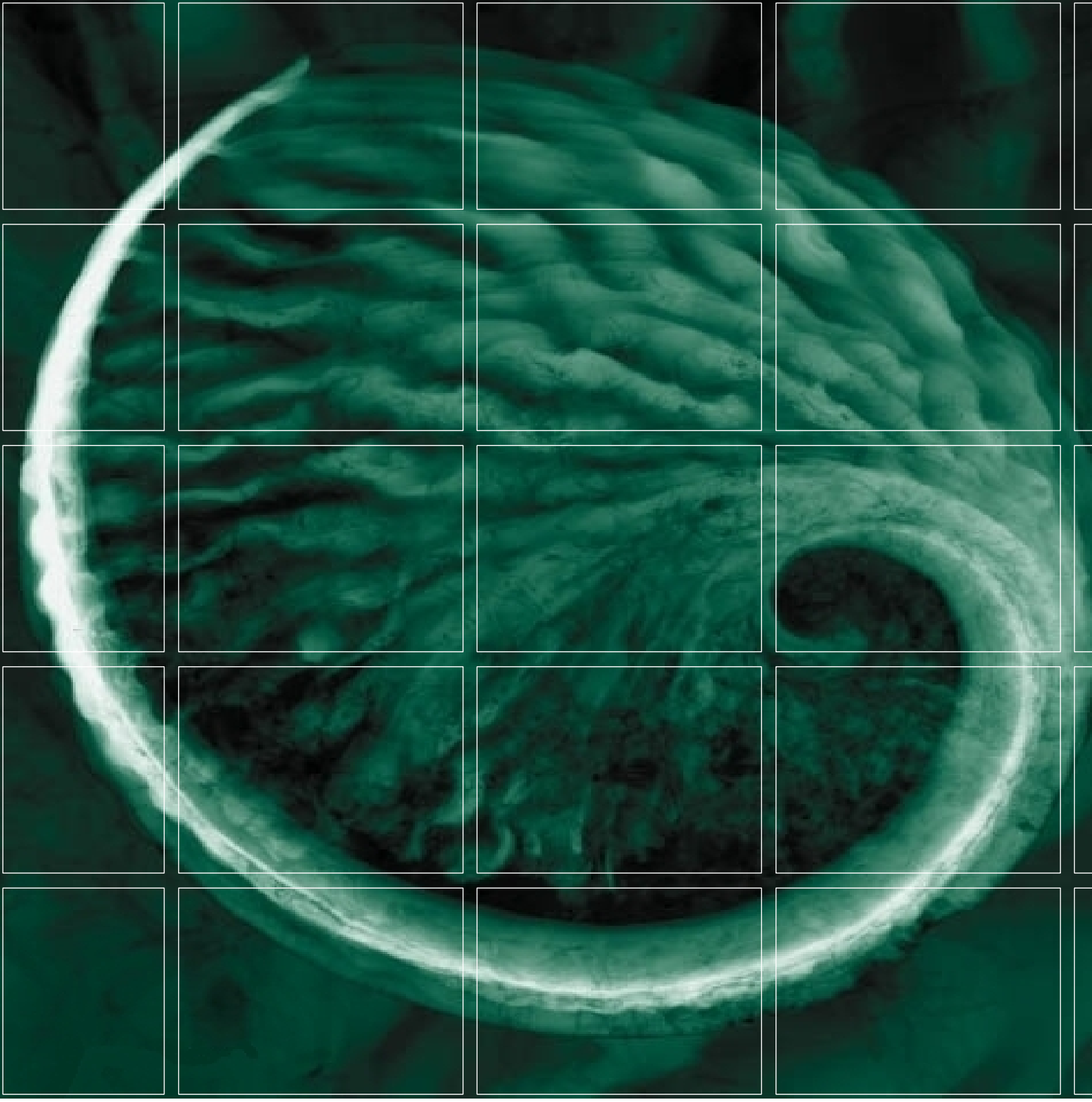

Riverside at Tea Gardens

Existing Industrial Area Noise Impact Assessment

Crighton Property Pty Ltd

February 2011
0043707RP02

www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

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Date:	*1 February, 2011*

Environmental Resources Management Australia Pty Ltd Quality System

Riverside at Tea Gardens

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FINAL REPORT

Crighton Properties

Riverside at Tea Gardens

Existing Industrial Area Noise Impact Assessment

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Reference: 0043707RP02

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Crighton Properties Pty Ltd (Crighton Properties) to undertake a Noise Impact Assessment of the proposed 'Riverside at Tea Gardens' residential and tourist development, located on Myall Street in Tea Gardens (NSW). The Noise Impact Assessment has been prepared in response to the Director General Requirements (DGR's), specifically Section 5.3 which requires 'a Noise Impact Assessment in accordance with the NSW Environmental Protection Authority's 'Industrial Noise Policy' (2000) to be undertaken. This assessment should identify the likely impact of the existing industrial area upon the proposed residential development and if necessary include methods for noise attenuation'. This report presents the results and findings of the Noise Impact Assessment which quantifies the likely worst-case noise impact of the existing industrial area upon the proposed Riverside at Tea Gardens residential and tourist development and if necessary includes methods for noise attenuation.

Conservatively ERM has assessed potential noise impacts during the standard daytime evening and night time (out-of-hours) assessment periods. ERM's Noise Impact Assessment has been completed with reference to, and in accordance with the following documents, acoustics standards and guidelines:

- *Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) NSW Industrial Noise Policy, January 2000;*

- *Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) – NSW Environmental Criteria for Road Traffic Noise (ECRTN), May 1999;*

- *Standards Australia AS1055.1-1997™ - Description and Measurement of Environmental Noise; Parts 1, 2 and 3;*

- *Standards Australia AS IEC 61672.1-2004™ - Electro Acoustics - Sound Level Meters Specifications; and*

- *Riverside Master Plan (.pdf) dated October 2010 as provided by Crighton Properties.*

Calculated noise levels ($L_{Aeq, 15\ min}$) are below the Project Specific Noise Levels (PSNL) at all Noise Assessment Locations (NAL) under calm and adverse meteorological conditions, during all assessment periods (daytime, evening and night time). Calculated noise levels (L_{AMax}) are below the recommended DECCW ECRTN sleep disturbance noise goals at the nearest residential receivers.

Noise associated the existing Tea Gardens Industrial Estate will therefore not result in adverse noise impacts on surrounding residential receivers within the proposed Riverside at Tea Gardens development ERM therefore makes no further recommendation in regards to any methods for noise attenuation.

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Crighton Properties Pty Ltd (Crighton Properties) to undertake a Noise Impact Assessment of the proposed 'Riverside at Tea Gardens' residential and tourist development, located on Myall Street in Tea Gardens (NSW).

This document has been prepared in response to the Director General Requirements (DGR's), specifically *DGR 5.3* which states '*a Noise Impact Assessment in accordance with the NSW Environmental Protection Authority's 'Industrial Noise Policy' (2000) should be completed. This assessment should identify the likely impact of the existing industrial area upon the proposed residential development, and if necessary include methods for noise attenuation*'.

This report presents the results and findings of the Noise Impact Assessment. It quantifies the likely worst-case noise impact of the existing industrial area upon the proposed Riverside at Tea Gardens residential and tourist development and where necessary, recommends methods for noise attenuation.

1.1 SITE UNDERSTANDING

The 'Riverside at Tea Gardens' site (the site) incorporates Lots 10 and 34 DP 270100 and Part Lot 1 DP 270100, and is approximately 222.5 hectares in area as illustrated on *Figure 1.1*. The site is bounded by Myall River to the east and Myall Street to the west. The Shearwater Residential Estate lies to the north of the site and residential development of Tea Gardens is to the south. The site has an approximate one kilometre frontage to Myall Street and two kilometre frontage to the Myall River.

