

# AMPLITUDE MODULATION DISCUSSION DOCUMENT

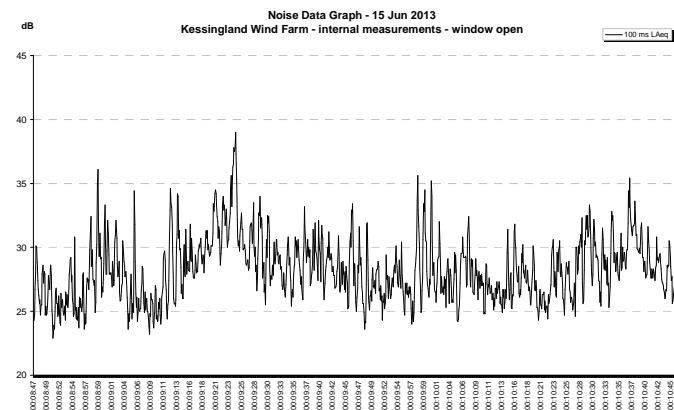
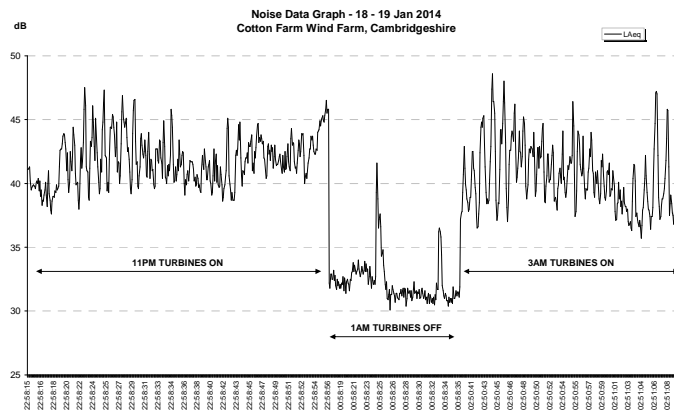
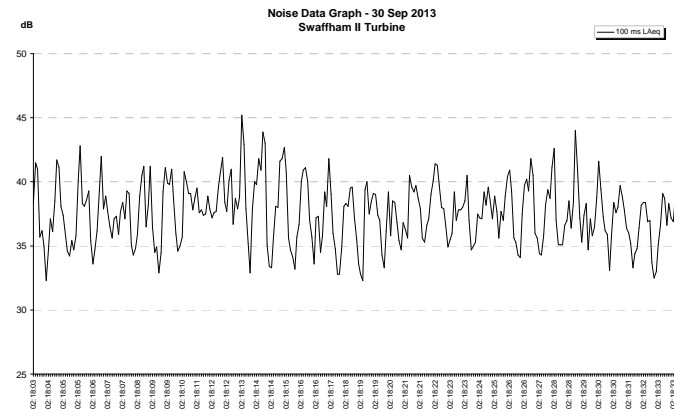
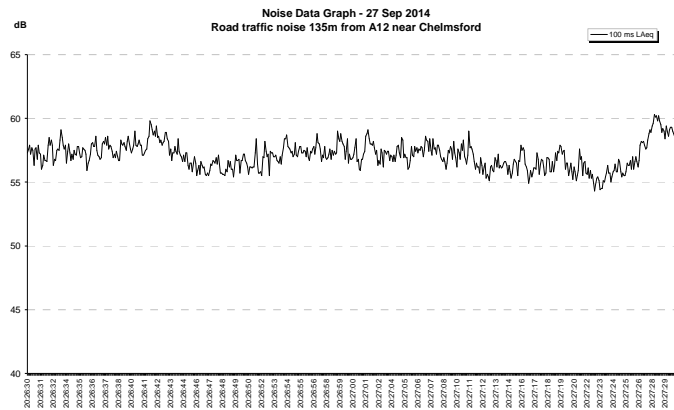


Provided by MAS Environmental Ltd working with the Independent Noise Working Group

