

Ruso Wind Partners, LLC  
Ruso Wind Project and Gen-Tie Line Project  
Docket Nos. PU-19-28/PU-19-29

**Late-Filed Exhibit No. 49 – Supplemental Sound and Shadow Flicker Analyses of Turbines T-19 and T-24 With SG-4.8-145 Turbines**

At the public hearing, a request was made for additional sound and shadow flicker modeling of Turbines T-19 and T-24 with SG-4.8-145 turbines. In response copies of the following are provided herewith:

1. Updated Turbine Layout Chart (Late-Filed Hearing Exhibit No. 49(a));
2. Updated Occupied Residence Chart (Late-Filed Hearing Exhibit No. 49(b));
3. Updated Shadow Flicker Results (Late-Filed Hearing Exhibit No. 49(c)); and
4. Updated Sound Study Results (Late-Filed Hearing Exhibit No. 49(d)).

Note that the updated shadow flicker and sound study modeling was conducted prior to the removal of turbines per discussions with the Minot Air Force Base (*see* Late-Filed Exhibit No. 51). As a result of removal of the additional turbines per the request of Minot Air Force Base, shadow flicker at Receptor 28 (a participating residence for which Ruso Wind has a shadow flicker waiver) will also be reduced to 30 hours or less per year.

Updated Turbine Layout Chart

Late-Filed Exhibit No. 49(a)

Layout 21	Layout 21 Classification	Layout 25	Layout 25 Classification	X [m]	Y [m]	SGRE SG 4.8-145 @ 107.5	SGRE SWT 2.415-108 @ 80	GE 2.3-116 @ 80	GE 2.5-116 @ 90	GE 2.82-127 @ 88.5
T-05	Primary	T-01	Primary	339488.3358	5303136.913	✓	✓	✓	✓	✓
T-08	Primary	T-02	Primary	340317.544	5304055.486	✓	✓	✓	✓	✓
T-10	Primary	T-03	Primary	341059.762	5304341.53	✓	✓	✓	✓	✓
T-12	Primary	T-04	Primary	341614.088	5304294.659	✓	✓	✓	✓	✓
T-01	Primary	T-05	Primary	338486.5307	5305223.714	✓	✓	✓	✓	✓
T-02	Primary	T-06	Primary	338614.2152	5305693.665	✓	✓	✓	✓	✓
T-06	Primary	T-07	Primary	340075.1494	5307578.771	✓	✓	✓	✓	✓
T-07	Primary	T-08	Primary	340281.6232	5309362.065	✓	✓	✓	✓	✓
T-11	Primary	T-09	Primary	341219.3316	5309097.79	✓	✓	✓	✓	✓
T-14	Primary	T-10	Primary	342499.687	5308909.227	✓	✓	✓	✓	✓
T-16	Primary	T-11	Primary	342623.1376	5309427.901	✓	✓	✓	✓	✓
T-28	Primary	T-12	Eliminated	345084.6531	5304964.183	N/A	N/A	N/A	N/A	N/A
T-32	Primary	T-13	Eliminated	345615.478	5306167.066	N/A	N/A	N/A	N/A	N/A
T-26	Primary	T-14	Eliminated	344885.3078	5306562.686	N/A	N/A	N/A	N/A	N/A
T-31	Primary	T-15	Primary	345472.713	5307356.966	✓	✓	✓	✓	✓
T-23	Primary	T-16	Primary	344318.1888	5308366.394	✓	✓	✓	✓	✓
T-18	Primary	T-17	Primary	343542.2071	5309244.776	✓	✓	✓	✓	✓
T-24	Primary	T-18	Primary	344339.5717	5309178.601	✓	✓	✓	✓	✓
T-52	Primary	T-19	Primary	344231.04	5309888.56	✓	✓	✓	✓	✓
T-20	Primary	T-20	Primary	343716.4738	5310405.117	✓	✓	✓	✓	✓
T-19	Primary	T-21	Primary	343686.8309	5311489.289	✓	✓	✓	✓	✓
T-25	Primary	T-22	Primary	344509.168	5310981.654	✓	✓	✓	✓	✓
T-27	Primary	T-23	Primary	345067.2941	5310992.432	✓	✓	✓	✓	✓
T-53	Primary	T-24	Primary	345728.95	5310611.68	✓	✓	✓	✓	✓
T-30	Primary	T-25	Primary	345209.5972	5309800.764	✓	✓	✓	✓	✓
T-29	Primary	T-26	Eliminated	345150.8993	5311682.926	N/A	N/A	N/A	N/A	N/A
T-33	Primary	T-27	Primary	345848.0307	5311385.758	✓	✓	✓	✓	✓
T-34	Primary	T-28	Primary	346345.3717	5311482.326	✓	✓	✓	✓	✓
T-35	Primary	T-29	Primary	346914.8176	5311456.844	✓	✓	✓	✓	✓
T-36	Primary	T-30	Primary	348199.2886	5310460.527	✓	✓	✓	✓	✓
T-37	Primary	T-31	Primary	348739.6602	5310657.551	✓	✓	✓	✓	✓
T-40	Primary	T-32	Primary	349359.6913	5310382.765	✓	✓	✓	✓	✓
T-42	Primary	T-33	Primary	350063.7084	5310184.325	✓	✓	✓	✓	✓
T-41	Primary	T-34	Primary	349675.2476	5309168.449	✓	✓	✓	✓	✓
T-39	Primary	T-35	Primary	349291.9133	5308635.955	✓	✓	✓	✓	✓
T-38	Primary	T-36	Primary	348960.0154	5309235.587	✓	✓	✓	✓	✓
T-09	Primary	T-37	Primary	340629.1972	5306141.447	✓	✓	✓	✓	✓
T-46	Primary	T-38	Primary	341153.72	5305742.05	X	✓	✓	✓	✓
T-49	Primary	T-39	Primary	341817.07	5305544.67	X	✓	✓	✓	✓
T-50	Primary	T-40	Primary	341929.3	5305074.13	X	✓	✓	✓	✓
T-13	Primary	T-41	Primary	342242.1011	5305719.268	✓	✓	✓	✓	✓
T-15	Primary	T-42	Primary	342619.802	5306043.763	✓	✓	✓	✓	✓
T-51	Primary	T-43	Primary	342821.07	5306819.7	X	✓	✓	✓	✓
T-17	Primary	T-44	Primary	343241.8887	5307077.115	✓	✓	✓	✓	✓

