

# Shadow Flicker Report

## Heritage Wind

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## **1.0 INTRODUCTION**

This memorandum report presents an update to the results of the shadow flicker analysis for the Heritage Wind Farm (the Project; Case No. 16-F-0546) that is proposed by Heritage Wind, LLC (the Applicant). Since the submittal of the 2020 Article 10 Application, the Applicant has signed additional leases and good neighbor agreements with landowners in the vicinity of the Facility. As there have not been any changes to the proposed turbine layout or turbine models from what was presented in the Article 10 Application, the shadow flicker analysis remains the same. This memorandum presents an updated discussion of the impacts to nonparticipating residences based on the updated participation status of residences.

## **2.0 METHODS**

The methods remain as presented in the Article 10 Application.

## **3.0 RESULTS**

A summary of the projected shadow flicker at each of the 703 receptors in the Project study area is presented below:

- 136 (19%) of the receptors are not expected to experience any shadow flicker;
- 3 (0%) of the receptors may be affected 0-1 hour/year;
- 238 (34%) of the receptors may be affected 1-10 hours/year;
- 166 (24%) of the receptors may be affected 10-20 hours/year;
- 73 (10%) of the receptors may be affected 20-30 hours/year;
- 87 (12%) of the receptors may be affected for more than 30 hours/year.

These results are the same as those presented in the Article 10 Application but are provided here for context.

## **4.0 DISCUSSION**

As the above results indicate, 87 receptors could exceed 30 hours of shadow flicker per year. However, 43 (49%) of these receptors are located on properties owned by Project participants. An additional two receptors are commercial and public structures, and shadow flicker limitations are established for nonparticipating residential receptors. The analysis indicates that only 42 nonparticipating residential receptors (including unknown structures) were predicted to receive in excess of 30 hours of shadow flicker per year, which is a decrease from the 44 nonparticipating residential receptors presented in the Article 10 Application. The details regarding anticipated shadow flicker at all receptors predicted to receive in excess of 30 hours are summarized below in Table 1.

**Table 1. Receptors Predicted to Exceed 30 Hours of Shadow Flicker Annually Post Curtailment**

Receptor ID	Project Status	Predicted Annual Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Max Daily Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Shadow Flicker (days/year) <sup>2</sup>	Hours/Year Avoided by Curtailment	Days/Year Avoided by Curtailment
<b>Residence Year-Round</b>						
43	Not Participating	30:07	1:18	91	0	0
80	Not Participating	32:02	0:58	194	2:10	0
216	Not Participating	32:25	0:47	175	5:32	2
945	Not Participating	33:35	1:27	188	23:51	18
1174	Not Participating	34:32	0:48	200	1:59	32
1196	Not Participating	35:41	0:57	186	1:03	0
1167	Not Participating	36:07	0:44	226	1:28	18
217	Not Participating	36:26	0:56	170	7:31	0
191	Not Participating	37:47	0:59	131	0	0
201	Not Participating	41:04	0:54	185	5:37	0
503	Not Participating	41:14	0:44	250	0	0
778	Not Participating	41:25	1:10	114	0:49	0
423	Not Participating	42:23	0:48	216	2:16	20
1172	Not Participating	42:23	0:49	210	2:15	22
193	Not Participating	43:15	0:54	165	4:12	0
164	Not Participating	44:11	0:56	174	18:36	12
373	Not Participating	49:39	1:07	142	0:36	0
444	Not Participating	50:19	0:59	207	1:08	1
916	Not Participating	52:41	1:10	234	18:49	0
911	Not Participating	53:50	2:04	151	12:26	18
218	Not Participating	54:31	1:14	166	13:17	0
229	Not Participating	56:40	1:17	194	1:27	0
119	Not Participating	57:24	1:09	203	0:24	0
246	Not Participating	59:26	1:47	188	6:35	3
235	Not Participating	59:51	1:11	206	6:13	19
824	Not Participating	62:29	1:10	179	12:21	38
232	Not Participating	62:59	1:21	207	1:42	0
242	Not Participating	65:33	1:32	192	11:58	0
199	Not Participating	66:13	1:08	194	2:22	1
899	Not Participating	66:42	1:41	203	14:35	0
202	Not Participating	67:29	1:18	189	3:46	0
237	Not Participating	68:28	1:32	178	1:57	0

