PORT AUTHORITY
OF NEW SOUTH WALES

GLEBE ISLAND & WHITE BAY

PORT NOISE POLICY

(DRAFT)

Contents

1 Introduction

1.1 Why this policy is needed

The ports in New South Wales are critical pieces of infrastructure essential for the transportation of goods and passengers. The port of Glebe Island and White Bay is a transportation hub that:

- enables efficient delivery of bulk construction materials
- accommodates the second cruise terminal in Sydney Harbour

To meet expected future demand for bulk construction materials in NSW, there is a need for new port developments and an increase in shipping numbers at Glebe Island and White Bay. Unless properly managed, this has the potential to increase noise levels and community exposure to noise over time. To improve noise management there is a need to transition noise management to a consistent approach that is simpler and fairer.

Individual port users currently monitor and evaluate noise under different environmental requirements and planning approvals. This leads to inconsistent reporting, noise limits and regulation between operators, inconsistency and uncertainty in the planning approval process for new port infrastructure, and a lack of clarity for local residents and the community.

Port Authority of New South Wales (Port Authority) has considered previous community feedback about port noise and has worked in consultation with the Environment Protection Authority (EPA) to develop the new Port Noise Policy. Given the location of the port to surrounding residential development some impacts will be inevitable. The purpose of this policy is to reduce impacts to the greatest extent practicable whilst allowing the ongoing operation of the port facility.

Port Authority is committed to proactively managing port noise in a way that is acceptable to residents and the local community while recognising Glebe Island and White Bay's ongoing, long-term status as a working port.

1.2 Benefits

By implementing this policy, Port Authority aims to achieve the following benefits for residents and stakeholders:

- improved and consistent management of noise from the port
- certainty for residents, industry, regulators and approval authorities about anticipated and acceptable levels of noise collectively from vessel and landside port activities
- establishment of a long term commitment to reduce vessel noise and community exposure
- enhanced communication about typical port noise emissions to the community and stakeholder through the production of noise maps.

This policy is the first of its kind in Australia. It sets noise triggers for an individual vessel in the context of overall community exposure to noise from Glebe Island and White Bay. There are currently no international or national design criteria that control noise emissions from a vessel to limit impacts on the community. Before this policy, the only noise criteria specific to vessels have been international requirements for on-board safety and crew comfort.

1.3 Policy objectives

Through changing context and interpretation, port noise management and requirements have become inconsistent for both landside activities and vessels, with different operators working towards different goals. This is because NSW industrial noise guidelines and regulations are relatively recent in the context of the construction and historic use of the port and berths.

Since the existing noise guidelines were introduced, noise assessments were carried out on an individual development basis for each port activity without considering the port's overall noise emissions. While the guidelines did have a cumulative assessment approach, it was not well suited to an active and dynamic port environment where vessel berthing activities resulted in transient background noise levels and impacts. Noise assessments have also contained inconsistencies as to whether vessel noise has been included or excluded as a source of industrial noise.

Compliance with noise limits set under the existing guidelines has generally been problematic given they use industrial noise criteria that were not specifically based on vessel noise, and that planning and construction of White Bay and Glebe Island predates the guidelines.

In light of the above, the Port Noise Policy aims for a best practice approach to port noise management. The policy's objectives are to:

- manage port noise as a whole precinct rather than as individual operators
- define and clarify a consistent approach to port noise management that has appropriate mechanisms to facilitate long term noise reduction of vessels
- improve and simplify management of landside port noise
- concisely communicate overall port noise managed under this policy through the use of noise mapping.

1.4 Key policy commitments

The Port Noise Policy, along with its guidelines, procedures and operating protocols, aims to achieve the above objectives through the following overarching commitments:

- proactive management of noise emissions from the port, by Port Authority and its tenants
- requirements for each individual ship visiting the berths of Glebe Island and White Bay to meet noise limits, and agreed consequences if these limits are exceeded
- fair and reasonable allocation of industrial noise criteria for landside activities, with consequences if the precinct criteria are exceeded
- certainty for the community, industry, regulators and approval authorities about the level of noise from collective port activities
- noise mapping of port activities to guide future noise assessments and planning controls for proposed new developments encroaching on the port in the areas surrounding Glebe Island and White Bay
- goals for long term noise reduction of vessel noise while recognising the continued long-term role of Glebe Island and White Bay as a transportation hub.

The Port Noise Policy's operating protocols, guidelines and procedures will be implemented to assist Port Authority in meeting these commitments. If their application may lead to an outcome in specific situations where commitments may not be achieved, Port Authority commits to always striving to achieve the policy objectives. This includes the use of other options to meet these overarching commitments, such as proposing amendments to the policy's operating protocols, guidelines and procedures.

1.5 Policy statement

Port Authority is committed to managing impacts from the port effectively and sustainably. To achieve this commitment, Port Authority has developed this port specific noise policy which collectively assesses and manages noise from:

- landside activities as a whole across the port on a precinct basis
- vessels on an individual and per berth basis.

By developing this Port Noise Policy, Port Authority intends to better manage noise emissions in a strategic way that provides more certainty to residents and the broader local community while also maximising the utilisation of the port within these noise limits. Ongoing utilisation is supported by *Sydney Regional Environmental Plan No 26 – City West* which recognises the need for ongoing 24-hour port operations and that these operations may generate noise and traffic movement.

Port Authority's corporate commitments and principles for managing noise from the activities at Glebe Island and White Bay are outlined in our operating protocols, developed under our guidelines and procedures (see

Table 1 in Section 3 of this policy for further detail).

These documents ensure that these port activities meet the requirements of the *Protection of the Environment Operations Act 1997* and the *Environmental Planning and Assessment Act 1979*, both aimed at protecting community amenity while allowing for critical port development.

There are three ways in which Port Authority influences port noise:

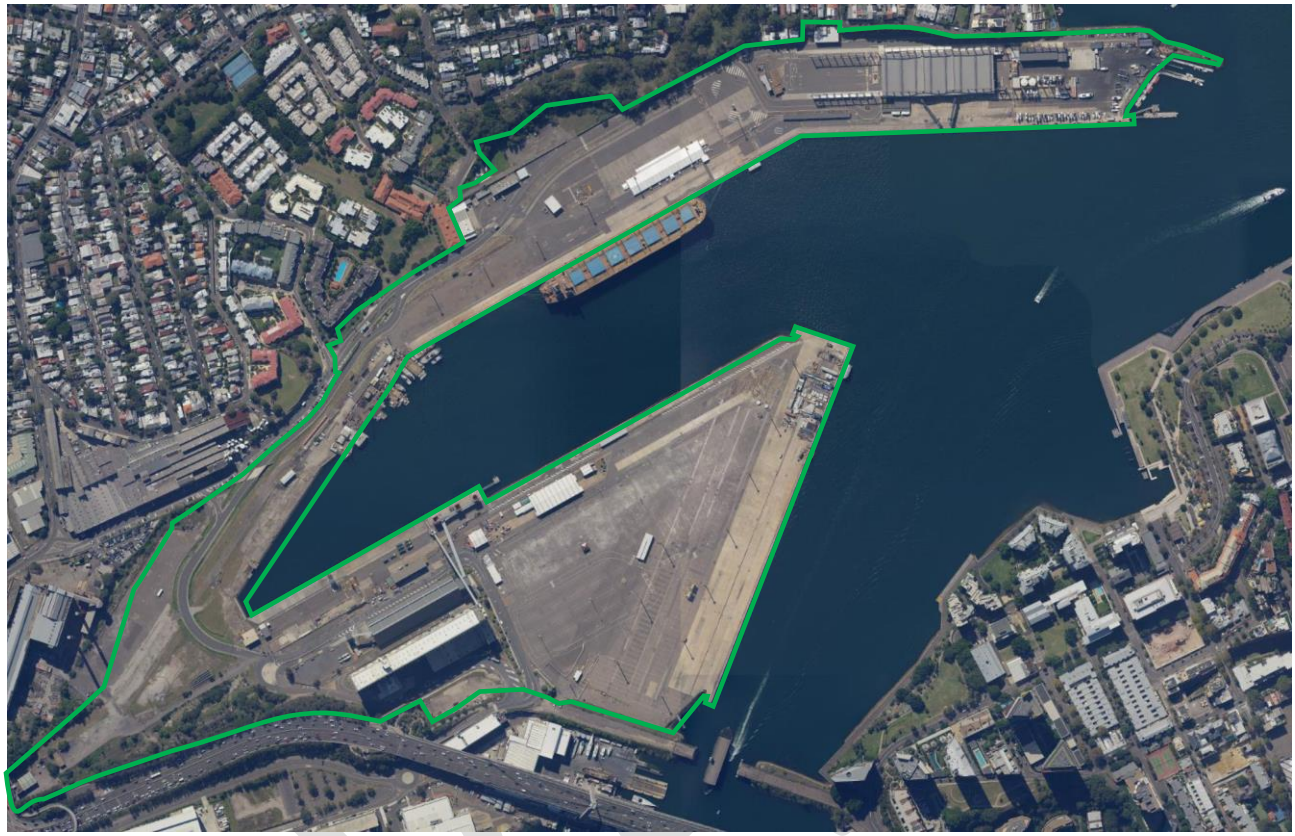
- development and operation of Port Authority's landside port infrastructure
- monitoring of its tenants' development and operation of port infrastructure
- management of noise from vessels berthed at Glebe Island or White Bay.

Effective management of port noise requires the combined effort of Port Authority, its tenants, regulatory and planning authorities and the vessel operators.

2 Policy scope

This Port Noise Policy aims to address port noise originating from port activities at Glebe Island and White Bay.

Figure 1: Spatial boundary of White Bay and Glebe Island



Source: SixMaps

Noise from port activities can fall within two broad categories:

- landside activities, typically including noise from the processing of cargo and warehousing operations
- vessels at berth, typically including noise from on-board generators, fans and cargo unloading systems (self-extraction using on-board equipment).

Environmental criteria for noise are generally applied to developments on port land through planning and environmental approvals. Any noise mitigation that is required is generally applied to noise at its origin and generally relates to achieving external noise levels.

This Port Noise Policy aims to set the environmental criteria for:

- existing tenants' future activities
- new port developments and operations
- vessels utilising the existing berths (existing tenants' operations) at Glebe Island and White Bay.

The environmental criteria specified in this policy are intended to be incorporated by approval authorities in planning approvals and environmental protection licences.

In addition, this policy identifies port noise levels and criteria which may be used as guidance in setting planning controls for new encroaching developments (commercial and residential) being constructed in areas near to the port. These planning controls will not include mitigation of noise at its origin as this is already being applied through this Port Noise Policy and other mechanisms. These planning controls may introduce criteria related to internal noise levels for these developments and focus on building design to reduce noise intrusion and land use conflicts. If adopted, this approach would be consistent with existing

provisions in the *State Environmental Planning Policy (Infrastructure)* 2007 (ISEPP) for developments proposed near busy roads and rail lines.

The Port Noise Policy is most relevant to the following stakeholders:

- Port Authority
- community
- port users (tenants and vessel operators)
- developers of commercial and residential land surrounding the port
- acoustical consultants
- regulators and approval authorities.

The associated guidelines, procedures and operating protocols are targeted to be used by Port Authority, port users and developers.

This Port Noise Policy seeks to manage the noise from port operations. Construction activities carried out at Glebe Island and White Bay, including the noise associated with the use of barges, are not subject to this Policy where they are governed by an existing and comprehensive construction noise assessment and approval framework. This is to avoid duplication and the creation of inconsistency in noise management of construction activities in the port.

The management of noise from cruise ships and the passenger activities at the White Bay Cruise Terminal and White Bay berth 4 is governed by the Port Authority's Noise Mitigation Strategy which predates this policy. While the White Bay Cruise Terminal Noise Mitigation Strategy was implemented before the development of this policy, it is generally consistent with the commitments in this policy.

3 Policy overview

This policy is structured so that the main text provides an overview of how noise is managed including key outcomes. How the outcomes are derived and applied are detailed in the associated guidelines, protocols, standards and noise maps.

Table 1: Port Noise Policy components for Glebe Island and White Bay

Document	Purpose	Key points
Port Noise Policy (this document)	Outlines overarching principles relating to noise from vessels and, for landside activities, managing a noise precinct. This includes the context for noise assessments for new port users and surrounding residential and commercial development.	Outlines why the policy was developed. Provides a summary of noise criteria for vessels and landside activities by following the appendices. Summary of how port noise will be managed.
Vessel Noise Guideline (Appendix F)	Outlines the approach to assessing and managing noise from vessels, including preparing noise maps of current and projected future noise levels.	Describes the process to set target noise levels for vessels and the steps for completing a vessel noise assessment.
Landside Precinct Noise Guideline (Appendix G)	Details the process of assessing noise from landside activities, setting user contribution criteria, monitoring compliance and identifying noise mitigation actions.	Shows how to set noise criteria for landside activities and how to complete a landside noise assessment.
Vessel Noise Operating Protocol (published online)	Details operating protocols applicable to each berth to manage vessels which exceed prescribed noise levels and includes specific actions to manage exceedances.	Defines the steps to be taken if a vessel is noisier than the trigger level.
Noise Standard (Appendix H)	Documents the allocation of contributions by individual port users to the whole-of-precinct noise criteria for landside activities, and defines the trigger noise level for vessels at berth.	Lists the vessel trigger levels and landside criteria for every berth and operator at the port.
Noise Maps (Appendix I)	Graphically outlines the port noise emission profile of Glebe Island and White Bay for landside and vessel noise and may be used to inform land use planning for new developments encroaching on the port and illustrate the expected noise environment surrounding the port.	Contains noise maps for all noise from the port. The vessel noise maps compare how annual noise levels vary around the port and over different years. The tables show the noise levels from each ship while it is at the berth. Additional maps show noise levels from landside activities and total worst-case noise levels for ships plus landside noise.

