Noise assessment methodology for land-use planning

Katie Teyhan (1) and Carl Fokkema (2)

(1) EMM Consulting Pty Limited, Newcastle, Australia
(2) EMM Consulting Pty Limited, Sydney, Australia

Abstract - This is a discussion paper relating to noise assessment practices for large industrial land releases. The aim is to promote discussion and collaboration on this topic and provide recommendations to improve the consistency and accuracy of such noise assessments. Through direct project experience we have gained valuable insight into regulator's expectations, opportunities and constraints in relation to the assessment and management of noise relating to land-use planning. Opportunities for improvement and clarification to the process outlined in the NSW Noise Policy for Industry (EPA, 2017) have been identified. Consistency in the noise assessment and modelling methodology, and developing an assessment framework, will increase certainty during the approval process. This will then lead to a more efficient development approval process and equitable outcomes for all stakeholders. Noise modelling methods and technical assumptions that could be utilised to predict and manage impacts from industrial land releases are described. Improving the accuracy and relevance of noise goals and noise modelling will enable relevant and practical outcomes to effectively manage noise from industrial areas in the future. The necessity to consider how the surrounding acoustical environment will change as the area and surrounds are developed is emphasised.

1 CONTEXT

Industrial land releases and subsequent industrial precincts are typically driven by economic demand and facilitated by government commitments to release land for employment zones and/or rezoning to support state or national infrastructure. Examples of such developments in NSW include Port Botany, Enfield Intermodal Facility, Western Sydney International Airport (WSI) incorporating Aerotropolis and Mamre Road Precincts as well as regional projects such as the Special Activation Precincts (SAPs) and Regional Job Precincts (RJPs). The area subject to such development typically requires convenient access to services and transport routes which, in turn, means they are often located near sensitive land uses, including existing or proposed residential areas. The areas may be 'greenfield' areas where there are few, if any, existing noise sources associated with commercial or industrial activity. This creates a situation where it may not be possible to retain the same level of amenity for existing neighbouring residential areas. Alternatively, the areas may be 'brownfield' and include existing uses where the identified area is subject to a significant expansion or intensification of uses.

Since the driver is typically economic demand, the planning and facilitation of these precincts is often significantly progressed before consideration is given to the potential change in amenity for nearby sensitive receptors. Although it is generally agreed that consideration of impacts to amenity should be considered as early as possible in the planning stages of such areas, challenges exist in this regard due to the high level of uncertainty regarding the likely end-user of the land, as well as the physical limitations of some areas to provide adequate separation distances between industrial uses and sensitive receptors. Hence, it is difficult to enable early consideration of the potential for residual noise impacts and how they can or will be managed.

Additional complexity can arise from changes in the location or density of noise sensitive receptors including:

- the introduction of new residential areas near to the precinct.
- changes in the density of existing residential land in or surrounding the precinct.
- mixed use developments, which could include residences, in or near the precinct.
- the introduction of new noise-sensitive developments, such as places of worship or childcare centres within the precinct (which are often permissible developments within an industrial zoning).

2 CURRENT NOISE POLICY

Noise policy for assessing and managing industrial noise across NSW is broadly summarised here. NSW Noise Policy for Industry (NPfI) 2017 (and the similarly structured NT Noise Management Framework Guideline (the guideline) dated September 2018 Version 0.1) are the only states to have noise policies that provide some level of technical guidance to assessing large existing or future clusters of industrial sources or uses that can be contained within a proposed expansion or new industrial area.

Other states utilise zoning levels, indicative noise levels, assigned levels, acoustic quality objectives and indicator levels. These are largely based on existing land use zoning for receivers. Victoria, South Australia and Western Australia consider the adjacent land use and zoning to determine noise limits to not unreasonably constrain development within permissible zones. In South Australia, the rezoning of land for a new industrial area would typically require the preparation of a detailed noise assessment to inform a change to the PlanSA Planning and Design Code and subsequent indicative noise levels for the subject precinct and surrounds.

