



# HEGGIES

REPORT 10-4309-R15

Revision 0

**White Bay Berth 4 Bulk Liquids Handling  
Sichem Defender  
Ship Noise Monitoring Report**

PREPARED FOR

Sydney Ports Corporation  
207 Kent Street  
SYDNEY NSW 2000

28 MAY 2007



# White Bay Berth 4 Bulk Liquids Handling

## Sichem Defender

### Ship Noise Monitoring Report

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DOCUMENT CONTROL

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10-4309-R15	Revision 0	28 May 2007	Scott McKeon	John Sleeman	John Sleeman



## EXECUTIVE SUMMARY

Heggies Pty Ltd (Heggies) has been commissioned by Sydney Ports Corporation (SPC) to conduct monitoring of noise emissions during the unloading of the Sichem Defender (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required by Clause M7.1(1a) of the EPA's Environment Protection Licence (Licence No 12095).

Noise measurements were carried out at nearby residential receivers during Sichem Defender vessel cargo handling operations in the early morning of 4 May 2007.

The measured noise levels were found to be potentially influenced by local traffic and domestic activity on occasion. A reference noise measurement was therefore carried out in close proximity to the Sichem Defender vessel, where the noise environment was dominated by the WB-4 based bulk liquids cargo handling noise sources. The reference noise level was then used to predict noise levels at the representative receivers, for comparison with the attended measurements.

Predicted ship based  $L_{Aeq(15\text{minute})}$  noise levels meet the Licence imposed noise goals at the representative location in Pyrmont. At Balmain, the measured noise levels exceed the  $L_{Aeq(15\text{minute})}$  noise goal by up to 3 dBA, and the  $L_{Aeq(\text{night})}$  noise goal is exceeded by 11 dBA.

Bulk liquids terminal related maximum ( $L_{Amax}$ ) noise levels were observed to comply at the representative monitoring location in Pyrmont/Glebe and an exceedance of up to 3 dBA at the representative monitoring location at Balmain, for the duration of attended measurements.

Subject to feasibility, practicality and reasonability, the potential noise control measures that may be considered in order to meet the Licence imposed noise goals (as required by Condition R4.1) and ensure noise amenity remains unchanged in the area would be implementation of an on-site noise management strategy. Noise impact mitigation measures have been evaluated in the Revised Noise Impact Mitigation and Management Strategy (Report10-4309-R10 Revision 1), with a list of mitigation measures considered feasible and reasonable identified in the Noise Impact Mitigation Action Plan.



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## 1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by Sydney Ports Corporation (SPC) to conduct monitoring of noise emissions during the unloading of the “Sichem Defender” (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required by Clause M7.1(1a) of the EPA’s Environment Protection Licence (Licence No 12095).

Noise measurements have been conducted during cargo handling operations (ship auxillary power unit (APU), ventilation fans, pumps and truck activity on the wharf) at two locations considered representative of the potentially most exposed residential receivers. The locations are at Balmain to the west and Pyrmont to the east of WB-4. Measurements at both representative locations have been conducted during the loading of bulk liquids from the ship to road tanker trucks. The measurements were conducted between 1.00 am and 4.00 am on 4 May 2007, with the weather conditions varying from calm to a slight North Easterly wind. During the measurement period the sky was clear.

For the survey period from 1.00 am to 4.00 am, the measurements of the ambient noise environment were on occasion influenced by domestic activity and local traffic noise at both Pyrmont and Balmain during this period.

An additional “reference” noise measurement was carried out in close proximity to the Sichem Defender vessel, where the noise environment was dominated by the WB-4 based bulk liquids cargo handling noise sources. The reference noise level was then used to predict noise levels at the representative receivers for comparison with the attended measurements.

The predicted noise levels correlated well with the measured levels, and were assessed against the noise goals set out in Table U1 of the Environment Protection Licence. Feasible and reasonable noise mitigation measures are discussed in broad terms, with the aim of minimising the noise impacts from the operations, where the noise goals are exceeded.



