

**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF SOUTH DAKOTA**

**IN THE MATTER OF THE APPLICATION OF  
CROWNED RIDGE, LLC FOR A FACILITIES PERMIT TO  
CONSTRUCTION 300 MEGAWATT WIND FACILITY**

**Docket No. EL19-003**

**REBUTTAL TESTIMONY AND EXHIBITS  
OF CHRIS OLLSON**

**May 24, 2019**

INTRODUCTION

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**Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.**

A. My name is Chris Ollson. My business address is 37 Hepworth Crescent, Ancaster, Ontario, Canada.

**Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?**

A. I am the sole proprietor of Ollson Environmental Health Management. This consultancy provides expertise on environmental health challenges related to siting of energy projects (e.g., oil and gas, pipelines, gas plants, wind turbines, solar, transmission lines, and energy-from-waste). Clients include a mix of private sector companies and governments at all levels.

**Q. WHAT ARE YOUR RESPONSIBILITIES?**

A. I am a consultant to Crowned Ridge Wind, LLC (“CRW”) on the scientific literature related to sound and shadow/flicker and proper siting of wind turbines to ensure the protection of health of residents.

**Q. ARE YOU THE SAME CHRIS OLLSON WHO SUBMITTED SUPPLEMENTAL TESTIMONY ON APRIL 10, 2019?**

A. Yes.

**Q. HAS THIS TESTIMONY BEEN PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION?**

A. Yes.

1 **Q. PLEASE DESCRIBE THE PURPOSE OF YOUR REBUTTAL TESTIMONY.**

2 A. The purpose of my testimony is to respond to the direct testimony of Staff witness David  
3 Hessler and Intervenors' proposed conditions as set forth in Staff witness Darren  
4 Kearney's Direct Testimony, Exhibit DK-8.

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6 **Staff Witness Hessler's Testimony**

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8 **Q. STAFF WITNESS HESSLER (TESTIMONY AT PAGE 5, LINES 4-7) ASSERTS**  
9 **THAT ANYTIME WIND TURBINES SOUND LEVELS ARE HIGHER THAN 40**  
10 **DBA, RESIDENTS WILL COMPLAIN, AND THE SEVERITY OF THE**  
11 **COMPLAINTS WILL INCREASE EXPONENTIALLY AS THE SOUND LEVEL**  
12 **APPROACHES 50 DBA. ALSO, INTERVENORS HAVE PROPOSED**  
13 **CONDITIONS 19, 20, 21 (KEARNEY EXHIBIT DK-8) THAT WOULD LIMIT**  
14 **SOUND AT 40 DBA AT THE PROPERTY LINE OF A NON-PARTICIPATING**  
15 **PROPERTY OWNER. DOES THE SCIENTIFIC PEER REVIEWED**  
16 **LITERATURE OR GOVERNMENT REPORTS SUPPORT A 40 DBA SOUND**  
17 **LIMIT FOR NON-PARTICIPANTS?**

18 A. No. The scientific literature published over the past decade from Europe and Canada  
19 showS that as wind turbine sound levels of sound increase over 40 dBA that there may be  
20 an increase in annoyance (not complaints) for some living around wind turbines. The  
21 level of annoyance certainly is higher for those non-participating homes at greater than  
22 45 dBA.

23

1 To elaborate, noise-related annoyance from common sound sources is prevalent in many  
2 communities. For instance, results of national surveys in Canada and the U.K. by  
3 Michaud et al. (2005) and Grimwood et al. (2002) attached as Exhibit CO-R-1 and -2,  
4 respectively, suggested that annoyance from noise (predominantly traffic noise) might  
5 impact approximately 8% of the general population. Even in small communities in  
6 Canada (i.e., <5000 residents) where traffic is relatively light compared to traffic in urban  
7 centers, Michaud et al. (2005) reported that 11% of respondents were moderately to  
8 extremely annoyed by traffic noise. Importantly, annoyance is not a medical condition. It  
9 is not a recognized medical disease and it is not classified in the World Health  
10 Organization's International Statistical Classification of Disease and Related Health  
11 Problems 11<sup>th</sup> revision – ICD 11.

12  
13 There have been a number of studies that have found that annoyance levels specific to  
14 wind turbine noise vary considerably upon whether one economically benefits. For  
15 example, Tables 3 and 4 from Bakker et al., 2012 (provided in my Supplemental  
16 Testimony as Exhibit CO-3) clearly indicate that the percentage of people that were  
17 rather/very annoyed of outdoor wind turbine noise (up to 54 dBA) that did not  
18 economically benefit was 12%, while it was only 3% for those who did economically  
19 benefit. In addition, no one who economically benefited from the wind project was  
20 rather/very annoyed with resulting indoor noise levels. This study, therefore, further  
21 supports that it is not the wind turbine noise itself that drives the annoyance state; rather,  
22 subjective factors such as visual cues and attitude are important.

