

Haste Makes Waste

**An Analysis of the
National Health and Medical Research Council
“Wind Turbines and Health
A Rapid Review of the Evidence
July 2010”**

**Prepared by
The Society for Wind Vigilance**

www.windvigilance.com

July 19, 2010

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NOTICE TO READER

The Society for Wind Vigilance is an international federation of physicians, engineers and other professionals promoting the development of authoritative wind turbine guidelines to protect the health and safety of communities. The mission of The Society for Wind Vigilance is to mitigate the risk of both physiological and psychological adverse health effects through the advancement of independent third party research and its application to the siting of industrial wind turbines.

The Society for Wind Vigilance uses authoritative references to support the assertions contained within this analysis. This analysis also contains statements and citations from individuals and or organizations associated with the wind energy industry.

Many of the citations used in this analysis are from references contained in National Health and Medical Research Council “Wind Turbines and Health A Rapid Review of the Evidence July 2010” (Rapid Review).

The Society for Wind Vigilance has contacted the National Health and Medical Research Council to obtain additional information related to the “Rapid Review”. Additional information has been included in this analysis.

The Society for Wind Vigilance has made every reasonable attempt to ensure the accuracy of this analysis. Any errors or omissions contained within this analysis are unintentional.

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EXECUTIVE SUMMARY

In July 2010 the National Health and Medical Research Council (NHMRC) released its 11 page report entitled “Wind Turbines and Health A Rapid Review of the Evidence July 2010” (Rapid Review).

The Society for Wind Vigilance (SWV) has conducted an analysis of the “Rapid Review”. Details of the analysis are included in Tables 1 to 6 of this document.

The “Rapid Review” is an incomplete literature review with no original research. The report is biased from the outset as it seeks to support a restricted and preconceived conclusion. The end result is a deficient public health document.

NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations.” ¹ The contents of the “Rapid Review” reveal a different reality. The list of reference omissions is immense.

The “Rapid Review” places an inappropriate level of credence in wind energy industry produced and or sponsored material to support its assertions. To compound this bias the “Rapid Review” selectively cites references which favour the wind energy industry while inexplicitly omitting relevant citations which do not.

For example the “Rapid Review” repetitively cites a wind energy association sponsored literature review but neglects to disclose this reference states wind turbine noise, including low frequency noise, may cause annoyance, stress and sleep disturbance. Acknowledged symptoms include distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, tinnitus and tension. ²

In a Public Statement the NHMRC contradicts these acknowledgements by stating “While a range of effects such as annoyance, anxiety, hearing loss, and interference with sleep, speech and learning have been reported anecdotally, there is no published scientific evidence to support adverse effects of wind turbines on health.” ³

The vetting and quality of material cited in the “Rapid Review” is at best suspect and at times ridiculous. The “Rapid Review” embraces the ranting opinions contained on “croakey the Crikey health blog” ⁴ while enigmatically challenging the World Health Organization authoritative position that annoyance is an adverse health effect – astounding.

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The “Rapid Review” is characterized by persistent allusions that people experience adverse health effects due to “attitude”, “negative opinions” and “worry”. These speculative theories are presented while ignoring authoritative knowledge on the subject of noise and health.

Ironically the NHMRC affirms the need for research recommending “...relevant authorities take a precautionary approach and continue to monitor research outcomes” ⁵ but makes no direct appeal for such an undertaking.

The Society for Wind Vigilance does concur with the “Rapid Review” on one point – the title of the report. The sub-standard quality of research confirms the review is rushed and hence the title “Rapid Review” is undeniably appropriate. The “Rapid Review” confirms the adage that haste makes waste.

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PRINCIPLE FINDINGS

The Rapid Review is a biased document fraught with contradictions and misinformation:

Specifically the Rapid Review

- is not a study: it is an incomplete literature review.
- is biased with a limited scope.
- displays selective bias in the presentation of the referenced material.
- displays selective bias by omission of relevant references including recent research on issues related to noise and health.
- contains statements which contradict listed and cited references.
- contains misleading statements.
- contains statements without appropriate authoritative references.
- exhibits a deficient understanding of the authoritative research on noise and health.

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CONCLUSIONS

1. The “Rapid Review” is a literature review with no original research.
2. The Society for Wind Vigilance expresses both its surprise and disappointment with the quality of the “Rapid Review”.
3. There are a number of errors of commission and omission.
4. The vetting and quality of material cited in the “Rapid Review” is at best suspect and at time ridiculous.
5. Crucial evidence gaps remain unaddressed.
6. The document is neither authoritative nor credible and does little to advance the understanding of the issue of industrial wind turbines and adverse health effects.
7. The NHMRC governing body ought to be concerned about the quality and bias of “Rapid Review”.
8. The reality of global reports of adverse health effects has not been addressed. The victims deserve consideration not denial.
9. Independent third party studies must be undertaken to establish the incidence and prevalence of adverse health effects relating to wind turbines. Beyond that a deeper understanding of the potential mechanisms for the impacts must be elucidated in order to define the mechanisms by which the sleep disturbance, stress and psychological distress occur.

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DETAILED ANALYSIS

The summary and related points cover a broad spectrum of claims. For convenience the remainder of the analysis and critique is done in a tabulated format of point - counter point. The volume of material necessitated this approach and hopefully will enhance the clarity of the critique being put forward.

The method utilized was to excerpt each of the claims and place it in the context of authoritative and contrary information. In addition an effort has been made to identify the errors of omission as well as those of commission.

The analysis is presented in 6 tables grouped by topic:

Table 1 - Analysis of Rapid Review Section: A Rapid Review of the Evidence

Table 2 - Analysis of Rapid Review Section: Sound and Noise from Wind Turbines

Table 3 - Analysis of Rapid Review Section: Effects of Noise from Wind Turbines on Human Health

Table 4 - Analysis of Rapid Review Section: Effects of Shadow Flicker and Blade Glint on Human Health

Table 5 - Analysis of Rapid Review Section: Measures to Mitigate Potential Impacts of Wind Turbines

Table 6 - Analysis of Rapid Review Section: Conclusion

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Reference	Table 1 Analysis of - Wind Turbines and Health - A Rapid Review of the Evidence Rapid Review contents in <i>italics</i> SWV Analysis in non italics
1	<p><i>Rapid Review statement (Wind Turbines and Health – A Rapid Review of the Evidence - page 2):</i></p> <p><i>“The purpose of this paper is to present findings from a rapid review of the evidence from current literature on the issue of wind turbines and potential impacts on human health. In particular the paper seeks to ascertain if the following statement can be supported by the evidence: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines. This statement is supported by the 2009 expert review commissioned by the American and Canadian Wind Energy Associations (Colby et al. 2009).”</i></p> <p>SWV analysis</p> <p>At the outset the “Rapid Review” is biased with a limited scope as defined by the statement:</p> <p style="padding-left: 40px;"><i>“In particular the paper seeks to ascertain if the following statement can be supported by the evidence: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.”</i></p> <p>The “Rapid Review” scope is not comprehensive as it merely seeks to support a restricted, biased and preconceived conclusion. The defined scope is inappropriate resulting in a deficient public health document.</p> <p>The “Rapid Review” ought to have conducted an objective review of the evidence to ascertain the plausibility and cause of the symptoms reported by humans exposed to industrial wind turbines.</p> <p>Wind turbines are a new source of community noise and there is limited published field data. ⁶ The “Rapid Review” ought to have explored</p>

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	<p>published research on the impacts of noise induced direct adverse health effects such as annoyance ^{7, 8} and sleep disturbance ⁹ as defined by authoritative bodies such as the World Health Organization.</p> <p>In an attempt to buttress its preconceived conclusion the “Rapid Review” has selectively cited the American Wind Energy Association and Canadian Wind Energy Association sponsored literature review entitled “Wind Turbine Sound and Health Effects” (A/CanWEA Panel Review).</p> <p>The “Rapid Review” ought to have exercised caution when relying on the findings of an industry sponsored research group. Experience has consistently demonstrated that reliance on industry convened and sponsored expertise is inappropriate when assessing health risks associated with an industry’s product. ^{10, 11, 12}</p> <p>On January 11, 2010 The Society for Wind Vigilance released a critique of the A/CanWEA Panel Review and concluded that it was “...neither authoritative nor convincing..” and “...independent third party studies must be undertaken establish the incidence and prevalence of adverse health effects relating to wind turbines. Beyond that a deeper understanding of the potential mechanisms for the impacts must be elucidated in order to define the mechanisms by which the sleep disturbance, stress and psychological distress occur.” ¹³</p> <p>On January 19, 2010 the NHS Knowledge Service released an independent critique of the A/CanWEA Panel Review and concluded “The link between psychological distress and physical symptoms has not been explored by this report. The acknowledgment that some people exposed to wind turbine noise suffer annoyance suggests that monitoring and maximum permitted levels need to be considered carefully in areas where turbines are planned. Overall, this review will probably not resolve this controversy as there was a lack of high-level evidence on which to base any solid conclusions. What is now needed are studies that compare</p>

