Appendix E

Noise Assessment

NOISE ASSESSMENT

MAYFIELD SITE PORT-RELATED ACTIVITIES CONCEPT PLAN EA

ACOUSTICS AND AIR

REPORT NO. 09077
VERSION F

WILKINSON MURRAY

NOISE ASSESSMENT

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VERSION F

July 2010

PREPARED FOR

AECOM AUSTRALIA PTY LTD
LEVEL 8, 17 YORK STREET
SYDNEY NSW, 2000

Wilkinson Murray Pty Limited
ABN 41 192 548 112 • Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Asian Office: Hong Kong**
t +61 2 9437 4611 • **f** +61 2 9437 4393 • **e** acoustics@wilkinsonmurray.com.au • **w** www.wilkinsonmurray.com.au

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1 INTRODUCTION

Wilkinson Murray Pty Ltd has been engaged by AECOM to assess operational and transportation noise for Environmental Assessment (EA) of the Concept Plan for the proposed redevelopment of the port area of the old BHP Newcastle Steelworks site in Mayfield, Newcastle. The redevelopment is being undertaken by Newcastle Port Corporation (NPC) and it is understood that the proposed Concept Plan development will facilitate upgraded port-related activities. The purpose of the EA is to assess potential environmental impacts that future developments may generate as the site is developed through to the year 2034, and recommend mitigation measures, if necessary.

Concept Approval for the development is sought to ensure a coordinated and environmentally sustainable approach to the development that would provide a level of certainty and provide a framework for future development.

The noise assessment consists of:

- A review of the existing assessment and approval conditions with respect to noise;
- Noise measurements at surrounding receivers and establishment of site-specific noise criteria;
- Assessment of the final operational stage of the development which includes noise from ships at the associated berths;
- Assessment of transport noise i.e. road and rail; and
- Establishment of planning principles to mitigate any noise impact.

As part of the EA process, the impact of construction noise would normally be assessed. However, in this case, as the exact nature of the infrastructure to be constructed on-site and hence the future construction methods are unknown, this aspect will be dealt with in the future Project Approval applications for the construction and operation of the individual facilities/precincts, when these are made by the prospective operators of the facilities.

2 SITE DESCRIPTION

The land proposed for redevelopment in Mayfield is located along the South Arm of the Hunter River, within the Newcastle Local Government Area (LGA), 7 kilometres north west of Newcastle (see Figure 2-1). A large portion of the site has been remediated, however, remediation activities are ongoing and scheduled for completion in 2012. Limited port-related activities are currently conducted at the site. An aboveground pipeline with associated infrastructure for handling coal tar and pitch products runs east to west across the northern portion of the site. Koppers has a lease for operating the pipeline and dedicated wharf. NPC has constructed a general cargo handling facility known as Mayfield No.4 Berth at the site for handling the import and export of a range of cargo types including ammonium nitrate. BHP are currently conducting dredging in the South Arm of the Hunter River and using a portion of the site to treat contaminated sediments.

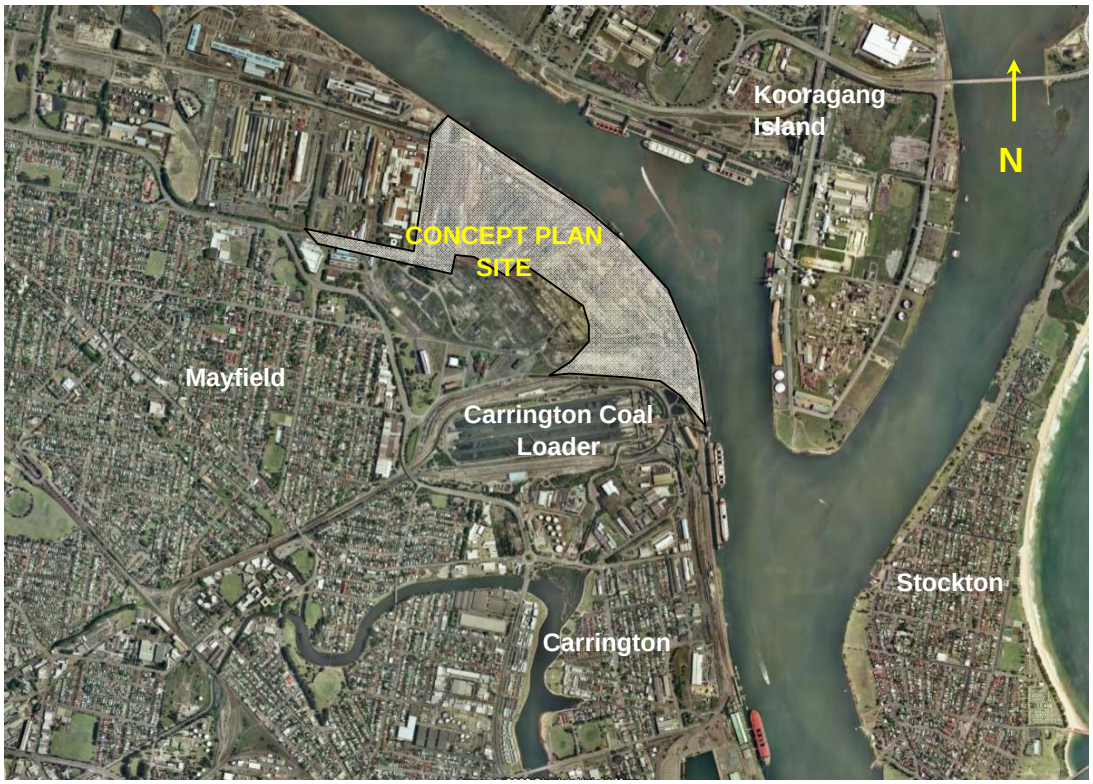

Figure 2-1 Proposed Site for Redevelopment

The site's surrounding areas of interest with respect to noise are:

- **North and East** - Hunter River with Kooragang Island which has significant heavy industry and Port facilities;
- **South** – Carrington Industrial Area; and
- **West** - Vacant Land known as the future Intertrade Industrial Park or IIP.

The nearby residential areas potentially affected by noise from the site are:

1. Stockton residences at a distance of approximately 2,300 metres from the centre of the site;
2. Mayfield residences at a distance of approximately 1,000 metres from the centre of the site; and;
3. Carrington residences at a distance of approximately 1,600 metres from the centre of the site.

Figure 2-2 presents a concept layout plan identifying the arrangement of port-related land uses on the site which include:

- NPC Operations Precinct;
- Bulk and General Precinct;
- General Purpose Precinct;
- Container Terminal Precinct;
- Bulk Liquid Precinct;
- Access Corridor; and
- Berth Precinct.

The proposed concept site would have five key land-based operational precincts which are described below:

- **NPC Operations Precinct.** The NPC Operations Precinct would be used by NPC for managing all operations within the Port of Newcastle. The precinct would be located at the south eastern end of the proposed concept site, fronting Berth 1. Various buildings and small-scale facilities, including vehicle and marine equipment maintenance areas, would be located in the precinct. The precinct would also likely be the location of the NPC dredging vessel.
- **Bulk and General Precinct**. The Bulk and General Precinct would be used for handling and storing bulk goods such as grain and other dry bulk goods, including cement, fertilizer, and coke cargoes, and for other general purposes. The precinct would be located in the south eastern portion of the proposed concept site, immediately to the north west of the NPC Operations Precinct and fronting Berth 2. Various buildings and infrastructure would be located in the precinct, including covered storage areas, storage silos, conveyor systems, and office buildings.
- **General Purpose Precinct.** The General Purpose Precinct would be used for handling and storing cargo containers, heavy machinery, break bulk and Roll on/Roll off (Ro/Ro) cargo. The precinct would be located in the central and north eastern portion of the proposed concept site, immediately to the north west of the Bulk and General Precinct and fronting Berths 3 and 4. Various buildings and infrastructure would be located in the precinct, including covered storage areas and areas of hardstand.
- **Container Terminal Precinct.**

  The Container Terminal Precinct would be used for container storage and transfer. The precinct would be located in the central and north western portion of the proposed concept site, immediately to the north west of the General Purpose Precinct and fronting Berths 5 and 6. Buildings and infrastructure including quayside and mobile cranes, rail mounted gantries, hardstand areas, and an administration building would be provided.

- **Bulk Liquid Precinct.**

  The Bulk Liquid Precinct would be used for receival, storage, blending and distribution of fuels. The precinct would be located in the far north western portion of the proposed concept site, immediately to the north west of the Container Terminal Precinct and fronting Berth 7. Buildings and structures including tank farms with steel storage tanks, fuel distribution pipelines and administration buildings would be provided.

The proposed concept also includes a Berth Precinct which would contain up to seven berths to support operations within the five land-based operational precincts described above. An access corridor accommodating the necessary infrastructure (e.g. road infrastructure, potable water, electricity, communications, gas and sewage) to service the facilities would also be provided.

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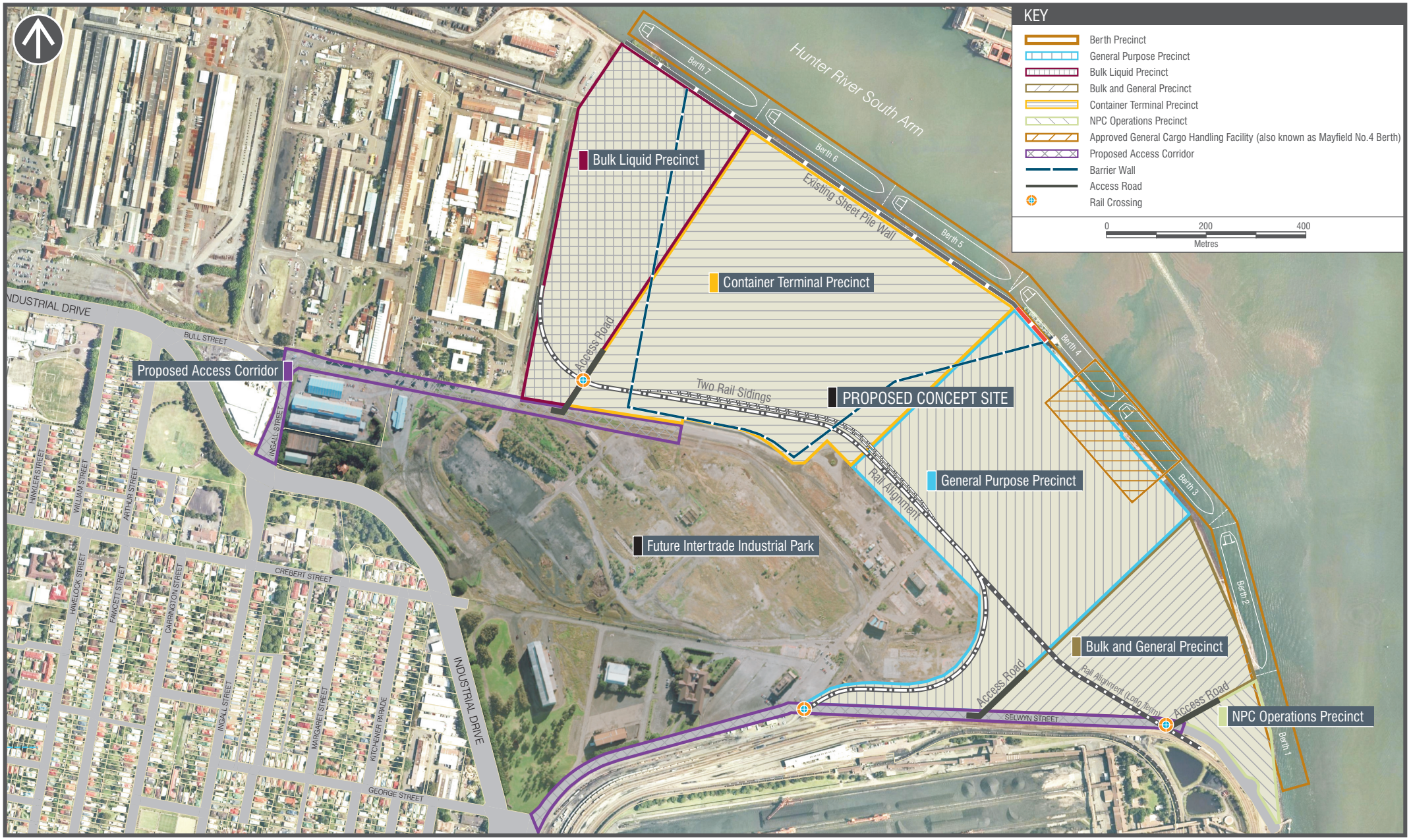

AECOM

CONCEPT PLAN

Noise Assessment

Mayfield Site Port-Related Activities Concept Plan

Figure 2-2

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3 ACOUSTIC PERFORMANCE CRITERIA

3.1 2001 Consent Conditions

An EIS was prepared by URS in 2000 titled "Development of a Multipurpose Terminal and Remediation of the Closure Area, BHP Newcastle Steelworks – Environmental Impact Statement". As a result of this assessment and development application DA 293-08-00 the following conditions of approval with respect to Noise and Vibration have been issued for the site by the Department of Planning:

"Noise – Operation Phase

5.11 The following noise limits apply to the operation of the Multi-Purpose Terminal at the locations shown is as follows:

Location	***Day-time (7am to 10pm)*** $L_{A90(15\ minute)}$	***Night-time (10pm to 7am)*** $L_{A90(15\ minute)}$
1. 52 Arthur Street	*49*	*38*
2. Mayfield East Public School	*47*	*37*
3. 21 Crebert Street	*49*	*39*
4. Newcastle TAFE	*44*	*38*
5. 1 Arthur Street	*48*	*33*

The noise limits apply during the day or night-time under winds up to 3 metres per second (measured at 10 metres above ground level) and Pasquill stability class from A to F.