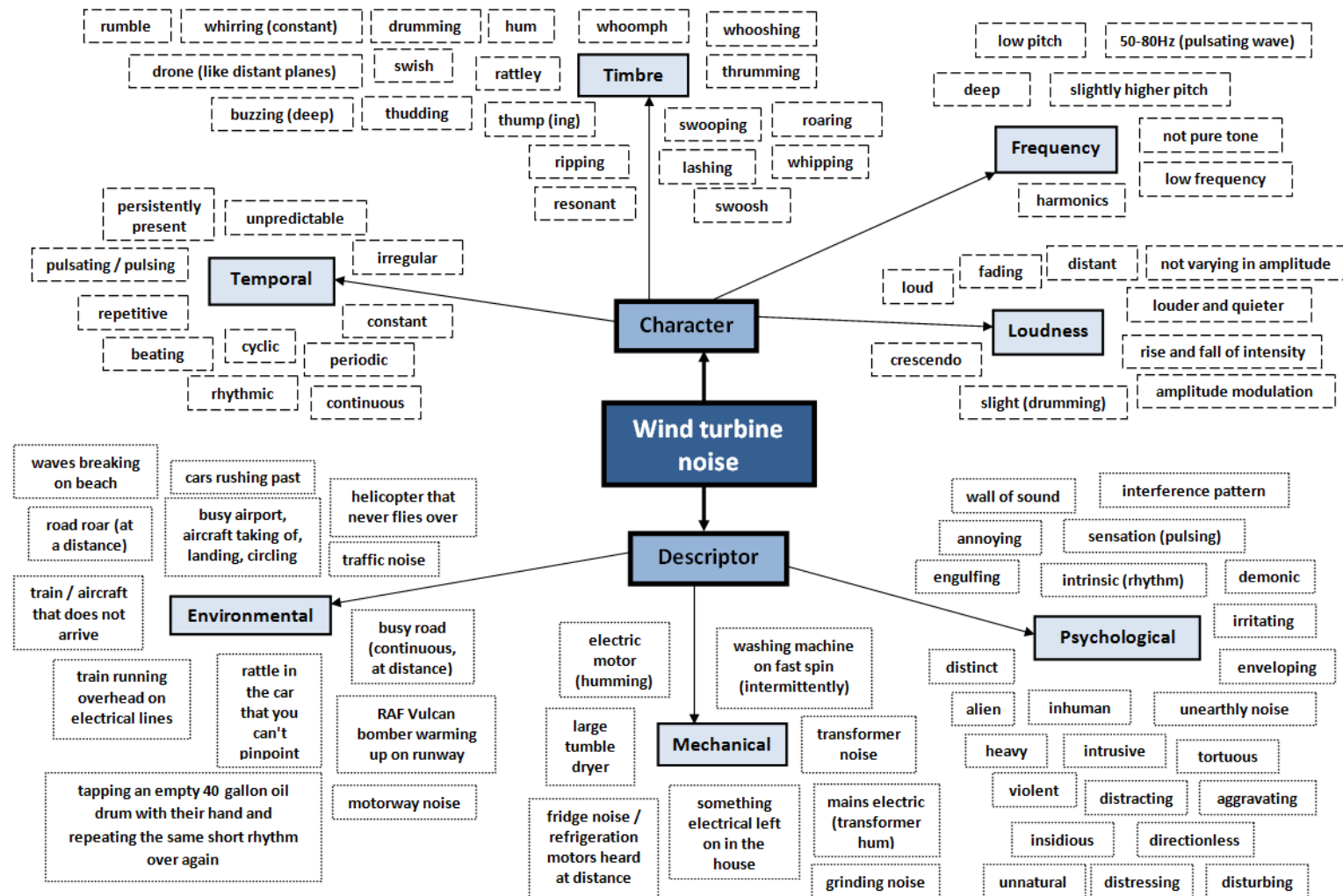
13th October 2015

## What is the problem?

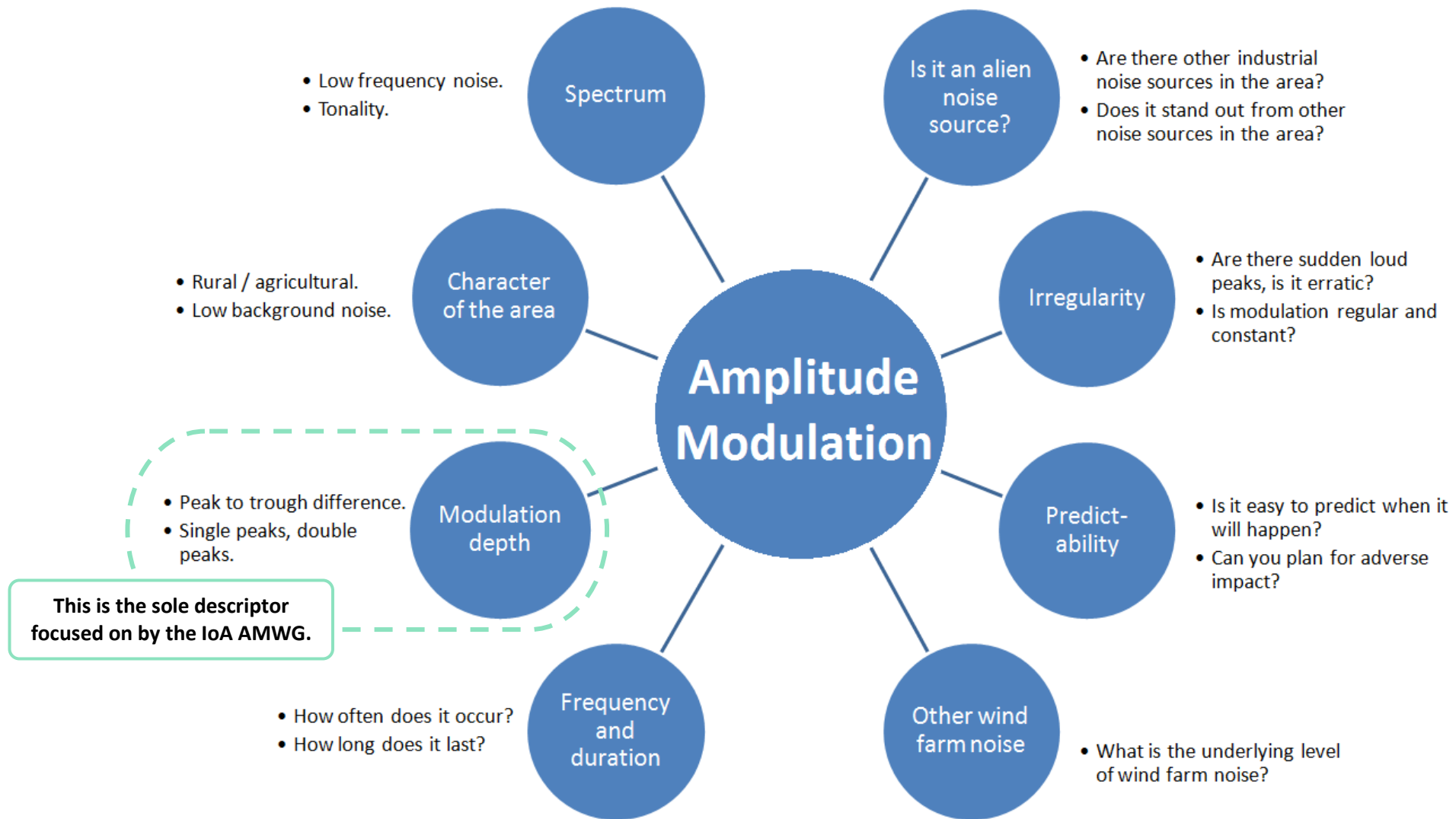
Noise complaints from wind farms are primarily related to amplitude modulation noise. This is commonly described as a 'whoomp', 'swish' or 'beating' type noise. Other common sources of noise, e.g. road traffic, may be louder but are generally perceived and considered benign, anonymous noises. It is the character of the noise that tends to make wind farm noise most intrusive. A recent Scottish study found that at 1-2km from the wind farm, 72% of those suffering audible noise strongly disliked the noise.



Wind farm noise and AM can be described in a variety of ways. This makes the problem of AM more difficult to identify and it can often be missed by those investigating noise complaints if residents' descriptions of the noise do not match those that the investigator considers relate to AM. The diagram below collates some of the ways in which wind farm noise and AM has been described to us.



Whilst AM is a distinct feature of wind farm noise, AM itself has many different aspects that contribute to its overall characteristic and its impact.





## Symptoms - how are people affected?

There are many different effects of AM noise, typically these escalate from noise nuisance, through annoyance, discomfort, attitudinal and behavioural changes, to sleep disturbance and in the most extreme cases people abandoning their homes. There is 'severe' dislike of this noise by most people.

### Nuisance, attitudinal and behavioural changes.

- A resident who used to enjoy gardening now wears headphones and listens to music when she wants to be outside, she finds the beating noise of the turbine disturbing and entraining.
