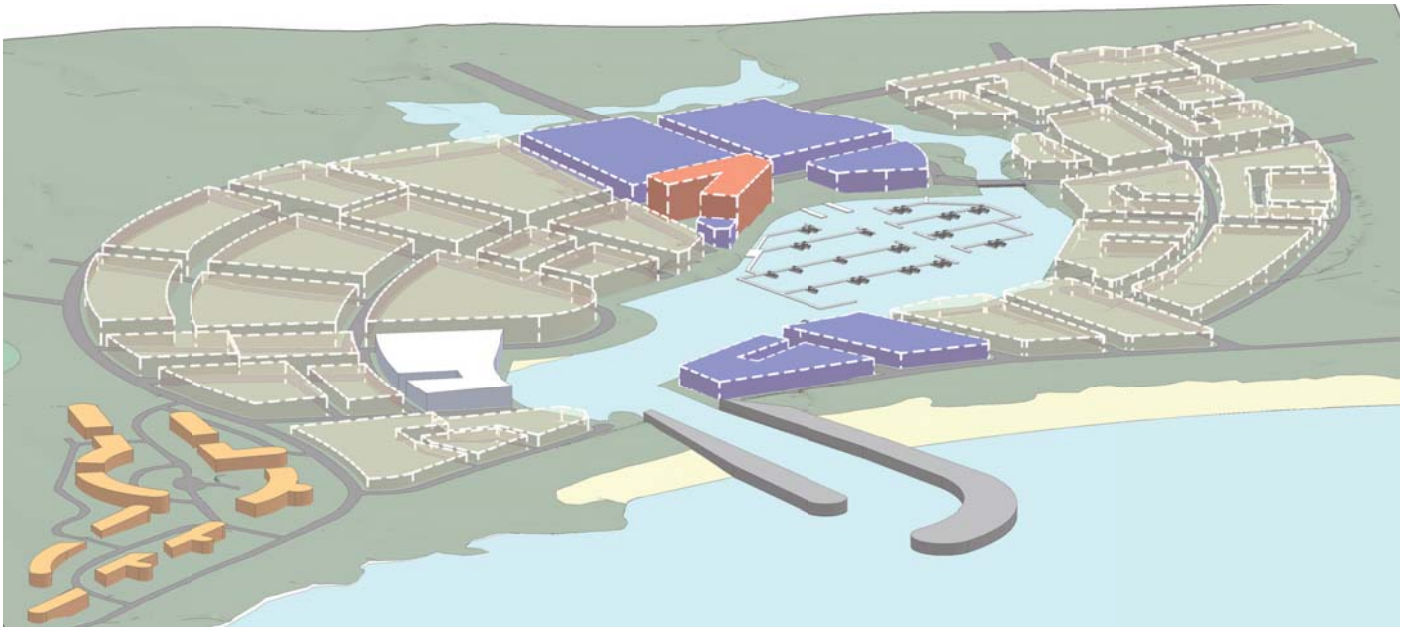

Shell Cove
Boat Harbour Precinct

Concept Plan Application and Environmental Assessment Appendix J - Air Quality and Noise

prepared by LFA (Pacific) Pty Ltd

date February 2010

SHELL COVE-BOAT HARBOUR PRECINCT - CONCEPT PLAN APPLICATION

ASSESSMENT OF AIR QUALITY AND NOISE

ACOUSTICS AND AIR

REPORT NO. 05135-CP
VERSION E

WILKINSON MURRAY

SHELL COVE-BOAT HARBOUR PRECINCT - CONCEPT PLAN APPLICATION

ASSESSMENT OF AIR QUALITY AND NOISE

REPORT NO. 05135-CP
VERSION E

JANUARY 2010

PREPARED FOR

AUSTRALAND HOLDINGS PTY LTD
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TABLE OF CONTENTS

1 INTRODUCTION

Australand Corporation Pty Limited (Australand) is proposing to construct a development at Boollwarroo Parade, Shell Cove, Shellharbour, known as the Shell Cove, Boatharbour Precinct. The development will require subdivision and will include the following facilities:

- Residential
- Commercial
- Retail
- Hotel
- Marina Facilities
- Public Parklands
- Technology Park

Wilkinson Murray Pty Limited has been commissioned to address specific updated Director General Environmental Assessment Requirements (DGRs) in support of a Concept Plan Application for Major Projects as per Part 3A of the Environmental Planning & Assessment Act 1979. The DGRs were provided in a letter dated 9th November, 2007 from Department of Planning (DoP) to Australand for Major Projects Application Number MP07_0027.

