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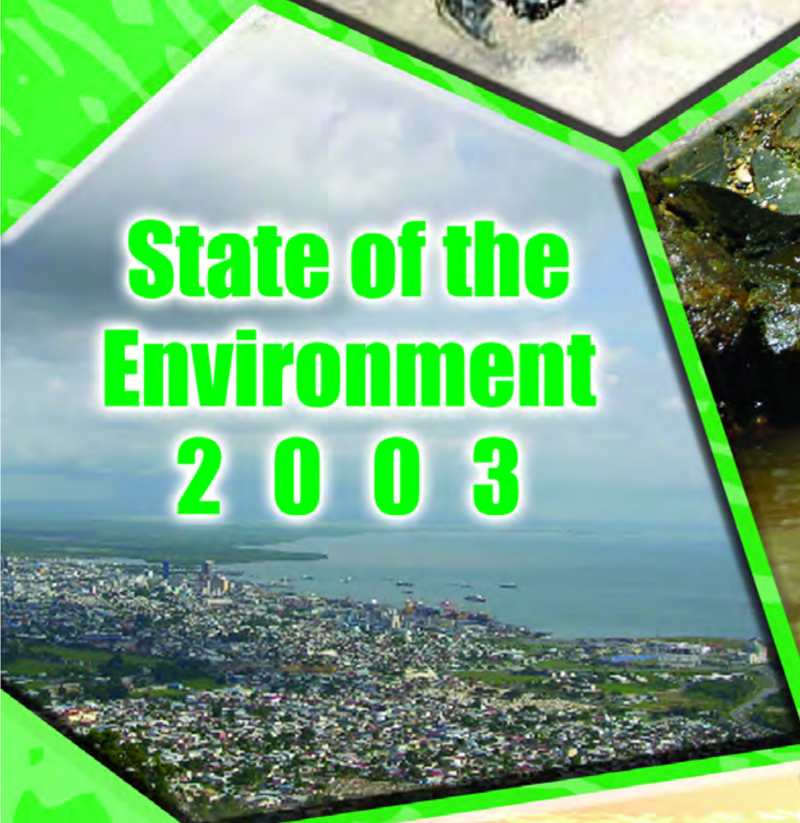
State of the Environment 2003



Mission Statement

The Environmental Management Authority is committed to protecting and conserving the natural environment to enhance the quality of life by promoting:

- ***Environmentally responsible behaviour***
- ***Development and enforcement of environmental legislation***
- ***Encouragement of voluntary compliance***
- ***The use of economic and other incentives***

This is to be achieved in an atmosphere of mutual respect, professionalism, accountability, transparency, collaboration and social responsibility.

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Chairman's Message

The EMA's 2003 Annual Report continues a tradition of periodic detailed review of the state of aspects of the environment requiring special attention. Due to the very large and rapidly increasing number of public complaints about noise, the EMA has selected the management of noise for special attention. In the Noise Pollution Control Rules, 2001, Parliament gave the EMA new duties to control ambient noise levels. The 2003 State of the Environment Report is the first attempt to reflect on the experience so far in implementing the new legislation.

EMA has found that although noise may not be top of everyone's priorities, it is certainly a big issue for many with 755 complaints being received in the period 2001-2003. Most of these complaints were from areas along the east west corridor such as Diego Martin, Port of Spain, San Juan and Arima, as well as along the west coast especially Chaguanas, Couva and San Fernando. The largest single category of complaints (52%) was about loud music. The EMA has developed a code of good practice with regard to noise control for the entertainment industry. Anyone holding a party or similar entertainment event is required to follow the guidelines in the code of good practice. Even so, during 2002 and 2003 legal action against noise polluters was taken on 70 occasions where attempts at eliciting voluntary compliance failed.

It is clear from members of the public that they fully support these attempts at noise control by the EMA but a lot more still needs to be done. A welcome development would be for the Police Service to start using its powers to confiscate music systems or other equipment if they cause real nuisance to others. In most countries, local police officers are usually the first line of defence against excessively noisy neighbours, with noise specialists from environmental and public health agencies being only used as a back up. Clearly, the regular Police Service will have other pressing priorities for some time to come and as a result, a more viable strategy in the short term might be to expand the number of specialist environmental police and locate them in different parts of Trinidad and Tobago.

The whole issue of controlling noise in Trinidad and Tobago is difficult business since people's reactions to noise can vary widely. One person's music can be another's intense irritation. Difficult balances have to be struck. Children who are learning, older people, or those with an illness may be most vulnerable. The EMA is attempting to balance the competing interest of various groups (e.g. religious organisations, fete promoters, residential neighbourhoods, steelband yards and industry) many of whom will never be satisfied. However, this should not be seen as a 'killjoy' strategy. Sound is an important part of communication, culture and many other parts of everyday life, but one person's important business may disturb another's concentration or sleep. We appeal to citizens to join with us in the spirit of compromise and make Trinidad and Tobago a better place for all our people.

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Dr. John Agard
Chairman

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Executive Summary

Noise pollution is unlike any other form of pollution that the EMA has to deal with. Due to its nature, noise pollution does not persist in the environment like waste or garbage and therefore offenders can easily disappear as quickly as the noise can. This makes enforcement difficult since the offender has to be caught in the act. However, where noise pollution is continuous as in the case of auto repair shops, woodworking, and the like, the noise can be identified and the offender caught.

Since the Noise Pollution Control Rules, 2001 became law in Trinidad and Tobago the EMA has received complaints numbering in the hundreds ranging from noise from entertainment activity to noise from woodworking shops, metal fabrication and other commercial activity. The EMA has also received and processed over five hundred applications for variations which helps control the level of noise from various activities including entertainment and commercial activity.

This State of the Environment Report will allow the reader to understand the health effects of loud sound (noise) as well as understand how the EMA has dealt with the issue of Noise Pollution in Trinidad and Tobago over the period 2001 - 2003.

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1.0 INTRODUCTION

The Environmental Management Authority, was constituted by an Act of Parliament, the Environmental Management Act, 1995, which was later repealed and replaced by the Environmental Management Act, 2000. One of the mandates given to the EMA is to manage and control pollution in Trinidad and Tobago. In partial fulfilment of this mandate the EMA has produced the Noise Pollution Control Rules, 2001 that was made into law by The Parliament in July of 2001. The Noise Pollution Control Rules form one of the pillars on which the EMA has built its campaign to protect the citizens of Trinidad and Tobago from Noise Pollution while allowing reasonable activities in the social, commercial, cultural, commercial and industrial sectors.

This State of the Environment Report will outline the progress the EMA has made in its pursuit of noise pollution reduction in Trinidad and Tobago as well as educate on the harmful effects of noise on human health and the environment.

1.1 THE NOISE POLLUTION CONTROL RULES, 2001

These rules were made by the Minister under sections 26(a)(b)(j)(k), 49, 51 and 81(5)(i) of the Environmental Management Act, 2000. The Noise Pollution Control Rules, 2001, prescribes Noise Emission Standards and outlines procedures for variations if an activity causes noise emissions to exceed the prescribed standards.

The Rules were enacted by Parliament and implemented by the EMA in 2001.

2.0 DEFINITIONS OF TECHNICAL TERMS

2.1 SOUND, NOISE AND VIBRATIONS

Noise is unwanted sound; it is derived from the Latin word "nausea," meaning seasickness. To the average person, "noise" is, at least, disagreeable or unwanted sound, and at worst, destructive sound.

According to the Environmental Management Act, 2000, "noise pollution" means any disturbance of the environment by a pollutant consisting of sound or other vibrations".

Further, "pollution" means "the creation or existence of any deviation from natural conditions within the environment, which based on technical, scientific or medical evidence is determined to cause or to be likely to cause harm to human health or the environment, the presence or release of any substance; or any other type of disturbance, whether by noise, energy, radiation, temperature variation, vibration, or objectionable odours; and "pollutant" shall have the corresponding meaning."

Noise is among the most pervasive pollutants today. Noise from road traffic, jet planes, garbage trucks, construction equipment, manufacturing processes, lawn mowers, leaf blowers, fetes and boom boxes, to name a few, are among the unwanted sounds that are routinely broadcast into the air.

The problem with noise is not only that it is unwanted, but also that it negatively affects human health and well being. Problems related to noise include hearing loss, stress, and high blood pressure, sleep loss, distraction and lost productivity and a general reduction in the quality of life and opportunities for tranquillity.

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We experience noise in a number of ways. On some occasions, we can be both the cause and the victim of noise, such as when we are operating noisy appliances or equipment. There are also instances when we experience noise generated by others, just as people experience second-hand smoke.

The air into which second-hand noise is emitted and through which it travels is a public good[1]. It belongs to no one person or group, but to everyone. People, businesses, and organizations, therefore, do not have unlimited rights to broadcast noise as they please, as if the effects of noise were limited only to their private property. On the contrary, they have an obligation to use the commons[2] in ways that are compatible with or do not detract from the use by others.

People, businesses, and organizations that disregard the obligation to not interfere with others' use and enjoyment of the commons by producing noise pollution are, in many ways, acting like a bully in a schoolyard. Although perhaps unknowingly, they nevertheless disregard the rights of others and claim for themselves, rights that are not theirs.

Noise is generated from a number of sources; these include but are not limited to:

- Industrial Activity
- Construction
- Entertainment Industry
- Residences

The information in Table 1 is intended to provide a general appreciation of the common sources of noise (anthropogenic or controllable by man) in Trinidad and Tobago. The list is not exhaustive, and the categories are not necessarily mutually exclusive.

Table 1: Example Of Pontential Noise Generating Activites

No.	Potential Noise Generating Activity	Examples Of Specific Sources
1	Industrial activity- medium and large scale	Compressors, pumps, engines, electric motors, generators, transformers, other electrical equipment, air-moving systems such as fans and ventilating systems, gas turbines, valves
2	Construction	All construction activities, e.g. pile driving, excavation, welding, grinding, carpentry
3	Industrial and commercial activity, on a small-scale, typically carried on in the vicinity of residences.	Auto -body repair ("body - straightening"), metal working, woodworking, garages, mechanic shops, tyre shops (Tools used include hammers, band saws, power saws, grinders, pneumatic tools), depots for heavy vehicles

[1]Public goods are non-excludable and non-rival in consumption. An example is a street sign. It will not wear out, even if large numbers of people are looking at it; and it would be extremely difficult, costly and highly inefficient to limit its use to only one or a few persons and try to prevent others from looking at it, too. A traffic light or clean air is a further example.

[2]The commons can be defined as all activities and ecological assets essential to or useful for human wealth and well-being that cannot be produced and distributed to individuals operating in price auction markets. In other words it includes all productivity and assets that must be produced and/or consumed, at least in part, collectively.

No.	Potential Noise Generating Activity	Examples Of Specific Sources
4	Other commercial activity typically carried out in the vicinity of residences	Restaurants, pubs, bars, human communication. air conditioning units, electric generators, water pumps
5	Operation of household appliances and equipment	Lawn-mowers, edge-trimmers. mist-blowers, leaf-blowers, chain-saws, other gasoline-powered equipment, air conditioning units, water pumps, kitchen appliances, vacuum cleaners, stereos and other sound systems, musical equipment and instruments, burglar alarms, motor vehicle alarms
6	Operation of stereos and other sound system in public places	Vendors, on the streets, at the beach, loudspeakers
7	Other residential- associated noise	Barking dogs, fire crackers and fireworks. "bussing bamboo", use of loudspeakers for announcements, human communication
8	Operation of vehicles, including aircraft	Trucks, tractors, other heavy vehicles; automobiles, motorcycles, defective or tampered muffler systems or engines, horns
9	Social activities	Open-air fetes, house parties, weddings, human communication; DJs shouting in microphones
10	Cultural activities	Related to cultural festivals

2.2 THE NATURE OF SOUND AND ITS UNIT OF MEASUREMENT

Sound is a wave motion (vibration), which occurs when the sound source (e.g. a person speaking) sets the nearest molecules of air into motion. This movement gradually spreads to other nearby air molecules away from the source and eventually reaches the eardrum and sets that into vibration, and so we are able to hear the sound.

Sound may consist of a single pure tone, but in most cases, it is made up of many tones at different frequencies and intensities. The disturbance generated by a sound is dependent on both the level of the sound as well as the frequency; higher frequencies tend to be more annoying than lower frequencies. A young healthy adult ear has a nominal range of hearing between 20 Hz and 20 000 Hz, although at very high levels, sound outside this range may be sensed.

The intensity of sound is usually measured by a unit called the decibel, or dB(A), where dB is the abbreviation for 'decibel' and A refers to the A scale, one of three frequency patterns on which sound is measured. The A scale is generally used for sound measurement as it more closely duplicates the human ear's variable sensitivity to sound of different frequencies.

Decibel levels progress logarithmically rather than arithmetically. Hence a small change in decibel value can represent a large change in the intensity of the noise. The intensity of a sound also decreases (according to the inverse square law) as the distance away from the source increases.

Apart from its frequency spectrum and the variations of sound level (intensity) with time, the disturbance generated by a sound (noise) is also characterized by its sound field, i.e. the region in which the sound is generated and transmitted.

Table 2 presents comparative levels of sound in dB(A).

Table 2: Comparative Noise Levels

SOUND PRESSURE LEVEL DB(A)	ACTIVITY	GENERAL CLASS
190	Theoretically, highest possible sound	DEAFENING
140	Jet engine takeoff	
130	Jackhammer; rock concert, close to pneumatic rock drill	
120	Possible onset of sensation of pain in human ear	
110	Dance hall; seated in calypso tent about 5 meters from the speakers	
100	5 meters from a diesel standby generator	
90	Loud hi-fi stereo system	DISTRACTING
80-85	Heavy city traffic	
70	Inside residence located on major roadway, daytime	
50-60	Ordinary conversation; general office environment	RANGE OF CONVERSATION
40-45	Quiet residential area at night	VERY QUIET
35	Quiet home	
20	People whispering	
10	Leaves gently rustling	
0	Theoretically, the weakest sound that can be heard by a person with good hearing	SOUND PROOF CHAMBERS

The decibel (dB) is used to measure sound level, but it is also widely used in electronics and signals. The dB is a logarithmic unit used to describe a ratio. The ratio may be power, or voltage or intensity or several other things.

