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# THE ART OF NOISE COMMUNICATION

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## ABSTRACT

Since Roman times, there have been continual attempts to mitigate the impacts of noise, and it is the assessment, understanding, communication and management of noise impacts that has provided the challenge for all involved in the process of reducing the impacts of noise. It is however, the communication of noise impacts to those who are, or potentially will be impacted that is often given the least consideration and is done in an ad hoc and inconsistent way.

The following paper examines the key aspects of noise communication and attempts to provide a summary of current practice and suggest strategies for improving the communication of information on noise so that it achieves the best outcomes. There is an examination of the statement by Paul Schomer (2005) that while good public relations may result in a 5 dB bonus (US EPA, 1974) the converse is also true, with bad public relations equivalent to a 5 dB penalty. The authors also discuss the merit of adopting multiple assessment criteria and introduce the concept of a risk based approach to communicating the noise impact message.

## INTRODUCTION

Annoyance due to noise has long been an aspect of the developing world and since Julius Caesar enacted probably the first piece of noise control legislation in 44 BC (Sandberg & Ejsmont, 2002) there have been continual attempts to mitigate the impacts. It is the assessment of the noise problem, the understanding of its impact, the communication of this impact and its subsequent management that provides the challenge for all involved in the process of reducing the impact of noise.

The present paper discusses how noise issues can be communicated effectively to public, media, and regulatory authorities, and the valuable role noise communication plays in the development of community expectation and in the management of noise issues.

In Australia, a process similar to that which takes place in most westernised countries is used to identify potential environmental impacts from proposed development projects. State government legislation is usually the driver for the assessment of environmental impacts and the process of identifying noise issues. Compliance with environmental requirements is generally demonstrated through the preparation of Environmental Impact Assessment (EIA) documentation. For major development this will usually be in the form of a Review of Environmental Factors (REF) or an Environmental Impact Statement (EIS).

The purpose of environmental impact assessment is to:

- assess the impacts of a proposed activity on the environment before making the decision on whether to carry it out;
- develop and assess measures to avoid or minimise those impacts if it is decided to carry out the activity.

For most proposed activities, environmental impact assessment can be considered throughout the six stages of project development as summarised in the following:

### Strategic

This establishes the need for the proposal. Defines the framework for the later stages including what will affect, and be affected by the proposal along with assessment of cumulative impacts.

### Concept

Evaluates a number of preliminary studies (including environmental assessment) undertaken to identify the need for the development and select a preferred option.

### Detailed Assessment

The preferred option is examined in detail along with the likely environmental impacts and proposed safeguards. To assist the process, specialist reports will be prepared where required and may include a detailed noise assessment. Outputs of this stage will include the production of EIA documentation (REFs, EISs etc.).

**Public Consultation**

Environmental impact assessment documentation is placed on exhibition and public comment is sought.

**Approval**

Having considered all of the EIA documentation and submissions, project approval may be granted by the appropriate consent authority subject to any required conditions. These conditions may include a requirement to meet noise level objectives.

**Implementation**

This stage establishes how the proposed work will be undertaken including any environmental safeguards. Development of any contract environmental specifications and environmental management systems will be completed at this stage. Audits and completion of noise monitoring requirements may be part of this process.

Typically for any new industrial plant or major infrastructure project such as a new road or railway, the public has a high level of concern regarding the impacts that will occur to the community and changes to the quality of life if the project is approved. Good, transparent noise communication can assist in alleviating community fears of new projects with the potential to generate high levels of noise.

Examples of such projects are:

- building a new chemical processing facility;
- major extensions to an existing airport;
- new freeway construction;
- new rail line; and
- mining in an eco-sensitive area.

For more controversial projects the proponent often will be frustrated when the findings of specialist environmental studies such as a noise assessment study are ignored by the public and a mistrust develops regarding the valuing of potential benefits that the development would bring as opposed to the public value of the loss of certain amenities in maintaining a life style. At such times, noise communication becomes an important tool in the overall noise management process.