The specific DGRs to be addressed by WM are as follows:

- 9.1 Address potential noise impacts, in particular noise from the adjacent quarry and road traffic noise, for future residents and appropriate noise mitigation methods
- 9.3 Address NSW Action for Air and Action for Transport Plans

With respect to noise, the development has been assessed primarily in accordance with the following policy guidelines published by the NSW Department of Environment, Climate Change & Water (DECCW):

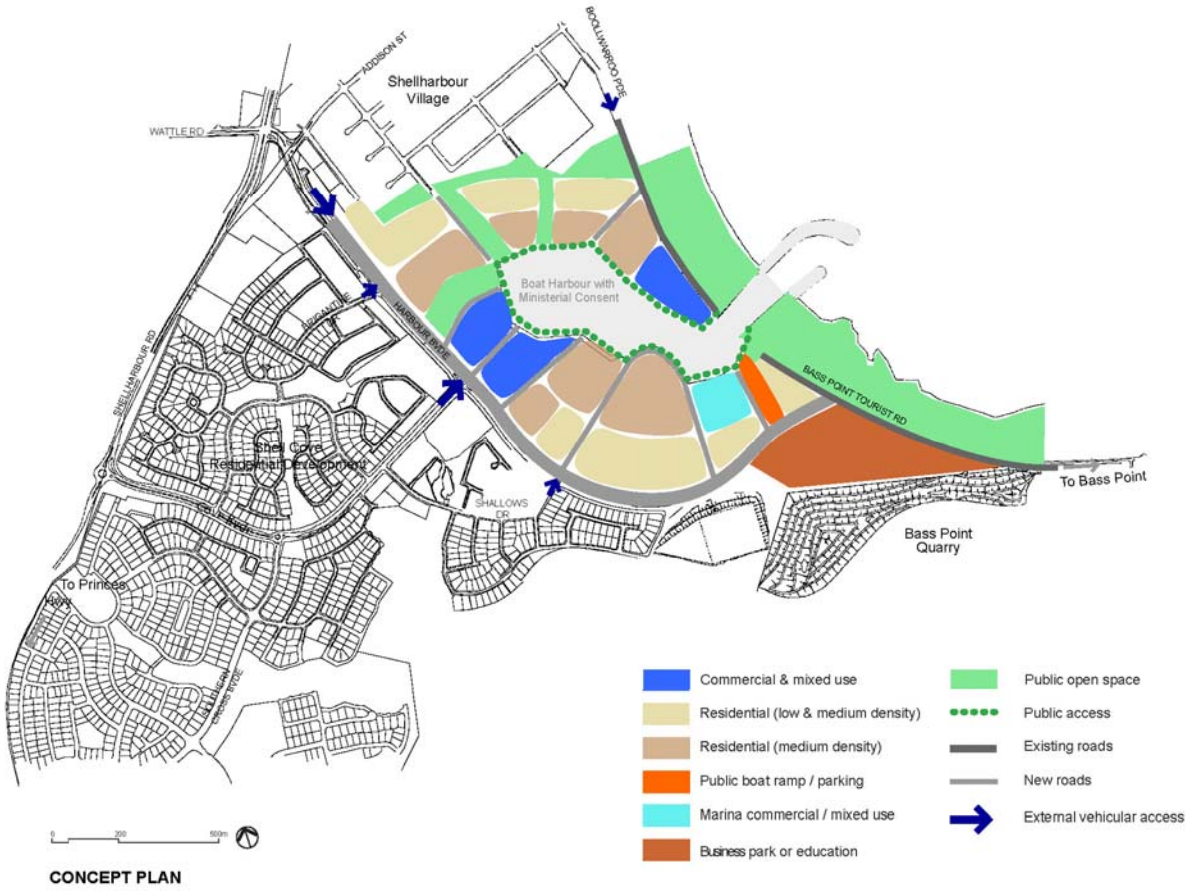
- NSW Industrial Noise Policy (INP), dated January 2000; and
- Environmental Criteria for Road Traffic Noise (ECRTN), dated May 1999.

2 SITE DESCRIPTION

The existing site is a mixture of disused farming land, an abandoned golf course, and public reserve. The proposed development is illustrated on Figure 2-1. The Figure 2-1 shows the preliminary master plan for the development which includes areas allocated to standard residential lots, medium density lots, apartment lots, mixed commercial and residential, and a technology park in the southern section of the development.

Surrounding the development are the existing township of Shellharbour to the north, separate housing development to the west, and to the south an existing quarry called Bass Point Quarry (but owned by Hanson Mining). The private haul road to the quarry (Bass Point Quarry Road) borders the south of the proposed site.

