23
Horses NW walker	69	70	900	10	4	20
Horses NE walker	69	100	900	10	12	9
Horses south ramp	85	50	30	5	6	29
Horses Drop-Off Zone	85	40	20	10	16	22
Horses north ramp	85	70	30	5	4	28
Horses south pr'nade	85	60	120	5	12	27
Horses north pr'nade	85	80	120	5	14	23
Horses north passage	85	100	30	5	24	5
Waste remove NW	88	20	300	1	14	35
Horses W stables	73	50	900	2x3	12	28
Horses E stables	73	80	900	2x4	18	18
Waste remove W stables	82	50	300	8	12	26
Waste remove S stables	82	80	300	4	18	16
Maintenance S shed	72	40	300	1	6	31
Maintenance N shed	72	80	300	1	8	23
				Combined		**40**
				Criteria (Day/Even)		**43/41**
				Impact		**0/0**

As can be seen by the results in Table 10, the cumulative noise impact from all site activities and equipment is predicted to be compliant with the criteria at nearest residential boundaries west of the site (R3), providing acoustic modifications noted above are incorporated into the design.

Table 11 shows a summary of predicted noise impacts during all time periods at nearest receivers with noise control in place.

Table 11: Summary Received Noise – All Nearby Receivers

Receiver Loc'n	Received Noise (Day/Evening/Night)						
	Period	dB(A),Leq	Crit	Impact	dB(A),Lm	Crit	Impact
School NW	Day	24	35#	0	-	N/A	-
R1	Evening	24	35#	0	-	N/A	-
	Night	21	35#	0	-	N/A	-
Residence NW	Day	41	43	0	-	N/A	-
R2	Evening	41	41	0	-	N/A	-
	Night	37	38	0	45	52	0
Residence W	Day	40	43	0	-	N/A	-
R3	Evening	40	41	0	-	N/A	-
	Night	37	38	0	49	52	0
Residences S	Day	42	43	0	-	N/A	-
R4	Evening	42	41	0	-	N/A	-
	Night	36	38	0	50	52	0

Internal Noise Level Criteria. A typical building will attenuate approximately 10dB(A) with windows open sufficient to provide adequate ventilation. Based on external noise level of 34dB(A) at nearest classrooms, internal noise levels from stables are not expected to exceed 24dB(A).

As can be seen by results in the above Table, noise associated with site activities and equipment will generally be compliant with the criteria during all time periods at all nearby receivers, providing acoustic treatment detailed in Section 4 is implemented. Sleep arousal during the night period from 10pm-7am is not expected to be an issue, as the facility will be quiet during these times, with very little activity, except for the occasional attendance by vets/stable staff, etc.

3.2.3 Received Noise – Horses on Public Roads

Item 17 of The *NSW Road Rules 2014* states the following:

***17.** Who is a rider*
(1) A
"rider" is the person who is riding a motor bike, bicycle, animal or animal-drawn vehicle.

In respect to the above, horses on public roads is assessed separate to site noise and is subject to the criteria described in Section 2.3.1 of this Report. Criteria are reproduced below:

Day	60 LAeq,15hr (external)	7am-10pm
Night	55 LAeq,9hr (external)	10pm-7am

At rural race courses, trainers will often exercise horses on public roads due to a lack of facilities at the course. However, our client has revealed that horses are not exercised on public roads in the vicinity of the race course due to the high level of traffic using both Chatham Road and Darling Street, which is a road safety issue. As can be seen by the stable development plans, adequate exercise facilities have been incorporated into the design to eliminate the need for horses to exercise on public roads.

We understand that on occasion horses may be walked from nearby off-site stables to the race course, although this practice will remain unchanged from the current situation.

In conclusion, residents will not experience any change in received noise from horses on public roads than from the current situation.

3.2.4 Construction Noise & Vibration (Impact on Neighbours)

Received noise produced by anticipated construction and demolition activities is shown in Table 12 below, for a variety of distances to a typical receiver, with no noise barriers or acoustic shielding in place and with each item of plant operating at full power. Entries in bold type highlight exceedances of the day Highly Noise Affected criteria of **75dB(A),Leq**.

