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White Bay Berth 4 Bulk Liquids Handling
Stolt Botan
Ship Noise Monitoring Report

Report Number 10-4309-R70

20 June 2016

Port Authority of New South Wales
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Walsh Bay NSW 2000

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Stolt Botan

Ship Noise Monitoring Report

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
10-4309-R70	Revision 0	20 June 2016	John Sleeman	Mark Blake	John Sleeman

Executive Summary

SLR Consulting Australia Pty Ltd (SLR, formerly Heggies Pty Ltd) has been commissioned by Port Authority of New South Wales (formerly Sydney Ports Corporation) to conduct monitoring of noise emissions during the loading of the Stolt Botan (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required under Clause M4.1(1a) of the EPA Environment Protection Licence (EPL, Licence No 12095).

The Stolt Botan vessel berthed at 5:28 pm on 29 May 2016 and departed at 9:09 am the following day. Noise measurements were carried out at nearby residential receivers during Stolt Botan vessel cargo handling operations during the night of 29 May 2016 and early morning of 30 May 2016.

The measured noise levels were found to be influenced by Anzac Bridge traffic, local traffic and the general urban hum. A reference noise measurement was therefore carried out in close proximity to the Stolt Botan 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 and Licence goals. Predicted noise levels represent the noise contribution from only the Stolt Botan vessel operations; whereas the noise levels measured at the receivers contain noise from all the surrounding noise sources such as roads and urban hum, as well as some contribution from the Stolt Botan operations.

At the representative locations in Pyrmont and Balmain, the predicted ship based LAeq(15minute) noise levels meet the Licence imposed noise goals. The predicted LAeq(night) noise level at Balmain was above the noise goal by 6 dBA.

At Balmain, bulk liquids terminal related maximum (LAmax) noise levels meet the EPL imposed noise goal. At Pyrmont bulk liquids terminal related maximum (LAmax) noise levels were not observed.

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 to ensure that noise amenity remains unchanged in the area would be the implementation of 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) together with a list of mitigation measures considered feasible and reasonable identified in the Noise Impact Mitigation Action Plan.

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1 INTRODUCTION

SLR has been commissioned by Port Authority of New South Wales to conduct monitoring of noise emissions during the loading of the Stolt Botan (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required under Clause M4.1(1a) of the EPA Environment Protection Licence (EPL, Licence No 12095).

Noise measurements were conducted when the ship was berthed during cargo handling operations (ship auxiliary 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 at Pyrmont to the east of WB-4. Measurements at both representative locations were conducted during the night-time. The measurements were conducted after the ship arrived, between 10:39 pm on 29 May and 12:24 am on 30 May with the weather consisting of a very slight south easterly wind and clear sky. The noise measurements in these locations contain noise contributions from nearby roads, Anzac Bridge traffic and general urban hum, as well as noise from the operations at WB-4.

An additional reference noise measurement was carried out in close proximity to the Stolt Botan 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 due only to operations of WB-4 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.

The facility layout comprises the following main elements:

- Five multiple-use berths spread along the northern side of White Bay
- Two storage / office buildings located north of White Bay, Wharf 3
- The WBCT building and adjoining car park situated to the northeast of White Bay, Wharf 5 (WB5)
- Internal road continuing from Robert Street providing truck access to the storage areas of Docks 1 to 6.

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

WB-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 4 and 5 storey residential developments are situated directly west of WB-4 and incorporate acoustic facade 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. To the southeast of the site is Glebe Island, another working port area with four 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 Pty Ltd) for the proposed bulk liquid terminal operation has previously identified 5 Waite Avenue and 36 Refinery Drive as the potentially 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 Avenue noise measurements require backyard access. Furthermore, the location at 13 Donnelly Street is in close proximity of 5 Waite Avenue. It is approximately the same distance away and is also directly exposed to loading operations at WB-4. It is therefore considered to be of a similar acoustical environment to that of 5 Waite Avenue, Balmain.