Figure 2-1 Concept Plan

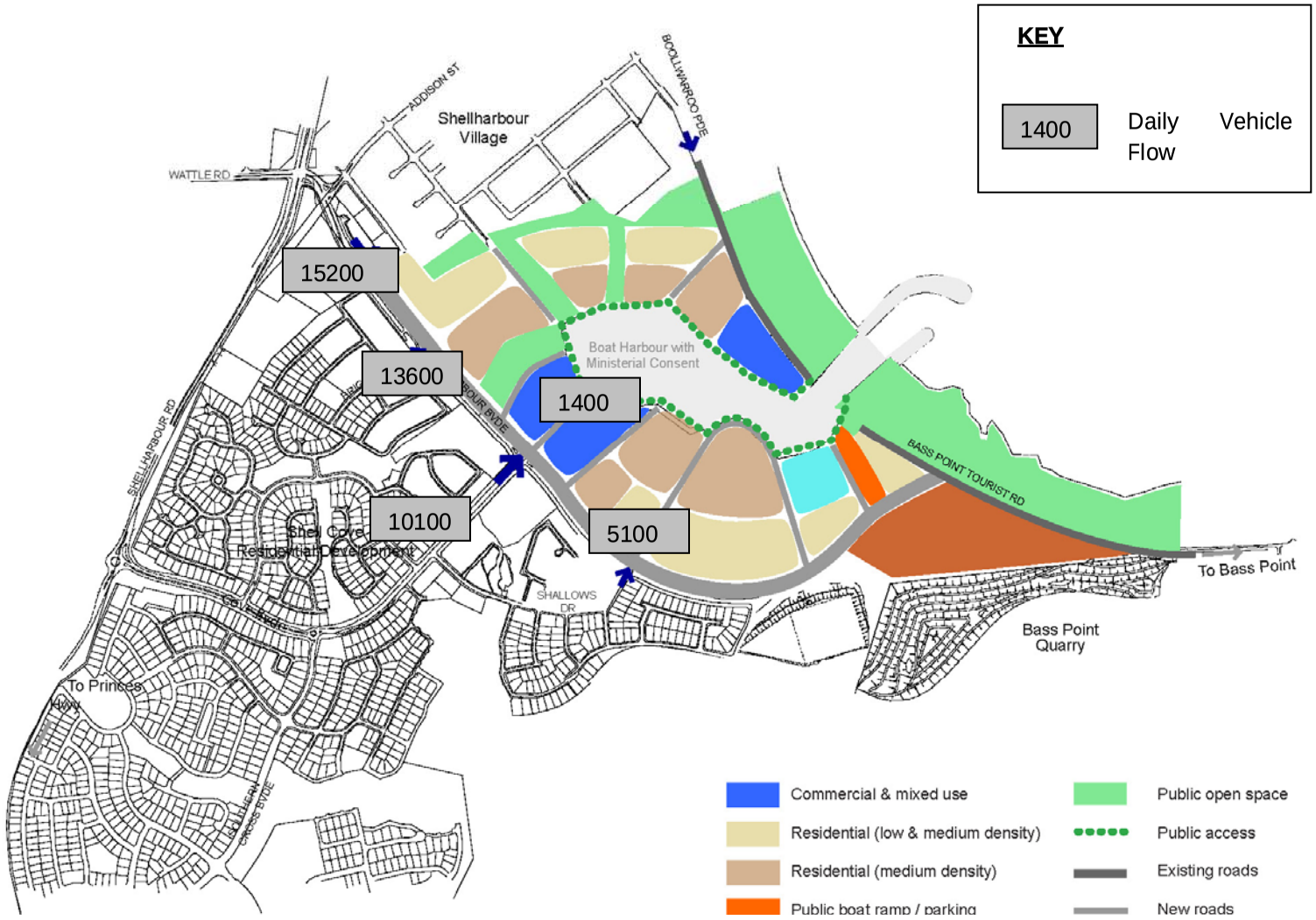


3 TRAFFIC NOISE

3.1 Proposed traffic network

As part of the development there will be roads built to provide access to the site and access within the site. The main road network and the predicted daily vehicle flows are shown on Figure 3-1.

Figure 3-1 Road Network and predicted daily vehicles flows



3.2 Traffic Noise Criteria

The guideline traffic noise criteria for new residential developments affected by the traffic noise are given in the DECCW ECRTN.

