LINDEMAN GREAT BARRIER REEF RESORT PROJECT

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N - NOISE IMPACT ASSESSMENT

Addendum: *This EIS was initially prepared assuming that the safe harbour was to be part of the Lindeman Great Barrier Reef Resort Project. With the commencement of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dredging Coral Reef Habitat Policy (2016), further impacts on Great Barrier Reef coral reef habitats from yet more bleaching, and the recent impacts from Tropical Cyclone Debbie, the proponent no longer seeks assessment and approval to construct a safe harbour at Lindeman Island. Instead the proponent seeks assessment and approval for upgrades to the existing jetty and additional moorings in sheltered locations around the island to enable the resort's marine craft to obtain safe shelter under a range of wind and wave conditions. Accordingly, remaining references to, and images of, a safe harbour on various figures and maps in the EIS are no longer current.*

Noise Impact Assessment

Lindeman Great Barrier Reef Resort

Prepared for

White Horse Australia Lindeman Pty Ltd

6 January 2017

Cardno
Shaping the Future

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Document Information

Prepared for	White Horse Australia Lindeman Pty Ltd
Project Name	Noise Impact Assessment
File Reference	Lindeman EIS Noise Assessment 01.03.16.docx
Job Reference	HRP15078
Date	6 January 2017
Version Number	003
Effective Date	03.03.16
Date Approved:	03.03.16

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	23.02.16	Draft Document	Javed Moazzam	Julie McDonagh
2	03.03.16	Draft Document	Javed Moazzam	Julie McDonagh
3	06.01.17	Updates to figures		

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Executive Summary

White Horse Australia Lindeman Pty Ltd propose to redevelop the existing resort at Lindeman Island into a world class integrated resort comprising three resorts (spa, eco resort and beach resort), tourist villas, safe harbour and associated infrastructure. The proposed design incorporates environmental improvements to protect the outstanding universal values of the Great Barrier Reef World Heritage Area and set new international standards in environmental sustainability and integrated resort design.

This report provides an environmental noise impact assessment of airborne noise and vibration impacts associated with the construction and operation of the development against the current relevant statutory criteria.

This report has not assessed underwater impacts of noise and vibration associated with this development which is the subject of another study.

This assessment has been prepared on the basis of the information available at the time of preparation of this report and the outcomes are solely dependent on the accuracy of the input information provided. Should the type, number and nature of the proposed noise sources and receivers change, the assessment will require updating accordingly.

Key aspects of the proposal include:

Noise Sensitive Areas:

- Beach resort - redevelopment of the existing resort to achieve a new 5 star Beach Resort with 136 units, conference centre, beach club and a central facilities building with restaurants, bars and lounges
- Spa resort - on the headland adjacent to the existing resort, a new 6 star Spa Resort is proposed with 59 units, central facilities, entry lounge, spa, sea view restaurant, pool and a signature rock bar providing spectacular alfresco dining close to the sea;
- Tourist villa precincts - two precincts accommodating 89 tourist villas are proposed to the north-east and the north-west of the existing resort;
- Eco resort - a new 5 Star Eco Resort near the existing lake consisting 41 villas, a central facility, boathouse and a waterside restaurant;
- Village - a central village precinct that will accommodate a bar, night club, restaurants, conference facility buildings, arrival centre, shops, sport and recreation centre, and a staff village;
- Glamping – facilities for 30 glamping facilities are being investigated in consultation with the State Government;

Potential Noise Sources

- Services infrastructure precinct – the existing services including power (solar proposed), and sewerage and water treatment plants will be replaced to increase capacity and reflect current best practice;
- Airstrip - the existing airstrip is proposed to be upgraded to provide for near all-weather status, capable of landing small jets and helicopters;
- Safe harbour - a new Safe Harbour is proposed to provide access for the transfer of guests via ferries, luxury vessels and private charters offering greater protection from the prevailing wind directions;

Additional Areas

- Golf course - a recreational golf course is proposed adjacent to the tourist villa precinct;
- Ecotourism - new ecotourism opportunities are proposed, including a National Park and Great Barrier Reef Educational Centre (for guests and visitors); and
- Environmental enhancements – native vegetation replanting, improvements to stormwater management and a shift towards renewable energy sources are proposed.

Assessment Criteria

The following assessment criteria relevant to noise impact and referenced from the ToR has been adopted for this assessment:

TOR Clause	Task	Section Reference
13.14.	Fully describe the characteristics of the noise and vibration sources that would be emitted when carrying out the activity (point source and general emissions). Describe noise and vibration emissions (including fugitive sources) that may occur during construction, commissioning, upset conditions and operation.	2.2.2, 6.1, 0, 6.3, & 7.1.4.2
13.15.	Predict the impacts of the noise emissions from the construction and operation of the project on the environmental values of the receiving environment, with reference to sensitive receptors, using the Queensland EPP (Noise) and recognised quality assured methods. Discuss separately the key project components likely to present an impact on noise and vibration for the construction and operation phases of the project	06, 07
13.16.	Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the: (a) activity's consistency with the objectives (b) cumulative impact of the noise with other known emissions of noise associated with existing development and possible future development (as described by approved plans) (c) potential impacts of any low-frequency (<200 Hz) noise emissions.	6.6
13.17.	Describe how the proposed activity, and in particular, the key project components described above, would be managed to be consistent with best practice environmental management for the activity. Where a government plan is relevant to the activity, or the site where the activity is proposed, describe the activity's consistency with that plan.	08

Assessment Conclusions

The following conclusions have been identified as a result of this assessment:

Operational Noise

- Predicted air-craft noise levels from the proposed run-way upgrade are likely to impact the proposed development. Therefore, indicative building construction requirements based on Queensland Development Code MP4.4 have been identified in this report. We recommend that a detailed design assessment is carried out to confirm this advice once the building plans and the types of air-craft to use the development have been finalised.
- Predicted noise levels from truck movements will are expected with the EPP daytime and evening noise limits. Operational truck movement operations should be limited to 3 trucks per day and should operate during daytime only.
- Based on the worst case scenario of 4 diesel generators running simultaneously, the predicted noise levels from the proposed energy plant is expected to exceed both daytime and night-time EPA noise limits. Therefore, an enclosure or noise barriers located around all 4 diesel generators has been recommended. In order to comply with the day and night-time noise limits, the total emitted sound power level from the enclosure should not exceed 83 and 81 dB(A) respectively. Based on the existing generator enclosure is likely to be required to achieve this should typical operation of the generators include periods where all four generators will be operating.
- Predicted noise levels from the proposed water treatment pump is expected to comply with the adopted assessment noise limits.
- Predicted noise levels from a medium boat docking will comply with the daytime and evening noise limits. Exceedances are predicted for docking boats with a maximum sound power level of 100 dB(A) or a sound pressure level of 78 dB(A) @ 5 metres. Boat docking activities are recommended to be limited to the daytime (7am to 6pm) and evening (6pm to 10pm) period only.

Construction Noise & Vibration

Predicted exceedance of the Department of Transport and Main Roads Transport Noise Management Code of Practice (TMR CoP) Construction noise criteria are predicted for a number of the proposed construction scenarios where part of the site has become operational.

General noise mitigation measures to minimise construction noise impacts as far as possible have been provided in Section 8.2.

The highest impacts are likely if piling is proposed. An assessment of piling during construction of the Safe Harbour in Zone 3 has been identified as having the highest expected impacts. However the adjacent resorts are not proposed to be operational during this construction phase so adverse impacts on human sensitive receivers are not expected.

Some management controls may be required once more detail about the construction scheduling is known with regards to impacts on the bat colonies located on the western side of the island. We recommend that a Construction Noise Management Plan is prepared for this project and this impact considered as part of that assessment.

The predicted exceedances are generally a result of very quiet ambient noise levels, and therefore stringent criteria, combined with large numbers of plant that have been adopted for each modelled scenario. This modelling has been carried out to provide a worst case scenario and it may be possible to reduce the number of plant on site and still provide the same level of operations by making processes more efficient.

Provision of noise barriers is not likely to be practical for this site given the elevated and moving sources and the distance of the site from the receivers.

Best practice construction noise mitigation measures are recommended in Section 8.2.2 of this report.

Sleep disturbance has not been assessed as the site is only proposed to operate during daytime and just into evening hours.

The nearest receivers that have the potential to experience vibration from the site (Zone 3), are located approximately 75 and 150 metres to the North West of potential piling activities. Ground vibration levels at 75 metres from driven piling, and general construction activities are expected to range between approximately 0.01 and 1.2 mm/second at the nearest receiver. Based on this, the estimated vibration level at all sensitive receivers near to the proposed Zone 3 site is likely to comply with both the human comfort and building damage criteria adopted for this project.

Contents

Noise Impact Assessment

01

INTRODUCTION

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1 Introduction

1.1 Background

White Horse Australia Lindeman Pty Ltd propose to redevelop the existing resort at Lindeman Island into a world class integrated resort comprising three resorts (spa, eco resort and beach resort), tourist villas, safe harbour and associated infrastructure. The proposed design incorporates environmental improvements to protect the outstanding universal values of the Great Barrier Reef World Heritage Area and set new international standards in environmental sustainability and integrated resort design.

Key aspects of the proposal include:

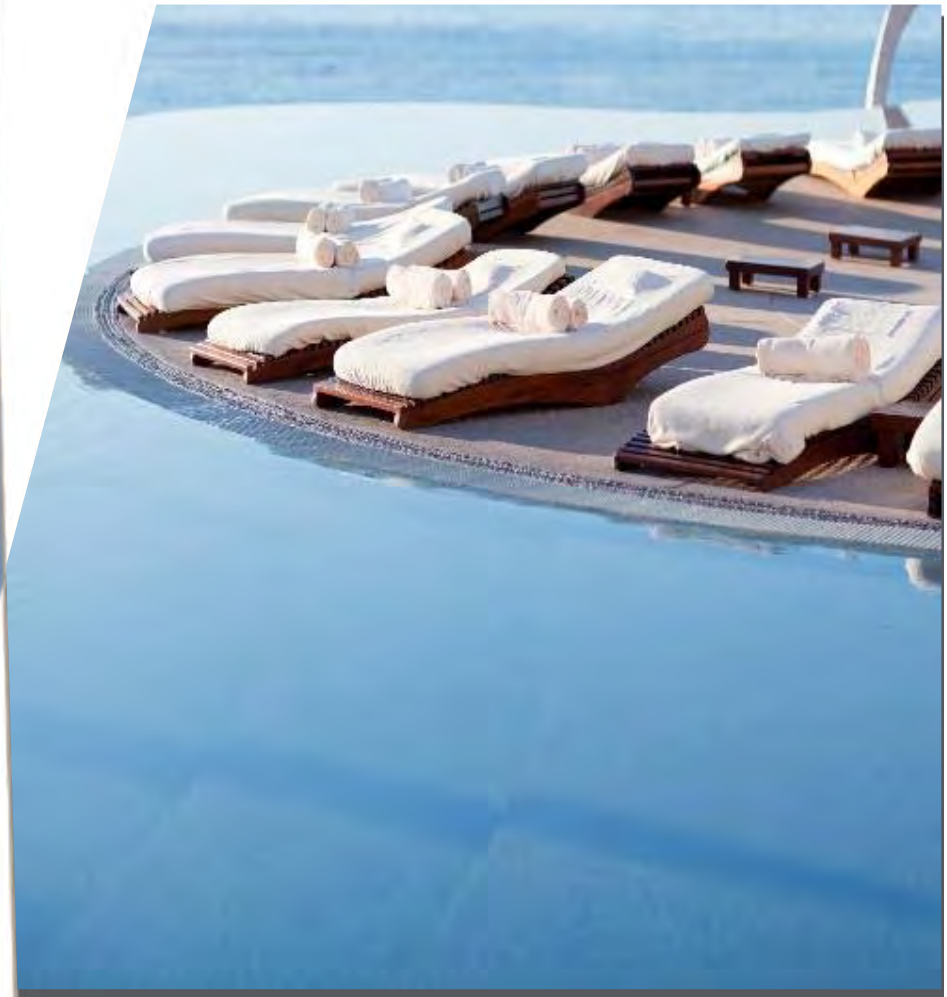
- Beach Resort - redevelopment of the existing resort to achieve a new 5 star beach resort with 136 suites, conference centre, beach club and a central facilities building with restaurants, bars and lounges
- Spa Resort - on the headland adjacent to the existing resort, a new 6 star Spa resort is proposed with 59 villas, central facilities, entry lounge, Spa, sea view restaurant, pool, and a signature rock bar providing spectacular alfresco dining close to the sea;
- Eco Resort - a new 5 Star Eco Resort near the existing lake consisting 41 villas, a central facility, a boathouse and a waterside restaurant;
- Tourist villa precincts - two precincts accommodating 89 tourist villas are proposed to the north-east and the north-west of the existing resort;
- Village - a central village precinct that will accommodate a bar, night club, restaurants, conference facility buildings, arrival centre, shops, sport and recreation centre, and a staff village;
- Services infrastructure precinct – a new precinct with services including power generation (solar with diesel back-up), sewage treatment and water treatment designed to reflect current best practice;
- Airstrip - the existing airstrip is proposed to be upgraded to provide for near all-weather status, capable of landing small jets and helicopters;
- Golf course – upgrades to the existing recreational golf course are proposed;
- Safe harbour - a new Safe Harbour is proposed to provide access for the transfer of guests via ferries, luxury vessels and private charters offering greater protection from the prevailing wind directions;
- Ecotourism facilities – a National Park and Great Barrier Reef Educational Centre and 30 glamping facilities are being investigated in consultation with the State Government; and
- Environmental enhancements – native vegetation replanting, improvements to stormwater management and a shift towards renewable energy sources are proposed.

This assessment has been carried out to determine the level of potential airborne noise and vibration impact that may occur on the island on noise sensitive receivers from proposed operation of the development.

Noise levels have been predicted and compared to current Queensland environmental noise and vibration criteria in accordance with the requirements of the project Terms of Reference.

The following sections detail the assumptions, modelling inputs, adopted criteria and predicted noise impacts expected on the development along with recommended mitigation measures where appropriate.

Noise Impact Assessment



02

PROJECT DESCRIPTION

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2 Project Description

2.1 Existing Site Description and Acoustic Environment

Lindeman Island is approximately 637 hectares in area with the resort occupying approximately 140 hectares on the southern part of this island. The island is located in the southern most area of the Whitsunday Islands. The location of the island is shown in Figure 1.

Figure 1 Location of Lindeman Island

2.1.1 Existing Site Description

An aerial photograph presented in Figure 2 and Figure 3 below shows the location of existing resort and the services infrastructures. A summary of existing site description is listed below:

- As can be seen in the Aerial Photographs presented in Figure 2, the existing resort is focussed on the south-western corner of Lindeman Island. The existing accommodation is housed in 14 wings with large central facilities building that housed the main restaurant, bars and entertainment facilities. The reception is further up the hill with Nicholson's Restaurant, conference rooms and staff accommodation on the plateau above the resort.
- All the services areas including power plant, sewerage treatment works, water filtration and general maintenance, fuel stores and Back of House facilities are also on the plateau.
- A grassed unlicensed airstrip is also situated on the plateau used by charter aircraft from the mainland and nearby Hamilton Island.
- Sea access is gained from jetty adjacent to the resort. This jetty is a Queensland Government asset and White Horse Australia are currently exploring the possibility of acquiring and maintaining the jetty from the State.

We understand that the resort is currently closed with accommodation for the three Caretakers provided in the centre of existing resort in the former villas/staff accommodation located to the west of the Airstrip. Apart from three Caretakers that maintain the resort's key facilities and airstrips, there are no current residents or guests residing on the site.

2.1.2 Existing Noise Sources

Based on the site inspection conducted on 22nd October 2015, a list of identified existing noise sources is presented below:

- Noise from a boat docking;
- Water treatment pump noise; and
- Diesel generator located within the central energy plant site

As the resort is currently not operational, noise from the existing noise sources was referenced but not separately assessed as a part of this assessment, as noise sources on site will be subject to change once the construction and operation of the development commences. The location of the existing Beach Resort and services infrastructure is presented in Figure 2 and Figure 3.

Figure 2 Existing Beach Resort

Figure 3 Location of Services Infrastructure

2.2 Proposed Development

2.2.1 Project Description

The current proposal prepared by DBI Design has evolved through consultation with the project partners (White Horse Australia Lindeman Pty Ltd), tourism industry leaders, specialist environmental/engineering consultants and potential hotel operators. The design intent is to create a luxury resort which responds to World Heritage Values of the Great Barrier Reef and incorporate world's best practice in sustainable design and construction.

Key aspects of the proposal prepared by DBI Design Pty Ltd include:

- Beach Resort - redevelopment of existing resort to achieve a new 5 star Beach Resort with 136 suites, conference centre, beach club and a new central facilities building which includes restaurants, bars and lounges;
- Spa Resort - on the headland adjacent to the existing resort a new 6 star Spa resort is proposed with 59 villas, central facilities, entry lounge, Spa, sea view restaurant, pool and signature rock bar. The signature rock bar is proposed to be located at the south-west corner of the headland and will provide spectacular alfresco dining close to the sea;
- Eco Resort - a new 5 star Eco Resort near the exiting lake consisting of 41 villas, a central facility, boathouse and a waterside restaurant;
- Tourist villa precincts - two precincts accommodating 89 tourist villas are proposed to the north-east and the north-west of the existing resort;
- Village - a central village precinct comprising restaurants, bar, night club, conference facility buildings, arrival centre, shops, sport and recreation centre and a staff village;
- Services infrastructure precinct - a new precinct with services including power generation (solar with diesel back-up), sewage treatment and water treatment designed to reflect current best practice;

- Airstrip - the existing airstrip is proposed to be upgraded to provide for near all-weather status and capable of landing small jets and helicopters;
- Golf course - upgrades to the existing recreational golf course are proposed;
- Safe harbour - a new Safe Harbour is proposed to provide access for the transfer of guests via ferries, luxury vessels and private charters which offers greater protection from the prevailing wind directions;
- Ecotourism facilities – a National Park and Great Barrier Reef Educational Centre and 30 glamping facilities are being investigated in consultation with the State Government; and
- Environmental enhancements – native vegetation replanting, improvements to stormwater management and a shift towards renewable energy sources are proposed.

The Master Plan layout prepared by DBI Design Pty Ltd (2016) is presented in **Appendix 3** of the EIS.

2.2.2 Proposed Operations - Noise Sources

Based on the proposed development project description presented above in Section 2.2.1, noise impact from the noise sources presented below have been assessed for this noise impact assessment:

- Boat docking noise
- Aircraft noise landing and take off
- Noise from proposed sewerage and water treatment plant
- Noise from refuse collection
- Noise from trucks delivering goods and produce
- Daily transport and/or parking for the work force and for guests/visitors to the resort
- Construction noise

Noise Impact Assessment

03

EXISTING NOISE ENVIRONMENT

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3 Existing Noise Environment

3.1 Ambient Noise Monitoring Methodology

Unattended noise monitors were installed at the following four locations (refer to Table 2) to measure ambient (i.e. background) noise levels between 22 October and 29 October 2015. Noise monitors were configured to measure 15-minute statistics and was measured as per Australian Standard 1055.1:1997 – "Acoustics – Description & Measurement of Environmental Noise", and the Qld Environmental Noise Measurement Manual.

Noise monitoring locations and equipment details are described below in Table 2 and Figure 4.

Table 2 Noise Monitoring Equipment

Location	Logger Type	Monitoring Location	Serial Number	Monitoring Dates
1	Norsonic 131	Air Strip	2976654	22 October 2015
2	Rion NL-21	Lindeman Jetty	509345	22 – 29 October 2015
3	Rion NL-21	Outlook Cliff	509346	22 – 29 October 2015
4	Rion NL-21	Golf Course Park	509343	22 – 23 October 2015

Figure 4 Noise Logger Locations.

3.2 Equipment Calibration

Calibration of the sound monitoring equipment was conducted before and after the measurement period, with a variance of less than + / - 0.3 dB(A) recorded.

3.3 Meteorological Monitoring Conditions

A summary of the environmental conditions noted during the measurement period were as follows (source weather station located on site):

Conditions: Fine

Wind: 0-9.7 m/s predominantly from E, ENE, N, NE, NNW direction

Humidity: 61 - 92%

Temperature: 21 – 27 ^{o}C

In the absence of any weather data from the actual monitoring location, weather information for the monitoring period from the nearest weather station (Hamilton Island) has been presented in **Appendix B**. it should be noted that Hamilton Island Airport (Station Id 033106) is located at 58.66 m above the sea level. At this height, higher wind speed will recorded relative to the wind speed at the monitoring location (1.5m above ground). Based on the monitoring results, site inspection and weather data presented in Appendix B, monitoring data has not been affected by adverse weather. Therefore, no measurement data has been excluded.

Detailed weather information recorded at the site during the monitoring period is detailed in **Appendix B**, which also indicates which data has been excluded for time periods that were affected by adverse weather as described in the following

Relevant extract from the EHP: Noise Measurement Manual regarding weather conditions is presented below:

7.6 Atmospheric Conditions

Noise should be measured during fine weather conditions with calm to light winds (0–10km/h). A wind direction favouring noise propagation from source(s) to receiver(s) should be chosen if this is a true representation of the normal situation. Different conditions and their effects on measurements should be noted.

3.4 Measurement Parameters

As environmental noise varies with time, the use of statistical descriptors is necessary to understand and describe these variations. For road traffic noise these descriptors are further classified for day time (7 am – 10 pm) and night time (10 pm – 7 am).

For environmental noise, the assessment period for day time is further split into day (7 am – 6 pm) and evening (6 pm – 10 pm). A-weighted statistical levels are used to describe ambient noise levels. The common descriptors used to describe environmental noise are described as follows:

L_{Amax}: the A-weighted maximum noise level measured during the measurement period.

L_{A1}: the A-weighted noise level exceeded for 1% of the measurement period.

L_{A10}: the noise A-weighted level exceeded for 10% of the measurement period, generally referred to as the average maximum sound pressure level.

L_{A90}: the A-weighted noise level exceeded for 90% of the measurement period, generally referred to as the background noise level (refer AS 1055.1 – 1997).

L_{Aeq} : the equivalent continuous noise level over the measurement period, generally referred to as the energetical average sound pressure level over the measurement period.

3.5 Measured Noise Levels

3.5.1 Unattended Noise Measurements

Measured noise levels at each logger location were observed to be affected by the following:

Table 3 Observed Existing Noise Environment

Logger	Location	Observed Noise Environment
1	Air Strip	No aircraft movements observed during the attended noise measurements. Primary sources of noise at this location were birds, insects and wind nearby trees. Occasional noise from a quad bike and golf buggies noted. Occasional aircraft flyover.
2	Lindeman Jetty	Surf and boat noise audible at this location. Boat noise only audible when boats docking at the jetty which was occasional Primary sources of noise at this location were surf and water lapping. Occasional noise from golf buggies noted. Occasional aircraft flyover.
3	Outlook Cliff	Primary sources of noise at this location were birds, insects and quite high levels of wind. Occasional noise from quad bikes noted. Occasional aircraft flyover.
4	Golf Course Park	Primary sources of noise at this location were birds, insects. Occasional noise from quad bikes noted. Occasional aircraft flyover.

There were some equipment failures during the monitoring period at some of the loggers and subsequently shorter periods of data were obtained at two of the locations. The monitoring period and details for each logger is presented below in Table 4.

Table 4 Noise Monitoring Period

Logger	Location	Monitoring Period	Note
1	Air Strip	22 October 2015, 9:15 am to 11:45 pm	Due to battery failure this monitor operated for less than a full 24 hour period.
2	Lindeman Jetty	22 October 2015, 9:25 am to 29 October, 3:10 pm	This monitor operated for the full seven day period.
3	Outlook Cliff	22 October 2015, 2:30 pm to 25 October, 9:00 pm	Due to battery failure this monitor operated for approximately 4 days.
4	Golf Course Park 9	22 October 2015, 10:45 am to 23 October 2015, 8:00 pm	Due to battery failure this monitor operated for only one 24 hour period.

The measured background noise levels measured during the monitoring period are presented below in Table 5.

Table 5 Measured Average Background Noise Levels

Logger	Descriptors	Measured Background Noise Levels		
		7 am to 6pm	6pm to 10pm	10pm to 7am
1	Average LA90	32.6	38.4	-
	LAeq	54.1	42.9	-
	RBL	28.7	35.4	-
2	Average LA90	41.5	41.5	31.9
	LAeq	47.8	45.0	41.5
	RBL	36.7	39.9	(1)22.3
3	Average LA90	32.2	33.2	36.3
	LAeq	43.4	38.6	43.9
	RBL	(1)25.9	31.0	32.6
4	Average LA90	37.6	39.4	34.8
	LAeq	45.2	45.5	41.3
	RBL	34.1	37.6	(1)28.4

(1)Where RBLs are calculated to be less than 30 dB(A), an RBL of 30 dB(A) has been adopted in accordance with general industry practice.

Measured ambient noise levels and monitoring graphs for these locations are presented in Figure 5, to Figure 8. The measured background noise at location 3 (Outlook Cliff) is lower than the background noise levels measured at location 2. As such, monitoring results from location 3 have been used to determine the benchmark design limits for the development to provide a conservative assessment.

Charts of each monitoring period are shown in **Appendix A**.

