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Haukkasalon tuulivoimapuisto, Kankaanpää

Melu- ja varjostusmallinnusraportti



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Haukkasalon tuulivoimapuisto, Kankaanpää

1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET

Pohjan Voima Oy suunnittelee Haukkasalon tuulivoimapuistoa Kankaanpään kaupungin alueelle. Tuulivoimahankkeen aiheuttamia melu- ja varjostusvaikutuksia on arvioitu laatimalla mallinnukset tuulivoimaloiden aiheuttamista äänenpainetasoista ja varjostuksista. Mallinnusten tavoitteena on osoittaa, kuinka laajalle alueelle kyseiset vaikutukset ulottuvat ja arvioida vaikutukset lähiseudun ympäristöolosuhteille ja vapaa-ajan asutukselle.

Tuulivoimaloiden aiheuttamia meluvaikutuksia on arvioitu WindPRO-ohjelmalla YVA-vaiheen kahden hankevaihtoehdon voimaloiden sijoitussuunnitelmien mukaisesti. Melu- ja varjostusmallinnukset on laatinut Miikka Saranpää Harju FCG Finnish Consulting Group Oy:stä. Laaduntarkastuksen on tehnyt Johanna Harju (FCG).

2 LÄHTÖTIEDOT JA MENETELMÄT

2.1 Melu

2.1.1 Melumallinnus ISO 9613-2

Tuulivoimaloiden aiheuttamat äänenpainetasot on mallinnettu WindPRO-laskentaohjelman Decibel-moduulilla ISO 9613-2 standardin mukaisesti. Ympäristöhallinnon tuulivoimaloiden melun mallintamista koskevan ohjeen 2/2014 mukaisesti tuulen nopeutena käytettiin 10 m korkeudella mitattuna 8 m/s, ilman lämpötilana 15 °C, ilmanpaineena 101,325 kPa, ilman suhteellisenä kosteutena 70 % ja maanpinnan kovuutena arvoa 0,4. Laskenta on tehty 4,0 m maan pinnan tasosta (Taulukko 6).

Hankevaihtoehdoissa 1 voimalamäärä on 16 kpl. Hankevaihtoehdossa 2 voimalamäärä on pienempi, koostuen yhteensä 12 tuulivoimalaitoksesta. Tuulivoimaloiden äänenpainetasot on mallinnettu molemmilla hankevaihtoehdoissa käyttäen V172-7,2 MW voimalaitosta (Taulukko 1). Hankevaihtoehdoissa 1 ja 2 voimalaitosten napakorkeutena on käytetty 214 metriä, jolloin voimalaitosten kokonaiskorkeudeksi muodostuu 300 metriä. V172-7,2 MW voimalaitoksen valmistajan ilmoittama tuulivoimalan tuottama äänitehotaso on 110,1 dB(A).

Yhteismelun mallinnoissa on huomioitu Haukkasalon suunniteltujen tuulivoimaloiden lisäksi Santakankaan tuulivoimahankkeen suunnitellut tuulivoimalat sekä Paholammin tuulivoimahankkeen suunnitellut tuulivoimalat ja rakennettujen Kirkonkallion (9 kpl) ja Kooninkallion (9 kpl) tuulivoimalat. Santakankaan tuulivoimalat on mallinnettu napakorkeuksiltaan 214 m korkeilla V172-7,2MW voimaloilla, joiden roottorin halkaisija on 172 metriä (Taulukko 2). Paholammin tuulivoimalat on mallinnettu V162-6,0 MW voimaloilla ja napakorkeudella 219 m (Taulukko 3). Kirkonkallion tuulivoimalat on mallinnettu N117-2,4MW voimaloilla, joiden napakorkeus on 120 m (Taulukko 4). Kooninkallion tuulivoimalat on mallinnettu N131-3MW voimaloilla, joiden napakorkeus on 144 m (Taulukko 5).

Melumallinnusten laskentatuloksia on havainnollistettu ns. keskiäänitasokarttojen avulla. Keskiäänitasokartoissa on melun keskiäänitaso- eli ekvivalenttiäänitasokäyrät (LAeq) 5 dB välein.

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Taulukko 1. Haukkasalon tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella V172-7,2 MW sekä melun erityispiirteet.

MALLINNUSOHJELMANTIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.584				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALOIDEN TIEDOT							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V172 – 7,2 MW		Sarjanumero/t:-	
Nimellisteho: 7,2 MW		Napakorkeus: 214 m		Roottorinhalkaisija: 172 m		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä: PO7200-0S (No STE)			
Kyllä	dB	Kyllä	dB	Noise mode säätö:			Kyllä
Ei		Ei		Noise mode, lähtömelutaso			110,1 dB(A)
AKUSTISET TIEDOT/LASKENNA LÄHTÖTIEDOT							
Third octave noise emission V172-7.2MW 50/60 Hz Document no 0128-4336_00							
Oktaaveittain [Hz], dB(A)		1/3-oktaaveittain [Hz], dB(A)					
		12,5	48,6	125,0	95,2	1250,0	97,8
62,5	91,5	16,0	54,7	160,0	97,2	1600,0	96,3
125	100,2	20	60,4	200,0	98,6	2000,0	94,3
250	104,1	25	66,1	250,0	99,5	2500,0	92
500	105	31,5	71,5	315,0	99,9	3150,0	89,3
1000	103,7	40	76,7	400,0	100,2	4000,0	86,2
2000	99,3	50,0	81,5	500,0	100,2	5000,0	82,8
4000	91,6	63,0	85,8	630,0	100,2	6300,0	79
8000	80,8	80,0	89,5	800,0	99,8	8000,0	74,7
110,1 dB(A)		100,0	92,6	1000,0	99	10000	70,1
Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
kyllä	Ei	kyllä	Ei	kyllä	Ei	kyllä	Ei

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Taulukko 2. Santakankaan tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella V172-7,2 MW sekä melun erityispiirteet.

MALLINNUSOHJELMANTIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.584				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALOIDEN TIEDOT							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V172 – 7,2 MW		Sarjanumero/t:-	
Nimellisteho: 7,2 MW		Napakorkeus: 214 m		Roottorinhalkaisija: 172 m		Tornin tyyppi: teräs/hybrid	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä: PO7200-0S (No STE)			
Kyllä	dB	Kyllä	dB	Noise mode säätö:			Kyllä
Ei		Ei		Noise mode, lähtömelutaso			110,1 dB(A)
AKUSTISET TIEDOT/LASKENNA LÄHTÖTIEDOT							
Third octave noise emission V172-7.2MW 50/60 Hz Document no 0128-4336_00							
Oktaaveittain [Hz], dB(A)		1/3-oktaaveittain [Hz], dB(A)					
		12,5	48,6	125,0	95,2	1250,0	97,8
62,5	91,5	16,0	54,7	160,0	97,2	1600,0	96,3
125	100,2	20	60,4	200,0	98,6	2000,0	94,3
250	104,1	25	66,1	250,0	99,5	2500,0	92
500	105	31,5	71,5	315,0	99,9	3150,0	89,3
1000	103,7	40	76,7	400,0	100,2	4000,0	86,2
2000	99,3	50,0	81,5	500,0	100,2	5000,0	82,8
4000	91,6	63,0	85,8	630,0	100,2	6300,0	79
8000	80,8	80,0	89,5	800,0	99,8	8000,0	74,7
110,1 dB(A)		100,0	92,6	1000,0	99	10000	70,1
Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
kyllä	Ei	kyllä	Ei	kyllä	Ei	kyllä	Ei

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Taulukko 3. Paholammin tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella V162-6,0 MW sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.584				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALOIDEN TIEDOT							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V162 STE		Sarjanumero/t:-	
Nimellisteho: 6,0 MW		Napakorkeus:219 m		Roottorin halkaisija:162 m		Tornin tyyppi: teräs	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:		-	
Ei		Ei		Noise mode, lähtömelutaso		-	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
Document nro: 0095-3732_00, 2020-09-11							
Voimalaitosvalmistajan mukaan melutaso 104,3 dB(A) on IEC-standardin 61400-11 mukainen takuuarvo.							
Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz], dB(A)					
31,5	-	12,5	47,9	125	86,8	1250	93,2
63	84,1	16	53,6	160	89	1600	92
125	91,9	20	58,5	200	90,7	2000	90,5
250	96,9	25	63	250	92,1	2500	88,8
500	99,2	31,5	67,4	315	93,2	3150	86,7
1000	98,7	40	71,6	400	94,1	4000	84,1
2000	95,4	50	75,2	500	94,5	5000	81,4
4000	89,4	63	78,6	630	94,7	6300	78,3
8000	80,4	80	81,8	800	94,5	8000	74,8
104,3 dB(A)		100	84,4	1000	94	10000	71,1
Melun erityispiirteiden mittaustulos ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudi-modulaatio)		Muu, Mikä:	
kyllä	ei	kyllä	ei	kyllä	ei	kyllä	ei

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Taulukko 4. Kirkkokallion tuulivoimapuiston mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella N117-2,4 MW sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.584				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALOIDEN TIEDOT							
Tuulivoimalan valmistaja: Nordex				Tyyppi: N117		Sarjanumero/t:-	
Nimellisteho: 2,4 MW		Napakorkeus:120 m		Roottorin halkaisija:117 m		Tornin tyyppi: teräs	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:		-	
Ei		Ei		Noise mode, lähtömelutaso		-	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
F008_146_A07_EN_R00_N117-2400kW_Third_Octave (A)							
Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz], dB(A)					
31,5	-	12,5	-	125	86,5	1250	94,7
63	85,3	16	-	160	87	1600	95,7
125	90,9	20	62,5	200	90,6	2000	93,3
250	96,1	25	63	250	90,4	2500	92,7
500	98,1	31,5	67,2	315	92,3	3150	92,3
1000	99,5	40	75,9	400	93,5	4000	90,4
2000	98,9	50	76,6	500	92,3	5000	86,6
4000	95,1	63	80,3	630	93,1	6300	83,5
8000	83,5	80	84,4	800	94,4	8000	76,1
105 dB(A)		100	84	1000	94,8	10000	-
Melun erityispiirteiden mittausta ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudi-modulaatio)		Muu, Mikä:	
kyllä	ei	kyllä	ei	kyllä	ei	kyllä	ei

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Taulukko 5. Kooninkallion tuulivoimapuiston mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella N131-3,0 MW sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.584				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALOIDEN TIEDOT							
Tuulivoimalan valmistaja: Nordex				Tyyppi: N131 STE		Sarjanumero/t:-	
Nimellisteho: 3 MW		Napakorkeus:144 m		Roottorin halkaisija:131 m		Tornin tyyppi: teräs	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	-	dB	Kyllä	-	dB	Noise mode säätö:	-
Ei			Ei			Noise mode, lähtömelutaso	-
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
Document nro: F008_246_A07_EN_R01_N131-3000kW_Third_Octave							
Valmistajan ilmoittama tuulivoimalan tuottama äänitehotaso vastaa keskiäänitasoa ja lisäämällä epävarmuus 1,5 dB(A) saadaan äänitehotaso vastaamaan takuuarvoa.							
Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz], dB(A)					
31,5	-	12,5	-	125	86,2	1250	96,2
63	84,4	16	-	160	88	1600	96,3
125	91,5	20	59,3	200	90	2000	94,4
250	96,3	25	65	250	91,2	2500	93,8
500	97,9	31,5	67,8	315	92,9	3150	93,4
1000	100,8	40	73	400	92,2	4000	93
2000	99,7	50	76,5	500	92,9	5000	90,8
4000	97,3	63	81,3	630	94	6300	86,1
8000	87,2	80	85,5	800	95,7	8000	80,1
106 dB(A)		100	86,2	1000	96,3	10000	70,1
Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudi-modulaatio)		Muu, Mikä:	
kyllä	ei	kyllä	ei	kyllä	ei	kyllä	ei

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Taulukko 6. Käytetyt mallinnusparametrit ISO 9613-2 laskelmissa

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT			
Laskenta korkeus		Laskentaruudun koko [m·m]	
ISO 9613-2: 4,0 m		25x25 m	
Suhteellinen kosteus		Lämpötila	
70 %	Muu, mikä ja miksi:	ISO 9613-2: 15 C°	
Maastomallin lähde ja tarkkuus			
Maastomallin lähde: MML maastotietokanta		Vaakaresoluutio:1,0	Pystyresoluutio:0,5
Maan- ja vedenpinnan absorption ja heijastuksen huomioiminen, käytetyt kertoimet			
ISO 9613-2	0,4 / vesialueilla 0		HUOM
Ilmakehän stabiilius laskennassa/meteorologinen korjaus			
Neutraali, (0): Neutraali		Muu, mikä ja miksi:	
Sääolosuhteiden huomiointi; laskennassa käytetty tuulen suunnat ja nopeus			
Tuulen suunta: 0-360°		Tuulen nopeus: 10 metrin korkeudella mitattuna 8 m/s	
Voimalan äänen suuntaavuus ja vaimentuminen			
Vapaa avaruus: kyllä		Muu, mikä, miksi:	

2.1.2 Matalataajuinen melu

Matalataajuinen melu laskettiin Ympäristöministeriön ohjeen 2/2014 mukaisin menetelmin käyttäen voimalavalmistajilta saatuja arvioita niiden äänitehotasoista.

Ohje 2/2014 antaa menetelmän matalataajuisen melun laskentaan rakennusten ulkopuolelle. Sosiaali- ja terveysministeriön Asumisterveysasetus 2015 antaa matalataajuiselle melulle toimenpiderajat asuinhuoneissa. Rakennusten sisälle kantautuva äänitaso arvioitiin Turun AMK:n (Keränen, Hakala ja Hongisto, 2019) julkistamien Anojanssi projektin tulosten mukaisten ääneneristävyysarvoin ja tuloksia verrattiin toimenpiderajoihin.

Anojanssi projektissa mitattiin ilmaääneneristävyys standardin ISO 16283-3:2016 mukaan. Projektissa valittiin 13 pientaloa ja 26 julkisivurakennetta niin, että edustettuina oli kevyitä, raskaita, uusia ja vanhoja julkisivurakenteita. Tuloksista johdettiin 84 % persentiili, joka kertoo arvon, joka ylittyi 84 % mitatuista suomalaisista pientaloista.

Taulukko 7. Suomalaisen pientalon julkisivun äänitasoeron alalikiarvo Anojanssi projektin tulosten mukaisesti.

f [Hz]	20	25	31.5	40	50	63	80	100	125	160	200
DL _o [dB]	7.6	8.3	9.2	10.3	11.5	13.0	14.8	16.8	18.8	21.1	22.8

Matalataajuisen melun laskelmassa huomioitiin maanpinnan muodon vaikutus ohjeen 4/2014 mukaisesti. Tulokset on esitetty taajuuskohtaisena taulukkona hankealuetta ympäröiville asuin- ja lomarakennuksille.

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2.2 Varjostusmallinnus

Tuulivoimaloiden varjostusvaikutukset on mallinnettu molemmissa hankevaihtoehdoissa käyttäen roottorinhalkaisijaltaan 200 metristä voimalaitosta, jonka napakorkeus on 200 metriä. Kokonaiskorkeudeltaan voimalat ovat tällöin 300 metriä korkea.

Taulukko 8. Haukkasalon tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden koko varjostusmallinnuksessa.

MALLINNUSOHJELMAN TIEDOT			
Mallinnusohjelma ja versio: WindPRO versiot 3.5.584		Mallinnusmenetelmä: ISO 9613-2	
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)			
Tuulivoimalan valmistaja: Generic		Tyyppi: Generic RD200xHH200	Sarjanumero/t:-
Nimellisteho:	Napakorkeus: 200 m	Roottorin halkaisija: 200 m	Tornin tyyppi: teräs/hybridi

Varjostuksen yhteismallinnuksissa on huomioitu Haukkasalon suunniteltujen tuulivoimaloiden lisäksi suunnitellut Santakankaan ja Paholammin tuulivoimalat sekä rakennetut Kirkonkallion ja Kooninkallion tuulivoimalat. Santakankaan tuulivoimalat on mallinnettu napakorkeuksiltaan 200 m korkeilla voimaloilla, joiden roottorin halkaisija on 200 metriä. Paholammin tuulivoimalat on mallinnettu napakorkeudella 219 metriä ja roottorin halkaisijalla 162 metriä. Kirkonkallion tuulivoimalat on mallinnettu napakorkeudella 120 metriä ja roottorinhalkaisijalla 117 metriä. Kooninkallion tuulivoimalat on mallinnettu voimaloilla, joiden napakorkeus on 144 metriä ja roottorin halkaisijalla 131 metriä.

Varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Laskennassa varjot huomioidaan, kun aurinko on yli 3 astetta horisontin yläpuolella. Varjoksi lasketaan tilanne, jossa siipi peittää vähintään 20 % auringosta.

Auringon keskimääräiset paistetunnit perustuvat Jyväskylän sääaseman mitattuihin säätietoihin 1991 - 2020. Laskentojen tuulen suunta ja nopeusjakaumana käytettiin NASA:n MERRA-dattaa (Modern Era Retrospective-analysis for Research and Applications) hankealueen läheisyydeltä.

Varjostusmallin laskennassa on huomioitu hankealueen korkeustiedot, tuulivoimaloiden sijainnit, tuulivoimalan napakorkeudet ja roottorin halkaisija sekä hankealueen aikavyöhyke. Mallinnuksessa otettiin huomioon auringon asema horisontissa eri kellon- ja vuodenaikoina, pilvisuus kuukausittain eli kuinka paljon aurinko paistaa ollessaan horisontin yläpuolella sekä tuulivoimalaitosten arvioitu vuotuinen käyntiaika.

Varjostuksen tarkastelukorkeutena lähialueen asuin- tai lomarakennusten pihapiirissä käytettiin 1,0 metriä ja laskenta-alueen kokoa 5,0 x 5,0 metriä. Laskentaikkunoiden suunnat asennettiin voimaloita kohti ns. "greenhouse mode". Mallinnus tehtiin niin sanotulle todelliselle tilanteelle (real case). Mallinnus tehtiin kahdelle eri laskentatilanteelle:

- 1) Todellinen tilanne, jossa puuston suojaavaa vaikutusta ei huomioitu (real case, no forest)
- 2) Todellinen tilanne, jossa puuston suojaavaa vaikutusta on huomioitu (real case, Luke forest). Puuston huomioivissa varjostusmallinnuksissa on huomioitu puuston peittävyys käyttämällä Luonnonvarakeskuksen vuoden 2019 puuston keskipituus aineistoa.

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Varjostusmallinnusten tuloksia on havainnollistettu karttojen avulla. Kartoilla esitetään varjostusvaikutuksen (1, 8 ja 20 tuntia vuodessa) laajuus. Sen lisäksi mallinnuksessa on erikseen laskettu vaikutus tuulivoimahankealueen ympäristössä oleviin herkkiin kohteisiin.

2.3 Raja- ja ohjearvot

2.3.1 Melu

Valtioneuvoston asetuksessa (1107/2015) tuulivoimaloille on määritelty suunnitteluarvot päivä- ja yöajan keskiäänitasojen maksimiarvolle. Jos tuulivoimalan melu sisältää tonaalisia, kapeakaistaisia tai impulssimaisia komponentteja, tai se on selvästi amplitudimoduloitunutta, mallinnustuloksiin tulee ohjeen mukaan lisätä viisi desibeliä ennen ohjearvoon vertaamista. Koska ohjearvo sisältää jo tyypillisen tuulivoimamelun piirteet, edellä mainitut äänenpiirteiden tulee olla tuulivoimalalle epätyypillisen voimakkaita, jotta mallinnustuloksissa täytyy huomioida viiden desibelin lisä äänenvoimakkuuteen.

Taulukko 9. Valtioneuvoston asetuksen mukaiset tuulivoimaloiden melutason toimenpiderajat (Valtioneuvoston asetus 27.8.2015).

Vaikutuskohde	Päivä (7-22)	Yö (22-7)
Pysyvä asutus	45 dB	40 dB
Loma-asutus	45 dB	40 dB
Hoitolaitokset	45 dB	40 dB
Oppilaitokset	45 dB	—
Virkistysalueet	45 dB	—
Leirintäalueet	45 dB	40 dB
Kansallispuistot	40 dB	40 dB

Sosiaali- ja terveystieteiden ministeriön asetuksessa (545/2015) on annettu matalataajuiselle melulle toimenpiderajoja. Toimenpiderajat koskevat asuinhuoneita ja ne on annettu taajuuspainottamattomina yhden tunnin keskiäänitasoina tersseittäin. Toimenpiderajat koskevat yöaikaa ja päivällä sallitaan 5 dB suuremmat arvot.

Taulukko 10. Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat nukkumiseen tarkoitetuissa tiloissa.

Terssikaista Hz	20	25	31,5	40	50	63	80	100	125	160	200
Keskiäänitaso L _{Zeq,1h} , dB	74	64	56	49	44	42	40	38	36	34	32
Edellisestä laskettu keskiäänitaso A-painotettuna L _{Aeq,1h} , dB	24	19	17	14	14	16	18	19	20	21	21

Lisäksi yöaikainen mahdollisesti unihäiriötä aiheuttava melu, joka erottuu selvästi taustamelusta, ei saa ylittää 25 dB yhden tunnin keskiäänitasona L_{Aeq,1h} mitattuna niissä tiloissa, jotka on tarkoitettu nukkumiseen.

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2.3.2 Varjostus

Suomessa ei ole viranomaisten antamia yleisiä määräyksiä tuulivoimaloiden muodostaman varjostuksen enimmäiskestoista eikä varjonmuodostuksen arviointiperusteista. Ympäristöministeriön tuulivoimarakentamisen suunnitteluohjeistuksessa esitetään käytettäväksi muiden maiden suosituksia välkkeen rajoittamisesta (Ympäristöministeriö 2012).

Useissa maissa on annettu raja-arvoja tai suosituksia hyväksyttävän välkevaikutuksen määrästä. Esimerkiksi Ruotsissa suositus on kahdeksan tuntia vuodessa ja 30 minuuttia päivässä.

Arvioinnissa on tarkasteltu vaikutuksia alueella, jossa varjoja tai välkettä mallinnuksen mukaisessa todellisessa tilanteessa ("Real Case") esiintyy vähintään kahdeksan tuntia vuodessa.

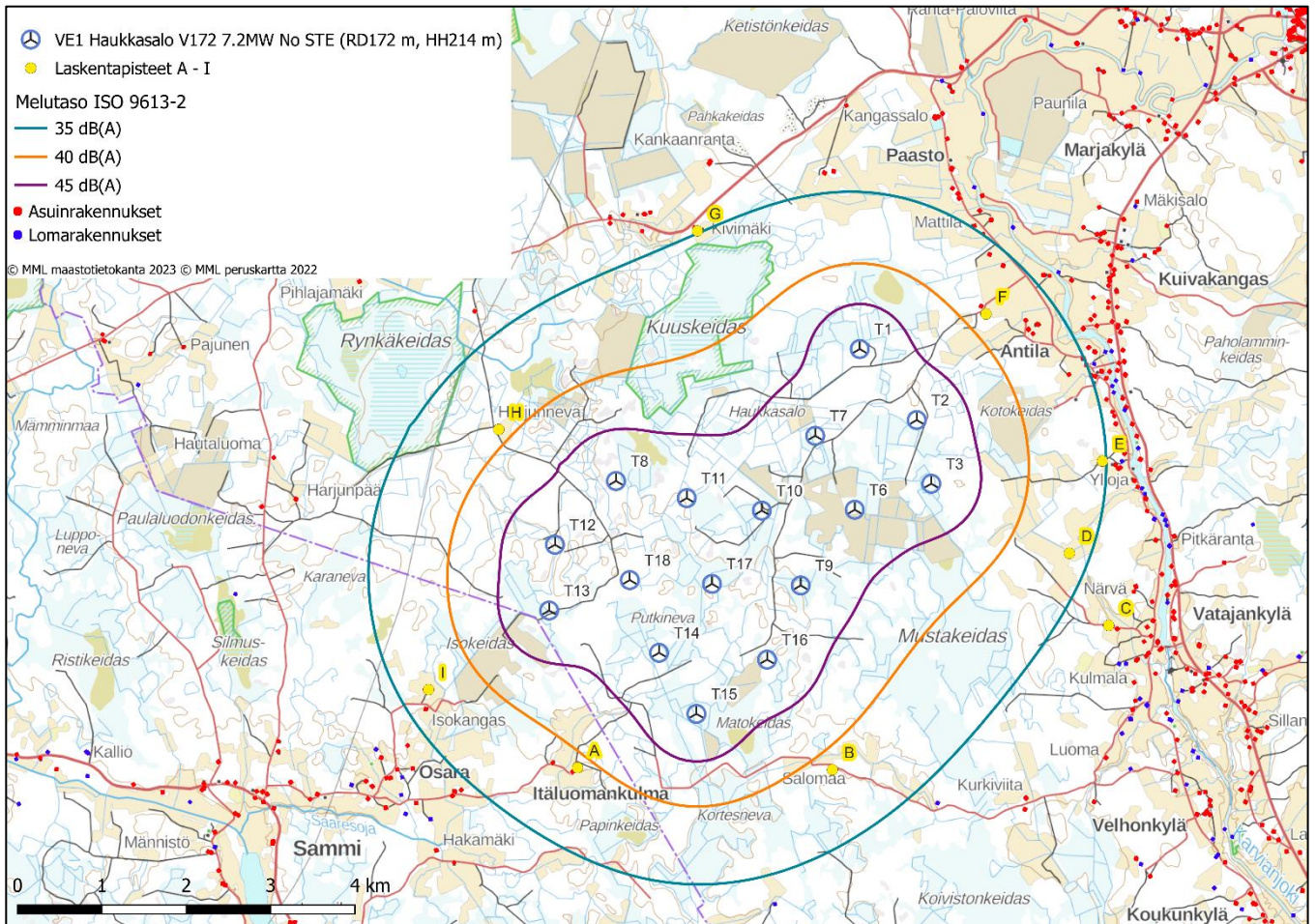
1.3.2023

3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET

3.1 Melu

3.1.1 VE1: Melun laskentatulokset (ISO 9613-2)

Hankevaihtoehdon 1 (VE1) melumallinnuksen tulosten mukaan melutaso 40 dB(A) ei ylitä lähimillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 1.



Kuva 1. Melumallinnuksen tulos hankevaihtoehdossa 1

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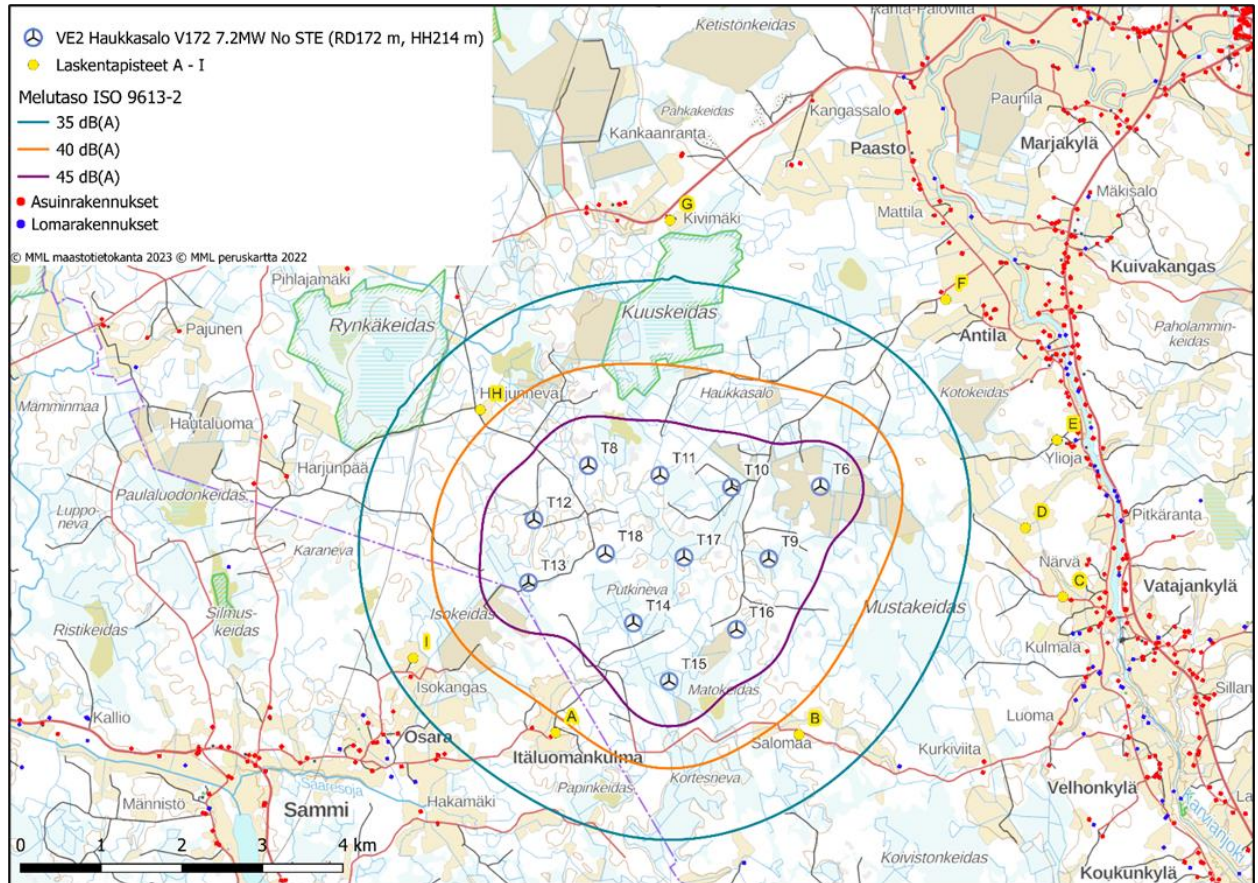
Taulukko 11. Laskennalliset melutasot Haukkasalon tuulivoimahankkeen ympäristössä hankevaihtoehdossa 1

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
A - Asuinrakennus	243 235	6 873 658	80	4	39,1
B - Asuinrakennus	246 258	6 873 632	87,4	4	38,7
C - Asuinrakennus	249 534	6 875 344	92,8	4	33
D - Lomarakennus	249 068	6 876 198	92,5	4	36,1
E - Asuinrakennus	249 460	6 877 291	95	4	35,2
F - Asuinrakennus	248 080	6 879 034	96,2	4	38,5
G - Asuinrakennus	244 657	6 880 019	94,1	4	34,9
H - Asuinrakennus	242 301	6 877 666	90	4	39,1
I - Asuinrakennus	241 468	6 874 582	81,7	4	36,6

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3.1.2 VE2: Melun laskentatulokset ISO 9613-2)

Hankevaihtoehdon 2 (VE2) melumallinnuksen mukaan melutaso 40 dB(A) ei ylitä lähimmillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 2.



Kuva 2. Melumallinnuksen tulos hankevaihtoehdossa 2

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Taulukko 12. Laskennalliset melutasot Haukkasalon tuulivoimahankkeen ympäristössä hankevaihtoehdossa 2

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta- korkeus (m)	Melutaso dB(A)
A - Asuinrakennus	243 235	6 873 658	80	4	39
B - Asuinrakennus	246 258	6 873 632	87,4	4	38,4
C - Asuinrakennus	249 534	6 875 344	92,8	4	30,3
D - Lomarakennus	249 068	6 876 198	92,5	4	32,2
E - Asuinrakennus	249 460	6 877 291	95	4	30,4
F - Asuinrakennus	248 080	6 879 034	96,2	4	31,3
G - Asuinrakennus	244 657	6 880 019	94,1	4	32,2
H - Asuinrakennus	242 301	6 877 666	90	4	38,9
I - Asuinrakennus	241 468	6 874 582	81,7	4	36,5

3.1.3 Matalataajuiset melutasot

Sisätilojen laskennallisia tuloksia on verrattu Sosiaali- ja terveysministeriön (STM) Asumisterveysasetuksessa (545/2015) annettuihin toimenpiderajoihin. Nämä ovat enimmäisarvoja, jotka on laadittu yöaikaiselle melulle nukkumiseen tarkoitettuihin tiloihin.

Haukkasalon tuulivoimahankkeen aiheuttama matalataajuinen melu ei kummassakaan hankevaihtoehdossa ylitä Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteiden sisätiloissa.

Hankevaihtoehdon 1 tulokset laskentapisteittäin on esitetty taulukossa 13 ja hankevaihtoehdon 2 taulukossa 14. Taulukoissa näkyy jokaisen laskentapisteen terssikaistakohtaiset arvot.

Tarkemmat matalataajuisen yhteismelun rakennuskohtaiset laskentatulokset ja kuvaajat on esitetty liitteissä 3 ja 4.

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Taulukko 13. Matalataajuisen melun laskentatulokset VE1

Pienitaajuisen melun laskenta menetelmä: ISO 9613-2, Anojanssi (Keränen, Hakala ja Hongisto, 2019)											
Terssin painottamaton äänitaso Leq dB - altistuvien laskentapisteiden (rakennusten) sisätiloissa											
Terssikaista [Hz]	20	25	31,5	40	50	63	80	100	125	160	200
Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat LZeq,1h, dB	74,0	64,0	56,0	49,0	44,0	42,0	40,0	38,0	36,0	34,0	32,0
Laskentapiste A	41,9	40,7	39,6	38,7	37,4	35,7	33,2	29,9	25,9	20,6	17,2
Laskentapiste B	41,8	40,5	39,3	38,4	37,1	35,4	32,8	29,5	25,6	20,2	16,8
Laskentapiste C	40,6	38,6	36,9	36,2	34,4	32,4	29,6	26,1	21,8	16,2	12,5
Laskentapiste D	41,6	39,7	38,3	37,6	35,9	34	31,3	27,9	23,8	18,3	14,8
Laskentapiste E	42,1	39,9	38,4	37,7	35,7	33,8	31,1	27,6	23,4	18	14,5
Laskentapiste F	42,3	40,6	39,3	38,5	37	35,2	32,6	29,3	25,3	20	16,6
Laskentapiste G	39,9	38,4	37,2	36,3	34,9	33,1	30,5	27,1	23	17,4	13,7
Laskentapiste H	42	40,7	39,6	38,7	37,5	35,8	33,2	29,9	26	20,7	17,2
Laskentapiste I	40,7	39,4	38,3	37,4	36,1	34,4	31,8	28,5	24,5	19	15,5

Taulukko 14. Matalataajuisen melun laskentatulokset VE2

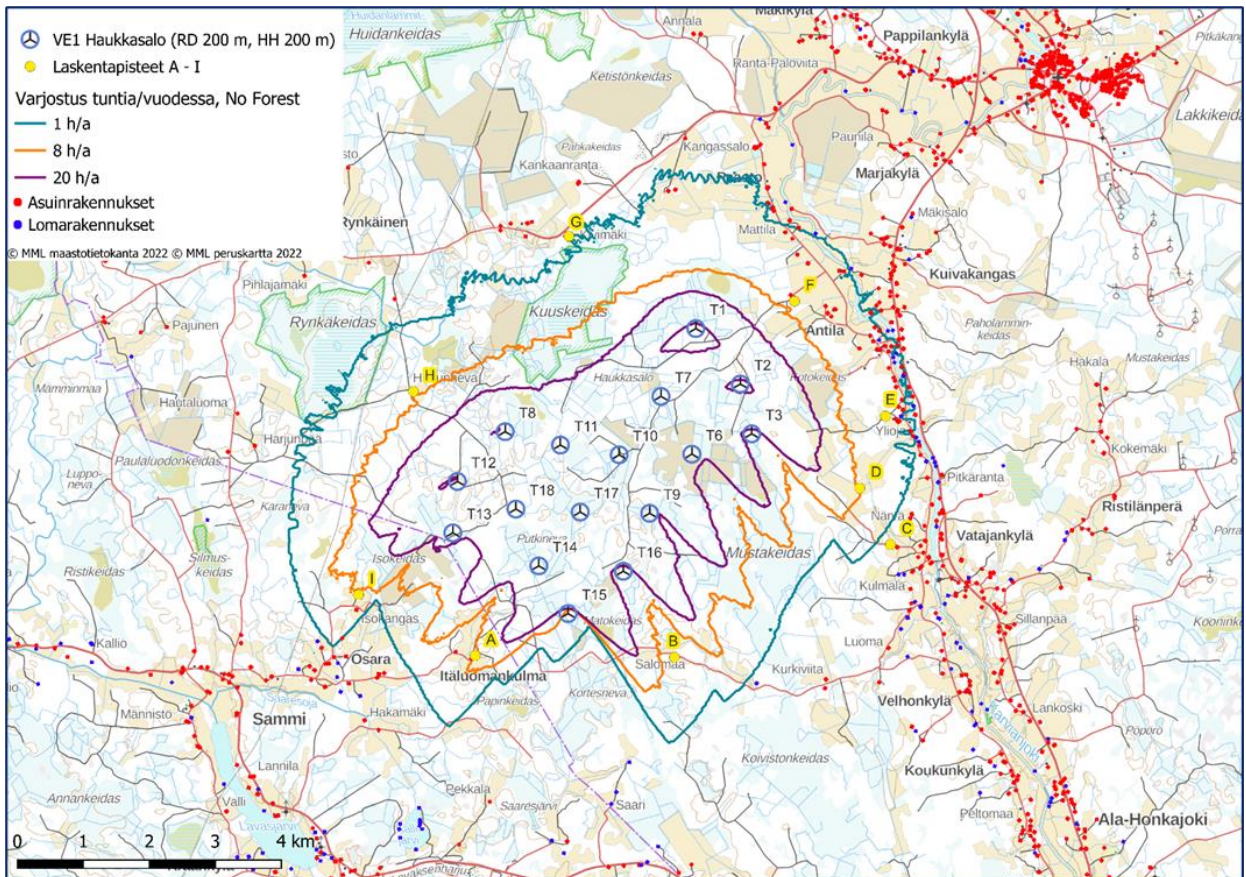
Pienitaajuisen melun laskenta menetelmä: ISO 9613-2, Anojanssi (Keränen, Hakala ja Hongisto, 2019)											
Terssin painottamaton äänitaso Leq dB - altistuvien laskentapisteiden (rakennusten) sisätiloissa											
Taajuus [Hz]	20	25	31,5	40	50	63	80	100	125	160	200
Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat LZeq,1h, dB	74,0	64,0	56,0	49,0	44,0	42,0	40,0	38,0	36,0	34,0	32,0
Laskentapiste A	41,7	40,4	39,3	38,4	37,2	35,5	32,9	29,7	25,7	20,5	17,1
Laskentapiste B	41,3	40	38,8	38	36,6	34,9	32,3	29,1	25,1	19,8	16,4
Laskentapiste C	39,7	37,4	35,6	35	32,9	30,9	28	24,4	20	14,2	10,4
Laskentapiste D	40,2	38	36,3	35,7	33,7	31,7	29	25,4	21,1	15,5	11,8
Laskentapiste E	41	38,4	36,5	36	33,6	31,5	28,7	24,9	20,6	15	11,4
Laskentapiste F	39,8	37,4	35,8	35,3	33,2	31,2	28,5	24,8	20,5	14,9	11,1
Laskentapiste G	38,4	36,7	35,5	34,7	33,1	31,3	28,6	25,1	20,9	15,3	11,4
Laskentapiste H	41,6	40,4	39,3	38,4	37,1	35,4	32,9	29,6	25,7	20,4	17
Laskentapiste I	40,4	39,2	38,1	37,2	35,9	34,2	31,6	28,3	24,3	18,9	15,3

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3.2 Varjostus

3.2.1 Hankevaihtoehto VE1, "Real Case, No forest"

Hankenvaihtoehdossa 1 varjostusvaikutusalueelle (8 h/a) sijoittuu 1 asuinrakennus. Mallinnustulosten mukaan varjostusta ilmenee vuodessa 8 h 43 min hankealueen eteläpuolella sijaitsevan asuinrakennuksen (laskentapiste A) alueella. Tarkemmat laskentatulokset on esitetty liitteessä 5.



Kuva 3. Varjostusmallinnuksen tulos hankevaihtoehdossa 1 (puuston suojaavaa vaikutusta ei ole huomioitu)

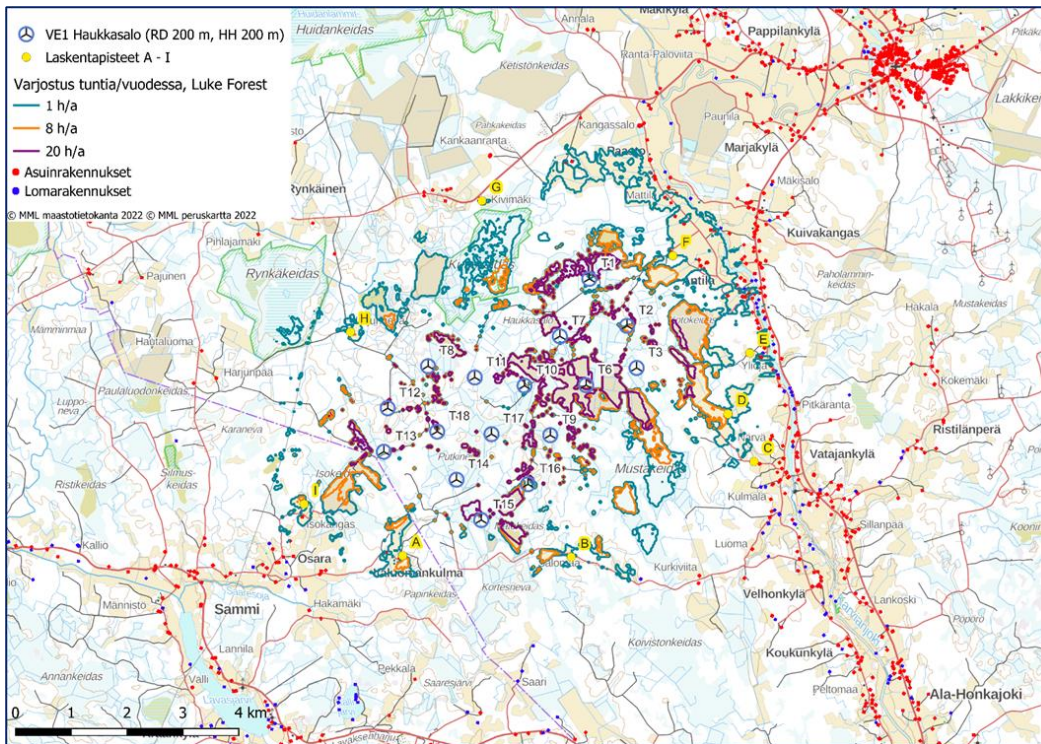
1.3.2023

Taulukko 15. Varjostusmallinnuksen tulos VE1, kun puuston suojaava vaikutusta ei ole huomioitu "Real case, no Forest".

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	8:43
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:38
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	7:34
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	3:12
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	6:58
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:51
H- Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:44
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:32

3.2.2 Hankevaihtoehto VE1, "Real Case, Luke Forest"

Hankevaihtoehdossa 1 ei > 8 h/a varjostusvaikutusalueelle sijoitu asuin- tai loma-ajanrakennuksia, kun puuston suojaava vaikutus otetaan huomioon. Mallinnustulosten mukaan vaikutus on suurimmillaan 7 h 44 min hankealueen länsipuolella sijaitsevan asuinrakennuksen (laskentapiste H) alueella. Tarkemmat laskentatulokset on esitetty liitteessä 6.



Kuva 4. Varjostusmallinnuksen tulos hankevaihtoehdossa 1 (puuston suojaava vaikutus huomioitu)

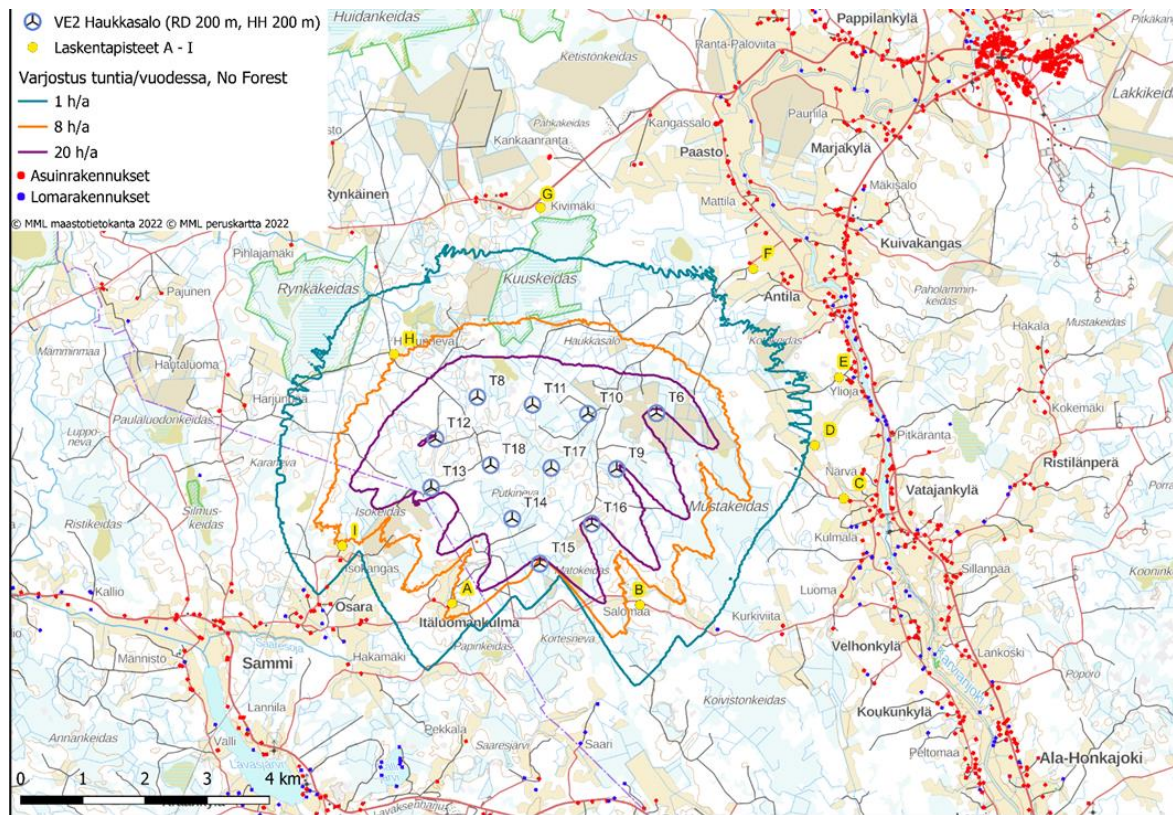
1.3.2023

Taulukko 16. Varjostusmallinnuksen tulos VE1, kun puuston suojaava vaikutus huomioitu "Real Case, Luke Forest".

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	0:00
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:38
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	3:12
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	4:54
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:51
H- Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:44
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:32

3.2.3 Hankevaihtoehto VE2, "Real Case, No Forest"

Hankevaihtoehdossa 2 varjostusvaikutusalueelle (8 h/a) sijoittuu 1 asuinrakennus. Mallinnustulosten mukaan varjostusta ilmenee vuodessa 8 h 43 min hankealueen eteläpuolella sijaitsevan asuinrakennuksen (laskentapiste A) alueella. Tarkemmat laskentatulokset on esitetty liitteessä 7.



Kuva 5. Varjostusmallinnuksen tulos hankevaihtoehdossa 2 (puuston suojaava vaikutusta ei ole huomioitu)

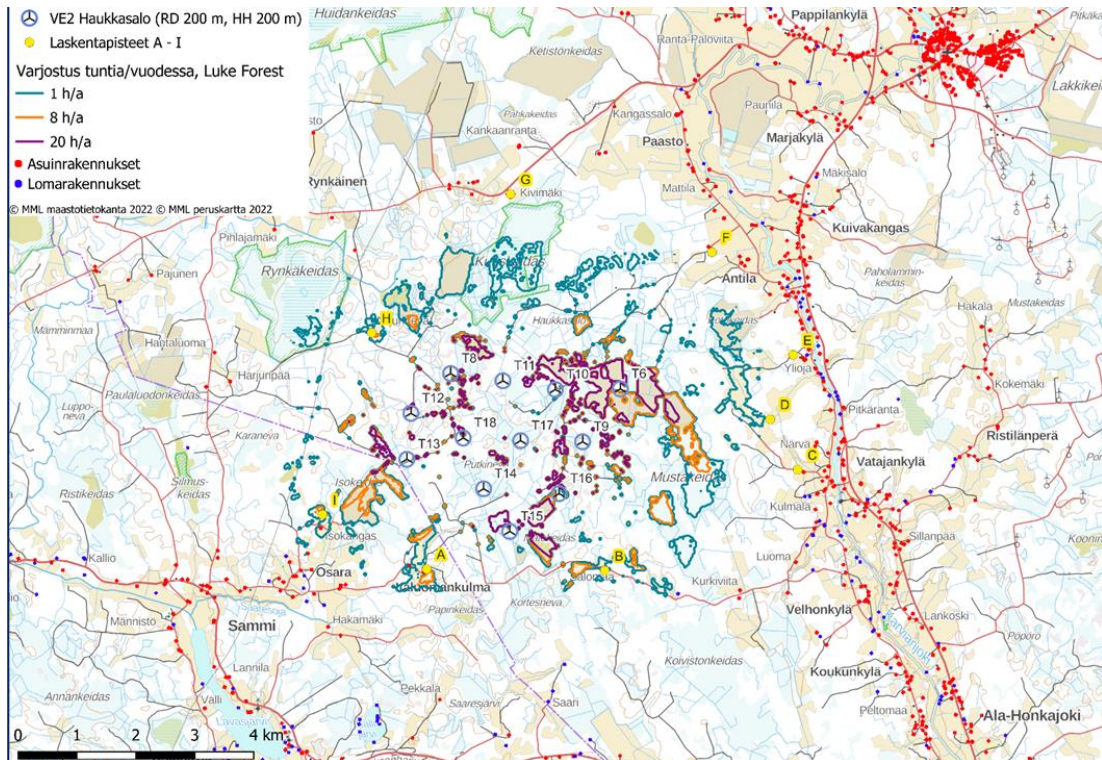
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Taulukko 17. Varjostusmallinnuksen tulos VE2, kun puuston suojaava vaikutusta ei ole huomioitu "real case, no forest".

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	8:43
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:38
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	0:00
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	0:00
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:00
H - Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:58
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:32

3.2.4 Hankevaihtoehto VE2, "Real Case, Luke Forest"

Hankevaihtoehdossa 2 ei > 8 h/a varjostusvaikutusalueelle sijoitu asuin- tai loma-ajanrakennuksia, kun puuston suojaava vaikutus otetaan huomioon. Mallinnustulosten mukaan vaikutus on suurimmillaan 7 h 58 min hankealueen länsipuolella sijaitsevan lomarakennuksen (laskentapiste H) alueella. Tarkemmat laskentatulokset on esitetty liitteessä 8.



Kuva 6. Varjostusmallinnuksen tulos hankevaihtoehdossa 2 (puuston suojaava vaikutus huomioitu)

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Taulukko 18. Varjostusmallinnuksen tulos VE2, kun puuston suojaava vaikutus huomioitu ”Real Case, Luke Forest”.

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	0:00
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:38
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	0:00
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	0:00
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:00
H - Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:58
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:32

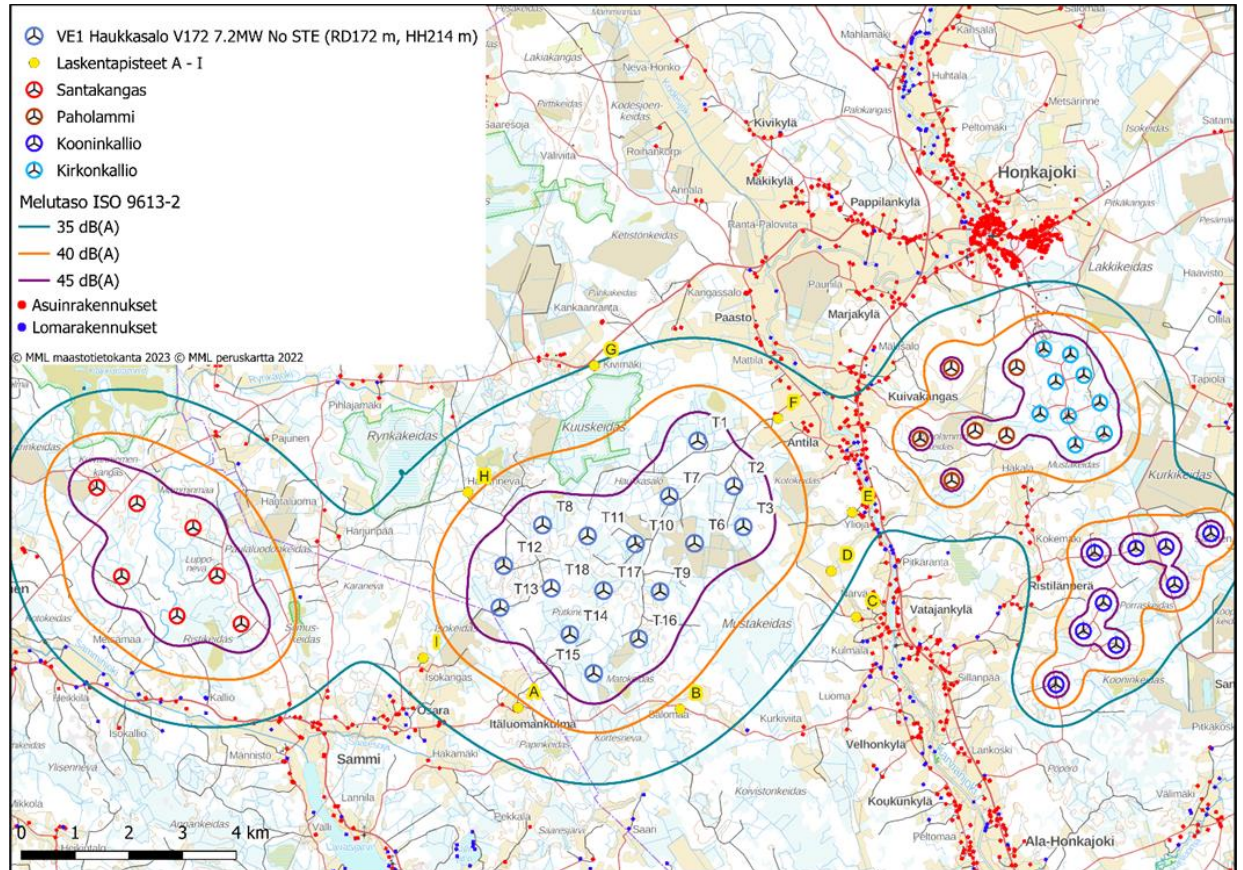
1.3.2023

4 MELUN JA VARJOSTUKSEN YHTEISMALLINNUSTEN TULOKSET

4.1 Melu

4.1.1 VE1: Yhteismelun laskentatulokset (ISO 9613-2)

Hankevaihtoehdon 1 (VE1) yhteismelun mallinnuksen mukaan melutaso 40 dB(A) ei ylitä Haukkasalon tuulivoimapuiston lähimmillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 9.



Kuva 7. Melun yhteisvaikutuksen mallinnuksen tulos hankevaihtoehdossa VE1.

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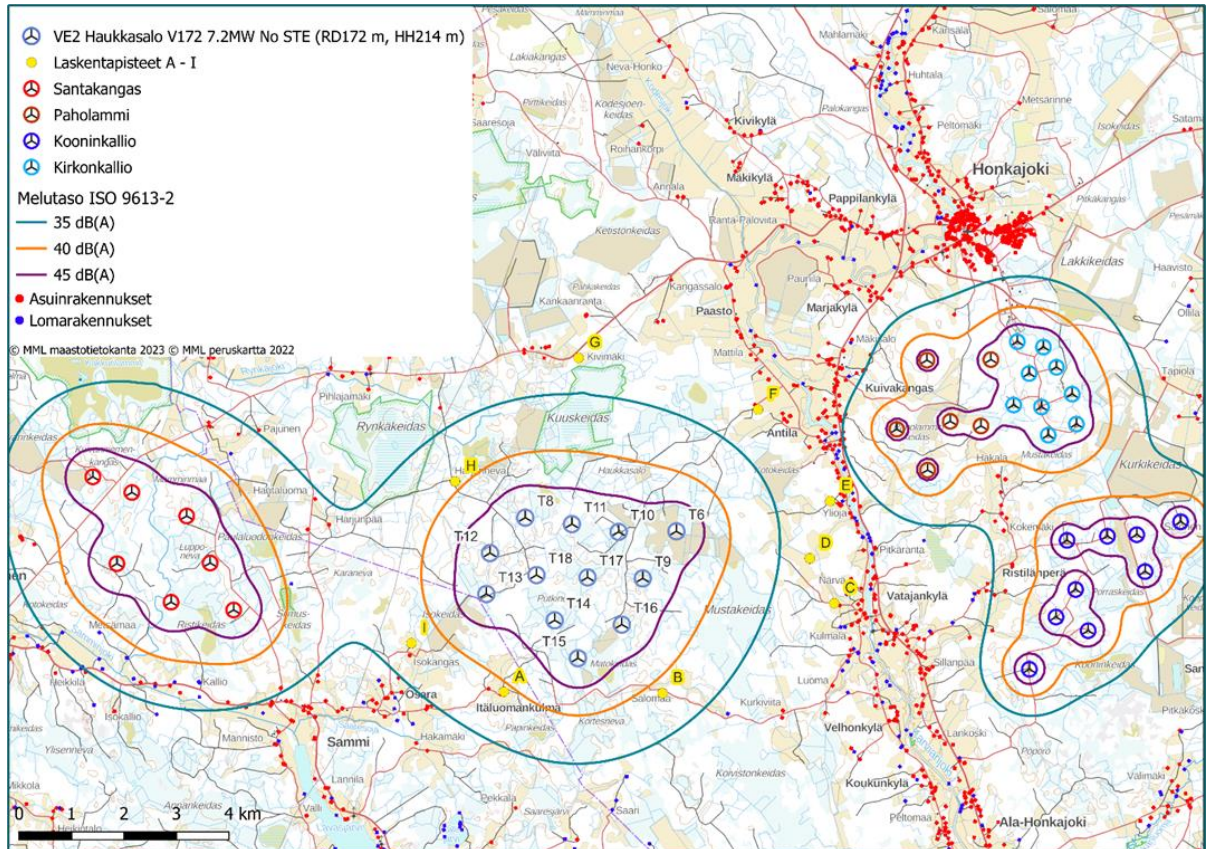
Taulukko 19. Laskennalliset yhteismelun tasot Haukkasalon tuulivoimahankkeen ympäristössä hankevaihtoehdossa 1

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-kor- keus (m)	Melutaso dB(A)
A - Asuinrakennus	243 235	6 873 658	80	4	39,3
B - Asuinrakennus	246 258	6 873 632	87,4	4	38,8
C - Asuinrakennus	249 534	6 875 344	92,8	4	33,8
D - Lomarakennus	249 068	6 876 198	92,5	4	36,5
E - Asuinrakennus	249 460	6 877 291	95	4	36,3
F - Asuinrakennus	248 080	6 879 034	96,2	4	38,7
G - Asuinrakennus	244 657	6 880 019	94,1	4	35,1
H - Asuinrakennus	242 301	6 877 666	90	4	39,3
I - Asuinrakennus	241 468	6 874 582	81,7	4	37,1

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4.1.2 VE2: Yhteismelun laskentatulokset (ISO 9613-2)

Hankevaihtoehdon 2 (VE2) yhteismelun mallinnuksen mukaan melutaso 40 dB(A) ei ylitä Haukkasalon tuulivoimapuiston lähimmillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 10.



Kuva 8. Melumallinnuksen tulos vaihtoehdossa VE 2.

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Taulukko 20. Laskennalliset yhteismelun tasot Haukkasalon tuulivoimahankkeen ympäristössä hankevaihtoehdossa 2

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-kor- keus (m)	Melutaso dB(A)
A - Asuinrakennus	243 235	6 873 658	80	4	39,2
B - Asuinrakennus	246 258	6 873 632	87,4	4	38,5
C - Asuinrakennus	249 534	6 875 344	92,8	4	31,7
D - Lomarakennus	249 068	6 876 198	92,5	4	33,2
E - Asuinrakennus	249 460	6 877 291	95	4	33,2
F - Asuinrakennus	248 080	6 879 034	96,2	4	32,5
G - Asuinrakennus	244 657	6 880 019	94,1	4	32,6
H - Asuinrakennus	242 301	6 877 666	90	4	39,1
I - Asuinrakennus	241 468	6 874 582	81,7	4	37

4.1.3 Matalataajuiset melutasot

Haukkasalon, Santakankaan, Paholammin, Kirkonkallion ja Kooninkallion tuulivoimahankkeiden aiheuttama matalataajuinen yhteismelu ei Haukkasalon kummassakaan hankevaihtoehdossa ylitä Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteiden sisätiloissa.