Table 12: Predicted Plant Item Noise Levels, dB(A)Leq

		Distance to Residence			
Plant/Activity	**(Lw)**	**25m**	**50m**	**75m**	**100m**
Mobile crane	(104)	68	62	58	56
Excavator with j'hammer	(114)	**78**	72	68	66
Excavator	(104)	68	62	58	56
J'hammer (internal)	(98)	62	56	52	50
Positrack	(108)	72	66	62	60
Hammering	(98)	62	56	52	50
Angle grinder	(106)	70	64	60	58
Air wrench (silenced)	(98)	62	56	52	50
Compactor	(111)	75	69	65	63
Road truck	(104)	68	62	58	56
Grader	(102)	66	60	56	54
Air compressor	(94)	58	52	48	46
Framing gun	(95)	59	53	49	47
Concrete Agitator	(112)	**76**	70	66	64
Concrete Pump	(110)	74	68	64	62
Circular saw	(109)	73	67	63	61
Pile boring rig	(114)	**78**	72.0	68.0	66.0

Residences are within 30-40 metres of the site and some construction activities are expected to exceed the criteria, particularly mobile plant. Noise levels above 70dB(A) are possible at closest locations, and community reaction is possible. The ICNG recommends that as a first course of action, consideration should be given as to whether any alternate feasible or reasonable method of construction is possible. Consultation with the construction contractor confirms that due to the nature of ground conditions there are no quieter alternates available. The ICNG further recommends that when alternate feasible and reasonable options have been considered the proponent then should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and any respite periods that will be provided. These strategies will be discussed in more detail in Section 8.

Nearest school classrooms are approximately 100 metres from construction activities and only major earthworks are expected to exceed the criteria within nearest school classrooms. Once initial earthworks are completed, noise levels are expected to reduce significantly implying compliance. In saying this, consultation with school staff is recommended to ensure noisy activities are carried out during less sensitive times and/or outside school class times. The majority of noise will enter buildings thru open doors and windows. Pre-planning at the school may be possible to ensure exposed entry doors are closed that face the construction site on rare occasions when noise levels may be higher than will be typical.

If pile boring occurs noise levels in the order of 69-72dB(A) are possible at nearest locations, which we acknowledge is high. To reduce noise levels any appreciable amount a physical barrier would be required to intercept the line of site between the source and receivers. We suggest that temporary acoustic barriers between the source and receiver. Placing shipping containers or similar moveable barriers adjacent to a rig is another practical method of noise control. Note that barriers will not be required in situations where intervening structures provide acoustic barriers between the source and receiver. Removal of existing boundary fences after other noise generating activities are completed may be considered in preference to the above. These strategies may reduce noise levels at residential locations by up to 10dB(A).

It should be noted that calculations are based on plant items operating in exposed locations and at full power, with no allowances made for intervening topography or shielding provided by intervening structures. Cumulative impacts, from several machines operating simultaneously, may be reduced when machines are operating in shielded areas not wholly visible to receivers. In saying this, if two or more machines were to operate simultaneously on the site, received noise levels would be raised and higher exceedances may occur.

Initial earthworks are expected to employ an excavator, and 1-2 dump trucks. The combined acoustic power level of these machines, assuming normal contractor's machines up to 10 years old in reasonably good condition, is expected to be in the range 100 to 104B(A),Leq. However, the machines will typically be spread over the site, and noise at any receiver is typically dominated by the few closest machines, such as an excavator loading a truck, while a second truck reverses into position to be loaded by an excavator. With a combined acoustic power level of 102 dB(A) for 3 typical machines operating at full power, above 60dB(A) is expected at the closest residence during peak activity.

Constructing temporary barriers of plywood, at least 2m high, at the perimeter of the construction site (or at least adjacent to noisy plant items) may be considered for mitigating some of the construction noise at nearest receivers. These barriers will offer the additional benefit of securing the site from unwanted visitors. With barriers in place, worst case construction will reduce by up to 10dB(A), although, as previously stated, these noise levels are expected to occur for a relatively short time and reduce as work progresses to a new area.

