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TONAL NUISANCE - AN ENFORCEMENT VIEW

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"Tonal Nuisance" is a term which describes something and defines nothing. In this paper I will use the term Nuisance in its legal context. A Statutory Nuisance in English Law is something defined by National Government or based upon the hundreds of years of evolving law made by the courts (Common Law Nuisance).

Under Statute law a statutory nuisance is something which is a nuisance (as at Common Law) or "prejudicial to health" which is defined in the Environmental Protection Act 1990 as "injurious or likely to cause injury to health". The Common Law principles regarding nuisance require that the "noise materially interferes with the enjoyment of land", that is, to be caused a nuisance, one must have rights to land and the use of that land must be adversely affected in some way - for example affecting sleep or basic household tasks. This is critical when one considers tonal noise.

However this sort of assessment has hitherto had a wide subjective aspect, especially as other factors such as locality have to be taken into account, (1) for example if local prevailing noise levels are high, for an action in nuisance to succeed distinct increases in level due to the noise source would be needed. Other factors such as the time of day, duration and intermittence and whether the noise is made maliciously will all affect the Court's decision.

So how does tonal nuisance fit in? In the UK a British Standard 4142 (2) is used for development purposes and assists in the prediction of whether complaints will arise (not whether or not there is a Nuisance). This standard works well in 80% of cases reported (3) and is commonly used outside of its terms of reference to gauge nuisance potential. In simple terms it uses difference in dBA between a rating level due to the source and background. The rating level of the source is adjusted for

percentage on time tone or other features (L_{Aeq} + correction - L_{A90}).

Very often enforcement officers use the term tonal nuisance for situations where this rating method gives no useful information but noise clearly gives rise to complaint. The sorts of situations that give rise to tone complaints are fans, electrical installations or producers of low frequency noise or items such as reversing bleepers on vehicles, the clank of metal parts on drag lines or open trucks (clearly some of these sources also have impulsive acoustic features which greatly affect the likelihood of the noise causing a nuisance). A model taking this into account has been proposed (4) which codifies good practice on investigation and description of these problems but requires the development of rating methods to rank features and fully implement the model. A great deal of work has or is being done on the perception of tones (5) (6) and on discrimination of narrow level sounds (7) and detectability of tones whose onset occurs after the onset of masking sounds (8).

The papers indicate that the perception of tones is detected at 4 to 6dB below that of the noise measured across the 1/3 octave band, and that a variety of cues such as loudness, roughness, pitch and onset are used to discriminate.

It is possible that changes in the cue used in discriminating the tone may be responsible for the increase in annoyance described (8) over and above that represented by increase in loudness. Bullmore (9) refers to an implementation of critical bands to assess tonal noise from wind farms promulgated by the Danish Authorities although this has not yet gained acceptance in the UK (10).

From an enforcement view point one must be able to assess nuisance from noise. In order not to impose unnecessary burdens on industry an objective assessment which reflects the response of the ordinary individual in his/ her setting is desirable. In English Law a business allegedly causing a nuisance has a defence if it can show that it is using Best Practicable Means, a concept roughly equivalent to BATNEEC (best available techniques not entailing excessive cost) promulgated by the EC (11). This concept enables the use of current technology at appropriate cost to be a defence. Thus it is entirely possible to deal with a nuisance characterised by broad band level noise which is reduced leaving a tonal problem of unassessed significance and which the person affected gladly accepts as a small price to pay for overall "peace and quiet". Of course, good practice would be to identify the potential problem beforehand (even if not complained of) and ensure that remedial measures dealt with it.

The sort of complaints that arise vary from very loud tonal events such as slipping drive belts on machinery or steam release valves on boilers (where there is little difficulty in resolving problems without measurement), to other sources such as machinery or plant where the

complainant tolerates noise for a time and then complains. Even if the matter is (subjectively) clear cut these persons often present in a rather anxious manner, even if in other areas of their lives they are self-assured, responsible people - reflecting perhaps even the lack of a rule of thumb of annoyance levels felt by the general public. Typical sources are small compressors, refrigeration plant or the heating plant in large residential buildings. Persons affected by low frequency noise may present in households where other persons do not hear the noise complained of.

