THE ACOUSTICS OF A SMALL SOUTH PACIFIC COUNTRY – ENVIRONMENTAL NOISE MANAGEMENT IN NEW ZEALAND

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1 INTRODUCTION

New Zealand is a small South Pacific nation of approximately 4 million people inhabiting a land area similar in size to Great Britain. New Zealand comprises two main islands (North Island and South Island) located at slightly warmer latitudes than the UK, although the maritime climate is completely dominated by the surrounding oceans and is not affected by the nearest continental land mass, Australia, some 3,000 km to the west of New Zealand.

New Zealanders live in a democracy with a Westminster style of government which is based in the capital city, Wellington located at the southern tip of the North Island. New Zealanders enjoy a westernised lifestyle, albeit with a GDP per capita below the top 10 OECD nations of the world. The population is 80% urban, living predominantly in the main cities of the North Island. In fact, two thirds of the population live in the top half of the North island due to warmer climate and the influence of Auckland, New Zealand's largest city.

Like other developed nations, New Zealand experiences significant noise and pollution effects as a result of man-made activities. This paper discusses the management of environmental noise in New Zealand, particularly focussing on policies adopted for the control of noise from commercial/industrial land uses, transportation sources and sources relating to outdoor recreation which are pertinent in relation to the management of a significant conservation estate, comprising some 23% of the land area of the nation.

This paper outlines the policies and methods currently used to manage the effects of environmental noise within both residential living environments, and within the natural environment of New Zealand's significant parks and reserves which are so often seen in tourist promotions as quiet and idyllic environments. This paper identifies where current methods appear to be successful in dealing with the multi facetted challenge of managing environmental noise in a modern society, however there are indications that the methods and standards currently employed will need to be expanded and developed further if future challenges and increasing expectations are to be adequately dealt with.

2 OVERVIEW OF ENVIRONMENTAL NOISE MANAGEMENT

The main method used to control the potential adverse effects of noise in the New Zealand environment is the provisions of the Resource Management Act 1991, an important piece of legislation which requires New Zealand's local authorities (similar in structure and function to UK's many Councils and local authorities) to establish policies and rules governing a range of environmental pollutants (including noise) and administer these requirements under a general ethos of "sustainable management" of natural and physical resources, focusing on the effects that land use activities have on the receiving environment. The definition of "environment" includes people and communities and their ability to provide for their social and cultural well-being as well as for their health and safety. It is therefore a requirement to provide for adequate amenity, as well as for the protection of public health (with an adequate margin for safety).

The development of the Resource Management Act was both an international context (the Rio summit and Agenda 21 policies signed up to by many western governments) and a domestic

context where a “green” political party emerged from a growing public awareness of environmental issues in the 1990’s. A revamp of planning legislation governing pollution control and environmental management in New Zealand was therefore inevitable. The new ideology sought to define a better balance between sustaining the life supporting capabilities of natural and physical resources, while not unduly restricting economic development and allowing society to provide for its economic and cultural well-being. These changes had profound effects on the way environmental noise issues were dealt with, particularly in respect of taking into account an integrated approach to pollution control and, for the first time, consideration of cumulative effects of environmental noise.

The Resource Management Act (1991) is implemented by local Council’s through a planning instrument called the “District Plan” which is analogous to a “rule book” designed to ensure the noise environment is managed in the most sustainable way and that adverse effects of noise generating activities are avoided, remedied or mitigated.

A special section of the Act places a “general duty” on all occupiers to adopt the best practicable option to ensure noise emitted from any site does not exceed a reasonable level. What constitutes a "reasonable level" is not defined by the Act, but instead empowers local authorities to set noise emission standards in its District Plan. Legally therefore, there is the duty to both comply with noise rules and to adopt the “best practicable option”. The term “best practical option” becomes important in specific circumstances and means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to -

a) The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and
b) The financial implications, and the effects on the environment, of that option when compared with other options; and
c) The current state of technical knowledge and the likelihood that the option can be successfully applied:

This duty applies to every person, company, legal entity, and the Crown, and includes persons undertaking activities on designated sites (these “designated sites” are sites specifically set aside for infrastructure projects such as roads, power stations etc. There are no exceptions.