5.12 In the event that the Applicant is unable to achieve the noise levels specified in Condition 5.11, the Director-General, in consultation with the EPA may agree to a request by the applicant to negotiate noise limits up to 5 dB(A) above the limits specified in Condition 5.11, provided the Director-General is satisfied that the applicant has demonstrated that all feasible and reasonable means to mitigate noise impacts have been considered. The application should include but need not be limited to:

a) full details of the measures proposed to mitigate noise impacts associated with the operation of the container terminal and the rail terminal;

b) a quantitative analysis of the extent to which the mitigation measures will achieve the noise limits specified in Condition 5.11;

c) identify all residential properties and sensitive receivers likely to be affected when all feasible and reasonable on-site mitigation strategies have been taken into account; and

d) details of the outcome of a community consultation process to be implemented by the Applicant to identify alternative on-site or off-site mitigation strategies that may be acceptable to the community.

Vibration

5.13 Prior to construction of the railway linking the MPT to the Morandoo sidings inroad, the Applicant shall prepare a vibration assessment report identifying the predicted impacts of rail related vibration as a result of the development. The assessment report shall be prepared in consultation with the Rail Infrastructure Corporation and be submitted for the approval of the Director-General. The Report shall include measurements of predicted vibration associated with the new rail line connecting the MPT and identify mitigation measures to be incorporated into the detailed design of the rail line."

These conditions were issued as a result of an assessment conducted in 2000 for a development which is different in a number of aspects from the Concept Plan which is now proposed. In addition, noise assessment methodology has changed in this period. Accordingly a review of existing noise conditions at surrounding residential areas, including Carrington and Stockton, has been conducted and as a result site-specific noise criteria has been established based on current noise assessment methodology and noise levels.

It is noted that the boundary of the proposed concept is different to the wider Closure Area boundary of the URS assessment (which includes the future IIP).

3.2 Ambient Noise Levels

Noise monitoring in the Mayfield and Carrington residential areas has been conducted to determine the existing ambient noise levels of these residential areas. Long term ambient noise levels have been monitored at the surrounding residences as detailed in Table 3-1.

Table 3-1 Noise Monitoring Locations

Location	Address	Monitoring Period	Comment
A	1 Arthur Street, Mayfield	18 to 24 March 2009	
B	2 Crebert St, Mayfield	24 to 29 September 2009	Subject to traffic noise from Industrial Drive
C	32 Elizabeth Street, Carrington	18 to 26 March 2009	Adjacent to industrial facilities in Carrington

The noise monitoring equipment consisted of ARL 215 environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sample periods. This equipment is capable of remotely monitoring and storing statistical noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Appendix A for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for monitoring locations are presented in graphical form in Appendix B. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 3-2 summarises the results, for daytime, evening and night time periods as defined in the NSW Department of Environment, Climate Change and Water's (DECCW) *NSW Industrial Noise Policy (INP)*. The summary values are:

- $L_{Aeq,Period}$ – The overall L_{Aeq} noise level measured over the assessment period; and
- RBL – The Rating Background Level is a measure of typical background noise levels which are used in determining noise criteria.

Figure 3.1 Logger Locations for Sites A and B

Figure 3.2 Logger Locations for Site C

Detailed results for monitoring locations are presented in graphical form in Appendix B. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 3-2 Summary of Measured Noise Levels

Noise Logging Site	RBL (dBA)			$L_{Aeq,period}$ (dBA)		
	Daytime 7 AM-6 PM	Evening 6-10 PM	Night Time 10 PM-7 AM	Daytime 7 AM-6 PM	Evening 6-10 PM	Night Time 10 PM-7 AM
A	46	47	46	53	53	50
B	49	42	40	69	65	60
C	44	43	39	57	54	46

Additionally, previous assessments of noise impacts on Stockton from industry on Kooragang Island (WM Report 08222 Ver A "Intermodal Good Facility Kooragang Island" January 2009) have determined the following RBLs at Stockton Village:

- Daytime 41 dBA
- Evening 43 dBA
- Night 43 dBA

The following sections describe the characteristics of the residential areas near the site.

Mayfield

Noise levels at residences to the west, as represented by the Arthur Street monitoring site (Site A), are subject to relatively constant noise levels throughout the day. An industrial noise contribution to the area of 45 dBA has been estimated based on site observations and noise measurements.

Noise levels at residences further to the south are represented by the Crebert Street monitoring site (Site B). These residences are subject to significant levels of traffic noise associated with intermittent traffic, including trucks on Industrial Drive. An industrial noise contribution to the area of 40 dBA has been estimated based on site observations and noise measurements.

The noise data at this location has been processed to determine the following traffic noise descriptors which are likely to be indicative of noise at residences in the vicinity of Industrial Drive.

- $L_{Aeq(15\ hr)}$ – Day 66 dBA
- $L_{Aeq(9\ hr)}$ – Night 62 dBA

Carrington

Residences on the northern end of Carrington residential area (Site C) are subjected to industrial noise from nearby industry and to a lesser degree noise from the coal loader. These areas can be classified as an industrial urban interface. A review of noise data indicates that noise from industry is clearly noticeable during the day, whereby a noise contribution from industry of 57 dBA during the day and 54 dBA in the evening has been established.

Stockton

The western side of Stockton is adjacent to Kooragang Island which is a major industrial area. As such, industrial noise is present in the area. Operator attended noise measurements have been conducted by Wilkinson Murray (WM Report 08222 Ver A "Intermodal Good Facility Kooragang Island" January 2009) and it has been determined that the noise contribution from existing industry is in the order of 47 dBA.

3.3 Industrial Noise Criteria

For sources such as the fixed plant associated with the facilities, appropriate noise criteria are specified in the *NSW Industrial Noise Policy (INP)*.

The *INP* recommends two criteria, "Intrusiveness" and "Amenity", both of which are relevant for the assessment of noise. In most situations, one of these is more stringent than the other and becomes the dominate noise criteria. The criteria are based on the L_{Aeq} descriptor, which is explained in Appendix A.

Where noise levels are currently low, noise levels from the proposed operation are limited by the intrusiveness criterion. In general, the L_{Aeq} noise level from such sources should not exceed the Rating Background Level (RBL) by more than 5 dBA. This is assessed over a typical worst case period of 15 minutes.

The amenity criterion sets an upper limit to control the total L_{Aeq} noise level from all industrial sources. For example, the potentially affected residences in Mayfield and Stockton are in an area which would be classified as "urban" and the relevant recommended "acceptable" amenity criteria for the $L_{Aeq,period}$ are 60, 50 and 45 dBA for daytime, evening and night time periods, respectively. The potentially affected residences in Carrington are in an area which would be classified as "urban/Industrial Interface" and the relevant recommended "acceptable" amenity criteria for the $L_{Aeq,period}$ are 65, 55 and 50 dBA for daytime, evening and night time periods, respectively.

Where noise levels from industrial sources are close to or above the acceptable levels then the amenity criterion, which incorporates a sliding scale to set limits, would apply. The sliding scale prevents the overall noise level exceeding the acceptable level due to the addition of a new noise source. Amenity criterion also needs to consider the possibility of other developments which may affect noise levels.

Table 3-3 presents applicable noise criteria for all surrounding receivers during the day, evening and night periods. As the most stringent noise criteria are based on the night period, compliance with criteria during this period will ensure compliance during all other periods.

Table 3-3 Project-Specific Noise Criteria at Residences

Location	Area	Intrusiveness $L_{Aeq,15min}$ (dBA)			Amenity $L_{Aeq,period}$ (dBA)		
		Day	Eve	Night	Day	Eve	Night
A- 1 Arthur Street, Mayfield	Urban	51	52	51	60	49	43
B- 2 Crebert St, Mayfield	Urban	54	47	45	60	50	43
C -32 Elizabeth Street, Carrington	Urban / Industrial Interface	49	48	44	65	49	50*
D -Stockton	Urban	46	48	48	60	47	37

*The night time amenity noise criterion is higher than the evening criterion at Carrington due to the fact that there is currently no significant industrial noise affecting residences during the night period. As a result, the criterion for this period is the recommended acceptable level of 50 dBA. In the case of the evening period, the existing industrial noise at Carrington has been determined to be 54 dBA therefore, in accordance with Table 2.2 of the INP, the amenity criterion for the evening is the acceptable level (55 dBA) minus 6 dBA which is 49 dBA.

3.4 Sleep Disturbance Criteria

Between 10.00 PM and 7.00 AM sleep disturbance from individual transient noise events such as container handling should be considered.

To avoid sleep disturbance from industrial operations the DECCW recommends in its *Environmental Noise Control Manual (ENCM)* that the $L_{A1,1minute}$ of the intruding noise should not exceed the background noise level by more than 15 dBA. The $L_{A1,1minute}$ represents the typical maximum noise level of transient events such as container handling and the use of horns etc.

As a result of a recent review of the latest research into sleep disturbance, the DECCW recognises that the current *ENCM* criterion is not ideal. Nevertheless, as there is insufficient evidence to conclude what should replace it, the DECCW recommends that this approach be used as a guide. Where the criterion in the *ENCM* is likely to be exceeded, more detailed analysis is required. This analysis generally involves determining the extent to which the criterion is exceeded and how many noise events are likely to occur during each night.

The sleep arousal criteria are provided in **Table 3-4**.

Table 3-4 Sleep Disturbance Screening Criteria

Location	RBL (dBA)	Sleep Disturbance Screening Criterion, $L_{A1,1minute}$ (dBA)
A - 1 Arthur Street, Mayfield	46	61
B - 2 Crebert St, Mayfield	40	55
C - 32 Elizabeth Street, Carrington	39	54
D - Stockton	43	58

3.5 Traffic Noise Criteria

Traffic associated with the proposed concept site would travel both north and south on Industrial Drive. It is assumed that approximately 80 percent of vehicles would travel to and from the north on Industrial Drive, with the remaining 20 percent travelling to and from the south. This would result in vehicles passing residences located along Industrial Drive. Guidance on setting noise criteria applicable to public roads in NSW is provided by the *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999). Table 1 of this document provides the following guidance presented in Table 3-5.

Table 3-5 Road Traffic Noise Criteria

TYPE OF DEVELOPMENT	CRITERIA		
	DAY (7 AM-10 PM) dB(A)	NIGHT (10 PM-7 AM) dB(A)	WHERE CRITERIA ARE ALREADY EXCEEDED
7. Land use developments with potential to create additional traffic on existing freeways / collector Roads	$L_{Aeq,15hr}$ 60	$L_{Aeq,9hr}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

3.6 Rail Noise Criteria

The DECCW's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (*IGANRIP*), 2007 provides guidance for assessment of rail infrastructure projects. *IGANRIP* specifies 'trigger levels', which are "non mandatory targets that can be used to initiate an assessment of noise impacts and consideration of feasible and reasonable mitigation measures" (refer to Table 3-6).

For residential receivers along the rail corridor that accesses the site, the noise trigger levels for absolute levels of rail noise have two components, L_{Aeq} (the equivalent continuous noise level due to train movements during an assessment period) and L_{Amax} (the maximum noise levels due to train passby).

The L_{Aeq} contribution level of rail noise is assessed over both day and night periods. The application of the L_{Amax} descriptor for residential land uses recognizes that rail events are not adequately described solely by the L_{Aeq} descriptor in terms of their effect on residential amenity and wellbeing.

Table 3-6 Airborne Rail Traffic Noise Trigger Levels for Residential Land Uses [Source: Extract of Table 1 of the DECCW's *IGANRIP*]

Type of Development	Day (7 AM – 10 PM)	Night (10 PM – 7 AM)	Comment
New rail line development	Development increases existing rail noise levels **and** resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project.
	60 $L_{Aeq(15hr)}$ 80 L_{Amax}	55 $L_{Aeq(9hr)}$ 80 L_{Amax}	
Redevelopment of existing rail line	Development increases existing rail noise levels **and** resulting rail noise levels exceed:		An 'increase' in existing rail noise levels is taken to be an increase of 2 dBA or more in L_{Aeq} in any hour or an increase of 3 dBA or more in L_{Amax}.
	65 $L_{Aeq(15hr)}$ 85 L_{Amax}	60 $L_{Aeq(9hr)}$ 85 L_{Amax}	

For the purpose of this assessment, the rail line is considered a 'redevelopment of an existing line' because the residences are currently exposed to railway noise.