Figure 5 Averaged Measured Noise Levels – Location 1 (Air Strip)

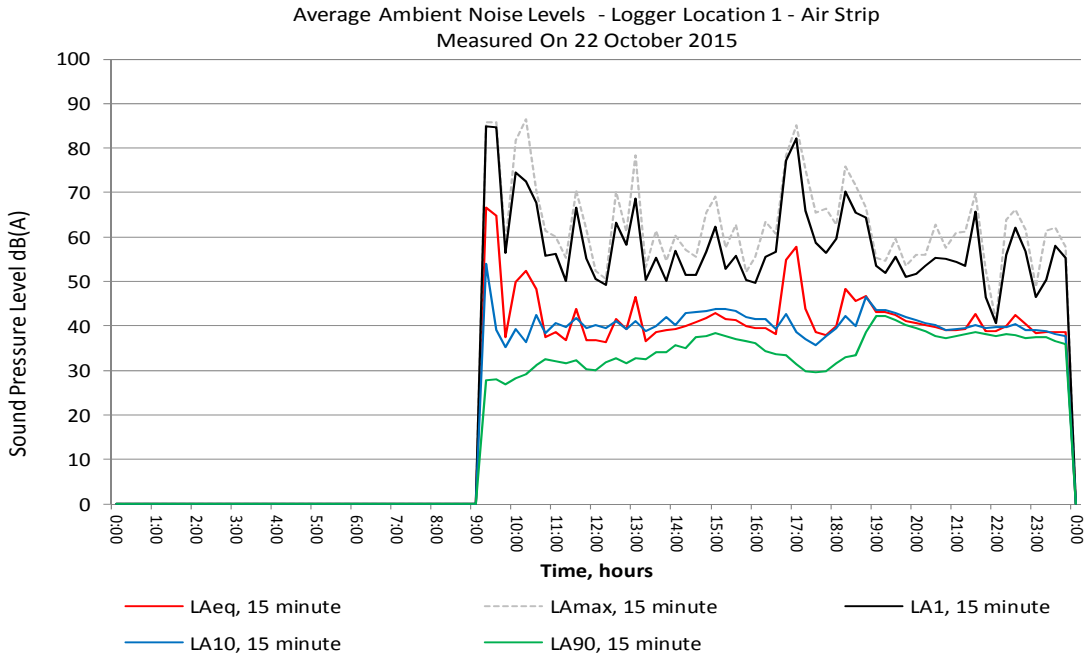


Figure 6 Averaged Measured Noise Levels – Location 2 (Lindeman Jetty)

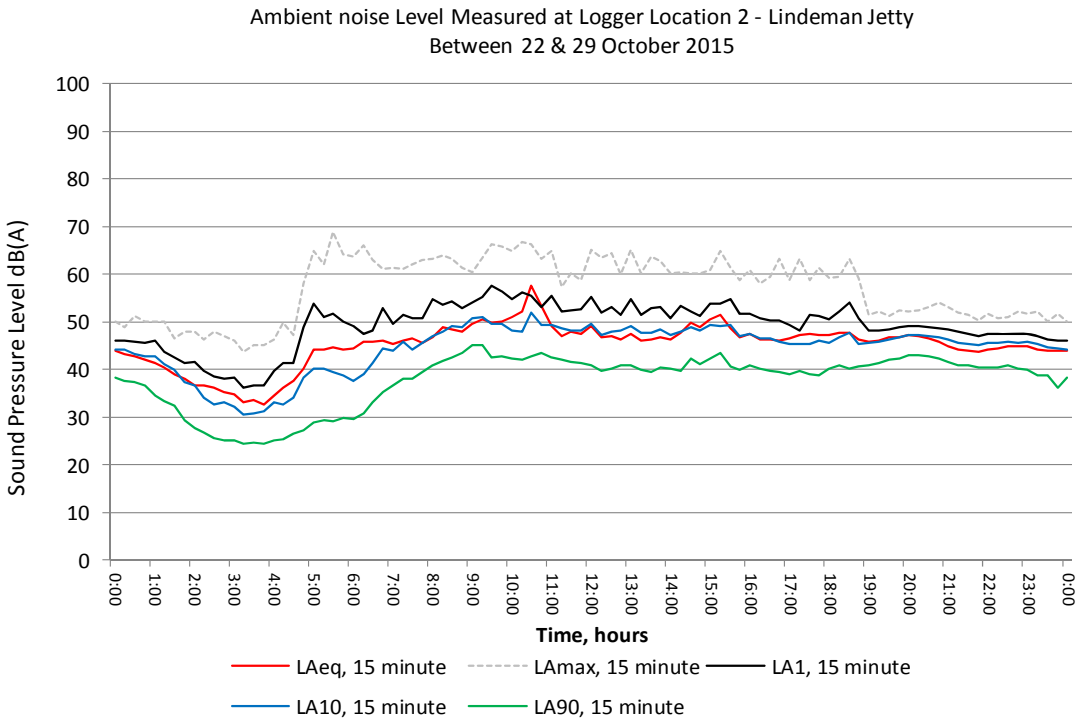


Figure 7 Averaged Measured Noise Levels – Location 3 (Outlook Cliff)

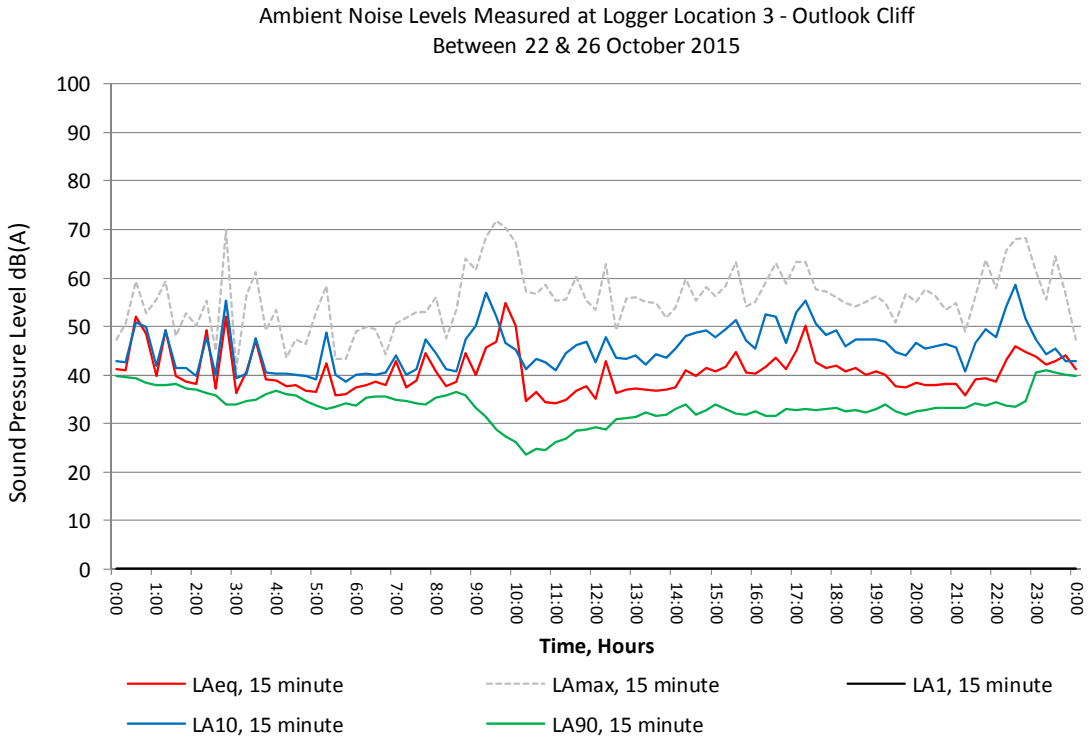
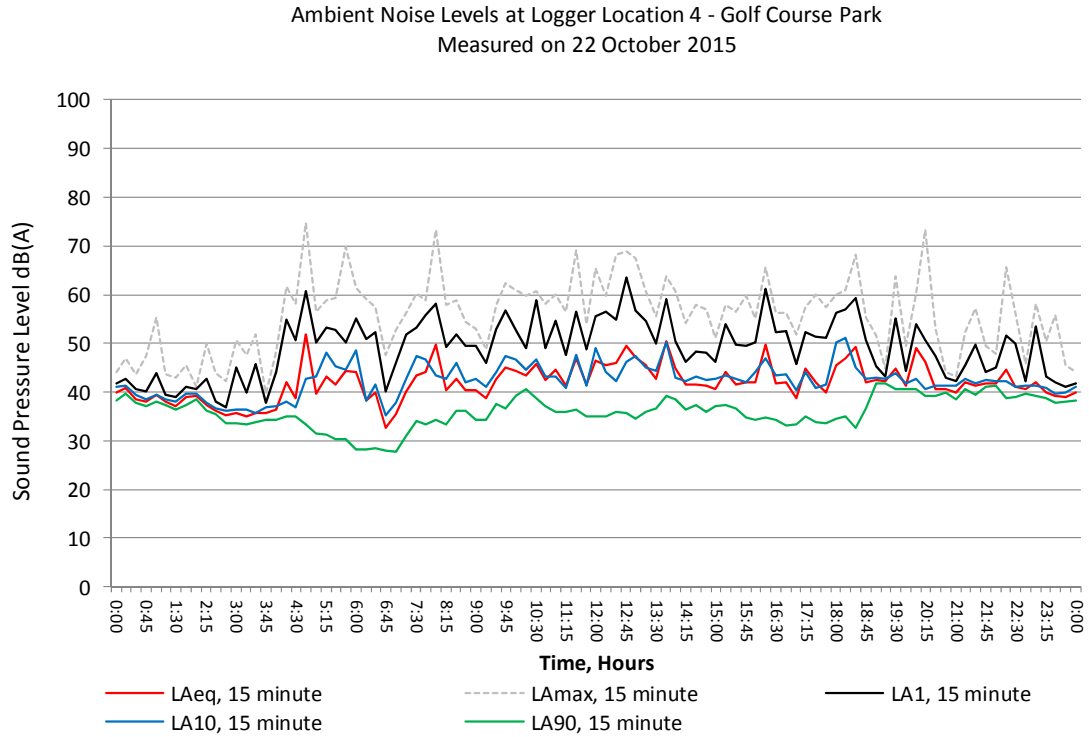


Figure 8 Averaged Measured Noise Levels – Location 4 (Golf Course Park)



3.5.2 Attended Noise Measurements

Minimal activities were observed during the site inspection and attended measurements on 22 October 2015 as the existing resort is currently not operational.

Attended measured source noise levels for the observed existing noise sources on the island are presented below in Table 6.

Table 6 Measured Ambient Noise Levels at Location 2 (Lindeman Jetty)

Noise Source	Measurement Distance	Measured Noise Levels, L_{Aeq} dB(A)	
		Measured Sound Pressure Level	Sound Power Level
Diesel Generator @ Louvre 1	1 metre	76	95
Diesel Generator @ Louvre 2	1 metre	76	95
Water Treatment Pump	1 metre	64	79
Medium Boat Docking	5 metre	73	94

04

NOISE & VIBRATION CRITERIA

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4 Noise & Vibration Criteria

4.1 Lindeman Island Great Barrier Reef Project Terms of Reference (ToR)

This assessment addresses expected airborne noise and vibration impacts only, and therefore ToR references to waterborne noise and vibration impacts have not been included in the section.

The objective of the ToR, with reference to noise and vibration is as follows:

"Development is planned, designed, constructed and operated to protect the environmental values of the acoustic environment".

The following clauses from the ToR refer to assessment of noise impact from the development:

Table 7 ToR Noise & Vibration Assessment Requirements

TOR Clause	Task
13.14.	Fully describe the characteristics of the noise and vibration sources that would be emitted when carrying out the activity (point source and general emissions). Describe noise and vibration emissions (including fugitive sources) that may occur during construction, commissioning, upset conditions and operation.
13.15.	Predict the impacts of the noise emissions from the construction and operation of the project on the environmental values of the receiving environment, with reference to sensitive receptors, using the Queensland EPP (Noise) and recognised quality assured methods. Discuss separately the key project components likely to present an impact on noise and vibration for the construction and operation phases of the project
13.16.	Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the: (a) activity's consistency with the objectives (b) cumulative impact of the noise with other known emissions of noise associated with existing development and possible future development (as described by approved plans) (c) potential impacts of any low-frequency (<200 Hz) noise emissions.
13.17.	Describe how the proposed activity, and in particular, the key project components described above, would be managed to be consistent with best practice environmental management for the activity. Where a government plan is relevant to the activity, or the site where the activity is proposed, describe the activity's consistency with that plan.
13.18.	Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed

4.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994* contains a number of quantitative noise criteria. Relevant noise criteria from the Queensland Environmental Protection Act (EPA) are listed below:

4.2.1 440R Building Work

(1) A person must not carry out building work in a way that makes an audible noise –

a) On a business day or Saturday, before 6:30am or after 6.30am; or

b) On any other day, at any time

(2) The reference in subsection (1) to a person carrying out building work –

a) Includes a person carrying out building work under an owner-builder permit; and

b) Otherwise does not include a person carrying out building work at premises used by the person only for residential purposes.

4.2.2 440S Regulated Devices

(1) This section applies to -

a) A person carrying out an activity other than building work; and

b) A person carrying out building work, at premises used by the person only for residential purposes, other than under an owner-builder permit.

(2) A person must not operate a regulated device in a way that makes an audible noise -

a) On a business day or Saturday, before 7.00am or after 7.00pm or

b) On any other day, before 8.00am or after 7.00pm.

(3) Subsection (2) does not apply to a person operating a grass-gutter or leaf-blower at a place that is a State-controlled road or a railway under an authority from the occupier of the place.

(4) Subsection (2) (a) does not apply to person operating a regulated device at a manual arts facility at an educational institution between 7.00pm and 10pm.

(5) In this section –

Grass-cutter means an electrical or mechanical device a function of which is to cut grass. Examples – brush cutter, edge cutter, lawnmower, ride-on mower, string trimmer

Leaf-blower means an electrical or mechanical device a function of which is to blow leaves.

Regulated device means any of the following –

a) A compressor;

b) A ducted vacuuming system;

c) A generator;

d) A grass-cutter;

e) An impacting tool;

f) A leaf-flower;

g) A mulcher;

h) An oxyacetylene burner;

i) An electrical, mechanical or pneumatic power tool.

Examples of a power tool – chainsaw, drill, electric grinder or sander, electric welder, nail gun

4.2.3 440T Pumps

(1) This section applies to premises at or for which there is a pump.

(2) An occupier of the premises must not use, or permit the use of, the pump on any day -

a) Before 7am, if it makes an audible noise; or

b) From 7am to 7pm if it makes a noise of more than 5dB(A) above the background level; or

c) From 7pm to 10pm, if it makes a noise of more than 3 dB(A) above the background level; or

d) After 10pm if it makes an audible noise

(3) Subsection (2) (a), (c) and (d) do not apply to a noise made at an educational institution, that is not more than 5 dB(A) above the background level.

(4) In this section –

(5) Pump –

a) Means an electrical, mechanical or pneumatic pump; and

Examples – liquid pump, air pump, heat pump

b) Includes a swimming pool pump and a spa blower.

4.2.4 440U Air-conditioning equipment

(1) This section applies to premises at or for which there is air-conditioning equipment.

(2) An occupier of the premises must not use, or permit the use of, the equipment on any day -

a) Before 7am, if it makes a noise of more than 3 dB(A) above the background level; or

b) From 7am to 10pm if it makes a noise of more than 5 dB(A) above the background level; or

c) After 10pm, if it makes a noise of more than 3 dB(A) above the background level.

4.2.5 440V Refrigeration Equipment

(1) This section applies to a person who is -

a) An occupier of premises at or for which there is plant or equipment for refrigeration (refrigeration equipment); or

b) An owner of refrigeration equipment that is on or in a vehicle, other than a vehicle used or to be used on a railway

(2) The person must not use, or permit the use of, the refrigeration equipment on any day –

a) Before 7am, if it makes a noise of more than 3 dB(A) above the background level; or

b) From 7am to 10pm, if it makes a noise of more than 5 dB(A) above the background level; or

c) After 10pm, if it makes a noise of more than 3 dB(A) above the background level.

(3) In this section –

Vehicle includes a trailer.

4.2.6 440ZA Operating Power Boat Engine at Premises

(1) A person must not operate, or permit the operation of, a power boat engine at premises in a way that makes audible noise -

a) On a business day or Saturday, before 7am or after 7pm; or

b) On any other day, before 8am or after 6.30pm.

(2) In this section –

Operate, a power boat engine, includes flushing the engine.

4.3 Environmental Protection (Noise) Policy 2008

The EPP (Noise) 2008 establishes noise limits with two key methods which are detailed as follows:

1. **Acoustic Quality Objectives**. These are fixed noise limits which relate to the receiving environment's land use characteristics (i.e. residential, childcare, etc.).
2. **Control of Background Creep**. These limits are established through pre-development ambient noise measurements, with the aim of ensuring the existing noise environment is not significantly increased.

The specifics of each method are described in section **4.3.1** (Acoustic Quality Objectives) and **4.3.2** (Control of Background Creep).

4.3.1 Acoustic Quality Objectives

The acoustic quality objectives for sensitive are addressed in Section 8 of the EPP (Noise) 2008 as shown in the excerpt below:

8 Acoustic quality objectives for sensitive receptors

(1) An acoustic quality objective stated in schedule 1, column 3 for a sensitive receptor stated in column 1 and for a time of day stated in column 2, is prescribed for enhancing or protecting the environmental value stated in column 4 of the schedule for the objective.

(2) An acoustic quality objective stated in schedule 1 is expressed as a measurement of an acoustic descriptor.

(3) It is intended that the acoustic quality objectives be progressively achieved as part of achieving the purpose of this policy over the long term.

(4) This section does not apply to a noise—

(a) mentioned in the Act, schedule 1, part 1, section 1; or

(b) experienced within a dwelling or a workplace if the noise is made within the dwelling or workplace.

(5) In this section—

(c) **workplace** see the *Workplace Health and Safety Act 1995*, section 9.

4.3.2 Control of Background Creep

Background creep is addressed in Section 10 of the EPP (Noise) 2008 as detailed in the below excerpt:

10 Controlling background creep

(1) This section states the management intent for an activity involving noise.

Note — See section 51 of the Environmental Protection Regulation 2008.

(2) To the extent that it is reasonable to do so, noise from an activity must not be –

(a) for noise that is continuous noise measured by LA90,T - more than nil dB(A) greater than the existing acoustic environment measured by LA90,T; or

(b) for noise that varies over time measured by LAeq,adj,T - more than 5dB(A) greater than the existing acoustic environment measured by LA90,T.

4.4 Australian Standards

The following Australian Standards provide criteria and methodologies that have been adopted in this assessment.

- Australian Standard AS1055: "Acoustics – Description and measurement of environmental noise".
- Australian Standard AS2021: Acoustics – "Aircraft noise intrusion – Building siting and construction"

4.5 Sleep Disturbance Criteria

4.5.1 World Health Organisation

The World Health Organisation (WHO) issued its "Guidelines for Community Noise" in April 1999. The WHO guideline states the following in regard to sleep disturbance from continuous noise from activities such as mining operations:

"*Where noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. When noise is composed of large proportion of low-frequency sounds a still lower guideline value is recommended, because low-frequency noise (e.g. from a ventilation system) can disturb rest and sleep even at low sound pressure levels."*

4.5.2 EPA EcoAccess Planning For Noise Control

The EcoAccess Guideline "Planning for Noise Control", in referring to the World Health Organisation guideline, makes the following general recommendations regarding short term transient noise events:

"As a rule in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately L_{Amax} 45 dB(A) more than 10 to 15 times per night."

For less regular night events, the allowable internal noise level is higher, as follows:

- Approximately 3 events per night, L_{Amax} 50 dB(A)
- Approximately 1 event per night, L_{Amax} 65 dB(A)

In the EcoAccess Guideline it is proposed that the noise reduction provided by a typical residential building façade is 5 to 10 dB(A) assuming open windows. That is, with an external noise source, a 5 to 10 dB(A) reduction in noise levels from outside a house to inside a house is expected when windows are fully open. Thus the indoor noise levels noted above could be considered as the following external noise levels:

- Approximately 10-15 events per night, L_{Amax} 50 to 55 dB(A)
- Approximately 3 events per night L_{Amax} 55 to 60 dB(A)
- Approximately 1 event per night, L_{Amax} 70 to 75 dB(A)

4.6 Road Traffic Noise Management Code of Practice, Volume 2 (TMR, 2014)

4.6.1 Construction Noise

The Queensland Department of Transport and Main roads (TMR) provides guidance for assessing construction noise impacts from road construction projects in the QLD Transport Noise Management Code of Practice (CoP) Volume 2 – Construction Noise & Vibration (TMR 2014).

In the absence of any other quantitative noise criteria in Qld Environmental Protection documentation, the criteria in this document has been adopted for the assessment of potential noise impacts from this project.

The level of noise impact and the requirement for mitigation measures is generally determined by the timing and duration of the noise emissions and the perceived impact of the noise above existing background noise levels.

4.6.1.1 Construction Activities and Work Periods

The Code specifies typical construction activities, which include the following:

- General construction (e.g. pile driving and compaction, work sites, earthworks)
- Construction traffic
- Blasting.

We understand that blasting will not be carried out for this project, and therefore this has not been considered further in this assessment.

Table 8 defines different work periods of the day adopted by the CoP for construction activities.

Table 8 Work Periods for Construction Activities

Work Period	General Construction & Construction Traffic
Standard Hours	Monday to Friday 7am to 6pm Saturday 8am to 1pm
Non-Standard Hours (Evening)	Monday to Friday 6pm to 10pm Saturday 1pm to 10pm Sunday 7am to 10pm
Non-Standard Hours (Night-time)	Monday to Sunday 10pm to 7am

Construction activities (including blasting) should be generally undertaken within the standard hours. Construction activities with the potential for significant impacts should be discouraged if possible in the night time. The use of high impact machinery such as pile-driving, vibratory rollers and impact devices (rock breakers and jackhammers) should be avoided where possible for night work construction in residential or other noise and vibration sensitive areas. Where night work is required in the vicinity of residential or other sensitive sites, careful planning is required and a higher level of control is recommended, to mitigate potential complaints of sleep disturbance.

4.6.1.2 Applicable Quantitative Noise Criteria – Residential Premises

The noise criterion for potentially affected residential properties, as taken from Section 3.2.1 of the code, is detailed in Table 9.

Table 9 External Construction Noise Criteria (Source: TMR, 2013)

Time of Day	External Noise Level $^{(4)}L_{Aeq\ (15\ min)}$, d(A)	
Standard Hours	Lower Limit	Upper Limit
	$^{(1)\ (2)\ (3)}$ RBL + 10	75 Where RBL > 55
		70 Where 40 < RBL ≤ 55
		65 Where RBL ≤ 40
Non - Standard Hours	RBL + 5	Not Applicable

Note:

(1) RBL + 5 dB(A) should be considered where a facility, equipment and long-term earthworks are required in an area for greater than 6 months.

(2) Where the lower limit value exceeds the upper limit value, the lower limit is taken to equal the upper limit value.

(3) Minimum lower limit are 50 dB(A) for Standard hours and 45 dB(A) for Non-Standard hours. A maximum lower limit of 75 dB(A) applies to Non-Standard hours

(4) Noise contribution from construction activity.

These criteria are further presented graphically in Figure 9 and Figure 10 for Standard hours and Non-Standard hours respectively. It is noted that these limits are for the noise contribution from construction only (component limit).

Figure 9 Construction noise criteria – standard hours

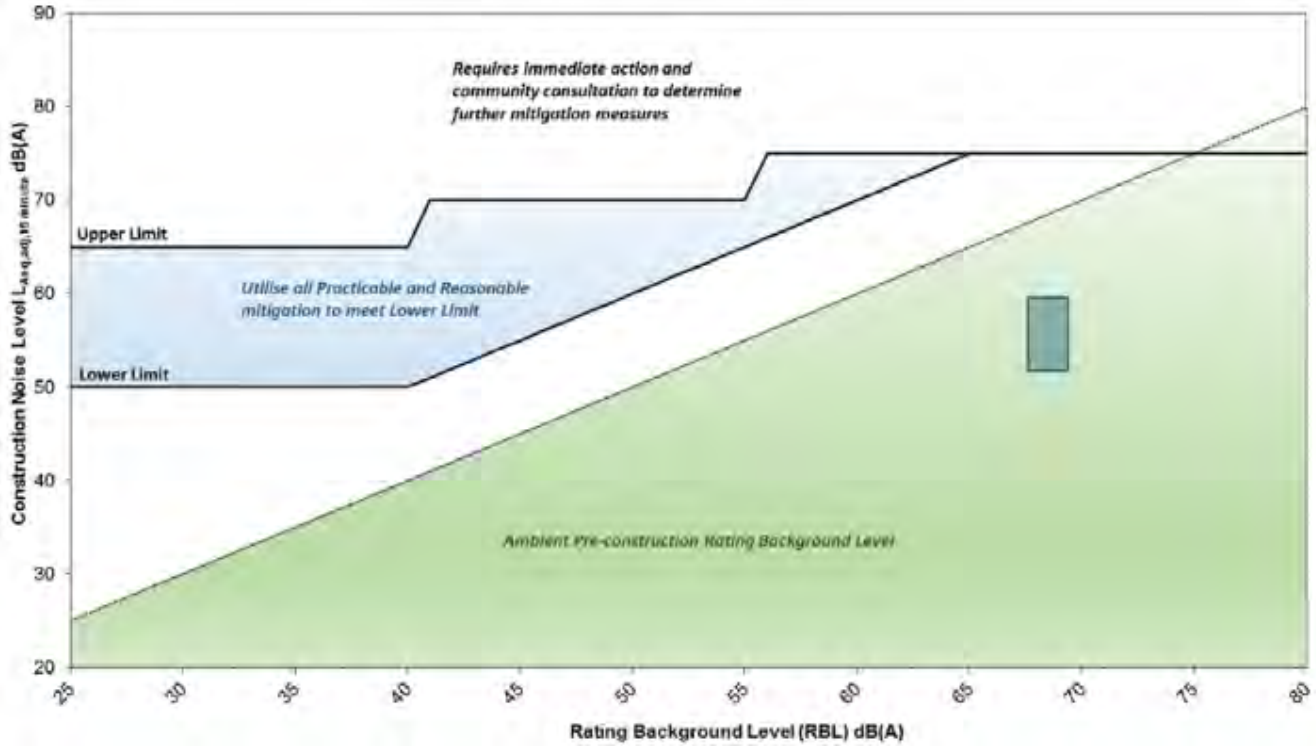
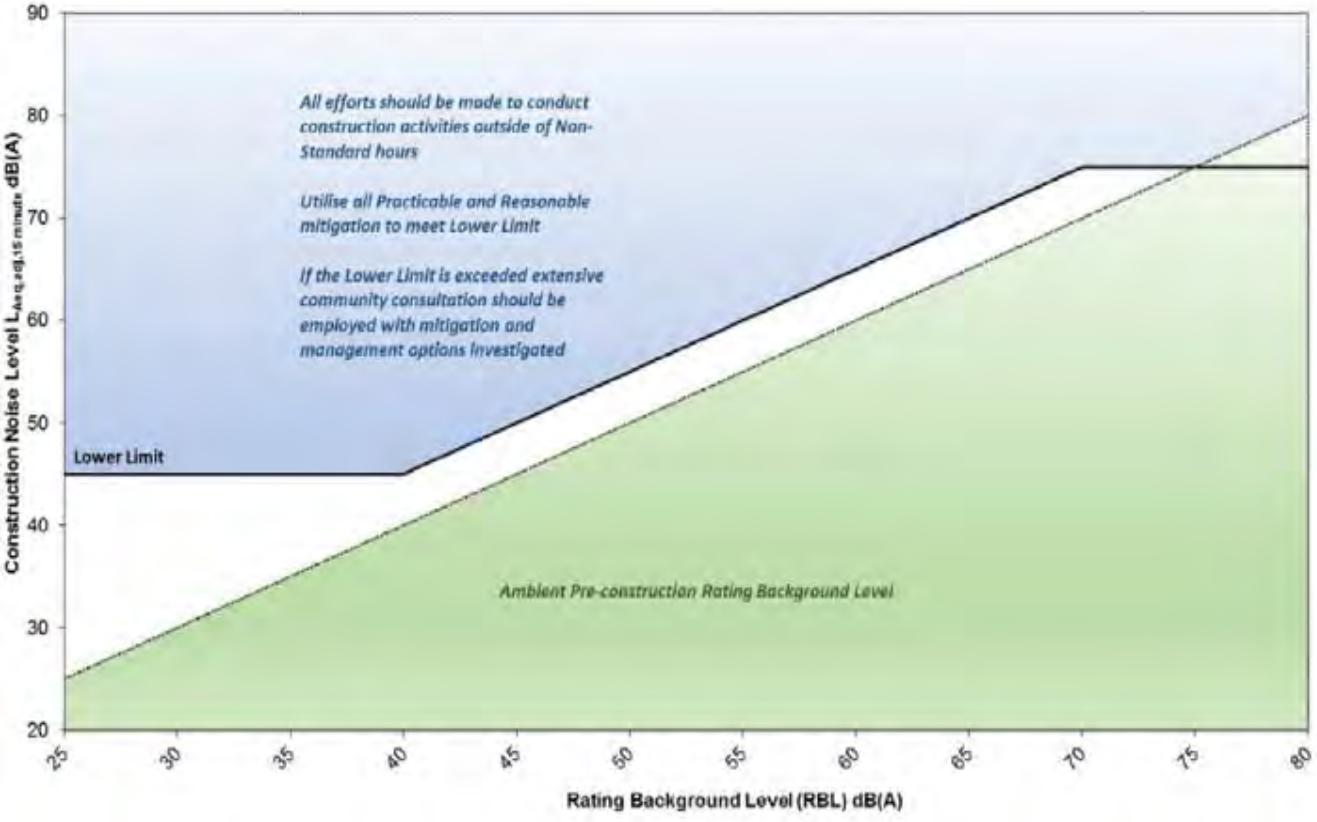


Figure 10 Construction noise criteria – non-standard hours



4.6.1.3 Applicable Quantitative Noise Criteria – Non-Residential Premises

For commercial and retail facilities when required to be assessed for construction noise impact, the upper limit values may be utilised. Where these premises include an external component such as outdoor dining / sports fields, it may be reasonable to minimise construction activity to when the majority of trade is conducted (e.g. lunchtime, sporting games).

In addition to the above, critical facilities require the internal criteria as presented in **Table 10** to be met where reasonable and practicable. The criteria should be considered for the operational hours of the facility.

Table 10 Internal Construction Noise Criteria for Critical Facility

Type of Occupancy/Activity	Internal Noise Level $^{(1)}L_{Aeq\ (15\ min)}$, d(A)
Medical/Health Buildings (wards, surgeries, operating theatres, consulting rooms)	40
Educational/Research Facilities (rooms designed for teaching/research purposes)	45
Court of Law (Court Room)	35
Court of Law (Court Reporting and Transcript Areas, Judge's Chambers)	40
Community Buildings (Libraries, Places of Worship)	45

Note:

(1) Noise contribution from construction activity.

4.6.1.4 Construction Traffic

Haulage/transportation associated with construction activities on roads within the project area has the potential to create traffic noise issues for existing sensitive receptors. The following criteria may be used to limit traffic noise caused by construction traffic:

Construction traffic should not increase the pre-construction traffic noise level $L_{A10,\ 1\ hour}$ by more than 3 dB(A). The increase due to construction traffic should be considered against the median minimum $L_{A10,\ 1\ hour}$ noise levels for each of the relevant hours within each work period. If measurements are unavailable, the increase should be considered against the predicted pre-construction $L_{A10,\ 1\ hour}$ noise level.

The code recommends that the construction traffic should be generally be assessed out to a minimum of 500 metres beyond the project area boundary. This distance may be increased where it is reasonable to assume that the community would perceive the construction traffic is associated with the project. However, as this project is located on an island and all of the sensitive receivers are located within the project area, construction traffic noise assessment is not applicable for this development and therefore, has not been included as a part of this assessment.

4.6.2 Construction Vibration

The CoP provides a section on the assessment of construction vibration form road projects. The criteria from this code of practice have been adopted for this assessment.

Vibration criteria for both human comfort and building damage due to ground borne vibration caused by construction activities (e.g. pile driving, compaction and blasting) are provided in this section. It should be noted that compliance in most cases with the human comfort criteria would also achieve the building damage criteria.

The *British Standard BS 5228-2:2009* provides an alternative approach to those historically used to assess human comfort presented in the *British Standard BS 6472-1:2008*. While BS 6472-1 provides guidance on human response to vibration in buildings in terms of VDV, BS 5228-2 Table B.1 provides guidance on the use of PPV which is typically measured to determine potential building damage.

For human comfort in order to minimise annoyance due to ground borne construction vibration, this Code adopts vibration levels with lower and upper limits as presented in Table 18. The low limits are generally considered to be just perceptible if just exceeded. The upper limits are considered to cause significant annoyance if exceeded.

All reasonable and practicable measures should be implemented to achieve the lower limit. Exceedance of the upper limit requires immediate action and extensive community consultation to determine further mitigation measures.

These criteria are summarised in Section 5, in Table 18.

05

ASSESSMENT BENCHMARKS

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5 Assessment Benchmarks

5.1 Operational Noise

The major operational noise sources associated with the proposed development and the applicable noise criteria are summarised below in Table 11.