Updated Turbine Layout Chart

Late-Filed Exhibit No. 49(a)

Layout 21	Layout 21 Classification	Layout 25	Layout 25 Classification	X [m]	Y [m]	SGRE SG 4.8-145 @ 107.5	SGRE SWT 2.415-108 @ 80	GE 2.3-116 @ 80	GE 2.5-116 @ 90	GE 2.82-127 @ 88.5
T-21	Primary	T-45	Primary	343745.7817	5307162.345	✓	✓	✓	✓	✓
T-48	Primary	T-46	Primary	341664.26	5307254.16	X	✓	✓	✓	✓
T-47	Primary	T-47	Primary	341262	5307733.99	X	✓	✓	✓	✓
ALT-03	Alternate	T-48	Primary	340663.4774	5308366.564	✓	✓	✓	✓	✓
ALT-05	Alternate	T-49	Alternate	342269.6217	5306948.959	✓	✓	✓	✓	✓
ALT-07	Alternate	T-50	Alternate	343117.4714	5306227.596	✓	✓	✓	✓	✓
ALT-08	Alternate	T-51	Primary	343517.5176	5308502.665	✓	✓	✓	✓	✓
ALT-10	Alternate	T-52	Alternate	344979.0861	5310374.012	✓	✓	✓	✓	✓
ALT-01	Alternate	T-53	Primary	337888.2426	5308605.779	✓	✓	✓	✓	✓
ALT-02	Alternate	T-54	Primary	338760.6319	5307711.388	✓	✓	✓	✓	✓
ALT-06	Alternate	T-55	Alternate	342621.4129	5303307.243	✓	✓	✓	✓	✓
ALT-09	Alternate	T-56	Alternate	344116.5846	5302636.274	✓	✓	✓	✓	✓
ALT-13	Alternate	T-57	Alternate	351085.6574	5309911.44	✓	✓	✓	✓	✓
T-45	Primary	T-58	Alternate	340239.42	5304679.86	X	✓	✓	✓	✓
T-44	Primary	T-59	Alternate	340073.48	5308592.97	X	✓	✓	✓	✓
T-43	Primary	T-60	Alternate	339945.61	5303463.85	X	✓	✓	✓	✓
ALT-04	Alternate	T-61	Alternate	341042.6529	5306632.975	✓	✓	✓	✓	✓
T-22	Primary	T-62	Eliminated	343897.6773	5305227.009	N/A	N/A	N/A	N/A	N/A
T-03	Primary	T-63	Alternate	338837.4625	5308371.264	X	X	✓	✓	X
ALT-12	Alternate	T-64	Eliminated	350685.2792	5306573.048	N/A	N/A	N/A	N/A	N/A
ALT-11	Alternate	T-65	Eliminated	349352.7646	5311160.96	N/A	N/A	N/A	N/A	N/A
T-04	Primary		Eliminated	339285.9298	5309501.186	N/A	N/A	N/A	N/A	N/A