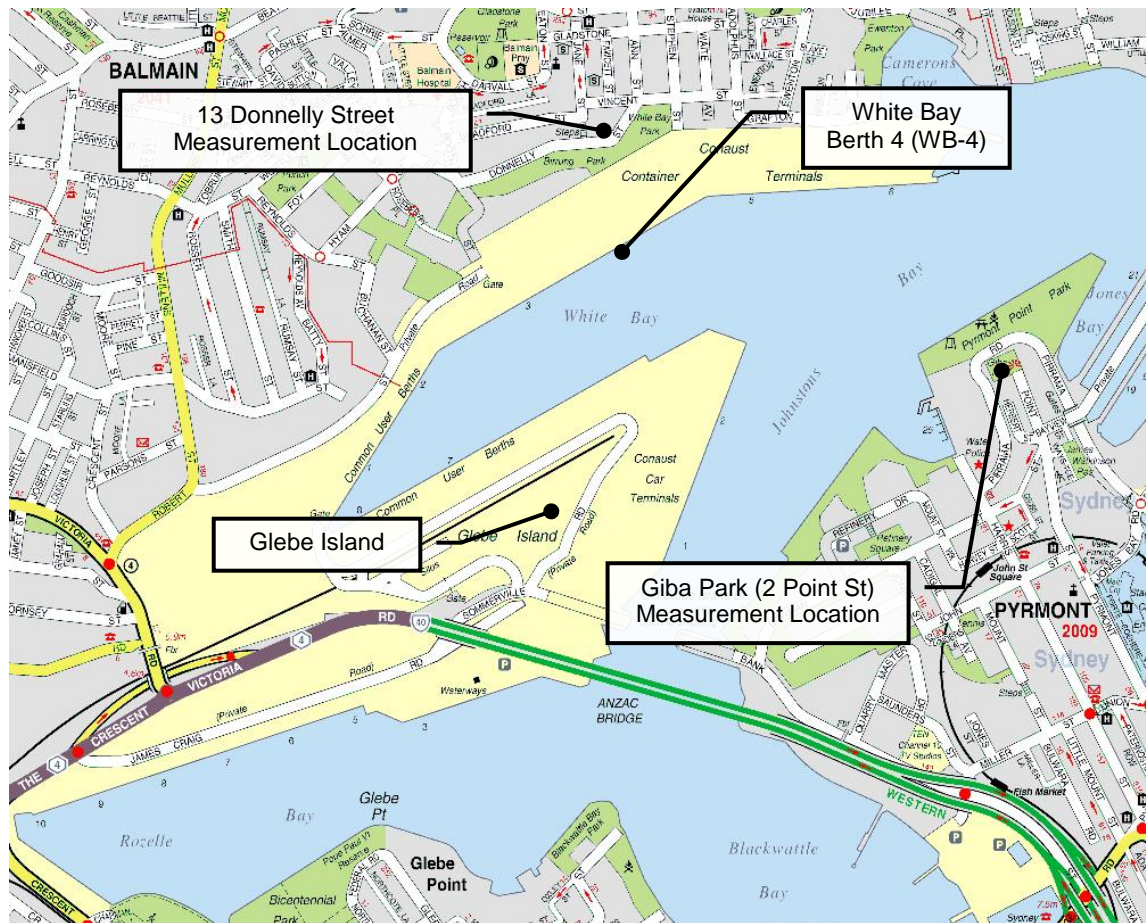
The monitoring location at 36 Refinery Drive, identified by the NIA as being the potentially most affected receiver in the Pyrmont / Glebe area, was found to be exposed to high levels of traffic related noise from the Anzac Bridge. Giba Park (a publicly accessible park situated at the front of the 4 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 acoustically equivalent to 2 Point Street, Pyrmont.

