SUBMISSION.

17 Vincent Street
Balmain NSW 2041
5.12.03

The Director
Standing Committee of State Development
Legislative Council
Parliament House
SYDNEY NSW 2000

Dear Sir,

re: **Inquiry into Port Infrastructure in NSW**

A. THERE ARE STRONG ARGUMENTS IN FAVOUR OT TRANSFERRING CONTAINER SHIPS OUT OF SYDNEY HARBOUR.

1. The site at White Bay is unsuitable for container ships. The distance of this location from the entrance to Sydney Harbour, the size of the ships, the inadequacy of White Bay as a container site and the need to truck cargo through congested CBD streets and to run trains at night, together with the noise pollution that characterizes the operation of these ships, all provide support.

2. The commercial 24 hour-a-day operation of these ships at these sites has severely damaged the amenity of thousands of residents of Balmain. Pyrmont and Lilyfield, with resulting sleep deprivation and associated health disorders.

3. The container terminal at Botany Bay is sufficient for the needs of Sydney. The container terminal at White Bay is a relic of past attitudes about the role of Sydney Harbour.

4. The information supplied to us indicates that the Port Kembla is a much better industrial site. Presumably, the same applies to Newcastle.

5. This transfer, with the appropriate infrastructure, will bring considerable economic and employment benefits to regional NSW.

B. **AN IMPORTANT PROVISO.**

We share the widespread concern that the vacant foreshore will be used primarily to increase revenue for the NSW Government; with excessive and poor quality residential development - a la the eyesores at Jackson Landing, Drummoyne and parts of the Parramatta River. Unless the NSW Government will put in place a Sydney-enhancing development at Millers Point, Darling Harbour, and Glebe Island, the planned redeployment of freight shipping should not go ahead.

C. THE TRANSFER OF OTHER CARGO SHIPS.
There is no virtue in a piecemeal approach to the problem of freight transport in NSW, attending

to only one form of cargo. Very similar considerations apply to other cargo types - why then not have a comprehensive plan dealing with all types of cargos which include:

a . Roll-on-Roll-off ships (eg the Wilhelmsen-Marius Line). These ships are too big to operate close to residential housing. The size of their engines with the consequent low frequency pulsatile noise and vibrations means that windows and doors 300 metres away rattle, with the low frequencies resonating inside the small rooms of Balmain. In addition, the loud impact noise from cargo passing over the ramps, has never been controlled. These ships will never be able to comply with noise guidelines at receiver sites ie at adjacent residential areas. If, after the closure of Darling (? in 2017), they are shifted to White Bay, there would be a public outcry. We consider their transfer to Newcastle/Port Kembla should accompany the transfer of the container ships there.

b. Car carriers. These are the loudest ships that enter the port and again are unable to meet noise standards at receiver sites. Their operation, day and night at wharves 1 & 2 at Glebe Island, so close to the residents of Pyrmont. has been justified in the past d by the fact that they pre-existed the residential development at Pyrmont. With the proposed redeployment, this argument looses much of its force. Keeping these ships in Sydney Harbour means either that Glebe Island remains as is, or that these ships will also will be transferred to White Bay where, because of the size of these ships, this will involve White Bay wharves 3 and upwards, with a devastating effect on the amenity of the residents of Balmain. Again, their transfer to Newastle/Port Kembla could accompany the transfer of container ships there.

c. Bulk carriers. In contrast to the above two ship types, there is, at this stage, the possibility that bulk carriers could comply with noise standards and therefore justifiably remain in Sydney Harbour. Unfortunately, there is no good information on which to assess this. There are many deficiencies in the EIS for the Bulk Grain Unloading Terminal (BGUT) - incorrect models used, important noise sources ignored as with low frequency noise from ships engines. Also, there has been no estimation made of total noise levels, the main noise parameter determining annoyance and sleep disturbance. With unloading continuing through the night, with banging of crane shovels against ship sides and with constant nighttime truck movements, it appears unlikely that nighttime noise standards at receiver sites will be satisfied for the BGUT. Bulk carriers that are unable to meet noise standards ,we consider should be transferred out of Sydney Harbour.

D. CONTINUATION OF THE WHITE BAY WHARVES.

There is a case for retaining some wharves either at Darling Harbour,Glebe Island or White Bay. If White Bay is to remain, little objection can be made to ships operating there commercially provided they comply with the noise guidelines in the EPA Industrial Noise Policy and the WHO (see below). Currently, ships will operate under common usage the SPC is putting in place. This needs to be monitored to prevent fly-by-night operators operating without control. However, as pointed out above, these wharves would not be suitable for car carriers, ROROs or bulk carriers which don't meet noise standards.

