BGMA Pty Ltd

ABN 55 101 186 805
Consulting Acoustical Engineers

Unit 21 / 12 Meadow Crescent,
Meadowbank NSW 2114
Ph: 02 98090745 Mob: 0405 493 726
Email: bgma1@bigpond.com

Reference: BGMA 151209

Saturday 26th December 2015

Jennifer French

"Glenfield Farm"
88 Leacocks Lane,
Casula NSW2170

Re: **"Glenfield Farm" vs Moorebank Intermodal Terminal & Intermodal Precinct**

Introduction

I, Brian Gregory Marston, the Principal of BGMA Pty Ltd, Consulting Acoustical Engineer, am providing this independent review of the proposed for the construction and operation of a transportation facility in the vicinity of "Glenfield Farm" Casula.

I have been in practice as an Acoustical Consulting Engineer for 35 years. As a basis to my current profession, I gained a Bachelor of Engineering (Mechanical) degree from the University of New South Wales in 1981.

I'm a Chartered Professional Engineer and have been a Member of the Institution of Engineers Australia since 1986. Furthermore, I've been a Full Member of the Australian Acoustical Society (since 1988), and of the Acoustical Society of America (since 2007). I have been a Member of the National Council of Acoustical Consultants since 1999, and my firm, BGMA Pty Ltd, has been a Member Firm since 2002.

In the course of my Acoustical Consulting practice I have been involved in numerous projects for private, commercial and industrial organisations requiring expertise in acoustics, noise and vibration issues.

In the preparation of this Report, I make reference to noise guidelines issued by the NSW EPA including the *Industrial Noise Policy* ("the INP"), the *Environmental Criteria for Road Traffic Noise* ("the ECRTN"), the *Environmental Noise Control Manual* ("ENCM") the *Rail Infrastructure Noise Guideline* ("RING") and the EPA's *Noise Guide for Local Government* ("NGLG").

"Glenfield Farm"

"Glenfield Farm" dates back to 1810-1817.

In 2003, the site was purchased by Department of Planning and in 2006, transferred to NSW Historic Houses Trust, where this was the first house to be saved through the Historic Houses Trust of NSW Endangered Houses Fund.

The residence at "Glenfield Farm" is the most intact house of the Macquarie period (1810-1821).

The NSW Office of Environment website lists the owners as the NSW Department of Planning & Infrastructure, but this is not correct. The property was put up for sale in 2011, and eventually purchased on 3rd of July 2013 with final transfer stamped 20th of October 2013.

I visited "Glenfield Farm" on Tuesday 15th December 2015.

> The residence and associated buildings are located on the ridgeline running along Leacocks Lane. Relative to "Glenfield Farm", the ridgeline continues to rise up toward the north-north-east, and to drop away towards the south-south-west.

The residence is a two storey residence with the upper level rooms located within the pitched roof of the residence.

Across the rear, there are dormer windows off these upper level rooms, facing to the south-east, toward the site of the transportation facility referred as the Moorebank Intermodal Terminal Project.

At the rear of this private residence, the garden slopes slightly toward the south-east for about 12 metres, before dropping away steeply to the level of the commuter line (at about 220 metres), and the elevated freight line (at about 240 metres).

The privately owned residence at "Glenfield Farm" will be affected by the proposed Moorebank Intermodal Terminal.

Background

This project originally placed the terminal as being between the Georges River and Moorebank Avenue with the site operated by the Moorebank Intermodal Company (MIC).

The project appears to have expanded to include a second terminal operated by the Sydney Intermodal Terminal Alliance (SIMTA) located on the western side of Moorebank Avenue.

Together, these form a combined Intermodal Precinct.

Acoustic Environment

The Parsons Brinckerhoff "*Moorebank Intermodal Terminal - Response to Submissions Report*" (Volume 4) May 2015 appears to be the latest in a succession of reports. That report includes as Appendix F a noise & vibration assessment prepared by SLR Consulting Australia Pty Ltd.

This appended report "*Moorebank Intermodal Terminal - Revised Project Report Noise and Vibration Assessment*" (27 April 2015) indicates three (3) monitoring locations for the establishing the local area acoustic environment.

The monitoring locations were only identified by general location. These monitoring locations were:

- Corryton Court, Wattle Grove to the east

  Rating Background Levels: 35 dB(A) [day] 36 dB(A) [evening] 32 db(A) [night]

- Goodenough Street Glenfield to the south

  Rating Background Levels: 35 dB(A) [day] 37 dB(A) [evening] 33 db(A) [night]

- Buckland Road Casula to the north

  Rating Background Levels: 39 dB(A) [day] 39 dB(A) [evening] 33 db(A) [night]

Acoustically, the Corryton Court location and the Goodenough Street location would closely approximate conditions at "Glenfield Farm".

The front facade of the "Glenfield Farm" residence faces away from the Intermodal Precinct, facing across Leacocks Lane towards a suburban area.

The rear of the residence is shielded from Leacocks Lane and the suburban area beyond, and faces east onto the Intermodal Precinct. In the east, the nearest suburb is Wattle Grove, 2.4 kilometres away. To the south, the nearest suburb is Glenfield, 1.3 kilometres away. The M5 Motorway is about 2.5 kilometres to the north-north-east.

Due to the configuration of local terrain, the underlying background $L_{Aeq,15min}$ noise level of the immediate area could be assumed to be traffic noise emissions from the M5 motorway.