Table 11 Operational Noise Sources and Applicable Noise Criteria

Noise Source	Applicable Noise Criteria
Mechanical Plant Noise	*Environmental Protection Act 1994* (Current as at 2 October 2015), Division 3, Default Noise Standards, Section 440U Air Conditioning and Section 440V Refrigeration Equipment
Aircraft Noise	*Australian Standard AS2021: Acoustics – "Aircraft noise intrusion – Building sitting and construction"*
Truck Movement	*Environmental Protection (Noise) Policy (EPP) 2008*
Boat Docking	*Environmental Protection (Noise) Policy (EPP) 2008* *Environmental Protection Act 1994* (Current as at 2 October 2015), Division 3, Default Noise Standards, Section 440ZA Operating Power Boat Engine at Premises
Water Treatment Pump	*Environmental Protection Act 1994* (Current as at 2 October 2015), Division 3, Default Noise Standards, Section 440T Pumps
Diesel Generator	*Environmental Protection Act 1994* (Current as at 2 October 2015), Division 3, Default Noise Standards, Section 440S Regulated Devices

5.1.1 Mechanical Plant Noise Criteria

Based on the measured average background noise levels presented in Table 5, the lowest average measured background levels for each period is presented below Table 12. Based on the average measured background noise levels, mechanical plant noise limits for the proposed development is presented below Table 12. Average background noise levels (L_{A90}), have been adopted rather than RBLs as the existing environment is generally continuously quiet, and the quietest of the three measurement locations has been adopted to provide a reasonable assessment basis. The limits below have been adopted on the basis of the criteria from the EPA 1994, Section 440U.

Table 12 Mechanical Plant Noise Limits

Period	Measured Lowest Background Noise Levels, L_{A90} dB(A)	Noise Limits, L_{Aeq}, dB(A)
Daytime (7am to 6pm)	32	35
Evening (6pm to 10pm)	33	36
Night (10pm to 7am)	32	35

5.1.1.1 Aircraft Noise - AS 2021:2000

Australian Standard AS2021-2000 "Acoustics – Aircraft Noise Intrusion – Building siting and construction" is the applicable standard for aircraft noise. This document sets the noise criteria for internal sound levels (in terms of maximum A-weighted noise levels, L_{Amax}) within buildings depending on the type/use of different rooms. Table 13 provides criteria for noise intrusion from aircraft noise.

Table 13 AS2021:2000 Specified Indoor Design Sound Level, dB(A)

Building type and activity	Indoor Design Sound Level, L_{Amax} dB(A)
House, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60
Hotels, motels, hostels	
Relaxing, sleeping	55
Social activities	70
Service activities	75
Commercial buildings, offices and shops	
Private offices, conference rooms	55
Shops, supermarkets, showrooms	75
Industrial	
Inspection, analysis, precision work	75
Light machinery, assembly, bench work	80
Heavy machinery, warehouse, maintenance	85

5.1.2 Noise Impact from Operational Truck / Delivery Movements & Boat Docking

In the absence of specific EPA 1994 criteria for these noise sources, noise from truck movements (deliveries of good and services and refuse collection) and boats docking, has been assessed against both the *EPP Noise (2008)* acoustic quality objectives. The applicable assessment criteria is presented below in Table 14.

Table 14 Truck Movements & Boats Docking Noise Impact Criteria

Sensitive receptor	Time of day	Acoustic quality objectives (measured at the receptor), dB(A)		
		LAeq, adj,1hr	LA10, adj,1hr	LA1, adj,1hr
Dwelling (for outdoors)	Daytime and Evening (7am to 10pm)	50	55	65
Dwelling (for indoors)	Daytime and Evening (7am to 10pm)	35	40	45
Dwelling (for indoors)	Night-time (10pm to 7am)	30	35	40

5.1.3 Water Treatment Plant Noise Impact

Table 15 below presents the noise limits for the water treatment plant based on the requirements of Section 440T from the EPA 1994.

Table 15 Water Treatment Plant Noise Limits

Period	Measured Lowest Background Noise Levels, L_{A90} dB(A)	Noise Limits, L_{Aeq}, dB(A)
Daytime (7am to 7pm)	32	37
Evening (7pm to 10pm)	33	36
Night (10pm to 7am)	32	32

5.1.4 Diesel Generator Noise Impact

Table 16 below presents the noise limits for water treatment plant referenced from the *EPA 1994, Section 440V – Refrigeration Equipment*, as there is no specific quantitative criteria for assessment of Diesel Generators used in this application. On this basis the following noise criteria applies:

Table 16 Diesel Generator Plant Noise Limits

Period	Measured Lowest Background Noise Levels, L_{A90} dB(A)	Noise Limits, L_{Aeq}, dB(A)
Daytime (7am to 7pm)	32	37
Evening (7pm to 10pm)	33	36
Night (10pm to 7am)	32	35

5.2 Construction Noise

The following construction noise limits for residential sensitive receivers have been adopted for this assessment:

Table 17 External Construction Noise Criteria (Source: TMR, 2013)

Time of Day	External Noise Level [4]$L_{Aeq\ (15\ min)}$, d(A)	
	Lower Limit	Upper Limit
Standard Hours	41	65 Where RBL > 55
Non - Standard Hours	[1]40	Not Applicable

[1]Average Evening RBL + 5 dB(A) based on non-standard hours not exceeding 6.30pm.

Additional criteria for non-residential receivers has not been adopted for this assessment given that there are not likely to be any non-residential sensitive receivers areas located within the project during the construction stages.

5.3 Construction Vibration

The following vibration criteria (generally adopted for assessment of construction vibration) have been adopted for vibration impacts associated with plant operations at the proposed site.

Table 18 Vibration Limit Criteria (mm/s) – Human Comfort

Building	Work Period	Resultant PPV mm/s	
		Lower Limit	Upper Limit
Dwellings (including hotels and motels)	Standard hours	1.0	2.0
	Non-Standard hours - evening	0.3	1.0
	Non-Standard hours - night-time		
Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)	All	0.3	1.0
Educational facilities (rooms designated for teaching purposes)	While In Use		
Court of Law (Court rooms)			
Court of Law (Court reporting and transcript areas, Judges' chambers)			
Community buildings (Libraries, places of worship)	While In Use	1.0	2.0
Commercial (offices) and retail areas			

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Noise Impact Assessment

06

OPERATIONAL NOISE & VIBRATION IMPACTS

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6 Operational Noise & Vibration Impacts

Operational noise has been assessed in the following sub-sections, and predicted noise contour maps associated with each noise source are contained in **Appendix C.** There is some potential for operational noise impact from bar/restaurant facilities on the site to impact the nearby residential areas if the separation distances between the two uses is inadequate. However, this noise source has not been assessed as the ocations of these facilities are subject to detailed design and it is expected that appropriate noise controls and building constructions would be adopted in the design and location of these facilities during future stages of the project.

6.1 Aircraft Noise

6.1.1 Assessment Basis

The existing airstrip consists of two runways. The main runway is aligned 18 / 36 and is a grass strip nominally 1097 metres long. The secondary runway is aligned 13 / 31 and is also grass with a nominal length of 680 metres.

Although well maintained the airstrip is not licensed and is not used by commercial aircraft apart from authorised charters. During the wet season the lowest part of the main runway – in the vicinity of the runway intersection – can be flooded and boggy which limits aircraft operations to helicopters only.

We understand that the proposal is to upgrade the main runway to a sealed surface with upgraded storm water drainage to allow for operations during rainy periods. The main sealed runway will be extended within the existing leased areas to approximately 800 metres which will open up the airfield to a wider variety of aircraft including twin propeller aircraft with a capacity of 19 seats. At this stage, a 9 seater ALA B350 has been proposed to operate 10 flights per day.

To determine the noise impact from the aircraft overpasses associated with the proposed runway, reference is made to the aircraft noise level data in *Australian Standard AS2021-2000 "Acoustics – Aircraft noise intrusion – Building siting and construction*". AS2021 does not contain source noise level data for ALA B350 aircraft and therefore, noise data from the following similar aircraft from AS2021 presented below, has been adopted for this assessment:

- SAAB 340, Boeing Dash 8, Fokker F50;
- Corporate Jet; and
- Light general aviation aircraft

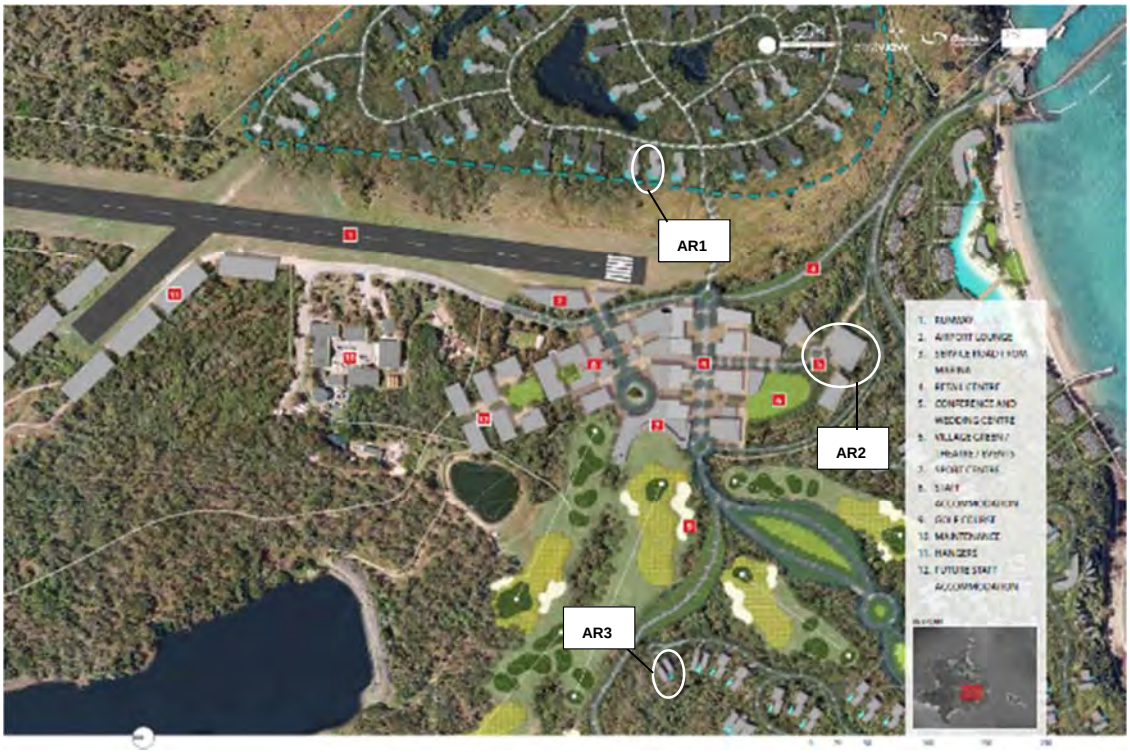
Noise levels for the above mentioned aircraft type at various distance have been referenced from Table 3.19 to Table 3.24 of AS2021-2000.

6.1.2 Location of Receivers

The locations of the most affected receiver in each identified sensitive receiver area (AR) are presented below in Figure 11 and defined as follows:

- AR1: Future Tourist Villas
- AR2: Conference and Wedding Centre
- AR3: 6 Star SPA Resort.

Figure 11 Location of Most Exposed Receivers – Potential Aircraft Noise Impacts



6.1.3 Predicted Aircraft Noise Levels

Noise from the nearest runway was considered in the assessment, with the distance between the runways/flight paths and the site determined in accordance with AS2021:2000 and shown in Table 19 below

Table 19 Distance Coordinates for Each Receivers

Receiver ID	(1)DS (m)	(2)DL (m)	(3)DT (m)
AR1	81	0	1120
AR2	21	168.76	1270
AR3	335	42	1116

(1)DS – distance from the runway centre-line to the site

(2)DL – distance along the runway centre-line to the receiver building site, starting from the closer end of the runway

(3)DT – distance along the runway centre-line to the receiver building site, starting from the furthest end of the runway

No corresponding aircraft noise levels in relation to the distance coordinates presented in Table 19 are available in AS2021:2000. As such, maximum noise levels from Table 3.19 to Table 3.24 of AS2021-2000 were considered to determine the building construction requirements for the proposed developments. Table 20 provides the adopted aircraft source L_{AMax} noise levels used in this assessment.

Table 20 AS2021 Aircraft Noise Levels L_{Amax} dB(A)

Aircraft Type	Aircraft Noise Levels, L_{Amax}		Distance Coordinates
	Arrivals	Take-Offs	
Corporate Jet	92	93	DS – 0m DT – 2500m DL – 500m
Light General Aviation Aircraft	88	92	DS – 0m DT – 1500m DL – 500m

Based on Table 20 L_{Amax}, 93 dB(A) based on the corporate jet take off noise level has been adopted to determine the minimum building facade noise reduction likely to be required for buildings in each receiver area within the proposed development.

Based on the noise limits presented in Table 13, required noise reduction for various building types associated with the proposed development are presented below in Table 21. These indicative noise reductions should be used to determine the external facades construction requirements for different building types of the proposed development.

It should be noted that this assessment has been based on the assumptions above, and is conservative on that basis, and that a more detailed assessment, including recording of noise measurement data from the proposed aircraft which will use the airstrip, is recommended to confirm the recommended noise reduction requirements during detailed design.

Table 21 Required Aircraft Noise Reduction Levels

Zone	Receiver Description	Indoor Design Sound Level, L_{Amax} dB(A)	Aircraft Noise Reduction (ANR) Required, dB(A)
Safe Harbour	Retail/Beach	75	18
5 Star Beach Resort	Visitor Centre	75	18
	Central Facilities	75	18
	Hilltop and Pool Suites	55	38
6 Star Spa Resort	Central Facilities	75	18
	Courtyard, Hilltop, Cliffside and Exclusive Villas	55	38
5 Star Eco Resort	Central Facilities	75	18
	Eco Butterfly and Eco Treetop Villa	55	38
	Glamping Facilities	75	18

Zone	Receiver Description	Indoor Design Sound Level, L_{Amax} dB(A)	Aircraft Noise Reduction (ANR) Required, dB(A)
Village & Maintenance	Airport Lounge	75	18
	Conference Centre	55	38
	Retail	75	18
	Sports Centre	75	18
	Staff Accommodation	55	38
	Maintenance	75	18
Lakeside Restaurant		75	18
Day Spa	Reception & Amenities	75	18
	Treatment Rooms	55	38

6.1.4 Recommended External Facade Construction Requirements

Building design for the proposed development has not been finalised at this stage. As such, recommended detailed building design advice has not been included in this assessment. In the absence of any detailed building design, Queensland Development Code Mandatory Part 4.4 (QDC) MP4.4 has been adopted to provide indicative building construction recommendations. This document contains minimum building constructions required to achieve certain noise reductions and is normally referenced where buildings are required to provide a reasonable level of noise reduction of traffic noise from state controlled roads.

Schedule 1 of QDC MP4.4 provide generic building construction requirements for minimum transport noise reduction (TNR in dB(A)) required for habitable rooms ranging from 40 dB(A) (Category 4) to 25 dB(A) (Category 1). Table 22 below details the building construction requirements for each category which may be applicable for the proposed development.

Table 22 Building Construction Requirements

Noise Category	Minimum Transport Noise Reduction (dB(A) Required for Habitable Rooms	Component of Buildings External Envelope	Minimum Rw Required for Each Component
Category 4	40	Glazing	43
		External Walls	52
		Roof	45
		Floors	51
		Entry Doors	35
Category 3	35	Glazing	38 (where total area of glazing for a habitable room is greater than 1.8m^2)
			35 (where total area of glazing for a habitable room is less than or equal to 1.8m^2)
		External Walls	47
		Roof	41
		Floors	45
		Entry Doors	33
Category 2	30	Glazing	35 (where total area of glazing for a habitable room is greater than 1.8m^2)
			32 (where total area of glazing for a habitable room is less than or equal to 1.8m^2)
		External Walls	41
		Roof	38
		Floors	45
		Entry Doors	33
Category 1	25	Glazing	27

Noise Category	Minimum Transport Noise Reduction (dB(A) Required for Habitable Rooms	Component of Buildings External Envelope	Minimum Rw Required for Each Component
			(where total area of glazing for a habitable room is greater than 1.8m^2)
			24 (where total area of glazing for a habitable room is less than or equal to 1.8m^2)
		External Walls	35
		Roof	35
		Entry Doors	33

6.2 Truck Movement Noise

6.2.1 Assessment Basis

Based on the Technical Memorandum – *'Lindeman Island EIS Initial Traffic Assessment',* dated December 2015, our assumptions regarding proposed vehicle movement on the island is presented below:

- Daily trips for operations workforce (500 people) – 64 light vehicle trips and 6 bus trips
- No information on operation deliveries have been provided at this stage. We assumed a maximum of 3 trucks per day will operate to deliver goods and services for the purpose of this assessment

It is understood that access to the Island is proposed by the new upgraded air strip and boats accessing the island through the proposed Safe Harbour. Movement around the resort will be undertaken by golf carts.

Based on our previous experience, golf carts are not likely to have any major noise impact on to the proposed development. On this basis, noise impact from the light vehicle trips have not been assessed in this report.

With regards to the deliveries during the operations of the development, the assumptions provided only refer to barge deliveries. Table 23 below shows operation delivery assumptions in relation to barge deliveries:

Table 23 Proposed Barge Movements

Component	Assumptions
Water	1 barge per week
Food	1 barge per week
Waste	1 barge per week
Fuel	1 barge per week

Based on the barge movement assumptions presented in the above table our assumption of truck movements (3 trucks per day) on the Island is considered to be conservative. For this reason, our predicted results from the truck movements should also be considered conservative to be updated once more

information becomes available. On this basis, further review and assessment may be required at the detailed design stage once building design and information regarding operation vehicle movement/locations are finalised.

SoundPLAN 7.4 3D noise modelling software was used to predict the noise impact from the above mentioned mobile vehicle sources. The following modelling inputs and assumptions were adopted for the modelling:

Table 24 Noise Modelling Inputs – Operational Transport Vehicle Noise

Modelling Element	Input/Assumption
Ground Elevation Geometry	Provided by Cardno
Ground Absorption	50% over soft ground
Methodology	Industrial Noise Impact: ISO 9613.2_1996 – "*Acoustics – Attenuation of Sound During Propagation Outdoors"*
Weather Condition	Calm Conditions
Façade Reflection	+2.5 dB(A) applied to traffic models, as all receivers are located at facades of receivers
Receiver Height	Assumed to be 1.8 and 4.6 meters above ground for ground and first floors respectively
Source Sound Power Levels	Revving sound power level of 110 dB(A) and idling sound power level of 102 dB(A) was assumed to calculate the sound power levels of truck movement along the different sections of the proposed road network on the Lindeman Island. Refer to **Figure 12** to **Figure 14** for the modelled sections of the proposed truck movements. Based on the distance travelled and 20km/h speed, calculated sound power levels was entered as line source 1.5m above ground level. Refer to **Table 25** for adopted truck line source sound power levels used for the modelling.

6.2.2 Modelled Scenarios and Source Sound Power Levels

It has been assumed that goods and services will be delivered and refuse will be collected from the 5 Star SPA Resort Central Facilities, 6 Star SPA Resort Central Facilities and Eco Resort Central Facilities. Therefore, 3 situations listed below were modelled to predict the truck movement noise associated with the development:

Table 25 Truck Movement Modelled Scenario

Situation	Distance Travelled at 20km/h	Calculated LAeq Sound Power Levels, dB(A)
Truck travelling to 5SSR.CF	285 meters	86
Truck travelling to 6SSR.CF	1012 meters	91

Situation	Distance Travelled at 20km/h	Calculated LAeq Sound Power Levels, dB(A)
Truck travelling to ER.CF	1436 meters	93

Figure 12 Truck Movement Path To 5 Star SPA Resort Central Facilities

Figure 13 Truck Movement Path To 6 Star SPA Resort Central Facilities

Figure 14 Truck Movement Path To Eco Resort Central Facilities

6.2.3 Predicted Noise Levels

Predicted noise levels from the truck movement for the 5 Star Resort path at the worst affected receivers are presented below in Table 26.

Table 26 Predicted Results from Truck Movement on 5 Star Resort (5SR) Path – Daytime, LAeq

Receiver	Obj No	Floor	Façade	Proposed Noise Limit, dB(A)	Predicted Noise Levels	Exceedance of Proposed Noise Limits, dB(A)
5SR 8	21	F1	N	50	50	-
5SR 10	19	GF	N	50	50	-
5SR 9	20	GF	N	50	49	-
5SR 11	17	F1	NE	50	48	-

Predicted noise levels from the truck movement for the 6 Star Resort path at the worst affected receivers are presented below in Table 26.

Table 27 Predicted Results from Truck Movement to 6 Star Resort Path – Daytime, LAeq

Receiver	Obj No	Floor	Façade	Proposed Noise Limits, dB(A)	Predicted Noise Levels	Exceedance of Proposed Noise Limits, dB(A)
5SR 10	19	GF	N	50	50	-
5SR 11	17	F1	NE	50	49	-
Village 9	314	GF	W	50	48	-
5SR 9	20	F1	N	50	47	-

Predicted noise levels from the truck movement for the Eco Resort path at the worst affected receivers are presented below in Table 28.

Table 28 Predicted Results from Truck Movement to Eco Resort Path – Daytime, LAeq

Receiver	Obj No	Floor	Façade	Proposed Noise Limits, dB(A)	Predicted Noise Levels	Exceedance of Proposed Noise Limits, dB(A)
5SR 10	19	F1	N	50	49	-
5SR 11	17	F1	N	50	49	-
P1V.12	382	GF	E	50	48	-
ER 2	397	GF	E	50	48	-

6.3 Diesel Generator Noise

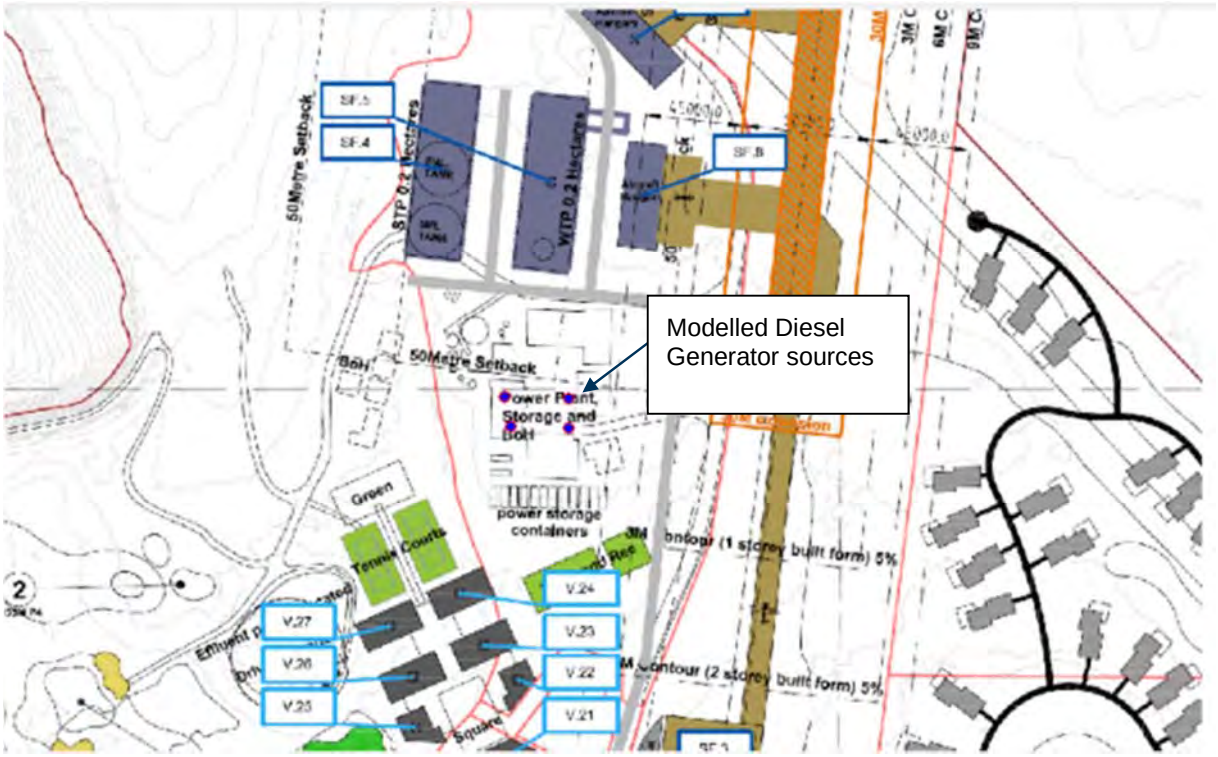
6.3.1.1 Assessment Basis

SoundPLAN 7.4 3D noise modelling software was used to predict the noise impact associated with the power plant of the proposed development.

In the absence of any detailed information, 4 diesel generators were entered in the computer model as point sources to predict the noise impact of the proposed power plant. Operation of all 4 generators simultaneously is expected to the worst case scenario when 0% solar energy is being utilised. We understand that this scenario is unlikely to occur on a regular basis.

Based on the attended measurement near the existing diesel generator, calculated sound power level of 95 dB(A) was entered at each source location. The location of the modelled generator sources are presented below in Figure 15.

Figure 15 Location of Power Plant Diesel Generator



The following modelling inputs and assumptions were made for the modelling:

Table 29 Noise Modelling Inputs

Modelling Element	Input/Assumption
Ground Elevation Geometry	Provided by Cardno
Ground Absorption	50% over soft ground
Methodology	Industrial Noise Impact: ISO 9613.2_1996 – "Acoustics – Attenuation of Sound During Propagation Outdoors"
Weather Condition	Calm Conditions
Receiver Height	Assumed to be 1.8 and 4.6 meters above ground for ground and first floors respectively
Source Sound Power Levels	Based on the attended measurements performed onsite, sound power level of 95 dB(A) was entered as a point source located at 1m above ground level.

6.3.2 Predicted Noise Levels

Predicted noise levels from the power plant (4 diesel generators) at the worst affected receivers are presented below in Table 30.

Table 30 Predicted Power Plant Noise , LAeq

Receiver	Obj No	Floor	Façade	Proposed Noise Limits, Night / Day, dB(A)	Predicted Noise Levels with No Mitigation	Exceedance of Proposed Noise Limits, dB(A)
V24	350	F2	E	35 / 37	54	19 / 17
V23	347	F2	E	35 / 37	51	16 / 14
V22	341	F2	NE	35 / 37	49	14 / 12
V27	353	F2	N	35 / 37	49	14 / 12

As shown in Table 30, predicted noise from diesel generator will exceed the EPA criteria. As such, an enclosure or noise barriers around all four diesel generators will be required. An enclosure will need to be designed in such a way that the maximum measured sound power level emitted from the enclosure is 83 dB (A) to comply with the daytime noise limits.

In order to comply with the evening and night-time noise limits, measured sound power levels outside the enclosure should be less than 81 dB(A) during the evening and night time operation.

This assessment has assumed that all four generators will be running concurrently which would only be the case when the entire island is being powered by the generators. Should a percentage of the energy be generated by solar panels, the noise levels will reduce accordingly.

We understand that the recommended optimum energy split for the development is 75% solar and 25% diesel generator power. Should this be the case, the expected noise emissions are likely to decrease by 12 dB(A). On this basis some treatment in the form of an enclosure or barrier is likely to still be required but to a lesser extent than with all 4 generators running simultaneously.

We recommend that a further detailed assessment is carried out once the typical operating energy split has been confirmed.

6.4 Water Treatment Pump

6.4.1 Assessment Methodology

SoundPLAN 7.4 3D noise modelling software was used to predict the noise impact associated with the water treatment plant proposed for the development. In the absence of any detailed information, one point source was entered in the computer model to predict the noise impact from the water treatment pump. Based on the attended measurement carried out near to the existing water treatment pump, a sound power level of 79 dB(A) was modelled at the location shown in Figure 16.

Figure 16 Location of the Water Treatment Pump

The following modelling inputs and assumptions were made for the modelling:

Table 31 Noise Modelling Inputs – Water Treatment Plant Pump

Modelling Element	Input/Assumption
Ground Elevation Geometry	Provided by Cardno
Ground Absorption	50% Over Soft Ground
Methodology	Industrial Noise Impact: ISO 9613.2_1996 – "Acoustics – Attenuation of Sound During Propagation Outdoors"
Weather Condition	Calm Conditions
Receiver Height	Assumed to be 1.8 and 4.6 meters above ground for ground and first floors respectively
Source Sound Power Levels	Based on the attended measurements performed onsite, sound power level of 79 dB(A) was entered as a point source above 1m above ground level

6.4.2 Predicted Noise Levels

Predicted noise levels from the water treatment plant at the worst affected receivers are presented below in Table 32.

Table 32 Predicted Water Treatment Plant (WTP) Noise – Daytime, LAeq

Receiver	Obj No	Flr.	Façade	Proposed Noise Limits, dB(A)			Predicted Noise Levels	Exceedance of Proposed Noise Limits, dB(A)
				Daytime	Evening	Night		
Village 24	350	F2	E	37	36	32	22	-
Village 23	347	F2	E	37	36	32	21	-
Village 27	353	F2	N	37	36	32	21	-
Village 21	335	F1	N	37	36	32	21	-

As shown in Table 32, predicted noise levels from the water treatment pump comply with the adopted EPA noise criteria. Information regarding whether the number of pumps will increase or any other treatment plant is to be added as a result of the development was not available at the time of preparation of this report.

However, given that the predicted noise levels are generally 10 dB(A) below the most stringent night-time criteria, exceedances are not likely to occur unless a significant increase in the number and size of plant occurs. If this is the case, then a more detailed, updated assessment of noise impacts from the WTP will be required.

6.5 Boat Docking Noise

6.5.1 Assessment Methodology

SoundPLAN 7.4 3D noise modelling software was used to predict the noise impact associated with the boats docking at the jetty of the proposed development. Based on attended measurements at the existing facility, a point source with a sound power level of 94 dB(A) was modelled at the location shown in Figure 17 to predict the boat docking noise.