In particular, the present paper discusses the following issues:

- the important link between perception, acceptability of noise, communication and noise management;
- how to explain noise to the public;
- the influence of noise perception on noise communication;
- what role is played by the regulatory agencies in noise communication and conflict resolution;
- cautions on the use and abuse of public trust in noise communication; and
- improving noise communication using a range of techniques.

For this paper ‘noise communication’ is defined as an interactive process of exchange of information and opinion on noise among individuals, groups, and institutions.

Noise communications involves multiple messages about the nature of noise and other messages, not strictly about noise, that express concerns, opinions, or reactions to noise or arrangements for noise management.

The following important elements emerge from the above definition:

- Noise communication is an on-going two-way process within the noise management program;
- Noise communication has a definite purpose, which is to raise the level of understanding of relevant issues or actions;
- Noise communication involves all parties - the organisation, employees, stakeholders, public, and government authorities;
- Noise communication is successful only to the extent that those involved are satisfied that they are adequately informed within the limits of available knowledge through a transparent process;
- Noise communication is a process that provides information on which government and industry, or individuals base their decisions;
- Successful noise communication does not guarantee that noise management decisions will maximise noise reduction; it only ensures that government authorities and the public understand the issues and the impacts.

It is obvious that noise communication and noise perception are closely interlinked, and the purpose of noise communication is to provide an improved understanding and perception of noise.

To date noise management in Australia has focused more on meeting noise criteria rather than trying to assess the noise impacts and as such, describe any loss of amenities and quality of life.

## PERCEPTION AND ACCEPTABILITY OF NOISE

Proponents, noise specialists and the regulatory authorities are not the only groups that have a vested interest in the outcome of the environmental approval process. Project financiers, shareholders, insurers, general public, neighbouring population, special interest groups and employees may also have an interest in the impacts that result from a development. Often the perception of noise from these parties varies.

It is generally accepted that the public mistrusts politicians, developers and paid experts. Whilst there is little that can be done to improve widely held views of politicians and developers, the acoustic community can take action to address its credibility.

Experts and specialists are often guilty of not acknowledging that the notion that noise as perceived by the scientific community is as rational as noise perceived by non-scientific public. This lack of understanding by the specialists of the public perception and the tendency to dismiss public understanding of technical issues has often resulted in adverse reaction and increased community opposition to a project. Often this public perception of specialists has been perpetuated by claims that meeting criteria is an acceptable outcome and will not result in an unacceptable impact.

It can never be expected that the general public will fully understand the scientific and engineering aspects of noise assessment and nor should they necessarily need to. Specialists will however, often forget who their target audience is, and overly complicate a simple message with technical jargon and use of difficult to understand concepts.

It should always be remembered that the objective of a specialist noise report is to provide an unbiased and objective assessment of the noise impacts of a proposal. The report must be written so that it is readable by the general public yet provide enough technical detail to satisfy scientific interroga-

tion. This is a view supported in a NSW Land and Environment Court decision (Prineas v Forestry Commission of NSW, 1983), where Justice Cripps stated that an EIS "should be written in understandable language and should contain material which would alert lay persons and specialists to problems inherent in the carrying out of the activity".

Successful noise management does not only include the technical aspects but also the political and social aspects. The latter requires an understanding of the non-specialists view. In a review of community noise surveys, Fields (1993) identified the value of good public relations along with four additional aspects of noise that communities identified as important. These were: fear of danger from the noise source; beliefs about the importance of the noise source; annoyance with non-noise impacts of the noise source; and general noise, as being important modifiers of annoyance.

## Link between Noise Communication and Noise Management

Much has been written on how organisations should communicate with the environment external to the corporation (public, stakeholders, government) (Azzone *et al*, 1997). The importance of timing of release of information, crafting of the message, interactions with the audience etc. are stressed. The definition of noise communication implies that the process requires accepting and involving the public as a legitimate partner and involving the people in on-going noise decisions. This also means that the industry needs to make changes in response to outside concerns rather than merely listen to them.

Good industrial noise communication is linked to noise management and other efforts to improve environmental health and safety.