- "...the noise was quite prominent in our bedroom... until about 2am, this is with the windows on the lock, we would have had them open but it's considerably worse."

### Stress related responses to noise.

- "...it is almost frightening when everything else around you is so quiet, to hear this industrial, slightly surreal thudding and whooshing..."
- "...once you are tuned into the noise it becomes increasingly more of a problem (especially when trying to either get to sleep or get back to sleep)."

### Sleep disturbance

- "Good morning Councillors, I hope you all slept well. Many here in Kessingland did not..."
- "It was an early wake up this morning around 4am to be precise. The EAM woke my daughter around this time and when she is up the whole household is up too. She has rearranged her bedroom with the bed furthest away from the windows but still this doesn't stop the EAM from affecting her."
- "I was lying there listening to it until 4am ish, needless to say I was extremely tired at work on Wednesday!"

### Abandon homes

- "We abandoned our home. We rent a house about five miles away — this is our fourth Christmas out of our own home. We couldn't sleep. It is torture — my GP describes it as torture. Three hours of sleep a night is torture."

## Why is it a problem?

Wind farms are commonly built in rural areas where background noise levels are very low, commonly around 18-25dB(A) at night time. Wind farm noise is perceived as more annoying than other noise sources of an equivalent loudness.

ETSU-R-97 limits do not protect and do not include any assessment of amplitude modulation noise.

