

SHADOW - Main Result

Calculation: WE7, 17x V136 162m hub height, RC

Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,48	2,04	4,26	6,77	7,65	9,03	8,39	5,87	3,73	1,94	0,60	0,10

Operational hours are calculated from WTGs in calculation and wind distribution:

VTT Wind Atlas, 12 Sectors, 75 m - 200 m

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
795	453	462	455	528	611	1.493	1.173	635	554	599	767	8.525

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: DEM FI+SE

Obstacles not used in calculation

Eye height: 1,5 m

Grid resolution: 10,0 m

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

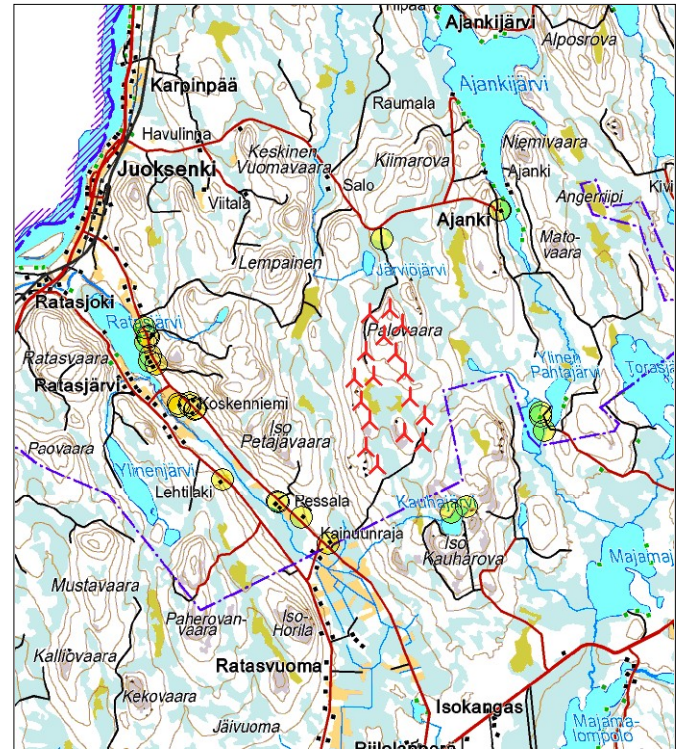
WTGs

	East	North	Z	Row data/Description	WTG type		Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.				Calculation distance [m]	RPM [RPM]
			[m]								
WTG 03	368.400	7.382.926	203,7	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 04	368.946	7.383.065	239,2	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 05	368.781	7.382.362	240,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 06	369.259	7.382.646	220,5	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 07	368.295	7.381.935	208,4	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 08	369.086	7.381.900	234,9	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 09	368.005	7.381.227	187,8	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 10	368.513	7.381.283	198,7	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 11	369.341	7.381.397	221,6	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 12	368.169	7.380.628	195,2	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 13	369.483	7.380.731	192,4	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 14	368.404	7.380.121	188,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 15	369.320	7.379.777	204,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 16	369.867	7.380.241	176,7	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 17	368.298	7.379.397	180,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 18	369.801	7.379.533	180,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 19	368.598	7.378.938	170,8	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0

Shadow receptor-Input

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
HH 104	362.498	7.382.201	72,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 111	362.611	7.381.844	70,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 116	362.592	7.381.690	64,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 145	372.940	7.380.355	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 152	372.919	7.380.235	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 159	373.024	7.379.850	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 168	370.975	7.377.840	184,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"

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Scale 1:200.000
 New WTG
 Shadow receptor

SHADOW - Main Result

Calculation: WE7, 17x V136 162m hub height, RC

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No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
HH 169	370.574	7.377.669	180,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
Metsästysmaja	368.740	7.384.928	190,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 146	362.453	7.382.574	77,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 153	362.544	7.382.362	79,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 155	362.550	7.382.324	78,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 175	362.755	7.381.607	74,7	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 199	363.667	7.380.593	72,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 200	363.362	7.380.565	66,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 204	363.662	7.380.526	70,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 205	363.375	7.380.502	65,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 206	363.805	7.380.458	73,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 208	363.785	7.380.418	70,7	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 229	364.527	7.378.562	93,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 232	365.959	7.377.974	71,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 233	365.996	7.377.961	70,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 235	366.608	7.377.543	73,4	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 236	367.325	7.376.870	72,9	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 27	371.874	7.385.678	120,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 28	371.842	7.385.676	120,1	1,0	1,0	1,5	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