Figure 17 Location of a Boat Docking Noise Source

The following modelling inputs and assumptions were adopted for the modelling:

Table 33 Noise Modelling Inputs – Boats Docking

Modelling Element	Input/Assumption
Ground Elevation Geometry	Provided by Cardno
Ground Absorption	50% Over Soft
Methodology	Industrial Noise Impact: ISO 9613.2_1996 – "Acoustics – Attenuation of Sound During Propagation Outdoors"
Weather Condition	Calm Conditions
Receiver Height	Assumed to be 1.8 and 4.6 metres above ground for ground and first floors respectively
Source Sound Power Levels	Based on the attended measurements performed onsite, sound power level of 94 dB(A) was entered as a point source at 1 metre above ground level.

6.5.2 Predicted Noise Levels

Predicted noise levels from the medium boat docking at the worst affected receivers are presented below in Table 34.

Table 34 Predicted Boat Docking Noise – Daytime, LAeq

Receiver	Obj No	Floor	Façade	Proposed Noise Limits, dB(A)	Predicted Noise Levels	Exceedance of Proposed Noise

						Limits, dB(A)
Beach club	1	GF	S	50	43	-
Future Tourist Villas	180	F1	S	50	42	-
Future Tourist Villas	181	F1	S	50	41	-
Future Tourist Villas	179	F1	S	50	41	-

As shown in Table 34, predicted noise from a medium sized boat docking at the jetty is predicted to comply with the adopted noise limits. Conceivably, larger boats may dock at the jetty or proposed Safe Harbour once the development is complete. A larger boat may have a source noise level of up to 10 dB(A) higher when docking. If this were the case, the noise criteria is likely to be exceeded. However these noise levels are likely to be short –term and occur infrequently so predicted noise emissions from boats are likely to be acceptable and not subject to noise mitigation requirements.

6.6 Assessment of Cumulative Noise Impacts

An extract from the issued ToR for the proposed development regarding the assessment of cumulative noise impact assessment is presented below:

TOR Clause 13.16

Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the:

(a) activity's consistency with the objectives

(b) cumulative impact of the noise with other known emissions of noise associated with existing development and possible future development (as described by approved plans)

(c) potential impacts of any low-frequency (<200 Hz) noise emissions.

We understand that clause 13.16 of TOR is applicable to the cumulative noise impacts from the proposed development onto the surrounding external receivers, as cumulative impacts on the development are not easily assessed and will vary with time and location across the development.

The closest habitable Island from the development is Hamilton Island and is located approximately 13 kilometres away from the proposed development. The location of the nearest external receivers as shown below in Figure 18.

Figure 18 Location of the nearest External Sensitive Receivers (Hamilton Island)

Based on the distance of Hamilton Island from the proposed development, Cardno believes that no adverse noise impact from the proposed development onto the nearest receivers is expected.

Therefore, as no external noise sensitive receivers are located within the close proximity of the development, a detailed assessment of cumulative noise impacts from proposed noise sources within the development has not been included in this report.

Noise Impact Assessment

07

CONSTRUCTION NOISE & VIBRATION IMPACTS

Cardno
Shaping the Future

7 Construction Noise & Vibration Impacts

7.1 Construction Noise Impact

7.1.1 Proposed construction staging and likely schedule of works

The construction period would involve a period of approximately three years commencing mid-2018. The Beach Resort is due for completion mid 2020, Spa Resort early 2021, Eco Resort in mid 2021, and the remaining facilities progressively completed through 2021. The resort will be opened at the same time in 2021.

7.1.2 Proposed construction and operational processes

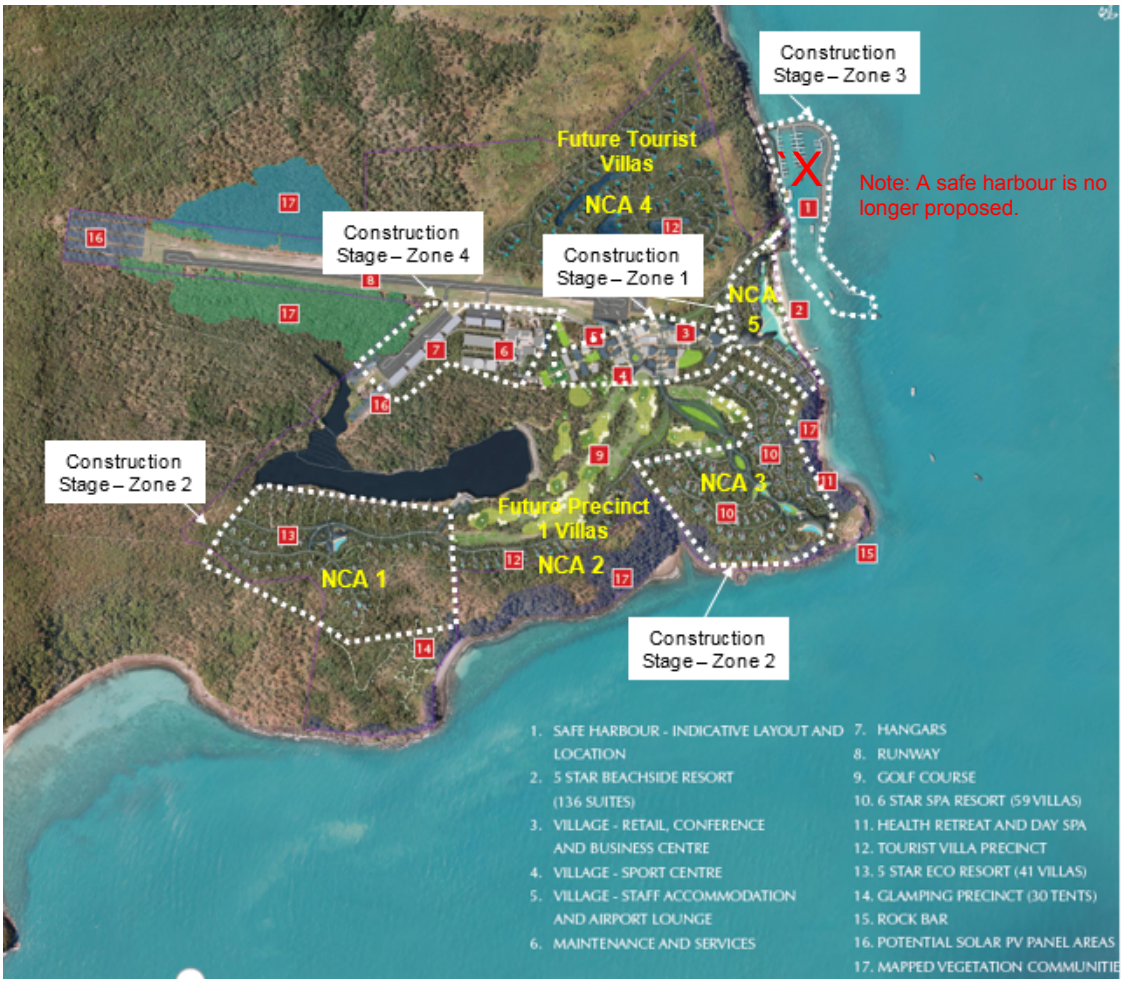
The following construction and operational processes are likely to be followed:

- Due to size and magnitude of the overall project, construction work will be undertaken in stages (refer to Chapter 4 of the EIS for further information). It should be noted that the noise assessment groups the construction activities into a number of zones (refer Figure 19) to enable the assessment of potential noise impacts;
- An accommodation camp will be established on site in the vicinity of existing accommodation area for the anticipated construction crew. The majority of the workforce will live in a “fly-in”/ “fly-out” regime with some workers commuting from the Airlie Beach area;
- Existing buildings will be demolished down to the foundations to enable the new structure for the 5 star resort layouts;
- The resorts would open at the same time in 2021;
- The method of construction of the hotels would be typical concrete framed structures complying with cyclone codes with aluminium windows and roofing to architects details;
- A concrete batching plant is proposed to be constructed on site and the proponent will explore building any pre-cast elements on site to expedite construction and minimise shipping requirements;
- Formwork systems options will be explored to speed up the construction process;
- A shipping regime will be established to ascertain the ability to have customs clear the goods in the Whitsunday to avoid delays of going to Brisbane for clearing and then transporting back up to the Whitsundays;
- The head contactor will have an overall construction manager based on site full time with Zone project managers looking after each precinct;
- The site has been broken up into noise catchment areas (NCAs) to summarise the predicted construction noise impacts on groups of sensitive receivers located in similar areas on the island as follows (refer Figure19 for locations of these NCAs):
  NCA 1: Residential Villas
  NCA 2: Future Precinct 1 Villas
  NCA 3: Residential Villas
  NCA 4: Future Tourist Villas
  NCA 5: Resort
  Construction noise has not been assessed to commercial receivers or surrounding national parks as there are no formal assessment criteria available for these types of receivers

- The project manager will have not only the responsibility of the delivery of the construction works but pay close attention to:
    - Safety;
    - Compliance with the proposed Environmental Management Plant (Terrestrial and Marine);
    - Materials Handling;
    - Worker Accommodation and transfers; and
    - Interface with all levels of authorities.
- The Developer proposes that the Project Manager will provide full time Supervision on the site during the construction process to ensure that all obligations to all levels of government are met.

The following figure shows the location of the modelled construction zones:

Figure 19 Modelled Construction Zones and Noise Catchment Areas.



7.1.3 Assessment Methodology

Construction noise modelling has been carried out for the worst case construction activities based on the above staging and assuming that some completed stages of the resort will be operational during construction of other stages. This assessment provides a worst case scenario for construction operations based on the

preliminary staging information available at the time of preparation of this assessment. It is assumed that construction works for the resorts, airstrip and safe harbour will occur between 6.30am and 6.30pm, seven days per week as the resort will not be operational at this time, and the villa construction will occur during standard (daytime) hours.

Detailed plant schedules were not available at time of preparation of this report, therefore typical construction plant for each stage has been assumed in the modelling.

On this basis it is proposed that further modelling would be carried out during detailed design, once additional input information is known, to confirm impacts and refine the concept mitigation measures detailed in this assessment, if required.

SoundPLAN 7.4 noise modelling software was used to predict construction noise impacting residential receivers. Separate noise models were constructed to predict noise levels for the various construction phases which are outlined in **section 7.1.2.**

The noise models were designed to represent a worst case scenario, based on the supplied information. This was achieved by assuming that all items of plant will operate simultaneously, as well as applying the most stringent criteria as the basis of the assessment.

7.1.4 Noise Modelling Inputs

- The base noise model used to predict operational impacts was used to construct the construction stage noise models. The base information included existing topography and buildings. To generate the construction noise models the following additional information was added:
- Source information (location and sound power level)
- The number of each type of plant operating

7.1.4.1 Modelled Scenarios

Table 35 below details the modelled construction stage scenarios. Noise contour maps for the following modelled scenarios are presented in Appendix D:

Table 35 Modelled Scenarios – Construction Noise Impact

Scenario No.	Description
1	Earthworks & Demolition – Zone 1
2	Structural Works Zone 1, Earthworks Zone 2
3	Finishing Zone 1, Structural Works Zone 2
4	Finishing Zone 2
5a	Construction works Zone 3 (Safe Harbour)
5b	Driven Piling Zone 3 (Safe Harbour)
6	Construction works Zone 4 (airstrip / airport)
7a	Construction works – Future Tourist Villas - Structure
7b	Construction works – Future Tourist Villas - Earthworks
7c	Construction works – Future Tourist Villas - Finishing

Scenario No.	Description
8a	Construction works – Future Precinct 1 Villas - Structure
8b	Construction works – Future Precinct 1 Villas - Earthworks
8c	Construction works – Future Precinct 1 Villas - Finishing

7.1.4.2 Assumed Source Sound Power Levels

The type and quantity of construction plant to be utilised for each construction phase was not available at the time of preparation of this assessment. Therefore typical plant types and numbers of plant likely to be associated with each construction phase have been estimated based on experience with previous similar projects.

Construction equipment Sound Power Levels have been sourced from measurements conducted for previous assessments and supplemented with values referenced from Australian Standard *AS 2436:2010 – "Guide to noise and vibration control on construction, demolition and maintenance sites"*.

Table 36 Plant Sound Power Levels

Plant Item	No. of Plant Modelled	Sound Power Level, dB(A)
Scenario 1 – Earthworks & Demolition Works – Zone 1		
Demolition saw	2	105
Power Tools	2	103
6-20t excavator	3	110
Bulldozer	2	108
Loader	2	113
40t truck	1	107
Truck and dog	1	103
Water Cart	1	110
Scenario 2 - Structural Works Zone 1, Earthworks Zone 2		
Tracked mobile crane	3	95
Formwork Carpentry tools	3	102
Concrete Agitator Trucks	2	109
Generator	3	93
Concrete pump	2	108
Immersion vibrating needles	4	103
Power Tools	2	103
Light vehicles (Utes)	3	87
Scenario 3 - Finishing Zone 1, Structural Works Zone 2		

Plant Item	No. of Plant Modelled	Sound Power Level, dB(A)
Power Tools	2	103
6-20t excavator	1	110
Watercart	1	107
Bobcat	1	106
Body Trucks	2	101
Tracked mobile crane	3	95
Formwork Carpentry tools	3	102
Concrete Agitator Trucks	2	109
Generator	3	93
Concrete pump	2	108
Immersion vibrating needles	4	103
Power Tools	2	103
Light vehicles (Utes)	3	87
Scenario 4 - Finishing Zone 2		
Jackhammer	1	105
Power Tools	2	103
6-20t excavator	1	110
Watercart	1	107
Bobcat	1	106
Body Trucks	2	101
Scenario 5a - Construction works Zone 3 (Safe Harbour)		
Power Tools	3	103
Concrete pump	1	108
Generator	1	93
Barge/Dredging	1	113
Scenario 5b – Driven Piling Zone 3 (Safe Harbour)		
Driven Piling Rig	1	132
Scenario 6 – Construction Works Zone 4 (Airstrip / Airport)		
Power Tools	3	103
Concrete pump	1	108
Generator	1	93
6-20t excavator	1	110

Plant Item	No. of Plant Modelled	Sound Power Level, dB(A)
Asphalt Paver	1	108
Concrete truck	1	107
Large Padfoot roller	1	111
40t truck	2	107
Scenario 7 & 8a – Future Tourist & Precinct 1 Villas - Earthworks		
6-20t excavator	3	110
Bulldozer	2	108
Vibratory roller	1	111
Loader	2	113
40t truck	1	107
Truck and dog	1	103
Water Cart	1	110
Large Padfoot roller	1	111
Scenario 7 & 8b – Future Tourist & Precinct 1 Villas – Structural Works		
Tracked mobile crane	3	95
Formwork Carpentry tools	3	102
Concrete Agitator Trucks	2	109
Generator	3	93
Concrete pump	2	108
Immersion vibrating needles	4	103
Power Tools	2	103
Light vehicles (Utes)	3	87
Scenario 7 & 8c - Future Tourist & Precinct 1 Villas – Finishing Works		
Jackhammer	1	105
Power Tools	2	103
6-20t excavator	1	110
Watercart	1	107
Bobcat	1	106
Body Trucks	2	101

7.1.4.3 Predicted Construction Noise Levels

The results of the noise modelling are displayed as noise contour maps in **Appendix D**. A noise map is provided for each model scenario, as detailed in Table 37. The noise contours represent the exceedance above the upper and lower external daytime noise limits (41 dB(A) and 65 dB(A) respectively), and non-standard hours criteria (40 dB(A)) which has been based on the evening time period as non-standard construction hours are not expected to exceed 6.30pm.

Predicted construction noise levels were determined in accordance with the methodology, and modelled scenario numbers as described in **Section 7.1.4.1.** Construction is proposed between 6.30am and 6.30pm seven days per week for the initial stages of the development when the resort is not operational, and then during standard daytime hours only, for construction of the villas. A summary of the predicted noise levels is provided below in **Table 37.**

Table 37 Construction Noise Impact Summary

Scenario No.	Results Summary
1	Construction noise impacts are expected to comply with the upper limit criteria of 65 dB(A) at all other occupied zones within the development. There is some predicted exceedance of the lower daytime and evening limit across the NCAs, but these areas will not be operational during this construction stage.
2	Exceedances of all noise limits are predicted within the development. Exceedances of the upper daytime limit are predicted at NCA3 in particular. This is not likely to be an issue as development will not be operation during this construction phase.
3	Exceedances of all noise limits are predicted across the development but as none of the areas where the limits are likely to be exceeded are operational at this time, this is likely to be acceptable. Exceedances of the daytime upper limit are expected in NCAs 1, 2 and 3.
4	Exceedances of the daytime upper limit are not predicted but some exceedances of the lower and evening limits are predicted across NCA 1 and 3 but as none of the areas where the upper limit is likely to be exceeded are operational at this time, this is likely to be acceptable.
5a	Construction of the Safe Harbour is likely to provide some exceedances of the lower daytime and evening limit in NCA 3 and 5 without piling. This is not likely to be an issue as these areas of the development will not be operation during this construction phase.
5b	Piling at the Safe Harbour is likely to provide significant exceedances of all noise limits in all NCAs. Some management controls may be required due to the magnitude of the predicted levels, in particular with regard to the impact on existing bat colonies within the island but as the resort will not be operational during this phase, the human impacts are likely to be acceptable.
6	Exceedances of the lower limits for both daytime and evening and predicted across all NCAs. However, exceedances of the upper limit daytime noise limits are predicted around the airstrip but not in any occupied zones. Therefore additional mitigation measures are not likely to be required other than best practice management.
7a	Exceedances of the upper noise limits are predicted in the Future tourist Villa area (NCA 4). There are predicted exceedances of the lower noise and evening limits, across all NCAs. As the resorts are likely to be operational during this period, construction is recommended for daytime hours only, and management controls may be required.
7b	
7c	

Scenario No.	Results Summary
8a	Exceedances of the upper noise limits are predicted within the future Precinct 1 Villa area but not in other zones. Exceedances of the lower limits are predicted across the site, and therefore similar measure to those described above for Scenario 7 are recommended.
8b	
8c	

7.2 Construction Vibration Impact

In general, plant with the potential to generate significant vibration includes:

- Vibratory rollers
- Rock hammers
- Bored & Driven Piling

Vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. A range of construction equipment proposed for the project may cause ground borne vibration, with driven piling likely to have the most significant impact.

On this basis, the following section provides an assessment of potential for vibration impact at the nearest sensitive receivers, based on works in Zone 3, as this is considered the worst case based on the proposed programming information available.

The assessment has been carried out in two parts on the basis that driven piling would generate the highest vibration levels, with general construction plant such as excavators, vibratory rollers and rock hammers generating lower levels of vibration.

Construction activities are considered to be sources of 'intermittent' vibration and have been assessed as such in terms of maximum peak particle velocity (PPV).

7.2.1 Vibration from Construction Activities

The potentially worst affected receivers were identified based on their location in relation to the proposed piling works, which would be expected to be carried out at the jetty in Zone 3 as follows:

- 5 Star SPA Resort, accommodation – at 150 metres from the jetty
- 5 Star SPA Resort commercial building – at 75 metres from the jetty

Vibration predicted for these receivers was carried out using the methodology detailed in the, Transit Noise and Vibration Impact Assessment (TNVIA) (Miller and US Federal Transit Administration, 2006), and based on the following vibration algorithm:

$PPV_{equip} = PPV_{ref} \times (7.62/D)^{1.5}$

where:

- PPV_{equip} is the peak particle velocity in mm/s of the equipment adjusted for distance
- PPV_{ref} is the reference vibration level in m/s at 7.62m (25 feet) from Table 5-1
- D is the distance from the equipment to the receiver in metres.

Note that the vibration algorithm from the TNVIA has been converted from imperial to metric.

Table 38 Vibration Source Levels for Construction Equipment (ref: TNVIA 2006)

Equipment	PPV at 7.62m (25ft) in mm/s
Pile Driver (Impact) (Upper)	38.56
Pile Driver (Impact) (Typical)	16.36
Vibratory Roller	5.33
Large Bulldozer	2.29
Rock breaker	2.26
Bored Piling	2.24
Loaded Trucks	1.93
Jackhammer	0.89

Based on the above, the predicted piling vibration levels for the assessed receivers are shown below in Table 39.

Table 39 Predicted Construction Vibration Levels at Nominated Receivers.

Receiver	Equipment	Distance, m	Predicted Receiver PPV, mm/s	Human Comfort Vibration Criteria mm/s
5 Star SPA Resort Commercial	Pile Driver (Impact) (Upper)	75	1.2 mm/s	1 – 2 mm/s
	General Construction Equipment		0.03 – 0.5 mm/s	
5 Star SPA Resort Accommodation	Pile Drive	150	0.4 mm/s	1 - 2 mm/s
	Construction Equipment		0.01 – 0.2 mm/s	

7.2.1.1 Construction Vibration Results Summary

The above table indicates that construction works are likely to provide vibration levels that are below 1.0 mm/s for most types of construction at the nearest commercial receiver (75 metres from the jetty).

The above figure indicates that the majority of construction works are likely to provide vibration levels that are just above 1 mm/s for piling at the nearest commercial premises but less than 2 mm/s so compliance with the criteria is expected.

Based on these results, the estimated vibration level at all sensitive receivers near to the proposed site is likely to comply with both the human comfort and building damage criteria adopted for this project.

Therefore vibration mitigation measures are not likely to be required where the separation distance between the works and receivers is 75 metres or greater.

08

RECOMMENDED MITIGATION MEASURES

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8 Recommended Mitigation Measures

8.1 Operational Noise Mitigation

8.1.1 Site Specific Measures

On the basis of the assessment results detailed in **Section 6** of this report the following site specific noise mitigation measures are recommended.

In the absence of any detailed building design, generic building construction requirements have been presented in this report to allow expected aircraft noise to comply with the indoor design levels recommended in AS 2021. We recommend that a detailed design assessment is carried out to confirm these recommendations once the building plans and the types of aircraft proposed for the site have been finalised.

Truck movement operations should be limited to 3 trucks per day and should operate during the daytime (7am to 6pm) and evening (6pm to 10pm) periods only.

An enclosure or noise barriers around all 4 diesel generators has been recommended. In order to comply with the daytime noise criteria, the total emitted sound power level of the enclosure should not exceed 83 dB(A). In order to comply with the night time noise limits, sound power levels of the enclosure should not exceed 81 dB(A). The detailed design of the enclosure will rely on the proposed maximum % operation of the generators, and if 75% solar power is used as we understand has been recommended as an optimum option, allowable sound power level noise emissions from the (sum of the) diesel generators may be increased by up to 12 dB(A).

Predicted noise levels from a medium boat docking will comply with the daytime and evening noise limits. Exceedances are predicted for docking boats with a maximum sound power level of 100 dB(A) or a sound pressure level of 78 dB(A) @ 5 metres. Boat docking activities are recommended to be limited to the daytime (7am to 6pm) and evening (6pm to 10pm) period only.

8.2 Construction Noise Mitigation – General

The following best practice construction noise and vibration mitigation measures based on recommendations provided within the TMR CoP 2014, Volume 2 and *Australian Standard AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites* should be applied to the project. Taking into consideration the currently available construction information, the general management of noise is addressed in this section, with management controls which are specific to the site detailed in Section 8.3.

Based on the predicted noise levels, piling is likely to generate noise levels at operational sensitive receivers significantly above the criteria, during standard working hours. Consultation with any operational resorts will be required before and during construction for this activity with the objective of:

- Advising the operators of the potential construction noise impacts;
- Informing the operators of measures that will be undertaken to reduce disturbance;
- Advising the operators of the reasons for any required evening works; (it is recommended that piling not be carried out during non-standard hours due to the predicted level of impact).
- Determining the preferred communication methods for advising patrons and residents (staff) of impending works (e.g. email, text, letter drop).
- Negotiating acceptable solutions (e.g. alternative accommodation) in situations where noise impacts during the day or evening period may exceed the criteria.

8.2.1 TMR Code of Practice Recommended Mitigation Measures

The TMR CoP 2014, Volume 2 provides general mitigation measures which may be used to reduce noise and vibration impacts.

8.2.1.1 Administrative Procedures

Administrative procedures may:

- Provide an induction to site personnel (including subcontractors) addressing the requirements of the NCMP and their responsibilities with regard to noise and vibration management ensuring
  - work occurs within approved hours
  - appropriate mitigation and management measures are being utilised.
- Provide ongoing education of supervisors, operators and sub-contractors on the need to minimise noise and vibration through toolbox meetings and on-site training.
- Include clauses that require minimisation of noise and vibration in subcontractor agreements.
- Provide a protocol for handling noise and vibration complaints that includes recording, reporting and acting on complaints.
- Organise work to be undertaken during the Standard hours where reasonable and practical and safe to do so.
- Include an outside Standard hours works procedure to minimise the impact of any significant noise and vibration works outside Standard hours.
- Avoid the use of radios or stereos outdoors where neighbours may be affected.
- Avoid the overuse of external public address systems or link these systems to the telephone system where neighbouring sensitive receivers may be affected.
- Avoid shouting, and minimise talking loudly and slamming vehicle doors.
- Avoid the use of horns within the construction area, except in the case of emergency or a requirement for safety.
- Where noise assessment indicates reverse beepers/warning signals are likely to result in adverse impacts on amenity, minimise mobile equipment reversing/movement or use alternative beepers, such as ‘broadband noise beepers’ or warning systems. All warning signals should meet the relevant occupational safety requirements. The above should be implemented for plant operating during night-time hours where reasonable and practicable.
- Where significant impacts are unavoidable, particularly at night, ensure that respite measures are implemented (see Section 8.4)
- Where respite measures are implemented and significant noise and vibration impacts still occur, alternative mitigation measures may be considered as a last resort such as those detailed in Section 8.4.

8.2.1.2 Construction Traffic & Deliveries

Construction traffic and deliveries mitigation and management procedures may include:

- Set the site entry and egress points as far from sensitive and critical receptors as practical. If sensitive sites surround the construction area, the entry and egress points should be designed to distribute the movements rather than directing all movements through a single entry/exit point.
- Provide on-site parking for staff and on-site truck waiting areas away from residences and other sensitive land uses.
- Avoid unnecessary revving of engines and switch off equipment when not required.
- Position loading and unloading points away from sensitive and critical receptors.

- Avoid traffic calming devices which may cause loads to react or secure loads to limit reaction.
- Ensure traffic movement is kept to a minimum (e.g. ensure trucks are fully loaded so that the volume of each delivery is maximised) and night-time construction traffic is redirected away from sensitive and critical receptors where possible.
- Regularly grade unsealed areas or fill potholes in sealed access roads and hardstand areas to reduce noise and vibration from vehicles.
- Refill aggregate bins prior to the bins being completely empty.

8.2.1.3 Plant & Equipment

Plant and equipment mitigation and management procedures may include:

- Select plant and equipment based on noise and vibration emission levels.
- Turn off plant and equipment or throttle them down to a minimum when not in use.
- Select appropriately sized equipment for the task, such as vibratory compactors and rock excavation equipment.
- Avoid using plant and equipment simultaneously adjacent to sensitive receptors. In contrast to noise, the total vibration level produced could be significantly less when each vibration source operates separately.

8.2.2 AS 2436 Best Practice Measures

The following best practice construction noise and vibration mitigation measures are based on recommendations provided within *Australian Standard AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites*.

- Construction noise and vibration should be minimised as far as is practically possible using methods such as:
  - Development and implementation of all reasonable and feasible site specific mitigation measures to meet noise criteria applicable to the proposal in consultation with residents.
  - Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc.
  - Keeping plant and equipment well maintained.
  - Locating concentrated areas of noise such as the crushers as remotely as possible from noise sensitive receivers.
  - Developing proposed hours of operation in consultation with the resort operators and the affected receivers with a view to minimising potential impacts as far as is practically feasible.
  - Conducting noise monitoring during operations for the purposes of assisting in noise mitigation and to verify the findings of this noise assessment, if complaints are received or proposed activities and number of plant exceed those assumed in this assessment.
  - Use of noise barriers where practical.
  - Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations.
  - Modification of work activities where noise or vibration is found to cause unacceptable impact.
  - Should operations be required outside daytime hours, all reasonable and feasible efforts should be undertaken to ensure noise levels would not exceed the INP Noise criteria stated in this Table 5-3 and Table 5-4 of this assessment.

- Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately.

- An operational Noise and Vibration Management Plan should be prepared for the project, to include, but not be limited to, the above measures.

8.2.2.1 Site Specific Measures

The following site specific mitigation measures are recommended:

8.2.2.1.1 Plant Controls

- Provision of construction site perimeter noise barriers is not likely to be effective or practical given the elevated nature of the sources and the distance between the site and receivers.
- Limit the number of plant operating at one time.
- Investigate whether "at plant" mitigation or muffled plant is available. This may not be practical for some of the plant given the nature of crushers and screeners, and the openness of the conveyors etc. However, provision of insulation lined steel enclosures around the crushing parts of the plant, and damping material applied to the areas impacted by dumping can significantly reduce noise emissions. Local noise barriers have also proven to be effective for similar facilities.
- Keep all plant and equipment well maintained.
- Use of broadband reversing alarms, or "quackers", on mobile equipment in accordance with the relevant health and safety regulations.
- Preference should be for electric powered plant over combustion engine powered plant.
- Preference should be for hydraulic or electric powered plant over pneumatic powered plant.
- Avoid metal to metal contact on equipment to reduce impulsive or scraping noise.

8.2.2.1.2 Manage Hours of Operation

- Developing proposed hours of operation in consultation with the resort operators and the affected receivers with a view to minimising potential impacts as far as is practically feasible.
- Do not carry out operations during evening or night-time hours.