3.1 Policy development

The following factors and documents were considered in developing this policy and the development of assessment criteria/trigger noise levels:

- planning and construction of White Bay and Glebe Island berths and other port infrastructure pre-dates any environmental noise legislation and guidelines
- the close proximity of the port to residential areas
- differences between the way that ports and industrial sites operate
- assessment criteria for other forms of transport (road, rail and aircraft)

- Environment Protection Licences for each of the premises for shipping in bulk licensed by the Environment Protection Authority in Glebe Island and White Bay
- NSW Environment Protection Authority (EPA) Noise Policy for Industry 2017
- NSW State Environmental Planning Policy (Infrastructure) 2007
- Sydney Regional Environmental Plan No 26 – City West
- New Zealand Standard 6809:1999, Acoustics – Port Noise Management and Land Use Planning

The application of existing NSW noise policy to a port holds some unique challenges as there are significant differences between a port and an industrial site, which are described in Table 2 below. It is primarily for these reasons that this policy has been developed.

Table 2: Port operations versus industrial operations

Port site	Industrial site
Ports are a unique piece of infrastructure that cannot be easily relocated.	An industrial site (or precinct) may be shifted over time to an alternative location to reflect changes in surrounding land use.
Vessels are transient and operate in a national or international context.	An industrial site comprises mostly fixed mechanical plant and equipment where there is a high degree of control over the equipment and opportunities to invest in noise reduction.
Noise emissions from individual operations may be sporadic and/or seasonal.	Noise emissions from industrial operations are typically relatively steady throughout the year.
Ports may act as a natural amphitheatre which limits the effect of shielding.	Industrial sites are mainly fixed infrastructure where the site and receivers share relatively level and similar topography.
Local regulation of noise emissions must be reasonably congruent with international standards.	Local regulation of noise emissions is largely independent of international standards.

Further detail on various factors considered in the development of this policy including historical context and changes in the port noise environment, other port and transport criteria, and factors influencing vessel noise are included in the following appendices:

- history of Glebe Island and White Bay (Appendix A)
- overview of other Australian and international port noise criteria (Appendix B)
- changes in noise levels at Glebe Island and White Bay (Appendix C)
- comparison with approaches for other vehicles (Appendix D)
- factors influencing vessel noise (Appendix E).

3.2 Policy commencement and review

This policy will commence as at 1 January 2021.

Port Authority will review this policy every five years, in conjunction with EPA and Department of Planning, Industry and Environment and stakeholders to ensure that the policy still meets the legislative framework and properly addresses the challenges of the port of Glebe Island and White Bay.

Port Authority in consultation with EPA will review the vessel trigger noise level every three years.

Further detail on the review of the vessel trigger noise level is contained in Vessel Noise Guideline (Appendix F, Section 6.3).

4 Noise guidelines

The Vessel Noise Guideline (Appendix F) and Landside Precinct Noise Guideline (Appendix G) outline the processes for setting and assessing noise criteria for port activities and communicating the outcomes to community and other stakeholders. The following sections describe the rationale of these two guidelines and how they will be implemented.

Where agreed with regulators and approval authorities the outputs of these guidelines may be incorporated into the following for port developments:

- conditions in planning approvals
- Environmental Protection Licences issued by the EPA.

The noise maps produced by implementing these guidelines may also be applied by approval authorities when developing planning controls for residential and commercial developments encroaching on the port on nearby land (Appendix I).

The environmental noise criteria in this policy aim to provide protection for noise sensitive receivers in the areas surrounding Glebe Island and White Bay. Residential receivers are assessed for vessel and landside noise outside the receiver at the residential property boundary or as defined in the EPA's Noise Policy for Industry. Other premises have internal noise criteria. These include schools, places of worship and hospitals (see the EPA's Noise Policy for Industry for additional detail and a complete list of receiver types).

Planning controls for residential and commercial developers on land near the port have internal noise criteria for living areas and bedrooms.

4.1 Vessel Noise Guideline

Similarities in noise emission and management approaches can be found between industrial operations and the landside activities at a port, however noise emissions from vessels differ from the noise emissions of vehicles within an industrial site.

Vessels differ from the management of noise from other vehicles that may support an industrial site, because (in the absence of this policy) they do not fall into either of these two categories:

- captive and solely used within the site
- visitors to the site with individual noise targets set by other criteria or regulations.

This has made the management of vessel noise, and the prediction and modelling of overall port noise, problematic. This has been addressed under the Vessel Noise Guideline by using Section 10 of the EPA's Noise Policy for Industry to set a trigger noise level for vessels at berth based on noise levels that may reasonably be achieved while minimising impacts on the community. The approach of setting triggers for individual vessels is consistent with the approach that has already been used to set noise targets for individual road and rail vehicles and aircraft (see Appendix D).

The setting of a trigger level for vessels simplifies future noise predictions as it puts an upper limit on the representative range in noise levels. This provides enough certainty to produce reliable noise maps that illustrate relative noise impact from multiple vessels visiting the port over representative time periods. For vessels at White Bay and Glebe Island the selected time periods for preparation of noise maps are 1 year, and the three months of summer and winter to provide information on any seasonal variation. This mapping technique with extended time period averages is used for road traffic noise, which use annual average traffic volumes, and to produce Australian Noise Exposure Forecast noise maps for airports (see Appendix D).

The vessel trigger level is also used as the representative ship noise level to evaluate noise from a new or redeveloped operation in an environmental assessment. Under this policy environmental assessments are also required to consider a worst case visit from a noisier vessel and potential cumulative impacts from vessels at other berths.

The guideline recommends mitigation is considered based on exceedance of specified target noise levels and exposure.

The requirement for vessels visiting Glebe Island and White Bay to comply with the trigger noise level is included in revised access agreements for tenants and terms and conditions for ship operators. The Vessel Noise Operating Protocol for each berth outlines the actions which are to be undertaken if a vessel exceeds the trigger noise level. The noise levels will be measured at each berth when a vessel is present. Where noise levels from the vessel exceed the noise trigger, the user will be required to ensure that the vessel can subsequently meet the noise trigger by applying corrective action.

If compliance with noise triggers cannot be achieved on a repeated basis, operating restrictions will be applied. Careful consideration should be given to applying unloading restrictions that increase the length of stay as restrictions are not wholly effective in reducing noise levels. This is because vessels still produce noise impacts when not unloading. A longer stay at berth generally increases overall noise exposure from the vessel.

The Vessel Noise Guideline outlines how trigger noise levels from all berths across the port are used to develop whole of port noise maps that illustrate annual and seasonal noise exposure by the port on surrounding areas. These maps also include future projections for the port.

The vessel trigger levels were derived using the EPA's Noise Policy for Industry based median noise levels and what is reasonable and feasible achieve at the port due to proximity to residences and current vessel design. For examples of vessel noise levels refer to previously published port noise measurements. In terms of overall noise, the trigger levels were reviewed against and found to be similar to noise level criteria for other vehicles in NSW and also to some port criteria in some other jurisdictions (see Appendix B and Appendix D). However, the review overall showed that noise criteria levels for port and vessel noise are inconsistent internationally and across Australia.

4.2 Landside Precinct Noise Guideline

The Landside Precinct Noise Guideline adopts the concepts of noise management precincts outlined in the EPA Noise Policy for Industry. A Noise Management Precinct enables an area with many proponents to operate as a single site that is required to meet the amenity level, where feasible and reasonable. This approach simplifies assessment and compliance by setting a single noise goal which all tenants must collectively meet.

The concept of a Noise Management Precinct will be introduced in all port tenant leases of Glebe Island and White Bay by 1 January 2021. Under each lease, each tenant has been allocated an individual maximum permissible noise level which collectively will meet the assessment criteria for the precinct.

The guideline sets the processes for undertaking an environmental assessment within the Noise Management Precinct for a port development and equitably allocates permissible noise emission and the burden of noise mitigation to each proponent. It also outlines ongoing noise monitoring and compliance requirements.

Precincts provide the flexibility to apply additional noise mitigation to an existing proponent if this is more cost effective and practicable than just mitigating noise from a new proponent. If this mechanism is utilised, the permissible noise emission for a proponent may change over time if a new proponent seeks approval to operate within a port and it is more cost effective to additionally mitigate an existing proponent.

The Noise Management Precinct will not include the operations of construction projects and staging support being carried out on Glebe Island and White Bay. This is because these activities are governed by their own separate planning processes and construction noise criteria (not directly related to precinct criteria, but rather EPA's Interim Construction Noise Guideline 2009), and which are not anticipated to continue with port operations in the long term.

4.3 Planning controls

The two guidelines outline the process for developing noise maps which may be used by approval authorities to inform the preparation of planning controls for new developments that are encroaching on the port. Planning controls may be used to ensure that internal noise levels in new buildings provide appropriate levels of amenity for their occupants. These controls are applied as internal noise level criteria.

Achieving the internal noise criteria requires the developer to locate the building away from noise, construct noise barriers or design the building façade to provide sufficient noise attenuation to meet the internal noise criteria.

5 Noise trigger levels and criteria

The following tables outline the initial vessel trigger noise levels and landside criteria established under this policy using the Vessel Noise Guideline and the Landside Precinct Noise Guideline.

The Noise Standard (Appendix H) sets the current vessel trigger noise levels and the detailed allocation of the landside noise criteria for individual port users. Note the vessel trigger noise levels will be periodically reviewed to consider whether the triggers may be lowered to reduce overall port noise.

These noise levels assume that they have taken into consideration any annoying characteristics as defined under the Vessel Noise Guideline and Landside Precinct Noise Guideline.

Table 3 outlines the vessel trigger levels to be applied to individual vessels at each berth. The trigger level is applicable at the worst affected sensitive receiver and have been obtained from a review of median noise levels from vessels (refer to supporting data from previously published port noise measurements) and what is reasonable and feasible to achieve.

Table 3: Vessel Trigger Noise Levels (external)

Environmental trigger applied to vessels at berth	Assessment Location	Day ($L_{Aeq, 15hr}$) (7am to 10pm)	Night ($L_{Aeq, 1hr}$) (10pm to 7am)	Night (L_{Amax}) (10pm to 7am)
Glebe Island 1 and 2	All sensitive receivers near the port	60 dBA	55 dBA	65 dBA
Glebe Island 7 and 8		60 dBA	55 dBA	65 dBA
White Bay 3		60 dBA	55 dBA	65 dBA
White Bay 4 (non-cruise)		60 dBA	55 dBA	65 dBA

The cumulative noise limit is outlined in Table 4. These criteria represent the total amenity noise level that all port landside activities collectively must not exceed following successive industrial developments. The precinct criteria are applicable at the worst affected sensitive receiver and are equivalent to the Noise Policy for Industry's amenity criteria for an urban industrial interface.

Table 4: Port landside precinct noise criteria

Category	Assessment Location	Day ($L_{Aeq, 11hr}$) (7am to 6pm)	Evening ($L_{Aeq, 4hr}$) (6pm to 10pm)	Night ($L_{Aeq, 9hr}$) (10pm to 7am)
External environmental criteria applied to the Noise Management Precinct	All residential land near the port	65 dBA	55 dBA	50 dBA
Internal environmental criteria applied to the Noise Management Precinct	Other noise sensitive receivers	Refer to the NSW EPA's Noise Policy for Industry, Table 2.2		

Note the total amenity noise level currently permitted to be emitted from port landside activities may be less than the cumulative noise limit as the cumulative noise limit is the maximum level following successive industrial development. The total amenity noise level that may currently be emitted from the port is the benchmark noise level. This is detailed further in Appendix G and Appendix H. Increases in the benchmark noise level are only permitted where the noise increase from a new port development or redevelopment is

reasonable and the total noise level does not exceed the cumulative noise limit. Guidance on acceptable noise level increases is taken from the Noise Policy for Industry.

The recommended minimum planning control (internal noise level) for new developments encroaching on the port are shown in

Table 5. Future noise levels should be sourced from Appendix I.

Table 5: Recommended planning control (internal)

Category	Assessment Location	Day ($L_{Aeq, 1hr}$) (7am to 10pm)	Night ($L_{Aeq, 1hr}$) (10pm to 7am)
Planning control applied to cumulative landside and vessel noise	New residential developments near the port	40 dBA	35 dBA

6 Management and mitigation of port noise

There are three distinct approaches used to mitigate noise from the port, each relating to either vessels, landside activities or whole of port noise levels.

Underpinning each of these are contracts between the Port Authority and each of the port users, which outline the noise criteria for vessels and landside activities with actions that will be undertaken if noise levels exceed agreed levels.

Port Authority also plays an active role in reviewing and setting trigger levels for vessels in a collaborative manner with stakeholders.

6.1 Noise monitoring

Port Authority will proactively monitor noise levels from vessels and measure collective noise levels from the landside precinct.

