City Pacific Limited

Townsville Ocean Terminal

Supplementary Acoustic Report

Friday, 16 November 2007

Report no: pr_Y05402AP_rev2.doc/96260

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Supplementary Acoustic Report

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1 Summary

The purpose of this report is to present the findings of a detailed site inspection and site noise survey work of specific port related activities, to accompany the Noise Assessment Report as part of the EIS for the Townsville Ocean Terminal project.

1.1 Assessment Description

The noise surveying was conducted over a period of two days, 17 and 18th October 2007. This period of noise surveying was carried out at a time where there were a number of ships in port that were of varying types, for example:

- Car carrier
- Oil tanker
- Container ships; and
- Bulk mineral ships

Based on this, a diverse range of activities were observed and surveyed and subsequent noise modelling has been based on these findings.

Rail activity from sugar trains and vehicular movements within the port were also observed and surveyed under a number of operating conditions including shunting and moving away from stabling areas. It is understood that it is not uncommon for multiple sugar trains to be idling in the same stabling yard. This was observed during the inspection, and has been considered within train modelling scenarios. This indicated that the general idling of multiple locomotives was found not to significantly impact the nearest residences at the proposed Breakwater Cove.

The most significant noise at the port that was surveyed, other than the ship horns, was the idling and unloading of the car carrier ship. The movement of the vehicles off the ship and travelling to the holding yard further within the port was not considered significant, however the operation of the ships hold (where vehicles are stored) exhaust fans during this process are constant. Analysis of the survey data and computer simulation modelling shows that the operation of these fans is the most significant noise impact to the proposed Breakwater Cove development.

1.2 Assessment Findings

This assessment has found the following:

- The noisiest activities measured at the Port were noise from the car carrier ship and the ships horns, which we understand are used infrequently.
- Predicted existing Port noise impact on Breakwater Cove is comparable to impact on the existing Casino accommodation for the noisiest Port activities.

- Noise impact for all existing Port activities measured with the exception of the car-carrier when located at Berth 9 or 10 and the ships horn are predicted to generally comply with the external design criteria at Breakwater Cove.
- Noise emissions from the car-carrier at Berth 9 is likely to comply with internal design criteria at Breakwater cove provided the building envelope sound ratings detailed above in section 6.2.1 are adopted.
- Predicted noise impact from future Port operations based on the 2030 Port of Townsville Masterplan is likely to be less than the noise impact from existing Port operations.
- Predicted noise impact from future Port operations are likely to comply with the external design criteria for all modelled activities.
- Predicted noise impact from future Port construction is not likely to have significant impact on Breakwater Cove.

1.3 Recommended Mitigation Measures

The following mitigation measures are recommended to control external noise impact on Breakwater Cove from existing Port operations:

Breakwater Cove Development

- Retain the 6 metre high acoustic barrier proposed to the east of the Breakwater Cove site.
- Acoustic design of glazing and the building envelope construction for exposed facades of the Breakwater Cove development to comply with the recommended noise reduction ratings detailed in section 6.2.1. Door and window orientation/ positioning in relation to sight lines to the port

Port of Townsville

Prediction calculations indicate that the mitigation measures within the Breakwater Cove Development are sufficient to mitigate the two issues of noise exceedance identified.

Notwithstanding that, it is recommended that discussions be held with the Port to determine whether it would be acceptable to further improve the situation by doing the following:

- Limiting the use of ships' horns to daytime hours wherever possible.
- Locating the car carrier ships to berths furthest to the east, eg., berths 2, 3 or 4.

These actions would have the added advantage of reducing the noise impact on existing nearby dwellings.

2 Statutory Noise Criteria Overview

2.1 Port Users, Activities and Existing Approvals

Storage, processing and workshop operations within the Port precinct are located at greater distance from the project site than berth operations. However, these operations may impact on future residences by emission of noise. Existing Port users conduct the following Environmentally Relevant Activities (ERAs) under existing approvals and licences issued by the Environmental Protection Agency (EPA) that require noise control and monitoring measures to be undertaken in accordance with the conditions of approval.

- Queensland Terminals Pty Ltd operates under Development Authority No. ENDC00473406 for chemical storage and stockpiling, loading or unloading. Condition 32 of this authority relates to noise control and requires that noise emissions comply with requirements of the Noise Abatement Act. Since then the Environmental Protection (Noise) Policy 1997 has superseded this legislation.
- Southern Cross Fertilizers Pty Ltd operates under Development Authority No. ENCD00514006 for stockpiling, loading or unloading and crude oil or petroleum storage. Conditions F1 to F3 relate to noise complaints and require the holder of the authority to take necessary actions to resolve any complaint by appropriate dispute resolution or implement noise abatement measures to achieve required noise limit levels.
- Shell Company of Australia and Australian Petroleum Pty Ltd conducts stockpiling, loading or unloading and crude oil or petroleum storage under Development Approval No. ENDC00250105B11. This authority does not prescribe conditions for noise.
- The Shell Company of Australia Limited conducts stockpiling, loading or unloading and crude oil or petroleum storage under Integrated Authority No. NR0448. Conditions D1 to D3 prescribe noise limits that must not be exceeded and requires noise monitoring be undertaken on receipt of a complaint.
- Queensland Cement Limited operates under Environmental Authority No. ENDC00250105B11 to undertake chemical manufacturing, processing or mixing and stockpiling, loading or unloading of bulk goods. Conditions E1 and E2 require the authority holder to prevent or minimise noise emissions and to not cause unreasonable noise beyond the site boundaries.
- Queensland Nickel Pty Ltd operates under Licence No. NR0091 for storage of crude oil or petroleum products and Environmental Authority No. 5020000183 for stockpiling, loading or unloading which are issued by the EPA. These approvals require the operator to prevent or minimise environmental nuisance and ensure that noise emissions comply with prescribed noise limits.
- MIM Holdings Pty Ltd operates under Licence No. NR0054 to conduct screening, stockpiling, loading or unloading and operation of a motor vehicle workshop.

- SIMS Metal Limited conducts metal recovery and regulated waste storage activities under Integrated Authority No. SR1420. This authority requires noise monitoring to be conducted in the event of a complaint and prescribed noise limits to be achieved at noise sensitive places and commercial places.
- Australian Marshall Services undertakes sawmilling or woodchipping activities under Approval No. ENRE00246705. The conditions of approval require that noise from these activities must not cause environmental nuisance at any noise sensitive place or commercial place.
- Townsville Port Authority holds an Environmental Authority (Licence No. NR238) to conduct sewerage treatment, marina or seaplane mooring and regulated waste storage. The conditions of this authority require that any necessary actions be taken to resolve a complaint by appropriate dispute resolution or implement noise abatement measures to achieve required noise limit levels.
- Patrick Logistics conduct storage of chemical and regulated waste under Development Approval No. ENRE00265205. There are no conditions relating to noise under this approval.
- BP Australia Limited operates under Development Approval No. IPCE00404506C11 for storage of crude oil or petroleum. This approval requires that any necessary actions be taken to resolve a complaint by appropriate dispute resolution or implement noise abatement measures to achieve required noise limits.
- Stockpiling, loading or unloading bulk goods are undertaken at Berth 7 within the Port of Townsville under Development Approval No. ENCD00454205. This approval requires that any necessary actions be taken to resolve a complaint by appropriate dispute resolution or that noise abatement measures are implemented to achieve specified noise limits.
- Incitec Fertilisers Limited conducts chemical manufacturing, processing or mixing under Licence No. NR0512. This licence requires recording and investigation of complaints of noise nuisance be undertaken.
- BHP Minerals operates under Environmental Authority No. NR162 for stockpiling, loading or unloading of bulk goods. This authority requires noise monitoring to be conducted in the event of a complaint and prescribed noise limits to be achieved at noise sensitive places and commercial places.
- S Colborne Pty Ltd operates a motor vehicle workshop under Licence No. NR0428. This licence requires management of environmental impacts in accordance with the conditions of a previous development approval for the site (conditions not provided).
- Northern Port Services Pty Ltd operates under NR0495 to conduct boilermaking or engineering activities and for operation of a motor vehicle workshop (conditions not provided).
- Northern Shipping and Stevedoring Pty Ltd operates under Licence No. NR268 for stockpiling, loading or unloading bulk goods. The licensee is required to take reasonable and practical measures to minimise noise emissions.

- Patrick Stevedores Operations Pty Ltd conducts stockpiling, loading or unloading of bulk goods under Environmental Authority No. NR233. The holder of the authority is required to achieve specified noise limits in the event of a complaint.
- Caltex Australia Petroleum Pty Ltd conducts crude oil or petroleum storage and stockpiling, loading or unloading of bulk goods under Environmental Authority No. NR361. The holder of the authority is required to take any necessary actions to resolve a complaint by appropriate dispute resolution or implement noise abatement measures to achieve specified noise limits.
- Queensland Sugar Limited operates under Licences No. NR0390, NR0517 and NR0391 for stockpiling, loading or unloading bulk goods. These licences require that specified noise limits are to be achieved in the event of a complaint.
- Licensed activities and conditions of approval for other operations within the Port precinct including Xstrata, Australian Molasses Trading, Chemtrans, Origin Energy, NSS Container Terminal, Pentarch Forests and Powerplay Catamarans were unknown at the time of writing this report.

It can be seen that the above environmental licences contain a wide variation of noise control requirements and criteria, with some being superseded by current legislation. Therefore a review of the current relevant general environmental noise impact legislation has also been carried out below.

2.2 Local Law

2.2.1 Existing Port Protection Code Requirements

Section 51 of the Breakwater Island Casino Agreement Act 2006 (BICA Act) defines the Surplus Casino Land (SCL) Port Protection Code. The purpose of the Code is to minimise impacts on the existing and future operations of the Port of Townsville from future development of the SCL.

Future development within the SCL will be required to comply with the probable solutions (self-assessable development) or specific outcomes (assessable development) of the Code in order to prevent conflict of incompatible land uses that may arise as a result of impacts such as emission of noise, dust, odour, from light and visual intrusion. This will primarily include provision of minimum noise levels inside the dwellings and suggested minimum building envelope construction elements required to achieve this. These would be calculated based on the methods in AS 3671.

The Port Protection Code identifies Specific Outcomes (SO) that relate to noise impacts. Probable Solutions are specified in the Code detailing appropriate design measures to achieve the SOs and to minimise impacts on future residences within the Breakwater Cove precinct from noise emissions from existing and future port operations. The recommended constructions could be included in the SOs as a recommended mitigation measure.

Refer to Section 3.4.1 of the Acoustic report prepared by Hyder Acoustics for specific details of the code's requirements.

2.3 Queensland State Law

2.3.1 EPA Regulations

Industrial Premises

The QLD Environmental Protection Agency Planning for Noise Control provides guidelines for the assessment of noise from industrial premises, commercial premises and mining operations. These guidelines fall under the Queensland EPA EcoAccess Planning for Noise Control Guideline. The objectives of the guideline are to:

- Control and prevent degradation of background noise from steady noise sources;
- Contain noise levels to acceptable levels above the background levels from variable and short-term noise sources; and
- Set noise levels to avoid sleep disturbance from night-time transient activities.

The guideline provides a procedure to identify planning noise level objectives for the area surrounding a development, comparing these to measured, existing noise levels, then adjusting the allowable noise component from the new development so that it's contribution does not raise the overall noise level above the noise level objective for that area.

However, this is not entirely appropriate for the assessment of Port noise impact given that the Port is an existing source and already considered to be part of the existing ambient noise environment.

Because the Port is an existing facility Hyder believes that adopting a "planning noise level" criteria for the relevant area type from the Guideline is a more appropriate design criteria for this assessment.

The Guideline recommends the following planning noise levels:

Table 1: QId EPA Maximum Planning Noise Levels

Noise Area Category	Description of Neighbourhood	Maximum *$L_{Aeq,1hr}$ PNL		
		Day	Evening	Night
Z1	Very rural, purely residential, less than 40 vehicles per hours	40	35	30
Z2	Negligible transportation, less than 80 vehicles per hour	50	45	40
Z3	Low density transportation, less than 200 vehicles per hour	55	50	45
Z4	Medium density transportation (less than 600 vehicles per hour) or some commerce or industry	60	65	50
Z5	Dense transportation (less than 1400 vehicles per hour) or some commerce or industry	65	60	55
Z6	Very dense transportation (less than 3000 vehicles per hour) or in commerce or bordering industrial districts	70	65	60
Z7	Extremely dense transportation (3000 or more vehicles per hour) or within predominantly industrial districts	75	70	65

**The above noise planning levels are in terms of the equivalent continuous A-weighted noise level over a 1 hour measurement period.*

2.4 Australian Standards

Australian Standards that apply to the assessment of noise and vibration associated with this development are a follows:

- AS/NZS:2107:2000 – "Acoustics – Recommended deign sound levels and reverberation times for building interiors."
- AS 3671:1989 – "Acoustics – Road Traffic Noise Intrusion – Building Siting and construction"
- AS 2021:2000 – "Acoustics – Aircraft noise intrusion – Building Siting and construction"
- AS 1055:1997 – "Acoustics – Description & Measurement of Environmental Noise"
- AS 1259:1990 – Acoustics – Sound Level Meters – Integrating & Non Integrating – Averaging.

- Australian Standard AS2670.2:1990 “Evaluation of Human Exposure to Whole-body Vibration”;
- British Standard BS7385.2:1993 “Evaluation and Measurement for Vibration in Buildings – Guide to Damage Levels from Ground-borne Vibration”; and
- German Standard DIN4150:1999 Part 3 “Structural Vibration in Buildings – Effects on Structures”.

In particular Australian Standard AS 1055 provides a table of estimated (typical) background A-weighted sound pressure levels ($L_{A90,T}$) for different Areas containing residences in Australia as follows:

Table 2: Extract from AS 1055 Appendix A

Noise area category	Description of Neighbourhood	Average background A-weighted sound pressure level, LA90,T					
		Monday to Saturday			Sundays and Public Holidays		
		0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5	Areas with very dense transportation or in commercial districts or bordering industrial districts.	60	55	50	60	55	50
R6	Areas with extremely dense transportation or within predominantly industrial districts.	65	60	55	65	60	55

Whilst the above is similar to the Qld EcoAccess criteria, the above criteria is less appropriate as it refers to averages over long periods of time and typical ship movements are likely to be more short term in nature.

3 Design Benchmark Criteria

3.1 External Noise Criteria at Breakwater Cove

At the time of preparation of this report, no specific planning noise levels for external noise impact from the existing Port activities and Port expansion were available as the Port is an existing facility an as such would generally has been previously considered as part of the existing ambient noise environment.

A satisfactory noise level criterion is required to provide guidance for maximum permissible noise levels from the port impacting on the Breakwater Cove development, in order to protect the amenity of these future residents.

The most relevant of the above criteria is the Queensland Environmental Protection Agency, the Ecoaccess document which provides planning guidelines for the control of noise emitted by industrial, commercial or mining operations.

With reference to Table 3 (Table 1 above) of the Ecoaccess document, the nearest receptors are Breakwater Cove and Jupiters Casino. These areas are predominantly residential areas with either medium density transportation and/or adjoining commerce or industry. Given this, the applicable noise emission criteria is shown below in Table 3.

Table 3: Planning noise emission levels from port activities at the Breakwater Cove development

Noise Area Category	**Description of Neighbourhood**	**Maximum hourly sound pressure level, $L_{Aeq,1hr}$ (PNL)**		
		Day	**Evening**	**Night**
Zone Z4	Medium density transportation (less than 600 vehicles per hour) or some commerce or industry	60	55	50

3.2 Internal Noise Criteria at Breakwater Cove

3.2.1 Steady State Noise

In order to control Port noise impact inside the Breakwater Cove dwellings building envelopes will need to provide adequate sound isolation. To determine the level of sound isolation required an internal noise criteria has been adopted on the basis of internal design noise levels recommended in Australian Standard AS/NZS 2107:2000.

The following internal levels are recommended by this standard for different room types:

AS 2107 states the following guidelines for internal sound levels in Residential Buildings in areas located near to minor roads:

Table 4 – Internal Design Sound Levels for Dwellings

Type of Occupancy	Recommend Design Sound Level L_{Aeq}, dB(A)	
	Satisfactory	Maximum
Living Areas	30	40
Sleeping Areas	30	35
Work Areas	35	40

Based on the above, minimum building envelope noise reduction ratings have been determined in section 6.2.1, using the method described in AS3671. AS 3671 is normally used to determine minimum building envelope requirements for traffic noise impact but provides a relevant method to determine building envelope requirements for relatively steady state noise such as ship noise etc.

3.2.2 Intermittent Short Term Noise

Table 5 summarises the recommended maximum intrusion levels for external noise into various buildings for intermittent noise sources. This criteria has adopted on the basis of AS 2021 –2000: Acoustics – Aircraft Noise Intrusion – Building Siting & Construction. This criterion is principally associated with aircraft flyover noise but can also be used to determine appropriate criteria for other short term, intermittent noise events, such as noise from the ship horns etc.

Table 5: Recommended Intermittent External Noise Intrusion Criteria

Space	Short Term Intrusive Noise
Sleeping, dedicated lounges	50 dB(A)
Other habitable areas	55 dB(A)
Bathrooms, toilets, laundries	60 dB(A)

These noise levels apply to daytime or night time intrusive noise. The noise criterion would apply with all windows and doors closed. This assumes that all living and sleeping spaces will be air-conditioned.