The ECRTN classifies roads according to their size, and gives different noise criteria for arterial, collector, and local roads. For development we would classify Harbour Boulevard, and Cove Boulevard west of Harbour Boulevard as collector roads, and the internal roads within that development as local roads. The noise criteria are:

- For residential developments exposed to collector roads — $L_{Aeq,(1hr)}$ 60 at day time and L_{Aeq} 55 at night time; and
- For residential developments exposed to traffic noise from local roads — $L_{Aeq,1hr}$ 55dBA for daytime and $L_{Aeq,1hr}$ 50dBA for night time.

(Note that these criteria refer to noise over a 1hour period, defined in the ECRTN as the tenth percentile hourly A-Weighted L_{Aeq} level during the daytime or night time period. In the noise predictions below this is represented by the noise during the busiest hour of the day.)

The ECRTN guideline states that for a new development all mitigations that are feasible and reasonable should be implemented in order to achieve these external noise and criteria.

In some cases it would not be reasonable or feasible to meet these criteria. In such cases the internal noise levels of the residential buildings should be designed to achieve satisfactory levels.

In considering external and internal noise levels at a new development, all aspects of the building design can be used to achieve satisfactory acoustic outcomes. Some examples of good acoustic design are: maximising the setback from the road; shielding of residential facades by commercial properties; and siting of sensitive rooms and ventilation openings in shielded parts of the building.

The new infrastructure State Environment Protection Policy recommends interior traffic noise levels for residential developments for busy roads. However, the principles would be relevant for this project.

Interior traffic noise levels for residential developments are given in Table 3-1.

Table 3-1 Recommended Interior Levels

Type of Occupancy	Recommended Maximum Sound Level, L_{Aeq}dB(A)	Applicable Period for Noise Metric*
Sleeping areas (bedrooms)	35	Night, 9 hour period (10pm – 7am)
Living areas (habitable rooms other than bedrooms)	40	Day, 15 hour period (7am – 10am)

Note: * consistent with Australian Standards and the external noise criteria set out in the NSW 'Environmental Criteria for Road Traffic Noise'

3.3 Traffic Volumes

The predicted traffic volumes at various locations on the proposed network have been provided by Australand. They are given in Table 3-2. Daily vehicle profiles and mix of heavy and light vehicles are described after the table.

Table 3-2 Daily traffic volumes

Street Name	Location	Vehicles per day at Full Development	Speed (km/hr)	% Heavies	
				Day	Night
Southern Cross Bvd	south of Cove Bvd	6900	60	4	2
	east of Shellharbour Rd	5900	60	4	2
Cove Bvd	east of Shellharbour Rd	16500	60	4	2
	east of Southern Cross Bvd	11500	60	4	2
	west of Harbour Boulevard	10100	50	4	2
	east of Harbour Boulevard	1400	40	3	1
Shellharbour Rd	north of Mary St	37100	80	5	8
	south of Wattle Rd	22700	80	5	8
Harbour Boulevard	north of Addison St	19100	60	4	2
	north of Brigantine Dr	15200	60	4	2
	north of Cove Bvd	11800	50	4	2
	south of Cove Bvd	13600	50	4	2
	north of Shallows Dr	5100	50	3	1
	south of Shallows Dr	5900	50	3	1
Bass Point Rd	east of Harbour Bvd	5700	60	2	1
	south of Tech Park	1900	60	2	1

Note: Based on 30,000sqm GFA Tech Park

The noise criteria are based on the worst case hourly flow. The predicted highest hourly flow would occur between 5.00pm and 6.00pm. The flow in that period is expected to be approximately 8% of the daily vehicles.

The average daytime flow is approximately 6% of the daily flow per hour. The average night time flow is approximately 1.2% of the daily flow. These values were used to determine $L_{Aeq,15hour}$ and $L_{Aeq,9hr}$ respectively.

3.4 Predicted Traffic Noise Levels

The predicted noise level depends on a number of factors.

Noise levels from the proposed roads were predicted using procedures based on the CoRTN prediction algorithms. The standard CoRTN prediction procedures were modified in the following ways.

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CoRTN algorithms using the well-validated approximation $L_{Aeq,1hr} = L_{A10,1hr} - 3$.
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representing typical values for Australian vehicles. Noise from a heavy vehicle exhaust was assessed as 8dBA lower than the noise from the engine. The combined noise from heavy vehicle exhaust and engine gives the sound level as defined in CoRTN. The acoustical energy for the various sources are then derived from speed, road surface and traffic volume.
- Small negative corrections for "Australian conditions", derived from documented validation of the CoRTN algorithms, have been included, both for calculations with and without Facade correction.
- Facade correction was used for all calculations.
- Ground was assumed to be 50% soft.