Updated Occupied Residence Chart  
Ruso Wind Project

**Late-Filed Exhibit No. 49(b)**

Occupied Residence ID	Nearest Turbine ID (Layout 21)	Nearest Turbine ID (Layout 25)	Distance to Nearest Turbine (feet)	Nearest Project Turbine Status	Status	Location Relative to Project Area	Loudest Modeled Sound (dBA): GE Turbines*	Loudest Modeled Sound (dBA): Siemens Turbines*	Highest Estimated Shadow Flicker (hours/year)*
1	T-31	15	12,821.4	Primary	Non-Participating	Outside	28.5	27.6	0
2	T-31	15	10,547.8	Primary	Non-Participating	Outside	26	25.2	0
3	T-31	15	9,290.9	Primary	Participating	Outside	27.4	23.6	0
4	T-31	15	11,781.7	Primary	Participating	Outside	--	--	0
5	T-39	35	16,428.5	Primary	Non-Participating	Outside	--	--	0
6	ALT-13	57	21,411.7	Alternate	Non-Participating	Outside	43.6	43.6	0
7	T-39	35	22,297.8	Primary	Non-Participating	Outside	43	43	0
8	ALT-9	56	8,104.1	Alternate	Non-Participating	Outside	23	22.2	0
9	ALT-9	56	11,277.3	Alternate	Participating	Outside	--	--	0
10	ALT-9	56	15,010.7	Alternate	Non-Participating	Outside	--	--	0
11	ALT-9	56	5,036.0	Alternate	Non-Participating	Outside	29.5	29	0
12	ALT-9	56	5,269.2	Alternate	Participating	Outside	38.3	37.9	0
13	T-50	40	2,719.4	Primary	Participating	Inside	42.7	41.9	21.1
14	T-50	40	1,646.3	Primary	Participating	Inside	46.2	45.4	32.4
15	T-43	60	2,048.3	Alternate	Participating	Inside	43.9	43.3	24.2
16	T-45	58	2,391.9	Alternate	Non-Participating	Inside	41.8	40.8	8
17	T-1	5	2,018.2	Primary	Non-Participating	Outside	43.1	41.3	0
18	ALT-4	61	2,213.6	Alternate	Participating	Inside	44.5	44	28.2
19	ALT-5	49	2,977.4	Alternate	Participating	Inside	43	42.5	21
20	T-11	9	1,702.5	Primary	Participating	Inside	42.9	42.9	16.5
21	T-16	11	2,884.1	Primary	Participating	Outside	40.4	40	12.2
22	T-20	20	1,718.9	Primary	Participating	Inside	44.3	44.3	24.8
23	T-33	27	4,036.4	Primary	Non-Participating	Outside	38.5	38.1	0
24	T-34	28	1,954.9	Primary	Participating	Inside	42.8	42.9	36.4
25	T-38	36	2,542.3	Primary	Non-Participating	Outside	40.5	40.3	16.5
26	T-39	35	17,793.7	Primary	Non-Participating	Outside	48.3	48.3	0
27	ALT-9	56	9,224.0	Alternate	Participating	Outside	35.2	34.8	8.7
28	ALT-7	50	5,798.5	Alternate	Participating	Inside	42.9	42.9	38.9
29	T-5	1	20,787.1	Primary	Non-Participating	Outside	--	--	0
30	T-5	1	21,935.7	Primary	Non-Participating	Outside	--	--	0
31	T-5	1	17,070.8	Primary	Non-Participating	Outside	--	--	0
32	T-5	1	16,621.8	Primary	Non-Participating	Outside	--	--	0

Updated Occupied Residence Chart  
Ruso Wind Project

**Late-Filed Exhibit No. 49(b)**

Occupied Residence ID	Nearest Turbine ID (Layout 21)	Nearest Turbine ID (Layout 25)	Distance to Nearest Turbine (feet)	Nearest Project Turbine Status	Status	Location Relative to Project Area	Loudest Modeled Sound (dBA): GE Turbines*	Loudest Modeled Sound (dBA): Siemens Turbines*	Highest Estimated Shadow Flicker (hours/year)*
33	T-5	1	16,080.7	Primary	Non-Participating	Outside	--	--	0
34	T-5	1	15,454.9	Primary	Non-Participating	Outside	--	--	0
35	ALT-9	56	6,331.4	Alternate	Participating	Outside	28.3	27.6	0
36	ALT-9	56	24,941.2	Alternate	Non-Participating	Outside	--	--	0
37	ALT-9	56	24,178.8	Alternate	Non-Participating	Outside	--	--	0
38	ALT-9	56	30,436.4	Alternate	Participating	Outside	22.4	22.4	0
39	T-39	35	34,679.2	Primary	Non-Participating	Outside	31.6	31.6	0
40	T-44	59	2,206.1	Alternate	Non-Participating	Inside	42.4	41.8	14.6
41	T-6	7	2,381.9	Primary	Non-Participating	Outside	43.7	43.3	27.2
42	ALT-9	56	17,849.8	Alternate	Non-Participating	Outside	--	--	0
43	ALT-9	56	9,194.7	Alternate	Non-Participating	Outside	21.5	20.4	0
44	ALT-9	56	8,671.8	Alternate	Non-Participating	Outside	22.2	21.3	0
45	T-39	35	29,551.7	Primary	Participating	Outside	34.8	34.8	0
46	T-1	5	23,957.3	Primary	Non-Participating	Outside	19.2	19.2	0
47	T-1	5	26,685.0	Primary	Non-Participating	Outside	24.5	24.5	0
48	ALT-13	57	28,751.6	Alternate	Non-Participating	Outside	47.7	47.7	0
49	T-1	5	17,081.6	Primary	Non-Participating	Outside	27.4	27.4	0
50	ALT-4	61	1,651.4	Alternate	Participating	Inside	46.1	45.6	56.6
51	ALT-13	57	16,446.0	Alternate	Non-Participating	Outside	44	44	0
52	ALT-13	57	15,335.2	Alternate	Non-Participating	Outside	47	47	0
53	ALT-13	57	14,711.6	Alternate	Non-Participating	Outside	49.3	49.3	0
54	ALT-1	53	2,175.2	Primary	Participating	Inside	40.4	40.3	8.9
55	ALT-1	53	9,853.0	Primary	Non-Participating	Outside	32.9	32.9	0
56	ALT-1	53	8,251.9	Primary	Non-Participating	Outside	31.8	31.7	0
57	ALT-1	53	9,477.7	Primary	Non-Participating	Outside	35.5	35.5	0
58	T-7	8	3,030.8	Primary	Non-Participating	Outside	37.5	37	0
59	ALT-13	57	15,995.4	Alternate	Non-Participating	Outside	24.1	24.1	0
60	ALT-13	57	14,524.7	Alternate	Non-Participating	Outside	35.3	35.3	0
61	ALT-13	57	13,945.7	Alternate	Non-Participating	Outside	36.3	36.3	0
62	ALT-13	57	13,716.4	Alternate	Participating	Outside	36.1	36.1	0
63	ALT-13	57	10,688.5	Alternate	Participating	Outside	38	38	0
64	ALT-1	53	10,803.5	Primary	Non-Participating	Outside	24.6	24.6	0