This criteria applies to noise from the ships horns impacting on Breakwater Cove sleeping/living areas.

4 Site Noise Surveying

Existing Port of Townsville operations may potentially impact on the future residences within Breakwater Cove by emission of noise from operational activities. The Port of Townsville operations that are nearest to Breakwater Cove are Berths 1, 2, 3, 9, 10 and 11. Operations at these berths include loading and unloading of:

- Bulk cement, scrap metal, minerals and ores;
- General cargo and containers;
- Motor vehicles and live cattle;
- Frozen beef, raw sugar, molasses and fertiliser;
- Passengers and luggage; and
- Discharge of bulk liquids and fuel oil bunkering.

A range of vessels are received at these berths including bulk carriers, tankers, cargo vessels, livestock carriers, vehicle carriers and cruise and naval vessels. At the time of the inspection and surveys, there were no naval vessels in port.

Goods are loaded and unloaded from these vessels by use of mobile handling equipment including hoppers and conveyors, forklifts, tractors, cranes and front-end loaders. Fixed cranes on the ships are also used.

Fuel loading is normally carried out at Berth 1. Measurements were not able to be recorded at this location due to a ban on electronic equipment near to the fuel loading berth for safety reasons. Fuel loading was observed to be subjectively quieter than other activities that were measured during the inspection (ship idling audible only). Therefore based on the above and the further proximity of Berth 1 to Breakwater Cove than 9 and 10, modelling was not considered to be a worst case scenario and was not carried out for Berth 1.

Similarly, Nickel Loading at Berth 11 was not measured or modelled due to its further proximity from Breakwater Cove and similar activities measured for other closer berths.

Other nearby Port operations includes Patrick Stevedores, Australian Molasses Trading, Origin Energy, Queensland Nickel, Xstrata and the NSS Container Terminal.

4.1 Equipment and Meteorological Conditions

4.1.1 Equipment

The following equipment was used for the preparation of this assessment:

- Rion NA27 Sound Level Meter – manned, short term measurements
- Rion NL-21 Sound Level Meter – unmanned, long term noise monitoring
- ARL EL-215 Noise Logger – unmanned long term noise monitoring

All equipment calibration levels were checked before and after the measurements, with no significant drift in level observed (less than +/- 0.5dB). Microphone calibration was undertaken using a Bruel & Kjaer 4231 microphone calibrator.

4.1.2 Meteorological Conditions

During the assessment the following meteorological conditions were noted. These are shown in Table 6.

Table 6: Ambient meteorological conditions during site surveying, 17 and 18th October 2007

	17th October	**18th October**
General conditions	Mostly fine, sunny, overnight storm developing	Partly cloudy
Temperature	Approximately 29^{0}C	Approximately 31^{0}C
Wind	Light winds, SSE tending ENE in the afternoon	ESE tending E in the afternoon. Gusty, up to 40 knots
Humidity	Approximately 50%	Approximately 45%

Due to the gusty wind conditions experienced on the 18th October, a portion of the noise measurements were affected, and it was noted that the wind affected the low frequency measurements, for example below approximately 250Hz. Some of these measurements were not used in the modelling as a result, however others have been used in the modelling. It was considered that as only the low frequencies were affected, the output of the computer model is considered marginally optimistic.

4.2 Port Activity during Noise Surveying

During the period 17th October to 19th October, up to sixteen ship movements occurred at the port. The term ship “movements” in this report refers to:

- One ship entering the port; or
- One ship leaving the port; or
- One ship manoeuvring from one berth to another berth during the ships time in port

The majority of these ships were cargo and container ships, with the more significant being the car carrying ship that was utilising Berth 9 from late evening on 17th October to approximately midday of the 18th October.

Dependant on the berth that a particular ship will utilise and direction of the ship at the birth, up to two tug boats will be used to assist the ship to turn in the “swing basin” and position at the berth. The noise from the tug boats are comparable to a container ship motoring away from the berth.

4.2.1 Noise Sources Observed

The more acoustically significant port noise sources that were identified during the inspection included:

- Cargo ships idling
- Car carrying ship idling and unloading vehicles
- Sugar train movements within the port precinct
- Ship exhaust stacks
- Ship horns
- Banging of containers during loading and unloading onto the various ships, the berths and onto other containers
- Cranes – both fixed to the berth and on the ship
- Loaders and forklifts, including reversing beepers
- Conveyor belt system
- Dumping of materials into skip bins (within an existing building) to be loaded onto a cargo ship

4.2.1.1 Operating Vessels

The following ships were in port at the time of the inspection and are referred to in sections of this report:

Table 7: Vessels in port at the time of the inspection/ noise survey, 17 & 18th October 2007

Vessel Name	Type of Vessel	Estimated Length (m)
Achilles	Cargo ship	106
Alcem Calaca	Bulk cement powder ship	135
Barrington	Fuel/ oil tanker	181
Brisbane	Channel Dredge	86
CCNI Ancud	Container ship	185
DD Vanguard	Container ship	159
Lucy Oldendorff	Container ship	157
Rockies Highway	Car Carrier	180
Sepik Coast	Cargo ship	77
Siteam Anja	Fuel/ oil tanker	183
Spring Bulker	Cargo ship	166
Star Bird	Cargo ship	97
Tasman Commander	Container ship	185
Union Alliance	Cargo ship	170
Yang Hai	Bulk minerals ship	190

There are a number of fixed noise sources associated with each ship that operates when in port. It should be noted that the ships main engines are turned off after berthing and the diesel generators (described below) are turned on. The typical noise sources include:

- Diesel powered generators. These generators are located below the deck of the ship and typically in an acoustic enclosure. The diesel generators operate continuously to provide power to the ships essential services during their time in port and at the berth. The major noise sources that are external to the ship are the exhaust stack and air intake risers.
- Exhaust and air intake fans. The air intake and exhaust fans on the car carrier ships operate continuously and were observed to be the loudest of all of the ships surveyed. To a lesser extent, air intake and exhaust fans operate continuously on all other ships, however these fans appeared to be smaller and were found not to be a significant impact outside the port boundaries. It is estimated that the operation of these fans would be in the order of 40-45dB(A) at the nearest residence at Breakwater Cove from Berth 10. This prediction does not take in to account shielding effects from site buildings/ containers or the proposed noise wall to Breakwater Cove. Taking into account the proposed noise wall, the predicted level is approximately 35-40dB(A).
- Cranes. Each container and cargo ship in port at the time of the inspection was equipped with a number of fixed cranes. Depending on the length and size of the ship, the number of cranes ranged from two to four, however only one crane on each of the ships was operating to load and unload cargo. These cranes are diesel driven with the engine being located behind the operator, at high level. The noise emission observed from these cranes was engine and exhaust emission
- Pumps and valves. This relates to the ship(s) that transport dry cement (powder). It was noted that the pump motor was located below deck on the Alcem Calaca at Berth 4, however the exhaust stack and pressure relief valve were located above deck. The relief valve operates to relieve pressure build up in the hold of the ship and is therefore not a continuous noise source, however will continue to relieve pressure during the process of emptying and filling the ship.

During the site inspection, three ships docked at Berth 10 and departed. This berth was considered to be the busiest during the inspection, with haulage vehicle movements, cranes operating, and large 27 tonne forklifts moving containers and other cargo. The ships docked here did not use the cranes on the ship, rather the diesel driven crane on the berth. This crane is shown in Figure 1.

Figure 1: Cargo crane positioned on Berth 10

The crane on berth 10 is diesel driven, similarly to those at Berth 2 and Berth 3 however these were not operating during the inspection. It was noted that the engine was at a slow idle when the crane was stationary or lowering cargo into the hold of the ship, but the engine would rev when lifting cargo out of the hold and during slewing. This was not constant during these processes.

The noise impacts associated with the operation of the crane were observed to be the engine revving during lifting and slewing and dropping of containers onto the berth or adjoining containers.

4.2.2 Ships Horn (whistle)

Each marine vessel is required to be equipped with a marine horn (whistle), as required under the 1972 International Regulations for Preventing Collisions at Sea (1972 COLREGS), endorsed by the International Maritime Organisation (IMO). The Regulation also specifies the technical requirements of these marine horns and are categorised into the class of the vessel, namely Class 1 (I) through to Class 4 (IV). The class is determined by the length of each vessel.

Table 8: Summary of 1972 COLREGS requirements for marine horns (whistles)

Vessel Class	Length of vessel (metres) (metres)	Limits of Fundamental Frequency (Hertz)	Minimum Sound Pressure Level at 1 metre (1/3 Octave Band)	Minimum Audibility Range (Nautical Miles)
I	>200 m	70-200 Hz	143 dB	2
II	75 – 200 m	130-350 Hz	138 dB	1.5
III	20 – 75 m	250-700 Hz	130 dB	1
IV	<20 m	250-700 Hz	120 dB	0.5

As described in previous sections of this report, a number of ships were in port at the time of the inspection and varied in length. Typically, the ships at Berth 10 were between approximately 75 metres and 106 metres in length. Typically, the majority of the cargo/ container ships at berths other than Berth 10 were estimated to be in the order of 185m in length. Subsequent research into individual ship lengths show that this estimate is comparable and therefore the associated marine horns at the time of the inspection would be applicable to Class II.

Research also indicates that ships greater than 200 metres in length may use Townsville Port and this is understood to become more frequent in the future expansion of the Port. These ships would be applicable to Class I. Noise modelling has been based on the noise level of a Class I type horn to represent the worst case scenario.

We understand from Port employees that ships horns are only used occasionally as a warning device or when there are no personnel available to guide them in and out of the Port.

4.3 Noise Monitoring

Unmanned noise monitoring has been undertaken at two locations within the port precinct and services two primary functions for the preparation of this assessment, namely:

- Verification of manned on site noise measurements of specific port activities
- General ambient noise monitoring to verify the result of the computer noise modelling

The monitoring was carried out at two locations that were safely accessible and considered representative of typical port operations and for verification, noted above. These locations are shown in Figure 2.

The noise loggers were positioned at the end of Berth 10 and also atop the Control Tower and continuously logged from 17th October 2007 to 18th October 2007. The loggers were set to short sample times to enable a more accurate measurement of individual processes/ activities at the port. For example, collecting a container, then

positioning it to then be loaded onto the ship is a short duration event, observed to be in the order of 1 minute.

Figure 2: Townsville Port – Noise logging locations: 17th to 18th October 2007

4.3.1 Continuous Background Noise Levels

Figure 3 and Figure 4 below give a graphical representation of the measured noise levels at each location over the measurement period:

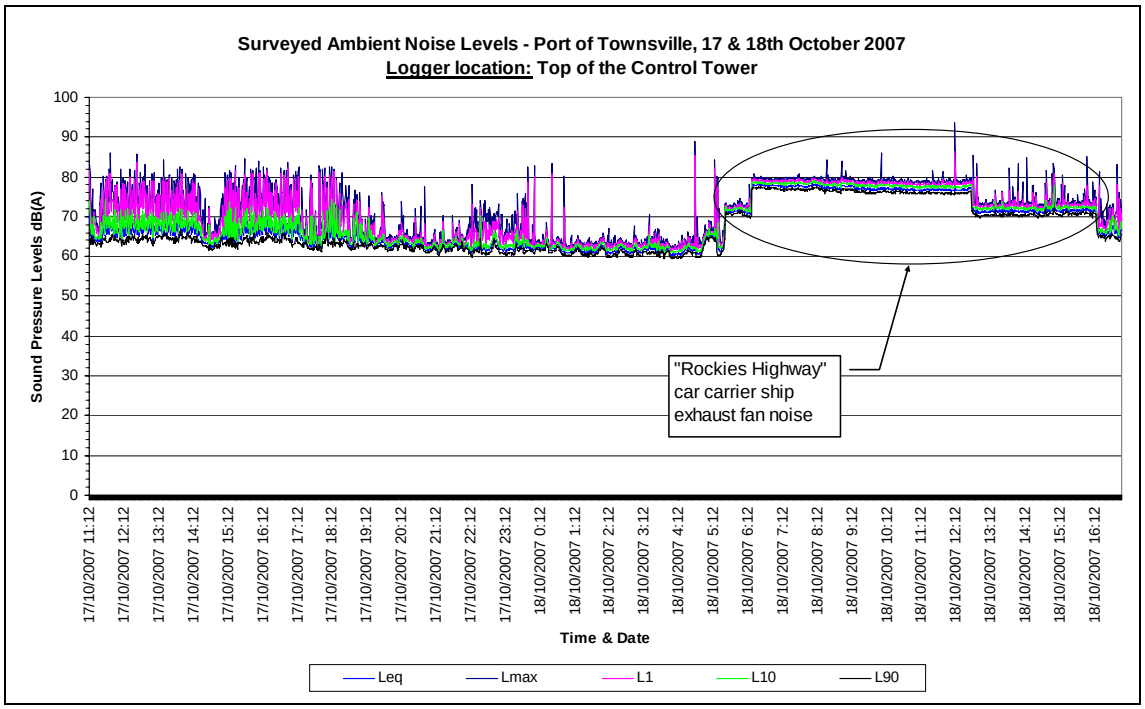


Figure 3: Ambient Noise Levels Measured at Logger Location 1 – Top of Control Tower

With reference to Figure 3, typical background noise levels at the top of the Control Tower were in the order of 60-65dB(A) during port operations such as loading and unloading of various container ships for example, however the noise level distribution chart clearly shows a significant increase of ambient noise levels due arrival of and the car-carrier activities.

Cross referencing the shipping time table provided to Hyder on site on 17th October 2007, this increase in noise level coincides with the arrival and loading/ unloading activities of the car carrier ship “Rockies Highway”.

This is also shown in Figure 4, however for several hours prior to the arrival of this ship, the noise measurements were contaminated by what was confirmed by the Port as a dust monitor that has been located near to the noise logger at this location.

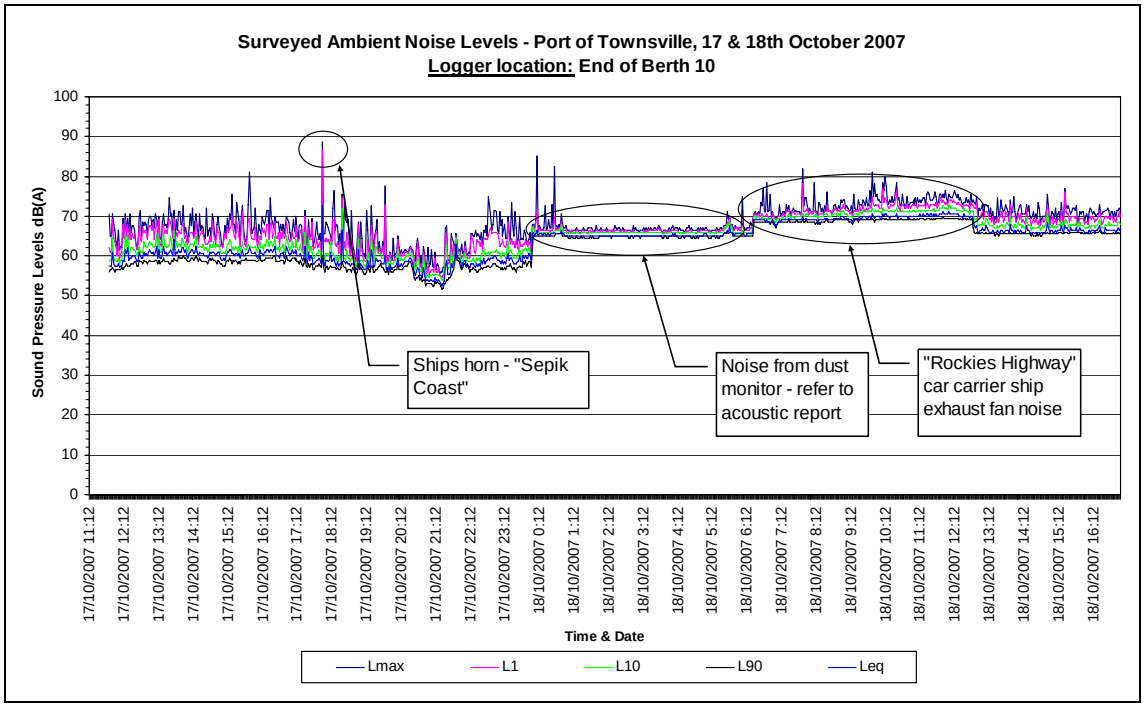


Figure 4: Ambient Noise Levels Measured at Logger Location 2 – End of Berth 10

In addition to noise emission from “Rockies Highway”, the noise monitoring location at the end of Berth 10 also clearly identifies ship horn noise. The Port confirmed that the ship horn was from the “Sepik Coast”, which had a revised departure time of 18:00 hours.

4.3.2 Manual Noise Measurement Results

The following noise source levels were measured manually and are shown in Table 9.