Haukkasalon hankevaihtoehdon 1 tulokset laskentapisteittäin on esitetty taulukossa 21 ja hankevaihtoehdon 2 tulokset taulukossa 22. Taulukoissa näkyy jokaisen laskentapisteen terssikaistakohtaiset arvot. Tarkemmat matalataajuisen yhteismelun laskentatulokset ja kuvaajat on esitetty liitteessä 11 ja 12.

1.3.2023

Taulukko 21. Matalataajuisen yhteismelun laskentatulokset VE1

Pienitaajuisen melun laskenta menetelmä: ISO 9613-2, Anojanssi (Keränen, Hakala ja Hongisto, 2019)											
Terssin painottamaton äänitaso Leq dB - altistuvien laskentapisteen (rakennusten) sisätilossa											
Terssikaista [Hz]	20	25	31,5	40	50	63	80	100	125	160	200
Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat LZeq,1h, dB	74,0	64,0	56,0	49,0	44,0	42,0	40,0	38,0	36,0	34,0	32,0
Laskentapiste A	41,9	40,7	39,6	38,7	37,4	35,7	33,2	29,9	25,9	20,6	17,2
Laskentapiste B	41,7	40,4	39,3	38,4	37,1	35,4	32,8	29,5	25,6	20,2	16,8
Laskentapiste C	40,4	38,3	36,8	36,1	34,2	32,3	29,6	26	21,8	16,2	12,4
Laskentapiste D	41,5	39,6	38,2	37,5	35,8	33,9	31,3	27,9	23,8	18,3	14,8
Laskentapiste E	42	39,8	38,3	37,6	35,7	33,7	31,1	27,5	23,4	18	14,5
Laskentapiste F	42,3	40,5	39,3	38,5	37	35,2	32,6	29,3	25,3	20	16,6
Laskentapiste G	39,8	38,3	37,2	36,3	34,9	33,1	30,5	27,1	23	17,4	13,7
Laskentapiste H	41,9	40,7	39,6	38,7	37,5	35,8	33,2	29,9	26	20,7	17,2
Laskentapiste I	40,6	39,4	38,3	37,4	36,1	34,4	31,8	28,5	24,5	19	15,5

Taulukko 22. Matalataajuisen yhteismelun laskentatulokset VE2

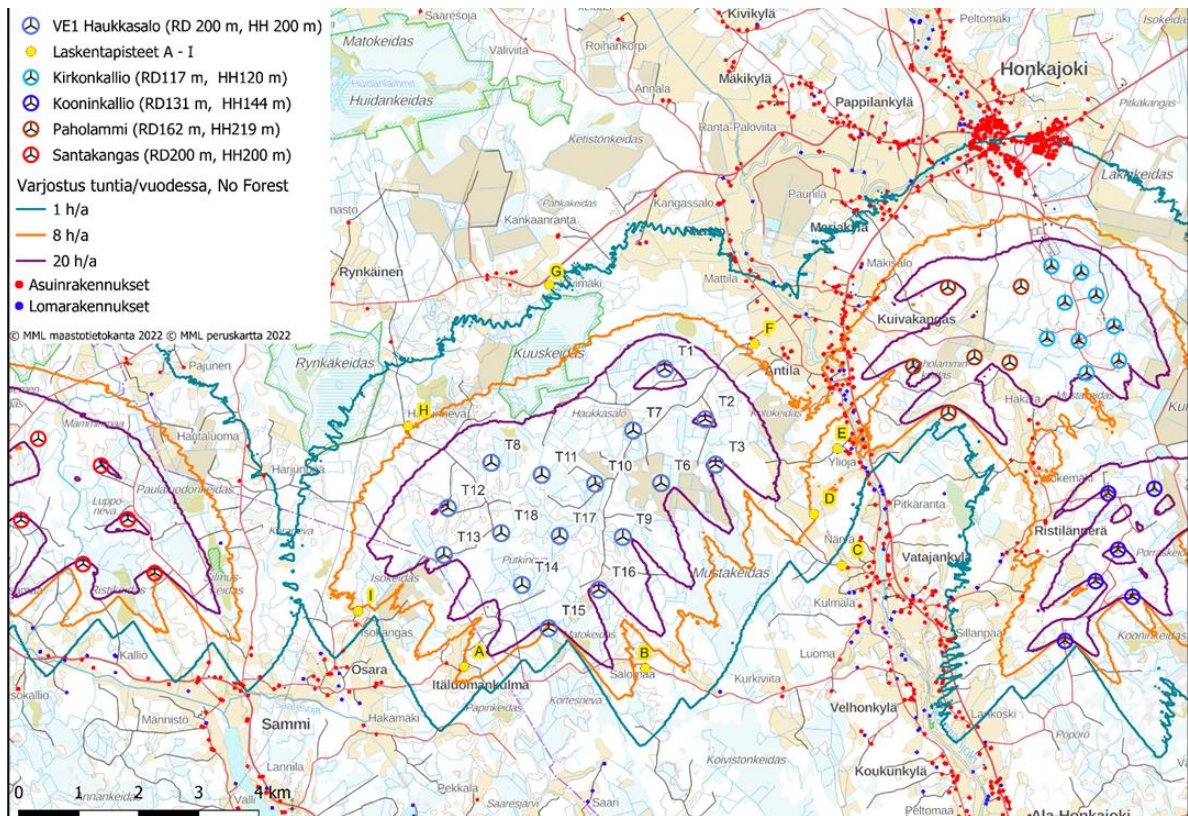
Pienitaajuisen melun laskenta menetelmä: ISO 9613-2, Anojanssi (Keränen, Hakala ja Hongisto, 2019)											
Terssin painottamaton äänitaso Leq dB - altistuvien laskentapisteen (rakennusten) sisätilossa											
Taajuus [Hz]	20	25	31,5	40	50	63	80	100	125	160	200
Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat LZeq,1h, dB	74,0	64,0	56,0	49,0	44,0	42,0	40,0	38,0	36,0	34,0	32,0
Laskentapiste A	41	39,9	38,9	38	36,8	35,1	32,6	29,4	25,5	20,3	16,9
Laskentapiste B	40,5	39,4	38,4	37,4	36,3	34,6	32,1	28,9	25	19,7	16,3
Laskentapiste C	35,2	34,1	33,1	32,1	30,9	29,1	26,5	23,1	18,9	13,2	9,3
Laskentapiste D	36,3	35,2	34,2	33,2	32	30,3	27,7	24,3	20,2	14,7	10,9
Laskentapiste E	35,2	34,1	33	32	30,9	29,1	26,4	23	18,8	13,2	9,3
Laskentapiste F	35,8	34,7	33,7	32,7	31,5	29,7	27,1	23,7	19,6	14	10,2
Laskentapiste G	36,5	35,4	34,4	33,4	32,2	30,5	27,9	24,5	20,4	14,9	11,1
Laskentapiste H	40,8	39,7	38,7	37,7	36,6	34,9	32,4	29,2	25,3	20,1	16,7
Laskentapiste I	39,1	38,1	37	36,1	34,9	33,2	30,7	27,4	23,5	18,1	14,6

1.3.2023

4.2 Varjostus

4.2.1 VE 1: Varjostuksen yhteisvaikutus, "Real Case, No Forest"

Hankevaihtoehdon 1 yhteisvaikutusmallinnuksessa hankealueen varjostusvaikutusalueelle (8 h/a) sijoittuu Haukkasalon läheisyydessä 1 asuinrakennus. Mallinnustulosten mukaan vuosittainen varjostusvaikutus on 8 h 59 min hankealueen eteläpuolella sijaitsevan asuinrakennuksen (laskentapiste A) alueella. Tarkemmat laskentatulokset on esitetty liitteessä 13.



Kuva 9. Varjostuksen yhteismallinnuksen tulos hankevaihtoehdossa 1 (puuston suojaava vaikutusta ei ole huomioitu)

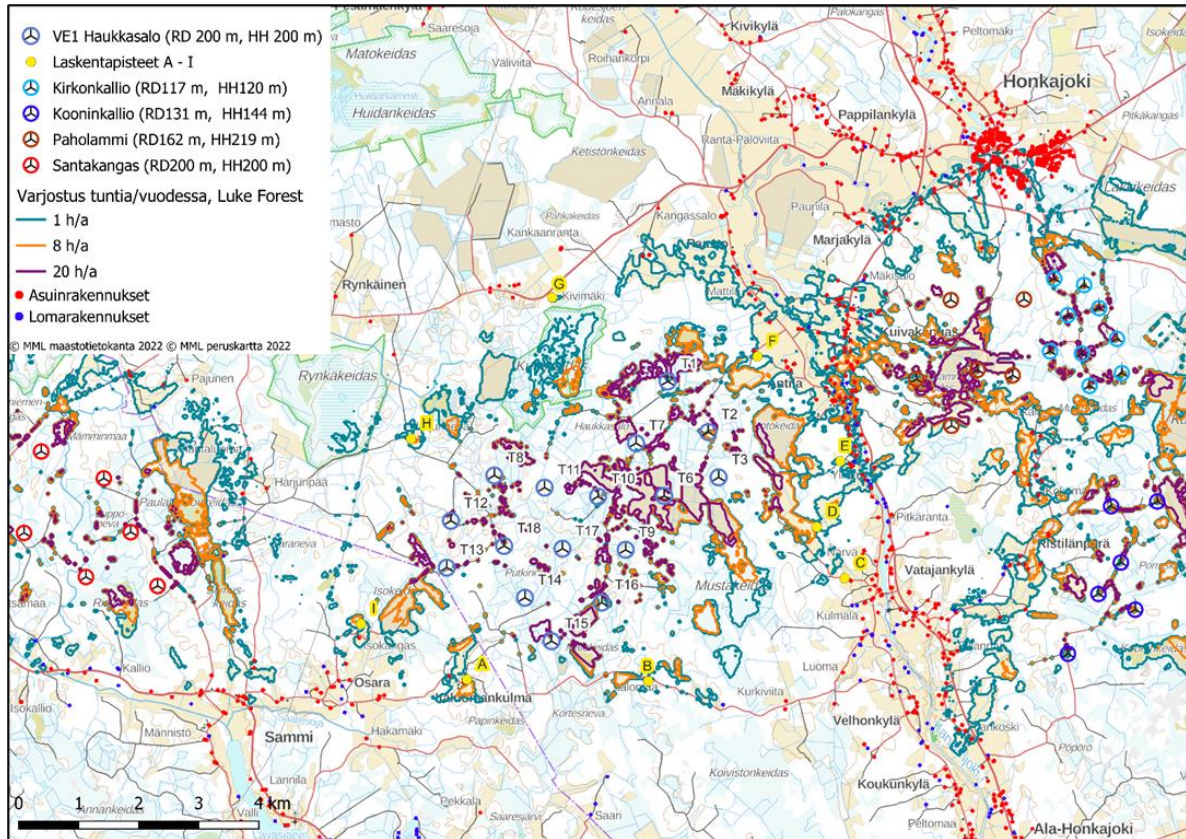
1.3.2023

Taulukko 23. Varjostuksen yhteismallinnuksen tulos VE1, kun puuston suojaava vaikutusta ei ole huomioitu "Real Case, No Forest".

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskettaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	8:59
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:48
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	7:47
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	5:30
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	7:10
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:52
H - Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:57
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:46

4.2.2 VE 1: Varjostuksen yhteisvaikutus, "Real Case, Luke Forest"

Huomioitaessa puuston suojaava vaikutus, ei hankevaihtoehdossa 1 sijoitu yli 8 h/a varjostusvaikutusalueelle asuin- tai loma-ajanrakennuksia. Mallinnustulosten mukaan vaikutus on suurimmillaan 7 h 57 min (lasketapiste H). Tarkemmat varjostuksen yhteisvaikutuksen lasketatulokset on esitetty liitteessä 14.



Kuva 10. Varjostuksen yhteismallinnuksen tulos hankevaihtoehdossa 1 (puuston suojaava vaikutus on huomioitu)

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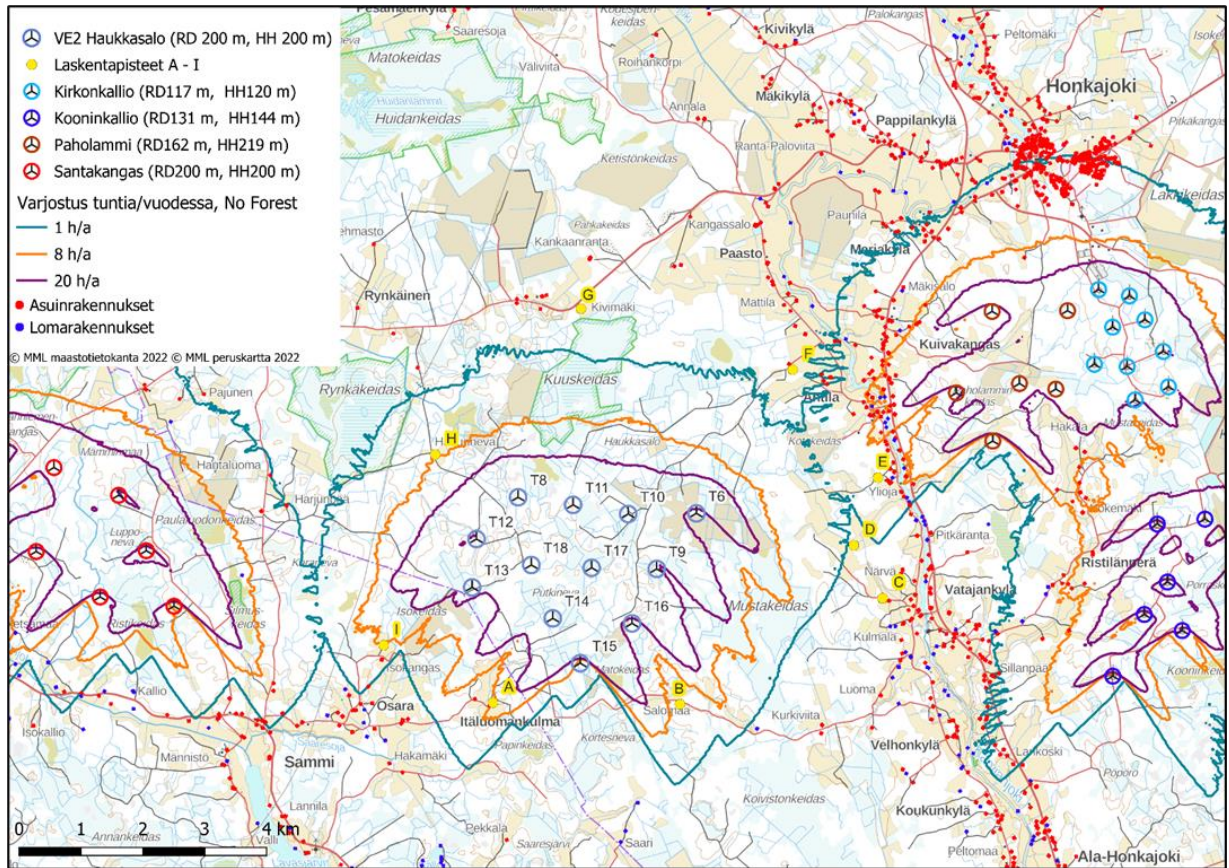
Taulukko 24. Varjostuksen yhteismallinnuksen tulos VE1, kun puuston suojaava vaikutus on huomioitu ”Real Case, Luke Forest”.

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaik- kuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	0:00
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:48
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	3:18
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	5:03
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:52
H- Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:57
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:46

4.2.3 VE 2: Varjostuksen yhteisvaikutus ”Real Case, No Forest”

Hankevaihtoehdon 2 yhteisvaikutusten mallinnusten mukaan yli 8 h/a varjostusvaikutusalueelle sijoittuu Haukkasalon läheisyydessä 2 asuinrakennusta. Vuosittainen varjostus on hankealueen eteläpuolella sijaitsevan asuinrakennuksen (laskentapiste A) alueella 9 tuntia ja luoteispuolella sijaitsevan asuinrakennuksen (laskentapiste H) alueella 8 tuntia 14 minuuttia. Tarkemmat varjostuksen yhteisvaikutuksen laskentatulokset on esitetty liitteessä 15.

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Kuva 11. Varjostuksen yhteismallinnuksen tulos hankevaihtoehdossa 2 (puuston suojaavaa vaikutusta ei ole huomioitu)

Taulukko 25. Varjostuksen yhteismallinnuksen tulos VE2, kun puuston suojaavaa vaikutusta ei ole huomioitu "Real Case, No Forest".

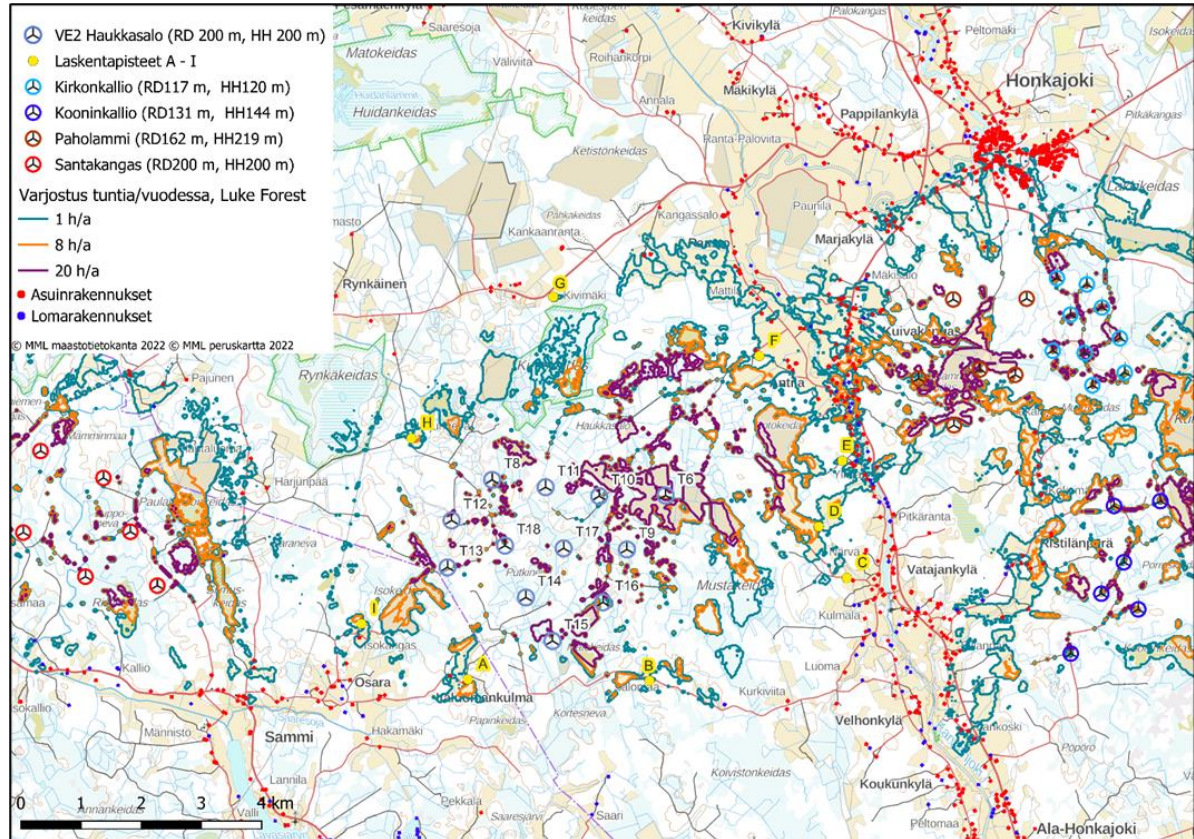
Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	9:00
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:49
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	2:13
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	0:00
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:00
H- Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	8:14
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:47

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4.2.4 VE 2: Varjostuksen yhteisvaikutus ”Real Case, Luke Forest”

Huomioitaessa puuston suojaava vaikutus, ei hankevaihtoehdossa 2 sijoitu yli 8 h/a varjostusvaikutusalueelle asuin- tai loma-ajanrakennuksia. Mallinnustulosten mukaan vaikutus on suurimmillaan 7 tuntia 57 minuuttia (laskentapiste H).

Tarkemmat hankevaihtoehdon 2 varjostuksen yhteisvaikutuksen laskentatulokset on esitetty liitteessä 16.



Kuva 12. Varjostuksen yhteismallinnuksen tulos hankevaihtoehdossa 2 (puuston suojaava vaikutus on huomioitu)

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Taulukko 26. Varjostuksen yhteismallinnuksen tulos VE2, kun puuston suojaava vaikutus on huomioitu ”Real Case, Luke Forest”.

Rakennus	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaik- kuna (m)	Varjostus (h/a)
A - Asuinrakennus	243 235	6 873 658	80	5,0 x 5,0	0:00
B - Asuinrakennus	246 258	6 873 632	87,4	5,0 x 5,0	5:48
C - Asuinrakennus	249 534	6 875 344	92,8	5,0 x 5,0	0:00
D - Lomarakennus	249 068	6 876 198	92,5	5,0 x 5,0	0:00
E - Asuinrakennus	249 460	6 877 291	95	5,0 x 5,0	3:18
F - Asuinrakennus	248 080	6 879 034	96,2	5,0 x 5,0	5:03
G - Asuinrakennus	244 657	6 880 019	94,1	5,0 x 5,0	0:52
H- Asuinrakennus	242 301	6 877 666	90	5,0 x 5,0	7:57
I - Asuinrakennus	241 468	6 874 582	81,7	5,0 x 5,0	7:46

FCG Finnish Consulting Group Oy

Miikka Saranpää, ins. AMK
Laatija

Johanna Harju, ins. AMK
Tarkastaja

1.3.2023

Liite 1. Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 - Hankevaihtoehto 1

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasa

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more

restrictive, positive is less restrictive.:

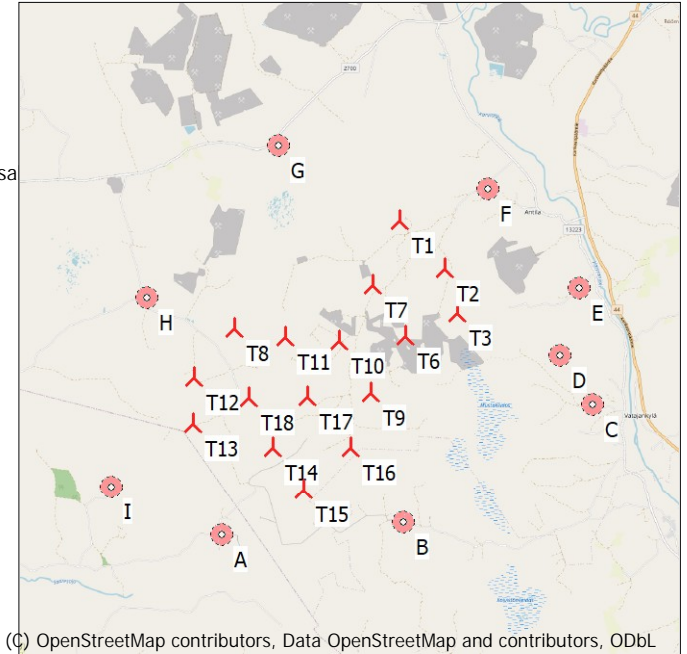
0,0 dB(A)

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]	Noise data		Wind speed [m/s]	LwA,ref [dB(A)]	
					Valid	Manufact.				Type-generator	Creator			Name
T1	246 582	6 878 619	95,6	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T10	245 421	6 876 704	92,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T11	244 530	6 876 852	90,9	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T12	242 968	6 876 299	90,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T13	242 898	6 875 520	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T14	244 202	6 875 018	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T15	244 645	6 874 295	83,7	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T16	245 483	6 874 938	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T17	244 829	6 875 835	90,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T18	243 855	6 875 881	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T2	247 257	6 877 777	97,6	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T3	247 430	6 877 022	96,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T6	246 523	6 876 714	95,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T7	246 054	6 877 590	94,8	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T8	243 691	6 877 054	93,7	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T9	245 882	6 875 817	92,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1



Calculation Results

Sound level

Noise sensitive area

No.	Name	East	North	Z	Immission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	4,0	40,0	39,1	159
B	B - Asuinrakennus	246 258	6 873 632	87,4	4,0	40,0	38,7	232
C	C - Asuinrakennus	249 534	6 875 344	92,8	4,0	40,0	33,0	1 543
D	D - Lomarakennus	249 068	6 876 198	92,5	4,0	40,0	36,1	707
E	E - Asuinrakennus	249 460	6 877 291	95,0	4,0	40,0	35,2	874
F	F - Asuinrakennus	248 080	6 879 034	96,2	4,0	40,0	38,5	245
G	G - Asuinrakennus	244 657	6 880 019	94,1	4,0	40,0	34,9	1 208
H	H - Asuinrakennus	242 301	6 877 666	90,0	4,0	40,0	39,1	158
I	I - Asuinrakennus	241 468	6 874 582	81,7	4,0	40,0	36,6	589

Project:

Haukkasalo_06052022

Licensed user:

FCG Finnish Consulting Group Oy

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Mikka Saranpää / mikka.saranpaa@fcg.fi

Calculated:

14.2.2023 15.41/3.5.584

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1

Distances (m)

WTG	A	B	C	D	E	F	G	H	I
T1	5980	4994	4406	3467	3168	1553	2379	4383	6510
T10	3746	3182	4329	3680	4079	3533	3400	3262	4482
T11	3444	3652	5222	4582	4946	4164	3168	2371	3808
T12	2653	4232	6630	6096	6563	5793	4082	1520	2278
T13	1891	3850	6633	6202	6792	6256	4827	2226	1709
T14	1668	2478	5338	5003	5724	5578	5018	3257	2766
T15	1546	1742	4996	4812	5667	5849	5720	4103	3187
T16	2585	1517	4068	3797	4618	4847	5145	4189	4027
T17	2697	2624	4726	4251	4851	4557	4184	3119	3584
T18	2306	3289	5700	5219	5776	5268	4213	2365	2715
T2	5753	4261	3330	2400	2254	1501	3431	4954	6607
T3	5374	3585	2689	1832	2046	2113	4080	5166	6437
T6	4485	3091	3306	2595	2991	2792	3793	4325	5482
T7	4835	3961	4139	3318	3417	2486	2800	3751	5480
T8	3425	4275	6083	5440	5770	4811	3116	1518	3322
T9	3413	2216	3680	3207	3867	3894	4374	4027	4579

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: ISO 9613-2 General 8,0 m/s
Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A A - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	5 980	5 984	15,97	110,1	0,00	86,54	-	-	0,00	0,00	-
T10	3 746	3 753	22,29	110,1	0,00	82,49	-	-	0,00	0,00	-
T11	3 444	3 451	23,39	110,1	0,00	81,76	-	-	0,00	0,00	-
T12	2 653	2 662	26,71	110,1	0,00	79,50	-	-	0,00	0,00	-
T13	1 891	1 903	30,81	110,1	0,00	76,59	-	-	0,00	0,00	-
T14	1 668	1 682	32,26	110,1	0,00	75,52	-	-	0,00	0,00	-
T15	1 546	1 560	33,13	110,1	0,00	74,86	-	-	0,00	0,00	-
T16	2 585	2 594	27,03	110,1	0,00	79,28	-	-	0,00	0,00	-
T17	2 697	2 706	26,50	110,1	0,00	79,65	-	-	0,00	0,00	-
T18	2 306	2 316	28,44	110,1	0,00	78,29	-	-	0,00	0,00	-
T2	5 753	5 758	16,50	110,1	0,00	86,20	-	-	0,00	0,00	-
T3	5 374	5 378	17,44	110,1	0,00	85,61	-	-	0,00	0,00	-
T6	4 485	4 491	19,89	110,1	0,00	84,05	-	-	0,00	0,00	-
T7	4 835	4 840	18,88	110,1	0,00	84,70	-	-	0,00	0,00	-
T8	3 425	3 432	23,46	110,1	0,00	81,71	-	-	0,00	0,00	-
T9	3 413	3 420	23,50	110,1	0,00	81,68	-	-	0,00	0,00	-
Sum			39,14								

- Data undefined due to calculation with octave data

Noise sensitive area: B B - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	4 994	4 999	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T10	3 182	3 189	24,41	110,1	0,00	81,07	-	-	0,00	0,00	-
T11	3 652	3 658	22,62	110,1	0,00	82,26	-	-	0,00	0,00	-
T12	4 232	4 238	20,67	110,1	0,00	83,54	-	-	0,00	0,00	-
T13	3 850	3 856	21,93	110,1	0,00	82,72	-	-	0,00	0,00	-
T14	2 478	2 487	27,56	110,1	0,00	78,91	-	-	0,00	0,00	-
T15	1 742	1 755	31,77	110,1	0,00	75,88	-	-	0,00	0,00	-
T16	1 517	1 532	33,35	110,1	0,00	74,70	-	-	0,00	0,00	-
T17	2 624	2 633	26,85	110,1	0,00	79,41	-	-	0,00	0,00	-
T18	3 289	3 295	23,99	110,1	0,00	81,36	-	-	0,00	0,00	-
T2	4 261	4 267	20,58	110,1	0,00	83,60	-	-	0,00	0,00	-
T3	3 585	3 592	22,86	110,1	0,00	82,11	-	-	0,00	0,00	-
T6	3 091	3 099	24,78	110,1	0,00	80,82	-	-	0,00	0,00	-
T7	3 961	3 967	21,55	110,1	0,00	82,97	-	-	0,00	0,00	-
T8	4 275	4 280	20,54	110,1	0,00	83,63	-	-	0,00	0,00	-
T9	2 216	2 226	28,92	110,1	0,00	77,95	-	-	0,00	0,00	-
Sum			38,70								

- Data undefined due to calculation with octave data

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: ISO 9613-2 General 8,0 m/s
Noise sensitive area: C C - Asuinrakennus

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	4 406	4 411	20,13	110,1	0,00	83,89	-	-	0,00	0,00	-
T10	4 329	4 334	20,37	110,1	0,00	83,74	-	-	0,00	0,00	-
T11	5 222	5 226	17,83	110,1	0,00	85,36	-	-	0,00	0,00	-
T12	6 630	6 633	14,57	110,1	0,00	87,43	-	-	0,00	0,00	-
T13	6 633	6 636	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
T14	5 338	5 341	17,53	110,1	0,00	85,55	-	-	0,00	0,00	-
T15	4 996	5 000	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T16	4 068	4 073	21,20	110,1	0,00	83,20	-	-	0,00	0,00	-
T17	4 726	4 731	19,19	110,1	0,00	84,50	-	-	0,00	0,00	-
T18	5 700	5 704	16,63	110,1	0,00	86,12	-	-	0,00	0,00	-
T2	3 330	3 337	23,82	110,1	0,00	81,47	-	-	0,00	0,00	-
T3	2 689	2 698	26,54	110,1	0,00	79,62	-	-	0,00	0,00	-
T6	3 306	3 312	23,92	110,1	0,00	81,40	-	-	0,00	0,00	-
T7	4 139	4 144	20,97	110,1	0,00	83,35	-	-	0,00	0,00	-
T8	6 083	6 087	15,73	110,1	0,00	86,69	-	-	0,00	0,00	-
T9	3 680	3 686	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
Sum			33,00								

- Data undefined due to calculation with octave data

Noise sensitive area: D D - Lomarakenus

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	3 467	3 474	23,30	110,1	0,00	81,82	-	-	0,00	0,00	-
T10	3 680	3 685	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
T11	4 582	4 586	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
T12	6 096	6 100	15,70	110,1	0,00	86,71	-	-	0,00	0,00	-
T13	6 202	6 205	15,47	110,1	0,00	86,86	-	-	0,00	0,00	-
T14	5 003	5 007	18,42	110,1	0,00	84,99	-	-	0,00	0,00	-
T15	4 812	4 816	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T16	3 797	3 803	22,11	110,1	0,00	82,60	-	-	0,00	0,00	-
T17	4 251	4 256	20,61	110,1	0,00	83,58	-	-	0,00	0,00	-
T18	5 219	5 223	17,84	110,1	0,00	85,36	-	-	0,00	0,00	-
T2	2 400	2 410	27,95	110,1	0,00	78,64	-	-	0,00	0,00	-
T3	1 832	1 844	31,18	110,1	0,00	76,32	-	-	0,00	0,00	-
T6	2 595	2 604	26,99	110,1	0,00	79,31	-	-	0,00	0,00	-
T7	3 318	3 324	23,87	110,1	0,00	81,43	-	-	0,00	0,00	-
T8	5 440	5 444	17,27	110,1	0,00	85,72	-	-	0,00	0,00	-
T9	3 207	3 214	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
Sum			36,07								

- Data undefined due to calculation with octave data

Noise sensitive area: E E - Asuinrakennus

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T10	4 079	4 084	21,16	110,1	0,00	83,22	-	-	0,00	0,00	-
T11	4 946	4 951	18,57	110,1	0,00	84,89	-	-	0,00	0,00	-
T12	6 563	6 566	14,69	110,1	0,00	87,35	-	-	0,00	0,00	-
T13	6 792	6 795	14,28	110,1	0,00	87,64	-	-	0,00	0,00	-
T14	5 724	5 728	16,58	110,1	0,00	86,16	-	-	0,00	0,00	-
T15	5 667	5 671	16,71	110,1	0,00	86,07	-	-	0,00	0,00	-
T16	4 618	4 622	19,50	110,1	0,00	84,30	-	-	0,00	0,00	-
T17	4 851	4 855	18,84	110,1	0,00	84,72	-	-	0,00	0,00	-
T18	5 776	5 779	16,45	110,1	0,00	86,24	-	-	0,00	0,00	-
T2	2 254	2 264	28,71	110,1	0,00	78,10	-	-	0,00	0,00	-
T3	2 046	2 057	29,88	110,1	0,00	77,26	-	-	0,00	0,00	-
T6	2 991	2 999	25,20	110,1	0,00	80,54	-	-	0,00	0,00	-
T7	3 417	3 424	23,49	110,1	0,00	81,69	-	-	0,00	0,00	-
T8	5 770	5 773	16,47	110,1	0,00	86,23	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T9	3 867	3 873	21,87	110,1	0,00	82,76	-	-	0,00	0,00	-
Sum			35,20								

- Data undefined due to calculation with octave data

Noise sensitive area: F F - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	1 553	1 567	33,08	110,1	0,00	74,90	-	-	0,00	0,00	-
T10	3 533	3 539	23,06	110,1	0,00	81,98	-	-	0,00	0,00	-
T11	4 164	4 169	20,89	110,1	0,00	83,40	-	-	0,00	0,00	-
T12	5 793	5 797	16,41	110,1	0,00	86,26	-	-	0,00	0,00	-
T13	6 256	6 259	15,35	110,1	0,00	86,93	-	-	0,00	0,00	-
T14	5 578	5 582	16,93	110,1	0,00	85,94	-	-	0,00	0,00	-
T15	5 849	5 852	16,28	110,1	0,00	86,35	-	-	0,00	0,00	-
T16	4 847	4 851	18,85	110,1	0,00	84,72	-	-	0,00	0,00	-
T17	4 557	4 562	19,68	110,1	0,00	84,18	-	-	0,00	0,00	-
T18	5 268	5 272	17,71	110,1	0,00	85,44	-	-	0,00	0,00	-
T2	1 501	1 516	33,47	110,1	0,00	74,61	-	-	0,00	0,00	-
T3	2 113	2 123	29,50	110,1	0,00	77,54	-	-	0,00	0,00	-
T6	2 792	2 800	26,07	110,1	0,00	79,94	-	-	0,00	0,00	-
T7	2 486	2 495	27,52	110,1	0,00	78,94	-	-	0,00	0,00	-
T8	4 811	4 815	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T9	3 894	3 899	21,78	110,1	0,00	82,82	-	-	0,00	0,00	-
Sum			38,49								

- Data undefined due to calculation with octave data

Noise sensitive area: G G - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	2 379	2 388	28,06	110,1	0,00	78,56	-	-	0,00	0,00	-
T10	3 400	3 406	23,56	110,1	0,00	81,65	-	-	0,00	0,00	-
T11	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T12	4 082	4 088	21,15	110,1	0,00	83,23	-	-	0,00	0,00	-
T13	4 827	4 832	18,90	110,1	0,00	84,68	-	-	0,00	0,00	-
T14	5 018	5 022	18,38	110,1	0,00	85,02	-	-	0,00	0,00	-
T15	5 720	5 724	16,60	110,1	0,00	86,15	-	-	0,00	0,00	-
T16	5 145	5 149	18,04	110,1	0,00	85,23	-	-	0,00	0,00	-
T17	4 184	4 189	20,83	110,1	0,00	83,44	-	-	0,00	0,00	-
T18	4 213	4 217	20,76	110,1	0,00	83,50	-	-	0,00	0,00	-
T2	3 431	3 438	23,44	110,1	0,00	81,73	-	-	0,00	0,00	-
T3	4 080	4 086	21,16	110,1	0,00	83,23	-	-	0,00	0,00	-
T6	3 793	3 799	22,13	110,1	0,00	82,59	-	-	0,00	0,00	-
T7	2 800	2 808	26,04	110,1	0,00	79,97	-	-	0,00	0,00	-
T8	3 116	3 123	24,68	110,1	0,00	80,89	-	-	0,00	0,00	-
T9	4 374	4 379	20,23	110,1	0,00	83,83	-	-	0,00	0,00	-
Sum			34,90								

- Data undefined due to calculation with octave data

Noise sensitive area: H H- Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	4 383	4 388	20,20	110,1	0,00	83,85	-	-	0,00	0,00	-
T10	3 262	3 269	24,09	110,1	0,00	81,29	-	-	0,00	0,00	-
T11	2 371	2 381	28,10	110,1	0,00	78,53	-	-	0,00	0,00	-
T12	1 520	1 534	33,33	110,1	0,00	74,72	-	-	0,00	0,00	-
T13	2 226	2 236	28,87	110,1	0,00	77,99	-	-	0,00	0,00	-
T14	3 257	3 264	24,11	110,1	0,00	81,27	-	-	0,00	0,00	-
T15	4 103	4 108	21,09	110,1	0,00	83,27	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T16	4 189	4 194	20,81	110,1	0,00	83,45	-	-	0,00	0,00	-
T17	3 119	3 126	24,67	110,1	0,00	80,90	-	-	0,00	0,00	-
T18	2 365	2 374	28,13	110,1	0,00	78,51	-	-	0,00	0,00	-
T2	4 954	4 959	18,55	110,1	0,00	84,91	-	-	0,00	0,00	-
T3	5 166	5 170	17,98	110,1	0,00	85,27	-	-	0,00	0,00	-
T6	4 325	4 330	20,38	110,1	0,00	83,73	-	-	0,00	0,00	-
T7	3 751	3 757	22,27	110,1	0,00	82,50	-	-	0,00	0,00	-
T8	1 518	1 533	33,34	110,1	0,00	74,71	-	-	0,00	0,00	-
T9	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
Sum			39,08								

- Data undefined due to calculation with octave data

Noise sensitive area: I I - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T1	6 510	6 514	14,79	110,1	0,00	87,28	-	-	0,00	0,00	-
T10	4 482	4 488	19,90	110,1	0,00	84,04	-	-	0,00	0,00	-
T11	3 808	3 814	22,07	110,1	0,00	82,63	-	-	0,00	0,00	-
T12	2 278	2 288	28,58	110,1	0,00	78,19	-	-	0,00	0,00	-
T13	1 709	1 722	31,99	110,1	0,00	75,72	-	-	0,00	0,00	-
T14	2 766	2 775	26,19	110,1	0,00	79,86	-	-	0,00	0,00	-
T15	3 187	3 194	24,39	110,1	0,00	81,09	-	-	0,00	0,00	-
T16	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
T17	3 584	3 591	22,87	110,1	0,00	82,10	-	-	0,00	0,00	-
T18	2 715	2 723	26,42	110,1	0,00	79,70	-	-	0,00	0,00	-
T2	6 607	6 611	14,61	110,1	0,00	87,41	-	-	0,00	0,00	-
T3	6 437	6 441	14,95	110,1	0,00	87,18	-	-	0,00	0,00	-
T6	5 482	5 486	17,17	110,1	0,00	85,79	-	-	0,00	0,00	-
T7	5 480	5 484	17,17	110,1	0,00	85,78	-	-	0,00	0,00	-
T8	3 322	3 330	23,85	110,1	0,00	81,45	-	-	0,00	0,00	-
T9	4 579	4 585	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
Sum			36,58								

- Data undefined due to calculation with octave data

Project:
Haukkasalo_06052022

Licensed user:
FCG Finnish Consulting Group Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
14.2.2023 15.41/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasalo_06052022_4.w2r (5)

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0,0 dB(A)

Octave data required

Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTG: VESTAS V172-7.2 7200 172.0 !O!

Noise: V172 - 7,2 MW PO7200 No STE PO7200-OS

Source Source/Date Creator Edited

Vestas 15.11.2022 USER 13.2.2023 10.23

DMS no.: 0128-4336_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data								
					63	125	250	500	1000	2000	4000	8000	
					[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
From Windcat	214,0	8,0	110,1	No	91,5	100,2	104,1	105,0	103,7	99,3	91,6	80,8	

Noise sensitive area: A A - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: B B - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: C C - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: D D - Lomarakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: E E - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: F F - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: G G - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: H H - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

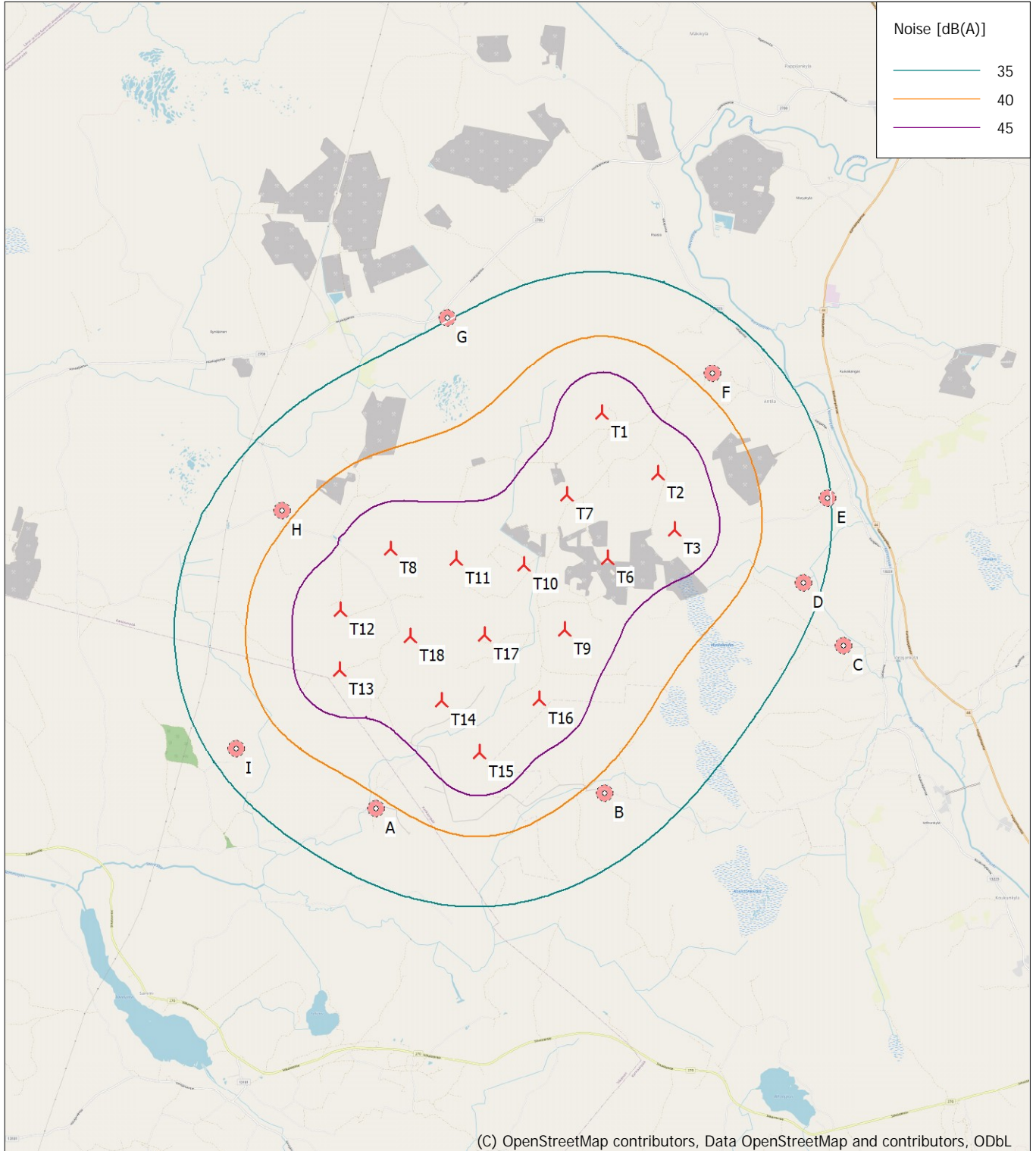
Noise sensitive area: I I - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

DECIBEL - Map 8,0 m/s

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1



Map: EMD OpenStreetMap , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 164 North: 6 876 457
New WTG Noise sensitive area
Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s
Height above sea level from active line object

Liite 2. Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 - Hankevaihtoehto 2

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasa

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more

restrictive, positive is less restrictive.:

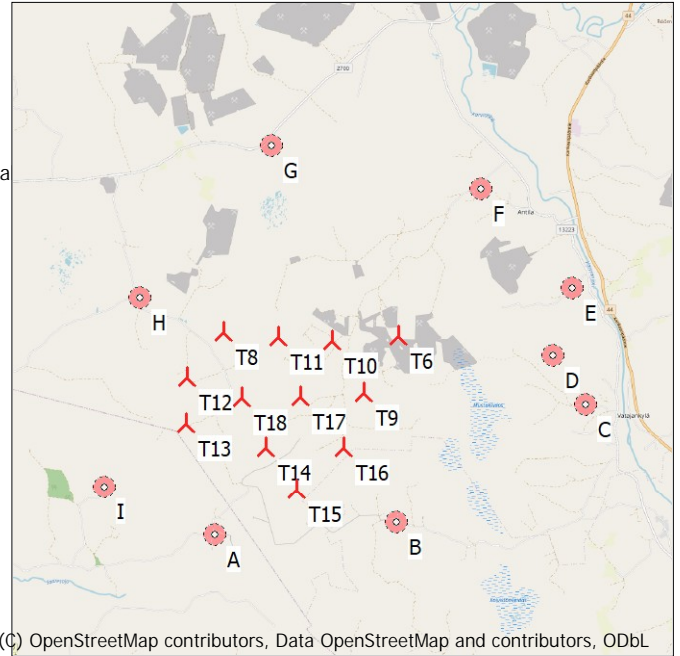
0,0 dB(A)

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]	Noise data		Wind speed [m/s]	LwA,ref [dB(A)]
					Valid	Manufact.	Type-generator				Creator	Name		
T10	245 421	6 876 704	92,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T11	244 530	6 876 852	90,9	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T12	242 968	6 876 299	90,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T13	242 898	6 875 520	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T14	244 202	6 875 018	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T15	244 645	6 874 295	83,7	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T16	245 483	6 874 938	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T17	244 829	6 875 835	90,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T18	243 855	6 875 881	87,5	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T6	246 523	6 876 714	95,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T8	243 641	6 876 974	93,6	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1
T9	245 882	6 875 817	92,0	VESTAS V172-7.2 7200 17...	Yes	VESTAS	V172-7.2-7 200	7 200	172,0	214,0	USER	V172 - 7,2 MW PO7200 No STE PO7200-0S	8,0	110,1



Calculation Results

Sound level

Noise sensitive area

No.	Name	East	North	Z	Immission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	4,0	40,0	39,0	176
B	B - Asuinrakennus	246 258	6 873 632	87,4	4,0	40,0	38,4	274
C	C - Asuinrakennus	249 534	6 875 344	92,8	4,0	40,0	30,3	2 213
D	D - Lomarakennus	249 068	6 876 198	92,5	4,0	40,0	32,2	1 556
E	E - Asuinrakennus	249 460	6 877 291	95,0	4,0	40,0	30,4	1 991
F	F - Asuinrakennus	248 080	6 879 034	96,2	4,0	40,0	31,3	1 772
G	G - Asuinrakennus	244 657	6 880 019	94,1	4,0	40,0	32,2	1 795
H	H - Asuinrakennus	242 301	6 877 666	90,0	4,0	40,0	38,9	183
I	I - Asuinrakennus	241 468	6 874 582	81,7	4,0	40,0	36,5	598

Project:

Haukkasalo_06052022

Licensed user:

FCG Finnish Consulting Group Oy

Osmontie 34, PO Box 950

FI-00601 Helsinki

+358104095666

Mikka Saranpää / mikka.saranpaa@fcg.fi

Calculated:

14.2.2023 15.47/3.5.584

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2

Distances (m)

WTG	A	B	C	D	E	F	G	H	I
T10	3746	3182	4329	3680	4079	3533	3400	3262	4482
T11	3444	3652	5222	4582	4946	4164	3168	2371	3808
T12	2653	4232	6630	6096	6563	5793	4082	1520	2278
T13	1891	3850	6633	6202	6792	6256	4827	2226	1709
T14	1668	2478	5338	5003	5724	5578	5018	3257	2766
T15	1546	1742	4996	4812	5667	5849	5720	4103	3187
T16	2585	1517	4068	3797	4618	4847	5145	4189	4027
T17	2697	2624	4726	4251	4851	4557	4184	3119	3584
T18	2306	3289	5700	5219	5776	5268	4213	2365	2715
T6	4485	3091	3306	2595	2991	2792	3793	4325	5482
T8	3339	4242	6109	5478	5824	4890	3208	1507	3229
T9	3413	2216	3680	3207	3867	3894	4374	4027	4579

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: ISO 9613-2 General 8,0 m/s
Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A A - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 746	3 753	22,29	110,1	0,00	82,49	-	-	0,00	0,00	-
T11	3 444	3 451	23,39	110,1	0,00	81,76	-	-	0,00	0,00	-
T12	2 653	2 662	26,71	110,1	0,00	79,50	-	-	0,00	0,00	-
T13	1 891	1 903	30,81	110,1	0,00	76,59	-	-	0,00	0,00	-
T14	1 668	1 682	32,26	110,1	0,00	75,52	-	-	0,00	0,00	-
T15	1 546	1 560	33,13	110,1	0,00	74,86	-	-	0,00	0,00	-
T16	2 585	2 594	27,03	110,1	0,00	79,28	-	-	0,00	0,00	-
T17	2 697	2 706	26,50	110,1	0,00	79,65	-	-	0,00	0,00	-
T18	2 306	2 316	28,44	110,1	0,00	78,29	-	-	0,00	0,00	-
T6	4 485	4 491	19,89	110,1	0,00	84,05	-	-	0,00	0,00	-
T8	3 339	3 346	23,79	110,1	0,00	81,49	-	-	0,00	0,00	-
T9	3 413	3 420	23,50	110,1	0,00	81,68	-	-	0,00	0,00	-
Sum			39,04								

- Data undefined due to calculation with octave data

Noise sensitive area: B B - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 182	3 189	24,41	110,1	0,00	81,07	-	-	0,00	0,00	-
T11	3 652	3 658	22,62	110,1	0,00	82,26	-	-	0,00	0,00	-
T12	4 232	4 238	20,67	110,1	0,00	83,54	-	-	0,00	0,00	-
T13	3 850	3 856	21,93	110,1	0,00	82,72	-	-	0,00	0,00	-
T14	2 478	2 487	27,56	110,1	0,00	78,91	-	-	0,00	0,00	-
T15	1 742	1 755	31,77	110,1	0,00	75,88	-	-	0,00	0,00	-
T16	1 517	1 532	33,35	110,1	0,00	74,70	-	-	0,00	0,00	-
T17	2 624	2 633	26,85	110,1	0,00	79,41	-	-	0,00	0,00	-
T18	3 289	3 295	23,99	110,1	0,00	81,36	-	-	0,00	0,00	-
T6	3 091	3 099	24,78	110,1	0,00	80,82	-	-	0,00	0,00	-
T8	4 242	4 247	20,64	110,1	0,00	83,56	-	-	0,00	0,00	-
T9	2 216	2 226	28,92	110,1	0,00	77,95	-	-	0,00	0,00	-
Sum			38,39								

- Data undefined due to calculation with octave data

Noise sensitive area: C C - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	4 329	4 334	20,37	110,1	0,00	83,74	-	-	0,00	0,00	-
T11	5 222	5 226	17,83	110,1	0,00	85,36	-	-	0,00	0,00	-
T12	6 630	6 633	14,57	110,1	0,00	87,43	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T13	6 633	6 636	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
T14	5 338	5 341	17,53	110,1	0,00	85,55	-	-	0,00	0,00	-
T15	4 996	5 000	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T16	4 068	4 073	21,20	110,1	0,00	83,20	-	-	0,00	0,00	-
T17	4 726	4 731	19,19	110,1	0,00	84,50	-	-	0,00	0,00	-
T18	5 700	5 704	16,63	110,1	0,00	86,12	-	-	0,00	0,00	-
T6	3 306	3 312	23,92	110,1	0,00	81,40	-	-	0,00	0,00	-
T8	6 109	6 113	15,67	110,1	0,00	86,73	-	-	0,00	0,00	-
T9	3 680	3 686	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
Sum			30,32								

- Data undefined due to calculation with octave data

Noise sensitive area: D D - Lomarakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 680	3 685	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
T11	4 582	4 586	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
T12	6 096	6 100	15,70	110,1	0,00	86,71	-	-	0,00	0,00	-
T13	6 202	6 205	15,47	110,1	0,00	86,86	-	-	0,00	0,00	-
T14	5 003	5 007	18,42	110,1	0,00	84,99	-	-	0,00	0,00	-
T15	4 812	4 816	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T16	3 797	3 803	22,11	110,1	0,00	82,60	-	-	0,00	0,00	-
T17	4 251	4 256	20,61	110,1	0,00	83,58	-	-	0,00	0,00	-
T18	5 219	5 223	17,84	110,1	0,00	85,36	-	-	0,00	0,00	-
T6	2 595	2 604	26,99	110,1	0,00	79,31	-	-	0,00	0,00	-
T8	5 478	5 482	17,18	110,1	0,00	85,78	-	-	0,00	0,00	-
T9	3 207	3 214	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
Sum			32,18								

- Data undefined due to calculation with octave data

Noise sensitive area: E E - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	4 079	4 084	21,16	110,1	0,00	83,22	-	-	0,00	0,00	-
T11	4 946	4 951	18,57	110,1	0,00	84,89	-	-	0,00	0,00	-
T12	6 563	6 566	14,69	110,1	0,00	87,35	-	-	0,00	0,00	-
T13	6 792	6 795	14,28	110,1	0,00	87,64	-	-	0,00	0,00	-
T14	5 724	5 728	16,58	110,1	0,00	86,16	-	-	0,00	0,00	-
T15	5 667	5 671	16,71	110,1	0,00	86,07	-	-	0,00	0,00	-
T16	4 618	4 622	19,50	110,1	0,00	84,30	-	-	0,00	0,00	-
T17	4 851	4 855	18,84	110,1	0,00	84,72	-	-	0,00	0,00	-
T18	5 776	5 779	16,45	110,1	0,00	86,24	-	-	0,00	0,00	-
T6	2 991	2 999	25,20	110,1	0,00	80,54	-	-	0,00	0,00	-
T8	5 824	5 827	16,34	110,1	0,00	86,31	-	-	0,00	0,00	-
T9	3 867	3 873	21,87	110,1	0,00	82,76	-	-	0,00	0,00	-
Sum			30,37								

- Data undefined due to calculation with octave data

Noise sensitive area: F F - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 533	3 539	23,06	110,1	0,00	81,98	-	-	0,00	0,00	-
T11	4 164	4 169	20,89	110,1	0,00	83,40	-	-	0,00	0,00	-
T12	5 793	5 797	16,41	110,1	0,00	86,26	-	-	0,00	0,00	-
T13	6 256	6 259	15,35	110,1	0,00	86,93	-	-	0,00	0,00	-
T14	5 578	5 582	16,93	110,1	0,00	85,94	-	-	0,00	0,00	-
T15	5 849	5 852	16,28	110,1	0,00	86,35	-	-	0,00	0,00	-
T16	4 847	4 851	18,85	110,1	0,00	84,72	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T17	4 557	4 562	19,68	110,1	0,00	84,18	-	-	0,00	0,00	-
T18	5 268	5 272	17,71	110,1	0,00	85,44	-	-	0,00	0,00	-
T6	2 792	2 800	26,07	110,1	0,00	79,94	-	-	0,00	0,00	-
T8	4 890	4 894	18,73	110,1	0,00	84,79	-	-	0,00	0,00	-
T9	3 894	3 899	21,78	110,1	0,00	82,82	-	-	0,00	0,00	-
Sum			31,31								

- Data undefined due to calculation with octave data

Noise sensitive area: G G - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 400	3 406	23,56	110,1	0,00	81,65	-	-	0,00	0,00	-
T11	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T12	4 082	4 088	21,15	110,1	0,00	83,23	-	-	0,00	0,00	-
T13	4 827	4 832	18,90	110,1	0,00	84,68	-	-	0,00	0,00	-
T14	5 018	5 022	18,38	110,1	0,00	85,02	-	-	0,00	0,00	-
T15	5 720	5 724	16,60	110,1	0,00	86,15	-	-	0,00	0,00	-
T16	5 145	5 149	18,04	110,1	0,00	85,23	-	-	0,00	0,00	-
T17	4 184	4 189	20,83	110,1	0,00	83,44	-	-	0,00	0,00	-
T18	4 213	4 217	20,76	110,1	0,00	83,50	-	-	0,00	0,00	-
T6	3 793	3 799	22,13	110,1	0,00	82,59	-	-	0,00	0,00	-
T8	3 208	3 215	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
T9	4 374	4 379	20,23	110,1	0,00	83,83	-	-	0,00	0,00	-
Sum			32,23								

- Data undefined due to calculation with octave data

Noise sensitive area: H H- Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	3 262	3 269	24,09	110,1	0,00	81,29	-	-	0,00	0,00	-
T11	2 371	2 381	28,10	110,1	0,00	78,53	-	-	0,00	0,00	-
T12	1 520	1 534	33,33	110,1	0,00	74,72	-	-	0,00	0,00	-
T13	2 226	2 236	28,87	110,1	0,00	77,99	-	-	0,00	0,00	-
T14	3 257	3 264	24,11	110,1	0,00	81,27	-	-	0,00	0,00	-
T15	4 103	4 108	21,09	110,1	0,00	83,27	-	-	0,00	0,00	-
T16	4 189	4 194	20,81	110,1	0,00	83,45	-	-	0,00	0,00	-
T17	3 119	3 126	24,67	110,1	0,00	80,90	-	-	0,00	0,00	-
T18	2 365	2 374	28,13	110,1	0,00	78,51	-	-	0,00	0,00	-
T6	4 325	4 330	20,38	110,1	0,00	83,73	-	-	0,00	0,00	-
T8	1 507	1 522	33,42	110,1	0,00	74,65	-	-	0,00	0,00	-
T9	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
Sum			38,87								

- Data undefined due to calculation with octave data

Noise sensitive area: I I - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T10	4 482	4 488	19,90	110,1	0,00	84,04	-	-	0,00	0,00	-
T11	3 808	3 814	22,07	110,1	0,00	82,63	-	-	0,00	0,00	-
T12	2 278	2 288	28,58	110,1	0,00	78,19	-	-	0,00	0,00	-
T13	1 709	1 722	31,99	110,1	0,00	75,72	-	-	0,00	0,00	-
T14	2 766	2 775	26,19	110,1	0,00	79,86	-	-	0,00	0,00	-
T15	3 187	3 194	24,39	110,1	0,00	81,09	-	-	0,00	0,00	-
T16	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
T17	3 584	3 591	22,87	110,1	0,00	82,10	-	-	0,00	0,00	-
T18	2 715	2 723	26,42	110,1	0,00	79,70	-	-	0,00	0,00	-
T6	5 482	5 486	17,17	110,1	0,00	85,79	-	-	0,00	0,00	-
T8	3 229	3 237	24,22	110,1	0,00	81,20	-	-	0,00	0,00	-

To be continued on next page...

Project:

Haukkasalo_06052022

Licensed user:

FCG Finnish Consulting Group Oy

Osmontie 34, PO Box 950

FI-00601 Helsinki

+358104095666

Mikka Saranpää / mikka.saranpaa@fcg.fi

Calculated:

14.2.2023 15.47/3.5.584

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T9	4 579	4 585	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
Sum			36,46								

- Data undefined due to calculation with octave data

Project:
Haukkasalo_06052022

Licensed user:
FCG Finnish Consulting Group Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
14.2.2023 15.47/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasalo_06052022_4.w2r (5)

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0,0 dB(A)

Octave data required

Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTG: VESTAS V172-7.2 7200 172.0 !O!