Updated Occupied Residence Chart  
Ruso Wind Project

**Late-Filed Exhibit No. 49(b)**

Occupied Residence ID	Nearest Turbine ID (Layout 21)	Nearest Turbine ID (Layout 25)	Distance to Nearest Turbine (feet)	Nearest Project Turbine Status	Status	Location Relative to Project Area	Loudest Modeled Sound (dBA): GE Turbines*	Loudest Modeled Sound (dBA): Siemens Turbines*	Highest Estimated Shadow Flicker (hours/year)*
65	ALT-1	53	9,600.5	Primary	Non-Participating	Outside	21	19.8	0
66	ALT-1	53	9,121.5	Primary	Non-Participating	Outside	21.6	20.6	0
67	T-7	8	6,348.8	Primary	Non-Participating	Outside	29.4	28.4	0
68	T-7	8	6,270.1	Primary	Non-Participating	Outside	30.5	29.5	0

\* Based on modeling conducted prior to removal of turbines 12, 13, 14, 26, & 62. Removal of these turbines reduces shadow flicker at Occupied Residence ID 28 to below 30 hours per year.

**RUSO WIND PROJECT  
SHADOW FLICKER RESULTS**



**SHADOW FLICKER DURATION - REVISED GE LAYOUT**

Receptor Name	Easting [m]	Northing [m]	Prior Layout Flicker Duration [hours/year]	Updated Layout Flicker Duration [hours/year]	Delta Flicker Duration [hours/year]
REC-01	347,694	5,305,600	0.5	0.0	-0.5
REC-02	347,680	5,305,020	0.6	0.0	-0.6
REC-03	347,909	5,304,719	0.0	0.0	0.0
REC-04	348,191	5,304,549	0.0	0.0	0.0
REC-05	349,744	5,303,649	0.0	0.0	0.0
REC-06	354,097	5,304,122	0.0	0.0	0.0
REC-07	354,025	5,303,758	0.0	0.0	0.0
REC-08	346,117	5,301,187	0.0	0.0	0.0
REC-09	346,418	5,300,083	0.0	0.0	0.0
REC-10	345,875	5,298,412	0.0	0.0	0.0
REC-11	344,515	5,301,154	0.0	0.0	0.0
REC-12	344,273	5,304,235	0.7	0.0	-0.7
REC-13	342,749	5,304,953	26.5	21.1	-5.4
REC-14	341,433	5,305,000	35.4	32.4	-3.0
REC-15	339,687	5,304,032	17.9	14.7	-3.2
REC-16	339,876	5,305,312	14.4	0.0	-14.4
REC-17	338,934	5,304,801	4.3	0.0	-4.3
REC-18	340,669	5,307,195	23.4	20.8	-2.7
REC-19	342,477	5,307,833	25.3	19.4	-5.9
REC-20	341,313	5,309,608	11.9	3.4	-8.5
REC-21	341,888	5,309,910	14.0	8.2	-5.8
REC-22	343,294	5,310,095	20.8	11.7	-9.1
REC-23	345,735	5,312,611	4.8	0.0	-4.8
REC-24	346,436	5,312,071	28.9	20.6	-8.4
REC-25	348,199	5,309,381	12.6	8.8	-3.9
REC-26	352,761	5,304,467	0.0	0.0	0.0
REC-27	346,120	5,304,608	5.8	5.7	-0.1
REC-28	344,636	5,305,323	36.5	31.3	-5.1
REC-29	335,222	5,298,453	0.0	0.0	0.0
REC-30	334,701	5,298,469	0.0	0.0	0.0
REC-31	336,517	5,298,866	0.0	0.0	0.0
REC-32	335,014	5,300,760	0.0	0.0	0.0
REC-33	334,792	5,301,735	0.0	0.0	0.0
REC-34	338,530	5,298,525	0.0	0.0	0.0
REC-35	342,951	5,301,098	0.0	0.0	0.0
REC-36	349,361	5,297,133	0.0	0.0	0.0
REC-37	349,894	5,298,060	0.0	0.0	0.0
REC-38	352,737	5,299,208	0.0	0.0	0.0
REC-39	354,601	5,299,496	0.0	0.0	0.0
REC-40	339,527	5,308,985	14.6	14.6	0.0
REC-41	339,544	5,308,074	30.6	27.2	-3.4
REC-42	348,546	5,299,477	0.0	0.0	0.0
REC-43	343,128	5,300,014	0.0	0.0	0.0
REC-44	344,170	5,299,994	0.0	0.0	0.0
REC-45	353,242	5,300,541	0.0	0.0	0.0
REC-46	331,315	5,303,851	0.0	0.0	0.0