Shadow, expected values
 Shadow hours

per year
 [h/year]

HH 104	0:00
HH 111	0:00
HH 116	0:00
HH 145	0:00
HH 152	0:00
HH 159	0:00
HH 168	0:00
HH 169	0:00
Metsästysmaja	0:00
RH 146	0:00
RH 153	0:00
RH 155	0:00
RH 175	0:00
RH 199	0:00
RH 200	0:00
RH 204	0:00
RH 205	0:00
RH 206	0:00
RH 208	0:00
RH 229	0:00
RH 232	0:00
RH 233	0:00
RH 235	0:00
RH 236	0:00
RH 27	0:00
RH 28	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
WTG 03	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (432	0:00	0:00
WTG 04	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (419	0:00	0:00
WTG 05	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (433	0:00	0:00
WTG 06	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (422	0:00	0:00
WTG 07	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (420	0:00	0:00
WTG 08	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (421	0:00	0:00

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SHADOW - Main Result

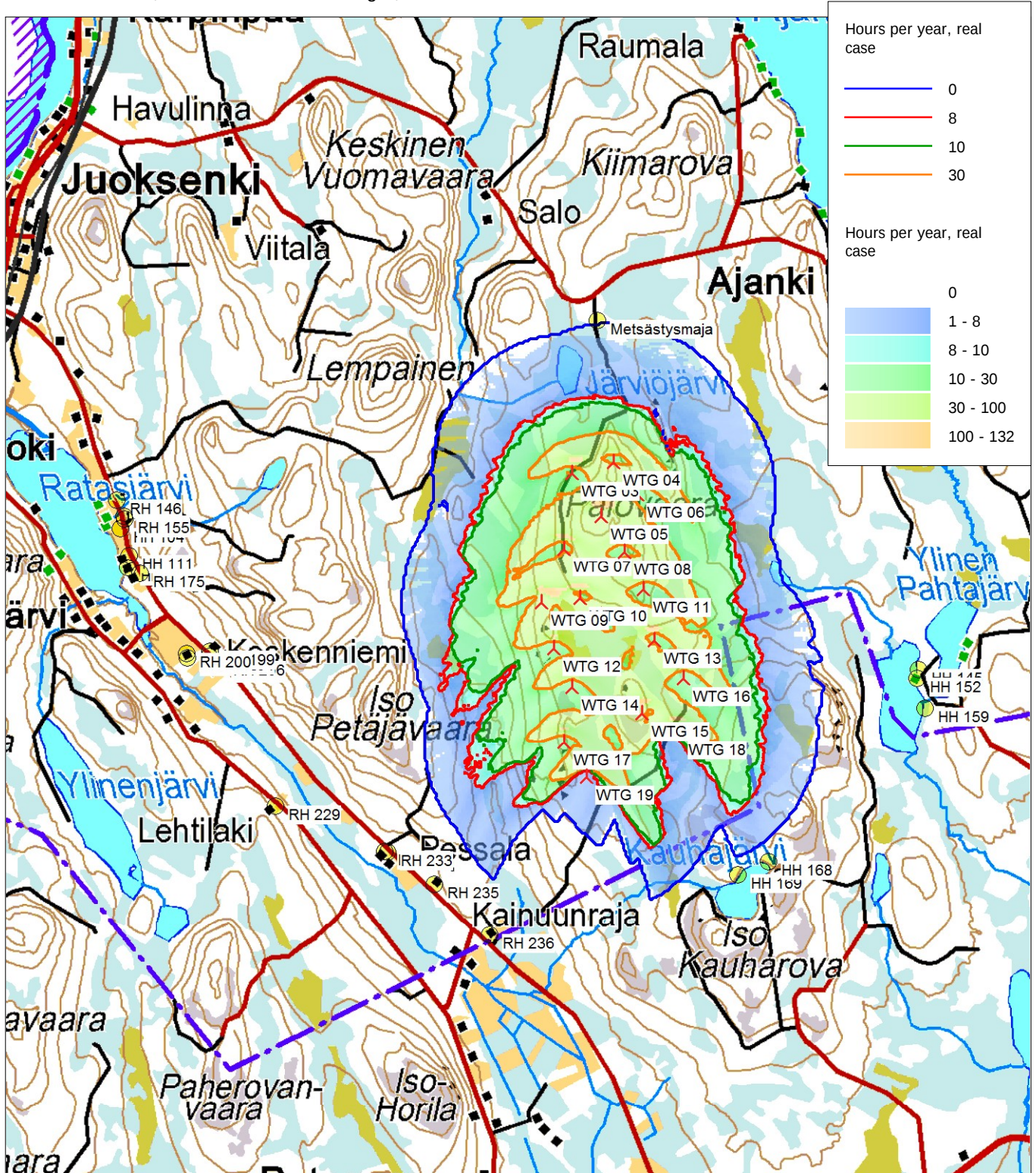
Calculation: WE7, 17x V136 162m hub height, RC