2.3 WHY DO WE USE DECIBELS

The ear is capable of hearing a very large range of sounds: the ratio of the sound pressure that causes permanent damage from short exposure to the limit that (undamaged) ears can hear is more than a million. To deal with such a range, logarithmic units are useful: the log of a million is 6, so this ratio represents a difference of 120 dB. Psychologists also say that our sense of hearing is roughly logarithmic. In other words, they think that you have to increase the sound intensity by the same factor to have the same increase in loudness.

Figure 1: Typical Outdoor Sound Measured on a quiet Suburban Street

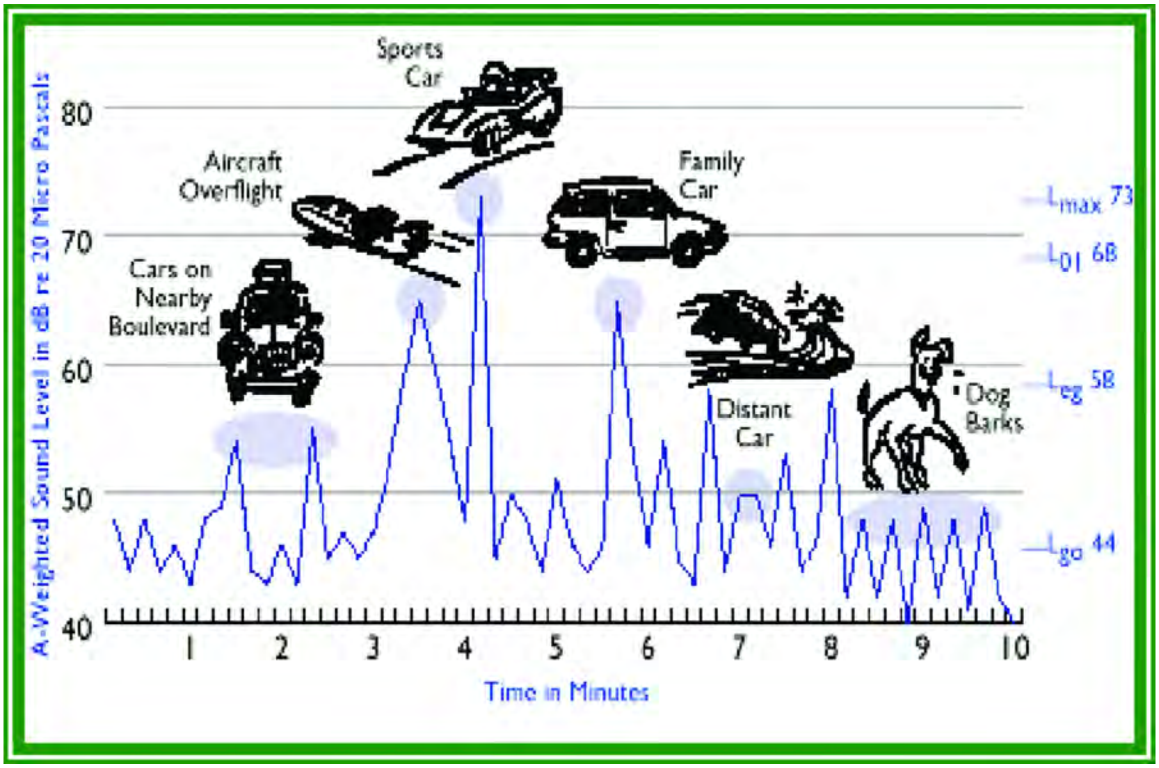

Figure 1 from an EPA report, shows a ten-minute time history of outdoor sound measured on a front lawn at a quiet suburban location on a typical, otherwise uneventful, afternoon. The maximum sound level, 73 dBA, occurs instantaneously when a sports car passes on the nearby street. Often, the background sound of an area is expressed as the sound level exceeded 90 percent of the time, symbolized as the L90. In Figure 1 the L90 is approximately 44 dBA; that is, the ambient sound level exceeds 44 dBA for about 90 per cent of the time interval depicted. In other words, the background sound level is about as quiet as it gets at a particular location. The one percentile sound level, L1, is generally taken to be representative of typically intrusive, high sound levels observed during a time interval. (One per cent of the 10-minute interval in Figure 1 is six seconds).

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2.4 ACCEPTABLE NOISE LEVELS

In 2001 the 'Noise Pollution Control Rules, (2001)' were passed in Parliament. These rules outline acceptable noise standards as follows:

ZONE I – Industrial Areas	**Anytime**-The sound pressure level shall not exceed the following: *(a)* equivalent continuous sound pressure level of 75 dBA; *(b)* instantaneous unweighted peak sound pressure level of 130 dB (peak).
ZONE II – Environmentally Sensitive Areas	**Daytime Limits**-On Mondays to Sundays of every week from 8.00 a.m. to 8.00 p.m. on each day- *(a)* the sound pressure level when measured as the equivalent continuous sound pressure level shall not be more than 3 dBA above the background sound pressure level; and *(b)* the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 120 dB (peak). Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 60 dBA. **Night-time Limits**-On Mondays to Sundays of every week from 8.00 p.m. to 8.00 a.m. on each day- *(a)* the sound pressure level when measured as the equivalent continuous sound pressure level shall not be more than 3 dBA above the background sound pressure level; and *(b)* the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 115 dB (peak) Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 60 dBA.
ZONE III – General Area	**Daytime Limits** – On Monday to Sundays of every week from 8.00 a.m. to 8.00 p.m. on each day- *(a)* the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dB A above the background sound pressure level; and *(b)* the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 120 dB (peak). Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 80 dBA. **Night-time Limits**-On Mondays to Sundays of every week from 8.00 p.m. to 8.00 a.m. on each day- *(a)* the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dBA above the background sound pressure level; and *(b)* the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 115 dB (peak). Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 65 dBA.

3.0 HEALTH EFFECTS OF NOISE POLLUTION

3.1 INTRODUCTION

The perception of sounds in day-to-day life is of major importance for human well being. Communication through speech, sounds from playing children, music, natural sounds in parklands, parks and gardens are all examples of sounds essential for satisfaction in every day life. According to the International Programme on Chemical Safety, an adverse effect of noise is defined as a change in the morphology and physiology of an organism that results in impairment of functional capacity, or an impairment of capacity to compensate for additional stress, or increases the susceptibility of an organism to the harmful effects of other environmental influences. This definition includes any temporary or long-term lowering of the physical, psychological or social functioning of humans or human organs. The health significance of noise pollution is discussed under separate headings, according to the specific effects:

1. Noise-induced hearing impairment;
2. Interference with speech communication;
3. Disturbance of rest and sleep;
4. Psychophysiological, mental-health;
5. Performance effects;
6. Effects on residential behaviour and annoyance;

This section also considers vulnerable groups and the combined effects of sounds from different sources.

3.2 NOISE-INDUCED HEARING IMPAIRMENT

Noise Induced 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 3 000--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 not 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 worldwide have disabling hearing difficulties. In developing countries, not only occupational noise but also environmental noise is an increasing risk factor for hearing impairment. Certain diseases, some industrial chemicals, ototoxic drugs, and blows to the head, accidents and hereditary origins can also cause hearing damage. Hearing deterioration is also associated with the ageing process itself (presbyacusis).

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 ears) may adversely affect speech comprehension.

3.3 INTERFERENCE WITH SPEECH COMMUNICATION

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 doorbells, 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 1 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 50 dB(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.

3.4 SLEEP DISTURBANCE

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 night-time 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 night time 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.

3.5 CARDIOVASCULAR AND PHYSIOLOGICAL EFFECTS

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.

3.6 MENTAL HEALTH EFFECTS

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 tranquillizers and sleeping pills, on psychiatric symptoms and on mental hospital admission rates, suggest that community noise may have adverse effects on mental health.

3.7 THE EFFECTS OF NOISE ON 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 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.

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3.8 EFFECTS OF NOISE ON RESIDENTIAL BEHAVIOUR AND 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.

3.9 VULNERABLE GROUPS

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; foetuses, 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.

4.0 NOISE CONTROL BARRIERS

All noise propagation can be broken into three parts:

1. The source
2. The path
3. The receiver

The **source** radiates sound based on its sound power (PWL). The **path** is how the sound travels through the air. The **receiver** is what the sound impinges upon (person, microphone, etc.).

In the music industry, the most common **noise sources** are described as a **point source**, like the sound from the speakers of a sound system. In the **free field**, sound propagates outward from point sources in uniform, concentric circles. Free field conditions exist when no obstacles block the sound path.

Noise from a source can either be **air borne** or structure borne. Noise that travels through the air and through building walls and openings is called air borne noise. Structure borne noise is a term used to describe mechanical vibrations carried from machinery through to a building's structure.

When a sound wave encounters an obstacle, five phenomena can occur: absorption, reflection, transmission, diffraction and refraction.

Some of these conditions can occur at the same time. Part of a sound wave's energy is **absorbed** and part is **reflected** when it strikes a surface. This fact is important when considering how to attenuate noise. For example, the more porous a surface, the more sound is absorbed rather than reflected.

When an object is a certain thickness; like a wall, part of the sound wave's energy is **transmitted** through it. In general, more sound energy will pass through a thin wall than a thick one. If sound-absorbing material is also added inside of the wall, then the amount of noise that gets through to the other side will be less than if the wall were left "untreated". The amount of noise lost when sound waves pass through a wall or barrier is called **Transmission Loss (TL)**. This is the difference between the noise level measured on the source side of a noise barrier, and the level measured on the receiver side.

Diffraction is a change in the direction of travel of sound when the sound encounters an obstacle. Objects capable of diffracting (bending) sound **must be large compared to the wavelength of the sound.** For low frequency noise, with its long wavelength, a barrier must be **acoustically large** (larger than the wavelength of the sound) to change the sound path, for example a bass wave at 40 Hz would have a wavelength of approximately 8.6 meters so the barrier would have to be greater than 8.6m deep to block the sound while to stop a wave of 5 KHz which has a wavelength of 69mm a much thinner barrier is needed.

Refraction changes the direction of travel of the sound by differences in the speed of propagation. Wind and temperature changes are most common causes of refraction. Sound travels faster in warmer air than in cooler air causing the tops of the wavefronts to go faster than the bottom parts. Under normal conditions, air temperatures decrease as altitude increases. This causes sound waves to refract upwards which decreases audibility along the ground. Sometimes, the temperature is higher above the ground than near the ground, a condition called a temperature inversion causing sound waves to bend back toward the ground and increase audibility. Temperature inversions are especially common at dawn, dusk, and in cold conditions. Also, because winds aloft are usually faster than at ground level, the upper part of a sound wave travels faster than the lower part **when travelling with the wind**. The sound wave travels **slower when travelling against the wind. Refraction** of the noise toward the ground occurs in the first instance and refraction away from the ground in the latter case.

Acoustical materials are divided into the following basic types:

1. Sound absorbing materials
2. Transmission loss or barrier materials
3. Resonator-type materials
4. Damping materials
5. Vibration isolators

Sound absorbing materials are porous materials such as rock wool, mineral wool, glass fibre, and foam. The effectiveness of acoustical material to absorb sound depends on its thickness, amount of airspace, and density. For every inch of thickness of a porous material (e.g., rock wool), sound loss is about 1 dB at 100 Hz to 4 dB at 3000 Hz.

The amount of sound absorbed at the surface of a material is described by an **absorption coefficient** (**a**). The absorption coefficient relates to sound reflection, where a high **a** equals low reflected energy and a low **a** equals high reflected energy. Marble slate has an absorption coefficient of 0.01 (almost no absorption and high reflection). Some specially constructed sound rooms score as high as 1.0 (total absorption and no reflected energy).

The absorption coefficient of a material typically increases with frequency. At low frequencies, porous materials absorb less sound, so that materials must be thicker to be effective. The overall performance of a sound-absorbing material is often described by the **Noise Reduction Coefficient** (**NRC**). The NRC is the arithmetic average of the absorption coefficient at 250, 500, 1000, and 2000 Hz.

Sound absorption differs from sound insulation. Sound absorption relates to sound reflection, whereas sound insulation relates to the amount of acoustic energy able to pass through material. The sound absorption provided by a 10 centimetre-thick (4-inch thick) fibreglass acoustical blanket is high, but its insulation quality is low. Sound is able to travel through the material to the other side. By contrast, a lead wall absorbs almost no sound but it is a very good insulator.

Lead is an example of a **transmission loss or barrier material**. Barrier materials are dense and rigid and are defined in terms of their **Transmission Loss** (**TL**). Transmission Loss is defined as the logarithmic ratio of the sound power on one side of a barrier (wall or partition) to the sound power transmitted to the other side. The higher the TL, the better a barrier material is at limiting or **attenuating** the amount of sound travelling through it. For example, a wall or barrier having a **TL** of 45 dB reduces a 120dB interior noise level to 75 dB. A wall with a TL of 60 dB reduces the same amount of noise to 60 dB.

As a general rule, the heavier and thicker the wall, the greater the **attenuation of the sound or higher the TL**. This is because it is difficult for sound waves in air to move or *excite* a dense, heavy wall. Sound transmission through walls, floors or ceilings varies with sound frequency, and the weight and stiffness of the construction. This gives rise to the effect known as the **mass law** in acoustics which states that for each doubling of the surface weight of the wall, there will be about 5 or 6 dB less transmitted sound. The mass law also states that for each doubling of the frequency (Hz) there will be about 5 or, 6 dB less transmitted sound. Doubling of the frequency has about the same effect as doubling the surface weight.

Perforated metal wall liners or tiles are examples of resonator materials. The holes in the liner or tile act as **resonate types of sound absorbers**. When a metal perforated liner is applied, sound impinging on the holes is absorbed into the cavities, but a portion is reradiated back toward the sound source in the form of a hemisphere. Because the sound energy is bounced back toward the source in semi-circular waves, sound is actually diffused and noise levels are reduced. The holes of liners can be sized and aligned in such a way that sound is absorbed and diffused at specific **frequencies**.

Once the noise sources are identified and measured, the next step is to **attenuate** the noise. Attenuation is defined as the difference in dB or dBA between two points in and along the path of sound propagation. The aim of attenuation is to reduce or divert the amount of sound energy reaching the receiver. The key to attenuation is to apply noise control materials and measures that are both effective and economical. Noise controls range from the simple to complex.

One of the simplest **attenuation** methods is to place enough distance between the noise source and the noise source receptor so that noise is not a concern. Establishing a buffer zone is possible when land is readily available. However, it usually takes a large amount of land to stop noise from affecting the surrounding environment. Recalling the 6 dB rule, it could take as much as 1,800 meters (approximately 5,900 feet) to reach 75 dB at the NSR when the source noise is a high as 140 dB.