Table 9: Summary of short term, manned noise survey results

Source	Measured Sound Pressure Level, dB(A)	Measurement Distance (metres, m)	Calculated Sound Power Level, dB(A)
Berth 10:			
Ship - "Sepik Coast"			
Large Forklift 27 tonne	72	6	95
Large Forklift moving	73	5	95
Crane slewing	77	5	99
Container unload/Crane set down	73	5	95
Container unload/Forklift pick up	79	5	101
Forklift Dropping Container	76	4	96
Crane moving with beeper	77	10	105
Crane Dropping Container	77	15	108

Crane moving with beeper	75	12	105
Forklift picking Container	77	20	111
Forklift with container with beeper	75	10	103
Truck fast idling	76	35	115
Truck slowly moving forward	72	5	83
Forklift reverse/beeper	86	5	108
Forklift Moving forward	80	5	102
Ship - "Achilles"			
Truck Idle	79	10	107
Truck moving forward	77	10	105
27 tonne Forklift reverse beeper	76	10	104
Rattle gun – ship maintenance	80	10	107
Truck Pass by	77	10	105
Rattle gun – ship maintenance	77	10	105
Ship idle – generators only	71	30	108
Berth 9:			
Ship - "Union Alliance"			
Truck Pass by	76	5	86
Forklift pass by	78	5	100
Crane dropping skip bin to dock	79	5	101
Forklift pass by	78	5	100
Forklift taking away skip bin	79	5	101
Crane dropping skip bin into ship	75	10	103
Truck pass by	80	5	90
Crane dropping skip bin to dock	84	5	106
Ship stack from tower/townside	63	40	103
Ship stack from tower/seaside	65	40	105
Ship - "Rockies Highway"			
Ship Idle – generators only	71	10	99
Ship with car movements	72	10	100
Ship idle with door closed	66	10	94
Ship noise – from top of tower	78	35	117
Ship noise – from top of tower	78	35	117
Ship noise – from top of tower	79	35	118
Ship noise at ground level	79	15	111
Ship noise - from end sea end of Berth 9	74	20	108
Ship noise at ground level	80	8	106
Ship noise front from sea end of Berth 9	81	8	107
Berth 8:			
Ship - "Brisbane"			
Ship noise – from rear of ship	66	30	104
Ship exhaust fans – from the front of the ship	72	15	104
Berth 7			
Ship - "Yang Hai"			
Ship idle – generators only	67	100	115

Conveyor belt operating	69	15	84
Conveyor system motor	73	15	105
Berth 4:			
Ship - "Alcem Calaca"			
Sweeper truck cleaning Berth 4	82	3	99
Sweeper truck cleaning Berth 4	83	3	100
Ships horn	82	480	144
Ship engine noise – positioning to berth	66	10	94
Ship engine noise – positioning to berth	65	10	93
Ship idle with beeper	69	10	97
Forklift/Loader	73	10	101
Ship Idle – generators only	66	10	94
Ship Idle – generators only	64	10	92
Hammering on cement transfer hose	77	25	113
Pump warming up, not pumping	71	15	103
Pump warming up, not pumping	71	15	103
Pump exhaust	77	15	109
Pump pressure valve	88	15	120
Pumping – cement being forced through the hose	75	15	106
Pump pressure valve	89	15	120
Pumping – cement being forced through the hose	74	15	106
Pump pressure valve	92	15	123
Berth 3:			
Ship - Spring Bulker			
Stack noise – generators only	77	30	114
Stack noise – generators only	77	30	114
Stack noise – generators only	77	30	114
Crane working	73	30	110
Crane dropping cage onto berth	71	10	99
27 tonne Forklift picking up load	75	10	103
Forklift small – pass by	73	10	101
Bob cat – pass by	73	10	101
Forklift pass by	78	10	106
Crane dropping cage onto berth	74	10	102
27 tonne Forks dropping cage onto berth	80	10	108
Fork lifts moving	76	10	104
General Port Activities:			
Lennon Drive Gates			
2 diesel locomotives idling	75	10	103
1 diesel locomotive rev/moving	82	10	96
Train carriage noise	71	10	0

Coke Pit			
2 truck pass	83	3	92
Loader reverse beeper	76	25	112
Bulk Sugar Sheds - Building 15			
1 diesel locomotive moving slow	66	10	80
1 diesel locomotive idling	70	10	98
1 diesel locomotive shunting/rev	71	10	85
1 diesel locomotive shunting/rev	72	10	86
1 diesel locomotive shunting/ brakes squeaking	70	10	83
1 diesel locomotive pass by	71	14	87
1 diesel locomotive pass/shunting	67	14	82
Helicopter/Shinook	73	335	132
Xstrada - Building 16			
Loading activities inside Xstrada	84	80	130
Loading activities inside Xstrada	80	80	126
"Rockies Highway" – idle, measured at ground level	64	30	102
"Rockies Highway" – idle, no truck movements	64	30	101
Loading activities inside Xstrada	77	80	123

5 Computer Modelling

5.1 Computer Model Verification Process

Computer simulation modelling of various port noise sources has been undertaken using proprietary software – SoundPlan 6.3, to verify the site noise survey data obtained on the 17th and 18th October 2007. Verification models were run for specific existing port noise sources including:

- Forklifts
- Cranes
- Haulage truck movements; and
- Impact noises such as containers being dropped on the ground and against each other

The noise survey data obtained from site was analysed and used as input to the computer model. The raw data was also corrected for background noise before input into the model, where required, as the measurements of some specific port activities were influenced by other port noise sources.

The noise logger locations were defined on the model as single point receivers, at the correct relative level (RL) of these locations. The noise loggers were used as reference points for site measurements and also to verify the output of the computer model, more specifically for continuous ship noise during the arrival and car loading activities carried out for the car carrier at Berth 9.

Initial computer output indicated that the model was approximately 1 to 2dB(A) lower than levels measured on site. This was attributed to the contribution of other noise sources at the Port which were fairly constant during the site inspection. Minor adjustments to the model were required in order to correlate predicted levels with levels measured on site however the car carrier ship did not require adjustment.

5.2 Computer Modelling Output

Graphical computer model noise impact predictions for existing and future Port operations are located in Appendix A and B of this report, respectively.

6 Noise Impact Assessment

6.1 External Noise Impact

6.1.1 Existing Port Operations

A number of "situations" have been modelled using the proprietary software – SoundPlan. The situations modelled represent our estimate of worst case port operations, based on our survey data from 17th and 18th October 2007. The situations modelled were:

1. Loading/ unloading activities on Berth 10
2. Impact noise from dropping containers etc on Berth 10
3. Loading/ unloading activities on Berth 9
4. Impact noise from dropping containers etc on Berth 9
5. Car carrier loading/ unloading activities on Berth 9
6. Dry cement ship loading/ unloading activities on Berth 4
7. Impact and unloading activities on Berth 3
8. Sugar train noise
9. Ships horn
10. Haulage truck movements within the port facility

The graphical computer model output for each modelled situation is presented in Appendix A of this report. The numerical values are presented in Table 10.

6.1.1.2 Predicted Noise Levels at Breakwater Cove Receivers

For the purpose of establishing "control" receiver locations, the nearest dwellings on each arm of the Breakwater Cove development were adopted. These are numbered "Dwelling 1" to "Dwelling 5". Dwellings 1 to 4 also benefit from shielding from the noise wall proposed for the Townsville Ocean Terminal, where dwelling 5 does not and has been modelled at 16.5 m to allow for noise at the top of the proposed apartment blocks which is likely to be the worst case scenario.

Figure 5 clearly identifies these locations.

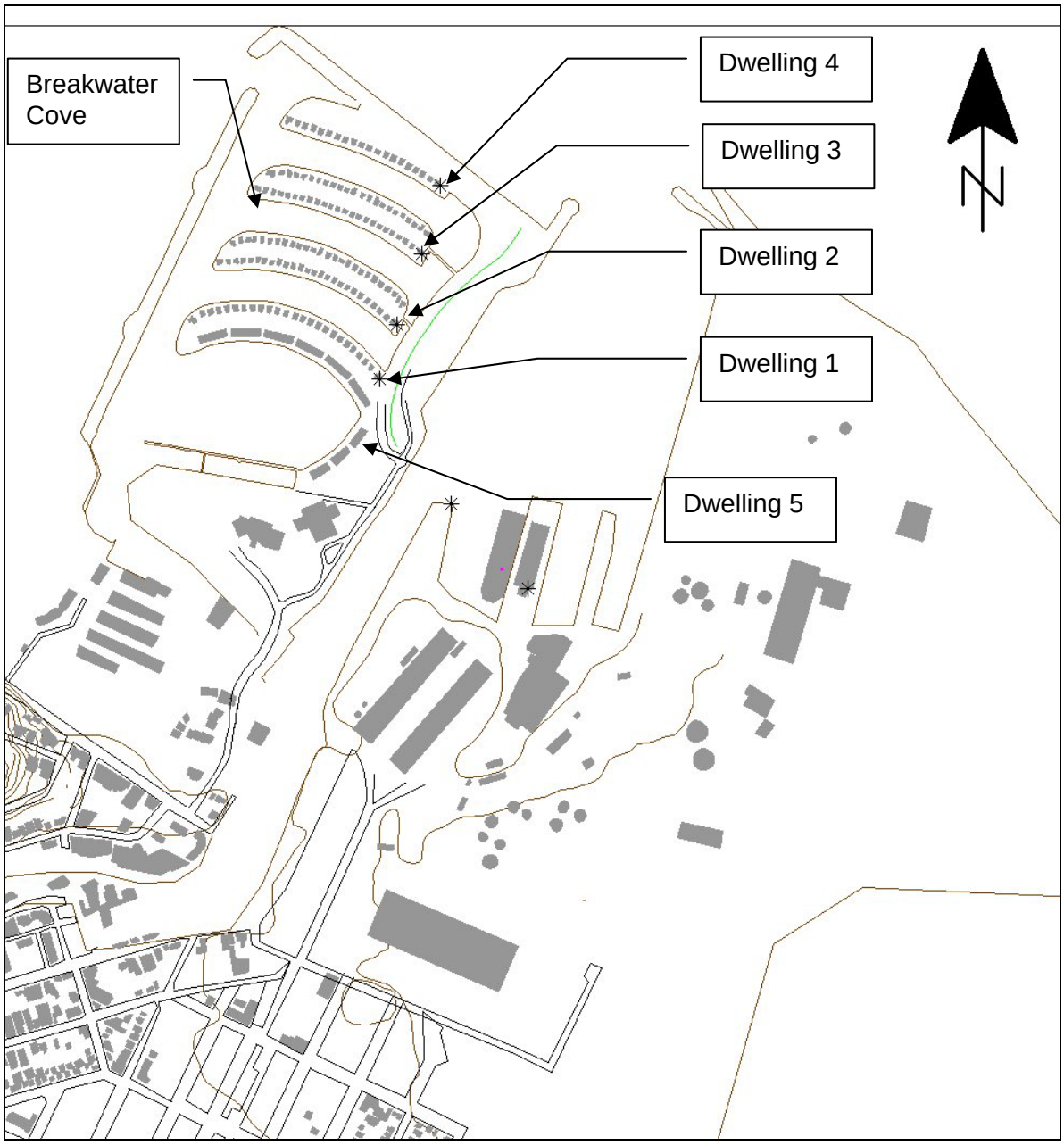


Figure 5: Modelled residential receiver locations

Table 10 summarises the predicted noise impact from each of the modelled situations of the existing port operations at the nominated receivers at Breakwater Cove.

Table 10: Summary of predicted noise levels

Situation Modeled	Noise sources in the model	Reference Receiver Location					
		Top of Control Tower	**End of berth 10**	**Dwelling 1**	**Dwelling 2**	**Dwelling 3**	**Dwelling 4**
Impact Berth 10	Forklift Dropping container, Truck Idling, 27 tonne Forklift Reverse beeper, Crane Dropping Container, "Sepik Coast" stack noise	50dB(A)	69dB(A)	50dB(A)	49dB(A)	46dB(A)	45dB(A)
	Distance from source	**230m**	**90m**	**375m**	**500m**	**660m**	**840m**
Loading Berth 10	Crane Moving With beeper, 27 tonne Forklift Idle, 27 tonne Forklift moving, Truck Idling, "Sepik Coast" stack noise	50dB(A)	67dB(A)	49dB(A)	48dB(A)	45dB(A)	44dB(A)
	Distance from source	**230m**	**90m**	**375m**	**500m**	**660m**	**840m**
Impact Berth 9	Forklift Taking Bin, Forklift & Reverse Beeper, Crane Dropping Bin To Deck, Forklift Dropping Bin to Deck, "Union" Stack Noise	46dB(A)	51dB(A)	36dB(A)	36dB(A)	34dB(A)	36dB(A)
	Distance from source	**80m**	**200m**	**500m**	**620m**	**730m**	**930m**
Loading Berth 9	Conveyor belt moving, Conveyor Motor, "Union" stack noise, Truck, 2 off small Forklifts	63dB(A)	62dB(A)	49dB(A)	49dB(A)	48dB(A)	47dB(A)
	Distance from source	**80m**	**200m**	**500m**	**620m**	**730m**	**930m**
Car Carrier Unloading Berth 9	"Rockies Highway" stack noise, Rockies Highway ship noise (cars leaving ship not modeled)	74dB(A)	71dB(A)	60dB(A)	60dB(A)	59dB(A)	58dB(A)
	Distance from source	**80m**	**200m**	**500m**	**620m**	**730m**	**930m**
Concrete Ship Pumping Berth 4	"Alcem Calaca" Stack noise, Pump Noise, Pump Pressure Release	36dB(A)	33dB(A)	28dB(A)	27dB(A)	26dB(A)	25dB(A)
	Distance from source	**270m**	**460m**	**750m**	**800m**	**890m**	**1.000m**
Train Noise	2x Trains Shunting Carridges,2xLoco motives (modeled closest to Proposed development)	43dB(A)	52dB(A)	42dB(A)	40dB(A)	38dB(A)	36dB(A)
	Distance from source	**180m**	**250m**	**490m**	**660m**	**790m**	**980m**
Table 7 continued							

Situation Modeled	Noise sources in the model	Reference Receiver Location					
		Top of Control Tower	**End of berth 10**	**Dwelling 1**	**Dwelling 2**	**Dwelling 3**	**Dwelling 4**
Horn Noise	1x Ships Horn At Entrance to port	60dB(A)	74dB(A)	74dB(A)	75dB(A)	76dB(A)	76dB(A)
	Distance from source	**780m**	**690m**	**730m**	**590m**	**510m**	**500m**
Truck Movements	2x Trucks Modeled closest to development	42dB(A)	52dB(A)	42dB(A)	40dB(A)	39dB(A)	36dB(A)
	Distance from source	**510m**	**530m**	**630m**	**820m**	**980m**	**1.200m**
Impact & Unloading Berth 3	"Spring Bulker" Stack Noise, Crane dropping Cage, Bobcat, Forklift Small, Forklift Dropping Cage onto berth	35dB(A)	45dB(A)	43dB(A)	41dB(A)	43dB(A)	42dB(A)
	Distance from source	**520m**	**560m**	**740m**	**730m**	**750m**	**810m**

Situation Modeled	Noise sources in the model	Reference Receiver Location					
		Top of Control Tower	**End of berth 10**	**Dwelling 5**			
Car Carrier Unloading Berth 9 (at 18m above ground)	"Rockies Highway" stack noise, Rockies Highway ship noise (cars leaving ship not modeled)			68dB(A)			
	Distance from source	**80m**	**200m**	**500m**			
Horn Noise (@ 18m above ground)	1x Ships Horn At Entrance to port	-	-	73dB(A)			
	Distance from source	**780m**	**690m**	**730m**			

The results indicate that individual noise impact from each of the situations identified above is generally within the external design noise emission guidelines summarised in Table 3 of this report for the time periods – daytime, evening and night, with the exception of the following operations:

- Berthing and operation of the car carrier ship; and
- Operation of the ship horn

The predicted exceedance above the night time criterion is approximately:

- Car carrier: 8-18 dB(A)
- Ship horn: 23-26 dB(A)

6.1.1.3 Predicted Noise Levels at Existing Receivers

Noise impact to Jupiters Casino has also been assessed for each of the modelled situations described above. The predicted noise impacts are comparable to those of

Breakwater Cove. The more significant of these impacts is the operation of the ship horn, which is predicted to be in the order of up to 70dB(A) at the northern façade of the casino at ground height and 75 dB(A) at the 6th floor.

The predicted levels of this assessment are shown in Table 11 below.

Table 11: Predicted existing port operations noise at Jupiters Casino

Situation Modelled	Activity	Predicted Receiver Level, dB(A)
Impact Berth 10	Forklift Dropping container, Truck Idling, 27 tonne Forklift Reverse beeper, Crane Dropping Container, "Sepik Coast" stack noise	Up to 55dB(A) at eastern most façade, but typically less than 45dB(A)
Loading Berth 10	Crane Moving With beeper, 27 tonne Forklift Idle, 27 tonne Forklift moving, Truck Idling, "Sepik Coast" stack noise	Up to 55dB(A) at eastern most facade, typically less than 45dB(A)
Impact Berth 9	Forklift Taking Bin, Forklift & Reverse Beeper, Crane Dropping Bin To Deck, Forklift Dropping Bin to Deck, "Union" Stack Noise	Up to 50dB(A)
Loading Berth 9	Conveyor belt moving, Conveyor Motor, "Union" stack noise, Truck, 2 off small Forklifts	Less than 45dB(A)
Car Carrier Unloading Berth 9	"Rockies Highway" stack noise, Rockies Highway ship noise (cars leaving ship not modeled)	Up to 65dB(A)
Concrete Ship Pumping Berth 4	"Alcem Calaca" Stack noise, Pump Noise, Pump Pressure Release	Less than 45dB(A)
Train Noise	2x Trains Shunting Carridges,2xLocomotives (modeled closest to Proposed development)	Up to 50dB(A)
Horn Noise	1x Ships Horn At Entrance to port	Up to 70dB(A)
Truck Movements	2x Trucks Modeled closest to development	Up to 50dB(A)
Impact & Unloading Berth 3	"Spring Bulker" Stack Noise, Crane dropping Cage, Bobcat, Forklift Small, Forklift Dropping Cage onto berth	Less than 45dB(A)
Car Carrier Unloading Berth 9 (modeled at 18 metre above ground to predict noise incident on upper levels of apartment buildings)	"Rockies Highway" stack noise, Rockies Highway ship noise (cars leaving ship not modeled)	Up to 70 dB(A)
Horn Noise (modeled at 18 metre above ground to predict noise incident on upper levels of apartment buildings)	1x Ships Horn At Entrance to port	Up to 75dB(A)

The above indicates that existing noise from the Port is likely to be lower than that experienced at the existing Casino, with the exception of car carrier and horn noise at the higher levels of the proposed Breakwater Cove apartments located nearest to the Port. This I largely because there is no shielding effect for these dwelling from the proposed Breakwater Cove acoustic barrier and their closer proximity to Berths 9 & 10.