Actions will be undertaken by Port Authority where noise levels exceed vessel noise trigger levels or the landside noise precinct criteria.

6.1.1 Vessel noise monitoring and management actions

Port Authority will measure the noise level for all visiting vessels and initiate actions, outlined in the operating protocols, if exceedances occur. A first step will be informing the tenants and vessel operator that the vessel exceeds the noise trigger level. This shall be identified by attended or automated noise measurement.

If the vessel is unable to immediately reduce noise, and Port Authority's attended measurement confirms the vessel is the noise source, then Port Authority will issue a corrective action notice to the vessel. The vessel will then be required to prepare and implement a management plan to reduce noise before the next visit. Significant ongoing exceedances on subsequent visits may result in a ban of the vessel.

The vessel operators of noisy vessels have the following options to avoid a ban of the vessel:

- successfully implementing a management and noise reduction plan
- mitigating the vessel
- selecting a quieter vessel for future visits.

The responsibility for addressing noise from specific vessels falls to the vessel operators and the overall responsibility for repeated failure to comply with the operating protocols is with the tenant.

Further detail is provided in the Operating Protocols developed for each berth.

6.1.2 Landside precinct noise monitoring and management actions

Port Authority will undertake noise monitoring of the landside precinct and compare it with the benchmark noise level for the precinct.

The operators of landside activities or owners of landside infrastructure are responsible for meeting noise criteria. The operators and owners may be external organisations (generally tenants) or Port Authority.

If noise levels from landside activities exceed the precinct criteria, Port Authority will require landside operators to verify and report on their noise emission. If a landside operator has exceeded their maximum permissible noise level, they will be required to reduce noise from their landside activities to meet their contractual commitments to Port Authority.

Under the principles of a noise precinct and the terms of the contracts between operators and Port Authority, noise reduction may be undertaken for an operator's own site or alternatively for another operators site if it is more cost effective and there are no reasonable objections.

6.2 Vessel noise reduction

There are currently no international or national environmental design criteria for noise emissions from a vessel to manage noise levels at nearby sensitive receivers. Outside this policy, the only noise requirements are those introduced during a vessel's design and construction stage for on-board safety and crew comfort.

Depending on the individual vessel, noise reduction may or may not be feasible for technical or economic reasons.

Potential mitigation for existing vessels may include additional or upgraded silencers, improved ducting design and attenuators for fans, pumps, generators and engines. While there are different types of silencers and attenuators available, their design and location within the length of exhaust ducting needs to be tuned to the noise source.

For engines and generators, key factors relating to noise are the operational revolutions per minute (rpm), number of cylinders and capacity of the engine, particularly to reduce low frequency tonal noise.

There are greater opportunities to reduce noise during the design phase of new ships beyond the minimum requirements for on-board comfort and safety, and this is the easiest time to incorporate mitigation measures.

Due to space and access requirements, opportunities to retrofit additional noise mitigation to a given vessel may be limited and can only be reviewed on a case by case basis.

6.3 Landside noise mitigation

The landside activities at White Bay and Glebe Island mostly relate to handling and processing passengers and cargo including bulk dry and liquid goods. These landside operations are similar to the activities in an industrial site, as are the potential mitigation options. These include:

- use of quieter plant and alternative material handling rates
- control of vehicle noise using silencing, speed restrictions, plant selection and smooth pavements without potholes, bumps and abrupt changes in level
- operational restrictions including hours of operation and material processing rates.
- noise barriers such as acoustic sheds, partial enclosures and other forms
- at-receiver noise treatments.

Additionally, while a vessel is at berth, the vessel may:

- provide acoustic shielding to receivers on the seaward side
- act as a reflector to landside receivers
- mask noise from landside activities or significantly alter the background noise level.

6.4 Whole of port noise mitigation

Port Authority mitigates whole of port noise levels using various strategies. These include:

- strategic planning for permitted activities at various berths
- contractual arrangements with port users to limit noise
- setting of achievable noise triggers for vessels and criteria for landside activities
- whole of port noise monitoring
- implementing protocols should vessel or landside noise exceed the triggers and criteria set under this policy
- periodic review of vessel trigger noise levels to consider reducing the level to quieter level.

Port Authority may consider additional noise mitigation where noise exposure is still significant after the application of these strategies.

6.4.1 Feasible and reasonable noise mitigation

Noise mitigation will only be considered where it is 'feasible and reasonable' as defined in Fact Sheet F of the EPA's Noise Policy for Industry:

> *A feasible mitigation measure is a noise mitigation measure that can be engineered and is practical to build and/or implement, given project constraints such as safety, maintenance, and reliability requirements. It may also include options such as amending operational practices (for example, changing a noisy operation to a less-sensitive period or location) to achieve noise reduction.*
>
> *Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic, and environmental effects, including the cost of the mitigation measure.*[1]

The EPA's Noise Policy for Industry requires that a consideration of 'reasonableness' must look at the range of feasible measures to determine which measures are appropriate, having regard to a number of factors outlined in Fact Sheet F:

- *Noise impacts:*
  - *existing and future levels, and projected changes in noise levels*
  - *level of amenity before the development, for example, the number of people affected or annoyed*
  - *the amount by which the triggers are exceeded.*
- *Noise mitigation benefits:*
  - *the amount of noise reduction expected, including the cumulative effectiveness of proposed mitigation measures, for example, a noise wall/mound should be able to reduce noise levels by at least 5 decibels*
  - *the number of people protected.*
- *Cost effectiveness of noise mitigation:*
  - *the total cost of mitigation measures*
  - *noise mitigation costs compared with total project costs, taking into account capital and maintenance costs*
  - *ongoing operational and maintenance cost borne by the community, for example, running air conditioners or mechanical ventilation.*
- *Community views:*
  - *engage with affected land users when deciding about aesthetic and other impacts of noise mitigation measures*
  - *determine the views of all affected land users, not just those making representations, through early community consultation*
  - *consider noise mitigation measures that have majority support from the affected community.*

[1] EPA Noise Policy for Industry (2017), Fact Sheet F: Feasible and Reasonable Mitigation www.epa.nsw.gov.au

There are additional factors to take into account when considering noise impacts for a port:

- noise impacts may be seasonal which lessens community annoyance for the same noise level[2]
- noise impacts may be sporadic for a limited number of consecutive hours or days before respite between vessel visits
- triggers for vessel noise should reflect what is reasonable for the operator in a national and international context.

There are also considerations for an existing port:

- once constructed and operational, a port cannot be easily relocated
- ports are significant infrastructure constructed following substantial government investment
- a port requires specific geographical features to provide safe berthing for loading and unloading and they are commonly extensively modified to provide sufficient water depth for vessels and cargo operations through dredging and land reclamation
- transportation modes (such as road and rail) have usually been established to support the land transport of passengers or bulk goods to and from the port
- EPA's Noise Policy for Industry and superseded Industrial Noise Policy acknowledges:
    - there are challenges for sites that predate the current noise policy to meet the latest noise criteria
    - where it is not possible to meet the latest noise criteria, to instead consider the use of alternative noise triggers that are practical to achieve with feasible and reasonable mitigation and within constraints associated with the site. The alternative triggers are implemented with a noise reduction strategy to reduce noise emissions towards the EPA policy criteria over a period of time.

6.4.2 Considerations for Glebe Island and White Bay noise mitigation

Glebe Island and White Bay have been port facilities for over 100 years following land reclamation and initial construction of the wharves that are still used today. The wharves and other port infrastructure of Glebe Island and White Bay are 'existing infrastructure' under the EPA's Noise Policy for Industry and all superseded EPA noise policies.

When assessing noise criteria and considering any noise mitigation for Glebe Island and White Bay the following reasonableness measures will be taken into account:

- the port infrastructure was constructed prior to any environmental noise criteria
- noise emissions from individual operators or proponents may be sporadic and/or seasonal which means that annual, seasonal and weekly noise exposure may vary, with quieter periods between vessel visits
- noise from an occupied berth may be reasonably consistent between different ship types or proponents over a period of many decades
- management of noise requires strategic planning of the port as a whole to manage noise from the individual operators. This requires individual proponents and operations to be located in places where they will create the least conflict with surrounding land uses
- landside operations may be shielded by the ship so that the noise from these operations is not as significant
- ports may be a natural amphitheatre limiting the effects of shielding, noting that vessel noise sources range from 0.5m to at least 25m above the waterline and receivers are often elevated by topography.

[2] Miedema, H.M.E. and Vos, H., 2004, Noise annoyance from stationary sources: Relationships with exposure metric day evening night level (DENL) and their confidence intervals, *The Journal of the Acoustical Society of America*, 116/1, pp 334 - 343

6.4.2 Berthing allocations

Minimising port noise involves an assessment of the current needs and uses of the berths at Glebe Island and White Bay and active management of the berths matching the appropriate uses to the appropriate locations. The primary current use for the berths at Glebe Island and White Bay is for the transportation of bulk goods, such as cement, gypsum, sugar, salt and tallow.

Vessels carrying bulk goods typically require overnight stays (24 hours or more) to provide sufficient time to unload or load cargo. The location of these activities within the port are best suited to the berths closer to ANZAC bridge at Glebe Island and berths 3 and 4 at White Bay, which already have a reasonable level of background noise due to nearby roads. Many of the residences in these noisier locations (particularly recent developments in Pyrmont and in Buchanan Street, Balmain) have been approved and designed to address night time noise levels from ANZAC bridge and the port.

The preferred location for the cruise ships is at White Bay berths 4 and 5 as the number of overnight visits from cruise ships is currently relatively low compared to bulk vessels at other berths and unlikely to significantly increase in the future. A noise attenuation program to mitigate noise from cruise ships commenced in October 2018 for White Bay Cruise Terminal, and extended to mitigate noise from cruise ships at White Bay berth 4 in January 2020.

Port Authority has a berthing allocation process which defines the considerations made in allocating ships not servicing Port Authority's usual port operators known as 'infrequent visitors' to berths at White Bay and Glebe Island. The process also sets the minimum expectations of behaviour (in relation to noise generating operations) required from these ships while utilising these berths. The aim is to provide guidance to ensure that the most appropriate available location is selected for infrequent visitors thereby minimising the impacts of these ships' activities on the local community.

Infrequent visitors currently include:

- vessels discharging project cargo (including equipment required for construction projects within Sydney)
- vessels in need – ships needing berth space at short notice, for example, to carry out emergency repairs, obtain refuge from adverse weather conditions and any ship under detention.

The berth allocation process defines the allocation of berths to infrequent visitor ships based on:

- availability
- suitability
- proximity to residents
- whether nearby residential areas are attenuated for noise
- equitable distribution.

6.4.3 Noise barriers

Noise barriers are generally not considered feasible and reasonable to reduce noise from vessels, particularly in Glebe Island and White Bay because:

- residences and vessels noise sources are usually elevated at White Bay and Glebe Island, which limits the effectiveness of practical noise barriers. Noise barriers would need to be more than 30 metres in height
- there is limited land available between the vessel and residence for construction of a barrier
- barriers may impact water views from the residential properties.

6.4.4 Shore power

Shore power is often suggested as a solution to reduce ship noise. However noise emission from a vessel would still continue as shore power only eliminates the need for generators and not the on-board systems the generators are powering (for example, air conditioning and ventilation systems, and cargo unloading

systems such as conveyors), which can be significant noise sources. Shore power may provide a minimal reduction in noise depending on the specific vessel.

A 2017 study of shore power for the White Bay Cruise Terminal also showed that only about 25% of vessels using the facility at that time had the capacity to use shore power, which would limit the benefits of installing a shore power capability (this study is currently in the process of being updated). The study also showed that the duration of the benefits during a typical visit (generally 12 hours) were limited due to the amount of time required to connect/disconnect and shut down/start up.

It is noted that the percentage of cruise vessels or visits may change with time depending on the capability of each of the scheduled ships and their frequency of visits.

For the bulk cargo vessels using Glebe Island and White Bay berths, there are currently no known vessels that can connect to shore power. Should this capability develop in the future, the benefits may be greater for a cargo vessel than a cruise vessel. Bulk goods vessels are typically in port longer than a cruise ship and so any noise reduction may have an improved outcome for noise exposure. The shore power systems required may also be less expensive to install as the power requirements for a cargo vessel are generally less than for a cruise vessel.

6.4.5 At-receiver treatments

Given the limitations of the mitigation options outlined above, at-receiver treatments, which include upgrading glazing and façade elements, are considered to be the most practical way to achieve significant noise mitigation for vessel noise. To be effective treatment must provide an air-tight seal to the outside. The sealing of airflow means that fresh air ventilation should be provided to the building. Roads and Maritime Services *Draft At-receiver treatment guideline (2017)* details how to retrofit treatments to existing buildings. Additional discussion on the mitigation of ship noise has recently been published in NEPTUNES's *Mitigation of Noise from Ships at Berth* (2019).

Port Authority, as part of its Noise Mitigation Strategy for White Bay Cruise Terminal, has committed to at-receiver treatments for eligible properties to address exceedances of the noise criteria outlined in the planning approval for the terminal.