The estimated Rating Background Level (RBL) levels for "Glenfield Farm" would be about 35 dB(A) by day (7:00 am to 6:00 pm), about 36 dB(A) in the evening (6:00 pm to 10:00 pm), and about 33 dB(A) at night (10:00 pm to 7:00 am).

Additional environmental background noise measurements undertaken at "Glenfield Farm" would be unlikely to produce different RBL results.

Explanation of Rating Background Level

In using RBL values, it is necessary to understand the derivation of these values.

Across any 24-hour period, the environmental "background" noise level is the noise level exceeded for 90% of the time in each of the 15-minute sampling periods. These will vary with the level of human activity in the area, and with meteorological factors.

> The first step in obtaining a Rating Background Level (RBL) is to remove the $L_{A90,15min}$ values, that are substantially elevated by wind related or rain related noise. Wind causes noise on the microphone windshield and vegetation to rustle.
>
> The second step is for each period, day (7:00 am to 6:00 pm), evening (6:00 pm to 10:00 pm), and night (10:00 pm to 7:00 am) for each day, to be separated and to select the $L_{A90,15min}$ value that is exceeded by 90% of the $L_{A90,15min}$ measurements, in each of those periods, for each day.
>
> The third step is to then select the median value for each of the three periods.

The Rating Background Level (RBL) is the median value of the "quieter" $L_{A90,15min}$ environmental "background" levels on the "quieter" days, for each period (daytime, evening, and night-time).

Discussion of Environmental Background Data

While it was claimed that twenty (20) months of data was analysed to obtain the above Rating Background Levels, specific details of the monitor locations, and duration of monitoring at each location was not provided.

For this type of "large industrial" wide-area monitoring, a minimum of three (3) weeks is required at a location, preferable six (6) weeks, to ensure capture of extended periods of "calm" or "near calm" conditions under High pressure & Low pressure weather conditions.

While the monitoring will establish the quieter "background" conditions, the measurements will not pick up the acoustic effects of early morning "atmospheric drainage flow" conditions. These "atmospheric drainage flows" tend to be localised micro-climate events that can create extremes of noise propagation.

> It would have assisted appreciation of the local acoustic environment if the twenty (20) months of data had been broken down into "weekday versus weekend" noise level measurement sets [to account for the weekly cycles of human activity], and into "month by month" data sets [to account for the seasonal variation in noise levels].
>
> In the original derivation of this analysis technique (undertaken by myself in 1998-1999), the $L_{Aeq,15min}$ noise levels was also analysed to provide an additional layer of understanding of the nature of the local acoustic environment, local micro-climate effects, and to assist in identifying the sources making up the local environmental "background" for an area.

Criteria – Industrial Noise

The NSW *Industrial Noise Policy* has two criteria, an Amenity Criteria and an Intrusiveness Criteria.

The first criterion is to address what is referred to as "creeping background" and to cap the noise level that an area will experience. The latter criterion limits each noise increase to only just noticeable.

According to the NSW *Industrial Noise Policy*, each area type has an "acceptable" $L_{Aeq,15min}$ Amenity noise level to avoid "creeping background".

> If the residence is considered to be in either a "rural" area, or a "suburban" area, the "acceptable" evening $L_{Aeq,15min}$ noise level ceiling is 45 dB(A) [6:00 pm to 10:00 pm], and the "acceptable" night-time $L_{Aeq,15min}$ noise level ceiling is 40 dB(A) [10:00 pm to 7:00 am].
>
> The "acceptable" daytime $L_{Aeq,15min}$ noise level ceiling [7:00 am to 6:00 pm] would be 50 dB(A) for a "rural" area, and 55 dB(A) for a "suburban" area.

SLR Consulting Australia Pty Ltd appears to have characterised all of the local areas as "suburban".

> For the Amenity Criteria alone, the "acceptable" daytime $L_{Aeq,15min}$ noise goal becomes 55 dB(A) [7:00 am to 6:00 pm], with an "acceptable" evening $L_{Aeq,15min}$ noise goal of 45 dB(A) [6:00 pm to 10:00 pm], and an "acceptable" night-time $L_{Aeq,15min}$ noise goal of 40 dB(A) [10:00 pm to 7:00 am].

The NSW *Industrial Noise Policy* also contains an Intrusiveness criterion of no more than "background plus 5".

> Within the SLR Consulting Australia Pty Ltd report, the nearest residential receiver locations are R6 and R7.
>
> Receiver R6 is vaguely described as "Leacocks Lane, Casula". Receiver R6 appears to be residential receiver located about 340 metres to the north and 683 metres from the Precinct.
>
> > SLR Consulting indicates an $L_{Aeq,15min}$ noise goal of 38 dB(A) or less.
>
> Receiver R7 is vaguely described as "Slessor Road, Casula" and appears to be a residential receiver located about 500 metres to the south-west and 1,127 metres from the Precinct.
>
> > SLR Consulting indicates an $L_{Aeq,15min}$ noise goal of 38 dB(A) or less.

Based on the intrusiveness noise limits attributed to Receiver R6 and Receiver R7 noise, the Intrusiveness noise goals for "Glenfield Farm" would most likely be a daytime $L_{Aeq,15min}$ noise limit [7:00 am to 6:00 pm] of 40 dB(A), an evening $L_{Aeq,15min}$ noise limit of 41 dB(A) [6:00 pm to 10:00 pm], and a night-time $L_{Aeq,15min}$ noise limit of 38 dB(A) [10:00 pm to 7:00 am].

