STATEMENT OF FACT

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Background

1.

Within the context of the proposed Arecleoch S36 wind power plant extension, it has been brought to my attention that misleading assertions have been made regarding the toxic effect of infrasound exposure, as well as, the work that I and my colleagues have been conducting over the past 30 years. With this Statement of Fact, it is my intention to clarify these misconceptions that have (willfully?) been put before the Reporters of this Planning Inquiry.

2.

I hold a Bachelor's degree in Physics from the State University of New York (1995) and a Master's degree in Biomedical Engineering from Drexel University in Philadelphia (2000). My Doctoral degree in Environmental Sciences from the Nova University of Lisbon (2010) quantified infrasound and low frequency noise (ILFN) within public transportations systems in order to determine how much exposure exists among the general population (within the context of Public Health) and among the operators of the vehicles (within the context of Safety & Health in the Workplace). In Appendix, please find my *curriculum vitae*.

3.

The specific assertion in question is as follows:

> "Ms Crosthwaite cites the theories of Mariana Alves-Pereira on "Vibro-acoustic disease" but these have been widely discredited. A 2010 review by the UK Health Protection Agency [CD11.1] on Health Effects of Exposure to Ultrasound and Infrasound noted that:
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> *One group has suggested that long-term occupational exposure to large pressure amplitude and low frequency noise may cause a diverse pathology, termed vibroacoustic disease (VAD), that is claimed to involve neurological, respiratory and cardiovascular disturbances. While those working in very high levels of audible noise may suffer some adverse consequences, and the prolonged use of hand-held vibrating tools may cause ill-health, there is no evidence that infrasound at levels normally encountered in the environment will lead to the development of VAD. Further, this disease itself has not gained clinical recognition. The few other case studies are not particularly informative regarding risks to health. Overall, there is a paucity of useful information regarding the potential of infrasound to cause health effects."*
>
> (Arecleoch Statement of Case, Hoare Lea, Paragraph 10)

Clarification of Scientific Issues

4.
With these (and other) assertions, the Reporters of this Planning Inquiry are being asked to believe that:

a) ILFN is only a wind-turbine related problem;

b) The ILFN emitted by wind–turbines is comparable to that existent in the natural environment;

c) Any acoustic phenomena occurring below the classical-established human hearing threshold is not harmful, i.e., "what you can't hear won't hurt you."

5.
The Russian Federation has established permissible exposure levels for infrasound since the 1970's. Figure 1 shows the numerical values limiting infrasound exposure for occupational and residential settings.

Premise	Sound pressure levels, dB, in octaval bands of averaged geometric frequencies, Hz				General sound pressure level dB "Lin"
	2	4	8	16	
Different jobs inside industrial premises and production areas:					
- Different physical intensity jobs	100	95	90	85	100
- Different intellectual emotional tension jobs	95	90	85	80	95
Populated area	90	85	80	75	90
Living and public premises	75	70	65	60	75

Figure 1. Permissible exposure levels for infrasound as per legislation of the Russian Federation. Note the different specified locations (occupational vs. general public), the segmentation of the acoustical spectrum into 2 Hz, 4 Hz, 8 Hz and 16 Hz, and the expression of these numerical values in dB Linear (as opposed to dBA).[1]

It is true that the values of the levels of infrasound in Figure 1 are, in general (but not always), larger than the levels produced by wind turbines at these frequencies.

The point, however, is to show that infrasound has been considered an agent of disease, requiring specific limits in order to protect workers and the general population.

[1] Stepanov V. (2000) Biological Effects of Low Frequency Acoustic Oscillations and their Hygienic Regulation. State Research Center of Russia: Moscow. https://apps.dtic.mil/dtic/tr/fulltext/u2/a423963.pdf

ILFN *is not* merely a wind-turbine problem and has been an issue for Public Health and Occupational Health for several decades.

6.

The idea that the type of infrasound emitted by wind turbines is in any way comparable to that existent in the natural environment is, simply put, wishful thinking.

Wind turbines emit *pulses* of acoustic energy – it is not a sporadic or continuous tonal emission.

The time interval between these *pulses* mathematically matches the wind turbine blade pass frequency.

The sound-pressure-level of these pulses is frequently seen as 10 dB or more over the background noise.

The steady mechanical nature of these pulses and their specific time-profile attributes *scientifically precludes* them from being considered as comparable to natural phenomena. This fact should be known by any acoustician working with wind power plants.

7.

The scientifically indefensible assertion "*what you can't hear won't hurt you,*" is a common theme among certain circles. This is not true, just as "*what you can't see won't hurt you"* is also not true.

Nevertheless, this is a long-standing notion that stems from the work conducted in the 1920's for the development of the telephone.

The 1978 experiment carried out by French scientists using *genetically-deaf mice*, clearly showed that infrasound exposure had a deleterious effect on performance of the *deaf* mice[2], i.e., physiological damage *was not* being imparted through the auditory system.

To the chagrin of many classical acousticians, acoustical phenomena *do not* only impact biological organisms through the auditory system.