Noise: V172 - 7,2 MW PO7200 No STE PO7200-OS

Source Source/Date Creator Edited

Vestas 15.11.2022 USER 13.2.2023 10.23

DMS no.: 0128-4336_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data								
					63	125	250	500	1000	2000	4000	8000	
					[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
From Windcat	214,0	8,0	110,1	No	91,5	100,2	104,1	105,0	103,7	99,3	91,6	80,8	

Noise sensitive area: A A - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: B B - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: C C - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Project:

Haukkasalo_06052022

Licensed user:

FCG Finnish Consulting Group Oy

Osmontie 34, PO Box 950

FI-00601 Helsinki

+358104095666

Mikka Saranpää / mikka.saranpaa@fcg.fi

Calculated:

14.2.2023 15.47/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: D D - Lomarakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: E E - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: F F - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: G G - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: H H - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: I I - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

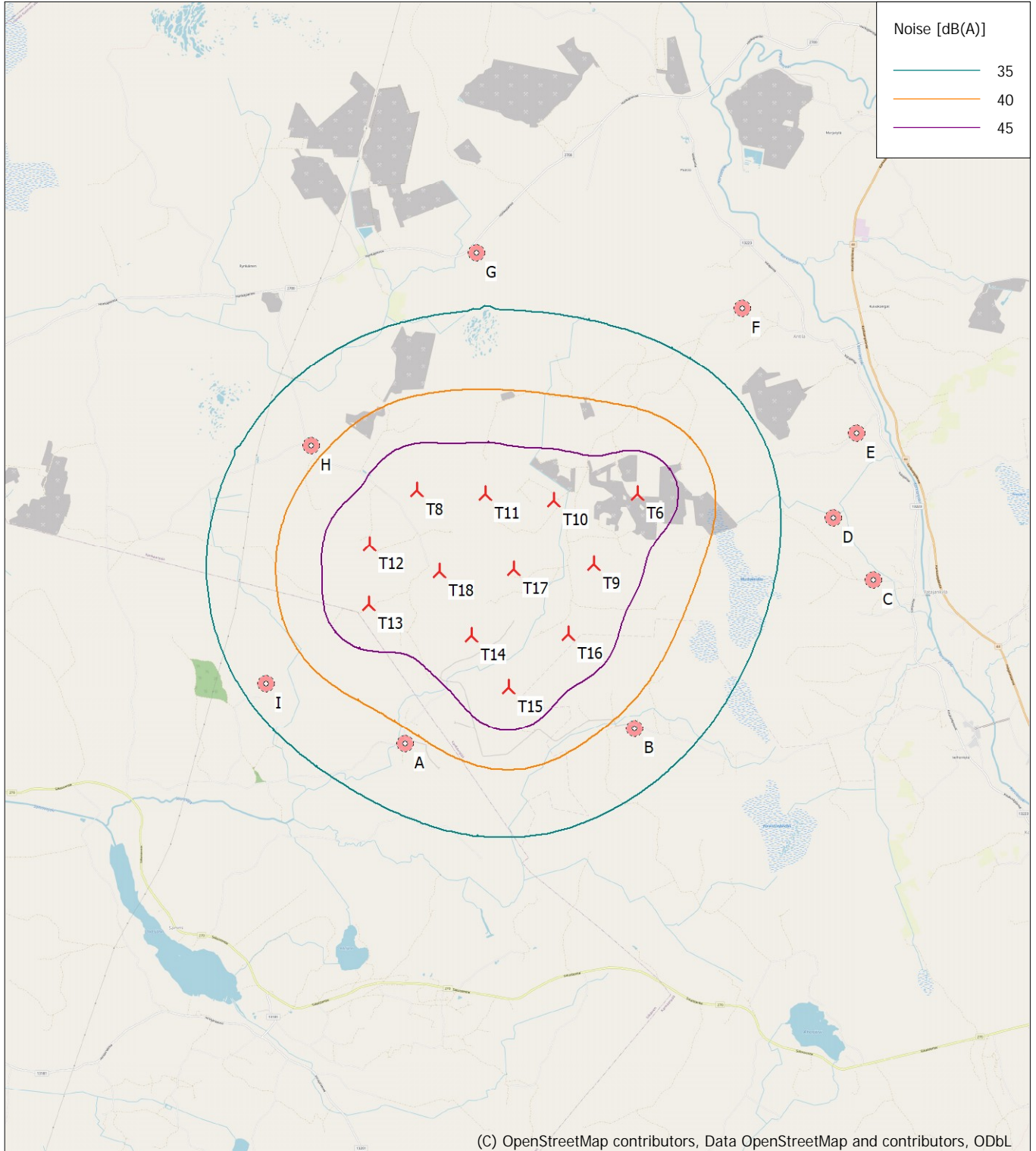
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

DECIBEL - Map 8,0 m/s

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL



Map: EMD OpenStreetMap, Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 244 711 North: 6 875 634

New WTG

Noise sensitive area

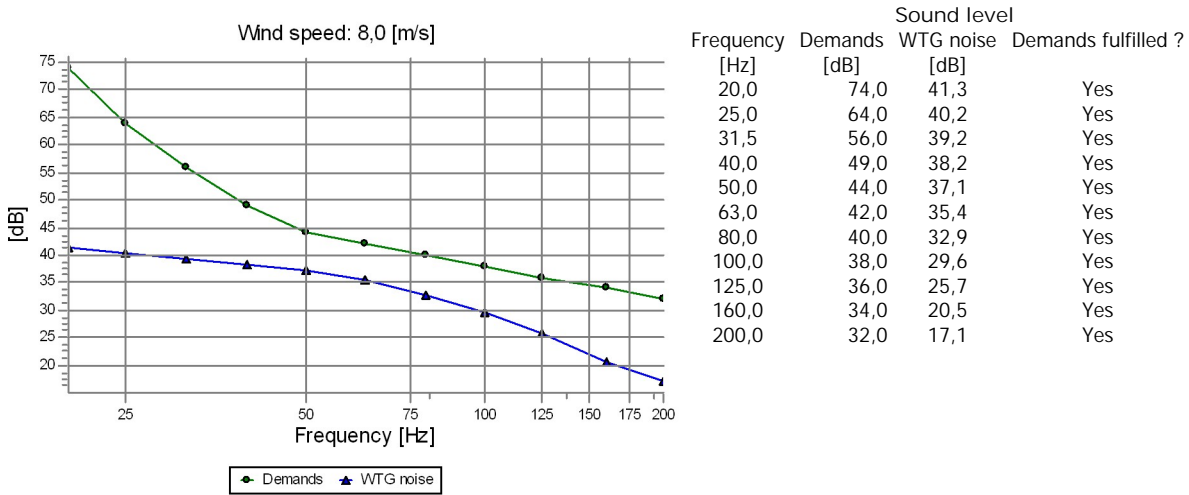
Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s
Height above sea level from active line object

1.3.2023

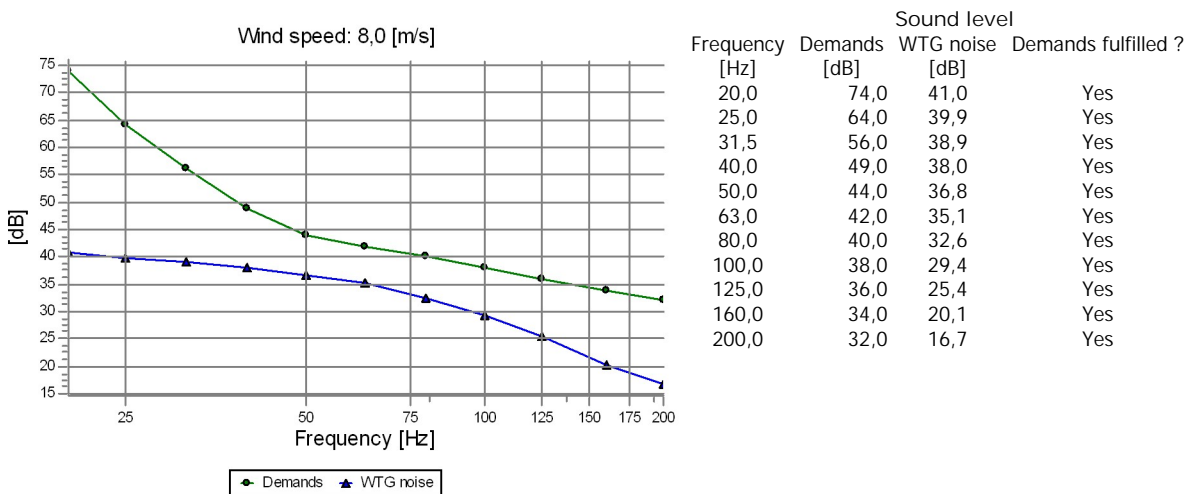
Liite 3. Matalataajuisen melun rakennuskohtaiset arvot - Hankevaihtoehto 1

DECIBEL - Detailed results, graphic

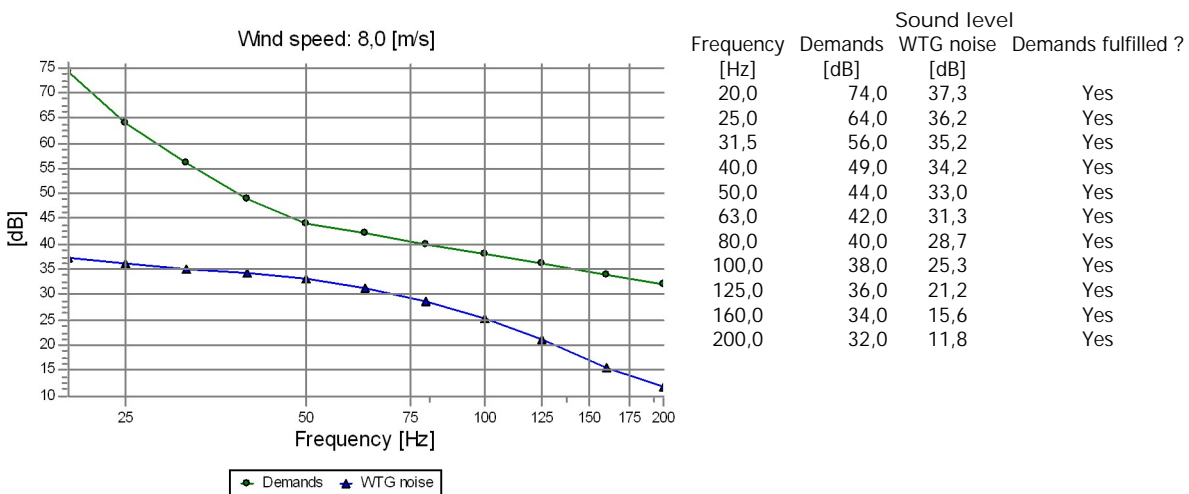
Calculation: MatalataajuiinenHaukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: Finland Low frequency
A A - Asuinrakennus



B B - Asuinrakennus

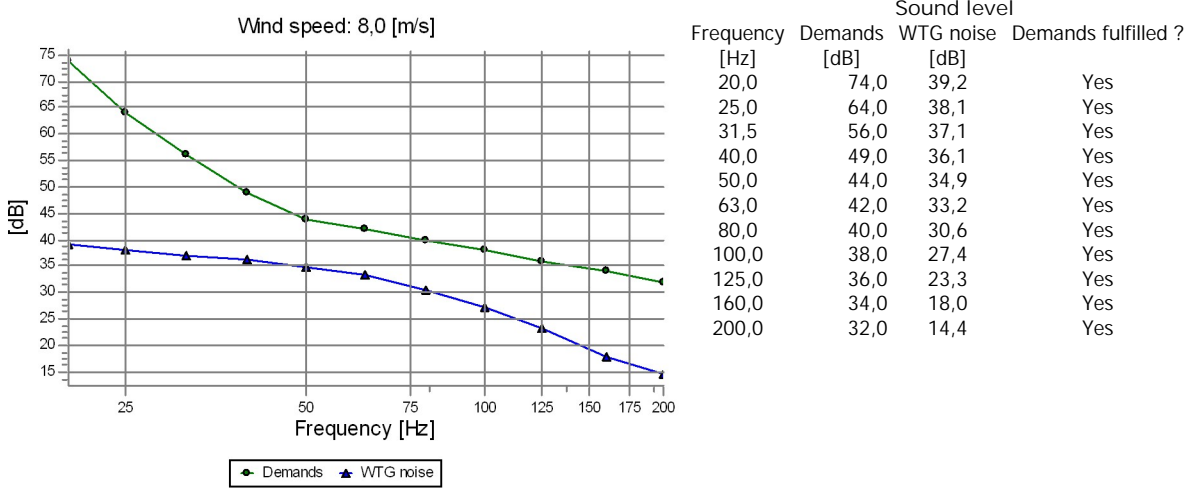


C C - Asuinrakennus

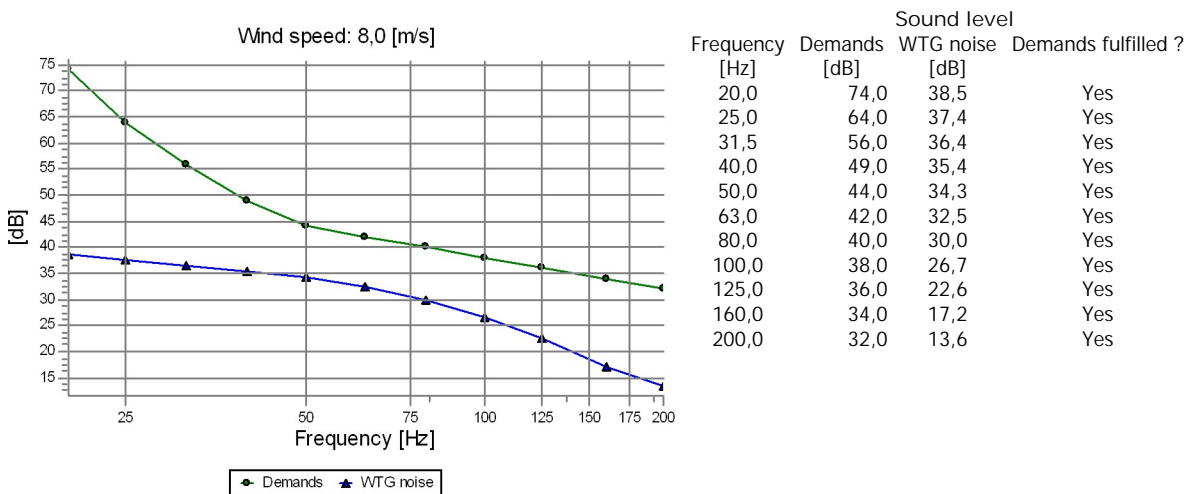


DECIBEL - Detailed results, graphic

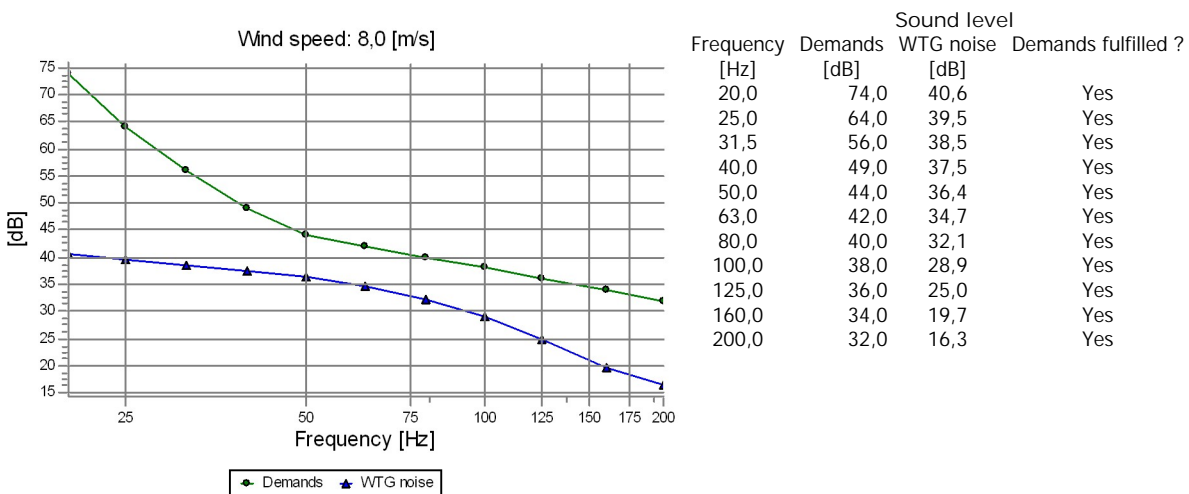
Calculation: MatalataajuiinenHaukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: Finland Low frequency
D D - Lomarakennus



E E - Asuinrakennus

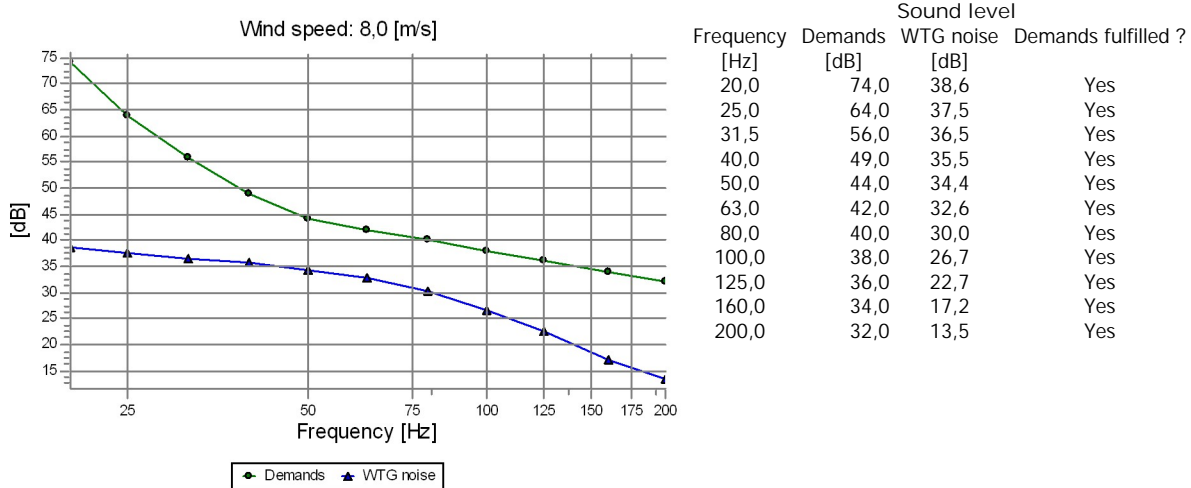


F F - Asuinrakennus

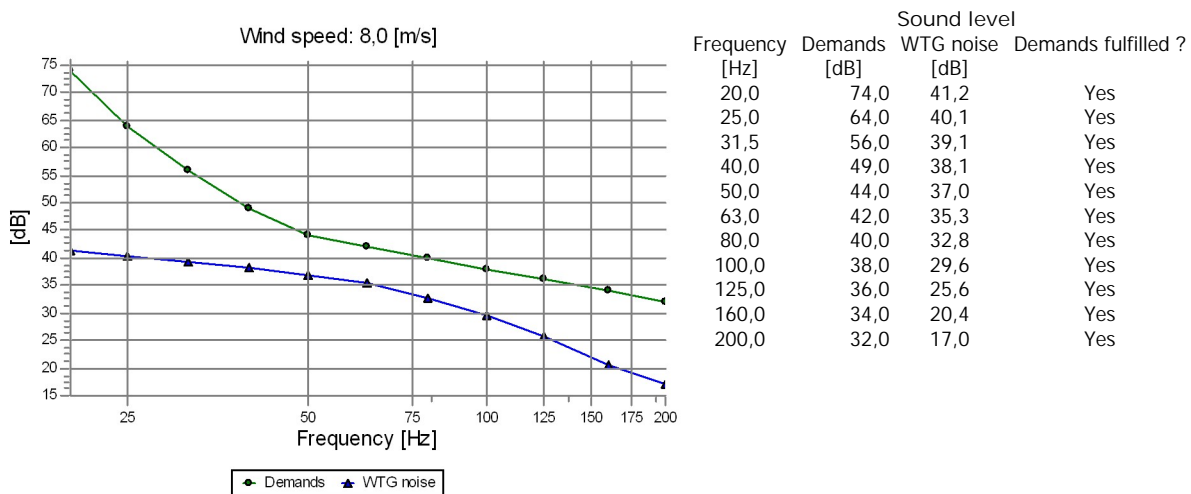


DECIBEL - Detailed results, graphic

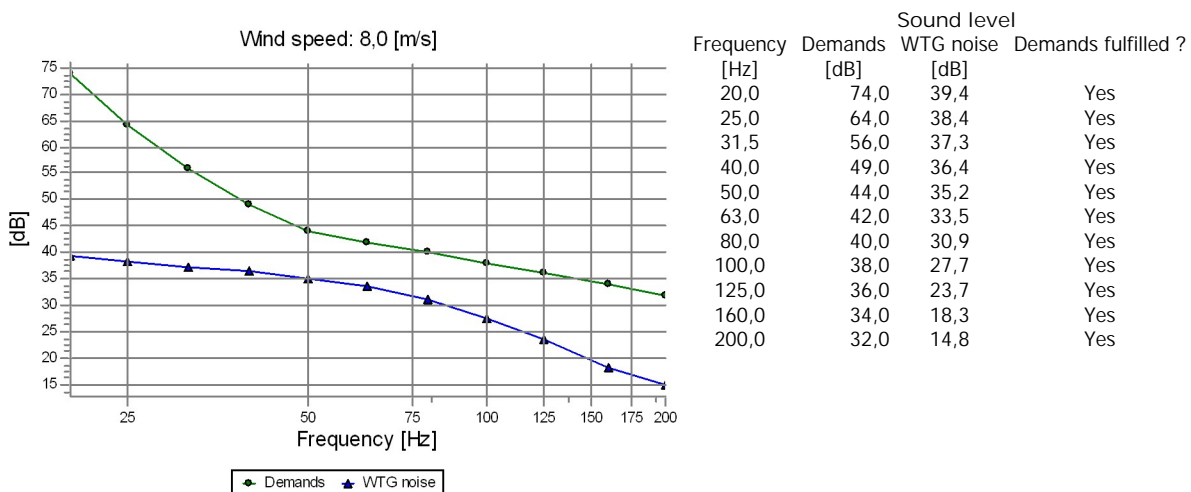
Calculation: MatalataajuiinenHaukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1Noise calculation model: Finland Low frequency
G G - Asuinrakennus



H H- Asuinrakennus



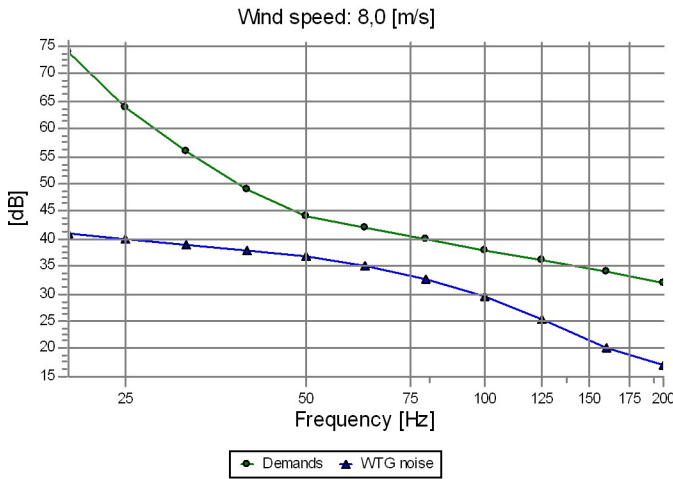
I I - Asuinrakennus



Liite 4. Matalataajuisen melun rakennuskohtaiset arvot - Hankevaihtoehto 2

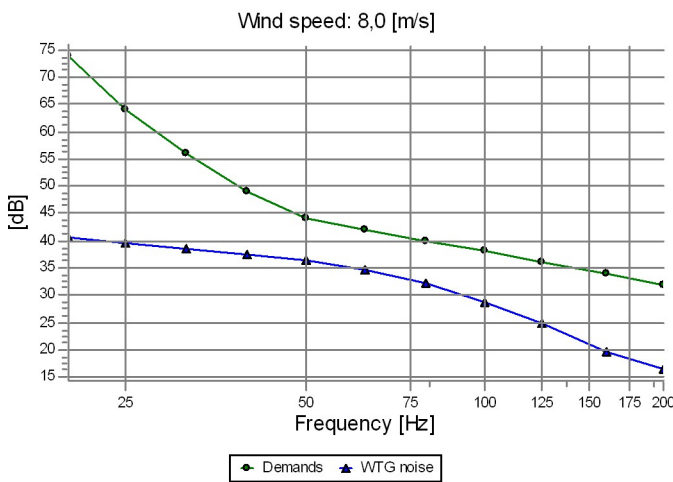
DECIBEL - Detailed results, graphic

Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: Finland Low frequency
A A - Asuinrakennus



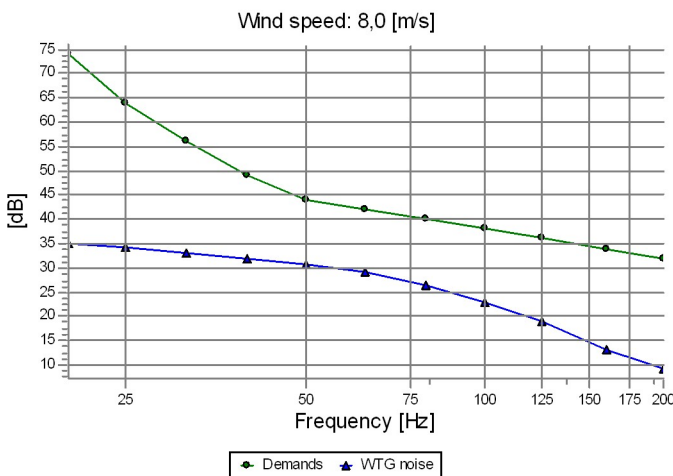
Frequency [Hz]	Demands [dB]	WTG noise [dB]	Demands fulfilled ?
20,0	74,0	41,0	Yes
25,0	64,0	39,9	Yes
31,5	56,0	38,9	Yes
40,0	49,0	38,0	Yes
50,0	44,0	36,8	Yes
63,0	42,0	35,1	Yes
80,0	40,0	32,6	Yes
100,0	38,0	29,4	Yes
125,0	36,0	25,5	Yes
160,0	34,0	20,3	Yes
200,0	32,0	16,9	Yes

B B - Asuinrakennus



Frequency [Hz]	Demands [dB]	WTG noise [dB]	Demands fulfilled ?
20,0	74,0	40,5	Yes
25,0	64,0	39,4	Yes
31,5	56,0	38,4	Yes
40,0	49,0	37,4	Yes
50,0	44,0	36,3	Yes
63,0	42,0	34,6	Yes
80,0	40,0	32,1	Yes
100,0	38,0	28,9	Yes
125,0	36,0	25,0	Yes
160,0	34,0	19,7	Yes
200,0	32,0	16,3	Yes

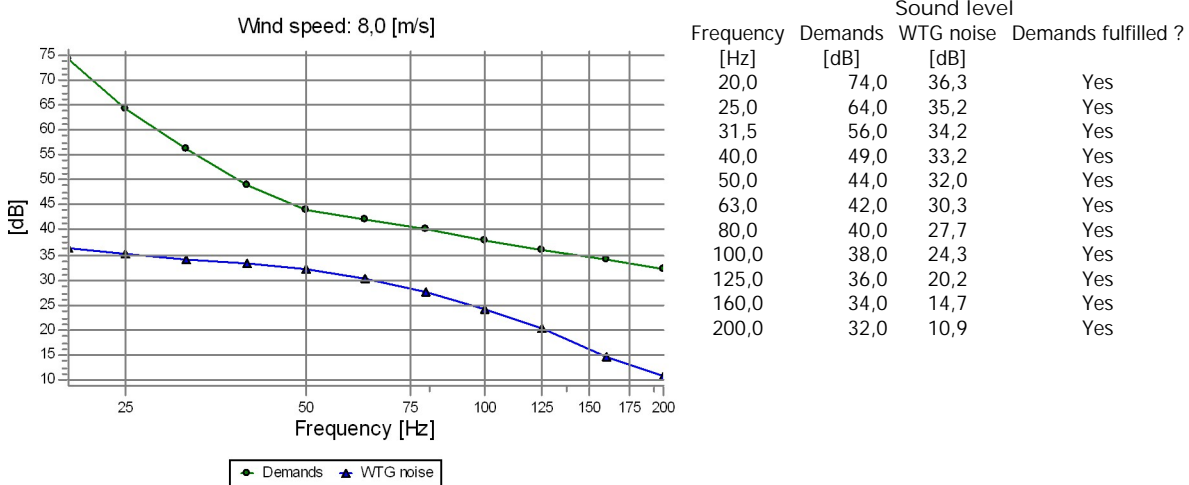
C C - Asuinrakennus



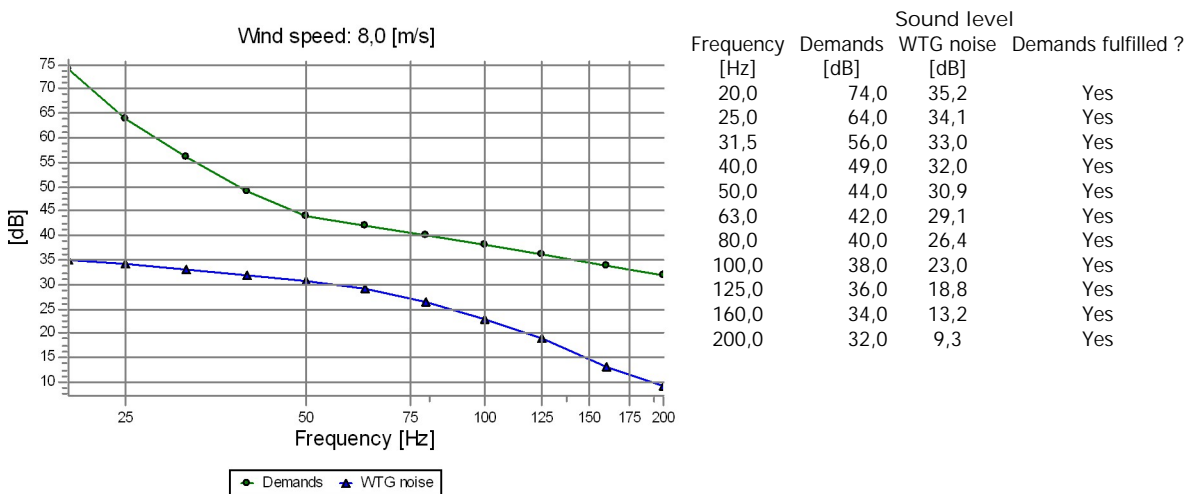
Frequency [Hz]	Demands [dB]	WTG noise [dB]	Demands fulfilled ?
20,0	74,0	35,2	Yes
25,0	64,0	34,1	Yes
31,5	56,0	33,1	Yes
40,0	49,0	32,1	Yes
50,0	44,0	30,9	Yes
63,0	42,0	29,1	Yes
80,0	40,0	26,5	Yes
100,0	38,0	23,1	Yes
125,0	36,0	18,9	Yes
160,0	34,0	13,2	Yes
200,0	32,0	9,3	Yes

DECIBEL - Detailed results, graphic

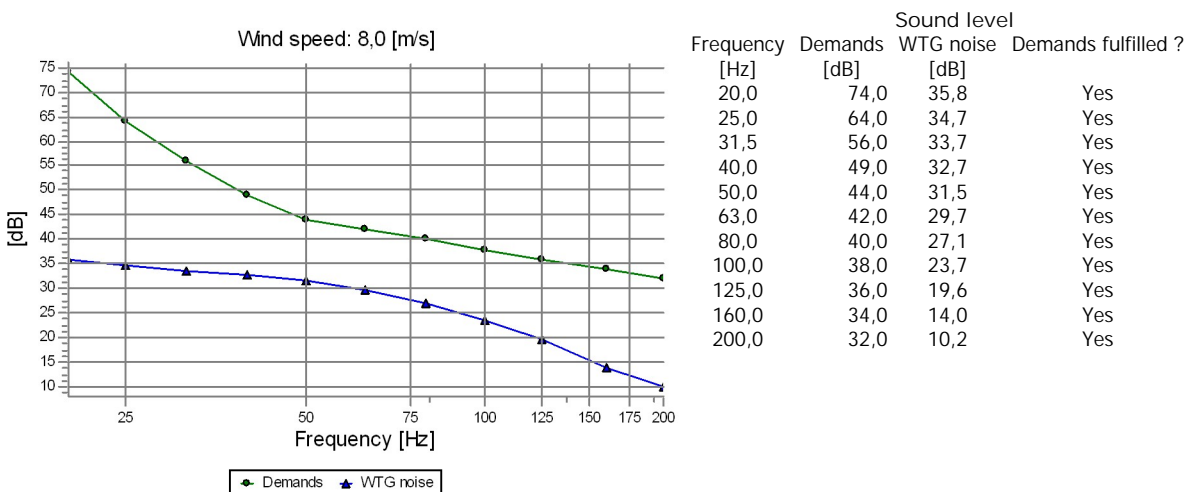
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: Finland Low frequency
D D - Lomarakennus



E E - Asuinrakennus

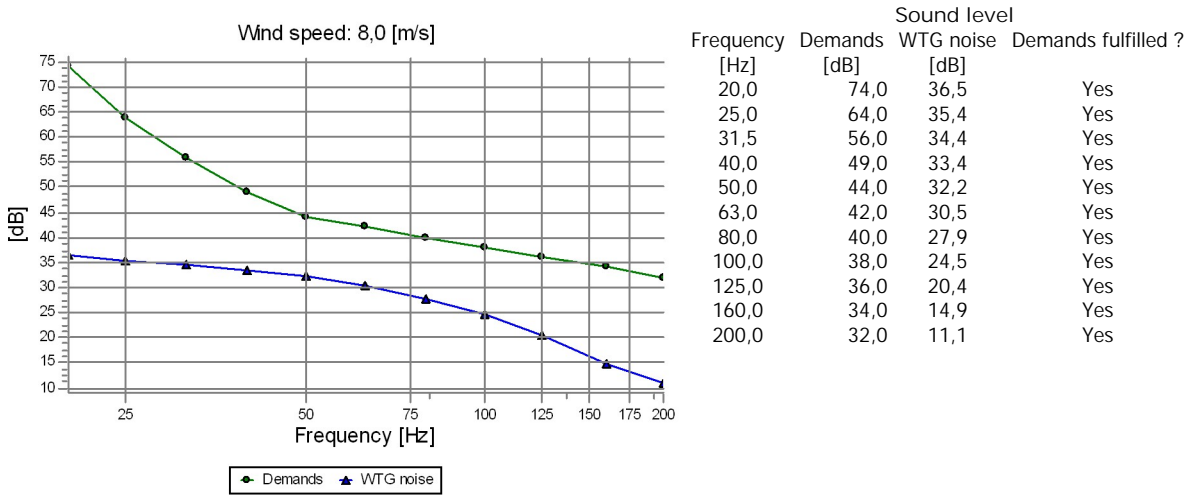


F F - Asuinrakennus

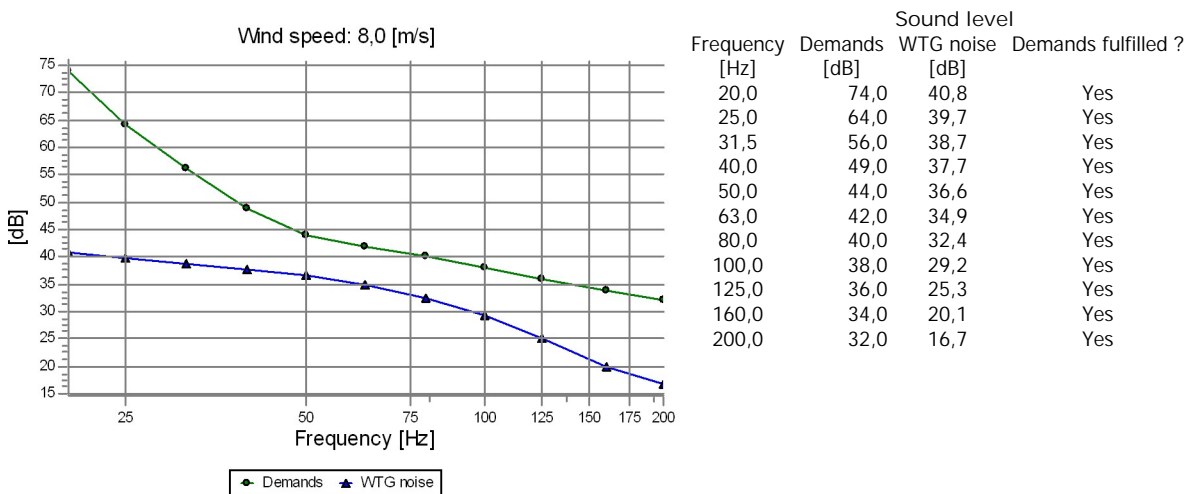


DECIBEL - Detailed results, graphic

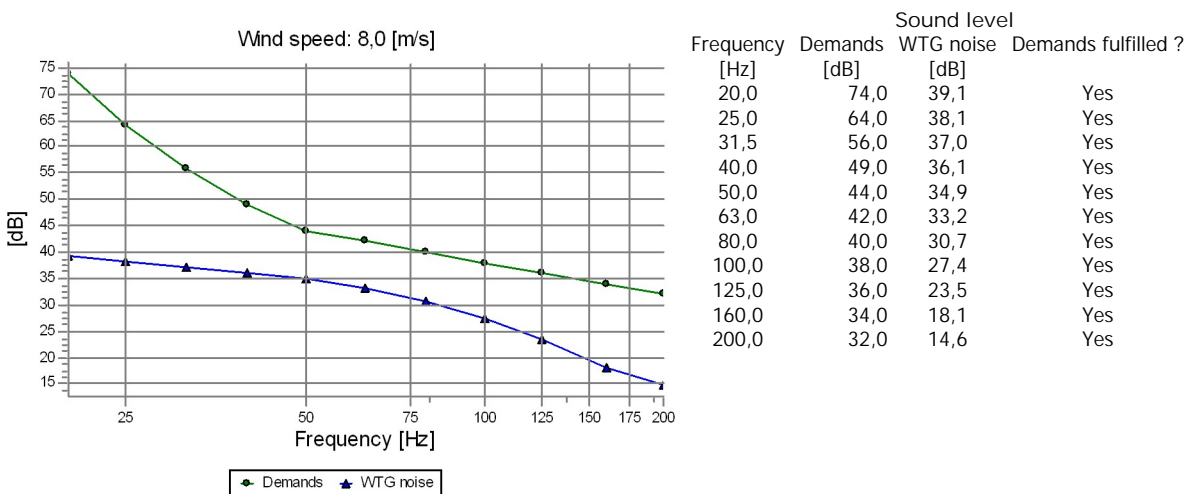
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2Noise calculation model: Finland Low frequency
G G - Asuinrakennus



H H- Asuinrakennus



I I - Asuinrakennus



1.3.2023

Liite 5. Varjostusmallinnuksen tulokset "Real Case, No Forest" - Hankevaihtoehto 1

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
582	477	425	459	574	730	937	1 097	854	709	615	560	8 017

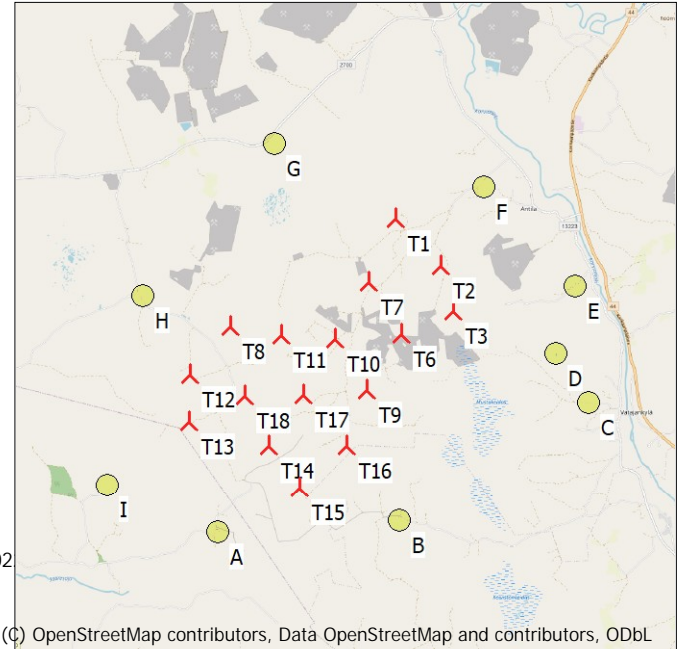
Idle start wind speed: Cut in wind speed from power curve

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: CONTOURLINE_Haukkasalo_06052022
Obstacles used in calculation
Receptor grid resolution: 1,0 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]
T1	246 582	6 878 619	95,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T10	245 421	6 876 704	92,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T12	242 968	6 876 299	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T13	242 898	6 875 529	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T2	247 257	6 877 777	97,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T3	247 430	6 877 022	96,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T7	246 054	6 877 590	94,8	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 691	6 877 054	93,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:125 000
New WTG Shadow receptor

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
		[m]	[m]	[m]	[m]	[m]	[m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	A - Asuinrakennus	8:43	
B	B - Asuinrakennus	5:38	
C	C - Asuinrakennus	0:00	
D	D - Lomarakennus	7:34	
E	E - Asuinrakennus	3:12	
F	F - Asuinrakennus	6:58	
G	G - Asuinrakennus	0:51	
H	H - Asuinrakennus	7:44	
I	I - Asuinrakennus	7:32	

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

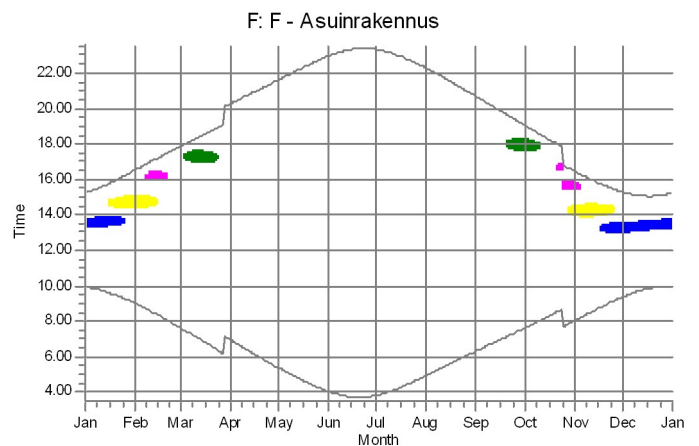
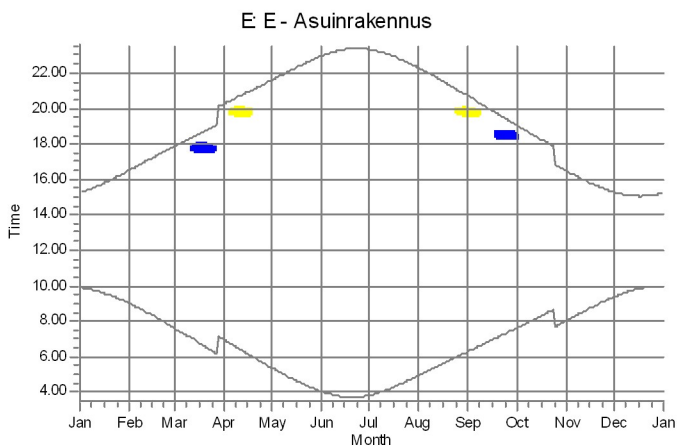
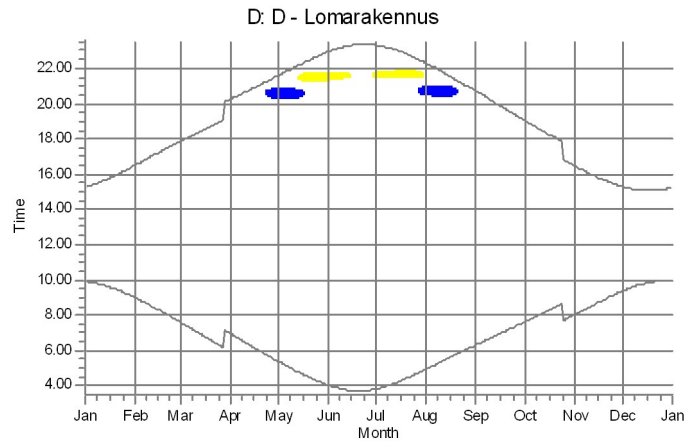
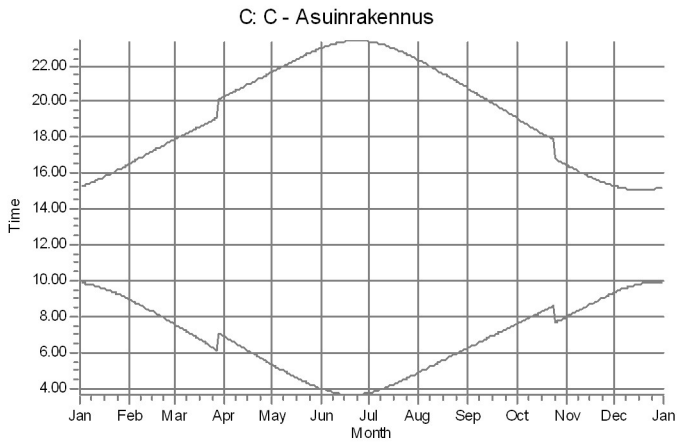
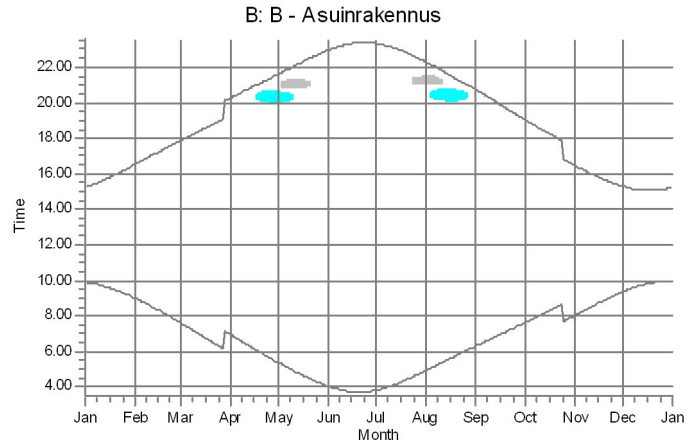
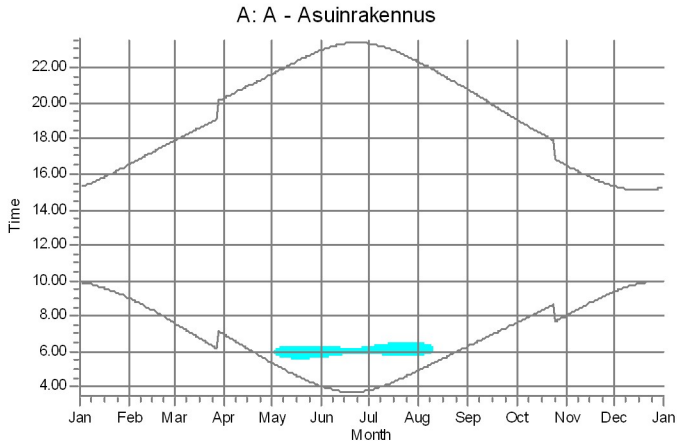
No.	Name	Expected [h/year]
T1	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	3:32
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:00
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	2:06
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	8:40
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	2:05
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	12:17
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:50
T2	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	7:38
T3	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	6:32
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
T7	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:46
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	2:48
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest



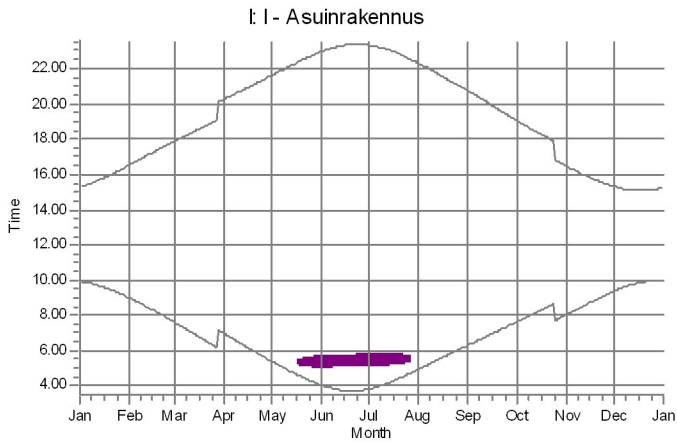
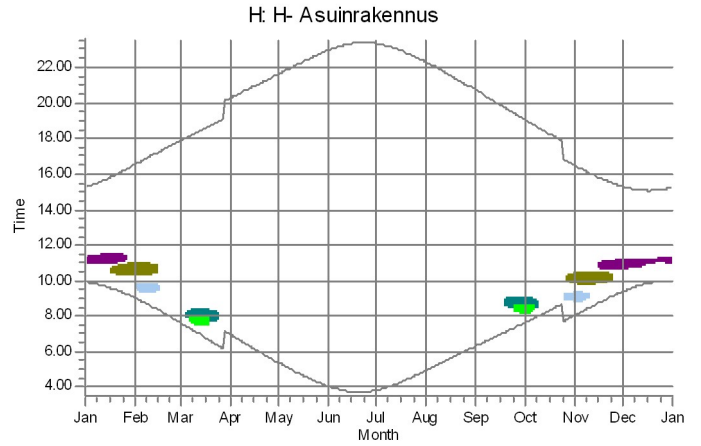
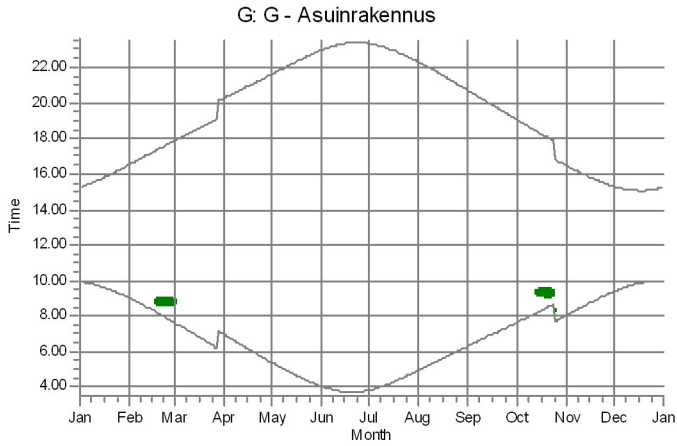
WTGs

- T1: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (247)
- T2: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (248)
- T3: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (249)

- T7: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (251)
- T14: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (258)
- T15: Generic RD200 7200 200.0 !OI! hub: 200,0 m (TOT: 300,0 m) (259)

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest



WTGs

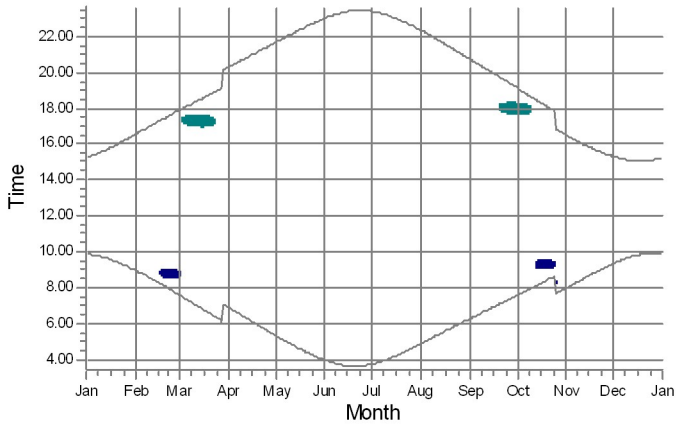
- T1: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (247)
- T8: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (252)
- T11: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (255)

- T12: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (256)
- T13: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (257)
- T18: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (261)

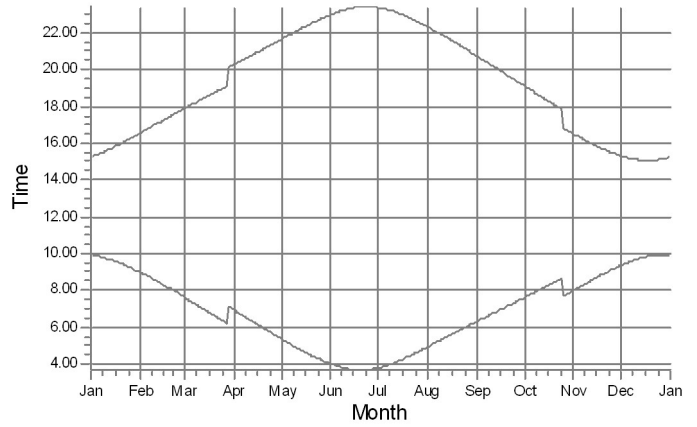
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest

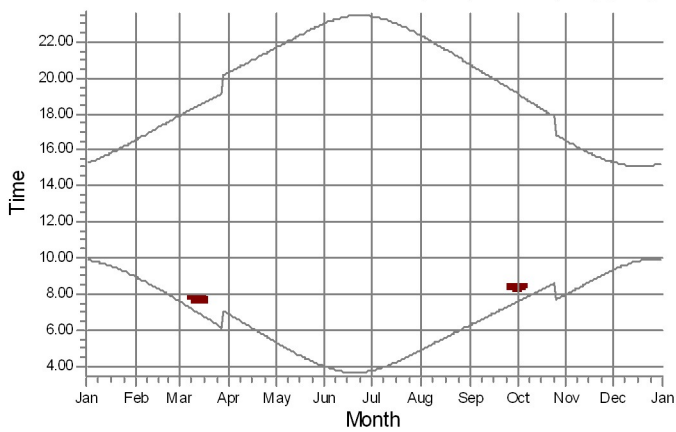
T1: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)



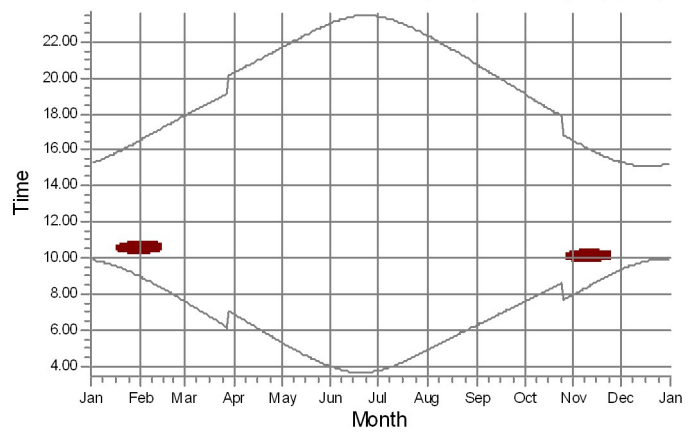
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)



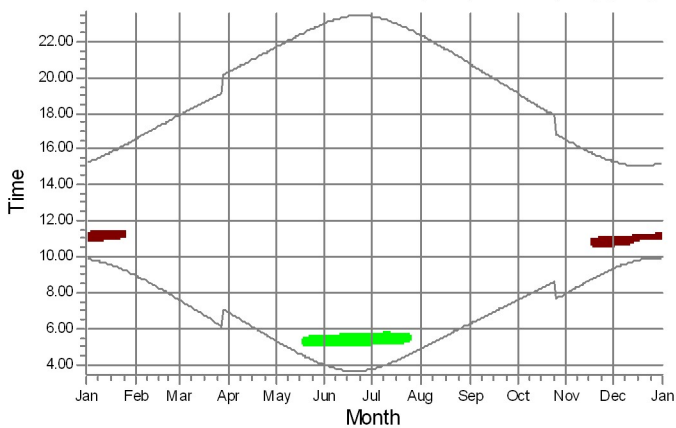
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)



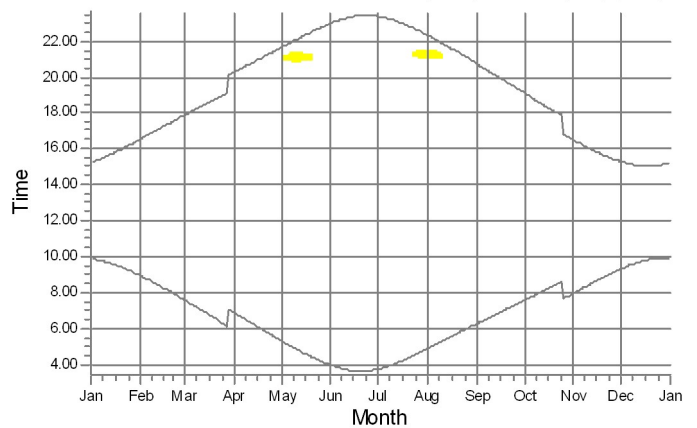
T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)



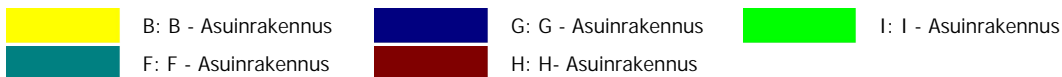
T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)



T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)



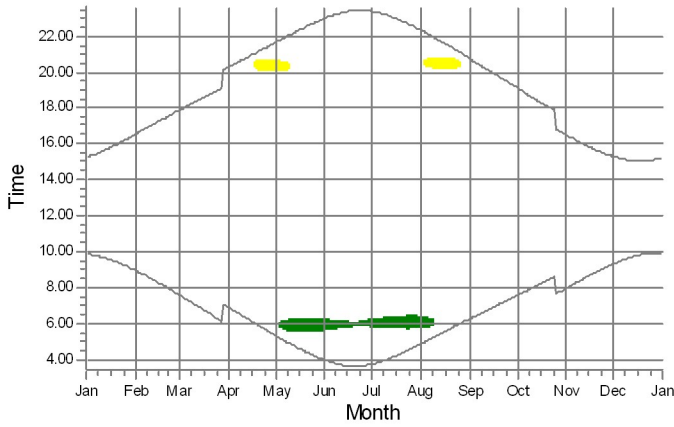
Shadow receptors



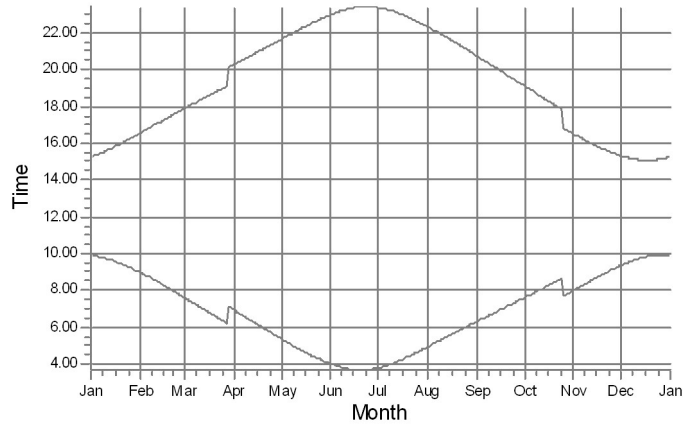
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest

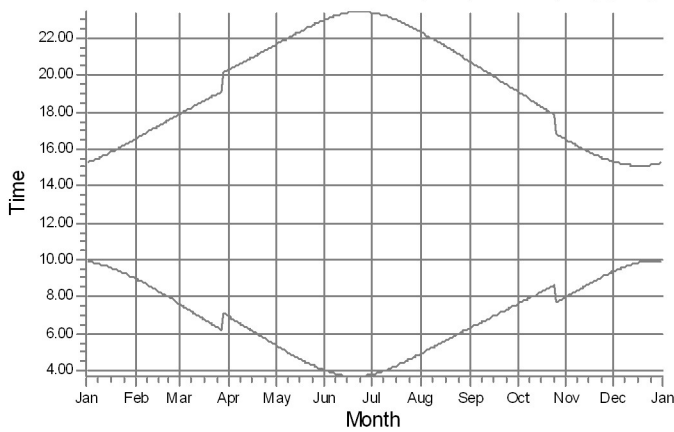
T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)



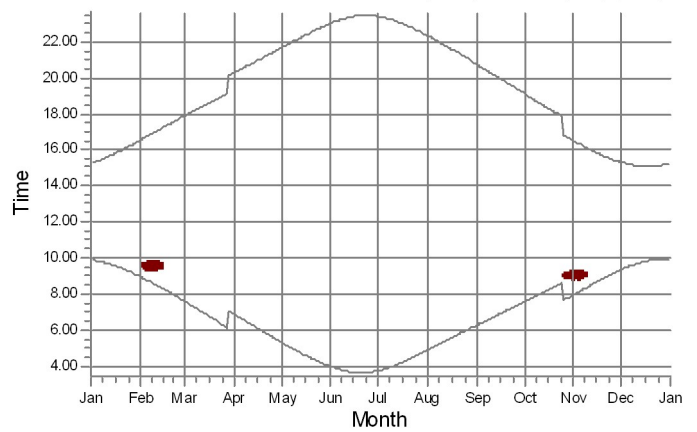
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)



