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Mr. Mike Keene, MCIP, RPP
Planner, Ministry of Municipal Affairs and Housing
Municipal Services Office - Eastern Region
8 Estate Lane, Rockwood House
Kingston, ON, K7M 9A8

Dear Mr. Keene,

First of all, thank you for replying before I had to leave for the meeting of Loyalist Township Council. "Most difficult" is not the same as impossible and so I petitioned Council to put back the cyclic noise clause. As you will now know, Council voted unanimously to keep the penalty for cyclic noise in its Official Plan Amendment. The address that I gave at the Council Meeting of Dec. 8th is attached. The purpose of this letter is to explain why this penalty is needed. The following paragraph is an edited version of a presentation that I made to Ms. Doris Dumais, Director of the Environmental Assessment and Approvals Branch of the Ministry of the Environment and her three acoustics engineers on August 27th of this year. The editing is just to fill in gaps in a presentation to a group that was already familiar with the problem of amplitude modulation of turbine noise.

Amplitude Modulation

Anyone who has stood 500 metres from an operating turbine at a time when there is little near-by traffic knows that wind turbines emit a characteristic amplitude-modulated noise. The frequency of modulation is the blade passage frequency. It is thought to be the result of the interaction of the wake-turbulence, which generates the aerodynamic noise, and the tower. The significance of this amplitude modulation was brought to world-wide attention by Fritz van den Berg in his doctoral thesis and a journal publication. He was investigating complaints of annoyance to residents of the Netherlands close to the Dutch/German border arising from wind turbine noise from a nearby German wind farm. He identified two problems:

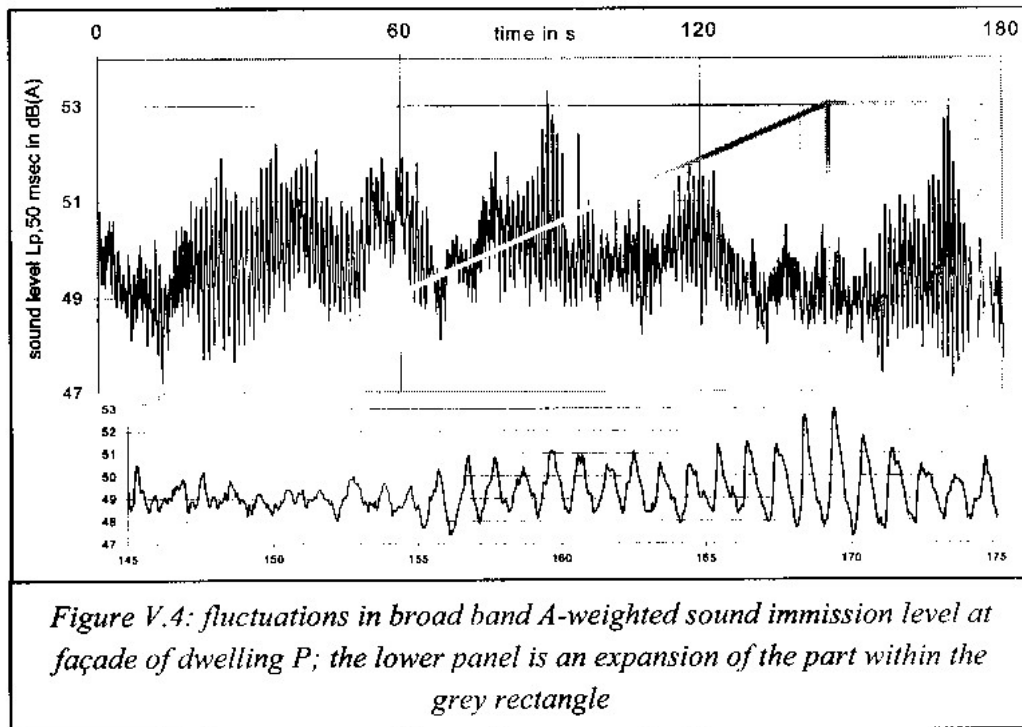
First of all, the Netherlands, Ontario and New Zealand were the only jurisdictions that allowed the sound level at a receptor to increase with wind speed. The logic was that as the wind speed increases so will the masking noise from the wind blowing through ground level trees and bushes and around buildings. The guidelines were based upon a so-called neutral atmosphere with a prescribed ratio of wind speed at hub height (which governs the turbine noise) to that at 10 metres (which governs the masking noise). By checking wind-speed ratios from easily accessible meteorological-tower wind-speed measurements, van den Berg