Initial analysis of the traffic flow shows that the noise is predominantly generated during morning and afternoon peak times. The night time noise levels are 7dBA quieter than the daytime noise levels (that is the loudest night time hour from 6am to 7am). As the criteria for night and day are only 5dBA different, the noise impact will be determined by daytime noise levels. Hence the following analysis focuses on the daytime noise impacts.

Typically in standard blocks and medium density blocks the bedrooms will be on upper levels. It is usual therefore to assess daytime levels to the ground floor, and night time noise to the upper levels.

Table 3-3 shows that the predicted noise level within 20m of the kerb would exceed the guidelines by 5-10 dBA at all locations except residences along Cove Boulevard east of Harbour Boulevard.

At 40m from the kerb the exceedances would be up to 7dBA along the busier sections of Harbour Boulevard.

Table 3-3 Predicted Traffic Noise Levels

Street Name	Location	Highest daytime hourly traffic flow	Daytime Noise Levels, $L_{Aeq,1hr}$		Night time Noise Levels, $L_{Aeq,1hr}$		Affected Blocks
			- 20m – from kerb	- 40m – from kerb	- 20m – from kerb	- 40m –from kerb	
Cove Boulevard	east of Harbour Boulevard	116	54	51	47	44	Commercial
Harbour Boulevard	north of Brigantine Dr	1262	70	67	63	60	Residential
	north of Cove Bvd	979	67	64	60	57	Commercial and Residential
	south of Cove Bvd	1129	66	63	59	56	Commercial
	north of Shallows Dr	423	64	61	57	54	Residential
	south of Shallows Dr	490	65	62	58	55	Residential
Bass Point Rd	east of Harbour Bvd	473	60	57	53	50	Residential

3.5 Recommendations

Table 3-3 shows that predicted traffic noise will exceed the L_{Aeq} 60dBA criterion at residences along Harbour Boulevard within approximately 40 metres of the road, depending on the particular block.

Noise Mitigation from this road could take several forms. A noise barrier could be used to protect residences at low level. In most cases, because the road will be higher than the bottom of the residences, such a barrier would also be effective at the first floor. However, to protect satisfactorily residences above, say, level 2 of an apartment building, unreasonably high noise barriers would be required. Low noise pavements could be used through Harbour Boulevard. Residential Facades experiencing noise levels above 60dBA could incorporate noise reduction features such as laminated glazing. This would provide satisfactory internal noise levels, however, would require the addition of air-conditioning or fresh air ventilation to the rooms to allow the windows to remain closed.

Example noise treatments to facades within 40m of the road are given in Table 3-4. These apply to facades facing the roads, or to side facades that are not shielded from the road by other parts of the building.

A low noise pavement would reduce noise from the road by approximately 3dBA at all residences. In this case the recommendations in Table 3-4 would apply to facades within 20m of the road.

Table 3-4 Examples of noise mitigation for facades within 40m of road (or 20m if low noise pavement is used)

Type of dwelling	Ground floor	Upper floor(s)
Apartments Harbour Boulevard	6mm laminated glazing, mechanical ventilation	6mm laminated glazing, mechanical ventilation
Medium Density, Apartment	Boundary fence OR 6mm laminated glazing and mechanical ventilation	6mm laminated glazing, mechanical ventilation
Medium Density	Boundary fence OR 6mm laminated glazing and mechanical ventilation	6mm laminated glazing, mechanical ventilation
Medium Density, Standard	Boundary fence OR 6mm laminated glazing and mechanical ventilation	Mechanical ventilation
Single Dwelling, Medium Density, Apartment	Boundary fence OR 6mm laminated glazing and mechanical ventilation	6mm laminated glazing, mechanical ventilation

4 NOISE FROM BOAT STORAGE

Boat storage is one of the potential uses of the mixed use precinct within the Boat Harbour. A dry stack building has been proposed adjacent to the public boat ramp. Two options were developed during the design process and presented in the Concept Application and Environmental Assessment (January 2010); one option orients the dry stack building north/south, the other east/west.

Typically dry stack facilities are busiest during daytime hours, with activity commencing at 6.00am. The noisiest activity at dry stack facilities is the forklift. Car movements might also be significant at night time, depending on the design of the facility. With judicious design the facility would cause minimal noise impact, and could be operated on a 24hour basis if necessary.

Recommendations for noise control would include:

- Purchase of lowest noise level fork lift for moving vessels;
- Design of facility to maximise shielding to residences from the buildings themselves
- Purpose built shielding (noise walls) to residences not sufficiently protected by building shielding;
- Signage such as "respect our neighbours and depart quietly" at access points near residences;

- Construction materials sufficient to reduce noise transmission through walls - for example no ventilation openings facing neighbours;
- If there is flexibility to do so, night time movements should be to racks furthest from residences;
- No running of boat engines in the facility during night time hours.