State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14) applies to wetlands within the eastern portion of the site adjacent to the Myall River, the remainder of the site is zoned for urban development. Part of the Riverside Estate has previously been developed and comprises a range of residential, retail/commercial, recreation and tourist development including 261 residential lots, a 3600m^2 shopping centre and supermarket as well as a medical centre, service station and monthly markets.

Directly west of the site and adjacent the north-western site boundary (the approximate one kilometre frontage to Myall Street) is the 'Tea Garden's Industrial Estate', the potential noise impact of this existing industrial area on the proposed residential and tourist development is the focus of this Noise Impact Assessment.

Figure 1.1 visually presents the site, the existing industrial estate and other relevant items referenced throughout this assessment.

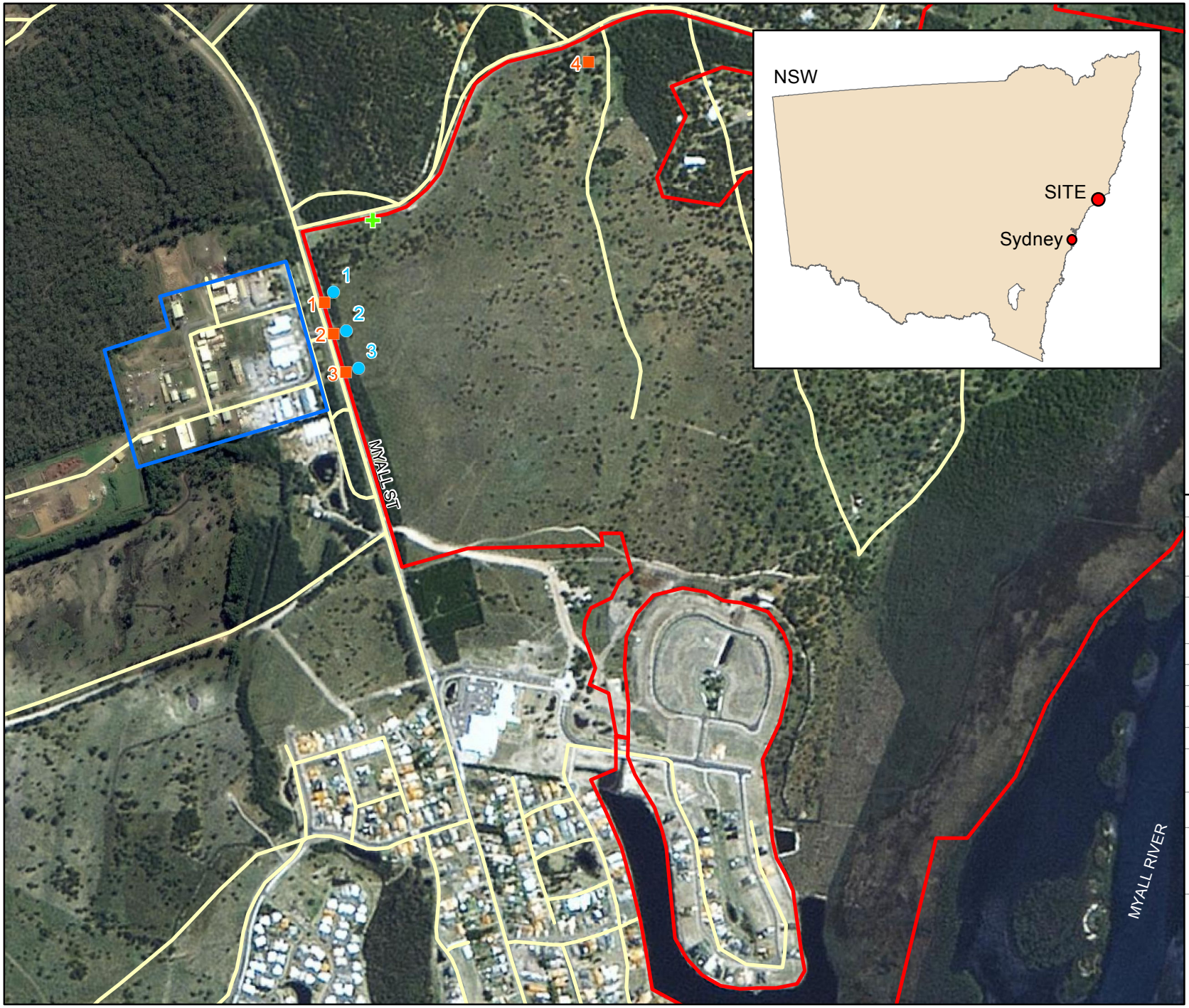

Figure 1.1

Locality Plan

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G001_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 70 140 210m

Environmental Resources Management Australia Pty Ltd

Brisbane, Canberra, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

1.2 ACOUSTIC GLOSSARY

Environmental noise levels generated by sources such as industry, construction and road traffic are commonly expressed in dB(A). The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics.

1.2.1 Noise Descriptors

The following descriptors are commonly used when assessing noise and may be referred to throughout this acoustic assessment.

- dB(A) - Noise level measurement units are decibels (dB). The 'A' weighting indicates that a filter has been applied to the measured results to mimic the human response to noise;

- L_{Aeq} - This level represents the equivalent or "average" noise energy during a measurement period. The $L_{Aeq,\ 15\ minute}$ noise descriptor simply refers to the L_{eq} noise level over a 15-minute period. Indeed, any of the noise descriptors described below may be defined in this way, with an accompanying time period (e.g. $L_{A10,\ 15\ minute}$) as required;

- L_{Amax} - The absolute maximum noise level in a measured time period;

- L_{A90} - The noise level exceeded for ninety (90) per cent of the time and is approximately the average of the minimum noise levels. The L90 level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes;

- Lw – 'Sound Power Level'. This is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment;

- Lp – 'Sound Pressure Level'. The level of sound pressure; expressed in decibels, as measured by a standard sound level meter with a microphone. This differs from Lw in that this is the received sound as opposed to the sound 'intensity' and is influenced by the environment;

- ABL – 'Assessment Background Level'. This is defined in the *Industrial Noise Policy* as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels; and

- RBL – 'Rating Background Level'. This is an overall single figure background level representing each assessment period over the whole monitoring period as defined in the *Industrial Noise Policy*. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- differences in noise levels of less than approximately 2 dB(A) are generally imperceptible;
- differences in noise levels of around 5 dB(A) are considered to be significant; and
- differences in noise levels of around 10 dB(A) are generally perceived to be a doubling (or halving) of the perceived loudness of the noise.

1.3 ASSESSMENT METHODOLOGY

This section provides a summary of the acoustic methodologies adopted to accurately quantify and assess noise emissions associated with the Tea Gardens Industrial Estate in accordance with *DGR 5.3*.

1.3.1 Standards and Guidelines

ERM's Noise Impact Assessment has been completed with reference to, and in accordance with the following documents, noise standards and guidelines:

- Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) NSW *Industrial Noise Policy*, January 2000;
- Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) – NSW *Environmental Criteria for Road Traffic Noise* (ECRTN), May 1999;
- Standards Australia AS1055.1-1997™ - *Description and Measurement of Environmental Noise; Parts 1, 2 and 3;*
- Standards Australia AS IEC 61672.1-2004™ - *Electro Acoustics - Sound Level Meters Specifications*; and
- Riverside Master Plan (.pdf), dated October 2010 as provided by Crighton Properties.