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	<p>people exposed to turbine noise with well-matched control subjects who have not had that exposure... This review panel was commissioned by an industry group, and included a variety of academic perspectives, but not an epidemiologist. Someone with this specific skill set should be included when environmental health hazards are assessed...”¹⁴</p> <p>An epidemiologist review determined the A/CanWEA Panel Review “... exemplifies the lack of expertise in population health science. It is difficult to make this clear without seeming petty, but this section reads like it was written by someone who took a single class on how to understand epidemiology, and half understood the material... The dismissal of the evidence is sometimes so bald that it seems like parody. Colby et al. (section 4.1.2) go so far as to write “There is no evidence that sound at the levels from wind turbines as heard in residences will cause direct physiological effects. A small number of sensitive people, however, may be stressed by the sound and suffer sleep disturbances.” Even if the latter characterization did not comically understate the evidence, these authors, within the space of a two-sentence paragraph, claim there are no physiological effects but note that there are observed cases of turbines causing a physical problem.”¹⁵</p> <p>Sleep specialist Dr Christopher Hanning reviewed the A/CanWEA Panel Review and noted:</p> <p>“The quality and authority of this review and its conclusions are open to considerable doubt. The medical members of the panel comprised a microbiologist, an otolaryngologist and an occupational health physician specialising in respiratory disease. From their biographies, none seems to have any expertise in sleep medicine or in psychology. The reference list shows that the literature review was far from complete. The panel admits that wind turbine noise causes annoyance which can lead to sleep disturbance but dismisses these findings. It is clear that they did not understand the significance of “annoyance” in a health context and neither</p>

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	<p>did they comprehend the importance of sleep disturbance in causing ill health.”¹⁶</p> <p>With no scientific rationale the “Rapid Review” selected a limited scope to seek evidence to support the conclusion “<i>There are no direct pathological effects from wind farms...</i>”</p> <p>The A/CanWEA Panel Review also used the “direct effect” qualifier: however the</p> <p>“...word “direct”, which is really nonsense since additional intermediate steps can always be inserted into a causal pathway, so the word is inherently meaningless in this context. Whatever the authors thought was a sufficient rationalization, it is clear that they are making great effort to rationalize denying the obvious conclusion, that there is evidence of physiologic effects.”¹⁷</p> <p>The diversionary qualification of “direct” effects has no place in a respectable public health document.</p> <p>The “Rapid Review” never provides conclusive scientific evidence to support its conclusion.</p> <p>The A/CanWEA Panel Review acknowledges wind turbine noise, including low frequency noise, may cause annoyance, stress and sleep disturbance and as a result people may experience adverse physiological and psychological symptoms.¹⁸ Inexplicably the “Rapid Review” neglects mentioning this in the report.</p> <p>The acknowledgements contained in the A/CanWEA Panel Review confirm wind turbine noise can cause the “direct” adverse health of annoyance and sleep disturbance as recognized by the World Health Organization.</p>

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	<p>The “Rapid Review” closes its conclusion with the ambiguous statement “...<i>any potential impact on humans can be minimised by following existing planning guidelines.</i>”</p> <p>The “Rapid Review” does not specify which “<i>potential impact on humans</i>” it has identified nor does it provide specific scientifically proven guidelines which will ensure human protection from these adverse health effects.</p> <p>The World Health Organization states “In all cases, noise should be reduced to the lowest level achievable in a particular situation. Where there is a reasonable possibility that public health will be damaged, action should be taken to protect public health without awaiting full scientific proof.” ¹⁹</p> <p>The Environment Protection and Heritage Council states wind turbine noise “...limits should be set to protect the general noise amenity of noise-sensitive sites, and to prevent unreasonable annoyance or disturbance... <i>and...ensure that sleep is not disturbed...</i>” ²⁰</p> <p>The direct adverse health effects of wind turbine induced annoyance and sleep disturbance occur at common residential setbacks with sound levels of 30 to 45 dBA. ²¹ In order to ensure the protection of humans from these adverse health effects wind turbine noise limits should be less than 30 dBA.</p>

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2	<p><i>Rapid Review statement (Sound and Noise from Wind Turbines - page 2):</i></p> <p><i>“The perception of the noise is also influenced by the attitude of the hearer towards the sound source. This is sometimes called the nocebo effect, which is the opposite of the better known placebo effect.”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” provides no reference to associate human attitudes to wind turbine noise with a “nocebo” effect.</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations.”²² yet a key word search of “nocebo” in “Noise and Health Journal”,²³ World Health Organization’s “Guidelines for Community Noise” and “Night Noise Guidelines for Europe” yields no results.</p> <p>A key word search of “nocebo noise” in Pubmed yields no results which support the “Rapid Review” statement.²⁴</p> <p>A key word search of “nocebo” in peer reviewed literature on the subject of human response to wind turbine noise returns no results.^{25, 26, 27, 28, 29}</p> <p>The term “nocebo” has no relevance in the context of wind turbines.</p> <p>Currently it appears the only reference which refers to the “nocebo” effect in the context of wind turbine noise is the American Wind Energy Association and Canadian Wind Energy Association sponsored literature review entitled “Wind Turbine Sound and Health Effects”.</p> <p>This wind energy industry sponsored speculation does not withstand</p>

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	<p>scrutiny.</p> <p>Phillips notes that “Colby et al. discuss this at length, labeling it a “placebo” effect (and adding the silly neologism “nocebo effect”). Such labeling does not make the health effects any less real or devastating...”³⁰</p>
3	<p><i>Rapid Review statement (Sound and Noise from Wind Turbines - page 2):</i></p> <p><i>“If people have been preconditioned to hold negative opinions about a noise source, they are more likely to be affected by it (AusWEA, 2004).”</i></p> <p>SWV analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations.”³¹ yet the “Rapid Review” has cited a 2004 fact sheet and attributes the document to the Australian Wind Energy Association. There is no reference cited in the fact sheet to support this unsubstantiated statement.³²</p> <p>See discussion in SWV Analysis Table 2 Reference 4.</p>
4	<p><i>Rapid Review statement (Sound and Noise from Wind Turbines - page 3):</i></p> <p><i>“As well as the general audible range of sound emissions, wind turbines also produce noise that includes a range of Special Audible Characteristics (SACs) such as amplitude modulation, impulsivity, low frequency noise and tonality (EPHC, 2009).”</i></p>

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	<p>SWV analysis</p> <p>The “Rapid Review” neglected to discuss the risk to human health associated with these special audible characteristics.</p> <p>For example World Health Organization states “The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time... Stronger reactions have been observed when noise is accompanied by vibrations and contains low frequency components, or when the noise contains impulses, such as with shooting noise.” ³³</p> <p>The Health Council of the Netherlands identified “...a number of forms of noise that may have a particularly pronounced effect on people exposed to them:</p> <ul style="list-style-type: none"> • Noise characterised by low-pitch components (buzzing) • Noise consisting entirely of one or more low buzzing sounds (low-frequency noise) • Tonal noise • Noise events characterised by a rapid increase in intensity at the beginning (impulse noise) • Industrial noise • Noise characterised by sporadic high LAmax or SEL values.” ³⁴ <p>Wind turbines are unique in that they produce most if not all of the above special audible characteristics.</p> <p>Another problematic special audible characteristic of wind turbine noise is that unlike other forms of noise it does not abate at night. ³⁵ The “Rapid Review” neglects to mention this special audible characteristic of wind turbine noise.</p> <p>See discussion on wind turbine low frequency noise and infrasound in</p>