demonstrated that average ratios were larger than that used by the three jurisdictions and that the ratios were significantly higher during the night-time when the atmosphere stabilizes. The Dutch government accepted the results and dropped an allowance for masking noise. The Ontario MOE fought hard to deny the van den Berg work. They supported masking noise as an allowance for the Kincardine and Wolfe Island wind energy developments and commissioned Dr. Ramani Ramakrishnan to write an appraisal of the van den Berg work. The Ramakrishnan report, which tore into the van den Berg work, was, in my opinion as a scientist, a travesty and I wrote so to both MOE and Dr Ramakrishnan. Since van den Berg's publications there had been other measurements, particularly from the National Renewable Energy Lab in the USA, formed to support wind energy development in the USA, which showed overwhelmingly that the ratios were large at night-time. Dr. Ramakrishnan had omitted all reference to these results.

By now, as you know, MOE has accepted in a half-hearted fashion that masking noise is a myth. I do not know what the situation is in New Zealand. When our Official Plan was being formulated, I assumed that MOE would dig its heels in and that was why we wanted to see wind-speed gradient measurements in the plan amendment. MOE has never disowned the Ramakrishnan report. Now that the clarification requires these measurements, you were quite correct in removing that clause.

The second problem that van den Berg identified was that turbines emit an amplitude modulation of the turbine sound of about 5 dBA. The frequency of the modulation is about 1Hz (cycle per second), the frequency with which a blade passes the tower. Figure V.4, reproduced from van den Berg's thesis, shows the noise at a residence neighbouring the wind farm on the Dutch/German border. The lower graph is an expansion of the upper compressed graph; both show the noise level as a function of time in seconds. Note the periodic variation with a frequency of about one per second, the blade passage frequency. Four turbines dominated in creating the noise. These turbines passed in and out of synchronization causing the amplitude modulation, the size of the oscillatory noise level, to rise and fall. The amplitude modulation of a single turbine is at least as large as the maximum seen in the graph; i.e. 5.5 dBA. Further measurements of amplitude modulation have been reported in the "Salford" report published by the British Wind Energy Authority. On page 38, the report quotes measurements of 3 to 5 dBA with measurements of 7 to 9 dBA in the frequency range 200 to 800 Hz. For one wind farm, the low frequency modulation was measured to be 12 to 15 dBA.

The ear responds to sound on a very short time scale (about a few hundred microseconds) and so responds to this modulation. However, the noise regulations in all jurisdictions use an average sound level (averaged over 10 minutes or 1 hour). This of course misses the peaks of the turbine noise! It is this modulation that is responsible for much of the distress associated with wind-



turbine noise. Field surveys have shown annoyance among 50% of a population exposed to wind turbine noise at the 40 dBA level compared to 3 to 4% for traffic noise at 40 dBA.

As you know, Ontario has a regulation to deal with noise that has a tonal component and also with noise that has a periodic component: NPC-104. I have extracted only part 2 because it is relevant here:

“If a sound has an audible cyclic variation in sound level such as a beating or other amplitude modulation then the observed value shall be increased by 5 dBA.”

Nowhere does it mention that this regulation applies to some cyclic variations and not others. However, the latest interpretation document from MOE reads as follows:

“No special adjustments are necessary to address the variations in wind turbine sound level (swishing sound) due to blade rotation. The temporal characteristic is not dissimilar to other sounds to which no adjustments are applied. It should be noted that the adjustments described in NPC-104 were not designed to apply to sounds exhibiting such temporal characteristic.”

The paragraph acknowledges the “variation in wind turbine sound level”, the “swishing sound” and a “temporal characteristic”. All of these are descriptions of an audible cyclic variation. The basis for not applying the penalty is that they have been negligent in prior cases and they are not going to change. Note that the regulation is quite general; there is no fine print to say where it applies and where it does not. At an earlier Focus Group meeting at MOE which I attended, we were told that any changes to the wind-turbine noise regulations and their interpretation would have to be approved by higher levels within the government. I leave it to your imagination to realize what has happened here.

I urge you and your Ministry to accept the motion passed unanimously by the Council. There were no absences and no abstentions. Furthermore, I urge you to advise other municipalities of the need for a similar paragraph in their Official Plan Amendments. In this municipality we are fortunate to have a group of residents and a Township Planner who are able to understand the noise issue and a Council that has listened to and acknowledged the concerns of its residents. I know that this is not the case in many municipalities in Ontario. As I have emphasized to our Council, the MOE is not living up to its responsibility to enforce the Environmental Protection Act and we must depend upon our local representatives to do this. They in turn must depend upon their higher authority which is your Ministry.

Yours sincerely,

John Harrison