**RUSO WIND PROJECT  
SHADOW FLICKER RESULTS**



**SHADOW FLICKER DURATION - REVISED GE LAYOUT**

Receptor Name	Easting [m]	Northing [m]	Prior Layout Flicker Duration [hours/year]	Updated Layout Flicker Duration [hours/year]	Delta Flicker Duration [hours/year]
REC-47	330,497	5,303,698	0.0	0.0	0.0
REC-48	355,658	5,302,436	0.0	0.0	0.0
REC-49	333,282	5,305,371	0.0	0.0	0.0
REC-50	341,489	5,306,401	52.9	48.8	-4.1
REC-51	355,125	5,306,943	0.0	0.0	0.0
REC-52	354,129	5,306,364	0.0	0.0	0.0
REC-53	354,113	5,306,604	0.0	0.0	0.0
REC-54	338,231	5,309,173	2.9	1.5	-1.4
REC-55	335,152	5,309,844	0.0	0.0	0.0
REC-56	335,405	5,309,006	0.0	0.0	0.0
REC-57	335,070	5,307,972	0.0	0.0	0.0
REC-58	340,057	5,310,258	2.1	0.0	-2.1
REC-59	355,938	5,310,385	0.0	0.0	0.0
REC-60	355,465	5,309,261	0.0	0.0	0.0
REC-61	355,286	5,309,260	0.0	0.0	0.0
REC-62	355,227	5,309,338	0.0	0.0	0.0
REC-63	354,309	5,309,437	0.0	0.0	0.0
REC-64	336,302	5,311,491	0.0	0.0	0.0
REC-65	337,238	5,311,459	0.0	0.0	0.0
REC-66	337,459	5,311,353	0.0	0.0	0.0
REC-67	339,506	5,311,135	0.0	0.0	0.0
REC-68	340,572	5,311,251	0.0	0.0	0.0

**Notes:**

- [1] All coordinates presented in WGS 84 UTM Zone 14N (meters)  
 [2] Receptor coordinates provided by Ruso Wind Partners LLC in "Ruso Homes - REVISED 2018-12-04 " on December 4, 2018  
 [3] WTG coordinates used for 'Prior Layout' provided by Ruso Wind Partners, LLC in "Ruso Layout 21 Coordinates and Picture 121918 " on December 19, 2018  
 [4] WTG coordinates used for 'Updated Layout' provided by Ruso Wind Partners, LLC in "Ruso Layout 25 Coordinates and Picture 022819 " on May 9, 2019  
 [5] Prior Layout: v25 with 65 WTG (65 x GE 2.82-127 - 89m HH)  
 [6] Updated Layout: v25 with 63 WTG (62 x GE 2.82-127 - 89m HH, 1 x GE 2.5-116 - 90m HH [T-63]) and ALT-64 and ALT-65 removed  
 [7] Methodology as presented in Burns & McDonnell report dated 12-21-2018  
 [8] Results presented without neighboring projects  
 [9] Obstacles included at 5 receptor locations, as details in Burns & McDonnell report dated 12-21-2018

**RUSO WIND PROJECT  
SHADOW FLICKER RESULTS**



**SHADOW FLICKER DURATION - REVISED SIEMENS LAYOUT**

Receptor Name	Easting [m]	Northing [m]	Prior Layout Flicker Duration [hours/year]	Updated Layout Flicker Duration [hours/year]	Delta Flicker Duration [hours/year]
REC-01	347,694	5,305,600	0.0	0.0	0.0
REC-02	347,680	5,305,020	0.0	0.0	0.0
REC-03	347,909	5,304,719	0.0	0.0	0.0
REC-04	348,191	5,304,549	0.0	0.0	0.0
REC-05	349,744	5,303,649	0.0	0.0	0.0
REC-06	354,097	5,304,122	0.0	0.0	0.0
REC-07	354,025	5,303,758	0.0	0.0	0.0
REC-08	346,117	5,301,187	0.0	0.0	0.0
REC-09	346,418	5,300,083	0.0	0.0	0.0
REC-10	345,875	5,298,412	0.0	0.0	0.0
REC-11	344,515	5,301,154	0.0	0.0	0.0
REC-12	344,273	5,304,235	0.0	0.0	0.0
REC-13	342,749	5,304,953	16.7	16.7	0.0
REC-14	341,433	5,305,000	21.1	21.1	0.0
REC-15	339,687	5,304,032	24.2	24.2	-0.1
REC-16	339,876	5,305,312	8.0	8.0	0.0
REC-17	338,934	5,304,801	0.0	0.0	0.0
REC-18	340,669	5,307,195	28.1	28.2	0.1
REC-19	342,477	5,307,833	21.0	21.0	0.0
REC-20	341,313	5,309,608	16.8	16.5	-0.3
REC-21	341,888	5,309,910	12.2	12.2	0.0
REC-22	343,294	5,310,095	21.1	24.8	3.7
REC-23	345,735	5,312,611	0.0	0.0	0.0
REC-24	346,436	5,312,071	36.6	36.4	-0.2
REC-25	348,199	5,309,381	16.5	16.5	0.0
REC-26	352,761	5,304,467	0.0	0.0	0.0
REC-27	346,120	5,304,608	8.7	8.7	0.0
REC-28	344,636	5,305,323	38.9	38.9	0.0
REC-29	335,222	5,298,453	0.0	0.0	0.0
REC-30	334,701	5,298,469	0.0	0.0	0.0
REC-31	336,517	5,298,866	0.0	0.0	0.0
REC-32	335,014	5,300,760	0.0	0.0	0.0
REC-33	334,792	5,301,735	0.0	0.0	0.0
REC-34	338,530	5,298,525	0.0	0.0	0.0
REC-35	342,951	5,301,098	0.0	0.0	0.0
REC-36	349,361	5,297,133	0.0	0.0	0.0
REC-37	349,894	5,298,060	0.0	0.0	0.0
REC-38	352,737	5,299,208	0.0	0.0	0.0
REC-39	354,601	5,299,496	0.0	0.0	0.0
REC-40	339,527	5,308,985	10.7	10.7	0.0
REC-41	339,544	5,308,074	39.7	9.1	-30.6
REC-42	348,546	5,299,477	0.0	0.0	0.0
REC-43	343,128	5,300,014	0.0	0.0	0.0
REC-44	344,170	5,299,994	0.0	0.0	0.0
REC-45	353,242	5,300,541	0.0	0.0	0.0
REC-46	331,315	5,303,851	0.0	0.0	0.0