3.7 Operational Vibration Criteria

When assessing vibration associated with train movements past residences there are two components that require consideration:

- Human exposure to vibration; and
- The potential for building damage from vibration.

The DECCW's *Assessing Vibration: A Technical Guideline* provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS6472:1992. Vibration from train passbys is intermittent vibration and is best assessed by the Vibration Dose Value (VDV) which is based on the *weighted* root mean quartic (rmq) acceleration. Research has shown that the VDV can be adequately approximated by the estimated vibration dose value (eVDV) for vibration exhibiting a crest factor (the ratio between peak and rms acceleration) below 6. Typically, train vibration has a crest factor well below 6 and thus the eVDV is a suitable assessment parameter.

BS6472:1992 provides the advice provided in Table 3-7 on the probability of adverse comment resulting from various values of eVDV.

Table 3-7 Probability of Adverse Comment Resulting from VDV in Residences [Source: Table 7, Appendix A, BS6472:1992]

Period	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Day (7 AM – 10 PM)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night (10 PM – 7 AM)	0.13	0.26	0.51

For operational vibration, it is recommended that values expected to have a low probability of adverse comment be adopted as goal levels. Therefore, a VDV of 0.2 to 0.4 was adopted during the day and a VDV of 0.13 was adopted during the night.

4 NOISE SOURCE LEVELS

Source noise levels were determined from noise measurements at similar port facilities. The source levels used in modelling are presented in **Table 4-1**.

Table 4-1 Indicative Octave Band Sound Power Levels of Typical Equipment used for Port Activities – Lw dB

Item of Equipment / Description	A Weighted	Octave Band Centre Frequency - Hertz							
		63	125	250	500	1000	2000	4000	8000
Ship Auxiliary Power Units	106	118	110	107	103	102	94	83	83
Ship Loading/Unloading	111	111	109	111	107	106	103	95	83
Tug	100	116	111	103	95	87	85	83	76
Quay Crane	111	111	109	111	107	106	103	95	83
Straddle Carrier	108	113	109	108	105	103	101	95	87
Rubber Tyre Gantry	101	106	102	101	98	96	94	88	80
Intra Terminal Vehicle ITV*	115	118	115	115	112	109	107	103	96
Forklift/Reach stacker	101	73	80	90	92	97	95	91	90
Trucks moving on site	100	96	102	100	98	95	92	88	82
Front End - Low Loader	112	109	106	103	107	109	104	98	91
Mobile Crane	104	109	106	104	100	99	98	91	85
Truck Processing Area	115	118	115	115	112	109	107	103	96
Truck queuing area	80	76	82	80	78	75	72	68	62
Truck/Train Loading/Unloading Area	108	108	106	108	104	103	100	92	80
Rail Loco Idle	94	100	96	91	89	89	87	82	75

* An ITV is used to refer to larger transport vehicles used to transfer containers in and around precincts.

Occasional or intermittent noise associated with the operation of the facility is likely to consist of noise from reversing alarms and rail shunting. Indicative sound power levels for these activities are 118 dBA and 103 dBA, respectively. Whilst these noise levels would not significantly affect overall L_{Aeq} noise emissions they are used to assess the potential for sleep disturbance.

4.1 Assumed Noise Mitigation

The future IIP, which is located between the proposed concept site and Mayfield residences, has not been included in this assessment. At this stage no application has been lodged and no approval granted for the IIP, therefore there is insufficient certainty in relation to IIP to include it in the assessment. In effect, the future form of the IIP would likely provide noise shielding of site operations, however operation of the IIP would also likely generate noise in their own right.

No other noise mitigation, such as specially silenced equipment or noise barriers has been included in the modelling as the purpose of the noise assessment is to test noise emissions from the site without specific site layout details and buildings. However, based on the results of the modelling, noise mitigation is recommended for the proposed concept as detailed in Section 6.2.

4.2 Meteorological Considerations

Certain meteorological conditions can enhance the propagation of sound from a noise source to a receiver. For example temperature inversions or low speed wind blowing from source to receiver could increase noise levels.

The *INP* requires assessment of noise emissions under meteorological conditions which could enhance noise propagation for significant periods during the year. For example, temperature inversions should be investigated if they occur for more than 30 percent of winter nights. Wind effects should be assessed if there is a source to receiver wind (at 10 metre height) of 3 metres per second or below for 30 percent of the time or more in any assessment period (day, evening, night) in any season.

Numerous noise assessments of industrial premises on and around Kooragang Island (including one conducted by Spectrum in 2007) have included detailed assessment of meteorological conditions and these have determined that noise assessments should take into account the following conditions:

- Calm, isothermal conditions;
- Wind of 3 metres per second (m/s) from the north west;
- Wind of 3 m/s from the south east; and
- Temperature inversion of 3 degrees per hundred metres.

The temperature inversion condition is often required to be assessed in conjunction with a 2 m/s drainage wind flowing from a source to a receiver. For the proposed concept, the noise source and nearest receivers are at the same elevation above sea level and therefore it is not considered necessary to include this drainage flow.

It is noted that a predominate wind from the south east would not increase industrial noise levels from the site as no residences are located downwind under this wind condition. Accordingly no assessment of this condition has been included in this noise assessment.

5 OPERATIONAL NOISE ASSESSMENT

A typical "*worst case*" operational scenario has been selected for noise modelling. As the development is at concept stage, the purpose of noise modelling is not to provide a detailed accurate prediction of resultant noise levels, rather the assessment has been conducted to determine the order of magnitude of potential noise impact based on a typical "worst case" operational scenario.

The typical "worse case" scenario consists of site operations that are proposed when the entire site is operational and at peak capacity. This is anticipated to occur in 2034. The operations and equipment included in this scenario are presented in **Table 5-1** and **Table 5-2.**

The noise from ships at the berths has also been included in the modelling (i.e. Ship Auxiliary Power Units). Whilst the ships themselves are not part of the site, the noise that emanates from the ships has been included to reflect actual operational conditions.

Table 5-1 Site Operations in 2034

Zone / Activity	Noise Sources	Transport	Berth*
NPC	Pilot Cutter		**1**
	Tug		
	Workshop		
BULK AND GENERAL			**2**
Dry Bulk storage	Ship Loading/Unloading	Road/Rail	
Coke Storage	Ship Loading/Unloading	Road / Rail	
Cement Storage	Ship Loading/Unloading Screw Conveyor	Road / Rail	
Boutique coal	Ship Loading/Unloading	Road	
Soda Ash – Im	Ship Loading/Unloading Screw Conveyor	Road	
Fertiliser – Im	Ship Loading/Unloading	Road	
Meals – Im	Ship Loading/Unloading	Road	
Sand - Ex	Ship Loading/Unloading	Road	
GENERAL PURPOSE			**3 (may also use Berth 4)**
Heavy machinery	Ship Loading/Unloading / Mobile Crane	Road	
Roll on Roll off cargo	Ship Loading/Unloading	Road	
Steel products	Ship Loading/Unloading	Road / Rail	
Timber products	Ship Loading/Unloading	Road / Rail	
Ammonia Nitrate – Ex	Ship Loading/Unloading	Road	
Scrap metal - Ex	Ship Loading/Unloading	Road / Rail	
Pine logs - Ex	Ship Loading/Unloading	Road / Rail	
CONTAINERS	Ship Loading/Unloading	Road / Rail	**4, 5 and 6**
	4 STS Cranes, fork lift / straddle carriers		
BULK LIQUID			
	Ship Loading/Unloading	Road	**7**

*As detailed in Table 5-2, four ships at berths have been included in this noise modeling scenario. Whilst ships would also use the other berths listed in this table, these berths have been selected for the purposes of noise modeling to represent a "typical" worse case operational scenario.

Based on the above scenario, the following equipment numbers have been modelled, as detailed in **Table 5-2.**

Table 5-2 Operational Noise Scenario Equipment

Precinct	Noise Modeling Scenario
NPC OPERATIONS	Tug
BULK AND GENERAL	Ship at Berth 2 Unloading Activity Trucks moving on site x 3 Mobile Crane Rubber Tyre Gantry Intra Terminal Vehicle ITV Front End Loader Truck Processing Area
GENERAL PURPOSE	Ship at Berth 4* Unloading Activities Intra Terminal Vehicle ITV Mobile Crane Trucks moving on site x 3 Forklift/Reach stacker Rubber Tyre Gantry Truck/Train Loading/Unloading Area Rail Locomotive Idle
CONTAINER TERMINAL	Ship at Berth 5 Quay Crane Straddle Carrier x 4 Forklift/Reach stacker x2 Mobile Crane Truck/Train Loading/Unloading Area
BULK LIQUID	Ship at Berth 7 Unloading Activities Trucks moving on site Mobile Crane

* Berth 4 can also handle containers.

6 OPERATIONAL NOISE MODELLING

For noise modelling purposes, equipment has been located across the relevant areas of the proposed sites, representing typical locations during the relevant day and night periods.

Site related noise emissions were modeled using the CONCAWE algorithms implemented in the "Cadna A" acoustic noise prediction software. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Screening effects from buildings;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and
- Meteorological conditions.

Computation of noise emissions were carried out based on calm meteorological conditions for the day periods, north westerly winds at 3 m/s and for a night temperature inversion of 3 degree / 100 m.

6.1 Noise Modeling Results

Table 6-1 presents the predicted noise levels based on the modeled scenario. The predicted noise levels should be considered as $L_{Aeq,15minute}$ levels. It is likely that $L_{Aeq,\ period}$ noise levels would be less as the plant and equipment is unlikely to operate at maximum power or for the entire day, evening or night period. Assuming that the plant and equipment only operates for half of the time period simultaneously the $L_{Aeq,\ period}$ noise level would be 3 dBA lower than the $L_{Aeq,15minute}$ levels. Therefore when comparing the amenity criteria to the predicted noise levels 3 dBA should be subtracted from the $L_{Aeq,15minute}$ levels.

Table 6-1 Predicted 2034 $L_{Aeq,15minutes}$ Noise Levels at Residential Receivers - dBA

LOCATION	Assessment Condition			Maximum Predicted Noise Level	Day / Night Noise Criterion
	Neutral	Wind NW	Inversion		
A - 1 Arthur Street, Mayfield	40	37	45	45	51/43
B - 2 Crebert St, Mayfield	45	45	50	50	54/43
C - 32 Elizabeth Street, Carrington	39	44	44	44	49/44
D - Stockton	39	44	44	44	46/37

Figure 6-1 and **Figure 6-2**, illustrates the noise propagation from the site to surrounding areas during the daytime and night time, respectively.

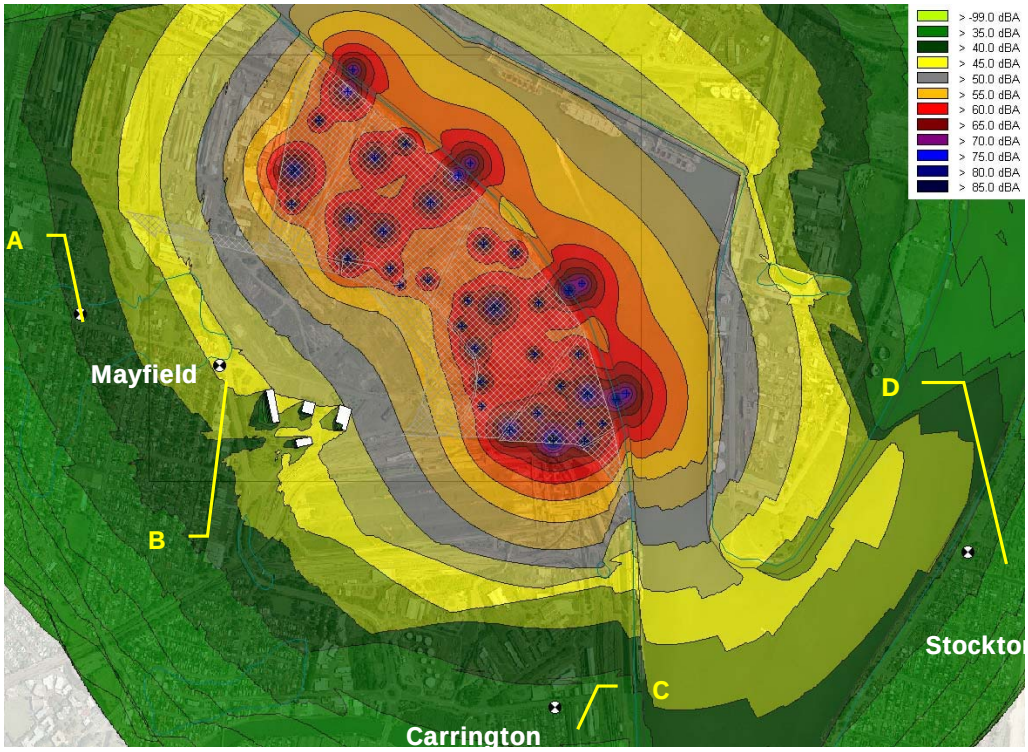


Figure 6-1 $L_{Aeq,15minute}$ **Daytime Noise Levels for 2034 Site Operations – Neutral Conditions**