There has been consistent denial for many years by the wind industry and those working for the wind industry that AM is a problem. They claim that if AM does occur it is only very rarely and for the minority of the time.

Noise measurements are primarily made external to dwellings but the majority of complaints relate to impact inside the dwelling, bedrooms etc. There is a noticeable difference between external and internal wind farm noise, internal noise often contains more dominant low frequency noise.

Problems are commonly dismissed as trivial by the majority who live in larger agglomerations and who are often exposed to higher levels of noise. This misses the impact of noise in relation to noise character and character of the area. Countryside and urban dwellers make different sacrifices, neither should suffer unreasonably or disproportionately.

"My retirement fund was my property  
....now made worthless."

"We did not pay to live in the peace of the  
countryside to hear your turbines ruin it!"

## What is the extent of the problem?

There are over 70 wind farms in the UK that we (MAS) are aware of as causing complaints. This is the experience of a small UK consultancy and it is likely that there are many more that we are not aware of. It tends to be a minorities problem, i.e. those living in rural areas or small rural communities and generally up to 2km from a wind farm.

The incidence of complaints from wind farm noise is low, why?

- **People rarely complain.** "15-25% of people identified as 'highly annoyed' by noise in social surveys are estimated to complain... the number of inhabitants in a community exposed to noise affects the number of complaints – and probably the importance attached to them by local authorities." (WHO, 2000, p.a12).
- **Stigma attached to those who complain.** "...remembering that objectors are far more ruthless than developers in their use/misuse of facts!" Dr Geoff Leventhall correspondence with IoA NWG 2006.
- **People don't think anything will happen.** The CIEH Survey of Local Authority Noise Enforcement Activity (2013) found that only approximately 6% of all noise complaints resulted in any action, either serving a notice, commencement of prosecution or some other remedy.
- **Fear over house prices.** "The Central Bedfordshire EHO said a complainant withdrew their complaint when it was realised that it may impact on any future sale of their property." (INWG WP3.1)
- **There is nothing that they can do.** Once it becomes a problem many are trapped as they suffer the noise but cannot sell their house. E.g. a wind farm in Scotland causes noise disturbance to a nearby resident, the EHOs say there is not a problem, she wants to move but cannot sell the house.

→ **Complaint fatigue (learned helplessness - people give up).** Noise complaints from a wind farm in Durham were made over 2 years ago. Noise measurements were undertaken by the local authority in 2013, but still nothing has been done to resolve the noise. Noise from two turbines at Kessingland caused complaints from nearby residents, who were told by the local authority that although the noise was a statutory nuisance there was nothing that they could do to help.

High Sharpley  
Wind Farm,  
Seaham Co  
Durham

"It is like a tumble dryer – a heavy, dense noise. "They will wake you up and you won't be able to get back to sleep."

Durham County Council said  
"Our investigations found that no noise or light effect from the turbines constituted a statutory nuisance and, therefore, we are unable to take any further action."

Cotton Farm  
Wind Farm,  
Cams

" This is getting beyond a joke 2 years have passed and little or nothing has been done."

" The email complaints continue without any response that the issues are to be resolved, as far as I am aware. It seems to me the XXDC and XDC are doing little to protect us, especially concerning in the circumstances when some of the complaints are for loss of sleep which is having a detrimental affect on work the next day."



## Is it just a UK problem?

There is substantial international evidence that AM exists and is a serious problem including:

**New Zealand:** introduced a wind farm standard in 2010 that includes the need to assess AM with stringent but simplistic controls.

**New South Wales:** draft planning guidelines include assessment of special audible characteristics including AM with simplistic controls.

**Japanese Government:** funded large research project from 2010 - 2013 sponsored by the Ministry of the Environment. Included field measurements and social surveys around 34 wind farms in Japan. They describe AM as "generally contained in wind turbine noise and it causes serious annoyance".

**Canadian Government:** sponsored Health Canada's \$2.1 million study on community noise and health.

**Australian Senate:** have established a Select Committee on Wind Turbines to investigate and report on the impact of turbines. Interim report includes recommendations to:

- Establish a *National Wind Farm Ombudsman* to handle complaints from concerned community residents about the operations of wind turbine facilities.
- Impose a levy on wind turbine operators accredited to receive renewable energy certificates to fund the costs of the *Independent Expert Scientific Committee on Industrial Sound*—including the funding of additional research—and the costs of a National Wind Farm Ombudsman.
- Make the data collected by wind turbine operators relating to wind speed, basic operation statistics including operating hours and noise monitoring freely and publicly available on a regular basis.
- Establish a National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure (NEPM).

## Australian Senate Select Committee on Wind Turbines.

**Fraud and corruption in the power generation industry.** Senator John Madigan's speech to the Australian Senate. 16 September 2015 [extracts].