**RUSO WIND PROJECT  
SHADOW FLICKER RESULTS**



**SHADOW FLICKER DURATION - REVISED SIEMENS LAYOUT**

Receptor Name	Easting [m]	Northing [m]	Prior Layout Flicker Duration [hours/year]	Updated Layout Flicker Duration [hours/year]	Delta Flicker Duration [hours/year]
REC-47	330,497	5,303,698	0.0	0.0	0.0
REC-48	355,658	5,302,436	0.0	0.0	0.0
REC-49	333,282	5,305,371	0.0	0.0	0.0
REC-50	341,489	5,306,401	56.5	56.6	0.1
REC-51	355,125	5,306,943	0.0	0.0	0.0
REC-52	354,129	5,306,364	0.0	0.0	0.0
REC-53	354,113	5,306,604	0.0	0.0	0.0
REC-54	338,231	5,309,173	21.6	8.9	-12.7
REC-55	335,152	5,309,844	0.0	0.0	0.0
REC-56	335,405	5,309,006	0.0	0.0	0.0
REC-57	335,070	5,307,972	0.0	0.0	0.0
REC-58	340,057	5,310,258	7.5	0.0	-7.5
REC-59	355,938	5,310,385	0.0	0.0	0.0
REC-60	355,465	5,309,261	0.0	0.0	0.0
REC-61	355,286	5,309,260	0.0	0.0	0.0
REC-62	355,227	5,309,338	0.0	0.0	0.0
REC-63	354,309	5,309,437	0.0	0.0	0.0
REC-64	336,302	5,311,491	0.0	0.0	0.0
REC-65	337,238	5,311,459	0.0	0.0	0.0
REC-66	337,459	5,311,353	0.0	0.0	0.0
REC-67	339,506	5,311,135	0.0	0.0	0.0
REC-68	340,572	5,311,251	0.0	0.0	0.0

**Notes:**

- [1] All coordinates presented in WGS 84 UTM Zone 14N (meters)
- [2] Receptor coordinates provided by Ruso Wind Partners LLC in "Ruso Homes - REVISED 2018-12-04" on December 4, 2018
- [3] WTG coordinates used for 'Prior Layout' provided by Ruso Wind Partners, LLC in "Ruso Layout 21 Coordinates and Picture 121918" on December 19, 2018
- [4] WTG coordinates used for 'Updated Layout' provided by Ruso Wind Partners, LLC in "Ruso Layout 25 Coordinates and Picture 022819" on May 9, 2019
- [5] Prior Layout: v25 with 66 WTG (42 x SG4.5-145 - 107.5m HH, 11 x SWT2.415-108 - 80m HH, 13 x SG4.5-145 - 107.5m HH (alt)): HH = hub height
- [6] Updated Layout: v25 with 62 WTG (41 x SG4.2-145 - 107.5m HH, 6 x SWT2.415-108 - 80m HH, 12 alt x SG4.2-145, 3 alt x SWT2.415-108); ALT-63, -64, -65 rem.
- [7] Methodology as presented in Burns & McDonnell report dated 12-21-2018
- [8] Results presented without neighboring projects
- [9] Obstacles included at 5 receptor locations, as details in Burns & McDonnell report dated 12-21-2018