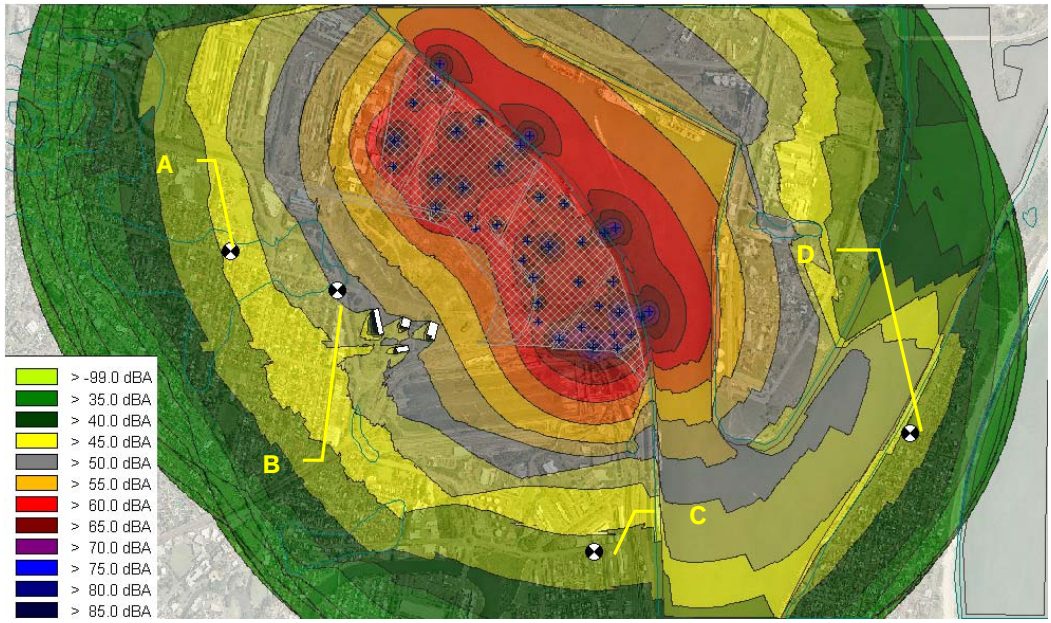


Figure 6-2 $L_{Aeq,15minute}$ **Night Time Noise Levels for 2034 Site Operations - Temperature Inversion Conditions**

6.2 Operational Noise Impacts

A review of the predicted noise levels, which are a typical worst case scenario, indicate that, in general, during the day and evening noise levels associated with the site would not likely contribute to noise levels that would adversely impact on the residential amenity of surrounding residences.

Whilst not excessive or unmanageable, it is in the night period, particularly when adverse weather conditions occur, such as temperature inversions, that there is more potential for adverse noise impact at residences. This is particularly the case at residences in Crebert Street, Mayfield where an exceedance at night of up to 7 dBA is predicted. These residences are in closest proximity to the site. An exceedance at night of up to 2 dBA is anticipated at residences in Arthur Street, Mayfield and up to 7 dBA is anticipated at residences in Stockton. The results are likely to be conservative because they assume that day and night activities operate at the same level of intensity which is unlikely.

A review of the potential noise contributions from site have identified that the main contributors to noise levels are the Intra Terminal Vehicles (ITV's) and noise associated with loading and unloading activities. Therefore, the following mitigation measures should be considered when planning for any future facilities on the site:

- The design loading or unloading facilities at future developments should take into consideration Mayfield and Stockton residences in particular. The use of building walls and roofs that shield noise associated with site activities from those residences should be considered. The use of sound absorptive treatment on large walls can reduce the likelihood of noise transfer to residences.

  Reductions in the order of 5 to 10 dBA can be readily achieved by strategically located noise barriers and buildings constructed in proximity of noise sources. Higher reduction in the order of 20 dBA can be achieved by constructing enclosures / buildings around noise sources requiring mitigation.

- Provide silencers and noise treatment to items such as ITV's and other items of plant that are identified to generate high noise levels (in the order of 115 to 120 dBA). As this is a new development, an audit of new plant can be conducted in the planning stage to determine any noise risks associated with equipment. Such an approach can allow the operator to adopt noise reduction equipment which is often an option on the purchase of new plant.

  Typically reductions of up to 10 dBA can be achieved by using acoustically treated motors and high performance silencer on equipment.

- The operation and location of site buildings and storage sheds should take into account noise emissions to nearby residences. When noise is taken into account in planning a new development the most cost effective noise reductions can be achieved. As all new facilities will be the subject of separate DA's the impact of noise can be addressed in the planning stage with respect to these concept findings.

- Minimize the operation of site vehicles during the night period where practical and feasible. This measure can effectively be incorporated into any operational environmental management plan that takes into account impact on the surround residences. In reality at nighttime the site is unlikely to operate at the same level of intensity as the day period across all precincts.

Based on our findings it is considered that the potential operational noise impacts associated with the NPC site are manageable with the adoption of the measures and procedures identified above.

In the assessment there it is only the night time operational noise at Mayfield and Stockton residences where potential noise impacts are indicated therefore if project proposals do not vary from the assumptions and worst case scenarios detailed in this report then any future DA noise assessment should only need to focus on the Mayfield and Stockton areas.

6.3 Sleep Disturbance Assessment

Maximum noise levels would typically be associated with large forklift reversing alarms. In normal handling, the typical $L_{A1,\ 1minute}$ noise level is 118 dBA.

Maximum noise levels have been predicted at all residences for a north west wind and for temperature inversion conditions. The highest predicted noise levels are presented in **Table 6-2**. The presented noise levels have a 5 dBA penalty applied for tonality.

Table 6-2 Maximum Noise Levels at Residences - $L_{A1,1minute}$

Location	Predicted Noise Level, dBA	Sleep Disturbance Screening Criterion, dBA
A - 1 Arthur Street, Mayfield	48	61
B - 21 Crebert St, Mayfield	54	55
C - 32 Elizabeth Street, Carrington	46	54
D - Stockton	46	58

As shown in **Table 6-2**, noise levels are predicted to comply with the sleep disturbance screening criterion at all locations. However it is noted the beeping of typical reversing alarms can be audible at long distances during night time hours, even if the noise level of the alarms complies with the noise criterion. Therefore as best practice it is recommended that "squawker" or broadband reversing alarms be installed on all equipment that would be used on-site during night time hours. The squawker type of alarm is less audible at distance but is still satisfactory in terms of safety.

7 ROAD AND RAIL TRAFFIC NOISE

Projection of traffic noise associated with the road and rail traffic potentially generated by proposed concept are detailed in the following sections.

Existing and future traffic projections have been based on the Transport Assessment prepared by AECOM in May 2010.

7.1 Predicted Road Traffic Noise Levels

Existing measured traffic noise levels at residences on Industrial Drive exceed the noise objectives of the ECRTN. Therefore the traffic noise contribution of the development should not result in an increase in traffic noise levels by more than 2 dBA.

Assessment of traffic noise impact has been conducted at three residential locations at residences on Industrial Drive, namely north west of Ingall Street, south of George Street and at Crebert Street. **Table 7-1** presents the current and future daily traffic flows at these locations.

Table 7-1 Industrial Drive Daily Traffic Flows

Location	2034 Traffic Flows (no Development)		2034 Traffic Flows (with Development)	
Location A - Industrial Drive north west of Ingall Street intersection	Approx Veh	%HV	Worst Case Veh	%HV
Daytime (7 AM to 10 PM)	31,500	4.2%	33,600	9.0%
Night (10 PM – 7 AM)	2,800	6.5%	3,500	21.5%
Location B - Industrial Drive west of Crebert Street intersection				
Daytime (7 AM to 10 PM)	31,500	4.2%	33,400	8.9%
Night (10 PM – 7 AM)	2,800	6.5%	3,500	21.0%
Location C - Industrial Drive south of George Street intersection				
Daytime (7 AM to 10 PM)	31,500	4.2%	32,100	5.5%
Night (10 PM – 7 AM)	2,800	6.5%	3,000	10.8%

Traffic noise levels at the facade of assessment residences have been predicted using the *Calculation of Road Traffic Noise (CORTN)* traffic noise prediction model. The model takes into account the following factors:

- Hourly traffic flows;
- Vehicle speeds (60 km/hr)
- Distance to residences from each traffic lane;
- Percentage heavy vehicles; and
- Shielding from barriers or topography.

Based on this information the following noise levels have been predicted at residences of interest along Industrial Drive as illustrated in Figure 7-1.

Figure 7-1 Traffic Assessment Locations

Table 7-2 presents the results of traffic noise predictions at the residential receivers along Industrial Drive. The predictions are based on an average vehicle speed of 60 km/hr. No noise barriers or fences have been included in the traffic noise prediction model.

Table 7-2 Predicted 2034 Industrial Drive Traffic Day and Night Noise Levels - dBA

Roadway	Traffic Noise Levels (dBA)		Predicted Increase in Traffic Noise	Noise Criteria $L_{Aeq(15\ hr)}$ / $L_{Aeq(9\ hr}$
	No Development	With Development		
Location A – North of Ingall Street				
Day	71.3	72.7	1.4	60/55
Night	64.5	67.1	2.6	
Location B – Crebert Street				
Day	71.3	72.7	1.4	60/55
Night	64.5	67.1	2.6	
Location C – South of George Street				
Day	71.3	71.7	0.4	60/55
Night	64.5	64.8	0.3	

The results indicate that noise levels at the nearest residences to Industrial Drive are subjected to relatively high traffic noise levels which exceed DECCW noise criteria with or without the development. Therefore the second noise objective, being that noise levels should not increase by more than 2 dBA as a consequence of the development, is applicable.

A review of predicted traffic noise levels indicates that the 2 dBA requirement is satisfied in all instances with the exception of residences on Industrial Drive in the vicinity of Ingall and Crebert Streets (Locations A and B) in the night period where an increase of 2.6 dBA is anticipated. At these locations, a noticeable change in traffic noise levels is likely to be experienced due to a predicted significant increase in heavy vehicle movements associated the proposed concept. It is anticipated that the noticeable change in traffic noise levels would occur at the later stages of the development, when approaching peak operations.

There are a limited number of residences along Industrial Drive at these locations. Much of the land bounding Industrial Drive is either commercial or parks. Therefore, the recommended option to mitigate the identified night time noise impact is to provide façade treatments to identified residences so that the internal acoustic amenity of residences is protected during the night time. There are approximately 20 residences located in the vicinity of the site that would require mitigation for night time traffic noise. These treatments typically consist of improved glazing on windows facing the roadway, along with mechanical ventilation that is either purpose designed or a propriety item such as an Aeropac acoustic ventilator. It is anticipated that only the front row of residences would require some form of treatment as these residences would shield those that are located behind them.

It should be noted that other noise mitigation measures such as noise barriers can be adopted to mitigate noise from traffic. However, as the predicted exceedance is limited to night time noise levels and because there are a limited number of residences along Industrial Drive, the use of façade treatments would be the most targeted and cost effective mitigation measure.

Since the results of the traffic noise assessment are based on traffic generation assumptions for the proposed concept in 2034, it is recommended that detailed traffic noise assessments be conducted at the Project application stage to determine the need for, and timing of, traffic noise mitigation along Industrial Drive near locations A and B. This is recommended because additional detail on traffic generation would be available at the Project application stage and also because it would enable the timing of the predicted noise exceedances to be more accurately determined. Details of façades to be treated and the exact details of treatments would require inspection of residences at this stage.

7.2 Rail Noise

It is anticipated that operation of the proposed concept would generate four trains per day in 2034. The rail line to the site would join the Port Waratah Loop which services the Carrington coal loaders and other Carrington industrial users. Current rail operations along this spur are in the order of 24 train movements per day.

To simulate a typical worst case scenario for modelling purposes, it was assumed that the proposed concept would generate additional trains as follows:

- Day 1 - 3 trains daytime, 1 train night time
- Day 2 - 2 trains daytime, 2 trains night time and so on

Estimates of train noise levels at typical nearest residences (nominally 28 Ackeron Street shown on Figure 7.2) along the rail access corridor, using the rail noise database that has been developed by Wilkinson Murray for Railcorp, have been based on the following assumptions:

- Type NR locomotives;
- An average distance of 30 metres to residences from the main rail line (refer to Figure 7.2); and
- A speed of 60 km/hr.

In the case of the cumulative noise from additional trains on the rail line, the existing number of night trains on this section of track has been estimated based on a review of hunter valley coal rail movements. This review indicates that approximately 30 percent of rail movements occur in the night period, equating to seven existing night movements. The existing seven train movements during the nightime generates an $L_{Aeq(9hr)}$ noise level of 53.9 dBA at adjacent residences. The addition of two trains at night equates to 11 future train movements which is predicted to result in a $L_{Aeq(9hr)}$ noise level of 55.9 dBA at adjacent residences. This level is below the IGANRIP night trigger level of 60 dBA.

