

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

**IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC
FOR A PERMIT FOR A WIND ENERGY FACILITY IN BON HOMME, CHARLES MIX,
AND HUTCHINSON COUNTIES, SOUTH DAKOTA, FOR PREVAILING WIND
PARK ENERGY FACILITY**

SD PUC DOCKET EL-18-026

**PREFILED REBUTTAL TESTIMONY OF CHRIS HOWELL
ON BEHALF OF PREVAILING WIND PARK, LLC**

September 26, 2018

1 **I. INTRODUCTION**

2

3 **Q. Please state your name.**

4 A. My name is Chris Howell.

5

6 **Q. Did you provide Direct Testimony in this Docket?**

7 A. Yes. I submitted direct testimony in this docket on May 30, 2018.

8

9 **Q. What is the purpose of your Rebuttal Testimony?**

10 A. The purpose of my Rebuttal Testimony is to provide the results of updated acoustic
11 modeling to reflect a taller hub height for the proposed turbine, two small turbine
12 shifts and nine (9) additional occupied residences that were identified in Prevailing
13 Wind Park, LLC’s (“Prevailing Wind Park”) re-review of residences within and near
14 the Prevailing Wind Park Project (“Project”) area, as described in Bridget Canty’s
15 Rebuttal Testimony. In addition, I will respond to the testimony of Mr. David Hessler,
16 submitted on behalf of the South Dakota Public Utilities Commission Staff (“Staff”);
17 Mr. Richard R. James, submitted on behalf of Intervenors; and Mr. Jerry L. Punch,
18 submitted on behalf of Intervenors.

19

20 **Q. Are there any exhibits attached to your Rebuttal Testimony?**

21 A. The following exhibit is attached to my Rebuttal Testimony:

- 22 • Exhibit 1: Memorandum Regarding Updated Modeling Results – Prevailing Wind
23 Park

24 **II. UPDATED ACOUSTIC MODELING**

25

26 **Q. Do you have any updates to your Direct Testimony?**

27 A. Yes. We have conducted updated acoustic modeling of the Project’s proposed
28 layout to model the proposed GE 3.8-137 turbine a with a taller hub height (111.5
29 meters v. 110 meters), sound for the additional nine (9) receptors, the revised
30 locations of Turbines 38 and 40, and the removal of turbine location T19. A
31 memorandum summarizing the results of our updated acoustic modeling is included

32 as **Exhibit 1**. Exhibit 1 includes graphical presentation of the predicted 45 dBA
33 contour lines overlain on aerials.

34

35 **Q. Could you summarize the results of your updated acoustic modeling?**

36 A. Yes. The updated modeling results are generally consistent with the previously
37 submitted sound study. All residences are expected to be below 45 A-weighted
38 decibels (dBA) and therefore meet the Bon Homme County Ordinance sound
39 limits.¹

40

41 **Q. Can you discuss the accuracy of your analysis of the anticipated sound levels
42 generated by the Project?**

43 A. Yes. As I previously discussed in my Direct Testimony (Howell Direct, lines 215-22),
44 the methods we used in this study to develop potential Project sound impacts are
45 consistent with those we have used in most of our predictive studies. Nearly half of
46 the projects we study each year require post-construction compliance
47 demonstration, and that monitoring has routinely shown that our prediction methods
48 are conservative (i.e., over-predict impacts).

49

50 **III. RESPONSE TO TESTIMONY OF DAVID HESSLER**

51

52 **Q. What is your overall response to Mr. Hessler's testimony?**

53 A. I have reviewed Mr. Hessler's Direct Testimony, dated September 10, 2018.
54 Mr. Hessler concludes that our noise modeling methodology and assumptions are
55 satisfactory. Mr. Hessler concurs with our conclusion that the Project will meet the
56 Bon Homme County 45 dBA noise limit for all residences, including those in Charles
57 Mix and Hutchinson counties, where no noise limits are in force (see Hessler Direct,
58 lines 1-4). He states that 45 dBA is an appropriate and reasonably fair regulatory

¹ Bon Homme Zoning Ordinance Section 1741 provides: "Noise level produced by the LWES shall not exceed forty five (45) dBA, average A-weighted sound pressure at the perimeter of occupied residences existing at the time the permit application is filed, unless a signed waiver or easement is obtained from the owner of the residence."