The Victorian Moorabool Planning Scheme Ordinance 13.07-1S contains an objective “to protect community amenity, human health and safety while facilitating appropriate commercial, industrial, infrastructure or other uses with potential adverse off-site impacts”. Strategies outlined in this regard are:

- Ensure that use or development of land is compatible with adjoining and nearby land uses.
- Avoid locating incompatible uses in areas that may be impacted by adverse off-site impacts from commercial, industrial and other uses.
- Avoid or otherwise minimise adverse off-site impacts from commercial, industrial and other uses through land use separation, siting, building design and operational measures.
- Protect commercial, industrial and other employment generating uses from encroachment by use or development that would compromise the ability of those uses to function safely and effectively.

The intent of the Ordinance is embedded in most State’s planning legislation however there is very limited information available regarding methodology to appropriately predict and assess likely impacts from hypothetical, future industrial precincts.

In NSW, the NPfI is the principal guidance for the assessment of industrial-type noise. The increase in noise above background levels (i.e. the intrusiveness of a source) and the absolute level of noise are important factors in how a community will respond to industrial noise. The NPfI requires evaluation of both noise trigger level types: intrusiveness and amenity.

Industrial noise goals for individual developments are normally the lowest of the derived intrusiveness and amenity levels together with specific requirements in relation to noise characteristics (e.g. low frequency noise, tonal noise and maximum noise events in the night-time period). Given the nature of the proposed precinct is a cluster of yet unknown industries, the relevant amenity noise levels are typically applied as goals for the entire precinct.

Determining appropriate amenity levels is based on noise targets specific to land use and associated activities. These targets, outlined in Table 2.2 of the NPfI, relate only to industrial type noise and do not include road, rail and/or community noise. Where industrial noise exists in the area, it needs to be demonstrated that noise from new industry combined with that from existing will stay below the recommended amenity noise levels. Determination of the relevant receiver amenity area requires consideration of all aspects of Table 2.3 of the NPfI including:

- Typical planning zoning as provided in a standard planning instrument;
- Existing background noise levels; and
- Qualitative description of receiver area and characteristics of the acoustic environment.

To ensure that industrial noise levels, existing plus new, remain within the recommended amenity noise levels, a project amenity noise level of the recommended level minus 5dB would typically apply. This approach is based on a receiver being impacted by three to four individual industrial noise sources of equivalent noise levels. Where an existing cluster of industry, for example, an industrial estate or port area, is undergoing redevelopment and/or expansion and the development constitutes a single premises addition or expansion, with no other redevelopment planned in the foreseeable future, the preceding approach can be applied. Where a greenfield or redevelopment of an existing cluster of industry consisting of multiple new noise-generating premises is proposed, the NPfI recommends Equation 1 (refer Figure 2.1). Where a greenfield development is proposed and it can be demonstrated that existing levels of industrial noise are more than 5dB lower than the relevant recommended amenity level, Equation 1 can be modified to reflect ‘amenity noise level’ in lieu of ‘amenity noise level minus 5dB’.

Equation 1: New multiple premises or redevelopment of existing clusters of industry

Individual project amenity noise level = $10\text{Log}\,(10^{(\text{ANL} - 5\ \text{dB}/10)}/\text{N})$

where:

ANL = relevant recommended amenity noise level from Table 2.2

N = number of proposed additional premises.

Figure 2.1 Extract from Section 2.4.2 of the NPfI (EPA, 2017)

The limitations of this equation have been acknowledged by regulators and consultants alike including the fact that it assumes equal noise contribution from all industry, does not consider the spatial variation of sites (their location relative to assessment locations) or potential acoustic shielding from building structures or ground topography.

Section 2.8 of the NPfI introduces the concept of a noise management precinct with the following objectives:

- to ensure that noise impacts are not exacerbated in residential areas close to a nominated industrial precinct
- to provide a mechanism that will allow noise impacts to be managed over time
- to allow a nominated industrial precinct to be fully utilised in a cost effective and efficient manner.

Within a noise management precinct, emissions from the whole area would be managed as a single site. For example, when a new development is proposed within the precinct, the responsible landowner or entity must demonstrate that the precinct would continue to meet the recommended amenity noise level if that project was operating. The principle that all feasible and reasonable means of mitigating noise impacts will be implemented would be consistently applied across all developments within the precinct. Measures to control noise may involve relocating a planned new activity to a different location than originally proposed, or to reduce noise emissions from other sources to accommodate it.