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	SWV Analysis Table 3 Reference 12.
5	<p><i>Rapid Review statement (Sound and Noise from Wind Turbines - page 3):</i></p> <p><i>“Macintosh and Downie (2006) conclude that based on these figures “noise pollution generated by wind turbines is negligible”.</i></p> <p>SWV analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations” ³⁶ yet the “Rapid Review” cites a reference which is neither current nor thorough.</p> <p>The authors of the reference cited do not appear to be knowledgeable on noise and health related issues. The reference cited uses a simplistic approach to assess noise exposure limits solely based on sound pressure levels. The reference cited does not consider special audible characteristics of wind turbine noise.</p> <p>See discussion in SWV Analysis Table 2 Reference 4.</p> <p>The reference cited does not consider peer reviewed studies of European wind turbine facilities which have consistently concluded that wind turbine noise is more annoying than other commonly experienced noise sources such as traffic, aircraft and rail. ^{37, 38, 39}</p> <p>The findings of these peer reviewed studies confirm the need for more sound mitigation ⁴⁰ and the urgent need for the development of maximum wind turbine noise guidelines in order to avoid potential adverse health effects. ⁴¹</p>

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	<p>“The sound level associated with wind turbines at common residential setbacks...may lead to annoyance and sleep disturbance.” ⁴² and evidence demonstrates “Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA.” ⁴³</p> <p>The inclusion of the above “Rapid Review” citation is misleading.</p>
6	<p><i>Rapid Review statement (Sound and Noise from Wind Turbines - page 3):</i></p> <p>“One of the most common assertions regarding potential adverse noise impacts of wind turbines is concerned with low frequency noise and infrasound. It should be noted that infrasound is constantly present in the environment and is caused by various sources such as ambient air turbulence, ventilation units, ocean waves, distant explosions, volcanic eruptions, traffic, aircraft and other machinery (Rogers, Manwell & Wright, 2006). In relation to wind turbines, Leventhall (2006) concludes that there is insignificant infrasound generated by wind turbines and that there is normally little low frequency noise. A survey of all known published results of infrasound from wind turbines found that wind turbines of contemporary design, where rotor blades are in front of the tower, produce very low levels of infrasound (Jakobsen, 2005). Another recent report concludes that wind farm noise does not have significant low-frequency or infrasound components (Ministry of the Environment, 2007). As discussed in further detail below the principal human response to audible infrasound is annoyance (Rogers, 2006).”</p> <p>SWV analysis</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>

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7	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 3):</i></p> <p><i>“The health and well-being effects of noise on people can be classified into three broad categories:</i></p> <ol style="list-style-type: none"> <i>1. subjective effects including annoyance, nuisance and dissatisfaction;</i> <i>2. interference with activities such as speech, sleep and learning; and</i> <i>3. physiological effects such as anxiety, tinnitus or hearing loss (Rogers, Manwell & Wright, 2006).</i> <p><i>“Several commentators argue that noise from wind turbines only produces effects in the first two categories (Rogers, 2006; Pedersen & Persson Waye, 2007).”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” statement that noise from wind turbines “...<i>only produces effects in the first two categories</i>” is concerning from a health care perspective. The qualification of “<i>only</i>” suggests the “Rapid Review” considers these two categories to be insignificant adverse health effects.</p> <p>The acknowledgement that wind turbines produce adverse effects in the first two categories is medically significant. The direct adverse health effects of wind turbine induced annoyance and sleep disturbance may cause other symptoms.</p> <p>For example the American Wind Energy Association and Canadian Wind Energy Association sponsored report describes the serious nature of noise induced annoyance by stating ““wind turbine syndrome” symptoms are not new and have been published previously in the context of “annoyance” to environmental sounds The following symptoms are based on the</p>

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	<p>experience of noise sufferers extending over a number of years: distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension....”⁴⁴</p> <p>The industry sponsored report goes on to elaborate “...in cases of extreme and persistent annoyance, leading to stress responses in the affected individual and may also result from severe tinnitus...”⁴⁵</p> <p>Geoff Leventhall, an author of the wind industry sponsored review, reportedly elaborated :</p> <p>“... there was no doubt people living near the turbines suffered a range of symptoms, including abnormal heart beats, sleep disturbance, headaches, tinnitus, nausea, visual blurring, panic attacks and general irritability....it’s ruining their lives – and it’s genuine...”⁴⁶</p> <p>These references indicate wind turbine noise is capable of adversely impacting humans in not just two, but all three of the “<i>broad categories</i>” listed in the “Rapid Review”.</p>
8	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 4):</i></p> <p><i>“Various studies of wind turbine effects on health have concentrated on the self reported perception of annoyance. There are difficulties with measuring and quantifying subjective effects of noise such as annoyance. According to the World Health Organization (WHO) (1999) annoyance is an adverse health effect, though this is not universally accepted. Kalveram proposes that annoyance is not a direct health effect but an indication that a person’s capacity to cope is under threat. The person has to resolve the threat or their coping capacity is undermined, leading to stress related health effects (Kalveram 2000). Some people are very annoyed at quite</i></p>

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	<p><i>low levels of noise, whilst other are not annoyed by high levels.”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” states measuring noise annoyance is difficult. World Health Organization disagrees.</p> <p>“The effect of community noise on annoyance can be evaluated by questionnaires or by assessing the disturbance of specific activities. However, it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance.” ⁴⁷</p> <p>Studies of European wind turbine facilities have consistently concluded that wind turbine noise is more annoying than other commonly experienced noise sources such as traffic, aircraft and rail. ^{48, 49, 50, 51}</p> <p>The need for guidelines for maximum exposure to wind turbine noise is urgent in order to avoid adverse health effects. ⁵²</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations” ⁵³ yet for some inexplicable reason the “Rapid Review” is compelled to challenge the legitimacy of World Health Organization peer reviewed research by suggesting annoyance is not an adverse health effect. ⁵⁴</p> <p>The claim that the World Health Organization acceptance of annoyance as a health issue is not universally accepted is unreferenced. The “Rapid Review” does not state which reputable organisations disagree.</p> <p>To support their challenge the “Rapid Review” cites “Kalveram 2000”.</p> <p>It appears the “Rapid Review” did not read or perhaps understand “Kalveram 2000”. “Kalveram 2000” proposes that a (the) mechanism for</p>

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	<p>annoyance is through a threat to one’s ability to cope. “Kalveram 2000” does not state that annoyance is not an adverse health effect.</p> <p>Kalveram’s research paper makes interesting reading but has no relevance on the subject of industrial wind turbine noise.</p> <p>A key word search of “Kalveram” in “Noise and Health Journal”⁵⁵, World Health Organization’s “Guidelines for Community Noise” and “Night Noise Guidelines for Europe” yields no results suggesting his research is not widely known or “universally accepted”. Kalveram 2000 does not appear to be peer reviewed.</p> <p>“Kalveram 2000” is an irrelevant inclusion in the “Rapid Review”.</p> <p>The “Rapid Review” suggestion that annoyance is not an adverse health effect directly contradicts the contents of the review. On page 4 the “Rapid Review” states <i>“One study of wind turbine noise and annoyance found that no adverse health effects other than annoyance could be directly correlated with noise from wind turbines.”</i></p> <p>The “Rapid Review” attempt to belittle annoyance as an adverse health effect is disturbing and demonstrates a deficit understanding of the effects of noise on human health.</p> <p>The US Environmental Protection Agency (EPA) states “...“annoyance” can have major consequences, primarily to one’s overall health.”⁵⁶</p> <p>There is ample peer reviewed scientific research to support World Health Organization position that annoyance is adverse health effects of noise.^{57, 58}</p> <p>In the last ten years peer reviewed scientific studies have demonstrated that annoyance is a risk to human health.</p>