For example, a manufacturing plant in a western suburb of Sydney proposed to build a new plant, the previous plant was old, and emitted high levels of noise. The facility was located relatively close to residential areas, and was the object of complaints from local residents.

When the company was seeking planning approvals to replace the old plant, there were several objections from local residents. Following much debate, the company was allowed to proceed with the construction, subject to a number of conditions. Apart from noise limits, the company was asked to set up a community consultation committee consisting of representatives from the company, local residents, local government authority, and the state Environment Protection Authority.

The committee met on a regular basis, and any community concerns were discussed openly. Additionally, the company had also set up a reporting system, whereby any incidents, emissions etc. were reported to the committee, and the remedial actions taken were discussed.

This noise communication effort increased community confidence in the company's operations. While the new technology in the plant design reduced noise emissions, the noise communication strategy in place also reduced community concerns and complaints significantly.

Based on the feedback from the community in the consultative committee meetings, the company continually made adjustments to its noise management efforts.

This is an example of when a company perceives the community as threatening the company's profitability, the company is more likely to mount an exemplary noise communication effort. However, good noise communication would beneficial for any project.

## Obstacles to Effective Noise Communication

Noise communication has the goal of informing the public about noise issues. This may seem easy to attain in principle, but is surprisingly difficult to accomplish. Two major obstacles are the limitations of scientific noise assessment and the public understanding of the issue.

## Limitations of noise assessment

Noise impact assessment will vary for specific projects; however generally it will consist of the following basic components:

- Identification of closest receivers;
- Determination of background noise levels;
- Development of noise criteria;
- Identification of noise sources and their sound power levels;
- Prediction of noise levels at sensitive land uses;
- Identification of noise criteria exceedances;
- Development of noise mitigation measures.

The general principle of noise assessments would appear to be the meeting of the noise criteria. If the noise criteria is met, most noise assessments will present a final conclusion that the "project will not have any impact on the residential receivers".

Some major limitations of noise analysis and assessment are:

- Predictions of noise impacts are associated with significant uncertainty. Specifically, environmental noise levels can vary up to 20dB due to changes in weather conditions;
- Equipment noise levels can vary substantially from manufacturer to manufacturer or even due to the level of maintenance;
- Meaningful comparisons of the assessed noise are often difficult as similar noises are not compared. Therefore, setting noise criteria becomes a complex debate. It is very difficult to find comprehensible ways of presenting complex technical material that is clouded by uncertainty and inherently difficult to understand;
- Comparison to noise criteria which has been set as a single A-weighted sound pressure level. There is usually very little consideration of other characteristics of noise that can result in high levels of annoyance including: emergence over background; displaying tonal qualities and modulation of the acoustic signal. An example here is the failure of a night–time $L_A$eq metric to account for the high levels of annoyance and sleep disturbance that result from the use of excessively noisy heavy vehicle engine brakes to reduce speed;
- Use of criteria that are set to protect a percentage (often 90%) of the population from being highly annoyed. Which obviously leaves a percentage (ie 10%) unsatisfied with the noise environment;
- Rarely adopt criteria that will protect the amenity of a location. (Some Australian States set criteria to protect 'passive recreation' and 'places of worship' however the levels set are more to accommodate the activity rather than protect the amenity.)

Noise is a quantitative term and generally when we have a quantitative measure, it needs a comparison to place it in

perspective. A numerical value of noise without benchmarks or points of reference is abstract and cannot be readily understood by the general public.

Acoustic practitioners often find themselves reducing the complexity of a situation down to whether it is 'above or below the criteria', which tends to infer that the criteria itself communicates some degree of acceptability of the noise level, and that meeting this criteria will mean that there will be no health impacts, no annoyance and no change in the noise amenity of the location. Clearly this is not the case and it may well be that meeting absolute noise criteria is only part of the story. To communicate the full picture of what impact the introduction of a noise source will have, also requires consideration of the quality of the receiving environment as well as the characteristics of the noise to be introduced. The challenge is how to both quantify and qualify changes in noise amenity.