E. RECOMMENDED NOISE MANAGEMENT.

In the past, commercial profitability has been pursued at the expense of the community's amenity. Noise management has been a reactive process, at best a marginal change or two after a new and noisy ship has begun to use the Port. The result has been non-observance of noises standards at night and non-compliance with the INP protocols for the management and control of noise pollution, characterized by excessive noise emissions from the dropping of containers, ship generators, portainer cranes and fork lifts, none of which have improved to any worthwhile extent over the last 4 years.

With the transformation away from a dedicated heavy industrial area, improved noise control should be part of the overall development plan. This includes a comprehensive noise policy, one that can be applied when a ship's use of the facility is being considered and a licence being issued, and noise standards that can be effectively and automatically applied. The following are needed:

1. Nighttime noise levels to adhere strictly to standards set out in the EPA Industrial Noise Policy (INP) and the WHO.
2 The EPA INP guidelines to be complied with. Particularly, that there be:
   a. Negotiation with the community on setting 'agreed-upon acceptable levels of noise impact'.
   b. A formal program of noise control.
   c. Enforcement provisions that are operative.
3. An independent and noise-aware Appropriate Regulatory Authority to be declared who is prepared to enforce noise standards.
4. The EPA to be directly involved in noise management.
5. There to be proper maintenance and noise insulation of machinery in use on the wharves.
6. Work place practices to be improved substantially.
7. The POEO (Protection of the Environment Operations Act) to be strengthened, so as to:
   a. Empower the community to protect its amenity in situations such as this.
   b. Provide licences with effective conditions on noise pollution reflecting community concerns.

Gordon McClatchie

Ann Bastock

Members, White Bay Noise Advisory Committee

Enclosures. 1. Letter drop.
2. Executive statement by WHO on noise control.

EIGHT NEW LEASES FOR GLEBE ISLAND

These leases are now "on the transport minister's desk". There is no indication that either the NSW Government or the Sydney Ports Corporation (SPC) have the amenity of the residents of Pyrmont, Balmain or Lilyfield on their agenda. Only long and loud community protest will put it there. Areas of concern are:

GLEBE ISLAND IS NOT AN APPROPRIATE SITE.

What is the rationale of bringing bulk cargo into the centre of Sydney Harbour - operating 24 hours a day in the midst of dense residential precincts - and loading and moving trains at night or trucking cargo through congested city streets? Alternate sites exist in Botany Bay and, unutilized, in regional NSW.

DISPROPORTIONATE INCREASE IN NIGHTTIME PORT OPERATION

There will be an increase in the proportion of cargo carried by freight trains which can only operate at night. This, and daytime road congestion, will cause a disproportionate increase in the nighttime operation of the Port.

DOUBLING OF NOISE LOUDNESS

The increased nighttime activity will disturb your sleep. Eventually, noise loudness at night will double.

INCREASE IN THROUGHPUT TONNEAGE

These leases are the first stage of the GI/WB Master Plan under which tonneage is planned to increase by 350%.

UNCONSTRAINED COMMERCIAL ACTIVITY

The SPC has not shown any intention to restrict commercial activity because of noise pollution.

UNREGULATED WORK PRACTICES

The SPC has never acted to control either noisy work practices, such as the handling of containers, or noisy machinery, such as fork lifts. Excessively loud reversing bells have recently been allowed.

INCORRECT NOISE ESTIMATES

The resulting loss of your amenity is concealed by the use of incorrectly low noise estimates for the Master Plan. These estimates are based on an assumed 40% increase in shipping which of course won't handle the 350% increase in throughput tonneage. The methodology has been severely criticized by a Sydney University analysis.

EXCEEDANCE OF NOISE STANDARDS

Even now, EPA Industrial Noise Policy amenity criteria are exceeded and WHO Community Noise guidelines markedly so. How much worse will it be when the Master Plan is fully implemented? Particularly as the SPC Master Plan for GI/WB does not comply with EPA INP Policy guidelines: no negotiation with the community on acceptable levels of noise impact; no formulation of control measures; no enforcement provisions.

Comments can be sent to:

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21. WHO GUIDELINES FOR COMMUNITY NOISE

WHO

Executive Summary

1. Introduction

Community noise (also called environmental noise., residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic; industries; construction and public work; and the neighbourhood. The main indoor noise sources are ventilation systems, office machines, home appliances and neighbours.

In the European Union about 40% of the population is exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB(A) daytime, and 20% are exposed to levels exceeding 65 db(A) When all transportation noise is considered, more than half of all European Union citizens is estimated to live in zones that do not ensure acoustical comfort to residents. At night, more than 30% are exposed to equivalent sound pressure levels exceeding 55 dB(A), which are disturbing to sleep. Noise pollution is also severe in cities of developing countries. It is caused mainly by traffic and alongside densely traveled roads equivalent sound pressure levels for 24 hours can reach 75-80 dB(A)

In contrast to many other environmental problems, noise pollution continues to grow and it is accompanied by an increasing number of complaints from people exposed to the noise. The growth in noise pollution is unsustainable because it involves direct, as well as cumulative, adverse health effects. It also adversely affects future generations and has socio-cultural, esthetic and economic effects.