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	<p>Noise induced annoyance contributes to stress ⁵⁹, sleep disturbance ⁶⁰ and an increased risk of regulation diseases. ⁶¹</p> <p>A peer reviewed World Health Organization study "...confirmed, on an epidemiological level, an increased health risk from chronic noise annoyance." ⁶²</p> <p>Annoyance may adversely affect physiological health. Research indicates that for "chronically strong annoyance a causal chain exists between the three steps health – strong annoyance – increased morbidity." ⁶³</p> <p>The subjective experience of noise stress can, through central nervous processes, lead to an inadequate neuro-endocrine reaction and finally to regulation diseases. ⁶⁴</p> <p>"With children the effects of noise-induced annoyance from traffic, as well as neighbourhood noise, are evident in the respiratory system." ⁶⁵ It is relevant that peer reviewed studies have consistently concluded that wind turbine noise is more annoying than traffic noise. ^{66, 67, 68, 69}</p>
9	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 4):</i></p> <p><i>"It has been suggested that if people are worried about their health they may become anxious, causing stress related illnesses. These are genuine health effects arising from their worry, which arises from the wind turbine, even though the turbine may not objectively be a risk to health (Chapman 2010). The measurement of health effects attributable to wind turbines is therefore very complex."</i></p>

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	<p>SWV analysis</p> <p>NHMRC asserts it "... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations" ⁷⁰ yet the "Rapid Review" has cited the ranting opinions contained on an internet blog (see ranting comments of "Chapman S. (2010)" contained within "croakey the Crikey health blog"). ⁷¹</p> <p>The author cited is entitled to his opinions; however speculative opinions are of no value in a health related literature review which purports to be objective and scientific.</p> <p>The inclusion of this citation is both irresponsible and ridiculous.</p> <p>The SWV has no other comment.</p>
10	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 4):</i></p> <p><i>"One study of wind turbine noise and annoyance found that no adverse health effects other than annoyance could be directly correlated with noise from wind turbines. The authors concluded that reported sleep difficulties, as well as feelings of uneasiness, associated with noise annoyance could be an effect of the exposure to noise, although it could just as well be that respondents with sleeping difficulties more easily appraised the noise as annoying (Pedersen & Persson Waye, 2007)."</i></p> <p>SWV analysis</p> <p>The "Rapid View" appears to have confused their Pederson references. "Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 116(6): 3460-3470." is not a 2007 but rather a 2004 reference. Accordingly, the following</p>

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	<p>SWV comments are based on the 2004 reference.</p> <p>The “Rapid Review” neglects to mention this reference is a study of small turbines. “Of the 16 wind turbines in the selected five areas, 14 had a power of 600–650 kW, the other two turbines having 500 kW and 150 kW. The towers were between 47 and 50 m in height.” ⁷² Disclosure of these details is important as modern turbines are typically greater than 2 MW and stand approximately 100 m at hub height and 150 m at blade tip.</p> <p>The reference cited does not state that “<i>respondents with sleeping difficulties more easily appraised the noise as annoying</i>”. This interpretation of the “Rapid Review” has been misleadingly attributed to “Pedersen & Persson Waye, 2007(4)” ⁷³</p> <p>The “Rapid Review” has understated the risk of wind turbine induced sleep disturbance.</p> <p>The reference cited states:</p> <p>“...16% of...respondents living at sound exposure above 35.0 dBA stated that they were disturbed in their sleep by wind turbine noise...The results suggest that the proportions of respondents annoyed by wind turbine noise are higher than for other community noise sources at the same A-weighted SPL and that the proportion annoyed increases more rapidly...The high occurrence of noise annoyance indicates that the noise intrudes on people’s daily life.” ⁷⁴</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations” ⁷⁵ yet the “Rapid Review” selectively cites just one of the European studies of with turbine facilities. The most recent and comprehensive of three studies of European wind turbines facilities concluded “Annoyance with wind turbine noise was associated with psychological distress, stress, difficulties</p>

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	<p>to fall asleep and sleep interruption.”⁷⁶</p> <p>A review of the Pederson studies reveals:</p> <p>“The recent analyses of the WINDFARM Perception and earlier Swedish studies by Pedersen and her colleagues gives, for the first time, robust evidence that wind turbines cause sleep disturbance and impair health and that this occurs at set-back distances previously regarded as adequate... Unfortunately all government and industry sponsored research in this area has used reported awakenings from sleep as an index of the effects of turbine noise and dismisses the subjective symptoms. Because most of the sleep disturbance is not recalled, this approach seriously underestimates the effects of wind turbine noise on sleep.”⁷⁷</p> <p>It is widely acknowledged that that in addition to annoyance and stress wind turbine noise may cause sleep disturbance.^{78, 79, 80, 81, 82}</p> <p>“The sound level associated with wind turbines at common residential setbacks...may lead to annoyance and sleep disturbance.”⁸³ and evidence demonstrates “Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA.”⁸⁴</p> <p>“Harry (2007) ... subsequently investigated 42 people in various locations in the U.K. living between 300 meters and 2 kilometers (1000 feet to 1.2 miles) from the nearest wind turbine. The most frequent complaint (39 of 42 people) was that their quality of life was affected. Headaches were reported by 27 people and sleep disturbance by 28 people. Some people complained of palpitations, migraines, tinnitus, anxiety and depression.”⁸⁵</p> <p>Describing the preliminary results of his controlled study Dr Michael Nissenbaum states:</p> <p>“In my investigation of Mars Hill, Maine, 22 out of about 30 adults</p>

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	<p>(‘exposed’) who live within 3500 feet of a ridgeline arrangement of 28 1.5 MW wind turbines were evaluated to date, and compared with 27 people of otherwise similar age and occupation living about 3 miles away (Not Exposed).</p> <p>Here is what was found: 82% (18/22) of exposed subjects reported new or worsened chronic sleep deprivation, versus 4% (1 person) in the non-exposed group. 41% of exposed people reported new chronic headaches vs 4% in the control group.</p> <p>59% (13/22) of the exposed reported ‘stress’ versus none in the control group, and 77% (17/22) persistent anger versus none in the people living 3 miles away. More than a third of the study subjects had new or worsened depression, with none in the control group. 95% (21/22) of the exposed subjects perceived reduced quality of life, versus 0% in the control group. Underlining these findings, there were 26 new prescription medications offered to the exposed subjects, of which 15 were accepted, compared to 4 new or increased prescriptions in the control group. The prescriptions ranged from anti-hypertensives and antidepressants to anti migraine medications among the exposed. The new medications for the non exposed group were anti-hypertensives and anti-arthritis.</p> <p>The Mars Hill study will soon be completed and is being prepared for publication.”⁸⁶</p> <p>Sleep disturbance is an adverse health effect.^{87, 88}</p> <p>The consequences of sleep disturbance can be serious.</p> <p>In 2009 World Health Organization released a 184 page peer reviewed summary of research regarding the risks to human health from noise induced sleep disturbance. <i>Some of the adverse health effect documented</i></p>

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	<p>in the report include poor performance at work, fatigue, memory difficulties, concentration problems, motor vehicle accidents, mood disorders (depression, anxiety), alcohol and other substance abuse, cardiovascular, respiratory, renal, gastrointestinal, musculoskeletal disorders, obesity, impaired immune system function and a reported increased risk of mortality.⁸⁹</p> <p>The “Rapid Review” ought to have acknowledged the risk of wind turbine noise induced sleep disturbance and its serious consequences.</p>
11	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 4):</i></p> <p><i>“Many factors can influence the way noise from wind turbines is perceived. The aforementioned study also found that being able to see wind turbines from one’s residence increased not just the odds of perceiving the sound, but also the odds of being annoyed, suggesting a multimodal effect of the audible and visual exposure from the same source leading to an enhancement of the negative appraisal of the noise by the visual stimuli (Pedersen & Persson Waye, 2007). Another study of residents living in the vicinity of wind farms in the Netherlands found that annoyance was strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape. The study also concluded that people who benefit economically from wind turbines were less likely to report noise annoyance, despite exposure to similar sound levels as those people who were not economically benefiting (Pedersen et al, 2009).”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” does not disclose the main findings of these studies nor does it provide context regarding the citations presented.</p>