It should be acknowledged that construction activities that produce higher noise for a shorter period are often more desirable than alternate construction techniques that produce lower noise for a much longer period. This combined with noise control strategies discussed in Section 8 will ensure that minimum disruption occurs.

3.2.5 Predicted Vibration Impacts

Occupants of nearby buildings may also have concerns about ground vibration levels from vibrating machinery (excavators, compactors, etc). Ground vibration measurements carried out previously, on other sites, can be used to indicate the likely range of vibration levels produced by construction activities. Previous results do not necessarily apply to this site without considering influencing factors such as ground resonant frequency, energy produced, etc. Table 13 lists the results of previous vibration measurements, with each measurement corrected to a standard distance of 20m to represent nearest residential receivers.

Table 13: Average Maximum Ground Vibration Measurement Results, mm/s Peak.

Ground Type	Measured Distance to Vibration mm/sec	Minimum 20m to Receiver mm/sec
Excavator on clay soil	80m, 0.012	0.14
Excavator on dry alluvial soil	15m, 0.23	0.16
Excavator on wet alluvial soil	10m, 0.52	0.28
Road truck on potholes	10m, 0.15-2.7	0.1-1.2
Compactor on clay	40m, 0.20	0.20

Measured at construction sites in Newcastle CBD.

Table 13 shows a variety of vibration levels mainly due to differences in ground conditions from one site to the next. The Table shows a marked difference between clay and dry ground, with low resulting vibration, and water saturated ground with vibration levels an order of magnitude higher. Results from measurements on wet alluvial or clay soil are likely to apply to the site.

Since vibration varies over time for each process the EPA Guideline recommends that the following formula be used to estimate the vibration dose at the receiver location:

Equation 1: $eVDV = 1.4 \times a \times t^{0.25}$

where: k is nominally 1.4 for crest factors below 6 a_{rms} = weighted rms accel (m/s²)
t = total cumulative time (seconds) of the vibration event(s)

The following estimated vibration doses are expected at nearest receivers:

	eVDV
Excavator	0.18
Compactor	0.24

Based on the above results, adverse comment is possible, particularly when earthworks take place. We therefore recommend that these activities are not carried out unless simultaneous attended vibration monitoring is conducted when within safe working distances noted in Table 16. As previously stated, in many cases higher levels of vibration (and noise) are preferable that occur for only a short period of time than processes producing lower amplitudes for a much longer time period.

The effect of vibration in a building is observed in two ways, namely, it is felt by the occupant, or it causes physical damage to the structure. Subjective detection can be one of direct perception from rattling of windows and ornaments, or dislodgement of hanging pictures and other loose objects. The second is structural damage which may be either architectural (or cosmetic) such as plaster cracking, movement or dislodgement of wall tiles, cracked glass etc, or major such as cracking walls, complete falls of ceilings, etc, which is generally considered to impair the function or use of the dwelling. Vibration can be felt at levels well below those considered to cause structural damage. Complaints from occupiers are usually due to the belief that if vibration can be felt then it is likely to cause damage. Slamming of doors or footfall within a building can produce vibration levels above those produced by construction activities.

Any future structural damage, whether cosmetic or major, which may occur to any building will only be a result of natural causes such as differential settlement of foundations (particularly if on poorly compacted fill), expansion and contraction cycles due to changes in temperature, shrinkage due to drying out of timber framing and pre-stressed areas of the building. Obvious structural damage from any of these sources can usually be identified with the particular cause. Generally, one particular source is not the cause of damage to a structure, but rather a combination of two or more.

Vibration levels are unlikely to cause direct failure, and it is considered the main action is triggering cracks in materials already subjected to stress or natural forces, however, as previously mentioned, this may also arise from internal forces such as slamming of doors. In our experience, vibration will only begin to trigger "natural cracking" at levels above 1mm/sec.

Construction vibration levels below 1mm/sec are expected at nearest residences. Levels are predicted to be marginally above background vibration levels and less than those produced by a passing bus or truck. We therefore consider structural damage to residences to be extremely unlikely from construction activities.

Findings by the Road Research Laboratory, reproduced in Table 14, gives an indication of the effects from varying magnitudes of vibration.