2. Noise sources and measurement

Physically, there is no distinction between sound and noise. Sound is a sensory perception and the complex pattern of sound waves is labeled noise, music, speech etc. Noise is thus defined as unwanted sound.

Most environmental noises can be approximately described by several simple measures. All measures consider the frequency content of the sounds, the overall sound pressure levels and the variation of these levels with time. Sound pressure is a basic measure of the vibrations of air that make up sound. Because the range of sound pressures that human listeners can detect is very wide, these levels are measured on a logarithmic scale with units of decibels. Consequently, sound pressure levels cannot be added or averaged arithmetically. Also, the sound levels of most noises vary with time, and when sound pressure levels are calculated, the instantaneous pressure fluctuations must be integrated over some time interval.

Most environmental sounds are made up of a complex mix of many different frequencies. Frequency refers to the number of vibrations per second of tile air in which the sound is propagating and it is measured in Hertz (Hz). The audible frequency range is normally considered to be 20-20 000 Hz for younger listeners with unimpaired hearing. However, our hearing systems are not equally sensitive to all sound frequencies, and to compensate for this various types of filters or frequency weighting have been used to determine the relative strengths of frequency components making up a particular environmental noise. The A-weighting is most commonly used and weights lower frequencies as less important than mid- and higher frequencies. It is intended to approximate the frequency response of our hearing system,

The effect of a combination of noise events is related to the combined sound energy of those events (the equal energy principle). The sum of the total energy over some time period gives a level equivalent to the average sound energy over that period. Thus, LAeq,T is the energy average equivalent level of the A-weighted sound over a period T. LAeq,T should be used to measure continuing sounds, such as road traffic noise or Types of more-or-less continuous industrial noises. However, when there are distinct events to the noise, as with aircraft or railway noise, measures of individual events such as the maximum noise level (LAmax), or the weighted sound exposure level (SEL), should also be obtained in addition to LAeq,T. Time varying environmental sound levels have also been described in terms of percentile levels.

Currently, the recommended practice is to assume that the equal energy principle is approximately valid for most types of noise and that a simple LAeq,T measure will indicate the expected effects of the noise reasonably well. When the noise consists of a small number of discrete events, the A-weighted maximum level (LAmax) is a better indicator of the disturbance to sleep and other activities. In most cases, however, the A-weighted sound exposure level (SEL) provides a more consistent measure of single-noise events because it is based on integration over the complete noise event. In combining day and night LAeq,T values, nighttime weightings are often added. Nighttime weightings are intended to reflect the expected increased sensitivity to annoyance at night, but they do not protect people from sleep disturbance.

Where there are no clear reasons for using other measures, it is recommended that LAeq,T be used to evaluate more-or-less continuous environmental noises. Where the noise is principally composed of a small number of discrete events, the additional use of LAmax or SEL is recommended. There are definite limitations to these simple measures, but there are also many practical advantages, including economy and the benefits a standardized approach.

3. Adverse health effects of noise

The health significance of noise pollution is given in chapter 3 of the Guidelines under separate headings according to the specific effects: noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep, psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; and interference with intended activities. This chapter also considers vulnerable groups and the combined effects of mixed noise sources.

Hearing impairment is typically defined as an increase in the threshold of hearing. Hearing deficits may be accompanied by tinnitus (ringing in the ears). Noise-induced hearing impairment occurs predominantly in the higher frequency range of 3 3 000-6 000 Hz, with the largest effect at 4 000 Hz. But with increasing LAeq,8h and increasing exposure time, noise-induced hearing impairment occurs even at frequencies as low as 2 000 Hz. However, hearing impairment is no expected to occur at LAeq,8h levels of 75 dB(A) or below, even for prolonged occupational noise exposure.

Worldwide, noise-induced hearing impairment is the most prevalent irreversible occupational hazard and it is estimated that 120 million people world-wide have disabling hearing difficulties

In developing countries, not only occupational noise but also environmental noise is an increasing risk factor for hearing impairment. Hearing damage can also be caused by certain diseases, some industrial chemicals.. ototoxic drugs, blows to the head, accidents and hereditary origins. Hearing deterioration is also associated with the ageing process itself (presbycusis).