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	<p>World Health Organization acknowledges that wind turbines have visual burdens.⁹⁰</p> <p>The health impact of visual burdens cannot be underestimated. An epidemiology study conducted by World Health Organization determined a “bad view out of window” increased the risk for depression by 40%. The same study also demonstrated disturbance by noise and sleep disturbance by noise increased the risk of depression 40%, and 100% respectively.⁹¹ In addition to visual burdens wind turbines create noise pollution which is acknowledged to cause annoyance, stress and sleep disturbance. In light of these statistics it is expected that people may have negative attitudes towards the visual impacts of wind turbines.</p> <p>“Anyone suffering new health problems that they perceive to be caused by the turbines is going to have a negative opinion. The health problems cause the dislike of the facilities, which manifests in hating the sight of them, etc., not the other way around.”⁹²</p> <p>“Higher visibility of the turbines was associated with higher levels of annoyance, and annoyance was greater when attitudes toward the visual impact of the turbines on the landscape were negative. However, the height of wind turbines means that they are also most clearly visible to the people closest to them and those who also receive the highest sound levels. Thus, proximity of the receiver to wind turbines makes it difficult to determine whether annoyance to the noise is independent of annoyance to the visual impact.”⁹³</p> <p>Regarding visually induced adverse health effects the “Rapid Review” and others^{94, 95, 96, 97, 98, 99, 100, 101} acknowledge shadow flicker may cause annoyance and or stress. It is expected that people who are visually exposed to wind turbines would be annoyed.</p>

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	<p>This is evidence that wind turbines must be sited to protect humans from the adverse health effect of visually induced annoyance. ^{102, 103, 104, 105, 106}</p> <p>The “Rapid Review” emphasizes <i>“The study also concluded that people who benefit economically from wind turbines were less likely to report noise annoyance, despite exposure to similar sound levels as those people who were not economically benefiting.”</i></p> <p>These observations may be accurate but it is of little relevance to protecting people from acknowledged wind turbine adverse health effects.</p> <p>Wind turbine participants may have a financial investment in the project in addition to benefiting financially. Participants are responsible for the noise and visual pollutions inflicted on the local population. It is expected participants would have a bias based on economic interests and responsibility.</p> <p>“For a wind turbine owner the sound of each blade passing means another half kWh is generated and is perhaps associated with the sound of coins falling into his lap, a lullaby. The very same rhythm, like the proverbial leaking faucet tap, might prevent his neighbour from falling asleep.” ¹⁰⁷</p> <p>“Wind turbines have different effects on different people. Some of these effects are somewhat predictable based on financial compensation, legal restrictions on free speech included in the lease contracts with hosting Landowners” ¹⁰⁸</p> <p>A sample wind turbine lease agreement states: “The Rent, in respect of the Specified Locations...represent compensation in full for...nuisance, noise, signal interference,..., casting of shadows and other inconveniences or damage...incurred by Lessor from the acts or omissions of Lessee.” ¹⁰⁹</p> <p>This lease agreement reveals the participant is advised of, and</p>

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	<p>compensated for, the wind turbine noise and visual pollution. Before signing an agreement, participants are granted the right to consciously decide whether or not they wish to be exposed to the noise and visual pollution in exchange for financial compensation. At the same time the non participating neighbours are stripped of any rights to decide on their exposures to wind turbine pollution.</p> <p>A smoker who consciously decides to enjoy the benefits of a cigarette will have a more positive attitude to the second hand smoke than would a non smoker. We would expect a similar response to unilaterally imposed wind turbine noise and shadow flicker.</p> <p>In many jurisdictions it is illegal for the smoker to force second smoke upon others. This legal protection is not enjoyed by non participating neighbours exposed to industrial wind turbine noise and visual pollution.</p> <p>The “Rapid Review” has conspicuously omitted critical findings made by the authors of the citations in this section.</p> <p>Relevant citations of these authors omitted in the “Rapid Review” include but are not limited to:</p> <p style="padding-left: 40px;">“Several possible exposures from wind turbines were studied: aural as well as visual. Sound was found to be the most annoying of the exposures.” ¹¹⁰</p> <p style="padding-left: 40px;">“Perhaps the main finding is that wind turbine sound is relatively annoying, more so than equally loud sound from aircraft or road traffic. A swishing character is perceived by most respondents, indicating that this is an important characteristic of wind turbine sound. Sound should therefore receive more attention in the planning of wind farms, and (more) sound mitigation measures must be considered.” ¹¹¹</p>

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	<p>“Annoyance with wind turbine noise was associated with psychological distress, stress, difficulties to fall asleep and sleep interruption.” ¹¹²</p> <p>“The study confirms that wind turbine noise is easily perceived and compared to sounds from other community sources relatively annoying.” ¹¹³</p> <p>Currently there is no health based generalized dose-response relationship developed to avoid possible adverse health effects from wind turbine noise exposure. ¹¹⁴</p> <p>The need for guidelines for maximum exposure to wind turbine noise is urgent in order to avoid possible adverse health effects. ¹¹⁵</p>
12	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 4):</i></p> <p><i>“In addition to audible noise, concerns have been raised about infrasound from wind farms and health effects. It has been noted that the effects of low frequency infrasound (less than 20Hz) on humans are not well understood (NRC, 2007). However, as discussed above, several authors have suggested that low level frequency noise or infrasound emitted by wind turbines is minimal and of no consequence (Leventhall, 2006; Jakobsen, 2005). Further, numerous reports have concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines (DTI, 2006; CanWEA, 2009; Chatham-Kent Public Health Unit, 2008; WHO, 2004; EPHC, 2009; HGC Engineering, 2007).”</i></p>

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	<p>SWV analysis</p> <p>The “Rapid Review” exhibits selective bias in the references cited.</p> <p>There are peer-reviewed studies showing that infra and low frequency sound can cause adverse health effects, especially when dynamically modulated. The extent to which infra and low frequency noise from wind turbines inside or outside homes causes adverse effects upon the human body remains an open question ^{116, 117, 118, 119, 120, 121} - there is no settled medical science on this issue as of yet.</p> <p>Wind turbines emit audible and inaudible low frequency noise. ^{122, 123}</p> <p>Audible low frequency noise may cause adverse health effects. ^{124, 125}</p> <p>As stated earlier annoyance is an adverse health effect. ^{126, 127}</p> <p>The American Wind Energy Association and Canadian Wind Energy Association sponsored literature review entitled “Wind Turbine Sound and Health Effects” acknowledges wind turbine low frequency noise, may cause annoyance. ¹²⁸</p> <p>The effects of low frequency noise induced annoyance and stress may be serious and it is acknowledged that “The claim that their "lives have been ruined" by the noise is not an exaggeration...” ¹²⁹</p> <p>It is acknowledged that “...LFN (<i>low frequency noise</i>) does not need to be considered “loud” for it to cause such forms of annoyance and irritation.” ¹³⁰</p> <p>Some of the documented effects of low frequency noise induced annoyance include task performance deterioration, reduced wakefulness, sleep disturbance, headaches, and irritation. ¹³¹</p>

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	<p>“Unlike higher frequency noise issues, LFN is very difficult to suppress. Closing doors and windows in an attempt to diminish the effects sometimes makes it worse because of the propagation characteristics and the low-pass filtering effect of structures. Individuals often become irrational and anxious as attempts to control LFN fail, serving only to increase the individual’s awareness of the noise, accelerating the above symptoms” ¹³²</p> <p>Regarding low frequency noise sufferers: “Those exposed may adopt protective strategies, such as sleeping in their garage if the noise is less disturbing there. Or they may sleep elsewhere, returning to their own homes only during the day.” ¹³³</p> <p>The SWV is in contact with individuals who have resorted to sleeping in a tent or their car to escape the wind turbine noise that has invaded their home. This cannot be denied.</p> <p>World Health Organization advises that “Health effects due to low-frequency components in noise are estimated to be more severe than for community noises in general...The evidence on low-frequency noise is sufficiently strong to warrant immediate concern.” and consequently “Noise with low-frequency components require lower guideline values.” ¹³⁴</p> <p>A Minnesota Department of Health report on health impacts of wind turbines stated in its conclusion that “Most available evidence suggests that reported health effects are related to audible low frequency noise.” ¹³⁵</p> <p>In a 2009 Environmental Review Report for an Ontario wind turbine project the consultant acknowledged that regarding wind turbine infrasound and adverse health effects “...it is recognized that this be an area of scientific uncertainty.” ¹³⁶ The same report also stated with regards to wind turbine low frequency noise (LFN) and adverse health effects “It is acknowledged that LFN may be one area of scientific uncertainty in the wind industry as a</p>