Appendix A

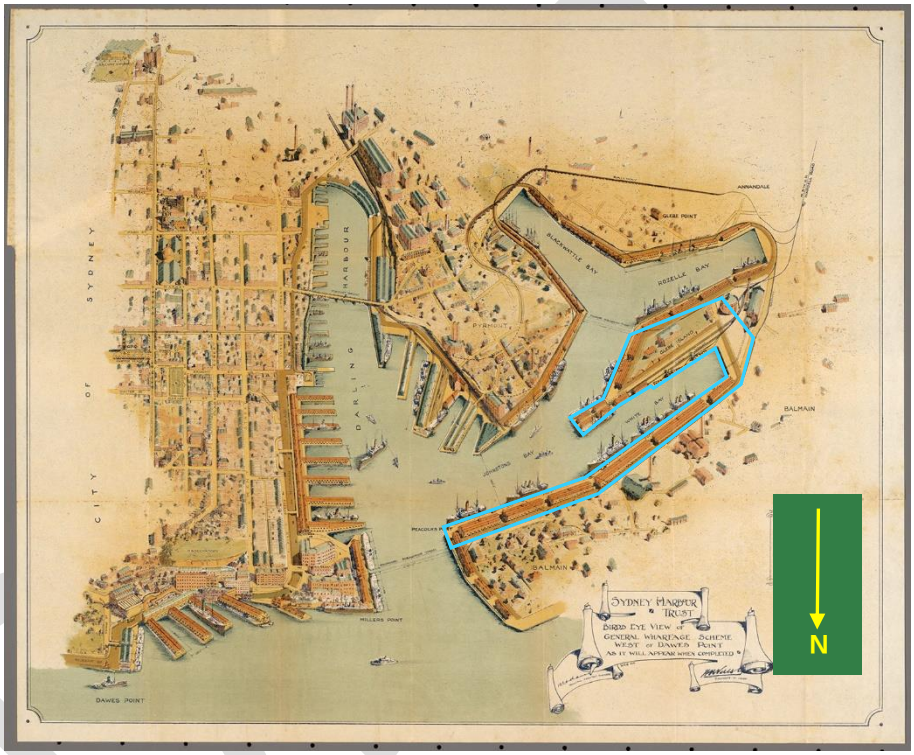
History of Glebe Island and White Bay

A.1. History of Glebe Island and White Bay

The berths and wharf infrastructure at Glebe Island and White Bay have a long history spanning over 100 years. Following land reclamation, the area of Glebe Island and White Bay became progressively industrialised with the improvement of land access for the carriage of goods to and from the port. The port resulted in significant and ongoing investment and employment opportunities.

An example of early planning for the port and associated industry is shown below from 1913. The area corresponding to the current port boundary is outlined in blue. While residential development near the port is evident at this time in Balmain, planning requirements at the time did not include restrictions on noise emissions.

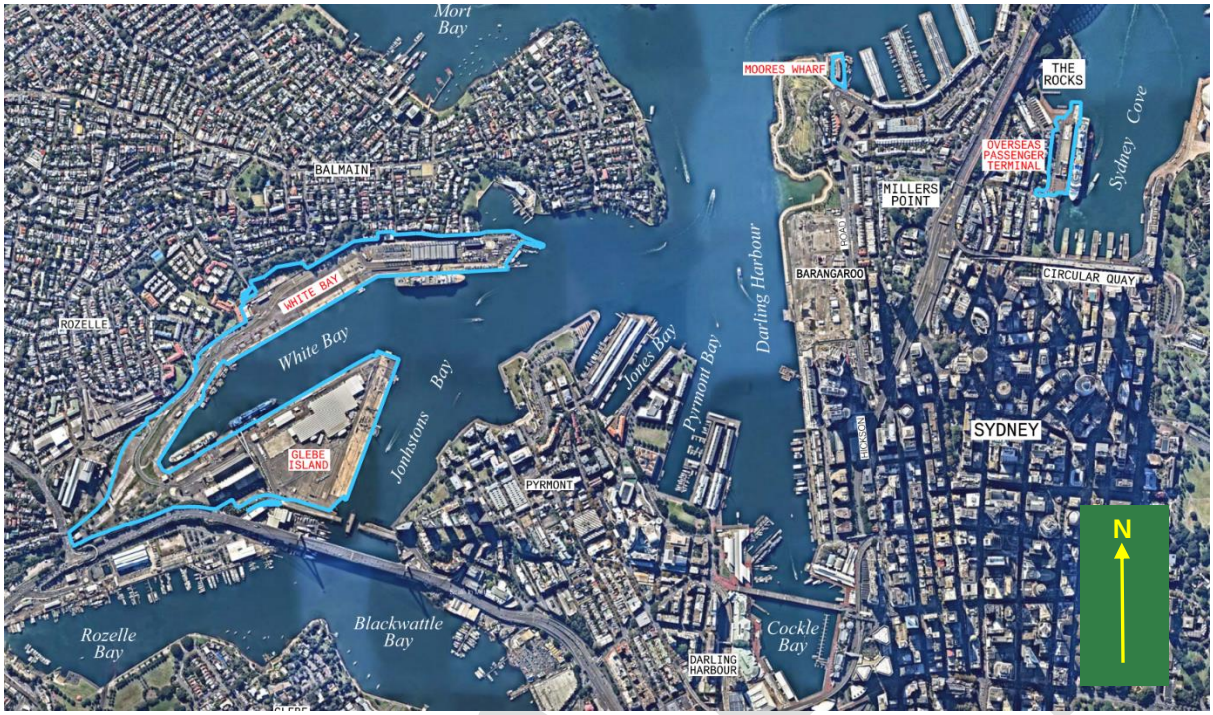
Figure 2 Planning of Glebe Island and White Bay circa 1913 with current port area outlined in blue



https://dictionaryofsydney.org/media/5588

More recently in 2000, a master plan for the port of Glebe Island and White Bay was approved by the NSW Department of Urban Affairs and Planning. The most significant changes from a noise perspective since the 1913 plan, have been increased residential development around the port and an increase in ship size (Figure 3). A timeline of summary of key uses and events follows.

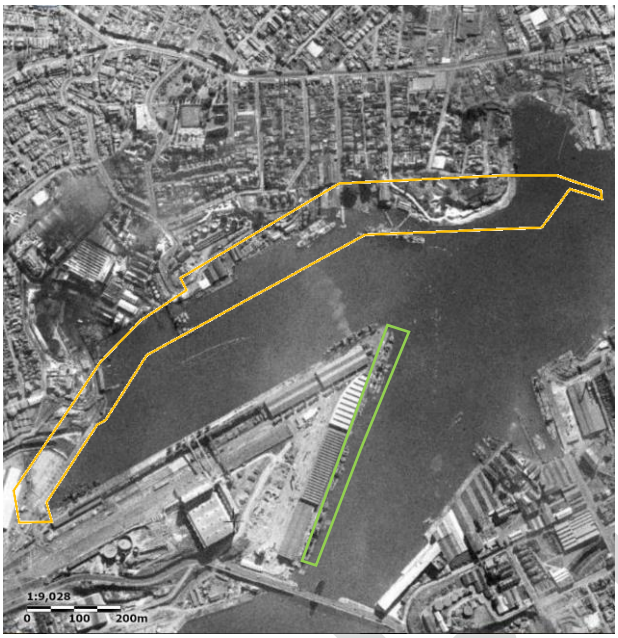
Figure 3 Current port areas outlined in blue



A summary of the uses of the port of Glebe Island and White Bay include:

- 1854-1902 - Steam saw mill and joinery works at White Bay
- 1875 – Australian Gas and Light Company gas processing at White Bay
- 1895 – Reclamation of White Bay by a Lever Brothers subsidiary for soap works which continued until 1988 by Unilever
- Early 1900's – Ship builders, a coal and engineering company operated at the site of the current White Bay Cruise Terminal
- 1901 – Construction of rail and Glebe Island Bridge to improve land connectivity
- 1912 – Construction of the coal fired White Bay Power Station
- 1915 – Works to level Glebe Island began using the sandstone cliffs to create wharfs and reclaim land to join it with Rozelle
- 1919 – Ships handling grain, timber and soap at White Bay
- 1920s to 1990s – Glebe Island silos constructed and used for handling grain
- 1930s through 1950s – Western area of the White Bay site adapted for bulk chemicals
- 1939 – Coal loader established at head of White Bay

Figure 4 1943 with overlay showing the area of the 1967-1969 reclamation and excavation at White Bay in yellow and the early 1970s reclamation at Glebe Island in green

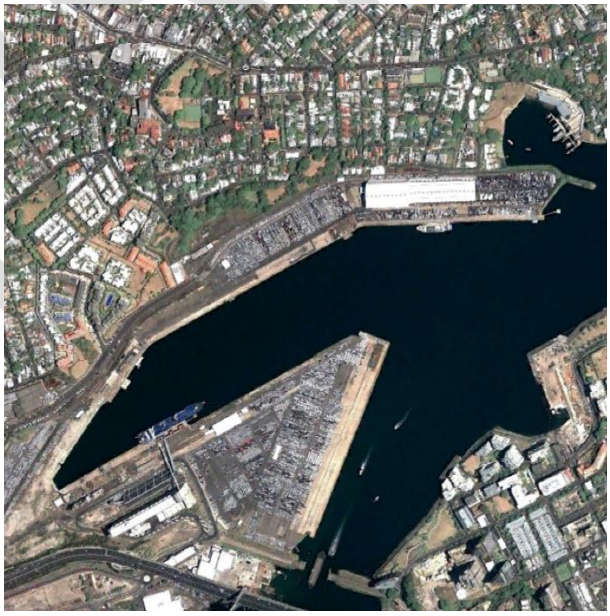


- Post WWII – Offloading of imported cars in post war boom at Glebe Island.
- 1965 – Chemical tank farm established at White Bay
- 1967-69 – Excavation (Balmain below Dural Street) and further land reclamation at White Bay to construct the White Bay Container Terminal at Berths 4, 5 and 6. The terminal covered 27 acres at completion.
- 1971-1972 reclamation to construct Glebe Island 1 and 2 for the container terminal which was in use until the early 1990s.
- 1982 – White Bay Berths 5 and 6 converted to roll on roll off cargo handling after previous operator shifted their container terminal to Botany Bay.
- 1987 to 2004 – P&O subsidiary, Conaust, used the container terminal at White Bay until 1993, container operations continued under P&O Ports until 2004.
- 1991 – Cement silos constructed and in current use at Glebe Island.
- 1993 – Commencement of lease of Glebe Island silos for import and storage of sugar by Sugar Australia.
- 1998 – Commencement of lease of Glebe Island silos for import and storage of cement by Cement Australia.
- 1990s to 2008 – AAT terminal for imported motor vehicles at Glebe Island.

Figure 5 2002 showing White Bay container terminal and Glebe Island car terminal

- Late 1990s – White Bay Noise Reference Committee established.
- 2004 – Import of gypsum commenced at Glebe Island by Gypsum Resources Australia.
- 2004 – White Bay ceased operating a container terminal.
- 2005 – Environment Protection Authority bulk shipping licence renewed to continue handling of vegetable oils and tallow at White Bay.
- 2006 – Glebe Island/White Bay Community Liaison Group established to communicate about future development.
- 2006 – Baileys Marine Fuels commenced operations from Berth 6 White Bay.
- 2004 – Miscellaneous port uses commenced.
- 2008 – Unloading of salt ships at Glebe Island commenced, and EPA bulk shipping licence obtained.

Figure 6 2009 showing White Bay and Glebe Island car import and storage facilities



- 2013 – White Bay Cruise Terminal opened.
- 2018 – Review of Environmental Factors for a proposed multi-user facility at Glebe Island
- 2018 – Proposal to relocate Hanson Construction concrete batching plant to Glebe Island

Figure 7 2016 showing White Bay Cruise Terminal, Glebe Island Convention Centre and Salt Ship

Appendix B

Australian and international port noise criteria

B.1. Overview of other Australian and international port noise criteria

Management of ship noise is an increasing global concern. Measurement approaches that are in use globally or in discussion are mostly L_{Aeq} based measures. The criteria are either industrial based criteria or port specific mitigation triggers. New South Wales has some of the most stringent industrial noise criteria globally. Denmark and the United Kingdom have criteria with similar requirements to New South Wales.

The most comprehensive approach to managing port noise appears to be outlined within a New Zealand Standard which sets recommended noise criteria for new and existing ports and contains recommended requirements for inclusion within environmental planning policy. The standard sets expectations for noise management by the port and for the construction of new noise sensitive receivers or alterations to existing noise sensitive receivers near the port. This standard has been implemented at a number of New Zealand ports since 1999 and draws from other New Zealand standards such as for land use planning around airports.

Table 6 Summary of noise criteria and mitigation trigger levels in use and applied to ports in NSW, and globally

Port location	**Time period**		
	Day, L_{eq}	**Evening, L_{eq}**	**Night, L_{eq}**
NSW	The *Noise Policy for Industry* outlines environmental criteria that are generally applied outside of the receiver. Low frequency effects are considered based on whether the noise is likely to exceed hearing thresholds inside the building based on a building with lightweight construction. Alternative internal noise level calculations may be undertaken for other building constructions.		
	35dBA to 65dBA ext	35dBA to 55dBA ext	35dBA to 50dBA ext
		dBA-dBC <15dBA trigger with a 2-5dBA penalty where estimated internal noise levels exceed estimated hearing thresholds between (10Hz and 160Hz)	
NSW WBCT mitigation trigger	55dBA	55dBA	55dBA
TAS	Tasmanian's Department of Environment has developed *Environment Protection Policy (Noise)* and detailed measurement procedures. This policy considers noise from ports to be a form of transportation noise rather than industrial noise. This is outlined in *Part 4 Transport Infrastructure*. The second is that *Part 4* outlines that separate transport noise strategy will be developed. The port corporation, TasPorts, has developed a standard *Environmental Standard – Nuisance Noise.* This standard describes a commitment to undertake baseline noise assessments and mapping every 5 years and to also revise these documents when there is a change in use.		