Finally, combining the two criteria (amenity & Intrusiveness), the overall Industrial Noise Policy noise limits for general operational noise emission from the Intermodal Precinct, when applied at the "Glenfield Farm" residence location, becomes:

Daytime $L_{Aeq,15min}$ noise limit	[7:00 am to 6:00 pm]	40 dB(A)
Evening $L_{Aeq,15min}$ noise limit	[6:00 pm to 10:00 pm]	41 dB(A)
Night-time $L_{Aeq,15min}$ noise limit	[10:00 pm to 7:00 am]	38 dB(A)

Both Receiver R6 location and "Glenfield Farm" appear to be at a similar distance from the edge of the Intermodal Precinct, although the exposure of reciever location R6 to the Precinct is not provided.

Criteria – Sleep Disturbance

The EPA's *Noise Guide for Local Government* ("NGLG") indicates a potential for "sleep disturbance" where an intruding sound exceeds the "background" by more than 15 dB(A), where the intruding sound is measured in terms of $L_{A01,1min}$ (the level exceeded for 1% of the specified measurement period of 1 minute), or L_{Amax} level, outside a bedroom window.

> *"Sleep disturbance" is likely to occur if the external L_{Amax} noise level at "Glenfield Farm" (3 metres or more from an exposed facade) exceeds 48 dB(A).*

The NSW *Interim Construction Noise Guideline* references the NSW *Environmental Criteria for Road Traffic Noise* ("the ECRTN") for "sleep disturbance" criteria. This document indicates "sleep arousal" occurring where internal L_{Amax} noise levels inside a bedroom exceed 50 to 55 dB(A).

> Caution needs to be applied in using this latter criterion as it applies to a noise source of relatively constant output that approach the receiver, pass the receiver, and then move away from the receiver.

Criteria – Construction Noise

The NSW *Interim Construction Noise Guideline* has a number of requirements based on construction noise emissions.

> "Recommended standard hours for construction work" are 7:00 am to 6:00 pm (Monday to Friday) 8:00 am to 1:00 pm (Saturday). Outside of these times, strong justification is required.
>
> The guideline contains "noise management levels" (NML) that are written in terms of $L_{Aeq,15min}$ noise levels and the use of $L_{Aeq,15min}$ noise levels appears to contain an assumption that all of the construction noise sources (contributing to the $L_{Aeq,15min}$ noise level) are relatively continuous, without sharp variations in noise level.
>
> Where a particular NML is exceeded certain actions are required.

The NSW *Interim Construction Noise Guideline* has two "noise management levels" [NML}.

> Up to an $L_{Aeq,15min}$ noise levels of "RBL + 10 dB", no special measures are required.
>
> Above $L_{Aeq,15min}$ noise level of "RBL + 10 dB", but less than an $L_{Aeq,15min}$ noise level of 75 dB(A), "the proponent should apply all feasible and reasonable work practices to meet the noise affected level".
>
> Above $L_{Aeq,15min}$ noise level of "RBL + 10 dB", but less than an $L_{Aeq,15min}$ noise level of 75 dB(A), "the proponent should inform all potentially affected residents of the nature of the work, the expected noise levels and duration, as well as contact details".
>
> Above an $L_{Aeq,15min}$ noise level of 75 dB(A), "the relevant authority may require respite periods by restricting the hours that very noisy activities can occur".

Outside "recommended standard hours for construction work", the first "noise management level" is "RBL + 5 dB".

> There is potential that rail construction works will occur outside "recommended standard hours for construction work".
>
> *With regard to the Interim Construction Noise Guideline, at "Glenfield Farm", the **evening** "noise management level" would be about 41 dB(A) [6:00 pm to 10:00 pm], and the **night time** about 38 dB(A) [10:00 pm to 7:00 am] if work is required "out of hours".*

The predicted $L_{Aeq,15min}$ construction noise levels **to the suburb of Casula** are given as 38 dB(A) to 52 dB(A).

It is not made clear whether the predicted construction noise levels are predicted to the eastern side of the ridgeline where "Glenfield Farm" is located, or to the western side of the ridgeline where suburban housing would be partially shielded by the barrier effect of the ridgeline and the noise levels significantly lower.

The use of the $L_{Aeq,15min}$ noise descriptor moderated short, sharp sound, which could cause "sleep disturbance", if work is carried out at night.

Noise Modelling

The noise predictions are made for two (2) meteorological conditions, based on Pasquil Stability Criteria for "neutral" conditions and for "adverse" conditions.

The first is where sound propagates spherically and is not distorted by vertical temperature, pressure, or wind speed profiles in the atmosphere. In the second, the vertical profiles distort the spherical spreading returning more sound to ground level.

The daytime conditions are described as having D Class Pasquil Stability with no wind, and the evening & night time conditions are described as F Class Pasquil Stability with temperature inversion of 3 degrees per 100 metres.

In winter, the night time "black body" radiation of ground heat (accumulated during the day) creates a chilled layer close to the ground. This chilled surface layer flow downhill following river valleys, such as the Georges River valley.

How deep and how intense the temperature inversion effect (due to local drainage flows) can be very site specific. These temperature inversion layers tend to develop after midnight can be from a few metres deep to tens of metres deep, and can persist until mid-morning or later when surface heating breaks up the layer.

The noise predictions under the "Adverse" conditions are the more important impacts where noise propagation is across distances greater than a few hundred metres.

The noise models usually have the ability to provide predictions to specific locations, as well as providing maps of equal noise level.