Based on predicted noise impacts shown in Table 11, the external noise criteria shown in Table 3 is satisfied for day, evening and night time periods, with the exception of the following existing port activities:

- Ships horn: exceedance up to 20dB(A) at 2 metres above ground
- Car carrier ship: exceedance up to 15dB(A) at 2 metres above ground
- Loading and impact activities at Berth 10: exceedance up to 5dB(A) at 2 metres above ground
- Ships horn exceedance up to 25 dB(A) at 18 metres above ground
- Car carrier ship exceedance up to 18 dB(A) at 1.5m and 18 metres above ground

6.1.1.4 Recommended Mitigation Measures

With reference to Section 4.3.3 of the Noise and Vibration Impact Assessment prepared by Hyder Consulting, it is understood that future residential development within the Breakwater Cove Precinct will be required to comply with Port Protection Codes to incorporate mitigation measures (where required) to control external noise intrusion into the buildings to control noise from the TOT Precinct, the Port and other external sources.

This assessment has identified a number of existing port operations that are predicted to exceed the adopted design noise emission criteria at Breakwater Cove from the Port and are:

- Ships horn
- Operation of the car carrier ship(s)
- Some cargo loading/ unloading activities on Berth 10

The Breakwater Cove project already incorporates a 6 metre high acoustic barrier which provides shielding to most of the proposed dwellings in the precinct.

All calculations used in this port noise assessment include this barrier.

Recommended additional noise mitigation methods that should be considered include the following:

<u>Breakwater Cove Development</u>

- Acoustic design of glazing and the building envelope construction for exposed facades of the Breakwater Cove development
- Door and window orientation/ positioning in relation to sight lines to the port

Port of Townsville

Prediction calculations indicate that the mitigation measures within the Breakwater Cove Development are sufficient to mitigate the two issues of noise exceedance identified.

Notwithstanding that, it is recommended that discussions be held with the Port to determine whether it would be acceptable to further improve the situation by doing the following:

- Limiting the use of ships' horns to daytime hours wherever possible.
- Locating the car carrier ships to berths furthest to the east, eg., berths 2, 3 or 4.

These actions would have the added advantage of reducing the noise impact on existing nearby dwellings.

6.1.2 Future Port Operations

A number of "situations" have been modelled using the proprietary software – SoundPlan. The situations modelled represent our estimate of worst case future port operations, based on our survey data from 17th and 18th October 2007 and the proposed 2030 Port of Townsville Masterplan. The situations modelled were:

1. Future Berth Ship Impact Sources South
2. Future Berth Ship Impact Sources North
3. Future Berth Ship Loading South
4. Future Berth Ship Loading North
5. Future Berth Car Carrier Worst Case

The graphical computer model output for each modelled situation is presented in Appendix B of this report. The numerical values are presented in Table 12.

6.1.2.5 Predicted Noise Levels at Breakwater Cove Receivers

For the purpose of establishing "control" receiver locations, the nearest dwellings on each arm of the Breakwater Cove development were adopted as for the modelling of existing Port operations. These are numbered "Dwelling 1" to "Dwelling 4". These receiver locations also benefit from shielding from the noise wall proposed for the Townsville Ocean Terminal.

Figure 6 clearly identifies these locations and shows one option for Port expansion from the Port of Townsville Masterplan provided by the Port to assist this assessment.

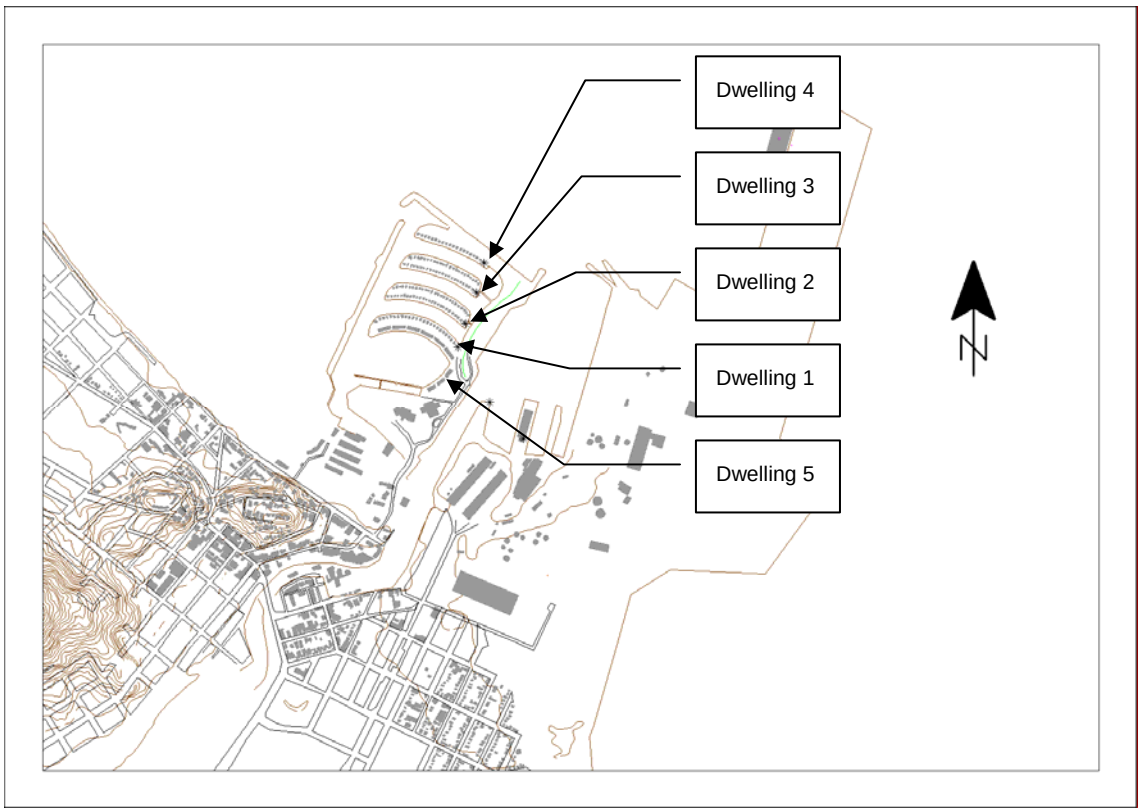


Figure 6: Modelled Future Port Expansion Scenario

Table 12 summarises the predicted noise impact from each of the modelled situations of the future port operations at the nominated receivers at Breakwater Cove.

Table 12: Summary of predicted noise levels

Situation Modeled	Noise sources in the model	Reference Receiver Location					
		Top of Control Tower	End of berth 10	Dwelling 1	Dwelling 2	Dwelling 3	Dwelling 4
Future Berth Ship Impact Sources South	Ship noise, crane unloading container, forklift unloading container, truck noise, reverse beeper	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)
Future Berth Ship Impact Sources North	Ship noise, crane unloading container, forklift unloading container, truck noise, reverse beeper	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)
Future Ship Loading South	Ship Noise, Crane Noise, Forklift Idling, Truck Idling	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)
Future Ship Loading North	Ship Noise, Crane Noise, Forklift Idling, Truck Idling	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)
Future Berth Car Carrier Worst Case	Stack Noise, Ship Noise	45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)	<45dB(A)

The results indicate that individual noise impact from each of the situations identified above is generally within the external design noise emission guidelines summarised in Table 3 of this report for the time periods – daytime, evening and night.

6.1.2.6 Predicted Future Noise Levels at Existing Receivers

A review of the noise predictions indicates that there is not likely to be any significant impact from the future Port operations on existing nearby residential receivers.

6.1.3 Future Port Construction Noise Impact

Based on the 2030 Port of Townsville Masterplan, there is likely to be some land reclamation and earthworks associated with the construction of the proposed expansion and new Berths.

The QLD Environmental Protection (Noise) Policy 1997, Environmental Protection Act 1994 and Environmental Protection Regulation 1998 do not provide assessment guidelines construction noise impacts in terms of the actual noise limits at present. The Environmental Protection Amendment Regulation (No. 2) 1999 recommends that where construction noise is audible, building works must not be undertaken:

- before 6:30am and after 6:30pm from Monday to Saturday; and
- anytime on Sundays or public holidays.

The closest Breakwater Cove residences are located approximately 1000 m from the nearest proposed future berth (as shown in the Port of Townsville Masterplan version R5). Based on typical construction noise levels of up to 115 dB(A), this indicates a typical predicted construction noise level of 47 dB(A) at the worst affected façade at Breakwater Cove.

This level is significantly less than the external daytime design background noise level for the development of 60 dB(A) and is therefore not likely to have any significant impact or be audible at Breakwater Cove.

6.2 Internal Noise Impact

Where Port noise levels impacting on Breakwater Cove are predicted to exceed the external design criteria, minimum building envelope constructions will be required to control noise inside the dwellings to acceptable noise levels. These being those recommended in AS 2107.

In order to establish appropriate design noise levels for each building, noise distribution over the site for the worst case scenario of continuous noise has been determined from Figure 18 for the car carrier at Berth 9. The use of this contour amps provides more clearly defined areas as shielding and topography have minimum effect at this height. This, however, may need to be refined during development of the Port Protection Codes and depending on whether the Port decides to adopt the mitigation measures recommended in this report.

The noise contour mapping shows 3 distinct zones within which the Port noise levels are similar. Figure 7 below shows these zones. This shows that Zone 1 will be the noisiest, as expected because of its proximity to the Port and in the case of the apartments, lack of topographical shielding.

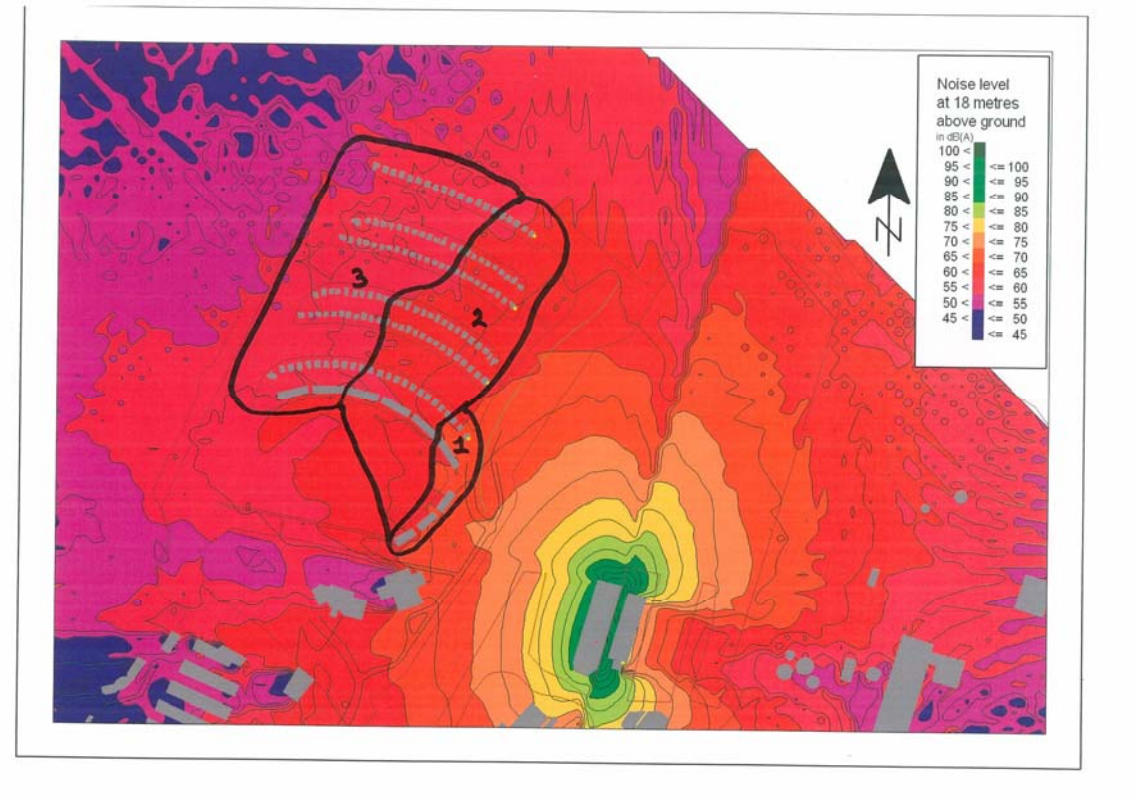


Figure 7: Site Noise Zoning Layout

6.2.1 Control of Car Carrier Noise

This assessment has established that compliance with the night-time period noise criteria (35 dB(A)) for sleeping areas at Breakwater Cove is the factor determining the minimum building envelope sound isolation performance. Analysis of the data shown in Figure 7 has established the following external immission noise levels on which the building designs should be based, representing the L_{Aeq} for the night-time period (10pm to 7 am) for each zone:

Zone 1: 70 dB(A)

Zone 2: 65 dB(A)

Zone 3: 60 dB(A)

It should be noted that due to ground level shielding and the proposed acoustic barrier noise levels externally are not likely to be this high in most locations but this external design level will ensure a high level of security that internal levels recommended in AS 2107 are likely to be achieved.

For sleeping areas, AS2107 recommendations reported above in Table 4 propose interior noise levels of between 35-40 dB(A). Using AS3671, this produces a Noise

Reduction (NR) requirement for each zone, and a noise category area as defined by the standard, as follows:

Zone 1:	NR 30-35	Category 3
Zone 2:	NR 25-30	Category 2-3
Zone 3:	NR 20-25	Category 2

The dwelling construction requirements described in AS3671 for the relevant categories are:

Category 1. Standard construction; openings, including open windows and doors may comprise up to 10% of the exposed facade. NR of approximately 10 dB(A) is expected.

Category 2. Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all glass facades. Windows, doors and other openings must be closed. NR of approximately 25 dB(A) is expected."

Category 3. Special construction chosen in accordance with Clause 3.4. Windows, doors and other openings must be closed. NR between 25 and 35 is expected."

AS 3671 goes on to recommend construction types that are likely to achieve the required NR ratings. These may be selected directly from the standard, but it will be important to ensure that alternative constructions are reviewed by a qualified acoustic consultant and certified prior to completion.

It is important to note that windows will need to be closed to comply with AS2107.

6.2.2 Control of Ship Horn Noise

The modelling indicates that horn noise is predicted to be around 5 dB(A) higher than that of the car-carrier noise at dwellings at Breakwater Cove.

In order to control noise from the ships horns to comply with the criteria adopted in section 3.2.2, A similar method to that above has been used to determine the required TNR and category construction required for each zone but using the internal noise criteria for short term noise events. Table 13 below details these requirements:

Table 13: Intermittent Noise Impact Control

Room	Location	External Design Noise Level dB(A)	Internal Criteria (AS2107) dB(A)	TNR	Required AS3671 Category Construction
Bed	Zone 1	75	50	25	2
Living		75	55	20	2
Bed	Zone 2	70	50	20	2
Living		70	55	15	2
Bed	Zone 3	65	50	15	2
Living		65	55	10	1

Based on the above, the building envelope requirements for control of car-carrier noise are likely to adequately control the sound isolation requirements for control of horn noise.

7 Conclusion

This assessment has determined the following:

- The noisiest activities measured at the Port were noise from the car carrier ship and the ships horns, which we understand are used infrequently.
- Predicted existing Port noise impact on Breakwater Cove is comparable to impact on the existing Casino accommodation for the noisiest Port activities.
- Noise impact for all existing Port activities measured with the exception of the car-carrier when located at Berth 9 or 10 and the ships horn are predicted to generally comply with the external design criteria at Breakwater Cove.
- Noise emissions from the car-carrier at Berth 9 is likely to comply with internal design criteria at Breakwater cove provided the building envelope sound ratings detailed above in section 6.2.1 are adopted.
- Predicted noise impact from future Port operations based on the 2030 Port of Townsville Masterplan is likely to be less than the noise impact from existing Port operations.
- Predicted noise impact from future Port operations are likely to comply with the external design criteria for all modelled activities.
- Predicted noise impact from future Port construction is not likely to have significant impact on Breakwater Cove.
- The following mitigation measures are recommended to control external noise impact on Breakwater Cove from existing Port operations:

<u>Breakwater Cove Development</u>

- Retain the 6 metre high acoustic barrier proposed to the east of the Breakwater Cove site.
- Acoustic design of glazing and the building envelope construction for exposed facades of the Breakwater Cove development to comply with the recommended noise reduction ratings detailed in section 6.2.1.
- Door and window orientation/ positioning in relation to sight lines to the port

<u>Port of Townsville</u>

Predictions indicate that the mitigation measures within the Breakwater Cove Development are sufficient to mitigate the two issues of noise exceedance identified.