The person's response to noise is of course governed by a number of factors apart from the acoustic features of the noise, such as information content, past experience, expectancy, physical and emotional arousal levels, activity (12). In addition to this is the ability or lack of ability to control the noise. It is a truism that people will tolerate noise for which they are responsible themselves but not if the same level of noise comes from elsewhere. In this respect district and large heating schemes may produce tonal noise no greater than that tolerated, or even welcomed, from domestic heating pumps. The lack of control by the complainant in a large heating scheme however may trigger complaints.

Investigation and assessment of alleged complaints of tonal nuisance is not simple. In those cases where the matter is clear cut (slipping drive belts for example) the resolution of the problem is in everyone's interest and so no formal assessment is made. Where this is not the case, measurements will need to be taken and any works required related to best practicable means. This is a problem for both the noise producer and noise enforcement officer alike: "will xdB reduction at y frequency band for z cost be good enough or do we need to spend more?" Studies of tonal annoyance have indicated that increased response due to increase in a tone level is greater than can be explained by apparent loudness (13). Without criteria there is a risk of reducing the noise from the level of a legal nuisance to one of irritation.

Another problem especially with low frequency noise is attending at a time when the complainant hears it, "There it is ..... no it's not". Low frequency noise has been the subject of a recent UK national meeting (14). Other tonal noises even if fairly predictable are often only noticeable when the background falls - typically night-time.

The assessment of the noise follows measurement and tonality is one of the factors to be taken into account (15). Measurement of noise A-weighted is irrelevant and it is a matter of luck whether 1/3 octave analysis shows anything although criteria do exist in these terms in ISO 1996 (BS7445) (16). The UK Government has not set criteria with respect to tones (17) (18) nor have other UK National Bodies (19) (20) and a National working party on neighbour noise has expressed "serious disturbance" in terms of A-weighted sound pressure levels (21) although the importance of tones is referred to.

The UK Government has commended a report on low frequency noise (22) which could really form the basis of any tonal noise investigation. However the suggested investigation protocol requires equipment and resources typically not held by local authorities; if hired in the authority runs the risk of the complainant saying, "It's not bad tonight". This report, useful as it is, does not assist in the assessment of tone other than to suggest that most problems are not legal Nuisances in any case. One way to carry out an investigation which side steps many of the practical difficulties in obtaining measurements is to provide the complainant with a "nuisance recorder" - a DAT recorder in a locked case which is fed a calibrated signal (usually from a sound level meter). The recorder is controlled remotely by the complainant who is asked to record when there is the tone complained of and when no disturbance occurs. This can be done on multiple occasions and the equipment left for a week. The tape can then either be analysed by the investigating officer or sent elsewhere. A quick, useful method of analysis has been described using spectrum mapping (23). The use of DAT tapes is commended for post processing, narrow band analysis (5). the noise floor of the equipment used must of course be considered.

However the assessment of the problem must be more than measurement, however elegant and sophisticated, as response to tones shows considerable variability both between and within different exposed populations. Whether a Nuisance exists will relate to a number of acoustic features and non-acoustic features of the noise. The "cue" which triggers awareness of noise which may be a nuisance can be a tone or another feature such as roughness/ smoothness or information content. Improvements in assessment of tones must be welcomed but in the context of the other acoustic features of the noise. To be useful assessment procedures must be robust or else they will simply not be used. This means not only that all parties should obtain the same results with the same data but that the assessment should be presented in a form that makes it understandable to Planners and Developers.

To be used the necessary equipment must be common if not standard to all parties in development and provide an accessible, meaningful result. Finally and most importantly proceedures should be endorsed by Government. Until these preconditions are met, acceptability (at the planning stage) and enforcement (at remediation stage) will be contentious for the foreseeable future.

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