## NOISE STUDY RESULTS - REVISED GE LAYOUT

Receptor Name	Easting [m]	Northing [m]	Ruso Sound Level [dBA]	New Frontier Sound Level [dBA]	Prairie Winds Sound Level [dBA]	Total Impact Sound Level [dBA]
REC-01	347,694	5,305,600	28.5	--	--	28.5
REC-02	347,680	5,305,020	26.0	--	--	26.0
REC-03	347,909	5,304,719	24.7	--	--	24.7
REC-04	348,191	5,304,549	--	--	--	--
REC-05	349,744	5,303,649	--	--	--	--
REC-06	354,097	5,304,122	--	43.6	--	43.6
REC-07	354,025	5,303,758	--	43.0	--	43.0
REC-08	346,117	5,301,187	23.0	--	--	23.0
REC-09	346,418	5,300,083	--	--	--	--
REC-10	345,875	5,298,412	--	--	--	--
REC-11	344,515	5,301,154	29.5	--	--	29.5
REC-12	344,273	5,304,235	38.3	--	--	38.3
REC-13	342,749	5,304,953	42.7	--	--	42.7
REC-14	341,433	5,305,000	46.2	--	--	46.2
REC-15	339,687	5,304,032	43.9	--	--	43.9
REC-16	339,876	5,305,312	41.8	--	--	41.8
REC-17	338,934	5,304,801	41.3	--	--	41.3
REC-18	340,669	5,307,195	44.5	--	--	44.5
REC-19	342,477	5,307,833	43.0	--	--	43.0
REC-20	341,313	5,309,608	42.9	--	--	42.9
REC-21	341,888	5,309,910	40.4	--	--	40.4
REC-22	343,294	5,310,095	44.3	--	--	44.3
REC-23	345,735	5,312,611	38.5	--	--	38.5
REC-24	346,436	5,312,071	42.8	--	--	42.8
REC-25	348,199	5,309,381	40.5	--	--	40.5
REC-26	352,761	5,304,467	--	48.3	--	48.3
REC-27	346,120	5,304,608	35.2	--	--	35.2
REC-28	344,636	5,305,323	42.9	--	--	42.9
REC-29	335,222	5,298,453	--	--	--	--
REC-30	334,701	5,298,469	--	--	--	--
REC-31	336,517	5,298,866	--	--	--	--
REC-32	335,014	5,300,760	--	--	--	--
REC-33	334,792	5,301,735	--	--	--	--
REC-34	338,530	5,298,525	--	--	--	--
REC-35	342,951	5,301,098	28.3	--	--	28.3
REC-36	349,361	5,297,133	--	--	--	--
REC-37	349,894	5,298,060	--	--	--	--
REC-38	352,737	5,299,208	--	22.4	--	22.4
REC-39	354,601	5,299,496	--	31.6	--	31.6
REC-40	339,527	5,308,985	42.4	--	--	42.4
REC-41	339,544	5,308,074	43.7	--	--	43.7
REC-42	348,546	5,299,477	--	--	--	--
REC-43	343,128	5,300,014	21.5	--	--	21.5
REC-44	344,170	5,299,994	22.2	--	--	22.2
REC-45	353,242	5,300,541	--	34.8	--	34.8
REC-46	331,315	5,303,851	--	--	19.2	19.2
REC-47	330,497	5,303,698	--	--	24.5	24.5
REC-48	355,658	5,302,436	--	47.7	--	47.7
REC-49	333,282	5,305,371	--	--	27.4	27.4
REC-50	341,489	5,306,401	46.1	--	--	46.1
REC-51	355,125	5,306,943	--	44.0	--	44.0
REC-52	354,129	5,306,364	--	47.0	--	47.0
REC-53	354,113	5,306,604	--	49.3	--	49.3
REC-54	338,231	5,309,173	40.4	--	--	40.4
REC-55	335,152	5,309,844	--	--	32.9	32.9
REC-56	335,405	5,309,006	22.8	--	31.2	31.8
REC-57	335,070	5,307,972	21.2	--	35.4	35.5
REC-58	340,057	5,310,258	37.5	--	--	37.5

## NOISE STUDY RESULTS - REVISED GE LAYOUT

Receptor Name	Easting [m]	Northing [m]	Ruso Sound Level [dBA]	New Frontier Sound Level [dBA]	Prairie Winds Sound Level [dBA]	Total Impact Sound Level [dBA]
REC-59	355,938	5,310,385	--	24.1	--	24.1
REC-60	355,465	5,309,261	--	35.3	--	35.3
REC-61	355,286	5,309,260	--	36.3	--	36.3
REC-62	355,227	5,309,338	--	36.1	--	36.1
REC-63	354,309	5,309,437	--	38.0	--	38.0
REC-64	336,302	5,311,491	--	--	24.6	24.6
REC-65	337,238	5,311,459	21.0	--	--	21.0
REC-66	337,459	5,311,353	21.6	--	--	21.6
REC-67	339,506	5,311,135	29.4	--	--	29.4
REC-68	340,572	5,311,251	30.5	--	--	30.5

**Notes:**

[1] All coordinates provided in UTM WGS 1984 Zone 14 (meters)

[2] All coordinates provided by Ruso Wind Partners, LLC in "Ruso Homes - REVISED 2018-12-04.KMZ"

[3] Sound level impacts broken down by individual project (Ruso, New Frontier, and Prairie Winds), and by total impact of the combined projects.