The form of implementation of a noise management precinct will depend on site specific circumstances but would likely require an entity to oversee it and hold all relevant parties accountable.

3 KEY LEARNINGS

3.1 Overview

Since the methodology provided in the NPfI for establishing noise trigger levels for industrial precincts has limitations, there is a lack of consistency amongst consultants and regulators in the methodology and assumptions used to prepare noise impact assessments for such developments. Further, there is very little opportunity for consideration of potential impacts to noise amenity during the early stages of a rezoning or industrial land release. Noise impacts from industrial developments are typically considered during the development application and detailed design stage on a case-by-case basis.

Based on our observations, the lack of clarity and consistency around expectations of the noise assessment for industrial precincts can lead to:

- delays in the approvals process due to back and forth with regulators about the adopted methodology
- unrealistic or unachievable noise limits specified in individual approval documents
- uncertainty regarding the long-term management and monitoring of noise emissions from industrial precincts and the developments within them.

In NSW the key challenges we have observed are:

- Ability to consider potential impacts to noise amenity early in the planning process because of the nature of the planning process as well as the uncertainty associated with the proposed end users of the subject site.
- The requirement for buffer zones between the proposed industrial land and neighbouring residential areas is not well understood during initial planning, or when the land is purchased by a proponent, thus the potential for the land to be developed for its intended purpose could be constrained by noise amenity without the knowledge of the landowner.
- Establishment of appropriate amenity noise goals in a changing acoustic environment.
- Absence of a consistent, equitable and pragmatic approach to modelling and establishment of noise limits for individual developments within an industrial precinct.
- Difficulty in provided an overarching approach to the long-term management and monitoring of noise emissions from industrial precincts.

3.2 Early consideration of noise amenity

Strategic land use planning and the benefits of considering potential noise impacts as early as possible in the planning process are discussed in Section 1.1.1 of NPfI (extract provided in Figure 3.1).

Strategic land-use planning

Strategic planning processes, for example, regional and local plans, provide an opportunity to avoid noise impacts that can occur when industrial areas are located in close proximity to residential areas or other noise-sensitive receivers. When preparing environmental plans and strategies, planning authorities can use the noise levels in the policy to inform decisions about the potential impacts of different types of development and use approaches such as buffering high-noise areas from sensitive receivers (for example, residential areas) and locating low-noise activities (such as business centres) in intervening areas.

Put simply, appropriate separation between industrial land uses and sensitive land uses will reduce the potential for noise-related land-use conflicts. Examples of strategic planning initiatives to promote better noise outcomes include:

- identifying and locating zones in a manner that reduces the potential for land-use conflicts with adjoining land uses or, where these conflicts cannot be avoided by separation alone, applying suitable controls in the planning instruments to ensure compatibility
- implementing communication mechanisms to inform members of the public moving into noise-affected areas, in order to avoid unrealistic expectations of noise amenity in affected areas
- using controls in land-use planning instruments to promote compatibility between existing noise generating activities or industrial zoned land and new residential developments for land affected by industrial activities. Examples of existing land-use planning controls for new residential development adjacent to busy roads and rail are contained in the *State Environmental Planning Policy (Infrastructure) 2007*. Land-use planning authorities could consider developing similar requirements for new residential areas or existing residential areas undergoing urban renewal with higher-density settlement patterns near major clusters of industries, for example ports
- considering existing industry or industrially-zoned land when changing land-use zones to a more sensitive use or greater density of residential settlement pattern to ensure that the planning decision does not unduly impact on existing land uses in the area.

Figure 3.1 Extract from Section 1.1.1 of the NPfI (EPA, 2017)

The rezoning and/or redevelopment of large areas is a complex planning issue and noise is just one factor to be considered in balancing the economic, social and health needs of a community. There are many different pathways by which individual developments are approved in an industrial area in NSW. There may be a mix of local development, designated development, integrated development and State Significant Development in an area. These different pathways complicate the management, regulation and control of noise (and other environmental issues) for individual proposals. Legislative instruments used for approval of rezonings (or individual developments within them) could be used, by including relevant provisions, to assist in managing noise issues. This would require a high level of collaboration and consultation with all relevant stakeholders.