1.3.2 Noise Assessment Locations

Based on ERM's review of aerial photos, observations made whilst on site and in accordance with the relevant DECCW noise guidelines (*Industrial Noise Policy* and *ECRTN*) the closest and/or potentially most affected residential receiver locations in proximity of the Tea Gardens Industrial Estate have been identified.

These locations will be adopted as the project specific Noise Assessment Locations (NAL) and are detailed below in *Table 1.1*, and are visually presented on *Figure 1.1.*

Table 1.1 Noise Assessment Locations (NAL)

NAL[3]	Description	GPS (UTM)	
		Easting	Northing
1	The closest and/or potentially most affected residential receiver locations in proximity to the Tea Gardens Industrial Estate. All located at the north-western extent of the site.	56H 419992	6387793
2		56H 420017	6387718
3		56H 420042	6387645

1. *Based on ERM's review of aerial photos and observations made whilst on site;*
2. *In accordance with the Industrial Noise Policy these NAL were determined as the most-affected points on or within the residential property boundary – or, where this was more than 30 m from the residence, at the most-affected point within 30 m of the residence; and*
3. *Refer to* ***Figure 1.1 for a visual presentation of these locations.***

2 QUANTIFYING INDUSTRIAL NOISE LEVELS

This section presents an overview of the acoustic methodology adopted in order to quantify noise levels and determine any potential noise impacts from the Tea Gardens Industrial Estate on the site.

2.1 OPERATING HOURS - TEA GARDENS INDUSTRIAL ESTATE

ERM notes that operations at the industrial area would typically occur during the daytime assessment period (7am to 6pm) only. However, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the *Industrial Noise Policy* and *ECRTN*.

2.2 OPERATOR ATTENDED ENVIRONMENTAL NOISE MEASUREMENTS

During the daytime assessment period (7am to 6pm) and whilst the Tea Gardens Industrial Estate was operating under normal conditions[1] a series of operator attended environmental noise measurements were completed in order to quantify the existing noise levels at each of the NALs, or the closest accessible point to each NAL.

2.3 NOISE MODELLING

During operator attended environmental noise measurements, noise levels from general operations were typically inaudible, therefore noise modelling was completed in order to more accurately quantify noise impacts potentially associated with the Tea Gardens Industrial Estate.

Brüel & Kjær's Predictor 7810 (Version 7.10) noise modelling software package has been used to calculate noise in accordance with the *ISO 9613.1* industry noise propagation algorithms (international method for general purpose, 1/1 octaves). The Predictor software package allows topographic details to be combined with ground regions, water, grass, significant building structures etc and project specific NALs to create a detailed and accurate representation of the site and surrounding area.

[1] Based on ERM observations made whilst on site, 24 November 2010

2.3.1 Noise Modelling Scenarios

Noise modelling has been undertaken for a range of noise emission scenarios, considered to be representative of worst-case noise level contributions at each of the NALs. These noise scenarios are based on measured noise levels noted during operator attended environmental noise measurements. Noise modelling considers standard daytime and out-of-hours (evening and night time) assessment periods[2]. The following worst-case likely noise scenarios were modelled:

- **Noise Scenario 1 –** Standard operations under calm meteorological conditions;
- **Noise Scenario 2 –** Standard operations under adverse meteorological conditions;
- **Noise Scenario 3 –** Out-of-hours operations under calm meteorological conditions;
- **Noise Scenario 4 –** Out-of-hours operations under adverse meteorological conditions; and
- **Noise Scenario 5 –** Sleep disturbance (night time only).

[2] In accordance with the *Industrial Noise Policy* the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods.

3 EXISTING LOCAL AREA ENVIRONMENT

This section describes the measured existing ambient and background noise levels of the area (based on attended and unattended measurements), used in deriving the project specific noise criteria, in accordance with the *Industrial Noise Policy*.

This section also presents the results of operator attended noise measurements which were completed in order to

- quantify the Tea Gardens Industrial Estate noise contribution;
- generate the project specific noise model; and
- to determine potential noise impact, if any.

This section also describes the measured and assumed existing meteorological conditions of the area, which have been adopted as part of the noise modelling process.

3.1 ENVIRONMENTAL NOISE LOGGING

A key element in assessing environmental noise impacts is to quantify the existing ambient and background noise environment at or near to the closest and/or potentially most affected noise sensitive receiver locations.

Unattended environmental noise logging and operator attended environmental noise measurements were completed in accordance with the short-term methodology described in *Section 3 - Determining existing noise levels* of the *Industrial Noise Policy*[3][4].

Environmental noise logging was undertaken on 24 November 2010 during the daytime period for a period of approximately 2 hours at the Environmental Noise Logging Location (ENL), as described in *Table* 3.1 and illustrated on *Figure 1.1*. Industrial noise associated with the Tea Gardens Industrial Estate was inaudible at this location, masked by ambient noise emissions.

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[3] This methodology has been adopted based on project discussions between Crighton Properties and ERM which concluded that the site is considered a low risk development

[4] This methodology in conjunction with operator attended environmental noise measurements, and the '*Estimated Average Background A-weighted sound pressure levels (LA90, T) for different areas containing residences in Australia*' from AS1055.3 - 1997™ has been adopted in order to quantify the existing noise environment of the area, and to establish the Rating Background Level (RBL) parameters for the daytime, evening and night time assessment periods.

Table 3.1 Environmental Noise Logging Location

ID	Description	GPS (UTM)	
		Easting	Northing
ENL1	Continuous unattended noise logging measurement location. The device was installed near the northern boundary of the site, approximately 140m from Myall Street and 210m from the nearest point of the Tea Gardens Industrial Estate.	56H 420067	6387934

3.1.1 Environmental Noise Logging Instrumentation

The measurement instrumentation used in this assessment complied in general accordance with the requirements of Standards Australia AS IEC 61672.1-2004™ - *Electro Acoustics - Sound Level Meters Specifications* with current NATA calibration certificates (certification at intervals not exceeding two years at the time of use). The equipment used for this assessment was as follows:

- 1 x ARL 215 Environmental Noise Logger; and
- 1 x Brüel & Kjaer Type 4230 Sound Level Calibrator.

Acoustic measurements were completed in general accordance with Standards Australia AS 1055.1-1997™ *Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

The Brüel & Kjaer sound level calibrator was used to calibrate the noise loggers prior to and after measurement, with no difference in measurement noted.

All data analysis has been completed by an accredited acoustician and member of the Australian Acoustical Society, being at the grade 'Associate Member' or higher.

3.1.2 Environmental Noise Logging Results

Noise level data was continuously recorded at 15 minute intervals throughout the monitoring period. The ABL and RBL were determined for daytime, evening and night time assessment periods, as defined in the *Industrial Noise Policy*. Results of ambient and background noise level measurements are presented in *Table* 3.2.

Noise logging charts (visual presentation of relevant 15-minute noise descriptors) are included in *Annex A*.