[4] Layout 25 with ALT-64 removed, ALT-65 removed; same as layout '25a - 20190627' but different turbine model; 63 x GE2.82-127



NOISE STUDY RESULTS - REVISED SIEMENS LAYOUT

Receptor Name	Easting [m]	Northing [m]	Ruso Sound Level [dBA]	New Frontier Sound Level [dBA]	Prairie Winds Sound Level [dBA]	Total Impact Sound Level [dBA]
REC-01	347,694	5,305,600	27.6	--	--	27.6
REC-02	347,680	5,305,020	25.2	--	--	25.2
REC-03	347,909	5,304,719	23.6	--	--	23.6
REC-04	348,191	5,304,549	--	--	--	--
REC-05	349,744	5,303,649	--	--	--	--
REC-06	354,097	5,304,122	--	43.6	--	43.6
REC-07	354,025	5,303,758	--	43.0	--	43.0
REC-08	346,117	5,301,187	22.2	--	--	22.2
REC-09	346,418	5,300,083	--	--	--	--
REC-10	345,875	5,298,412	--	--	--	--
REC-11	344,515	5,301,154	29.0	--	--	29.0
REC-12	344,273	5,304,235	37.9	--	--	37.9
REC-13	342,749	5,304,953	41.9	--	--	41.9
REC-14	341,433	5,305,000	45.4	--	--	45.4
REC-15	339,687	5,304,032	43.3	--	--	43.3
REC-16	339,876	5,305,312	40.8	--	--	40.8
REC-17	338,934	5,304,801	41.3	--	--	41.3
REC-18	340,669	5,307,195	44.0	--	--	44.0
REC-19	342,477	5,307,833	42.5	--	--	42.5
REC-20	341,313	5,309,608	42.9	--	--	42.9
REC-21	341,888	5,309,910	40.0	--	--	40.0
REC-22	343,294	5,310,095	44.3	--	--	44.3
REC-23	345,735	5,312,611	38.1	--	--	38.1
REC-24	346,436	5,312,071	42.9	--	--	42.9
REC-25	348,199	5,309,381	40.3	--	--	40.3
REC-26	352,761	5,304,467	--	48.3	--	48.3
REC-27	346,120	5,304,608	34.8	--	--	34.8
REC-28	344,636	5,305,323	42.9	--	--	42.9
REC-29	335,222	5,298,453	--	--	--	--
REC-30	334,701	5,298,469	--	--	--	--
REC-31	336,517	5,298,866	--	--	--	--
REC-32	335,014	5,300,760	--	--	--	--
REC-33	334,792	5,301,735	--	--	--	--
REC-34	338,530	5,298,525	--	--	--	--
REC-35	342,951	5,301,098	27.6	--	--	27.6
REC-36	349,361	5,297,133	--	--	--	--
REC-37	349,894	5,298,060	--	--	--	--
REC-38	352,737	5,299,208	--	22.4	--	22.4
REC-39	354,601	5,299,496	--	31.6	--	31.6
REC-40	339,527	5,308,985	41.8	--	--	41.8
REC-41	339,544	5,308,074	43.3	--	--	43.3
REC-42	348,546	5,299,477	--	--	--	--
REC-43	343,128	5,300,014	20.4	--	--	20.4
REC-44	344,170	5,299,994	21.3	--	--	21.3
REC-45	353,242	5,300,541	--	34.8	--	34.8
REC-46	331,315	5,303,851	--	--	19.2	19.2
REC-47	330,497	5,303,698	--	--	24.5	24.5
REC-48	355,658	5,302,436	--	47.7	--	47.7
REC-49	333,282	5,305,371	--	--	27.4	27.4
REC-50	341,489	5,306,401	45.6	--	--	45.6
REC-51	355,125	5,306,943	--	44.0	--	44.0
REC-52	354,129	5,306,364	--	47.0	--	47.0
REC-53	354,113	5,306,604	--	49.3	--	49.3
REC-54	338,231	5,309,173	40.3	--	--	40.3
REC-55	335,152	5,309,844	--	--	32.9	32.9
REC-56	335,405	5,309,006	21.9	--	31.2	31.7
REC-57	335,070	5,307,972	20.0	--	35.4	35.5
REC-58	340,057	5,310,258	37.0	--	--	37.0

NOISE STUDY RESULTS - REVISED SIEMENS LAYOUT

Receptor Name	Easting [m]	Northing [m]	Ruso Sound Level [dBA]	New Frontier Sound Level [dBA]	Prairie Winds Sound Level [dBA]	Total Impact Sound Level [dBA]
REC-59	355,938	5,310,385	--	24.1	--	24.1
REC-60	355,465	5,309,261	--	35.3	--	35.3
REC-61	355,286	5,309,260	--	36.3	--	36.3
REC-62	355,227	5,309,338	--	36.1	--	36.1
REC-63	354,309	5,309,437	--	38.0	--	38.0
REC-64	336,302	5,311,491	--	--	24.6	24.6
REC-65	337,238	5,311,459	19.8	--	--	19.8
REC-66	337,459	5,311,353	20.6	--	--	20.6
REC-67	339,506	5,311,135	28.4	--	--	28.4
REC-68	340,572	5,311,251	29.5	--	--	29.5

Notes:

[1] All coordinates provided in UTM WGS 1984 Zone 14 (meters)

[2] All coordinates provided by Ruso Wind Partners, LLC in "Ruso Homes - REVISED 2018-12-04.KMZ"

[3] Sound level impacts broken down by individual project (Ruso, New Frontier, and Prairie Winds), and by total impact of the combined projects.

[4] Layout 25 with ALT-64 removed, ALT-65 removed, T-19 model swapped, T-24 model swapped; 41 x SG4.2-145 (primary), 6 x SWT-2.415-108 (primary), 13 x SG4.2-145 (alternate), 3 x SWT-2.415-108 (alternate)