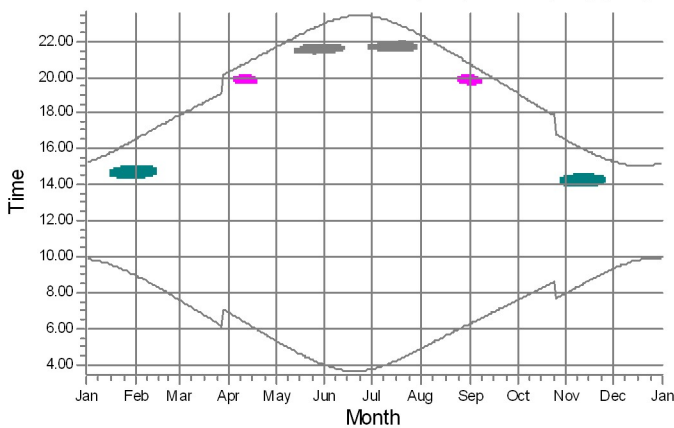
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)



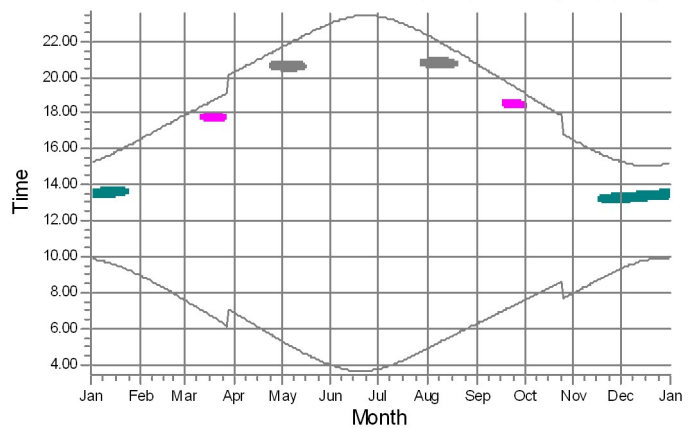
T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)









T2: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)



T3: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)



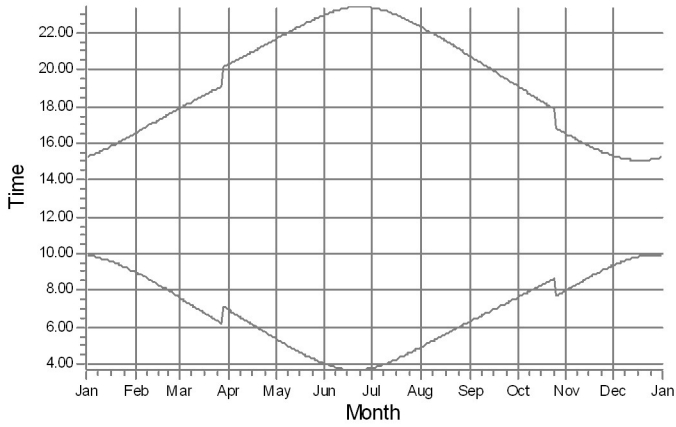
Shadow receptors

	A: A - Asuinrakennus		D: D - Lomarakennus		F: F - Asuinrakennus
	B: B - Asuinrakennus		E: E - Asuinrakennus		H: H - Asuinrakennus

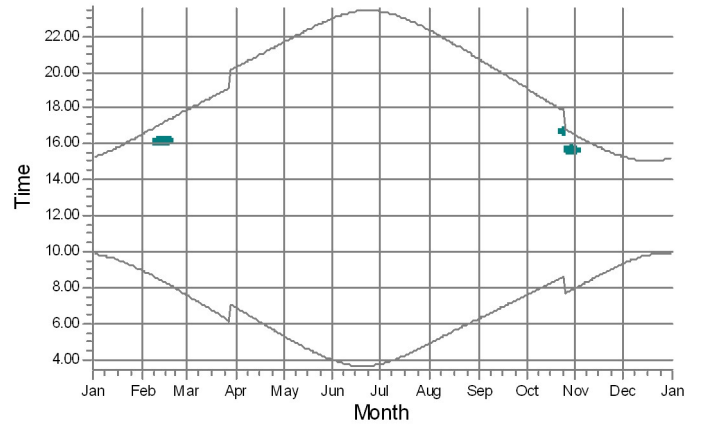
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest

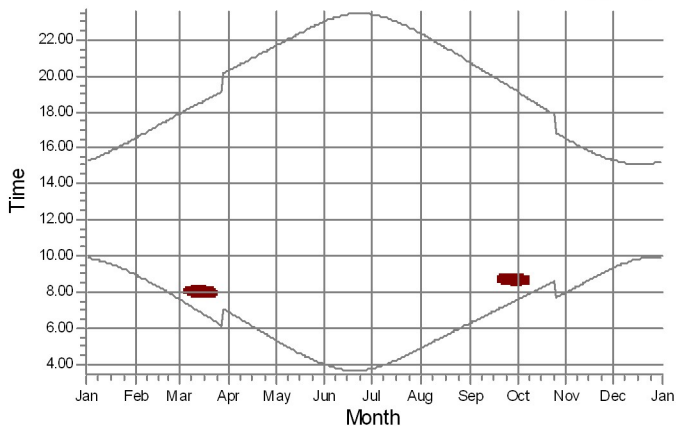
T6: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (250)



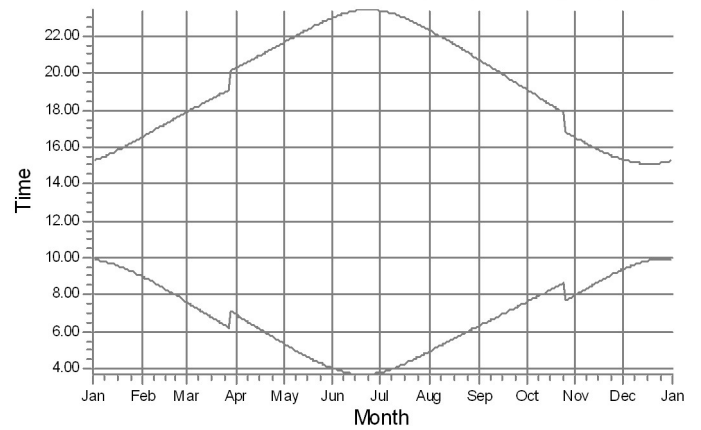
T7: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (251)



T8: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (252)



T9: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (253)



Shadow receptors



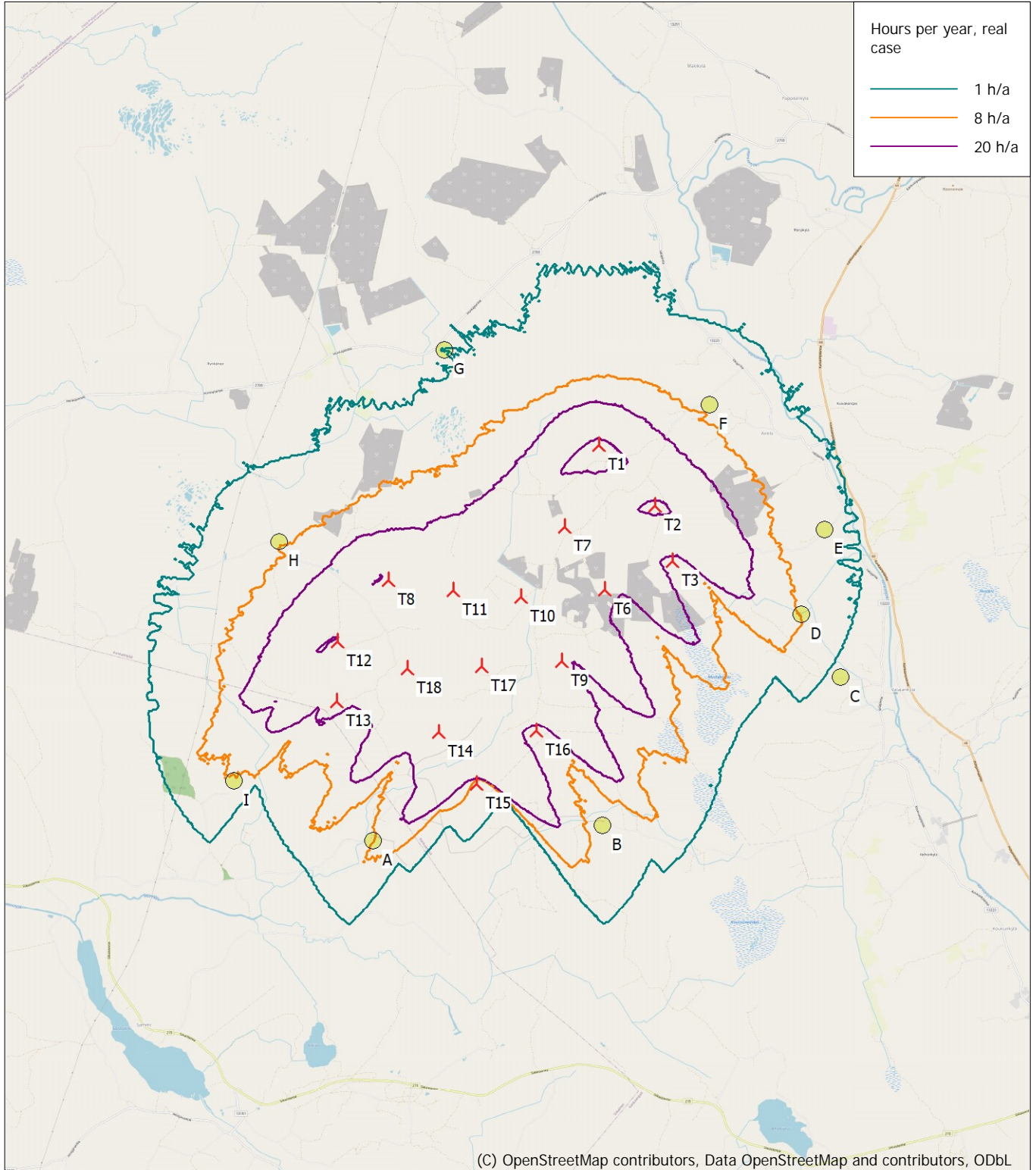
F: F - Asuinrakennus



H: H - Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest



Map: EMD OpenStreetMap , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 220 North: 6 876 750
 New WTG Shadow receptor
 Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
 Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 6. Varjostusmallinnuksen tulokset "Real Case, Luke Forest" - Hankevaihtoehto 1

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80 2,30 4,40 6,00 7,40 8,10 8,40 6,70 4,10 1,90 0,70 0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
582	477	425	459	574	730	937	1 097	854	709	615	560	8 017

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

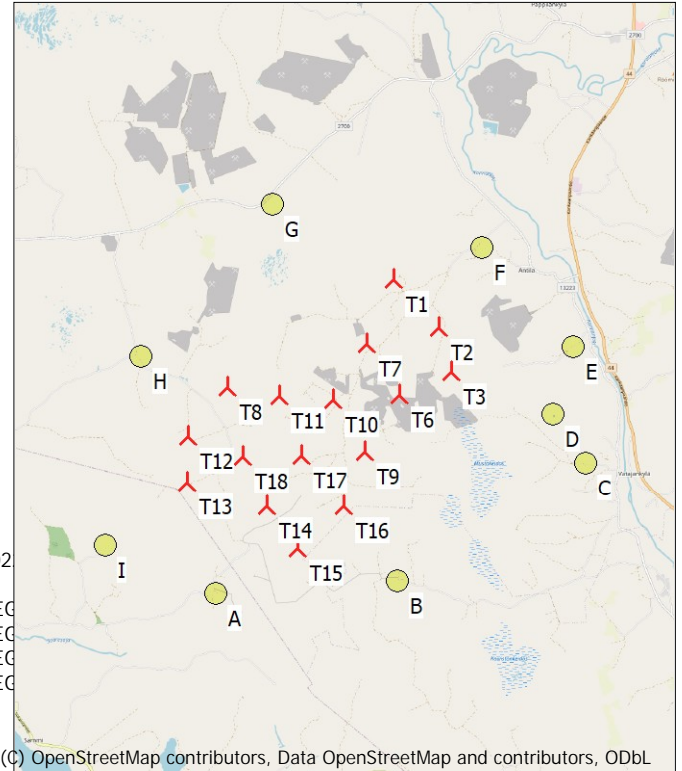
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Haukkasalo_06052022

Area object(s) used in calculation:
Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG
Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG
Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG
Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG
Obstacles used in calculation
Receptor grid resolution: 1,0 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.	Type-generator				Calculation distance [m]	RPM [RPM]
T1	246 582	6 878 619	95,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T10	245 421	6 876 704	92,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T11	244 530	6 876 852	90,9	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T12	242 968	6 876 299	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T13	242 898	6 875 520	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T14	244 202	6 875 018	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T15	244 645	6 874 295	83,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T16	245 483	6 874 938	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T17	244 829	6 875 835	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T18	243 855	6 875 881	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T2	247 257	6 877 777	97,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T3	247 430	6 877 022	96,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T6	246 523	6 876 714	95,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T7	246 054	6 877 590	94,8	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T8	243 691	6 877 054	93,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T9	245 882	6 875 817	92,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	



Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0

To be continued on next page...

Project:

Haukkasalo_06052022

Licensed user:

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 FI-00601 Helsinki
 +358104095666
 Miikka Saranpää / miikka.saranpaa@fcg.fi
 Calculated:
 14.2.2023 12.47/3.5.584

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest

...continued from previous page

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	A - Asuinrakennus	0:00
B	B - Asuinrakennus	5:38
C	C - Asuinrakennus	0:00
D	D - Lomarakennus	0:00
E	E - Asuinrakennus	3:12
F	F - Asuinrakennus	4:54
G	G - Asuinrakennus	0:51
H	H - Asuinrakennus	7:44
I	I - Asuinrakennus	7:32

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

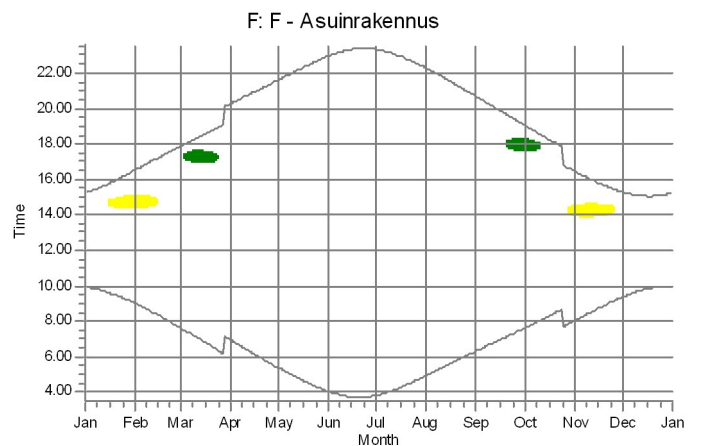
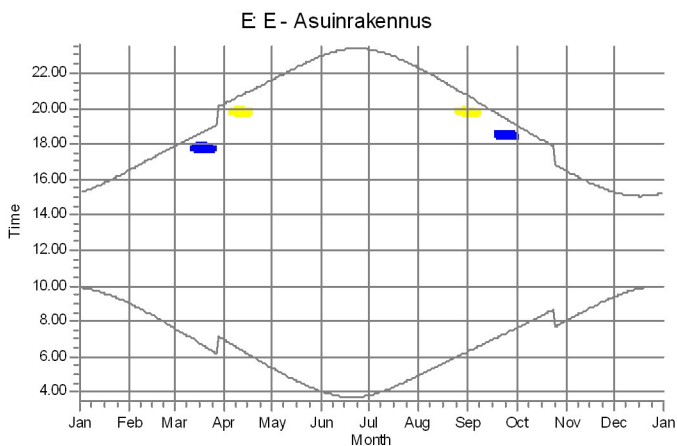
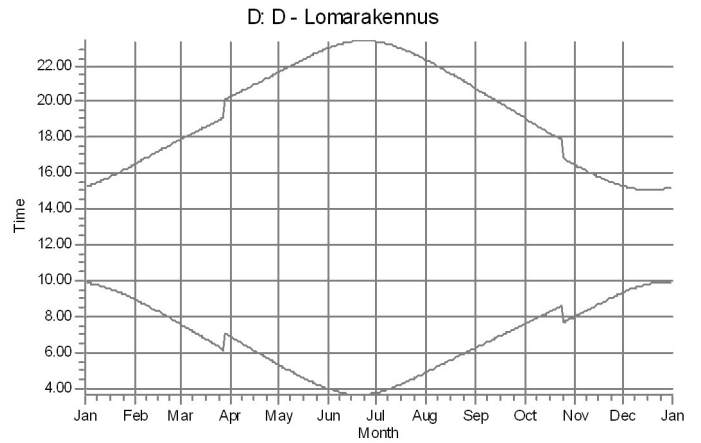
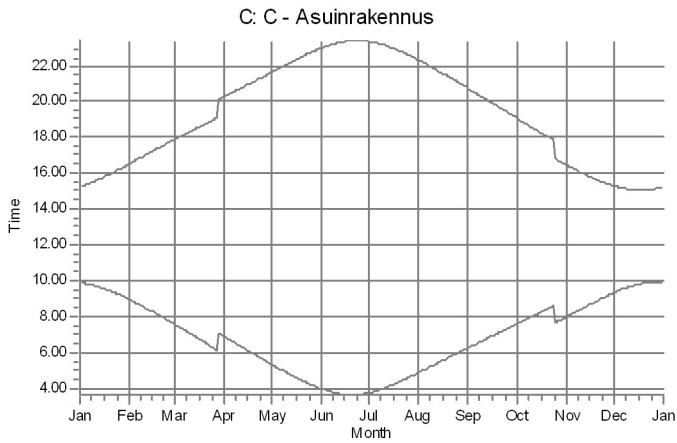
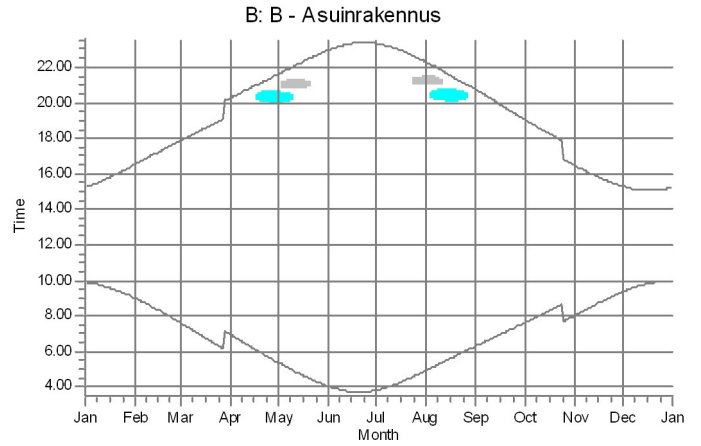
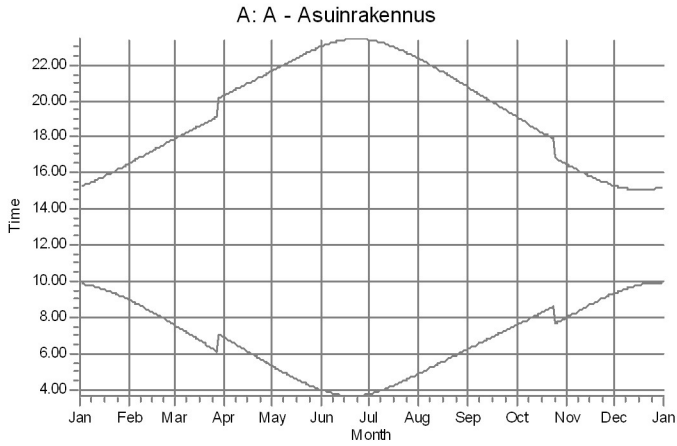
No.	Name	Expected [h/year]
T1	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	3:32
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:00
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	2:06
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	8:40
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	2:05
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	3:33
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:50
T2	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	3:44
T3	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	1:36
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
T7	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	2:48
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest



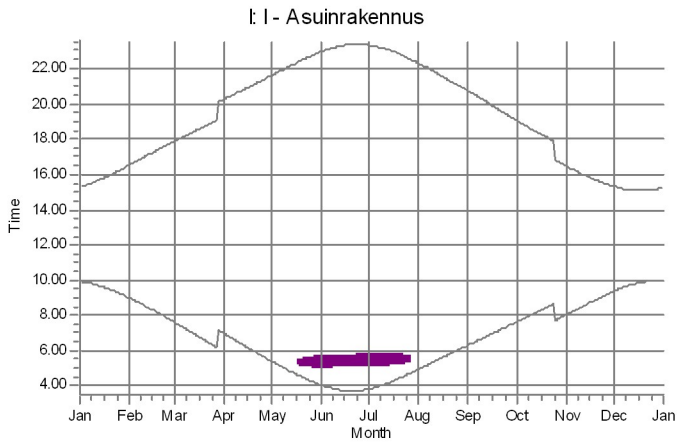
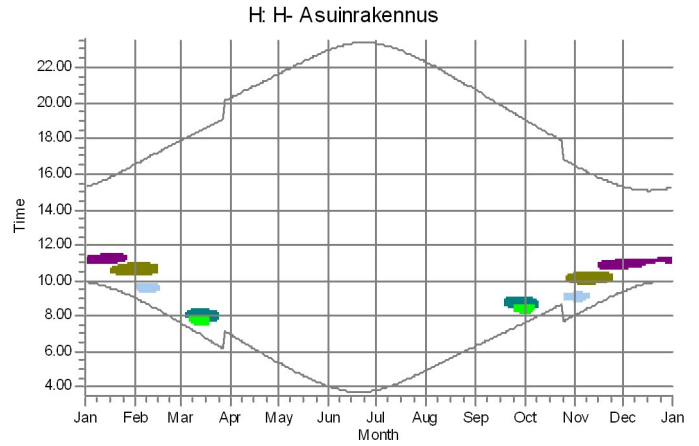
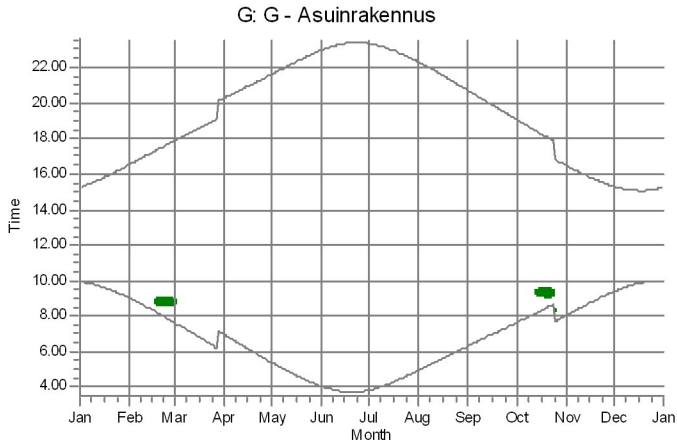
WTGs

- T1: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (247)
- T2: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (248)
- T3: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (249)

- T14: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (258)
- T15: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (259)

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest



WTGs

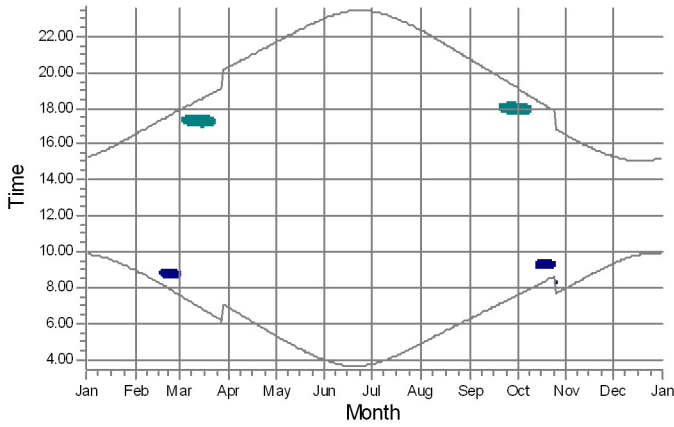
- T1: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (247)
- T8: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (252)
- T11: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (255)

- T12: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (256)
- T13: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (257)
- T18: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (261)

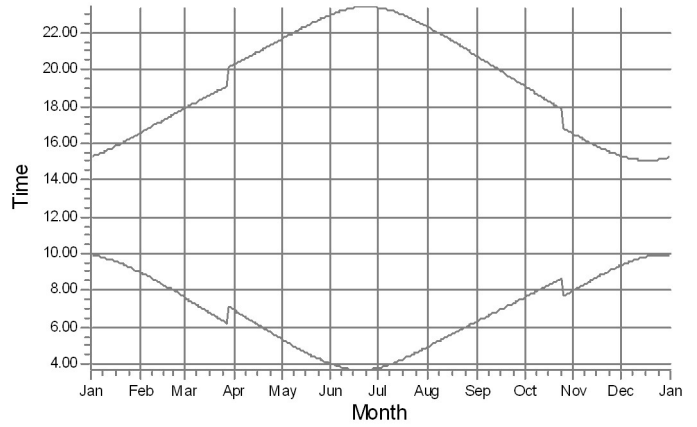
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest

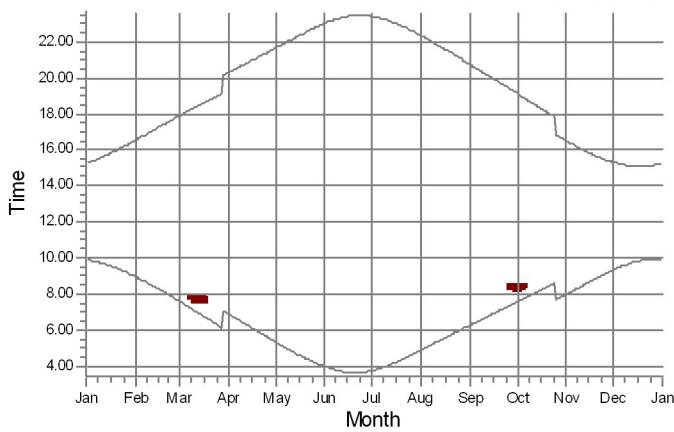
T1: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)



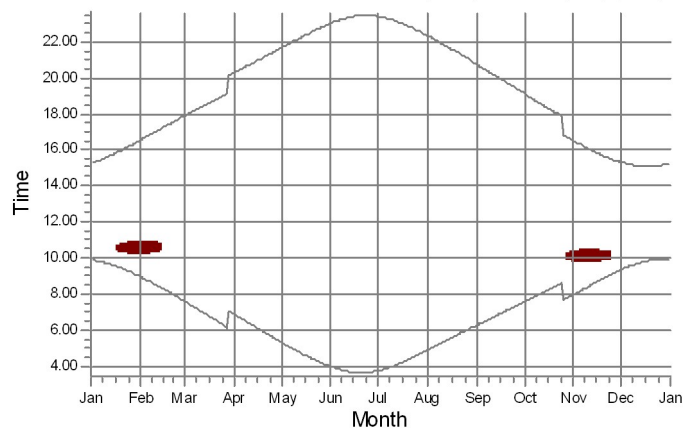
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)



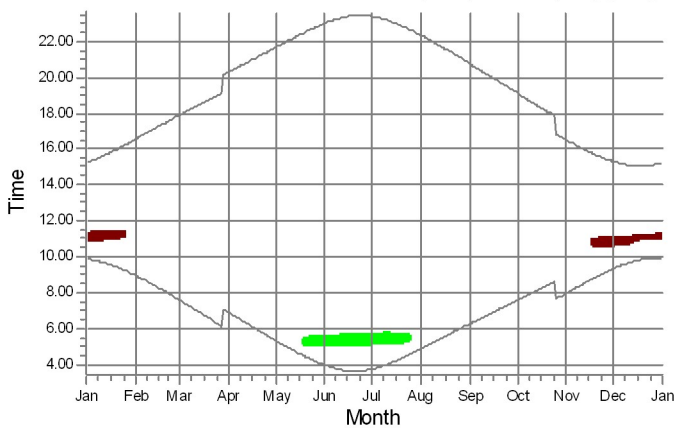
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)



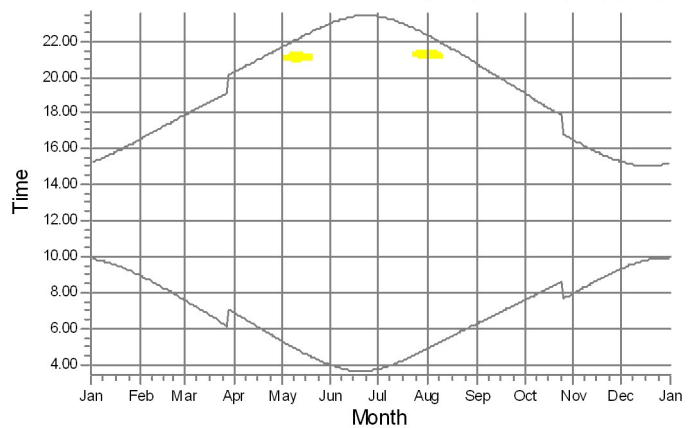
T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)



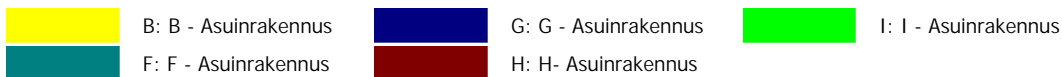
T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)



T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)



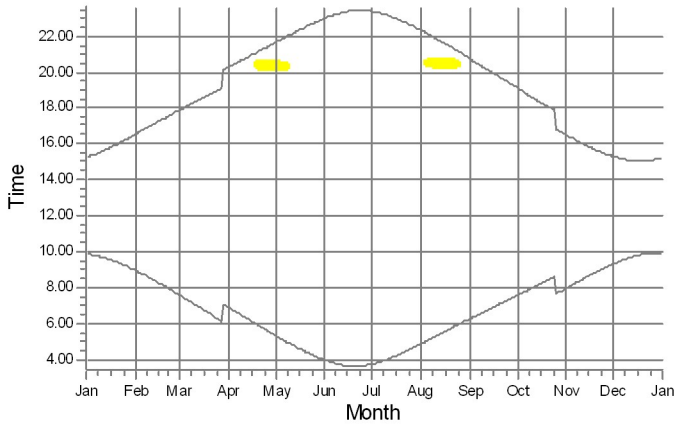
Shadow receptors



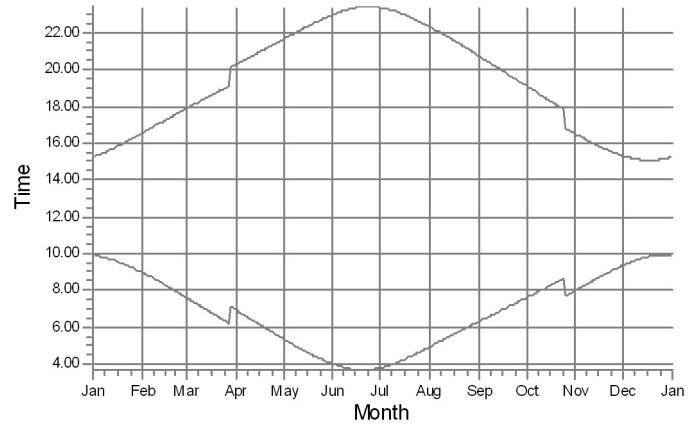
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest

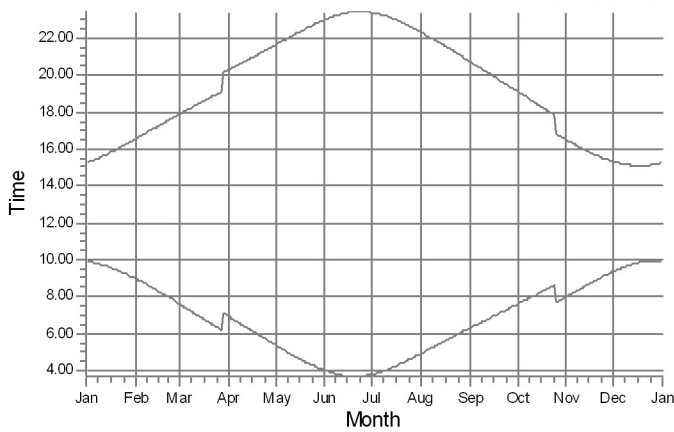
T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)



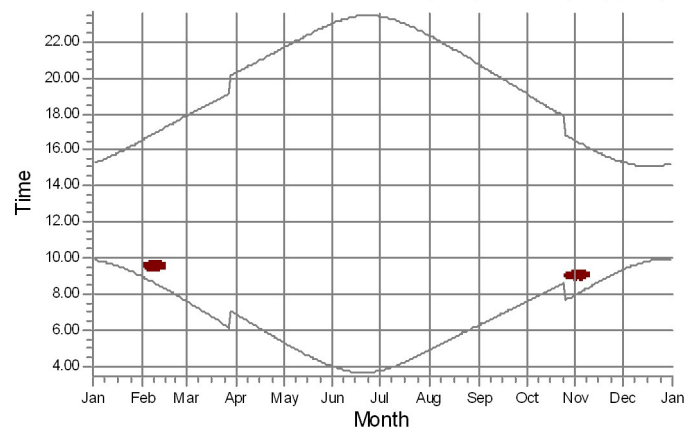
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)



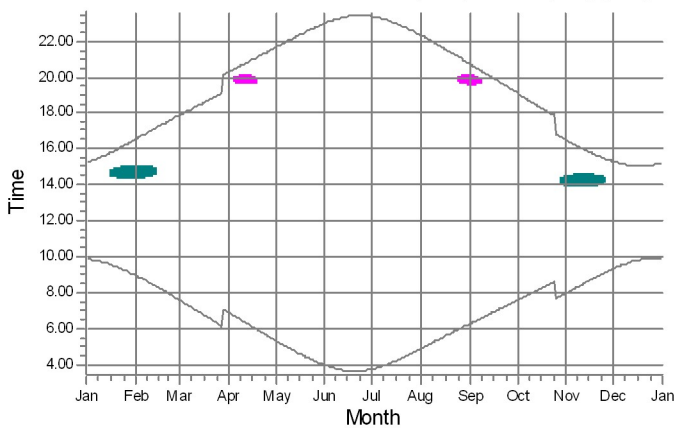
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)



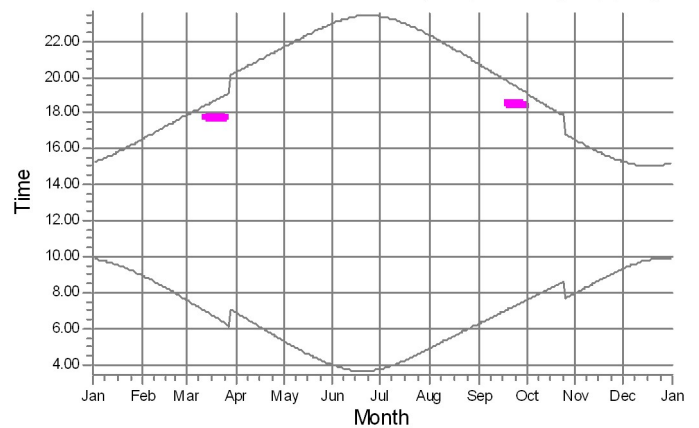
T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)



T2: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)



T3: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)

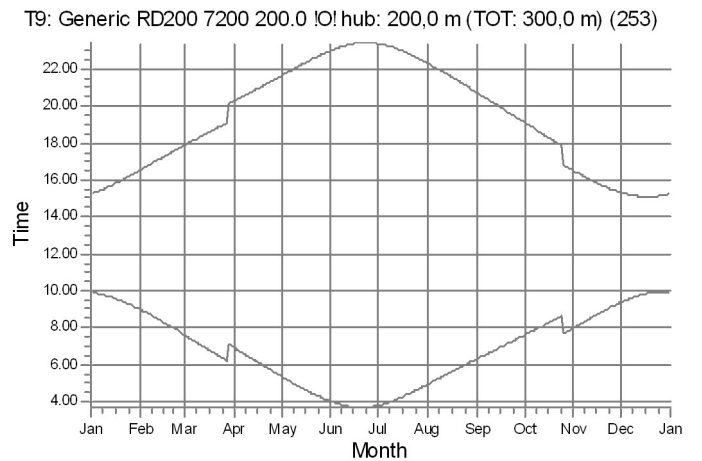
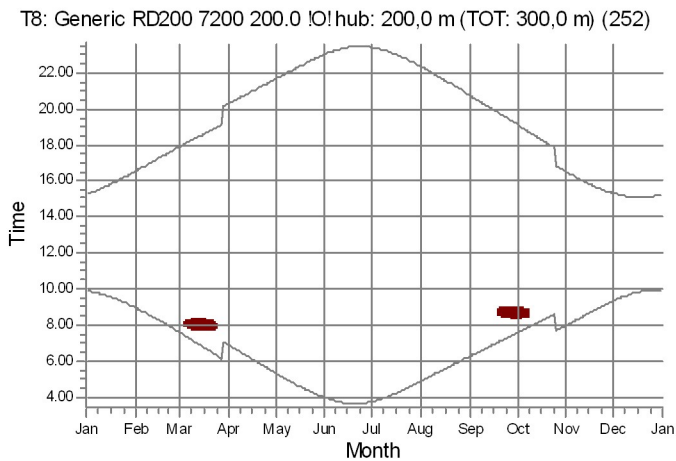
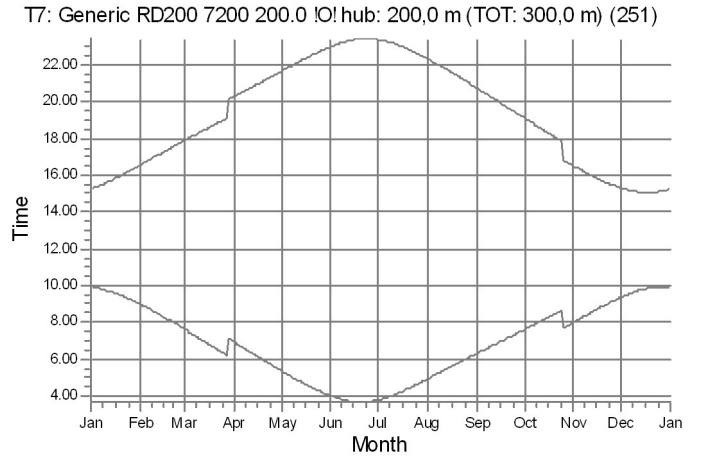
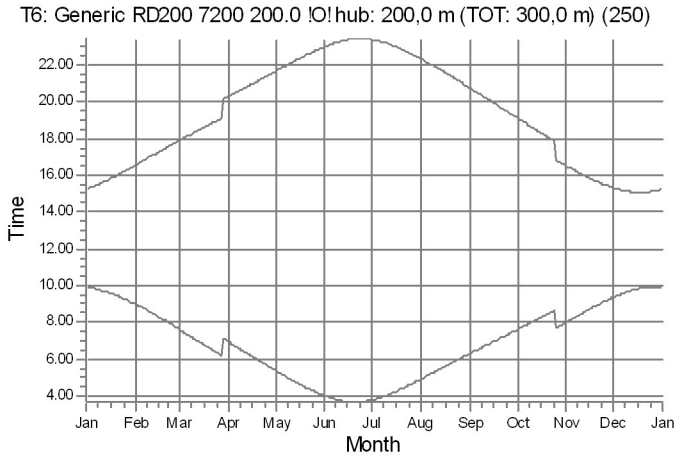


Shadow receptors


	B: B - Asuinrakennus		F: F - Asuinrakennus
	E: E - Asuinrakennus		H: H - Asuinrakennus

SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest

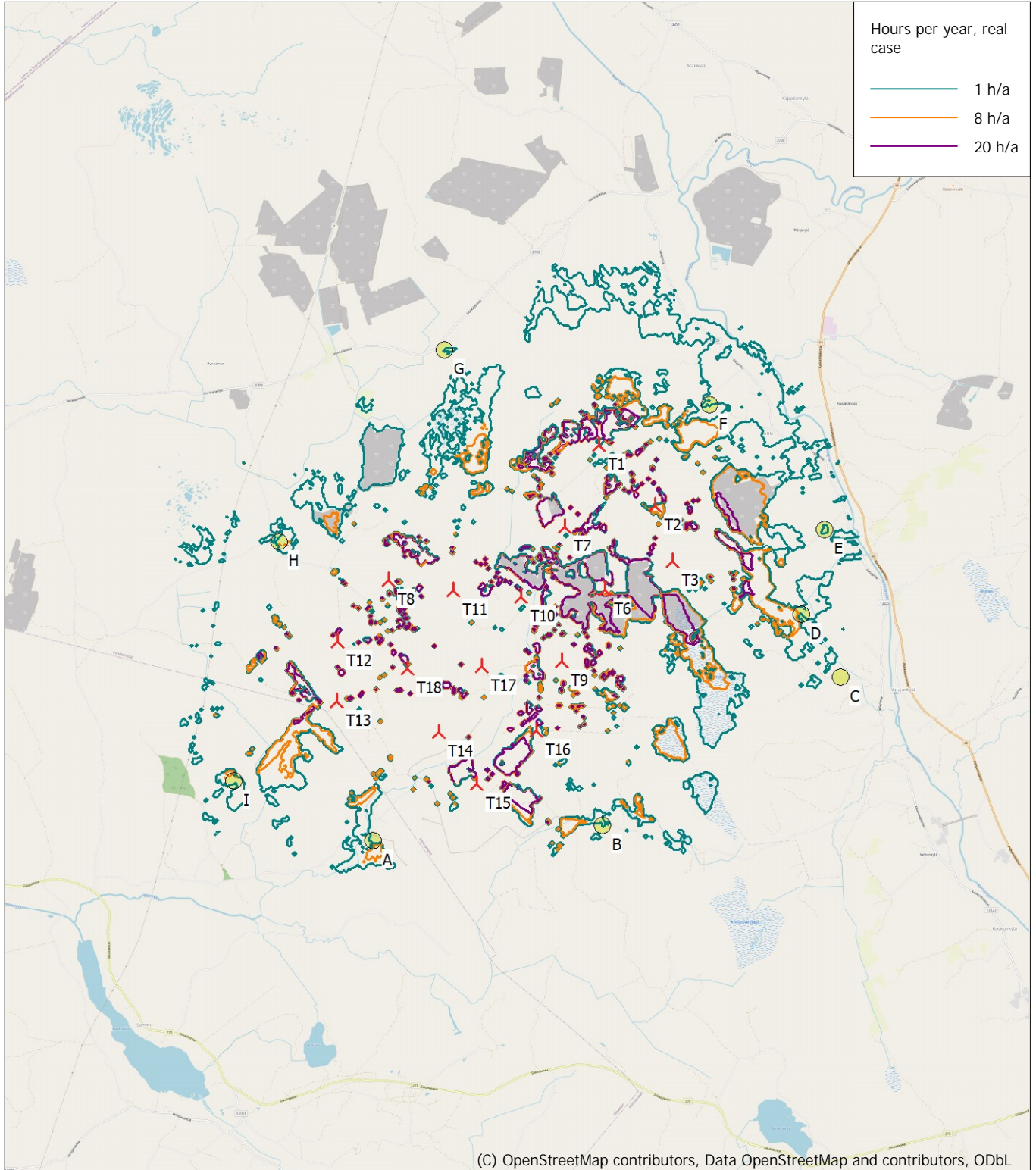


Shadow receptors

 H: H- Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest



Map: EMD OpenStreetMap , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 220 North: 6 876 750
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 7. Varjostusmallinnuksen tulokset "Real Case, No Forest" - Hankevaihtoehto 2

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
582	477	425	459	574	730	937	1 097	854	709	615	560	8 017

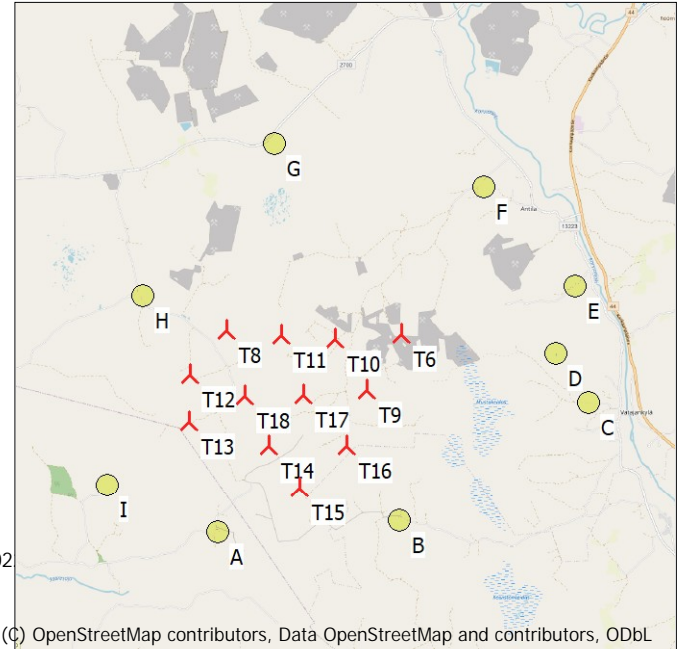
Idle start wind speed: Cut in wind speed from power curve

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: CONTOURLINE_Haukkasalo_06052022
Obstacles used in calculation
Receptor grid resolution: 1,0 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]
T10	245 421	6 876 704	92,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T12	242 968	6 876 299	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T13	242 898	6 875 520	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 641	6 876 974	93,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:125 000

▲ New WTG

● Shadow receptor

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
		[m]	[m]	[m]	[m]	[m]	[m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	A - Asuinrakennus	8:43	
B	B - Asuinrakennus	5:38	
C	C - Asuinrakennus	0:00	
D	D - Lomarakennus	0:00	
E	E - Asuinrakennus	0:00	
F	F - Asuinrakennus	0:00	
G	G - Asuinrakennus	0:00	
H	H - Asuinrakennus	7:58	
I	I - Asuinrakennus	7:32	

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

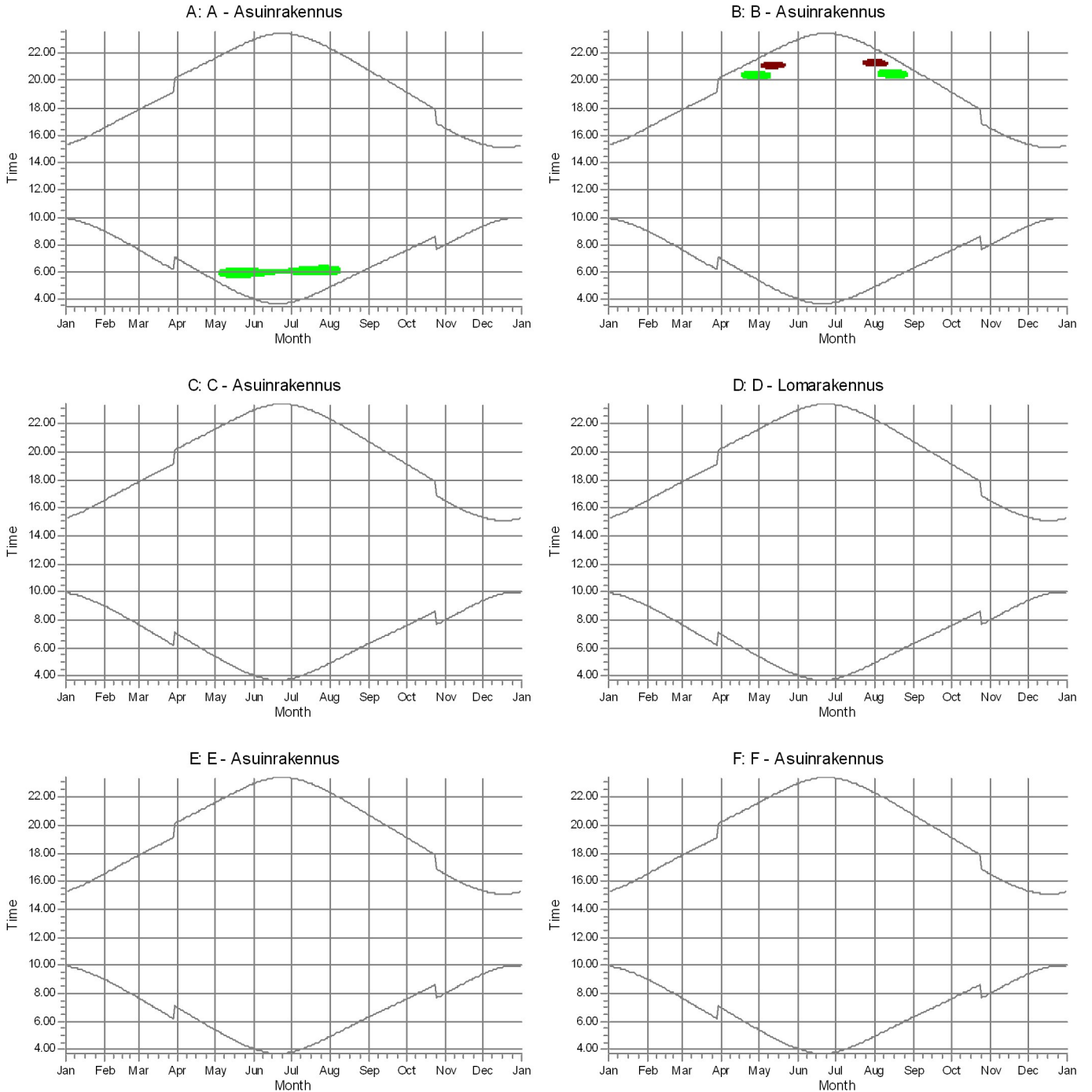
No.	Name	Expected [h/year]
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)	1:00
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)	2:06
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)	8:40
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)	2:05
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)	12:17
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)	0:50
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)	2:45
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (302)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest



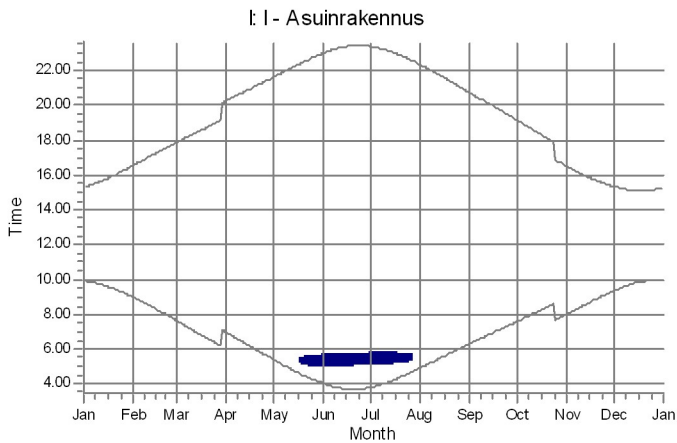
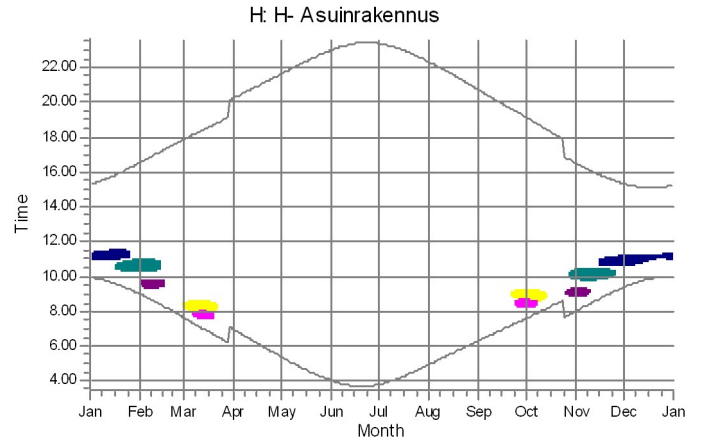
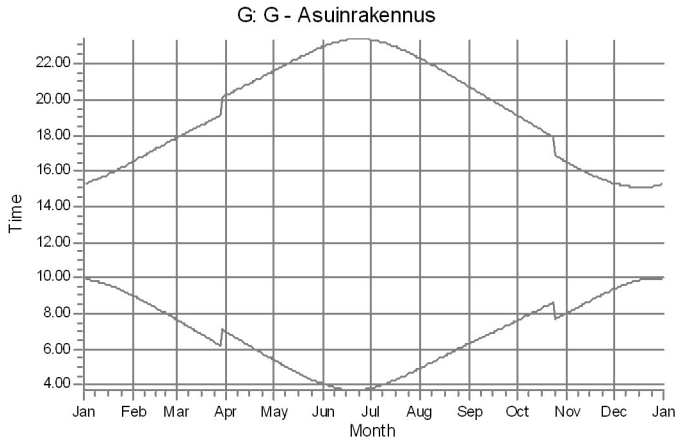
WTGs

T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)




T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)



SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest



WTGs

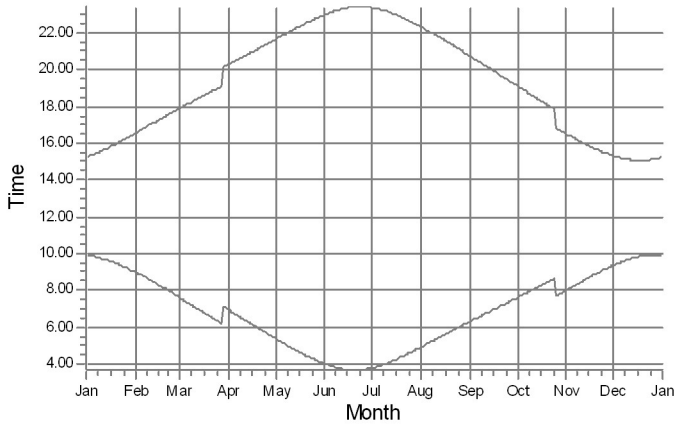
	T8: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)
	T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)
	T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)

	T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)
	T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)

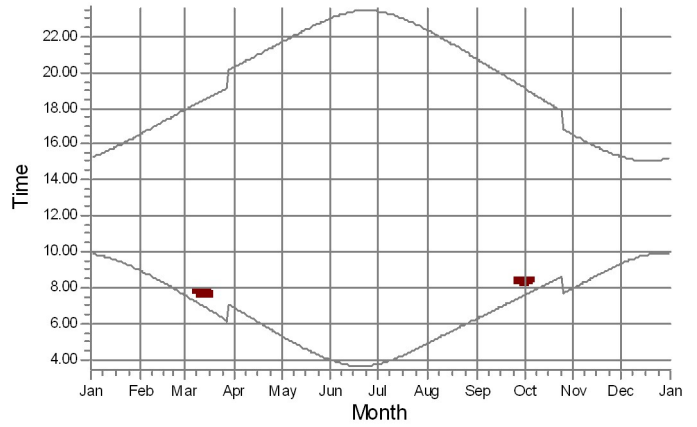
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest

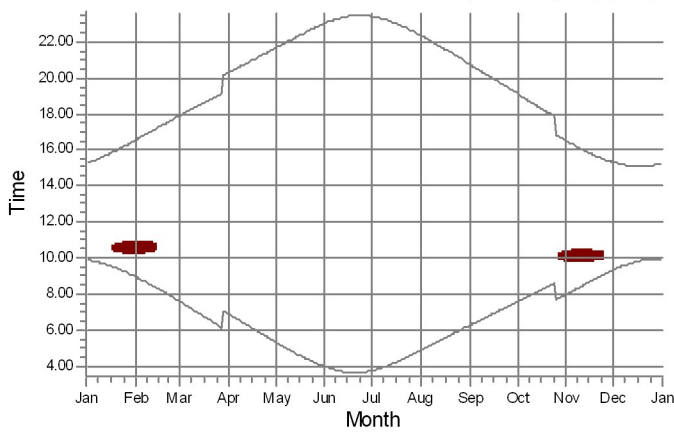
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)



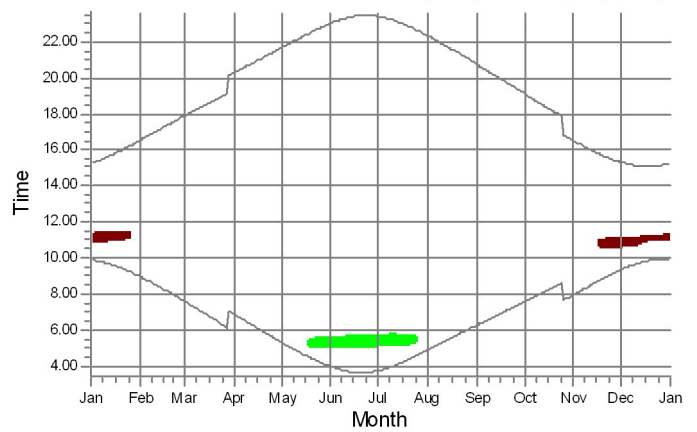
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)



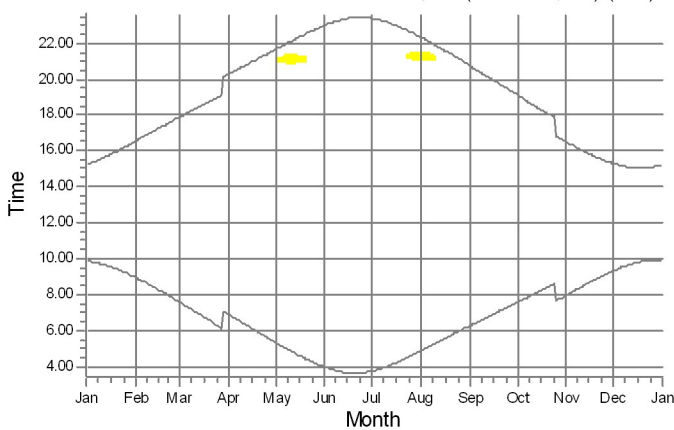
T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)



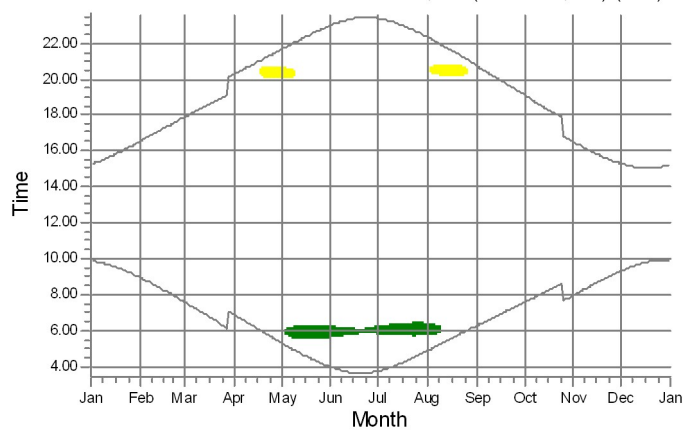
T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)







T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)



T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)



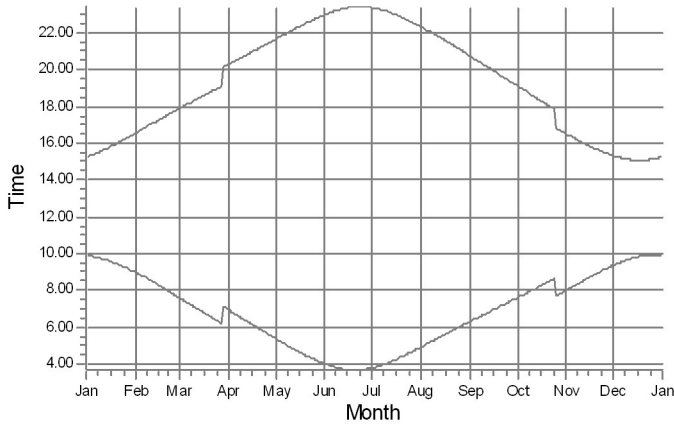
Shadow receptors

- | | | | |
|---|----------------------|---|----------------------|
|  | A: A - Asuinrakennus |  | H: H - Asuinrakennus |
|  | B: B - Asuinrakennus |  | I: I - Asuinrakennus |

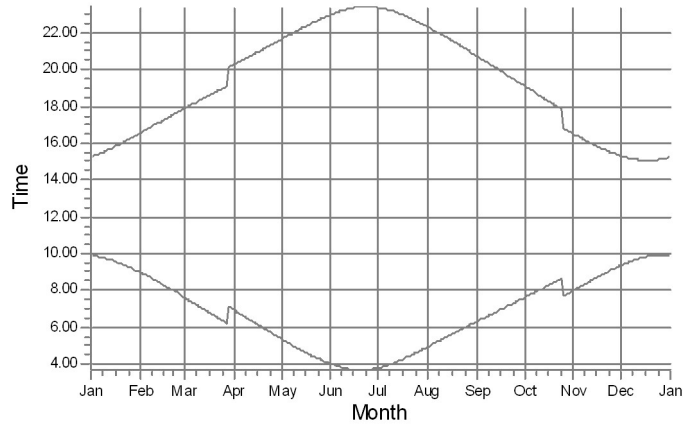
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest

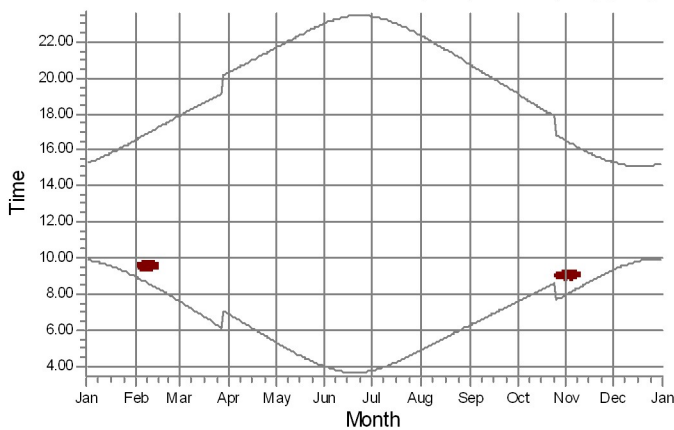
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)



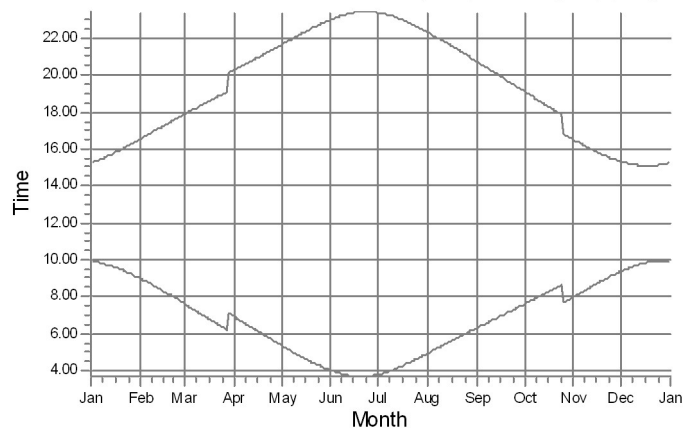
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)



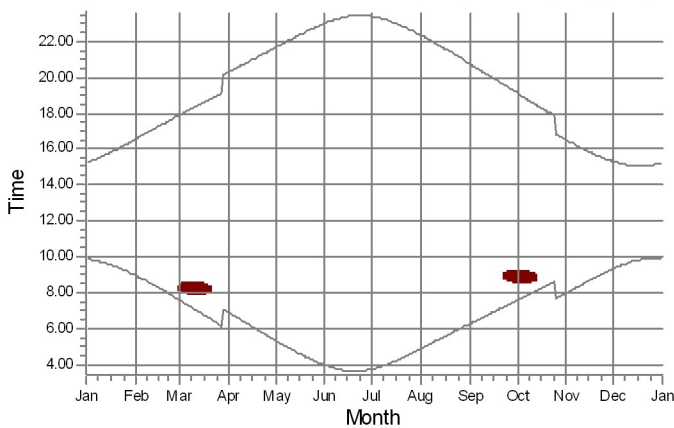
T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)



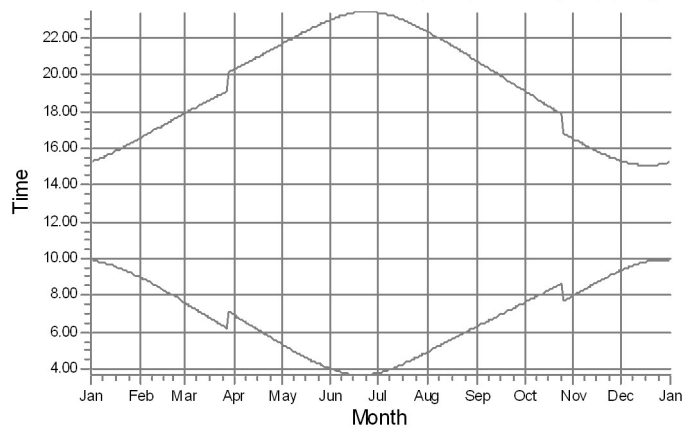
T6: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)



T8: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)



T9: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (302)

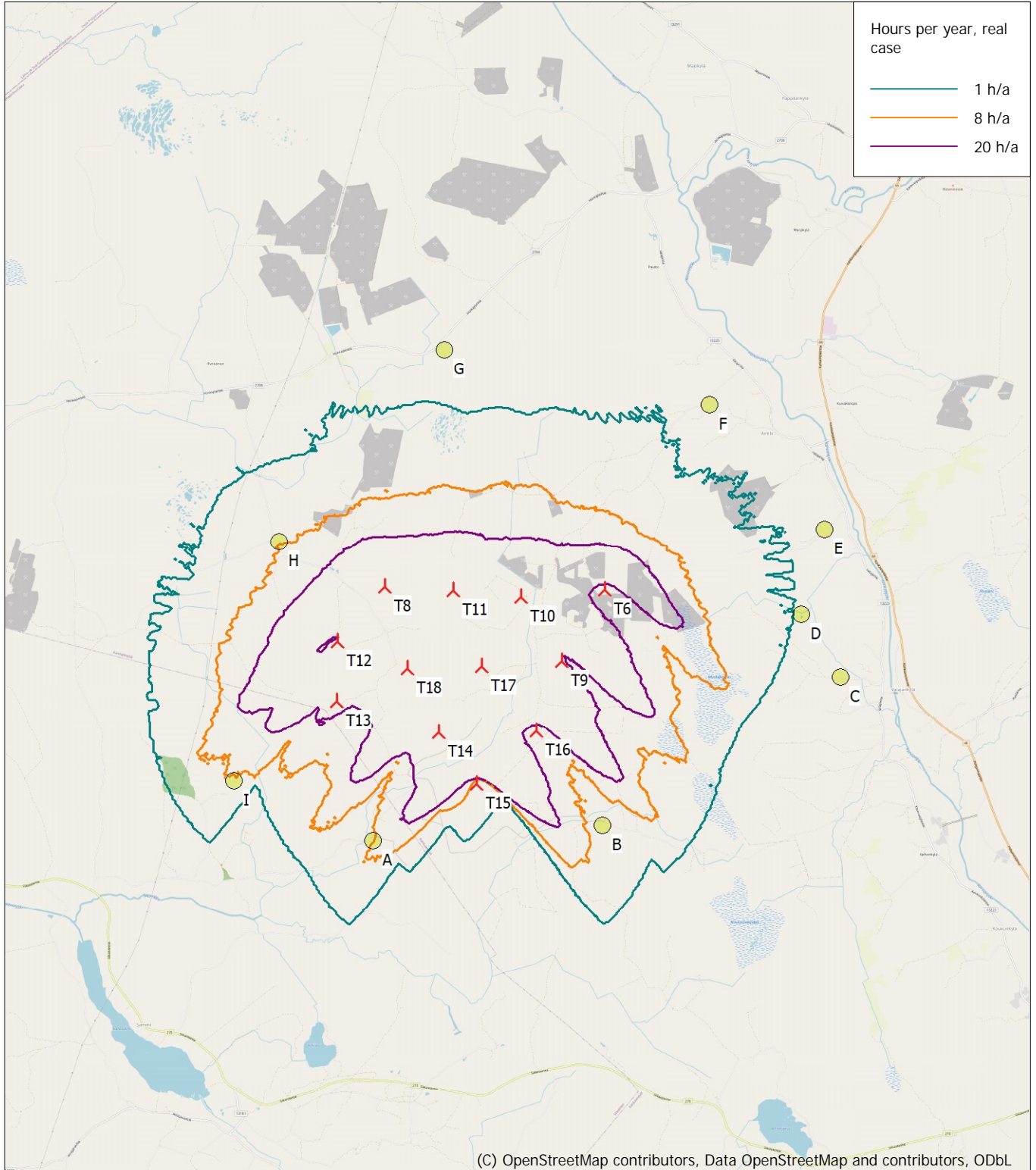


Shadow receptors

H: H- Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest



Map: EMD OpenStreetMap , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 220 North: 6 876 750

▲ New WTG ● Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)

Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 8. Varjostusmallinnuksen tulokset "Real Case, Luke Forest" - Hankevaihtoehto 2

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
582	477	425	459	574	730	937	1 097	854	709	615	560	8 017

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: CONTOURLINE_Haukkasalo_06052022

Area object(s) used in calculation:

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REC

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REC

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REC

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REC

Obstacles used in calculation

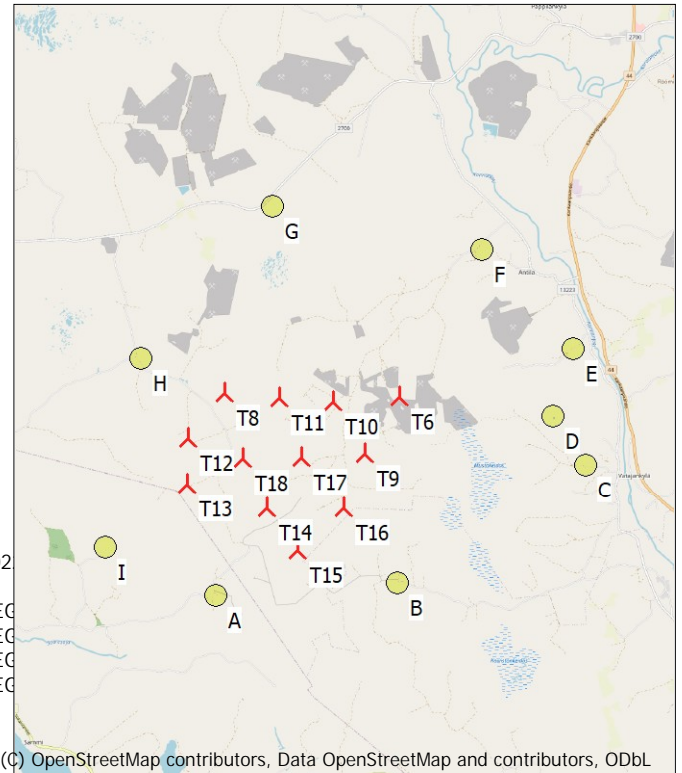
Receptor grid resolution: 1,0 m

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.	Type-generator				Calculation distance [m]	RPM [RPM]
T10	245 421	6 876 704	92,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T11	244 530	6 876 852	90,9	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T12	242 968	6 876 299	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T13	242 898	6 875 520	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T14	244 202	6 875 018	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T15	244 645	6 874 295	83,7	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T16	245 483	6 874 938	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T17	244 829	6 875 835	90,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T18	243 855	6 875 881	87,5	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T6	246 523	6 876 714	95,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T8	243 641	6 876 974	93,6	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	
T9	245 882	6 875 817	92,0	Generic RD200 7200 200.0 !O! hub...Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4	



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:125 000
New WTG Shadow receptor

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	A - Asuinrakennus	0:00	
B	B - Asuinrakennus	5:38	
C	C - Asuinrakennus	0:00	
D	D - Lomarakennus	0:00	
E	E - Asuinrakennus	0:00	
F	F - Asuinrakennus	0:00	
G	G - Asuinrakennus	0:00	
H	H - Asuinrakennus	7:58	
I	I - Asuinrakennus	7:32	

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

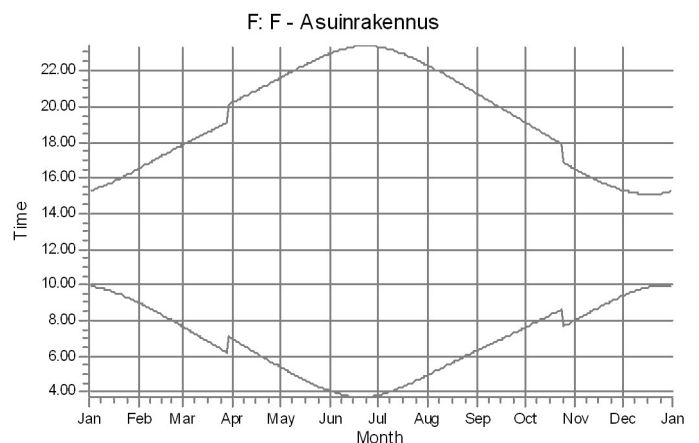
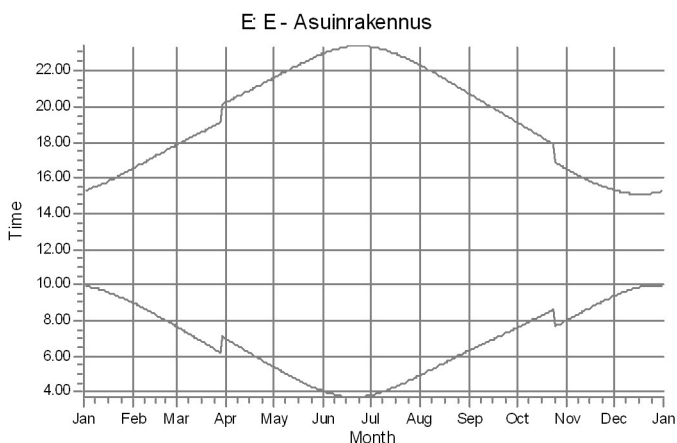
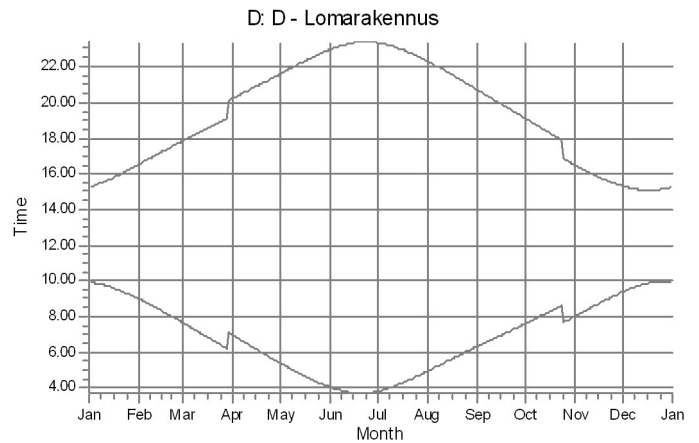
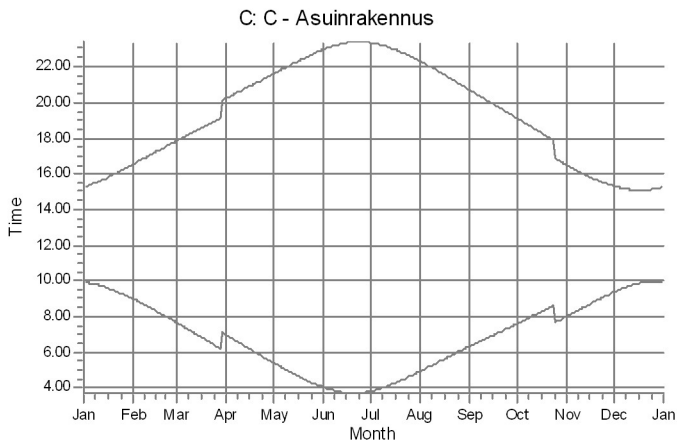
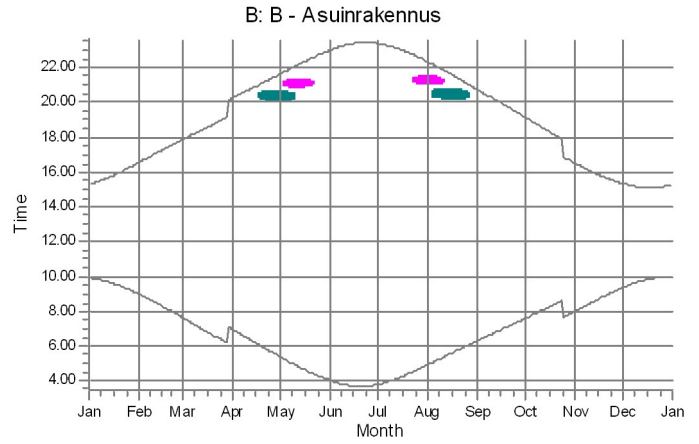
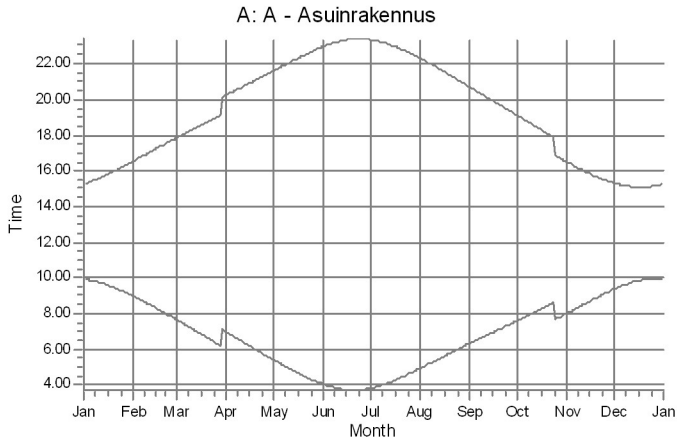
No.	Name	Expected [h/year]
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)	1:00
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)	2:06
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)	8:40
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)	2:05
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)	3:33
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)	0:50
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)	2:45
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (302)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest



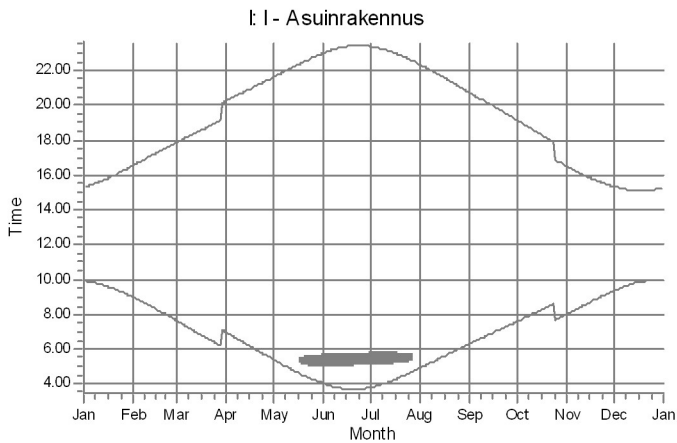
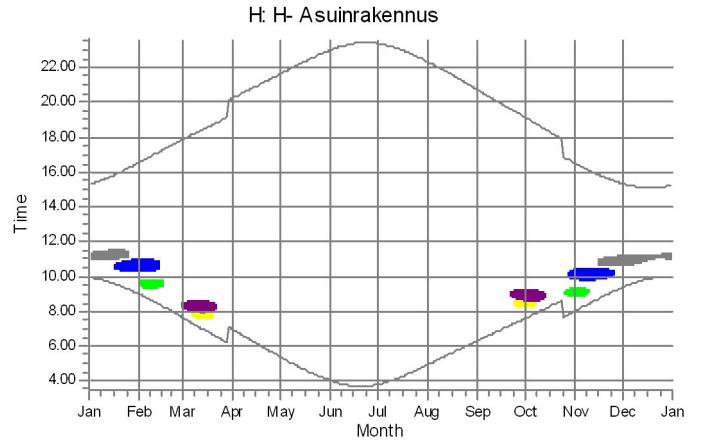
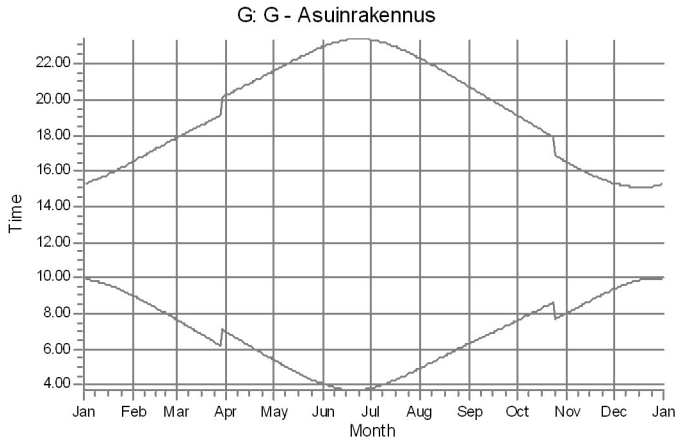
WTGs

T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)




T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)



SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest



WTGs

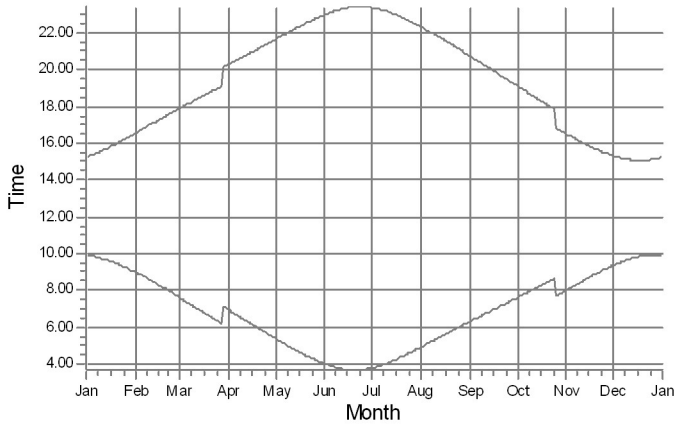
	T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)
	T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)
	T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)

	T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)
	T8: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)

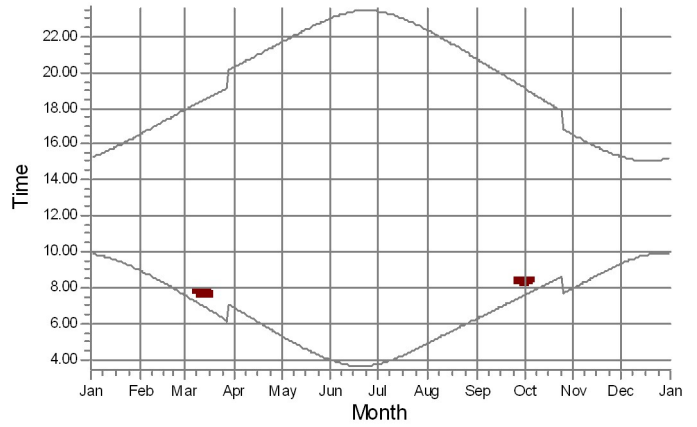
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest

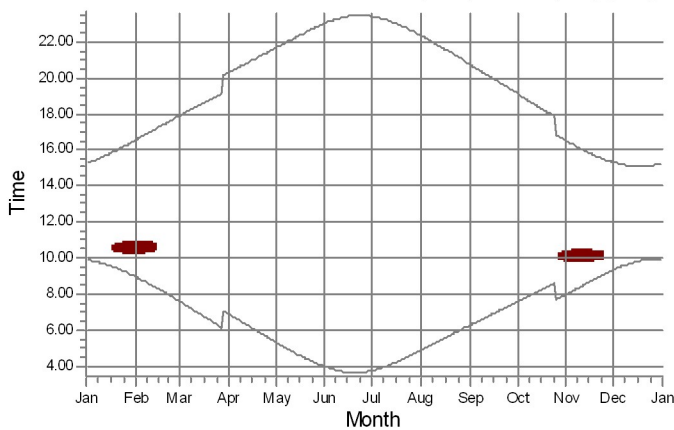
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)



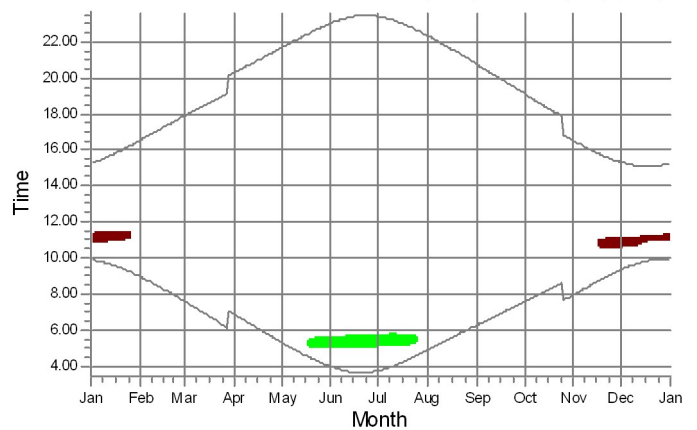
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)



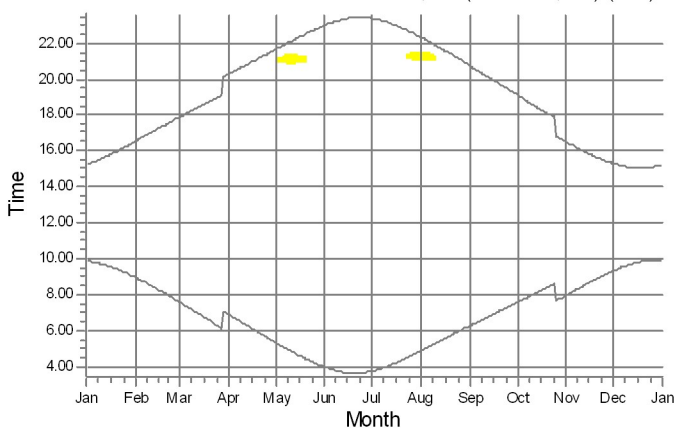
T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)



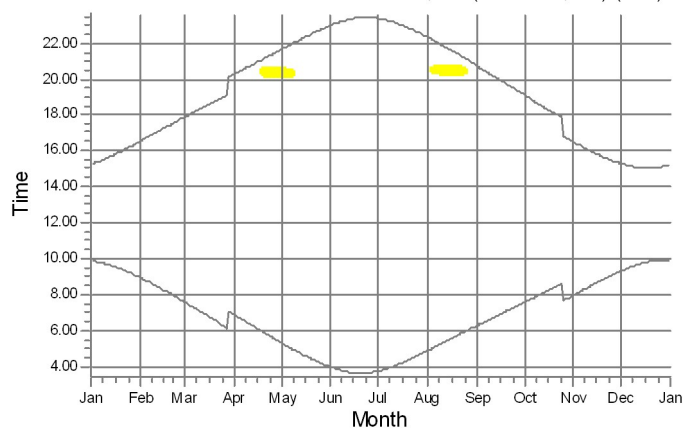
T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)



T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)



T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)



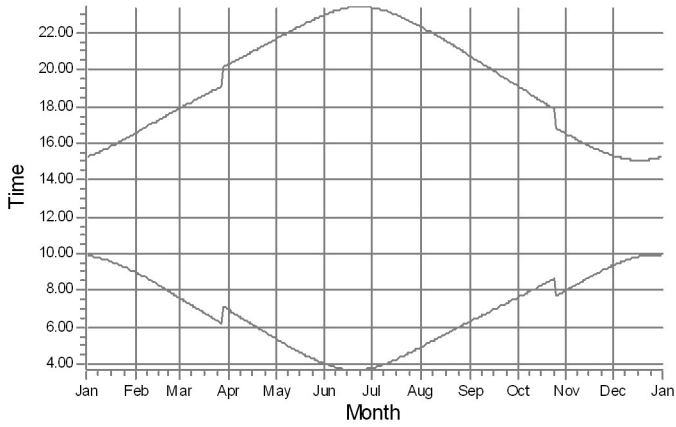
Shadow receptors

B - Asuinrakennus
 H - Asuinrakennus
 I - Asuinrakennus

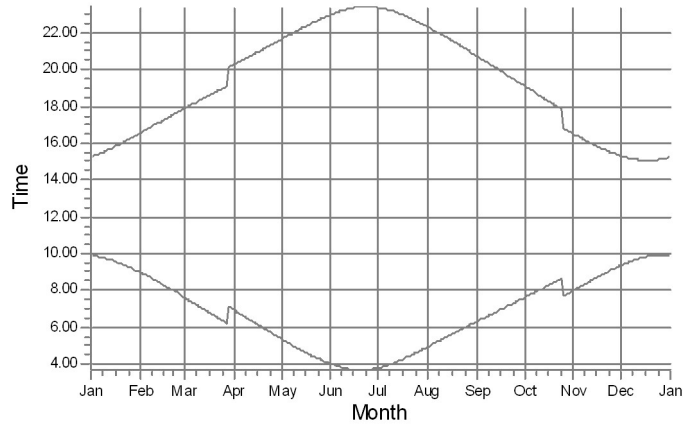
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest

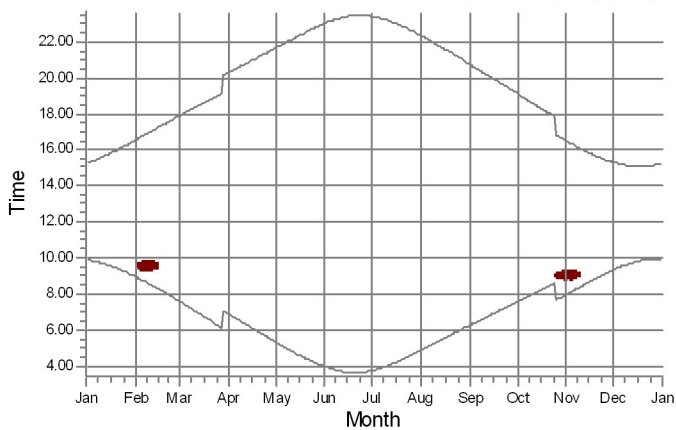
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)



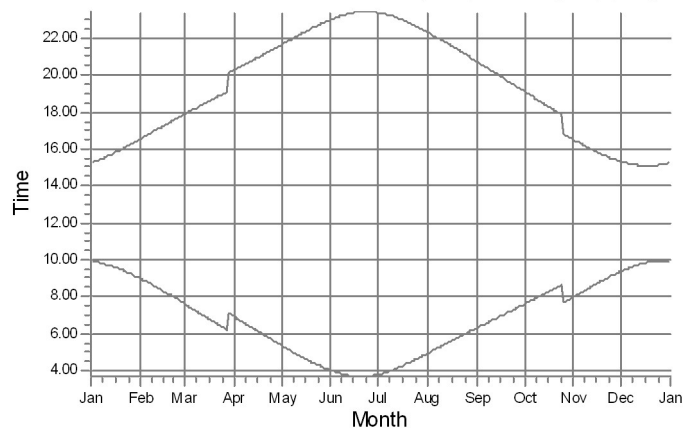
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)



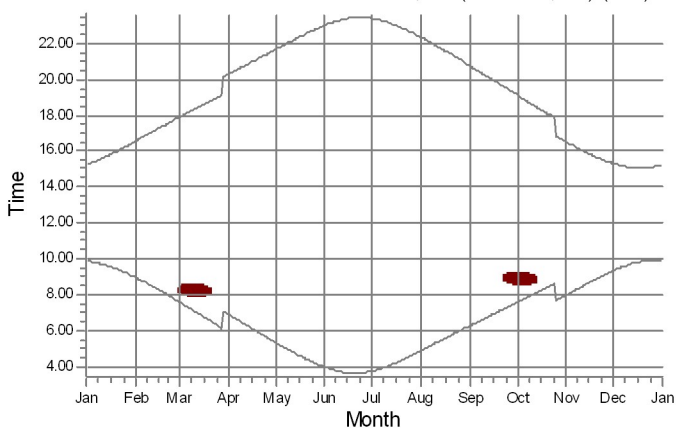
T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)



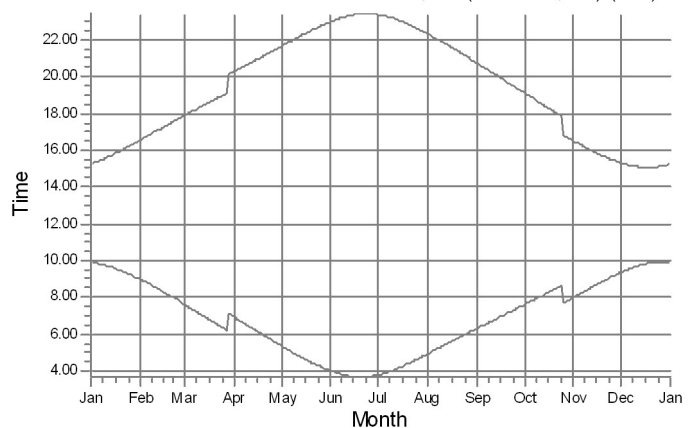
T6: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)



T8: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)



T9: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (302)

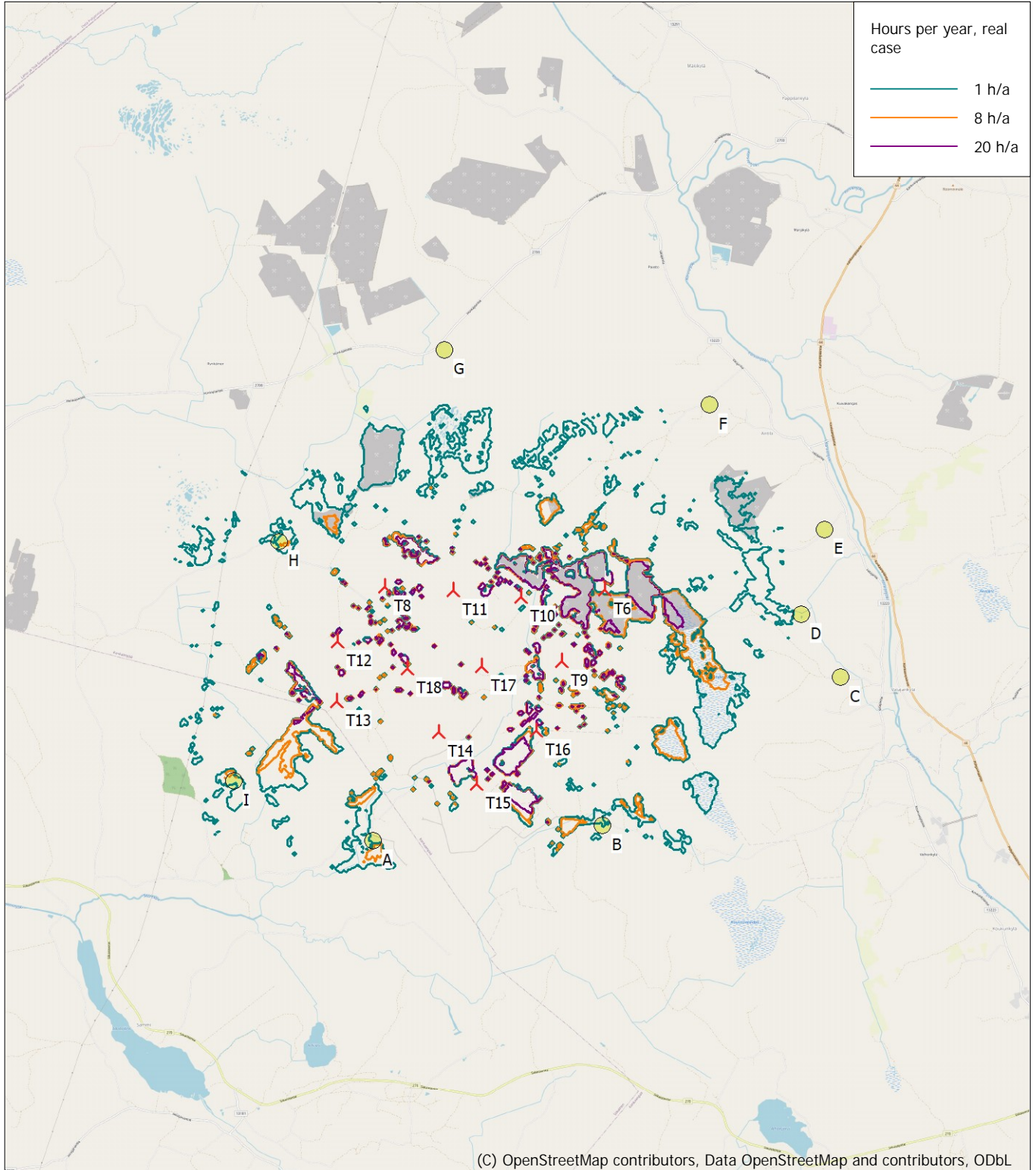


Shadow receptors

H: H- Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest



Map: EMD OpenStreetMap , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 220 North: 6 876 750
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 9. Melun yhteismallinnuksen tulokset VE1

Project:

Haukkasalo_06052022

Licensed user:

FCG Finnish Consulting Group Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
17.2.2023 13.43/3.5.584

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasa

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

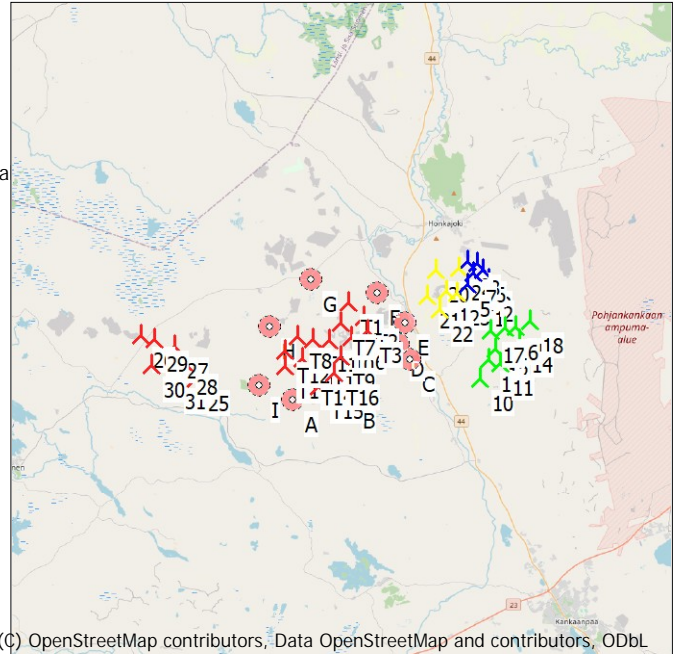
0,0 dB(A)

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTGs

Table with 12 columns: East, North, Z, Row data/Description, WTG type Valid, Manufact., Type-generator, Power, rated [kW], Rotor diameter [m], Hub height [m], Noise data Creator, Name, Wind speed [m/s], LwA,ref [dB(A)]. Rows 1-29.



Calculation Results

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus

Sound level

No.	Name	East	North	Z [m]	Immission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	4,0	40,0	39,3	141
B	B - Asuinrakennus	246 258	6 873 632	87,4	4,0	40,0	38,8	223
C	C - Asuinrakennus	249 534	6 875 344	92,8	4,0	40,0	33,8	1 521
D	D - Lomarakennus	249 068	6 876 198	92,5	4,0	40,0	36,5	683
E	E - Asuinrakennus	249 460	6 877 291	95,0	4,0	40,0	36,3	841
F	F - Asuinrakennus	248 080	6 879 034	96,2	4,0	40,0	38,7	218
G	G - Asuinrakennus	244 657	6 880 019	94,1	4,0	40,0	35,1	1 195
H	H - Asuinrakennus	242 301	6 877 666	90,0	4,0	40,0	39,3	132
I	I - Asuinrakennus	241 468	6 874 582	81,7	4,0	40,0	37,1	557

Distances (m)

WTG	A	B	C	D	E	F	G	H	I
1	11466	8843	5185	5115	4338	5554	9073	11341	12769
10	10023	7008	3927	4688	4965	7156	10440	11517	11790
11	11195	8201	4869	5482	5499	7573	11016	12399	12902
12	11068	8119	4610	5102	4970	6958	10452	12008	12702
13	10617	7640	4236	4824	4835	6919	10353	11743	12297
14	12433	9487	5957	6397	6149	7999	11541	13266	14052
15	12426	9531	5913	6249	5876	7603	11161	13035	13980
16	11877	8992	5362	5689	5324	7084	10638	12479	13423
17	11113	8242	4597	4916	4574	6397	9939	11720	12650
18	13297	10402	6784	7103	6689	8335	11894	13853	14844
19	9942	7541	4110	3739	2744	3672	7187	9508	11106
2	12042	9408	5741	5690	4914	6077	9574	11895	13346
20	10240	8100	4955	4386	3254	3356	6642	9288	11209
21	9001	6722	3521	2966	1863	2672	6216	8478	10109
22	9110	6601	3098	2805	1945	3432	6988	9010	10377
23	10405	7920	4384	4124	3208	4263	7780	10081	11619
24	11231	8918	5519	5124	4078	4541	7860	10475	12296
25	5383	8325	11448	11026	11562	10698	8140	4879	3447
26	8842	11612	14335	13754	14066	12743	9531	6905	6849
27	6912	9675	12453	11904	12272	11076	8053	5157	4920
28	6114	8970	11919	11430	11880	10843	8035	4919	4128
29	8043	10810	13551	12981	13314	12037	8890	6162	6051
3	12223	9664	6036	5899	5039	5996	9434	11880	13459
30	7771	10686	13693	13207	13651	12566	9632	6632	5814
31	6572	9525	12640	12203	12714	11773	9053	5881	4647
4	11591	9049	5439	5274	4405	5404	8873	11268	12825
5	11144	8655	5094	4861	3944	4875	8343	10747	12344
6	12210	9742	6177	5947	5008	5748	9113	11670	13373
7	11701	9268	5740	5466	4501	5215	8595	11135	12847
8	12198	9805	6301	6002	5009	5570	8864	11504	13302
9	11839	9514	6082	5716	4681	5110	8369	11043	12898
T1	5980	4994	4406	3467	3168	1553	2379	4383	6510
T10	3746	3182	4329	3680	4079	3533	3400	3262	4482
T11	3444	3652	5222	4582	4946	4164	3168	2371	3808
T12	2653	4232	6630	6096	6563	5793	4082	1520	2278
T13	1891	3850	6633	6202	6792	6256	4827	2226	1709
T14	1668	2478	5338	5003	5724	5578	5018	3257	2766
T15	1546	1742	4996	4812	5667	5849	5720	4103	3187
T16	2585	1517	4068	3797	4618	4847	5145	4189	4027
T17	2697	2624	4726	4251	4851	4557	4184	3119	3584
T18	2306	3289	5700	5219	5776	5268	4213	2365	2715
T2	5753	4261	3330	2400	2254	1501	3431	4954	6607
T3	5374	3585	2689	1832	2046	2113	4080	5166	6437
T6	4485	3091	3306	2595	2991	2792	3793	4325	5482
T7	4835	3961	4139	3318	3417	2486	2800	3751	5480
T8	3425	4275	6083	5440	5770	4811	3116	1518	3322
T9	3413	2216	3680	3207	3867	3894	4374	4027	4579

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A A - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	11 466	11 467	0,42	105,0	0,00	92,19	-	-	0,00	0,00	-
10	10 023	10 024	1,93	106,0	0,00	91,02	-	-	0,00	0,00	-
11	11 195	11 196	0,49	106,0	0,00	91,98	-	-	0,00	0,00	-
12	11 068	11 069	0,64	106,0	0,00	91,88	-	-	0,00	0,00	-
13	10 617	10 619	1,18	106,0	0,00	91,52	-	-	0,00	0,00	-
14	12 433	12 434	-0,88	106,0	0,00	92,89	-	-	0,00	0,00	-
15	12 426	12 428	-0,88	106,0	0,00	92,89	-	-	0,00	0,00	-
16	11 877	11 878	-0,28	106,0	0,00	92,49	-	-	0,00	0,00	-
17	11 113	11 114	0,59	106,0	0,00	91,92	-	-	0,00	0,00	-
18	13 297	13 298	-1,76	106,0	0,00	93,48	-	-	0,00	0,00	-
19	9 942	9 945	1,57	104,3	0,00	90,95	-	-	0,00	0,00	-
2	12 042	12 043	-0,21	105,0	0,00	92,61	-	-	0,00	0,00	-
20	10 240	10 243	1,18	104,3	0,00	91,21	-	-	0,00	0,00	-
21	9 001	9 004	2,88	104,3	0,00	90,09	-	-	0,00	0,00	-
22	9 110	9 113	2,72	104,3	0,00	90,19	-	-	0,00	0,00	-
23	10 405	10 408	0,97	104,3	0,00	91,35	-	-	0,00	0,00	-
24	11 231	11 234	-0,04	104,3	0,00	92,01	-	-	0,00	0,00	-
25	5 383	5 388	17,42	110,1	0,00	85,63	-	-	0,00	0,00	-
26	8 842	8 844	11,03	110,1	0,00	89,93	-	-	0,00	0,00	-
27	6 912	6 915	14,07	110,1	0,00	87,80	-	-	0,00	0,00	-
28	6 114	6 117	15,67	110,1	0,00	86,73	-	-	0,00	0,00	-
29	8 043	8 046	12,21	110,1	0,00	89,11	-	-	0,00	0,00	-
3	12 223	12 224	-0,40	105,0	0,00	92,74	-	-	0,00	0,00	-
30	7 771	7 774	12,64	110,1	0,00	88,81	-	-	0,00	0,00	-
31	6 572	6 575	14,67	110,1	0,00	87,36	-	-	0,00	0,00	-
4	11 591	11 592	0,28	105,0	0,00	92,28	-	-	0,00	0,00	-
5	11 144	11 144	0,79	105,0	0,00	91,94	-	-	0,00	0,00	-
6	12 210	12 211	-0,39	105,0	0,00	92,74	-	-	0,00	0,00	-
7	11 701	11 702	0,16	105,0	0,00	92,37	-	-	0,00	0,00	-
8	12 198	12 199	-0,37	105,0	0,00	92,73	-	-	0,00	0,00	-
9	11 839	11 840	0,01	105,0	0,00	92,47	-	-	0,00	0,00	-
T1	5 980	5 984	15,97	110,1	0,00	86,54	-	-	0,00	0,00	-
T10	3 746	3 753	22,29	110,1	0,00	82,49	-	-	0,00	0,00	-
T11	3 444	3 451	23,39	110,1	0,00	81,76	-	-	0,00	0,00	-
T12	2 653	2 662	26,71	110,1	0,00	79,50	-	-	0,00	0,00	-
T13	1 891	1 903	30,81	110,1	0,00	76,59	-	-	0,00	0,00	-
T14	1 668	1 682	32,26	110,1	0,00	75,52	-	-	0,00	0,00	-
T15	1 546	1 560	33,13	110,1	0,00	74,86	-	-	0,00	0,00	-
T16	2 585	2 594	27,03	110,1	0,00	79,28	-	-	0,00	0,00	-
T17	2 697	2 706	26,50	110,1	0,00	79,65	-	-	0,00	0,00	-
T18	2 306	2 316	28,44	110,1	0,00	78,29	-	-	0,00	0,00	-
T2	5 753	5 758	16,50	110,1	0,00	86,20	-	-	0,00	0,00	-
T3	5 374	5 378	17,44	110,1	0,00	85,61	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T6	4 485	4 491	19,89	110,1	0,00	84,05	-	-	0,00	0,00	-
T7	4 835	4 840	18,88	110,1	0,00	84,70	-	-	0,00	0,00	-
T8	3 425	3 432	23,46	110,1	0,00	81,71	-	-	0,00	0,00	-
T9	3 413	3 420	23,50	110,1	0,00	81,68	-	-	0,00	0,00	-
Sum			39,26								

- Data undefined due to calculation with octave data

Noise sensitive area: B B - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	8 843	8 844	3,77	105,0	0,00	89,93	-	-	0,00	0,00	-
10	7 008	7 010	6,59	106,0	0,00	87,91	-	-	0,00	0,00	-
11	8 201	8 203	4,55	106,0	0,00	89,28	-	-	0,00	0,00	-
12	8 119	8 120	4,68	106,0	0,00	89,19	-	-	0,00	0,00	-
13	7 640	7 642	5,47	106,0	0,00	88,66	-	-	0,00	0,00	-
14	9 487	9 488	2,65	106,0	0,00	90,54	-	-	0,00	0,00	-
15	9 531	9 532	2,59	106,0	0,00	90,58	-	-	0,00	0,00	-
16	8 992	8 994	3,35	106,0	0,00	90,08	-	-	0,00	0,00	-
17	8 242	8 244	4,49	106,0	0,00	89,32	-	-	0,00	0,00	-
18	10 402	10 403	1,45	106,0	0,00	91,34	-	-	0,00	0,00	-
19	7 541	7 545	5,19	104,3	0,00	88,55	-	-	0,00	0,00	-
2	9 408	9 409	2,97	105,0	0,00	90,47	-	-	0,00	0,00	-
20	8 100	8 103	4,26	104,3	0,00	89,17	-	-	0,00	0,00	-
21	6 722	6 726	6,67	104,3	0,00	87,55	-	-	0,00	0,00	-
22	6 601	6 605	6,93	104,3	0,00	87,40	-	-	0,00	0,00	-
23	7 920	7 924	4,55	104,3	0,00	88,98	-	-	0,00	0,00	-
24	8 918	8 921	3,00	104,3	0,00	90,01	-	-	0,00	0,00	-
25	8 325	8 328	11,79	110,1	0,00	89,41	-	-	0,00	0,00	-
26	11 612	11 614	7,56	110,1	0,00	92,30	-	-	0,00	0,00	-
27	9 675	9 677	9,90	110,1	0,00	90,71	-	-	0,00	0,00	-
28	8 970	8 972	10,85	110,1	0,00	90,06	-	-	0,00	0,00	-
29	10 810	10 811	8,49	110,1	0,00	91,68	-	-	0,00	0,00	-
3	9 664	9 665	2,62	105,0	0,00	90,70	-	-	0,00	0,00	-
30	10 686	10 688	8,63	110,1	0,00	91,58	-	-	0,00	0,00	-
31	9 525	9 527	10,10	110,1	0,00	90,58	-	-	0,00	0,00	-
4	9 049	9 050	3,47	105,0	0,00	90,13	-	-	0,00	0,00	-
5	8 655	8 656	4,05	105,0	0,00	89,75	-	-	0,00	0,00	-
6	9 742	9 744	2,52	105,0	0,00	90,77	-	-	0,00	0,00	-
7	9 268	9 269	3,16	105,0	0,00	90,34	-	-	0,00	0,00	-
8	9 805	9 806	2,43	105,0	0,00	90,83	-	-	0,00	0,00	-
9	9 514	9 516	2,83	105,0	0,00	90,57	-	-	0,00	0,00	-
T1	4 994	4 999	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T10	3 182	3 189	24,41	110,1	0,00	81,07	-	-	0,00	0,00	-
T11	3 652	3 658	22,62	110,1	0,00	82,26	-	-	0,00	0,00	-
T12	4 232	4 238	20,67	110,1	0,00	83,54	-	-	0,00	0,00	-
T13	3 850	3 856	21,93	110,1	0,00	82,72	-	-	0,00	0,00	-
T14	2 478	2 487	27,56	110,1	0,00	78,91	-	-	0,00	0,00	-
T15	1 742	1 755	31,77	110,1	0,00	75,88	-	-	0,00	0,00	-
T16	1 517	1 532	33,35	110,1	0,00	74,70	-	-	0,00	0,00	-
T17	2 624	2 633	26,85	110,1	0,00	79,41	-	-	0,00	0,00	-
T18	3 289	3 295	23,99	110,1	0,00	81,36	-	-	0,00	0,00	-
T2	4 261	4 267	20,58	110,1	0,00	83,60	-	-	0,00	0,00	-
T3	3 585	3 592	22,86	110,1	0,00	82,11	-	-	0,00	0,00	-
T6	3 091	3 099	24,78	110,1	0,00	80,82	-	-	0,00	0,00	-
T7	3 961	3 967	21,55	110,1	0,00	82,97	-	-	0,00	0,00	-
T8	4 275	4 280	20,54	110,1	0,00	83,63	-	-	0,00	0,00	-
T9	2 216	2 226	28,92	110,1	0,00	77,95	-	-	0,00	0,00	-
Sum			38,78								

- Data undefined due to calculation with octave data

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s
Noise sensitive area: C C - Asuinrakennus

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 185	5 187	10,65	105,0	0,00	85,30	-	-	0,00	0,00	-
10	3 927	3 930	14,14	106,0	0,00	82,89	-	-	0,00	0,00	-
11	4 869	4 872	11,24	106,0	0,00	84,75	-	-	0,00	0,00	-
12	4 610	4 612	11,93	106,0	0,00	84,28	-	-	0,00	0,00	-
13	4 236	4 239	13,06	106,0	0,00	83,55	-	-	0,00	0,00	-
14	5 957	5 959	8,69	106,0	0,00	86,50	-	-	0,00	0,00	-
15	5 913	5 916	8,78	106,0	0,00	86,44	-	-	0,00	0,00	-
16	5 362	5 365	10,03	106,0	0,00	85,59	-	-	0,00	0,00	-
17	4 597	4 600	11,97	106,0	0,00	84,26	-	-	0,00	0,00	-
18	6 784	6 785	7,01	106,0	0,00	87,63	-	-	0,00	0,00	-
19	4 110	4 116	13,80	104,3	0,00	83,29	-	-	0,00	0,00	-
2	5 741	5 742	9,35	105,0	0,00	86,18	-	-	0,00	0,00	-
20	4 955	4 960	11,12	104,3	0,00	84,91	-	-	0,00	0,00	-
21	3 521	3 528	15,97	104,3	0,00	81,95	-	-	0,00	0,00	-
22	3 098	3 106	17,73	104,3	0,00	80,85	-	-	0,00	0,00	-
23	4 384	4 390	12,88	104,3	0,00	83,85	-	-	0,00	0,00	-
24	5 519	5 523	9,55	104,3	0,00	85,84	-	-	0,00	0,00	-
25	11 448	11 450	7,75	110,1	0,00	92,18	-	-	0,00	0,00	-
26	14 335	14 336	4,83	110,1	0,00	94,13	-	-	0,00	0,00	-
27	12 453	12 455	6,66	110,1	0,00	92,91	-	-	0,00	0,00	-
28	11 919	11 921	7,23	110,1	0,00	92,53	-	-	0,00	0,00	-
29	13 551	13 552	5,56	110,1	0,00	93,64	-	-	0,00	0,00	-
3	6 036	6 037	8,71	105,0	0,00	86,62	-	-	0,00	0,00	-
30	13 693	13 694	5,43	110,1	0,00	93,73	-	-	0,00	0,00	-
31	12 640	12 642	6,47	110,1	0,00	93,04	-	-	0,00	0,00	-
4	5 439	5 440	10,04	105,0	0,00	85,71	-	-	0,00	0,00	-
5	5 094	5 096	10,88	105,0	0,00	85,14	-	-	0,00	0,00	-
6	6 177	6 178	8,41	105,0	0,00	86,82	-	-	0,00	0,00	-
7	5 740	5 742	9,35	105,0	0,00	86,18	-	-	0,00	0,00	-
8	6 301	6 302	8,16	105,0	0,00	86,99	-	-	0,00	0,00	-
9	6 082	6 083	8,61	105,0	0,00	86,68	-	-	0,00	0,00	-
T1	4 406	4 411	20,13	110,1	0,00	83,89	-	-	0,00	0,00	-
T10	4 329	4 334	20,37	110,1	0,00	83,74	-	-	0,00	0,00	-
T11	5 222	5 226	17,83	110,1	0,00	85,36	-	-	0,00	0,00	-
T12	6 630	6 633	14,57	110,1	0,00	87,43	-	-	0,00	0,00	-
T13	6 633	6 636	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
T14	5 338	5 341	17,53	110,1	0,00	85,55	-	-	0,00	0,00	-
T15	4 996	5 000	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T16	4 068	4 073	21,20	110,1	0,00	83,20	-	-	0,00	0,00	-
T17	4 726	4 731	19,19	110,1	0,00	84,50	-	-	0,00	0,00	-
T18	5 700	5 704	16,63	110,1	0,00	86,12	-	-	0,00	0,00	-
T2	3 330	3 337	23,82	110,1	0,00	81,47	-	-	0,00	0,00	-
T3	2 689	2 698	26,54	110,1	0,00	79,62	-	-	0,00	0,00	-
T6	3 306	3 312	23,92	110,1	0,00	81,40	-	-	0,00	0,00	-
T7	4 139	4 144	20,97	110,1	0,00	83,35	-	-	0,00	0,00	-
T8	6 083	6 087	15,73	110,1	0,00	86,69	-	-	0,00	0,00	-
T9	3 680	3 686	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
Sum			33,79								

- Data undefined due to calculation with octave data

Noise sensitive area: D D - Lomarakennus

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 115	5 117	10,82	105,0	0,00	85,18	-	-	0,00	0,00	-
10	4 688	4 690	11,72	106,0	0,00	84,42	-	-	0,00	0,00	-
11	5 482	5 484	9,75	106,0	0,00	85,78	-	-	0,00	0,00	-
12	5 102	5 104	10,66	106,0	0,00	85,16	-	-	0,00	0,00	-
13	4 824	4 827	11,36	106,0	0,00	84,67	-	-	0,00	0,00	-
14	6 397	6 399	7,77	106,0	0,00	87,12	-	-	0,00	0,00	-
15	6 249	6 251	8,07	106,0	0,00	86,92	-	-	0,00	0,00	-
16	5 689	5 691	9,27	106,0	0,00	86,10	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
17	4 916	4 918	11,12	106,0	0,00	84,84	-	-	0,00	0,00	-
18	7 103	7 105	6,42	106,0	0,00	88,03	-	-	0,00	0,00	-
19	3 739	3 746	15,13	104,3	0,00	82,47	-	-	0,00	0,00	-
2	5 690	5 691	9,47	105,0	0,00	86,10	-	-	0,00	0,00	-
20	4 386	4 392	12,87	104,3	0,00	83,85	-	-	0,00	0,00	-
21	2 966	2 974	18,32	104,3	0,00	80,47	-	-	0,00	0,00	-
22	2 805	2 814	19,06	104,3	0,00	79,99	-	-	0,00	0,00	-
23	4 124	4 130	13,75	104,3	0,00	83,32	-	-	0,00	0,00	-
24	5 124	5 129	10,63	104,3	0,00	85,20	-	-	0,00	0,00	-
25	11 026	11 028	8,23	110,1	0,00	91,85	-	-	0,00	0,00	-
26	13 754	13 756	5,37	110,1	0,00	93,77	-	-	0,00	0,00	-
27	11 904	11 906	7,25	110,1	0,00	92,52	-	-	0,00	0,00	-
28	11 430	11 431	7,77	110,1	0,00	92,16	-	-	0,00	0,00	-
29	12 981	12 983	6,12	110,1	0,00	93,27	-	-	0,00	0,00	-
3	5 899	5 900	9,00	105,0	0,00	86,42	-	-	0,00	0,00	-
30	13 207	13 209	5,90	110,1	0,00	93,42	-	-	0,00	0,00	-
31	12 203	12 205	6,92	110,1	0,00	92,73	-	-	0,00	0,00	-
4	5 274	5 276	10,43	105,0	0,00	85,45	-	-	0,00	0,00	-
5	4 861	4 863	11,47	105,0	0,00	84,74	-	-	0,00	0,00	-
6	5 947	5 948	8,90	105,0	0,00	86,49	-	-	0,00	0,00	-
7	5 466	5 468	9,98	105,0	0,00	85,76	-	-	0,00	0,00	-
8	6 002	6 004	8,78	105,0	0,00	86,57	-	-	0,00	0,00	-
9	5 716	5 718	9,41	105,0	0,00	86,14	-	-	0,00	0,00	-
T1	3 467	3 474	23,30	110,1	0,00	81,82	-	-	0,00	0,00	-
T10	3 680	3 685	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
T11	4 582	4 586	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
T12	6 096	6 100	15,70	110,1	0,00	86,71	-	-	0,00	0,00	-
T13	6 202	6 205	15,47	110,1	0,00	86,86	-	-	0,00	0,00	-
T14	5 003	5 007	18,42	110,1	0,00	84,99	-	-	0,00	0,00	-
T15	4 812	4 816	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T16	3 797	3 803	22,11	110,1	0,00	82,60	-	-	0,00	0,00	-
T17	4 251	4 256	20,61	110,1	0,00	83,58	-	-	0,00	0,00	-
T18	5 219	5 223	17,84	110,1	0,00	85,36	-	-	0,00	0,00	-
T2	2 400	2 410	27,95	110,1	0,00	78,64	-	-	0,00	0,00	-
T3	1 832	1 844	31,18	110,1	0,00	76,32	-	-	0,00	0,00	-
T6	2 595	2 604	26,99	110,1	0,00	79,31	-	-	0,00	0,00	-
T7	3 318	3 324	23,87	110,1	0,00	81,43	-	-	0,00	0,00	-
T8	5 440	5 444	17,27	110,1	0,00	85,72	-	-	0,00	0,00	-
T9	3 207	3 214	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
Sum			36,52								