59 noise limit for wind projects at non-participating residences (see Hessler Direct, lines
60 8-9). I agree with those conclusions, and I further agree with Mr. Hessler's
61 statement that regardless of sound level, not everyone will be completely satisfied
62 with turbine sound emissions.

63

64 I do not agree with Mr. Hessler's assertion that Burns & McDonnell Engineering
65 Company, Inc. ("Burns & McDonnell") should attempt to study or model the
66 subjective reactions of the community. That type of evaluation is not required, and
67 in my opinion, would be highly speculative.

68

69 **Q. Mr. Hessler faults your analysis for not "assessing or addressing in any way**
70 **the potential for an adverse community reaction to project noise." Do you**
71 **agree with this criticism?**

72 A. I agree that our analysis did not assess the potential for an adverse community
73 reaction to Project noise, but I do not agree that it should have done so. The Burns
74 & McDonnell analysis identified the Project's anticipated sound level impacts, using
75 industry-accepted methods, to determine whether the Project will comply with Bon
76 Homme County's applicable and quantifiable noise limit of 45 dBA at currently
77 inhabited dwellings. Community reaction is subjective and based on a number of
78 factors other than the sound levels actually produced.² This is true whether that
79 reaction is positive or negative. Thus, the potential for adverse community reaction
80 to Project noise is neither an objective standard for the Project to meet nor the
81 applicable regulatory standard.

82

² Michaud, David S., et. al. "Personal and situational variables associated with wind turbine noise annoyance." J. Acoust. Soc. Am. 139 (3), March 2016.

Haac, R., K. Kaliski, M. Landis, B. Hoen, J. Firestone, J. Rand. (2018) Predicting audibility of and annoyance to wind power project sounds using modeled sound. Lawrence Berkley National Laboratory. Preliminary Results Webinar. February 27, 2018.

83 **Q. Are you familiar with the work of Australian acoustician Steven Cooper, as**
84 **referenced by Mr. Hessler?**

85 A. Yes, I am familiar with Mr. Cooper of The Acoustics Group in Australia and his work.
86 Mr. Hessler refers to a paper that Mr. Cooper authored.³ The referenced paper
87 discusses a very specific method for monitoring and reproducing sound from wind
88 farms for a select group of people identified as being sensitized to wind turbine
89 noise. The paper is an extension of a sound level measurement study at the Cape
90 Bridgewater Wind Farm near Victoria, Australia, for which Mr. Cooper was the lead
91 investigator. Among other things, Mr. Cooper sought to measure infrasound and low
92 frequency sound, recreate those sounds in a laboratory, and correlate that sound to
93 adverse health effects.

94

95 **Q. What is your opinion of Mr. Cooper's study?**

96 A. I do not believe that the study provides helpful information to the Commission with
97 respect to the Project. It has methodological flaws and does not reproduce a
98 realistic environment. The study suggests that people who are more sensitive to low
99 frequency noise are able to identify low frequency noise in a controlled environment.
100 While a control group consisting of nine people (one who is hearing impaired and
101 four acousticians) was used in the study, the main test group consisted entirely of
102 people self-identified as being sensitive to wind turbine noise. The study did not
103 reproduce the types of noise that one would actually experience near a wind farm;
104 there is a significant difference in the characteristics and amplitude of the measured
105 indoor sound levels and what was reproduced in the laboratory environment. The
106 sound levels generated within Mr. Cooper's laboratory, which represent the noise
107 recorded within a single home at the Cape Bridgewater project, are significantly
108 higher (10 to 20 dB) than the ambient sound level for low frequencies and the mid
109 frequencies. Generating specific audio files in a controlled environment does not
110 actually replicate the sound a person would experience outside of a laboratory. As

³ Cooper, S., Chan, C. (2017). *Subjective perception of wind turbine noise - The stereo approach*. Proc. Mtgs. Acoust. Vol. 31, 040001.