The extent of hearing impairment in populations exposed to occupational noise depends on the value of LAeq,8h., the number of noise-exposed years, and on individual susceptibility. Men and women are equally at risk for noise-induced hearing impairment. It is expected that environmental and leisure-time noise with a LAeq,24h of 70 dB(A) or below will not cause hearing impairment in the large majority of people, even after a lifetime exposure. For adults exposed to impulse noise at the workplace, the noise limit is set at peak sound pressure levels of 140 dB, and the same limit is assumed to be appropriate for environmental and leisure-time noise. In the case of children, however, taking into account their habits while playing with noisy toys, the peak sound pressure should never exceed 120 dB. For shooting noise with LAeq,24h levels greater than 80 dB(A) there may be an increased risk for noise-induced hearing impairment.

The main social consequence of hearing impairment is the inability to understand speech in daily living conditions, and this is considered to be a severe social handicap. Even small values of hearing impairment (10 dB averaged over 2 000 and 4 000 Hz and over both cars) may adversely affect speech comprehension.

Speech intelligibility is adversely affected by noise. Most of the acoustical energy of speech is in the frequency range of 100-6 000 Hz, with the most important cue-bearing energy being between 300-3 000 Hz. Speech interference is basically a masking process, in which simultaneous interfering noise renders speech incapable of being understood. Environmental noise may also mask other acoustical signals that are important for daily life, such as door bells, telephone signals, alarm clocks. fire alarms and other warning signals, and music.

Speech intelligibility in everyday living conditions is influenced by speech level; speech pronunciation; talker-to-listener distance; sound level and other characteristics of the interfering noise; hearing acuity; and by the level of attention. Indoors, speech communication is also affected by the reverberation characteristics of the room. Reverberation times over I s produce loss in speech discrimination and make speech perception more difficult and straining. For full sentence intelligibility in listeners with normal hearing the signal-to-noise ratio (i.e. the difference between the speech level and the sound level of the interfering noise) should be at least 15 dB(A) Since the sound pressure level of normal speech is about 50dB(A) noise with sound levels of 35 dB(A) or more interferes with the intelligibility of speech in smaller rooms. For vulnerable groups even lower background levels are needed, and a reverberation time below 0.6 s is desirable for adequate speech intelligibility, even in a quiet environment.

The inability to understand speech results in a large number of personal handicaps and behavioural changes. Particularly vulnerable are the hearing impaired, the elderly, children in the process of language and reading acquisition, and individuals who are not familiar with the spoken language.

Sleep disturbance is a major effect of environmental noise, It may cause primary effects during sleep, and secondary effects that can be assessed the day after nighttime noise exposure. Uninterrupted sleep is a prerequisite for good physiological and mental functioning, and the primary effects of sleep disturbance are: difficulty in falling asleep; awakenings and alterations of sleep stages or depth; increased blood pressure, heart rate and finger pulse amplitude; vasoconstriction; changes in respiration; cardiac arrhythmia; and increased body movements. The difference between the sound levels of a noise event and background sound levels, rather than the absolute noise level, may determine the reaction probability. The probability of being awakened increases with the number of noise events per night. The secondary, or after effects, the following morning or day(s) are reduced perceived sleep quality; increased fatigue; depressed mood or well-being; and decreased performance.

For a good night's sleep, the equivalent sound level should not exceed 30 dB(A) for continuous background noise, and individual noise events exceeding 45 dB(A) should be avoided. In setting limits for single nighttime noise exposures, the intermittent character of the noise has to be taken into account. This can be achieved, for example, by measuring the number of noise events, as well as the difference between the maximum sound level and the background sound level. Special attention should also be given to: noise sources in an environment with low background sound levels; combinations of noise and vibrations; and to noise sources with low-frequency components.

Physiological Functions. In workers exposed to noise, and in people living near airports, industries and noisy streets, noise exposure may have a large temporary, as well as permanent, impact on physiological functions, After prolonged exposure, susceptible individuals in the general population may develop permanent effects, such as hypertension and ischaemic heart disease associated with exposure to high sound levels. The magnitude and duration of the effects are determined in part by individual characteristics, lifestyle behaviours and environmental conditions. Sounds also evoke reflex responses, particularly when they are unfamiliar and have a sudden onset.

Workers exposed to high levels of industrial noise for 5-30 years may show increased blood pressure and an increased risk for hypertension. Cardiovascular effects have also been demonstrated after long-term exposure to air- and road-traffic with LAeq,24h values of 65-70 dB(A). Although the associations are weak, the effect is somewhat stronger for ischaemic heart disease than for hypertension. Still, these small risk increments are important because a large number of people are exposed.

Mental Illness. Environmental noise is not believed to cause mental illness directly, but it is assumed that it can accelerate and intensify the development of latent mental disorders. Exposure to high levels of occupational noise has been associated with development of neurosis, but the findings on environmental noise and mental-health effects are inconclusive. Nevertheless, studies on the use of drugs such as tranquilizers and sleeping pills, on psychiatric symptoms and on mental hospital admission rates, suggest that community noise may have adverse effects on mental health.

