

**Liite 1: N170 x 9 x HH145 varjostusmallinnusten tulokset "real case, no forest"**

## SHADOW - Main Result

**Calculation:** Suolakangas N170 x 9 x HH145 real case\_no forest

### 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  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

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

MERRA\_basic\_E22.668\_N62.500

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
685 506 417 419 535 785 969 1 258 974 797 630 627 8 601  
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: Height Contours: Korkeuskäyrät\_Kauhajoki.wpo (1)

Obstacles used in calculation

Eye height: 1,5 m

Grid resolution: 10,0 m

All coordinates are in

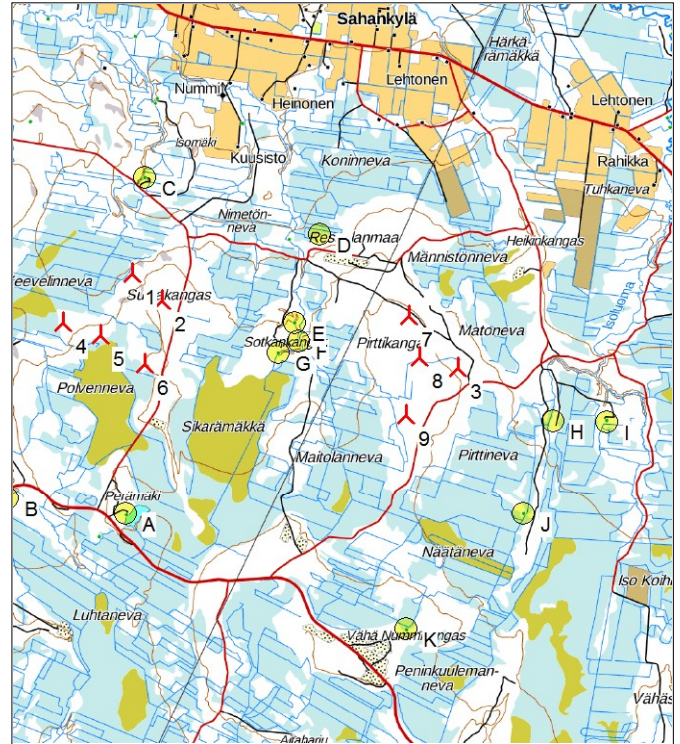
Finish TM ETRS-TM35FIN-ETRS89

### WTGs

	East	North	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	259 028	6 927 918	155,0	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
2	259 417	6 927 571	167,1	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
3	263 335	6 926 670	167,7	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
4	258 111	6 927 269	153,3	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
5	258 603	6 927 114	162,1	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
6	259 194	6 926 732	170,0	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
7	262 679	6 927 363	172,5	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
8	262 825	6 926 815	172,0	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7
9	262 650	6 926 058	172,5	NORDEX N170/4.0-4.5 4500 170.0...Yes	Yes	NORDEX	N170/4.0-4.5-4 500	4 500	170,0	145,0	1 807	10,7

### Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Height	Degrees from	Slope of	Direction mode
				[m]	[m]	[m]	a.g.l. [m]	south cw [°]	window [°]	
A	Lomarakennus (Perämäki)	258 941	6 924 744	171,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
B	Lomarakennus (Nummikankaantie 218)	257 371	6 924 948	149,3	5,0	5,0	2,0	0,0	90,0	"Green house mode"
C	Lomarakennus (Heikinkatu 25)	259 185	6 929 195	135,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
D	Lomarakennus (Ressulanmaa)	261 505	6 928 439	146,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
E	Lomarakennus (Sotkankangas I)	261 168	6 927 279	162,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
F	Lomarakennus (Sotkankangas II)	261 217	6 927 029	160,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
G	Lomarakennus (Sotkankangas III)	260 951	6 926 878	160,8	5,0	5,0	2,0	0,0	90,0	"Green house mode"
H	Lomarakennus (Ruostetuoma)	264 587	6 925 975	157,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
I	Lomarakennus (Heikinkankaantie 135)	265 298	6 925 969	153,1	5,0	5,0	2,0	0,0	90,0	"Green house mode"
J	Lomarakennus (Pukinharju)	264 198	6 924 751	163,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
K	Lomarakennus (Vähä Nummikangas)	262 649	6 923 216	187,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"