Based on the results of the modelling, existing train movements generate an L_{Amax} noise level of 83 dBA at residences nearest the rail line. Since the L_{Amax} is the maximum noise level due to a train passby, the L_{Amax} would not increase as a result of the additional rail movements. The L_{Amax} of 83 dBA complies with IGANRIP trigger level of 85 dBA.

In the case of vibration generated by trains at residences along the rail line these are not anticipated to change from existing train vibration levels associated with trains currently servicing the Port Waratah Loop. In addition, it is Wilkinson Murray's experience that since residences are more than 20 metres from the rail line, vibration from freight trains at low speeds is not considered to be an issue of concern. Therefore the VDVs are not expected to be exceeded as a result of additional trains using the rail line. It should be noted that the noise from the train operations while within the NPC site was included in the operational noise assessment.

Figure 7.2 Residences Adjacent to Rail Line

8 CONCLUSION

Predicted noise levels from operations at the proposed concept site indicate that the potential for noise impact at surrounding residences would be greatest in the night period when adverse weather conditions (temperature inversions) occur. Noise criteria exceedances of up to 7 dBA during the night period are predicted at Crebert Street, Mayfield. An exceedance at night of up to 2 dBA is anticipated at residences in Arthur Street, Mayfield and up to 7 dBA is anticipated at residences in Stockton. In the case of day time operations, noise levels at all surrounding residences are expected to be below established noise criteria

Based on a review of the predicted results, noise mitigation measures have been recommended for minimising night time noise including the use of noise barriers at select locations and providing silencers on equipment. These measures should be included in future detailed assessments at the time Project applications are prepared.

Review of traffic noise based on projected traffic volumes with and without the proposed concept development indicate compliance with DECCW traffic noise criteria at residences along Industrial Drive during the daytime period. However at night an exeedance is indicated at a number of residences along Industrial Drive due to an increase in heavy vehicle traffic. It is anticipated that the exceedances in night time traffic noise levels would occur at the later stages of the development, when approaching peak operations. It is considered that the most feasible measures to protect the acoustic amenity of these residences is to provide façade treatment and ventilation to affected rooms of these residences.

An increase of up to eight rail movements (four trains a day has been assessed with respect to DECCW IGANRIP criteria. Based on the results of the modelling, an $L_{Aeq(9hr)}$ noise level of 55.9 dBA and L_{Amax} noise level of 83 dBA at residences nearest the rail line is anticipated, which is below the applicable trigger levels specified in the IGANRIP.

Based on the findings of this noise assessment it is considered that the night time operational and traffic noise impacts associated with the proposed concept are manageable and can be mitigated to acceptable levels. It is recommended that further detailed assessments be conducted at the Project application stage to confirm the need for, timing and extent of mitigation required.

Version	Status	Date	Prepared by	Checked by
F	Final	10 May 2010	Brian Clarke	John Wassermann

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

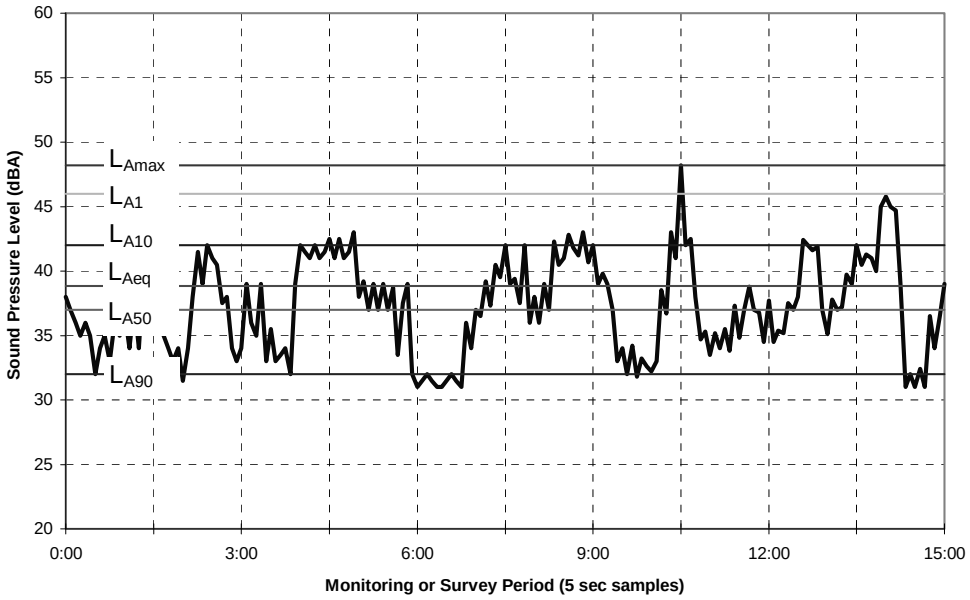
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.


60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
L_{Amax}
L_{A1}
L_{A10}
L_{Aeq}
L_{A50}
L_{A90}
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

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APPENDIX B

NOISE MEASUREMENT RESULTS

Location: 1 A Arthur Street

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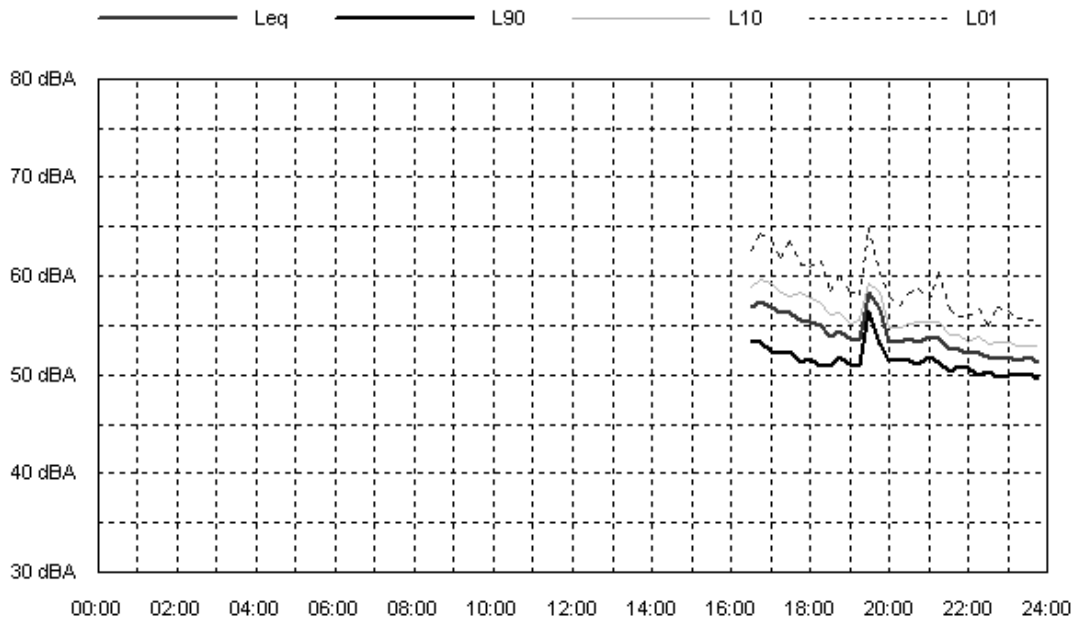

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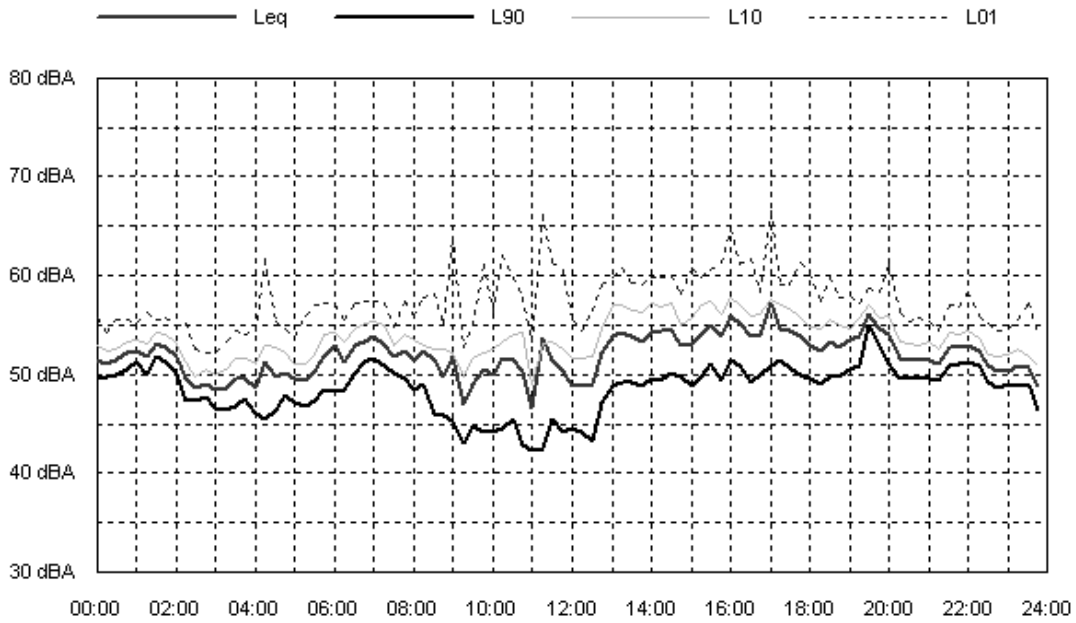

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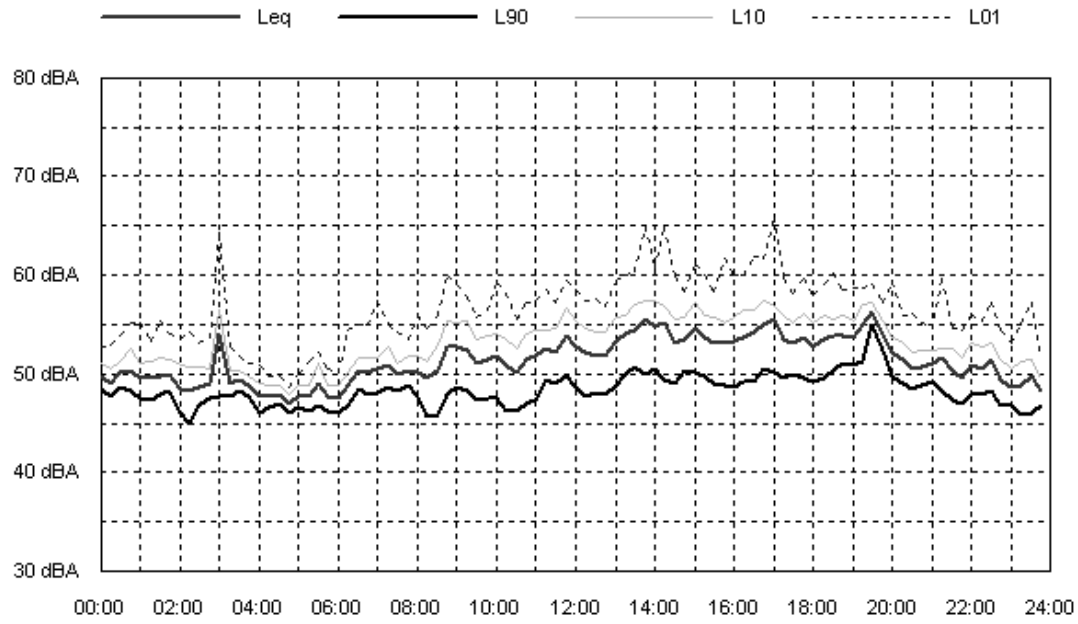

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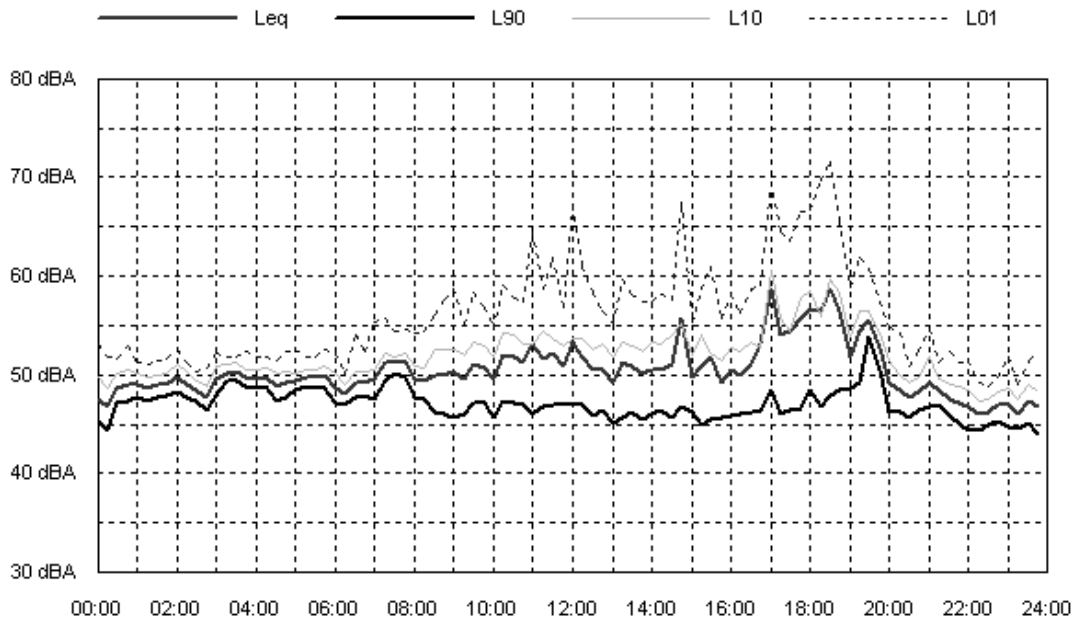