8.2.2.1.3 Management & Behaviour Controls

- Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, though staff site inductions, notice boards, and prestart meetings.
- Avoid the need for reversing in the new area by creating a loop road or similar.
- Avoid dropping materials from height.
- Workers should avoid shouting, minimise talking loudly, and avoid slamming vehicle doors.

8.3 Construction Noise Mitigation – Project Specific

Construction noise should be minimised as far as is practically possible by applying methods such as:

8.3.1 Hours of Operation

1. Carrying out works within *standard hours* for construction work when adjacent areas (such as the resorts are operational i.e. for the villa construction phases only) as follows:
   i) 7:00am to 6:00pm Monday to Friday
   ii) 8:00am to 1:00pm Saturday
2. Construction work and deliveries should only be conducted during standard hours, unless:
   i) The relevant authorities determine that the delivery of oversize plant or structures should be conducted during night-time hours (e.g. for safety);
   ii) Disruption to transport or utilities would occur.
3. The hours of operation for the villa construction phases should be developed in consultation with the operators / occupants of the affected resorts with a view to minimising potential impacts as far as is practically feasible.
4. Night-works are not recommended where adjacent zones are occupied.

8.3.2 Haulage

1. Spoil haulage should be conducted on the haulage. Routes located as far from occupied zones as is possible.
2. Spoil should not be hauled offsite during the night period. Preferably, spoil should be stockpiled and removed from the site the following day. If required, site generated night-time haulage should not allow more than 1 vehicle pass by any occupied accommodation in any 1 hour period.
3. Trucks waiting to enter construction areas should park in compounds, and not park in front of accommodation.
4. Trucks should avoid compression braking within the project extent.
5. The layout of compounds should reduce the need for having to reverse wherever possible, and reverse “quackers” instead of beepers should be used as much as possible.

8.3.3 Barriers

1. Temporary buildings and site offices should be placed around the outer edge of compounds:
2. Wherever possible, temporary crash barriers located between residents and construction works should be fitted with solid hoardings (ensuring no gaps, and ideally a minimum panel mass of 12.5 kg/m^2) to provide a minimum 2 metre high solid acoustic barrier, if practical to do so.

8.3.4 Plant Source Controls

1. General recommendations that should be adhered to project wide include:
2. Keeping plant and equipment well maintained.
3. Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations.
4. Preference should be for electric powered plant over combustion engine powered plant.

5. Preference should be for hydraulic or electric powered plant over pneumatic powered plant.
6. Avoid metal to metal contact on equipment to reduce impulsive or scraping noise.
7. Fixed plant (e.g. generators) should be sited in locations that maximise separation distance or existing screening features to the nearest residents.
8. Plant selections should not have noise SWLs higher than those specified in Table 40. Data can usually be obtained from the manufacturer, or machinery measured in the absence of manufacturer's data.

Table 40 Recommended Maximum Plant SWLs

Equipment	Sound Power Level, dB(A)
Asphalt Paver	108
Bobcat	106
Bored piling	122
Bulldozer	108
Chainsaw	102
Concrete Pump	108
Crane	105
Dump truck	107
EWP	80
Excavator	108
Generator	93
Grader	110
Hand compactor	113
Loaders	113
MRV	97
Mulcher	113
Profiler	104
Rock breaker	118
Rock saw	118
Spray Sealing Equipment	106
Vibratory roller	113
Water Cart	107
Welder	96
Asphalt Paver	108

8.4 Additional Noise Mitigation – Specific Construction Phases/Scenarios

In combination with general noise mitigation measures, additional mitigation may be required for each construction phase and scenario. The additional mitigation may consist of the following:

- Alternative Accommodation, for residents / patrons who may experience intrusive noise.
- Monitoring, at sensitive locations where noise impacts are anticipated.
- Individual Briefings, within 48 hours of proposed work, to provide personalised advice and also receive feedback.
- Letterbox Drops, to advise large areas of occupants of potential noise impacts.
- Project Specific Respite Offer, for some occupants (staff) exposed to lengthy periods of noise and vibration.
- Phone Calls, within 7 days of proposed work, to provide personalised advice and also receive feedback.
- Specific Notifications, no later than 7days ahead of construction activities, to support existing information and advertise unscheduled works.

8.5 Construction Noise Monitoring Program

Construction noise monitoring should be carried out at key locations within the project impact area. Pre-construction noise levels should be recorded at a number of locations to determine baseline noise levels.

The locations would be confirmed once more information regarding the project construction staging is available. Once baseline monitoring has been carried out, weekly noise monitoring would be carried out at those baseline locations located near to the construction works occurring during that time period.

Monthly noise monitoring reports should be prepared detailing all of the monitoring results and any exceedances of project criteria. This information should then be used to inform the construction team on whether compliance is being achieved and whether the proposed noise mitigation strategies need to be altered to accommodate exceedances.

In addition, it is proposed that additional noise monitoring may be carried out as part of complaint management strategy if required.

Noise Impact Assessment

09

CONCLUSIONS

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9 Conclusions

This assessment has identified the following:

9.1 Operational Noise

- Predicted air-craft noise levels from the proposed run-way upgrade are likely to impact the proposed development. Therefore, indicative building construction requirements based on Queensland Development Code MP4.4 have been identified in this report. We recommend that a detailed design assessment is carried out to confirm this advice once the building plans and the types of air-craft to use the development have been finalised
- Predicted noise levels from truck movements will are expected with the EPP daytime and evening noise limits. Operational truck movement operations should be limited to 3 trucks per day and should operate during daytime only.
- Based on the worst case scenario of 4 diesel generators running simultaneously, the predicted noise levels from the proposed energy plant is expected to exceed both daytime and night-time EPA noise limits. Therefore, an enclosure or noise barriers located around all 4 diesel generators has been recommended. In order to comply with the day and night-time noise limits, the total emitted sound power level from the enclosure should not exceed 83 and 81 dB(A) respectively. Based on the existing generator enclosure is likely to be required to achieve this should typical operation of the generators include periods where all four generators will be operating.
- Predicted noise levels from the proposed water treatment pump is expected to comply with the adopted assessment noise limits.
- Predicted noise levels from a medium boat docking will comply with the daytime and evening noise limits. Exceedances are predicted for docking boats with a maximum sound power level of 100 dB(A) or a sound pressure level of 78 dB(A) @ 5 metres. Boat docking activities are recommended to be limited to the daytime (7am to 6pm) and evening (6pm to 10pm) period only.

9.2 Construction Noise & Vibration

Predicted exceedance of the TMR CoP Construction noise criteria are predicted for a number of the proposed construction scenarios where part of the site has become operational.

General noise mitigation measures to minimise construction noise impacts as far as possible have been provided in Section 8.2.

The highest impacts are likely if piling is proposed. An assessment of piling during construction of the Safe Harbour in Zone 3 has been identified as having the highest expected impacts. However the adjacent resorts are not proposed to be operational during this construction phase so adverse impacts on human sensitive receivers are not expected. Some management controls may be required once more detail about the construction scheduling is known with regards to impacts on the bat colonies located on the western side of the island. We recommend that a Construction Environmental Management Plan is prepared and this impact considered.

The predicted exceedances are generally a result of very quiet ambient noise levels, and therefore stringent criteria, combined with large numbers of plant that have been adopted for each modelled scenario. This modelling has been carried out to provide a worst case scenario and it may be possible to reduce the number of plant on site and still provide the same level of operations by making processes more efficient.

Provision of noise barriers is not likely to be practical for this site given the elevated and moving sources and the distance of the site from the receivers.

Best practice construction noise mitigation measures are recommended in Section 8.2.2 of this report.

Sleep disturbance has not been assessed as the site is only proposed to operate during daytime hours.

The nearest receivers that have the potential to experience vibration from the site (Zone 3), are located approximately 75 and 150 metres to the North West of potential piling activities. Ground vibration levels at 75 metres from driven piling, and general construction activities are expected to range between approximately 0.01 and 1.2 mm/second at the nearest receiver. Based on this, the estimated vibration level at all sensitive receivers near to the proposed Zone 3 site is likely to comply with both the human comfort and building damage criteria adopted for this project.

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Noise Impact Assessment

10

RISK ASSESSMENT

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10 Risk Assessment

10.1 Risk Assessment Approach

The Terms of Reference requires the Environmental Impact Statement to "predict the impacts of the noise emissions from the construction and operation of the project on the environmental values of the receiving environment, with reference to sensitive receptors."

Potential noise impacts for both the operational and construction phases of the proposal have been identified by this assessment. A risk assessment has been developed to assess the circumstances that could result in such impacts, using a standard risk assessment matrix as presented in Table 41. This risk evaluation process affords a score ranging from Low (1) to Extreme (25).

Table 41 Standard Risk Assessment Matrix

RISK MATRIX	CONSEQUENCES				
PROBABILITY	Catastrophic Irreversible Permanent (5)	Major Long Term (4)	Moderate Medium Term (3)	Minor Short Term Manageable (2)	Insignificant Manageable (1)
Almost Certain (5)	(25) Extreme	(20) Extreme	(15) High	(10) Medium	(5) Medium
Likely (4)	(20) Extreme	(16) High	(12) High	(8) Medium	(4) Low
Possible (3)	(15) High	(12) High	(9) Medium	(6) Medium	(3) Low
Unlikely (2)	(10) Medium	(8) Medium	(6) Medium	(4) Low	(2) Low
Rare (1)	(5) Medium	(4) Low	(3) Low	(2) Low	(1) Low

The resulting risk assessment is presented in Table 42.

Table 42 Risk Assessment

Potential Impact	Significance of Impact: Unmitigated	Mitigation Measure			Significance of Impact: Mitigated
		Design	Construction	Operation	
Aircraft Noise					
Aircraft noise causing sleep disturbance at night	▪ (16) High	▪ Provide adequate building construction to accommodation in accordance with AS 2021	▪ Not applicable	▪ Do not operate aircraft at night except for emergencies	▪ (1) Low
High levels of aircraft noise during the day	▪ (16) High	▪ Provide adequate building construction to sensitive areas in accordance with AS 2021	▪ Not applicable	▪ Manage timing and number of aircraft movements	▪ (4) Low
Operational Truck Noise					
Excessive truck noise from deliveries and refuse collection	▪ (3) Low	▪ Not required	▪ Not applicable	▪ Manage hours of deliveries / refuse collection	▪ (1) Low

Potential Impact	Significance of Impact: Unmitigated	Mitigation Measure			Significance of Impact: Mitigated
		Design	Construction	Operation	
Diesel Generator noise					
Excessive noise at sensitive receivers from diesel generators	• (16) High	▪ Provide Barrier or enclosures around the generators Adopt a percentage of solar power energy production	▪ Not Applicable	▪ Manage maintenance operation during daytime hours only	▪ (1) Low
Boat Docking Noise (Safe Harbour)					
Excessive noise from Safe Harbour boats at nearby sensitive receivers	• (4) Low	Provide adequate noise screening / enclosure	Not applicable	Boats with sound power levels over 101 dB(A) may cause excessive noise impacts. Limit the number of larger boats using the harbour. Restrict use to daytime.	▪ (1) Low
Water Pump Noise					
Excessive plant noise at nearby sensitive receivers	• (4) Low	▪ Provide adequate noise screening / enclosure	▪ Not applicable	▪ Not applicable	▪ (1) Low
Construction Noise					
Excessive construction noise at existing external receivers	• (1) Low	▪ Not applicable	▪ Not required – nearest external sensitive receivers are located at least 13 km away from development.	▪ Not applicable	▪ (1) Low
Excessive Evening construction noise at operational sensitive areas	• (16) High	▪ Provide local barriers screening and plant controls	▪ Prepare and implement a Noise and Vibration Management Strategy and maintain equipment ▪ Maintain buffer distances	▪ Not applicable	▪ (1) Low
Excessive construction noise impacts at sensitive areas during the day.	• (12) medium	▪ Not applicable	▪ Manage staging to locate construction as far from operational areas as possible ▪ Maintain buffer distances	Not applicable	▪ (8) Medium

Noise Impact Assessment

11

APPENDICES

11 Appendices

11.1 List of Appendices

Appendix A: 7 Day Monitoring Charts

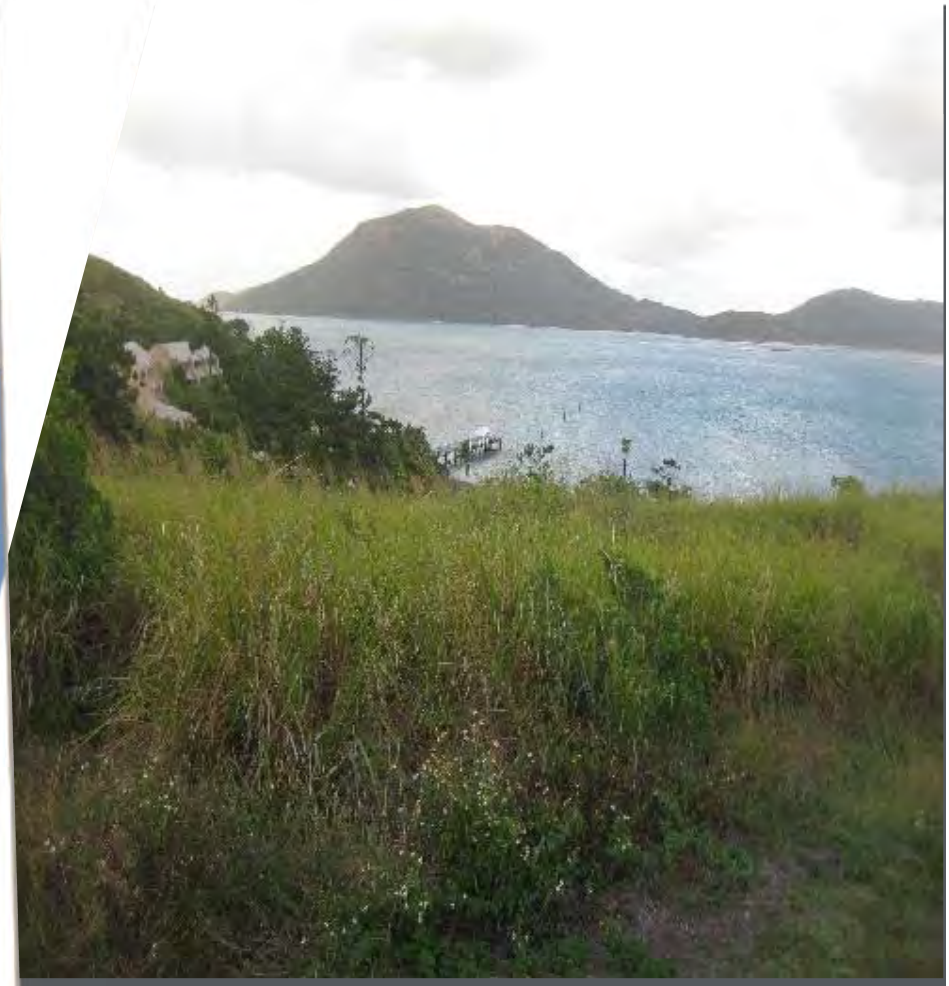
Appendix B: Weather Data during the Noise Monitoring Period

Appendix C: Noise Contour Maps – Operational Noise

Appendix D: Noise contour Maps – Construction Noise

12

GLOSSARY OF TERMS & ABBREVIATIONS



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12 Glossary of Terms and Abbreviations

A-weighted Level	As per dB(A) defined below.
Ambient Sound	Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.
Background Sound Level	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources.
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
dB(A)	Unit of acoustic measurement electronically weighted to approximate the sensitivity of human hearing to sound frequency.
L_{90}, L_{10} etc.	A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, i.e. L_{90} is the level which is exceeded for 90% of an observation period. L_{90} is commonly referred to as a basis for measuring the background sound level.
$L_{Abg, T}$	The A-weighted background sound level measured over a time interval T.
$L_{Aeq, T}$	Equivalent continuous A-weighted sound pressure level. This is the value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.
RBL	Rating Background Noise Level
Sound Pressure Level, Lp, dB, of a sound	A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to the reference sound pressure of 20 microPascals.
Sound Power Level, Lw, dB of a source	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power level is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt.
ISO 9613	International standard – Acoustics – Attenuation of sound during Propagation outdoors

Noise Impact Assessment

APPENDIX A

7 DAY NOISE MONITORING CHARTS

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Figure 20 Ambient Noise Levels Measured on 22 October 2015 (Logger 1) – Air Strip)

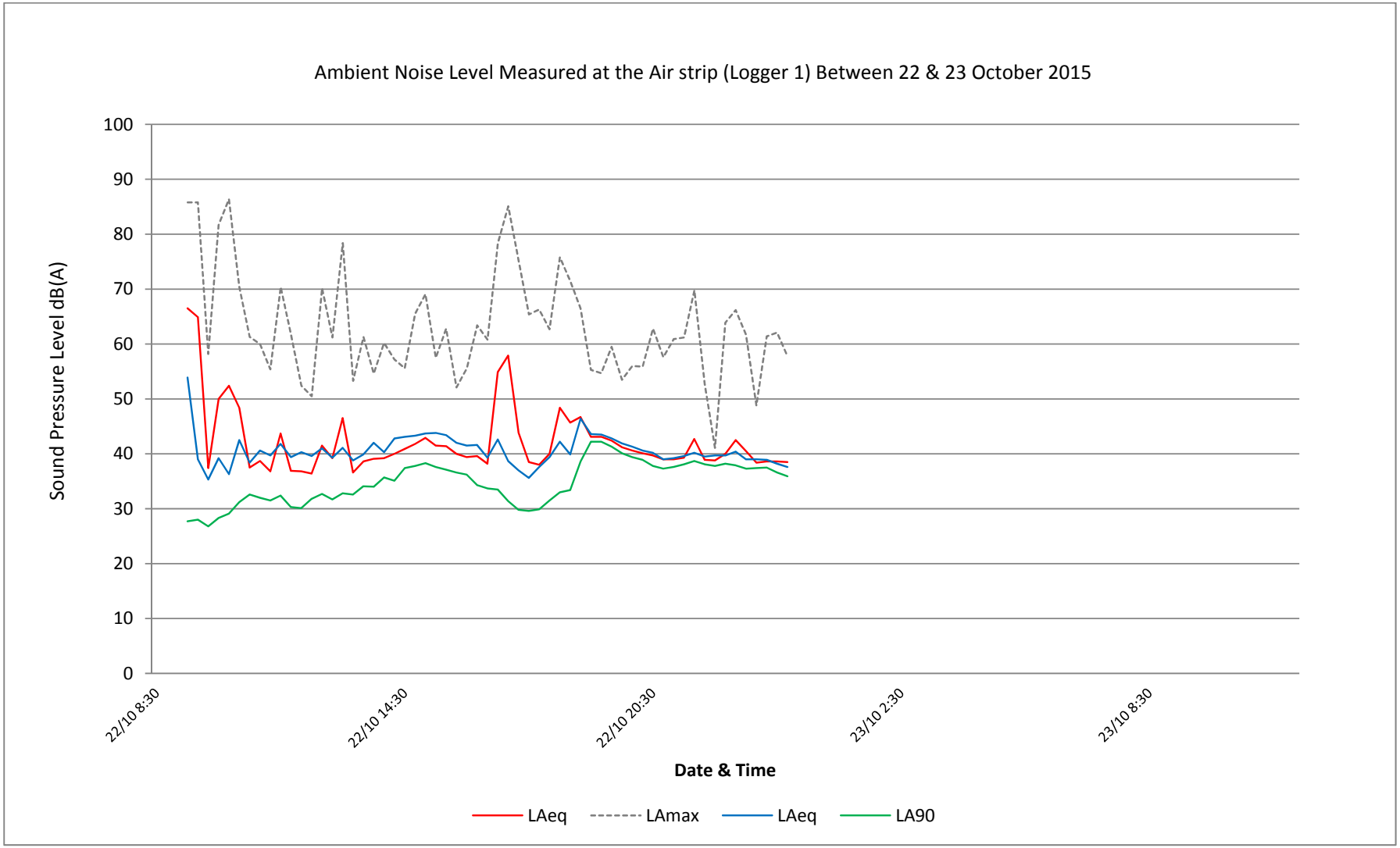


Figure 21 Ambient Noise Levels Measured between 22 and 29 October 2015 (Logger 2 – Lindeman Jetty)

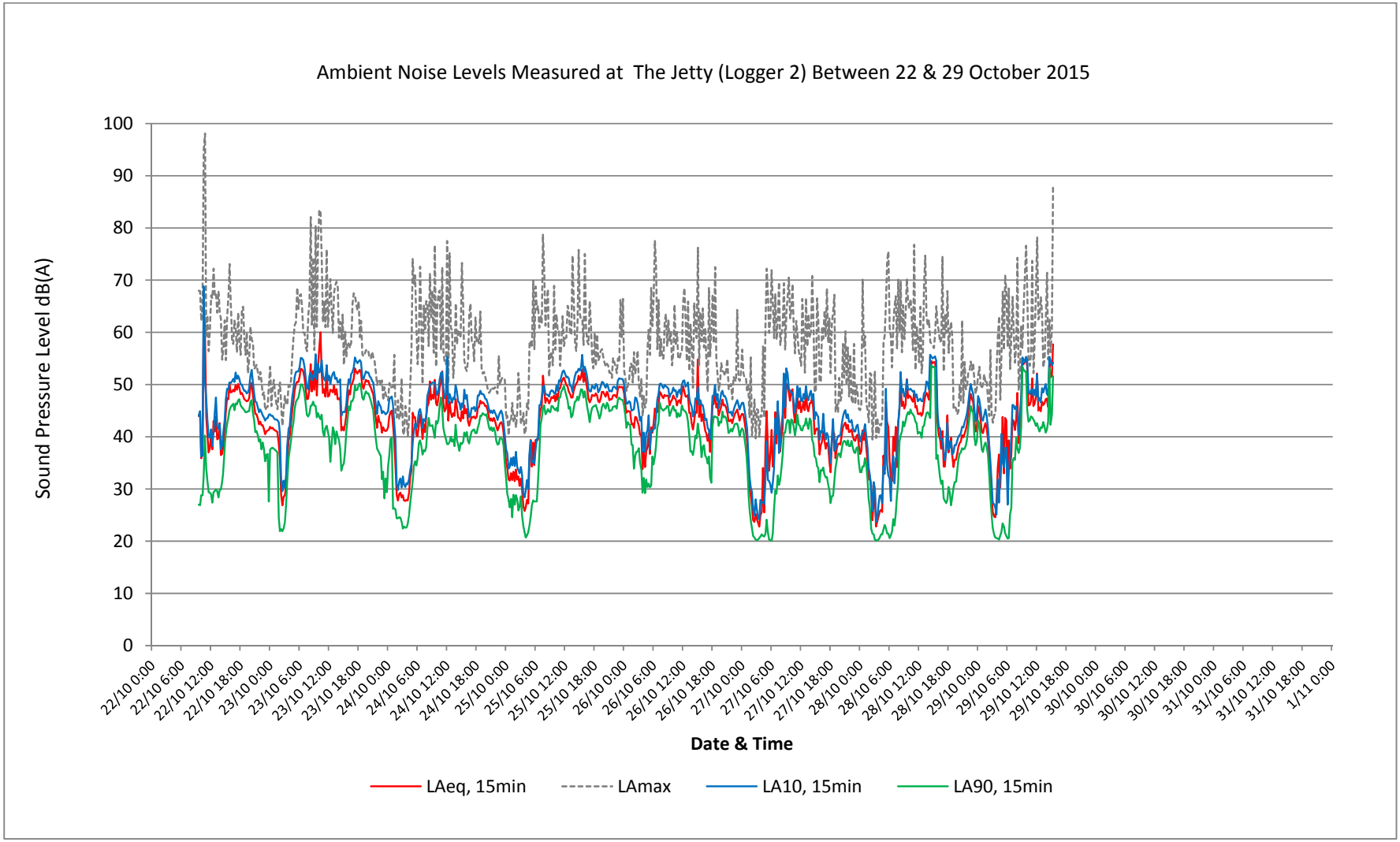


Figure 22 Ambient Noise Levels Measured between 22 and 25 October 2015 (Logger 3 – Outlook Cliff)

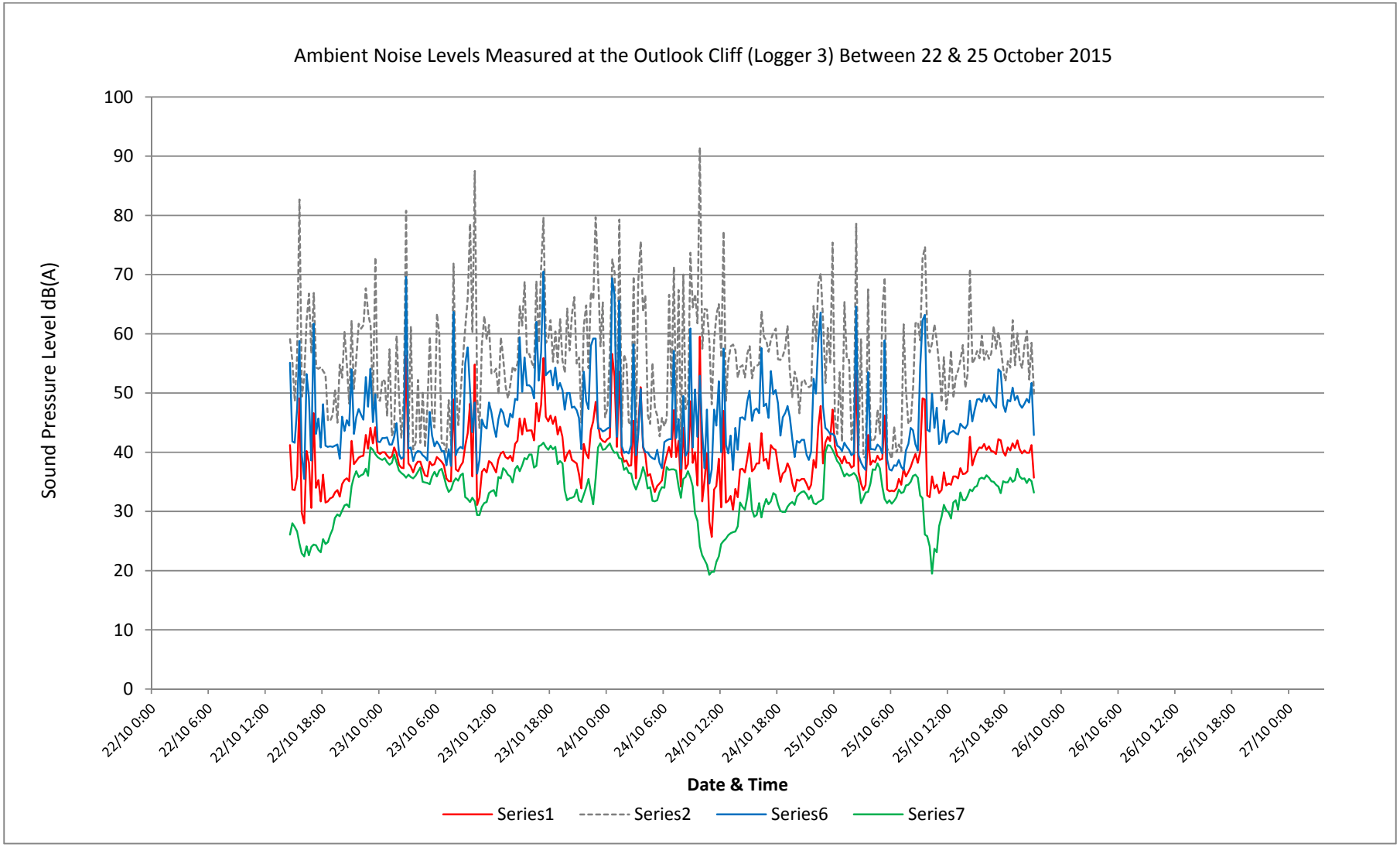
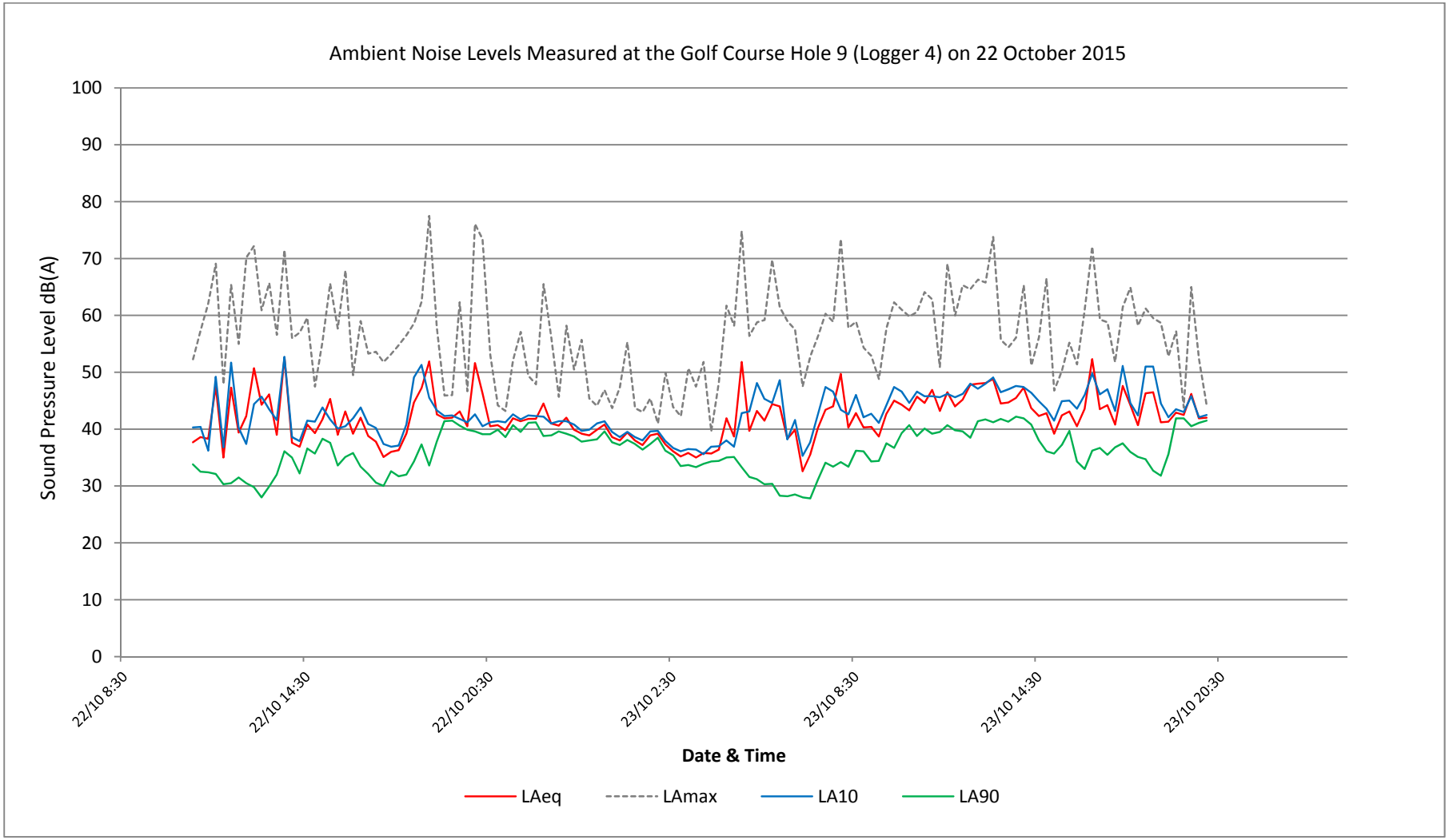