Table 3.2 Measured Noise Levels

Date	Time	Measured Noise Levels, dB(A)				
		Leq	L10	L90	Lmin	Lmax
24.11.10	12:30	55	54	43	39	77
	12:45	54	54	42	39	72
	13:00	52	52	43	39	74
	13:15	52	53	43	40	73
	13:30	54	55	45	42	73
	13:45	55	55	45	43	76
	14:00	55	56	44	41	74
	14:15	52	52	45	42	72

1. *The LA90 represents the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level;*
2. *The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period;*
3. *Where the measured LA90 (RBL) is lower than 30 dB(A), a RBL of 30 dB(A) is applied in accordance with the Industrial Noise Policy;*
4. *As per the Industrial Noise Policy application Notes, the LA90 (RBL) for evening must not be greater than the daytime LA90 (RBL), and the night time LA90 (RBL) must not be greater than the evening LA90 (RBL). When this occurs, the LA90 (RBL) is adjusted to the lower value;*
5. *All unattended noise measurements were of 15 minutes duration each; and*
6. *During the installation of the noise logging device the following meteorological conditions were noted. Temperature of approximately 23° Celsius, cloud cover of 2/8 Octas, wind speeds gusting up to but not in excess of 5m/s, average wind speeds of 3 to 4m/s and typically an easterly (45°) wind direction.*

3.2 OPERATOR ATTENDED NOISE MEASUREMENTS

3.2.1 Existing Industrial Noise Levels

In order to quantify the existing industrial noise contribution, during the daytime assessment period (7am to 6pm) on 24 November 2010 and whilst the Tea Gardens Industrial Estate was operating under normal conditions[5] a series of operator attended environmental noise measurements were completed on Myall Street at each of the NALs, or the closest accessible point to each NAL.

Results of these measurements including noted industrial and extraneous noise sources are presented in *Table 3.3*. The measurement locations are as per *Figure 1.1* and as previously described.

[5] Based on ERM observations made whilst on site, 24 November 2010

Table 3.3 Operator Attended Noise Industrial Measurement

Measurement Location			Measured Noise Levels, dB(A)			
	GPS (UTM)					
ID	Easting	Northing	Leq	L90	Lmax	Lmin
OANM 1	56H 419975	6387773	65	45	84	40
OANM 2	56H 419992	6387713	66	45	81	39
OANM 3	56H 420016	6387713	66	46	81	41

1. ***OANM 1*** *noted noise sources include: wind blown vegetation (40 to 43 dB), animal noises (~43 dB), car-pass-by's on Myall Road (65 to 75 dB), vehicles entering and exiting the Tea Gardens Industrial Estate (x 14 at 42 to 55 dB), grinding (47 dB for approximately 15 seconds), reverse beeper (<45 dB for approximately 30 seconds) and general industrial noise e.g. air conditioning units was inaudible;*
2. ***OANM 2*** *noted noise sources include: wind blown vegetation (41 to 42 dB), animal noises (41 to 42 dB), distant traffic noise (43 to 46 dB), operator noise (55 to 65 dB for <25 seconds), car-pass-by's on Myall Street (70 to 80 dB), metal on metal contact (49 dB for approximately 3 seconds), vehicles entering and exiting the Tea Gardens Industrial Estate (x 29 at 55 to 70 dB) and general industrial noise e.g. air conditioning units was inaudible;*
3. ***OANM 3*** *noted noise sources include: wind blown vegetation (42 to 43 dB), animal noises (42 to 43 dB), car-pass-by's on Myall Street (65 to75 dB), vehicles entering and exiting the Tea Gardens Industrial Estate (x 12 at 45 to 55 dB) and general industrial noise e.g. air conditioning units was inaudible;*
4. *All operator attended noise measurements were of 15 minutes duration; and*
5. *During OANM1 to OANM 3 the following meteorological conditions were noted. Temperature of approximately 27° Celsius, cloud cover of 3/8 Octas, wind speeds gusting up to but not in excess of 3m/s, average wind speeds of between 1 and 4m/s and typically an easterly (45°) wind direction.*

Noted Noise Emission Sources

General and/or constant noise emissions from the existing industrial estate were inaudible for the duration of the operator attended measurements. Noted noise emission sources were more associated with intermittent noise sources such as vehicles entering and exiting the industrial area, reverse beepers, metal on metal contact and grinding. ERM has considered the modifying factors outlined in *Section 4 – 'Modifying Factor' Adjustments* of the *Industrial Noise Policy*. The correction factor for intermittent noise sources (+ 5 dB) is subjectively assessed, applied when noise levels vary by more than 5 dB and adjustments are to be only applied during the night time period. Based on ERM observations made during the attended noise measurements and review of typical industrial area operations, ERM has not applied the modifying factors outlined in *Section 4 – 'Modifying Factor' Adjustments* as the 5 dB noise level variation was not clearly determinable.

Noise impacts potentially associated with transient or impulsive noise emissions have been assessed in accordance with the sleep disturbance noise criteria outlined in *Section 4.2* of this report.

3.2.2 *Existing Ambient and Background Noise Levels*

Additionally an operator attended environmental noise measurement was completed in order to better understand the existing ambient and background noise environment and to validate the unattended noise logging data. This additional measurement was completed at a location considered to be acoustically different to that of the selected noise logging location e.g. road traffic noise was only just audible at this location.

Industrial noise associated with the Tea Gardens Industrial Estate was inaudible at this location. The measurement location is visually presented in *Figure 1.1* and as described in *Table 3.3*.

Results of this measurement, including all noted extraneous noise sources are presented in *Table 3.4*.

Table 3.4 Operator Attended Noise Environmental Measurement

Measurement Location			Measured Noise Levels, dB(A)			
	GPS (UTM)					
ID	Easting	Northing	Leq	L90	Lmax	Lmin
OANM 4	56H 420491	6388243	50	45	63	43

1. *OANM 4 noted extraneous noise sources include: wind blown vegetation (45 to 50 dB), animal noises (43 to 47 dB), car-pass-by's (x 3 at 50 to 53 dB), distant urban hum (<43 dB), distant traffic (<43 dB), operator noise (<20 seconds at 46 to 48 dB) and operator noise (LAMax 63 dB);*
2. *This measurements was of 15 minutes duration; and*
3. *During OANM4 the following meteorological conditions were noted. Temperature of approximately 26° Celsius, cloud cover of 3/8 Octas, wind speeds gusting up to but not in excess of 5m/s, average wind speeds of <4m/s and typically an easterly (45°) wind direction.*

3.3 *EXISTING METEOROLOGICAL ENVIRONMENT*

This section describes the measured and assumed existing meteorological conditions of the area. These conditions have been adopted in each of the modelled noise scenarios in accordance with the *Industrial Noise Policy*.

3.3.1 *Prevailing Wind Conditions*

Wind has the potential to increase noise impacts at a receiver when it is light, stable and blows from the direction of the noise source. As the strength of the wind increases, the noise produced by the wind usually obscures noise from most industrial noise sources.

Section 5 of the *Industrial Noise Policy* requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30 per cent of the time during any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

In order to accurately assess the meteorological conditions of the area an assessment of prevailing winds has been undertaken in accordance with the DECCW 'Noise Enhancement Wind Analysis' (NEWA) program. NEWA has been developed to assist in the analysis of meteorological data to ascertain whether wind speed and direction is required to be considered in a noise assessment, as defined by the *Industrial Noise Policy*.

Suitable half-hourly data (meteorological data file) was sourced from the Bureau of Meteorology (BOM) Station 61078, located at Williamtown (the closest BOM weather station to Tea Gardens, NSW) and included a full year of meteorological observations; recorded between 2 December 2009 and 2 December 2010.

This data was analysed to determine the frequency of occurrence of prevailing winds, so that adverse meteorological conditions could be included in the project specific noise model.

Results of the NEWA analysis are summarised in *Table 3.5*. Based on the NEWA analysis results presented below, a single noise scenario for adverse meteorological conditions was modelled based on the prevailing worst-case 3m/s wind at 270° (source to receiver) for standard daytime and night time (out-of-hours) assessment periods.

It should be noted that lesser impacts would typically be predicted where prevailing wind conditions blow noise away from the receiver (receiver to source wind).