### Limitations of public understanding

Having to communicate noise impact information is inherently difficult. In an environmental commission of inquiry a few years ago, there was some debate among experts as to what was an acceptable noise criterion for noise from an engineering establishment. During a recess, an elderly lady from the local residents' action group said to an expert: "*I'm afraid that I have to rely on experts like you, but it is not without some apprehension, as I do not really understand what this noise dB(A) level is*".

People's perceptions of noise are often inconsistent and in many cases, inaccurate. This has led the expert labouring under the illusion that his/her perception of noise is the correct one, as it is based on scientific analysis, whereas that of the non-specialist is necessarily irrational.

The public generally does not distinguish between the magnitude of a maximum noise level and its likelihood of occurrence. Merely mentioning possibility of a high noise level (no matter how rare) could increase their level of concern.

## IMPROVING NOISE COMMUNICATION

Since noise communication usually involves multiple messages from many sources, and because these messages contain difficult and complex ideas, there is no simple way of making noise communication easy. Noise messages necessarily compress technical information, which can lead to misunderstanding, confusion, and distrust.

Preparing noise messages can involve choosing between a message that is so extensive and complex that only experts can understand it, and a message that is more easily understood by non-experts but that is selective and thus subject to challenge as being inaccurate or manipulative.

### Value of Good Community Consultation

A novel concept in noise communication, based on the perception of noise, could be that expert perception of noise and the lay person's perception of noise are at odds and the resultant reactions of these two individuals are diametrically opposed. Therefore, the total noise must be the sum of these two noise perceptions and not just one or the other, leading to the following equation:

Noise = Statistical Noise Level + Outrage

Statistical Noise Level is the product of noise magnitude and probability, while 'outrage' is a function of whether people feel the authorities can be trusted, whether control over noise management is shared with affected communities, etc. No matter how serious the noise is (in Statistical Noise Level terms), and no matter how much technical detail is used to explain it, this view maintains that the degree of 'outrage' is likely to determine much of the public's response to the noise.

Communication about noise then, is not merely an exercise in explaining data from formal noise assessments. Outrage factors must be recognised, understood and addressed.

Schomer (2005) believes that whilst only scant information is available to quantify an adjustment for public perception, it is reasonable to assume a range from a 5dB penalty to a 5dB bonus depending on the quality of the relations between the noisemaker and the community. This range is within that which the authors have experienced in Australia, and may in-fact tend to be a conservative estimate of the benefits of good community relations. Anecdotally, values of greater than 5 dB(A) have been suggested for road and mine projects, whilst communities have been known to tolerate 20+ dB(A) above recommended noise levels for short term construction projects with otherwise good environmental and community outcomes.

### Development of an additional criterion to meet shortfalls in current practice

There is increasing acknowledgement that use of a single criterion does not provide adequate guidance on assessment of environmental noise as evidenced by the following three examples:

i. DoTaRS (2000) have stated the shortfalls in communicating aircraft noise impacts by a single complex noise descriptor, *"experience in recent years has demonstrated that the aircraft noise problem is not confined to areas inside the noise contours. In fact most complaints about aircraft noise at Australian airports come from people who live outside the published ANEF noise contours ……90% of the complaints came from residents of areas outside the 20 ANEF contour"*. To improve communication of air traffic noise impacts, the N70 results are now also being reported which the community has indicated provides an additional and easier to understand measure of noise impact.

ii. A column by the Asia Pacific editor in Noise/News Sept 2007 discusses a move in Europe to look more broadly than just the absolute criteria when assessing the impact of noise. The suggestion is to examine action levels and exposure limits.

iii. In NSW, the precedent for use of more than one assessment criterion was established with the introduction of criteria for industrial facilities (EPA, 2000) which provided separate Amenity Criteria to compliment Intrusive Criteria and sleep disturbance measures.

### Understanding and Accepting Noise Depends on a Wide Control Base

Empowering the public is one of the most effective ways to address outrage factors. This can be facilitated by offering the public (through community or residents' groups) early and then continuing input into decision making. It is important to ensure that this does not become a mere presentation of information. This process should include real and thorough power sharing, not just public participation of the 'decide-announce-defend' variety.