Receptor ID	Project Status	Predicted Annual Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Max Daily Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Shadow Flicker (days/year) <sup>2</sup>	Hours/Year Avoided by Curtailment	Days/Year Avoided by Curtailment
892	Not Participating	74:57	1:40	220	8:13	0
889	Not Participating	77:30	1:38	210	0:01	0
912	Not Participating	77:40	2:00	217	0:06	0
222	Not Participating	81:25	1:35	185	6:22	0
236	Not Participating	85:42	1:37	244	1:17	0
239	Not Participating	90:10	1:44	237	3:50	0
764	Participating	31:21	1:18	150	0	0
388 <sup>3</sup>	Participating	31:49	1:07	137	0	0
927	Participating	32:10	1:05	154	17:54	39
919	Participating	34:44	0:49	158	0	0
535	Participating	36:32	1:21	191	9:45	0
1182	Participating	37:07	0:46	175	0:51	0
920	Participating	37:18	0:53	155	0	0
1140	Participating	37:44	1:17	167	1:38	0
441	Participating	40:12	0:48	186	0:52	0
240	Participating	40:20	0:50	214	0	0
264 <sup>3</sup>	Participating	40:48	1:39	207	16:45	1
980	Participating	41:13	1:30	209	20:31	4
382	Participating	41:41	1:07	146	0	0
185	Participating	41:45	0:52	145	0	0
534	Participating	52:04	1:34	216	7:58	0
438	Participating	53:19	1:04	229	3:14	3
249	Participating	55:46	1:44	208	31:32	0
369	Participating	57:44	1:00	207	0	0
1009	Participating	58:38	2:03	239	4:56	1
41	Participating	63:16	1:22	179	0	0
<b>Unknown Structure<sup>1</sup></b>						
1485	Not Participating	30:16	0:46	156	0:53	20
1487	Not Participating	30:28	0:50	152	0	0
1489	Not Participating	42:15	0:56	189	0	0
1488	Not Participating	42:38	0:56	192	0	0
896	Participating	45:17	1:10	160	0:37	0
895	Participating	47:49	1:16	162	0:49	0
894	Participating	51:41	1:23	158	0:20	0

Receptor ID	Project Status	Predicted Annual Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Max Daily Shadow Flicker (hh:mm) <sup>2</sup>	Predicted Shadow Flicker (days/year) <sup>2</sup>	Hours/Year Avoided by Curtailment	Days/Year Avoided by Curtailment
<b>Public Structure</b>						
915	Not Participating	80:20	1:56	232	0:19	0
<b>Residence Dilapidated</b>						
497	Participating	73:30	1:40	254	2:34	0
1249	Participating	87:25	1:48	276	3:09	0
<b>Residence Seasonal</b>						
1248	Participating	42:03	1:30	129	0	0
<b>Commercial Structure</b>						
591	Not Participating	30:04	1:36	143	2:28	0
1145	Participating	33:02	1:08	142	1:49	1
1238	Participating	33:10	2:21	143	0:13	0
1142	Participating	33:12	1:11	156	1:40	0
1144	Participating	33:59	1:10	167	0:18	0
1141	Participating	35:58	1:12	189	1:42	0
1143	Participating	39:57	1:16	150	3:50	0
1011	Participating	41:54	1:52	212	7:08	0
1147	Participating	42:25	1:21	155	3:50	0
1013	Participating	42:55	1:49	200	5:44	7
1148	Participating	43:31	1:21	155	3:50	0
1146	Participating	44:07	1:23	158	3:50	0
1012	Participating	45:19	1:56	219	6:37	0
763	Participating	46:32	1:28	183	0	0
1014	Participating	51:48	1:58	226	4:54	5
762	Participating	54:52	1:33	206	0:30	0
1010	Participating	58:42	2:04	247	4:15	1
1015	Participating	62:56	2:05	268	2:58	1

<sup>1</sup> Unknown structures are structures that could not be definitively classified during field verification.

<sup>2</sup> Results do not account for the screening effect of trees or orientation of windows.

<sup>3</sup> The participation status has been updated to reflect landowner agreements that have been signed since the submittal of the Article 10 Application.

The results of the operational curtailment analysis remain as presented in Appendix 15-A to the Article 10 Application. Therefore, 42 nonparticipating receptors (41 residential or unknown receptors) are predicted to receive more than 30 hours of shadow flicker per year.

Receptors 264 and 388 are now participating receptors and Tables 2 and 3 of Appendix 15-A of the Article 10 Application would no longer include them.

## **5.0 CONCLUSIONS**

*WindPRO* predicted that following a proposed curtailment schedule, 87 receptors will receive more than 30 hours per year of shadow flicker from the Project turbines. Of the 87 receptors, 43 are located on properties owned by Project participants, while the remaining 44 receptors are nonparticipating. However, two of the nonparticipating receptors are commercial or public structures, and will be occupied only periodically. As a result, there is little, if any, likelihood that individuals in these receptors will actually experience 30 hours per year of shadow flicker.

The remainder of the conclusions are as presented in the Article 10 Application.