Shrubs and trees are often used as natural noise blockers. For trees to be effective barriers, they must be in a continuous stand, 50 feet tall, 100 feet deep, have dense foliage down to the ground, and be evergreen.

Barriers are free-standing walls or structures intended to block source noise. The barrier functions by absorbing a large amount of the sound energy and/or deflecting it away from the source. Barriers reduce sound levels, but work best at reducing high frequency noise. Barriers are most effective when they are at least three times larger than the wavelength of the major noise contributor. For best results, barriers should have a high transmission loss and be highly absorptive. Barriers made from a combination of sound-absorbing and transmission loss materials give highest acoustic performance. Concrete walls are often used as barriers. As a dense material, concrete is a better sound insulator than sound absorber, so barriers made from concrete reflect sound rather than absorb it.

When a barrier is wrapped around a noise source, it acts as a **partial enclosure**. Partial enclosures come in a variety of configurations: two-sided, three-sided with a roof, four-sided without a roof, and so on. Barriers and partial enclosures can be effective and economical noise reducers, lowering noise levels by up to 12 or 15 dB.

5.0 NOISE POLLUTION CONTROL AND ENFORCEMENT IN TRINIDAD AND TOBAGO

The EMA addresses Noise Pollution Control and Management through:

1. Regulatory Compliance

2. Non-Regulatory Compliance

5.1 REGULATORY COMPLIANCE

Regulatory Compliance is achieved through the implementation of the Noise Pollution Control Rules, 2001 (Rules). These Rules give the EMA the power to investigate Noise Related Complaints and enforce the Noise Standards set out in the Rules.

The Compliance Unit of the EMA is responsible for implementation of the Rules. The Unit is lead by a Technical Coordinator and includes Regulatory Compliance Officers and Assistants, and the Environmental Police Unit. The unit works closely with the Legal and Policy Department of the EMA in enforcement matters related to noise.

Technical Coordinator - This Officer supervises and provides technical guidance for the unit.

Regulatory Compliance Officers and Assistants –These officers are responsible for the day-to-day management and administration of the Noise Pollution Control Rules, 2001. The following specific duties are assigned to them:

- Receive and process Event and Facility Noise Variations
- Receive and Investigate Noise Complaints
- Advise the Legal Department on actions being taken against noise offenders
- Maintain the Noise Register and associated databases.

Environmental Police Unit – These are Police Officers specifically assigned responsibility under the Environmental Management Act, 2000. They are charged with the following Noise related duties

- Receive and Investigate Noise Complaints
- Serve notices of violation on noise offenders
- Provide support to Regulatory Compliance Officers on Site Visits

Legal Officers – These officers are lawyers who perform the following duties:

- Prepare Notices of Violation
- Prepare Assessment of Damage Reports
- Prepare Administrative Orders
- Represent the EMA in Consent Agreements and Court matters
- Provide legal advice and support to other units involved in the management of noise.

Noise Advisory Council – This body was appointed by the Board of the EMA and has the responsibility of providing advice to the Regulatory Compliance Officers when they have an Application for a Facility Variation before them.

Tobago House of Assembly – The Department of Natural Resources and the Environment of the Tobago House of Assembly enforces the Noise Pollution Control Rules, 2001 in Tobago. The Department of Natural Resources and the Environment also screens and advises the EMA on noise variations applications originating in Tobago.

5.1.1 Analysis of Noise Complaints Received by the EMA During the Period December 1995 - December 2004.

Table 3: Yearly Summary of Noise Complaints received by the EMA 1995 - 2003

Year	Total Received	Total Invalid	Total Valid
1995	1	0	1
1996	17	4	13
1997	16	6	10
1998	19	2	17
1999	53	8	45
2000	65	16	49
2001	260	36	224
2002	286	38	248
2003	229	81	148
Total	**946**	**191**	**755**

Invalid complaints are those that were received by the EMA, but on screening of the complaint the matter that was being brought forward was not one that the EMA has the power to investigate.

Figure 2 : Graph showing Percentage Breakdown of all Noise Complaints received by the EMA 1995 - 2004.

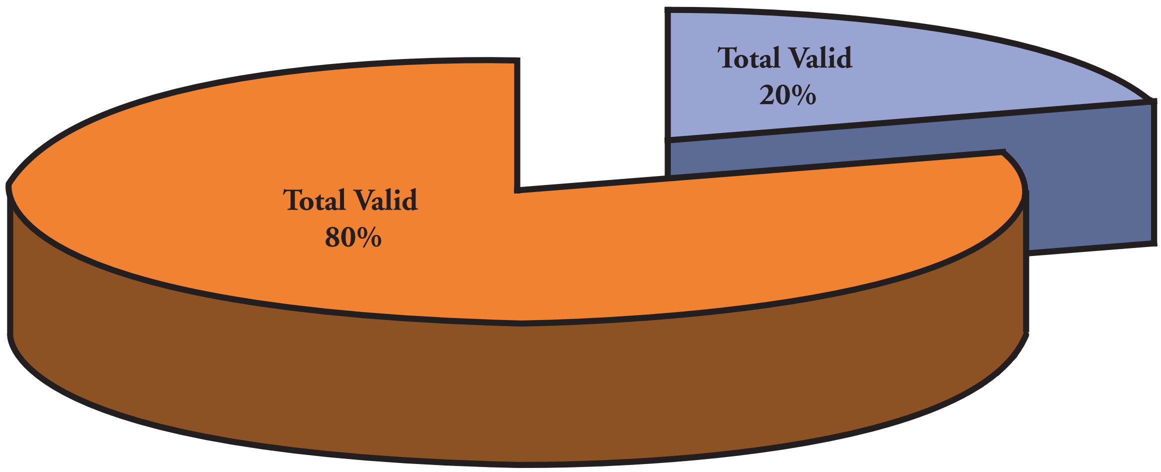
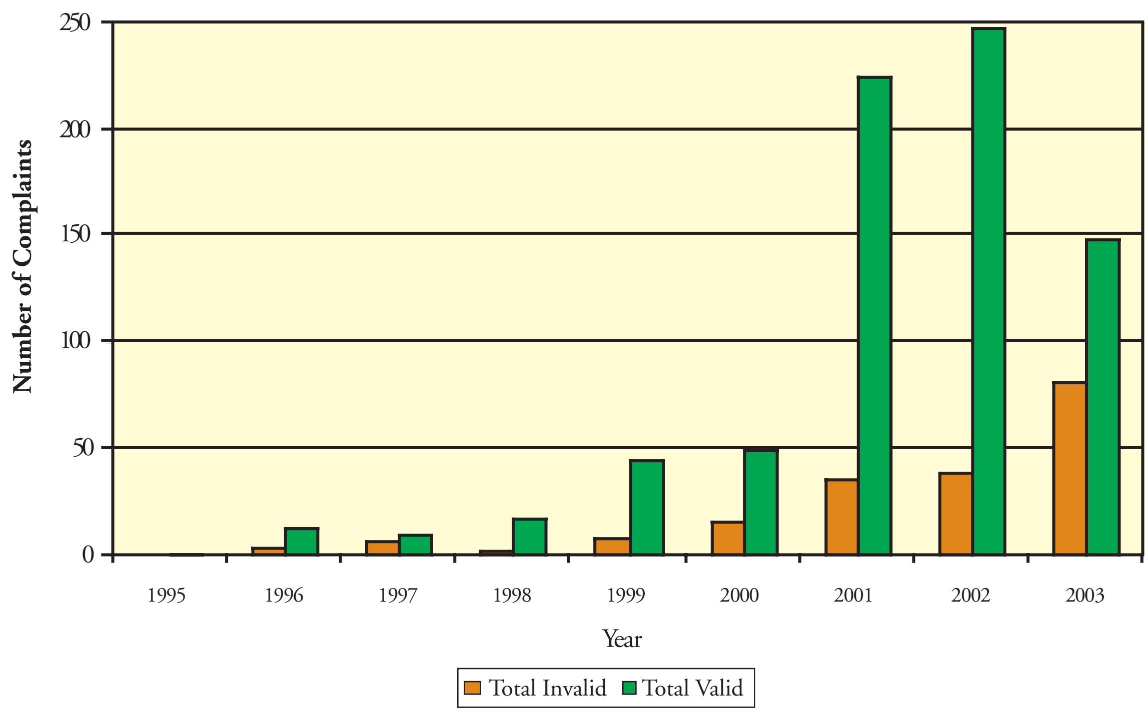


Figure 3 : Graph showing Yearly Comparison of Noise Complaints



Since the enactment of the Noise Pollution Control Rules, 2001, the EMA has received a total of 1064 complaints related to Noise Pollution. The EMA has been able to resolve 26 % of those received. A further 21% of files has been closed due to the complaint being an issue that the EMA does not have jurisdiction.

The Following table shows the reasons for closing files:

Table 4: Closure Circumstances

Closure Circumstances	%
Complaint Not Justified	35.7%
Voluntary Compliance	22.1%
Not Stated	10.9%
Noise Generating Activity Ceased	8.1%
For Information Only	4.2%
Complainant Failed to Produce Further Information	3.5%
Person Complained Against Relocated	3.5%
Complainant Withdrew Complaint	2.8%
Matter not under EMA's Jurisdiction	2.0%
Anonymous	1.7%
Complainant Relocated	1.1%
Enforcement by other Agency	0.9%
Enforcement not Possible	0.9%
Private Legal Action	0.7%
Problem Ceased	0.7%
Enforcement Action by the EMA	0.6%
Not Noise Related	0.6%

It should be noted that the EMA has been receiving and investigating Noise Related Complaints prior to the enactment of the Noise Pollution Control Rules, 2001, however the majority of complaints have been received during the period 2001 - 2003 (775 complaints).

The evidence required to record a breach of the Noise Standards involves the measurement of the Sound Pressure Level at the property line of the offending party for 30 minutes. Over the time the EMA has been in operation, many offenders have recognised that the EMA enforcement officers are required to take these readings in order for the EMA to take action, as a result, most offenders reduce or eliminate the source of the offending noise when an officer is attempting to obtain a sound pressure level measurement. This learned behaviour has made the resolution of Noise Complaints very difficult as seen by the steady drop in number of complaints closed from 2001 to 2003.

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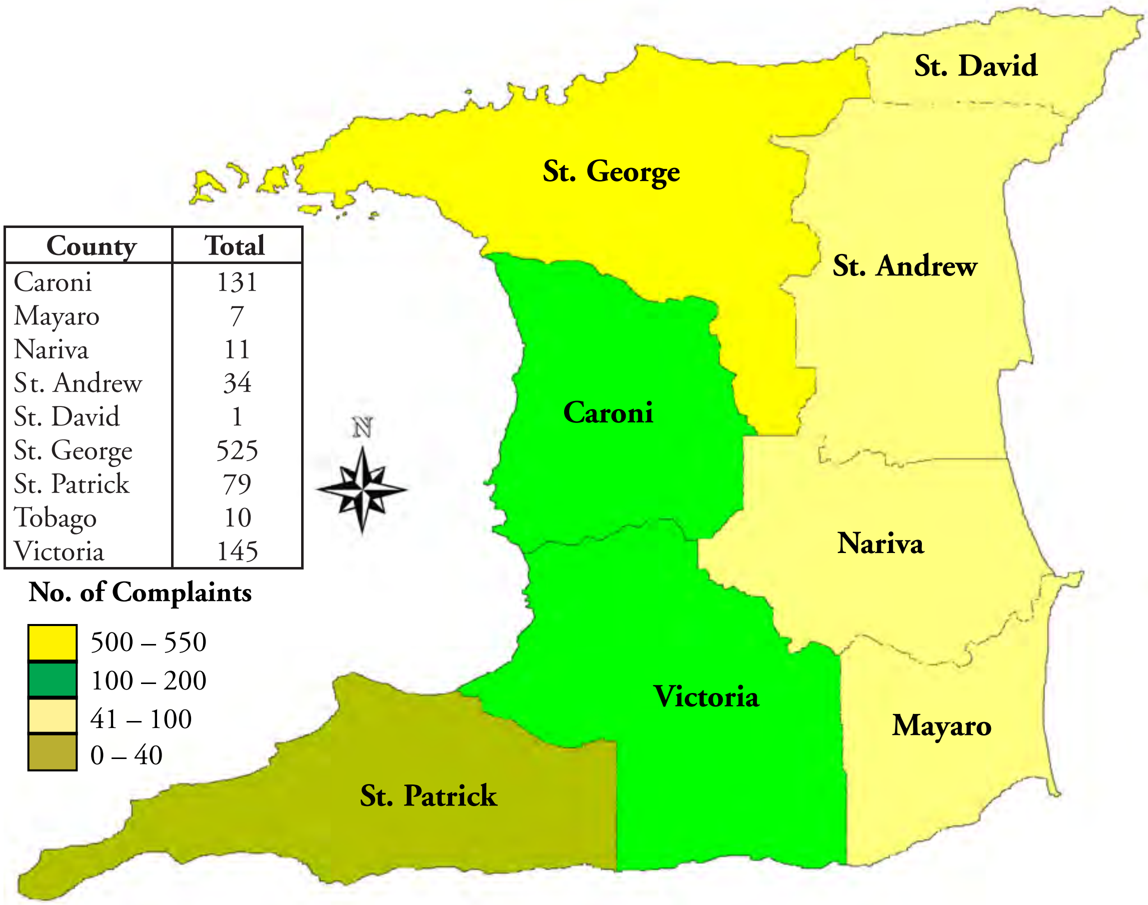
Figure 4: Map showing Number of Complaints received per County, 1995-2003



County	Total
Caroni	131
Mayaro	7
Nariva	11
St. Andrew	34
St. David	1
St. George	525
St. Patrick	79
Tobago	10
Victoria	145

An analysis of the noise complaint data base has shown that the top twenty towns in terms of number of complaints received are centred along the east - west corridor and along the north - south axis of the west coast of Trinidad. The following maps show the major areas of noise complaints as well as a projected density distribution of noise complaints.

From the distribution of complaints, it is clear that the majority of complaints are received from the most populated areas.