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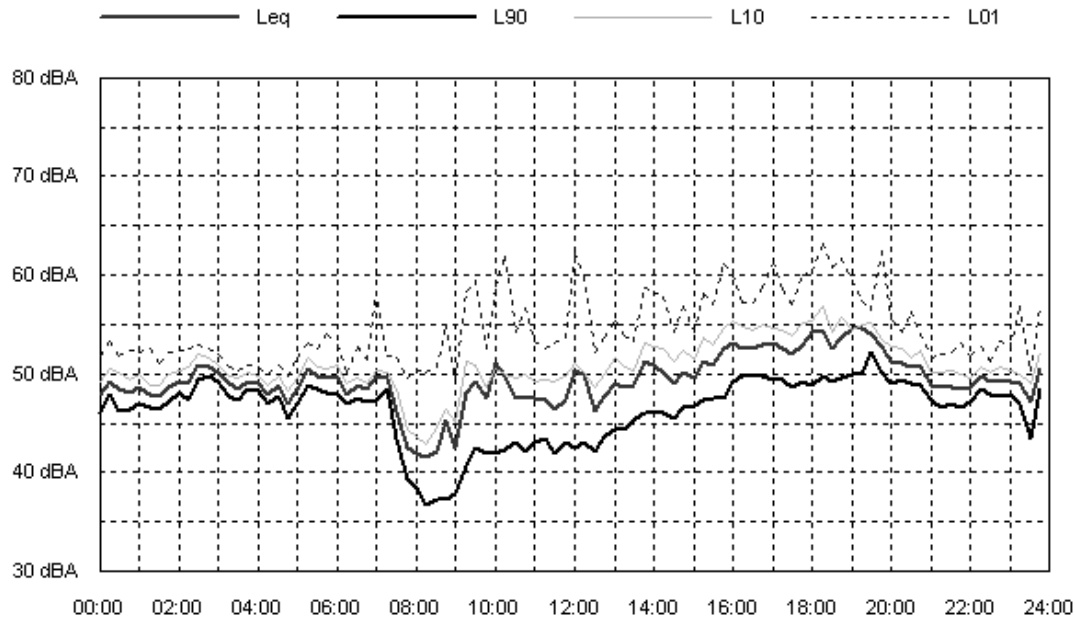

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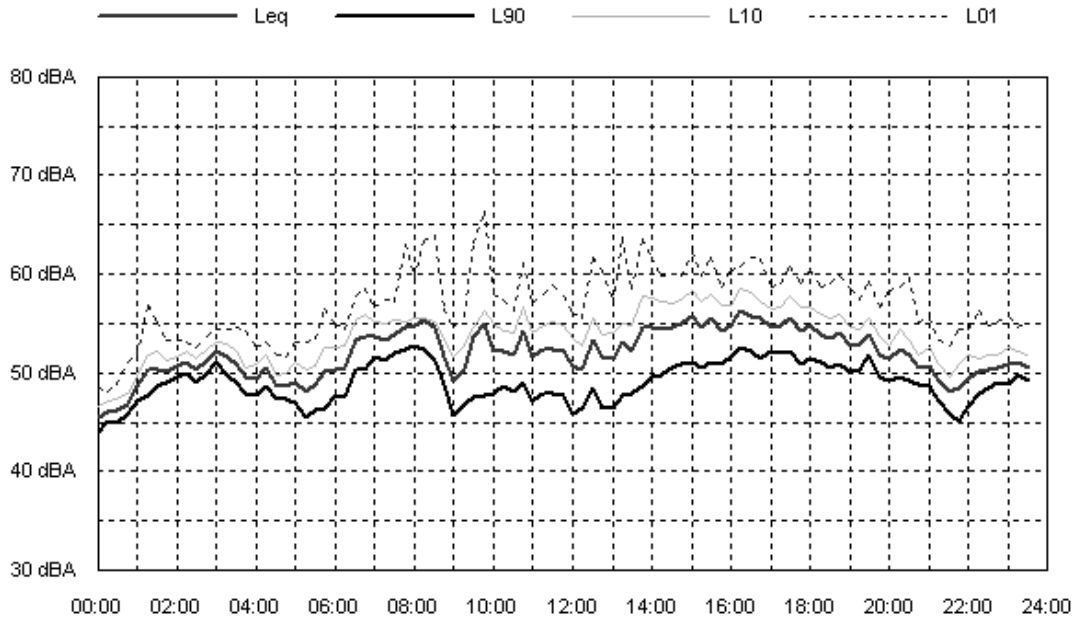

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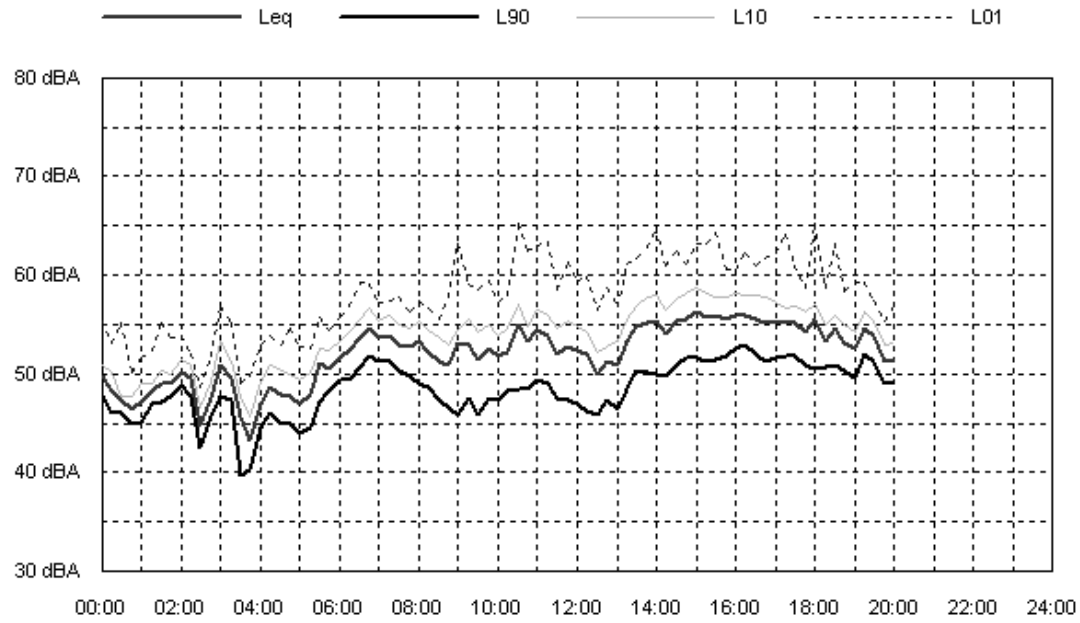

Location: 2 Crebert Street Mayfield

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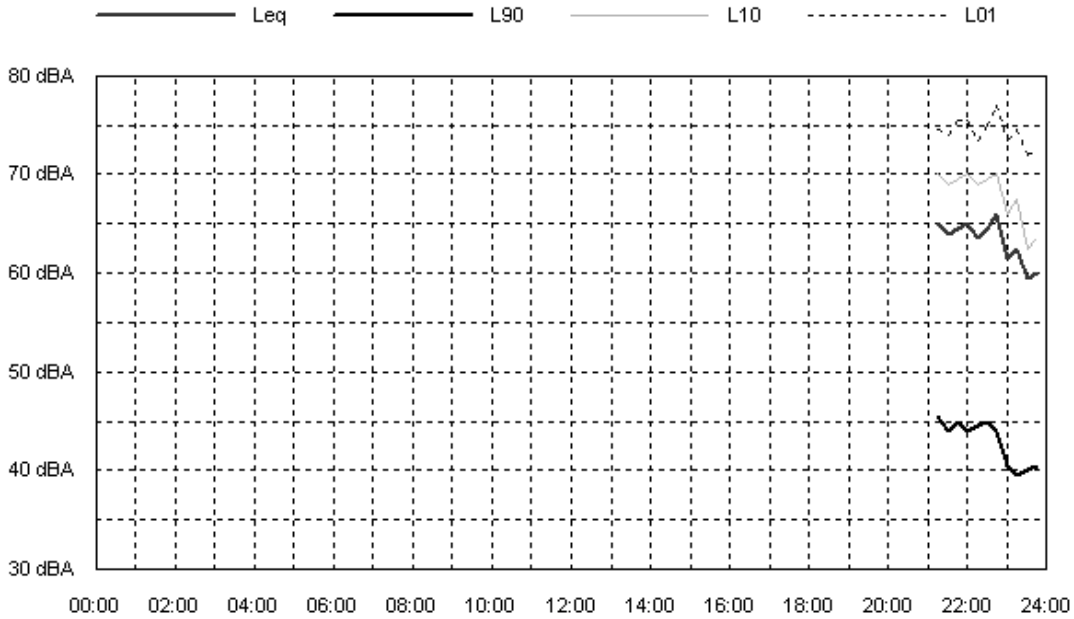

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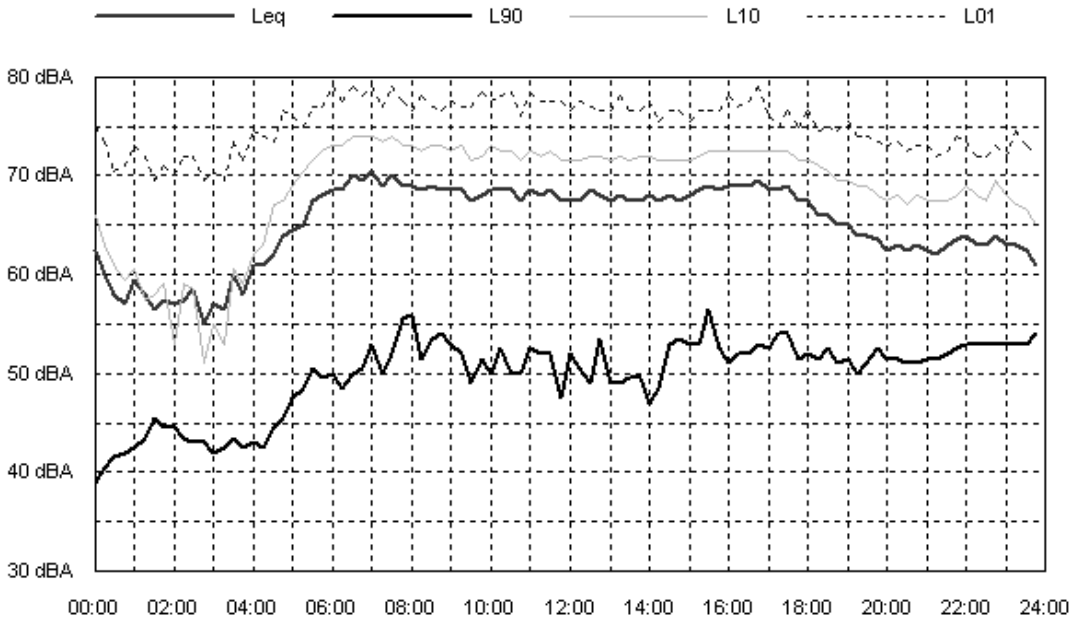

