Comment on Wind Speed Gradient and the October 2008 Noise Regulations

In Ontario the *Noise Guidelines for Wind Farms* (aka the "MOE Interpretation") effectively sets the limits for how noisy wind turbines can be at the neighbors' homes. There are several controversial areas in the Interpretation, all of which lessen the protection afforded to the neighbors. One of these controversial areas was the "masking" provision, which allowed the noise level to go above the calm baseline of 40dBA in windy conditions – with the theory being that the noise from the wind would "mask" the noise from the turbines. In October of 2008 the Interpretation was updated, and one of the updates affected the masking provision. However this change led to a fair amount of confusion and this comment is an attempt to shed light on the significance of the change.

Introduction

Before we get to the change and its importance, we need to understand how noise levels are calculated in the first place. All manufacturers specify how much noise their turbines make at different wind speeds. Unfortunately, the speed of the wind varies as you get higher off the ground, so there needs to be some standard for determining which wind speed you use to make the calculation. The typical manufacturer measured the wind speed at 10 metres above the ground, representing the level of our homes, and then measured the noise produced by his wind turbine under varying wind speeds.

This produces Chart #1, which might look something like this:

Wind Speed at 10 metres (m/s)	4	6	8	10
Turbine Sound Power (dBA)	101	103	105	107

The developer would then feed these numbers into a computer modeling tool which would produce estimates of the noise received at the homes in the area.

But if the wind gets stronger as we get higher off the ground, what was the wind speed at the height of the turbine itself, generally 80 metres above ground? As a practical matter, most of the manufacturers' measurements are taken during the day, when a typical multiplier might be 1.5. So the wind at hub height is actually 6, 9, 12 and 15 m/s in Chart #1. Note that this multiplier (the "gradient") is not specified or acknowledged anywhere; it is simply a consequence of how the measurements were done.

The pre-October 2008 MOE Interpretation was based on this understanding of the noise specifications.

Problems Arise

A Dutch researcher, van den Berg, was studying complaints of higher-than-expected noise at a project and his investigation showed that the likely cause was a larger-than-expected wind gradient especially at nighttime. This higher gradient would lead to a relatively higher wind speed and more noise at the turbine, while the wind speed near to the ground would not be enough to supply the expected masking noise. It was demonstrated that at night-time the gradient could be 2.5 or higher. This daily cycle is quite common and is a consequence of the sun not heating the earth's surface during the night. The lack of heat from below reduces the mixing of the atmosphere close to the ground, which in turn makes it easier for the wind to speed up as it gets further from the obstructions on the ground. Nighttime is characterized by a "stable" atmosphere, compared to an "unstable" one during the day.

Initially, Ontario resisted taking this new information into account, but finally relented with this new understanding reflected in the October 2008 Interpretation.

The New Rules

The October 2008 Interpretation included the following:

> "The wind speed profile on site of the Wind Farm may have an effect on the manufacturer's wind turbine acoustic emission data and, consequently, on the sound levels predicted at a Point of Reception. Therefore, the wind turbine generator acoustic emission levels must be consistent with the wind speed profile of the project area. "

The "wind speed profile" was essentially the new and improved gradient. The importance of the change is best shown by looking at before and after examples.

Chart #2 below shows an example of how the manufacturer's specifications would appear under the old rules and the resulting noise as might be received at a nearby home. Note that this example shows the noise received at the home is within Ontario limits.

Wind Speed at 10 metres (m/s)	4	6	8	10
Wind Speed at Hub (m/s)	6	9	12	15
Turbine Sound Power (dBA)	101	103	105	107
Noise Level at Home (dBA)	38	40	42	44
Ontario Limit (dBA)	40	40	45	51

With the new rules, the wind speed at the hub increases, increasing the noise produced. A developer must now use the new higher production when modeling the noise received at a nearby home.

Chart #3 shows an example of how this might look.

Wind Speed at 10 metres (m/s)	4	6	8	10
Wind Speed at Hub (m/s)	10	15	20	25
Turbine Sound Power (dBA)	103.5	107	108	108
Noise Level at Home (dBA)	40.5	44	45	45
Ontario Limit (dBA)	40	40	45	51

Note that in this example, using the same arrangement as before except with the new rules, the noise received at the nearby home is not within Ontario's limits. The developer would have to increase the distance (aka "setback") in order to obtain an approval.

A reasonable question to ask is, why make this so complicated? Why couldn't Ontario just restate the noise limits to be 40dBA regardless of the wind speed? Most other jurisdictions in fact do just that, and as a practical matter the noise consultants may end up doing so too in practice. A speculation would be that Ontario realized they had to do something, but the industry convinced them that just dropping the masking allowance altogether would be too restrictive and/or make non-conformance too easy to detect. So they jointly came up with this least restrictive yet still defensible scheme that is complex enough where a complaining homeowner would have a more difficult time proving the non-conformance.