Generally, local authorities develop a District Plan via a public process that ensures robust policies and objectives that seek to maintain and enhance the quality of the urban environment, with associated noise rules to give effect to these policies and objectives. Both noise emission and noise immission type rules are set out within District Plans. Variations from Council to Council do occur, and yet there are national standards in place to provide overall guidance on environmental noise measurement and assessment in New Zealand.

3 NOISE MEASUREMENT UNITS

New Zealand Standards (see section 4) are widely adopted as technical guidelines for the measurement and assessment of general environmental noise in New Zealand. Traditionally, these standards have uses the L10 measure as the main method for quantifying environmental noise levels such as for the purposes of assessing impact. The Lmax unit is also widely referenced in these standards for application during night time as a means of limiting sleep disturbance.

In more recent times there has been a move to shift to align with international practice and adopt the continuous equivalent sound level method (Leq,T) which is based on the equal energy principle.

For transportation noise, the use of the level Day/Night unit (Ldn) has been widely adopted especially in respect of aircraft noise and noise from helicopter landing areas and sea ports. For road traffic noise the L10 (18 hour) measurement unit was originally adopted however the use of the Leq (24 hour) unit has been adopted since about 1991 for the assessment of noise from road traffic. The Leq (24 hour) unit is used within traffic noise guidelines developed by the state roading authority as the base unit for traffic noise assessment related to any residential type activity or an

educational facility. In recent times there have been discussions relating to adopting a traffic noise metric which weights the measurement according to parts of the day or night when noise effects can be more pronounced (eg. Ldn or Lden) however no firm decisions have yet been made at this time (September 2006).

Overall, the units for noise measurement and assessment in New Zealand are derived from, and are therefore reasonably consistent with measurement units defined within international standards and adopted widely within overseas jurisdictions. The shift towards replacing L10 type limits with Leq limits within planning rules set out in District Plans in New Zealand will take some time owing to the slow pace with which District Plans are reviewed and rules are updated.

4 NEW ZEALAND STANDARDS

As mentioned above, New Zealand standards are the technical basis for noise measurement and assessment in New Zealand. These standards are not unique in that they have their roots in international standards (such as ISO 1996), but have been developed as a suite of standards suited to New Zealand planning mechanisms and the legal system. In some cases, New Zealand standards have been amended or improved due to case law, however in many cases the current version of the standard is the initial standard of its type, as only three standards have been reviewed and replacement versions issued.

The following summarises the current versions of New Zealand standards which deal with noise and acoustic matters;

NZS 6801: 1999 Acoustics – Measurement of sound
Guides on equipment, measurement methods and precautions. Requires measurements to be performed within certain minimum requirements. Also ensures measurements are reported to a minimum standard. Widely referenced within noise rules and planning requirements.

NZS 6802: 1999 Acoustics – Assessment of environmental sound
This standard almost always accompanies NZS6801 and guides on how measured sound levels are to be interpreted and assessed, especially in relation to assessing compliance following sound level monitoring. Contains procedures for assessing sounds containing special audible character, and recommends lowering of the compliance limit by 5 dBA under specified conditions to account for the added annoyance of special characteristics such as impulsive sounds, sounds with prominent tones, etc. NZS 6802:1999 also guides on decibel suitable guideline levels for the reasonable protection of health and amenity for land used for residential purposes. The recommended range of noise limits for residentially zoned sites is:

Day 45 to 55 dBA Leq
Night 35 to 45 dBA Leq and 70–75 dBA Lmax.

Note; The definition of “night” and “day” is not covered by NZS6802, instead this is left to the discretion of each local authority which publishes its own definition of these time periods (however, many Councils adopt night time as commencing at 10 pm and finishing at 7am).