Performance. It has been shown, mainly in workers and children, that noise can adversely affect performance of cognitive tasks. Although noise-induced arousal may produce better performance in simple tasks in the short term, cognitive performance substantially deteriorates for more complex tasks. Reading, attention, problem solving and memorization are among the cognitive effects most strongly affected by noise. Noise can also act as a distracting stimulus and impulsive noise events may produce disruptive effects as a result of startle responses.

Noise exposure may, also produce after effects that negatively affect performance. In schools around airports, children chronically exposed to aircraft noise under-perform in proof reading, in

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persistence on challenging puzzles, in tests of reading acquisition and in motivational capabilities. It is crucial to recognize that some of the adaptation strategies to aircraft noise, and the effort necessary to maintain task performance, come at a price. Children from noisier areas have heightened sympathetic arousal, as indicated by increased stress hormone levels, and elevated resting blood pressure. Noise may also produce impairments and increase in errors at work, and some accidents may be an indicator of performance deficits,

Social and Behavioural Effects of Noise; Annoyance. Noise can produce a number of social and behavioural. effects as well as annoyance. These effects are often complex, subtle and indirect and many effects are assumed to result from the interaction of a number of non-auditory variables. The effect of community noise on annoyance can be evaluated by questionnaires or by assessing the disturbance of specific activities. However, it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance. This is because annoyance in populations varies not only with the characteristics of the noise including the noise source, but also depends to a large degree on many non-acoustical factors of a social, psychological, or economic nature. The correlation between noise exposure and general annoyance is much higher at group level than at individual level. Noise above 80 dB(A) may also reduce helping behaviour and increase aggressive behaviour. There is particular concern that high-level continuous noise exposures may increase the susceptibility of schoolchildren to feelings of helplessness.

Stronger reactions have been observed when noise is accompanied by vibrations and contains low-frequency components, or when the noise contains impulses, such as with shooting noise. Temporary, stronger reactions occur when the noise exposure increases over time, compared to a constant noise exposure. In most cases, LAeq,24h and Ldn, are acceptable approximations of noise exposure related to annoyance, However, there is growing concern that all the component parameters should be individually assessed in noise exposure investigations, at least in the complex cases. There is no consensus on a model for total annoyance due to a combination of environmental noise sources.

Combined Effects on Health of Noise from Mixed Sources. Many acoustical environments consist of sounds from more than one source, i.e. there are mixed sources, and some combinations of effects are common. For example, noise may interfere with speech in the day and create steep disturbance at night. These conditions certainly apply to residential areas heavily polluted with noise. Therefore. it is important that the total adverse health load of noise be considered over 24 hours, and that the precautionary principle for sustainable development be applied.

Vulnerable Subgroups. Vulnerable subgroups of the general population should be considered when recommending noise protection or noise regulations. The types of noise effects, specific environments and specific lifestyles are all factors that should be addressed for these subgroups. Examples of vulnerable subgroups are: people with particular diseases or medical problems (e.g. high blood pressure); people in hospitals or rehabilitating at home; people dealing with complex cognitive tasks; the blind; people with hearing impairment; fetuses, babies and young children; and the elderly in general. People with impaired hearing are the most adversely affected with respect to speech intelligibility. Even slight hearing impairments in the high-frequency sound range may cause problems with speech perception in a noisy environment. A majority of the population belongs to the subgroup that is vulnerable to speech interference.

I. Guideline values

In chapter 4, guideline values are given for specific health effects of noise and for specific environments.

Specific health effects.

Interference with Speech Perception. A majority of the population is susceptible to speech interference by noise and belongs to a vulnerable subgroup. Most sensitive are the elderly and persons with impaired hearing. Even slight hearing impairments in the high-frequency range may cause problems with speech perception in a noisy environment. From about 40 years of age, the ability of people to interpret difficult, spoken messages with low linguistic redundancy is impaired compared to people 20-30 years old. It has also been shown that high noise levels and long reverberation times have more adverse effects in children, who have not completed language acquisition, than in young adults.

When listening to complicated messages (at school, foreign languages, telephone conversation) the signal-to-noise ratio should be at least 15 dB with a voice level of 50 dB(A) This sound level corresponds on average to a casual voice level in both women and men at I m distance. Consequently, for clear speech perception the background noise level should not exceed 35 dB(A) In classrooms or conference rooms, where speech perception is of paramount importance, or for sensitive groups, background noise levels should be as low as possible,. Reverberation times below I s are also necessary for good speech intelligibility in smaller rooms. For sensitive groups, such as the elderly, a reverberation time below 0.6 s is desirable for adequate speech intelligibility even in a quiet environment.