## 2 SITE DESCRIPTION

The White Bay Port facility is located at the southern end of the Balmain peninsula. The facility occupies approximately 40 hectares of waterfront land and forms a crescent around White Bay, with a water frontage of about 2,100 m in length.

The facility layout comprises the following main elements:

- Five multiple-use berths spread along the northern side of White Bay;
- Storage warehouse situated to the northeast of White Bay, Berth 4 (WB-4); and
- Internal road continuing from Robert Street providing truck access to storage areas of Docks 1 to 6.

The Glebe Island facility which includes two multiple-use berths and two car terminal berths is located adjacent to the White Bay Port on a neighbouring peninsula south of White Bay.

Berth 4 is located approximately in the middle of the northern side of White Bay, as shown in **Figure 1**. To the north and northwest of the site is a mixture of residential dwellings consisting of 1 and 2 storey detached houses and terraces. A number of recently constructed 4 and 5 storey residential developments are situated directly west of Berth 4 and incorporate acoustic façade treatments to achieve satisfactory internal noise levels. In addition, buildings in direct view were designed to provide significant acoustical shielding to the rest of the development. The storage warehouse (on port land) to the northeast of WB-4 is about 20 m at the highest point and provides significant acoustic shielding to the residential properties directly behind. To the southeast of the site is Glebe Island, another working port area with four berths, two of which are currently used as car terminals and two as multiple-use berths. To the southeast of WB-4, about 550 m across the water, is the Pyrmont Peninsula, with a number of high-rise residential apartments near the waterfront.

### 2.1 Measurement Locations

The Noise Impact Assessment (NIA) Study (Report Number 10-4309-R1 prepared by Heggies) for the proposed bulk liquid terminal operation has previously identified 5 Waite Street and 36 Refinery Drive as the most affected receiver locations within the Balmain / Rozelle and Pyrmont / Glebe areas respectively.

For the current study, in the Balmain / Rozelle area, monitoring was carried out only at 13 Donnelly Street (also assessed in the noise impact assessment) due to the availability of day/night access to the property boundary. Note that noise measurements at 13 Donnelly Street can be carried out off street, whereas at 5 Waite Street noise measurements require backyard access. Furthermore, the location at 13 Donnelly Street is in close proximity of 5 Waite Street. It is approximately the same distance away and is also directly exposed to unloading operations at WB-4. It is therefore considered to be of similar acoustical environment to that of 5 Waite Street, Balmain.

The monitoring location at 36 Refinery Drive, identified by the NIA as the most affected receiver in the Pyrmont / Glebe area, was found to be exposed to high levels of traffic related noise from the Anzac Bridge. Giba Park (a publicly accessible park situated at the top of the 4 level apartment complex at 2 Point Street) was therefore selected as the representative measurement location for the Pyrmont / Glebe area, as it allowed ship noise measurements to be taken in the relative absence of traffic noise. Giba Park is considered to be equivalent to level 5, 2 Point Street.