Further emphasizing this fact are the studies being carried out by Chinese scientists where fine bio-molecular pathways are being studied in order to counteract the deleterious effects of infrasound exposure in military personnel. Here are a few examples of the titles of their studies:

- Infrasound-induced hemodynamics, ultrastructure, and molecular changes in the rat myocardium. (2007)[3]

[2] Busnel RG, Lehmann AG. (1978) Infrasound and sound: Differentiation of their psychophysiological effects through use of genetically deaf animals. Journal of the Acoustical Society of America, 63:974-77.

- Involvement of microglial cells in infrasonic noise-induced stress via upregulated expression of corticotrophin releasing hormone type 1 receptor. (2010)[4]

- Glial cell-expressed mechanosensitive channel TRPV4 mediates infrasound-induced neuronal impairment. (2013) [5]

- Damage to hippocampus of rats after being exposed to infrasound. (2016)[6]

- Inhibitive effects of FGF2/ FGFR1 pathway on astrocyte-mediated inflammation *in vivo* and *in vitro* after infrasound exposure. (2018)[7]

8.

How could it be that noise-exposed workers and families living in the vicinity of wind turbines develop the same pathology?

It is true that the infrasound levels quantified within the homes in the vicinity of wind turbines are lower than the levels found in the workplace.

But this is where the academic biological background (i.e., knowledge of cells, tissues and organs and, indeed, Medical Sciences) becomes important, and is oftentimes lacking among classical acousticians.

The ***time of exposure*** is critical for the development of pathology. The human body is resilient and tends to heal after most types of physical aggression. Consider, for example, the boxer, who fights for 15 rounds, after which s/he is removed from the ring. A respite is given to the body so that, after healing, the same boxer is ready for another competition.

ILFN exposure in homes located near wind turbines can occur *without respite*, for weeks at a time, unlike workers who have the benefit of a daily respite when they go home from their work-shift.

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[3] Pei Z, Sang H, Li R, Xiao P, He J, Zhuang Z, et al. Infrasound-induced hemodynamics, ultrastructure, and molecular changes in the rat myocardium. Environmental Toxicology. 2007;**22**:169-175. DOI: 10.1002/tox.20244

[4] Du F, Yin L, Shi M, Cheng H, Xu X, Liu Z, et al. Involvement of microglial cells in infrasonic noise-inducedstress via upregulated expression of corticotrophin releasing hormone type 1 receptor. Neuroscience. 2010;**167**:909-919. DOI: 10.1016/j. neuroscience.2010.02.060

[5] Shi M, Du F, Liu Y, Li L, Cai J, Zhang GF, et al. Glial cell-expressed mechanosensitive channel TRPV4 mediates infrasound-induced neuronal impairment. Acta Neuropathologica. 2013;126:725-739. DOI: 10.1007/ s00401-013-1166-x

[6] Zhang MY, Chen C, Xie XJ, Xu SL, Guo GZ, Wang J. Damage to hippocampus of rats after being exposed to infrasound. Biomedical and Environmental Sciences. 2016;**29**: 435-442. DOI: 10.3967/bes2016.056

[7] Shi YJ, Shi M, Xiao LJ, Li L, Zou LH, Li CY, et al. Inhibitive effects of FGF2/ FGFR1 pathway on astrocyte-mediated inflammation in vivo and in vitro after infrasound exposure. Frontiers in Neuroscience. 2018;**12**:582. DOI: 10.3389/fnins.2018.00582

In homes located near wind turbines, the time over which humans are exposed to pulsed infrasound (a physical aggression) can be extensive – much longer than the exposure of workers, who usually end their workday after an 8-hour shift, thus removing themselves from the toxic environment.

Hence, the levels of infrasound in these contaminated homes are indeed lower than the levels encountered in the workplace, but the time over which exposure occurs is ***much longer*** than in the workplace. And, more worrisome in terms of clinical outcomes, residential exposure to infrasound includes the periods of sleep – families are exposed to a toxic agent of disease while they are sleeping *and* while they are awake in the home.

Clarification of Other Issues, as Raised in **Arecleoch Statement of Case, Hoare Lea, Paragraph 10**

9.
"… but these [my purported theories on vibroacoustic disease] have been widely discredited…"

(Arecleoch Statement of Case, Hoare Lea, Paragraph 10)

Where? By whom?

I am unaware of any scientific papers "widely discrediting" my work on the biological response to ILFN exposure.

10.
Quote from the UK Health Protection Agency "…Overall, there is a paucity of useful information regarding the potential of infrasound to cause health effects."

(Arecleoch Statement of Case, Hoare Lea, Paragraph 10)

This is absolutely true! There is no interest in this topic by the governmental agencies responsible for Public Health and, as a direct consequence, there is no available funding to conduct independent, in-depth and scientifically-valid studies on the matter.

Conclusion

11.
Based on the documents presented to me, it is my opinion that important issues associated with Public Health and the acoustic emissions from wind turbines are being (willfully?) obfuscated from the Reporters of this Planning Inquiry.