There is no explanation as to why both types of output were not provided for both the operational noise predictions and for the "worst case" construction noise predictions.

Scenarios – Construction (General)

The project has been divided into a number of scenarios with the noise level predictions provided as a range of values for differing activities.

The scenarios assessed were Scenario 1, Scenario 2A, Scenario 2B, and Scenario 3.

Scenario 1 (construction) is construction of the initial 250,000 TEU per annum IMEX Terminal and the 100,000 sq.m warehousing at the project site.

Scenario 2A (construction) is construction of the additional 250,000 TEU per annum capacity at the IMEX Terminal.

Scenario 2B (construction) is construction of the additional 250,000 TEU per annum capacity at the IMEX Terminal and 150,000 sq.m warehousing at the project site.

The predicted construction noise levels are provided to broad suburban area, but not to specific locations.

For the **suburb of Casula**, the predicted $L_{Aeq,15min}$ noise "construction" noise levels were given as follows:

For "piling works", up to 55 dB(A) in Scenario 1, up to 51 dB(A) in Scenario 2A, and up to 53 dB(A) in Scenario 2B.

For "excavation", up to 52 dB(A) in Scenario 1, up to 49 dB(A) in Scenario 2A, and up to 50 dB(A) in Scenario 2B.

For "compaction", up to 52 dB(A) in Scenario 1, up to 49 dB(A) in Scenario 2A, and up to 50 dB(A) in Scenario 2B.

For "on site heavy vehicles", up to 44 dB(A) in Scenario 1, up to 40 dB(A) in Scenario 2A, up to 42 dB(A) Scenario 2B.

For "concreting", up to 49 dB(A) in Scenario 1, up to 46 dB(A) in Scenario 2A, and up to 47 dB(A) in Scenario 2B.

From my own observations, the suburban residences are on the western side of Leacocks Lane are on the western side of a ridgeline, whereas the "Glenfield Farm" residence is on the eastern side of that ridgeline and thus fully exposed to noise emissions from the Precinct.

The question has to be asked, how much barrier effect was introduced by the ridgeline along Leacocks Lane when calculating to Casula?, and how much higher would the noise levels be at "Glenfield Farm"?

"Glenfield Farm" is on the fully exposed eastern side of the ridgeline, fully exposed to the construction noise from the rail connection and from the Precinct?

While "piling works" is predicted in terms of 15-minute L_{Aeq} values, this is an operation that can have a "work cycle" that significantly shorter than the 15-minute over which the L_{Aeq} is energy averaged.

In Table 9 of the report, under construction activities, "piling works" are described as "for rail access between project site and the SSFL". The predicted $L_{Aeq,15min}$ noise level to Casula is only up to 52 dB(A).

In Table 9, the "piling" equipment is described as a "vibratory piling rig" with a sound power level of 121 dB(A). Vibratory piling rigs are typically used in compliant soil, not in solid rock.

The question has to be asked, how much louder will "piling works" be, if rock is encountered, and alternate methods need to be used?

Scenarios – Operational

Again the project is divided into a number of scenarios with the noise levels for operational noise, but this time to specific receivers.

The nearest receiver location approximating to the residence at "Glenfield Farm" is Receiver R6, which is described as "Leacocks Lane, Casula".

Operational noise levels are provided for Scenario 2A, Scenario 2B, and Scenario 3 under "neutral" and "adverse" meteorological conditions to receiver location R6.

The predicted "operational" noise levels are as follows:

In Scenario 2A, the predicted "unmitigated" noise level at Receiver R6 is 33 dB(A) ["neutral" conditions] and 35 dB(A) ["adverse" conditions].

In Scenario 2B, the predicted "unmitigated" noise level at Receiver R6 is 34 dB(A) ["neutral" conditions] and 35 dB(A) ["adverse" conditions].

In Scenario 3, the predicted "unmitigated" noise level at Receiver R6 is 36 dB(A) ["neutral" conditions] and 37 dB(A) ["adverse" conditions].

Later in the report, unmitigated **cumulative** "operational" noise impacts are introduced for a range of .scenario, **but this time the predictions are to general suburban areas**.

In Scenario A, the predicted "unmitigated" noise level to the suburb of Casula is 42 dB(A) ["neutral" conditions], and 44 dB(A) ["adverse" conditions].

In Scenario B, the predicted "unmitigated" noise level to the suburb of Casula is 43 dB(A) ["neutral" conditions], and 45 dB(A) ["adverse" conditions].

In Scenario C1, the predicted "unmitigated" noise level to the suburb of Casula is 40 dB(A) ["neutral" conditions], and 42 dB(A) ["adverse" conditions].

In Scenario C2, the predicted "unmitigated" noise level to the suburb of Casula is 41 dB(A) ["neutral" conditions], and 43 dB(A) ["adverse" conditions].

Under "neutral" conditions, Scenario A through to Scenario C2 exceed the daytime noise limit by zero to 3 dB(A) or more, and the night time noise limit **by 2 dB(A) to 5 dB(A) or more to Casula**.

Under "adverse" conditions, Scenario A through to Scenario C2 exceed the daytime noise limit by 2 dB(A) to 5 dB(A) or more, and the night time noise limit **by 4 dB(A) to 7 dB(A) or more to Casula**.

The Industrial Noise Policy noise limits for general "operational" noise emission at the "Glenfield Farm" residence would be 40 dB(A) between 7:00 am and 6:00 pm (daytime), 41 dB(A) between 6:00 pm and 10:00 pm (evening), and 38 dB(A) between 10:00 pm to 7:00 am (night time).