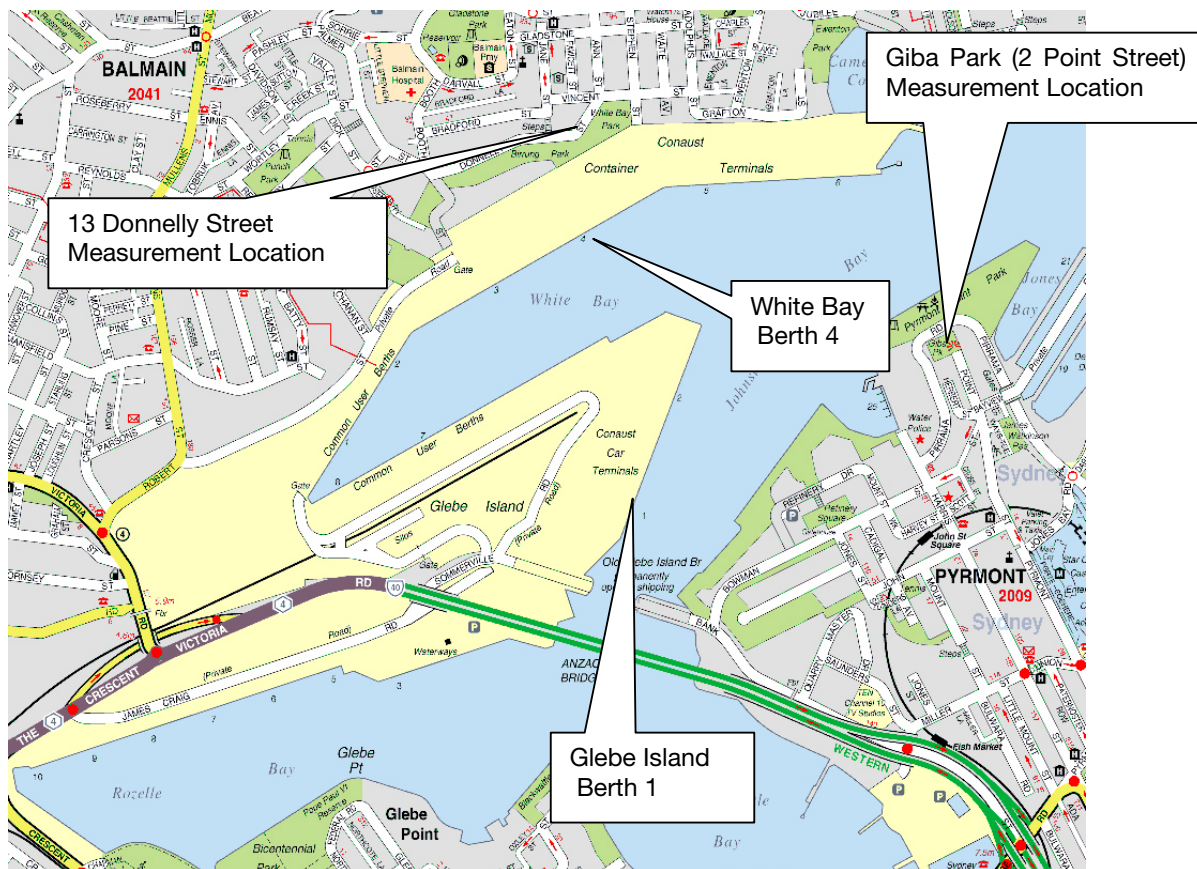
**Table 1** summarises the receiver locations where measurements were conducted in each area and gives a brief description of each location. A more detailed description and photos of the selected monitoring locations are presented in **Appendix B** and **Appendix C**.

**Table 1 Representative Receiver Locations**

<b>Location</b>	<b>Representative Receiver Location</b>	<b>Description</b>
Balmain and Rozelle	13 Donnelly Street, Balmain	Ground level at the front of residence, about 7 m away from the facade
Pymont and Glebe	2 Point Street, Pymont	At Giba Park, on top of a 4 storey building at 2 Point Street (ie height equivalent of a 5 storey building)
Reference Measurement	White Bay Berth 4 Deck	On deck of White Bay Berth 4, and approximately 40 m from the ship rear engine room/exhaust stack area, the main source of noise from the Sichem Defender vessel



Figure 1 White Bay / Glebe Island Layout with Attended Noise Monitoring Locations







### 3 EPA LICENCE NOISE GOALS

For the purpose of the bulk liquid cargo handling operations at White Bay Berth 4 (WB-4), the Environment Protection Licence granted by the EPA sets out the project noise goals at the neighbouring residential communities. The noise goals are set out in Table U1 of the Licence conditions and reproduced in **Table 2**.