Figure 23 Ambient Noise Levels Measured on 22 October 2015 (Logger 4 – Golf Course Air Strip)



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Noise Impact Assessment

APPENDIX B

WEATHER DATA DURING THE MONITORING PERIOD

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Table 43 Weather Conditions During the Monitoring Period

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
22/10/2015 0:00	22.1	84	1.9	ENE	0
22/10/2015 0:30	21.9	85	1.9	NE	0
22/10/2015 1:00	21.9	85	1.9	NE	0
22/10/2015 1:30	21.9	87	0.0	-	0
22/10/2015 2:00	21.8	87	0.0	-	0
22/10/2015 2:30	21.7	90	1.9	N	0
22/10/2015 3:00	21.6	91	1.7	NW	0
22/10/2015 3:30	21.3	91	1.7	NNW	0
22/10/2015 4:00	21.4	91	1.1	NW	0
22/10/2015 4:30	21.1	91	0.0	-	0
22/10/2015 5:00	21.3	92	0.0	-	0
22/10/2015 5:30	21.3	91	0.0	-	0
22/10/2015 6:00	21.4	91	1.1	NNW	0
22/10/2015 6:30	21.8	87	1.7	N	0
22/10/2015 7:00	22.2	85	1.7	NW	0
22/10/2015 7:30	22.5	84	1.7	WNW	0
22/10/2015 8:00	23.3	76	1.9	NNW	0
22/10/2015 8:30	23.4	79	1.9	SW	0
22/10/2015 9:00	23.8	80	1.9	SSW	0
22/10/2015 9:30	24.5	76	1.7	WSW	0
22/10/2015 10:00	25	73	1.9	SSW	0
22/10/2015 10:30	26	67	3.1	NNE	0
22/10/2015 11:00	25.5	71	5.6	NW	0
22/10/2015 11:30	26.3	66	5.6	NNW	0
22/10/2015 12:00	25.6	65	6.7	NNW	0
22/10/2015 12:30	26	64	7.2	NNW	0
22/10/2015 13:00	26.4	67	7.8	NW	0
22/10/2015 13:30	26	68	7.8	NW	0
22/10/2015 14:00	25.8	67	8.6	NW	0
22/10/2015 14:30	26.1	69	8.3	NW	0
22/10/2015 15:00	25.5	70	8.6	NNW	0
22/10/2015 15:30	25.9	68	8.6	NNW	0
22/10/2015 16:00	25.8	67	8.6	NNW	0
22/10/2015 16:30	25.4	71	8.3	NNW	0
22/10/2015 17:00	25.1	72	8.6	NNW	0
22/10/2015 17:30	24.4	76	9.7	NNW	0
22/10/2015 18:00	24	77	9.2	NNW	0
22/10/2015 18:30	23.8	80	8.6	NNW	0
22/10/2015 19:00	23.7	81	8.6	NNW	0
22/10/2015 19:30	23.6	82	8.6	NNW	0
22/10/2015 20:00	23.5	81	9.2	NNW	0
22/10/2015 20:30	23.5	82	9.2	NNW	0
22/10/2015 21:00	23.5	83	8.6	NNW	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
22/10/2015 21:30	23.4	83	8.3	NNW	0
22/10/2015 22:00	23.4	83	8.3	NNW	0
22/10/2015 22:30	23.4	85	7.8	NNW	0
22/10/2015 23:00	23.4	84	7.8	NNW	0
22/10/2015 23:30	23.3	83	8.6	NNW	0
23/10/2015 0:00	23.1	83	8.3	NNW	0
23/10/2015 0:30	23.1	83	7.8	NNW	0
23/10/2015 1:00	23.1	84	6.7	NNW	0
23/10/2015 1:30	23	83	5.6	NNW	0
23/10/2015 2:00	22.9	83	5.3	NNW	0
23/10/2015 2:30	22.9	84	6.1	NNW	0
23/10/2015 3:00	22.8	84	4.7	N	0
23/10/2015 3:30	22.9	83	5.6	NNW	0
23/10/2015 4:00	23	81	6.1	NNW	0
23/10/2015 4:30	23.1	82	7.8	NNW	0
23/10/2015 5:00	23.1	82	8.3	NNW	0
23/10/2015 5:30	23	81	8.3	NNW	0
23/10/2015 6:00	23.2	80	8.3	NNW	0
23/10/2015 6:30	23.4	79	7.8	NNW	0
23/10/2015 7:00	23.7	76	8.3	NNW	0
23/10/2015 7:30	23.8	76	7.8	NNW	0
23/10/2015 8:00	24.2	75	8.6	NNW	0
23/10/2015 8:30	24.6	74	8.3	NNW	0
23/10/2015 9:00	24.9	73	8.3	NNW	0
23/10/2015 9:30	25.6	69	8.3	NNW	0
23/10/2015 10:00	25.4	67	8.6	NNW	0
23/10/2015 10:30	26.3	63	7.8	NNW	0
23/10/2015 11:00	26.7	64	8.3	NNW	0
23/10/2015 11:30	26.5	64	8.6	NNW	0
23/10/2015 12:00	27	63	8.3	NNW	0
23/10/2015 12:30	27.4	63	8.3	NNW	0
23/10/2015 13:00	27.1	63	8.3	NNW	0
23/10/2015 13:30	27.5	62	9.2	NNW	0
23/10/2015 14:00	27	62	9.7	NNW	0
23/10/2015 14:30	27.2	62	8.3	NNW	0
23/10/2015 15:00	27	63	9.2	NNW	0
23/10/2015 15:30	26.8	61	9.2	NNW	0
23/10/2015 16:00	26.6	65	7.8	NNW	0
23/10/2015 16:30	25.7	73	8.3	NW	0
23/10/2015 17:00	25.3	73	8.3	NW	0
23/10/2015 17:30	25.2	76	6.1	NNW	0
23/10/2015 18:00	24.7	73	6.1	N	0
23/10/2015 18:30	24.4	79	5.3	NW	0
23/10/2015 19:00	24.3	80	4.7	NNW	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
23/10/2015 19:30	24.1	79	5.6	NNW	0
23/10/2015 20:00	24.1	80	4.2	NNW	0
23/10/2015 20:30	23.9	80	3.1	N	0
23/10/2015 21:00	23.7	80	1.7	NNE	0
23/10/2015 21:30	23.6	80	2.5	N	0
23/10/2015 22:00	23.4	82	2.5	N	0
23/10/2015 22:30	23.2	82	1.9	N	0
23/10/2015 23:00	23.3	82	3.6	N	0
23/10/2015 23:30	23.4	81	3.1	N	0
24/10/2015 0:00	23	85	0.0	-	0
24/10/2015 0:30	22.8	88	3.1	WNW	0
24/10/2015 1:00	22.9	87	3.6	NNW	0
24/10/2015 1:30	23	87	3.6	NNW	0
24/10/2015 2:00	23	86	3.6	N	0
24/10/2015 2:30	23	88	3.6	N	0
24/10/2015 3:00	23	88	4.2	N	0
24/10/2015 3:30	23.1	86	5.3	N	0
24/10/2015 4:00	23	85	4.7	N	0
24/10/2015 4:30	23.2	83	3.6	N	0
24/10/2015 5:00	23.1	83	4.2	N	0
24/10/2015 5:30	23.3	81	3.6	NNE	0
24/10/2015 6:00	23.6	79	3.1	NE	0
24/10/2015 6:30	24.3	79	2.5	ENE	0
24/10/2015 7:00	24.9	77	3.6	ENE	0
24/10/2015 7:30	25.5	72	5.3	NE	0
24/10/2015 8:00	25.4	74	6.1	ENE	0
24/10/2015 8:30	26.1	67	6.1	NE	0
24/10/2015 9:00	27.5	63	6.1	E	0
24/10/2015 9:30	27.5	63	6.7	E	0
24/10/2015 10:00	26.8	68	7.8	E	0
24/10/2015 10:30	26.4	68	7.8	E	0
24/10/2015 11:00	26.3	73	9.2	E	0
24/10/2015 11:30	26.9	66	8.3	E	0
24/10/2015 12:00	26.5	67	8.3	E	0
24/10/2015 12:30	26.8	69	8.3	E	0
24/10/2015 13:00	26.8	65	7.8	E	0
24/10/2015 13:30	26.5	66	7.8	E	0
24/10/2015 14:00	26.8	67	7.8	E	0
24/10/2015 14:30	26.1	66	7.8	E	0
24/10/2015 15:00	25.7	68	8.6	E	0
24/10/2015 15:30	25.8	70	7.8	E	0
24/10/2015 16:00	25.7	67	6.7	E	0
24/10/2015 16:30	25.4	70	7.2	ENE	0
24/10/2015 17:00	26	65	6.7	NE	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
24/10/2015 17:30	25.5	69	4.7	NE	0
24/10/2015 18:00	24.5	75	6.1	NE	0
24/10/2015 18:30	24.1	77	4.7	NE	0
24/10/2015 19:00	23.8	78	4.7	ENE	0
24/10/2015 19:30	23.8	79	4.2	NE	0
24/10/2015 20:00	23.6	80	4.7	NE	0
24/10/2015 20:30	23.6	80	5.6	ENE	0
24/10/2015 21:00	23.6	83	5.6	ENE	0
24/10/2015 21:30	23.4	82	4.2	NE	0
24/10/2015 22:00	23.3	82	4.7	NE	0
24/10/2015 22:30	23.3	82	3.6	NE	0
24/10/2015 23:00	23.2	84	4.2	ENE	0
24/10/2015 23:30	23.1	84	4.2	ENE	0
25/10/2015 0:00	23	84	3.6	ENE	0
25/10/2015 0:30	23.1	84	2.5	E	0
25/10/2015 1:00	22.9	86	3.1	E	0
25/10/2015 1:30	22.9	86	4.2	E	0
25/10/2015 2:00	23.1	85	4.2	ENE	0
25/10/2015 2:30	23.1	83	4.2	ENE	0
25/10/2015 3:00	23.1	82	4.7	E	0
25/10/2015 3:30	23.3	83	5.3	E	0
25/10/2015 4:00	23.1	84	4.2	E	0
25/10/2015 4:30	23.1	85	3.6	ENE	0
25/10/2015 5:00	22.8	85	3.6	ENE	0
25/10/2015 5:30	22.7	86	3.1	ENE	0
25/10/2015 6:00	23.3	83	3.6	E	0
25/10/2015 6:30	24.2	79	3.6	E	0
25/10/2015 7:00	23.9	81	5.3	E	0
25/10/2015 7:30	25.1	77	6.1	E	0
25/10/2015 8:00	25.2	75	6.7	E	0
25/10/2015 8:30	25.6	70	6.7	ESE	0
25/10/2015 9:00	25.7	72	7.2	E	0
25/10/2015 9:30	25.6	70	7.2	E	0
25/10/2015 10:00	25.6	72	7.8	E	0
25/10/2015 10:30	25.8	72	7.2	E	0
25/10/2015 11:00	26.3	70	7.2	ESE	0
25/10/2015 11:30	26.4	70	7.8	E	0
25/10/2015 12:00	26.1	70	8.3	E	0
25/10/2015 12:30	25.8	71	7.2	E	0
25/10/2015 13:00	26.2	71	7.8	E	0
25/10/2015 13:30	25.8	70	7.8	E	0
25/10/2015 14:00	25.5	71	8.3	E	0
25/10/2015 14:30	25.4	72	7.8	E	0
25/10/2015 15:00	25.4	72	8.3	E	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
25/10/2015 15:30	24.5	73	8.3	E	0
25/10/2015 16:00	24.8	72	7.8	E	0
25/10/2015 16:30	24.6	73	8.6	E	0
25/10/2015 17:00	24.3	76	8.3	E	0
25/10/2015 17:30	24.2	77	8.3	E	0
25/10/2015 18:00	23.9	77	8.3	E	0
25/10/2015 18:30	23.9	79	8.3	E	0
25/10/2015 19:00	23.7	81	7.2	E	0
25/10/2015 19:30	23.8	80	6.7	E	0
25/10/2015 20:00	23.7	79	6.1	E	0
25/10/2015 20:30	23.7	80	6.1	E	0
25/10/2015 21:00	23.6	81	5.6	E	0
25/10/2015 21:30	23.7	83	6.7	E	0
25/10/2015 22:00	23.5	82	6.7	E	0
25/10/2015 22:30	23.5	82	6.1	E	0
25/10/2015 23:00	23.6	83	6.7	E	0
25/10/2015 23:30	23.4	83	6.7	E	0
26/10/2015 0:00	23.5	82	6.1	E	0
26/10/2015 0:30	23.5	83	6.7	E	0
26/10/2015 1:00	23.3	84	7.2	ESE	0
26/10/2015 1:30	23.3	84	6.7	ESE	0
26/10/2015 2:00	23.3	85	7.2	ESE	0
26/10/2015 2:30	23.4	84	6.1	E	0
26/10/2015 3:00	23.6	85	5.3	E	0
26/10/2015 3:30	23.5	83	7.8	E	0
26/10/2015 4:00	23.4	83	7.2	E	0
26/10/2015 4:30	23.3	82	6.7	E	0
26/10/2015 5:00	23.4	82	6.1	E	0
26/10/2015 5:30	23.4	81	6.1	E	0
26/10/2015 6:00	23.6	81	6.1	ESE	0
26/10/2015 6:30	24.3	78	6.1	ESE	0
26/10/2015 7:00	24.5	75	6.1	E	0
26/10/2015 7:30	24.9	74	6.7	ESE	0
26/10/2015 8:00	25.8	71	5.6	ESE	0
26/10/2015 8:30	25.6	72	5.6	E	0
26/10/2015 9:00	25.9	71	6.1	E	0
26/10/2015 9:30	25.8	71	6.1	E	0
26/10/2015 10:00	26.3	71	6.1	E	0
26/10/2015 10:30	26	72	6.7	E	0
26/10/2015 11:00	26.4	71	6.7	E	0
26/10/2015 11:30	26.3	72	7.2	E	0
26/10/2015 12:00	26.1	72	7.8	E	0
26/10/2015 12:30	26	73	8.3	E	0
26/10/2015 13:00	26.1	72	8.3	E	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
26/10/2015 13:30	25.8	72	8.3	E	0
26/10/2015 14:00	25.7	72	7.8	E	0
26/10/2015 14:30	25.7	73	7.2	E	0
26/10/2015 15:00	25.5	75	7.8	E	0
26/10/2015 15:30	25.3	75	7.2	E	0
26/10/2015 16:00	24.9	76	7.8	E	0
26/10/2015 16:30	24.9	76	7.2	E	0
26/10/2015 17:00	24.7	77	5.6	ESE	0
26/10/2015 17:30	24.5	77	5.3	E	0
26/10/2015 18:00	24.2	79	5.6	E	0
26/10/2015 18:30	24.1	78	5.3	E	0
26/10/2015 19:00	24	79	4.2	E	0
26/10/2015 19:30	24.2	80	3.1	E	0
26/10/2015 20:00	24.1	83	6.7	E	0
26/10/2015 20:30	24.1	83	7.2	E	0
26/10/2015 21:00	23.9	83	5.3	E	0
26/10/2015 21:30	23.8	83	5.3	ENE	0
26/10/2015 22:00	23.8	82	4.2	NE	0
26/10/2015 22:30	23.6	82	5.6	ENE	0
26/10/2015 23:00	23.6	84	4.7	ENE	0
26/10/2015 23:30	23.5	83	5.3	ENE	0
27/10/2015 0:00	23.4	83	5.3	E	0
27/10/2015 0:30	23.2	83	3.1	NE	0
27/10/2015 1:00	23	84	1.9	NE	0
27/10/2015 1:30	22.8	86	2.5	NE	0
27/10/2015 2:00	22.9	86	3.1	ENE	0
27/10/2015 2:30	22.9	86	3.6	ENE	0
27/10/2015 3:00	22.9	85	3.6	NE	0
27/10/2015 3:30	22.8	86	3.1	ENE	0
27/10/2015 4:00	22.7	86	2.5	ENE	0
27/10/2015 4:30	22.6	86	3.1	ENE	0
27/10/2015 5:00	22.6	86	3.6	ENE	0
27/10/2015 5:30	22.6	86	4.2	NE	0
27/10/2015 6:00	23	84	3.6	NE	0
27/10/2015 6:30	24.2	79	2.5	NE	0
27/10/2015 7:00	24.8	76	4.2	E	0
27/10/2015 7:30	26	73	4.2	E	0
27/10/2015 8:00	24.6	77	5.3	E	0
27/10/2015 8:30	26	73	5.6	E	0
27/10/2015 9:00	26.2	71	6.7	E	0
27/10/2015 9:30	26.1	73	7.2	E	0
27/10/2015 10:00	25.9	70	7.2	E	0
27/10/2015 10:30	26.3	69	8.3	E	0
27/10/2015 11:00	26.8	68	7.8	E	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
27/10/2015 11:30	26.4	67	7.2	E	0
27/10/2015 12:00	25.5	74	7.2	E	0
27/10/2015 12:30	25.4	76	7.2	E	0
27/10/2015 13:00	25.3	73	7.8	E	0
27/10/2015 13:30	25.4	74	7.2	E	0
27/10/2015 14:00	25.5	73	7.2	E	0
27/10/2015 14:30	26.1	71	6.7	E	0
27/10/2015 15:00	25.4	73	7.2	E	0
27/10/2015 15:30	25.3	74	7.2	E	0
27/10/2015 16:00	25.1	71	7.8	E	0
27/10/2015 16:30	24.9	74	7.8	E	0
27/10/2015 17:00	24.7	74	7.2	E	0
27/10/2015 17:30	24.6	76	6.7	E	0
27/10/2015 18:00	24.5	75	5.3	NNE	0
27/10/2015 18:30	24	77	4.7	NE	0
27/10/2015 19:00	23.8	78	4.7	ENE	0
27/10/2015 19:30	23.7	80	4.7	ENE	0
27/10/2015 20:00	23.6	80	3.6	ENE	0
27/10/2015 20:30	23.4	80	4.2	ENE	0
27/10/2015 21:00	23.3	80	3.1	ENE	0
27/10/2015 21:30	23.2	81	1.9	NNE	0
27/10/2015 22:00	23.1	82	2.5	NNE	0
27/10/2015 22:30	23.1	81	3.6	NNE	0
27/10/2015 23:00	23	80	2.5	N	0
27/10/2015 23:30	22.7	85	0.0	-	0
28/10/2015 0:00	22.5	85	0.0	-	0
28/10/2015 0:30	22.5	85	0.6	NE	0
28/10/2015 1:00	22.4	85	0.6	ENE	0
28/10/2015 1:30	22.3	85	1.7	NE	0
28/10/2015 2:00	22.4	85	1.9	NE	0
28/10/2015 2:30	22.3	87	1.1	N	0
28/10/2015 3:00	22.1	89	1.7	NNW	0
28/10/2015 3:30	21.9	91	2.5	NNW	0
28/10/2015 4:00	22	90	1.7	NW	0
28/10/2015 4:30	22.1	91	1.1	WNW	0
28/10/2015 5:00	22.2	91	0.6	W	0
28/10/2015 5:30	22.1	88	0.0	-	0
28/10/2015 6:00	22.5	88	0.6	W	0
28/10/2015 6:30	24	80	0.6	E	0
28/10/2015 7:00	24.1	77	1.7	E	0
28/10/2015 7:30	26.1	72	4.2	E	0
28/10/2015 8:00	25.7	68	5.6	E	0
28/10/2015 8:30	26	70	6.7	E	0
28/10/2015 9:00	25.7	68	7.8	E	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
28/10/2015 9:30	26.4	66	6.7	E	0
28/10/2015 10:00	26.4	65	7.8	E	0
28/10/2015 10:30	26.1	66	8.3	E	0
28/10/2015 11:00	26.2	67	7.8	E	0
28/10/2015 11:30	26.1	68	8.3	E	0
28/10/2015 12:00	26.3	68	8.6	E	0
28/10/2015 12:30	25.8	69	8.6	E	0
28/10/2015 13:00	25.5	72	7.8	E	0
28/10/2015 13:30	25.6	68	8.3	E	0
28/10/2015 14:00	25.9	70	7.8	E	0
28/10/2015 14:30	25.5	69	8.3	E	0
28/10/2015 15:00	25.4	68	7.8	E	0
28/10/2015 15:30	25.2	68	7.2	E	0
28/10/2015 16:00	26.3	62	5.6	ENE	0
28/10/2015 16:30	26.3	62	6.1	NE	0
28/10/2015 17:00	25.8	64	5.3	NE	0
28/10/2015 17:30	25	67	6.1	ENE	0
28/10/2015 18:00	24.3	70	5.3	ENE	0
28/10/2015 18:30	24	72	5.3	ENE	0
28/10/2015 19:00	23.7	75	5.3	ENE	0
28/10/2015 19:30	23.5	75	5.3	ENE	0
28/10/2015 20:00	23.5	76	5.6	ENE	0
28/10/2015 20:30	23.4	77	4.7	NE	0
28/10/2015 21:00	23.1	78	3.6	ENE	0
28/10/2015 21:30	23.1	79	3.6	NE	0
28/10/2015 22:00	23	79	3.6	NE	0
28/10/2015 22:30	23.1	78	3.1	N	0
28/10/2015 23:00	22.8	78	2.5	N	0
28/10/2015 23:30	23	78	3.6	N	0
29/10/2015 0:00	22.8	79	1.9	N	0
29/10/2015 0:30	22.6	82	1.7	NW	0
29/10/2015 1:00	22.5	81	3.1	N	0
29/10/2015 1:30	22.6	80	1.9	NNE	0
29/10/2015 2:00	22.3	81	1.9	NNE	0
29/10/2015 2:30	22.3	83	1.9	NE	0
29/10/2015 3:00	22.8	78	3.1	N	0
29/10/2015 3:30	22.6	80	0.0	-	0
29/10/2015 4:00	22.3	80	0.0	-	0
29/10/2015 4:30	22.3	81	1.1	ENE	0
29/10/2015 5:00	22.4	82	0.0	-	0
29/10/2015 5:30	22.6	80	0.0	-	0
29/10/2015 6:00	22.9	80	2.5	ESE	0
29/10/2015 6:30	23.8	74	4.7	E	0
29/10/2015 7:00	24.1	70	5.3	E	0

Date & Time	Temp ^{0}C	Humidity %	Wind Speed m/s	Wind Direction	Rain 10 min mm
29/10/2015 7:30	24.2	72	4.2	E	0
29/10/2015 8:00	24.9	68	5.6	E	0
29/10/2015 8:30	24.9	69	6.1	E	0
29/10/2015 9:00	25.3	67	6.1	E	0
29/10/2015 9:30	26.4	64	7.2	E	0
29/10/2015 10:00	25.4	65	7.2	E	0
29/10/2015 10:30	26.1	65	7.2	E	0
29/10/2015 11:00	26.8	63	7.8	E	0
29/10/2015 11:30	26.3	65	7.8	E	0
29/10/2015 12:00	26.2	66	8.3	E	0
29/10/2015 12:30	25.7	66	8.3	E	0
29/10/2015 13:00	25.9	68	8.6	E	0
29/10/2015 13:30	25.8	66	8.6	E	0
29/10/2015 14:00	25.8	66	8.3	E	0
29/10/2015 14:30	25.4	67	8.6	E	0
29/10/2015 15:00	25.3	68	8.6	E	0
29/10/2015 15:30	25.1	68	8.3	E	0
29/10/2015 16:00	24.9	71	8.3	E	0
29/10/2015 16:30	24.9	72	7.8	E	0
29/10/2015 17:00	24.7	72	7.2	E	0
29/10/2015 17:30	24.5	71	5.6	ENE	0
29/10/2015 18:00	24.3	72	5.6	ENE	0
29/10/2015 18:30	24.2	74	6.1	ENE	0
29/10/2015 19:00	24	74	5.3	ENE	0
29/10/2015 19:30	23.9	75	5.3	ENE	0
29/10/2015 20:00	23.8	75	4.7	ENE	0
29/10/2015 20:30	23.7	75	4.2	ENE	0
29/10/2015 21:00	23.6	76	3.1	ENE	0
29/10/2015 21:30	23.5	77	2.5	E	0
29/10/2015 22:00	23.4	78	3.1	ENE	0
29/10/2015 22:30	23.6	78	4.2	ENE	0
29/10/2015 23:00	23.6	79	5.3	E	0
29/10/2015 23:30	23.6	79	5.3	E	0

APPENDIX C

NOISE CONTOUR MAPS – OPERATIONAL NOISE

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Figure 24 Predicted Noise Impact – Truck Movement to 5SSR.CF