Mr President, wind farm operators have found a far less expensive and simple process to game the system. They employ compliant “experts.”

There’s no doubt that MDA’s commercial arrangements with both Acciona and Pacific Hydro adversely affected the independence of reports and the legitimacy of conclusions... **There must be arm’s length relationships between acousticians and windfarm operators.**

While Acciona and Pacific Hydro were busy breaching their permits to maximise their profits, residents were and still are often exposed to horrendously excessive noise... **With callous indifference, the Victorian government has consistently failed in its duty of care to these people.**

In submission 456, Sonia Trist explains how officers from the Victorian Planning Department admitted noise limits are exceeded at her home, one apologising that: “The Department adjusts information to obtain the required results.” In June 2014, this retiring officer called me and later sent me an email, blowing-the-whistle on his department:

*"There is so much more to convey and I am sorry that I cannot do so now. **Department incompetence and indifference is the primary reason for the current situation.** I found it hard to find the truth, working inside, so it must be hard for your side. On “my side” are those exposed to excessive and harmful, sleep destroying, audible noise emissions at levels that exceed noise standards and breach permits. Those not on my side include complicit regulators, wilfully blind health bodies, greedy operators who put corporate profits before country people. And neither are crooked acousticians flaunting a fraudulent reporting formula, that concludes compliance when there isn’t."*

**This industry demands root and branch regulatory reform.**

In my opinion the greed and scientific half truths from the wind industry will be seen by history as one of the worst corporate and government abuses of democracy in the 21st century. **The wind industry's strategies of denial, obfuscation, sustained personal attacks on professionals advising of the problems and ridicule of those who are suffering followed by buy outs with gagging clauses must be exposed for the ruse that it is.**

Dr Bruce Rapley - Principal Consultant, Acoustics and Human Health, Atkinson & Rapley Consulting Ltd

Views given to Senate Select Committee on Wind Turbines in June 2015.

<http://www.johnmadigan.com.au/speeches/2015/9/16/fraud-and-corruption-in-the-wind-industry>

<https://www.youtube.com/watch?v=hu3Zv90j-DU>

## **What has happened and what is going on in the UK?**

In the UK issues surrounding AM were recognised and discussed back in 2006. It was recognised by the 2006 noise working group that audible AM required additional consideration. Since then most have denied AM is a problem and / or claimed that it is too rare to warrant consideration or investigation. Those in the UK who previously denied AM was a problem do now appear to be recognising the seriousness of the issue, Dr Geoff Leventhall (a member of the IoA AMWG and previously on the 2006 noise working group) has recently reported to the Australian Senate Hearing that amplitude modulation is, in his opinion, the biggest issue with wind farm noise.

## **Current Situation in the UK**

The Institute of Acoustics (IoA) has formed a working group on amplitude modulation (AMWG) to derive a metric for AM. The IoA are looking only at the modulation depth of AM and not the other contributory factors identified on page 4 above. The scope of the IoA AMWG is limited to deriving a metric, i.e. a number or value, to describe AM and does not extend to how this should be used to determine acceptability of AM or how this might be used to control AM at the planning stage (noise condition).

The IoA AMWG is largely drawn from the historical noise working group from 2006. The chronology of this is considered on page 12.

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## The IoA AMWG AM metric

The IoA AMWG released a consultation document describing their proposed AM metrics at the end of April 2015. This was subject to consultation with a final deadline for responses of 7th July 2015. The preference of the IoA AMWG is to have proprietary software that can be run to automatically assess AM.

MAS have undertaken extensive testing of the proposed AM metrics as part of this consultation process and found that:

- The proposed metrics are subject to significant flaws.
- The methods consistently underestimate AM modulation depth, methods 2 and 3 are often less than half of the true modulation depth.
- The metrics do not recognise AM when there is AM (false negatives).
- The metrics identify AM when there is not AM (false positives).
- AM metrics do not relate to subjective impact