Notwithstanding that, it is recommended that discussions be held with the Port to determine whether it would be acceptable to further improve the situation by doing the following:

- Limiting the use of ships' horns to daytime hours wherever possible.

- Locating the car carrier ships to berths furthest to the east, eg., berths 2, 3 or 4.

These actions would have the added advantage of reducing the noise impact on existing nearby dwellings.

8 References

- Ecoaccess – Environmental Licences and Permits – Planning for Noise Control, issued by the Environmental Protection Authority, dated 21 April 2005
- www.Vesseltracker.com
- Image obtained using Google Earth 2007
- Australian Standard AS2107:2000 "*Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors*"
- AS 3671:1989 – "Acoustics – Road Traffic Noise Intrusion – Building Siting and construction"
- AS 1055:1997 – "Acoustics – Description & Measurement of Environmental Noise"
- AS 1259:1990 – Acoustics – Sound Level Meters – Integrating & Non Integrating – Averaging.
- QLD Environment Protection Agency EcoAccess Guideline Planning for Noise Control
- Townsville City Plan 2005
- Townsville Port Protection Agreement
- Breakwater Island Casino Agreement Act 1984 (as amended BICA)
- Port of Townsville Masterplan Report R5, 20 August 2007
- Townsville Port Protection Codes

Appendix A

Noise Contour Maps – Existing Port

Figure 8: Predicted Noise Impact – Impact Noise Sources Berth 10

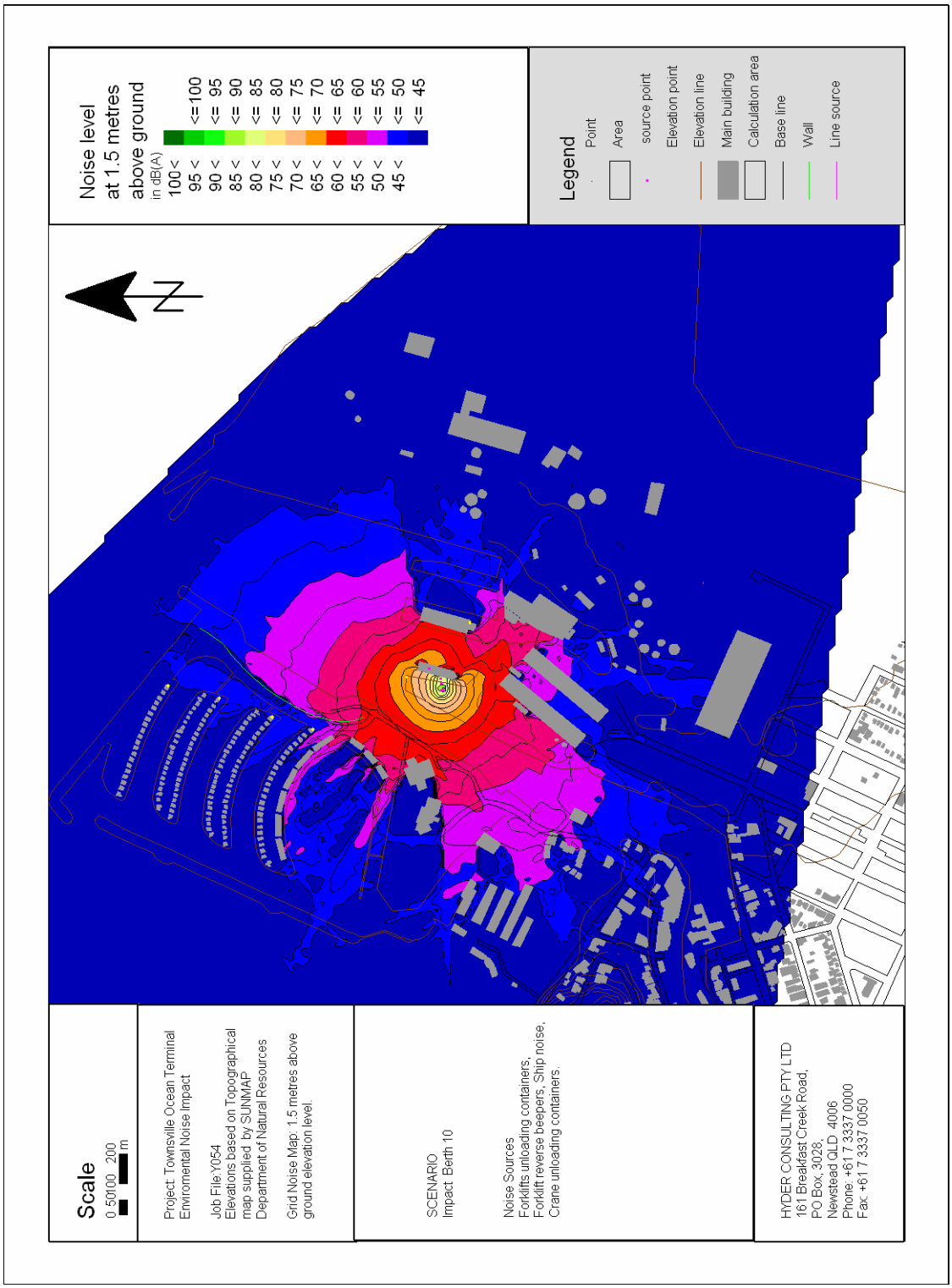


Figure 9: Predicted Noise Impact – Loading Berth 10

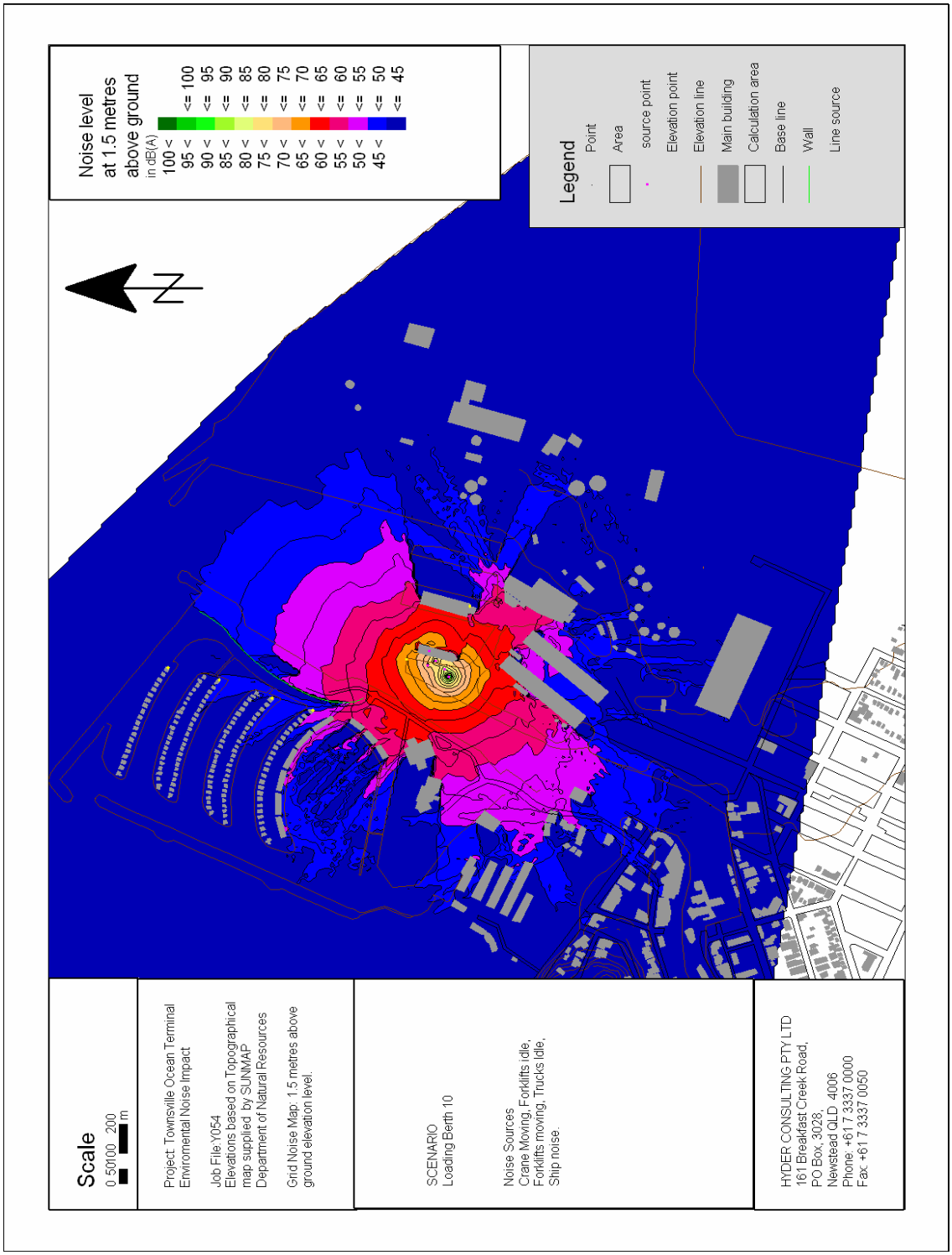


Figure 10: Predicted Noise Impact – Impact Noise Sources Berth 9

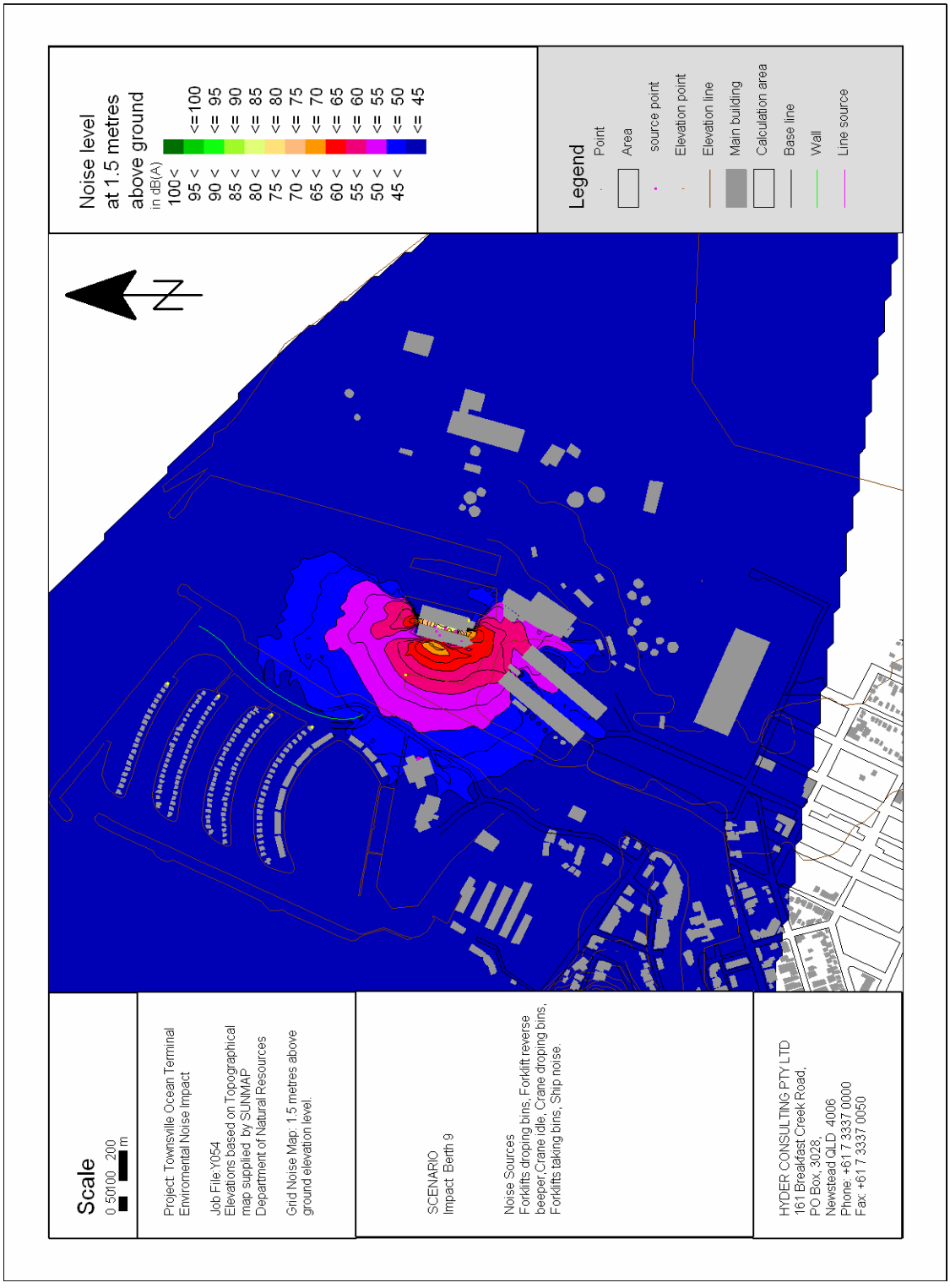