During the early phase of a rezoning or redevelopment project there is an opportunity to adopt some form of modelling strategy to inform the site's developable area and layout. This could include the incorporation of buffer zones or progressive intensification of use from the boundary with noisier developments located toward the centre of precincts. The type of use and hours of operation could also be identified at this stage. This would then provide more certainty to developers and create a more streamlined approvals process for individual developments.

Permissible uses within an industrial zoning can often include noise-sensitive developments, for example places of worship or childcare centres. The sensitivity of these developments to noise may place restrictions on the adjoining property to be developed for industrial use. As such, due consideration should be given to whether these types of development should be allowed as part of an industrial land release or rezoning. If they are to be allowed, there may be restrictions that could be placed on their location within the subject area to minimise the potential for noise impact on the sensitive development as well as minimising the constraints to the developable area. Consideration could also be given to relaxing the noise amenity expectation for such developments within an industrial zoning, similar to the requirement outlined in the NPfI for isolated residences within an industrial zoning. Alternatively, the method for relaxing internal criteria for schools from $L_{Aeq,1hr}$ 35 dB to $L_{Aeq,1hr}$ 40dB (as per the notes to Table 2.2 of the NPfI) where existing schools are exposed to existing industrial noise sources could be adopted. Consideration would also need to be given to appropriate design of external active recreation or play areas for such developments.

3.3 Establishing relevant amenity area

Section 2.4.3 of the NPfI states that "*When land uses in an area are undergoing significant change, for example, residential subdivisions with associated development of local and regional roads, the background noise levels would be expected to change, sometimes significantly.*" The ambient acoustic environment would also be expected to change, both quantitatively and qualitatively, in the situation where significant industrial development or infrastructure has been approved near to existing residential areas.

The first and most important key in the assessment of noise from industrial development is the determination of the appropriate amenity noise levels to be achieved at the surrounding sensitive residential land use.

In the development of appropriate amenity noise levels, guidance is provided in Table 2.3 of the NPfI which outlines the typical zoning, background noise levels and qualitative description of the acoustic environment associated with the NPfI receiver amenity categories. The NPfI also states that "*careful judgement based on site-specific circumstances and consultation with the relevant planning/licencing authority may be required in some circumstances*". In this regard, it is important to consider the existing and approved uses that generate noise in the area, the intended use of the land and the overall intent for the area.

The potential to develop an area that has already been rezoned for industrial use should not be unreasonably restricted by assuming that the acoustic environment at nearby residences will not change due to development of the industrial land. This is especially true for areas adjacent to state significant infrastructure or large industrial land releases that have been deemed to be important for the social and economic benefit of the broader

community. The importance of early communication and consultation with the potentially affected community cannot be overstated.

Acknowledgement that introduction of an industrial precinct or large-scale infrastructure project will change the acoustic amenity of the area is important. Both the character and absolute level of the acoustic environment for retained noise-sensitive areas adjacent industrial areas will change; there will likely be increases in most, if not all, acoustic descriptors of the ambient environment. In fact, retaining 'existing' residential use and aiming to maintain the historical acoustic environment could significantly stifle land use for intended industrial activities and potentially sterilise large tracts of land due to the need to provide buffer zones.