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

Location	Representative Receiver Location	Description
Balmain and Rozelle	13 Donnelly Street, Balmain	Ground level at the side of the residence, level with the façade
Pyrmont and Glebe	2 Point Street, Pyrmont	At Giba Park, in front of 4 storey building at 2 Point Street
Reference Measurement	WB-4 Deck	On deck of WB-4, approximately 65 m from the rear engine room/exhaust stack area, and approximately 6 m from the pumps mechanism on deck, the main source of noise from the activity.

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 (EPL) 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 Licence Noise Goals (Reproduced from Table U1)

Location	Night		
	LAeq(15minute)	LAeq(Night)	LAm _{ax}
Balmain and Rozelle	49 dBA	41 dBA	59 dBA
Pyrmont and Glebe	41 dBA	Not Applicable	51 dBA

Explanatory notes:

1. LAm_{ax} 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 intrusive criteria will also ensure compliance with the amenity criteria.

4 MEASUREMENT METHODOLOGY AND INSTRUMENTATION

The EPL requires LA_{eq} (A-weighted equivalent continuous) sound pressure level measurements to be carried out at locations representative of those potentially most affected (i.e. waterfront) locations during loading operations (e.g. ship pumps and truck activity on the wharf in addition to APUs), in accordance with Clause M4.1(2).

After the ship berths, the equipment is 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 loading is continuous, with up to four road tankers filling the ship at any one time. Ship noise measurements during periods of activity can be measured at any time after loading commences, representing "normal maximum operations".

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. In this instance the measurements were conducted during the early morning period after the ship arrival.

The bulk liquids ship Stolt Botan berthed at 17:28 pm on 29 May 2016 and departed at 9:09 am the following day. Pumping commenced at 6:25 pm on 29 May and was completed at 5:00 am on the 30 May 2016. The measurements were conducted after the ship arrived, and during the night-time for comparison with the Licence goals. Measurements were conducted between 10:39 pm on 29 May and 12:24 am on 30 May.

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

A reference measurement was conducted in close proximity to the Stolt Botan, where the noise environment was dominated by bulk liquids loading 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 calculated based on the reference measurement and noise contributions related to the bulk liquids cargo handling were estimated at each noise sensitive location.

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 dB 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	2414604	Brüel & Kjær Modular Precision Sound Level Meter
4189	2368563	Brüel & Kjær 12.5 mm Prepolarised Condenser Microphone
4231	2482669	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) are usually considered to be sufficient to provide adequate information to enable 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 of periods of unloading activities were carried out during the night of 29 May 2016, commencing at approximately 10:39 pm.

Two separate 15 minute measurements were carried out at the representative Balmain location during cargo handling operations at WB-4, at 10:39 pm and 11:46 pm on 29 May 2016. At this location, for the first and second measurement, the noise from bulk handling at WB4 was clearly audible and was considered the main contributor to the measurement, with the measurements also potentially influenced by traffic on Anzac Bridge, local traffic and general urban noise.

One 15 minute noise measurement was also carried out at the representative receiver at the Pymont site, commencing at 12:24 am on the 30 May 2016. At this location, the vessel was 'just' audible. The measurement was generally influenced by Anzac Bridge and City West Link traffic as well as the general urban hum.

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 — Ambient Noise and Unloading Activity

Address	Start Time	L_{Aeq} (15min)	L_{A90} (15min)	WB-4 Related L_{Amax} Range	Comments
13 Donnelly Street (Balmain/Rozelle)	10:39 pm	50 dBA	49 dBA	51 dBA to 58 dBA	L_{Aeq} influenced by WB-4 noise during both surveys. Anzac Bridge traffic audible. Estimated WB-4 contribution: 50 dBA.
	11:46 pm	49 dBA	47 dBA	52 dBA to 58 dBA	
Level 5, 2 Point Street (Pymont/Glebe)	12:24 am	49 dBA	46 dBA	Non observed	Stolt Botan 'just' audible. Ambient by Anzac Bridge city hum and park watering system.