Figure 5: Map showing Top 20 Areas in Trinidad for Receipt of Noise Complaints

Place	Total Received 1995-2003
Port-of-Spain	77
Arima	60
San Fernando	49
San Juan	44
Chaguanas	40
Diego Martin	38
Arouca	29
Curepe	27
Tunapuna	27
Penal	23
Couva	22
Maraval	21
St. James	20
Princes Town	19
D'Abadie	18
Barataria	17
La Romaine	16
Sangre Grande	16
Carapichaima	15
Tacarigua	14

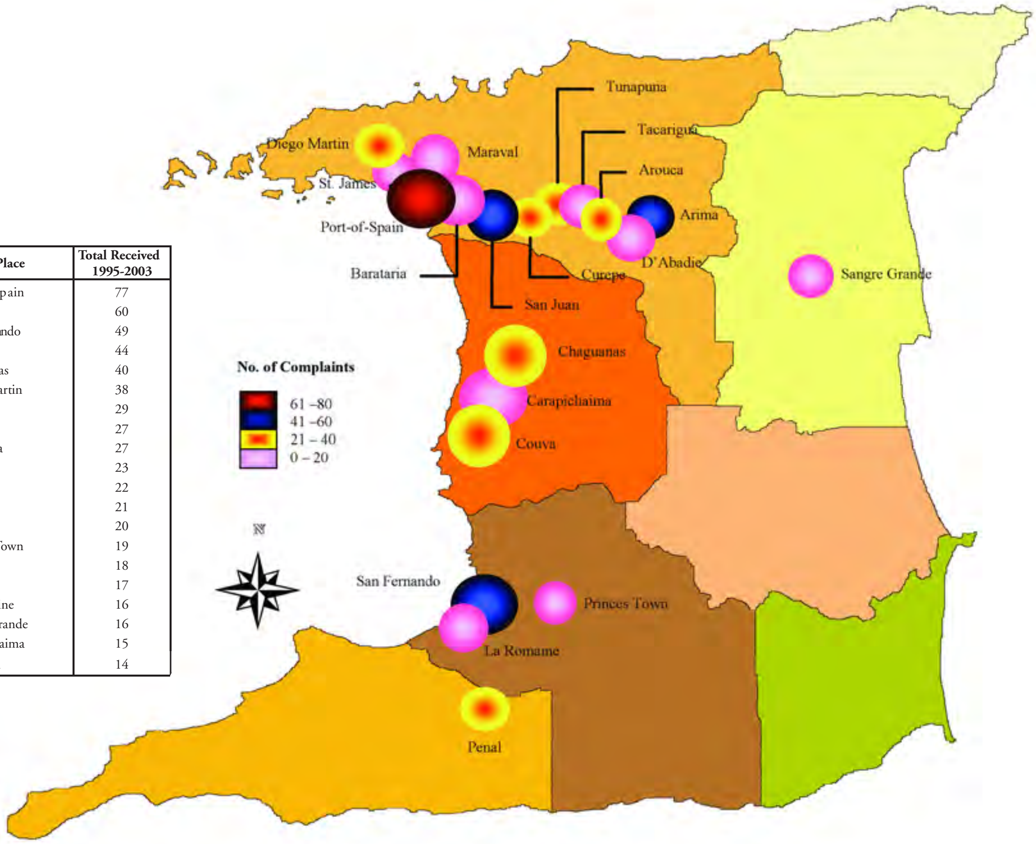
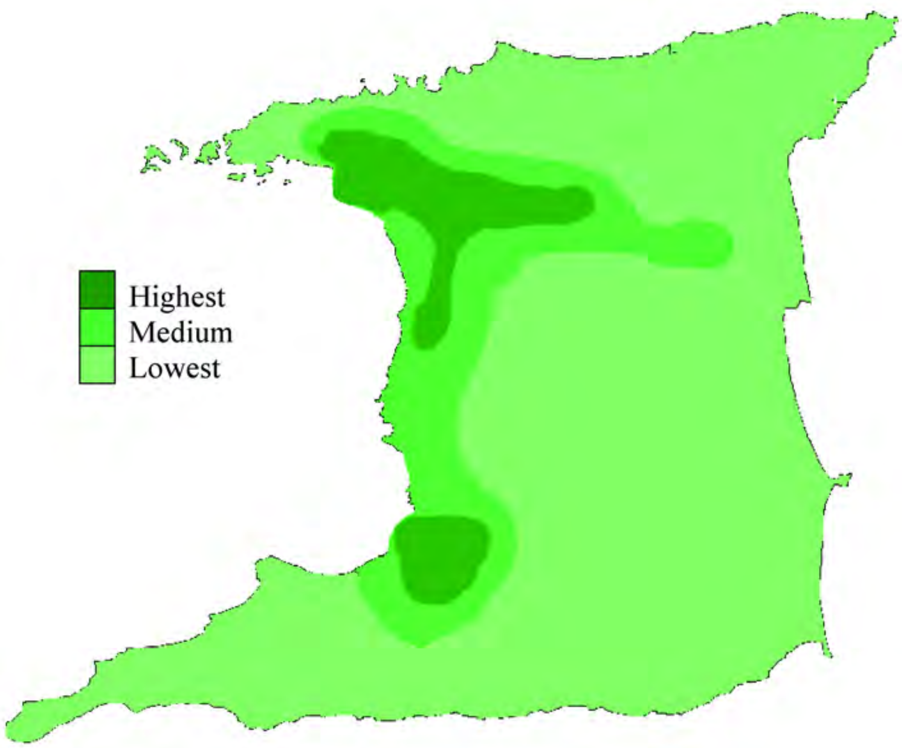


Figure 6: Map showing Noise Complaint Density Distribution



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The predominance of complaints has been against loud music from both private residences and commercial properties, the following is a breakdown of source of complaints:

Table 5: Breakdown of Complaints received by type of noise generating activity

Source	% of Complaints Received
Loud Music (general)	24%
Loud Music (neighbours)	16%
Pubs/Bars/Clubs/Restaurants	12%
Minor Sources*	9%
Industrial Commercial Noise	9%
Metal Fabrication/Welding/Works	7%
Religious Activity	4%
Air Conditioning Units	4%
Fetes	4%
Loud Noise from Vehicles (repair)	3%
Furniture Manufacture / Woodworking	3%
Loud Noise from Vehicles (general)	2%
Steelpan	2%
Construction Noise	1%
Compressors/generators	1%

* Minor Sources includes noise from Aircraft, Animals, Drumming, Fireworks, Sawmills, Schools, Sporting/Cultural Activity, Traffic and Water Pumps

Figure 7: Map showing Major Categories of Noise Sources by County - Trinidad

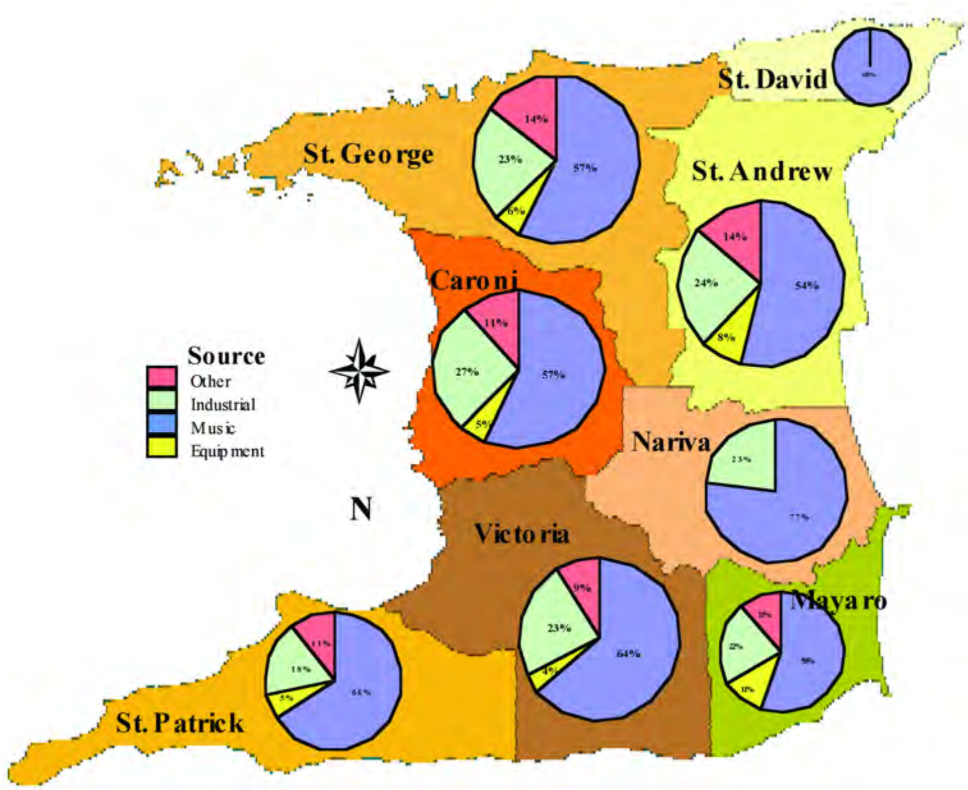

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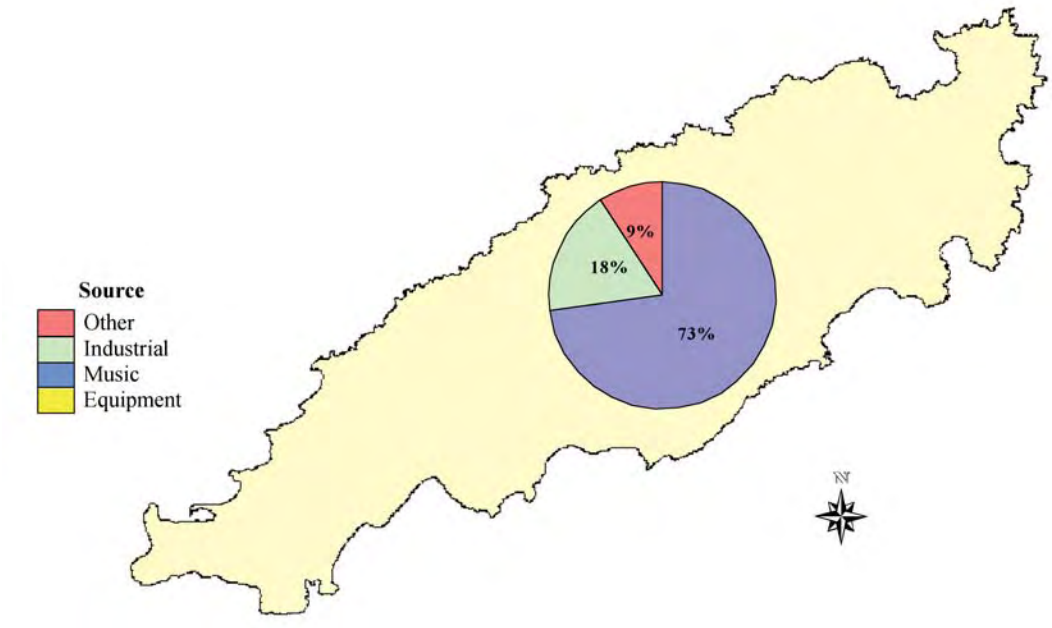
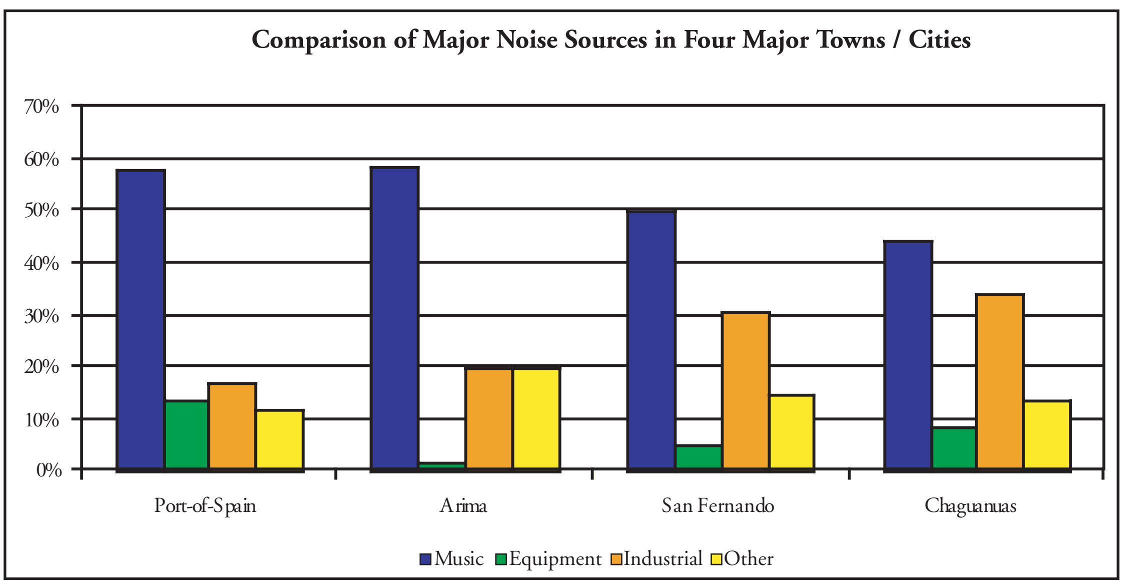
Figure 8: Map showing Major Categories of Noise Sources - Tobago



Over 50 per cent of all received Noise Related cases are caused by noise generated from loud music. This is true for all counties in Trinidad and in Tobago.

The following table illustrates that in the trends observed in each county is followed by the four major cities/towns in Trinidad, where between 40 - 60 per cent of all noise complaints are as a result of noise from loud music.

Figure 9: Comparison of Source of Noise in Port-of-Spain, San Fernando, Arima and Chaguanas.



The environmental police unit is the primary enforcement arm in investigating noise complaints. They have conducted close to two thousand (1965) site visits on behalf of the EMA.