Public involvement in decision making, from site selection to operational practice, is vital to ensure the legitimacy of the

decision (even if ultimately the 'public' disagrees) as this process will promote trust. From this, two broad themes are apparent: that communication effort should be more systematically oriented to specified audiences and; that openness is the surest policy.

The major features of effective noise communication are:

- Setting realistic and relevant goals;
- Effective dialogue;
- Early and sustained interaction;
- Accountability;
- Independent review;
- Scientific/ technical accuracy and completeness;
- Evaluation and feedback;
- Respect for audience and its concerns;
- Refraining from using 'influence strategies' that would affect credibility; and
- Handling uncertainty such as weather conditions and variations in sound power levels.

## Use of Simple Acoustic Tools

Giving the community something it can relate to is a powerful way of conveying a transparent message. Graphics such as those in Figures 1 and 2 present easily understood relationships whereas stating simply that a noise source will meet 'background + 5 dB' doesn't tell the public anything about noise impacts or even if they will hear the noise source.

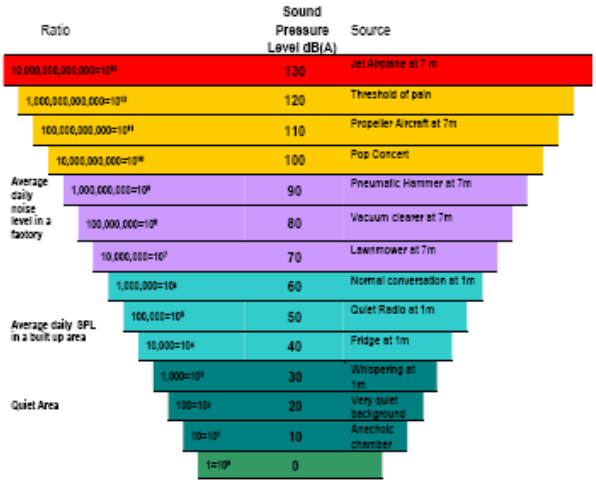



**Figure 1. Typical Sound Pressure Levels and Ratio's**

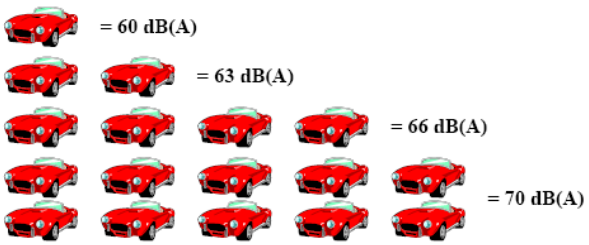



**Figure 2. Addition of Noise Sources**

## Addressing Change in Noise Amenity

Intuitively we accept that the opening of a new mine in an area with very low existing noise levels would cause far more change to the amenity of that location than would a mine that is opened next to an existing mining operation in a highly degraded noise catchment even though both proposals result in the same absolute noise levels.

To differentiate between the two proposals requires a more subjective measure which values the existing noise amenity of a locality upon which the noise source will impact. This measure does not need to be related directly to annoyance or health impacts which are best assessed by absolute criteria. It needs to measure a less tangible quality more related to visual amenity in the way it is to be assessed.

The need to develop a measure of the impact of a proposal on the noise amenity of a location is in response to community concern that use of absolute criteria does not consider situations where a project results in significant changes to the existing noise exposure in an area.