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No.	Name	Worst case [h/year]	Expected [h/year]
WTG 09	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (426	0:00	0:00
WTG 10	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (423	0:00	0:00
WTG 11	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (425	0:00	0:00
WTG 12	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (427	0:00	0:00
WTG 13	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (424	0:00	0:00
WTG 14	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (428	0:00	0:00
WTG 15	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (431	0:00	0:00
WTG 16	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (434	0:00	0:00
WTG 17	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (429	0:00	0:00
WTG 18	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (435	0:00	0:00
WTG 19	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (430	0:00	0:00

SHADOW - Map

Calculation: WE7, 17x V136 162m hub height, RC



0 1 2 3 4 km

Map: T250, Print scale 1:75.000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 367.697 North: 7.381.320

New WTG

Shadow receptor

Flicker map level: DEM FI+SE

SHADOW - Main Result

Calculation: VE7, 17x V136 162m hub height, WC

Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: DEM FI+SE

Obstacles not used in calculation

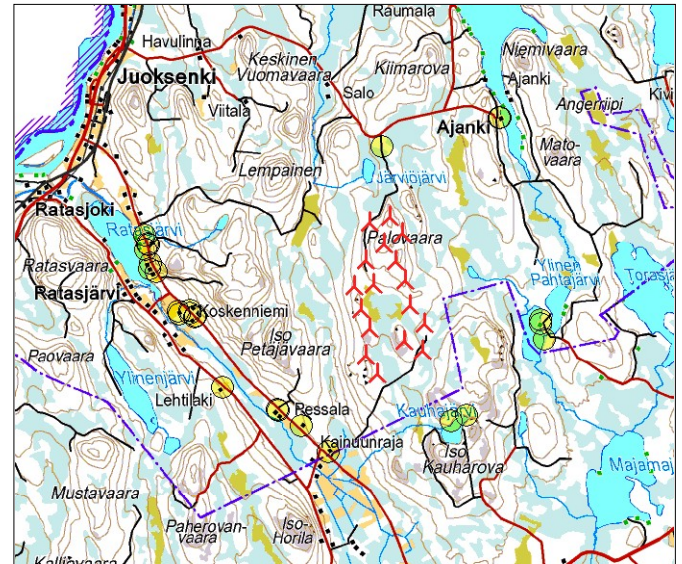
Eye height: 1,5 m

Grid resolution: 10,0 m

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTGs



▲ New WTG

Scale 1:200.000

● Shadow receptor

	East	North	Z	Row data/Description	WTG type		Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.				Calculation distance [m]	RPM [RPM]
			[m]								
WTG 03	368.400	7.382.926	203,7	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 04	368.946	7.383.065	239,2	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
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WTG 07	368.295	7.381.935	208,4	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 08	369.086	7.381.900	234,9	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
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WTG 11	369.341	7.381.397	221,6	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 12	368.169	7.380.628	195,2	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 13	369.483	7.380.731	192,4	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 14	368.404	7.380.121	188,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 15	369.320	7.379.777	204,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 16	369.867	7.380.241	176,7	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 17	368.298	7.379.397	180,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 18	369.801	7.379.533	180,0	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0
WTG 19	368.598	7.378.938	170,8	VESTAS V136-3.45 34...	Yes	VESTAS	V136-3.45 3rdOc-3.450	3.450	136,0	162,0	1.809 0,0