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## Annoyance Levels in the Bakker et al., 2012 Study.

**Table 3**  
Response to outdoor wind turbine sound among economically benefitting and non-benefitting respondents.

	Response										Total	
	Do not notice		Notice, not annoyed		Slightly annoyed		Rather annoyed		Very annoyed		n	%
	n	%	n	%	n	%	n	%	n	%		
No economical benefit	255	44	184	31	78	13	41	7	28	5	586	100
Economical benefit	15	15	68	69	13	13	2	2	1	1	99	100

**Table 4**  
Response to indoor wind turbine sound among economically benefitting and non-benefitting respondents.

	Response										Total	
	Do not notice		Notice, not annoyed		Slightly annoyed		Rather annoyed		Very annoyed		n	%
	n	%	n	%	n	%	n	%	n	%		
No economical benefit	394	68	98	17	46	8	21	4	20	4	579	100
Economical benefit	53	54	39	39	7	7	0	0	0	0	99	100

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Furthermore, Michaud et al. (2018) (Exhibit CO-R-3) go on to state “Aggregate annoyance was effectively 0 (i.e., least squares mean – 0.11) among the 110 participants who reported to receive personal benefit from having wind turbines in the area, compared to an average of 1.93 among those who did not report such benefits.” It is for these reasons I believe it is appropriate to set a 50 dBA limit for participating homes, because statistically landowners who economically benefit do not report annoyance from the wind turbines at levels over 50 dBA.

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Further, a Canadian study (CO-Exhibit 11 in my Supplemental Testimony) concluded that:

The results provide no evidence that self-reported or objectively measured stress reactions are significantly influenced by exposure to increasing levels of WTN up to 46 dB. There is an added level of confidence in the findings as this is the first study to date to investigate the potential stress impacts associated with WTN exposure using a combination of self-reported and objectively measured endpoints.

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Therefore, at sound levels of 46 dBA wind turbine noise annoyance should not be considered a health impact and the level of annoyance falls within levels that we accept in our daily lives. Accordingly, Staff witness Hessler and the Intervenors advancement

1 of a 40 dBA design standard is not supported by the weight of scientific evidence,  
2 because, regardless of the sound level being low in the Project area, it will result in some  
3 potential increase in annoyance in local populations. However, the annoyance level  
4 would be considered acceptable given:

- 5 • the annoyance level is similar to that of other forms of noise sources and  
6 approximately (e.g., road, rail, airplane);
- 7 • it is being influenced by other factors, including attitudes and visual cues with  
8 respect to the turbines themselves, and that it is not the noise itself that is driving  
9 this annoyance; and,
- 10 • that in the largest of its kind study by Health Canada (supported by past research)  
11 living with wind turbine noise <46 dBA was not associated with self-reported or  
12 physical measures of health or well-being.

13 Thus, the scientific literature does not support Intervenors' proposed conditions imposing  
14 a 40 dBA sound limit for non-participants nor Staff witness Hessler's position that the  
15 project should be viewed from the perspective of whether it is meeting 40 dBA for non-  
16 participants.

17 **Q. EVEN IF WIND TURBINE ANNOYANCE DOES NOT LEAD TO HEALTH**  
18 **EFFECTS AT 45 dBA CAN IT ADVERSELY AFFECT QUALITY OF LIFE FOR**  
19 **THOSE LIVING NEAR WIND TURBINES?**

20 A. The science shows that noise at 45 dBA poses no impact to quality of life. Determining  
21 if annoyance or any other perceived health effects for those living around wind projects  
22 has also been examined by determining if there has been a diminishment in their overall

1 quality of life (“QOL”). This relates directly to whether annoyance leads to a  
2 deterioration of QOL.

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4 Feder et al. (2015) conducted an assessment of quality of life using the WHOQOL-BREF  
5 among participants living in the vicinity of wind turbines Journal of Environmental  
6 Research. (Health Canada) (Exhibit CO-R-4), a World Health Organization Quality of  
7 Life – BREF (WHOQOL-BREF) administered a questionnaire to 1238 participants that  
8 lived between 820 feet to 7 miles away from wind turbines. This questionnaire evaluates  
9 self-reported physical health, psychological, social relationships, and environment in  
10 relation to QOL. Regardless of sound level at people’s homes wind turbine noise did not  
11 influence QOL. The authors stated:

12 The present study findings do not support an association between exposure  
13 to WTN up to 46 dBA [820 ft] and any of the WHOQOL-BREF domains  
14 (Physical Health, Psychological, Social Relationships and Environment)  
15 or the two stand-alone questions pertaining to rated QOL and Satisfaction  
16 with Health. Participants who were exposed to higher WTN levels did not  
17 rate their QOL or Satisfaction with Health significantly worse than those  
18 who were exposed to lower WTN levels, nor did they report having  
19 significantly worse outcomes in terms of factors that comprise the 4  
20 domains.