Figure 11: Predicted Noise Impact –Loading Berth 9

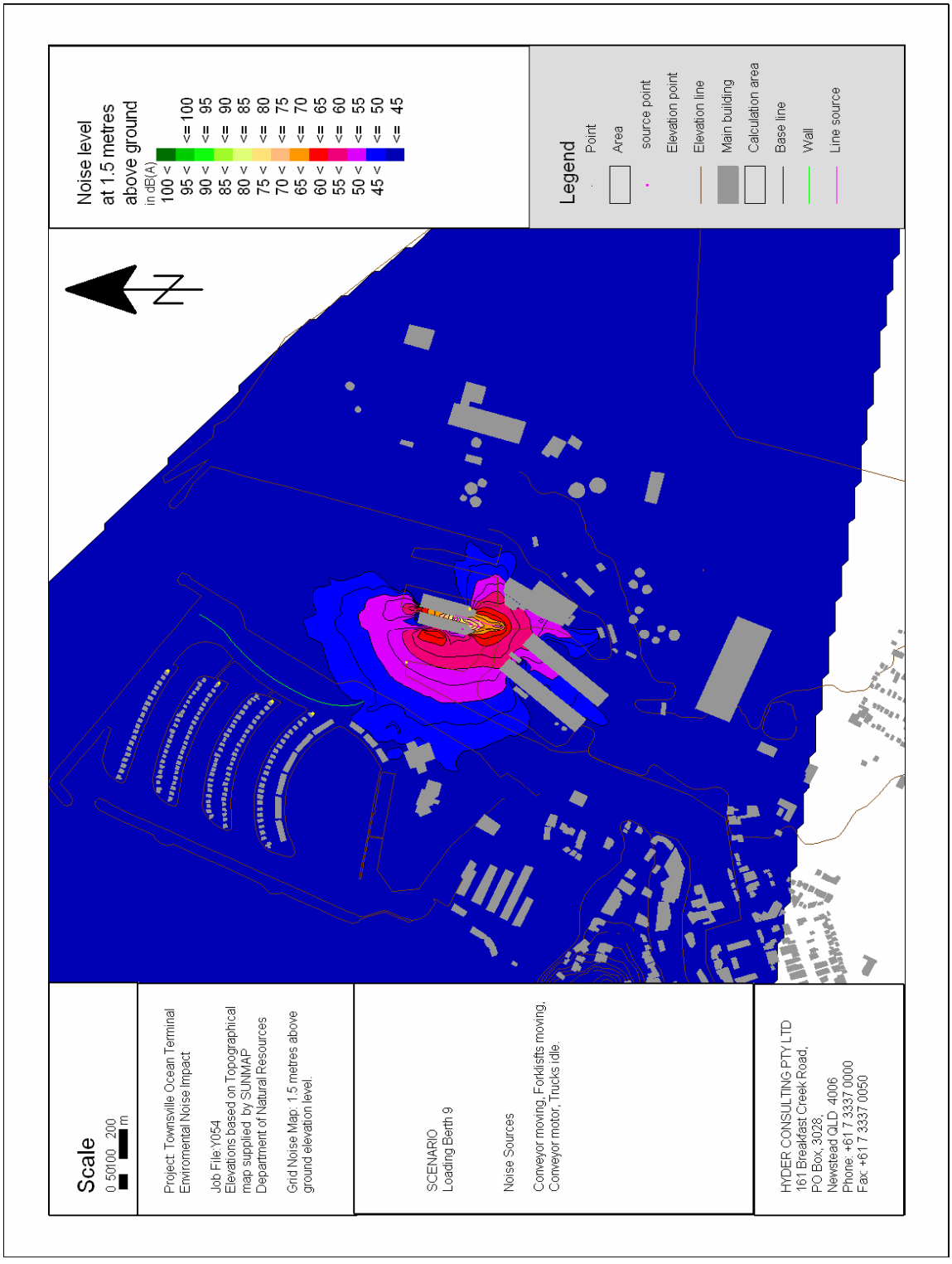


Figure 12: Predicted Noise Impact – Car Carrier Unloading Berth 9

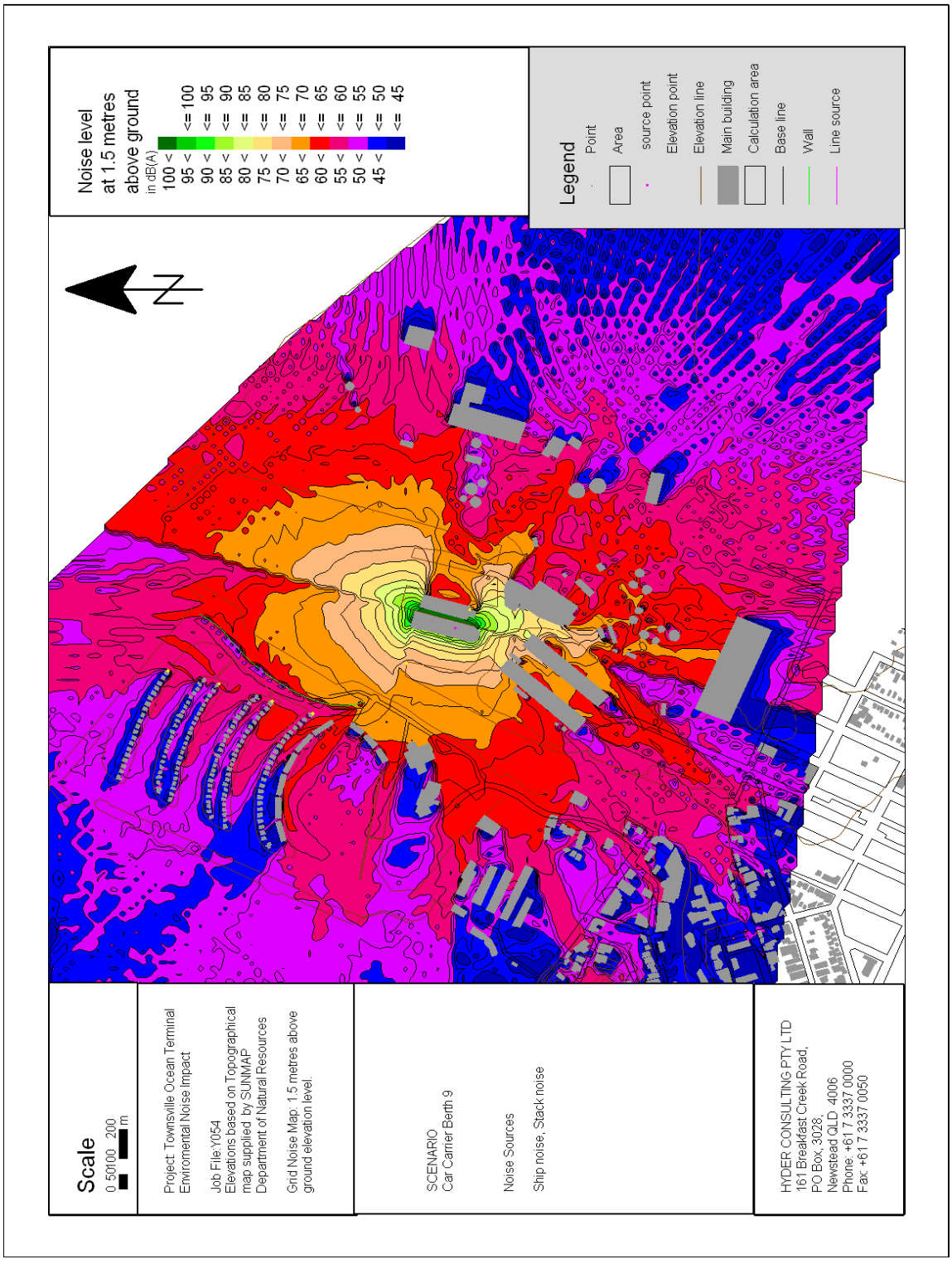


Figure 13: Predicted Noise Impact – Concrete Ship Pumping Berth 4

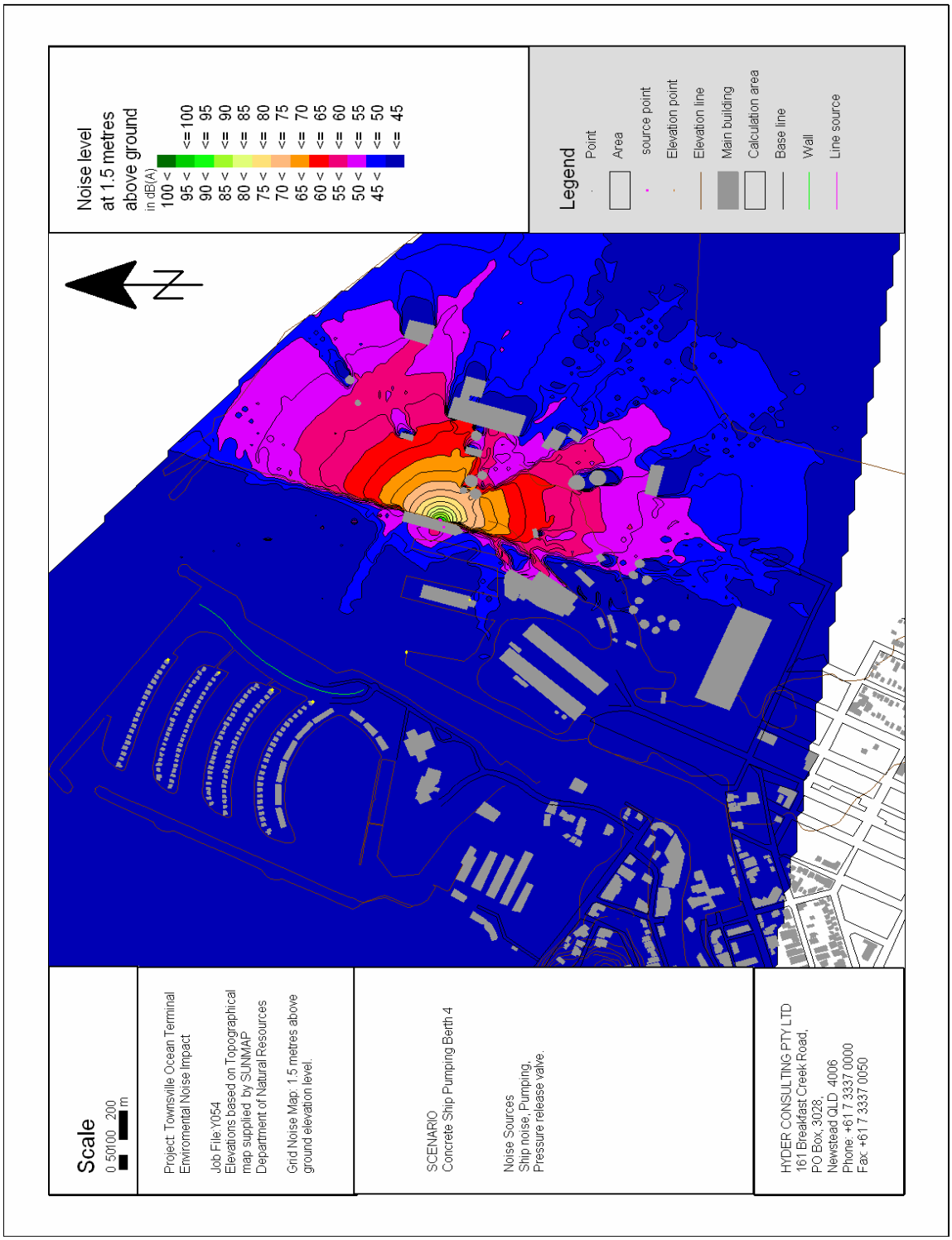


Figure 14: Predicted Noise Impact – Train Noise

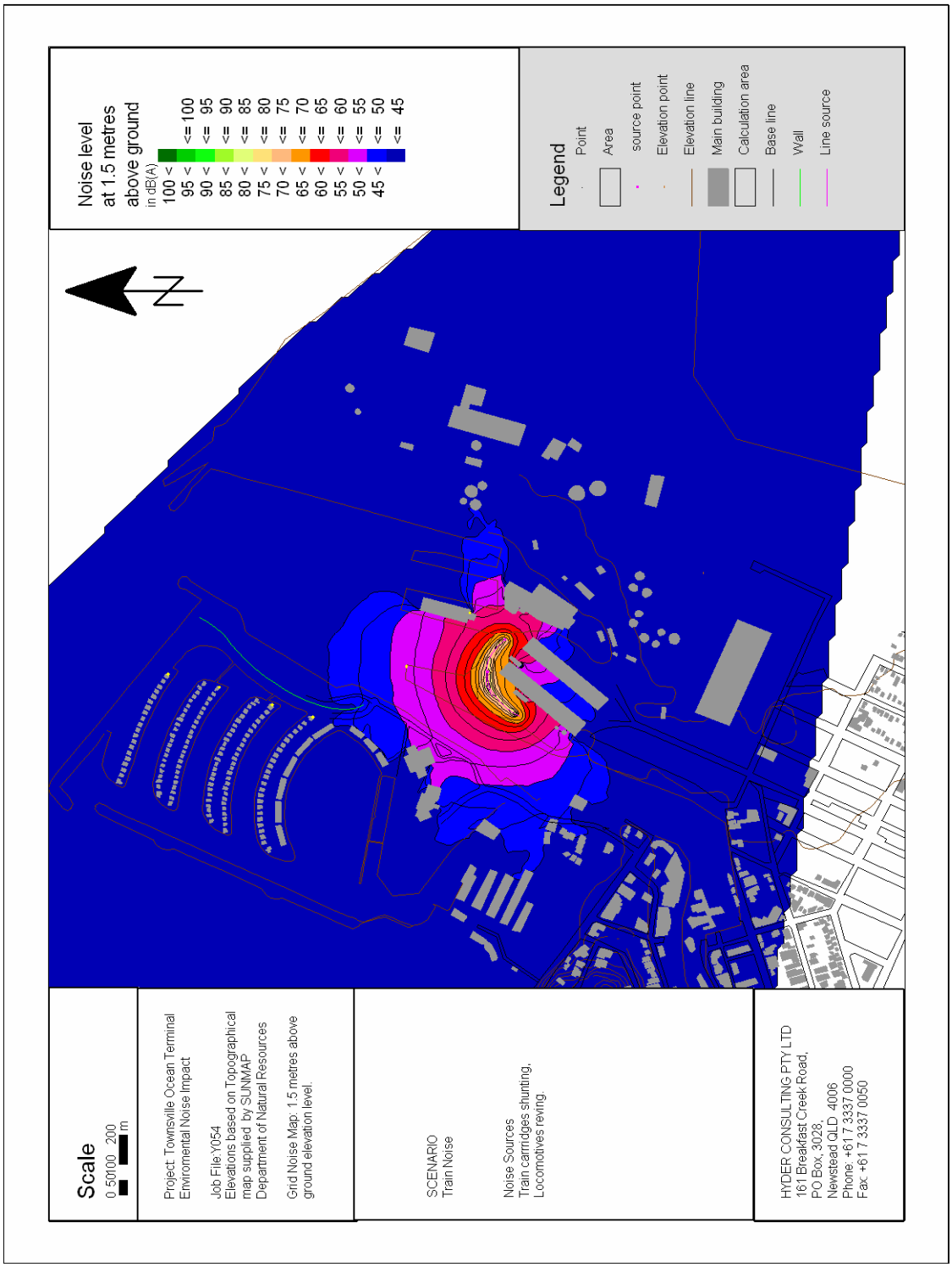


Figure 15: Predicted Noise Impact – Horn Noise

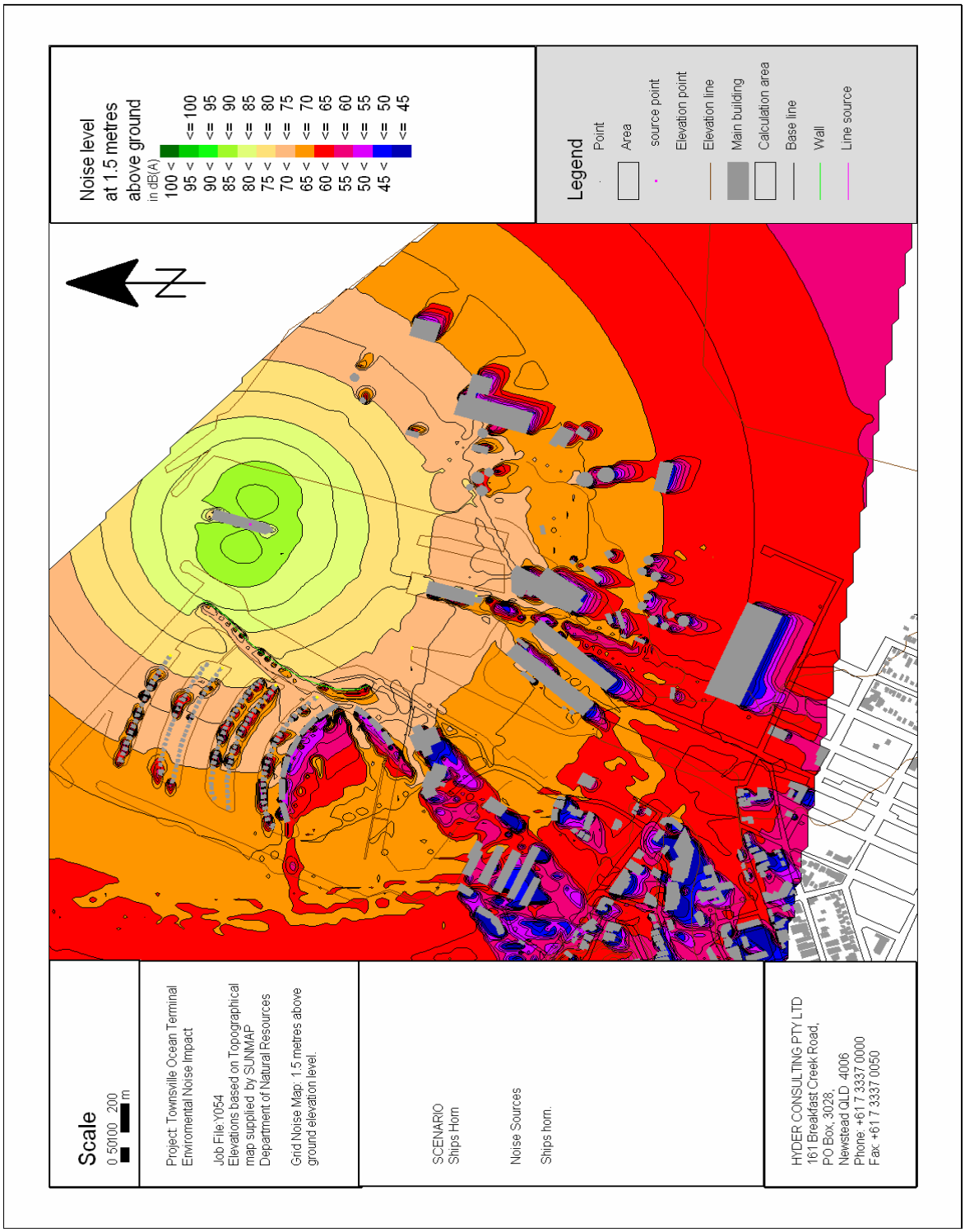


Figure 16: Predicted Noise Impact – Truck Movements

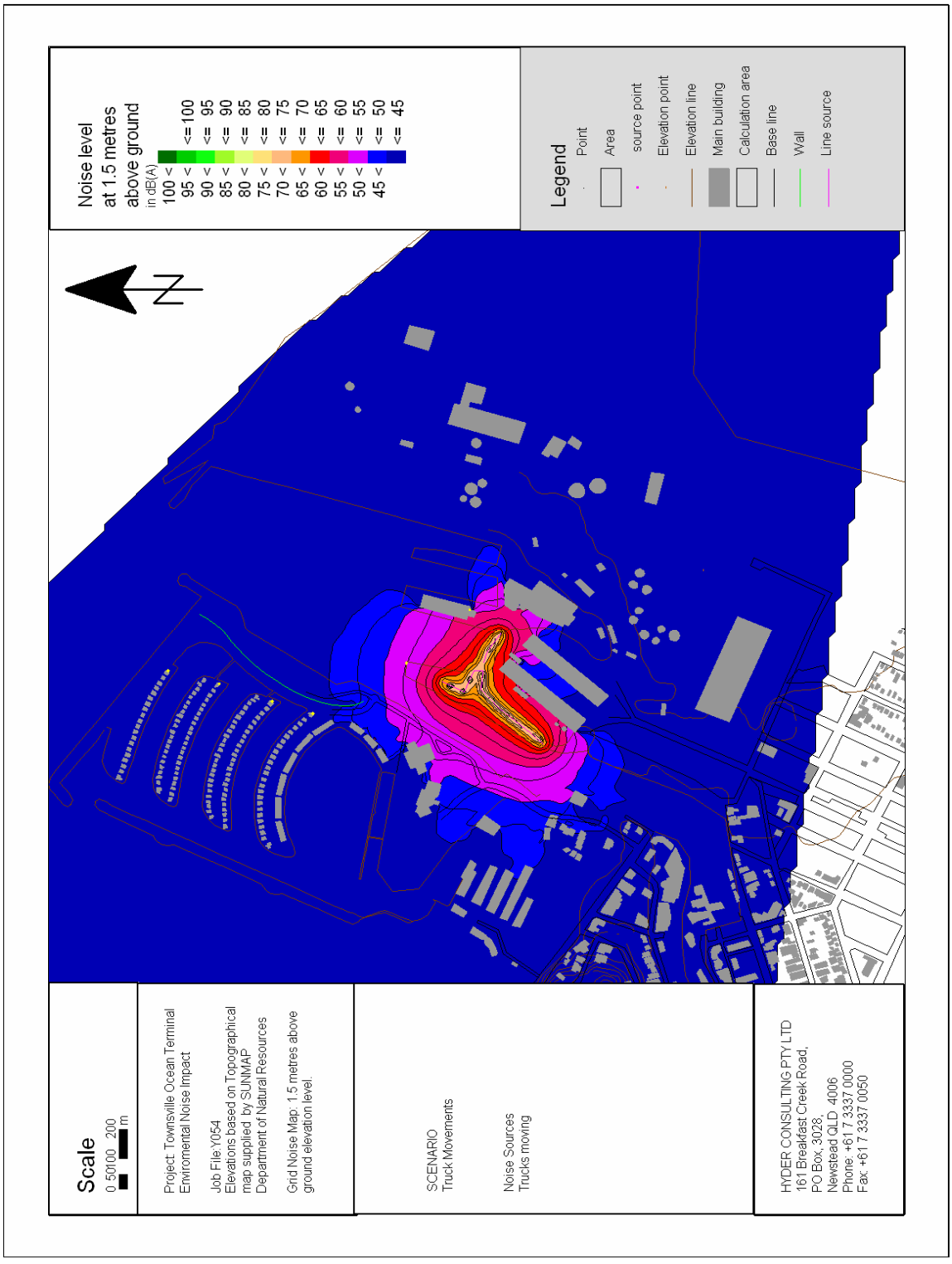


Figure 17: Predicted Noise Impact – Impact Sources & Unloading Berth 3

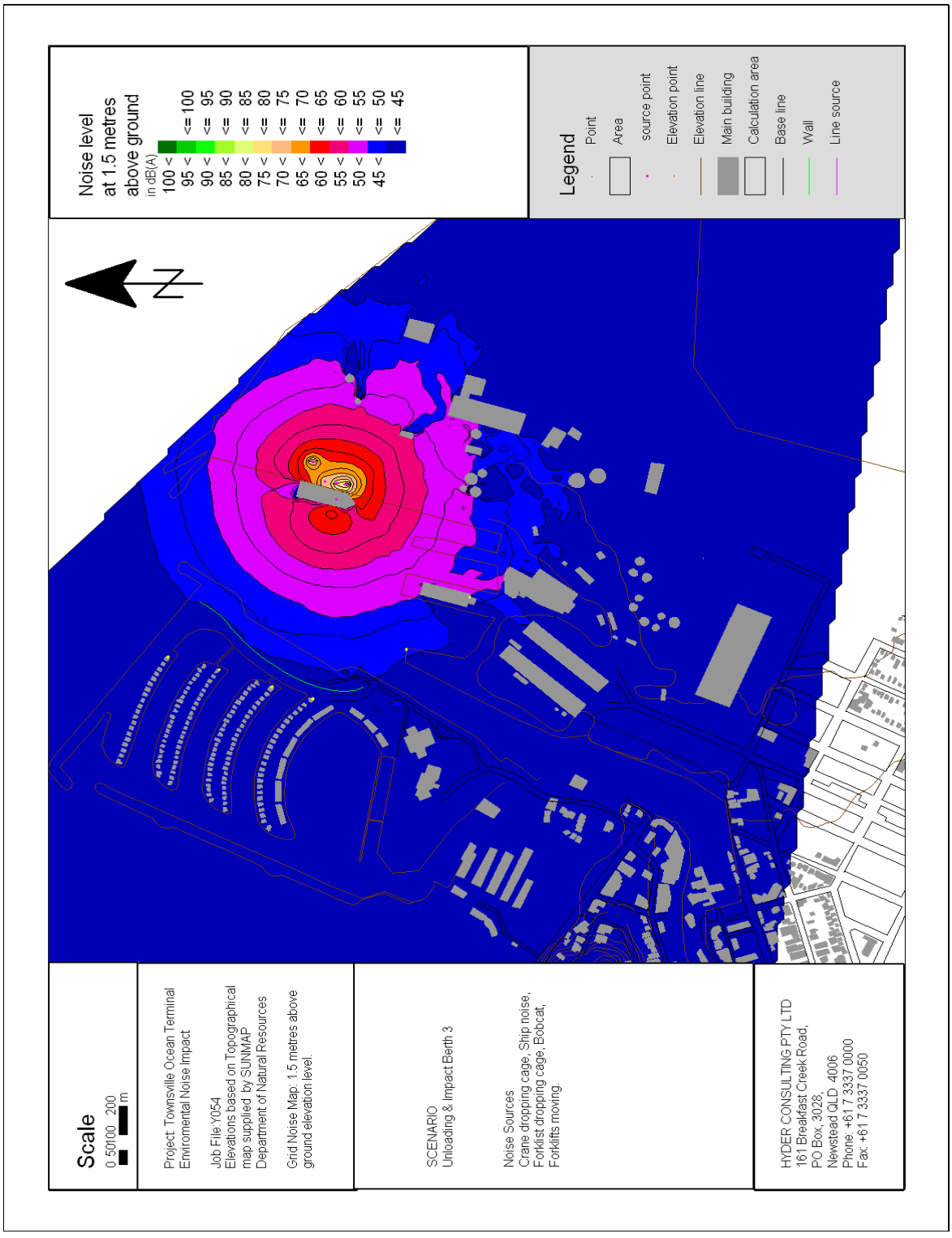


Figure 18: Predicted Noise Impact – Car Carrier Unloading Berth 9 at 18m above ground

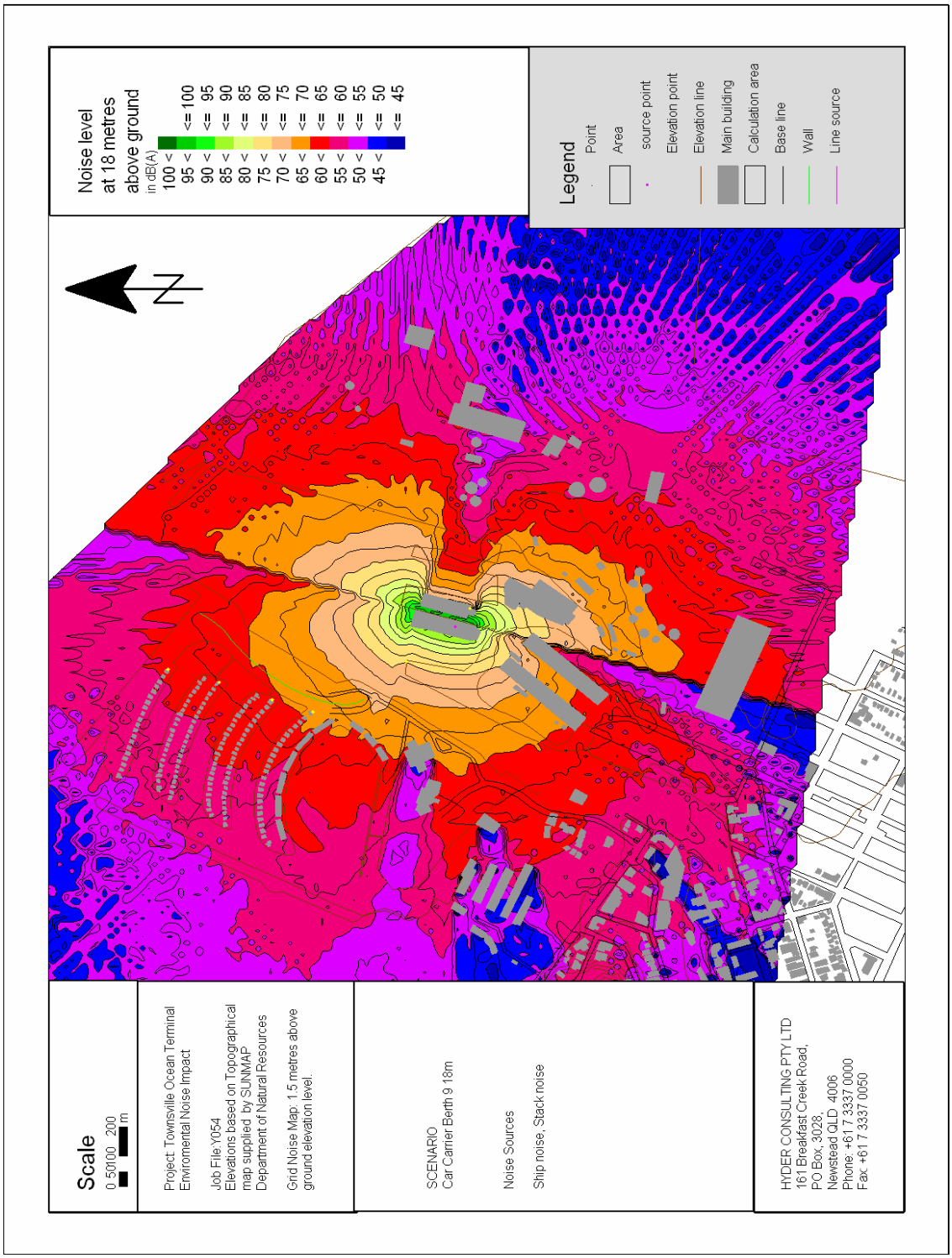
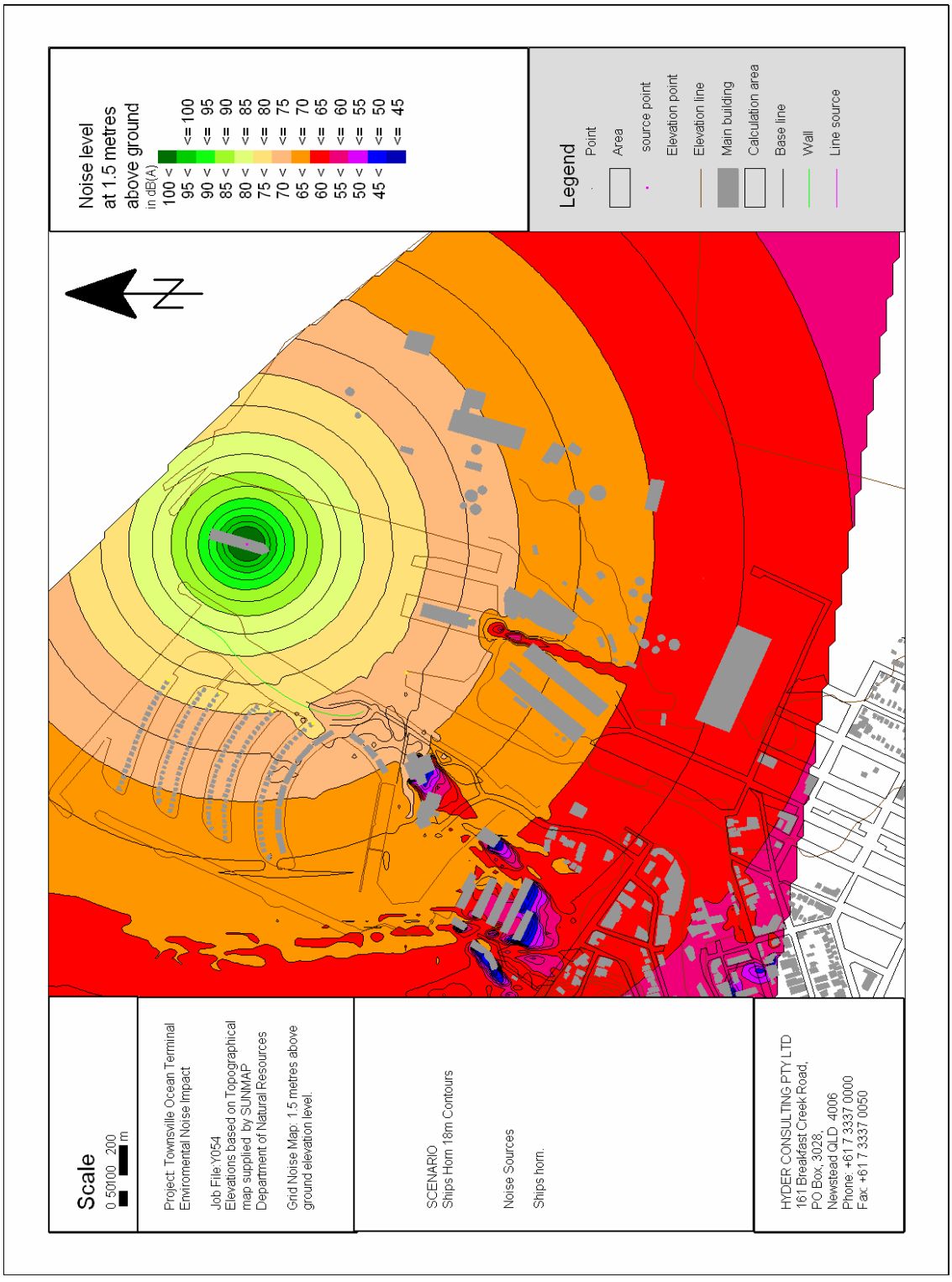