The Legal and Policy Department of the EMA is responsible for enforcement of the EM Act. They do this through the issuance of Notices of Violations which may result in entering into Consent Agreements with the party who is in breach of the Noise Pollution Control Rules, 2001 or take further action by service of an Administrative Order where a Consent Agreement cannot be agreed upon. The Following table gives a breakdown of legal action taken under the Noise Pollution Control Rules:

Table 6: Breakdown of Legal Action Taken under the Noise Pollution Control Rules, 2001

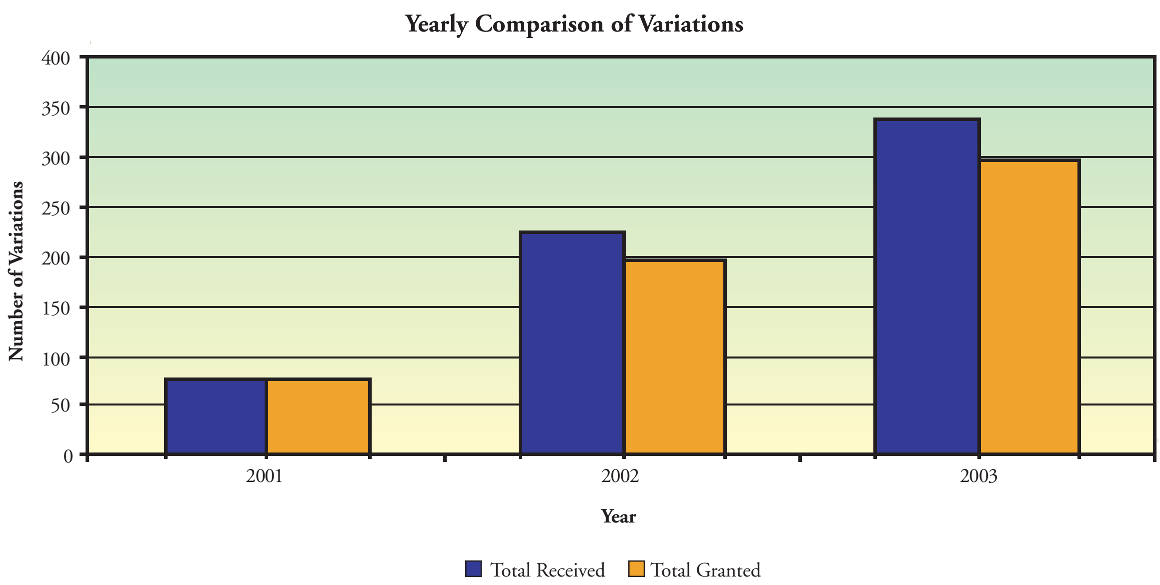
Action Taken	2002	2003
Notices of Violations Served	25	45

5.1.2 Analysis of Variation Applications Received by the EMA 2001 - 2003

Table 7: Yearly Comparison of Variations Received by the EMA 2001 - 2003

Year	Total Received	Total Granted	Event Granted	Facility Granted	% Granted
2001	78	77	276	0	99%
2002	226	197	22	0	87%
2003	340	298	298	0	88%

Figure 10: Graph Showing Yearly Comparison of Variations Received and Variations Granted by the EMA 2001- 2004



The Total number of Variations received by the EMA showed a continuous increase over the period 2001 - 2003. The increase can be attributed to an increasing awareness within the population about the need to apply for Variations for sound generating events.

In all of the years the majority of applications received and granted are for single events and in the majority of Variations the Approved Sound Pressure Level is 80 dBA.

Table 8: Approved Maximum Sound Pressure Level

Approved Level (dBA)	2002	2003
75	4	5
80	173	282
85	0	4

5.1.2.1 Types of Applicants:

There are eight major groups of applicants for Variations. The groups and number of variations per group per year is as follows:

Table 9: Number of Applications per year by the Major Groups Of Applicants

	2002		2003	
Applicant	Total (2002)	Granted (2002)	Total (2003)	Granted (2003)
Church	11	11	14	11
Commercial Entity	89	74	138	121
Community/Centre/Group/Council	21	20	25	22
Government Department	20	17	41	37
Group - Other	12	12	24	23
Individual	49	41	42	39
School	21	19	50	49
Sports/Cultural Group	3	3	6	5

Figure 11: Graph Showing Comparison of Variations Received and Variations Granted for 2002 for Each Major Group of Applicant

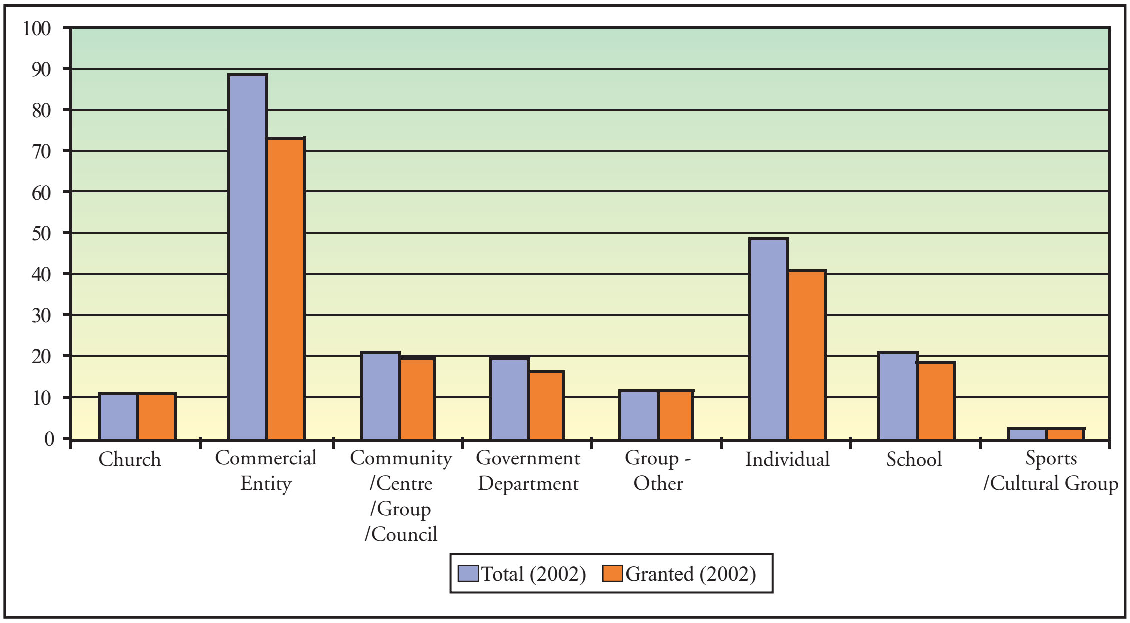


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Figure 12: Graph Showing Comparison of Variations Received and Variations Granted for 2003 for Each Major Group of Applicant

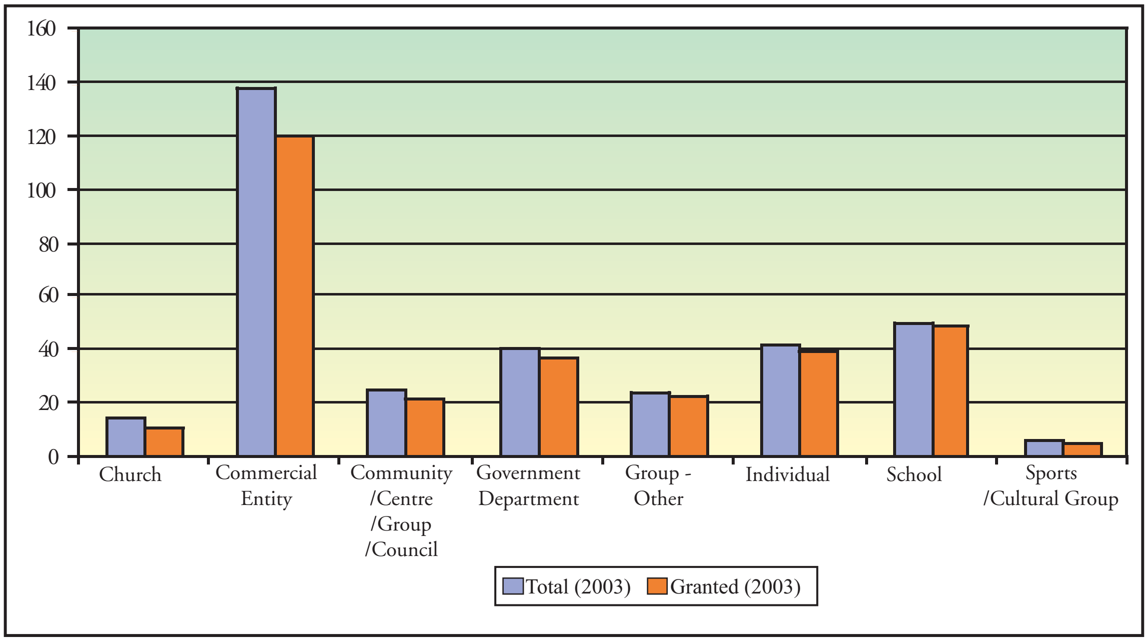
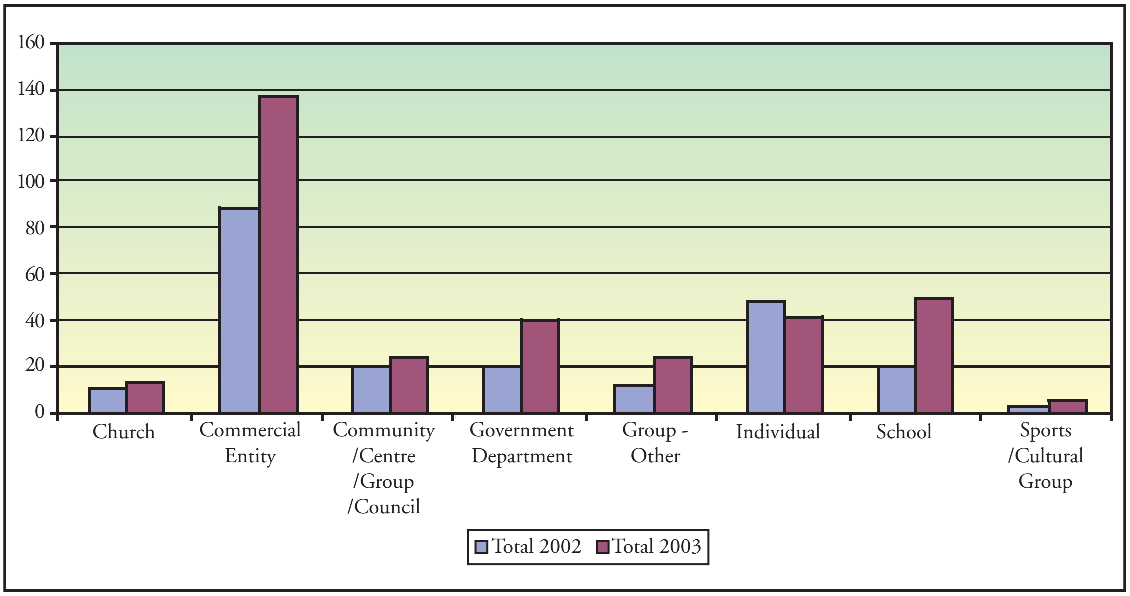
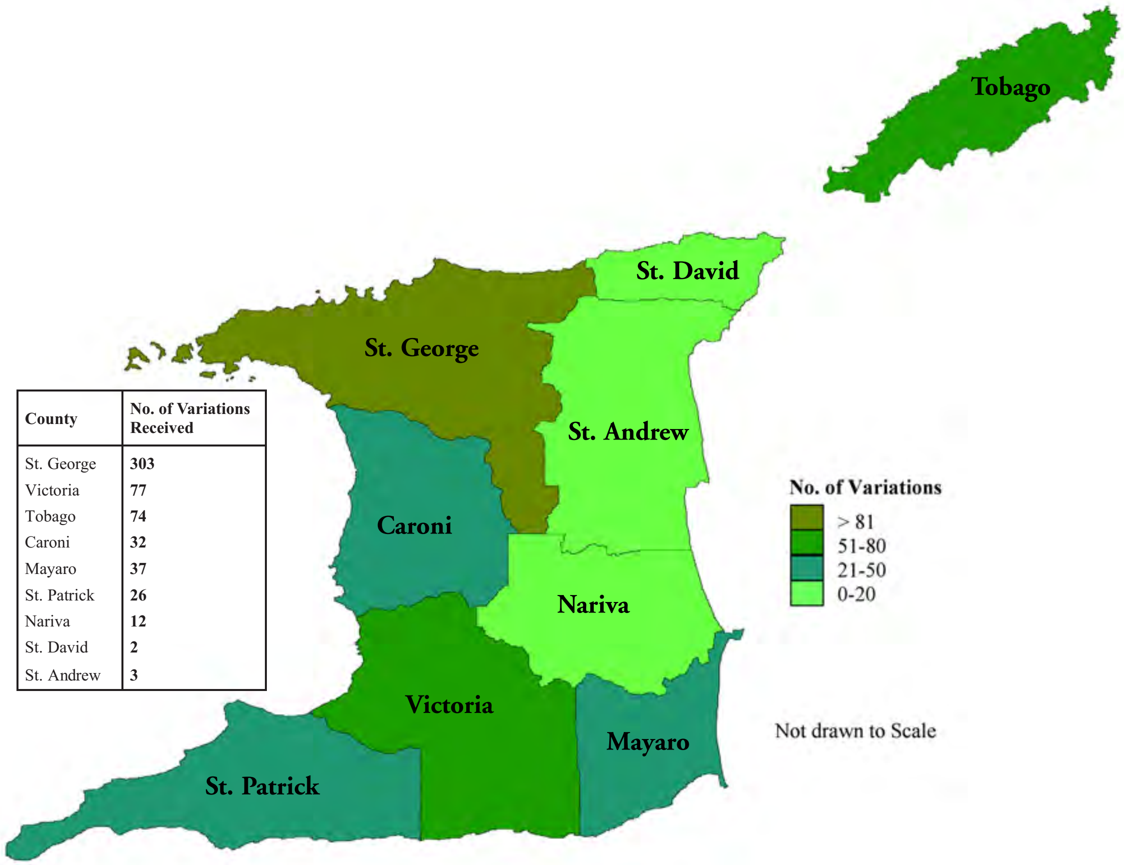


Figure 13: Graph Showing Comparison of Variations Received for Each Major Group of Applicant per year



Applications from Commercial Entities make up the majority of applications received. Applications range from Parties to Industrial Activity such as construction during the night time. The Next highest groups are Individual, Schools and Government Entities. For Individuals, the majority of applications are for private house parties and weddings while for schools and Government Entities the majority of applications are for fetes.