Table 3.5 DECCW Meteorological Analysis Results (BOM Station 61078)

Wind direction (± 90 degrees)	Season	Percentage occurrence of winds - in the speed range > 0.5 and < 3.0 m/s		
		Day	Evening	Night
0	Summer	4.9	7.2	3.9
	Autumn	2.1	4.7	2.3
	Winter	4.3	8.7	1.8
	Spring	6.5	7.7	2
45	Summer	6.5	9.9	7.3
	Autumn	6.4	14	4.8
	Winter	10.6	20.5	8.1
	Spring	10.5	13.1	6.8
90	Summer	4.1	8.9	6.4
	Autumn	5.5	5.9	3.1
	Winter	4.8	10.8	4.1
	Spring	9.2	9.6	5.1
135	Summer	20.4	21.6	13.2
	Autumn	19.4	19.1	17.7
	Winter	17.3	19	17.5
	Spring	15.2	22.3	11.3
180	Summer	18.6	22.2	13.4
	Autumn	16	19.9	14.8
	Winter	19.7	25.1	19.9
	Spring	16.2	20.3	11.6
225	Summer	16	17.3	10.3
	Autumn	14.5	14.8	13.1
	Winter	12.6	20	12.4
	Spring	13.5	15.6	7.2
270	Summer	**37.4**	26	**43.9**
	Autumn	**30.3**	26.7	**40.3**
	Winter	29.7	24.1	**44**
	Spring	22.5	20.6	**39**
315	Summer	8.8	12.7	5.2
	Autumn	2.6	6.8	2.3
	Winter	3.1	6.2	1.1
	Spring	6.5	8	2

1. *In accordance with the DECCW's Industrial Noise Policy, percentage occurrence of winds >30% are considered as 'prevailing'; and*
2. *Prevailing winds are highlighted here in bold.*

3.3.2 Temperature Inversion Conditions

Temperature inversions, most common at night in winter can increase noise levels by focusing sound waves. Temperature inversions are likely to occur infrequently at Tea Gardens. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30 per cent of the total night-time (i.e. the evening and night time periods) during winter, or about two nights per week. Temperature inversions are generally determined based on the occurrence of atmospheric stability classes, with moderate and strong inversions corresponding to atmospheric stability categories, Class-F and Class-G respectively.

ERM has not assessed meteorological data in order to determine prevailing temperature inversions and has instead applied the default *Industrial Noise Policy* atmospheric stability categories for daytime, evening and night time assessment periods. A Class-D temperature inversion condition has been included in the daytime assessment and a Class-F (3° C/100m) temperature inversion condition has been included in the evening and night time assessments. This is a conservative approach as temperature inversion impacts are unlikely to occur for greater than 30 per cent of the time.

3.3.3 Summary of Modelled Meteorological Conditions

The following meteorological conditions have been modelled:

- a 3m/s wind at 270° (source to receiver) for daytime and Class-D temperature inversion condition for the daytime assessment period; and
- a 3m/s wind at 270° (source to receiver) for daytime and Class-F (3° C/100m) temperature inversion condition for the evening and night time out-of-hours assessment periods.

ERM reiterates that in addition, calm meteorological conditions, which represent the majority of the time, have been modelled for standard daytime, evening and night time (out-of-hours) assessment periods.

Operations at the industrial area would typically occur during the daytime assessment period (7am to 6pm) only, however evening and night time periods are assessed to consider any out-of-hours works that may occur.

4 PROJECT SPECIFIC NOISE LEVELS

The DECCW specifies criteria for noise emissions in the *Industrial Noise Policy*. The policy applies to a range of facilities or individual industrial sources e.g. air conditioning equipment. This policy sets out two separate noise criteria designed to ensure developments meet environmental noise objectives. The first criterion accounts for intrusive noise and the second applies to the protection of amenity of particular land uses.

The 'intrusiveness' criterion essentially means that the equivalent continuous sound pressure level (L_{eq}) of a noise source should not be more than 5 dB above the measured LA90 RBL. This criterion typically applies to developments impacting on nearby residential developments, however in this case the criterion applies to potential noise impacts associated with the existing industrial estate impact on the proposed Tea Gardens residential development.

The 'amenity' criterion assessment is based on noise criteria specific to land use and associated activities[6]. The criterion relates to industrial-type noise and does not include rail, road or community noise. Amenity criterion is important in assessment of the cumulative impact of a proposal, where applicable in conjunction with other proposed or existing industrial noise sources.

This assessment has adopted the more stringent of the two *Industrial Noise Policy* criteria.

Further to the operational criteria described above, sleep disturbance noise impacts have been assessed in accordance with the DECCW's *Environmental Criteria for Road Traffic Noise* (*ECRTN*).

4.1 OPERATIONAL NOISE CRITERIA

Based on the measured ambient and background noise levels presented *Section 3* and the '*Estimated Average Background A-weighted sound pressure levels (LA90, T) for different areas containing residences in Australia*' from AS1055.3 - 1997™ the Project Specific Noise Levels (PSNL) have been derived for daytime (as measured), evening and night time (as per AS1055.3 - 1997™) assessment periods.

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[6] ERM has adopted the Recommended (L_{Aeq}) Noise Level for 'Suburban' areas, described in the *Industrial Noise Policy* as '*Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics: decreasing noise levels in the evening period and/or evening ambient noise levels defined by the natural environment and infrequent human activity. This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP*'.

The adopted ambient and background noise levels for daytime, evening and night time assessment periods and the resultant Project Specific Noise Levels (PSNL) are outlined below in *Table 4.1*. This identifies that the night time PSNL of 35 dB(A) as the most stringent criterion. Compliance with this limiting noise criterion indicates that impacts, if any, will be minimal during all assessment periods. This is particularly the case given that out-of-hours works are not expected to occur at the Industrial Estate.

Technical Note:

In determining the L_{A90} RBL for daytime assessment (the main focus of this Noise Impact Assessment), ERM has conservatively adopted the minimum recorded L_{A90} noise level.

The Project Specific Noise Levels (PSNL $L_{Aeq, 15minute}$) are highlighted in green in *Table 4.1.*

Table 4.1 Project Specific Noise Levels

NAL	Period	RBL LA90	Intrusive Criteria (RBL + 5 dB) LAeq, 15 min	Acceptable Amenity Level[2] LAeq, period	Measured Ambient Noise LAeq, period[3]	Amenity Criterion LAeq, Period	PSNL LAeq, 15 min
1	Daytime	42	47	55	No 'period' measurement completed	55	47
	Evening	35	40	45		45	40
	Night	30	35	40		40	35
2	Daytime	42	47	55		55	47
	Evening	35	40	45		45	40
	Night	40	35	40		40	35
3	Daytime	42	47	55		55	47
	Evening	35	40	45		45	40
	Night	40	35	40		40	35

1. *The LA90 represents the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level;*
2. *Where the measured LA90 (RBL) is lower than 30 dB(A), a RBL of 30 dB(A) is applied in accordance with the Industrial Noise Policy; and*
3. *As per the Industrial Noise Policy Application Notes, the LA90 (RBL) for evening must not be greater than the daytime LA90 (RBL), and the night time LA90 (RBL) must not be greater than the evening LA90 (RBL). When this occurs, the LA90 (RBL) is adjusted to the lower value.*

4.2 *SLEEP DISTURBANCE NOISE CRITERIA*[7]

The DECCW has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance have not been defined under the *Industrial Noise Policy*. Furthermore, the application notes of the *Industrial Noise Policy* identify that current guidelines set out in the DECCW's Environmental Noise Control Manual (ENCM) *Section 19-3* are not ideal, and where exceedances occur, the DECCW recommends more detailed analysis be undertaken.