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22 Overall, the recent work by Health Canada suggests that quality of life should not be  
23 diminished for non-participating residents around the CRW project.

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25 **Q. STAFF WITNESS HESSLER’S TESTIMONY AT PAGE 5 LINES 17 TO PAGE 6**  
26 **LINE 5 CLAIMS THAT CRW SHOULD MOVE 16 PRIMARY TURBINE**  
27 **LOCATIONS TO ALTERNATIVE LOCATIONS TO REDUCE THE DBA FOR**  
28 **NON-PARTICIPANTS FROM A RANGE OF 43-45 DBA TO 41 OR 42 DBA.**

1           **DOES THE SCIENTIFIC PEER REVIEWED LITERATURE OR**  
2           **GOVERNMENT REPORTS SUPPORT THE NEED TO REDUCE THE DBA AS**  
3           **HE PROPOSES?**

4       A.     There is no evidence in the scientific literature that a minor shift in noise levels from  
5           wind turbines from 43-45 to 41-42 dBA would change annoyance levels or complaint  
6           numbers. Such fine-tuning has not been reported in any of the literature. Knowing that  
7           the human ear can barely perceive a change in sound at 3 dBA it is unlikely that such a  
8           change would even be perceptible.

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10          Most importantly, as stated above the bulk of the peer-reviewed scientific literature has  
11          demonstrated that the sound level itself does not contribute to the annoyance (or  
12          potentially complaints), rather it is visual cue and attitude that play a larger role.  
13          Therefore, such an arbitrary minor modification to sound levels is not supported by the  
14          scientific literature.

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16                                **Intervenors' Proposed Conditions**

17       **Q.     THE INTERVENORS' PROPOSED CONDITION 1 (KEARNEY EXHIBIT DK-8)**  
18           **WOULD REQUIRE THAT THERE BE A 2 MILE SETBACK FROM ALL NON-**  
19           **PARTICIPATING LANDOWNERS. IS SUCH A CONDITION SUPPORTED BY**  
20           **THE SCIENTIFIC PEER REVIEWED LITERATURE OR GOVERNMENT**  
21           **REPORTS?**

22       A.     No. As previously described in my Supplemental Testimony the appropriate manner in  
23           which wind turbine setbacks should be governed is by sound limits at the exterior of the



1 homes. To achieve the 45 dBA limit at non-participating homes it effectively requires a  
2 minimum setback distance of approximately 2000 feet. There is no peer reviewed  
3 scientific literature that supports the need for a 2 mile set back.

4 **Q. THE INTERVENORS' PROPOSED CONDITION 2 (KEARNEY EXHIBIT DK-8)**  
5 **REQUIRES THAT THERE BE A 2 MILE SETBACK FROM THE WAVERLY**  
6 **SCHOOL TO PROTECT CHILDREN FROM DISTURBANCES FROM THE**  
7 **PROJECT WHILE IN THEIR LEARNING ENVIRONMENT. IS SUCH A**  
8 **CONDITION SUPPORTED BY THE SCIENTIFIC PEER REVIEWED**  
9 **LITERATURE OR GOVERNMENT REPORTS?**

10 A. No. In 2008, Shield & Dockrell (Exhibit CO-R-5) published a paper in the Journal of the  
11 Acoustical Society of America (The effects of environmental and classroom noise on the  
12 academic attainments of primary school children.) In this paper, they describe the typical  
13 level of noise a child would experience in a primary school classroom:

14 For much of the day in a primary school classroom, young children are  
15 exposed to the noise of other children producing "classroom babble" at  
16 levels typically of around 65 dBA LAeq, while the typical overall  
17 exposure level of a child at primary school has been estimated at around  
18 72 dBA LAeq.  
19

20 The modeled sound level at Waverly School was 39 dBA and the closest turbine is 6,207  
21 feet away. At this setback distance, the sound level at the exterior of the school would be  
22 well below typical sound levels already experienced in the classroom. Given that the  
23 average sound level in a primary classroom (without external noise) is 65 dBA, and that  
24 the modeled sound level is 39.1 dBA at the exterior of the school the resulting sound  
25 would not be audible inside the classroom, even with windows open. Accordingly, there  
26 would be no additional benefit to setting wind turbines back two miles from the school.