Figure 14: Map Showing Number of Variations Received Per Region



County	No. of Variations Received
St. George	**303**
Victoria	**77**
Tobago	**74**
Caroni	**32**
Mayaro	**37**
St. Patrick	**26**
Nariva	**12**
St. David	**2**
St. Andrew	**3**

Figure 15: Map Showing Percent Variations Received Per Region

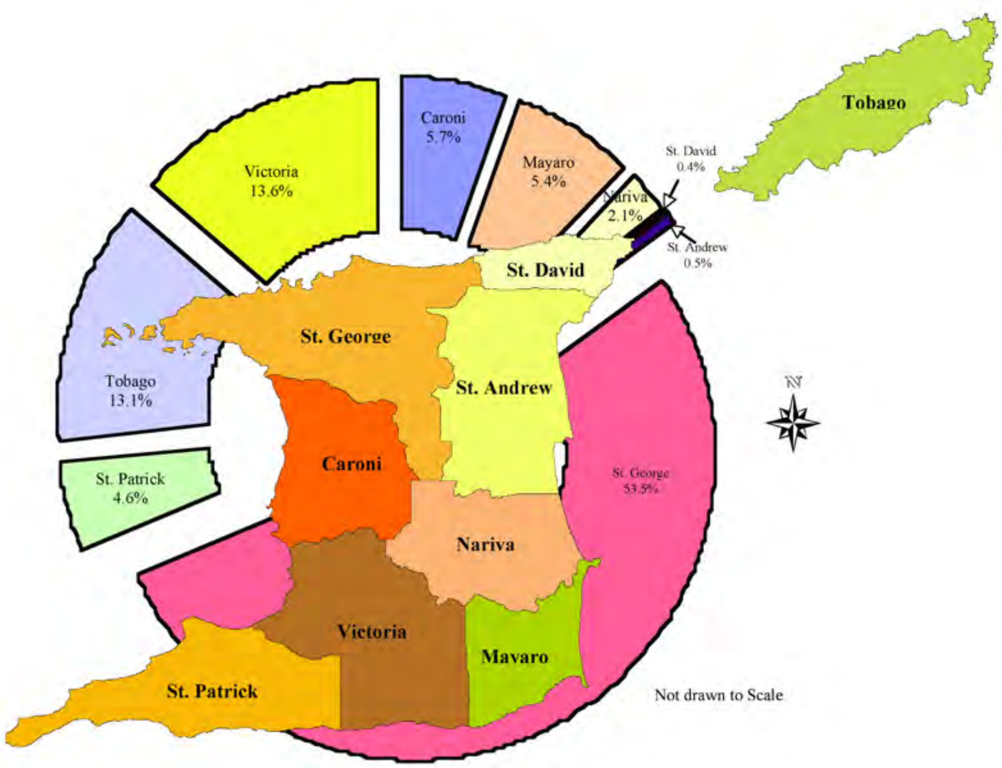
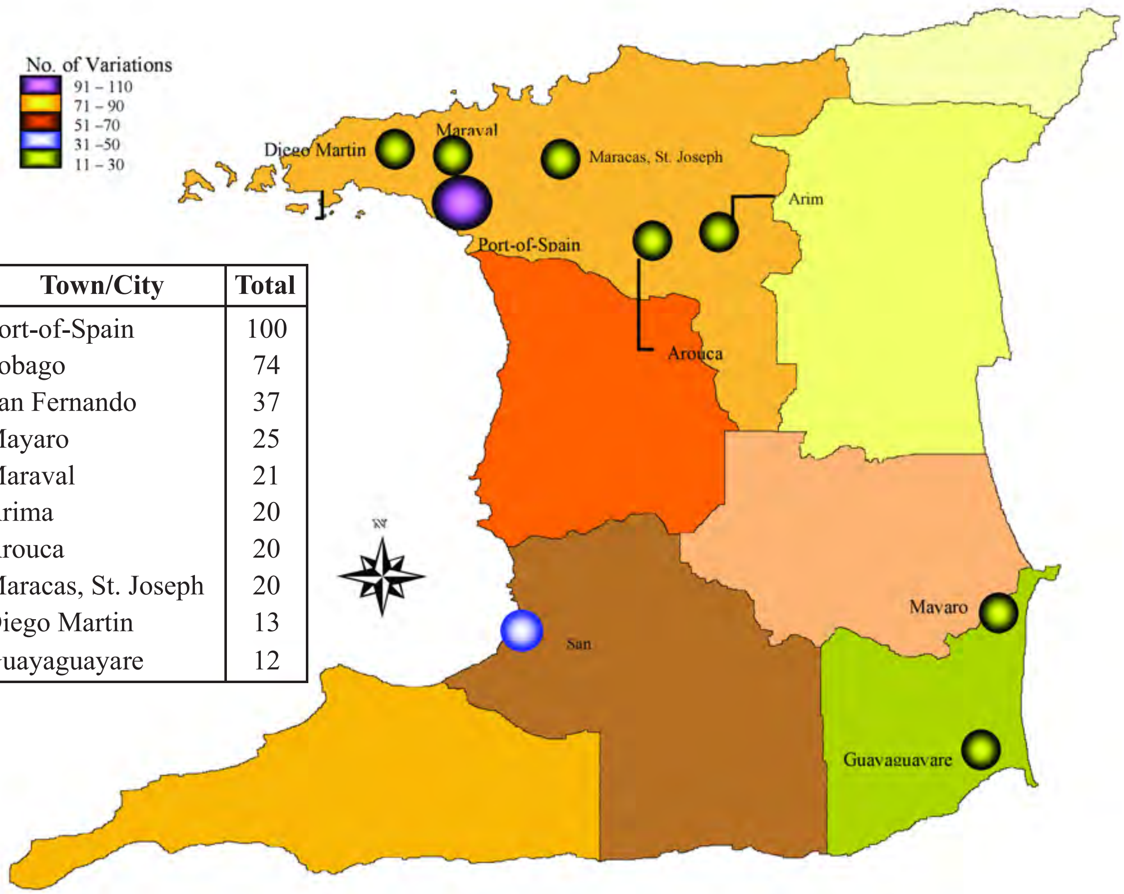
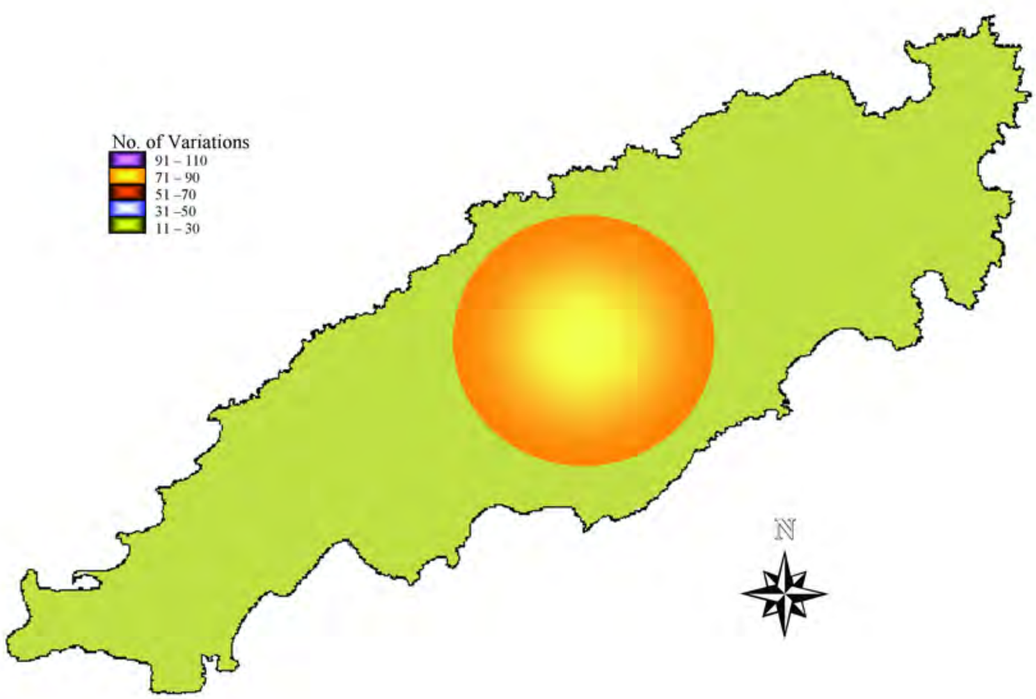


Figure 16: Map Showing Towns in Trinidad with greater than 10 applications for Variation.



Town/City	Total
Port-of-Spain	100
Tobago	74
San Fernando	37
Mayaro	25
Maraval	21
Arima	20
Arouca	20
Maracas, St. Joseph	20
Diego Martin	13
Guayaguayare	12

Figure 17: Map Showing Number of Variation Applications in Tobago



As with Noise Complaints, the major areas from which the EMA receives applications for Variations are in the more densely populated areas of Trinidad and Tobago. Port-of-Spain remains the number one town for receipt of applications for Variations which is due to the majority of fetes being held in and around Port-of-Spain.

5.1.3 Noise Pollution Control Rules Review

An annual review process for the rules has been implemented that will feedback into the implementation of the rules. The annual reviews are also aimed at identifying any amendments to the rules that many be necessary to further develop Noise Management Strategies.

Noise pollution variation application forms along with instructional booklet and policies for noise complaint processing have been developed as part of the implementation process for the Noise Rules.

5.1.4 Co-operation with other agencies

The EMA continues to have a very close relationship with the Department of Natural Resources and the Environment (DNRE) of the Tobago House of Assembly. Several noise complaints and applications for noise variations come through the DNRE. The DNRE has assisted with at least thirty (30) variations and ten (10) noise complaints.

The Town And Country Planning Division (TCPD) of the Ministry of Planning and Development has also been of importance in determining several applications for variations as well as complaints.

Some Magistrates request that persons applying for a bar license have a Noise Variation. This has helped in getting people to comply with the Noise Pollution Control Rules.

5.1.5 Capacity Building

The EMA has over the last year trained fourteen Police Officers in the use of Noise Measurement Equipment. Recently, a Tobago Environmental Police Unit (EPU) was established and this will be followed by the Establishment of an EPU in South Trinidad. This in addition to increasing the number of Noise Meters will enable faster response to Noise Complaints and will allow greater coverage over Trinidad and Tobago.

5.2 NON-REGULATORY COMPLIANCE

The Noise Pollution Control Rules, 2001 provides the legislative power to deal with noise pollution. Legislative power is not a sufficient tool to effectively combat pollution in general and specifically noise pollution. In this regard, the EMA is engaged in non-regulatory activities aimed at achieving the goal of an acceptable acoustic environment. The following are discussions on projects and programmes that the EMA has undertaken to help in its management of noise.

5.2.1 Entertainment Industry Forum

An analysis of the complaints related to Noise Pollution in Trinidad and Tobago shows that the majority of these complaints are as a result of activities emanating from the Entertainment Based Activities as follows:

Venues	Activities generating noise	People Affected
Outdoor Concert Venues	• Bands playing loud music • Disc Jockeys playing loud music • Bands, Disc Jockeys and Performers playing loudly during rehearsals • Loud special effects e.g. fireworks	Neighbours, Performers
Restaurants, Nightclubs, Hotels & Bars	• Receptions • Floor Shows • Concerts • Live and recorded music for dancing	Neighbours, Audience, Staff & Performers
Pan Yards	• Steelbands rehearsing	Neighbours & Pan Players
Performing Arts Venues	• Rehearsals and Performances	Neighbours, Performers Audience & Staff
Education Establishments	• School Concerts • School Parties • School brass or steel bands rehearsing	Neighbours, Performers, School Children

An Analysis of the Variations Database shows that the majority of applications for Noise Variations are from this industry. This prompted the EMA to undertake a project aimed at both gaining insight from this business sector as well as educating the member of this industry on the procedures related to the Noise Pollution Control Rules, 2001.

The project involved public consultations and one on one interviews with entertainers and venue owners which were instructive in developing the code.

The discussions with the public and the stakeholders of the Entertainment Industry revealed the following concerns of the sector:

1. There needs to be the establishment of dedicated Cultural/Entertainment centres in Trinidad and Tobago for the purpose of hosting large events away from residential areas.

2. The Noise Pollution Control Rules needs to be amended to make the application for variations more flexible.

3. More education of the industry and the public at large needs to be done by the EMA with regards to the rules and the requirements under them.

Coming out of this project, a Code of Practice has been developed to guide entertainers and venue owners in the setting up of venues to reduce the level of noise generated from them. The Code defined strategies for all the major players in the Entertainment Industry as follows:

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1. Venue Owners
2. Venue Operators
3. Entertainers
4. Sound Engineers/Equipment Personnel
5. Panmen
6. General Guidelines

The strategies for each group identified above can be found in Appendix 2.

5.2.2 Education

Education and Awareness is a key tool in the management of Noise Pollution in Trinidad and Tobago. It is important both from the point about educating the population at large in terms of their rights with regard to noise pollution and educating potential producers of noise as to their responsibilities and consequences of non-compliance with the Noise Pollution Control Rules, 2001.

Several presentations were made during the year to help increase public awareness and understanding of the NPCR, 2001. The Education and Public Awareness Department also is actively involved in writing articles, television appearances and print and media advertisements aimed at raising the awareness of the population in regard to noise pollution.

Additionally, it is important to involve young citizens of Trinidad and Tobago in the prevention and control of noise pollution. The Education and Public Awareness Department of the EMA and the Ministry of Education jointly developed a secondary schools' public speaking competition where topics such as noise pollution are debated. This helps to raise the awareness in the school system. An example of this was seen in the recently concluded Secondary Schools public speaking competition where one of the topics focused on Noise Pollution and the relationship it has to the culture of Trinidad and Tobago. This topic was tackled by the majority of the finalists of the competition and the winning speech focused on the relationship between Noise and Culture in Trinidad and Tobago.

6.0 FUTURE ACTIVITIES

The EMA is committed to continuous improvement and streamlining of all of its activities. The Management of Noise has been identified as a Strategic Priority by the EMA's. The EMA will conduct the following activities in order to meet this objective:

1. **Revise Noise Pollution Control Rules.** A comprehensive evaluation of the written laws of Trinidad and Tobago (including the Noise Pollution Control Rules 2001), various programmes which address noise control and related issues, such as physical (land use) planning and development, towards:

   (i) Identifying existing legislation which is relevant, applicable and adequate;
   (ii) Identifying existing legislation which is relevant and applicable but inadequate and are to be amended or supplemented to include noise control provisions, or to clarify and emphasize noise control provisions

2. **Develop Environmental Code for Noise.** The EMA will work with the relevant agency or public authority to develop appropriate legal requirements to regularize land use and development in Trinidad and Tobago so that industrial and commercial establishments which are potential noise generators, would not be located in close proximity to residential areas.

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Further, the feasibility of designating specific areas, distant from residential areas, as areas in which fetes, concerts and social, cultural, religious, and community events may be held, will be explored. The designation of such areas would reduce the potential of noise disturbance to residents, while allowing patrons the opportunity for enjoyment of the event.