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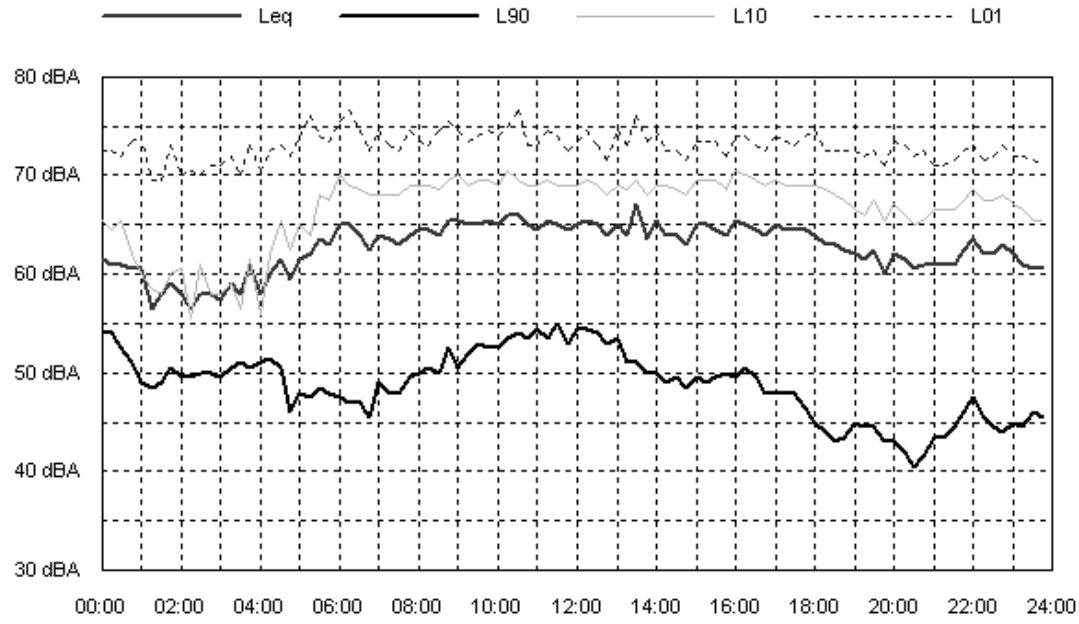

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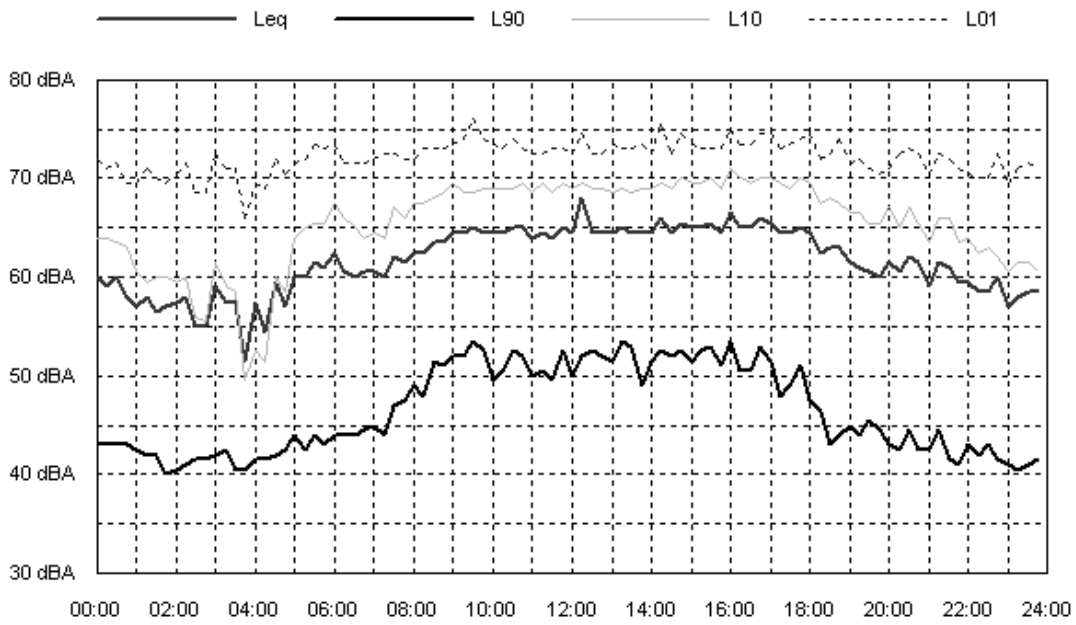

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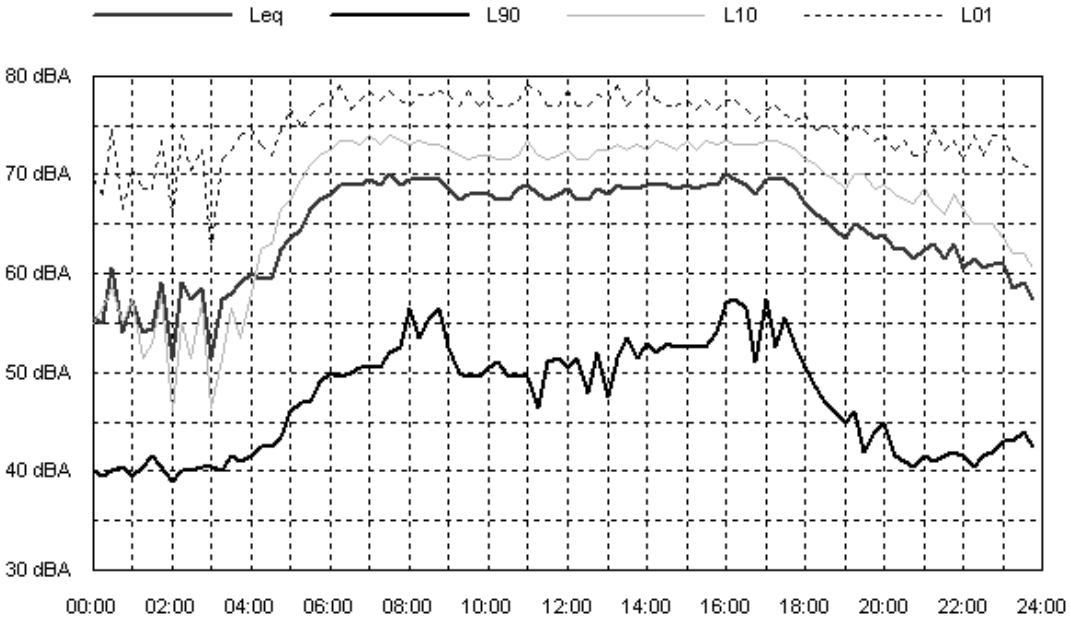

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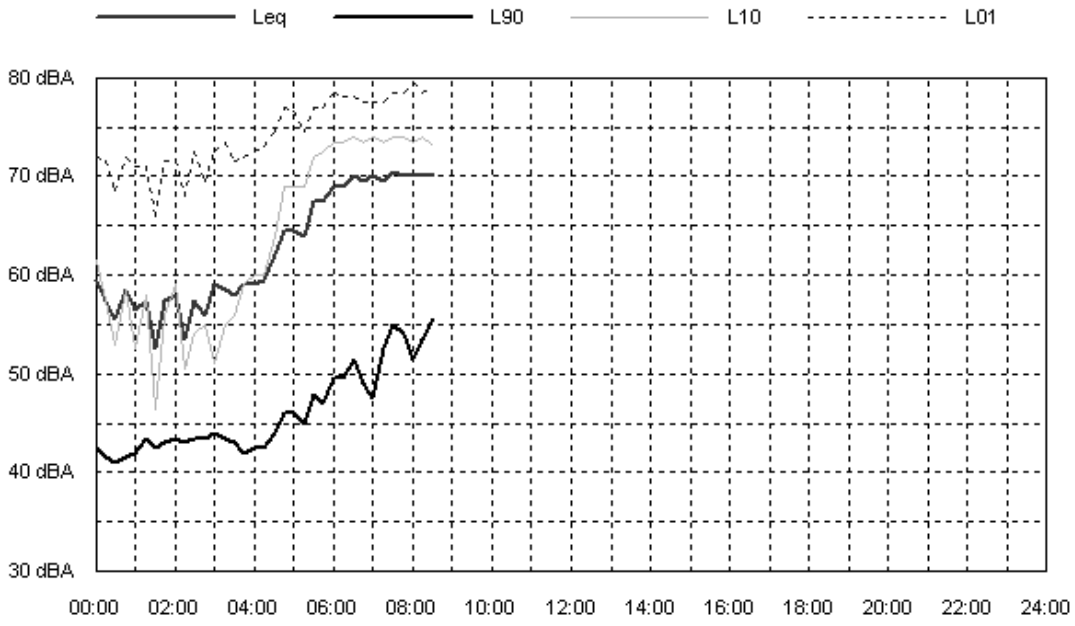
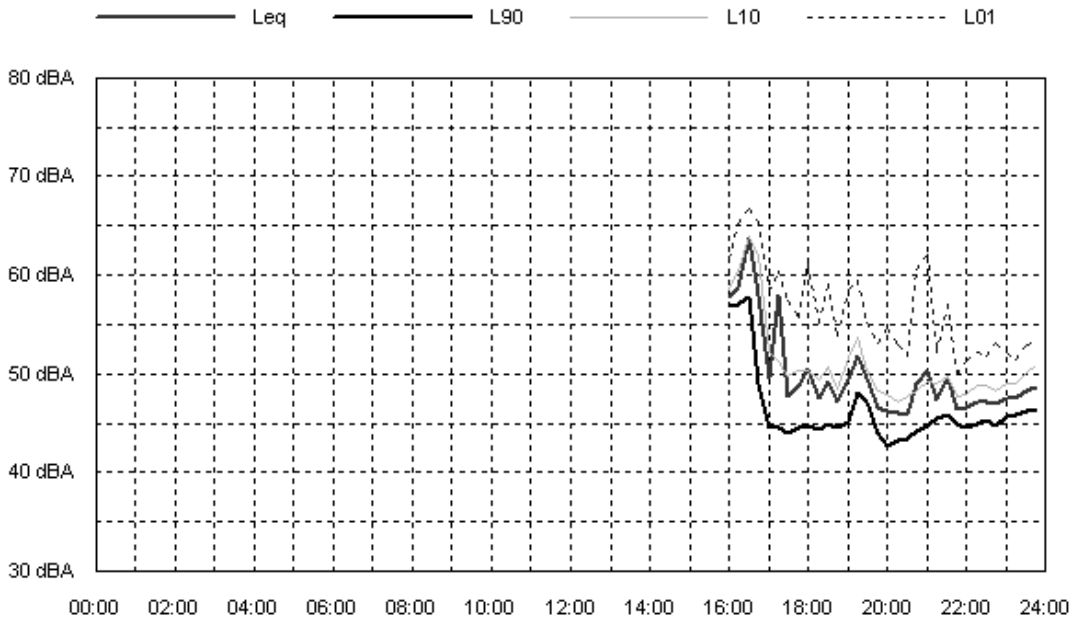


Location: 32 Elizabeth Street Carrington

Wed 18 Mar 09



Location: 32 Elizabeth Street Carrington

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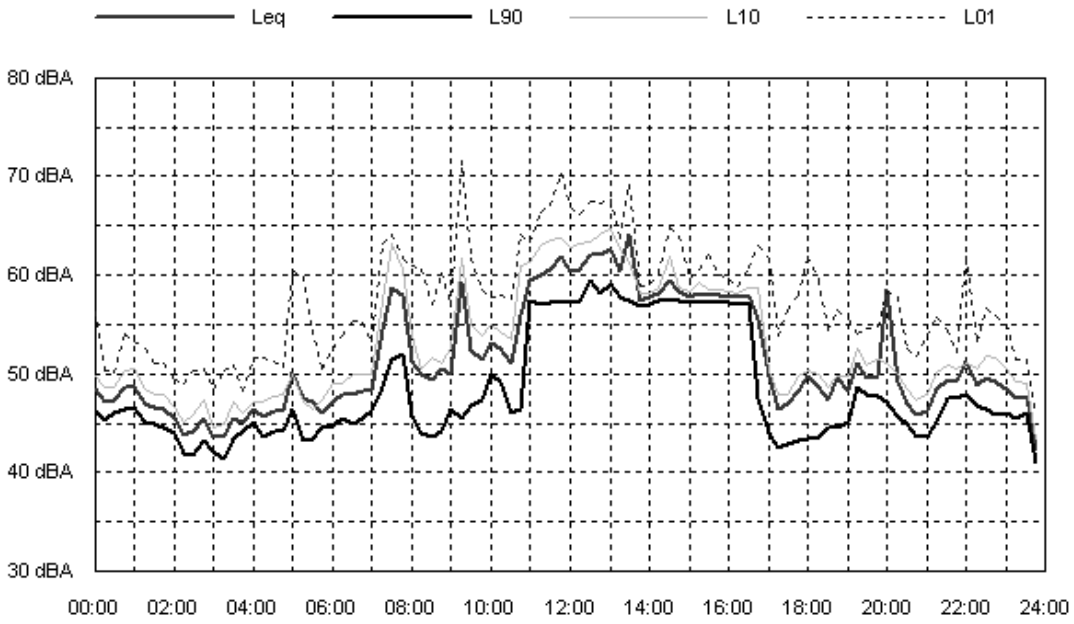