Port location	Time period		
	Day, L_{eq}	**Evening, L_{eq}**	**Night, L_{eq}**
	Tasmanian's Environmental Protection Authority policy does not specify noise criteria for ports.		
New Zealand	Standard 6809:1999 Acoustics – Port Noise Management and Land Use Planning This standard defines inner and outer noise contour control boundaries which are used to identify existing residences that qualify for noise treatment due to noise emission from and existing or new port. The same control boundaries are also used to set triggers for the mitigation of new residences encroaching on the port. Noise mapping uses 55dBA L_{dn} to create an outer control boundary and 65dBA L_{dn} to create an inner control boundary. The L_{dn} is assessed over 5 consecutive busy days. Note: a noise level of L_{dn} is equivalent to L_{Aeq} plus 6dBA for 24/7 noise exposure for 5 days from a vessel emitting a constant level of noise. This drops to L_{Aeq} minus 1 for 1 day of noise exposure. At its most stringent, the inner and outer control boundaries relate to 49dBA and 59dBA L_{Aeq} respectively for 5 days of continuous exposure. Or for a 24 hour visit the inner and outer boundaries would be 56dBA and 66dBA respectively. These control boundaries are recommended by the standard for inclusion in planning instruments to manage noise amenity at sensitive buildings. Properties are considered to be noise affected at levels above 55dBA L_{dn} and within the outer control boundary. New noise-sensitive buildings, and alterations or additions to existing buildings in areas within the outer control boundary should only be permitted where they are adequately noise insulated so that internal noise levels do not exceed 45dBA L_{dn}. Construction of new noise sensitive is not recommended buildings where noise levels are above 65dBA L_{dn} unless the building can be adequately noise insulated. The criteria for existing ports is 65dBA L_{dn} over the long term and for individual nights, 60dBA L_{Aeq} and 85dBA L_{Amax}. For new ports the port is responsible for providing noise treatments to existing noise sensitive receivers within the outer control boundary and it is recommended that planning instruments are amended to require new sensitive buildings or alterations to existing buildings to include noise treatments. Under this standard daytime is defined as from 7am to 10pm and night time from 10pm to 7am.		
Port of Napier, New Zealand	This port has implemented *NZS 6809* with a mitigation trigger for port noise of 65dBA L_{dn}. Home owners pay 40% if between 65dBA-68dBA		

Port location	Time period		
	Day, L_{eq}	**Evening, L_{eq}**	**Night, L_{eq}**
Port of Nelson, New Zealand	This port has implemented *NZS 6809* with a mitigation trigger of 40 dBA L_{dn} (5 day) internal within all living areas, 55dBA L_{dn} external is a "Noise Affected Property"		
Denmark	*Vejledning fra miljøstyrelsen nr.5/1984, "Ekstern støj fra virksomheder".* The Danish Environmental Protection Agency Guide for external noise from companies identifies external and internal noise criteria that are applied to vessels at berth.		
	50ext	45ext	40ext
	25dBA int (10-160Hz)	20dBA int (10-160Hz)	20dBA int (10-160Hz)
	85dBG int	85dBG int	85dBG int
EU			
EU directive	Appears to have resulted in noise mapping but little action against industrial noise criteria		
Finland	Sourced from *Government resolution on noise abatement (2007)*		
	55	55	55
Italy	*Italian Regulation on Noise and Zoning of Urban Areas, Government Decree (1st December 1997)* Criteria are set for emission and immission depending on the class of the territory. Land near ports is considered Class IV. *Class IV territory - in this class are the areas with high human activity, high inhabitants density, high road traffic, many commercial activities; these areas are near main roads, main railways or ports.* Limits are placed on emission per source and immission from multiple sources.		
Emission, Class IV	60	60	50
Immission, Class IV	65	65	55
Sweden	*Vägledning om industri- och annat verksamhetsbuller (2015)* The Swedish EPA's Guidance on industrial and other operational noise identifies noise criteria which has been applied to ports. It also references the *Ljudnivåer utomhus vid ny bostadsbebyggelse* which identifies design requirements for new residential buildings in noise affected areas with noise levels up to 10dBA higher than the industrial criteria. The Swedish TFK Transport Research Institute (Report June 2013) highlights that complications have arisen with the criteria for ports and residential development, especially where the criteria		

Port location	**Time period**		
	Day, L_{eq}	**Evening, L_{eq}**	**Night, L_{eq}**
EPA criteria	are significantly quieter than ambient noise levels from other nearby sources including road traffic.		
	50	45	40
United Kingdom	*BS 4142: 2014 - Methods for rating and assessing industrial and commercial sound*		
	Background+5dBA	Background+5dBA	Background+5dBA

L_{dn} - note for this 24hr L_{Aeq} parameter a 10dBA penalty is added to the night time level
Int – Internal noise level
Ext – external noise level

Appendix C

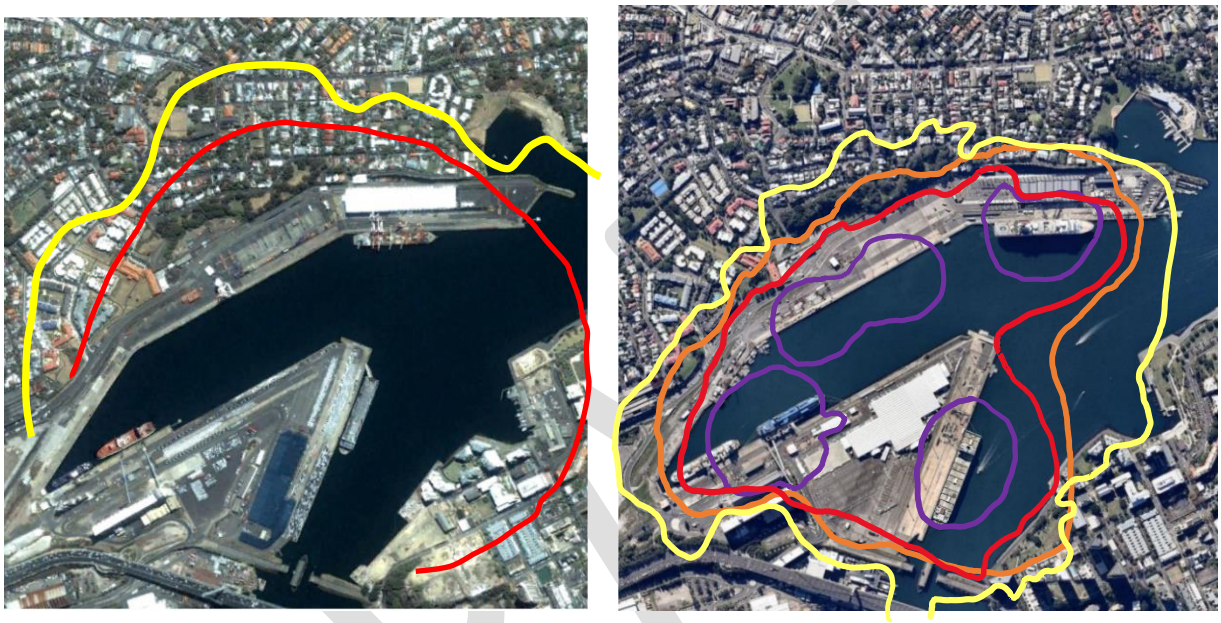
Changes in noise levels at Glebe Island and White Bay

C.1. Changes in port noise

The following figure summarises noise mapping completed in 1994 (based on nine vessels, measured as part of preparation for the White Bay and Glebe Island Master Plan) and 2019 (based on a typical peak period with five vessels). The purpose of noise mapping is to provide a broad overview of noise levels in the precinct. The 2019 figure also shows noise levels using purple and orange contours which are more representative of typical conditions at the port. Overall noise levels in the noise modelling maps show a reduction between 1994 and 2019 in most locations as the contours do not extend as far into surrounding areas.

Figure 8 Port noise levels from 1994 and 2019

1994 *2019*



Red Contour – 60dBA Temperature Inversion
Yellow Contour – 55dBA Temperature Inversion
Purple Contour – 60dBA Standard conditions
Orange Contour – 55dBA Standard conditions

The biggest changes in noise are near Pyrmont and Balmain. Noise levels have reduced near Pyrmont since 2009 after new car imports at Glebe Island ceased and also near White Bay berth 4 following the cessation of container operations.

The overall noise levels appear to reflect the number and type of ships in port. The current noise levels reflect the fact the port is operating with a historically low number of ship visits and less intensive landside activities.

C.2. Background noise levels

Background noise levels are established by measurement during a representative time period. Attended monitoring involves an operator attending the site and taking measurements. This has been completed by attended noise measurement (involving an operator attending the site and taking measurements) and subsequently by seven consecutive days of unattended measurement from an installed noise logger.

The main change to background noise levels (excluding the port activities) occurred following the completion of the ANZAC Bridge in 1995. Background noise levels (L_{A90}, which is the noise level is exceeded for 90 per cent of the measurement period) at different locations in the port now correlate to L_{Aeq} traffic noise emission from the bridge when ships are not in port. The figure below shows the predicted noise levels from ANZAC Bridge.

Figure 9 Daytime traffic noise levels

Figure 10 Night time traffic noise levels

Influence of the port and wind on background noise levels

The noise levels from individual proponents are sporadic and increase when a ship is in port. This may cause the background noise levels at other berths to vary significantly throughout the year. This can lead to different intrusiveness criteria (background + 5dBA) depending on when the logging was completed. An outcome of this is that a single residence may have different criteria applicable for different operators within the port and even while utilising the same berth.

Another factor which may change background noise levels by 5dBA is wind direction. Noise levels downwind of a source may be up to 5dBA higher in winder conditions as the weather directs more noise to the receiver. This becomes most pronounced at distances greater than 200m. For example, noise levels from ANZAC Bridge, which dominate the background noise levels in the absence of port activity, may vary by 5dBA at Balmain depending on wind direction. This can lead to different background plus 5dBA criteria depending on which days and time of year noise levels were logged.

This effect also applies to background noise levels from existing ships since in most instances the distance between adjacent receivers near a new proponent and other proponents is greater than 200m. The orientation of the other vessels (port side or starboard side to the berth) during logging may also change background noise levels as many vessels emit different amounts of noise in different directions. For example, a vessel may emit 10dBA more noise out of the port side than the starboard side due to fan orientations.

The issue of the wind direction's influence on background noise levels is less pronounced for smaller industrial precincts or when receivers are close to other industry.

Background noise levels also may vary between nearby residences even when noise from industrial sites and wind conditions are constant. This may be due to:

- Shielding by buildings, topography and barriers between the main source of noise and the receiver location.
- Self shielding by an individual building, background noise levels may be different between each façade.
- Localised noise sources such as air conditioning, water features, pumps and rustling foliage from individual trees in exposed locations such as a port. These sources can cause variations in background noise level over short distances in an urban area.

These localised variations can make the design and specification of at-receiver treatments complex when based on exceedance of background plus 5dBA criteria as the background is only known at the measurement location. The actual background level is not known for each residence over the wider area. Given that at-receiver treatments are designed to reduce internal noise levels it could be argued whether it is equitable to base their design on exceedances of an estimated external background noise level. It may be more equitable to design at-receiver treatments to produce a similar internal noise level from port noise across a community.

Appendix D

Comparison with criteria for other vehicles

D.1. Overview

All vehicles used in the transportation of passengers and freight have individual criteria set for the vehicle, except for vessels. The vehicles with individual noise targets include:

- cars
- trucks
- buses
- aircraft
- rail locomotives
- carriages

These targets ensure that noise levels for each of these vehicles, within their class, are reasonably similar without noisy outliers. Routine checks are also generally made against the noise targets to ensure the vehicle is being maintained in good working order that is consistent with the noise target when it was registered.

The formal noise targets and associated regulations provide a mechanism to gradually reduce noise over time as technology and expectations change.

Since the vehicles have defined noise targets, the accumulative noise exposure from multiple vehicles using transport infrastructure may be reliably predicted as the noise emission from each vehicle is within known bounds. The noise exposure level is then used to assess noise impact and guide the design of noise mitigation.

Within Australia the exposure levels for road and rail generally use L_{Aeq} metrics over time periods of less than 24 hours. While aircraft use an annual exposure level. These exposure levels consider the noise level of the vehicle and duration of exposure when present and also the duration of silence in the absence of that vehicle. An exposure metric is most relevant to evaluate noise impacts where each individual source is only present for a limited time duration and where it is difficult to estimate when multiple vehicles may be present at the same time and what combinations of vehicle types may occur at the same time. The exposure metric allows noise exposure maps to be produced of the infrastructure to inform the community and planning decisions.

This Port Noise Policy represents the first noise targets set for individual vessels while at berth either in Australia or internationally. This means that it is problematic to meaningfully model and predict existing and future noise exposure from a port as the noise emission from many current and future vessels is unknown. It is also problematic to regulate noise emission from a port when the vessels do not have any design standards for noise.