Again, the question has to be asked, how much barrier effect was introduced by the ridgeline along Leacocks Lane when calculating to Casula?, and "How much higher would the noise levels be at "Glenfield Farm?"

"Glenfield Farm" is on the fully exposed eastern side of the ridgeline, fully exposed to the operational noise from the Precinct?"

Criteria – Rail Noise

According to the SLR Consulting Australia Pty Ltd report (Appendix F of the "*Moorebank Intermodal Terminal - Revised Project Report Noise and Vibration Assessment*" report (27 April 2015) freight movements must be assessed using the NSW *Industrial Noise Policy,* when freight trains movements occur within the Precinct, and freight movements must be assessed using the *Rail Infrastructure Noise Guideline* between the SSFL and the Precinct boundary.

When locomotives and freight wagons are within the boundary of the Precinct, it is dealt with under the *Industrial Noise Policy*.

Under the NSW *Industrial Noise Policy*, (INP) the noise limits are in terms of an $L_{Aeq,15min}$ noise limit of 40 dB(A) [daytime], 41 dB(A) [evening] and 38 dB(A) [night].

As I understand this has already been addressed in the operational noise.

When locomotives and freight wagons are outside of the boundary of the Precinct, it is dealt with under the *Rail Infrastructure Noise Guideline*.

Under the NSW *Rail Infrastructure Noise Guideline*, (RING), the noise limits or "trigger levels" are in terms of a 15-hour $L_{Aeq,15hr}$ noise limit of 65 dB(A) [daytime + evening], and 9-hour $L_{Aeq,9hr}$ noise limit of 60 dB(A) [night], but only if the development increases the existing $L_{Aeq,15hr}$ or $L_{Aeq,9hr}$ by 2 dB (or more).

A second set of "trigger points" are a L_{AFmax} of 80 dB(A) from a new rail line development, or an L_{AFmax} of 85 dB(A) from redevelopment of an existing line.

These latter "trigger points" are of concern in terms of "sleep disturbance" especially where the ability to mitigate noise at a residence is highly restricted.

It appears that the L_{Amax} is referring to the maximum noise output from the locomotive exhaust, where to locomotive is travelling at a uniform speed along a relatively straight track. Under those conditions, an "internal" L_{Amax} noise level of 50 to 55 dB(A) should be acceptable, inside a dwelling.

With those "running" conditions, a standard home could be upgraded to achieve acceptable internal noise levels, but a heritage home, such as the residence at "Glenfield Farm" could not.

For a heritage home, such as the residence on "Glenfield Farm", the external L_{Amax} noise levels would need to be restricted to about 75 dB(A) or less, at night, to avoid "sleep disturbance".

Description of Rail Connection

The Precinct is to be connected to the Southern Sydney Freight Line (SSFL) via a spur line that wraps around the southern end of the Precinct, crosses the Georges River, and then passes up the western side of the Georges River with two (2) branches connecting to the Southern Sydney Freight Line (SSFL).

The northern connection of the spur line to the Southern Sydney Freight Line (SSFL), appears to be about 450 metres to the north-east of the "Glenfield Farm" residence with a curve radius of greater than 300 metres.

The southern connection of the spur line to the Southern Sydney Freight Line (SSFL), appears to be about 245 metres from the "Glenfield Farm" residence. This branch appears to have a curve radius of considerably less than 300 metres, and thus potentially a source of "wheel squeal".

Rail Noise Impacts

The noise impact of rail noise can be calculated to the residence at "Glenfield Farm" by typical Sound Exposure Levels (SEL) for train noise. A Sound Exposure Level (SEL) is a mathematical construct whereby the acoustic energy of a passing noise source is expressed in decibels as the accumulated acoustic energy concentrated to a 1 second period.

The Main South Line is about 220 metres from the "Glenfield Farm" residence.

A recent review of commuter traffic through Casula Station indicates that daytime traffic consists of about 264 commuter trains between 7:00 am and 10:00 pm, and 46 trains between 10:00 pm and 7:00 am.

My own measurements of a 4-carriage commuter train indicate a Sound Exposure Level of 82 dB(A) at 15 metres with a L_{Amax} noise level of 78 dB(A) at 15 metres.

A single 4-carriage commuter train within a 15 hour "daytime" period would a component $L_{Aeq,15hr}$ contribution of only about 23.5 dB(A).

A single 4-carriage commuter train within a 9 hour "night time" period would a component $L_{Aeq,15hr}$ contribution of only about 25.7 dB(A).

These noise levels need to be logarithmically added to account for train numbers.

With 264 commuter trains passing the site between 7:00 am and 10:00 pm, the residence at "Glenfield Farm" would be exposed to a "day time" $L_{Aeq,15hr}$ noise level of 48 dB(A).

With 46 commuter trains passing the site between 10:00 pm and 7:00 am, the residence at "Glenfield Farm" would be exposed to a "night time" $L_{Aeq,9hr}$ noise level of about 42 dB(A).

The L_{Amax} noise levels, both day and night, would be 55 dB(A).

The Southern Sydney Freight Line (SSFL) is 240 metres from the "Glenfield Farm" residence. This also appears to be the point where the southern branch of the spur line attaches to the SSFL.

Each of the "operational" Scenarios indicate a number of "on-site" rail freight movements.

In Scenario 2A, there are 13 during the daytime, 4 in the evening, and 1 in the night time.

In Scenario 2B, there are 19 during the daytime, 6 in the evening, and 15 in the night time.