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	<p>whole.”¹³⁷</p> <p>The National Research Council concurs: “Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans.... studies on human sensitivity to very low frequencies are recommended.”¹³⁸</p> <p>“...non-aural physiological and psychological effects may be caused by levels of low frequency noise below the individual hearing threshold.”¹³⁹</p> <p>“Low-frequency noise may also produce vibrations and rattles as secondary effects.”¹⁴⁰</p> <p>“Although infrasound levels from large turbines at frequencies below 20 Hz are too low to be audible, they may cause structural elements of buildings to vibrate.”¹⁴¹</p> <p>A NASA technical paper on wind turbine noise states “People who are exposed to wind turbine noise inside buildings experience a much different acoustic environment than do those outside....They may actually be more disturbed by the noise inside their homes than they would be outside....One of the common ways that a person might sense the noise-induced excitation of a house is through structural vibrations. This mode of observation is particularly significant at low frequencies, below the threshold of normal hearing.”¹⁴²</p> <p>“Jung and colleagues (2008), in a Korean study, concluded that low-frequency noise in the frequency range above 30 Hz can lead to psychological complaints and that infrasound in the frequency range of 5–8 Hz can cause complaints due to rattling doors and windows in homes.”¹⁴³</p>

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	<p>A 2010 peer reviewed article concluded:</p> <p>“1) Hearing perception, mediated by the inner hair cells of the cochlea, is remarkably insensitive to infrasound. 2) Other sensory cells or structures in the inner ear, such as the outer hair cells, are more sensitive to infrasound than the inner hair cells and can be stimulated by low frequency sounds at levels below those that are heard. The concept that an infrasonic sound that cannot be heard can have no influence on inner ear physiology is incorrect. 3) Under some clinical conditions, such as Meniere’s disease, superior canal dehiscence, or even asymptomatic cases of endolymphatic hydrops, individuals may be hypersensitive to infrasound. 4) A-weighting wind turbine sounds underestimates the likely influence of the sound on the ear. A greater effort should be made to document the infrasound component of wind turbine sounds under different conditions. 5) Based on our understanding of how low frequency sound is processed in the ear, and on reports indicating that wind turbine noise causes greater annoyance than other sounds of similar level and affects the quality of life in sensitive individuals, there is an urgent need for more research directly addressing the physiologic consequences of long-term, low level infrasound exposures on humans.” ¹⁴⁴</p> <p>The logical approach to preventing these adverse effects would be to develop regulations to protect humans from wind turbine low frequency noise and infrasound.</p> <p>The wind industry resists such regulations. For example in 2009 the Province of Ontario, Canada proposed requirements for wind energy developers to “...monitor and address any perceptible infrasound (vibration) or low frequency.” ¹⁴⁵ The Canadian Wind Energy Association is opposed to such requirements and has petitioned “...that the proposed requirement for infrasound or low frequency noise monitoring as a condition...be removed.” ¹⁴⁶</p>

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	<p>Regarding the references cited by the “Rapid Review” in this section the following observations can be made:</p> <p>Many of the references cited by the “Rapid Review” do not support the statement “<i>there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines</i>”. See details below:</p> <p>NRC, 2007: The “Rapid Review” neglected to include the following relevant citations “...wind-energy projects create negative impacts on human health and well-being, the impacts are experienced mainly by people living near wind turbines who are affected by noise and shadow flicker...Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans.... studies on human sensitivity to very low frequencies are recommended.” ¹⁴⁷</p> <p>Leventhall, 2006: The “Rapid Review” neglected to include the following citation: “Turbulent air inflow conditions cause enhanced levels of low frequency noise, which may be disturbing...” ¹⁴⁸ Wind turbine low frequency noise many cause annoyance. ¹⁴⁹</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>DTI, 2006:</p> <p>See discussion in SWV Analysis Table 3 Reference 14 for a commentary on this reference.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>

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	<p>CanWEA, 2009:</p> <p>See discussion in SWV Analysis Table 3 Reference 15 for a commentary on this reference.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>Chatham-Kent Public Health Unit, 2008: This reference discusses infrasound but does not comment on audible wind turbine low frequency noise and low frequency noise induced annoyance.</p> <p>See discussion in SWV Analysis Table 3 Reference 17 for a commentary on this reference.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>WHO, 2004: The “Rapid Review” has misled the reader by citing this reference to support the statement “<i>there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines</i>”.</p> <p>This reference makes no mention of wind turbine low frequency noise or infrasound.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>See discussion in SWV Analysis Table 3 Reference 18 for a commentary on this reference.</p>

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	<p>EPHC, 2009:</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>See discussion in SWV Analysis Table 3 Reference 19 for a commentary on this reference.</p> <p>HGC Engineering, 2007: This reference makes no mention of audible wind turbine low frequency noise and low frequency noise induced annoyance.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p> <p>See discussion in SWV Analysis Table 3 Reference 20 for a commentary on this reference.</p>
13	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects’ (Berglund & Lindvall 1995).”</i></p> <p>SWV analysis</p> <p>The wind energy industry and many authors of literature reviews often cite this reference. The adverse health effects associated with low frequency noise below the hearing threshold is unsettled science as the above quotation implies.</p>

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	<p>“According to Berglund et al [Berglund B; Hassmen P; Soames Job RF. Sources and effects of low-frequency noise. JASA Journal of the acoustical society of America 1996 May; 99(5): 2985 – 3002]: ... standards should consider the option of allowing less noise in the low-frequency range since the possibility exists that a stimulus may have an effect even without conscious (auditory) detection. Definitive solutions to these problems would require unethical exposures to low-frequency noise ... The balance of probability would appear to favour the conclusion that low-frequency noise has a variety of adverse effects on humans, both physiological and psychological ... The evidence provided ... warrants concerned action without the potentially extremely lengthy delay that may be occasioned by waiting for definitive proof which may never arise.”¹⁵⁰</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>
14	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“Infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour (DTI, 2006).”</i></p> <p>SWV analysis</p> <p>Dr Christopher Hanning has written a critique of the reference cited by the “Rapid Review” which states:</p> <p>“The wind industry relies on a DTI report by the Hayes McKenzie Partnership (HMP) published in 2006 which investigated low frequency noise at three UK wind farms. As far as can be determined, no medical or</p>

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	<p>physiological expertise was used in the design of the study...Draft versions of the report (DTI 2006a,b,c) have recently come to light as a result of Freedom of Information requests....recommendations were removed from the final version of the report. No scientific explanation for their removal seems to have been offered...It is quite clear that relying on the conclusions of this report, as published, is unwise as they are, at best, misleading.”¹⁵¹</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>
15	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“Findings clearly show that there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health (CanWEA, 2009).”</i></p> <p>SWV analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations”¹⁵² yet the “Rapid Review” has cited a wind energy trade association quotation from its own fact sheet.</p> <p>Based on a review of the CanWEA (Canadian Wind Energy Association) fact sheet it was determined that none of the references cited support the CanWEA statement “...<i>there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health.</i>”</p> <p>To the contrary Canada’s federal health authority, Health Canada, states “...that there are peer-reviewed scientific articles indicating that wind</p>

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	<p>turbines may have an adverse impact on human health.” ¹⁵³</p> <p>Health Canada cites eight peer reviewed articles to support this statement.</p> <p>The SWV notes that none of these eight articles is listed in the CanWEA fact sheet cited by the “Rapid Review”. ¹⁵⁴</p> <p>The SWV notes that only one of these eight articles is listed in the “Rapid Review” reference section. See discussion on the “Rapid Review” interpretation of “Pedersen & Persson Waye, 2007” in SWV Analysis Table 3 References 10 and 11.</p>
16	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans. Subaudible, low frequency sounds and infrasound from wind turbines do not present a risk to human health (Colby, et al 2009).”</i></p> <p>SWV analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations” ¹⁵⁵ yet the “Rapid Review” cited the American Wind Energy Association and Canadian Wind Energy Association sponsored literature review (A/CanWEA Panel Review).</p> <p>The SWV conducted an analysis of this reference and determined:</p> <p>“The conclusions of the A/CanWEA Panel Review are not supported by its</p>

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17	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“The Chatham-Kent Public Health Unit (Ontario, Canada) reviewed the current literature regarding the known health impacts of wind turbines in order to make an evidence-based decision. Their report concluded that current evidence failed to demonstrate a health concern associated with wind turbines.</i></p> <p><i>‘In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed ... there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence’ (Chatham-Kent Public Health Unit, 2008).”</i></p> <p>SWV analysis</p>