5 QUARRY NOISE

5.1 Quarry Description and Operations

The Bass Point Quarry is operated by Hanson Construction Materials Pty Ltd.

The quarry operates 24 hours a day and has an expected lifetime of 56 years.

A private haul road to the quarry is used throughout the day. A noise barrier has been built on the northern side of the haul road to protect all residences along the route. This has been the subject of previous acoustic investigations and the specific noise goals have been determined for the haul road.

It is further proposed to build a mound at the north of the quarry. This would provide some shielding to the QBZ (Quarry Buffer Zone) technical precinct and to some of the residential lots. The plan of the mound has been provided and it is included in the noise model described below.

5.2 Background Noise Levels

This section of the report describes ambient noise measurements as conducted by RHA (RHA Report No. 4264-R1, Revision 1 – Shell Cove Estate – Harbour and Marina Noise and Vibration Impact Assessment, 30 June 1995.), and repeat measurements conducted by Wilkinson Murray between 22 August and 5 September 2005.

According to the RHA report the existing noise environment is predominantly surf, wind and, in some locations, traffic. The only significant sources of industrial noise are the quarry and the haul road at the southern end of the site.

The results of the noise monitoring by Wilkinson Murray and RHA are summarised in Table 5-2. The background noise level quoted is the Rating Background Level (RBL) as defined in the DECCW's INP. The measurement locations are shown on Figure 5-1.

Table 5-1 Long-Term Background Noise Data

Number	Location	Accumulated RBL Noise Levels (dBA)		
		Daytime	Evening	Night Time
1	65 Boollwarroo Parade	42	46	44
2	4 Whitsunday Drive	34	36	35
3	17 William Street	34	35	32

Daytime is defined as 7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm on Sundays & Public Holidays. Evening is defined as 6.00pm-10.00pm Monday to Sunday (including public holidays). Night time is all other times.

Figure 5-1 Background noise measurement locations

Image Source: Dept of Lands

5.3 Noise Criteria

For the quarry operations appropriate noise criteria are specified in the *NSW Industrial Noise Policy (INP)*. The criterion depends on whether existing noise levels in an area are close to recommended amenity levels for different types of residential receiver areas (i.e. urban, rural, near existing roads).

Two criteria are specified in the INP: the intrusiveness criterion and the amenity criterion.

In general, intrusiveness criterion is that the L_{Aeq} noise level from such sources should not exceed the Rating Background Level (RBL) by more than 5dBA.

The amenity criterion sets an upper limit to control the total L_{Aeq} noise level from all industrial sources. In this case, the potentially affected residences in an area which would be classified as "Suburban" and the relevant recommended "acceptable" amenity criteria for $L_{Aeq,}$ period are 55, 45 and 40dBA for daytime, evening and night time periods respectively. Where noise levels are currently low, as is generally the case here, noise levels from the proposed operation are

limited by the intrusiveness criterion. The amenity criterion does not need to be discussed further for this project.

To assign intrusiveness criteria to the various lots in the proposal, the future background noise level was estimated from the measurements in Table 5-1. As measurements at 65 Boollwarroo Parade were significantly influenced by surf noise they would be relevant only to the residences facing the sea. Also, as the density of residences increases in the area the background is likely to increase slightly above the lowest levels measured in William Street. Given these factors, and having regard for the layout of the proposed lots, the criteria in Table 5-2 are proposed.

In Section 6 noise criteria for the quarry haul road are discussed. While they set higher limits than those discussed here for the quarry itself, they are not considered appropriate for all residences in the Boat Harbour Precinct.

Table 5-2 Intrusiveness Criteria

Location	Accumulated RBL Noise Levels (dBA)		
	Daytime	Evening	Night Time
Lots adjacent to the ocean (approximately within 200m of the ocean)	45	45	45
All other lots	40	40	40

5.4 Noise Criteria for Non-Residential Receivers

The INP criteria for relevant non-residential receivers near the quarry are:

- Oval (Active Recreation Criterion) – L_{Aeq} 55dBA when in use; and
- Tech Precinct - L_{Aeq} 65dBA when in use.

5.5 Noise Model

Noise was predicted using the Cadna A software. This software implements the procedures of International Standard *ISO 9613 Acoustics -- Attenuation of sound during propagation outdoors*. This software takes into account:

- Noise level of sources;
- Distance to receivers;
- Effects of intervening topography, noise barriers and buildings; and
- Effects of meteorology.

5.6 Meteorology

The INP requires consideration of meteorological conditions which might enhance the

propagation of noise from the quarry to the residences.