In Scenario 3, there are 20 during the daytime, 7 in the evening, and 16 in the night time.

The daytime period is 11 hours long, the evening 4 hours long, and the night-time period is 9 hours long.

Scenario 2B indicates a mean value of about 1.7 rail movements per hour (day & night) and Scenario 3 indicates a mean value of about 1.8 rail movements per hour (day & night).

If a rail movement is considered to be movement in one direction only, then that would indicate one to two freight trains per hour entering or leaving the Precinct per hour (if uniformly distributed).

The report has indicative noise levels for locomotives and freight wagons in terms of Sound Exposure Levels (SEL) at 15 metres, and L_{Amax} noise levels at 15 metres.

A Class 82 locomotive is listed as having an SEL of 85 dB(A) at 15 metres at 80 km/h, and an L_{Amax} exhaust noise level of 89 dB(A) at 15 metres.

A single Class 82 locomotive passing the residence within the 15-hour daytime period would contribute a component $L_{Aeq,15hr}$ contribution of only about 25.6 dB(A), and about 27.9 dB(A) within the 9-hour "night time" period, if travelling at 80 km/h.

The external L_{Amax} noise levels could be up to 65 dB(A), as a gradually rising and then falling sound.

A C44Aci locomotive is listed as having an SEL of 88 dB(A) at 15 metres at 80 km/h, and an L_{Amax} exhaust noise level of 92 dB(A) at 15 metres

A single C44Aci locomotive passing the residence within the 15-hour daytime period would contribute a component $L_{Aeq,15hr}$ contribution of only about 28.6 dB(A), and about 30.9 dB(A) within the 9-hour "night time" period, if travelling at 80 km/h.

The external L_{Amax} noise levels could be up to 68 dB(A), as a gradually rising and then falling sound.

A 1 kilometre long row of freight wagons is listed as having an SEL of 100 dB(A) at 15 metres at 80 km/h, and L_{Amax} noise levels of up to 93 dB(A) at 15 metres.

A 1 kilometre long row of freight wagons passing the residence within the 15-hour daytime period would contribute a component $L_{Aeq,15hr}$ contribution of only about 40.6 dB(A), and about 42.9 dB(A) within the 9-hour "night time" period, if travelling at 80 km/h.

The L_{Amax} noise levels could be up to 69 dB(A), consisting of short, sharp percussive sounds.

About two hundred & sixty (260) freight trains in the daytime period (7:00 am to 10:00 pm), and about fifty (50) freight trains during the night time period (10:00 pm to 7:00 am)to exceed the day time & night time $L_{Aeq,T}$ rail noise "trigger levels".

*If noise impacts are **only** based on the "exhaust noise of the locomotives" and the "free rolling noise of the freight wagons", then the rail noise associated with the Intermodal Precinct are acceptable, **but these are not the only noises**.*

"Wheel Squeal"

Noise mitigation measures have been described to reduce construction & operational noise from the Precinct.

These include: the selection of quiet equipment; modification of equipment; the use of alternate "reversing" alarms; and incorporation of noise barriers by building location and barrier construct.

These are all standard noise control measures.

In reference to "wheel squeal" associated with freight wagons, the proposed solution is "oilers".

Despite numerous enquiries, including those directly involved in research into this form of noise control, I have been unable to get any responses, as to the degree of noise reduction that is reliably achieved, nor the long-term guaranteed minimum noise reduction that can be relied upon.

It has been my experience that unless a noise reduction device can be relied on to work with 100% effectiveness, it is not acceptable as a noise reduction strategy.

The southern branch of the spur line where it connects to the Southern Sydney Freight Line appears to have a curve radius of 300 metres or less and thus susceptible to "wheel squeal".

On 19th October 2012, I undertook measurement of "wheel squeal" in Beecroft.

On that occasion, I measured L_{Amax} noise levels of 100 dB(A) to 108 dB(A) at 28.5 metres. This equates to L_{Amax} noise levels of 106 dB(A) to 114 dB(A) at 15 metres.

The predicted L_{Amax} noise level would equate to 81 dB(A) to 89 dB(A) at the residence at "Glenfield Farm", if these measurements were translated to "Glenfield Farm".

Even if the "wheel squeal" were to occur on the other side of the curve, 300 metres further away, the predicted L_{Amax} noise level would equate to 74 dB(A) to 82 dB(A).

Discussion

The residence at "Glenfield Farm" is a heritage listed building dating from 1817 (only 29 years after the arrival of the First Fleet). As a heritage listed building there are severe restrictions on what can be done to this building, if at all, to restricted in noise intrusion.

General Operational Noise Levels

Cumulative external "operational" L_{Aeq} noise levels of 43 dB(A) to 45 dB(A) are predicted to the suburb of Casula for its 24 hour operation.

> *With open windows, the expected internal L_{Aeq} noise levels are expected to be about 7 dB lower than the external L_{Aeq} noise levels.*

At Glenfield Farm", the evening "noise management level" would be about 41 dB(A) [6:00 pm to 10:00 pm], and about 38 dB(A) [10:00 pm to 7:00 am].

> *It is unclear as to whether the predicted "operational" noise levels are to the eastern side of the ridgeline, where "Glenfield Farm" is located, or to the western side of the ridgeline, where suburban housing would be partially shielded by the barrier effect of the ridgeline.*
>
> *It is essential that the cumulative external "operational" L_{Aeq} noise levels to "Glenfield Farm" be clarified, such that the "noise management levels" are achieved to the buildings at "Glenfield Farm".*

Construction Noise Levels

General on-site construct L_{Aeq} noise levels are expected to be up to 55 dB(A) for "piling works", up to 52 dB(A) for "excavation" and "compaction", up to 44 dB(A) for "heavy vehicles on site", and up to 49 dB(A) for "concreting" to the suburb of Casula.