Table 14: Reaction of People and Damage to Buildings

Peak Vel (mm/s)	Human Reaction	Effect on Buildings
0 to 0.15	Imperceptible by people – no intrusion	Highly unlikely to cause damage
0.15 to 0.3	Threshold of perception – possibility of intrusion	Highly unlikely to cause damage
2.0	Vibrations perceptible	Recommended upper level of vibration for historical buildings
2.5	Level at which vibration becomes annoying	Very little risk of damage
5	Annoying to occupants	Threshold at which the risk of damage to houses is possible
10 to 15	Vibrations considered unpleasant and unacceptable	Will cause cosmetic damage and possibly structural damage

Construction noise and vibration strategies are discussed in detail in Section 8.

SECTION 4
Summary of Recommended Noise Control

4. NOISE CONTROL RECOMMENDATIONS

4.1 The proposed operating hours 3.30am-8.30am for the new stables is acceptable.

4.2 Deliveries and pickup of horses is only permitted during the day and evening (7am-10pm). No delivery or pickup at night (10pm-7am).

4.3 Space planning has been incorporated into the design of the Equine Drop-Off/Pick-Up Zone to eliminate the need for reversing and use of reverse alarms. Therefore, signs should be erected in conspicuous locations discouraging drivers from reversing.

4.4 Acoustic fences are to be erected at the following locations (also see Figure 3):

Location	Height
West site boundary opposite the Maintenance Shed	2400mm

An acoustic fence is one which is impervious from the ground to the recommended height, and is typically constructed from Colorbond steel, lapped and capped timber, Hebel Powerpanel or similar. No significant gaps should remain in the fence to allow the passage of sound below the recommended height. A gap of 50-75mm is permitted at ground level to aid in drainage. Other construction options are available if desired, providing the fence or wall is impervious and of equivalent or greater surface mass than the above construction options.

4.5 Perimeter of Horse Ramps 01, 02 must have enclosed balustrade to a minimum height of 1200mm above FFL (also See Figure 3).

4.6 No acoustic barriers are required adjacent to mechanical plant providing noise emissions for individual items are below the specified limits:

Item	*Max SPL at a Dist of 1 metre*	*Lw*
Air Conditioning Condenser	69dB(A)	75dB(A)
Refrigeration Condenser	70dB(A)	76dB(A)
Exhaust Discharge	70dB(A)	76dB(A)
Compressor	72dB(A)	78dB(A)
Pool Pumps	78dB(A)	84dB(A)

4.7 Acoustic barriers are to be constructed at the fan discharge of exhaust plant that exceeds the limits specified in 4.6 above. Barriers must fully enclose at least three sides towards any residence. In our experience, a more efficient and structurally secure barrier is one that encloses all four sides. The barrier must extend at least 600mm above and below the fan centre and/or the discharge outlet and must be no further than 1200mm from the edges of the exhaust. Barrier construction should consist of *either* Acoustisorb panels (available through Modular Walls) *or* an outer layer of one sheet of 12mm fibre cement sheeting (Villaboard, Hardiflex), or 19mm marine plywood. The inside (plant side) is to be lined with an absorbent foam to reduce reverberant sound (fibrous infills are not recommended as they will deteriorate if wet), Note that variations to barrier construction or alternate materials are not permitted without approval from the acoustical consultant. Barrier construction is based solely on acoustic issues. Visual, wind load issues must be considered and designed by appropriately qualified engineers.

4.8 Acoustic barriers are to be constructed adjacent to air conditioning and refrigeration plant that exceeds the limits specified in 4.6 above. Acoustic barriers 300mm above the highest plant item must be erected between the plant and residences. Barrier construction is to consist of *either* Acoustisorb panels (available through Modular Walls) *or* an outer layer of 12mm fibre cement sheeting, 25mm construction plywood, Hebel Powerpanel, or similar material, with an absorbent inner surface of perforated metal (minimum 10-15% open area) backed with a water resistant acrylic batt or blanket.