**Table 2 EPA License Noise Goals (Reproduced from Table U1)**

Location	Night		
	LAeq(15minute)	LAeq(Night)	LAmx
Balmain and Rozelle	49 dBA	41 dBA	59 dBA
Pymont and Glebe	41 dBA	Not Applicable	51 dBA

Explanatory notes:

1. LAmx means maximum A-weighted sound pressure level measured on fast time weighting during the time over which sound is measured.
2. All other acoustic terms including 'night' have the same meaning as in the INP.
3. Not Applicable: In instances where the amenity criteria LAeq(Night) has been determined to be a higher number than the intrusive criteria LAeq(15minute) that the amenity criteria is less stringent than the intrusive criteria, then the amenity criteria becomes 'not applicable'. This is because compliance with the criteria will ensure compliance with the intrusive criteria will ensure compliance with the amenity criteria.



## 4 MEASUREMENT METHODOLOGY AND INSTRUMENTATION

The licence calls for  $L_{Aeq}$  (A-weighted equivalent continuous) sound pressure level measurements to be carried out at locations representative of those potentially most affected (ie, waterfront) locations during periods of inactivity (eg, ship Auxiliary Power Units (APUs) operating) and during unloading operations (eg, ship pumps and truck activity on the wharf in addition to APUs), in accordance with Clause M7.1 (2).

A window of opportunity to measure ship noise levels during periods of unloading inactivity exists immediately after the ship berths, while the unloading equipment is being set up (hoses unrolled and connected to the ship's manifold etc). The equipment setup phase usually lasts less than 2 hours, after which the unloading is continuous, with at least two road tankers filling the ship at any one time. Ship noise measurements during periods of activity can be measured at any time after unloading commences.

The previous ship noise monitoring report prepared by Heggies (Report Number 10-4309-R2 Revision 1) concluded that measurements are best carried out at night (preferably after 1.00 am). Extraneous noise (not related to the subject activity) is generally at a minimum at this time and measurement results are consequently likely to be much more meaningful.

The bulk liquids ship Sichem Defender berthed at approximately 3.00 pm on Thursday 3 May 2007. Measurements were conducted between 1.10 am and 4.00 am on 4 May following the arrival of the vessel.

Attended noise level measurements were carried out at 1.5 m above ground level at 13 Donnelly Street and 1.5 m above ground level at Giba Park, located on top of the residential apartment complex at 2 Point Street, Pyrmont.

As a result of fan noise from local traffic and domestic activity, direct measurements of the bulk liquids loading related noise at the representative receivers was potentially influenced by noise from these sources.

A "reference" measurement was conducted in close proximity to the Sichem Defender, where the noise environment was dominated by bulk liquids unloading related noise. The "reference" measurement was then used as a basis for the estimation of WB-4 activity related noise at the receivers of interest.

An equivalent ship sound power level was therefore calculated based on the "reference" measurement and noise contributions related to the bulk liquids cargo handling were estimated at each noise sensitive location. The predicted noise levels were compared with measurements of WB-4 activity related noise at the receivers of interest.

All items of acoustic instrumentation employed during the noise monitoring surveys were designed to comply with the requirements of AS IEC 61672.1 2004: "*Electroacoustics-Sound level meters-Specifications*" and carried appropriate and current NATA (or manufacturer) calibration certificates. Calibration was checked prior to and subsequent to the survey. Any drift in calibration was within 0.5 dBA and considered acceptable.

The survey instrumentation used during the studies is set out in **Table 3**.



**Table 3 Noise Survey Instrumentation**

Type	Serial Number	Instrument Description
2260	2414605	Brüel & Kjær Modular Precision Sound Level Meter
4189	2378026	Brüel & Kjær 12.5 mm Prepolarised Condenser Microphone
4231	2022772	Brüel & Kjær Calibrator

Environmental noise measurements were carried out with reference to the guidelines contained within the NSW Industrial Noise Policy 2000 (INP). In circumstances where it was not practical to carry out measurements at the potentially most affected receiver locations as predicted by the Noise Impact Assessment, locations of similar noise characteristics were chosen, as described in **Section 2.1**.