Shadow receptor-Input

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
HH 104	362.498	7.382.201	72,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 111	362.611	7.381.844	70,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 116	362.592	7.381.690	64,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 145	372.940	7.380.355	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 152	372.919	7.380.235	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 159	373.024	7.379.850	110,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 168	370.975	7.377.840	184,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"
HH 169	370.574	7.377.669	180,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
Metsäystymaja	368.740	7.384.928	190,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 146	362.453	7.382.574	77,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 153	362.544	7.382.362	79,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 155	362.550	7.382.324	78,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 175	362.755	7.381.607	74,7	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 199	363.667	7.380.593	72,2	1,0	1,0	1,5	0,0	90,0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: VE7, 17x V136 162m hub height, WC

...continued from previous page

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
RH 200	363.362	7.380.565	66,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 204	363.662	7.380.526	70,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 205	363.375	7.380.502	65,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 206	363.805	7.380.458	73,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 208	363.785	7.380.418	70,7	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 229	364.527	7.378.562	93,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 232	365.959	7.377.974	71,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 233	365.996	7.377.961	70,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 235	366.608	7.377.543	73,4	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 236	367.325	7.376.870	72,9	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 27	371.874	7.385.678	120,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
RH 28	371.842	7.385.676	120,1	1,0	1,0	1,5	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

No.	Shadow, worst case		
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
HH 104	0:00	0	0:00
HH 111	0:00	0	0:00
HH 116	0:00	0	0:00
HH 145	0:00	0	0:00
HH 152	0:00	0	0:00
HH 159	0:00	0	0:00
HH 168	0:00	0	0:00
HH 169	0:00	0	0:00
Metsästysmaja	0:00	0	0:00
RH 146	0:00	0	0:00
RH 153	0:00	0	0:00
RH 155	0:00	0	0:00
RH 175	0:00	0	0:00
RH 199	0:00	0	0:00
RH 200	0:00	0	0:00
RH 204	0:00	0	0:00
RH 205	0:00	0	0:00
RH 206	0:00	0	0:00
RH 208	0:00	0	0:00
RH 229	0:00	0	0:00
RH 232	0:00	0	0:00
RH 233	0:00	0	0:00
RH 235	0:00	0	0:00
RH 236	0:00	0	0:00
RH 27	0:00	0	0:00
RH 28	0:00	0	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
WTG 03	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (432	0:00	
WTG 04	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (419	0:00	
WTG 05	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (433	0:00	
WTG 06	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (422	0:00	
WTG 07	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (420	0:00	
WTG 08	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (421	0:00	
WTG 09	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (426	0:00	
WTG 10	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (423	0:00	
WTG 11	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (425	0:00	
WTG 12	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (427	0:00	
WTG 13	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (424	0:00	
WTG 14	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (428	0:00	
WTG 15	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (431	0:00	

To be continued on next page...

Project:

Palovaara_Ahkiovaara

Licensed user:

wpd AG
Stephanitorsbollwerk 3 (Haus LUV)
DE-28217 Bremen
+49 7142 77810
Johanna Bohn / j.bohn@wpd.de
Calculated:
06.04.2016 09:59/3.0.651