▲ New WTG

● Shadow receptor

## SHADOW - Main Result

**Calculation:** Suolakangas N170 x 9 x HH145 real case\_no forest

### Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	Lomarakennus (Perämäki)	0:00	0:00
B	Lomarakennus (Nummikankaantie 218)	0:00	0:00
C	Lomarakennus (Heikinkatu 25)	6:31	6:31
D	Lomarakennus (Ressulanmaa)	2:01	2:01
E	Lomarakennus (Sotkankangas I)	6:32	6:32
F	Lomarakennus (Sotkankangas II)	7:21	7:21
G	Lomarakennus (Sotkankangas III)	6:51	6:51
H	Lomarakennus (Ruostetuoma)	5:20	5:20
I	Lomarakennus (Heikinkankaantie 135)	0:00	0:00
J	Lomarakennus (Pukinharju)	0:00	0:00
K	Lomarakennus (Vähä Nummikangas)	0:00	0:00

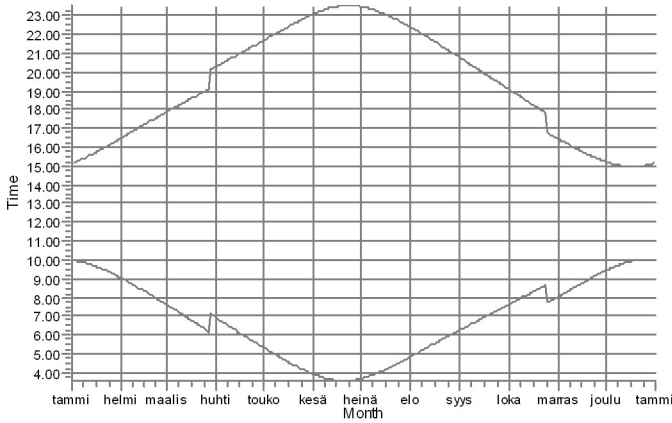
Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (57)	39:17	3:54
2	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (58)	45:29	7:16
3	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (59)	19:15	5:20
4	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (60)	0:00	0:00
5	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (61)	0:00	0:00
6	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (62)	7:40	1:36
7	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (63)	42:56	9:52
8	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (64)	17:55	3:49
9	NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (65)	8:39	1:30