Hearing Impairment. Noise that gives rise to hearing impairment is by no means restricted to occupational situations. High noise levels can also occur in open air concerts, discotheques, motor sports, shooting ranges, in dwellings from loudspeakers, or from leisure activities. Other important sources of loud noise are headphones, as well as toys and fireworks which can emit impulse noise. The ISO standard 1999 gives a method for estimating noise-induced hearing impairment in populations exposed to all types of noise (continuous, intermittent, impulse) during working hours. However, the evidence strongly suggests that this method should also be used to calculate hearing impairment due to noise exposure from environmental and leisure time activities. The ISO standard 1999 implies that long-term exposure to LAeq,24h noise levels of up to 70 dB(A) will not result in hearing impairment, To avoid hearing loss from impulse noise exposure, peak sound pressures should never exceed 140 dB for adults, and 120 dB for children,

Sleep Disturbance. Measurable effects of noise on sleep begin at LAeq levels of about 30 dB. However, the more intense the background noise, the more disturbing is its effect on sleep. Sensitive groups mainly include the elderly, shift workers, people With physical or mental disorders and other individuals who have difficulty sleeping

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Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep. Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of the equivalent sound level of the noise, as well as in terms of maximum noise levels and the number of noise events, It should be noted that low-frequency noise, for example, from ventilation systems, can disturb rest and sleep even at low sound pressure levels.

When noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. For noise with a large proportion of low frequency sound a still lower guideline value is recommended. When the background noise is low, noise exceeding 45 dB LAmax should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep. It should be noted that the adverse effect of noise partly depends on the nature of the source. A special situation is for newborns in incubators, for which the noise can cause sleep disturbance and other health effects.

Reading Acquisition. Chronic exposure to noise during early childhood appears to impair reading acquisition and reduces motivational capabilities. Evidence indicates that the longer the exposure, the greater the damage. Of recent concern are the concomitant psychophysiological changes (blood pressure and stress hormone levels). There is insufficient information on these effects to set specific guideline values. It is clear, however, that daycare centres and schools should not be located near major noise sources, such as highways, airports, and industrial sites.

Annoyance. The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at LAeq levels below 55 dB(A) and few are moderately annoyed at LAeq levels below 50 dB(A) Sound levels during the evening and night should be 5-10 dB lower than during the day. Noise with low-frequency components require lower guideline values. For intermittent noise, it is emphasized that it is necessary to take into account both the maximum sound pressure level and the number of noise events. Guidelines or noise abatement measures should also take into account residential outdoor activities.

Social Behaviour. The effects of environmental noise may be evaluated by assessing its interference with social behavior and other activities. For many community noises, interference with rest/recreation/watching television seem to be the most important effects. There is fairly consistent evidence that noise above 80 dB(A) causes reduced helping behavior, and that loud noise also increases aggressive behavior in individuals predisposed to aggressiveness. In schoolchildren, there is also concern that high levels of chronic noise contribute to feelings of helplessness. Guidelines on this issue, together with cardiovascular and mental effects, must await further research.

Specific environments.

A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. It is equally important to measure the maximum values of noise fluctuations, preferably combined with a measure of the number of noise events. If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low- components are present, noise measures based on A-weighting are inappropriate. The difference between dB(C) and dB(.A) will give crude information about the presence of low frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low frequency components in noise may increase considerably the adverse effects on health.

In Dwellings. The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 dB LAeq for continuous noise and 45 dB LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. At nighttime, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime the sound level of interfering noise should not exceed 35 dB LAeq. The maximum sound pressure level should be measured with the sound pressure set at "Fast".

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.

In Schools and Preschools. For schools, the critical effects of noise are speech interference, disturbance of information extraction (e.g. comprehension and reading acquisition), message communication and annoyance, To be able to hear and understand spoken messages in class rooms, the background sound level should not exceed 35 dB LAeq during teaching sessions, For hearing impaired children, a still lower sound level may be needed. The reverberation time in the classroom should be about 0.6 s and preferably lower for hearing impaired children. For assembly halls and cafeterias in school buildings, the reverberation time should be less than I s . For outdoor playgrounds the sound level of the noise from external sources should not exceed 55 dB LAeq, the same value given for outdoor residential areas in daytime.

For preschools, the same critical effects and guideline values apply as for schools. In bedrooms in preschools during sleeping hours, the guideline values for bedrooms in dwellings should be used.

In Hospitals. For most spaces in hospitals. the critical effects are sleep disturbance, annoyance, and communication interference, including warning signals. The LAmax of sound events during the night should not exceed 40 dB(A) indoors. For ward rooms in hospitals, the guideline values indoors are 30dB LAeq, together with 40 dB LAmax during night. During the day and evening the guideline value indoors is 30 dB LAeq. The maximum level should be measured with the sound pressure instrument set at "Fast".