3. **Develop Code of Practice for Specific Industries.** Based on the research in the development of this National Strategy, priority will be given to establishing codes of practice related to the control of noise from the following activities: auto body repair and refurbishing; saw milling, woodworking and furniture manufacturing; metal fabrication and other metal work; and construction industries.

4. **Design and implement an Education and Public Awareness Campaign to achieve Noise Reduction Objectives.** We shall design and implement appropriate public awareness programmes, in collaboration with the relevant public authorities and the media, to educate the public on the subject of noise control, relevant legal requirements and the respective enforcing authorities, penalties for non-compliance, and procedures for appeal.

With increased efficiency of operations the EMA looks forward to improving the percentage closure of noise complaints as well as to significantly increase the number of offenders that the EMA takes legal action against.

7.0 CONCLUSION

The EMA is committed to ensuring that Noise Pollution is dealt with in an effective manner while being cognisant of the need for sustainable development of the economy and the social and cultural landscape of Trinidad and Tobago.

The levels of noise from various activities are causing acute nuisance to the affected public as seen by the high number of noise complaints received by the EMA both pre and post enactment of the Noise Pollution Control Rules, 2001. The experience at the EMA shows that Noise is a serious problem in Trinidad and Tobago. Its immediate effects are acute and cause both inconvenience and serious health problems in those affected persons. This combination results in the high level of complaints since people are no longer willing to 'live' with the noise that disrupts their lives.

With the enactment of the Noise Pollution Control Rules, the EMA has the ability to deal with these complaints.

The EMA firmly believes that it is important to elevate the level of environmental awareness in Trinidad and Tobago. This will go a long way in achieving voluntary compliance with the Noise Standards set out in the Noise Pollution Control Rules, 2001 and will encourage environmentally responsible behaviour.

The EMA will continue to carry out its mandate of preserving and conserving the environment while encouraging healthy and sustainable development that will benefit the economic, social and cultural life of the citizens of our Twin Isle Republic, thus ensuring a high quality of life for this and future generations of citizens of Trinidad and Tobago.

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GLOSSARY

ABSORPTION

A property of materials that allows a reduction in the amount of sound energy reflected. The introduction of an absorbent into the surfaces of a room will reduce the sound pressure level in that room by not reflecting all of the sound energy striking the room's surfaces. The effect of absorption merely reduces the resultant sound level in the room produced by energy that has already entered the room.

ABSORPTION COEFFICIENT

Is a measure of the sound-absorbing ability of a surface. It is defined as the fraction of incident sound energy absorbed or otherwise not reflected by a surface. Unless otherwise specified, a diffuse sound field is assumed. The values at the sound-absorption coefficient usually range from about 0.01 for marble slate to almost 1.0 for long absorbing wedges often used in anechoic rooms.

ACOUSTICS

(1) The science of sound, including the generation, transmission, and effects of sound waves, both audible and inaudible. (2) The physical qualities of a room or other enclosure (such as size, shape, amount of noise) that determine the audibility and perception of speech and music within the room.

ACOUSTIC TRAUMA

Damage to the hearing mechanism caused by a sudden burst of intense noise, or by a blast. The term usually implies a single traumatic event.

AIRBORNE SOUND

Is sound that reaches the point of interest by propagation through air.

AMBIENT NOISE

Is the total of all noise in the environment, other than the noise from the source of interest. This term is used interchangeably with background noise.

ANECHOIC ROOM

A room in which the boundaries absorb nearly all the incident sound, thereby, effectively creating free field conditions.

ANSI

The American National Standards Institute.

ARTICULATION INDEX (AI)

A numerically calculated measure of the intelligibility of transmitted or processed speech. It takes into account the limitations of the transmission path and the background noise. The articulation index can range in magnitude between 0 and 1.0. If the AI is less than 0.1, speech intelligibility is generally low. If it is above 0.6, speech intelligibility is generally high.

ATTENUATION

The reduction of sound intensity by various means (e.g., air, humidity, porous materials...)

AUDIO FREQUENCY

Is the frequency of oscillation of an audible sound wave or any frequency between 20 and 20,000 Hz.

AUDIOGRAM

Is a graph showing individual hearing acuity as a function of frequency.

AUDIOMETER

Is an instrument for measuring individual hearing acuity.

A-WEIGHTED SOUND LEVEL

A measure of sound pressure level designed to reflect the acuity of the human ear, which does not respond equally to all frequencies. The ear is less efficient at low and high frequencies than at medium or speech-range frequencies. Therefore, to describe a sound containing a wide range of frequencies in a manner representative of the ear's response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the noise level. Sound level meters have an A-weighting network for measuring A-weighted sound level.

BACKGROUND NOISE

The total of all noise in a system or situation, independent of the presence of the desired signal. In acoustical measurements, strictly speaking, the term "background noise" means electrical noise in the measurement system. However, in popular usage, the term "background noise" is often used to mean the noise in the environment, other than the noise from the source of interest.

BAND

Any segment of the frequency spectrum.

BAND PASS FILTER

A wave filter that has a single transmission band extending from a lower cut-off frequency greater than zero to a finite upper cut-off frequency.

BROADBAND NOISE

Noise with components over a wide range of frequencies.

CALIBRATOR (ACOUSTICAL)

This is a device, which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to Standard specifications.

COCHLEA

A spirally coiled organ located within the inner ear, which contains the receptor organs essential to hearing.

CUT-OFF FREQUENCIES

The frequencies that mark the ends of a band, or the points at which the characteristics of a filter change from pass to no-pass.

CYCLE

The complete sequence of values of a periodic quantity that occurs during one period.

CYCLES PER SECOND

A measure of frequency numerically equivalent to hertz.

CYLINDRICAL WAVE

A wave in which the surfaces of constant phase are coaxial cylinders. A line of closely-spaced sound sources radiating into an open space produces a free sound field of cylindrical waves.

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DAMPING

The dissipation of energy with time or distance. The term is generally applied to the attenuation of sound in a structure owing to the internal sound-dissipative properties of the structure or to the addition of sound-dissipative materials.

dBA

Unit of sound level. The weighted sound pressure level by the use of the A metering characteristic and weighting specified in ANSI Specifications for Sound Level Meter, S1.4-1983. dBA is used as a measure of human response to sound.

DECIBEL

A unit of sound pressure level, abbreviated dB.

DIFFRACTION

A modification which sound waves undergo in passing by the edges of solid bodies.

DIRECTIVITY INDEX

In a given direction from a sound source, the difference in decibels between (a) the sound pressure level produced by the source in that direction, and (b) the space-average sound pressure level of that source, measured at the same distance.

DOPPLER EFFECT (DOPPLER SHIFT)

The apparent upward shift in frequency of a sound as a noise source approaches the listener or the apparent downward shift when the noise source recedes. An example is the change in pitch of the siren of an ambulance as it approaches and passes by.

DOSIMETER

A device worn by a worker for determining the worker's accumulated noise exposure with regard to level and time according to a pre-determined integration formula.

ECHO

A wave that has been reflected or otherwise returned with sufficient magnitude and delay, so as to be detected as a wave distinct from that directly transmitted.

FAR FIELD

Describes a sound source region in free space where the sound pressure level obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). Also, in this region the sound particle velocity is in phase with the sound pressure. Closer to the source where these two conditions do not hold constitutes the "near field" region.

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FILTER

A device for separating components of a signal on the basis of their frequency. It allows components in one or more frequency bands to pass relatively unattenuated, and it attenuates components in other frequency bands.

FREE SOUND FIELD (FREE FIELD)

A sound field in which the effects of obstacles or boundaries on sound propagated in that field is negligible.

FREQUENCY

The number of times per second that the sine wave of sound repeats itself, or that the sine wave of a vibrating object repeats itself.

HAIR CELL

Sensory cells in the cochlea, which transforms the mechanical energy of sound into nerve impulses.

HARMONIC

A sinusoidal (pure-tone) component whose frequency is a whole-number multiple of the fundamental frequency of the wave. If a component has a frequency twice that of the fundamental it is called the second harmonic, etc.

HEARING

The subjective human response to sound.

HEARING LEVEL

A measured threshold of hearing at a specified frequency, expressed in decibels relative to a specified standard of normal hearing. The deviation in decibels of an individual's threshold from the zero reference of the audiometer.

HEARING LOSS

A term denoting an impairment of auditory acuity. The amount of hearing impairment, in decibels, measured as a set of hearing threshold levels at specified frequencies. Types of hearing loss are:

1. Conductive: A loss originating in the conductive mechanism of the ear;.
2. Sensor-neural: A loss originating in the cochlea or the fibres of the auditory nerve;
3. Noise induced: A sensor-neural loss attributed to the effects of noise.

HEARING THRESHOLD LEVEL (HTL)

Amount (in decibels) by which an individual's threshold of audibility differs from a standard audiometric threshold.

HERTZ (Hz)

Unit of measurement of frequency, numerically equal to cycles per second

IMPACT INSULATION CLASS (IC)

A single-figure rating that compares the impact sound insulating capabilities of floor-ceiling assemblies to a reference contour.

IMPACT SOUND

The sound produced by the collision of two solid objects. Typical sources are footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building.

IMPULSIVE NOISE

a. Either a single sound pressure peak (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) or multiple sound pressure peaks (with either rise time less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 200 millisecond pauses, b)

b. A sharp sound pressure peak occurring in a short interval of time.

INFRASONIC

Sounds of a frequency lower than 20 hertz.

INTENSITY

The sound energy flow through a unit area in a unit time.

INVERSE SQUARE LAW

A description of the acoustic wave behaviour in which the mean-square pressure varies inversely with the square of the distance from the source. This behaviour occurs in free field situations, where the sound pressure level decreases 6 dB with each doubling of distance from the source.

ISO

The International Organization for Standardization.

LEVEL

The logarithm of the ratio of a quantity to a reference quantity of the same kind. The base of the logarithm, the reference quantity, and the kind of level must be specified.

LOGARITHM

The exponent that indicates the power to which a number must be raised to produce a given number. For example, for the base 10 logarithm, used in acoustics, 2 is the logarithm of 100.

LOUDNESS

The subjective judgement of intensity of a sound by humans. Loudness depends upon the sound pressure and frequency of the stimulus. Over much of the frequency range it takes about a threefold increase in sound pressure (a tenfold increase in acoustical energy, or, 10 dB) to produce a doubling of loudness.

LOUDNESS LEVEL

Measured in phons, it is numerically equal to the median sound pressure level (dB) of a free progressive 1000 Hz wave presented to listeners facing the source, which in a number of trials is judged by the listeners to be equally loud.

MASKING

1. The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound.
2. The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound.

MASKING NOISE

A noise that is intense enough to render inaudible or unintelligible another sound that is also present.

MEDIUM

A substance carrying a sound wave.

NEAR FIELD

The sound field very near to a source, where the sound pressure does not obey the inverse square law and the particle velocity is not in phase with the sound pressure.

NIOSH

The National Institute for Occupational Safety and Health.

NOISE

1. Unwanted sound.
2. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources.
3. An erratic, intermittent, or statistically random oscillation

NOISE ISOLATION CLASS (NIC)

A single number rating derived in a prescribed manner from the measured values of noise reduction between two areas or rooms. It provides an evaluation of the sound isolation between two enclosed spaces that are acoustically connected by one or more paths.

NOISE LEVEL

For airborne sound, unless specified to the contrary, it is the A-weighted sound level.

NOISE REDUCTION (NR)

The numerical difference, in decibels, of the average sound pressure levels in two areas or rooms. A measurement of "noise reduction" combines the effect of the sound transmission loss performance of structures separating the two areas or rooms, plus the effect of acoustic absorption present in the receiving room.

NOISE REDUCTION COEFFICIENT (NRC)

A measure of the acoustical absorption performance of a material, calculated by averaging its sound absorption coefficients at 250, 500, 1000 and 2000 Hz, expressed to the nearest multiple of 0.05.

NON-IMPULSIVE NOISE

All noise not included in the definition of impulsive noise.

OCTAVE

The interval between two sounds having a frequency ratio of two. - There are 8 octaves on the keyboard of a standard piano.

OCTAVE BAND

A segment of the frequency spectrum separated by an octave.

OCTAVE BAND LEVEL

The integrated sound pressure level of only those sine-wave components in a specified octave band.

OSCILLATION

The variation with time, alternately increasing and decreasing, of (a) some feature of an audible sound, such as the sound pressure; or (b) some feature of a vibrating solid object, such as the displacement of its surface.

OSHA

The Occupational Safety and Health Administration.

PEAK SOUND PRESSURE

The maximum absolute value of the instantaneous sound pressure in a specific time interval. Note: in the case of a periodic wave, if the time interval considered is a complete period, the peak sound pressure becomes identical with the maximum sound pressure.

PERIOD

The duration of time it takes for a periodic wave form (like a sine wave) to repeat itself.

PERMANENT THRESHOLD SHIFT (PTS)

A permanent decrease of the acuity of the ear at a specified frequency as compared to a previously established reference level. The amount of permanent threshold shift is customarily expressed in decibels.

PHON

The unit of measurement for loudness level.

PINK NOISE

Noise with constant energy per octave bandwidth.

PITCH

The attribute of auditory sensation that orders sounds on a scale extending from low to high. Pitch depends primarily upon the frequency of the sound stimulus, but it also depends upon the sound pressure and waveform of the stimulus.

PLANE WAVE

A wave whose wave fronts are parallel and perpendicular to the direction in which the wave is travelling.

PRESBYCUSIS

The decline in hearing acuity that is attributed to the aging process.

PURE TONE

A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch.

RANDOM NOISE

An oscillation whose instantaneous magnitude is not specified for any given instant of time. It can be described statistically by probability distribution functions giving the traction of the total time that the magnitude of the noise lies within a specified range.

REFLECTION

The return of a sound wave from a surface.

REFRACTION

The bending of a sound wave from its original path, either because it is passing from one medium to another or by changes in the physical properties of the medium, e.g., a temperature or wind gradient in the air.

RESONANCE

The relatively large amplitude of vibration produced when the frequency of some source of sound or vibration "matches" the natural frequency of vibration of some object, component, or system.

RESONATOR

A device that resounds or vibrates in sympathy with a source of sound or vibration.

REVERBERANT FIELD

The region in a room where the reflected sound dominates, as opposed to the region close to the noise source where the direct sound dominates.