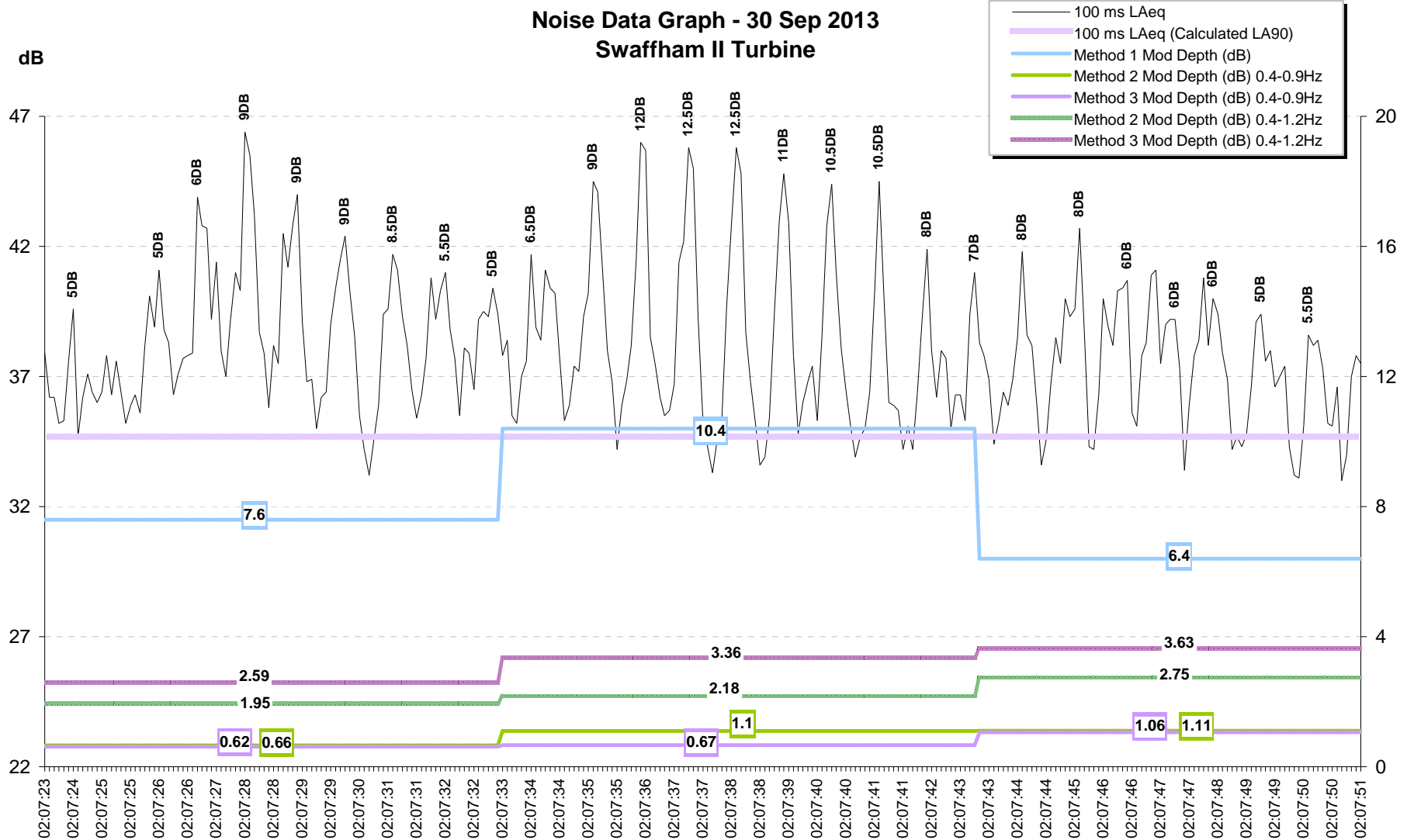
There is already a lot of scepticism from local communities regarding the IoA approach. The evidence is that AM will not be classed as a problem if the IoA metrics are used. There will be a lot of anger from local communities if the situation continues as present with a lack of recognition of AM issues and a lack of means to rectify these issues.

A basic analysis of the time trace (noise level vs time) is far simpler and far more informative of the different aspects that contribute to the overall characteristic and impact of AM than the automated methods proposed by the IoA AMWG. The IoA AMWG only consider the modulation depth and not, for example, how the AM varies with time.