NZS 6803: 1999 Acoustics – Construction noise
This standard specifically deals with the measurement and assessment of noise from construction activities and adopts Leq limits applying at residential and commercial receiving sites which are necessarily higher than noise limits normally recommended for day to day activities (eg. recommendations of NZS6802:1999). The methods to calculate and predict construction noise lend heavily from the approach of British Standard BS 5228, however the overall approach is designed to integrate with other New Zealand Standards and New Zealand planning legislation.

NZS 6805: 1992 Airport noise management and land use planning
New Zealand Standard NZS6805:1992 uses the Air Noise Boundary concept to delineates areas of land likely to receive significant future noise, and to set long term controls over growth in aircraft noise around airports. Thus, the dual aims are to manage land uses in noise affected areas surrounding airports, and to cap the long term growth in airport noise in these areas to levels that are compatible with the levels of noise received. The standard is an important planning instrument which is designed to provide for efficient aviation activity while recognising the need to protect community health and welfare, consistent with the sustainable management principles of the Resource Management Act.

The air noise boundary is based on the location of the predicted future Ldn 65 dBA contour line. The predictions are made over a 10 to 20 year time frame and allow for growth in air traffic, while new aircraft types and operational procedures must be taken into account. The other "arm" of NZS6805 recommends that noise sensitive uses do not locate on land within the future Ldn 65 contour area (Airnoise Boundary), but are permitted within the Ldn 55 to 65 area (Outer Control Boundary) so long as acoustic insulation is incorporated within new buildings.

NZS6805 also covers the technical issues associated with aircraft noise measurement.

NZS 6807: 1994 Noise management and land use planning for helicopter landing areas
This standard is very similar to the above aircraft noise standard, but is adapted to be applied at helicopter landing areas which includes heliports or helipads. The future predicted Ldn 65 dBA contour is termed the "Heli Noise Boundary" and similar dual recommendations as above for NZS6805 are made with respect to noise limitation and land use planning within affected areas.

NZS 6809: 1999 Acoustics – Port noise: Management and land use planning
As with NZS6805 (airport noise) and NZS6807 (helicopter noise), this standard uses a "noise boundary" approach to the control of port noise. Like these standards, NZS6809 adopts the Ldn metric as the main method for quantifying port noise (although Leq values measured over shorter 15 minute periods are recommended for enforcement purposes). The recommendations of NZS6809 provide for planning controls to be based on limiting future port noise using a predicted "port noise boundary" while NZS6809 also recommends land use planning measures which avoid new noise-sensitive developments occurring in areas subject to > 65 dBA Ldn. The development of new noise-sensitive activities is permitted within the Ldn 55 to 65 area (Outer Control Boundary) so long as acoustic insulation is incorporated within new buildings.

NZS 6808: 1998 Acoustics – The assessment and measurement of sound from wind turbine generators
NZS6808:1998 was developed for the specific measurement and assessment of noise from wind turbine generators to aid both wind farm development and Local Authority planning procedures by providing a suitable method for the measurement and assessment of noise from these types of sources. NZS6808:1998 provides guidance on the limits of acceptability for sound received at residential and noise sensitive locations emitted from both wind farms and single wind turbines. The method specifically recommends the steps to be taken in assessing potential noise effects of wind farms prior to their development at the planning application stage. NZS6808 recommends extensive ambient background sound measurement (L95) under a range of typical wind conditions at critical receiving locations prior to establishing a wind farm. NZ6808:1998 recommends wind farm noise limits be set for these receiving locations at a level of 40 dBA or 5 dB above the background, whichever the greater.

NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors.
This standard prescribes recommended internal sound levels and reverberation times for various indoor spaces such as living rooms, bedrooms, classrooms, offices, halls, etc. The stated range of values are recommendations only as all New Zealand Standards do not have to be complied with unless they are specifically adopted within a rule or law (such as within a District Plan).

5 LAND TRANSPORT NOISE

Like most developed nations, noise from land transport is gaining prominence due to a range of factors, including:

- increased private vehicle use
- a greater number of vehicles and increasing traffic densities
- increased proportion of trucks and service vehicles
- changing travel patterns (ie, vehicles are on the road at all hours of the day and night, not just peak hours)
- growing population
- increasing population densities in most urban centres (particularly around transport nodes)
- increased community awareness of adverse factors in the environment.