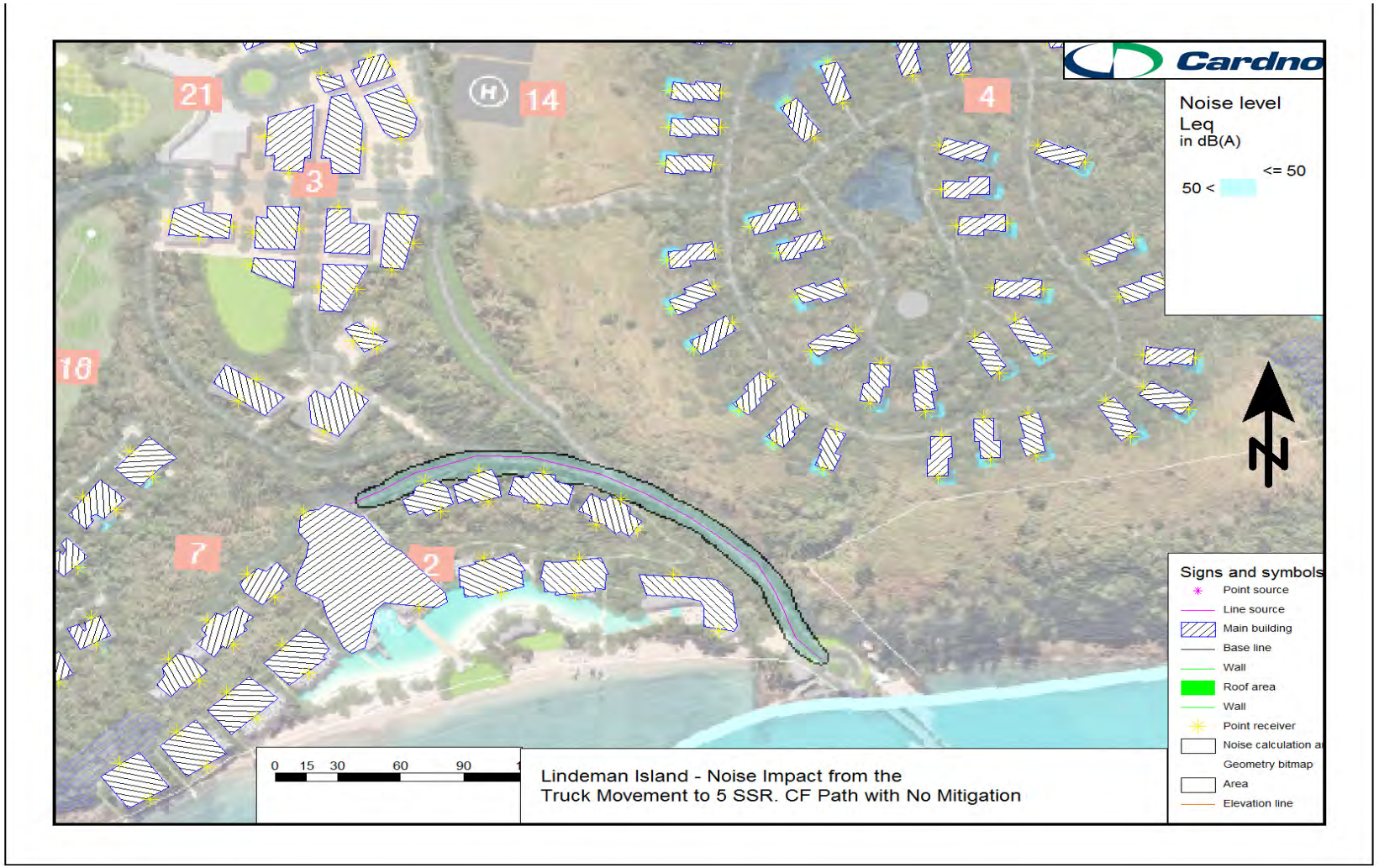

Figure 25 Predicted Noise Impact – Truck Movement to 6SSR.CF

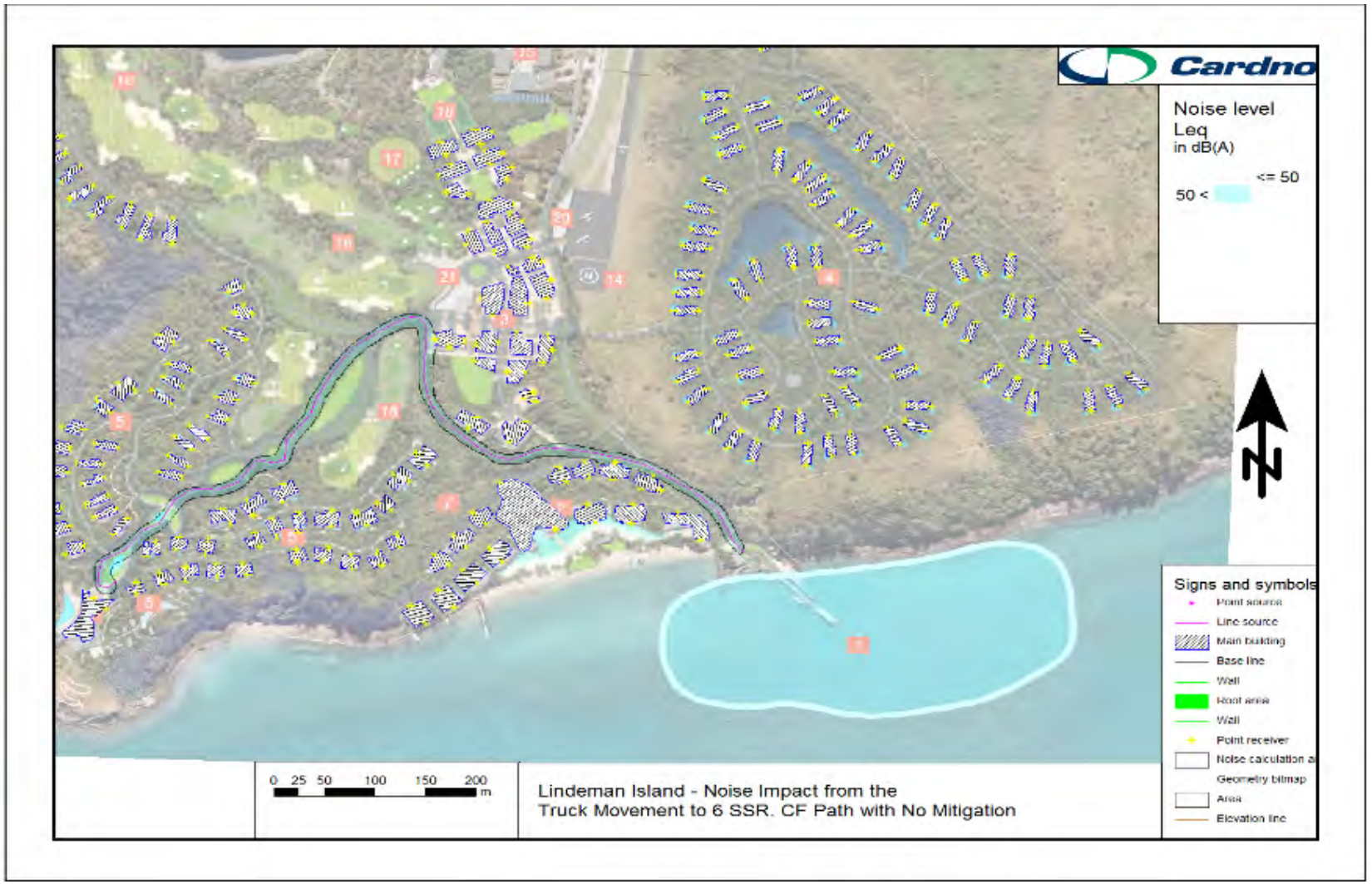

Figure 26 Predicted Noise Impact – Truck Movement to ER.CF

Figure 27 Predicted Noise Impact – Water Treatment Pump

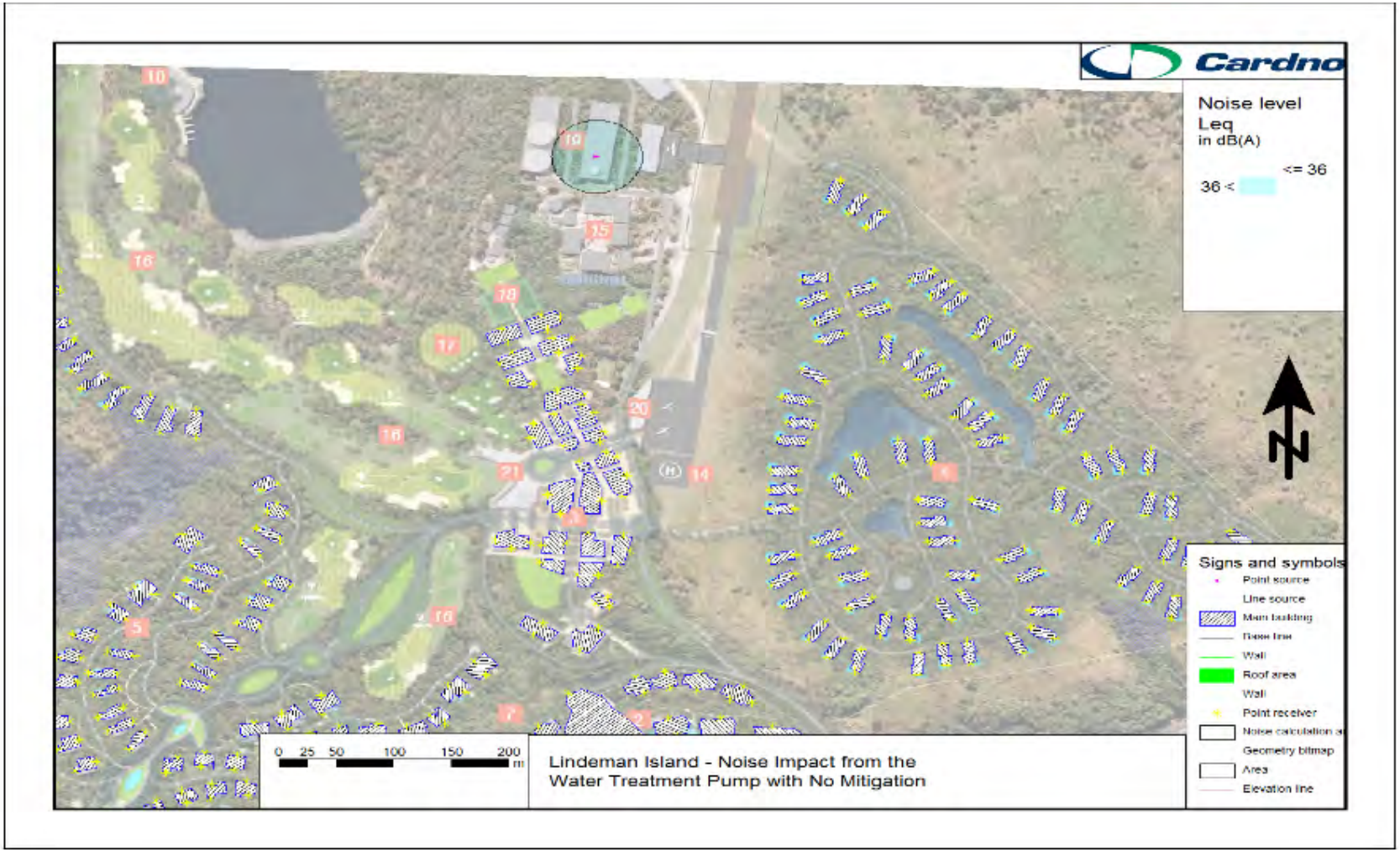

Figure 28 Predicted Noise Impact No Mitigation – Diesel Generator

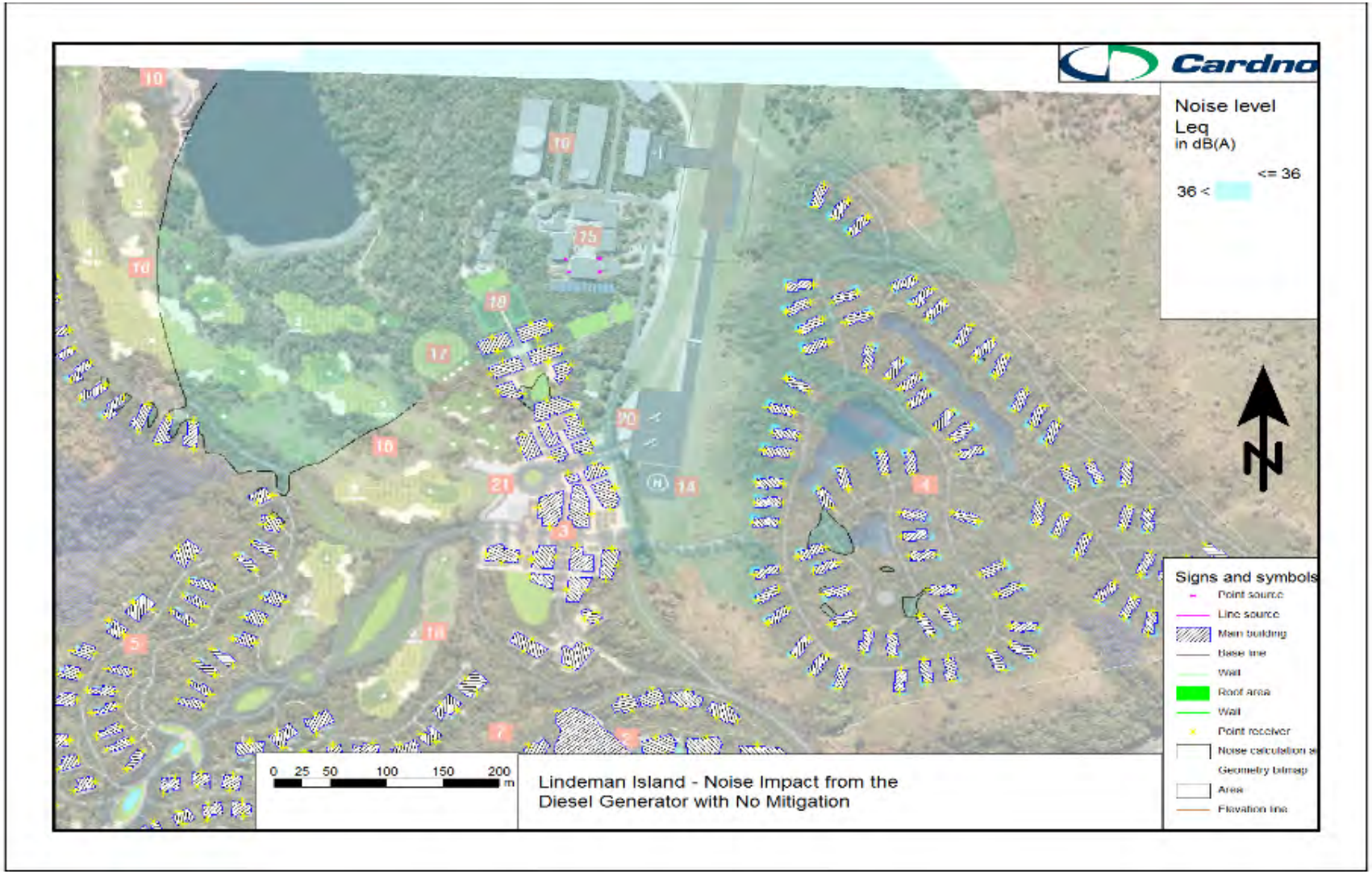

Figure 29 Predicted Noise Impact No Mitigation – Boat Docking

APPENDIX D

NOISE CONTOUR MAPS – CONSTRUCTION NOISE

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Figure 30 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 1 – Zone 1 – Earthworks & Demolition

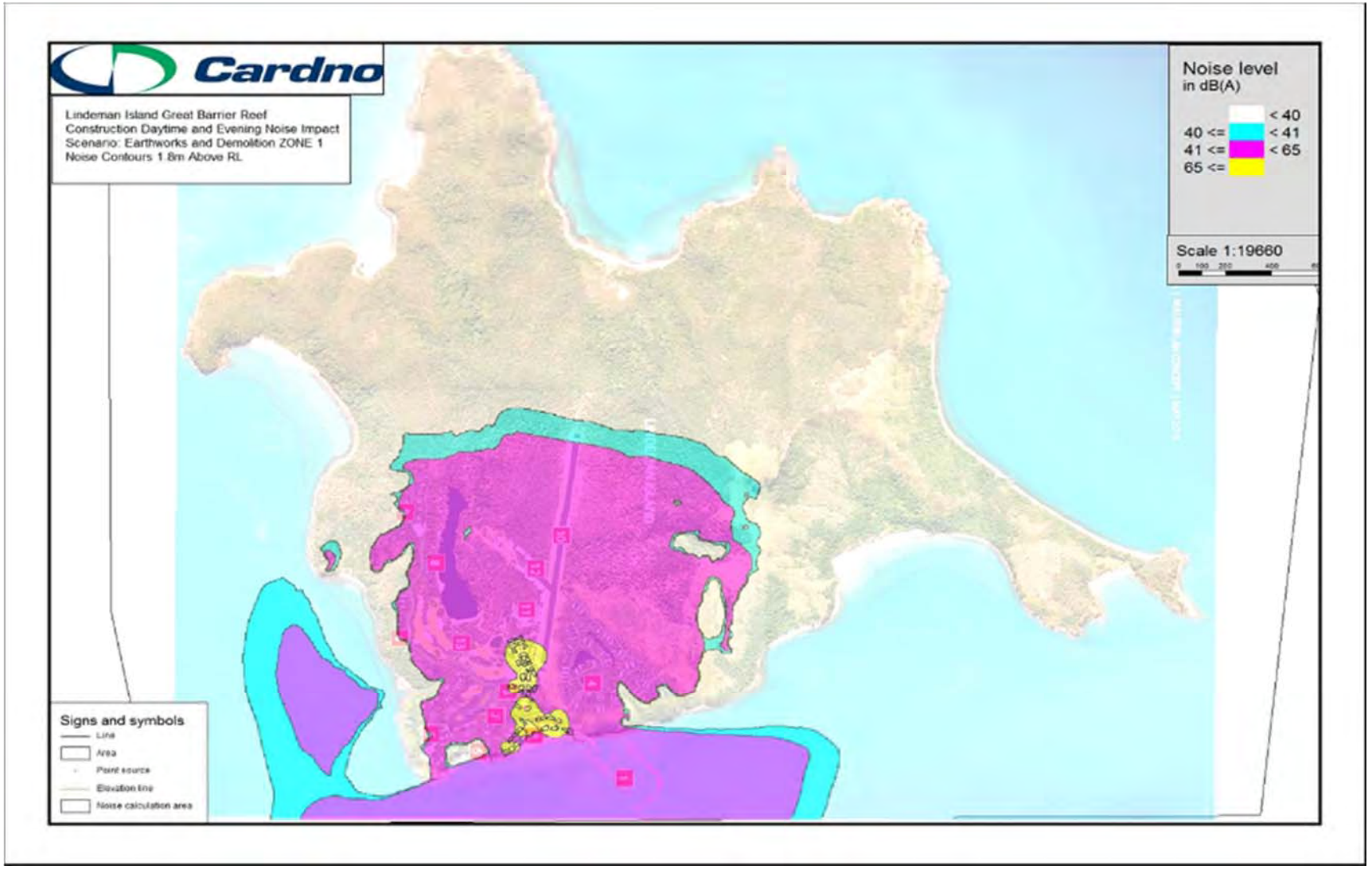


Figure 31 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 2 – Zone 1, Structural Works & Zone 2, Earthworks

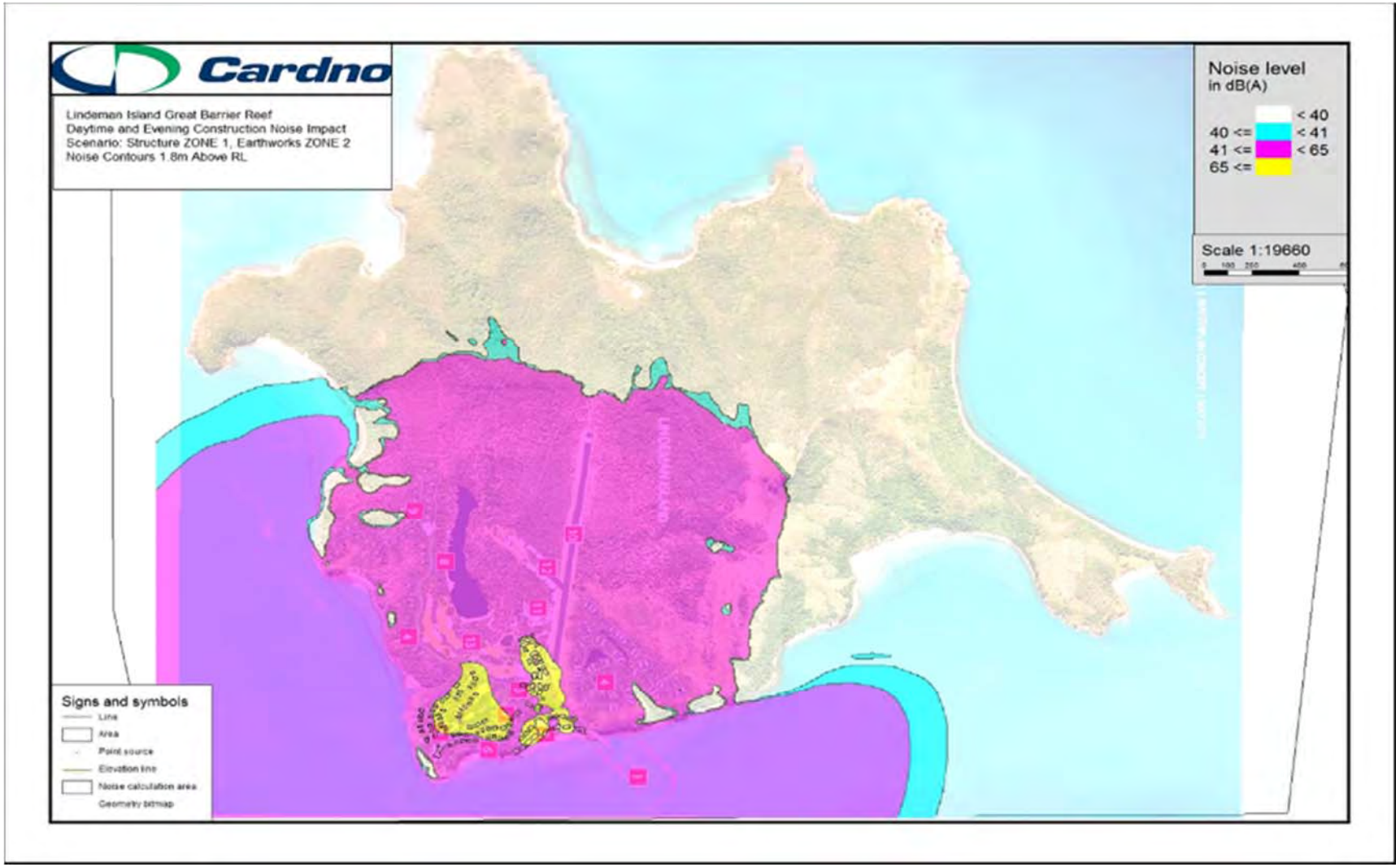


Figure 32 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits Noise - Scenario 3 – Zone 1, Finishing & Zone 2, Structural Works

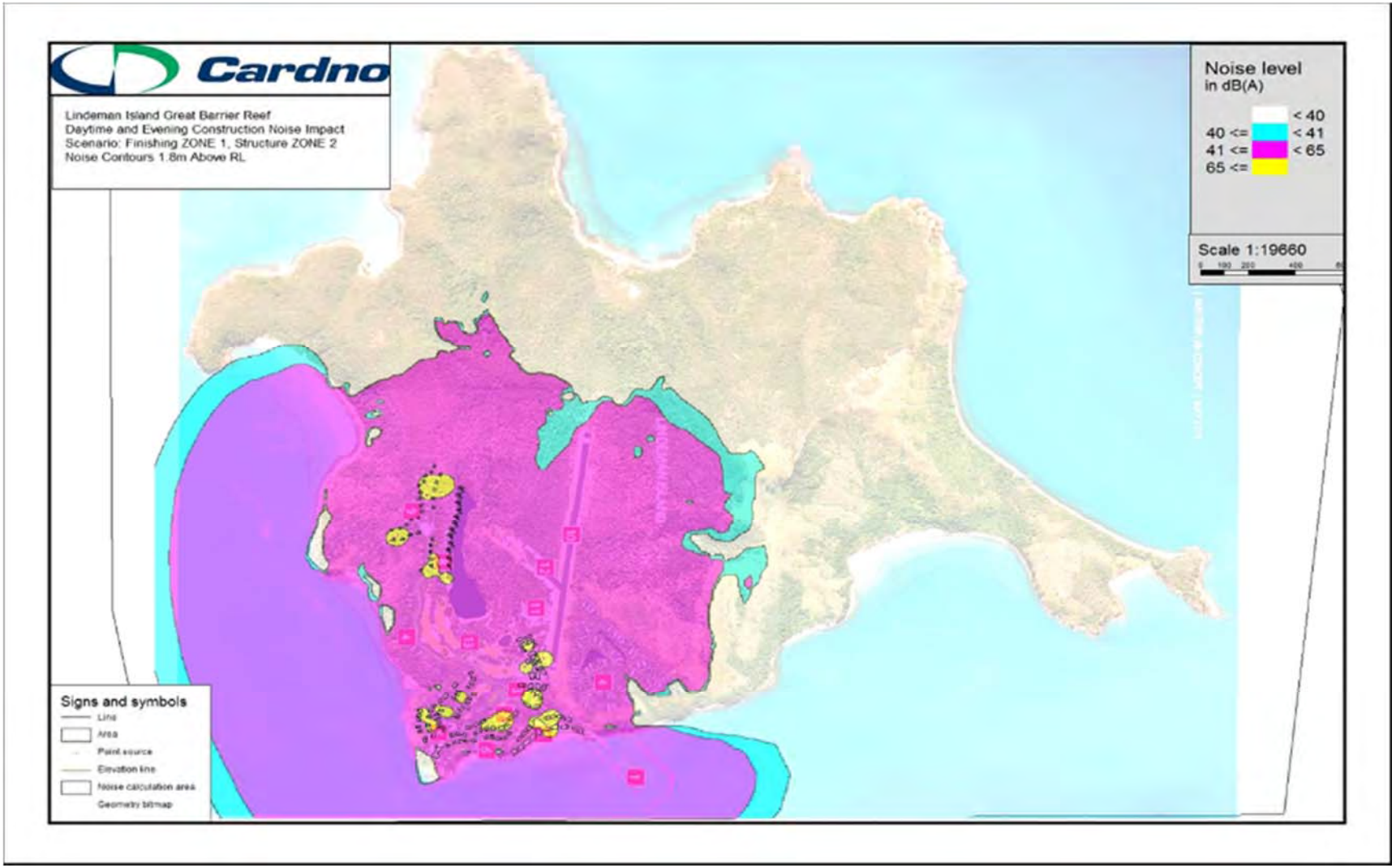


Figure 33 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 4 – Zone 2, Finishing

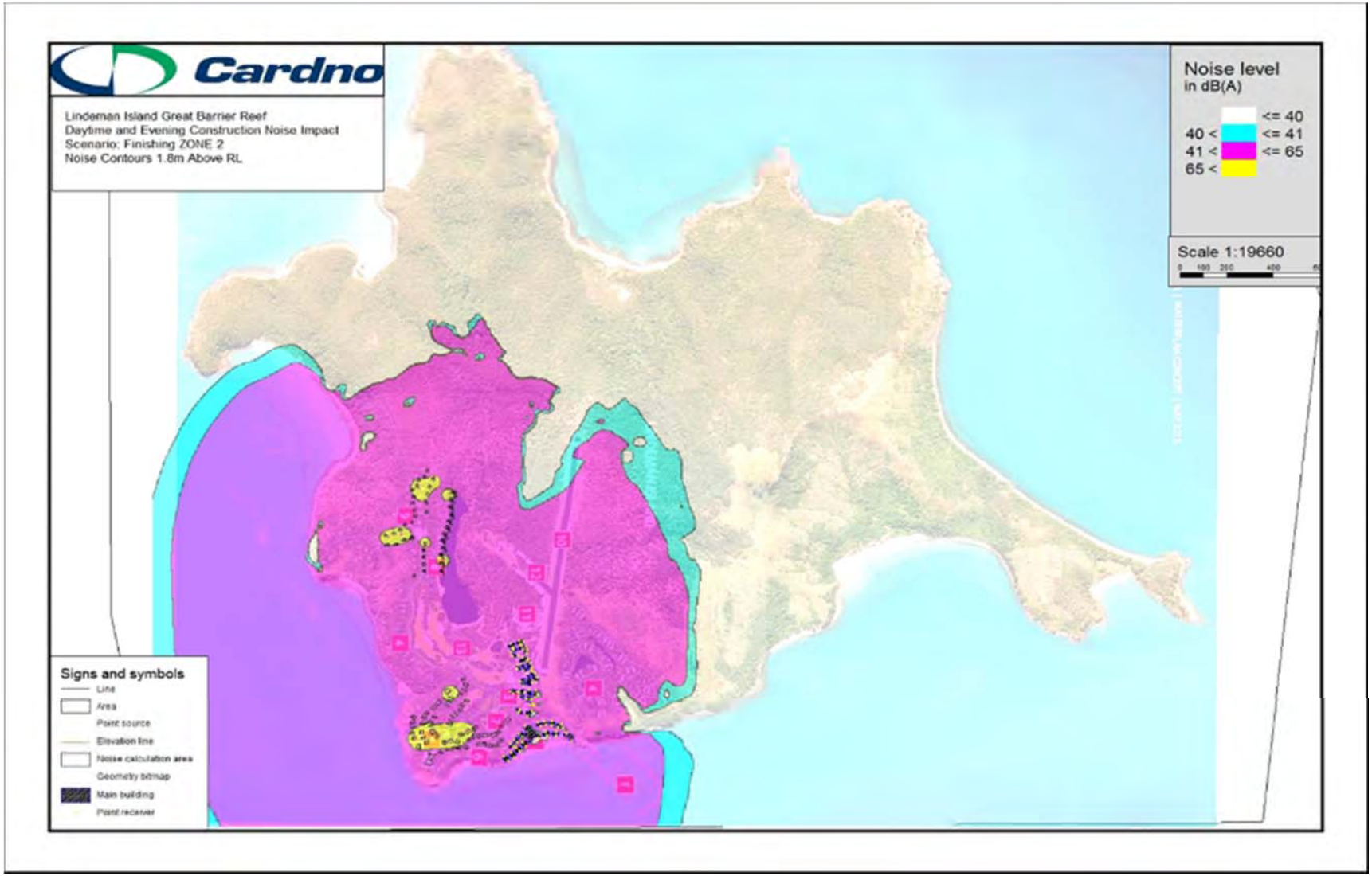


Figure 34 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 5a - Zone 3, Safe Harbour Construction

Figure 35 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 5b - Zone 3, Driven Piling