Determining the Noise Policy for Industry amenity category for residential receivers published in Acoustics Australia Vol. 50, No. 3 September 2022 provides guidance on how to apply Table 2.3 of the NPfI. It states that the relevant amenity category should be based on the land zoning as the first step. The article goes on to outline that strong justification would be required to vary this approach. There may be circumstances where the existing ambient noise levels and/or description of the acoustic environment does not align with current zoning to justify a change in receiver category. Additionally, theremay be future plans to modify the zoning or the surrounding land use is changing significantly. In our experience, it would also be useful to consider future land-use planning ideas both within the precinct and adjacent areas. In the development of amenity goals for precincts, the context of the planned future land-use configuration should be considered in order to more equitably manage noise impact and support the requirements of land-uses that were intended for the rezoned areas. Whilst the land zoning is an important consideration in determining the relevant amenity category, it should not be the only one. The full extent of NPfI Table 2.3 should be considered including typical background noise levels (both existing and future if the acoustic environment is undergoing significant change) and the qualitative nature of the amenity area. Land zoning (as defined in a planning instrument) is just one consideration in determining the relevant receiver category. The relevant receiver amenity category should also be considered in the context of the long-term planning intent of the subject area. This may include where significant development has already been approved and/or is under construction or where previously greenfield land is rezoned.

The challenge is determining a reasonable level of change in the acoustic environment whilst balancing the values of acoustic amenity, retained residential areas, need for employment zones in key areas and other stakeholder factors.

3.4 Equitable noise limits and assessing impacts

Consistent assumptions, methodology and a greater understanding of the limitations of noise modelling and assessment will result in increased efficiency in the development approval process, more equitable outcomes for all stakeholders, and allow for preparation for effective management of noise into the future.

The noise assessment methodology and associated assumptions will depend on available information at the time of the assessment. If there is no or limited information available, then perhaps only a preliminary assessment can be undertaken to assess the feasibility of a proposed industrial precinct. This could be done by making assumptions about sound power levels associated with light, medium or heavy industrial sites and locating these appropriately across the subject area. If there is more certainty about lot layout and/or the types of development that will utilise the area, then assumptions for noise modelling can be refined and limits established through optimisation of noise modelling results for individual lots.

General methodologies that could be considered in the modelling and assessment of proposed industrial precinct are summarised in the following sections.

3.4.1 Reverse modelling

This method may be applicable where a greenfield site area is being considered for development and the constraints are to be established. The key sensitive receivers surrounding the broader study area can be considered as ‘sources’ with a sound power level (Lw) representing a typical anticipated use within the precinct. Noise contours can then be developed within a 3-D noise modelling program under adverse meteorological conditions to identify areas within the subject area where such developments would be unlikely to generate noise impacts. The modelled sound power level could be adjusted for specific locations to assist in the phased planning of the site or to determine where certain types of industry would be best placed within the subject area.

3.4.2 Risk mapping

This method involves assigned sound power levels in a consistent grid across the total proposed development site. It allows for determination of noise levels and transfer functions to representative sensitive receiver locations. This can then inform a high-level plan for relevant sound power levels for sites based on a dB/m^2 or similar value. Similar to the reverse modelling method, risk mapping enables the identification of areas within the precinct where certain types of industry may be more suitable than others (ie high noise vs low noise developments). The intent of this method would not be to determine appropriate sound power levels per lot (since lots may not be known at this stage) but to identify high and low risk areas across the site.

3.4.3 Concept noise allocation modelling

A concept masterplan will typically include identification of individual lots and, sometimes, building footprints. This information allows for more detail to be incorporated into a noise model. For example, if it is known that the proposed development is likely to be used for warehousing, then gross floor area can be determined for warehouses and logistics areas. These areas can then be considered and assessed within a 3-D noise modelling program to determine noise propagation across the area to sensitive receivers and noise limits optimised based on relative site area and location to sensitive receivers including any acoustic shielding provided by existing topography or proposed buildings on the subject site. This allows for noise limits to be established on a per lot basis that each individual proponent would need to demonstrate the ability to meet as part of their development application process. Consideration may be required in the staging of a development when including anticipated buildings and the associated noise reductions. The intent should be to consider the total precinct, fully utilised. Hence, when the site is partially constructed and operating, some noise contributions may be higher than the intended lot allocation, however the partially developed site could still be within the overall precinct allowance due to lower number of total noise sources. As the precinct progresses to being fully developed there will be more noise sources/sites but also greater shielding from buildings/structures. Progressive modelling could be adopted to manage this transition.

3.4.4 Detailed noise modelling

Detailed noise modelling can only be utilised where there is certainty about the proposed development. For example, there is a defined site boundary, building footprint and construction type, mechanical plant and all noise sources are known for an individual development. Noise emissions should then be assessed based on noise limits that have already been determined earlier in the planning pathway for the precinct.