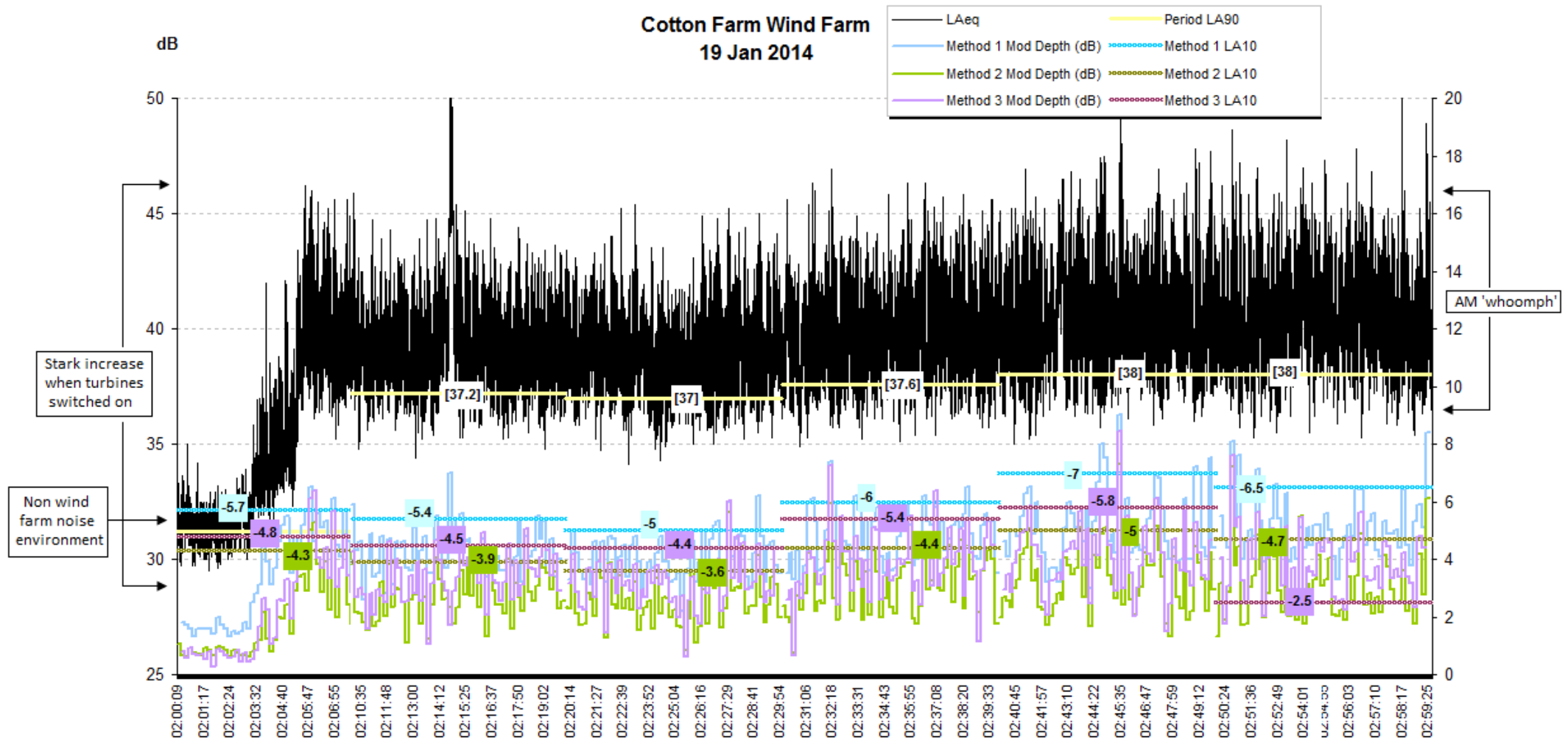
**Out of a total of 20 responses to the consultation document at least 6 have raised serious concerns with the IoA preferred FFT approach and have confirmed preference for a time domain based approach to AM assessment.**



Example of IoA AMWG proposed metrics rating of AM generated by Swaffham II turbine. Despite AM modulating by up to 12-13dB(A) the IoA preferred methods (methods 2 and 3) rate this AM only between 0.6 and 3.6.



Example of failure of IoA AMWG proposed metrics rating of AM at Cotton Farm Wind Farm. If a 5dB penalty was applied to the ETSU-R-97 minimum night time noise limit (43dB LA90), which was proposed by Renewable UK and is the clear preferred approach of the IoA, this impact would be considered acceptable, i.e. no change in the situation / placebo control.