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**Q. A NUMBER OF THE INTERVENORS' PROPOSED CONDITIONS (KEARNEY EXHIBIT DK-8) REQUIRE THE MEASUREMENT AND MONITORING OF INFRASOUND. ARE THESE CONDITIONS SUPPORTED BY THE SCIENTIFIC PEER REVIEWED LITERATURE OR GOVERNMENT REPORTS?**

A. No. As previously described in my Supplemental Testimony, although infrasound is emitted from wind turbines it is at a level well below the perception threshold and the limited number of international general standards for infrasound (not specific to wind turbines). Although infrasound is not modeled for wind turbine projects the level of infrasound at varying distances from wind turbines can be predicted based on previous measurements in the scientific literature. These levels have been demonstrated to be well below any international infrasound standards at even 1000 feet from wind turbines. As stated by the Ministry for the Environment, Climate and Energy of the Federal State of Bade Wuerttemberg in Germany (Exhibit CO-R-6) "adverse effects relating to infrasound from wind turbines cannot be expected on the basis of the evidence at hand." Therefore, there would be no need to measure or monitor infrasound levels from the Crowned Ridge Wind project to ensure the protection of health.

**Q. A NUMBER OF THE INTERVENORS' CONDITIONS (KEARNEY EXHIBIT DK-8) ARE PREMISED ON PEOPLE COMPLAINING ABOUT PHYSICAL CONDITIONS OR HEALTH ISSUES THEY BELIEVE ARE BROUGHT ON BY THE CRW WIND PROJECT. DOES THE SCIENTIFIC PEER REVIEWED LITERATURE OR GOVERNMENT REPORTS SUPPORT IMPOSING**

1           **CONDITIONS BECAUSE PEOPLE MAY ATTRIBUTE A PHYSICAL OR**  
2           **HEALTH ISSUE TO THE CRW WIND PROJECT?**

3    A.    As stated in my Supplemental Testimony an exterior sound limit of 45 dBA at non-  
4           participating homes is sufficient to ensure the protection of health of the residents. The  
5           scientific studies, including those published by Health Canada (the Michaud papers)  
6           indicate that both objective and subjective measures of health are not impacted by wind  
7           turbine sound at 45 dBA at the exterior of non-participating homes.

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9           In addition, the phenomenon of complaints associated with those who previously opposed  
10          wind projects has been studied in Australia. In 2013, Chapman et al., published (Exhibit  
11          CO-R-7; The Pattern of Complaints about Australian Wind Farms Does Not Match the  
12          Establishment and Distribution of Turbines: Support for the Psychogenic,  
13          'Communicated Disease' Hypothesis.) This paper demonstrated that the majority of wind  
14          projects generated no complaints from surrounding landowners. However, they reported:

15                   The large majority 116/129(90%) of complainants made their first  
16                   complaint after 2009 when anti wind farm groups began to add health  
17                   concerns to their wider opposition. In the preceding years, health or noise  
18                   complaints were rare despite large and small-turbine wind farms having  
19                   operated for many years.

20  
21          Professor Chapman and his colleagues concluded:

22                   The reported historical and geographical variations in complaints are  
23                   consistent with psychogenic hypotheses that expressed health problems  
24                   are “communicated diseases” with nocebo effects likely to play an  
25                   important role in the aetiology of complaints.

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27          In other words, those who opposed the wind farms prior to their construction and were  
28          concerned about health impacts are far more likely to file complaints and mistakenly  
29          attribute symptoms to the operation of the wind project.

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2 Q. **THE INTERVENORS' PROPOSED CONDITION 19 (KEARNEY EXHIBIT DK-**  
3 **8) WOULD REQUIRE THAT "NO FLICKER SHALL BE ALLOWED TO CROSS**  
4 **NON-PARTICIPATING LANDOWNER'S PROPERTY LINE." IS SUCH A**  
5 **CONDITION SUPPORTED BY THE SCIENTIFIC PEER REVIEWED**  
6 **LITERATURE OR GOVERNMENT REPORTS?**

7 A. No. As previously described in my Supplemental Testimony shadow flicker does not  
8 impact health. Shadow flicker limits at homes have been developed to reduce any undue  
9 nuisance effect for residents. Shadows cast by wind turbines on open spaces or fields  
10 does not result in a "flicker effect", similar to that which can be experienced in enclosed  
11 rooms in a home. Instead it can be observed as an intermittent shadow on the ground  
12 (e.g., in a field) that does not cause annoyance. There have been no scientific reports that  
13 such shadows produce an annoyance for neighboring properties.

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16 Q. **DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?**

17 A. Yes, it does.