Since patients have less ability to cope with stress, the LAeq level should not exceed 35 dB in most rooms in which patients are being treated or observed. Attention should be given to the sound levels in intensive care units and operating theaters. Sound inside incubators may result in health problems for neonates, including sleep disturbance, and may also lead to hearing impairment. Guideline, values for sound levels in incubators must await future research.

Ceremonies, Festivals and Entertainment Events. In many countries, there are regular ceremonies, festivals and entertainment events to celebrate life periods. Such events typically produce loud sounds, including music and impulsive sounds. There is widespread concern about the effect of loud music and impulsive sounds on young people who frequently attend concerts, discotheques, video arcades, cinemas, amusement parks and spectator events. At these events, the sound level typically exceeds 100 dB LAeq. Such noise exposure could lead to significant hearing impairment after frequent attendances.

Noise exposure for employees of these venues should be controlled by established occupational standards; and at the very least, the same standards should apply to the patrons of these premises. Patrons should not be exposed to sound levels greater than 100 dB 1,Aeq during a four-hour period more than four times per year. To avoid acute hearing impairment the LAmax should always be below I 10 dB.

Headphones. To avoid hearing impairment from music played back in headphones, in both adults and children, the equivalent sound level over 24 hours should not exceed 70 dB(A). This implies that for a daily one hour exposure the LAeq level should not exceed 85 dB(A) To avoid acute hearing impairment LAmax should always be below 110 dB(A). The exposures are expressed in free-field equivalent sound level,

Toys, Fireworks and Firearms. To avoid acute mechanical damage to the inner car from impulsive sounds from toys, fireworks and firearms, adults should never be exposed to more than 140 dB(lin) peak sound pressure level. To account for the vulnerability in children when playing, the peak sound pressure produced by toys should not exceed 120 dB(lin). measured close to the cars (100 mm), To avoid acute hearing impairment LAmax should always be below 110 dB(A).

Parkland and Conservation Areas. Existing large quiet outdoor areas should be preserved and the signal-to-noise ratio kept low.

Table I presents the WHO guideline values arranged according to specific environments and critical health effects. The guideline values consider all identified adverse health effects for the specific environment, Am adverse effect of noise refers to any temporary or long-term impairment of physical, psychological or social functioning that is associated with noise exposure. Specific noise limits have been set for each health effect, using the lowest noise level that produces an adverse health effect (i.e. the critical health effect). Although the guideline values refer to sound levels impacting the most exposed receiver at the listed environments, they are applicable to the general population. The time base for LAeq for "daytime" and "nighttime" is 12-16 hours and 8 hours, respectively. No time base is given for evenings, but typically the guideline value should be 5-10 dB lower than in the daytime. Other time bases are recommended for schools, preschools and playgrounds, depending on activity.

It is not enough to characterize the noise environment in terms of noise measures or indices based only on energy summation (e.g., LAeq), because different critical health effects require different descriptions. It is equally important to display the maximum values of the noise fluctuations, preferably combined with a measure of the number of noise events. A separate characterization of nighttime noise exposures is also necessary. For indoor environments, reverberation time is also an important factor for things such as speech intelligibility. If the noise includes a large proportion of low-frequency components, still lower guideline values should be applied. Supplementary to the guideline values given in Table 1, precautions should be taken for vulnerable groups and for noise of certain character (e g. low-frequency components, low background noise).

Table 1: Guideline values for community noise in specific environments.

Specific environment	Critical health effect(s)	LAeq dB (A)l	Tiime base [hours]	LAmax fast [dB])
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, nighttime	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms & pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoor	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, nighttime	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1	-	-
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music and other sounds through headphones/ earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and	Hearing impairment (adults)	-	-	140
		-	-	#2

firearms	Hearing impairment (children)	-	-	120
		-	-	#2
Outdoors in parkland arid conservation areas	Disruption of tranquillity	#3	-	-

#1: As low as possible.
#2: Peak sound pressure (not LAF, max) measured 100 mm from the ear.
#3:Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.

#4 Under headphones, adapted to free-field values.

5. Noise Management

Chapter 5 is devoted to noise management with discussions on: strategies and priorities in managing indoor noise levels; noise policies and legislation; the impact of environmental noise; and on the enforcement of regulatory standards.

The fundamental goals of noise management are to develop criteria for deriving safe noise exposure levels and to promote noise assessment and control as part of environmental health programmes. These basic goals should guide both international and national policies for noise management. The United Nation's Agenda 21 supports a number of environmental management principles on which government policies, including noise management policies, can be based: the principle of precaution; the "polluter pays" principle; and noise prevention, In all cases, noise should be reduced to the lowest level achievable in the particular situation. When there is a reasonable possibility that the public health will be endangered, even though scientific proof may be lacking, action should be taken to protect the public health, without awaiting the full scientific proof. The full costs associated with noise pollution (including monitoring, management, lowering levels and supervision) should be met by those responsible for the source of noise. Action should be taken where possible to reduce noise at the source.