Meteorological conditions which would warrant further investigation are:

- Temperature inversions for more than 30% of time during winter nights; and
- Source to receiver winds below 3m/s for more than 30% of the time for any assessment period (day, evening or night).

Analysis of meteorological data from Port Kembla has shown that neither of these conditions is likely apply to this site. Hence prediction of noise under meteorological conditions which enhance noise propagation is not considered further in this report.

5.7 Equipment noise levels

Noise source levels of the equipment included in the noise model are given in Table 5-3.

Table 5-3 Sound Levels of Quarry Equipment

Source	Sound Power Level, L_{Aeq} dBA
Raw Material Feed To Crusher:	
Caterpillar 990 wheel loader (80t)	111
Caterpillar 777 dumptruck (85t)	100
Komatsu hd 465 dumptruck (65t)	100
General Production	
Komatsu wa500 wheel loader(31t)	99
Caterpillar 980 wheel loader (30t)	102
Komatsu hd405 dumptruck (40t)	100
Caterpillar 773 watercart(50t)	100
Caterpillar 12g grader	102
bobcat	95
Sales	
Caterpillar 988 wheel loader(50t)	104
Komatsu wa500 wheel loader (31t)	99

5.8 Prediction and Assessment of Noise Levels from Quarry

The results of the noise model predictions are given in Table 5-4. Noise was predicted to a receiver height of 4m as the nearest lots will have at least two levels.

Table 5-4 Predicted Noise Levels from Quarry

Location	Predicted Noise Level, $L_{Aeq,15min}$	Criterion, $L_{Aeq},15min$
Harbour Boulevard, from Bass Point Road to Shallows Drive (east intersection)	36	45
Harbour Boulevard, between Shallows Drive (east intersection) and Shallows Drive (west intersection)	39	40
Harbour Boulevard, between Shallows Drive (west intersection) and Cove Boulevard	34	40
Harbour Boulevard, west of Cove Boulevard	<30	40
Boollwarroo Parade near entrance to harbour	33	40
Oval	44	55
Tech Precinct	41	65

Table 5-4 shows that the noise from the quarry is predicted to meet the criterion at all locations.

6 PREDICTION AND ASSESSMENT OF NOISE LEVELS FROM HAUL ROAD

6.1 Noise Criteria

Specific noise criteria for this project are set out in a letter from the DECCW to WM, dated 8 December 2000. As for the quarry, the two forms of criterion are applicable – "amenity" criteria which control the total noise level from all industrial noise sources, and "intrusiveness" criteria which are based on the difference between noise levels from a particular source and the background noise level in the absence of the source in question.

The relevant noise level criteria are set out in Table 6-1. Both the intrusiveness and amenity criteria should be met during all time periods.

Table 6-1 Noise Level Criteria as Determined by the NSW DECCW

Time Period	Noise Criterion (dBA)	
	Intrusiveness LAeq,15min	Amenity LAeq,Period
Daytime (7.00am-6.00pm)	50	60
Evening (6.00pm-10.00pm)	45	50
Night time (10.00pm-7.00am)	40	45

Note: On Sundays and Public Holidays, the daytime period is 8.00am-6.00pm and night time is 10.00pm-8.00am.

The DECCW letter indicates that where the intrusiveness criteria are exceeded by up to 5dBA, *residential development may occur provided the house incorporates acoustic treatments in its layout and construction and potential residents are formally notified that the site is exposed to noise from the operation of the quarry and its haul road*. Where these criteria are exceeded by more than 5dBA, *residential development should not occur*.

6.2 Consequences for Vehicle Noise Levels

The period of time when the truck movements on this road are highest and the criterion most stringent is the hour between 6.00-7.00am. This is in the night time period, and an LAeq,15min value of 40dBA is required to meet the intrusiveness criterion.

It is understood that 55 truck movements has been agreed between Australand Holdings and Pioneer Construction Materials (known as Hanson Construction Materials (HCM)) as the maximum number of movements between 6.00-7.00am. This value is therefore assumed in calculating the LAeq noise level during this period.

To achieve the criterion of 40dBA the logarithmic average Sound Exposure Level (SEL) from each truck movement should not exceed 58dBA. SEL is a measure of the total noise energy recorded during a noise event. With acoustic controls and notification of residents regarding noise exposure, residences may be constructed with noise levels up to 45dBA which is equivalent to a logarithmic average SEL of 63dBA.

6.3 Haul Road Noise Assessment

In previous assessments of Haul Road noise acoustic treatments have been recommended for residences to be built near the noise barrier.