Given the relatively constant nature of noise related to the bulk liquids cargo handling operations, short-term measurements (of 15 minute duration) were considered to be sufficient to provide an estimate of the  $L_{Aeq(night)}$  noise levels at the selected residential receivers. A brief description of acoustic terminology used in this report is presented in **Appendix A**.

Attended measurements during periods of unloading activity were carried out during the early morning of 4 May 2007, commencing at approximately 1.00 am, as extraneous ambient noise unrelated to port activities is generally at a minimum at this time.

Two separate 15 minute measurements were carried out at the representative Balmain location during cargo handling operations at WB-4, at 1.38 am and 3.34 am.

Two 15 minute noise measurements were also carried out at the representative receiver at the Pyrmont site, at 1.02 am and at 2.14 am. At this location, both measurements were on occasion influenced by local traffic noise and domestic activity.



## 5 RESULTS AND ANALYSIS

The results of the 15 minute duration attended noise measurements are summarised in **Table 4**. Discussion of the results is presented in **Section 6** of this report. It should be noted that the measured noise levels presented below include noise from the bulk liquids cargo handling facility at WB-4 as well as ambient noise unrelated to the facility.

**Table 4 Measured Noise Levels - Unloading Activity**

Address	Start Time	LAeq (15min)	LA90 (15min)	WB-4 Related LAmix Range	Comments
13 Donnelly Street (Balmain / Rozelle)	1.38 am	52 dBA	51 dBA	53 dBA to 58 dBA	WB-4 noise dominates LAeq
	3.34 am	52 dBA	50 dBA	53 dBA to 62 dBA	WB-4 noise dominates LAeq
Level 5, 2 Point Street (Pyrmont / Glebe)	1.02 am	46 dBA	43 dBA	44 dBA to 48 dBA	Sichem Defender "just audible" <sup>1</sup>
	2.14 am	46 dBA	43 dBA	44 dBA to 47 dBA	

Notes 1: During the two measurements at Point Street the LAeq was affected by local traffic and domestic activity

During the first and second measurement at 2 Point Street (at approximately 1.02 am and 2.14 am), an LAeq noise level of 46 dBA was measured on both occasions. During the measurements at Point Street, the ambient noise resulted from local traffic and distant city noise, with seagulls also influencing the LAeq level. During both measurements associated WB-4 ship noise was just audible.

During the first and second measurements at 13 Donnelly Street (at approximately 1.38 am and 3.34 am) noise from WB-4 operations such as the ship APU, wharf based pumps and truck noise was clearly audible. Noise from the ship APU as well as the wharf pumps were the dominant noise sources, and found to be constant in nature.

Noise from trucks was observed to be the main contributor to the maximum (LAmix) noise level events. A summary of the LAmix events at the Balmain site are presented in **Table 5**.

**Table 5 Summary of Attended LAmix Noise Levels at 13 Donnelly Street, Balmain**

LAmix Source	LAmix Range	Notes
Truck air brakes	54 dBA to 60 dBA	Truck air brake noise could be heard from trucks at arrival to the site. The events last for approximately 1 second.
Trucks arriving and leaving the site	53 dBA to 62 dBA	Truck engine noise.
Clunk	53 dBA to 58 dBA	Metal clunk noise could be heard from the site when tank hatches were opened.

**Table 6 Summary of Attended LAmix Noise Levels at 2 Point St Street, Pyrmont**

LAmix Source	LAmix Range	Notes
Clunk	46 dBA to 47 dBA	Metal clunk noise could be heard from the site.
Trucks arriving and leaving the site	44 dBA to 48 dBA	Truck noise was heard from trucks operating on WB 4.



In order to confirm the contribution to the ambient by bulk liquids related noise, noise levels were predicted based on the reference measurement taken in close proximity of the Sichem Defender, where the noise environment was dominated by bulk liquids unloading related noise.