An analogous example in transportation to vessels, where noise emission is currently unregulated, is heavy vehicle engine compression brake noise. The solution proposed by the National Transport Commission is to set a criterion at a level that can be reasonably achieved. Outlier vehicles that exceed this standard are known to cause community complaint and also cause an increase in traffic noise exposure.

The following sections outline the individual targets for the various vehicles and the noise exposure criteria that have been developed for noise mapping and evaluation of noise mitigation.

D.2. Aircraft

Individual aircraft

Australia's *Air Navigation (Aircraft Noise) Regulations 2018* require, under Commonwealth law, that all aircraft operating in Australia comply with noise standards introduced under the Convention on Civil Aviation. The standards are set out in the International Civil Aviation Organization's (ICAO) Environmental Protection document.

The noise level characteristics of an aircraft are documented as the effective perceived noise in decibels (EPNdB). The outcome of this regulation is that noise levels from different aircraft of the same classification are similar and that over time noise levels from aircraft are reduced.

There are currently no equivalent international or domestic standards for vessels.

Airport infrastructure and surrounding development

Ports and airports are both critical pieces of national infrastructure. Australia uses noise maps with 20 year projections of aircraft noise to implement planning controls for residential development affected by airports. The noise maps are expressed using a noise exposure metric developed for aircraft noise that is related to community annoyance. The metric relates intermittent and variable noise from aircraft flyovers to an average number. These maps are developed for existing and planned airports and are managed by the Federal Government through the Department of Infrastructure, Regional Development and Cities.

An example of a noise map is illustrated in Figure 11 for Sydney Airport for the year 2033. The noise contours for a new or upgraded airport are used to identify which receivers are eligible for mitigation by the airport and for new receivers the map is used to identify where residential and commercial developers of new buildings are required to address noise impacts. The actions to be undertaken within each noise contour band are defined by *Australian Standard - Aircraft noise intrusion, Building siting and construction*.

These maps are also produced for proposed airports. An example application is that developers have been required to design for future noise from Badgery's Creek Airport (now Western Sydney Airport) for at least the last 10 years.

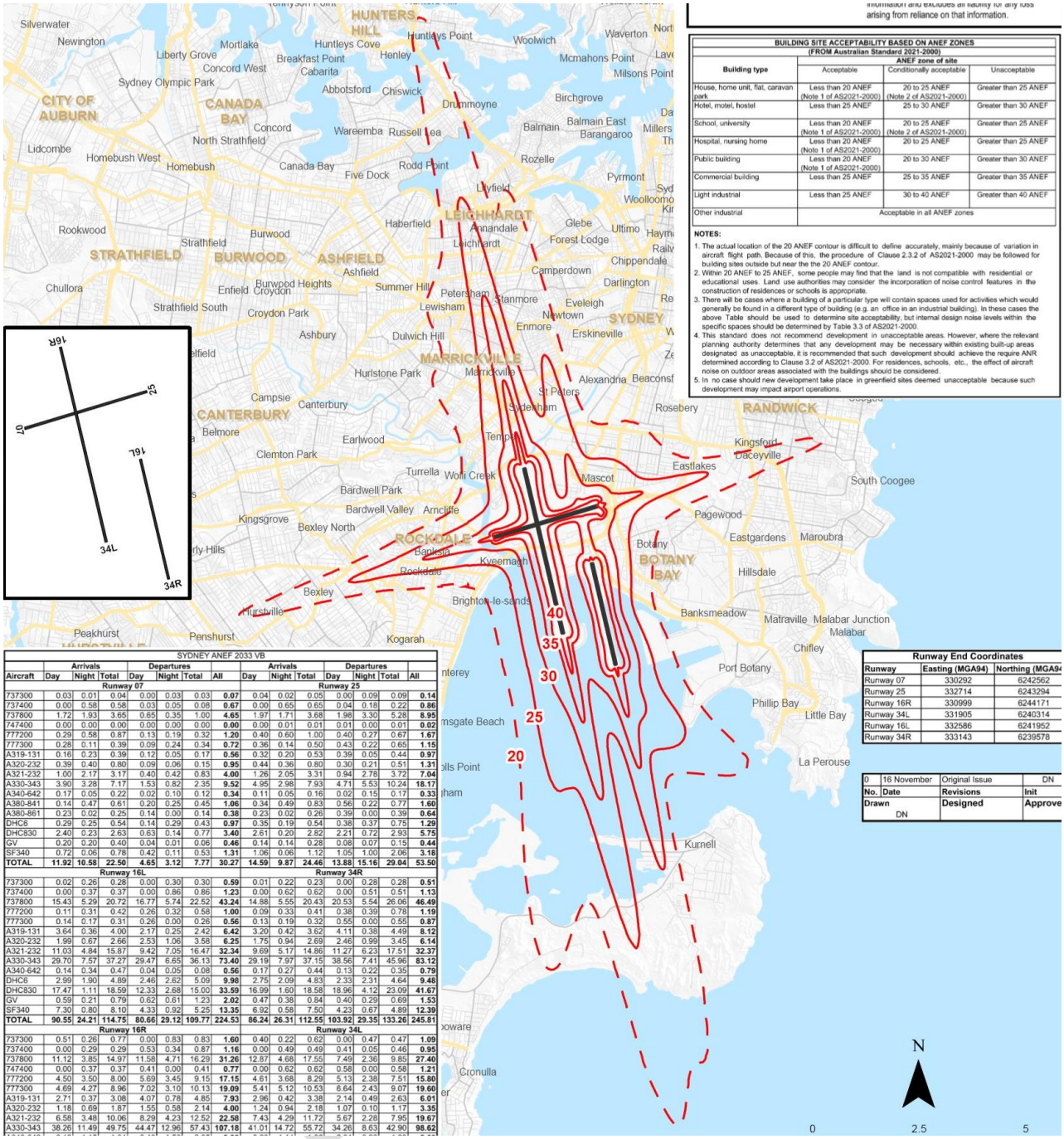
Noise associated with aircraft maintenance and other ancillary operations are assessed under New South Wales industrial criteria and have a greater opportunity to be mitigated using standard approaches for industrial sites.

For ports, where berths are regularly empty, the intermittency of noise exposure has some common elements with aircraft noise. Both ports and airports are also critical pieces of national infrastructure. The criteria and triggers for the mitigation of aircraft noise are based on fixed values and do not relate to background L_{A90} noise levels.

New Zealand has also recognised the similarity between the management of noise from airports and ports. This is reflected in *NZS:6809 Standard for Port Noise Management and Land Use Planning* which acknowledges *NZS 6805:1992 Airport noise management and land use planning.* The airport noise standard was developed seven years before the port standard.

Aircraft noise maps are considered over an annual period which provides enough averaging time to account for seasonal variations in air travel demand, various aircraft types, different runway configurations due to various wind conditions and variable flight paths due to weather and safety requirements.

Figure 11 **Sydney Airport Australian Noise Exposure Forecast (ANEF) map for 2033**



BUILDING SITE ACCEPTABILITY BASED ON ANEF ZONES (FROM Australian Standard 2021-2000)			
Building type	ANEF zone of site		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF (Note 2 of AS2021-2000)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF (Note 2 of AS2021-2000)	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 25 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

NOTES:

1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight path. Because of this, the procedure of Clause 2.3.2 of AS2021-2000 may be followed for building sites outside but near the the 20 ANEF contour.
2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider the incorporation of noise control features in the construction of residences or schools is appropriate.
3. There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases the above Table should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3 of AS2021-2000.
4. This standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the require ANR determined according to Clause 3.2 of AS2021-2000. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.
5. In no case should new development take place in greenfield sites deemed unacceptable because such development may impact airport operations.

Runway End Coordinates		
Runway	Easting (MGA94)	Northing (MGA94
Runway 07	330292	6242562
Runway 25	332714	6243294
Runway 16R	330999	6244171
Runway 34L	331905	6240314
Runway 16L	332586	6241952
Runway 34R	333143	6239578

No.	Date	Revisions	Init
0	16 November	Original Issue	DN
Drawn DN		Designed	Approve

SYDNEY ANEF 2033 VB

Aircraft	Arrivals Day	Arrivals Night	Arrivals Total	Departures Day	Departures Night	Departures Total	All	Arrivals Day	Arrivals Night	Arrivals Total	Departures Day	Departures Night	Departures Total	All
	Runway 07							Runway 25						
737300	0.03	0.01	0.04	0.00	0.03	0.03	**0.07**	0.04	0.02	0.05	0.00	0.09	0.09	**0.14**
737400	0.00	0.58	0.58	0.03	0.05	0.08	**0.67**	0.00	0.65	0.65	0.04	0.18	0.22	**0.86**
737800	1.72	1.93	3.65	0.65	0.35	1.00	**4.65**	1.97	1.71	3.68	1.98	3.30	5.28	**8.95**
747400	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.01	0.01	0.01	0.00	0.01	**0.02**
777200	0.29	0.58	0.87	0.13	0.19	0.32	**1.20**	0.40	0.60	1.00	0.40	0.27	0.67	**1.67**
777300	0.28	0.11	0.39	0.09	0.24	0.34	**0.72**	0.36	0.14	0.50	0.43	0.22	0.65	**1.15**
A319-131	0.16	0.23	0.39	0.12	0.05	0.17	**0.56**	0.32	0.20	0.53	0.39	0.05	0.44	**0.97**
A320-232	0.39	0.40	0.80	0.09	0.06	0.15	**0.95**	0.44	0.36	0.80	0.30	0.21	0.51	**1.31**
A321-232	1.00	2.17	3.17	0.40	0.42	0.83	**4.00**	1.26	2.05	3.31	0.94	2.78	3.72	**7.04**
A330-343	3.90	3.28	7.17	1.53	0.82	2.35	**9.52**	4.95	2.98	7.93	4.71	5.53	10.24	**18.17**
A340-642	0.17	0.05	0.22	0.02	0.10	0.12	**0.34**	0.11	0.05	0.16	0.02	0.15	0.17	**0.33**
A380-841	0.14	0.47	0.61	0.20	0.25	0.45	**1.06**	0.34	0.49	0.83	0.56	0.22	0.77	**1.60**
A380-861	0.23	0.02	0.25	0.14	0.00	0.14	**0.38**	0.23	0.02	0.26	0.39	0.00	0.39	**0.64**
DHC6	0.29	0.25	0.54	0.14	0.29	0.43	**0.97**	0.35	0.19	0.54	0.38	0.37	0.75	**1.29**
DHC830	2.40	0.23	2.63	0.63	0.14	0.77	**3.40**	2.61	0.20	2.82	2.21	0.72	2.93	**5.75**
GV	0.20	0.20	0.40	0.04	0.01	0.06	**0.46**	0.14	0.14	0.28	0.08	0.07	0.15	**0.44**
SF340	0.72	0.06	0.78	0.42	0.11	0.53	**1.31**	1.06	0.06	1.12	1.05	1.00	2.06	**3.18**
TOTAL	**11.92**	**10.58**	**22.50**	**4.65**	**3.12**	**7.77**	**30.27**	**14.59**	**9.87**	**24.46**	**13.88**	**15.16**	**29.04**	**53.50**
	Runway 16L							Runway 34R						
737300	0.02	0.26	0.28	0.00	0.30	0.30	**0.59**	0.01	0.22	0.23	0.00	0.28	0.28	**0.51**
737400	0.00	0.37	0.37	0.00	0.86	0.86	**1.23**	0.00	0.62	0.62	0.00	0.51	0.51	**1.13**
737800	15.43	5.29	20.72	16.77	5.74	22.52	**43.24**	14.88	5.55	20.43	20.53	5.54	26.06	**46.49**
777200	0.11	0.31	0.42	0.26	0.32	0.58	**1.00**	0.09	0.33	0.41	0.38	0.39	0.78	**1.19**
777300	0.14	0.17	0.31	0.26	0.00	0.26	**0.56**	0.13	0.19	0.32	0.55	0.00	0.55	**0.87**
A319-131	3.64	0.36	4.00	2.17	0.25	2.42	**6.42**	3.20	0.42	3.62	4.11	0.38	4.49	**8.12**
A320-232	1.99	0.67	2.66	2.53	1.06	3.58	**6.25**	1.75	0.94	2.69	2.46	0.99	3.45	**6.14**
A321-232	11.03	4.84	15.87	9.42	7.05	16.47	**32.34**	9.69	5.17	14.86	11.27	6.23	17.51	**32.37**
A330-343	29.70	7.57	37.27	29.47	6.65	36.13	**73.40**	29.19	7.97	37.15	38.56	7.41	45.96	**83.12**
A340-642	0.14	0.34	0.47	0.04	0.05	0.08	**0.56**	0.17	0.27	0.44	0.13	0.22	0.35	**0.79**
DHC6	2.99	1.90	4.89	2.46	2.62	5.09	**9.98**	2.75	2.09	4.83	2.33	2.31	4.64	**9.48**
DHC830	17.47	1.11	18.59	12.33	2.68	15.00	**33.59**	16.99	1.60	18.58	18.96	4.12	23.09	**41.67**
GV	0.59	0.21	0.79	0.62	0.61	1.23	**2.02**	0.47	0.38	0.84	0.40	0.29	0.69	**1.53**
SF340	7.30	0.80	8.10	4.33	0.92	5.25	**13.35**	6.92	0.58	7.50	4.23	0.67	4.89	**12.39**
TOTAL	**90.55**	**24.21**	**114.75**	**80.66**	**29.12**	**109.77**	**224.53**	**86.24**	**26.31**	**112.55**	**103.92**	**29.35**	**133.26**	**245.81**
	Runway 16R							Runway 34L						
737300	0.51	0.26	0.77	0.00	0.83	0.83	**1.60**	0.40	0.22	0.62	0.00	0.47	0.47	**1.09**
737400	0.00	0.29	0.29	0.53	0.34	0.87	**1.16**	0.00	0.49	0.49	0.41	0.05	0.46	**0.95**
737800	11.12	3.85	14.97	11.58	4.71	16.29	**31.26**	12.87	4.68	17.55	7.49	2.36	9.85	**27.40**
747400	0.00	0.37	0.37	0.41	0.00	0.41	**0.77**	0.00	0.62	0.62	0.58	0.00	0.58	**1.21**
777200	4.50	3.50	8.00	5.69	3.45	9.15	**17.15**	4.61	3.68	8.29	5.13	2.38	7.51	**15.80**
777300	4.69	4.27	8.96	7.02	3.10	10.13	**19.09**	5.41	5.12	10.53	6.64	2.43	9.07	**19.60**
A319-131	2.71	0.37	3.08	4.07	0.78	4.85	**7.93**	2.96	0.42	3.38	2.14	0.49	2.63	**6.01**
A320-232	1.18	0.69	1.87	1.55	0.58	2.14	**4.00**	1.24	0.94	2.18	1.07	0.10	1.17	**3.35**
A321-232	6.58	3.48	10.06	8.29	4.23	12.52	**22.58**	7.43	4.29	11.72	5.67	2.28	7.95	**19.67**
A330-343	38.26	11.49	49.75	44.47	12.96	57.43	**107.18**	41.01	14.72	55.72	34.26	8.63	42.90	**98.62**