The DECCW's *Environmental Criteria for Road Traffic Noise* (*ECRTN*) provides further guidance on sleep disturbance and states that 'maximum' internal noise levels (L_{AMax}) below 50 to 55 dB(A) are unlikely to cause awakening reactions.

This internal noise criterion equates to an external sleep disturbance criteria of 60 dB(A) to 65 dB(A) assuming 10 dB(A) loss between the residential façade with windows partially open. This is based on a minimum of 20 % window area left open (*Environmental Criteria for Road Traffic Noise*, Environment Protection Authority, 1999).

Therefore, the derived ECTRN sleep disturbance criteria of 60 dB(A) L_{AMax} (preferred) and 65 dB(A) L_{AMax} (maximum) has been adopted for the assessment of potential sleep disturbance impacts at the site.

[7] ERM reiterates that industrial area operations typically occur during the daytime assessment period only however, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the Industrial Noise Policy and ECRTN.

5 NOISE IMPACT ASSESSMENT

This section outlines the results and findings of noise modelling completed using Brüel & Kjær's Predictor 7810 (Version 7.10) noise modelling software package. Results are presented in tabular format and are visually presented in noise contours for each of the five noise scenarios.

5.1 NOISE EMISSION SOURCES

As per the noted noise level contributions and operational periods observed during operator attended noise measurements (refer *Table 3.3*), the following noise emission sources and Sound Power Levels (Lw) have been included in the noise model (see *Tables 5.1 and 5.2*).

Table 5.1 Operational Noise Emission Sources

Description	Source type	Lw Leq, 15min dB(A)	Comments	
			Daytime	Night time
Vehicle Idling	Point source	70	Representative Lw noise level contribution over the 15 minute assessment period. - 100% 'operational' during standard daytime period	Representative Lw noise level contribution over the 15 minute assessment period - 25% 'operational' during evening and night time (out-of-hours) periods
Metal On Metal Contact		64		
Grinding		69		
Reverse Beeper 1		72		
Reverse Beeper 2		69		
Vehicle Idling (x 2)		70		
Vehicles moving on northern side of site entrance	Moving source	97	15 vehicles at 20 km/h - per 15 minute period[3]	7 vehicles at 20 km/h - per 15 minute period
Vehicles moving on southern side of site entrance		97		

1. *In each case the worst-case Leq, 15minute noise level contribution has been adopted;*
2. *Based on typical operational activities for industrial areas during daytime, evening and night time periods, a time weighting factor has been applied to the evening and night time Lw values so that the reduced noise levels that are expected to occur out-of-hours are accurately reflected; and*
3. *Based on the noted peak vehicle flow, entering and exiting the existing industrial estate.*

Table 5.2 ***Sleep Disturbance Noise Emission Sources***

Description	Source type	Lw Leq, 15min dB(A)	Comment	
			Daytime	Night time
Metal on Metal Contact	Point Source	89	Not Applicable	LAMax noise level, representative of potential noise emissions associated with sleep awakenings and disruptions
Reverse Beeper 1		84		
Reverse Beeper 2		84		

5.2 *CALCULATED OPERATIONAL NOISE LEVELS*

Based on the measured Lw values presented in presented *Table 5.1* and the previously described noise scenarios, the worst case calculated operational noise levels for calm and adverse meteorological conditions are presented in *Table 5.3* and

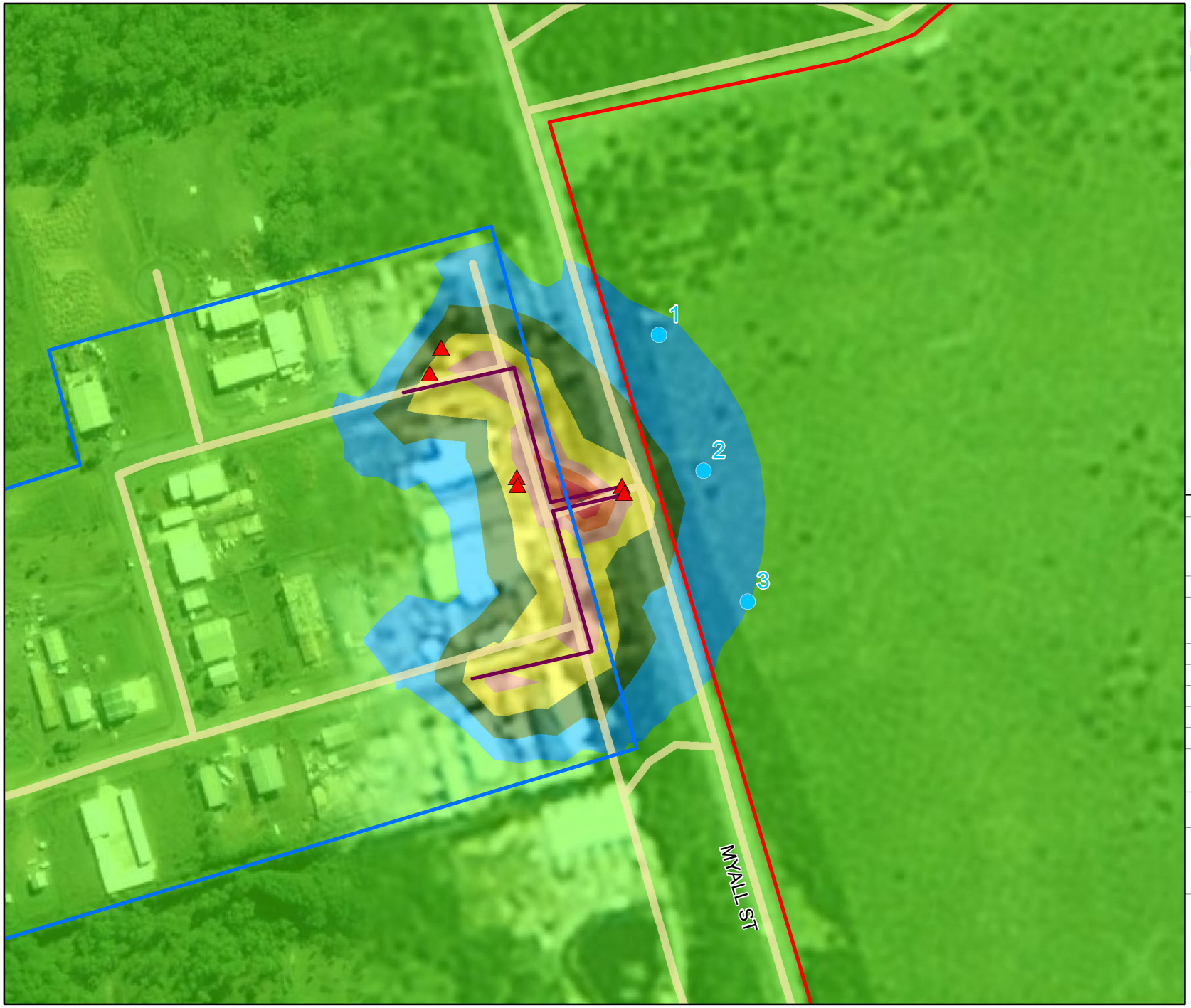
Table 5.4. Noise contours for calm and adverse meteorological conditions are visually presented in *Figure 5.1* to *Figure 5.4*.