**Table 1.** Human Reaction to Increase in SPL

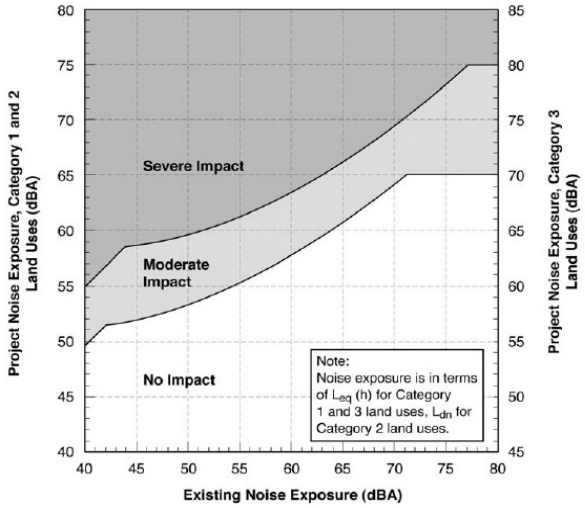
| Increase in Sound Pressure Level, dB | Human Reaction |
|---|---|
| Under 5 | Unnoticed to tolerable |
| 5-10 | Intrusive |
| 10-15 | Very noticeable |
| 15-20 | Objectionable |
| Over 20 | Very objectionable to intolerable |

Source: (Down and Stocks, 1978)

Table 1 suggests for any permitted operation the goal should be to minimise increases in sound pressure level above the ambient levels at noise sensitive receivers. Increases ranging from 0-3dB should have no appreciable effect on receivers. Increases from 3 to 5 may have potential for adverse noise impact only in cases where the most sensitive of receivers are present. Sound pressure level increases of more than 5 dB would be quiet noticeable and may be found to be intrusive. A SPL increase of 10 dB would result in a perceived doubling of noise and would be very noticeable and require noise mitigation consideration.

It is suggested that setting of absolute criteria for a major infrastructure project such as a new road in a greenfield site may limit the extent of impact but will often fail to adequately quantify the change that would occur to that location. Conversely, the ability of an environment with a high existing noise exposure to receive an additional noise impact may be extremely low.

One way of qualifying an impact on the acoustic amenity of location and quantifying the perception of change on this location is with reference to Noise Impact Curves. The curves shown in Figure 3 are used by the US Federal Transit Authority (FTA) to indicate the perception of change that can be expected when there is an increase in existing transportation noise levels.




Source: (FTA, 2006)

**Figure 3. Impact of Increase in Relative Noise Levels**

The use of curves to quantify the amenity of a location is a relatively new concept, but it is based on the results of well accepted studies of transportation noise impacts. The FTA (2006) recently noted that *"There has been little change in the understanding of annoyance from transport noise since a seminal body of work was undertaken in the 1960s and 1970s with conclusions being still considered valid today"*.

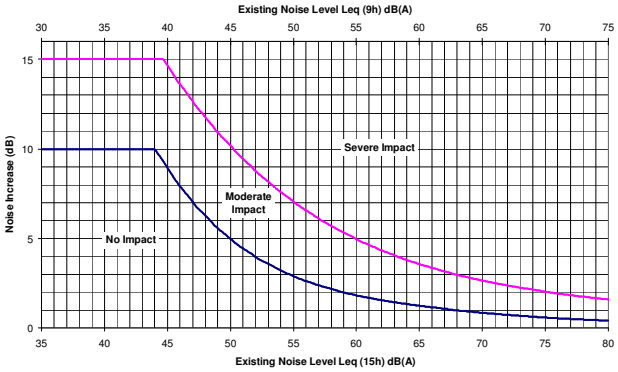



**Figure 4. Noise Impact Curves**

Figure 4 displays the approximate conversion of the data from the FTA (2006) in Ldn to Leq(15h) and Leq(9h) descriptors which are more commonly used in NSW and presents it as the perceived change in noise amenity.

The Noise Impact Curves above present some interesting information which can aid in predicting likely responses to increased noise levels. The graph indicates that people already exposed to high levels of noise should only be expected to tolerate only a small increase in the amount of noise in their community.

In contrast, if the existing noise levels are quite low, it is reasonable to allow a greater increase in noise exposure to account for an equivalent change in annoyance. It is however recognised that a large noise increase in a low noise environment ('relative' noise impact) can have a moderate or severe impact on the noise amenity of a location even if the absolute criteria are not exceeded.

As the existing level of ambient noise increases, the allowable level of absolute transport noise increases, but the size of acceptable increase is progressively reduced.

Absolute criteria establish an A weighted sound pressure level that has usually been set to protect a nominated percentage (generally 90%) of the population from being 'highly annoyed'.