There is no New Zealand Standard for measurement or assessment of road traffic or rail noise in New Zealand. There are only guidelines issued by the state roading authority (Transit New Zealand) covering road traffic noise which are only applied where planning permission is required for new or altered roads. These guidelines are termed Transit New Zealand's *"Guidelines for the Management of Road Traffic Noise -State Highway Improvements*" and were produced in November 1994 . In practice, these guidelines have served as a de facto national standard for management of road traffic noise arising only from new or altered roads because there are no other applicable national guidelines or standards. There are no standards applying to noise from existing roads.

It is perhaps surprising that there is no New Zealand standard dealing with traffic noise given that the policies and publications of the Ministry of Transport, Land Transport NZ and roading authorities (e.g. New Zealand Transport Strategy 2002, and Transit New Zealand's Environmental Plan, Version 1, November 2004) all acknowledge the impact of road traffic noise on people and communities in New Zealand and local surveys of annoyance (e.g. Dravitzki *et al* 2002[1]) indicate traffic noise impact can be significant.

There have been two attempts to establish a New Zealand Standard for road traffic noise however these have not been successful. The reason is generally, that there have been no developed government policies which allow the benefits of reducing noise from existing roads to be used as a basis for justifying the expenditure on noise mitigation measures. Although, there are measures such as addressing the noise from new and in-use vehicles aimed at kerbing roadside traffic noise levels, there is no co-ordinated approach to deal with noise from the existing road network and this can be seen as a major short-coming of the current methods to manage the effects of environmental noise in New Zealand.

However, there are several promising developments in terms of Transit New Zealand's policy work and the central government (Ministry of Transport) which indicate a policy framework may be developed in the near future which may involve the use of noise mapping techniques to identify the worst traffic noise "black spots" with specific benefit/cost policies to be developed which can be used to justify expenditure on mitigation measures (such as the installation of noise barriers or the treatment of a length of road with a quieter road surface) which can be applied to reduce noise in specific geographic areas alongside busy roads. There are also changes being made within the vehicle regulations in 2006/2007 to better identify noisy vehicles in the vehicle fleet and to implement individual vehicle noise limits as an allied method for kerbing noise levels experienced at the roadside.

6 NOISE IN NATURAL AREAS

There are significant areas of new Zealand that are set aside as national parks where there are little or no man made noise sources present. The ambient sound climate in such areas is therefore mainly affected by a range of natural sound sources. The patterns of birds and animals can play a

significant component, which coupled with diurnal weather and wind patterns encompass the factors that are mainly responsible for the levels of sound measured in these areas.

The natural quiet of these areas is often one of the more important positive aspects of the visitor experience. The quiet ambient sound levels in remote areas is often a key aspect of tourist promotions where visitors are enticed to "get away from it all". However, the experience of the key conservator of the national parks and reserves, the NZ Department of Conservation, has found that there can be conflicts when establishing permits for commercial tourist ventures in natural areas. Usually the methods of transporting tourists into and out of these areas, whether by road, by air or by watercraft, can lead to adverse noise effects. Often the problem is experienced at low decibel levels. In a low noise environment the area noise impact by roads, airfields or watercraft is so much larger as we are usually dealing with noise impacts at levels below 40 to 50 dBA. Levels which are unimportant in built up urban environments.

The Department of Conservation has developed methods to manage the effects of noise impact in national parks by requiring tour operators to use low-noise equipment and by controlling numbers of vehicles and timing of access to specific wilderness areas. In one example, air tour operators are requested to avoid a certain valley area near Mount Cook (New Zealand's highest mountain) so that mountaineers and walkers are not unduly affected by aircraft noise. There are also other examples of operator agreements to avoid certain areas in Fiordland National Park as a means of allowing ground based tourist activities to proceed without undue noise impact from aircraft overhead. Due to legal enforcement difficulties with New Zealand aviation law, the Department of Conservation are only able to request co-operation of aircraft operators as there are problems attempting to enforce no-fly areas in the legal sense.