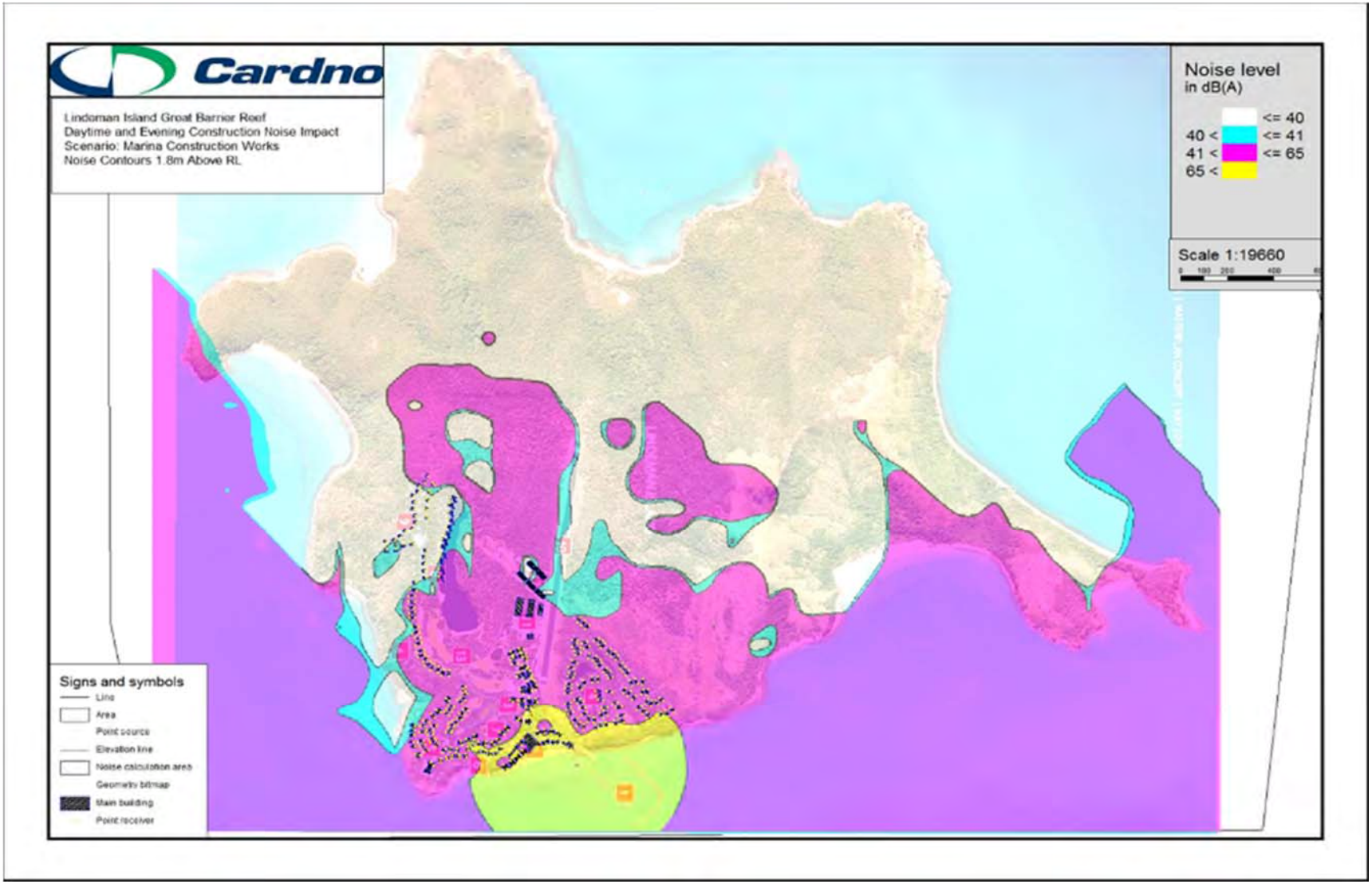


Figure 36 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 6 - Zone 4, Airport Works

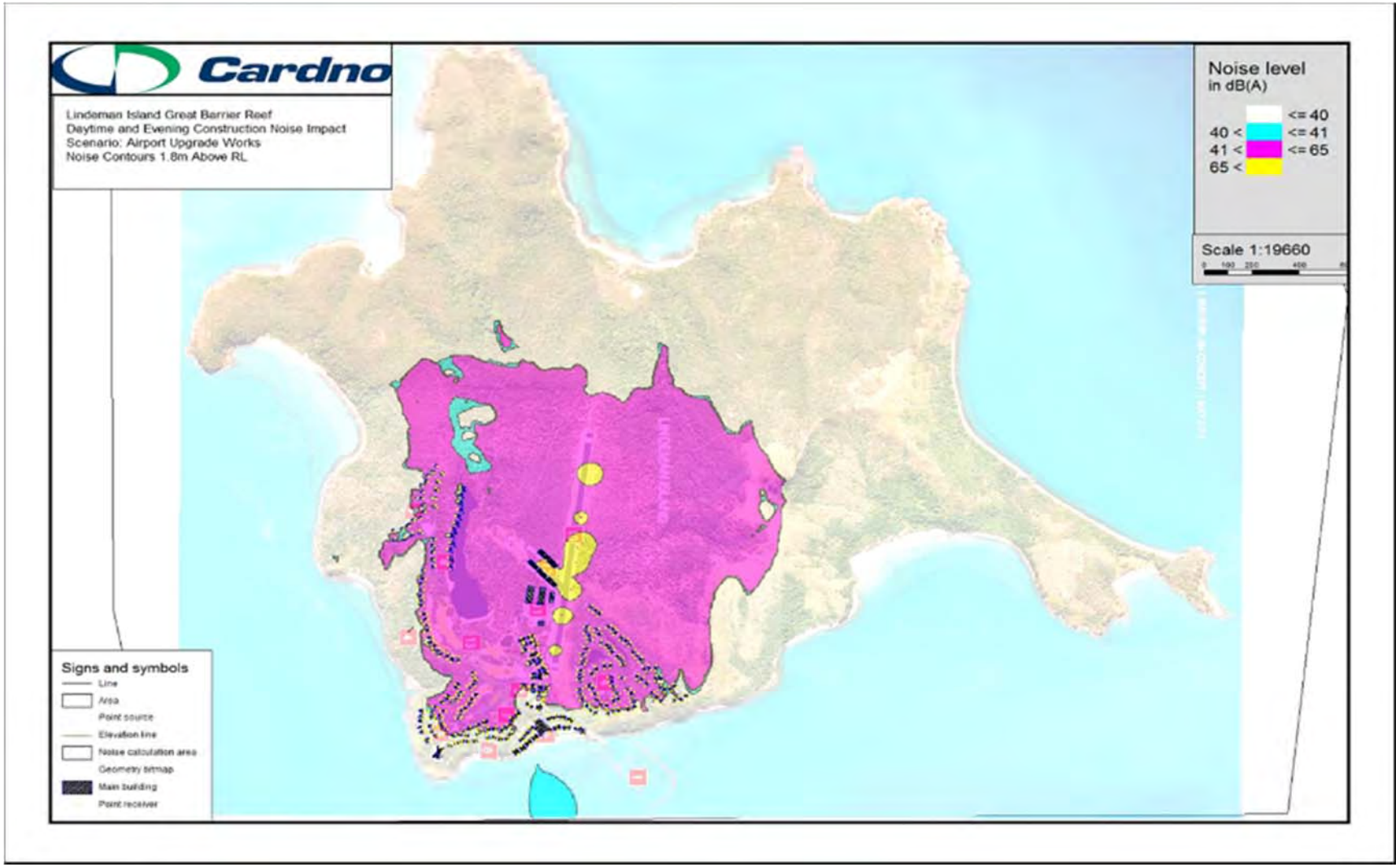


Figure 37 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 7a – Future Tourist Villas, Earthworks

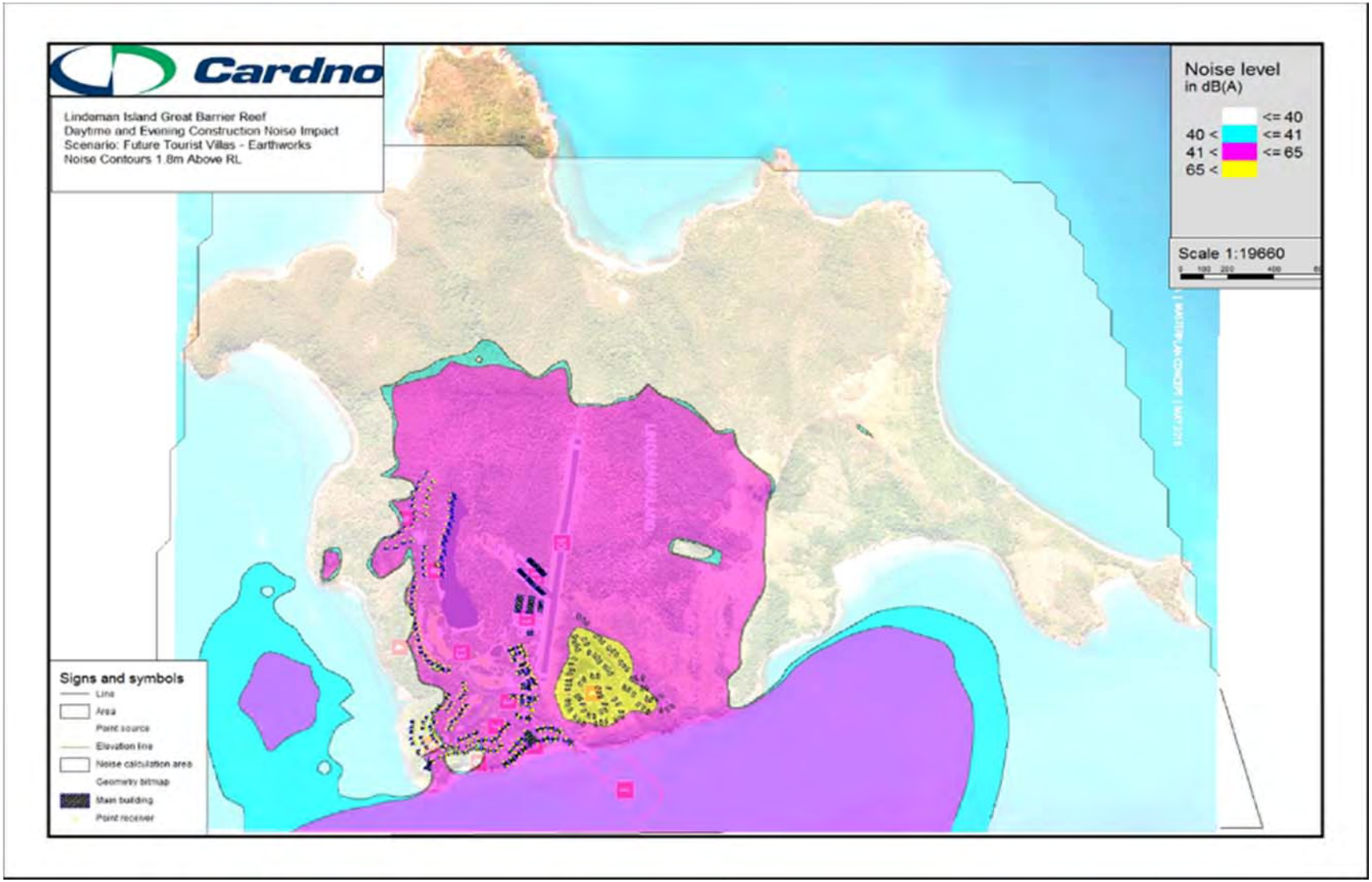


Figure 38 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 7b – Future Tourist Villas, Structural Works

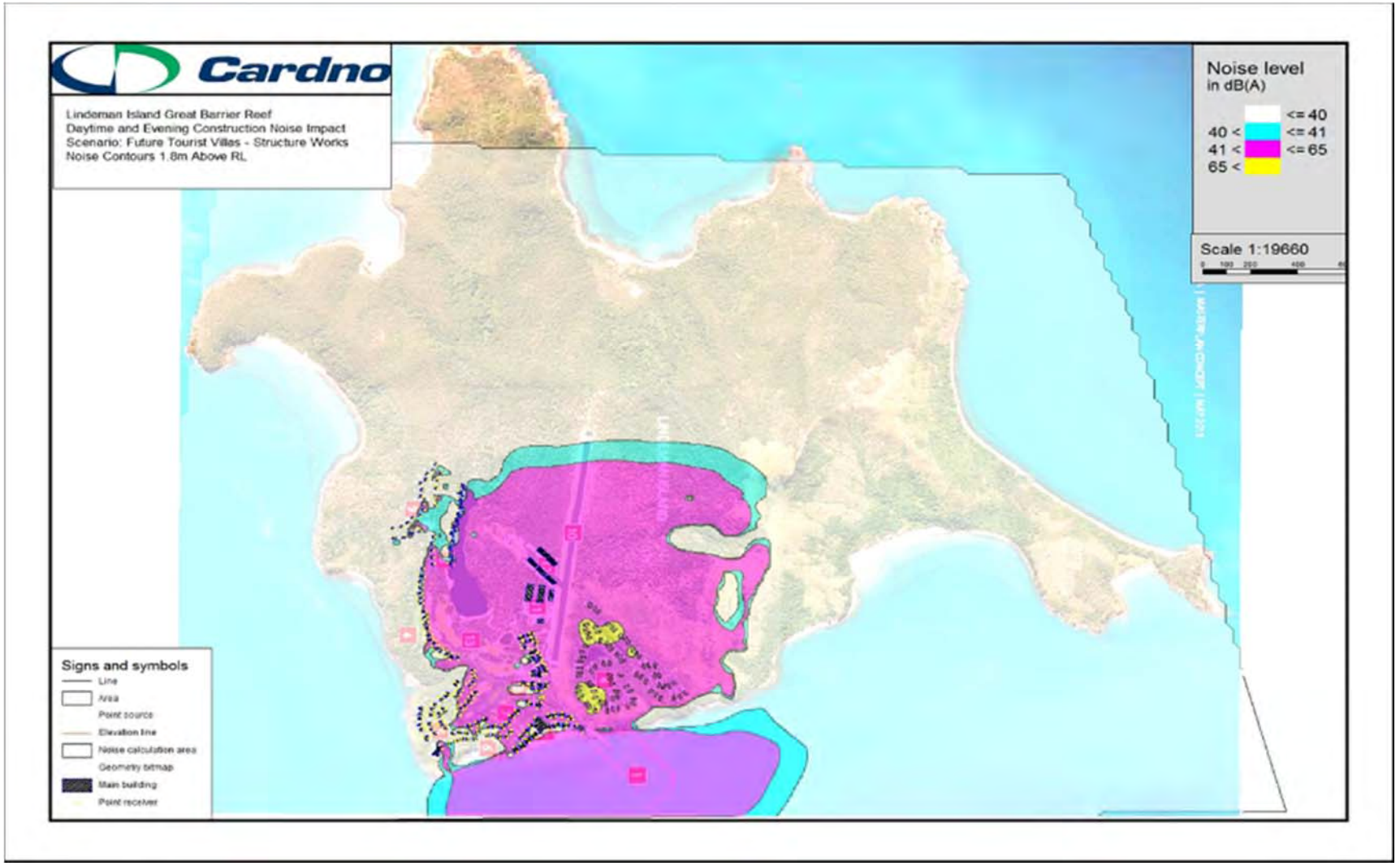


Figure 39 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 7c – Future Tourist Villas, Finishing

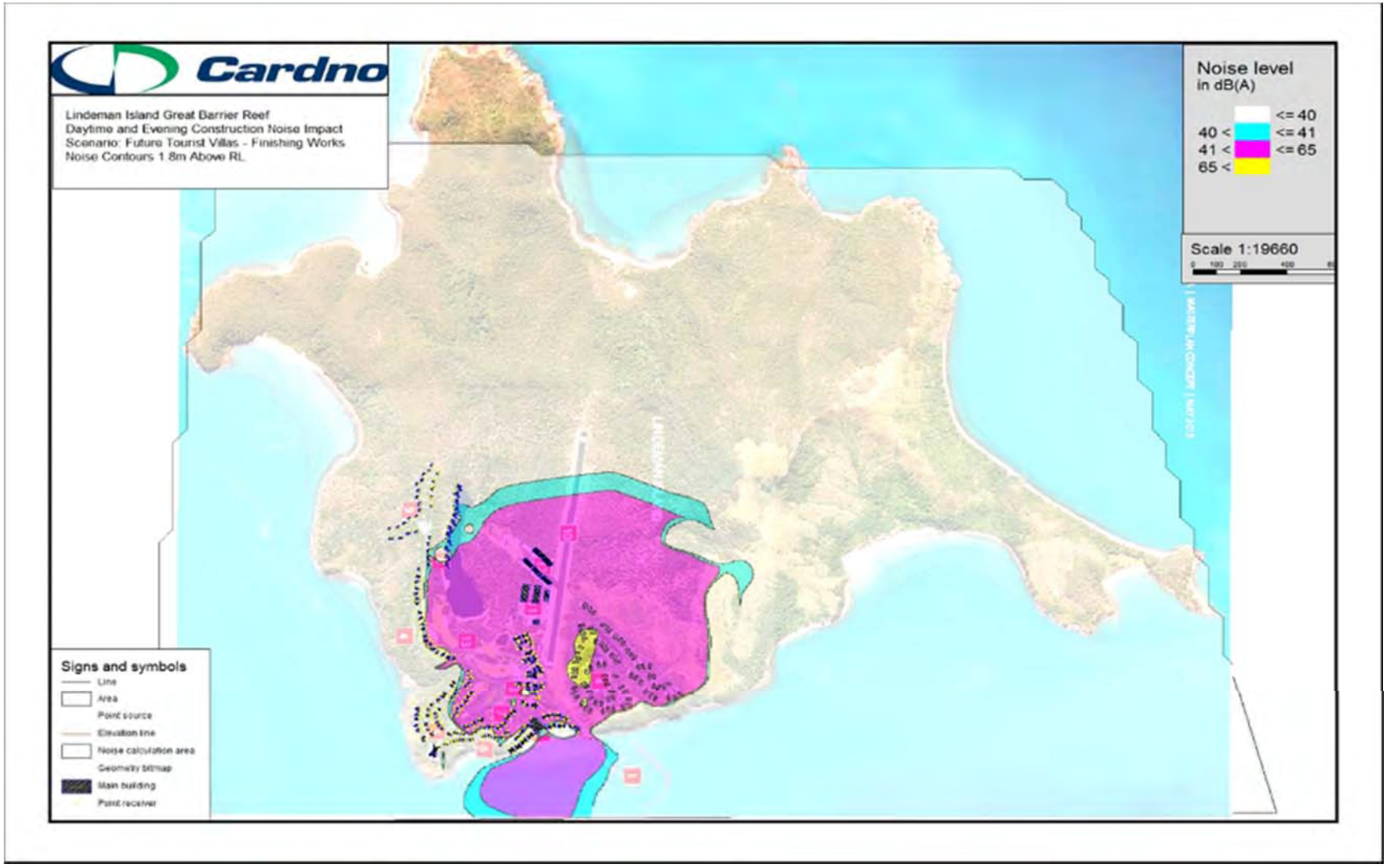


Figure 40 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 8a – Future Precinct 1 Villas, Earthworks

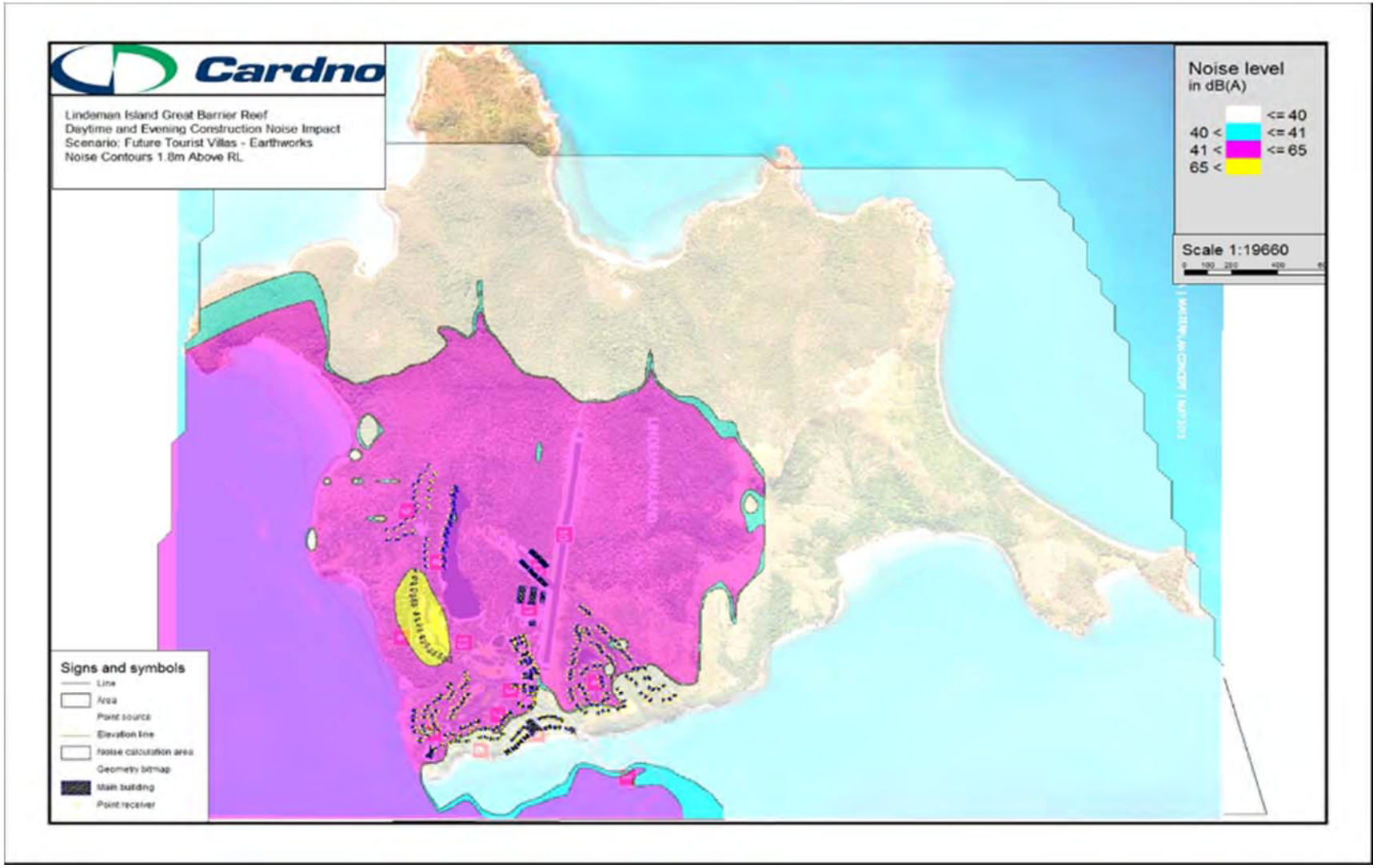


Figure 41 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 8b - Future Precinct 1 Villas, Structural Works

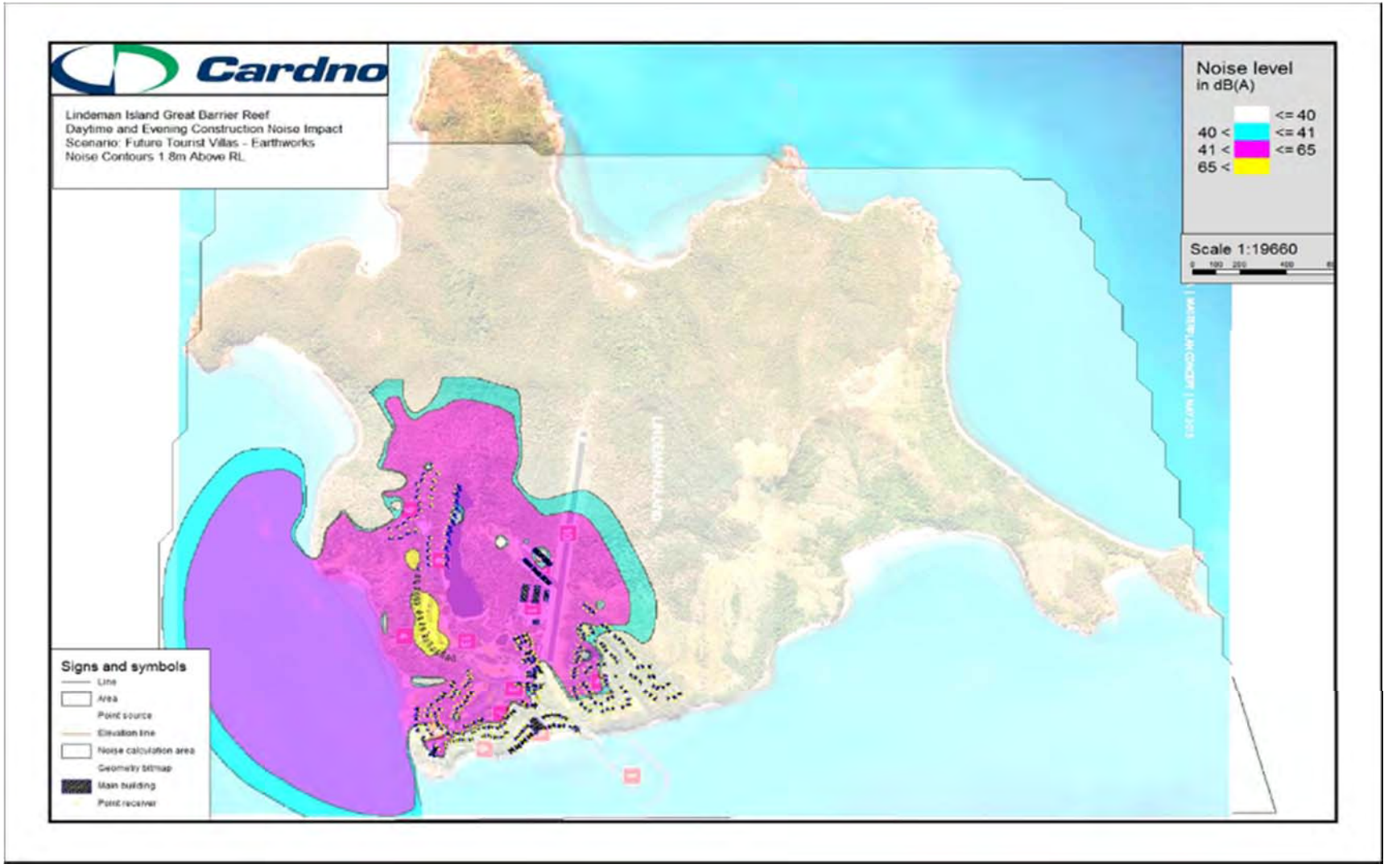
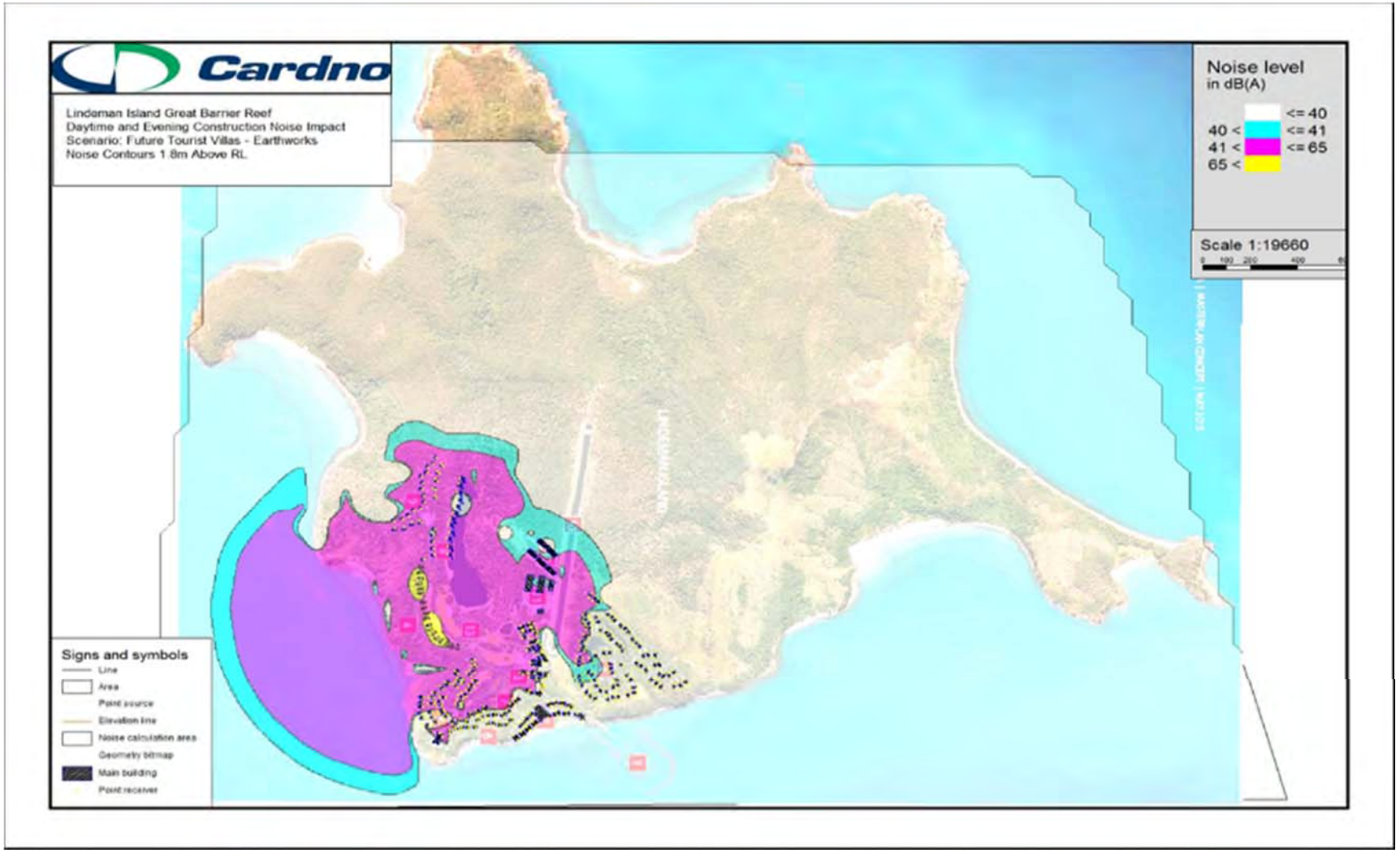


Figure 42 Predicted Construction Noise Exceedance of Daytime & Evening Noise Limits - Scenario 8c - Future Precinct 1 Villas, Finishing



About Cardno

Cardno is an ASX200 professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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