In recognition that it is dangerous to rely solely on absolute criteria to communicate noise impacts, there is a school of thought that there is a need for multiple criteria to adequately protect the noise environment. Such additional criteria should provide guidance on how an introduced noise source will impact upon the perception of the noise amenity of a location.

The authors believe that assessment of noise impacts using tools such as Noise Impact Curves in concert with Absolute Criteria communicates a more holistic view of the broader impacts of noise to a location and the perception of change to that location.

### Noise Message Checklist

Those who prepare noise messages should ensure that the messages are complete. A noise information checklist for this purpose is shown in table 2 on page 7.

## CONCLUSIONS

Discussions on this topic of noise perception and acceptability may be summarised by the following conclusions:

- Noise perception by specialists and professionals can be completely different to that of an impacted community.
- Perception of noise is multi-dimensional in character, and each dimension should be considered in order to understand the full spectrum of noise perception.
- Understanding the dimensions and parameters of uncertainty goes a long way towards understanding noise perception.
- While the specialist may tend to view the noise perception by the impacted community as non-rational, the proponents and decision makers cannot afford to ignore the reasonableness of public perception, which must be understood and addressed.
- There is an inverse correlation between perceived noise and perceived benefits, of various technologies. The higher the perceived benefit, the lower is the perceived noise and vice versa. Therefore, changing the perceived benefits may be one way of changing the perceived noise, but there should be demonstrable honesty and integrity on the part of the organisation.
- There is a fundamental inequity in the distribution of benefits arising from a new industrial development, as the local community perceives to be bearing the noise, where there are no tangible benefits. It is worthwhile for the proponent to address this issue, and have a better relationship with the local community.
- The 'dread' factors in the public perception of noise resulting in outrage should not be ignored in the noise management process. It is not only the technical aspects of the noises that need to be assessed and communicated, but also the outrage factors.
- Is the process democratic? Decisions on high-noise technology developments are essentially political. This does not, however, remove the necessity for the scientific assessment of noise.
- Public acceptance of a noise decision generally depends on the answers to three questions:
  - Is it what we want to hear?

- Is the information source credible?
- Has the process been transparent?

- Definitions of noise vary for different perceivers, and whoever controls the definition, controls the solution and exercises power. Unless the technical analysis is robust and the decision making process is democratic, gaining public acceptance would be fraught with controversy.
- Policy and decision makers need to consider the use of multiple assessment tools (such as noise impact curves) to provide a holistic understanding of the noise impacts a proposal may have on the amenity of a location.

**Table 2.** Noise Message Checklist

| | |
|---|---|
| 1 | Information about the nature of noises |
| 1.1 | What are the concerns? |
| 1.2 | What is the probability of the noise? |
| 1.3 | What is the extent of the noise? |
| 1.8 | What is the total population affectation? |
| 2 | Information about the nature of benefits |
| 2.1 | What are the benefits associated with the noise? |
| 2.2 | What is the probability that the projected benefit will actually follow the activity in question? |
| 2.5 | How many people benefit and how long do benefits last? |
| 2.6 | Which groups get a disproportionate share of the benefits? |
| 2.7 | What is the total benefit |
| 3 | Information on alternatives |
| 3.1 | What are the alternatives to the noise in question? |
| 3.2 | What is the effectiveness of each alternative? |
| 3.3 | What are the noises and benefits of alternative actions and of not acting? |
| 3.4 | What are the costs and benefits of each alternative and how are they distributed? |
| 4 | Uncertainties in knowledge about noises |
| 4.1 | What are the weaknesses of available data? |
| 4.2 | What are the assumptions on which estimates are based? |
| 4.3 | How sensitive are the estimates to changes in assumptions? |
| 4.4 | How sensitive is the decision to changes in the estimates? |
| 4.5 | What other noise and noise control assessments have been made and why are they different from those now being offered? |
| 5 | Decision making |
| 5.1 | Who is responsible for the decision? |
| 5.2 | What issues have legal importance? |
| 5.3 | What constrains the decision? |
| 5.4 | What resources are available? |

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