A further example of a method to manage noise in the outdoor recreational setting is the District Plan administered by the Queenstown lakes District Council which requires all watercraft to not exceed Lmax 65 dBA at 20 m when operating a maximum speed on local waterways. The world famous Shotover Jet Boat tour operator uses watercraft that are specifically designed to meet this noise limit. Watercraft are often associated with noise issues, eg. jet skis ("personal water craft") operating near shore have sometimes been cause for complaint.

Overall, managing noise impact within New Zealand's significant natural areas is becoming more important as tourism in New Zealand increases. With over 3 million visitors a year, further innovative ideas will have to be developed to preserve the natural ambience of quiet national park areas, this being a key attribute of the natural beauty of these areas that tourists seek to visit.

7 SUMMARY & CONCLUSION

Like most developed nations of the world, there are significant environmental noise issues in new Zealand. There are a range of management methods that are being used to control the effects of noise. These can be summarised as;

a) reducing noise at the source

b) reducing the transmission of noise

c) avoiding or mitigating noise at the receiving end.

Under the current New Zealand legislative regime policies and rules are in place at each of these levels to provide some measure of comfort that environmental noise effects are being managed, at least to some degree.

The most significant area for concern is probably land transport noise experienced along major road corridors, particularly in built up, urban areas, and residential subdivisions near these roads where there appears to be no methods in place to control or reduce the slowly increasing total noise associated within incremental growth in road traffic volumes. At this stage New Zealand lacks

methods to suitably identify and evaluate the adverse environmental noise effects of the existing land transport system, and methods to provide information on possible benefits that could be delivered by adopting any selected policy. It appears such deficiencies may be planned to be addressed in a policy development process underway at the Ministry of Transport, however having established such methods in the future, the government still needs to develop methods to allocate resources to mitigate the effects of noise from the existing network. Although not as prominent an issue as road transport noise, noise associated with the movement of passengers and freight by rail also needs to be considered as currently there are no policies in this regard.

Ironically, the more complex matter of managing noise from commercial and industrial premises appears to be reasonably well handled at the local authority level under the duties and responsibilities imposed on them by the Resource Management Act. Mixed use urban environments are typified by commercial and residential activities, often sited in close proximity to each other. In accordance with overseas trends, population densities in city centres are increasing as the numbers of inner city apartments increase each year. While noise from such sources as street works and rubbish collection can cause problems it is the potential noise effects of commercial activities (such as entertainment premises in inner city living areas) that District Plans appear able to adequately control. Not all local authorities have achieved success in this, however it is important to note that the policy and management methods exist and it is often a matter of each Council developing appropriate action steps within the available policy tools to hand

Experience in New Zealand has shown that setting noise limits at the site boundary is often the best way to minimise adverse noise effects on sensitive land use activities in the local area. Setting district plan noise limits higher than normal guideline levels for areas used for residential purposes would normally be accompanied by a parallel requirement for acoustic insulation of all new buildings housing noise-sensitive activities.

Experience in New Zealand indicates the use of “Noise Management Plans” within planning rules and requirements can be an effective method for ensuring environmental noise is adequately controlled. For example, Noise Management Plans have been put in place where there is vigorous community reaction to potential noise effects from airport expansions or new industrial plantrs near residential sites. A noise management plan usually contains:

- ☑ identification of the range of potential noise sources
- ☑ specific steps that will be taken to ensure compliance with specified noise limits (these may be linked to a resource consent or district plan limit)
- ☑ a written undertaking from the author (eg. an acoustic engineer) that the means given in the plan will be adequate to ensure compliance with the noise limits specified in the conditions
- ☑ a programme of noise measurement to check that compliance has been achieved through monitoring and testing.

Overall, while the New Zealand experience in developing and putting in practice effective methods to manage noise in the environment, is generally positive

8 REFERENCES

1. Dravitzki, V.K., Walton D., and Wood, C.W.B. 2002. "Effects of Road Texture on Traffic Noise and Community Annoyance at Urban Driving Speeds". Transit New Zealand Research Report 2005.