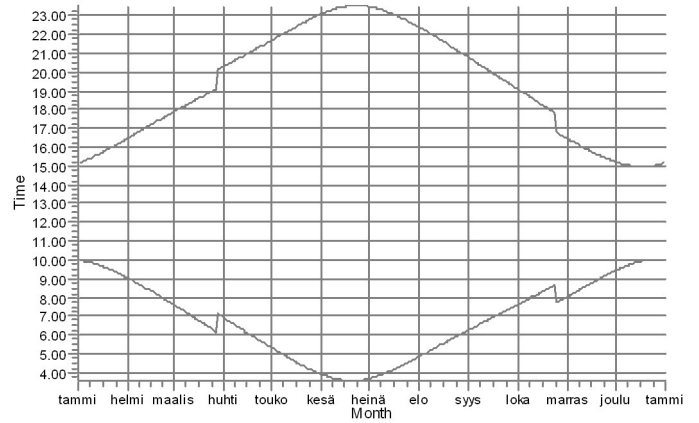
**SHADOW - Calendar, graphical**

**Calculation:** Suolakangas N170 x 9 x HH145 real case\_no forest

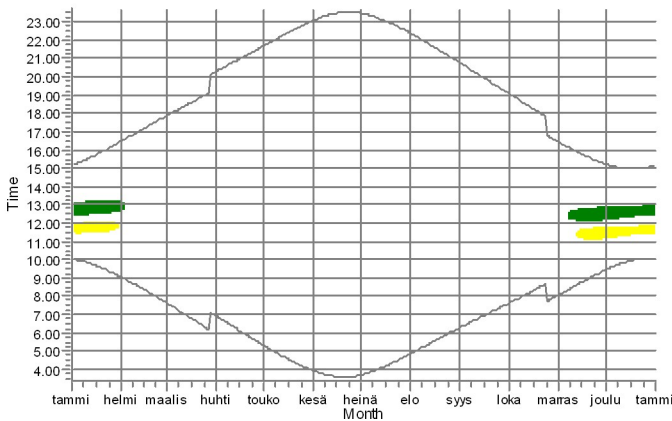
**A: Lomarakennus (Perämäki)**



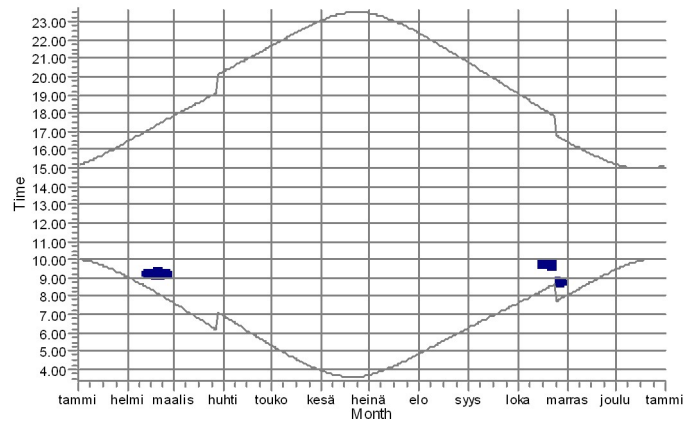
**B: Lomarakennus (Nummikankaantie 218)**



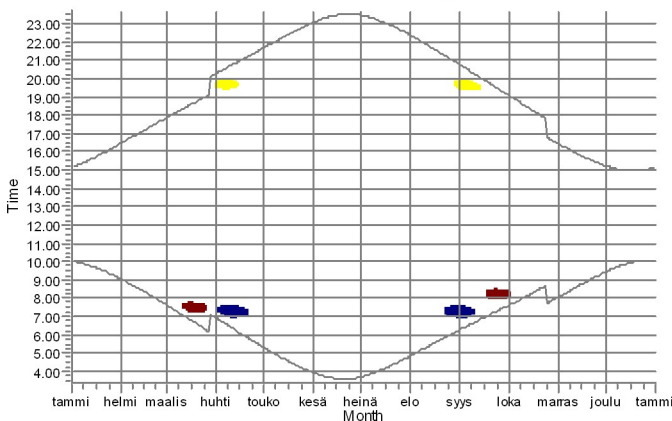
**C: Lomarakennus (Heikinkatu 25)**



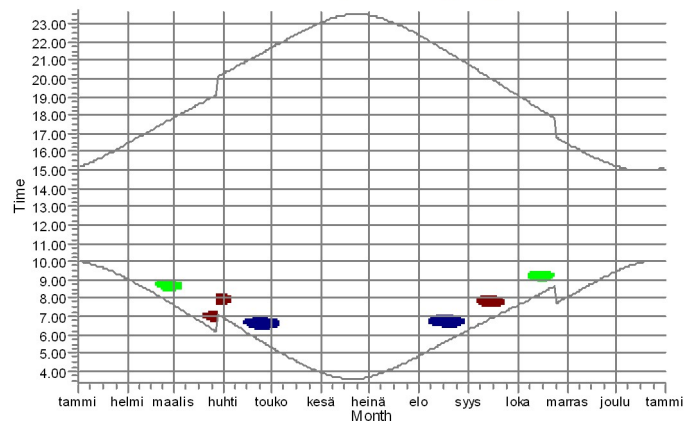
**D: Lomarakennus (Ressulanmaa)**



**E: Lomarakennus (Sotkankangas I)**



**F: Lomarakennus (Sotkankangas II)**



**WTGs**

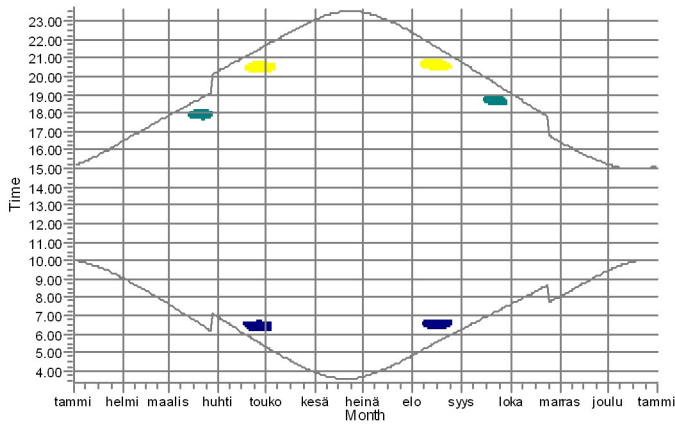
- 1: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (57)
- 2: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (58)
- 7: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (63)

- 8: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (64)
- 9: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (65)