Table 5.3 ***Calculated Noise Levels - CALM***

NAL	Calculated Noise Level LAeq, 15min			PSNL LAeq, 15min			Comply?
	Daytime	Evening	Night time	Daytime	Evening	Night time	
1	36	32	32	47	40	35	√
2	38	34	34				√
3	35	32	32				√

Table 5.4 ***Calculated Noise Levels - ADVERSE***

NAL	Calculated Noise Level LAeq, 15min			PSNL LAeq, 15min			Comply?
	Daytime	Evening	Night time	Daytime	Evening	Night time	
1	36	33	33	47	40	35	√
2	38	34	34				√
3	36	32	32				√



Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Noise Sources
- Moving Source
- Road

Noise Contours

- 0 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70

Figure 5.1

Noise Contours - Daytime Calm

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G002_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 25 50 75m

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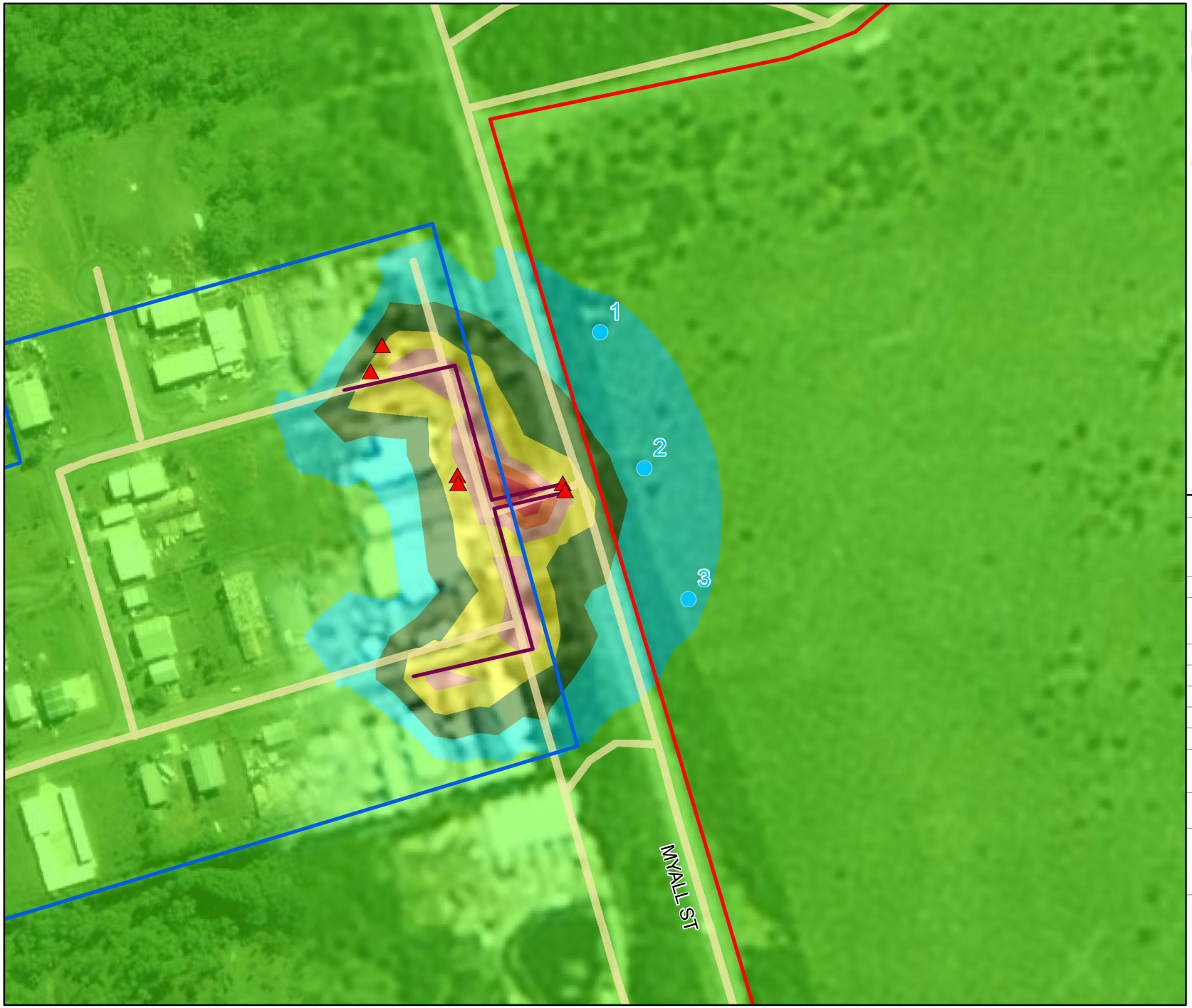

Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Noise Sources
- Moving Source
- Road

Noise Contours

- 0 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70

Figure 5.2

Noise Contours - Daytime Adverse

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G003_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 25 50 75m

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Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Noise Sources
- Moving Source
- Road

Noise Contours

- 0 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

Figure 5.3

Noise Contours - Night Time Calm

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G004_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 25 50 75m

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Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Noise Sources
- Moving Source
- Road

Noise Contours

- 0 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

Figure 5.4

Noise Contours - Night Time Adverse

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G005_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 25 50 75m

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5.3 *CALCULATED SLEEP DISTURBANCE NOISE LEVELS*[8]

Based on the measured Lw values presented in *Table 5.2* the worst case calculated sleep disturbance noise levels are presented in *Table 5.5*. Noise contours are visually presented in *Figure 5.5*

Table 5.5 Calculated Sleep Disturbance Noise Levels

NAL	Calculated Noise Level LAMax	Preferred ECRTN criterion (external) LAMax	Comply?
1	38	60	√
2	39		√
3	36		√

These calculated values are below the derived L_{AMax} *ECTRN* sleep disturbance criteria of 60 dB (preferred) and 65 dB (maximum) that have been adopted for this assessment.

Based on observations made by ERMs acoustician whilst on site, an industrial area of this type is typically unlikely to generate transient or impulsive noise emissions potentially associated with sleep arousal or disturbance during the out-of-hours assessment period. This assumed scenario provides worst-case noise level results and is not considered to be representative of normal noise conditions associated with the Tea Gardens Industrial Estate. Furthermore, the industrial/commercial noise emissions are not expected to typically occur outside of daytime hours. Although the potential exists for noise events to occur beyond this time, the frequency of the events is likely to be limited. Accordingly, operations are unlikely to cause awakening reactions and sleep disturbance impacts are not considered to be associated with, or a feature of, existing or future operations.

[8] ERM reiterates that industrial area operations typically occur during the daytime assessment period only however, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the Industrial Noise Policy and ECRTN.

Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Noise Sources
- Road

Noise Contours

- 0 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75

Figure 5.5

Noise Contours - Sleep Disturbance

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2010 Environmental Assessment (Noise Impact Assessment) - Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_G006_R0.mxd	
Date:	7/12/2010	Drawing Size: A4
Drawn By:	SW	Reviewed By: NL
Projection:	GDA 1994	
Scale:	Refer to scale bar	

N

0 25 50 75m

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5.4 *DISCUSSION OF RESULTS*

Results and findings of ERM's Noise Impact Assessment are summarised as below:

- potential operational noise impacts have been assessed in accordance with the Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) NSW *Industrial Noise Policy*, January 2000;

- potential sleep disturbance noise impacts, have been assessed in accordance with the Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) – NSW *Environmental Criteria for Road Traffic Noise* (ECRTN), May 1999;

- calculated noise levels ($L_{Aeq,\ 15\ minute}$) are below the Project Specific Noise Levels (PSNL) at all Noise Assessment Locations (NAL) under calm and adverse meteorological conditions, during all assessment periods (daytime, evening and night time);

- calculated noise levels (L_{AMax}) are below the recommended DECCW *ECRTN* sleep disturbance noise goals at and NAL, being the closest and/or or potentially most affected residential receiver locations in proximity of potential transient noise impacts;

- noise emissions associated with the existing industrial area do not result in adverse noise impacts on the residential receivers within the proposed Riverside at Tea Gardens development; and

- given the calculated compliance with the relevant noise standards and guidelines ERM make no further recommendations in regards to any methods for noise attenuation.