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	<p>It is relevant that the citation’s full conclusion states:</p> <p style="padding-left: 40px;">“This paper concludes and concurs with the original quote from Chatham-Kent’s Acting Medical Officer of Health, Dr. David Colby,</p> <p style="padding-left: 40px;">“In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed, it is my opinion that there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence.”” ¹⁶⁰</p> <p>There are over one hundred Ontario residents who are reporting adverse health from exposure to industrial wind turbines. ¹⁶¹ Some of these victims are currently being or have been billeted by wind energy developers at the developer’s expense. ¹⁶² Others have had their homes bought out by the wind energy developer and are now silenced by non disclosure clauses. Other victims live in self funded safe houses or have abandoned their homes to protect their health. The balance continues to suffer in their existing homes. These statements cannot be denied.</p> <p>The guidelines Dr. Colby unconditionally endorsed in June 2008 ¹⁶³ were subsequently replaced four months later in October 2008. ¹⁶⁴</p> <p>In March 2009 SkyPower, a wind energy developer advertised Dr Colby as one of the “Representatives from Skypower” ¹⁶⁵. Dr Colby has stated that he received an honorarium for this service. ¹⁶⁶</p> <p>An October 2009 letter from The College of Physicians and Surgeons of Ontario, Inquiries, Complaints and Reports Committees Decisions and Reasons states that:</p>

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	<p>“...the Committee observes, Dr. Colby’s expertise is in medical microbiology and infectious diseases, an area quite distinct from audiology or other fields to the physical impact of wind turbines on human health. Thus the committee wishes to remind Dr. Colby, going forward, of the importance of fully disclosing the extent of his qualifications in a field that he has been retained as an “expert” and also to ensure he fully disclose to the public the organization or corporation by whom he has been retained by an expert.” ¹⁶⁷</p> <p>In December 2009 Dr Colby coauthored a report which acknowledges wind turbine noise, including low frequency noise, may cause annoyance, stress and sleep disturbance and that as a result people may experience adverse physiological and psychological symptoms. ¹⁶⁸</p> <p>In a December 2009 radio interview Dr Colby stated:</p> <p>“We’re not denying that there are people annoyed and that maybe some of them are getting stressed out enough about being annoyed that they’re getting sick.” ¹⁶⁹</p> <p>The reference cited by the “Rapid Review”, Chatham-Kent Public Health Unit, 2008, is an inadequate public health document. This statement is based on the following:</p> <ul style="list-style-type: none"> • The report is an incomplete literature review. • The report displays selective bias favouring the wind energy industry in the presentation of the material referenced. • Heavy reliance on references from the wind energy industry (CanWEA, AWEA, BWEA, Danish Wind Energy Association) • Heavy reliance on references from listed members of CanWEA i.e. Howe Gastmeier Chapnik Limited. Mississauga HGC Engineering ¹⁷⁰

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	<ul style="list-style-type: none"> • The report displays selective bias favouring the wind energy industry by the omission of relevant references. • As a result of the above deficiencies the report provides incomplete risk assessments related to health including the failure to adequately consider the health impacts of wind turbine induced annoyance, stress or sleep disturbance. (based on a key word searches of “annoyance”, “stress” and “sleep disturbance”) • The report fails to identify the risk of wind turbine low frequency noise induced annoyance. • The report fails to identify the issue of shadow flicker induced annoyance. • The guidelines unconditionally endorsed in June 2008 were subsequently replaced in October 2008 with new wind turbine noise guidelines. • Exhibits a deficient understanding of the authoritative research on noise and health. • The report uses pre-emptive stereotyping of individuals who have concerns about associated with wind turbine facilities ie “Those Opposed to Wind Power”.
18	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“Wind energy is associated with fewer health effects than other forms of traditional energy generation and in fact will have positive health benefits (WHO, 2004).”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” selectively cites this reference and thereby gives the reader the false impression this report is a comprehensive review of all the health effects associated with wind turbines.</p>

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19	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“There are, at present, very few published and scientifically-validated cases of an SACs of wind farm noise emission being problematic ... the extent of reliable published material does not, at this stage, warrant inclusion of SACs... into the noise impact assessment planning stage (EPHC, 2009).”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” neglects to mention that the updated July 2010 version of this reference does not contain these statements but rather states:</p> <p>“The Guidelines recognise that compliance with reasonable noise limits should provide for sufficient buffers between the wind farm and noise-sensitive sites, to ensure that the noise emissions are reasonable and that</p>

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	<p>they are free of annoying noise characteristics (tonality, modulation and impulsiveness.)”¹⁷³</p> <p>A UK report documented sleep disturbance caused by wind turbine amplitude modulation and recommended a penalty adjustment to noise guidelines to protect the local population.¹⁷⁴ Other researchers believe a penalty should be considered for wind turbine noise.¹⁷⁵</p> <p>The American Wind Energy Association and Canadian Wind Energy Association sponsored report entitled “Wind Turbine Sound and Health Effects acknowledges that wind turbine low frequency noise and amplitude modulation may cause annoyance, stress and sleep disturbance.”¹⁷⁶</p> <p>Studies of European wind turbine facilities which have consistently concluded that wind turbine noise is more annoying than other commonly experienced noise sources such as traffic, aircraft and rail.^{177, 178, 179, 180}</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>
20	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“While a great deal of discussion about infrasound in connection with wind turbine generators exists in the media there is no verifiable evidence for infrasound and production by modern turbines (HGC Engineering, 2007).”</i></p> <p>SWV analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations”¹⁸¹ yet the “Rapid Review” has cited a “best practices” document prepared by</p>

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	<p>HGC Engineering for the Canadian Wind Energy Association (CanWEA). HGC Engineering is listed as a member of the industry trade association CanWEA. ¹⁸²</p> <p>See discussion regarding CanWEA in SWV Analysis Table 3 Reference 15.</p> <p>See discussion on wind turbine low frequency noise and infrasound in SWV Analysis Table 3 Reference 12.</p>
21	<p><i>Rapid Review statement (Effects of Noise from Wind Turbines on Human Health - page 5):</i></p> <p><i>“The opposing view is that noise from wind turbines produces a cluster of symptoms which has been termed Wind Turbine Syndrome (WTS). The main proponent of WTS is a US based paediatrician, Dr Pierpont, who has released a book ‘Wind Turbine Syndrome: A report on a Natural Experiment, presents case studies explaining WTS symptoms in relation to infrasound and low frequency noise. Dr Pierpont’s assertions are yet to be published in a peer-reviewed journal, and have been heavily criticised by acoustic specialists. Based on current evidence, it can be concluded that wind turbines do not pose a threat to health if planning guidelines are followed.”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” emphasizes Dr. Pierpont’s research has not been <i>“published in a peer-reviewed journal”</i> and hence considers it irrelevant.</p> <p>The “...tactic for dismissing evidence is to argue that scientific analyses that are not in a peer reviewed journal are uninformative. It should be obvious that this might be a ground rule for a term paper or a debating</p>

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	<p>club, but is not a good rule for truth-seeking ...And there are many kinds of useful peer review; the Pierpont (2009) book, the source of much argument in this area, appears to have been peer reviewed more completely than most papers that appear in journals, and thus the arguments that it should not count because it was not peer reviewed represent either an ignorance of what the peer review process really is or pure rhetorical maneuvering.”¹⁸³</p> <p>The “Rapid Review” dismissal of Dr. Pierpont’s research is not universally accepted. Dr. Pierpont’s research has been cited in a number of authoritative references.^{184, 185, 186, 187}</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations”¹⁸⁸ yet the majority of the references cited by the “Rapid Review” have not been published in a peer-reviewed journal. Many have been produced by authors associated with the wind energy industry.</p> <p>The “Rapid Review” even cites ranting opinions contained on “croakey the Crikey health blog”.¹⁸⁹ It is assumed the internet blog cited by the “Rapid Review” has not been peer reviewed.</p> <p>The “Rapid Review” neglects to mention that the American Wind Energy Association and Canadian Wind Energy Association sponsored report entitled “Wind Turbine Sound and Health Effects” critiqued Dr Pierpont’s published case studies and did not deny that the symptoms reported may be caused by wind turbine noise.</p> <p>The wind industry sponsored report disputes the mechanism of action offered by Dr. Pierpont and concludes ““wind turbine syndrome” symptoms are not new and have been published previously in the context of “annoyance” to environmental sounds The following symptoms are based on the experience of noise sufferers extending over a number of</p>