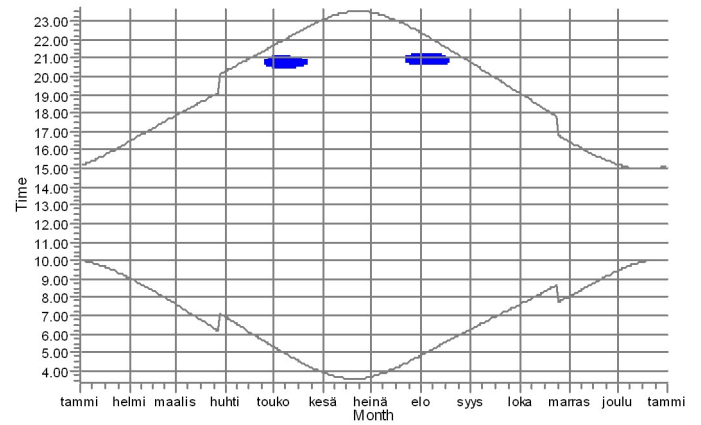
## SHADOW - Calendar, graphical

**Calculation:** Suolakangas N170 x 9 x HH145 real case\_no forest

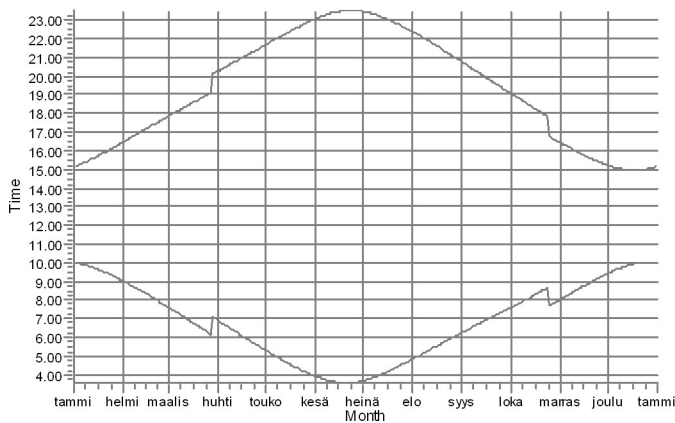
G: Lomarakenus (Sotkankangas III)



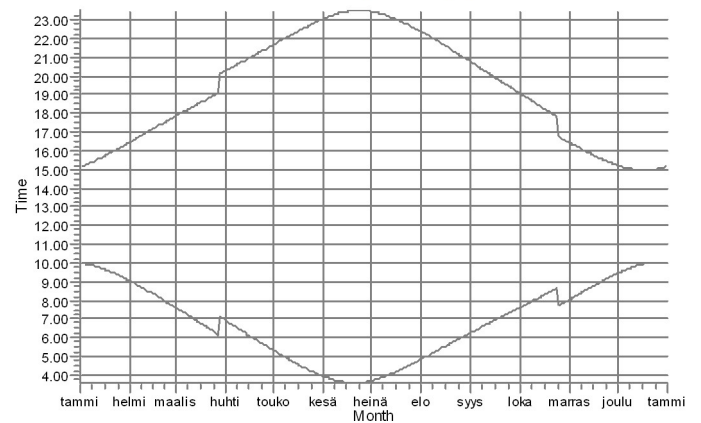
H: Lomarakenus (Ruostetuoma)



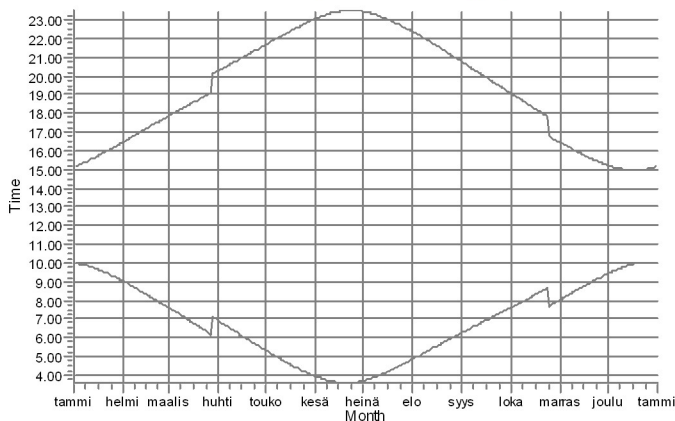
I: Lomarakenus (Heikinkankaantie 135)