111 such, the sounds generated and amplified for the test subjects to experience are not
112 realistic.

113

114 **Q. Do you agree with Mr. Hessler’s analysis of Mr. Cooper’s study?**

115 A. I do not agree that the Commission should rely on Mr. Cooper’s study. As I noted
116 previously, the study has methodological flaws, making it unreliable. It also does not
117 replicate the sound that individuals will actually experience near a wind farm.

118

119 **IV. RESPONSE TO TESTIMONY OF RICHARD R. JAMES**

120

121 **Q. Have you reviewed the Prefiled Testimony of Richard R. James, submitted on**
122 **behalf of intervenors in this proceeding?**

123 A. Yes. I have reviewed Mr. James’ testimony, as well as the exhibits attached to his
124 testimony.

125

126 **Q. Mr. James critiques your assessment of the Project using a 45 dBA sound**
127 **limit. How do you respond to his critique?**

128 A. The Project did not independently choose to apply the 45 dBA sound level. Rather,
129 the Bon Homme County ordinance limit of 45 dBA sound level for non-participants
130 was identified as the applicable regulatory noise limit for the Project. The Project is
131 voluntarily applying the same 45 dBA standard in Charles Mix and Hutchinson
132 Counties, neither of which has an applicable noise limit. Additionally, this is the
133 level that Mr. Hessler testifies is an appropriate and reasonable level.

134

135 **Q. Mr. James states that “the maximum sound level for audible sounds should be**
136 **35 dBA (Leq) and 50 dBC, especially for nighttime wind turbine noise.” (James**
137 **Direct, lines 101-02) How do you respond?**

138 A. I do not agree. First, C-weighted levels are of no significance to sounds created by
139 wind farms. Second, as noted by Mr. Hessler in his Direct Testimony, the 45 dBA
140 level is appropriate and C-weighting also has other serious technical problems.

141

142 **Q. Are you familiar with the paper titled *Noise: Wind Farms* included as Exhibit 2**
143 **to Mr. James' testimony?**

144 A. Yes. The paper describes wind turbines in general, and how they make noise. It
145 goes on to recommend that further research should be conducted as there is no
146 definitive evidence of wind turbine noise and direct health effects.

147
148 **Q. Do you believe that the *Noise: Wind Farms* paper provides the Commission**
149 **with important information related to the Project?**

150 A. I believe the paper makes it clear that complaints arising from wind farms are more
151 related to how people feel about the wind farm than the actual sound levels emitted
152 by the wind farm. Because of this, the paper is not very useful to the Commission in
153 relation to the Project.

154
155 **Q. Are you familiar with the work of Dr. Paul Schomer, titled *A Possible Criterion***
156 **for *Wind Farms*, included as Exhibit 3 to Mr. James' testimony?**

157 A. Yes. Dr. Schomer attempts to identify a single metric to use for determining
158 acceptability of a wind farm's sound levels based on an assumed percentage of
159 residents that would be highly annoyed. Dr. Schomer argues that the percent of
160 people highly annoyed is relatable to specific noise metrics and levels. He
161 summarizes that a day-night average sound level, where a 10 dB penalty is applied
162 to nighttime hours (DNL), is related to an equivalent sound level for a 24-hour period
163 (Leq 24-hour). Dr. Schomer's proposed metric is based on subjective perceptions
164 rather than measurable metrics. In my opinion, that is why the proposed metric has
165 not been accepted in the acoustical community.