- Data undefined due to calculation with octave data

Noise sensitive area: E E - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	4 338	4 340	12,89	105,0	0,00	83,75	-	-	0,00	0,00	-
10	4 965	4 967	11,00	106,0	0,00	84,92	-	-	0,00	0,00	-
11	5 499	5 502	9,71	106,0	0,00	85,81	-	-	0,00	0,00	-
12	4 970	4 972	10,99	106,0	0,00	84,93	-	-	0,00	0,00	-
13	4 835	4 837	11,33	106,0	0,00	84,69	-	-	0,00	0,00	-
14	6 149	6 151	8,28	106,0	0,00	86,78	-	-	0,00	0,00	-
15	5 876	5 878	8,86	106,0	0,00	86,38	-	-	0,00	0,00	-
16	5 324	5 326	10,12	106,0	0,00	85,53	-	-	0,00	0,00	-
17	4 574	4 576	12,03	106,0	0,00	84,21	-	-	0,00	0,00	-
18	6 689	6 691	7,20	106,0	0,00	87,51	-	-	0,00	0,00	-
19	2 744	2 753	19,36	104,3	0,00	79,80	-	-	0,00	0,00	-
2	4 914	4 916	11,33	105,0	0,00	84,83	-	-	0,00	0,00	-
20	3 254	3 262	17,06	104,3	0,00	81,27	-	-	0,00	0,00	-
21	1 863	1 876	24,32	104,3	0,00	76,47	-	-	0,00	0,00	-
22	1 945	1 958	23,79	104,3	0,00	76,84	-	-	0,00	0,00	-
23	3 208	3 215	17,25	104,3	0,00	81,14	-	-	0,00	0,00	-
24	4 078	4 084	13,91	104,3	0,00	83,22	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
25	11 562	11 563	7,62	110,1	0,00	92,26	-	-	0,00	0,00	-
26	14 066	14 067	5,08	110,1	0,00	93,96	-	-	0,00	0,00	-
27	12 272	12 274	6,85	110,1	0,00	92,78	-	-	0,00	0,00	-
28	11 880	11 882	7,27	110,1	0,00	92,50	-	-	0,00	0,00	-
29	13 314	13 315	5,80	110,1	0,00	93,49	-	-	0,00	0,00	-
3	5 039	5 041	11,01	105,0	0,00	85,05	-	-	0,00	0,00	-
30	13 651	13 652	5,47	110,1	0,00	93,70	-	-	0,00	0,00	-
31	12 714	12 715	6,39	110,1	0,00	93,09	-	-	0,00	0,00	-
4	4 405	4 407	12,70	105,0	0,00	83,88	-	-	0,00	0,00	-
5	3 944	3 946	14,06	105,0	0,00	82,92	-	-	0,00	0,00	-
6	5 008	5 010	11,09	105,0	0,00	85,00	-	-	0,00	0,00	-
7	4 501	4 503	12,43	105,0	0,00	84,07	-	-	0,00	0,00	-
8	5 009	5 011	11,09	105,0	0,00	85,00	-	-	0,00	0,00	-
9	4 681	4 683	11,94	105,0	0,00	84,41	-	-	0,00	0,00	-
T1	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T10	4 079	4 084	21,16	110,1	0,00	83,22	-	-	0,00	0,00	-
T11	4 946	4 951	18,57	110,1	0,00	84,89	-	-	0,00	0,00	-
T12	6 563	6 566	14,69	110,1	0,00	87,35	-	-	0,00	0,00	-
T13	6 792	6 795	14,28	110,1	0,00	87,64	-	-	0,00	0,00	-
T14	5 724	5 728	16,58	110,1	0,00	86,16	-	-	0,00	0,00	-
T15	5 667	5 671	16,71	110,1	0,00	86,07	-	-	0,00	0,00	-
T16	4 618	4 622	19,50	110,1	0,00	84,30	-	-	0,00	0,00	-
T17	4 851	4 855	18,84	110,1	0,00	84,72	-	-	0,00	0,00	-
T18	5 776	5 779	16,45	110,1	0,00	86,24	-	-	0,00	0,00	-
T2	2 254	2 264	28,71	110,1	0,00	78,10	-	-	0,00	0,00	-
T3	2 046	2 057	29,88	110,1	0,00	77,26	-	-	0,00	0,00	-
T6	2 991	2 999	25,20	110,1	0,00	80,54	-	-	0,00	0,00	-
T7	3 417	3 424	23,49	110,1	0,00	81,69	-	-	0,00	0,00	-
T8	5 770	5 773	16,47	110,1	0,00	86,23	-	-	0,00	0,00	-
T9	3 867	3 873	21,87	110,1	0,00	82,76	-	-	0,00	0,00	-
Sum			36,34								

- Data undefined due to calculation with octave data

Noise sensitive area: F F - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 554	5 556	9,78	105,0	0,00	85,89	-	-	0,00	0,00	-
10	7 156	7 158	6,32	106,0	0,00	88,10	-	-	0,00	0,00	-
11	7 573	7 574	5,59	106,0	0,00	88,59	-	-	0,00	0,00	-
12	6 958	6 959	6,69	106,0	0,00	87,85	-	-	0,00	0,00	-
13	6 919	6 921	6,76	106,0	0,00	87,80	-	-	0,00	0,00	-
14	7 999	8 000	4,88	106,0	0,00	89,06	-	-	0,00	0,00	-
15	7 603	7 605	5,54	106,0	0,00	88,62	-	-	0,00	0,00	-
16	7 084	7 086	6,45	106,0	0,00	88,01	-	-	0,00	0,00	-
17	6 397	6 399	7,77	106,0	0,00	87,12	-	-	0,00	0,00	-
18	8 335	8 337	4,34	106,0	0,00	89,42	-	-	0,00	0,00	-
19	3 672	3 679	15,39	104,3	0,00	82,31	-	-	0,00	0,00	-
2	6 077	6 078	8,62	105,0	0,00	86,68	-	-	0,00	0,00	-
20	3 356	3 364	16,63	104,3	0,00	81,54	-	-	0,00	0,00	-
21	2 672	2 681	19,71	104,3	0,00	79,57	-	-	0,00	0,00	-
22	3 432	3 440	16,32	104,3	0,00	81,73	-	-	0,00	0,00	-
23	4 263	4 269	13,28	104,3	0,00	83,61	-	-	0,00	0,00	-
24	4 541	4 547	12,38	104,3	0,00	84,15	-	-	0,00	0,00	-
25	10 698	10 700	8,62	110,1	0,00	91,59	-	-	0,00	0,00	-
26	12 743	12 745	6,37	110,1	0,00	93,11	-	-	0,00	0,00	-
27	11 076	11 078	8,17	110,1	0,00	91,89	-	-	0,00	0,00	-
28	10 843	10 844	8,45	110,1	0,00	91,70	-	-	0,00	0,00	-
29	12 037	12 039	7,10	110,1	0,00	92,61	-	-	0,00	0,00	-
3	5 996	5 998	8,79	105,0	0,00	86,56	-	-	0,00	0,00	-
30	12 566	12 568	6,54	110,1	0,00	92,99	-	-	0,00	0,00	-
31	11 773	11 775	7,39	110,1	0,00	92,42	-	-	0,00	0,00	-
4	5 404	5 406	10,12	105,0	0,00	85,66	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
5	4 875	4 876	11,43	105,0	0,00	84,76	-	-	0,00	0,00	-
6	5 748	5 750	9,34	105,0	0,00	86,19	-	-	0,00	0,00	-
7	5 215	5 216	10,58	105,0	0,00	85,35	-	-	0,00	0,00	-
8	5 570	5 571	9,74	105,0	0,00	85,92	-	-	0,00	0,00	-
9	5 110	5 111	10,84	105,0	0,00	85,17	-	-	0,00	0,00	-
T1	1 553	1 567	33,08	110,1	0,00	74,90	-	-	0,00	0,00	-
T10	3 533	3 539	23,06	110,1	0,00	81,98	-	-	0,00	0,00	-
T11	4 164	4 169	20,89	110,1	0,00	83,40	-	-	0,00	0,00	-
T12	5 793	5 797	16,41	110,1	0,00	86,26	-	-	0,00	0,00	-
T13	6 256	6 259	15,35	110,1	0,00	86,93	-	-	0,00	0,00	-
T14	5 578	5 582	16,93	110,1	0,00	85,94	-	-	0,00	0,00	-
T15	5 849	5 852	16,28	110,1	0,00	86,35	-	-	0,00	0,00	-
T16	4 847	4 851	18,85	110,1	0,00	84,72	-	-	0,00	0,00	-
T17	4 557	4 562	19,68	110,1	0,00	84,18	-	-	0,00	0,00	-
T18	5 268	5 272	17,71	110,1	0,00	85,44	-	-	0,00	0,00	-
T2	1 501	1 516	33,47	110,1	0,00	74,61	-	-	0,00	0,00	-
T3	2 113	2 123	29,50	110,1	0,00	77,54	-	-	0,00	0,00	-
T6	2 792	2 800	26,07	110,1	0,00	79,94	-	-	0,00	0,00	-
T7	2 486	2 495	27,52	110,1	0,00	78,94	-	-	0,00	0,00	-
T8	4 811	4 815	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T9	3 894	3 899	21,78	110,1	0,00	82,82	-	-	0,00	0,00	-
Sum			38,75								

- Data undefined due to calculation with octave data

Noise sensitive area: G G - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	9 073	9 074	3,44	105,0	0,00	90,16	-	-	0,00	0,00	-
10	10 440	10 441	1,40	106,0	0,00	91,38	-	-	0,00	0,00	-
11	11 016	11 017	0,70	106,0	0,00	91,84	-	-	0,00	0,00	-
12	10 452	10 453	1,39	106,0	0,00	91,38	-	-	0,00	0,00	-
13	10 353	10 354	1,51	106,0	0,00	91,30	-	-	0,00	0,00	-
14	11 541	11 542	0,09	106,0	0,00	92,25	-	-	0,00	0,00	-
15	11 161	11 162	0,53	106,0	0,00	91,95	-	-	0,00	0,00	-
16	10 638	10 639	1,16	106,0	0,00	91,54	-	-	0,00	0,00	-
17	9 939	9 940	2,04	106,0	0,00	90,95	-	-	0,00	0,00	-
18	11 894	11 895	-0,30	106,0	0,00	92,51	-	-	0,00	0,00	-
19	7 187	7 191	5,81	104,3	0,00	88,14	-	-	0,00	0,00	-
2	9 574	9 575	2,74	105,0	0,00	90,62	-	-	0,00	0,00	-
20	6 642	6 646	6,83	104,3	0,00	87,45	-	-	0,00	0,00	-
21	6 216	6 220	7,81	104,3	0,00	86,88	-	-	0,00	0,00	-
22	6 988	6 992	6,17	104,3	0,00	87,89	-	-	0,00	0,00	-
23	7 780	7 784	4,79	104,3	0,00	88,82	-	-	0,00	0,00	-
24	7 860	7 864	4,65	104,3	0,00	88,91	-	-	0,00	0,00	-
25	8 140	8 143	12,07	110,1	0,00	89,22	-	-	0,00	0,00	-
26	9 531	9 533	10,09	110,1	0,00	90,59	-	-	0,00	0,00	-
27	8 053	8 055	12,20	110,1	0,00	89,12	-	-	0,00	0,00	-
28	8 035	8 037	12,23	110,1	0,00	89,10	-	-	0,00	0,00	-
29	8 890	8 893	10,97	110,1	0,00	89,98	-	-	0,00	0,00	-
3	9 434	9 435	2,93	105,0	0,00	90,50	-	-	0,00	0,00	-
30	9 632	9 634	9,97	110,1	0,00	90,68	-	-	0,00	0,00	-
31	9 053	9 055	10,74	110,1	0,00	90,14	-	-	0,00	0,00	-
4	8 873	8 874	3,73	105,0	0,00	89,96	-	-	0,00	0,00	-
5	8 343	8 344	4,52	105,0	0,00	89,43	-	-	0,00	0,00	-
6	9 113	9 114	3,38	105,0	0,00	90,19	-	-	0,00	0,00	-
7	8 595	8 596	4,14	105,0	0,00	89,69	-	-	0,00	0,00	-
8	8 864	8 865	3,74	105,0	0,00	89,95	-	-	0,00	0,00	-
9	8 369	8 370	4,48	105,0	0,00	89,45	-	-	0,00	0,00	-
T1	2 379	2 388	28,06	110,1	0,00	78,56	-	-	0,00	0,00	-
T10	3 400	3 406	23,56	110,1	0,00	81,65	-	-	0,00	0,00	-
T11	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T12	4 082	4 088	21,15	110,1	0,00	83,23	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T13	4 827	4 832	18,90	110,1	0,00	84,68	-	-	0,00	0,00	-
T14	5 018	5 022	18,38	110,1	0,00	85,02	-	-	0,00	0,00	-
T15	5 720	5 724	16,60	110,1	0,00	86,15	-	-	0,00	0,00	-
T16	5 145	5 149	18,04	110,1	0,00	85,23	-	-	0,00	0,00	-
T17	4 184	4 189	20,83	110,1	0,00	83,44	-	-	0,00	0,00	-
T18	4 213	4 217	20,76	110,1	0,00	83,50	-	-	0,00	0,00	-
T2	3 431	3 438	23,44	110,1	0,00	81,73	-	-	0,00	0,00	-
T3	4 080	4 086	21,16	110,1	0,00	83,23	-	-	0,00	0,00	-
T6	3 793	3 799	22,13	110,1	0,00	82,59	-	-	0,00	0,00	-
T7	2 800	2 808	26,04	110,1	0,00	79,97	-	-	0,00	0,00	-
T8	3 116	3 123	24,68	110,1	0,00	80,89	-	-	0,00	0,00	-
T9	4 374	4 379	20,23	110,1	0,00	83,83	-	-	0,00	0,00	-
Sum			35,10								

- Data undefined due to calculation with octave data

Noise sensitive area: H H- Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	11 341	11 342	0,56	105,0	0,00	92,09	-	-	0,00	0,00	-
10	11 517	11 518	0,12	106,0	0,00	92,23	-	-	0,00	0,00	-
11	12 399	12 400	-0,85	106,0	0,00	92,87	-	-	0,00	0,00	-
12	12 008	12 009	-0,43	106,0	0,00	92,59	-	-	0,00	0,00	-
13	11 743	11 744	-0,14	106,0	0,00	92,40	-	-	0,00	0,00	-
14	13 266	13 267	-1,73	106,0	0,00	93,46	-	-	0,00	0,00	-
15	13 035	13 036	-1,50	106,0	0,00	93,30	-	-	0,00	0,00	-
16	12 479	12 480	-0,93	106,0	0,00	92,92	-	-	0,00	0,00	-
17	11 720	11 721	-0,11	106,0	0,00	92,38	-	-	0,00	0,00	-
18	13 853	13 854	-2,29	106,0	0,00	93,83	-	-	0,00	0,00	-
19	9 508	9 511	2,16	104,3	0,00	90,56	-	-	0,00	0,00	-
2	11 895	11 896	-0,05	105,0	0,00	92,51	-	-	0,00	0,00	-
20	9 288	9 291	2,47	104,3	0,00	90,36	-	-	0,00	0,00	-
21	8 478	8 481	3,66	104,3	0,00	89,57	-	-	0,00	0,00	-
22	9 010	9 013	2,86	104,3	0,00	90,10	-	-	0,00	0,00	-
23	10 081	10 084	1,39	104,3	0,00	91,07	-	-	0,00	0,00	-
24	10 475	10 477	0,88	104,3	0,00	91,41	-	-	0,00	0,00	-
25	4 879	4 883	18,76	110,1	0,00	84,77	-	-	0,00	0,00	-
26	6 905	6 908	14,08	110,1	0,00	87,79	-	-	0,00	0,00	-
27	5 157	5 161	18,01	110,1	0,00	85,25	-	-	0,00	0,00	-
28	4 919	4 923	18,65	110,1	0,00	84,84	-	-	0,00	0,00	-
29	6 162	6 165	15,56	110,1	0,00	86,80	-	-	0,00	0,00	-
3	11 880	11 881	-0,03	105,0	0,00	92,50	-	-	0,00	0,00	-
30	6 632	6 635	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
31	5 881	5 884	16,20	110,1	0,00	86,39	-	-	0,00	0,00	-
4	11 268	11 269	0,65	105,0	0,00	92,04	-	-	0,00	0,00	-
5	10 747	10 748	1,25	105,0	0,00	91,63	-	-	0,00	0,00	-
6	11 670	11 671	0,19	105,0	0,00	92,34	-	-	0,00	0,00	-
7	11 135	11 136	0,80	105,0	0,00	91,93	-	-	0,00	0,00	-
8	11 504	11 504	0,38	105,0	0,00	92,22	-	-	0,00	0,00	-
9	11 043	11 044	0,90	105,0	0,00	91,86	-	-	0,00	0,00	-
T1	4 383	4 388	20,20	110,1	0,00	83,85	-	-	0,00	0,00	-
T10	3 262	3 269	24,09	110,1	0,00	81,29	-	-	0,00	0,00	-
T11	2 371	2 381	28,10	110,1	0,00	78,53	-	-	0,00	0,00	-
T12	1 520	1 534	33,33	110,1	0,00	74,72	-	-	0,00	0,00	-
T13	2 226	2 236	28,87	110,1	0,00	77,99	-	-	0,00	0,00	-
T14	3 257	3 264	24,11	110,1	0,00	81,27	-	-	0,00	0,00	-
T15	4 103	4 108	21,09	110,1	0,00	83,27	-	-	0,00	0,00	-
T16	4 189	4 194	20,81	110,1	0,00	83,45	-	-	0,00	0,00	-
T17	3 119	3 126	24,67	110,1	0,00	80,90	-	-	0,00	0,00	-
T18	2 365	2 374	28,13	110,1	0,00	78,51	-	-	0,00	0,00	-
T2	4 954	4 959	18,55	110,1	0,00	84,91	-	-	0,00	0,00	-
T3	5 166	5 170	17,98	110,1	0,00	85,27	-	-	0,00	0,00	-
T6	4 325	4 330	20,38	110,1	0,00	83,73	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T7	3 751	3 757	22,27	110,1	0,00	82,50	-	-	0,00	0,00	-
T8	1 518	1 533	33,34	110,1	0,00	74,71	-	-	0,00	0,00	-
T9	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
Sum			39,27								

- Data undefined due to calculation with octave data

Noise sensitive area: I I - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	12 769	12 770	-0,96	105,0	0,00	93,12	-	-	0,00	0,00	-
10	11 790	11 791	-0,19	106,0	0,00	92,43	-	-	0,00	0,00	-
11	12 902	12 903	-1,37	106,0	0,00	93,21	-	-	0,00	0,00	-
12	12 702	12 704	-1,16	106,0	0,00	93,08	-	-	0,00	0,00	-
13	12 297	12 298	-0,74	106,0	0,00	92,80	-	-	0,00	0,00	-
14	14 052	14 053	-2,48	106,0	0,00	93,96	-	-	0,00	0,00	-
15	13 980	13 981	-2,41	106,0	0,00	93,91	-	-	0,00	0,00	-
16	13 423	13 424	-1,88	106,0	0,00	93,56	-	-	0,00	0,00	-
17	12 650	12 651	-1,11	106,0	0,00	93,04	-	-	0,00	0,00	-
18	14 844	14 845	-3,20	106,0	0,00	94,43	-	-	0,00	0,00	-
19	11 106	11 109	0,10	104,3	0,00	91,91	-	-	0,00	0,00	-
2	13 346	13 346	-1,52	105,0	0,00	93,51	-	-	0,00	0,00	-
20	11 209	11 211	-0,02	104,3	0,00	91,99	-	-	0,00	0,00	-
21	10 109	10 112	1,35	104,3	0,00	91,10	-	-	0,00	0,00	-
22	10 377	10 380	1,00	104,3	0,00	91,32	-	-	0,00	0,00	-
23	11 619	11 621	-0,49	104,3	0,00	92,30	-	-	0,00	0,00	-
24	12 296	12 299	-1,24	104,3	0,00	92,80	-	-	0,00	0,00	-
25	3 447	3 453	23,38	110,1	0,00	81,76	-	-	0,00	0,00	-
26	6 849	6 852	14,18	110,1	0,00	87,72	-	-	0,00	0,00	-
27	4 920	4 925	18,64	110,1	0,00	84,85	-	-	0,00	0,00	-
28	4 128	4 134	21,00	110,1	0,00	83,33	-	-	0,00	0,00	-
29	6 051	6 054	15,81	110,1	0,00	86,64	-	-	0,00	0,00	-
3	13 459	13 459	-1,63	105,0	0,00	93,58	-	-	0,00	0,00	-
30	5 814	5 817	16,36	110,1	0,00	86,29	-	-	0,00	0,00	-
31	4 647	4 652	19,42	110,1	0,00	84,35	-	-	0,00	0,00	-
4	12 825	12 826	-1,01	105,0	0,00	93,16	-	-	0,00	0,00	-
5	12 344	12 344	-0,52	105,0	0,00	92,83	-	-	0,00	0,00	-
6	13 373	13 374	-1,55	105,0	0,00	93,53	-	-	0,00	0,00	-
7	12 847	12 847	-1,03	105,0	0,00	93,18	-	-	0,00	0,00	-
8	13 302	13 303	-1,48	105,0	0,00	93,48	-	-	0,00	0,00	-
9	12 898	12 899	-1,09	105,0	0,00	93,21	-	-	0,00	0,00	-
T1	6 510	6 514	14,79	110,1	0,00	87,28	-	-	0,00	0,00	-
T10	4 482	4 488	19,90	110,1	0,00	84,04	-	-	0,00	0,00	-
T11	3 808	3 814	22,07	110,1	0,00	82,63	-	-	0,00	0,00	-
T12	2 278	2 288	28,58	110,1	0,00	78,19	-	-	0,00	0,00	-
T13	1 709	1 722	31,99	110,1	0,00	75,72	-	-	0,00	0,00	-
T14	2 766	2 775	26,19	110,1	0,00	79,86	-	-	0,00	0,00	-
T15	3 187	3 194	24,39	110,1	0,00	81,09	-	-	0,00	0,00	-
T16	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
T17	3 584	3 591	22,87	110,1	0,00	82,10	-	-	0,00	0,00	-
T18	2 715	2 723	26,42	110,1	0,00	79,70	-	-	0,00	0,00	-
T2	6 607	6 611	14,61	110,1	0,00	87,41	-	-	0,00	0,00	-
T3	6 437	6 441	14,95	110,1	0,00	87,18	-	-	0,00	0,00	-
T6	5 482	5 486	17,17	110,1	0,00	85,79	-	-	0,00	0,00	-
T7	5 480	5 484	17,17	110,1	0,00	85,78	-	-	0,00	0,00	-
T8	3 322	3 330	23,85	110,1	0,00	81,45	-	-	0,00	0,00	-
T9	4 579	4 585	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
Sum			37,14								

- Data undefined due to calculation with octave data

Project:
Haukkasalo_06052022

Licensed user:
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Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
17.2.2023 13.43/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasalo_06052022_4.w2r (5)

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0,0 dB(A)

Octave data required

Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N117/2400 2400 116.8 !O!

Noise: Level 0 - 105.0dB(A) Kirkkokallio

Source Source/Date Creator Edited
NORDEX 16.4.2014 USER 19.10.2021 13.38
F008_146_A07_EN
Revision 00
2014-04-16

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63	125	250	500	1000	2000	4000	8000
From Windcat	120,0	8,0	105,0	No	85,3	90,9	96,1	98,1	99,5	98,9	95,1	83,5

WTG: NORDEX N131/3000 3000 131.0 !O!

Noise: Level - 106 dB(A) - R00

Source Source/Date Creator Edited
NORDEX 11.3.2014 USER 3.2.2022 20.04
F008_246_A07_EN
Revision 01
2014-03-11

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63	125	250	500	1000	2000	4000	8000
From Windcat	144,0	8,0	106,0	No	84,4	91,5	96,3	97,9	100,8	99,7	97,3	87,2

Project:
Haukkasalo_06052022

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Calculated:
17.2.2023 13.43/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus

WTG: VESTAS V162-6.0 HH219 6000 162.0 IO!

Noise: V162 - 6.0 MW Mode 0 STE - 10-2020

Source	Source/Date	Creator	Edited
Vestas	26.10.2019	USER	4.8.2022 13.03

DMS no.: 0095-3732_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	219,0	8,0	104,3	No	83,7	91,7	96,7	99,2	98,8	95,6	89,7	80,9

WTG: VESTAS V172-7.2 7200 172.0 IO!

Noise: V172 - 7,2 MW PO7200 No STE PO7200-0S

Source	Source/Date	Creator	Edited
Vestas	15.11.2022	USER	13.2.2023 10.23

DMS no.: 0128-4336_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	214,0	8,0	110,1	No	91,5	100,2	104,1	105,0	103,7	99,3	91,6	80,8

Noise sensitive area: A A - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: B B - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: C C - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: D D - Lomarakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: E E - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: F F - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Project:

Haukkasalo_06052022

Licensed user:

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Miikka Saranpää / miikka.saranpaa@fcg.fi

Calculated:

17.2.2023 13.43/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: G G - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: H H- Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: I I - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

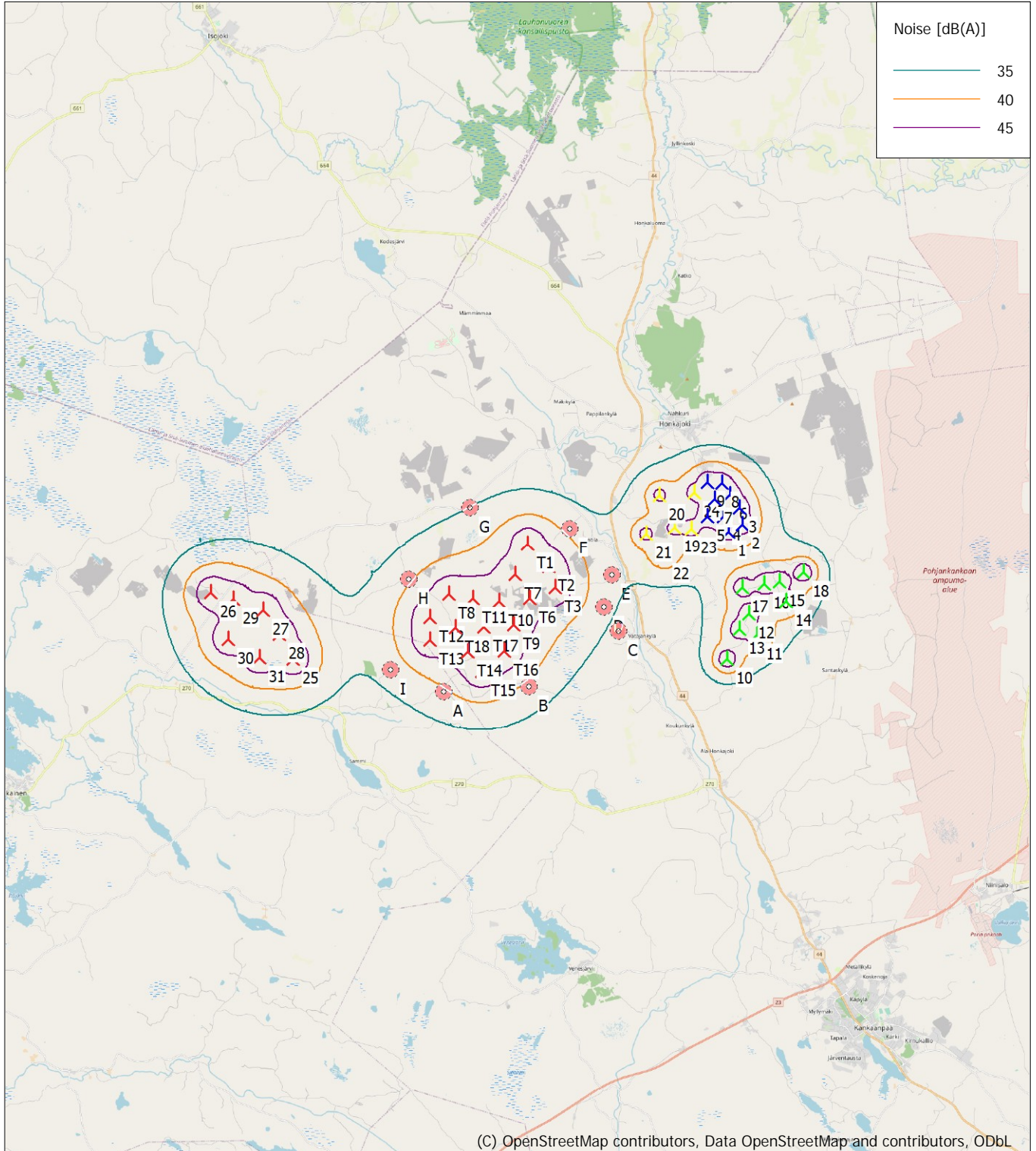
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

DECIBEL - Map 8,0 m/s

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutus



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

0 2,5 5 7,5 10km

Map: EMD OpenStreetMap, Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 767 North: 6 877 207

🚧 New WTG

🏠 Noise sensitive area

Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s

Height above sea level from active line object

Liite 10. Melun yhteismallinnuksen tulokset VE2

Project:

Haukkasalo_06052022

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Calculated:
17.2.2023 13.48/3.5.584

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasa

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

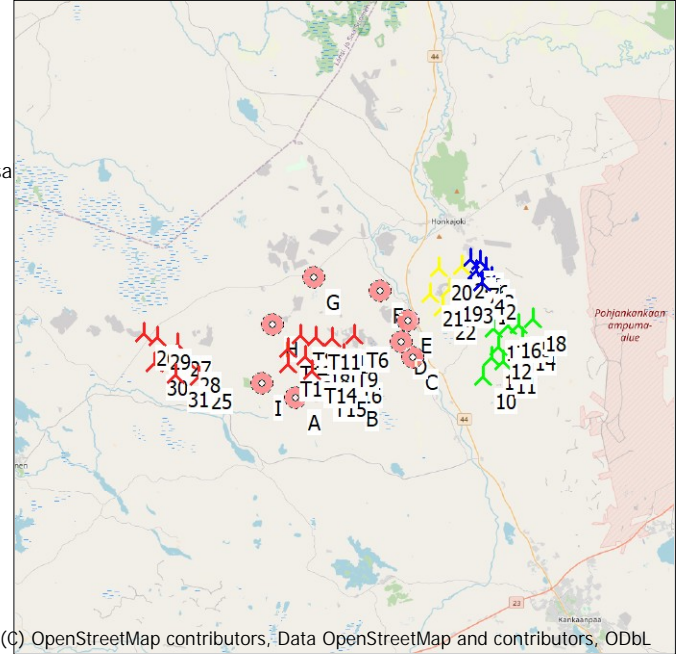
Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more

restrictive, positive is less restrictive.:

0,0 dB(A)



All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTGs

Table with columns: East, North, Z, Row data/Description, WTG type (Valid, Manufact., Type-generator), Power, rated [kW], Rotor diameter [m], Hub height [m], Noise data (Creator, Name), Wind speed [m/s], LwA,ref [dB(A)].

Calculation Results

DECIBEL - Main Result

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

Sound level

No.	Name	East	North	Z [m]	Immission height [m]	Demands Noise [dB(A)]	Sound level	
							From WTGs [dB(A)]	Distance to noise demand [m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	4,0	40,0	39,2	159
B	B - Asuinrakennus	246 258	6 873 632	87,4	4,0	40,0	38,5	265
C	C - Asuinrakennus	249 534	6 875 344	92,8	4,0	40,0	31,7	2 199
D	D - Lomarakennus	249 068	6 876 198	92,5	4,0	40,0	33,2	1 541
E	E - Asuinrakennus	249 460	6 877 291	95,0	4,0	40,0	33,2	1 353
F	F - Asuinrakennus	248 080	6 879 034	96,2	4,0	40,0	32,5	1 758
G	G - Asuinrakennus	244 657	6 880 019	94,1	4,0	40,0	32,6	1 782
H	H - Asuinrakennus	242 301	6 877 666	90,0	4,0	40,0	39,1	159
I	I - Asuinrakennus	241 468	6 874 582	81,7	4,0	40,0	37,0	567

Distances (m)

WTG	A	B	C	D	E	F	G	H	I
1	11466	8843	5185	5115	4338	5554	9073	11341	12769
10	10023	7008	3927	4688	4965	7156	10440	11517	11790
11	11195	8201	4869	5482	5499	7573	11016	12399	12902
12	11068	8119	4610	5102	4970	6958	10452	12008	12702
13	10617	7640	4236	4824	4835	6919	10353	11743	12297
14	12433	9487	5957	6397	6149	7999	11541	13266	14052
15	12426	9531	5913	6249	5876	7603	11161	13035	13980
16	11877	8992	5362	5689	5324	7084	10638	12479	13423
17	11113	8242	4597	4916	4574	6397	9939	11720	12650
18	13297	10402	6784	7103	6689	8335	11894	13853	14844
19	9942	7541	4110	3739	2744	3672	7187	9508	11106
2	12042	9408	5741	5690	4914	6077	9574	11895	13346
20	10240	8100	4955	4386	3254	3356	6642	9288	11209
21	9001	6722	3521	2966	1863	2672	6216	8478	10109
22	9110	6601	3098	2805	1945	3432	6988	9010	10377
23	10405	7920	4384	4124	3208	4263	7780	10081	11619
24	11231	8918	5519	5124	4078	4541	7860	10475	12296
25	5383	8325	11448	11026	11562	10698	8140	4879	3447
26	8842	11612	14335	13754	14066	12743	9531	6905	6849
27	6912	9675	12453	11904	12272	11076	8053	5157	4920
28	6114	8970	11919	11430	11880	10843	8035	4919	4128
29	8043	10810	13551	12981	13314	12037	8890	6162	6051
3	12223	9664	6036	5899	5039	5996	9434	11880	13459
30	7771	10686	13693	13207	13651	12566	9632	6632	5814
31	6572	9525	12640	12203	12714	11773	9053	5881	4647
4	11591	9049	5439	5274	4405	5404	8873	11268	12825
5	11144	8655	5094	4861	3944	4875	8343	10747	12344
6	12210	9742	6177	5947	5008	5748	9113	11670	13373
7	11701	9268	5740	5466	4501	5215	8595	11135	12847
8	12198	9805	6301	6002	5009	5570	8864	11504	13302
9	11839	9514	6082	5716	4681	5110	8369	11043	12898
T10	3746	3182	4329	3680	4079	3533	3400	3262	4482
T11	3444	3652	5222	4582	4946	4164	3168	2371	3808
T12	2653	4232	6630	6096	6563	5793	4082	1520	2278
T13	1891	3850	6633	6202	6792	6256	4827	2226	1709
T14	1668	2478	5338	5003	5724	5578	5018	3257	2766
T15	1546	1742	4996	4812	5667	5849	5720	4103	3187
T16	2585	1517	4068	3797	4618	4847	5145	4189	4027
T17	2697	2624	4726	4251	4851	4557	4184	3119	3584
T18	2306	3289	5700	5219	5776	5268	4213	2365	2715
T6	4485	3091	3306	2595	2991	2792	3793	4325	5482
T8	3339	4242	6109	5478	5824	4890	3208	1507	3229
T9	3413	2216	3680	3207	3867	3894	4374	4027	4579

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A A - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	11 466	11 467	0,42	105,0	0,00	92,19	-	-	0,00	0,00	-
10	10 023	10 024	1,93	106,0	0,00	91,02	-	-	0,00	0,00	-
11	11 195	11 196	0,49	106,0	0,00	91,98	-	-	0,00	0,00	-
12	11 068	11 069	0,64	106,0	0,00	91,88	-	-	0,00	0,00	-
13	10 617	10 619	1,18	106,0	0,00	91,52	-	-	0,00	0,00	-
14	12 433	12 434	-0,88	106,0	0,00	92,89	-	-	0,00	0,00	-
15	12 426	12 428	-0,88	106,0	0,00	92,89	-	-	0,00	0,00	-
16	11 877	11 878	-0,28	106,0	0,00	92,49	-	-	0,00	0,00	-
17	11 113	11 114	0,59	106,0	0,00	91,92	-	-	0,00	0,00	-
18	13 297	13 298	-1,76	106,0	0,00	93,48	-	-	0,00	0,00	-
19	9 942	9 945	1,57	104,3	0,00	90,95	-	-	0,00	0,00	-
2	12 042	12 043	-0,21	105,0	0,00	92,61	-	-	0,00	0,00	-
20	10 240	10 243	1,18	104,3	0,00	91,21	-	-	0,00	0,00	-
21	9 001	9 004	2,88	104,3	0,00	90,09	-	-	0,00	0,00	-
22	9 110	9 113	2,72	104,3	0,00	90,19	-	-	0,00	0,00	-
23	10 405	10 408	0,97	104,3	0,00	91,35	-	-	0,00	0,00	-
24	11 231	11 234	-0,04	104,3	0,00	92,01	-	-	0,00	0,00	-
25	5 383	5 388	17,42	110,1	0,00	85,63	-	-	0,00	0,00	-
26	8 842	8 844	11,03	110,1	0,00	89,93	-	-	0,00	0,00	-
27	6 912	6 915	14,07	110,1	0,00	87,80	-	-	0,00	0,00	-
28	6 114	6 117	15,67	110,1	0,00	86,73	-	-	0,00	0,00	-
29	8 043	8 046	12,21	110,1	0,00	89,11	-	-	0,00	0,00	-
3	12 223	12 224	-0,40	105,0	0,00	92,74	-	-	0,00	0,00	-
30	7 771	7 774	12,64	110,1	0,00	88,81	-	-	0,00	0,00	-
31	6 572	6 575	14,67	110,1	0,00	87,36	-	-	0,00	0,00	-
4	11 591	11 592	0,28	105,0	0,00	92,28	-	-	0,00	0,00	-
5	11 144	11 144	0,79	105,0	0,00	91,94	-	-	0,00	0,00	-
6	12 210	12 211	-0,39	105,0	0,00	92,74	-	-	0,00	0,00	-
7	11 701	11 702	0,16	105,0	0,00	92,37	-	-	0,00	0,00	-
8	12 198	12 199	-0,37	105,0	0,00	92,73	-	-	0,00	0,00	-
9	11 839	11 840	0,01	105,0	0,00	92,47	-	-	0,00	0,00	-
T10	3 746	3 753	22,29	110,1	0,00	82,49	-	-	0,00	0,00	-
T11	3 444	3 451	23,39	110,1	0,00	81,76	-	-	0,00	0,00	-
T12	2 653	2 662	26,71	110,1	0,00	79,50	-	-	0,00	0,00	-
T13	1 891	1 903	30,81	110,1	0,00	76,59	-	-	0,00	0,00	-
T14	1 668	1 682	32,26	110,1	0,00	75,52	-	-	0,00	0,00	-
T15	1 546	1 560	33,13	110,1	0,00	74,86	-	-	0,00	0,00	-
T16	2 585	2 594	27,03	110,1	0,00	79,28	-	-	0,00	0,00	-
T17	2 697	2 706	26,50	110,1	0,00	79,65	-	-	0,00	0,00	-
T18	2 306	2 316	28,44	110,1	0,00	78,29	-	-	0,00	0,00	-
T6	4 485	4 491	19,89	110,1	0,00	84,05	-	-	0,00	0,00	-
T8	3 339	3 346	23,79	110,1	0,00	81,49	-	-	0,00	0,00	-
T9	3 413	3 420	23,50	110,1	0,00	81,68	-	-	0,00	0,00	-
Sum			39,16								

- Data undefined due to calculation with octave data

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

Noise sensitive area: B B - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	8 843	8 844	3,77	105,0	0,00	89,93	-	-	0,00	0,00	-
10	7 008	7 010	6,59	106,0	0,00	87,91	-	-	0,00	0,00	-
11	8 201	8 203	4,55	106,0	0,00	89,28	-	-	0,00	0,00	-
12	8 119	8 120	4,68	106,0	0,00	89,19	-	-	0,00	0,00	-
13	7 640	7 642	5,47	106,0	0,00	88,66	-	-	0,00	0,00	-
14	9 487	9 488	2,65	106,0	0,00	90,54	-	-	0,00	0,00	-
15	9 531	9 532	2,59	106,0	0,00	90,58	-	-	0,00	0,00	-
16	8 992	8 994	3,35	106,0	0,00	90,08	-	-	0,00	0,00	-
17	8 242	8 244	4,49	106,0	0,00	89,32	-	-	0,00	0,00	-
18	10 402	10 403	1,45	106,0	0,00	91,34	-	-	0,00	0,00	-
19	7 541	7 545	5,19	104,3	0,00	88,55	-	-	0,00	0,00	-
2	9 408	9 409	2,97	105,0	0,00	90,47	-	-	0,00	0,00	-
20	8 100	8 103	4,26	104,3	0,00	89,17	-	-	0,00	0,00	-
21	6 722	6 726	6,67	104,3	0,00	87,55	-	-	0,00	0,00	-
22	6 601	6 605	6,93	104,3	0,00	87,40	-	-	0,00	0,00	-
23	7 920	7 924	4,55	104,3	0,00	88,98	-	-	0,00	0,00	-
24	8 918	8 921	3,00	104,3	0,00	90,01	-	-	0,00	0,00	-
25	8 325	8 328	11,79	110,1	0,00	89,41	-	-	0,00	0,00	-
26	11 612	11 614	7,56	110,1	0,00	92,30	-	-	0,00	0,00	-
27	9 675	9 677	9,90	110,1	0,00	90,71	-	-	0,00	0,00	-
28	8 970	8 972	10,85	110,1	0,00	90,06	-	-	0,00	0,00	-
29	10 810	10 811	8,49	110,1	0,00	91,68	-	-	0,00	0,00	-
3	9 664	9 665	2,62	105,0	0,00	90,70	-	-	0,00	0,00	-
30	10 686	10 688	8,63	110,1	0,00	91,58	-	-	0,00	0,00	-
31	9 525	9 527	10,10	110,1	0,00	90,58	-	-	0,00	0,00	-
4	9 049	9 050	3,47	105,0	0,00	90,13	-	-	0,00	0,00	-
5	8 655	8 656	4,05	105,0	0,00	89,75	-	-	0,00	0,00	-
6	9 742	9 744	2,52	105,0	0,00	90,77	-	-	0,00	0,00	-
7	9 268	9 269	3,16	105,0	0,00	90,34	-	-	0,00	0,00	-
8	9 805	9 806	2,43	105,0	0,00	90,83	-	-	0,00	0,00	-
9	9 514	9 516	2,83	105,0	0,00	90,57	-	-	0,00	0,00	-
T10	3 182	3 189	24,41	110,1	0,00	81,07	-	-	0,00	0,00	-
T11	3 652	3 658	22,62	110,1	0,00	82,26	-	-	0,00	0,00	-
T12	4 232	4 238	20,67	110,1	0,00	83,54	-	-	0,00	0,00	-
T13	3 850	3 856	21,93	110,1	0,00	82,72	-	-	0,00	0,00	-
T14	2 478	2 487	27,56	110,1	0,00	78,91	-	-	0,00	0,00	-
T15	1 742	1 755	31,77	110,1	0,00	75,88	-	-	0,00	0,00	-
T16	1 517	1 532	33,35	110,1	0,00	74,70	-	-	0,00	0,00	-
T17	2 624	2 633	26,85	110,1	0,00	79,41	-	-	0,00	0,00	-
T18	3 289	3 295	23,99	110,1	0,00	81,36	-	-	0,00	0,00	-
T6	3 091	3 099	24,78	110,1	0,00	80,82	-	-	0,00	0,00	-
T8	4 242	4 247	20,64	110,1	0,00	83,56	-	-	0,00	0,00	-
T9	2 216	2 226	28,92	110,1	0,00	77,95	-	-	0,00	0,00	-
Sum			38,47								

- Data undefined due to calculation with octave data

Noise sensitive area: C C - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 185	5 187	10,65	105,0	0,00	85,30	-	-	0,00	0,00	-
10	3 927	3 930	14,14	106,0	0,00	82,89	-	-	0,00	0,00	-
11	4 869	4 872	11,24	106,0	0,00	84,75	-	-	0,00	0,00	-
12	4 610	4 612	11,93	106,0	0,00	84,28	-	-	0,00	0,00	-
13	4 236	4 239	13,06	106,0	0,00	83,55	-	-	0,00	0,00	-
14	5 957	5 959	8,69	106,0	0,00	86,50	-	-	0,00	0,00	-
15	5 913	5 916	8,78	106,0	0,00	86,44	-	-	0,00	0,00	-
16	5 362	5 365	10,03	106,0	0,00	85,59	-	-	0,00	0,00	-
17	4 597	4 600	11,97	106,0	0,00	84,26	-	-	0,00	0,00	-
18	6 784	6 785	7,01	106,0	0,00	87,63	-	-	0,00	0,00	-
19	4 110	4 116	13,80	104,3	0,00	83,29	-	-	0,00	0,00	-
2	5 741	5 742	9,35	105,0	0,00	86,18	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
20	4 955	4 960	11,12	104,3	0,00	84,91	-	-	0,00	0,00	-
21	3 521	3 528	15,97	104,3	0,00	81,95	-	-	0,00	0,00	-
22	3 098	3 106	17,73	104,3	0,00	80,85	-	-	0,00	0,00	-
23	4 384	4 390	12,88	104,3	0,00	83,85	-	-	0,00	0,00	-
24	5 519	5 523	9,55	104,3	0,00	85,84	-	-	0,00	0,00	-
25	11 448	11 450	7,75	110,1	0,00	92,18	-	-	0,00	0,00	-
26	14 335	14 336	4,83	110,1	0,00	94,13	-	-	0,00	0,00	-
27	12 453	12 455	6,66	110,1	0,00	92,91	-	-	0,00	0,00	-
28	11 919	11 921	7,23	110,1	0,00	92,53	-	-	0,00	0,00	-
29	13 551	13 552	5,56	110,1	0,00	93,64	-	-	0,00	0,00	-
3	6 036	6 037	8,71	105,0	0,00	86,62	-	-	0,00	0,00	-
30	13 693	13 694	5,43	110,1	0,00	93,73	-	-	0,00	0,00	-
31	12 640	12 642	6,47	110,1	0,00	93,04	-	-	0,00	0,00	-
4	5 439	5 440	10,04	105,0	0,00	85,71	-	-	0,00	0,00	-
5	5 094	5 096	10,88	105,0	0,00	85,14	-	-	0,00	0,00	-
6	6 177	6 178	8,41	105,0	0,00	86,82	-	-	0,00	0,00	-
7	5 740	5 742	9,35	105,0	0,00	86,18	-	-	0,00	0,00	-
8	6 301	6 302	8,16	105,0	0,00	86,99	-	-	0,00	0,00	-
9	6 082	6 083	8,61	105,0	0,00	86,68	-	-	0,00	0,00	-
T10	4 329	4 334	20,37	110,1	0,00	83,74	-	-	0,00	0,00	-
T11	5 222	5 226	17,83	110,1	0,00	85,36	-	-	0,00	0,00	-
T12	6 630	6 633	14,57	110,1	0,00	87,43	-	-	0,00	0,00	-
T13	6 633	6 636	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
T14	5 338	5 341	17,53	110,1	0,00	85,55	-	-	0,00	0,00	-
T15	4 996	5 000	18,44	110,1	0,00	84,98	-	-	0,00	0,00	-
T16	4 068	4 073	21,20	110,1	0,00	83,20	-	-	0,00	0,00	-
T17	4 726	4 731	19,19	110,1	0,00	84,50	-	-	0,00	0,00	-
T18	5 700	5 704	16,63	110,1	0,00	86,12	-	-	0,00	0,00	-
T6	3 306	3 312	23,92	110,1	0,00	81,40	-	-	0,00	0,00	-
T8	6 109	6 113	15,67	110,1	0,00	86,73	-	-	0,00	0,00	-
T9	3 680	3 686	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
Sum			31,68								

- Data undefined due to calculation with octave data

Noise sensitive area: D D - Lomarakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 115	5 117	10,82	105,0	0,00	85,18	-	-	0,00	0,00	-
10	4 688	4 690	11,72	106,0	0,00	84,42	-	-	0,00	0,00	-
11	5 482	5 484	9,75	106,0	0,00	85,78	-	-	0,00	0,00	-
12	5 102	5 104	10,66	106,0	0,00	85,16	-	-	0,00	0,00	-
13	4 824	4 827	11,36	106,0	0,00	84,67	-	-	0,00	0,00	-
14	6 397	6 399	7,77	106,0	0,00	87,12	-	-	0,00	0,00	-
15	6 249	6 251	8,07	106,0	0,00	86,92	-	-	0,00	0,00	-
16	5 689	5 691	9,27	106,0	0,00	86,10	-	-	0,00	0,00	-
17	4 916	4 918	11,12	106,0	0,00	84,84	-	-	0,00	0,00	-
18	7 103	7 105	6,42	106,0	0,00	88,03	-	-	0,00	0,00	-
19	3 739	3 746	15,13	104,3	0,00	82,47	-	-	0,00	0,00	-
2	5 690	5 691	9,47	105,0	0,00	86,10	-	-	0,00	0,00	-
20	4 386	4 392	12,87	104,3	0,00	83,85	-	-	0,00	0,00	-
21	2 966	2 974	18,32	104,3	0,00	80,47	-	-	0,00	0,00	-
22	2 805	2 814	19,06	104,3	0,00	79,99	-	-	0,00	0,00	-
23	4 124	4 130	13,75	104,3	0,00	83,32	-	-	0,00	0,00	-
24	5 124	5 129	10,63	104,3	0,00	85,20	-	-	0,00	0,00	-
25	11 026	11 028	8,23	110,1	0,00	91,85	-	-	0,00	0,00	-
26	13 754	13 756	5,37	110,1	0,00	93,77	-	-	0,00	0,00	-
27	11 904	11 906	7,25	110,1	0,00	92,52	-	-	0,00	0,00	-
28	11 430	11 431	7,77	110,1	0,00	92,16	-	-	0,00	0,00	-
29	12 981	12 983	6,12	110,1	0,00	93,27	-	-	0,00	0,00	-
3	5 899	5 900	9,00	105,0	0,00	86,42	-	-	0,00	0,00	-
30	13 207	13 209	5,90	110,1	0,00	93,42	-	-	0,00	0,00	-
31	12 203	12 205	6,92	110,1	0,00	92,73	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
4	5 274	5 276	10,43	105,0	0,00	85,45	-	-	0,00	0,00	-
5	4 861	4 863	11,47	105,0	0,00	84,74	-	-	0,00	0,00	-
6	5 947	5 948	8,90	105,0	0,00	86,49	-	-	0,00	0,00	-
7	5 466	5 468	9,98	105,0	0,00	85,76	-	-	0,00	0,00	-
8	6 002	6 004	8,78	105,0	0,00	86,57	-	-	0,00	0,00	-
9	5 716	5 718	9,41	105,0	0,00	86,14	-	-	0,00	0,00	-
T10	3 680	3 685	22,52	110,1	0,00	82,33	-	-	0,00	0,00	-
T11	4 582	4 586	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
T12	6 096	6 100	15,70	110,1	0,00	86,71	-	-	0,00	0,00	-
T13	6 202	6 205	15,47	110,1	0,00	86,86	-	-	0,00	0,00	-
T14	5 003	5 007	18,42	110,1	0,00	84,99	-	-	0,00	0,00	-
T15	4 812	4 816	18,95	110,1	0,00	84,65	-	-	0,00	0,00	-
T16	3 797	3 803	22,11	110,1	0,00	82,60	-	-	0,00	0,00	-
T17	4 251	4 256	20,61	110,1	0,00	83,58	-	-	0,00	0,00	-
T18	5 219	5 223	17,84	110,1	0,00	85,36	-	-	0,00	0,00	-
T6	2 595	2 604	26,99	110,1	0,00	79,31	-	-	0,00	0,00	-
T8	5 478	5 482	17,18	110,1	0,00	85,78	-	-	0,00	0,00	-
T9	3 207	3 214	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
Sum			33,22								

- Data undefined due to calculation with octave data

Noise sensitive area: E E - Asuinrakennus

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	4 338	4 340	12,89	105,0	0,00	83,75	-	-	0,00	0,00	-
10	4 965	4 967	11,00	106,0	0,00	84,92	-	-	0,00	0,00	-
11	5 499	5 502	9,71	106,0	0,00	85,81	-	-	0,00	0,00	-
12	4 970	4 972	10,99	106,0	0,00	84,93	-	-	0,00	0,00	-
13	4 835	4 837	11,33	106,0	0,00	84,69	-	-	0,00	0,00	-
14	6 149	6 151	8,28	106,0	0,00	86,78	-	-	0,00	0,00	-
15	5 876	5 878	8,86	106,0	0,00	86,38	-	-	0,00	0,00	-
16	5 324	5 326	10,12	106,0	0,00	85,53	-	-	0,00	0,00	-
17	4 574	4 576	12,03	106,0	0,00	84,21	-	-	0,00	0,00	-
18	6 689	6 691	7,20	106,0	0,00	87,51	-	-	0,00	0,00	-
19	2 744	2 753	19,36	104,3	0,00	79,80	-	-	0,00	0,00	-
2	4 914	4 916	11,33	105,0	0,00	84,83	-	-	0,00	0,00	-
20	3 254	3 262	17,06	104,3	0,00	81,27	-	-	0,00	0,00	-
21	1 863	1 876	24,32	104,3	0,00	76,47	-	-	0,00	0,00	-
22	1 945	1 958	23,79	104,3	0,00	76,84	-	-	0,00	0,00	-
23	3 208	3 215	17,25	104,3	0,00	81,14	-	-	0,00	0,00	-
24	4 078	4 084	13,91	104,3	0,00	83,22	-	-	0,00	0,00	-
25	11 562	11 563	7,62	110,1	0,00	92,26	-	-	0,00	0,00	-
26	14 066	14 067	5,08	110,1	0,00	93,96	-	-	0,00	0,00	-
27	12 272	12 274	6,85	110,1	0,00	92,78	-	-	0,00	0,00	-
28	11 880	11 882	7,27	110,1	0,00	92,50	-	-	0,00	0,00	-
29	13 314	13 315	5,80	110,1	0,00	93,49	-	-	0,00	0,00	-
3	5 039	5 041	11,01	105,0	0,00	85,05	-	-	0,00	0,00	-
30	13 651	13 652	5,47	110,1	0,00	93,70	-	-	0,00	0,00	-
31	12 714	12 715	6,39	110,1	0,00	93,09	-	-	0,00	0,00	-
4	4 405	4 407	12,70	105,0	0,00	83,88	-	-	0,00	0,00	-
5	3 944	3 946	14,06	105,0	0,00	82,92	-	-	0,00	0,00	-
6	5 008	5 010	11,09	105,0	0,00	85,00	-	-	0,00	0,00	-
7	4 501	4 503	12,43	105,0	0,00	84,07	-	-	0,00	0,00	-
8	5 009	5 011	11,09	105,0	0,00	85,00	-	-	0,00	0,00	-
9	4 681	4 683	11,94	105,0	0,00	84,41	-	-	0,00	0,00	-
T10	4 079	4 084	21,16	110,1	0,00	83,22	-	-	0,00	0,00	-
T11	4 946	4 951	18,57	110,1	0,00	84,89	-	-	0,00	0,00	-
T12	6 563	6 566	14,69	110,1	0,00	87,35	-	-	0,00	0,00	-
T13	6 792	6 795	14,28	110,1	0,00	87,64	-	-	0,00	0,00	-
T14	5 724	5 728	16,58	110,1	0,00	86,16	-	-	0,00	0,00	-
T15	5 667	5 671	16,71	110,1	0,00	86,07	-	-	0,00	0,00	-
T16	4 618	4 622	19,50	110,1	0,00	84,30	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
T17	4 851	4 855	18,84	110,1	0,00	84,72	-	-	0,00	0,00	-
T18	5 776	5 779	16,45	110,1	0,00	86,24	-	-	0,00	0,00	-
T6	2 991	2 999	25,20	110,1	0,00	80,54	-	-	0,00	0,00	-
T8	5 824	5 827	16,34	110,1	0,00	86,31	-	-	0,00	0,00	-
T9	3 867	3 873	21,87	110,1	0,00	82,76	-	-	0,00	0,00	-
Sum			33,19								

- Data undefined due to calculation with octave data

Noise sensitive area: F F - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5 554	5 556	9,78	105,0	0,00	85,89	-	-	0,00	0,00	-
10	7 156	7 158	6,32	106,0	0,00	88,10	-	-	0,00	0,00	-
11	7 573	7 574	5,59	106,0	0,00	88,59	-	-	0,00	0,00	-
12	6 958	6 959	6,69	106,0	0,00	87,85	-	-	0,00	0,00	-
13	6 919	6 921	6,76	106,0	0,00	87,80	-	-	0,00	0,00	-
14	7 999	8 000	4,88	106,0	0,00	89,06	-	-	0,00	0,00	-
15	7 603	7 605	5,54	106,0	0,00	88,62	-	-	0,00	0,00	-
16	7 084	7 086	6,45	106,0	0,00	88,01	-	-	0,00	0,00	-
17	6 397	6 399	7,77	106,0	0,00	87,12	-	-	0,00	0,00	-
18	8 335	8 337	4,34	106,0	0,00	89,42	-	-	0,00	0,00	-
19	3 672	3 679	15,39	104,3	0,00	82,31	-	-	0,00	0,00	-
2	6 077	6 078	8,62	105,0	0,00	86,68	-	-	0,00	0,00	-
20	3 356	3 364	16,63	104,3	0,00	81,54	-	-	0,00	0,00	-
21	2 672	2 681	19,71	104,3	0,00	79,57	-	-	0,00	0,00	-
22	3 432	3 440	16,32	104,3	0,00	81,73	-	-	0,00	0,00	-
23	4 263	4 269	13,28	104,3	0,00	83,61	-	-	0,00	0,00	-
24	4 541	4 547	12,38	104,3	0,00	84,15	-	-	0,00	0,00	-
25	10 698	10 700	8,62	110,1	0,00	91,59	-	-	0,00	0,00	-
26	12 743	12 745	6,37	110,1	0,00	93,11	-	-	0,00	0,00	-
27	11 076	11 078	8,17	110,1	0,00	91,89	-	-	0,00	0,00	-
28	10 843	10 844	8,45	110,1	0,00	91,70	-	-	0,00	0,00	-
29	12 037	12 039	7,10	110,1	0,00	92,61	-	-	0,00	0,00	-
3	5 996	5 998	8,79	105,0	0,00	86,56	-	-	0,00	0,00	-
30	12 566	12 568	6,54	110,1	0,00	92,99	-	-	0,00	0,00	-
31	11 773	11 775	7,39	110,1	0,00	92,42	-	-	0,00	0,00	-
4	5 404	5 406	10,12	105,0	0,00	85,66	-	-	0,00	0,00	-
5	4 875	4 876	11,43	105,0	0,00	84,76	-	-	0,00	0,00	-
6	5 748	5 750	9,34	105,0	0,00	86,19	-	-	0,00	0,00	-
7	5 215	5 216	10,58	105,0	0,00	85,35	-	-	0,00	0,00	-
8	5 570	5 571	9,74	105,0	0,00	85,92	-	-	0,00	0,00	-
9	5 110	5 111	10,84	105,0	0,00	85,17	-	-	0,00	0,00	-
T10	3 533	3 539	23,06	110,1	0,00	81,98	-	-	0,00	0,00	-
T11	4 164	4 169	20,89	110,1	0,00	83,40	-	-	0,00	0,00	-
T12	5 793	5 797	16,41	110,1	0,00	86,26	-	-	0,00	0,00	-
T13	6 256	6 259	15,35	110,1	0,00	86,93	-	-	0,00	0,00	-
T14	5 578	5 582	16,93	110,1	0,00	85,94	-	-	0,00	0,00	-
T15	5 849	5 852	16,28	110,1	0,00	86,35	-	-	0,00	0,00	-
T16	4 847	4 851	18,85	110,1	0,00	84,72	-	-	0,00	0,00	-
T17	4 557	4 562	19,68	110,1	0,00	84,18	-	-	0,00	0,00	-
T18	5 268	5 272	17,71	110,1	0,00	85,44	-	-	0,00	0,00	-
T6	2 792	2 800	26,07	110,1	0,00	79,94	-	-	0,00	0,00	-
T8	4 890	4 894	18,73	110,1	0,00	84,79	-	-	0,00	0,00	-
T9	3 894	3 899	21,78	110,1	0,00	82,82	-	-	0,00	0,00	-
Sum			32,50								