During the measurements at 13 Donnelly Street (at approximately 10:39 pm and 11:46 pm) noise from WB-4 operations such as the ship APU was clearly audible. Noise from the ship APU (engine + fans) and pumps were considered to be the dominant sources influencing the L_{Aeq} noise level and were found to be constant in nature. The L_{Aeq} was also potentially influenced by the Anzac Bridge traffic during both surveys.

During the measurement at Point Street, the measured ambient noise was predominantly influenced by Anzac Bridge and City West Link traffic as well the general urban hum or city noise. Noise from the vessel berthed was 'just' audible at Pymont.

Noise from intermittent wharf activity (truck and wharf related noise) was audible at Balmain, with a summary of the L_{Amax} noise events at the site presented in **Table 5**. No noise from intermittent ship activity was observed at Pymont.

Table 5 Summary of Attended L_{Amax} Noise Levels at 13 Donnelly Street, Balmain

L _{Amax} Source	L _{Amax} Range	Notes
Wharf impact noise	51 dBA to 53 dBA	Impact noise from the wharf.
Truck engine	53 dBA to 58 dBA	Truck engine audible as it both arrived and departed.
Truck parking brake	58 dBA	Air release audible when parking brake engaged.

In order to confirm the contribution to the ambient noise by bulk liquids related noise, noise levels were predicted based on the reference measurements taken in close proximity of the Stolt Botan, where the noise environment was dominated by bulk liquids loading related noise.

Table 6 presents the reference noise measurements carried out on the WB-4 wharf, 67 m away from the exhaust of the vessel, the Stolt Botan, where the noise environment was dominated by bulk liquids cargo handling related noise.

Table 6 Stolt Botan Measured Reference Sound Pressure Levels

Reference	Location	Dominated Source	Distance from Source	Height of Source	L _{Aeq}
1	WB-4	Engine/ APU	67 m	18 m	55 dBA
2	WB-4	Silenced Pump	8 m	1 m	67 dBA

Calculations were performed with the reference measurements taken in close proximity of the Stolt Botan vessel. Therefore, for comparison with the EPL conditions, which are applicable during the night-time period only, calculations were performed in order to determine the L_{Aeq(15minute)} and the L_{Aeq(9hour)} noise levels.

Predictions indicate bulk liquids loading related L_{Aeq(15minute)} noise levels at the representative receiver at 13 Donnelly Street are 49 dBA for the ship (APU + fans) and pumps. At 2 Point Street, the predicted noise level for the ship and pumps is 40 dBA.

The measured L_{Aeq(15minute)} noise level of 49 dBA is similar with the predicted noise level at 13 Donnelly Street, and consistent with influence from Anzac Bridge traffic and the general city ambient noise level during the survey period. The predicted L_{Aeq(15minute)} noise level at 2 Point Street is below the measured ambient noise level at this location and is consistent with WB-4 related noise being slightly audible.

A comparison of the measured and predicted noise levels with the noise goals listed in the Licence conditions is presented in **Table 7**, **Table 8** and **Table 9**.

Table 7 Comparison of Measured/Predicted Noise Levels with L_{Aeq(15minute)} Noise Goals

Prediction Location	Measured/Predicted L _{Aeq} Noise Levels ¹	L _{Aeq(15 minute)} Noise Goals	Assessment against EPL Noise Goals
13 Donnelly Street (Balmain/Rozelle)	49/47 dBA	49 dBA	Complies
Level 5, 2 Point Street (Pyrmont/Glebe)	49/34 dBA	41 dBA	Complies

Note 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 barely audible over the general ambient noise. This level meets the 41 dBA EPL condition.

Table 8 Comparison of Predicted Noise Levels against LAeq(night) Noise Goals

Prediction Location	Predicted LAeq Noise Levels ¹	LAeq(night) Noise Goals	Assessment against EPL Noise Goals
13 Donnelly Street Balmain/Rozelle)	47 dBA	41 dBA	6 dB above
Level 5, 2 Point Street (Pyrmont/Glebe)	40 dBA	N/A	N/A

Note 1: The predicted LAeq(9hour) night-time level is the same as the predicted LAeq(15minute) noise level presented in Table 7 as a result the ship being loaded for 7 hours of the 9 hour night-time period .