166
167 **Q. Do you agree with Mr. James' analysis of Dr. Schomer's paper?**

168 A. No. Mr. James appears to argue that Dr. Schomer makes recommendations similar
169 to those of Mr. James regarding noise thresholds in rural communities. Dr.
170 Schomer's analysis does not support the use of dBC criteria, which runs counter to
171 Mr. James' recommendation that a 50 dBC limit be used. Additionally, as I
172 discussed above, I disagree that using a 24-hour average limit is appropriate for

173 sound produced by a wind farm, as it is likely to misrepresent the sound level of a
174 wind farm at any given time. A 24-hour Leq limit may be less restrictive than a lower
175 sound level over a shorter-duration, such as the 45 dBA limit applied with respect to
176 the Project.

177

178 **Q. Mr. James appears to assert that the Project should apply noise limits to**
179 **property lines as opposed to occupied residences. Do you agree?**

180 A. No. As I discussed above, the only applicable noise limit with respect to the Project
181 is that set by Bon Homme County. I agree with Mr. Hessler's testimony that the
182 sound levels at residences is the appropriate measurement and consistent with the
183 generally accepted methodology.

184

185 **Q. Have you reviewed Exhibit 6 to Mr. James' testimony?**

186 A. Yes, I have looked at Mr. James' Exhibit 6. There are various figures and
187 descriptions for measuring infrasound at several residences.

188

189 **Q. Do you believe that Exhibit 6 to Mr. James' testimony presents useful**
190 **information to the Commission with respect to this Project?**

191 A. No, I do not. The graphics and charts demonstrate that the sound levels measured
192 at a different, non-similar project are all significantly below the levels of perception
193 presented within numerous studies of infrasound perception and hearing from ISO
194 226.

195

196 **Q. Mr. James notes that ISO 9613-2 "states it is not applicable for noise sources**
197 **that are more than 30 meters above the ground or receiver elevation" (James**
198 **Direct, lines 249-350) and Mr. James indicates that ISO 9613-2 is not**
199 **appropriate for wind turbine noise. How do you respond?**

200 A. Using a model based on ISO 9613-2 methods for wind farm sound is a good
201 predictor of what will be measured upon completion of the Project, and is the
202 international standard approach for acoustical studies for wind farms. The modeling
203 results have been proven accurate when compared to measured results in

204 numerous studies by professionals in the industry, standards developers, and
205 government agencies.

206

207 **Q. Mr. James comments on the values for ground attenuation reflected in the**
208 **Burns & McDonnell sound model, stating that the values used for ground**
209 **attention were not disclosed and that the “proper value for ground attenuation**
210 **is ‘0’ to turn off any calculations of ground effect.” (James Direct, lines 354-**
211 **55) How do you respond?**

212 A. Using “0” for ground absorption is considered overly conservative, and is
213 representative of “hard ground” (i.e., paving, water, ice, concrete). The Project area
214 is predominantly agricultural in nature, which according to ISO 9613-2 is considered
215 “porous ground.” ISO 9613-2 suggests a ground absorption value of 1.0 for “porous
216 ground.” As a conservative assumption for the Project, we used a ground
217 absorption value of 0.5 within the model to simulate mixed ground (equally hard and
218 porous).

219

220 According to ISO 9613-2, ground absorption plays a role in three distinct areas: the
221 source, the middle, and the receiver. While the source and middle are at significant
222 elevations, the receiver area is near grade and will be influenced by the ground
223 absorption. The influence of ground absorption due to elevation of the source and
224 receiver, and therefore the middle area, is automatically determined within the
225 model. Again, assuming “0” for ground absorption near the receiver is considered
226 overly conservative.

227

228 **Q. Do you agree with Mr. James’ conclusion that predicted sound levels at**
229 **receptors in and near the Project are at least 5 dBA less than what should be**
230 **expected under operating conditions?**

231 A. No. We are confident that our modeling results are conservative and that the noise
232 levels predicted in our modeling will not be exceeded when the Project is
233 operational. Models can be set up to under predict or over predict. In a regulatory
234 setting in which compliance is based on actual wind turbine sound levels (as is the

235 case in Bon Homme County), it does not benefit the Project to under predict
236 potential sound levels. As a result, we use conservative values when practical. We
237 have developed and refined our modeling techniques using actual measurement
238 data as a basis for comparison, and generally, in a manner that has been proven
239 accurate throughout the years. As I discussed in my Direct Testimony and above,
240 post-construction monitoring results of projects for which we have completed
241 predictive sound studies are typically lower than our predictions.