**Table 7** presents the “reference” noise measurements carried out 50 m away from the bulk liquids vessel Sichem Defender, and also 10 m from the generator /pumping unit located on the wharf, where the noise environment was dominated by bulk liquids cargo handling related noise. The first measurement was taken 50 m from the rear of the ship in the direction towards 13 Donnelly Street, Balmain, where ship noise dominated the ambient. The second “reference” noise measurement was taken 10 m from the pump /generator unit that was operational on the wharf.

**Table 7 Sichem Defender “Reference” Noise Level**

Reference	Location	Distance from Source	Height of Source	Start Time	LAeq
1	WB-4	50 m	15 m	02:56 am	64 dBA
2	WB-4	10m	1.5 m	03.15 am	74 dBA

Calculations performed with the reference measurements taken in close proximity of the Sichem Defender vessel indicate bulk liquids unloading related LAeq noise levels at the representative receivers at 13 Donnelly Street and 2 Point Street of 51 dBA and 38 dBA respectively. The predicted levels at 13 Donnelly Street, Balmain agree with the measurements, with a predicted LAeq level of 51 dBA, and measured level of 52 dBA. At 2 Point Street, Pyrmont, the predicted levels are below the measured background or (LA90) of 43 dBA, which is consistent with the ship noise “just” audible.

A comparison of the predicted noise levels with the noise goals listed in the Licence Conditions are presented in **Table 8**, **Table 9** and **Table 10**.

**Table 8 Assessment of Measured/Predicted Noise Levels Against LAeq(15minute) Noise Goals**

Prediction Location	Measured / Predicted LAeq Noise Levels	LAeq(15 minute) Noise Goals	LAeq (15 minute) Exceedance of Licence Goals
13 Donnelly Street (Balmain / Rozelle)	52/51 dBA	49 dBA	Up to 3 dBA exceedance
Level 5, 2 Point Street (Pyrmont / Glebe) <sup>1</sup>	46/38 dBA	41 dBA	No exceedance

Notes 1: At 2 Point Street, the predicted level is considered more representative of WB-4 noise, given the significant contribution to the ambient by other sources at this location, and that WB-4 noise was “just audible” This level meets the 41 dBA licence condition.

**Table 9 Assessment of Measured/Predicted Noise Levels Against LAeq(night) Noise Goals**

Prediction Location	Measured / Predicted LAeq Noise Levels	LAeq(night) Noise Goals	LAeq Exceedance of Licence Goals
13 Donnelly Street Balmain / Rozelle) <sup>1</sup>	52/51 dBA	41 dBA	Up to 11 dBA Exceedance
Level 5, 2 Point Street (Pyrmont / Glebe) <sup>2</sup>	46/38 dBA	N/A	N/A

Note 1: The measured noise level also includes contributions from extraneous noise.

Note 2: At 2 Point Street, the predicted level is considered more representative of WB-4 noise, given the significant contribution to the ambient by other sources at this location, and that WB-4 noise was “just audible”.



**Table 10 Assessment of (WB-4 Related) Measured Noise Levels Against LA<sub>max</sub> Noise Goals**

<b>Measurement Location</b>	<b>Range of Maximum Measured Levels (LA<sub>max</sub> Range)</b>	<b>LA<sub>max</sub> Noise Goals</b>	<b>Range of Recorded LA<sub>max</sub> Exceedances of the Licence Noise Goals</b>
13 Donnelly Street (Balmain / Rozelle)	53 dBA to 62 dBA	59 dBA	Up to 3 dBA exceedance
Level 5, 2 Point Street (Pyrmont / Glebe)	44 dBA to 48 dBA	51 dBA	No exceedance



## 6 DISCUSSION

Predicted ship based LAeq(15minute) noise levels meet the Licence imposed noise goals at the representative location in Pyrmont. At Balmain, the measured noise levels exceed the LAeq(15minute) noise goal by up to 3 dBA, and the LAeq(night) noise goal is exceeded by 11 dBA.