Table 9 Assessment of (WB-4 Related) Measured Noise Levels against LAmax Noise Goals

Measurement Location	Range of Maximum Measured Levels (LAmax Range)	LAmax Noise Goals	Assessment of Measured LAmax Range against EPL Noise Goals
13 Donnelly Street (Balmain/Rozelle)	51 dBA to 58 dBA	59 dBA	Complies
Level 5, 2 Point Street (Pyrmont/Glebe)	Non observed	51 dBA	Complies

6 DISCUSSION

Predicted ship based LAeq(15minute) noise levels meet the EPL imposed noise goals at the representative locations in Pyrmont and Balmain. The predicted LAeq(night) noise level is above the noise goal by 6 dB at Balmain.

Bulk liquids terminal related maximum (LAmax) noise levels were not observed at Pyrmont. At Balmain, bulk liquids terminal related maximum (LAmax) noise levels comply with the EPL goal.

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

A Revised Noise Impact Mitigation and Management Strategy (Report No 10-4309-R10 Revision 1) 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 Noise 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 Stolt Botan bulk liquids cargo handling operations during the night of 29 May and early morning of 30 May 2016. The measured noise levels were found to be potentially influenced by road traffic noise (Anzac Bridge and City West Link) and the general urban hum. A reference noise measurement was carried out in close proximity of the Stolt Botan 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 EPL imposed noise goals at the representative locations in Pyrmont and Balmain. At Balmain, the predicted $L_{Aeq(\text{night})}$ noise level is above the noise goal by 6 dB.

At Balmain, bulk liquids terminal related maximum (L_{Amax}) noise levels meet the EPL imposed noise goal. At Pyrmont bulk liquids terminal related maximum (L_{Amax}) noise levels were not observed.

Potential noise control measures that may be considered to meet the EPL 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.

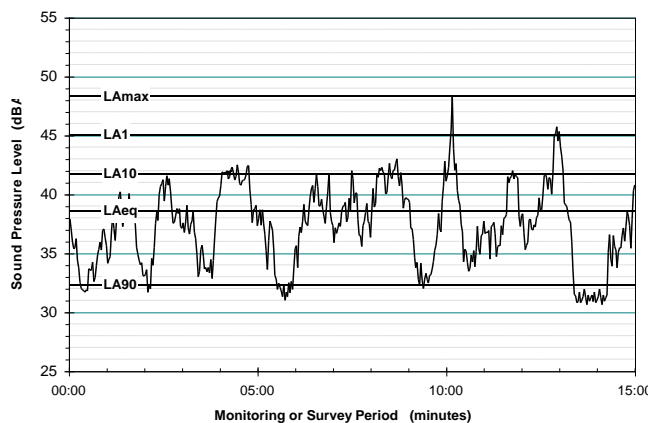
ACOUSTIC TERMINOLOGY USED IN THE REPORT

Typical Noise Indices

This Report makes repeated reference to certain noise level descriptors, in particular the LA10, LA90 and LAeq and LAmax 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(period) is the measurement parameter used to describe the average sound level over the period. For daytime the period is 7 am to 6 pm, for evening 6 pm to 10 pm, and for night-time 10 pm to 7 am.
- 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 LAmax is simply the maximum noise level and is often represented by the LA1(1min), being the level exceeded 1% of 1 minute, ie the noise level exceeded for 0.6 of a second.

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).