242

243 **V. RESPONSE TO TESTIMONY OF JERRY L. PUNCH**

244

245 **Q. Dr. Punch suggests that LAmax is the optimal noise measurement metric.**
246 **Why didn't Burns & McDonnell use LAmax as a noise measurement metric in**
247 **its Sound Study?**

248 A. LAmax is not appropriate as a noise measurement metric for noise from wind
249 turbines. According to the World Health Organization's (2009) Night Guidelines
250 ("WHO Guidelines"), LAmax is useful to predict short-term or instantaneous noise
251 sources, such as that from barking dogs, clapping thunder, or passing cars. Thus,
252 LAmax is designed to quantify sound levels emitted from very infrequent sources of
253 noise. Wind turbines create noise on a more regular basis.

254

255 Additionally, the WHO Guidelines do not suggest LAmax as a guideline limit.
256 Rather, they suggest an Lnight, outdoor level of 40 dBA. This is an average sound
257 level during all nighttime hours (8-hour period) over each night of an entire year, and
258 the metric is inclusive of any sound that may occur. Lnight, outdoor is generally not
259 an appropriate metric for wind projects, as there will be many nights when the wind
260 turbines are not operating and would reduce the Lnight, outdoor level. The predicted
261 sound levels for the Project will be below 45 dBA would apply on any given night,
262 would not be averaged out over an entire year, and would differentiate wind turbine
263 noise from other intrusive sounds.

264

265 **Q. Dr. Punch suggests that, as an alternative to LAmax, 36-38 dBA, based on a**
266 **24-hour measurement period, is an appropriate noise limit. Do you agree?**

267 A. As discussed above, a 24-hour Leq limit is not appropriate for this type of source,
268 and is likely to misjudge the sound level of a wind farm at any given time. As such, a
269 24-hour Leq limit may be less restrictive than a lower sound level over a shorter-
270 duration, such as the 45 dBA limit applied with respect to the Project.

271
272 **Q. Dr. Punch critiques the Burns & McDonnell sound study for not including a**
273 **discussion of the annoyance and adverse health impacts of the Project. Do**
274 **you agree with Dr. Punch's assessment?**

275 A. I agree that we did not perform an analysis of annoyance. That is not a criterion for
276 compliance and would be speculative at best. The Burns & McDonnell sound study
277 focused on demonstrating compliance with the applicable sound regulations for the
278 Project.

279
280 **Q. What is your response to Dr. Punch's identification of shortcomings in your**
281 **study of background sounds?**

282 A. Dr. Punch indicated that the Burns & McDonnell ambient study showed high sound
283 levels. The report does show that an ambient L90 sound level of 45 dBA was
284 measured, but states that it was one measurement location during early evening
285 hours. All other measurements were less than 40 dBA. Sources of extraneous
286 noise were provided in Appendix A of the report. For this particular instance, birds
287 and high-speed cars are noted during the evening hours when the ambient sound
288 level reached 45 dBA. This is a reasonable early-evening sound level near a
289 roadway.

290
291 Another of the items Dr. Punch takes exception to is the use of A-weighting as
292 "misleading" in how it handles low frequencies. The report does not mislead the
293 reader and clearly states that the A-weighting network emphasizes the middle
294 frequencies and deemphasizes sounds in the low and high frequencies. A-weighting
295 is fully appropriate because the noise limit for comparison is A-weighted.

296 Additionally, as I previously discussed, using other weightings is not appropriate for
297 wind farms.

298

299 **VI. CONCLUSION**

300

301 **Q. Does this conclude your Rebuttal Testimony?**

302 A. Yes.

303

304 Dated this 26th day of September, 2018.

Chris Howell

305

306

307 Chris Howell

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