## What is the alternative?

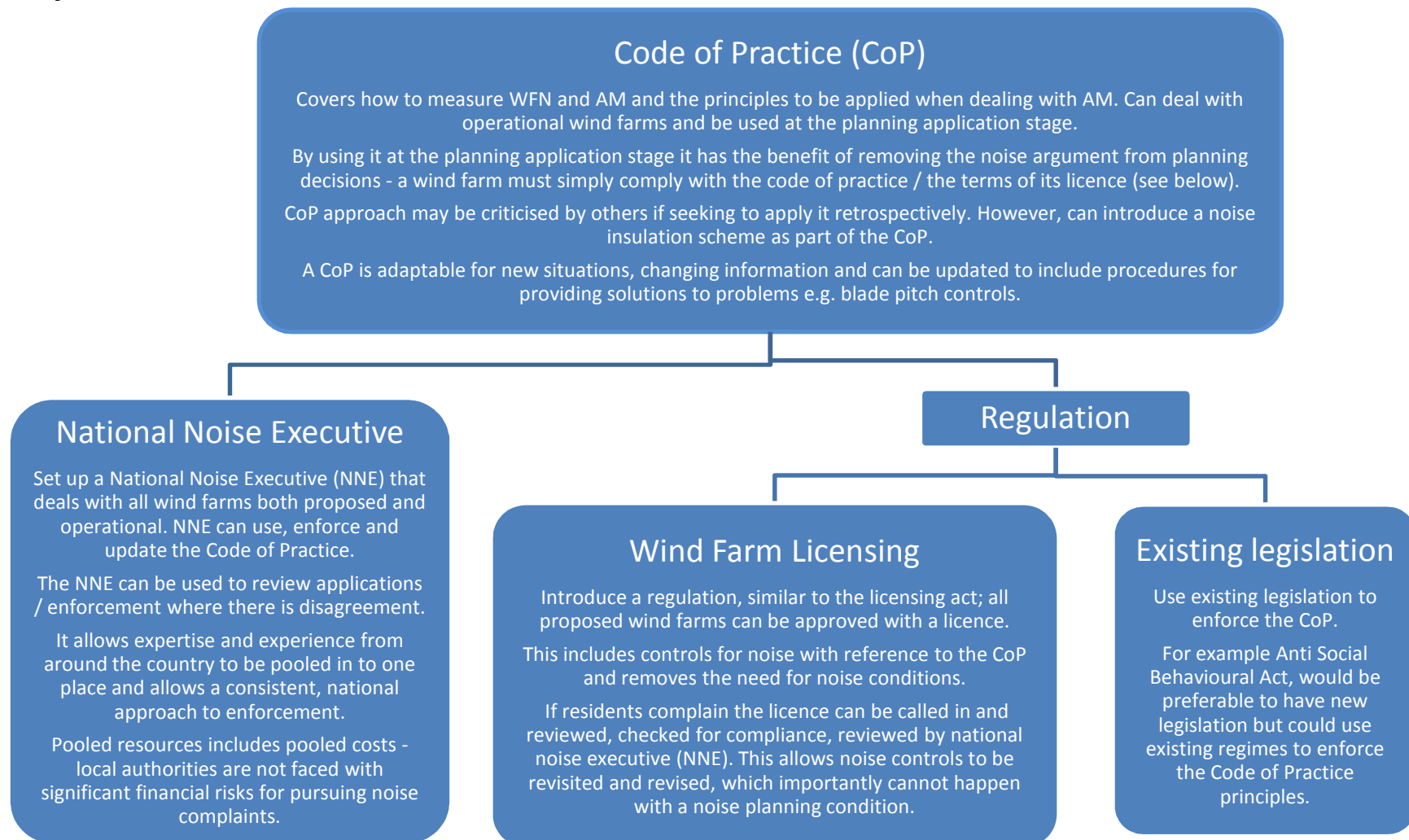
A noise control for AM is needed, but there are problems with achieving this solely by way of a noise condition.

- A condition only deals with wind farms in the planning process - what about existing complaints?
- What if the proposed AM condition does not actually enforce AM that is causing significant adverse impact? There is no scope to change a planning condition.
- What about other aspects of AM, for example low frequency noise? If this emerges as an additional problem it cannot be retrospectively adopted in to the planning control.
- There is already a lack of willingness to enforce noise conditions on wind farms e.g. Cotton Farm, 2 years down the line nothing happened, others much longer.
- There is no duty to enforce a planning condition.
- If enforcement action is taken the process is difficult and time consuming - open to procrastination.

The evidence so far is that the IoA approach is limited and will not stop the problem. What is needed is something that is adaptable, open to change and covers the broader issues of impact, e.g. in the same way waste sites are subject to variable licenses and the Licensing Act 2003 introduced licence reviews for music venues.

Whatever the solution someone has to make a judgement on what is or is not acceptable AM. There is an unwillingness to accept current approaches to AM assessment used to date. The best way to move forward is to have a national document which sets out the guiding principles of how to make that assessment: **Code of Practice.**

## The way forward



**NOTE:** Forming a NNE has potential to save substantial local administration costs by removing noise issues of national significance from local authorities. The savings could fund a national noise insulation scheme.

**Find out more:** <http://www.masenv.co.uk/windfarms>

**See and listen to the latest noise from Cotton Farm Wind Farm:** [http://www.masenv.co.uk/~remote\\_data/plot.php](http://www.masenv.co.uk/~remote_data/plot.php)

**Listen to more examples of wind farm noise:**

- Knabs Ridge Wind Farm, Harrogate: [http://www.masenv.co.uk/dBGraph/Knabbs\\_Ridge](http://www.masenv.co.uk/dBGraph/Knabbs_Ridge)
- Kessingland Wind Farm, Suffolk: <http://www.masenv.co.uk/dBGraph/Kessingland>
- Kessingland - internal, windows shut: [http://www.masenv.co.uk/dBGraph/Kessingland\\_3](http://www.masenv.co.uk/dBGraph/Kessingland_3)
- Delabole Wind Farm, North Cornwall: <http://www.masenv.co.uk/dBGraph/Delabole>
- Wadlow Wind Farm, East Cambridgeshire: <http://www.masenv.co.uk/dBGraph/Wadlow>
- Site D - comparison of turbines on and turbines off: [http://www.masenv.co.uk/dBGraph/Site\\_D](http://www.masenv.co.uk/dBGraph/Site_D)