Figure 19: Predicted Noise Impact – Horn Noise at 18m above ground



Appendix B

Noise Contour Maps – Future Port

Figure 20: Predicted Noise Impact – Future Berth Ship Impact Sources South

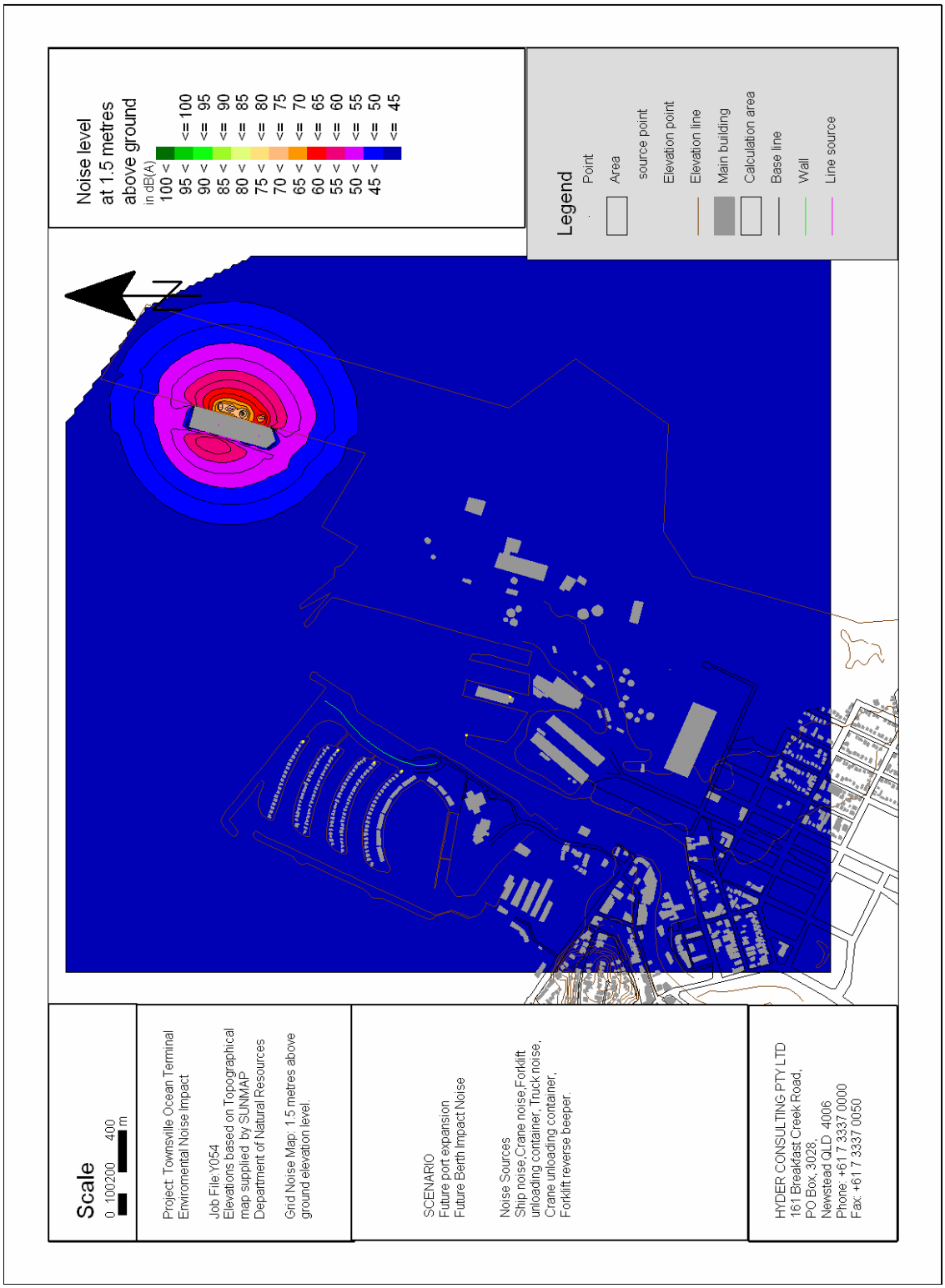


Figure 21: Predicted Noise Impact – Future Berth Ship Impact Sources North

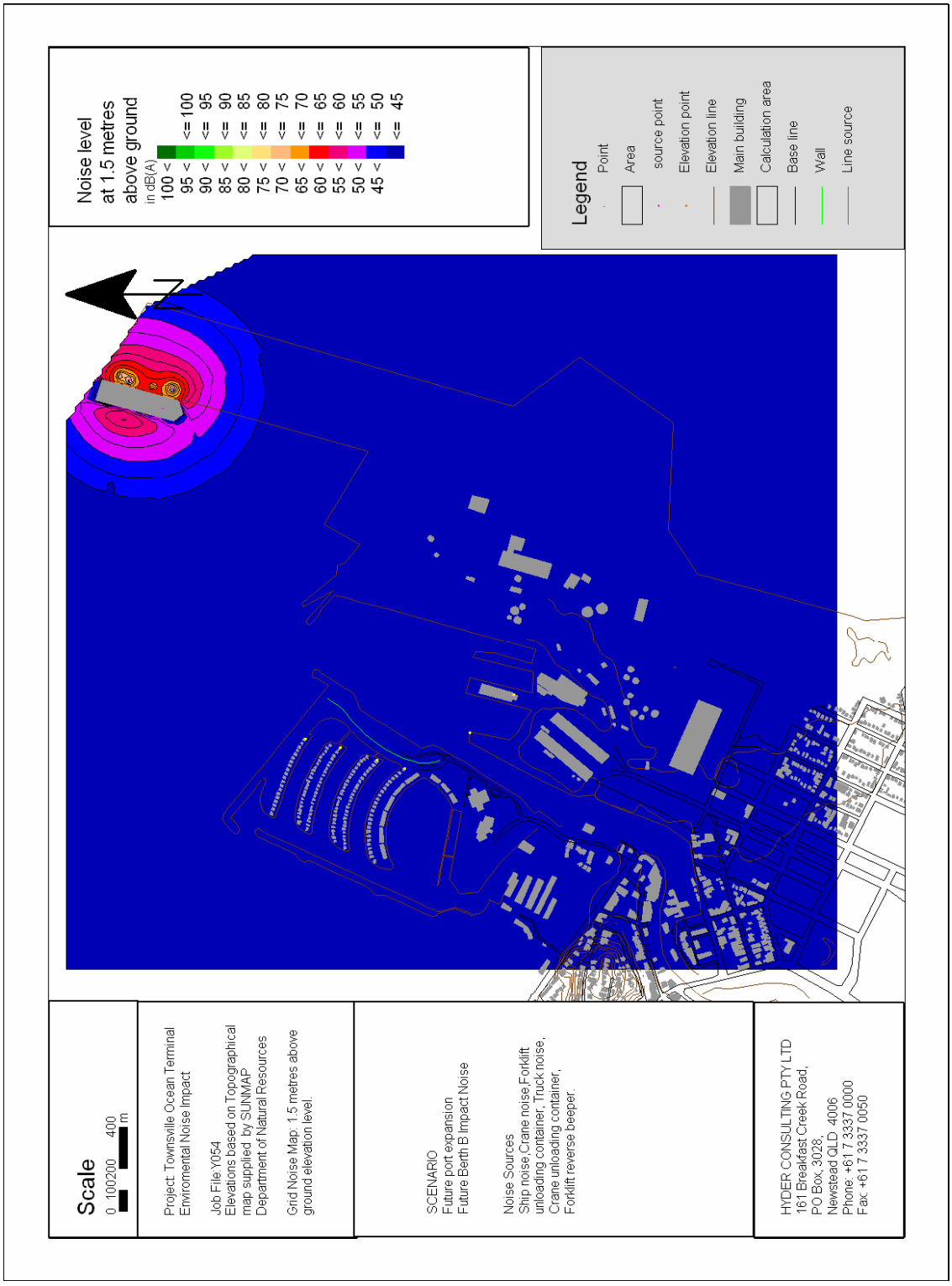


Figure 22: Predicted Noise Impact – Future Berth Ship Loading South

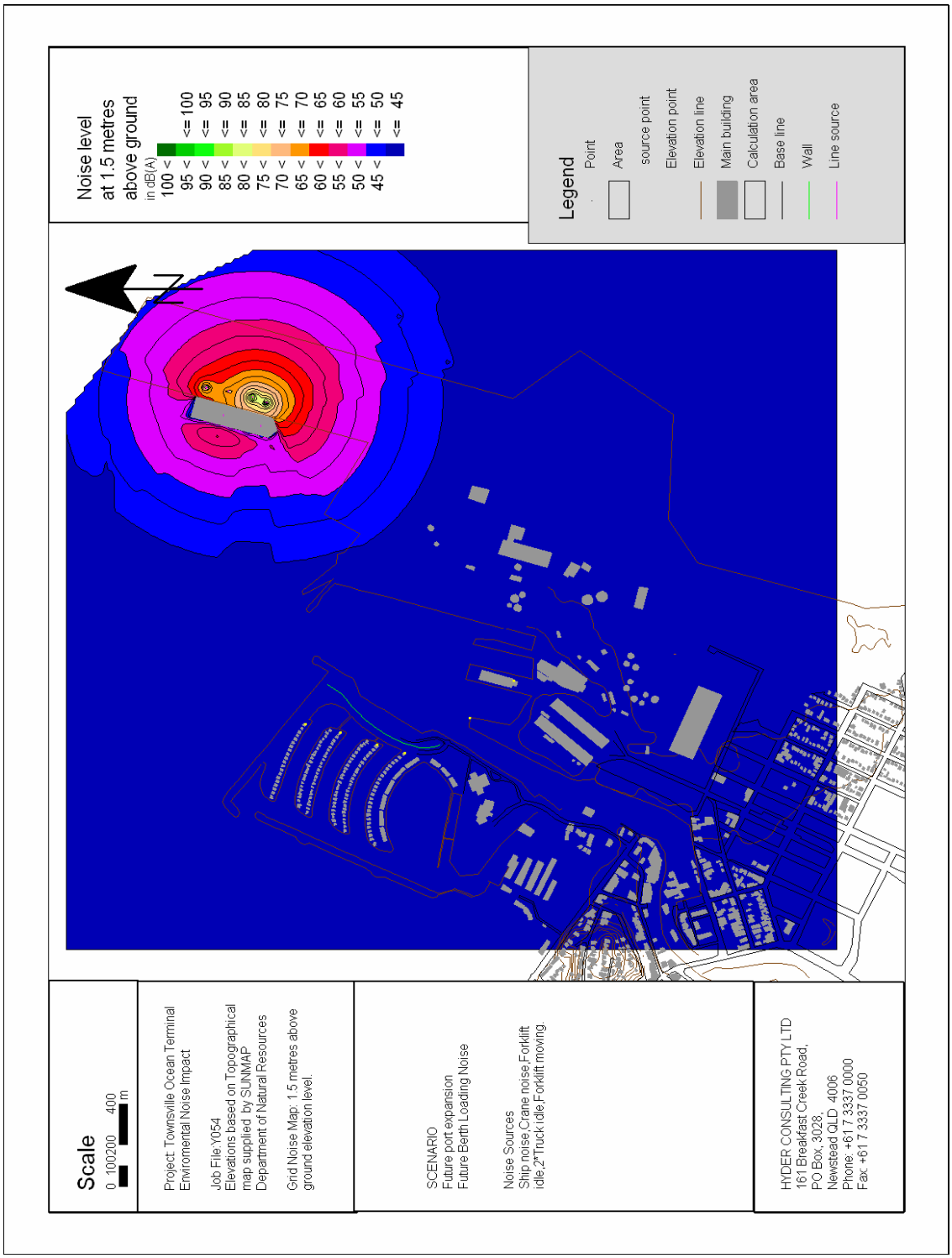


Figure 23: Predicted Noise Impact – Future Berth Ship Loading North

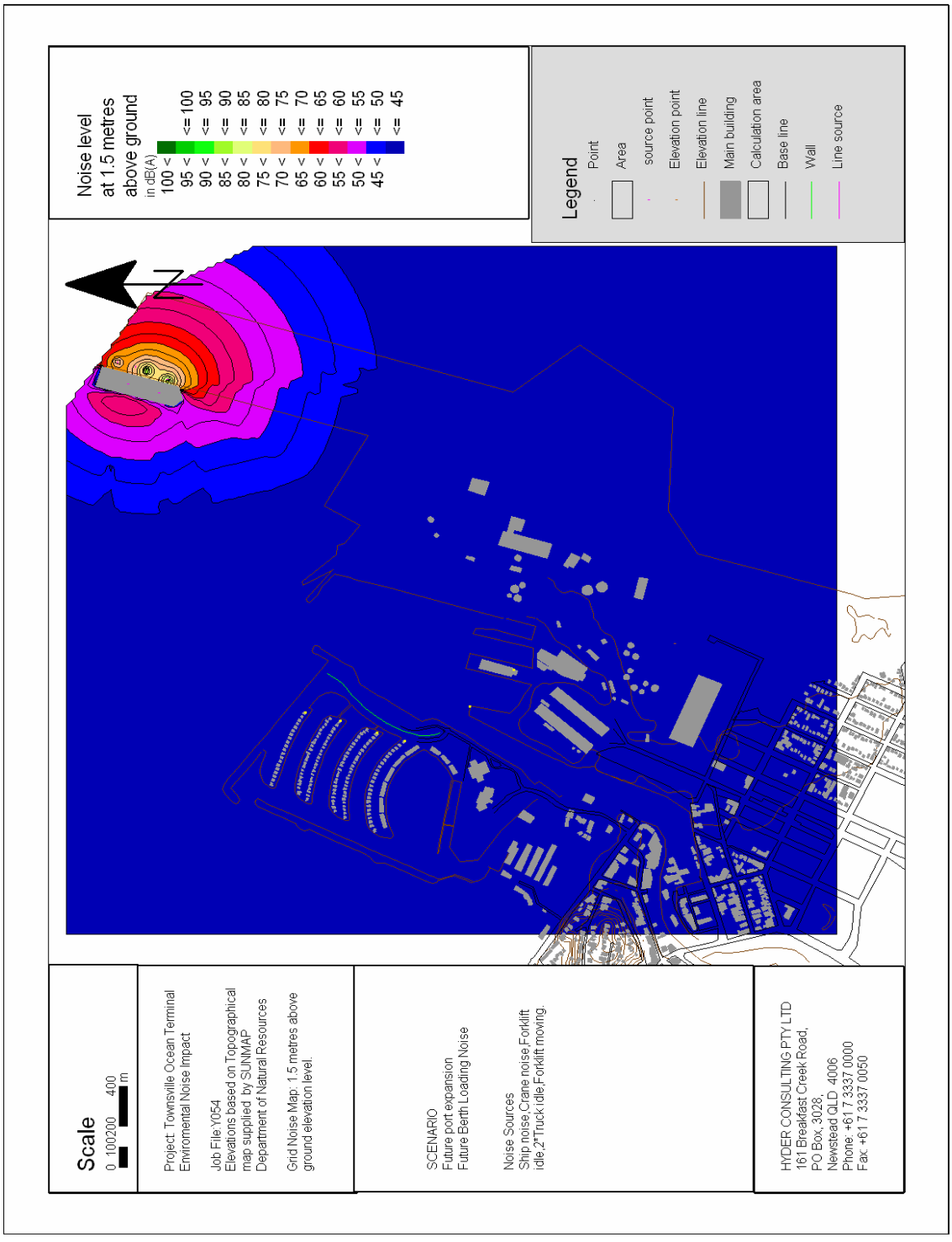
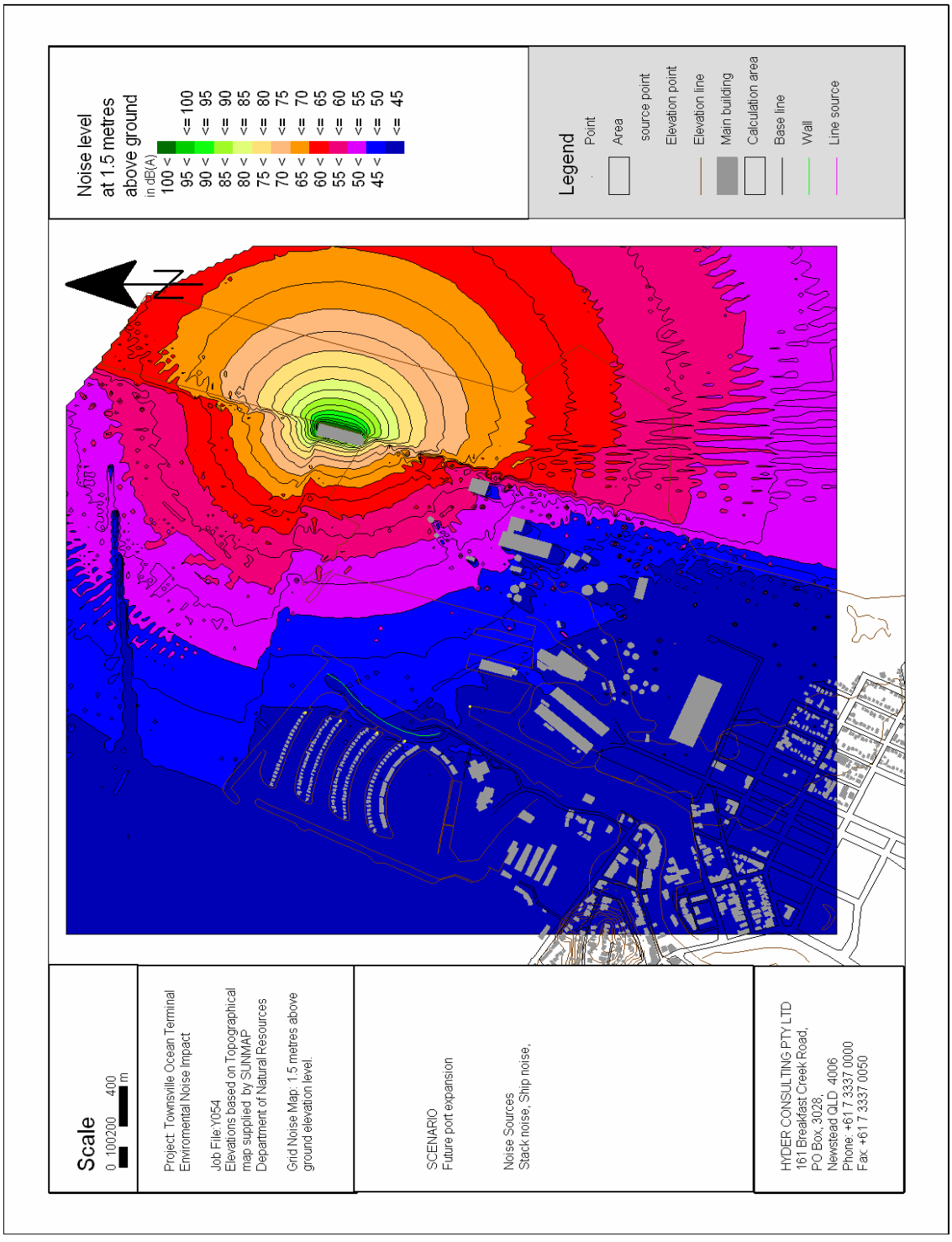


Figure 24: Predicted Noise Impact – Future Berth Car Carrier Worst Case



Appendix C

Glossary of Terms

Appendix C – Technical Terms

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, ie L_{90} is the level which is exceeded for 90 percent 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. 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.

Noise Rating Number:
A single number ascribed to a prescribed set of measured octave band sound pressure levels, usually of either plant noise or of the background sound level. The number ascribed is the greatest of the set of octave band noise rating numbers (*q.v*) calculated from the measured set of octave band sound pressure levels.

Noise Reduction:
The difference in sound pressure level between any two areas. The term 'noise reduction' does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply.

Sound Isolation:
A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term 'sound isolation' does not specify any grade or performance quality and requires the units to be specified for any contractual condition.

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.

Speech Intelligibility:
The percentage of meaningful speech material spoken by a talker or talkers that is correctly interpreted by a listener or listeners. One unit used to measure speech intelligibility is the Articulation Index.

Speech Privacy:
A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. Methods of assessment of speech privacy are described in AS2822, in which normal privacy is identified as a condition with an articulation index of less than 0.1, and confidential privacy as a condition with an articulation index of less than 0.05. In these conditions the percentage of mono-syllabic words understood by a listener would be about 10 percent and 5 percent respectively. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.

STC Rating:
Refers to Sound Transmission Class, which is an American based single number system of representing sound transmission loss of building elements. STC ratings will not be used as a performance specification basis for this project. Instead, refer to the definition of Weighted Sound Reduction Index, Rw.

Transmission Loss:
Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in some countries. A formal test rating of sound transmission properties of any construction, but usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. International, British and Australian Standards apply to test methods for both situations.

Weighted Sound Reduction Index, Rw:
A single number value used to compare the sound reduction index for building elements. Rw and STC are not identical though may be considered, for most applications, as interchangeable. High Rw values means high sound reduction. Rw is not a recommended basis for selecting or specifying facade glazing but does work well for partitions, etc inside buildings.

Rw refers to the weighted sound reduction index determined from laboratory measurements of sound transmission loss of a building element. R'w refers to the weighted sound reduction index determined from field measurement of sound transmission loss of building elements, according to AS1276, and is similar to Field STC Rating.

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