4.9 All pool pumps and ancillary equipment must be located in the dedicated pool services plant room in Block D. If noise emissions exceed the limits specified in 4.6 above, acoustic louvres in preference to standard ventilation louvres are required for any openings in plant room walls on the south facade. The louvres must have the following insertion loss values (typically Fantech SBL1, Nap Silentflo 300S Line or Robertson Type 7010):

Required Insertion Loss Values for Acoustic Barriers/Plant Room Louvres – dB

	Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
NR	10	12	15	19	20	18	18	14
STL	4	6	9	13	14	12	12	8

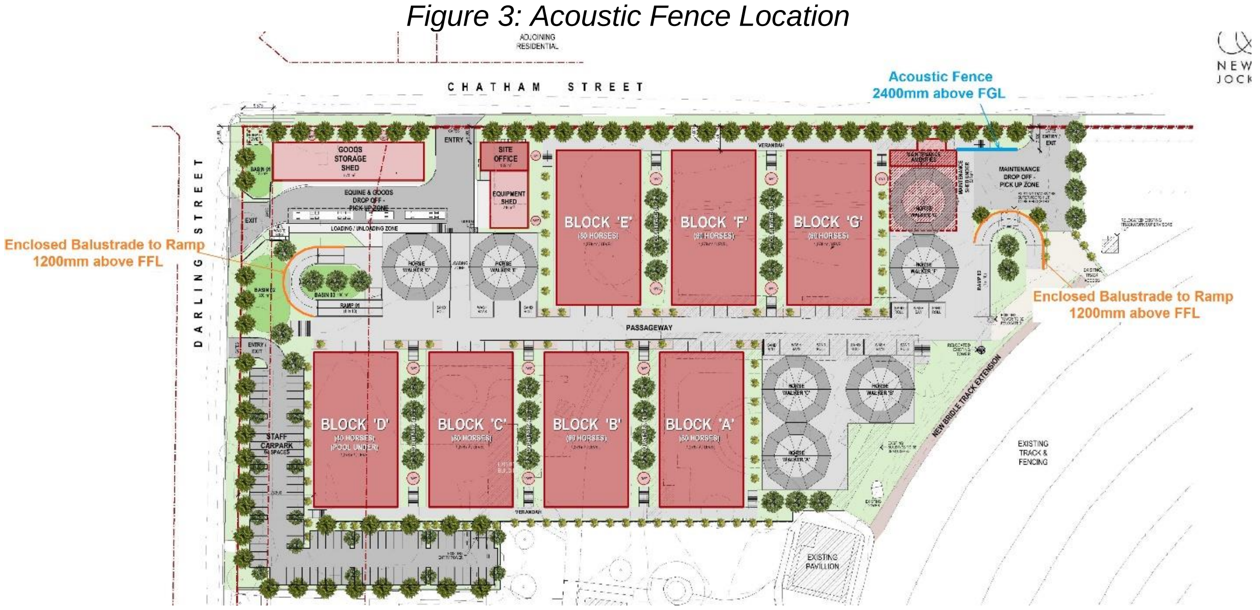
4.10 The contractor responsible for supplying and installing mechanical plant must provide evidence that installed plant meets this noise emission limit, or that noise control included with the plant is effective in reducing the sound level to the specified limit.

4.11 Once the plant layout has been finalised, details should be forwarded to the acoustic consultant for approval.

4.12 It is strongly recommended that waste collection be restricted to weekdays 7.00am to 6.00pm.

4.13 Construction Certificate documentation must be forwarded to Reverb Acoustics to ensure all recommendations within this report have been incorporated into the design of the site.

Figure 3: Acoustic Fence Location



Additional Comments

Notwithstanding compliance with relevant criteria, which may or may not occur during typical operations of the stables, the following factors are relevant for consideration:

The site is currently occupied by the NJC. The proposal will produce significantly less noise than under the current situation and our client intends to implement extensive noise control measures and strategies, many of these aimed at reducing noise impacts at nearby residences. The following factors and comments are presented in response to concerns from nearest neighbours:

- Pre-cast concrete construction will ensure that significant noise transmission thru the building structure is eliminated. Furthermore, ventilation openings have been strategically placed in consultation with the acoustic consultant to ensure larger openings face towards non-sensitive areas and/or opening sizes are kept to the minimum required for the intended purpose.
- Acoustic fences are only required adjacent to noisy activities that will occur in exposed locations, are above the criteria if noise control is not implemented, and where other structures do not provide adequate shielding. Reference to Figure 3 shows the extend of required acoustic barriers and fencing, based on the above conditions.
- Walkways and the new dedicated tie-up area, adjacent to the track are well shielded from nearest receivers by intervening buildings and structures, ensuring noise emissions are kept to a minimum at all times.
- An additional 121 staff carparks and 6 motorcycle parks have been provided under the revised design to ensure morning trackwork staff off street parking well removed from residential neighbours.
- Further Improvements include erection of acoustic fences, selection of quieter equipment in line with industry best practice and enforcement of requisite time restrictions on noisier activities.