4 LONG-TERM MANAGEMENT AND MONITORING OF NOISE EMISSIONS

Section 2.8 of the NPfI introduces the concept of a noise management precinct. The form of implementation of a noise management precinct will depend on site specific circumstances. Regardless of the form it takes, it would require a responsible landowner or entity to manage the precinct as a single site. In our experience this is the main obstacle to implementing a noise management precinct. Subject to the approval process, a precinct may be rezoned under a state planning body, but individual uses are approved under a range of approval pathways including state departments, local councils or even complying development. There will be a requirement for increased communication between regulatory authorities in terms of best managing the precinct for equitable outcomes for all stakeholders. This could be solved, in some way, by consideration of the following during the approval process for the rezoning or industrial area:

- noise abatement programs for existing residential properties both inside and outside the development area (where relevant), exposed to noise from the development
- development of an overarching noise management plan which describes the general approach to monitoring and managing noise emissions from the development
- planning controls for new residential or other noise sensitive developments within or near the development.

Long-term management and monitoring of noise emissions from the area could consider something as simple as a regularly updated spreadsheet to track individual and cumulative noise emissions from sites within a precinct at key receivers. Computer noise modelling and/or a detailed noise monitoring program could also be adopted to assist in the management of noise from the precinct. Information in the modelling/monitoring systems could be populated by initial noise predictions and reviewed/updated via compliance measurements as the precinct is progressively developed. However, this would require an entity to be responsible for its development, ongoing maintenance and implementation. For a precinct where rezoning was approved under a state or local planning body, that body would seem the natural choice to manage this aspect. There may be opportunities for the relevant regulatory authority to incorporate conditions of approval that would appropriately address cumulative noise from an area that goes beyond the relevant state noise policy or guideline, but this should occur in a transparent and logical approach.

5 DISCUSSION AND NEXT STEPS

We hope that this paper promotes discussion and collaboration on this topic between acoustics consultants, regulators of noise and relevant planning authorities. Improving the consistency and accuracy of noise assessments relating to industrial land-use planning will likely lead to a more efficient development approval process and more equitable outcome for all stakeholders.

EMM has identified the following matters as opportunities for improvement and/or clarification via further discussion and collaboration with all relevant stakeholders:

- Formal acknowledgement of the limitations of the current NPfI methodology for establishing amenity noise levels in areas near an existing or proposed cluster of industry (Section 2.4.2 and Equation 1) and development of additional guidance regarding an appropriate alternative.
- Consideration of how potential impacts to noise amenity can be determined earlier in the planning process.

- Consideration of how future background noise levels and noise characteristics for an area will change, and thus alter the receiver amenity category based on Table 2.3 of NPfI, for residential areas where the nature of the acoustic environment is expected to change significantly over the short, medium or long-term.

- Development of guidelines regarding methodology and assumptions for noise modelling with the aim of providing a consistent, equitable and pragmatic approach to modelling and establishment of noise limits for individual developments within an industrial precinct.

- Consideration of an appropriate entity to be responsible for managing a noise management precinct (or similar concept).

- Development of a framework for an overarching approach to the long-term management and/or monitoring of noise emissions from industrial precincts which could utilise simple spreadsheet tracking, computer noise modelling and/or a detailed noise monitoring program.

REFERENCES

Environment Protection Authority South Australia. (2009). *Guidelines for the use of the Environment Protection (Commercial and Industrial Noise) Policy 2023*.

Environment Protection Authority Victoria. (2021). *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues 1826.4*.

Marsh, C., & Downey, G. (2022). Determining the Noise Policy for Industry noise amenity category for residential receivers. *Acoustics Australia*. Australian Acoustical Society.

Northern Territory Environment Protection Authority. (2018). *Northern Territory Noise Management Framework Guideline*.

NSW Environment Protection Authority. (2017). *Noise Policy for Industry*.

PlanSA. (2024). *Planning and Design Code*.

Victoria State Government. (2018). *Moorabool planning scheme*.