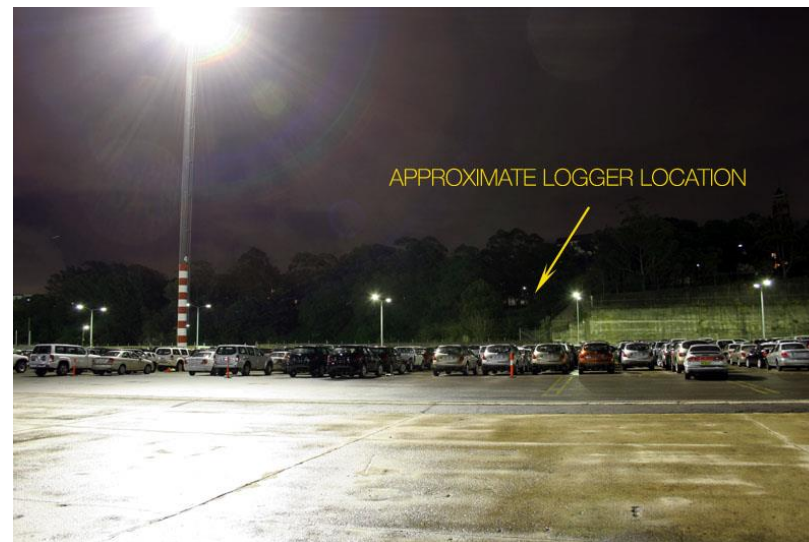
Sensitivity of People to Noise Level Changes

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.

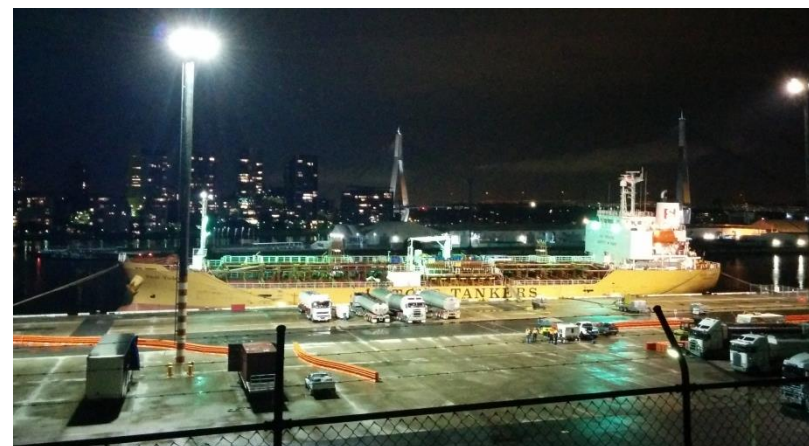
The location is situated approximately 170 m away from and directly overlooking White Bay Berth 4 (across the park). It is elevated some 15 m above dock level. The measurement was conducted from street level (from a footpath) with Donnelly Street traffic less than 2 m away.



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

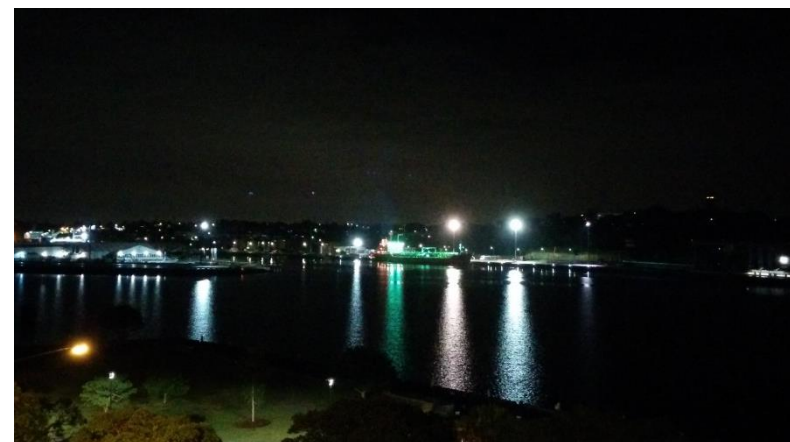
This monitoring location is situated approximately 660 m away from White Bay Berth 4 (across the bay). Monitoring was conducted at a height equivalent of a 5 storey building, on the cliffs edge. Pirrama Road encircles the park on the western, northern and eastern sides, approximately 15 m below.



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 St towards the bulk liquids ship, berthed at WB-4