J: Lomarakenus (Pukinharju)



K: Lomarakenus (Vähä Nummikangas)



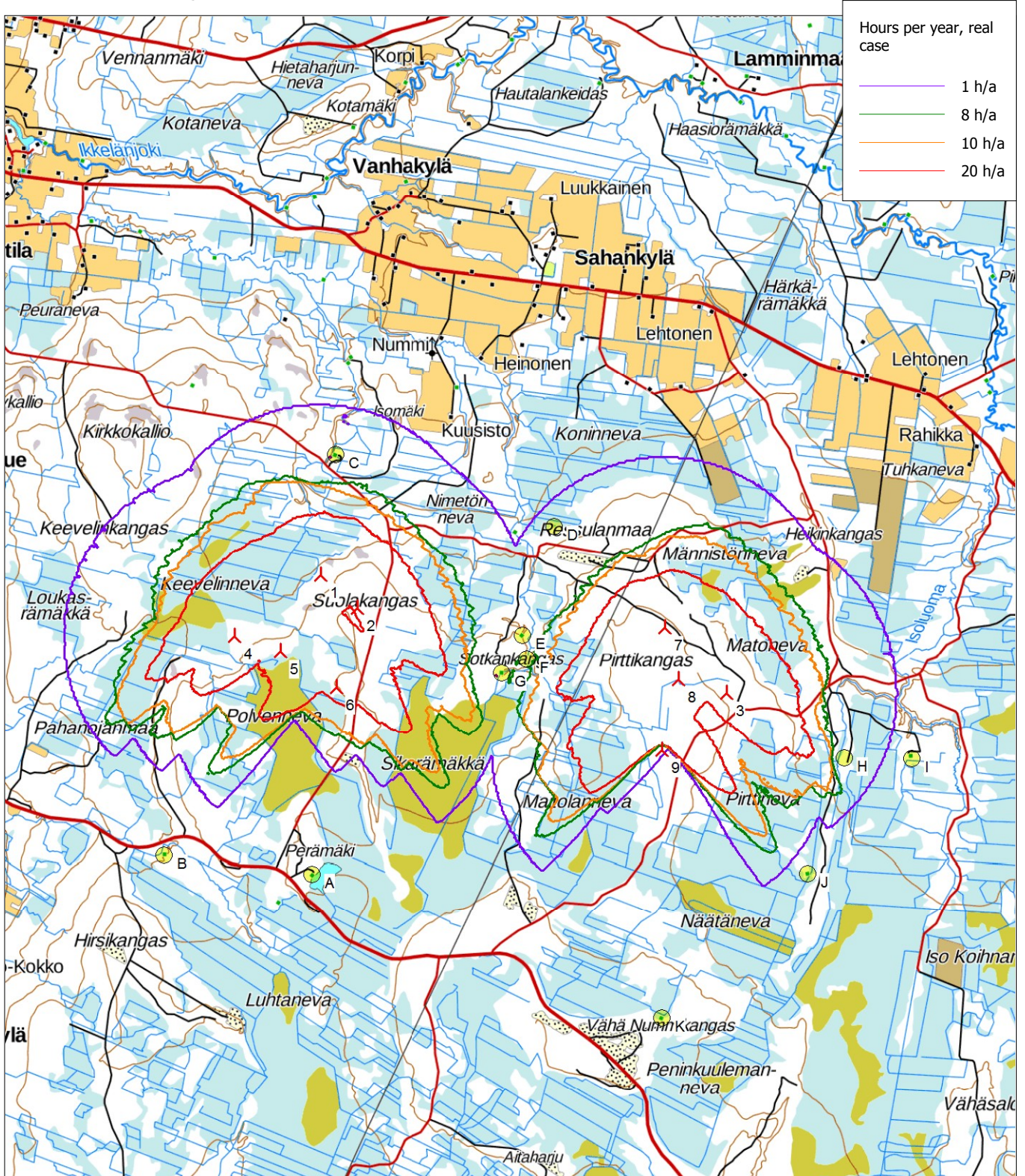
### WTGs

2: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (58)  
 3: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (59)

6: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (62)  
 7: NORDEX N170/4.0-4.5 4500 170.0 !O! hub: 145,0 m (TOT: 230,0 m) (63)