Improvements proposed by our client will result in lower average noise levels at all nearby residences by reducing or eliminating activities such as floating horses to the track, loading/unloading, etc, during more sensitive time periods and implementing effective noise control. On this basis alone, refusal of the proposal would be unjustified from an acoustics point of view.

SECTION 5

Construction Noise & Vibration Strategies

5 CONSTRUCTION NOISE & VIBRATION CONTROL STRATEGIES

5.1 Noise & Vibration Monitoring Program

We recommend that attended noise and vibration should be carried out at commencement of each process/activity that has the potential to produce excessive noise and/or vibration. Attended monitoring offers the advantage of immediate identification of noise or vibration exceedances at the receiver and ameliorative action required to minimise the duration of exposure. Unattended long-term monitoring only identifies a problem at a later date and is not recommended. Table 15 should be used as a guide for the construction team to consider and follow. When the nominated activity occurs within the safe working distance, attended vibration monitoring should be conducted at the relevant receiver type. It is usual practice to conduct attended noise monitoring in conjunction with vibration monitoring, as activities that produce high vibration amplitudes also regularly produce high levels of noise.

Table 15: Vibration Monitoring Program - Minimum Distance when Monitoring is Required

Activity/Process	Receiver Type	Distance to Receiver (m)
Tracked machine	Heritage structure	40
	Residential building	20
	Commercial	10
Pile boring	Heritage structure	40
	Residential building	20
	Commercial	10
Crane	Heritage structure	20
	Residential building	10
	Commercial	5
Concrete pours	Heritage structure	20
	Residential building	10
	Commercial	5
Truck movements	Heritage structure	20
	Residential building	10
	Commercial	5

Note: Attended vibration monitoring should also be conducted for other activities identified by the contractor that have the potential to create vibration, not noted in the above Table.

5.2 Vibration Management Strategies

In addition to vibration monitoring, the following management strategies should also be considered:

Dilapidation Survey: We understand that this has been done as part of the management process.

Monitoring Changes in Building: Use of callipers, tell tales, etc, prior to commencement of major vibration generating works.

Underpinning, Reinforcement, Bracing, etc: Additional structural support to adjoining buildings, excavations, etc.

5.3 Equipment Selection

All combustion engine plant, such as generators, compressors and welders, should be carefully checked to ensure they produce minimal noise, with particular attention to residential grade exhaust silencers and shielding around motors.

Trucks and other machines should not be left idling unnecessarily, particularly when close to residences. Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made. Framing guns and impact wrenches should be used sparingly, particularly in elevated locations, with assembly of modules on the ground preferred.

Table 16 shows some common construction equipment, together with noise control options and possible alternatives.