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	<p>years: distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension....”¹⁹⁰</p> <p>These acknowledgements are evidence that wind turbine noise may cause adverse health effects in humans.</p>

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Reference	<p>Table 4</p> <p>Analysis of Rapid Review- Effects of Shadow Flicker and Blade Glint on Human Health</p> <p>Rapid Review contents in <i>italics</i> SWV Analysis in non italics</p>
	<p><i>Rapid Review statement (Effects of Shadow Flicker and Blade Glint on Human Health - page 6):</i></p> <p><i>“In summary, the evidence on shadow flicker does not support a health concern (Chatham-Kent Public Health Unit, 2008) as the chance of conventional horizontal axis wind turbines causing an epileptic seizure for an individual experiencing shadow flicker is less than 1 in 10 million (EPHC, 2009). As with noise, the main impact associated with shadow flicker from wind turbines is annoyance.”</i></p> <p>SWV analysis</p> <p>The “Rapid Review” statement is inaccurate and misleading.</p> <p>Stating “<i>shadow flicker does not support a health concern</i>” and then acknowledging “<i>As with noise, the main impact...is annoyance</i>” is contradictory.</p> <p>Both the reference cited (<i>Chatham-Kent Public Health Unit, 2008</i>) and the “Rapid Review” demonstrates a deficient understanding of the adverse effects associated with shadow flicker.</p> <p>According to the World Health Organization wind turbines have noise and visual burdens. ¹⁹¹</p> <p>The National Research Council states “...wind-energy projects create negative impacts on human health and well-being, the impacts are experienced mainly by people living near wind turbines who are affected by noise and shadow flicker.” ¹⁹²</p> <p>Rotating wind turbine blades interrupt the sunlight producing unavoidable flicker bright enough to pass through closed eyelids, and moving shadows</p>

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	<p>cast by the blades on windows can affect illumination inside buildings.¹⁹³ This effect is commonly known as shadow flicker.</p> <p>Wind turbine shadow flicker has the potential to induce photosensitive epilepsy seizures; however the risk is low with large modern models and if proper planning is adhered to.¹⁹⁴ Planning should ensure the flash frequency does not exceed three per second, and the shadows cast by one turbine on another should not have a cumulative flash rate exceeding three per second.¹⁹⁵</p> <p>Other acknowledged wind turbine visually induced adverse health effects include annoyance and or stress.^{196, 197, 198, 199, 200, 201, 202, 203}</p> <p>“Annoyance of residents can occur over a long term basis if they are repeatedly subject to shadow flicker, or on a short term basis as a consequence of an extended period of continuous exposure. Both are considered important impacts.”²⁰⁴</p> <p>“...shadow flicker can be an issue both indoors and outdoors when the sun is low in the sky. Therefore, shadow flicker may be an issue in locations other than the home.”²⁰⁵</p> <p>To mitigate risk to human health wind turbines should be sited to ensure people will not be adversely affected. For example in the northern hemisphere people located East-NE or WNW from the turbine must be protected from shadow flicker.²⁰⁶</p> <p>Recommended shadow flicker setbacks for current wind turbine designs are 10 rotational diameters which would typically translate to approximately 800m – 900 m.²⁰⁷</p> <p>Greater setback distances may be required when wind turbines are sited on elevated ridges as the shadows can be cast over distances of several</p>

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	<p>kilometres.²⁰⁸</p> <p>Wind turbine noise including low frequency noise may also contribute to the overall annoyance.²⁰⁹</p> <p>“Wind turbine noise is easily perceived and annoying even at low A-weighted SPLs....Wind turbines are furthermore prominent objects whose rotational movement attracts the eye. Multimodal sensory effects or negative aesthetic response could enhance the risk of annoyance. Adverse reactions could possibly lead to stress-related symptoms due to prolonged physiological arousal and hindrance to psychophysiological restoration.”²¹⁰</p> <p>Careful site planning and design is required in order to avoid the adverse effects of shadow flicker.²¹¹ In most jurisdictions shadow flicker is not explicitly regulated.²¹² This leaves the decision making up to the members of an industry that states “...there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health.”²¹³</p> <p>Just like international wind turbine noise regulations²¹⁴ shadow flicker regulations that do exist vary widely²¹⁵ indicating they are not based on science but rather the lobbying of the wind industry.</p> <p>Further investigation into the effects of wind turbine stressors including shadow flicker is required to assist in the development of authoritative guidelines designed to mitigate potential adverse health effects.^{216, 217, 218, 219}</p> <p>The “Rapid Review” makes no mention of these references or the findings documented within.</p>

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Reference	<p>Table 5</p> <p>Analysis of Rapid Review - Measures to Mitigate Potential Impacts of Wind Turbines</p> <p>Rapid Review contents in <i>italics</i> SWV Analysis in non italics</p>
22	<p><i>Rapid Review statement (Measures to Mitigate Potential Impacts of Wind Turbines- page 7):</i></p> <p><i>“As with the introduction of any new technology, some communities are against wind farms being located in their area. Some factors which may increase community concern include coerced or unequal exposure, industrial, exotic and/or memorable nature of the turbine, dreaded, unknown or catastrophic consequences, substantial media attention, potential for collective action and a process which is unresponsive to the community. Voluntary exposure, for example choosing to house the turbine on community land, reduces concern (Adapted by Professor Chapman from Covello et al. methodology 1986).”</i></p> <p>SWV Analysis</p> <p>NHMRC asserts it “... only uses the best available evidence, in the form of peer-reviewed scientific literature, to formulate its recommendations” ²²⁰ yet the “Rapid Review” has cited speculative opinions from personal correspondence. ²²¹</p> <p>The author cited is entitled to his opinions; however speculative opinions are of no value in a health related literature review which purports to be objective and scientific.</p> <p>See discussion in SWV Analysis Table 3 Reference 9.</p> <p>See discussion in SWV Analysis Table 3 Reference 11.</p> <p>The SWV has no other comment.</p>

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23	<p><i>Rapid Review statement (Measures to Mitigate Potential Impacts of Wind Turbines- page 7):</i></p> <p><i>“Therefore if planning guidelines are followed and communities are consulted with in a meaningful way, resistance to wind farms is likely to be reduced and annoyance and related health effects avoided.”</i></p> <p>SWV Analysis</p> <p>The “Rapid Review” statement <i>“Therefore if planning guidelines are followed and communities are consulted with in a meaningful way ... annoyance and related health effects avoided.”</i> can only valid if the guidelines are based on independent third party clinical research.</p> <p>To date no such study has been undertaken.</p> <p>International wind turbine noise ²²² and shadow flicker regulations vary widely ²²³ not because of science but rather as a result of the lobbying efforts of the wind industry.</p> <p>As long as the hired consultants of the wind energy industry are influencing policy makers the number of people reporting adverse health effects will continue to grow.</p>

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Reference	<p>Table 6</p> <p>Analysis of Rapid Review – Conclusion</p> <p>Rapid Review contents in <i>italics</i> SWV Analysis in non italics</p>
24	<p><i>Rapid Review statement (Conclusions - page 8):</i></p> <p><i>However, renewable energy generation is associated with few adverse health effects compared with the well documented health burdens of polluting forms of electricity generation (Markandya & Wilkinson, 2007).</i></p> <p>SWV Analysis</p> <p>Including this reference is misleading as the article cited commented on various forms of electricity generation and related health effects as they pertain to gas emissions only.</p> <p>The article does not assess or even mention wind turbine issues defined by the “Rapid Review” (ie wind turbine infrasound, noise, shadow flicker and blade glint).</p>
25	<p><i>Rapid Review statement (Conclusions - page 8):</i></p> <p><i>“There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.”</i></p> <p>SWV Analysis</p> <p>See discussion in SWV Analysis Table 1 Reference 1.</p>

End of Analysis

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- ¹ Email correspondence from publichealthenquiries@nhmrc.gov.au Friday, July 16, 2010
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