SHADOW - Main Result

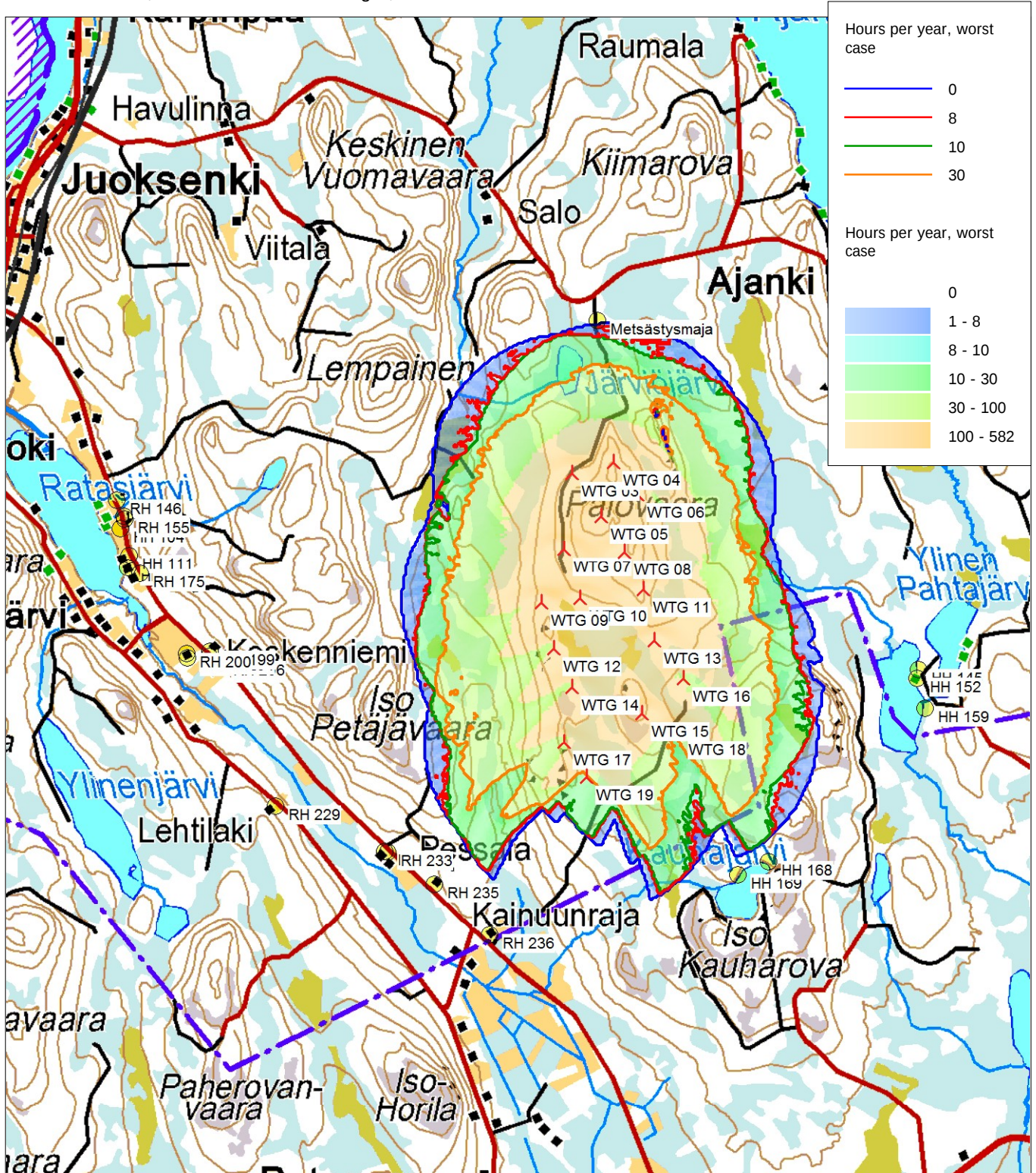
Calculation: VE7, 17x V136 162m hub height, WC

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
WTG 16	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (434	0:00	
WTG 17	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (429	0:00	
WTG 18	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (435	0:00	
WTG 19	VESTAS V136-3.45 3450 136.0 !O! hub: 162,0 m (TOT: 230,0 m) (430	0:00	

SHADOW - Map

Calculation: VE7, 17x V136 162m hub height, WC



Map: T250, Print scale 1:75.000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 367.697 North: 7.381.320

New WTG

Shadow receptor

Flicker map level: DEM FI+SE