**SHADOW - Map**

**Calculation:** Suolakangas N170 x 9 x HH145 real case\_no forest

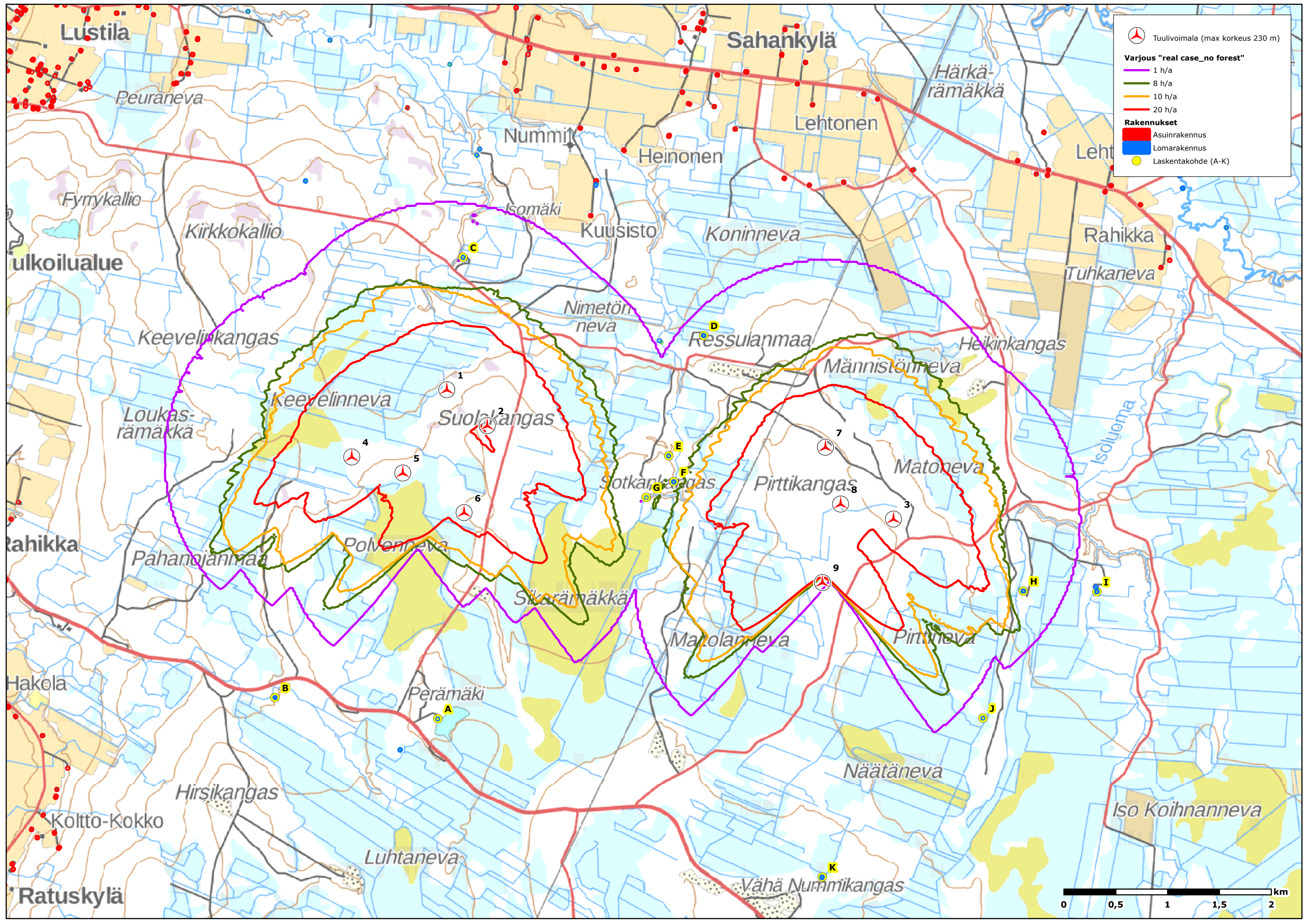



Map: Maastokartta , Print scale 1:60 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 260 450 North: 6 927 214

New WTG

Shadow receptor

Flicker map level: Height Contours: Korkeuskäyrät\_Kauhajoki.wpo (1)



 Tuulivoimala (max korkeus 230 m)  
**Varjous "real case\_no forest"**  
 1 h/a  
 8 h/a  
 10 h/a  
 20 h/a  
**Rakennukset**  
 Asuinrakennus  
 Lomarakennus  
 Laskentakohte (A-K)