A legal framework is needed to provide a context for noise management. National noise standards can usually be based on a consideration of international guidelines, such as these Guidelines for Community Noise, as well as national criteria documents, which consider dose response relationships for the effects of noise on human health. National standards take into account the technological, social, economic and political factors within the country. A staged program of noise abatement should also be implemented to achieve the optimum health protection levels over the long term.

Other components of a noise management plan include: noise level monitoring; noise exposure mapping; exposure modeling; noise control approaches (such as mitigation and precautionary measures); and evaluation of control options. Many of the problems associated with high noise levels can be prevented at low cost, if governments develop and implement an integrated strategy for the indoor environment, in concert with all social and economic partners. Governments should establish a "National Plan for a Sustainable Noise Indoor Environment" that applies both to new construction as well as to existing buildings.

The actual priorities in rational noise management will differ for each country. Priority setting in noise management refers to prioritizing the health risks to be avoided and concentrating on the most important sources of noise. Different countries have adopted a range of approaches to noise control, using different policies and regulations. A number of these are outlined in chapter 5 and Appendix 2, as examples. It is evident that noise emission standards have proven insufficient and that the trends in noise pollution are unsustainable.

The concept of environmental an environmental noise impact analysis is central to the philosophy of managing environmental noise. Such an analysis should be required before implementing any project that would significantly increase the level of environmental noise in a community (typically, greater than a 5 dB increase). The analysis should include: a baseline description of the existing noise environment; the expected level of noise from the new source; an assessment of the adverse health effects; an estimation of the population at risk; the calculation of exposure-response relationships; an assessment of risks and their acceptability; and a cost-benefit analysis.

Noise management should:

1. Start monitoring human exposures to noise.

2. Have health control require mitigation of noise imissions, and not just of noise source emissions. The following should be taken into consideration:
   specific environments such as schools, playgrounds, homes, hospitals
   environments with multiple noise sources, or which may amplify the effects of noise.
   sensitive time periods such as evenings, nights and holidays.
   groups at high risk, such as children and the hearing impaired.

3. Consider the noise consequences when planning transport systems and land use.

4 .Introduce surveillance systems for noise-related adverse health effects.

5. Assess the effectiveness of noise policies in reducing adverse health effects and exposure, and in improving supportive "soundscapes".

6. Adopt these Guidelines for Community Noise as intermediary targets for improving human health.

7. Adopt precautionary actions for a sustainable development of the acoustical environments.

Conclusions and recommendations

In chapter 6 are discussed: the implementation of the guidelines, further WHO work on noise; and research needs are recommended.

Implementation. For implementation of the guidelines it is recommended that:

Governments should protection the population from community noise and consider it an integral part of their policy of environmental protection.
Governments should consider implementing action plans with short-term, medium-term and long-term objectives for reducing noise levels.

Governments should adopt the Health Guidelines for Community Noise values as targets to be achieved in the long-term.
Governments should include noise as an important public health issue in environmental impact assessments.
Legislation should be put in place to allow for the reduction of sound levels
Existing legislation should be enforced.
Municipalities should develop low noise implementation plans.
Cost-effectiveness and cost-benefit analyses should be considered potential instruments for meaningful management decisions.
Governments should support more policy-relevant research.

Future Work. The Expert Task Force worked out several suggestions for future work for the WHO in the field of community noise. "0 should:
Provide leadership and technical direction in defining future noise research priorities. Organize workshops on how to apply the guidelines.
Provide leadership and coordinate international efforts to develop techniques for designing supportive sound environments (e.g. "soundscapes").
Provide leadership for programs to assess the effectiveness of health-related noise policies and regulations.
Provide leadership and technical direction for the development of sound methodologies for environmental and health impact plans.
Encourage further investigation into using noise exposure as an indicator of environmental deterioration (e.g. black spots in cities).
Provide leadership and technical support, and advise developing countries to facilitate development of noise policies and noise management.

Research and Development. A major step forward in raising the awareness of both the public and of decision makers is the recommendation to concentrate more research and development on variables which have monetary consequences. This means that research should consider not only dose-response relationships between sound levels, but also politically relevant variables, such as noise-induced social handicap; reduced productivity; decreased performance in learning; workplace and school absenteeism; increased drug use; and accidents.

In Appendices 1-6 are given: bibliographic references; examples of regional noise situations (African Region, American Region, Eastern Mediterranean Region, South East Asian Region, Western Pacific Region); a glossary-, a list of acronyms-, and a list of participants.

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