REVERBERATION

The persistence of sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped.

REVERBERATION ROOM

A room having a long reverberation time especially designed to make the sound field inside it as diffuse (homogeneous) as possible.

REVERBERATION TIME (RT)

The reverberation time of a room is the time taken for the sound pressure level to decrease 60 dB from its steady-state value when the source of sound energy is suddenly interrupted. It is a measure of the persistence of an impulsive sound in a room as well as of the amount of acoustical absorption present inside the room. Rooms with long reverberation times are called live rooms.

RMS SOUND PRESSURE

The square root of the time averaged square of the sound pressure.

ROOT-MEAN-SQUARE (RMS)

1. The root-mean-square value of a time-varying quantity is obtained by squaring the function at each instant, obtaining the average of the squared values over the interval of interest, and then taking the square root of this average. For a sine wave, if you multiply the RMS value by the square root of 2, or about l.41, you get the peak value of the wave. The RMS value, also called the effective value of the sound pressure, is the best measure of ordinary continuous sound, but the peak value is necessary for assessment of impulsive noises.

2. A term' describing the mathematical process of determining an 'average' value of a complex signal.

SABIN

A measure of the sound absorption of a surface; it is the equivalent of one square foot of a perfectly absorptive surface.

SHIELDING

The attenuation of a sound, achieved by placing barriers between a sound source and the receiver.

SONE

The unit of measurement for loudness. One sone is the loudness of a sound whose loudness level is 40 phons. Loudness is proportional to the sound's loudness rating, e.g., two sones are twice as loud as one sone.

SOCIOCUSIS

Loss of hearing caused by noise exposures that are part of the social environment, exclusive of occupational-noise exposure, physiological changes with age, and disease.

SOUND

1. An oscillation in pressure, stress, particle displacement, particle velocity, etc., in elastic or partially elastic medium, or the superposition of such propagated alterations. 2. An auditory sensation evoked by the oscillation described above. Not all sound waves can evoke an auditory sensation: e.g. ultrasound.

SOUND LEVEL

The weighted sound pressure level obtained by the use of a sound level meter and frequency weighting network, such as A, B, or C as specified in ANSI specifications for sound level meters (ANSI Sl.4-1971, or the latest approved revision). If the frequency weighting employed is not indicated, the A-weighting is implied.

SOUND LEVEL METER

An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

SOUND POWER

The total sound energy radiated by a source per unit time. The unit of measurement is the watt.

SOUND PRESSURE

The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

SOUND PRESSURE LEVEL (SPL)

20 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound pressure level in units of decibels is expressed as SPL (dB) = 20 log p/pr.

SOUND TRANSMISSION CLASS (STC)

The preferred single figure rating system designed to give an estimate of the sound insulation properties of a structure or a rank ordering of a series of structures.

SOUND TRANSMISSION LOSS (STL)

A measure of sound insulation provided by a structural configuration. Expressed in decibels, it is 10 times the logarithm to the base 10 of the reciprocal of the sound transmission coefficient of the configuration.

SPECTRUM

The description of a sound wave's resolution into its components of frequency and amplitude.

SPEECH-INTERFERENCE LEVEL (SIL)

A calculated quantity providing a guide to the interference of a noise with the reception of speech. The speech-interference level is the arithmetic average of the octave band levels of the interfering noise in the most important part of the speech frequency range. The levels in octave bands centred at 500, 1000, and 2000 Hz are commonly averaged to determine the speech-interference level.

SPEED (VELOCITY) OF SOUND IN AIR

344 m/sec (l128 ft/sec) at 70 degrees F in air at sea level.

SPHERICAL DIVERGENCE

The condition of propagation of spherical waves that relates to the regular decrease in intensity of a spherical sound wave at progressively greater distances from the source. Under this condition the sound pressure level decreases 6 decibels with each doubling of distance from the source.

SPHERICAL WAVE

A sound wave in which the surfaces of constant phase are concentric spheres. A small (point) source radiating into an open space produces a free sound field of spherical waves.

STEADY-STATE SOUNDS

Sounds whose average characteristics remain relatively constant in time. A practical example of a steady-state sound source is an air conditioning unit.

TEMPORARY THRESHOLD SHIFT (TTS)

A temporary impairment of hearing acuity as indicated by a change in the threshold of audibility.

THIRD-OCTAVE BAND

A frequency band whose cut-off frequencies have a ratio of 2 to the one-third power, which is approximately 1.26. The cut-off frequencies of 891 Hz and 1112 Hz define the 1000 Hz third-octave band in common use.

THRESHOLD OF AUDIBILITY (THRESHOLD OF DETECTABILITY)

The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of trials.

THRESHOLD OF PAIN

The minimum sound pressure level of a sound outside the ear that will produce a transition from discomfort to definite pain.

THRESHOLD SHIFT

A change in the threshold of audibility at a specified frequency from a threshold previously established. The amount of threshold shift is customarily expressed in decibels.

TIMBRE

An attribute of auditory sensation allowing a subject to judge that two sounds similarly presented and having the same loudness and pitch are dissimilar, e.g., trumpet vs. violin.

TINNITUS

Ringing in the ear or noise sensed in the head. Onset may be due to an acoustic trauma and persist in the absence of acoustical stimulation (in which case it may indicate a lesion of the auditory system).

TONE

A sound of definite pitch. A pure tone has a sinusoidal waveform.

TRANSDUCER

A device capable of being actuated by waves from one or more transmission systems or media and supplying related waves to one or more other transmission systems or media. Examples are microphones, accelerometers, and loudspeakers.

ULTRASONIC

Sounds or a frequency higher than 20,000 hertz.

VIBRATION

An oscillatory motion of solid bodies described by displacement, velocity, or acceleration with respect to a given reference point.

VIBRATION ISOLATOR

A resilient support for vibrating equipment designed to reduce the amount of vibration transmitted to the other structures.

WAVE

A disturbance that travels through a medium by virtue of the elastic properties of that medium.

WAVELENGTH

For a periodic wave (such as sound in air), the distance between analogous points on any two successive waves. The wavelength of sound in air or in water is inversely proportional to the frequency of the sound. Thus, the lower the frequency, the longer the wavelength.

WEIGHTING

Prescribed frequency filtering provided in a sound level meter.

WHITE NOISE

Noise whose energy is uniform over wide range of frequencies, being analogous in spectrum characteristics to white light.

WINDSCREEN

A porous device used to cover the microphone of a sound level measurement system, which is designed to minimize the effects of winds, and wind gusts on the sound levels being measured. Typically made of open cell polyurethane foam and spherically shaped.

Appendix

STRATEGIES FOR THE ENTERTAINMENT INDUSTRY

Music noise is best managed by adopting a planned strategy. This code provides appropriate strategies for the different persons and activities generating noise. Principally, persons generating noise must know when music levels become music noise. This way they will know when control measures need to be put in place. Measuring music noise is a complex operation and should be conducted by a competent person. The operators in music venues are not normally experienced in this field. The EMA has trained personnel and there are private companies competent in this field. However, music operators should have some knowledge of how noise is measured, so that they can understand the music noise control strategies outlined in this code. Interested parties should select the strategy that applies to their particular situation.

STRATEGY NO. 1 - FOR AN OWNER

You are a person who owns, but does not operate an entertainment venue. As an owner, you may lease the venue to another person who operates the venue as an entertainment centre. In this case, you are the owner and the other person is the operator. If you also perform as an operator then you are both the owner and operator and should follow Strategy No. 2.

As an owner you are responsible for ensuring all practicable building devices and modifications which may be needed to reduce principally the noise exposures of people beyond the boundaries of the venue, as well as the people within the venue. You should also bring to the attention of the operator of the venue:

- the Noise Pollution Control Rules, 2001 enacted under the Environmental Management Act, 2000.
- the contents of this code.

STRATEGY NO. 2 - FOR AN OPERATOR OF ENTERTAINMENT VENUES

You are the person who operates an entertainment venue listed in Table 1 (Page 5). You are the person who directly engages the services of an entertainment promoter or music performer. You can be a hotel licensee, nightclub or disco proprietor, restaurant manager, or similar person in charge of an entertainment facility. For example, you may employ a music band to perform at a hotel function or a steelband at a poolside event or a group of performers for a large outdoor concert.

As the operator or person in control of the entertainment venue, you are expected to:

- ensure that all efforts have been made to prevent risks to the safety and health of all concerned from excessive music noise.
- communicate this information to employees, promoters and performers.
- be familiar with the Noise Pollution Control Rules, 2001 enacted under the Environmental Management Act, 2000, and in particular to ensure that any variations required under the said code are acquired by the promoter in accordance with the procedures established.
- be familiar with the contents of this code.

On a long-term basis, you should identify situations and areas of the venue where noise is likely to be above the exposure standard. Arrange for a noise assessment to be carried out by a competent person during a typical louder than normal performance. If the assessment indicates that the exposure standard as outlined in the Noise Pollution Control Rules, 2001 was exceeded then you should consider the following:

- reducing the noise at source i.e. reduction of the music level. This has to be achieved through consultation with the entertainment providers.
- relocation or reorientation of stage and/or speakers to reduce sound transmitted to affected persons.
- use of sound barriers.
- use of multiple speakers distributed throughout a venue as opposed to a single bank of speakers.
- employ the assistance of professional acoustic consultants and sound engineers to achieve the most cost effective options.

STRATEGY NO. 3 - FOR ENTERTAINMENT PROVIDERS

You will most likely be a self-employed person who:

- is engaged by an operator or person in control of an entertainment venue to supply or provide music entertainment.
- promotes musical performances and engages the services of performers and/or technical staff.
- leads a band and or orchestra or other musical performing group and employs the musicians who perform in that group.

As a promoter or performer in this situation you should:

- ensure that all efforts have been made to prevent risks to the safety and health of all concerned from excessive music noise.
- communicate this information to the performers and technical staff you engage.
- be familiar with the Noise Pollution Control Rules, 2001 enacted under the Environmental Management Act, 2000, and in particular to ensure that any variations required under the said code are acquired by you in accordance with the procedures established.
- be familiar with the contents of this code.

If you employ workers such as sound mixer/engineer, lighting crews or musicians you will need to ensure that the terms and conditions of any variations supplied by the EMA are strictly adhered to throughout the time span of the function.

STRATEGY NO. 4 - FOR SOUND EQUIPMENT PERSONNEL

You will most likely be a supplier and/or installer of sound systems for indoor and outdoor events. You may also be the operator of the system at the venue. You may be self-employed and/or employ other people to do this work. You should:

- be familiar with the Noise Pollution Control Rules, 2001 enacted under the Environmental Management Act, 2000, and in particular to ensure that any variations obtained for an event at a particular venue are adhered to as detailed by the EMA.
- be familiar with the contents of this code.
- arrange the placement and orientation of the loudspeakers to minimise as far as practicable the sound directed to nearby residential buildings.
- arrange the placement of loudspeakers to enable restriction of access to a reference position where peak noise levels are likely to exceed 140 decibels.
- provide employees with appropriate personal hearing protectors where exposures exceed the exposure standard for noise.

STRATEGY NO. 5 - FOR STEELBAND PERSONNEL

You will most likely be a steelband manager, captain, or arranger responsible for practice sessions of the band. You may also be the person who negotiates with promoters for the performance of the band at various venues. You should:

- be familiar with the Noise Pollution Control Rules, 2001 enacted under the Environmental Management Act, 2000 and adhere to the terms and conditions of any variations obtained from the EMA by the promoter of an event.
- be familiar with the contents of this code.
- plan the times of practice to minimise the disturbance to neighbours.
- engage neighbours in discussion before practise sessions and functions to establish good relations.
- arrange for suitable breaks in playing time to minimise the continuous exposure of loud sounds to players.
- provide players with appropriate personal hearing protectors where exposures exceed the exposure standard for noise.

STRATEGY NO. 6 - GENERAL GUIDELINES FOR OPEN AIR ACTIVITIES

Large scale open air activities offer the biggest concern for noise control in the entertainment industry. They are now a major part of the music scene in Trinidad and Tobago. Especially at Carnival time, they provide new opportunities for the promotion of artistes. Extensive sound amplification is employed and usually causes disturbances to nearby residents. Noise level from various activities including set up, rehearsal, main event and even dismantling can exceed stipulated maximum noise levels.

Most staging systems are designed with speaker banks to the left and right of a stage. The sound companies that are hired usually provide the stage as well, so they have the power to control the location and orientation of the stage and the speaker banks.

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Sound engineers tend to place most of the high-energy content of the mix in mono (i.e., bass instruments, most low-mid information and vocals) because they are concerned about maximizing power and coverage. The two speaker bank positions are effectively operating as mono loudspeakers reproducing identical simultaneous sounds, developing a low frequency energy source.

The standard left/right configuration is designed primarily to address the sound engineer and has little to do with presenting a well-resolved sound field to the audience. The solution to this basic geometric problem is for the main loudspeaker stacks to be placed far enough offstage to provide effective stereo imaging for the audience. There is a further advantage here in that the control of sound levels placed upon the mix engineer relates mainly to the near field system because the main speaker banks are out of his hearing. In this way higher sound pressure levels can be allowed at the mixer without compromising off-site noise levels.

There are two very distinct processes that are necessary to achieve good environmental noise control. They are informed sound design at an early stage in planning of the event and implementation of effective monitoring and control during the event.
The key is to design for the lowest energy input to the system in order to achieve the required sound pressure level in the audience area. If the total energy dissipated can be reduced, then it is clear that the total energy leaving the site will be reduced and therefore more readily controlled.

Promoters of these events should apply to the EMA for variations in accordance with the Noise Pollution Control Rules, 2001. Advance notices should be distributed to nearby residential buildings, hospitals or other noise sensitive users to alert people of the date, time, venue and programme of the activity.

All practical noise mitigation measures should be employed (see figure 1 on Page 15) including but not limited to the following:

- orient the stage to point away from nearby sensitive areas.
- enclose the stage and speakers on three sides with sound absorbing or reflecting barriers to reduce the sound levels to sensitive areas.
- where practical, use a cluster of small power loudspeakers instead of a few large power loudspeakers.
- use directional loudspeakers and orient them to point towards the audience and away from nearby sensitive areas.
- where possible, orient speakers so that the prevailing winds blow away from sensitive areas.
- orient speakers so that the sound travels towards large open land areas or the sea.
- testing of sound system should be kept as short as practical and full blown rehearsals also kept to a minimum. These activities should be performed during the period 9:00 a.m. to 7:00 p.m.

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