In the masterplan for the Boat Harbour Precinct, the nearest residences to the haul road are those in lots B6 and B7. The nearest residence would be approximately 150m from the haul road noise barrier. At this distance no specific acoustic treatments are necessary in order to meet the noise criterion at the residences.

Note also that noise would also be further reduced by residences in previous stages (Stage 10) of the Shell Cove development that are between the haul road and Lots B6 and B7.

7 AIR QUALITY ASSESSMENT

Action for Air focuses primarily on regional air pollution in the Greater Metropolitan Region (GMR) of NSW, which is home to about 70% of the State's population and encompasses the major metropolitan centres of Sydney, Newcastle and Wollongong.

The two main regional pollution problems of prime concern within the GMR are photochemical smog and particle pollution.

The Action Plan's key objectives are:

- Integrate air quality goals and urban transport planning
- Provide more and better transport choices
- Make cars, trucks and buses cleaner
- Promote cleaner business
- Promote cleaner homes
- Manage the impact of open burning
- Monitor, report on and review air quality

To fit within the broad objectives of the Action for Air the following design concepts have been used to develop the concept for the Boat Harbour Precinct:

- The land use pattern within the proposed Boat Harbour Precinct area has been directed toward minimising internal traffic generation and optimising air quality;
- Providing direct pedestrian and vehicular access to Boat Harbour edge;
- Providing continuity of pedestrian and cycle access around the Boat Harbour;
- Providing pedestrian/cycle access paths to key facilities within the area, ie town centre and marina facilities;
- Minimising through traffic to Bass Point and/or to the technical park area such that it does not intrude upon the Boat Harbour Precinct, thus enhancing air quality and reducing congestion and vehicular conflict within the Precinct;

- Providing public transport; and
- Providing direct assess for motor vehicles to the arterial road network.

8 CONCLUSION

Noise from traffic and the Bass Point Quarry and Haul Road have been assessed at the proposed Boat Harbour Precinct of the Shell Cove development.

Traffic noise is predicted to exceed the guideline criteria at residences facing Harbour Boulevard – that main traffic entry to the precinct. Recommendations for building siting and construction against traffic noise were given.

Traffic management procedures were described that implement *Action for Air* objectives.

Design of the boat dry stack facility was discussed to minimise noise to residential neighbours.

Noise from the Haul Road is predicted to be satisfactory at all residential lots in this precinct.

Noise from the Bass Point Quarry is predicted to meet the noise criterion at all locations.

Note
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance
We are committed to and have implemented AS/NZS ISO 9001:2000 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	11 July 2008	George Jenner	John Wassermann
B	Draft	27 April 2009	George Jenner	John Wassermann
C	Draft	7 July 2009	George Jenner	John Wassermann
D	Final	8 September 2009	George Jenner	John Wassermann
E	Final	1 February 2010	George Jenner	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.

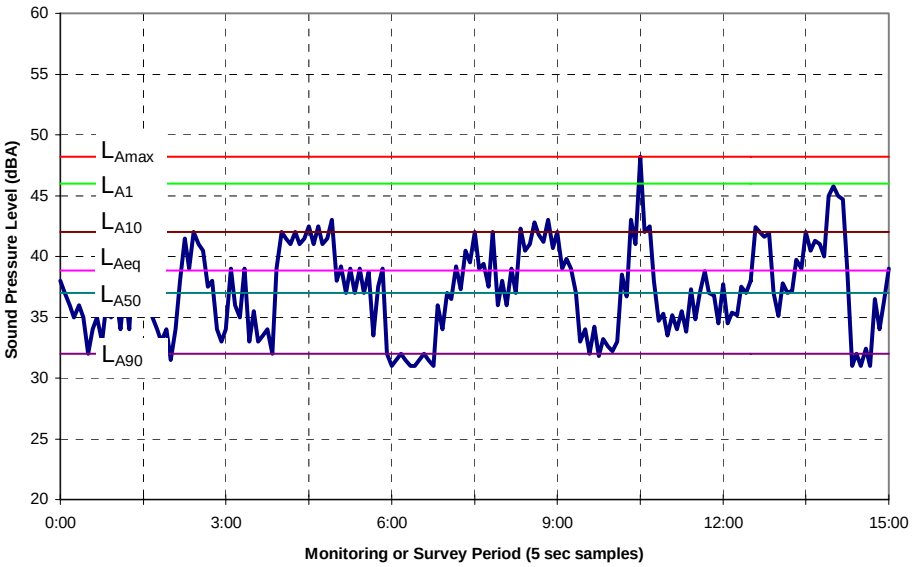
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise 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)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)