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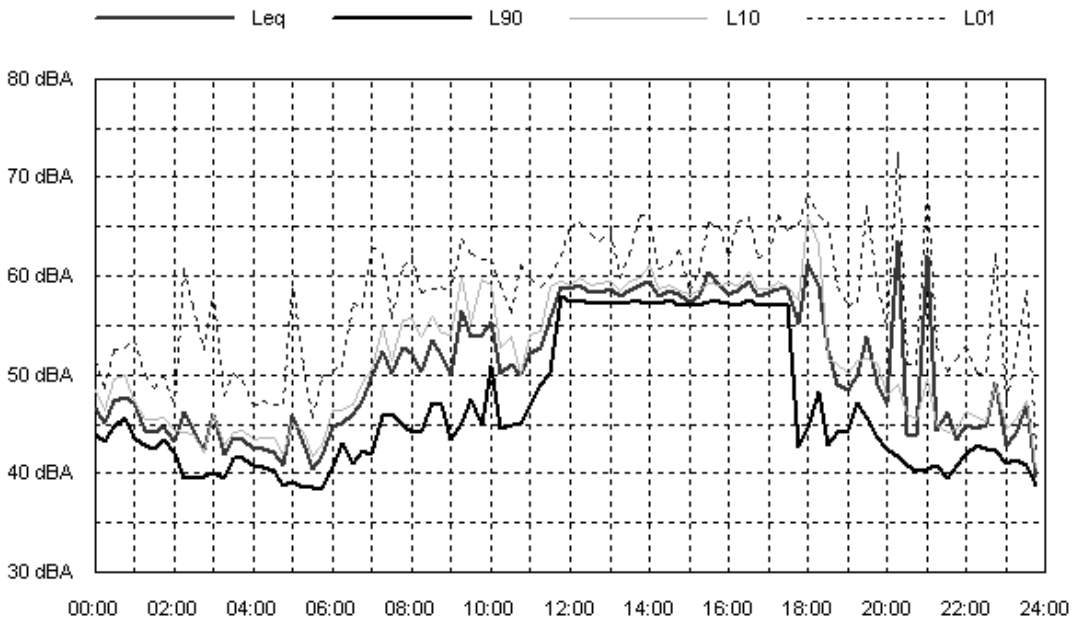

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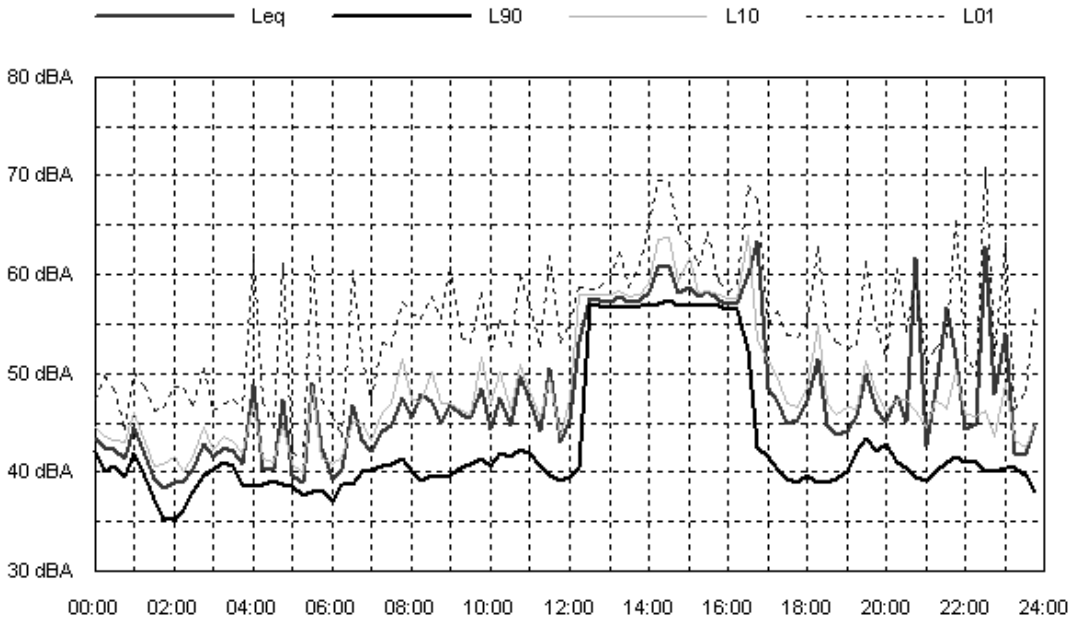

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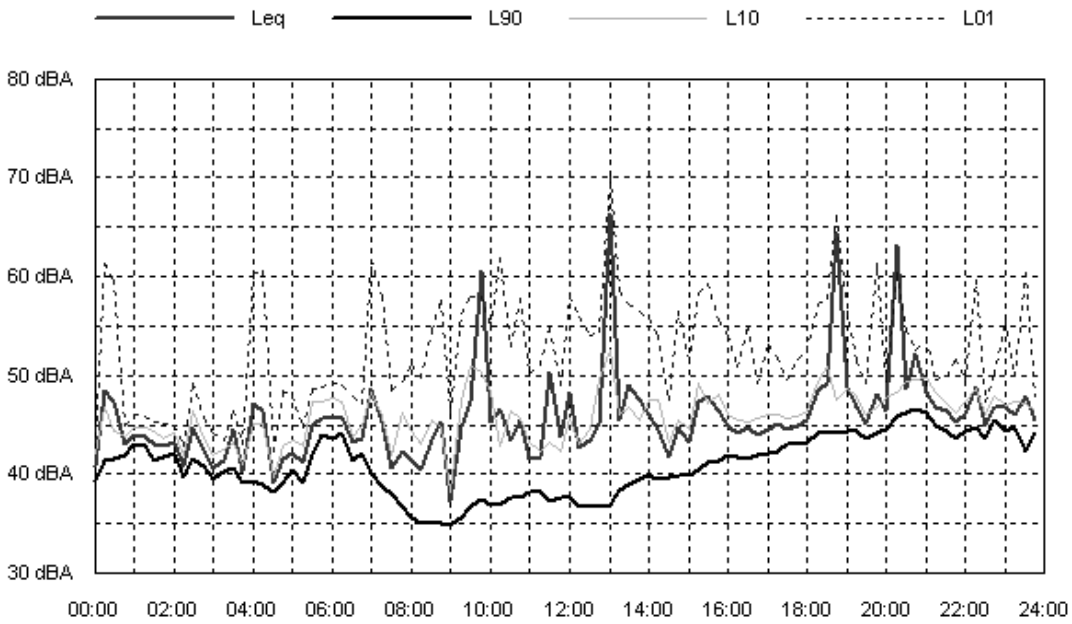

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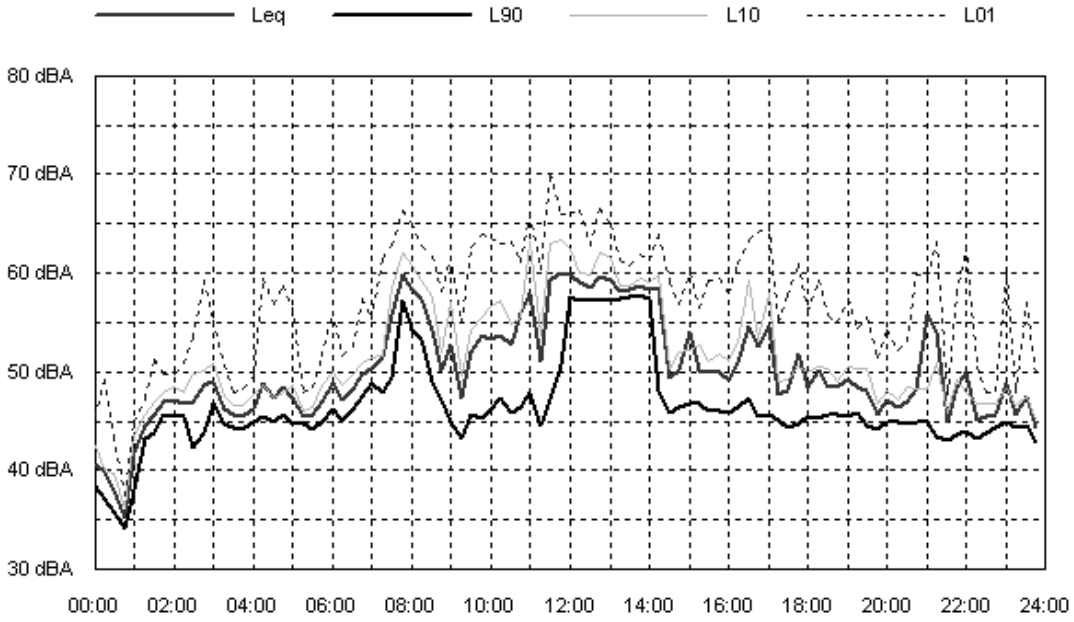
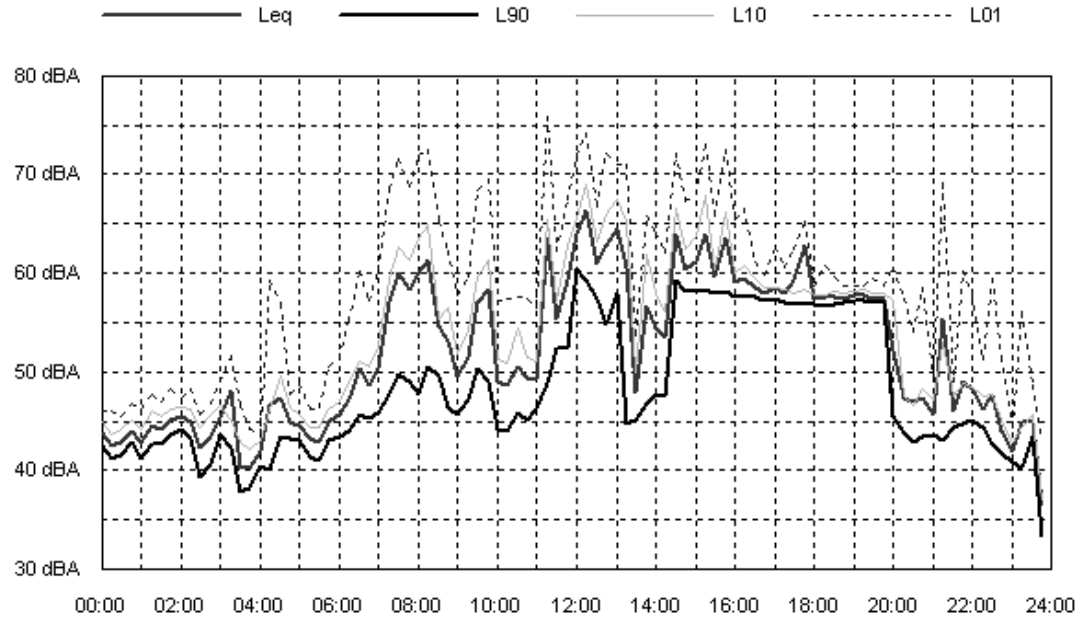
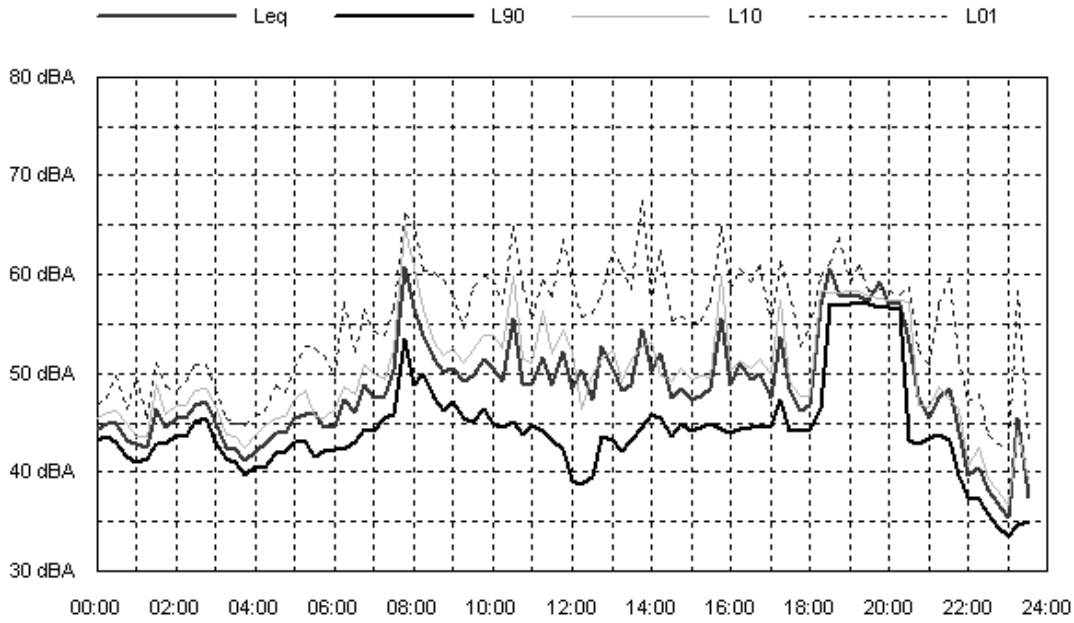


Tue 24 Mar 09



Location: 32 Elizabeth Street Carrington

Wed 25 Mar 09



Thu 26 Mar 09