A comparison of the predicted noise levels based on Sichem Defender measurements with those predicted by the NIA model (based on Botany Treasure) indicates that the Sichem Defender is a similar vessel when compared with the Botany Treasure. This observation is supported by noise monitoring results of previously monitored bulk liquids ships to date.

Bulk liquids terminal related maximum (LAmax) noise levels were observed to comply at the representative monitoring location in Pyrmont/Glebe and an exceedance of up to 3 dBA at the representative monitoring location at Balmain, for the duration of attended measurements.

In order to fulfil the requirement of Licence Condition R4.1, and in relation to compliance with Licence Conditions O4.1 and O4.2, the potential in-concept noise control measures are discussed below for the sources identified during the attended monitoring.

A Revised Noise Impact Mitigation and Management Strategy (Report No 10-4309-R10 Revision1) has been prepared for the operation. Taking into consideration the infrequency and limited duration of the operation, expected costs, development times, uncertainty of effective outcome, and the impact on flexibility in relation to ships that may be used in the operation, the implementation of ship specific engineering noise control measures is not considered practical nor reasonable within the Revised Noise Impact Mitigation and Management Strategy. Instead, the document recommends an on-site mitigation management strategy be implemented based on operator awareness and procedures to identify and repair abnormally noisy equipment, as outlined within the Noise Impact Mitigation Action Plan.



## 7 CONCLUSION

Noise measurements were carried out during the Sichem Defender cargo handling operations in the early morning of 4 May 2007. The measured noise levels were found to be potentially influenced by local traffic and domestic activity. A reference noise measurement was therefore carried out in close proximity to the Sichem Defender vessel, where the noise environment was dominated by the WB-4 based bulk liquids cargo handling noise sources. The reference noise level was then used to predict noise levels at the representative receivers, for comparison with the attended measurements.

Predicted ship based  $L_{Aeq(15\text{minute})}$  noise levels meet the Licence imposed noise goals at the representative location in Pyrmont. At Balmain, the measured noise levels exceed the  $L_{Aeq(15\text{minute})}$  noise goal by up to 3 dBA, and the  $L_{Aeq(\text{night})}$  noise goal is exceeded by 11 dBA.

Bulk liquids terminal related maximum ( $L_{Amax}$ ) noise levels were observed to cause no exceedance at the representative monitoring location in Pyrmont/Glebe and an exceedance of up to 3 dBA at the representative monitoring location at Balmain, for the duration of attended measurements.

Potential noise control measures that may be considered to meet the Licence imposed noise goals (as required by Condition R4.1) subject to feasibility, practicality and reasonability, include a combination of applying engineering noise control measures to trucks and an on-site noise management strategy. Noise impact mitigation measures have been evaluated in the Revised Noise Impact Mitigation and Management Strategy (Report 10-4309-R10 Revision 1), with a list of mitigation measures considered feasible and reasonable identified in the Noise Impact Mitigation Action Plan.