Table 16: Noise Control, Common Noise Sources

Equipment / Process	Noise Source	Noise Control	Possible Alternatives
Compressor Generator	Engine	Fit residential muffler. Acoustic enclosure.	Electric in preference to petrol/diesel. Plant to be Located outside building Centralised system.
	Casing	Shielding around motor.	
Concrete breaking Drilling Core Holing	Hand piece	Fit silencer, reduces noise but not efficiency Enclosure / Screening	Use rotary drill or thermic lance (used to burn holes in and cut concrete) Laser cutting technology
	Bit	Dampened bit to eliminate ringing. Once surface broken, noise reduces. Enclosure / Screening.	
	Air line	Seal air leaks, lag joints	
	Motor	Fit residential mufflers.	
Drop/Circular saw Brick saw	Vibration of blade/product.	Use sharp saws. Dampen blade. Clamp product.	Use handsaws where possible. Retro-fitting.
Hammering	Impact on nail		Screws
Brick bolster	Impact on brick	Rubber matting under brick	Shielded area.
Rotary drills Boring	Drive motor and bit.	Acoustic screens and enclosures	Thermic lance Laser cutting technology.
Explosive tools (i.e. ramset gun)	Cartridge explosion	Use silenced gun	Drill fixing.
Material handling	Material impact	Cushioning by placing mattresses, foam, waffle matting on floor. Acoustic screening.	
Waste disposal	Dropping material in bin, trolley wheels.	Internally line bins/chutes with insertion rubber, conveyor belting, or similar.	
Dozer, Excavator, Truck, Grader, Crane	Engine, track noise	Residential mufflers, shielding around engine, rubber tyred machinery.	
Pile driving/boring	Hammer impact engine	Shipping containers between pile & receiver	Manual boring techniques

Note: Generally, noise reductions of 7-10dB will be achieved with the use of barriers, 15-30dB by enclosures, 5-10dB from silencers and up to 20-25dB by substitution with an alternate process.

5.4 Acoustic Barriers/Screening

To minimise noise impacts during construction, early work should concentrate on grading and levelling the areas closest to buildings. In the event of complaints arising from occupants of nearby buildings, we offer the following additional strategies for consideration:

- Place acoustic enclosures or screens directly adjacent to stationary noise sources such as compressors, generators, drill rigs, etc.
- Temporary barriers of plywood, excess fill, etc, at least 2m high, at the perimeter of the construction site

5.5 Consultation/Complaints Handling Procedure

The construction contractor should analyse proposed noise control strategies in consultation with the Acoustic Consultant as part of project pre-planning. This will identify potential noise problems and eliminate them in the planning phase prior to site works commencing.

Occupants of nearby buildings should be notified of the intended construction timetable and kept up to date as work progresses, particularly as work changes from one set of machines and processes to another. In particular, occupants should understand how long they will be exposed to each source of noise and be given the opportunity to inspect plans of the completed development. Encouraging public understanding and "participation" gives the local community a sense of ownership in the development and promotes a good working relationship with construction staff. Programming noisy activities (such as sheet piling) outside critical times for court buildings should be arranged.

We recommend that construction noise management strategies should be implemented to ensure disruption to the occupants of nearby residences and school classrooms is kept to a minimum. Noise control strategies include co-ordination between the construction team and interested parties to ensure the timetable for noisy activities does not coincide with sensitive activities. This is particularly important at nearest school classrooms.

The site manager/environmental officer and construction contractor should take responsibility and be available to consult with community representatives, perhaps only during working hours. Response to complaints or comments should be made in a timely manner and action reported to the concerned party.

All staff and employees directly involved with the construction project should receive informal training with regard to noise control procedures. Additional ongoing on the job environmental training should be incorporated with the introduction of any new process or procedure. This training should flow down contractually to all sub-contractors.

5.6 Risk Assessment

A risk assessment should be undertaken for all noisy activities and at the change of each process. This will help identify the degree of noise and/or vibration impact at nearby receivers and ameliorative action necessary. A sample Risk Assessment Check Sheet is included in Appendix B as a guide.

SECTION 6
Conclusion

6.1 CONCLUSION

A noise impact assessment for a proposal to construct new horse stables at the existing racecourse on the corner of Chatham Road and Darling Street, Broadmeadow, has been completed, resulting in noise control recommendations summarised in Section 4 of this Report. The site is suitable for the intended purpose providing recommendations outlined in this report are incorporated into the design. With these or equivalent measures in place, noise from the site will be either within the criterion or generally below the existing noise levels in the area for the majority of the time. As previously stated, traffic numbers visiting the site will be significantly reduced once the new stables are operational, creating a positive acoustic impact in the residential area.

With relatively constant traffic on nearby roads, and the abundance of nearby commercial development, noise generated by the proposed site will be audible at times but not intrusive at any nearby residence. As the character and amplitude of activities associated with the site will be similar to those already impacting the area, it will be less intrusive than an unfamiliar introduced source and should be acceptable to residents.