Technical Note:

ERM understands that the proposed road infrastructure (Myall Street) is being upgraded to a four lane road entering and exiting a near-by round a bout. This proposed upgrade is understood to include earth mounds and foliage at the edge of the road alignment and as part of the median strip. Shielding of this type (breaking the direct line of sight between the source and the receiver) may provide an additional 8 dB (A) to 10 dB(A) noise attenuation for the closest, and/or potentially most affected residential receivers in proximity to the existing industrial area.

6 CONCLUSION

Environmental Resources Management Australia Pty Ltd (ERM) on behalf of Crighton Properties Pty Ltd (Crighton Properties) has completed a comprehensive and robust Noise Impact Assessment of the proposed 'Riverside at Tea Gardens' residential and tourist development, located on Myall Street in Tea Gardens (NSW).

In response to the Director General Requirements *(DGR 5.3)*, this report presents the results and findings of the Noise Impact Assessment which quantifies the likely worst-case noise impact of the existing industrial area upon the proposed Riverside at Tea Gardens residential and tourist development. Conservatively, ERM has assessed potential noise impacts during the standard daytime, evening and night time (out-of-hours) assessment periods.

ERM's Noise Impact Assessment has been completed with reference to, and in accordance with the following documents, noise standards and guidelines:

- Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) NSW Industrial Noise Policy, January 2000;
- Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) – NSW Environmental Criteria for Road Traffic Noise (ECRTN), May 1999;
- Standards Australia AS1055.1-1997™ - Description and Measurement of Environmental Noise; Parts 1, 2 and 3;
- Standards Australia AS IEC 61672.1-2004™ - Electro Acoustics - Sound Level Meters Specifications; and
- Riverside Mater Plan (.pdf), dated October 2010. As provided by Crighton Properties.

Calculated noise levels ($L_{Aeq, 15\ min}$) are below the Project Specific Noise Levels (PSNL) at all Noise Assessment Locations (NAL) under calm and adverse meteorological conditions, during all assessment periods (daytime, evening and night time). Calculated noise levels (L_{AMax}) are below the recommended DECCW ECRTN sleep disturbance noise goals at the nearest residential receivers. Noise emissions associated the existing Tea Gardens Industrial Estate will therefore not result in adverse noise impacts on surrounding residential receivers within the proposed Riverside at Tea Gardens development. Given the calculated compliance with the relevant noise standards and guidelines ERM makes no further recommendation in regards to any methods for noise attenuation.

REFERENCES

Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) NSW **Industrial Noise Policy**, January 2000;

Department of Environment, Climate Change and Water (DECCW - formerly the Environment Protection Authority, EPA) – NSW **Environmental Criteria for Road Traffic Noise** (ECRTN), May 1999;

Standards Australia **AS1055.1-1997™ - Description and Measurement of Environmental Noise; Parts 1, 2 and 3**;

Standards Australia **AS IEC 61672.1-2004™ - Electro Acoustics - Sound Level Meters Specifications**; and

Riverside Mater Plan (.pdf), dated October 2010. As provided by Crighton Properties.

Annex A

Noise Logging Chart - 24 November 2010

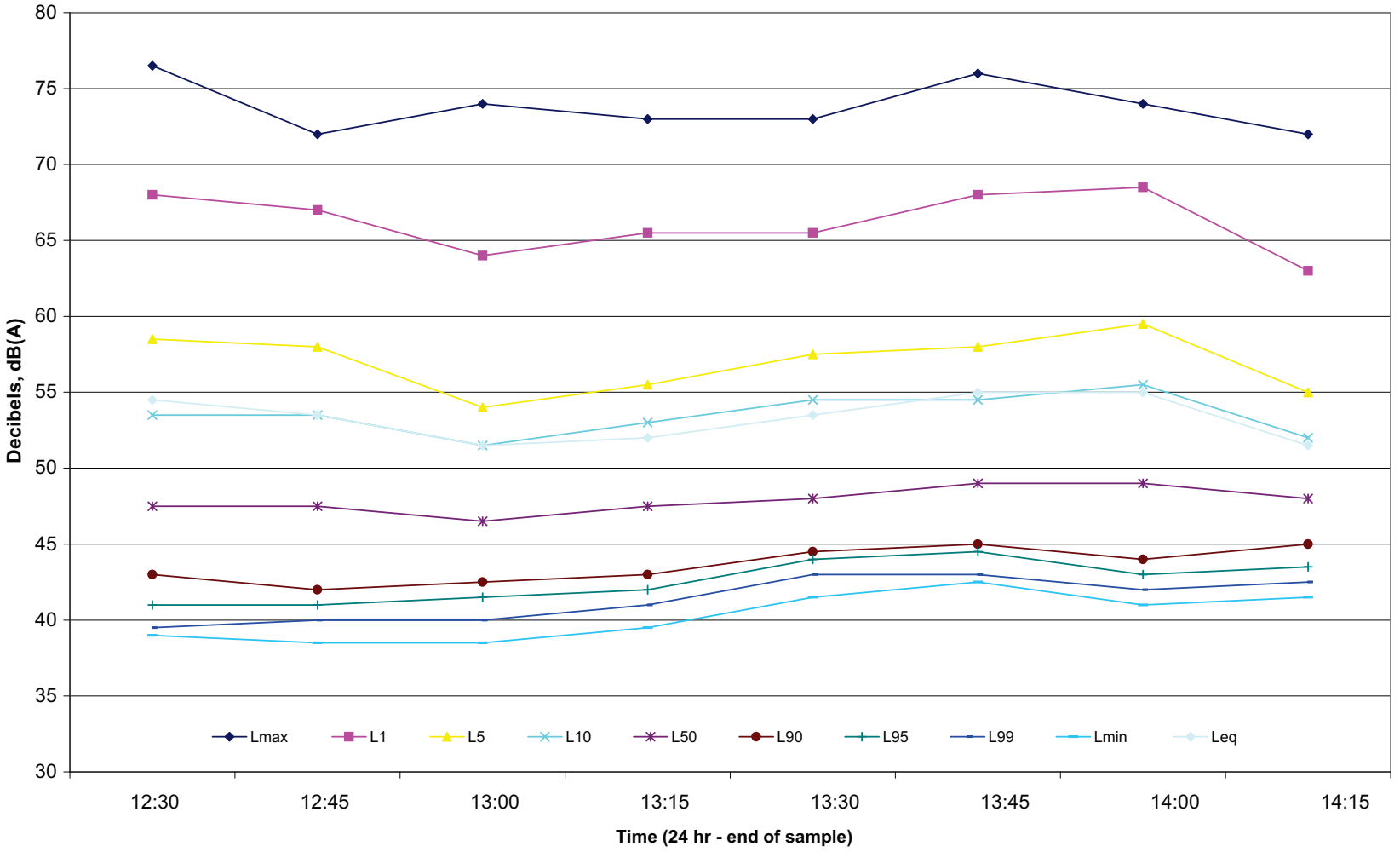

Figure A.1

Noise Logging Chart - 24 November 2010

Client:	Crighton Properties Pty Ltd	
Project:	Riverside at Tea Gardens	
Drawing No:	0043707s_NIA_C001_R0.cdr	
Date:	08/12/2010	Drawing size: A4
Drawn by:	ML	Reviewed by: NL
Scale:	Not to Scale	

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