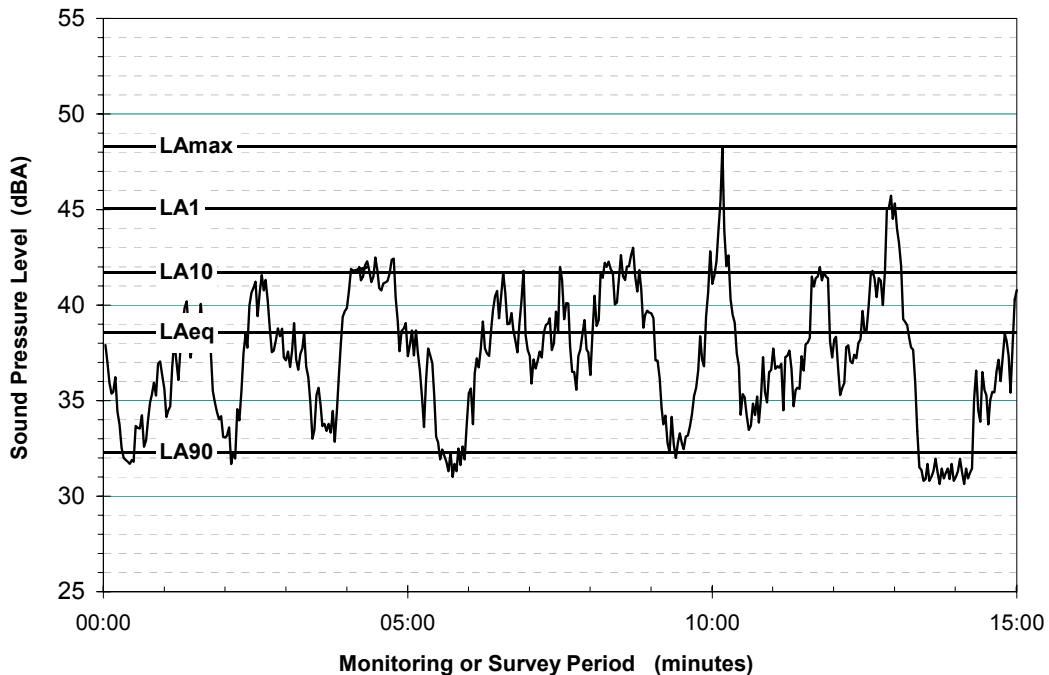
## ACOUSTIC TERMINOLOGY USED IN THE REPORT

### Typical Noise Indices

This Report makes repeated reference to certain noise level descriptors, in particular the LA10, LA90 and LAeq and LAm<sub>ax</sub> noise levels.

- The LA10 is the A-weighted sound pressure level exceeded 10% of a given measurement period and is utilised normally to characterise typical maximum noise levels.
- The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period. The LAeq(15hour) is the measurement parameter used to describe the road traffic noise level over the entire daytime (7.00 am to 10.00 pm) period. The LAeq(9hour) is the measurement parameter used to describe the road traffic noise level over the entire night-time (10.00 pm to 7.00 am) period. Similarly, the LAeq(1hour) is the measurement parameter used to describe the road traffic noise level during the loudest 1-hour period during the daytime or night-time periods.
- The LA90 noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the “background” level.
- The LAm<sub>ax</sub> noise level is the maximum A-weighted noise level associated with road traffic movements.

### Graphical Display of Typical Noise Indices



## Typical Noise Levels

The following table presents examples of typical noise levels.

**Typical Noise Levels**

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerb side of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to Quiet
50	General Office	
40	Inside private office	Quiet to Very quiet
30	Inside bedroom	
20	Unoccupied recording studio	Almost silent

## A-Weighting or dBA Noise Levels

The overall level of a sound is usually expressed in terms of dBA, which is measured using the “A-weighting” filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the “loudness” of that sound. Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

## Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness

## Appendix B

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13 DONNELLY STREET, BALMAIN

### 13 DONNELLY STREET, BALMAIN

The location is situated approximately 170 m away from and directly overlooking White Bay Berth 4 (across the park). It is elevated some 15 m above dock level. The measurement was conducted from street level (from a footpath) with Donnelly Street traffic less than 2 m away.



Aerial Photo showing the monitoring location at 13 Donnelly Street, relative to White Bay Berth 4 (WB-4).



View from WB-4 deck towards 13 Donnelly Street



View from 13 Donnelly St towards the bulk liquids ship, berthed at WB-4

## Appendix C

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2 POINT STREET, PYRMONT

### 2 POINT STREET, PYRMONT

This monitoring location is situated approximately 660 m away from White Bay Berth 4 (across the bay). Monitoring was conducted at a height equivalent of a 5 storey building, on the cliffs edge. Pirrama Road encircles the park from west, north and east sides, approximately 15 m below.



Aerial Photo showing the monitoring location at 2 Point Street, relative to White Bay Berth 4 (WB-4).



View from WB-4 deck towards 2 Point Street



View from 2 Point Street towards the bulk liquids ship berthed at WB-4