D.3. Road

Individual vehicles

To provide consistency in noise emission from roads and to also prevent community annoyance from noisy vehicles, all road worthy vehicles in Australia must comply with the *Australian Design Rules*. The *Australian Design Rules* specify maximum permitted noise levels for light and heavy vehicle classes with some additional allowances for heavy vehicles of different tonnage.

An outcome of the *Australian Design Rules* is that road worthy vehicles within each class all have similar noise levels and emit noise at a level that the community is accustomed to hearing. Transport for NSW (formerly Roads and Maritime Services) assists EPA with management of heavy vehicle noise through their heavy vehicle inspection stations.

The noise requirement in the *Australian Design Rules* is that a vehicle must be quieter than a prescribed level at a reference distance. The noise requirement from time to time is updated to a more stringent level which over time acts to reduce the noise from vehicles on Australia's roads.

There are also actions to reduce noise from heavy vehicles in the NSW *Government Long Term Transport Master Plan (Transport for NSW 2012)* and the NSW Government *Freight and Ports Strategy (Transport for NSW 2013)*. One form of heavy vehicle noise that is referred to in the transport masterplan and freight and ports strategy is engine compression brake noise which is currently unregulated. The Australian Design Rules do not discuss engine compression brakes which are not a specific legal requirement.

The National Transport Commission in coordination with Transport for NSW, RMS and other State's transport agencies has developed a draft model law and test procedure which may be enacted under Commonwealth law once trials have been completed. This approach seeks to create an infringement for uncharacteristically noisy engine compression brakes which according to the Regulatory Impact Statement reflect 2% of the nation's heavy vehicle fleet.

There are no equivalent design requirements or management approaches for vessels. This means that there is a wide range in noise levels between different vessels and ones that are uncharacteristically noisy generate community complaints.

Road infrastructure

The EPA outlines criteria for noise emission from roads in New South Wales in the Road Noise Policy. The exposure time and averaging for roads for noise measurement is generally based on 7 days worth of data to produce exposure averages for the day and night time periods using an L_{Aeq} noise descriptor.

Annual traffic volumes are used and converted to an equivalent daily day and night time traffic volume for noise mapping, the design of roads and the assessment of noise mitigation.

The use of annual traffic volumes ensures that the modelled noise levels are reflective of typical annual noise exposure rather than being influenced by seasonal effects.

The EPAs road noise policy covers different road types and whether the road is an upgrade or a new road. How these criteria are to be interpreted and assigned to road projects is outlined by Roads and Maritime Services' Noise Criteria Guideline. A summary of the road criteria is presented in Table 7. Typical night time criteria for roads are similar to measured ship noise levels at the port.

Table 7 NSW road traffic noise criteria

Road category Type of project/land use	Assessment criteria (external)	
	Day (7am–10pm)	**Night (10pm–7am)**
Freeway/ arterial/ sub-arterial roads		
1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55	$L_{Aeq, (9\ hour)}$ 50
2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 60	$L_{Aeq, (9\ hour)}$ 55
3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads		
4. Existing residences affected by noise from new local road corridors	$L_{Aeq, (1\ hour)}$ 55	$L_{Aeq, (1\ hour)}$ 50
5. Existing residences affected by noise from redevelopment of existing local roads		
6. Existing residences affected by additional traffic on existing local roads generated by land use developments		
In areas with very low existing traffic noise		
7. Existing residences affected by noise from new roads	$L_{Aeq, (Period)}$ 42-55	$L_{Aeq, (Period)}$ 42-50
8. Existing residences affected by noise from existing roads	$L_{Aeq, (Period)}$ 42-60	$L_{Aeq, (Period)}$ 42-55

Roads and Maritime Services' *Noise Mitigation Guideline* outlines the process for managing exceedances of the criteria by identifying reasonable and feasible noise mitigation. It should be noted that exceedance of noise does not necessarily result in noise mitigation. Noise mitigation is generally considered reasonable where noise levels have increased by more than 2dBA and exceed criteria or are 5dBA or more above noise criteria.

Roads and Maritime Services' *draft At-receiver Noise Treatment Guideline* outlines approaches to specify noise mitigation so that internal noise levels are 20dBA less than the external noise criteria with windows closed. For the case of road traffic noise, which has a set amenity level, the outcome are internal noise levels that meet the requirements of *Australian Standard 2107 Recommended design sound levels and reverberation times for building interiors.*

The road criteria and triggers for noise mitigation relate to fixed values relative to existing traffic noise and do not relate to background L_{A90} noise levels. This means for a road with given traffic parameters compliance will be achieved at the same distance at any location. This is not the case for ports where noise emission and exceedances usually relate to background noise levels.

Noise Abatement Program

RMS has a noise abatement program to reduce noise at residences affected by existing roads that are not currently the subject of a road upgrade. Around $12 million dollars of funding per annum is available for the

construction of noise barriers and the installation of at-receiver treatment which includes upgraded doors, windows, seals and fresh air ventilation.

A receiver may be eligible for treatment where external noise levels are equal to or exceed 65dBA $L_{Aeq,15hr}$ in the daytime or 60dBA $L_{Aeq\ 9hr}$ at night. Note that maximum noise levels are usually much higher than these thresholds during the passby of an individual vehicle.

Encroaching development

Road transport infrastructure and the occupants of new buildings in NSW are afforded protection through *State Environmental Planning Policy (Infrastructure) (ISEPP)* and council planning conditions. ISEPP establishes controls for roads with an Average Annual Daily Total (AADT) greater than 20,000. For lower AADT, the responsibility for implementing controls is through the local council. The ISEPP and council controls place requirements on developers of new buildings and occupants sensitive to road traffic noise constructed near roads.

For road traffic noise ISEPP states the following:

> *Clause 102: Development for any of the following purposes that is on land in or adjacent to a road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data available on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration: building for residential use a place of public worship a hospital an educational establishment or childcare centre*
>
> *Clause 103: Any development which involves penetration of the ground to a depth of at least 3m below ground level (existing) on land that is the road corridor of roads or road projects as specified in schedule 2 of the SEPP.*
>
> *For clauses 87 (rail) and 102 (road): If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> *-35dBA at any time 10pm–7am in any bedroom in the building*
> *-40dBA at any time anywhere else in the building (other than a garage, kitchen, bathroom or hallway)*

The Department of Planning also published a guideline to assist in the design of buildings for road and rail titled *Development Near Rail Corridors and Busy Roads – Interim Guideline (2008)*.

There are currently no equivalent planning policies or guidelines for the construction of buildings near ports.

D.4. Rail noise

Individual locomotives and wagons

Within the NSW State Government managed rail network there is an environment protection licence which places requirements on noise emission from individual locomotives. The requirements are relevant where locomotives are being introduced to the rail network for the first time or have been substantially modified since operating on the rail network. The noise requirements are set out in Table 8.

Table 8 Environment Protection Licence requirements for locomotives on the State Government managed rail network

Operating condition	Speed and external location	External noise limit
Low idle with compressor radiator fans and air conditioning operating at maximum load occurring at low idle	Stationary, 15 metre contour, except end positions (front and rear)	70 dB $L_{Amax, F, 30s}$
All other throttle settings under self-load with compressor, radiator fans and air conditioners operating	Stationary, 15 metre contour, except end positions (front and rear)	87 dB $L_{Amax, F, 30s}$ 95 dB $L_{ZMax, F, 30s}$

Tonality requirements are included on the basis of third octave band analysis.
• No third octave band below 160 Hz to exceed 15 dBA above both adjacent bands
• No third octave band 160 Hz to 400 Hz to exceed 8 dBA above both adjacent bands
• No third octave band above 400 Hz to exceed 5 dBA above both adjacent bands
The overall linear noise level is to also not exceed the overall A-weighted noise level by more than 15 dB

It was reported in the 2017 Australian Acoustics Society conference publication, *Beyond Industry vs Government: A Partnership Approach to Managing Freight Rail Noise in NSW*, that approximately 70% of the locomotives operating on the network meet the licence requirements.

In addition to the environmental protection licences, various pollution reduction programs have been implemented which are legally binding on the licensee. These have addressed noise from wagons and specific mechanisms of noise generation.

As with noise from heavy vehicles there are actions for rail noise in the NSW Government *Long Term Transport Master Plan* and the NSW Government *Freight and Ports Strategy*.

There is not currently any environmental protection licence that places performance requirements on individual vessels in a port. Any environmental protection licences have related to industrial noise criteria at residences.

Freight Noise Attenuation Program

The *Freight Noise Attenuation Program (FNAP*) has allocated $50 million over 10 years to provide at-receiver treatments to residences exposed to high levels of freight rail noise (Transport for NSW, *Freight Noise Attenuation Program 2017*). This includes upgraded windows, doors, seals and fresh air ventilation.

The motivation behind the program was that noise was identified as a barrier to improving efficiency of goods transportation by rail. It was designed to provide relief to residents in the short term, while at-source noise controls are developed and implemented.

A receiver may be eligible for treatment where external noise levels are equal to or exceed 70dBA $L_{Aeq\ 15hr}$ in the daytime or 65dBA $L_{Aeq\ 9hr}$ at night. Note that maximum noise levels are usually much higher than these thresholds during the passby of an individual locomotive or wagon.

Rail infrastructure

Rail noise, like road noise, has a specific NSW EPA guideline and criteria. This guideline is called the *Rail Infrastructure Noise Guideline (2013)* and sets out noise trigger levels (criteria).

Type of development	Noise trigger level dB(A) external	
	7 am – 10 pm	**10 pm – 7 am**
New rail line development	60 $L_{Aeq(15h)}$ or 80 L_{AFmax}	55 $L_{Aeq(9h)}$ or 80 L_{AFmax}
Redevelopment of existing rail line	65 $L_{Aeq(15h)}$ or 85 L_{AFmax}	65 $L_{Aeq(15h)}$ or 85 L_{AFmax}

Mitigation is considered where noise level triggers are exceeded for new developments. For the upgrade of existing rail corridors the consideration of feasible and reasonable mitigation is triggered where L_{Aeq} noise levels exceed criteria and increase by 2dB or more, or existing rail L_{Amax} noise levels exceed criteria and increase by 3dB or more.

Typical noise levels from vessels at receivers are similar to the criteria for new rail lines and quieter than the noise criteria for the redevelopment of existing rail lines.

D.5. Vehicles operating within an industrial premise

Vehicles operating on land within an industrial site such as on private railway lines, roads or haul roads, and airport facilities are commonly assessed against the *Noise Policy for Industry*. However, these differ from vessels and may be separated into two categories.

The first category are those vehicles which are not part of that site and operate on public infrastructure and in public airspace. These vehicles are visitors to the site. All of these vehicles already have individual noise targets based on the various criteria and regulations previously described in this appendix.

The second category of vehicles are those which are captive and only operate within the industrial site. Noise emission from these vehicles may be tightly controlled and designed to meet the relevant noise criteria.

Vessels are different as they do not fit within either of these categories. They currently do not have any individual noise targets and they are not captive to the site. Operationally they are closer to the first category but, in the absence of the Port Noise Policy, do not have individual noise targets.