> *Again, it is essential that the construction L_{Aeq} noise levels to "Glenfield Farm" be clarified such that appropriate action is taken.*
>
> *This will be of particular importance during construction of the spur line and its connection to the Southern Sydney Freight Line.*

Sleep Disturbance

"Sleep disturbance" is assessed between 10:00 pm and 7:00 am.

Passing commuter trains are likely to produce L_{Amax} noise levels of up to 55 dB(A). Passing Class 82 locomotives and passing C44Aci locomotives are likely to produce L_{Amax} exhaust noise levels of up to 65 dB(A) and 68 dB(A).

> *Due to nature of rise and fall of these noise sources, if the internal L_{Amax} noise levels can be reduced to 50 to 55 dB(A), then these noise levels would be attenuated to an acceptable internal level.*
>
> *These noise levels would only require windows to be closed to attenuate the noise of freight trains **passing** "Glenfield Farm".*

Freight wagons are likely to produce short, sharp L_{Amax} noise levels of up to 69 dB(A). These noise levels are most likely to occur when the freight trains are slowly entering or leaving the rail spur to the Precinct.

> For this type of noise, "sleep disturbance" has to be assessed relative to the external "background" noise level of 33 dB(A). "Sleep disturbance" is likely to occur if the external L_{Amax} noise level exceeds 48 dB(A).
>
> > *The L_{Amax} noise emissions from the relative motion of freight wagons are likely to exceed the "sleep disturbance" criteria **by up to 21 dB(A)**.*

Based on my own measurements, "wheel squeal" is likely to produce L_{Amax} noise levels of up to 89 dB(A). "Wheel squeal" appears to be tonal noise, with several tones, with sudden onset, and varying considerably in tonal duration and level.

"Wheel squeal" noise levels are likely to exceed the "sleep disturbance" criteria ***by up to 41 dB(A)****.*

Unless "oilers" can be show to be effective 100% of the time and able to provide sufficient mitigation, they should not even be suggested as a noise mitigation measure.

Despite several approaches, professional –to-professional, the researchers have in this area have refused to provide any answers.

Acoustic Predictions

Acoustic prediction relies on the correct placement and description of the noise sources, correct assessment of the acoustic pathway, and correct identification and location of the receivers.

Sources

The sources need to be located at heights relevant to the type of machinery used. Even warehouses needs to be included, based on the internal reverberant sound levels due to internally operating equipment.

In the operational phase & in the construction phase, "continuous" the $L_{Aeq,15min}$ noise sources, the "intermittent" $L_{Aeq,15min}$ noise sources, and L_{Amax} noise levels really need to be assessed separately, depending on the type of noise source being modelled, and on the "character" of the noise source.

While the $L_{Aeq,15min}$ *noise descriptor provides a reasonable approximation of noise sources with relative constant output, it is not appropriate for description of impact noise or intermittent type noises, which are better described by the* L_{Amax} *noise descriptor.*

In the NSW Industrial Noise Policy, "modifying factor corrections" are provided depending on whether a noise is "tonal", has significant "low frequency" components, is "intermittent", or of short or long "duration", to bring assessment of noise impacts into line with the definition of "offensive noise" contained in the NSW "Protection of Environmental Noise Operations Act".

In the construction phase, should rock be encountered during the "piling" or "excavation" operations, the type and level of noise to be expected is likely to be very different from the type and level of noise when soil (only) conditions are assumed.

Similarly with rail noise prediction, the type and level of noise to be expected when freight trains are running at constant speed on straight level track are likely to be very different from the freight trains that are being shunted type, travelling at slow & varying speed on entering or leaving the spur line.

Pathways

The acoustic pathways have to take into account the topography of the area, out to the noise contour line where the predicted noise levels would fall below 30 dB(A), when the acoustic propagation is enhanced under "adverse" meteorological conditions, adjusted for frequency dependent atmospheric attenuation.

The accuracy of any acoustic model will be dependent on the coarseness of the original topographical maps referenced. It is unclear whether the maps used for prediction were 10 metre contours, 5 metre contours, 2 metre contours or even 1 metre contours.

Where there is significant variation in terrain, the courser the original map, the more inaccurate the predicted results, especially where those significant variations occur in close proximity to a receiver point.

Receivers

The predicted noise levels need to be to the upper level window-top heights of surrounding residences,

In previous projects that I have undertaken, I have undertaken multiple predictions at multiple heights above ground level, especially where receiving residences are more than just single storey residences.

*Having visited the area of Casula, the residence at "Glenfield Farm" **should** have been identified as a "sensitive receiver" due to its location on the eastern side of the ridge line.*

Adverse Conditions

"Wind profiles" are best left out of large area acoustic modelling.

The inclusion of wind into any noise modelling is **only an approximation**, as actual wind profiles vary considerably depending on surface roughness conditions and also upon the topography of the local area.

Calculation of "adverse" propagation should be restricted to "thermal inversion" modelling conditions. Caution has to be exercised when there is the possibility that local topography induced "drainage flows" may occur during the winter months.

"Drainage-flow" induced "thermal inversions" (of limited depth) can be far more intense than are ever hinted at by the Pasqual Stability" approach.