To reduce the impact in the area during construction, we recommend that louder construction activities, should be completed with the minimum of undue delay. In any case, all reasonable attempts should be made to complete significant noisy activities within as short a time as possible. As previously stated, construction activities that produce higher noise for a shorter period are often more desirable than alternate construction techniques that produce lower noise for a much longer period

Construction activities should generally be restricted to the nominated hours. If construction does occur outside the standard hours, it is vital that the local community be informed of the construction timetable with letter drops, meetings, etc.

Significant variation in measured vibration levels may occur due to site specific conditions such as the ground resonant frequency, driving frequency of equipment and energy of the associated process. Therefore, a regular noise and vibration monitoring program should be implemented, as described in Table 7. This program will verify our predictions and in the event that complaints may arise, enable strategies to be implemented, where required.

To minimise the chances of disruption to neighbours from excessive vibration (i.e. during site preparation, pile boring, etc), activities should not occur within the distances nominated in Table 16, unless simultaneous vibration and noise monitoring is carried out. Similarly, two compactors should not be operated in tandem over any part of the site, unless simultaneous attended vibration monitoring is conducted at the nearest receiver(s). Where practicable, required compaction should be achieved by heavy non-vibrating equipment.

We conclude, with a high degree of confidence, that vibration levels at the predicted magnitudes will not cause direct structural damage to any building. We suspect any damage that may occur to nearby buildings during construction activities would be the result of natural forces, as discussed in the previous section. It should be noted, however, that vibration may be noticed at times while a person is standing or seated quietly. Other noticeable indicators are rattling of window frames and ornaments, and visible movement of hanging pictures, etc.

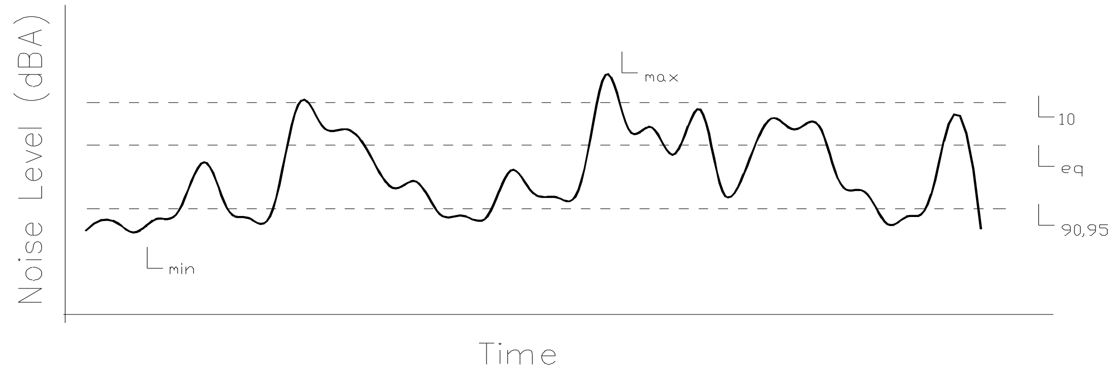
Providing the recommendations presented in this report are implemented noise emissions from operation and construction at the site will not have any long term adverse impact upon the acoustical amenity of nearby residents. We therefore see no acoustic reason why the proposal should be denied.

Steve Brady M.A.S.A. A.A.A.S.
Principal Consultant

APPENDIX A
Definition of Acoustic Terms

Definition of Acoustic Terms

Term	Definition
dB(A)	A unit of measurement in decibels (A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
ABL	*Assessment Background Level* – A single figure representing each individual assessment period (day, evening, night). Determined as the L90 of the L90's for each separate period.
RBL	*Rating Background Level* – The overall single figure background level for each assessment period (day, evening, night) over the entire monitoring period.
Leq	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event has the same amount of acoustic energy as the given event.
L90	The noise level which is equalled or exceeded for 90% of the measurement period. An indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
L10	The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and was previously used in Australia as the descriptor for intrusive noise (usually in dBA).



APPENDIX B
Risk Assessment Checklist

Risk Assessment Checklist

Item/Date	Risk Identified (Yes/No)	Risk Level (H/M/L)	Noise Control Required (Yes/No)	Noise Control Strategy