D.6. Encroaching development

As with roads, rail infrastructure and the amenity of nearby residents is afforded a degree of protection under the *State Environmental Planning Policy (Infrastructure) (ISEPP)*. For rail noise ISEPP states the following:

> *Clause 85: any development on land that is in or immediately adjacent to a rail corridor, if the development is: likely to have an adverse effect on rail safety; involves the placing of a metal finish on a structure and the rail corridor concerned is used by electric trains, or; involves the use of a crane in air space above any rail corridor.*
>
> *Clause 86: any development (other than development to which clause 88 of the Infrastructure SEPP applies) that involves the penetration of the ground to a depth of at least 2m below ground level (existing) on land that is: within or above a rail corridor; or within 25m (measured horizontally) of a rail corridor; or within 25m (measured horizontally) of the ground directly above an underground rail corridor Note: the consent authority must not grant consent without consulting with the rail authority and obtaining concurrence consistent with clauses 86(2)–(5).*
>
> *Clause 87: Development for any of the following purposes that is on land that is in or immediately adjacent to a rail corridor and the consent authority considers development is likely to be adversely affected by rail noise or vibration: building for residential use a place of public worship a hospital an educational establishment or childcare centre*
>
> *For clauses 87 (rail) and 102 (road): If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
>
> *-35dBA at any time 10pm–7am in any bedroom in the building*
> *-40dBA at any time anywhere else in the building (other than a garage, kitchen, bathroom or hallway)*

The Department of Planning's guideline *Development Near Rail Corridors and Busy Roads – Interim Guideline (2008)* provides detailed guidance for the design of buildings.

Again, there are no equivalent planning policies or guidelines for the construction of buildings near ports.

Appendix E

Factors influencing vessel noise

E1. Sources of air-borne noise

A vessel is essentially self-sufficient in providing accommodation and a workplace for crew. This requires the generation of electricity for the accommodation and workplace and also to drive fresh air ventilation of areas such as habitable spaces, cargo holds and engine rooms. When at berth the main form of continuous noise is the generators and ventilation systems. Depending on the vessel either the noise from the ventilation systems or generators may dominate unless the vessel is loading or unloading cargo. On some vessels the loading or unloading of cargo may increase noise levels from the ship in addition to the cargo operations due to extraction systems and increased load on the electrical power generators.

E2. Measurement

There are two potential ways to measure vessel noise. The first is to assess the noise emission of the vessel. This is not an easy task as a commercial ship may be over 200m in length with noise sources over 35m above the berth. There are a large number of parameters to take into account and difficulties in measurement in a port location. This is not commonly done due to these challenges, however it does allow accurate noise maps of ship noise to be produced and options to mitigate noise at the source to be identified.

The second way to measure vessel noise, and the most common, is to take a measurement at a location chosen to measure environmental compliance. Compliance measurements are useful to evaluate impacts at a particular location with a certain orientation and elevation relative to the vessel, but they do not directly allow predictions to be made of noise levels in other locations at different relative orientations and heights.

Full measurement of the vessel noise is uncommon and there are no test procedures or standards that set out consistent approaches to undertake this assessment. In most instances environmental modelling is undertaken using data from environmental compliance measurements and applied in a model using some conservatism to manage risk.

The EU based committee, **N**oise **E**xploration **P**rogram **T**o **U**nderstand **N**oise **E**mitted by **S**eagoing Ships (NEPTUNES), has developed the *Noise Measurement Protocol Moored Ships* to improve the consistency of ship noise measurement. At this point the procedure does not provide an approach for full characterisation but introduces an approach to ensure measurement approaches are robust and that data provides an indication of relative noise levels between different vessels.

Detailed discussion of noise measurement and relevant descriptors is contained within Appendix F.

Descriptors

Noise levels from industry and vessels are normally measured in L_{Aeq} which is an averaging parameter on a sound energy basis. The value produced by this averaging parameter includes any steady noise sources and the effects of shorter-term peaks and troughs. In a port situation and particularly at the recommended measurement distance of 200m in the NEPTUNES Protocol, extraneous noise sources (natural and urban sounds) may begin to have a significant influence or even dominate measured noise levels. The distance of 200m is recommended to minimise measurement error for an object as large as a ship.

Extraneous noise can make measurements problematic due to the conflicting requirement of needing larger distances due to the size of the ship but also needing to be close enough so noise from the vessel is loud enough to be reliably measured.

Typically, different times within a 24 hour period may be identified where extraneous noise is lower which may facilitate noise measurement. However, in the case of many cruise ship visits at White Bay Cruise Terminal, the vessels are rarely berthed during quiet periods at night. Measurements completed by Spoke Acoustics during the daytime at Grafton Street, Balmain were sometimes reliable for noisier vessels but for most vessels required measurements to be paused during periods of extraneous noise. However, to obtain the recommended 5 minutes of data in the NEPTUNES Protocol the duration of the measurement was up to 1 hour and 10 minutes when allowing for periods when the measurement had to be paused to eliminate extraneous noise.

Where noise emission from the ship is constant over the measurement period other statistical parameters may be used to detect the vessel in the presence of extraneous noise. When appropriately selected, these statistical parameters can identify the quieter periods during the measurement when the ship dominates in the absence of louder extraneous noise sources. Examples of useful statistical parameters are the minimum noise level, the lowest 1st percentile, the lowest 5th percentile and the lowest 10th percentile noise levels which are written as L_{Amin}, L_{A99}, L_{A95} and L_{A90} respectively.

In many instances ship noise is only quasi-steady and may have minor fluctuations. In this instance a correction factor between the percentile parameter and L_{Aeq} may be required to ensure that the noise measurement captures a representative level rather than the minimum noise level produced by the vessel.

The NSW EPA requires the consideration of other modifying factors such as tonality, intermittency and low frequency for industrial noise sources. Where parameters at a noise sensitive receiver exceed defined thresholds a penalty of up to 5dBA may be applied for each of these factors. Where there is more than one factor present the total value of penalties is capped at 10dBA. In contrast criteria in guidelines for other forms of transportation noise such as road traffic noise, rail noise and aircraft noise receive no penalties even though annoying characteristics, that may otherwise be subject to a modifying factor, may be present. This is because the modifying factors are an inherent part of the noise source and already considered in the transportation specific noise criteria under their respective guidelines and standards.

For vessels specific research has not been completed to identify vessel criteria that includes penalties for annoying characteristics. Appendix F of this policy identifies that target levels set for vessels should include consideration of annoying characteristics and that standard approaches used for industrial sources may be problematic when evaluating low frequency noise. Appendix F outlines that approaches to include low frequency noise need to be developed. These new approaches may parallel those used in NSW for diesel locomotives where both A-weighted and Z-weighted noise levels are evaluated.

Directivity

Most noise sources have a degree of directivity which means that more noise is emitted in some directions compared with other directions. This is a consideration during measurement of noise from a vessel. For example, the engine/generator exhausts will send more noise in one direction, generally in the direction of the exhaust vent. The degree of directivity also changes with frequency. The structure of the ship and configuration of vent openings will influence the directivity of the fan and ventilation noise. Horns will also normally have a high degree of directivity.

Noise from ventilation systems may be highly directional with significantly more noise directed out one side of the vessel. A noise reduction of 10dBA was achieved for residences affected from one cargo vessel by orientating the vessel with the starboard side to residences rather than the port side.

Frequency content

Engine and generator noise is commonly thought of as low frequency and there is always a measurable low frequency component. The fundamental and low order firing modes of the diesel engine are low frequency and contribute to the general characteristics. An aspect that is often not considered is that some of the perceived noise level comes from the mid range to higher frequency noise from the burst of exhaust gas each time the engine fires at its fundamental. This periodic burst of exhaust gas is heard as a modulation which can give the perception of low frequency noise.

Fan noise may be low frequency but will generally be broad band depending on the fan speed, the number of blades and any acoustic treatments fitted into the ducts and vents. Flow noise from air ventilation systems is also generally broadband. Of note though is that a number of cruise and bulk goods vessels which have received complaints about low frequency noise all featured noise levels dominated by fans.

Vessels have noise content across a broad range of frequencies which may be in similar frequency bands to natural and urban extraneous noise. This makes compliance measurement more complex than other forms of noise emission from mechanical systems as broadband noise measurements are required.

Modulation

Modulation involves a rapid increase and decrease in noise level repeated periodically. This is inherent in combustion engine noise from the firing of each cylinder and relates strongly to the perceived power and sportiness of an engine. Some individual engines may feature this as a low frequency chugging noise.

Modulation also comes into play when there is more than one source with similar frequency and operating parameters operating within audible distances of each other and especially when they are located near each other. This can produce interference and reinforcement of the two noise levels, and is perceived as a strong chugging sound. Noise measurements at Glebe Island have on occasion shown modulation of around 7dBA once every second when two plumes of heat were evident from the exhaust stacks of a single vessel. The two plumes indicate that two engines or generators were running.

Factors that may influence measurements

Electrical load

At berth the main source of constant noise from vessels is the onboard generators that produce the electricity required to supply the vessel. The electrical load on the ship may vary, particularly on cargo vessels with extraction systems. This means generator noise levels can vary by about 8dBA, based on measurements at Glebe Island. Cruise ships appear to be steadier in their noise emission which is mostly likely due to relatively constant HVAC loads supplying accommodation. Cruise ship variation (based on WBCT measurements) may be around 2dBA to 3dBA depending on the ambient air temperature and associated HVAC cooling requirements.

Condition

Silencers and on-board conveyor extractions systems can deteriorate with age. Wear and tear may commonly account for around 10dBA change in noise level between different vessels, and for a single vessel at different points in time.

Appendix F
Vessel Noise Guideline

Appendix G

Landside Noise Guideline

Appendix H
Noise Standard

Appendix I

Noise Maps

Glossary

ANZAC Bridge is a major public road comprising of a 8 lane bridge spanning Glebe Island and Johnstons Bay at Pyrmont, forming part of the Western Distributor leading from the Sydney central business district and cross city tunnel to the inner west and northern suburbs of Sydney.

Cumulative Noise Level outlines the landside cumulative noise limits and total noise level from the precinct at representative locations around the port.

Cumulative Noise Limit is the maximum noise level that could be permitted by the port precinct following successive industrial developments in the port.

Collective Benchmark Noise Level is the overall criteria applied to the total noise level from all landside operators within the port.

DA means development applications assessed under the Environment and Planning Assessment Act (1979) (NSW)

EPA means New South Wales Environment Protection Authority.

Feasible and reasonable has the same meaning as defined in the Noise Policy for Industr**y**

Maximum Permissible Noise Level is the component of the cumulative port precinct noise criteria that has been allocated to an individual berth, facility or tenant.

Noise Descriptors these are noise statistical noise parameters. In general, noise levels in any location vary continuously and any sound level meter will show this changing decibel level on the display. To make sense of the range in noise levels that may occur within a standard time period, various statistics are used in acoustics. These noise descriptors may also have notation which describes the measurement period over which noise has to be measured and the letter 'A' or 'C' or 'Z' which denotes the weighting filter that was used.

An A-weighting filter is used to approximate the perceived loudness of noise levels at the moderate noise levels encountered in the outdoor environment from transportation and industrial noise.

A C-weighting filter was designed to approximate the perceived loudness of noise levels at higher noise levels than the A-weighting filter.

A Z-weighting filter is unfiltered between 10 Hz and 20kHz and is the same as a linear unfiltered response in this frequency range. By comparison linear includes all frequencies including those beyond our hearing range. It is now used instead of linear in noise standards. The negligible differences are defined so they make little difference in measurement but make it more economic to produce a sound level meter.

The simplest noise descriptors are the **L90**, **L50** and **L10** descriptors. The number in each of these descriptors indicates the percentage of time that noise levels exceed the indicated value. For example an **LA90** is the noise level that was exceeded 90% of the time, **LA50** is the noise level that was exceeded 50% of the time (also the median) and **LA10** is the noise level that was exceeded 10% of the time, each using an A-weighting filter.

LAmax is the maximum noise level averaged over 1/8 of a second for the purposes of measuring industrial, vessel, road and rail noise in NSW.

Leq is equivalent sound pressure level minus the stead sound level (dB) that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.

LAeq is an Leq which has had the noise levels adjusted with an A-weighted filter (dBA).

LCeq is an Leq which has had the noise levels adjusted with a C-weighted filter (dBC). At these higher levels the human auditory system is more sensitive to low frequency noise. However for transport and industrial noise it is also used for moderate noise levels where the greater sensitivity to low frequency noise is used to help identify how much low frequency noise is present. For example if the LAeq and

LCeq noise levels both measure 54dBA and 54dBC respectively then there is little low frequency noise present. However if the LCeq noise level is 58dBC then this indicates the presence of some low frequency noise.

Noise Policy for Industry means the New South Wales Environment Protection Authority Noise Policy for Industry published in 2017 and available at www.epa.nsw.gov.au.

Planning and Assessment Act means *Environmental Planning and Assessment Act 1979* (NSW).

Vessel Trigger Noise Level are the noise levels that must be met by a vessel at a berth otherwise the Vessel Noise Operating Protocol will be triggered and actions potentially taken against the vessel. Trigger levels are set for each berth and are applied at the worst affected sensitive receiver. Trigger levels may include a number of noise parameters including L_{Aeq}, L_{Ceq} and L_{Amax}.

Worst affected noise sensitive receiver is a term that describes the main receiver of interest when assessing noise under the NSW EPA's Noise Policy for Industry. This may not be the closest building as the closest building use may not be deemed sensitive under the NSW EPA Noise Policy for Industry. Furthermore it may not be the closest residence due to factors such as shielding and elevation effects. However in most instances it is the closest residence to the berth.

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