Barrier Effects

The residences on the western side of Leacocks Lane (Casula) are single and double storey residences on the western side of the ridgeline running along Leacocks Lane.

The residence at "Glenfield Farm" is a double storey residence on the eastern side of the ridgeline, on the edge of an escarpment, fully exposed to the Precinct.

Whereas residences on the western side of Leacocks Lane would benefit from the barrier effect of the ridgeline, the residence at "Glenfield Farm" is fully exposed with no ridgeline barrier effect.

The residence at "Glenfield Farm" is potentially the most sensitive receiver location in Casula, and potentially, due to its age & heritage status, the least able to the least able counter any noise impacts.

Noise Prediction Presentation

The mode of presenting acoustic impacts varies even within this report.

Operational noise predictions are provided as 1) predicted noise propagation to specific receivers, across to 2) a very "broad-brush" approach of predicting noise propagation to entire suburbs.

In the early stages, when the site was just the Moorebank Intermodal Terminal, prediction to individual receiver locations was used, although "Glenfield Farm" was not one of those.

When the effect of the overall Intermodal Precinct is considered, the combined cumulative results are presented as a wide range of predicted values to entire suburban areas.

It is not indicated where the lower levels will occur, nor where the higher levels will occur. While it can be expected that the higher levels will occur closer to the Precinct, it does not indicate where along the nearer edge, these higher levels will occur, nor even if, in the case of Casula, whether the residence at "Glenfield Farm" was even considered in the predictions.

Concerns

The design of the Intermodal Precinct appears to be a "work in progress" leaving many questions unanswered.

On major projects that I have been associated with before, the noise problems have had to be addressed before construction commences, rather than addressed "on the run".

It would appear that "Glenfield Farm", as a very sensitive location, that has been ignored in any of the acoustic assessments to date. Despite its very exposed location, it was not included into the array of receivers addressed in the "operational noise".

> I would suggest that because of its unique location, that the $L_{Aeq,15min}$ impacts on the residence should be provided. This only requires the inclusion of one additional receiver point into the already prepared acoustic models. In my experience with acoustic modelling, this is a quick & easy exercise, provided the terrain models are of sufficient accuracy.
>
> Given its very exposed location, I would suggest that this would be a critical "compliance location" for both operational and construction noise mitigation.

I am concerned at the potential noise impacts of "piling works" on the residents at "Glenfield Farm".

> While "vibratory piling" is considered a much quieter method of "piling", it presupposes that all piling will occur in compliant soil.
>
> Should rock be encountered, it is unlikely that this quieter method of "piling" will continue to be used.
>
> I would suggest that given the nature of "piling operations" that the "modifying factor corrections" contained within the NSW Industrial Noise Policy be considered when assessing its impact.

I am concerned at the noise emissions of freight wagons entering and leaving the precinct.

> While the northern branch of the spur line appears to have a large radius with points well away from "Glenfield Farm", the southern branch appears to have tight radius and appears to connect very close to "Glenfield Farm".
>
> There is likely to be considerable noise as the freight wagons pass over the sets of points connecting the Precinct access spur line to the Southern Sydney Freight line. There is also likely to be considerable noise as the wagons adjust to changes in speed, as the locomotives brake and accelerate.
>
> These shunting noises do not appear to have been assressed.

The connection to the Southern Sydney Freight line is likely to take place over several nights, and would be in close proximity to the residence at "Glenfield Farm".

> The impact of construction on the "Glenfield Farm" residence during that connection exercise will need to be carefully assessed.

I am very concerned at the potential for "wheel squeal" to occur on the southern branch of the spur line, where the spur line connects to the Southern Sydney Freight Line.

> I have heard "brake squeal" and I have heard the "squeal" associated with misalignment of freight wagon wheels, both of which are amenable to resolution by maintenance practices, but the noise of "wheel squeal" associated with locomotives pulling freight wagons around tight curves appears to remain a major and continuing rail noise problem, that has not been adequately addressed despite decades of ongoing research.

I am concerned that "oilers" are put forward as the solution for "wheel squeal".

> When I have approached researchers in this area, seeking to discover the efficacy of "oilers" as a solution to this problem, those researchers have refused to provide any information. This would indicate to me that "oilers" are still not a proven or reliable mitigation measure.

I would strongly suggest that until such time as their reliability and effectiveness is proven, that other means of noise mitigation be confirmed.

The presence of "Glenfield Farm", as a very sensitive location with an occupied private residence, appears to have been completely overlooked by the reports.

The residence and grounds of "Glenfield Farm" must be brought into consideration, for "construction" noise impact, for the "operational" noise impacts, and in particular for the "rail movement" noise impacts that the Precinct will introduce, on and close to the Southern Sydney Freight Line.

The "Glenfield Farm" site is not amenable to "quick fix" solutions due to its age and due to the topography of the site. The residence is not amenable to structural changes and the site is on the edge of the escarpment overlooking, both the rail connections and the Intermodal Precinct.

How such an exposed and sensitive location could have been overlooked in the acoustic assessments is beyond belief.

Brian Marston

Principal Consultant - BGMA Pty Ltd

Affiliations & Qualifications

Full member	Institution of Engineers Australia	(IEAust)	
	Chartered Professional Engineer	(CPEng)	since 1986
Full member	Australian Acoustical Society	(AAS)	since 1988
Full member	National Council of Acoustical Consultants	(NCAC)	since 1999
Full Member	Acoustical Society of America	(ASA)	since 2007