- Data undefined due to calculation with octave data

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

Noise sensitive area: G G - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	9 073	9 074	3,44	105,0	0,00	90,16	-	-	0,00	0,00	-
10	10 440	10 441	1,40	106,0	0,00	91,38	-	-	0,00	0,00	-
11	11 016	11 017	0,70	106,0	0,00	91,84	-	-	0,00	0,00	-
12	10 452	10 453	1,39	106,0	0,00	91,38	-	-	0,00	0,00	-
13	10 353	10 354	1,51	106,0	0,00	91,30	-	-	0,00	0,00	-
14	11 541	11 542	0,09	106,0	0,00	92,25	-	-	0,00	0,00	-
15	11 161	11 162	0,53	106,0	0,00	91,95	-	-	0,00	0,00	-
16	10 638	10 639	1,16	106,0	0,00	91,54	-	-	0,00	0,00	-
17	9 939	9 940	2,04	106,0	0,00	90,95	-	-	0,00	0,00	-
18	11 894	11 895	-0,30	106,0	0,00	92,51	-	-	0,00	0,00	-
19	7 187	7 191	5,81	104,3	0,00	88,14	-	-	0,00	0,00	-
2	9 574	9 575	2,74	105,0	0,00	90,62	-	-	0,00	0,00	-
20	6 642	6 646	6,83	104,3	0,00	87,45	-	-	0,00	0,00	-
21	6 216	6 220	7,81	104,3	0,00	86,88	-	-	0,00	0,00	-
22	6 988	6 992	6,17	104,3	0,00	87,89	-	-	0,00	0,00	-
23	7 780	7 784	4,79	104,3	0,00	88,82	-	-	0,00	0,00	-
24	7 860	7 864	4,65	104,3	0,00	88,91	-	-	0,00	0,00	-
25	8 140	8 143	12,07	110,1	0,00	89,22	-	-	0,00	0,00	-
26	9 531	9 533	10,09	110,1	0,00	90,59	-	-	0,00	0,00	-
27	8 053	8 055	12,20	110,1	0,00	89,12	-	-	0,00	0,00	-
28	8 035	8 037	12,23	110,1	0,00	89,10	-	-	0,00	0,00	-
29	8 890	8 893	10,97	110,1	0,00	89,98	-	-	0,00	0,00	-
3	9 434	9 435	2,93	105,0	0,00	90,50	-	-	0,00	0,00	-
30	9 632	9 634	9,97	110,1	0,00	90,68	-	-	0,00	0,00	-
31	9 053	9 055	10,74	110,1	0,00	90,14	-	-	0,00	0,00	-
4	8 873	8 874	3,73	105,0	0,00	89,96	-	-	0,00	0,00	-
5	8 343	8 344	4,52	105,0	0,00	89,43	-	-	0,00	0,00	-
6	9 113	9 114	3,38	105,0	0,00	90,19	-	-	0,00	0,00	-
7	8 595	8 596	4,14	105,0	0,00	89,69	-	-	0,00	0,00	-
8	8 864	8 865	3,74	105,0	0,00	89,95	-	-	0,00	0,00	-
9	8 369	8 370	4,48	105,0	0,00	89,45	-	-	0,00	0,00	-
T10	3 400	3 406	23,56	110,1	0,00	81,65	-	-	0,00	0,00	-
T11	3 168	3 175	24,47	110,1	0,00	81,03	-	-	0,00	0,00	-
T12	4 082	4 088	21,15	110,1	0,00	83,23	-	-	0,00	0,00	-
T13	4 827	4 832	18,90	110,1	0,00	84,68	-	-	0,00	0,00	-
T14	5 018	5 022	18,38	110,1	0,00	85,02	-	-	0,00	0,00	-
T15	5 720	5 724	16,60	110,1	0,00	86,15	-	-	0,00	0,00	-
T16	5 145	5 149	18,04	110,1	0,00	85,23	-	-	0,00	0,00	-
T17	4 184	4 189	20,83	110,1	0,00	83,44	-	-	0,00	0,00	-
T18	4 213	4 217	20,76	110,1	0,00	83,50	-	-	0,00	0,00	-
T6	3 793	3 799	22,13	110,1	0,00	82,59	-	-	0,00	0,00	-
T8	3 208	3 215	24,31	110,1	0,00	81,14	-	-	0,00	0,00	-
T9	4 374	4 379	20,23	110,1	0,00	83,83	-	-	0,00	0,00	-
Sum			32,61								

- Data undefined due to calculation with octave data

Noise sensitive area: H H- Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	11 341	11 342	0,56	105,0	0,00	92,09	-	-	0,00	0,00	-
10	11 517	11 518	0,12	106,0	0,00	92,23	-	-	0,00	0,00	-
11	12 399	12 400	-0,85	106,0	0,00	92,87	-	-	0,00	0,00	-
12	12 008	12 009	-0,43	106,0	0,00	92,59	-	-	0,00	0,00	-
13	11 743	11 744	-0,14	106,0	0,00	92,40	-	-	0,00	0,00	-
14	13 266	13 267	-1,73	106,0	0,00	93,46	-	-	0,00	0,00	-
15	13 035	13 036	-1,50	106,0	0,00	93,30	-	-	0,00	0,00	-
16	12 479	12 480	-0,93	106,0	0,00	92,92	-	-	0,00	0,00	-
17	11 720	11 721	-0,11	106,0	0,00	92,38	-	-	0,00	0,00	-
18	13 853	13 854	-2,29	106,0	0,00	93,83	-	-	0,00	0,00	-
19	9 508	9 511	2,16	104,3	0,00	90,56	-	-	0,00	0,00	-
2	11 895	11 896	-0,05	105,0	0,00	92,51	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
20	9 288	9 291	2,47	104,3	0,00	90,36	-	-	0,00	0,00	-
21	8 478	8 481	3,66	104,3	0,00	89,57	-	-	0,00	0,00	-
22	9 010	9 013	2,86	104,3	0,00	90,10	-	-	0,00	0,00	-
23	10 081	10 084	1,39	104,3	0,00	91,07	-	-	0,00	0,00	-
24	10 475	10 477	0,88	104,3	0,00	91,41	-	-	0,00	0,00	-
25	4 879	4 883	18,76	110,1	0,00	84,77	-	-	0,00	0,00	-
26	6 905	6 908	14,08	110,1	0,00	87,79	-	-	0,00	0,00	-
27	5 157	5 161	18,01	110,1	0,00	85,25	-	-	0,00	0,00	-
28	4 919	4 923	18,65	110,1	0,00	84,84	-	-	0,00	0,00	-
29	6 162	6 165	15,56	110,1	0,00	86,80	-	-	0,00	0,00	-
3	11 880	11 881	-0,03	105,0	0,00	92,50	-	-	0,00	0,00	-
30	6 632	6 635	14,56	110,1	0,00	87,44	-	-	0,00	0,00	-
31	5 881	5 884	16,20	110,1	0,00	86,39	-	-	0,00	0,00	-
4	11 268	11 269	0,65	105,0	0,00	92,04	-	-	0,00	0,00	-
5	10 747	10 748	1,25	105,0	0,00	91,63	-	-	0,00	0,00	-
6	11 670	11 671	0,19	105,0	0,00	92,34	-	-	0,00	0,00	-
7	11 135	11 136	0,80	105,0	0,00	91,93	-	-	0,00	0,00	-
8	11 504	11 504	0,38	105,0	0,00	92,22	-	-	0,00	0,00	-
9	11 043	11 044	0,90	105,0	0,00	91,86	-	-	0,00	0,00	-
T10	3 262	3 269	24,09	110,1	0,00	81,29	-	-	0,00	0,00	-
T11	2 371	2 381	28,10	110,1	0,00	78,53	-	-	0,00	0,00	-
T12	1 520	1 534	33,33	110,1	0,00	74,72	-	-	0,00	0,00	-
T13	2 226	2 236	28,87	110,1	0,00	77,99	-	-	0,00	0,00	-
T14	3 257	3 264	24,11	110,1	0,00	81,27	-	-	0,00	0,00	-
T15	4 103	4 108	21,09	110,1	0,00	83,27	-	-	0,00	0,00	-
T16	4 189	4 194	20,81	110,1	0,00	83,45	-	-	0,00	0,00	-
T17	3 119	3 126	24,67	110,1	0,00	80,90	-	-	0,00	0,00	-
T18	2 365	2 374	28,13	110,1	0,00	78,51	-	-	0,00	0,00	-
T6	4 325	4 330	20,38	110,1	0,00	83,73	-	-	0,00	0,00	-
T8	1 507	1 522	33,42	110,1	0,00	74,65	-	-	0,00	0,00	-
T9	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
Sum			39,08								

- Data undefined due to calculation with octave data

Noise sensitive area: I I - Asuinrakennus

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	12 769	12 770	-0,96	105,0	0,00	93,12	-	-	0,00	0,00	-
10	11 790	11 791	-0,19	106,0	0,00	92,43	-	-	0,00	0,00	-
11	12 902	12 903	-1,37	106,0	0,00	93,21	-	-	0,00	0,00	-
12	12 702	12 704	-1,16	106,0	0,00	93,08	-	-	0,00	0,00	-
13	12 297	12 298	-0,74	106,0	0,00	92,80	-	-	0,00	0,00	-
14	14 052	14 053	-2,48	106,0	0,00	93,96	-	-	0,00	0,00	-
15	13 980	13 981	-2,41	106,0	0,00	93,91	-	-	0,00	0,00	-
16	13 423	13 424	-1,88	106,0	0,00	93,56	-	-	0,00	0,00	-
17	12 650	12 651	-1,11	106,0	0,00	93,04	-	-	0,00	0,00	-
18	14 844	14 845	-3,20	106,0	0,00	94,43	-	-	0,00	0,00	-
19	11 106	11 109	0,10	104,3	0,00	91,91	-	-	0,00	0,00	-
2	13 346	13 346	-1,52	105,0	0,00	93,51	-	-	0,00	0,00	-
20	11 209	11 211	-0,02	104,3	0,00	91,99	-	-	0,00	0,00	-
21	10 109	10 112	1,35	104,3	0,00	91,10	-	-	0,00	0,00	-
22	10 377	10 380	1,00	104,3	0,00	91,32	-	-	0,00	0,00	-
23	11 619	11 621	-0,49	104,3	0,00	92,30	-	-	0,00	0,00	-
24	12 296	12 299	-1,24	104,3	0,00	92,80	-	-	0,00	0,00	-
25	3 447	3 453	23,38	110,1	0,00	81,76	-	-	0,00	0,00	-
26	6 849	6 852	14,18	110,1	0,00	87,72	-	-	0,00	0,00	-
27	4 920	4 925	18,64	110,1	0,00	84,85	-	-	0,00	0,00	-
28	4 128	4 134	21,00	110,1	0,00	83,33	-	-	0,00	0,00	-
29	6 051	6 054	15,81	110,1	0,00	86,64	-	-	0,00	0,00	-
3	13 459	13 459	-1,63	105,0	0,00	93,58	-	-	0,00	0,00	-
30	5 814	5 817	16,36	110,1	0,00	86,29	-	-	0,00	0,00	-
31	4 647	4 652	19,42	110,1	0,00	84,35	-	-	0,00	0,00	-

To be continued on next page...

DECIBEL - Detailed results

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
4	12 825	12 826	-1,01	105,0	0,00	93,16	-	-	0,00	0,00	-
5	12 344	12 344	-0,52	105,0	0,00	92,83	-	-	0,00	0,00	-
6	13 373	13 374	-1,55	105,0	0,00	93,53	-	-	0,00	0,00	-
7	12 847	12 847	-1,03	105,0	0,00	93,18	-	-	0,00	0,00	-
8	13 302	13 303	-1,48	105,0	0,00	93,48	-	-	0,00	0,00	-
9	12 898	12 899	-1,09	105,0	0,00	93,21	-	-	0,00	0,00	-
T10	4 482	4 488	19,90	110,1	0,00	84,04	-	-	0,00	0,00	-
T11	3 808	3 814	22,07	110,1	0,00	82,63	-	-	0,00	0,00	-
T12	2 278	2 288	28,58	110,1	0,00	78,19	-	-	0,00	0,00	-
T13	1 709	1 722	31,99	110,1	0,00	75,72	-	-	0,00	0,00	-
T14	2 766	2 775	26,19	110,1	0,00	79,86	-	-	0,00	0,00	-
T15	3 187	3 194	24,39	110,1	0,00	81,09	-	-	0,00	0,00	-
T16	4 027	4 033	21,33	110,1	0,00	83,11	-	-	0,00	0,00	-
T17	3 584	3 591	22,87	110,1	0,00	82,10	-	-	0,00	0,00	-
T18	2 715	2 723	26,42	110,1	0,00	79,70	-	-	0,00	0,00	-
T6	5 482	5 486	17,17	110,1	0,00	85,79	-	-	0,00	0,00	-
T8	3 229	3 237	24,22	110,1	0,00	81,20	-	-	0,00	0,00	-
T9	4 579	4 585	19,61	110,1	0,00	84,23	-	-	0,00	0,00	-
Sum			37,04								

- Data undefined due to calculation with octave data

Project:
Haukkasalo_06052022

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Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
17.2.2023 13.48/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Haukkasalo_06052022_4.w2r (5)

Area type with hard ground: järvet

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Fixed penalty added to source noise of WTGs with pure tones

WTG catalogue

Height above ground level, when no value in NSA object:

4,0 m; Don't allow override of model height with height from NSA object

Uncertainty margin:

0,0 dB; Uncertainty margin in NSA has priority

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0,0 dB(A)

Octave data required

Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N117/2400 2400 116.8 !O!

Noise: Level 0 - 105.0dB(A) Kirkkokallio

Source Source/Date Creator Edited
NORDEX 16.4.2014 USER 19.10.2021 13.38
F008_146_A07_EN
Revision 00
2014-04-16

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63	125	250	500	1000	2000	4000	8000
From Windcat	120,0	8,0	105,0	No	85,3	90,9	96,1	98,1	99,5	98,9	95,1	83,5

WTG: NORDEX N131/3000 3000 131.0 !O!

Noise: Level - 106 dB(A) - R00

Source Source/Date Creator Edited
NORDEX 11.3.2014 USER 3.2.2022 20.04
F008_246_A07_EN
Revision 01
2014-03-11

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63	125	250	500	1000	2000	4000	8000
From Windcat	144,0	8,0	106,0	No	84,4	91,5	96,3	97,9	100,8	99,7	97,3	87,2

Project:
Haukkasalo_06052022

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Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
17.2.2023 13.48/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

WTG: VESTAS V162-6.0 HH219 6000 162.0 IO!

Noise: V162 - 6.0 MW Mode 0 STE - 10-2020

Source	Source/Date	Creator	Edited
Vestas	26.10.2019	USER	4.8.2022 13.03

DMS no.: 0095-3732_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	219,0	8,0	104,3	No	83,7	91,7	96,7	99,2	98,8	95,6	89,7	80,9

WTG: VESTAS V172-7.2 7200 172.0 IO!

Noise: V172 - 7,2 MW PO7200 No STE PO7200-0S

Source	Source/Date	Creator	Edited
Vestas	15.11.2022	USER	13.2.2023 10.23

DMS no.: 0128-4336_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	214,0	8,0	110,1	No	91,5	100,2	104,1	105,0	103,7	99,3	91,6	80,8

Noise sensitive area: A A - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: B B - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: C C - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: D D - Lomarakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: E E - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: F F - Asuinrakennus

Predefined calculation standard:

Immission height(a.g.l.): Use standard value from calculation model

Uncertainty margin: Use default value from calculation model

Project:
Haukkasalo_06052022

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Miikka Saranpää / miikka.saranpaa@fcg.fi
Calculated:
17.2.2023 13.48/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: G G - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: H H- Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

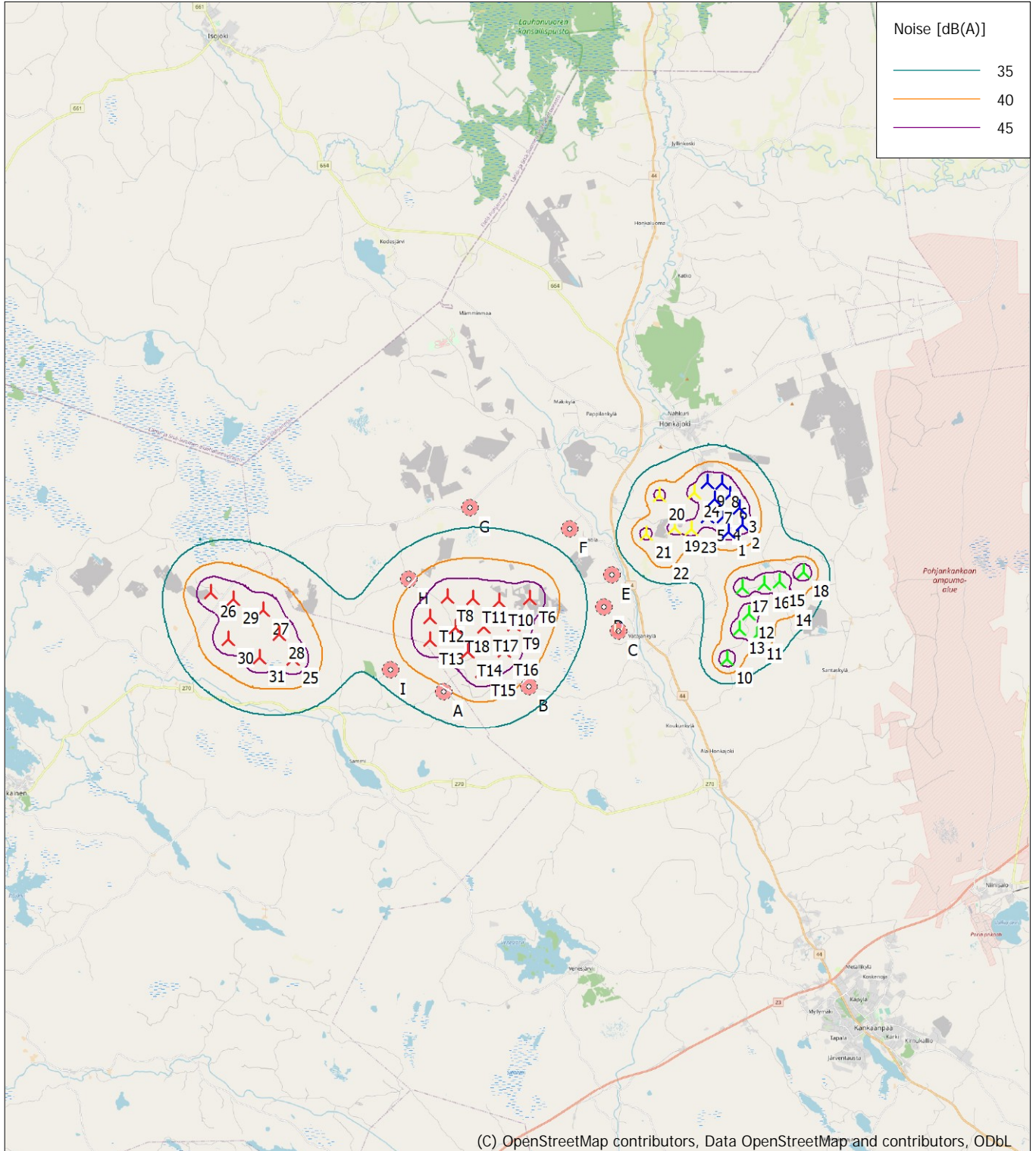
Noise sensitive area: I I - Asuinrakennus

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

DECIBEL - Map 8,0 m/s

Calculation: Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutus

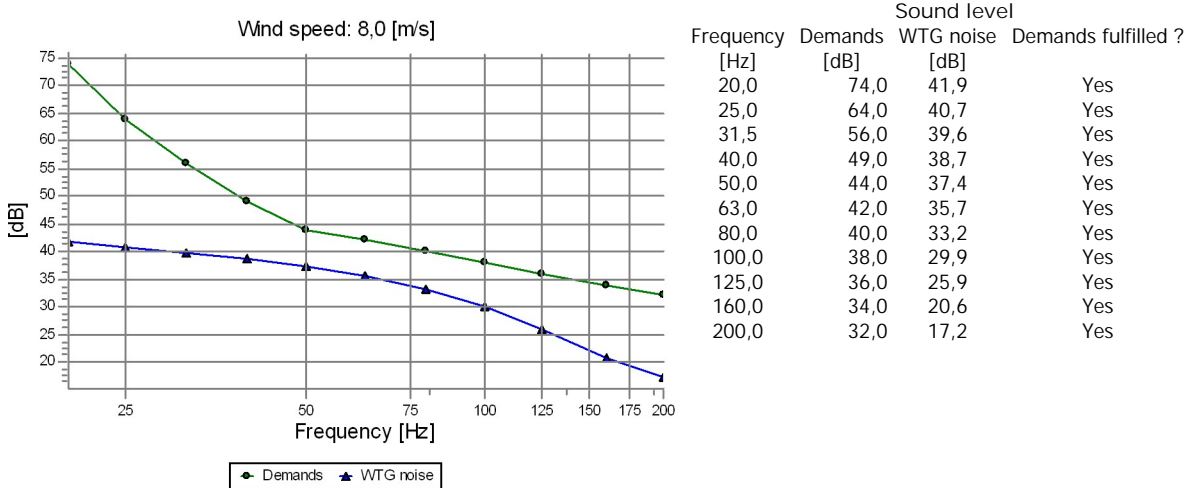


Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 767 North: 6 877 207
 New WTG Noise sensitive area
 Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s
 Height above sea level from active line object

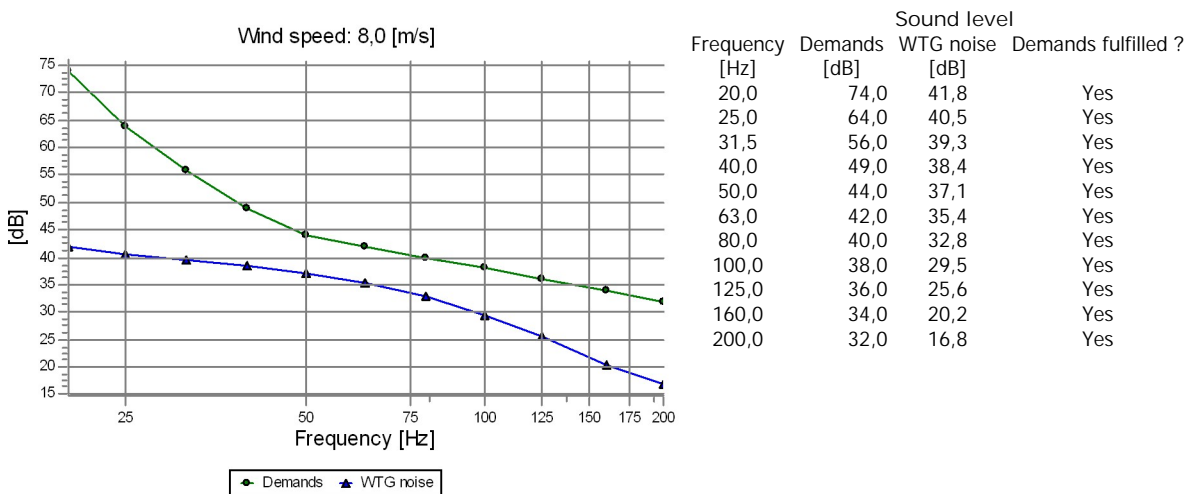
Liite 11. Matalataajuisen melun yhteisvaikutuksen rakennuskohtaiset arvot – VE1

DECIBEL - Detailed results, graphic

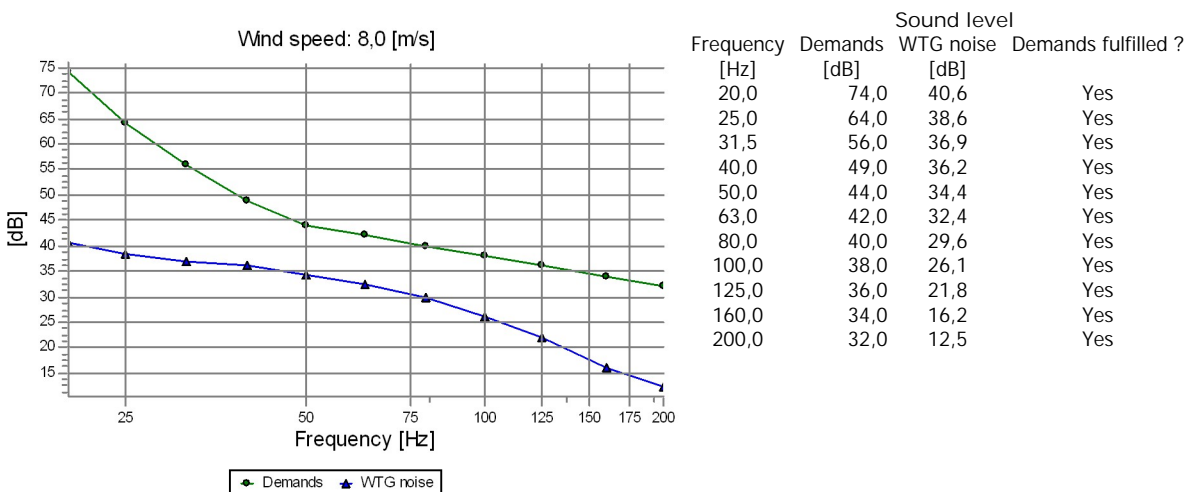
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: Finland Low frequency
A A - Asuinrakennus



B B - Asuinrakennus

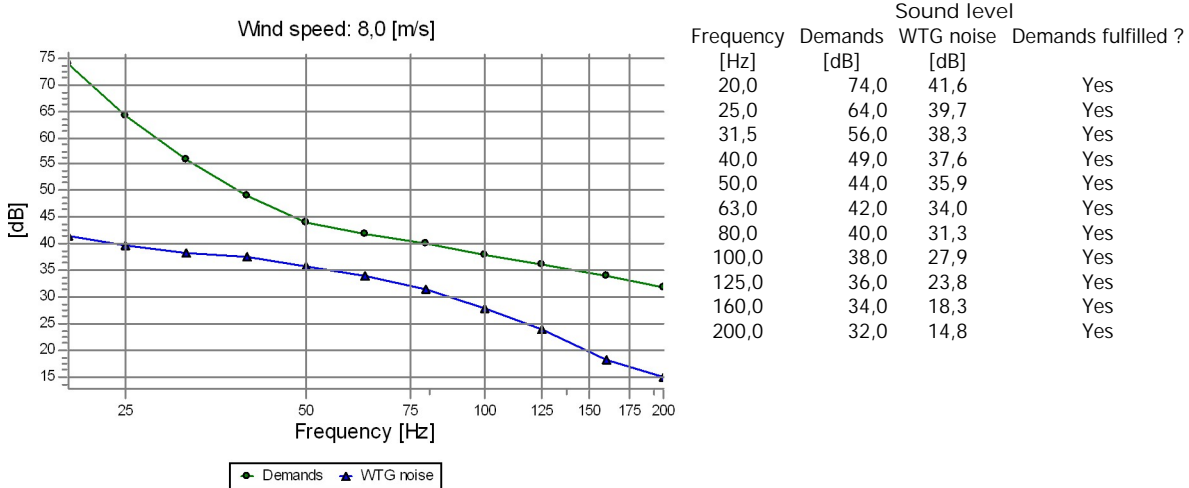


C C - Asuinrakennus

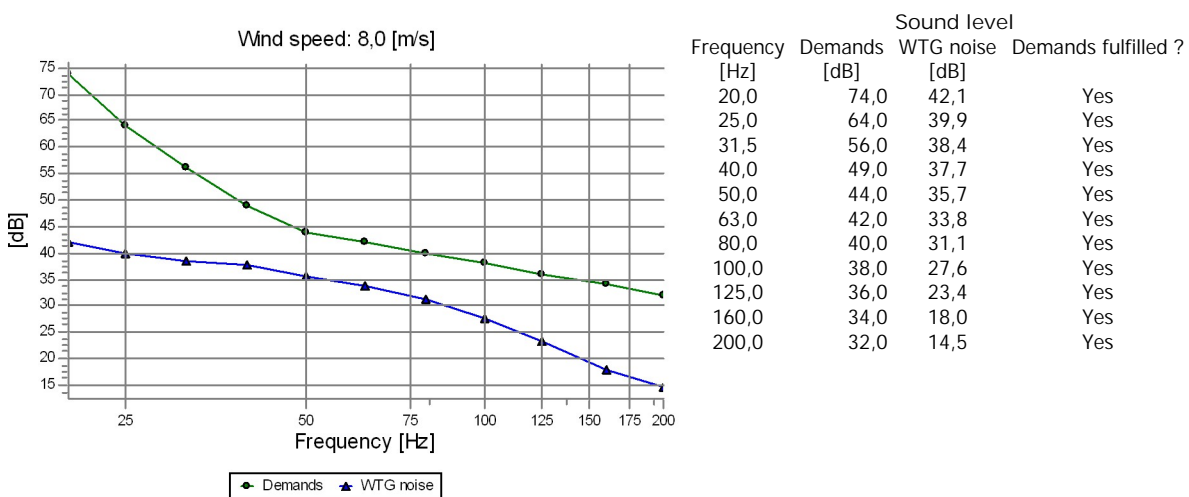


DECIBEL - Detailed results, graphic

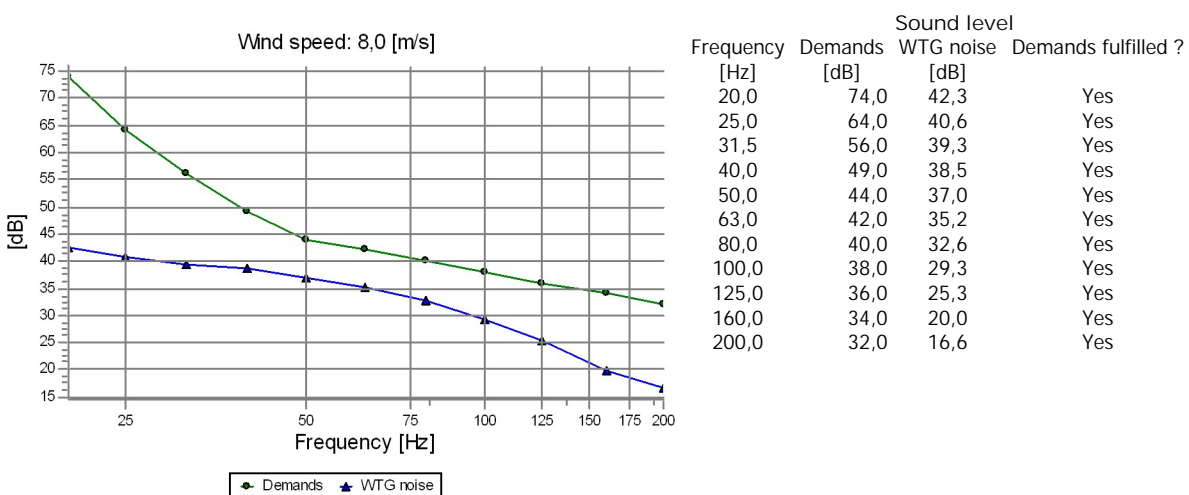
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: Finland Low frequency
D D - Lomarakennus



E E - Asuinrakennus

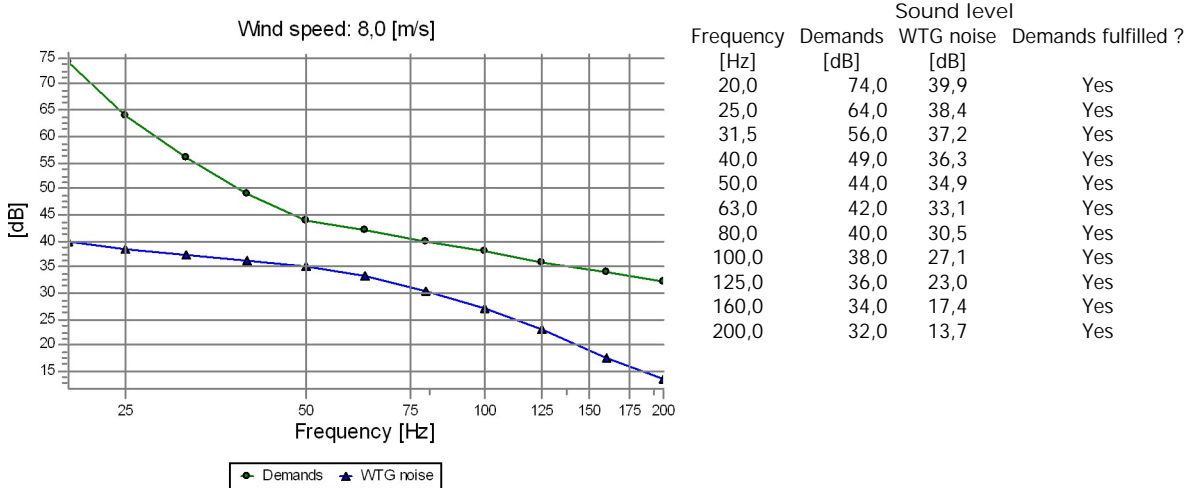


F F - Asuinrakennus

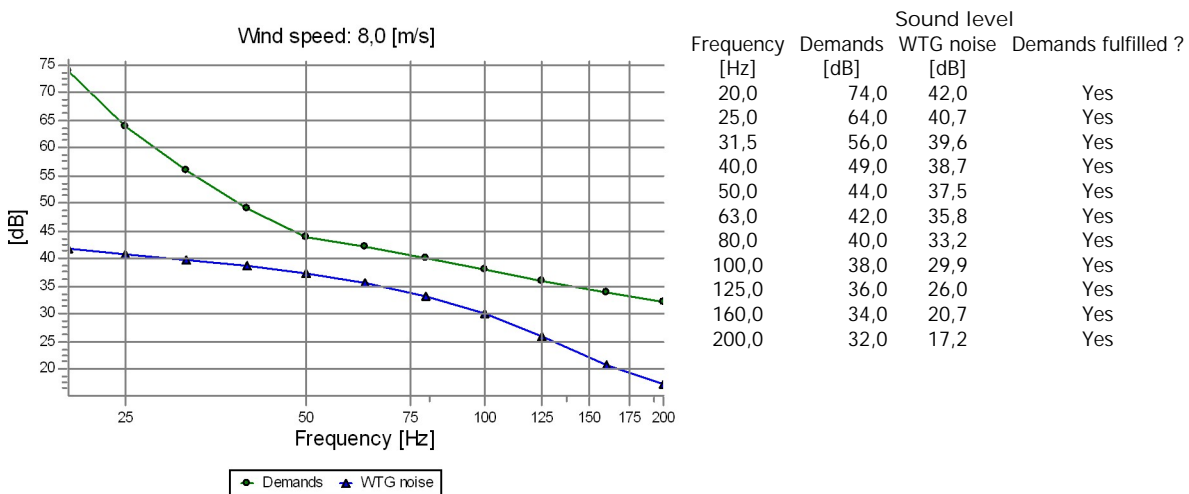


DECIBEL - Detailed results, graphic

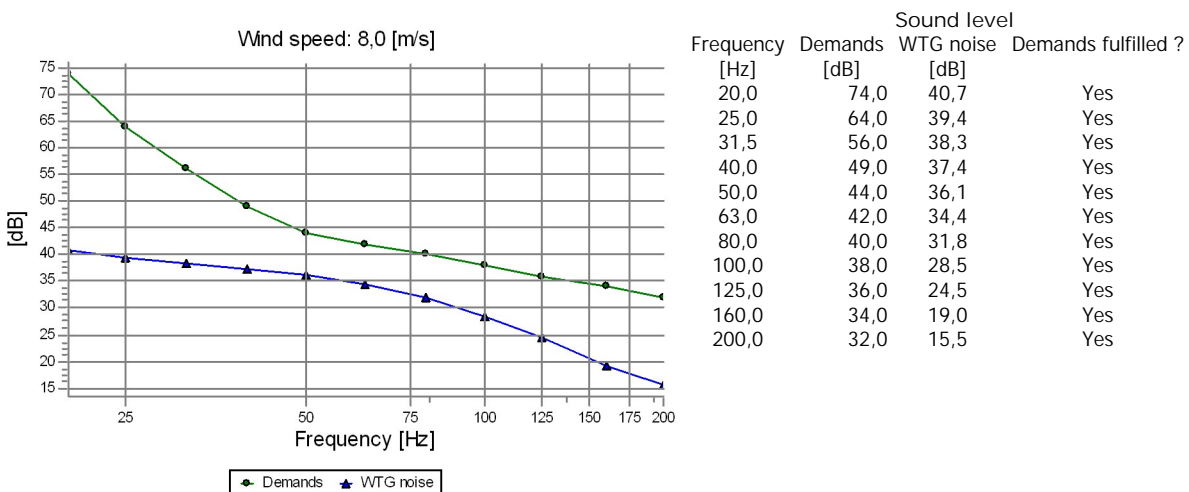
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE1_yhteisvaikutusNoise calculation model: Finland Low frequency
G G - Asuinrakennus



H H- Asuinrakennus



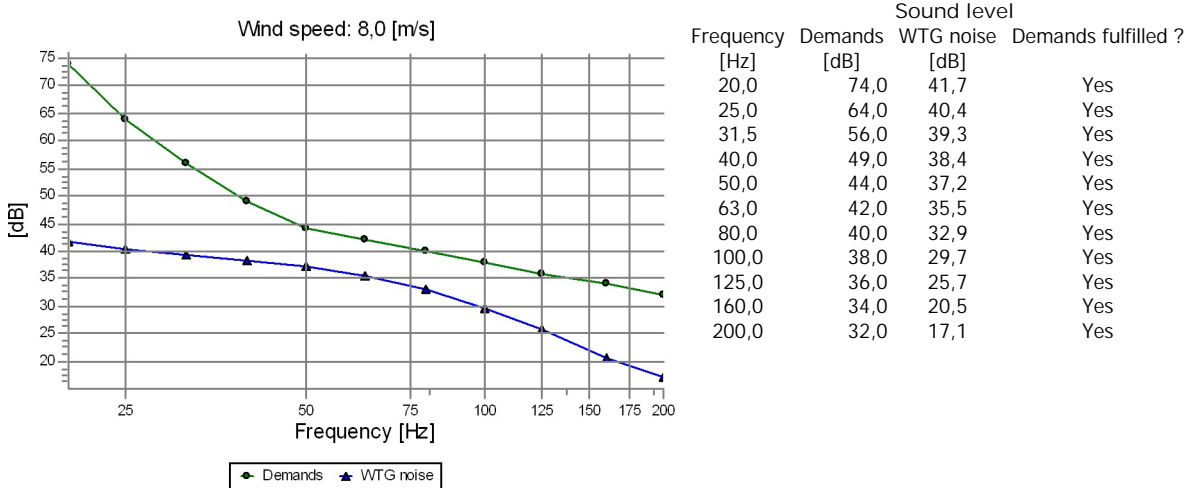
I I - Asuinrakennus



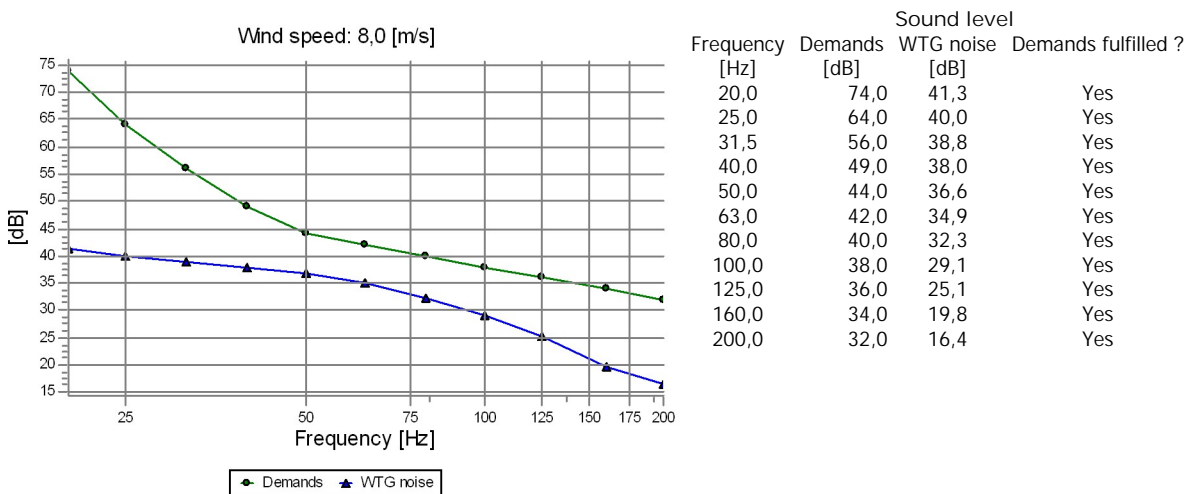
Liite 12. Matalataajuisen melun yhteisvaikutuksen rakennuskohtaiset arvot - VE2

DECIBEL - Detailed results, graphic

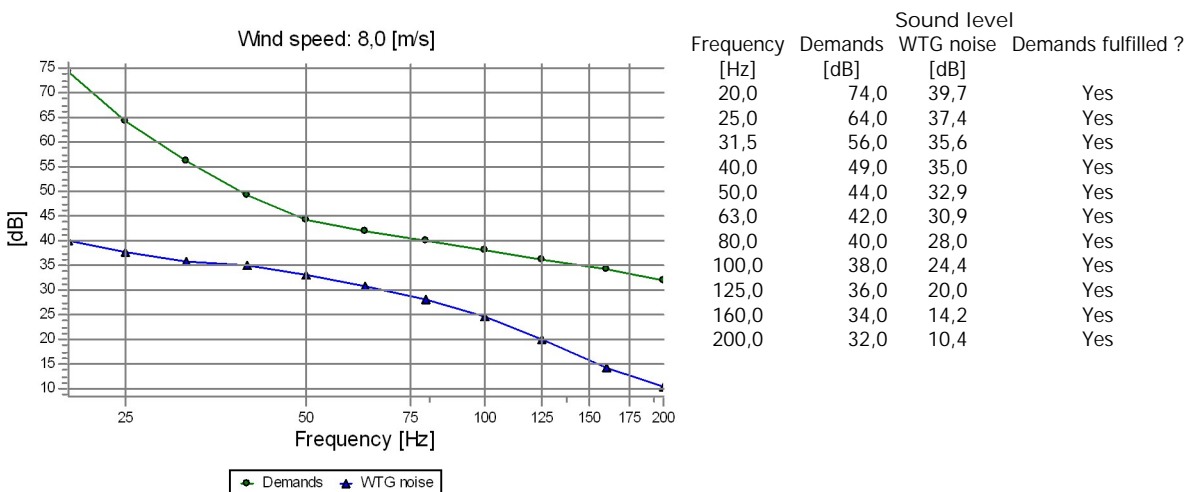
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: Finland Low frequency
A A - Asuinrakennus



B B - Asuinrakennus

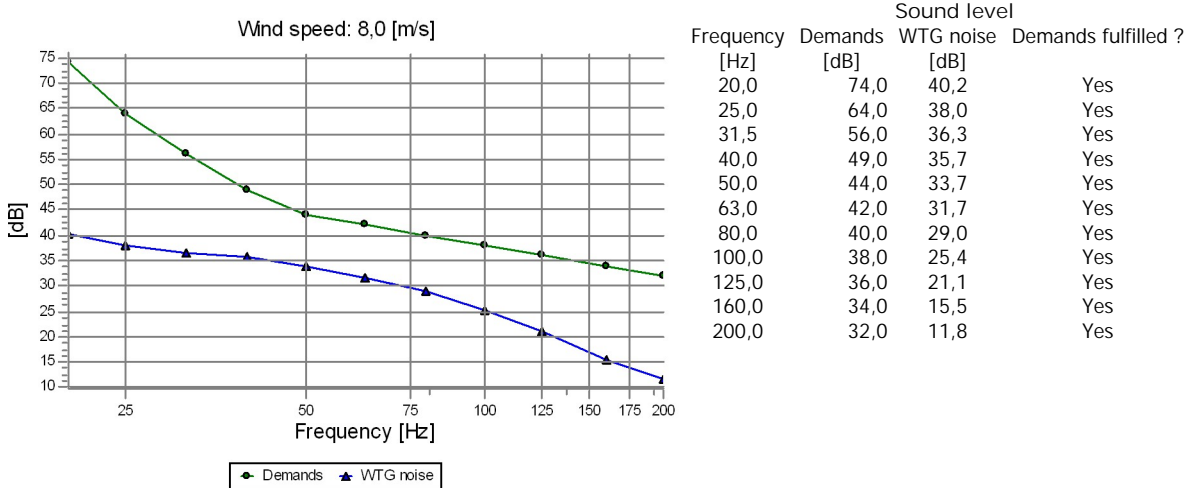


C C - Asuinrakennus

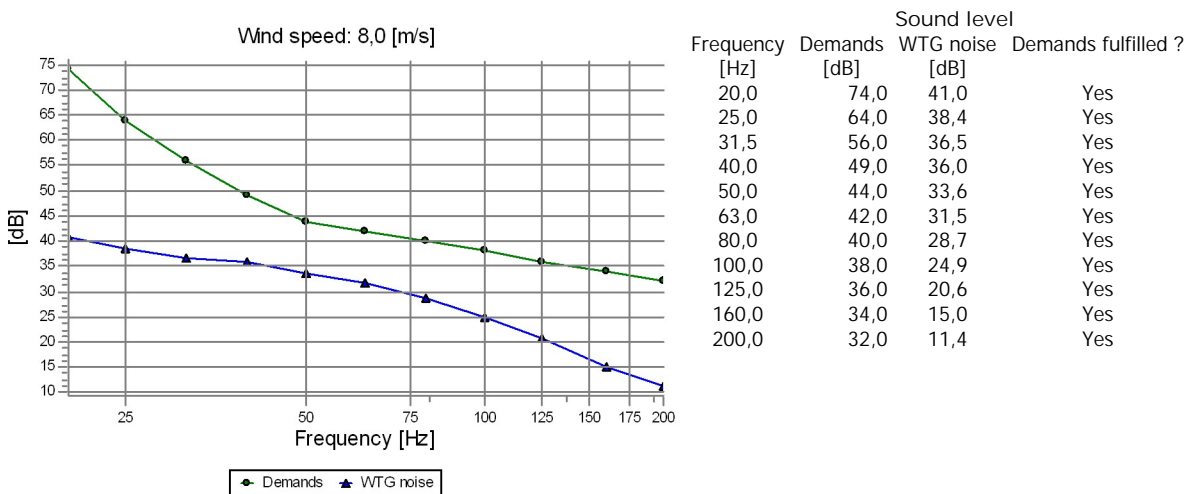


DECIBEL - Detailed results, graphic

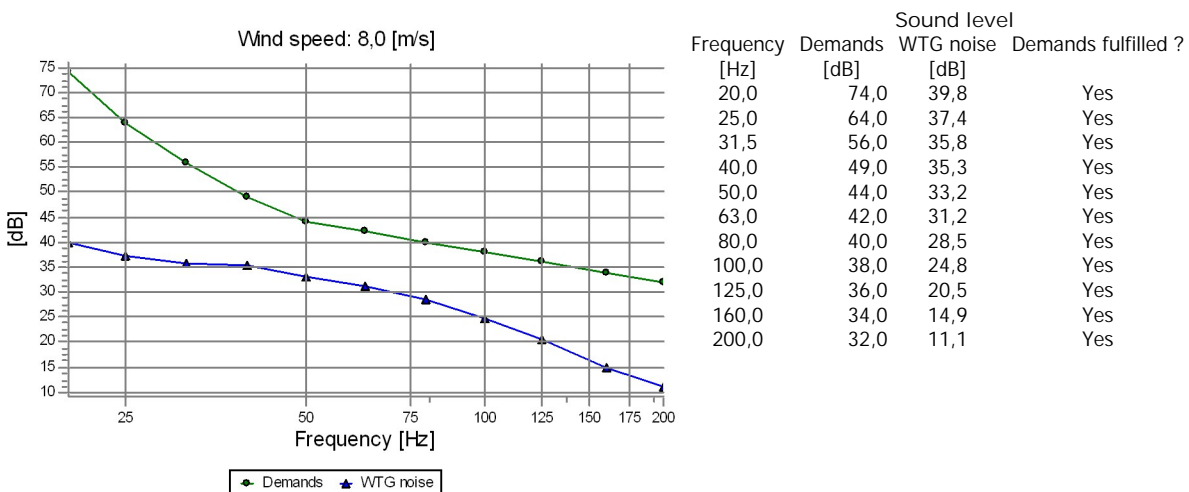
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: Finland Low frequency
D D - Lomarakennus



E E - Asuinrakennus

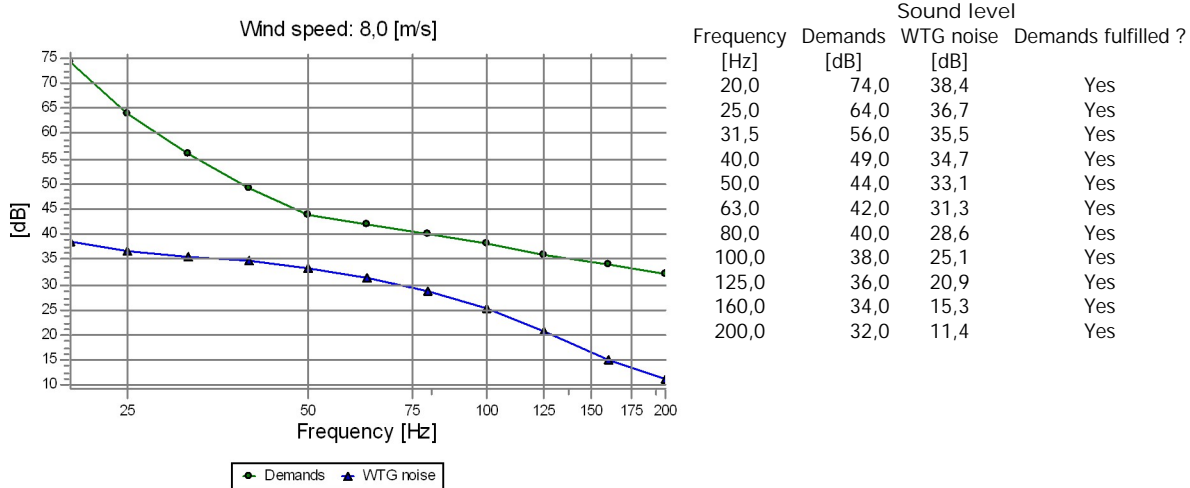


F F - Asuinrakennus

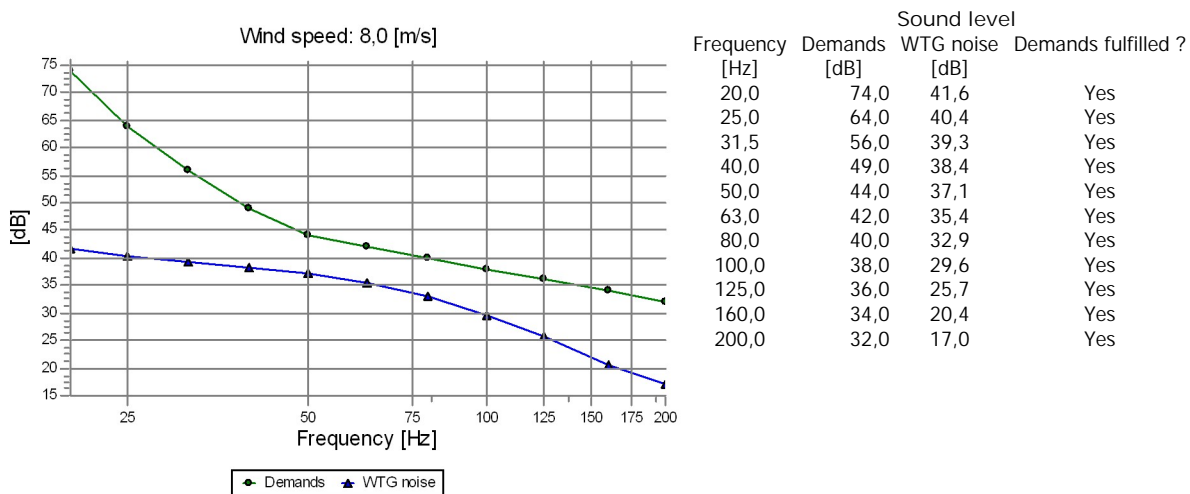


DECIBEL - Detailed results, graphic

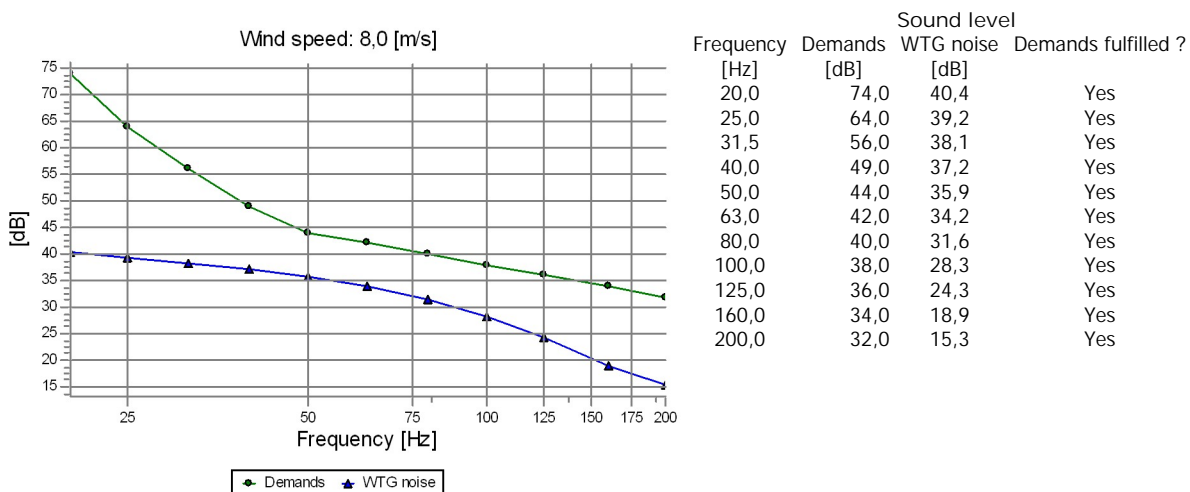
Calculation: Matalataajuinen_Haukkasalo_V172_7.2MW_No_STE_RD172xHH214_VE2_yhteisvaikutusNoise calculation model: Finland Low frequency
G G - Asuinrakennus



H H- Asuinrakennus



I I - Asuinrakennus



Liite 13. Yhteisvaikutus varjostusmallinnuksen tulokset "Real Case, No Forest" - VE1

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
599	491	437	472	590	751	965	1 129	879	730	633	576	8 252

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

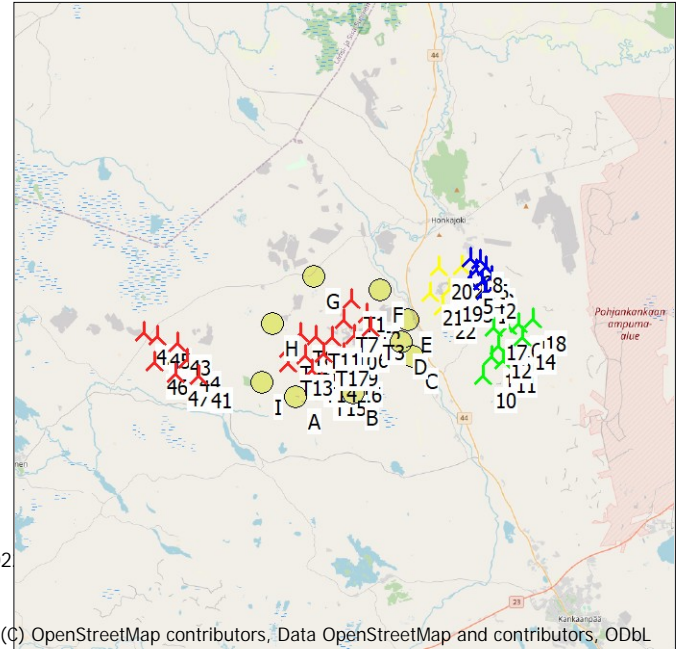
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Haukkasalo_0605202
Obstacles used in calculation
Receptor grid resolution: 1,0 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	253 616	6 878 546	105,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
10	253 256	6 874 085	105,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
11	254 378	6 874 820	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
12	254 139	6 875 605	109,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
13	253 765	6 875 081	106,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
14	255 464	6 875 947	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
15	255 305	6 876 650	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
16	254 745	6 876 621	107,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
17	253 975	6 876 541	107,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
18	256 142	6 876 896	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
19	251 747	6 878 810	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
2	254 154	6 878 757	112,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
20	251 304	6 879 975	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
21	250 727	6 878 659	100,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
22	251 315	6 877 881	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
23	252 334	6 878 721	102,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
24	252 523	6 879 987	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
3	254 073	6 879 328	112,6	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
4	253 487	6 879 084	110,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
41	238 078	6 875 215	80,3	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
42	235 391	6 877 752	80,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
43	237 182	6 877 006	80,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
44	237 630	6 876 111	79,3	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
45	236 137	6 877 454	78,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
46	235 851	6 876 098	77,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
47	236 884	6 875 364	75,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
5	252 957	6 879 121	107,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
6	253 775	6 879 840	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
7	253 252	6 879 721	117,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
8	253 525	6 880 225	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
9	253 026	6 880 328	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
T1	246 582	6 878 619	95,6	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T10	245 421	6 876 704	92,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

To be continued on next page...



SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

...continued from previous page

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
			[m]									
T12	242 968	6 876 299	90,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T13	242 898	6 875 520	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T2	247 257	6 877 777	97,6	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T3	247 430	6 877 022	96,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T7	246 054	6 877 590	94,8	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 691	6 877 054	93,7	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values
		Shadow hours per year [h/year]
A	A - Asuinrakennus	8:59
B	B - Asuinrakennus	5:48
C	C - Asuinrakennus	0:00
D	D - Lomarakennus	7:47
E	E - Asuinrakennus	5:30
F	F - Asuinrakennus	7:10
G	G - Asuinrakennus	0:52
H	H - Asuinrakennus	7:57
I	I - Asuinrakennus	7:46

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

No.	Name	Expected [h/year]
1	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)	0:00
11	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)	0:00
12	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)	0:00
17	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)	0:00
19	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
2	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)	0:00
20	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

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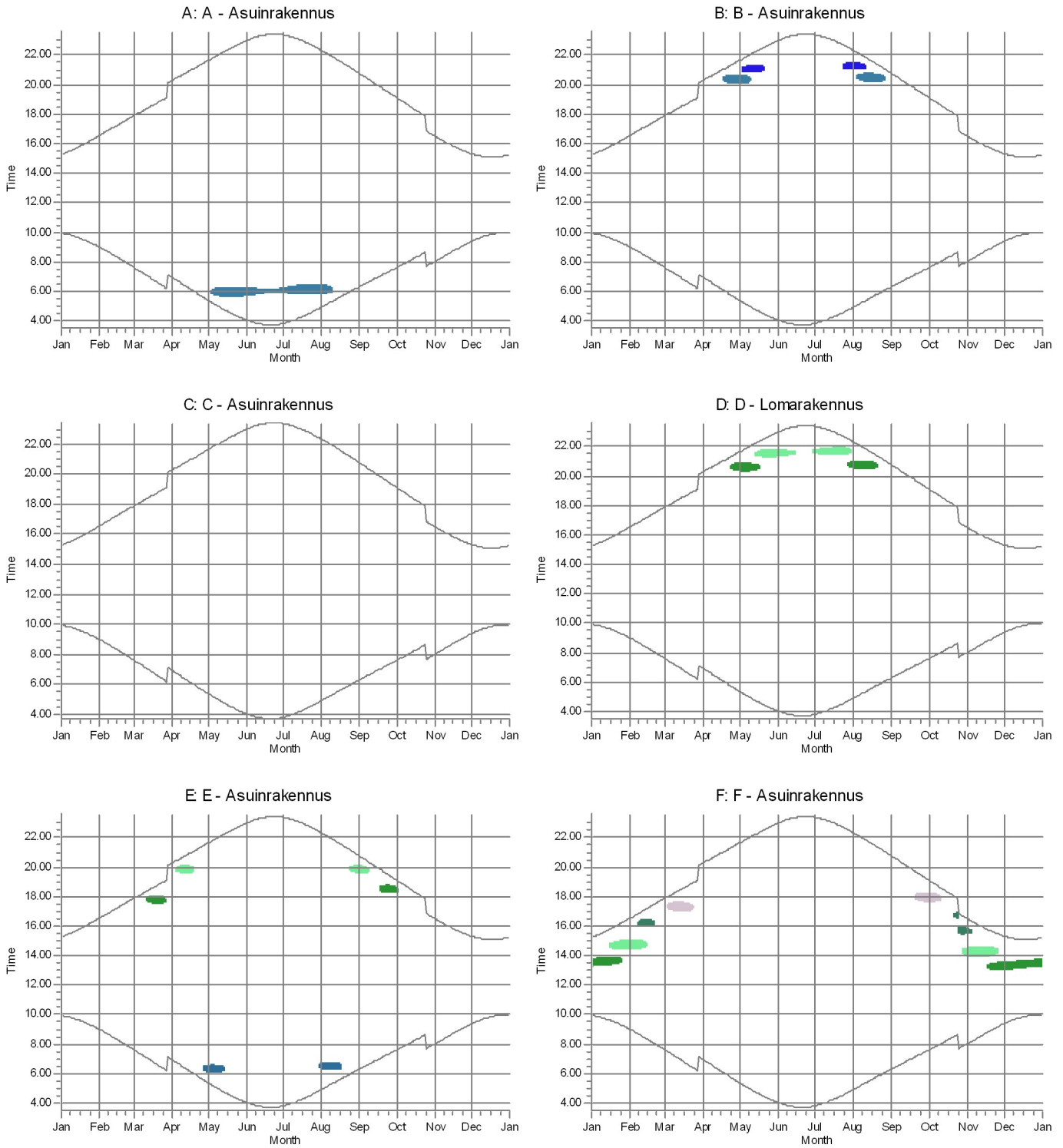
No.	Name	Expected [h/year]
21	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
22	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	2:13
23	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
24	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
3	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)	0:00
4	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (87)	0:00
41	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	0:00
42	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
43	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	0:00
44	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	0:00
45	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (296)	0:00
46	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (297)	0:00
47	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (298)	0:00
5	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (88)	0:00
6	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (89)	0:00
7	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (90)	0:00
8	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (91)	0:00
9	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)	0:00
T1	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	3:38
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:02
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	2:09
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	8:55
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	2:09
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	12:38
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:51
T2	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	7:52
T3	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	6:44
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
T7	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:47
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	2:53
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus



WTCs

22: VESTAS V162-6.0 HH169 6000 162.0 IOI hub: 219.0 m (TOT: 300.0 m)
T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T2: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (248)

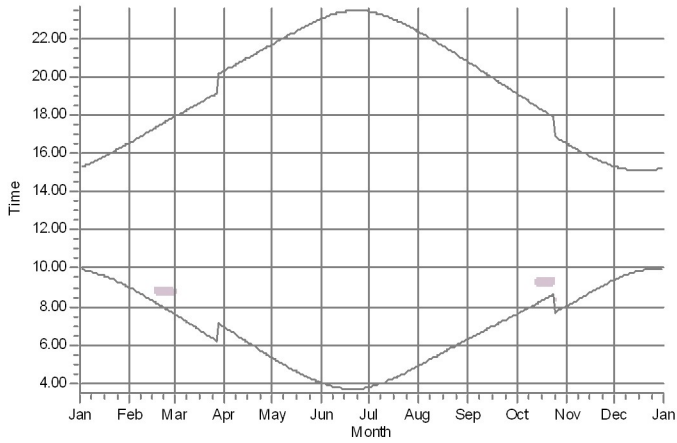
T3: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (249)
T7: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (251)
T14: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (258)

T15: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (259)

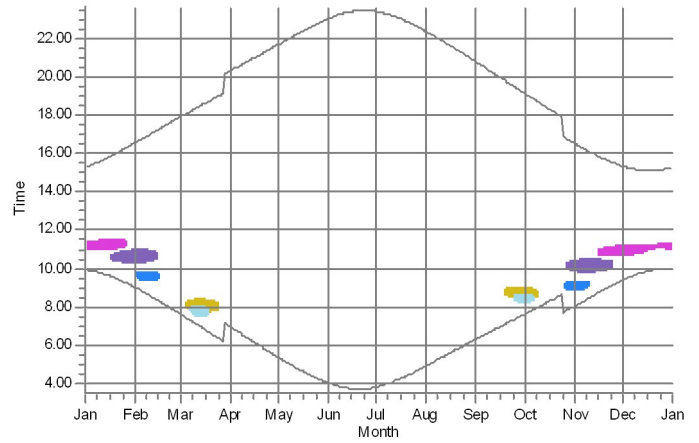
SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

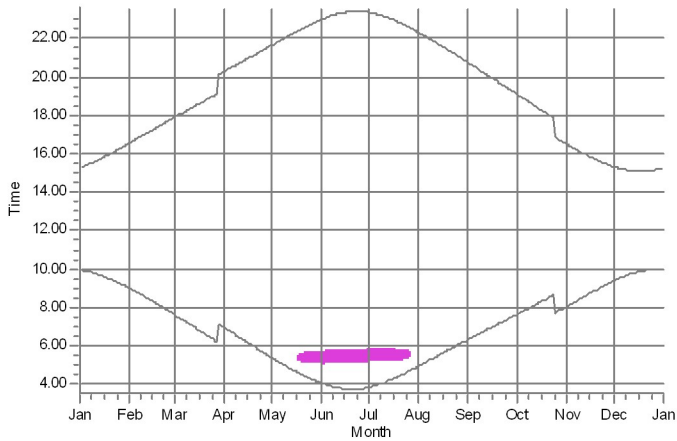
G: G - Asuinrakennus



H: H - Asuinrakennus



I: I - Asuinrakennus



WTGs

T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T8: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (252)

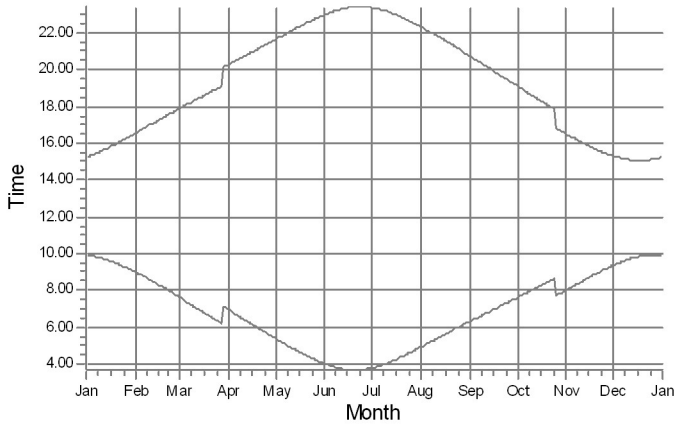
T11: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (255)
T12: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (256)

T13: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (257)
T18: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (261)

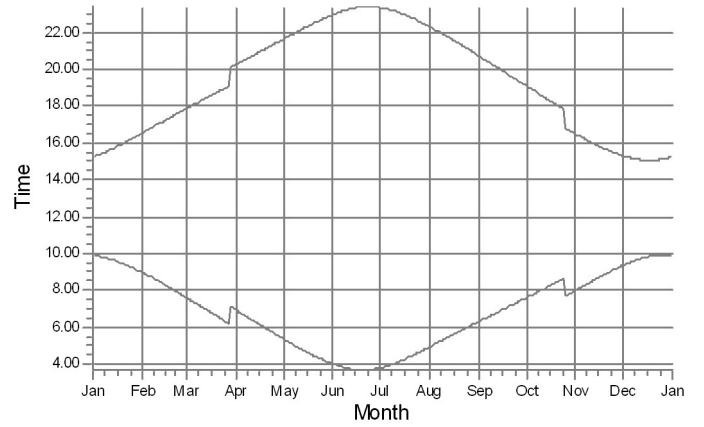
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

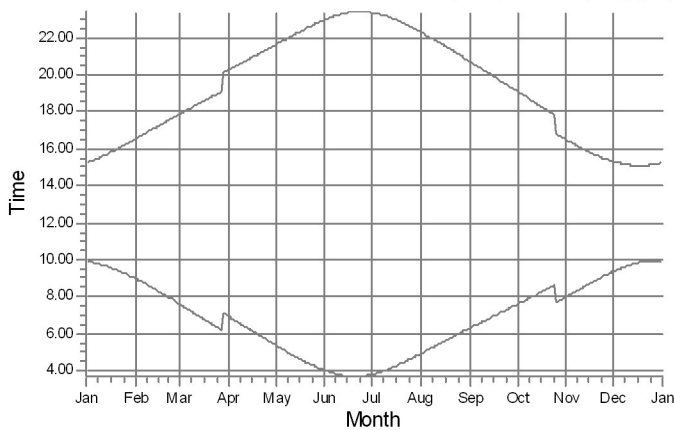
1: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)



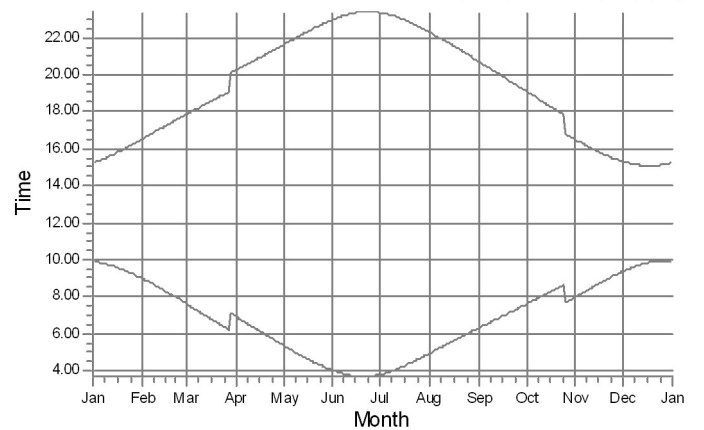
10: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)



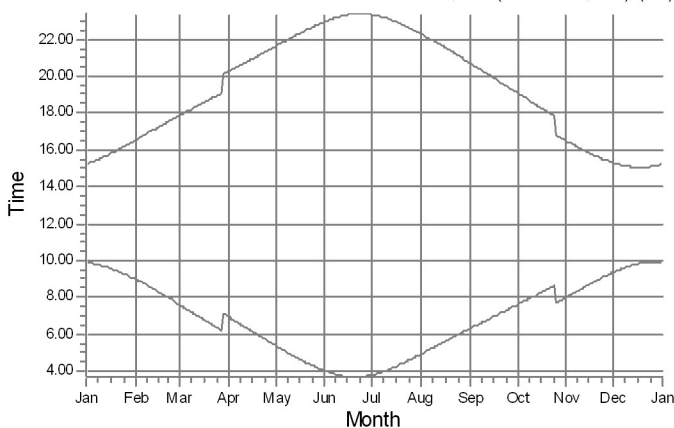
11: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)



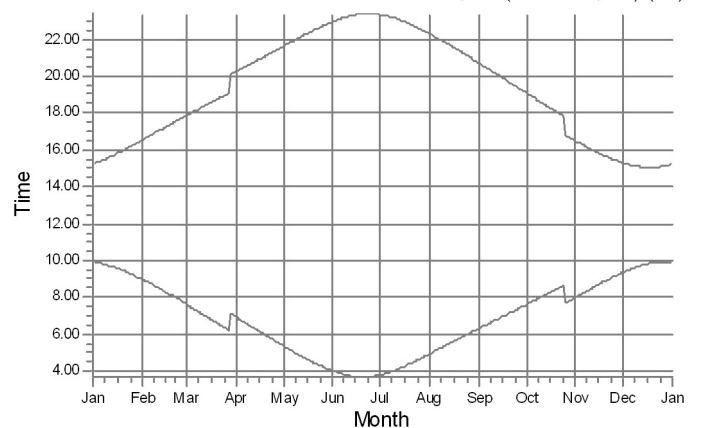
12: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)



13: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)



14: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)

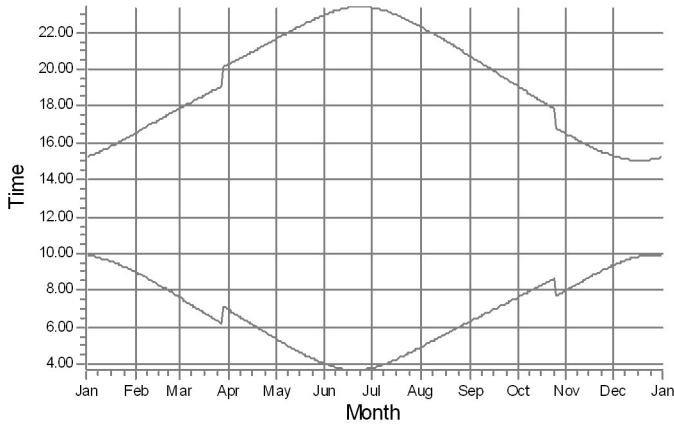


Shadow receptors

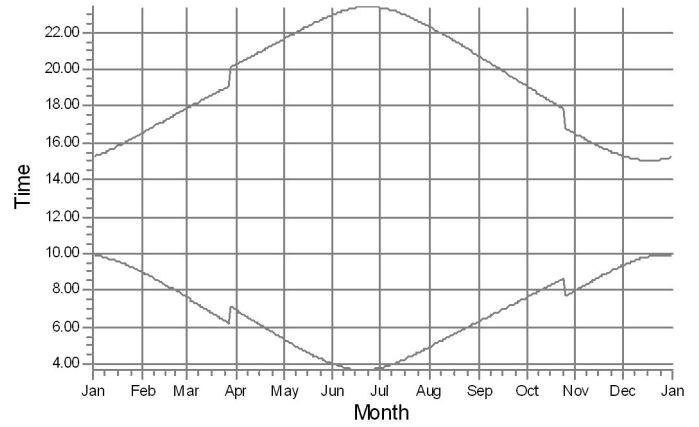
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

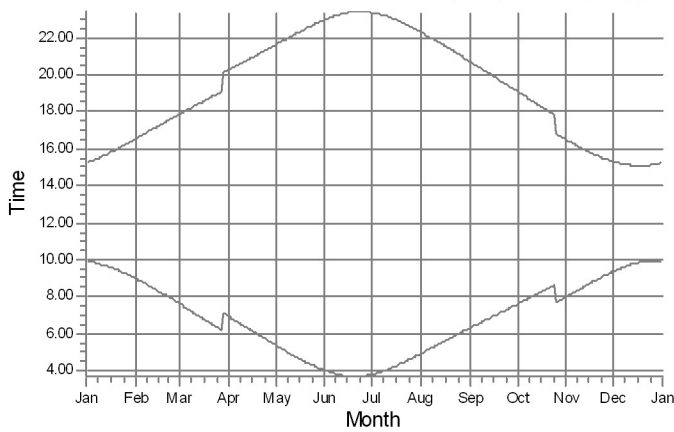
15: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)



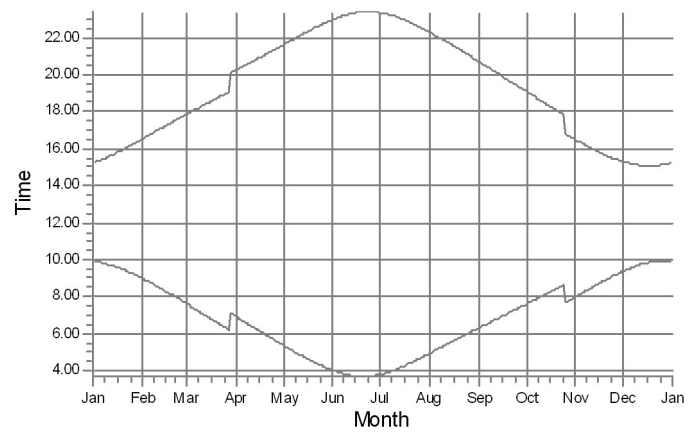
16: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)



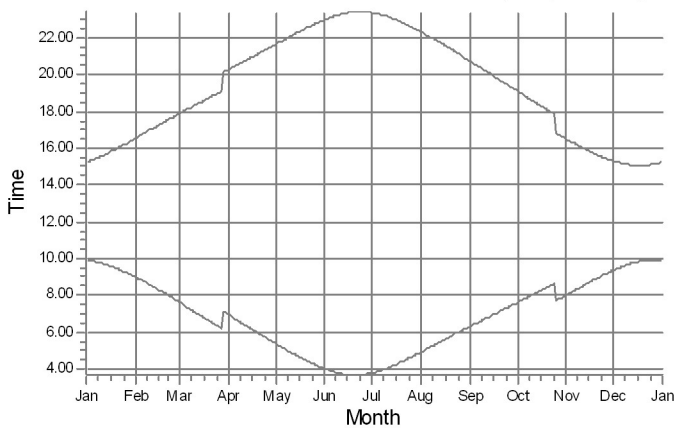
17: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)



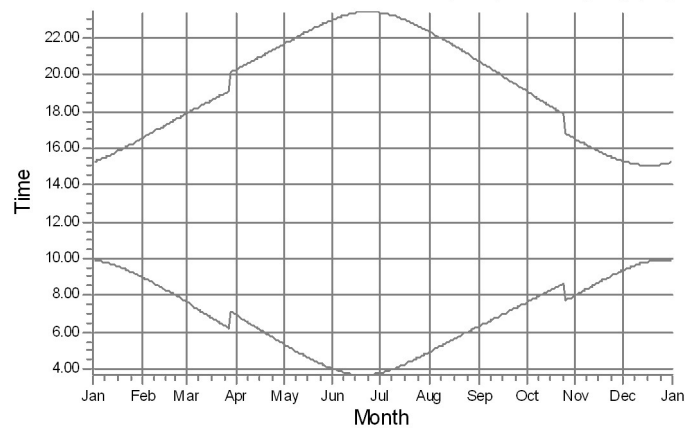
18: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)



19: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



2: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)

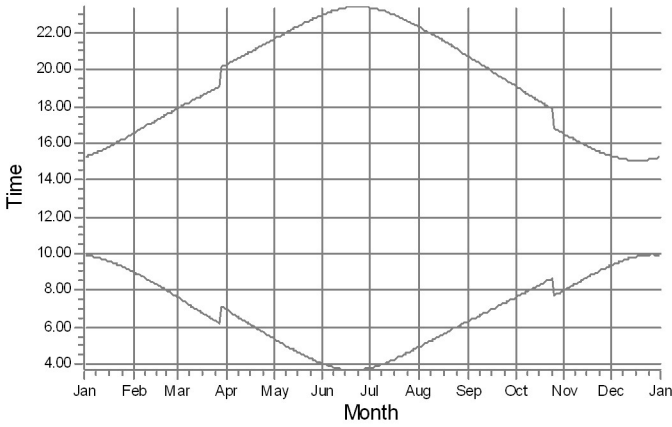


Shadow receptors

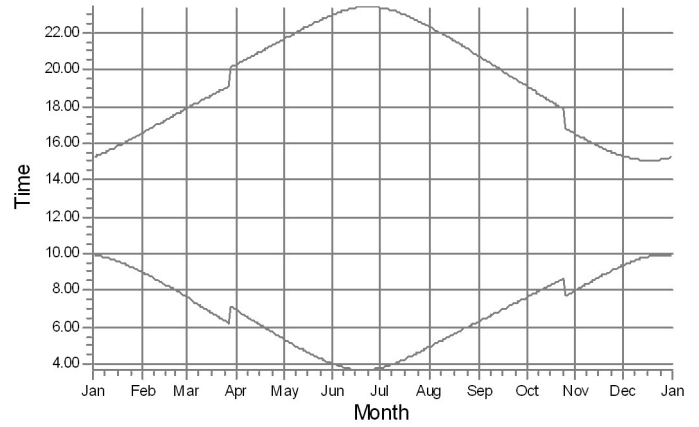
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

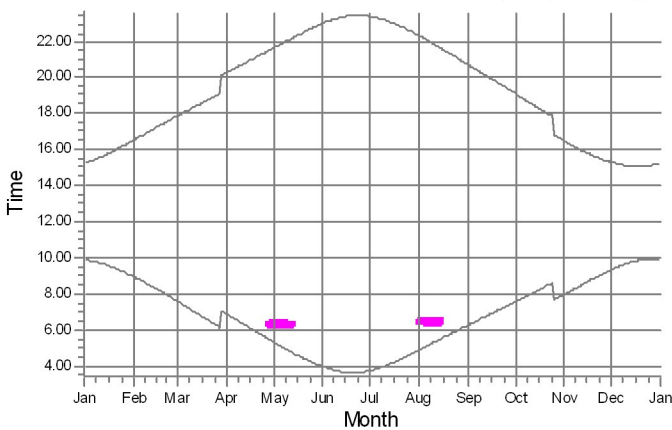
20: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



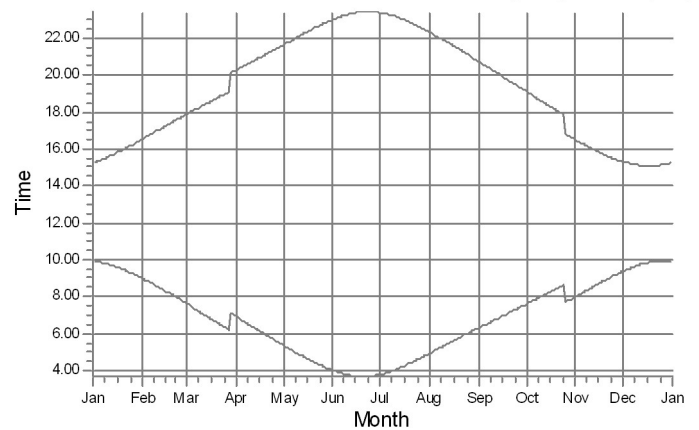
21: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



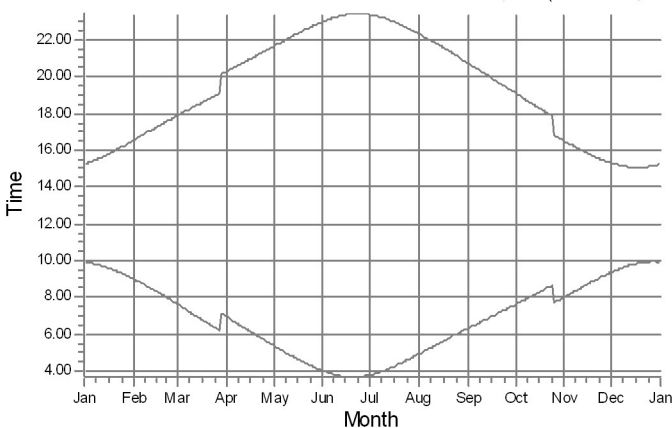
22: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



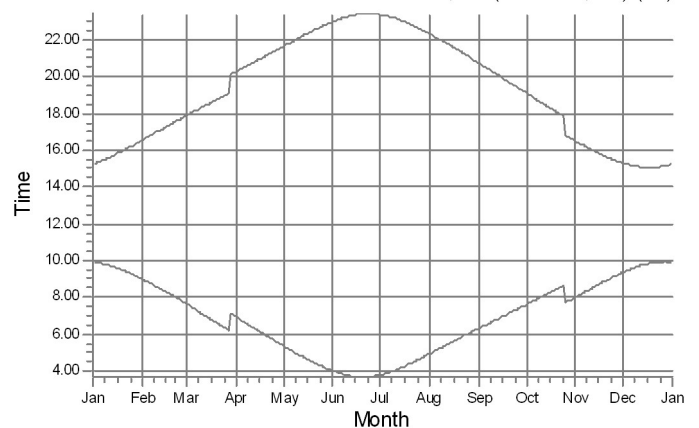
23: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



24: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



3: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)



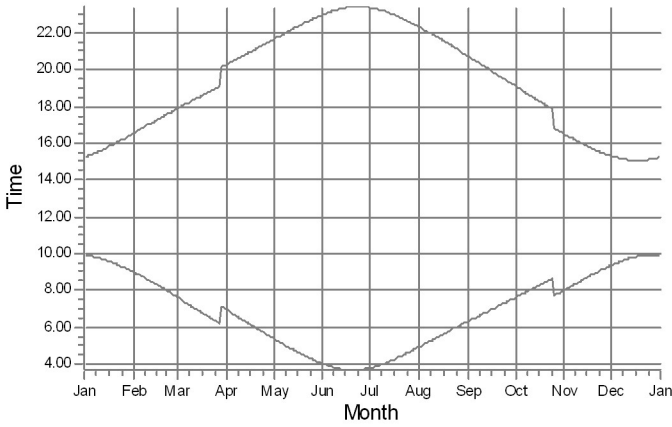
Shadow receptors

E: E - Asuinrakennus

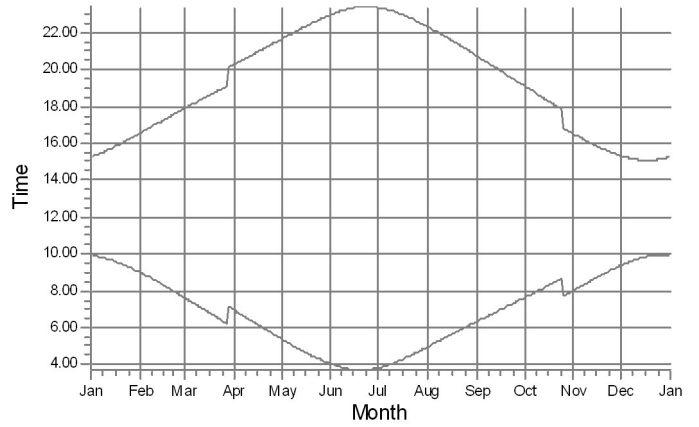
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

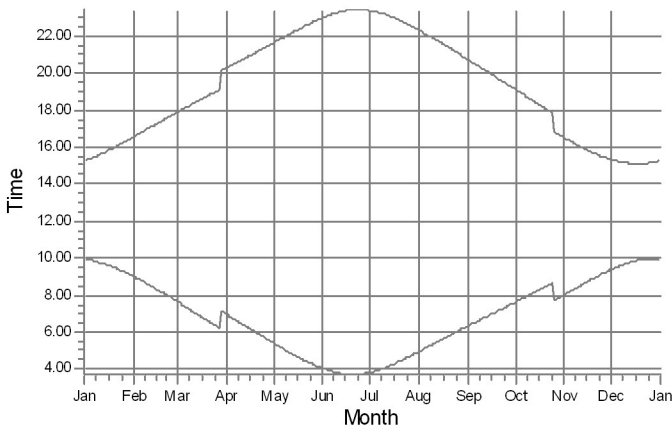
4: NORDEX N117/2400 2400 116.8 !O!hub: 120,0 m (TOT: 178,4 m) (87)



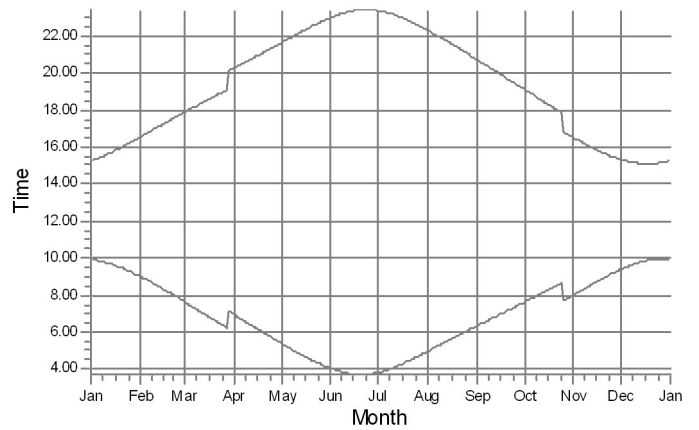
41: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (292)



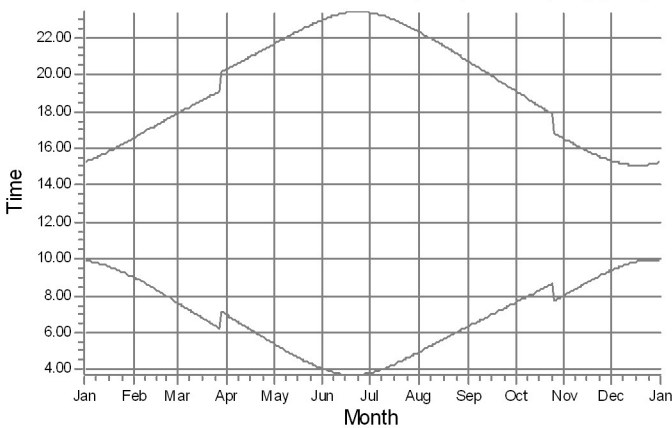
42: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (293)



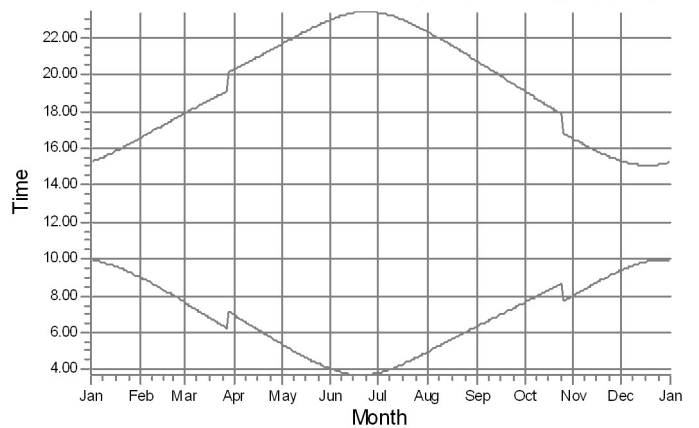
43: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (294)



44: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (295)



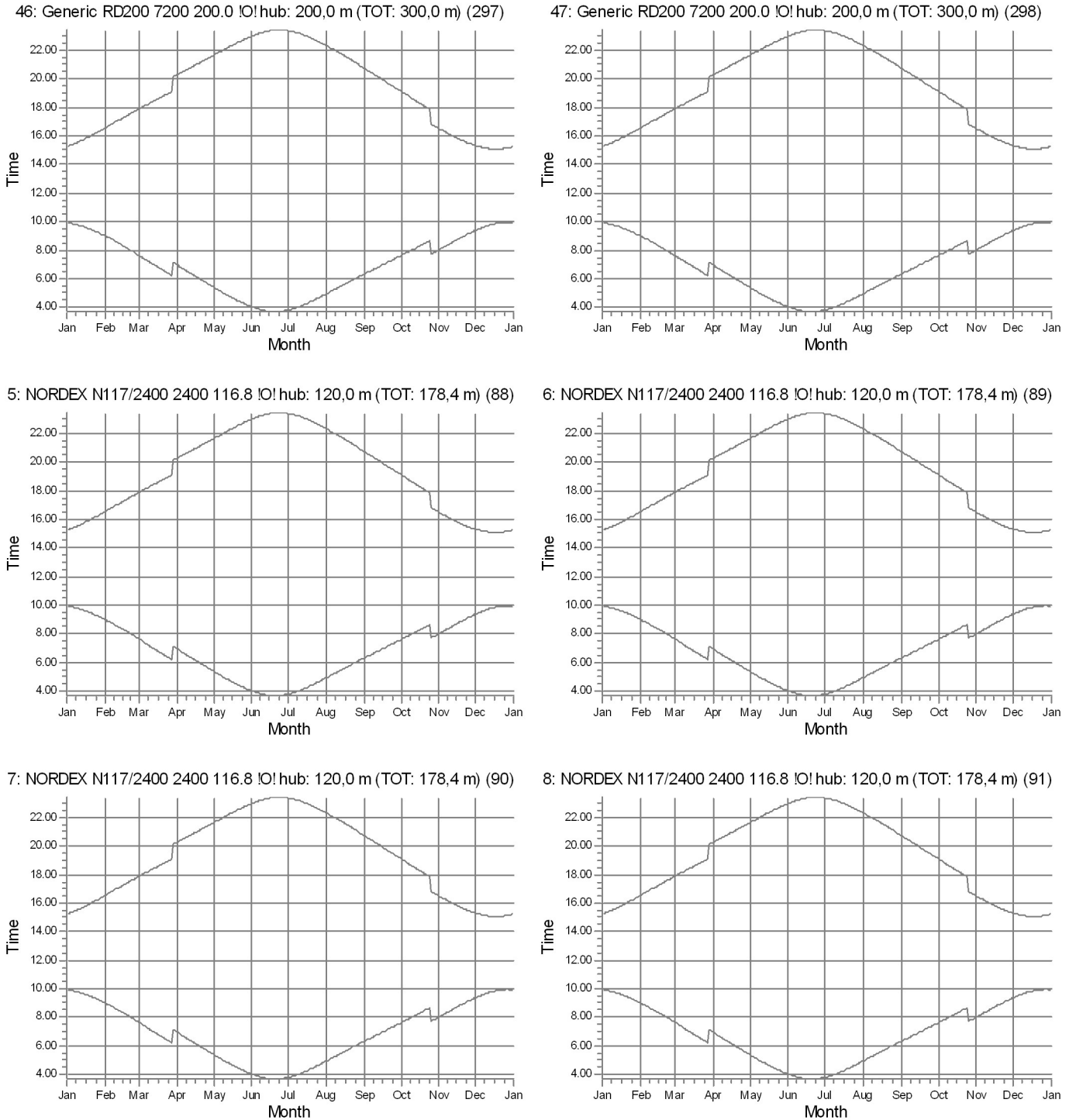
45: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (296)



Shadow receptors

SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

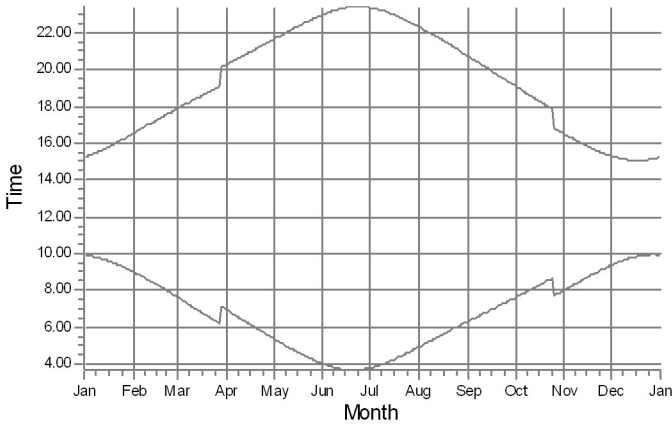


Shadow receptors

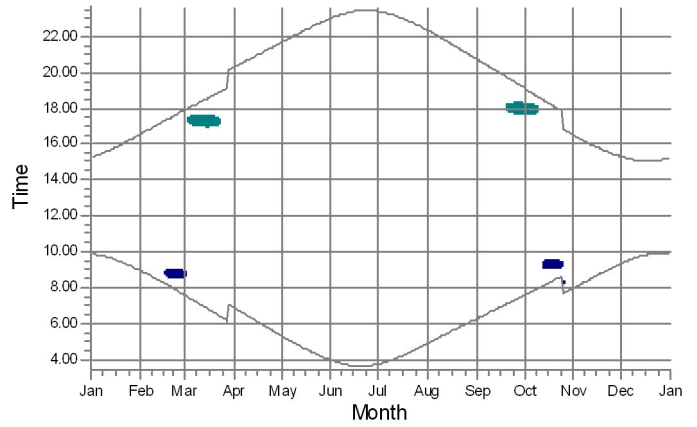
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

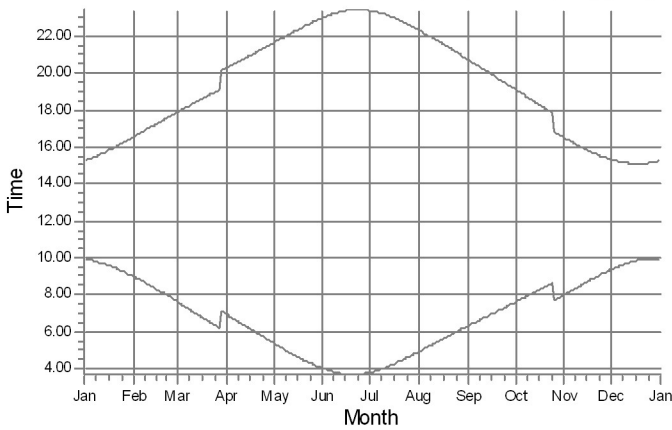
9: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)



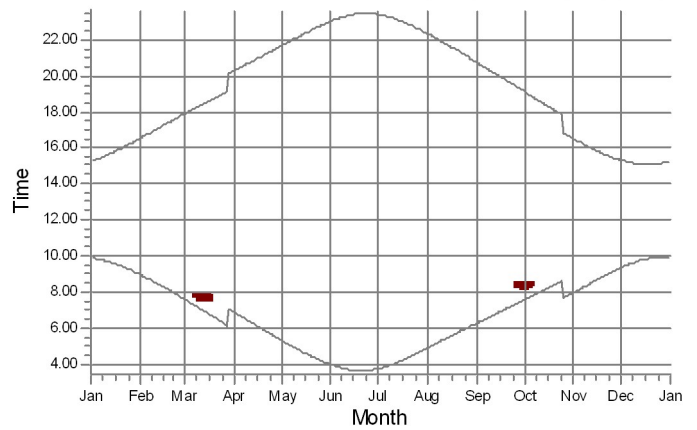
T1: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)



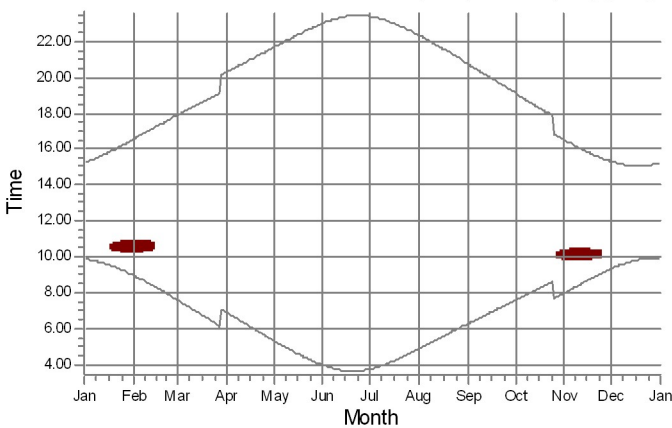
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)



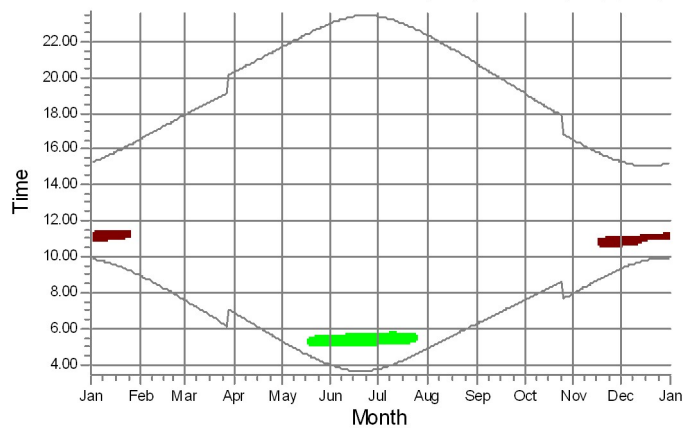
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)






T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)



T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)



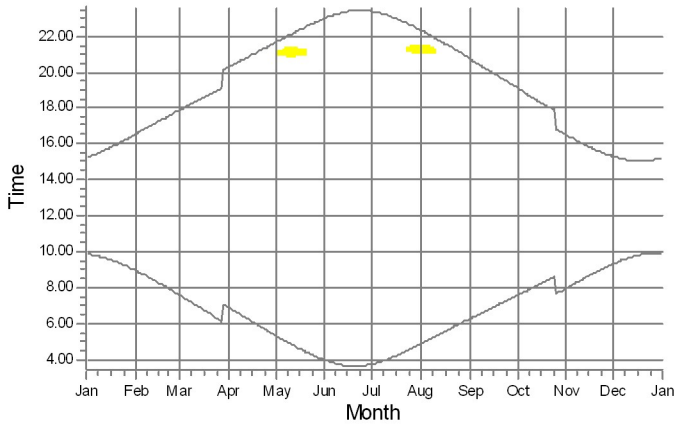
Shadow receptors

	F: F - Asuinrakennus		H: H - Asuinrakennus
	G: G - Asuinrakennus		I: I - Asuinrakennus

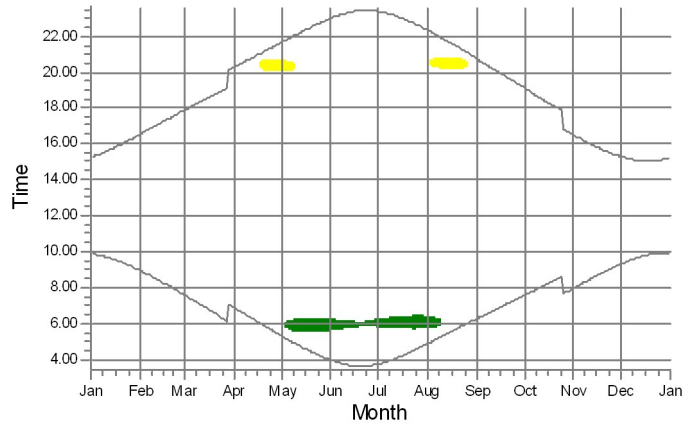
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

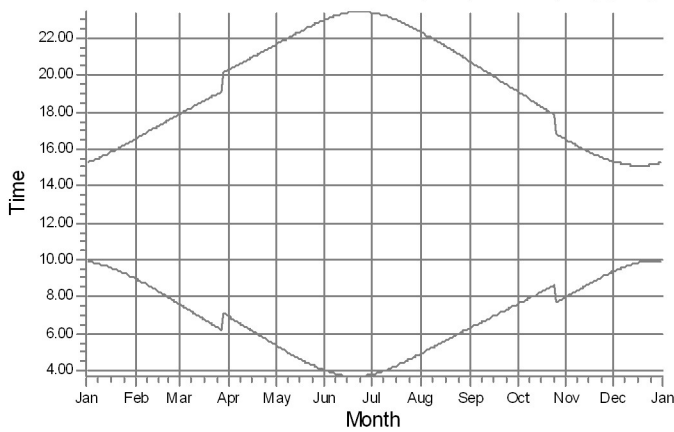
T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)



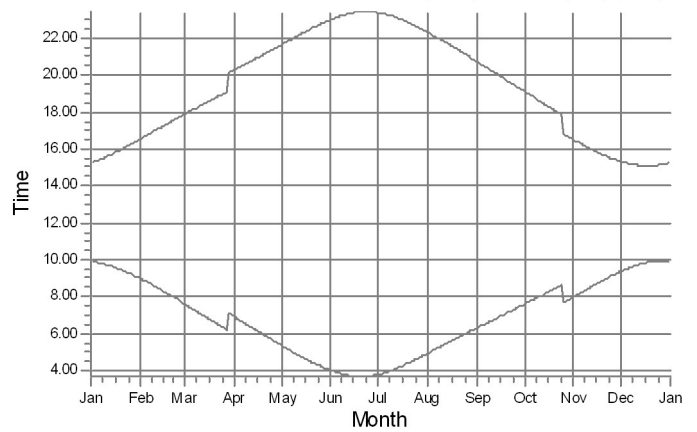
T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)



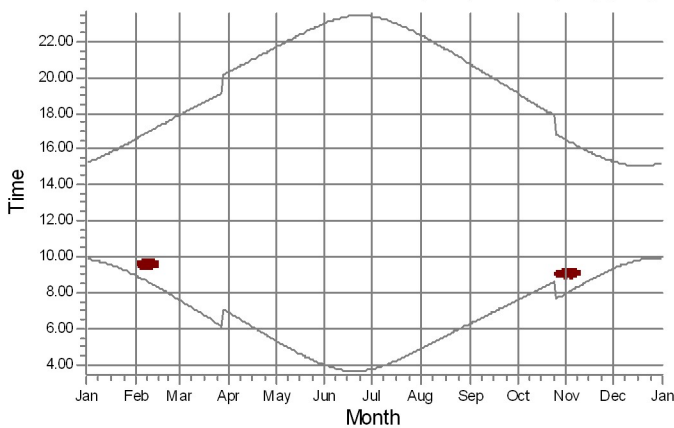
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)



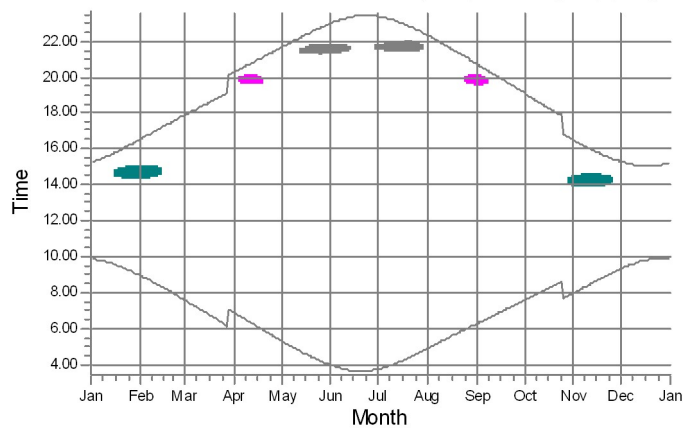
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)









T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)



T2: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)



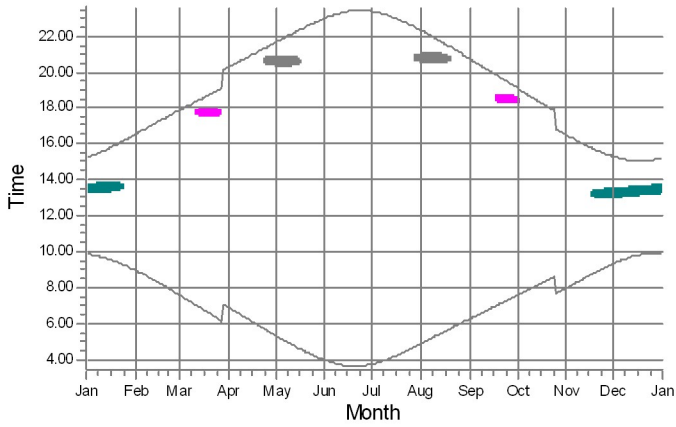
Shadow receptors

	A: A - Asuinrakennus		D: D - Lomarakennus		F: F - Asuinrakennus
	B: B - Asuinrakennus		E: E - Asuinrakennus		H: H - Asuinrakennus

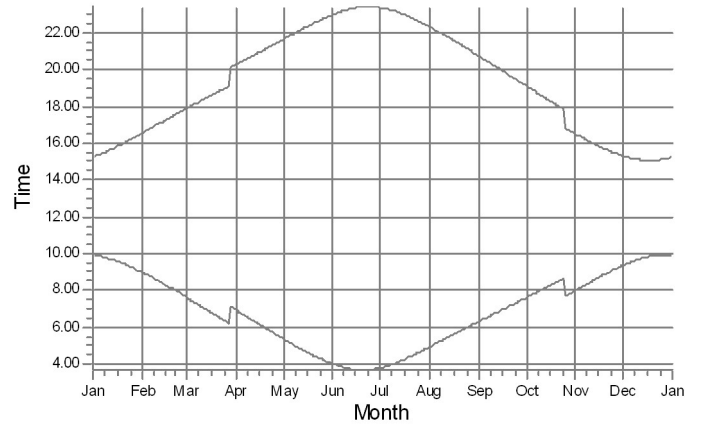
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus

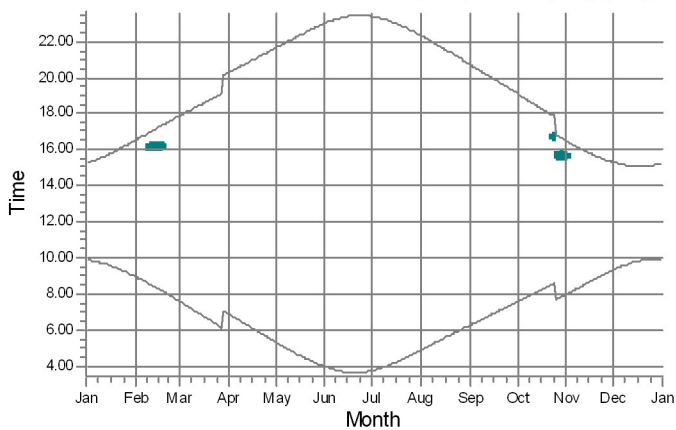
T3: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (249)



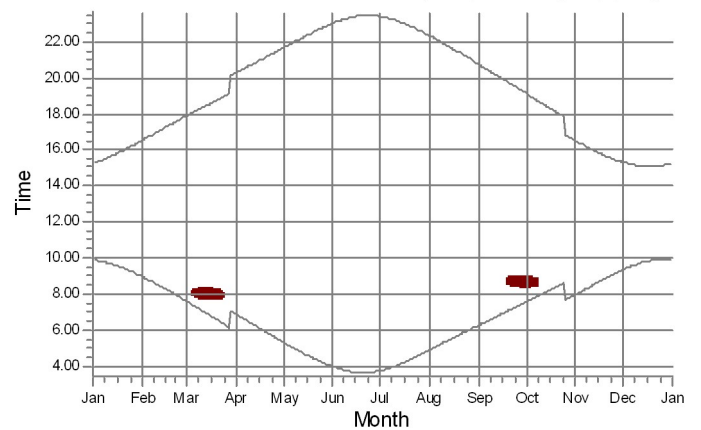
T6: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (250)



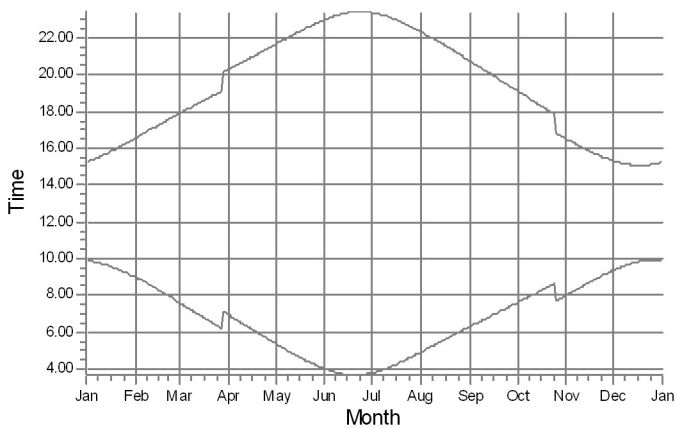
T7: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (251)



T8: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (252)



T9: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (253)

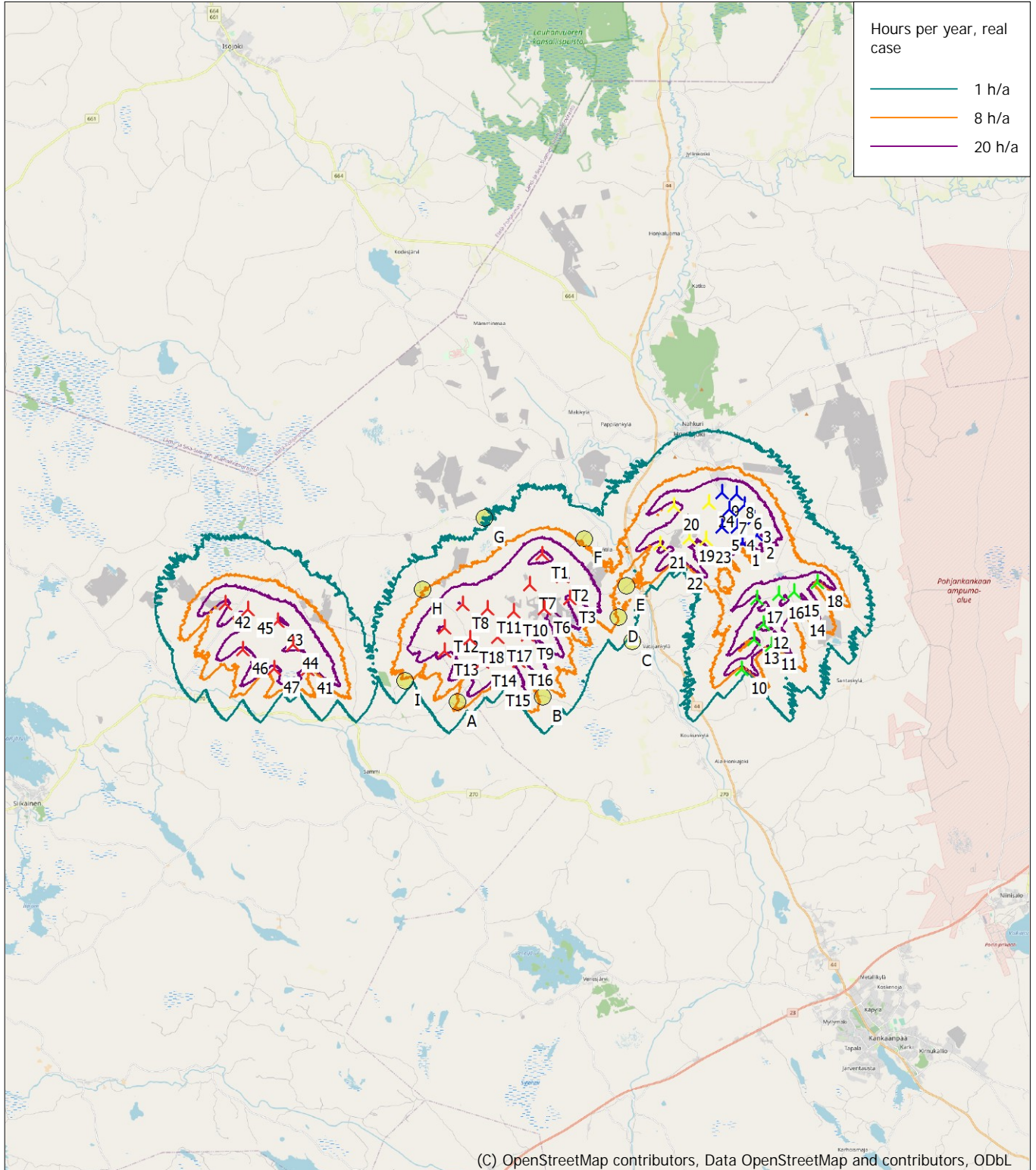


Shadow receptors

	D: D - Lomarakennus		F: F - Asuinrakennus
	E: E - Asuinrakennus		H: H - Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE1_Generic_RD200xHH200_No_Forest_yhteisvaikutus



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 280 North: 6 877 290
 🚧 New WTG 🟡 Shadow receptor
 Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
 Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 14. Yhteisvaikutus varjostusmallinnuksen tulokset "Real Case, Luke Forest" - VE1

SHADOW - Main Result

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80 2,30 4,40 6,00 7,40 8,10 8,40 6,70 4,10 1,90 0,70 0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
599 491 437 472 590 751 965 1 129 879 730 633 576 8 252
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: CONTOURLINE_Haukkasalo_06052022

Area object(s) used in calculation:

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Obstacles used in calculation

Receptor grid resolution: 1,0 m

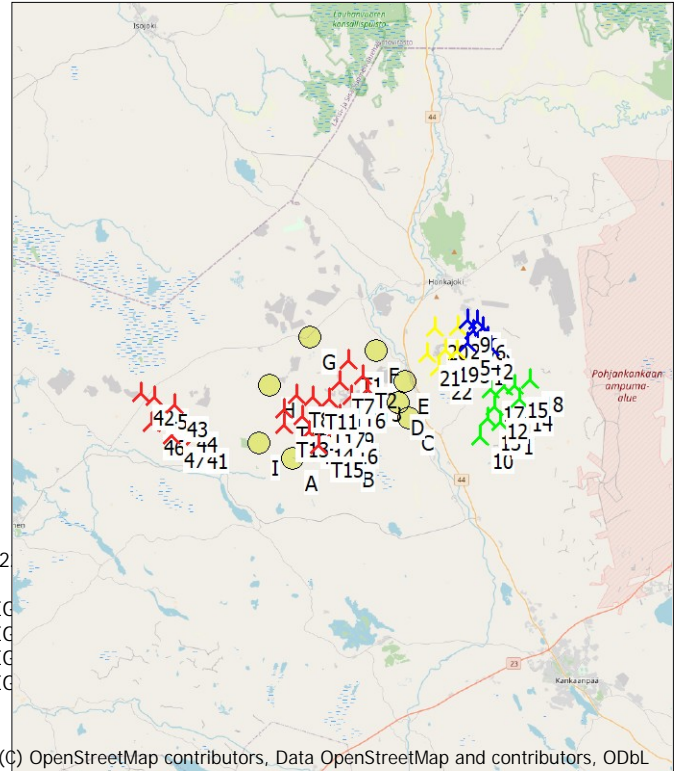
All coordinates are in

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	253 616	6 878 546	105,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
10	253 256	6 874 085	105,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
11	254 378	6 874 820	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
12	254 139	6 875 605	109,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
13	253 765	6 875 081	106,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
14	255 464	6 875 947	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
15	255 305	6 876 650	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
16	254 745	6 876 621	107,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
17	253 975	6 876 541	107,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
18	256 142	6 876 896	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
19	251 747	6 878 810	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
2	254 154	6 878 757	112,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
20	251 304	6 879 975	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
21	250 727	6 878 659	100,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
22	251 315	6 877 881	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
23	252 334	6 878 721	102,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
24	252 523	6 879 987	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
3	254 073	6 879 328	112,6	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
4	253 487	6 879 084	110,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
41	238 078	6 875 215	80,3	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
42	235 391	6 877 752	80,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
43	237 182	6 877 006	80,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
44	237 630	6 876 111	79,3	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
45	236 137	6 877 454	78,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
46	235 851	6 876 098	77,5	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
47	236 884	6 875 364	75,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
5	252 957	6 879 121	107,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
6	253 775	6 879 840	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
7	253 252	6 879 721	117,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8

To be continued on next page...



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:400 000
New WTG Shadow receptor

SHADOW - Main Result

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

...continued from previous page

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
			[m]									
8	253 525	6 880 225	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
9	253 026	6 880 328	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
T1	246 582	6 878 619	95,6	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T10	245 421	6 876 704	92,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T12	242 968	6 876 299	90,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T13	242 898	6 875 520	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T2	247 257	6 877 777	97,6	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T3	247 430	6 877 022	96,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T7	246 054	6 877 590	94,8	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 691	6 877 054	93,7	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	a.g.l. [m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values
		Shadow hours per year [h/year]
A	A - Asuinrakennus	0:00
B	B - Asuinrakennus	5:48
C	C - Asuinrakennus	0:00
D	D - Lomarakennus	0:00
E	E - Asuinrakennus	3:18
F	F - Asuinrakennus	5:03
G	G - Asuinrakennus	0:52
H	H - Asuinrakennus	7:57
I	I - Asuinrakennus	7:46

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

No.	Name	Expected [h/year]
1	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)	0:00
11	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)	0:00
12	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

...continued from previous page

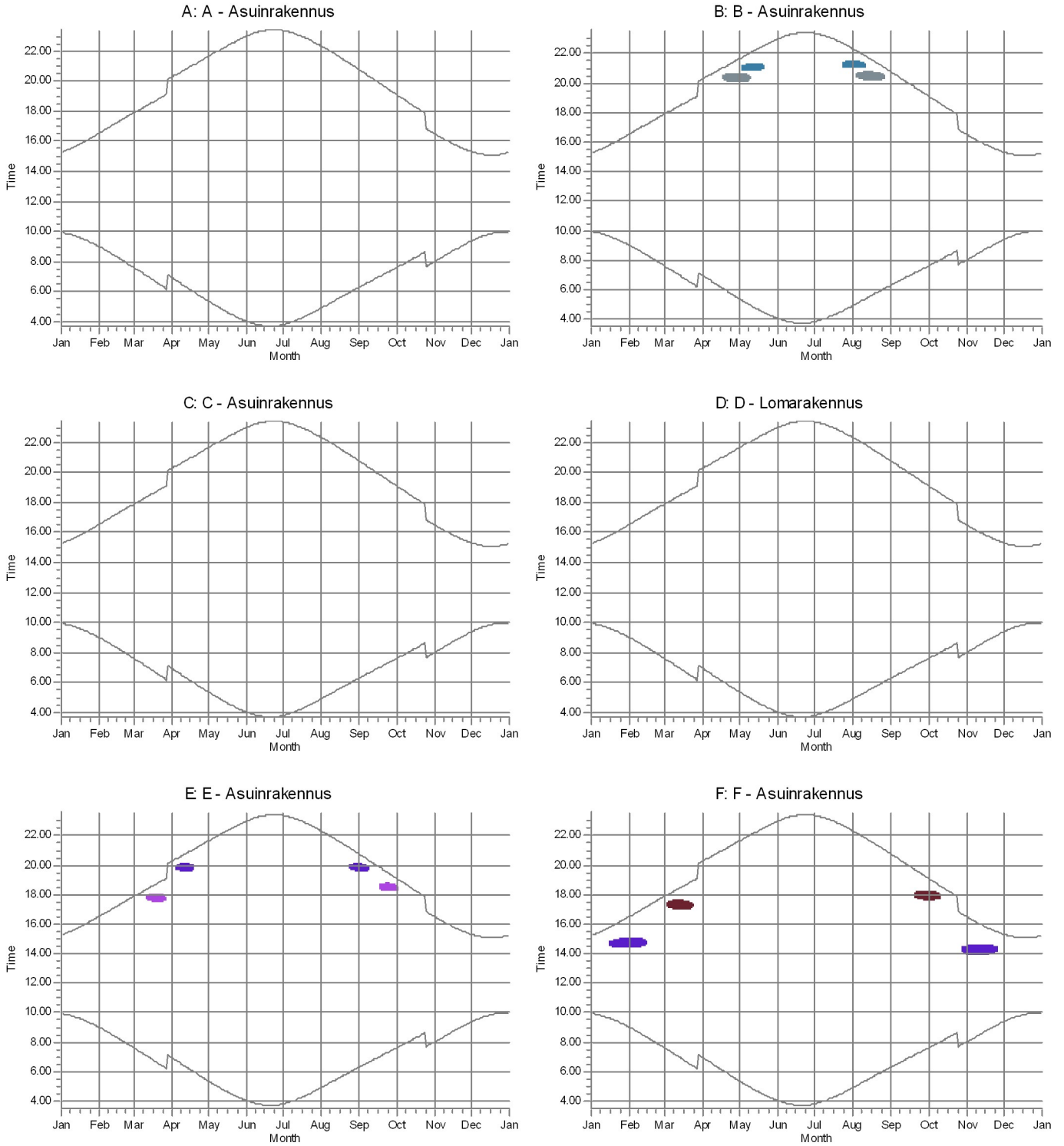
No.	Name	Expected [h/year]
17	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)	0:00
19	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
2	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)	0:00
20	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
21	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
22	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
23	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
24	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
3	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)	0:00
4	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (87)	0:00
41	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	0:00
42	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
43	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	0:00
44	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	0:00
45	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (296)	0:00
46	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (297)	0:00
47	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (298)	0:00
5	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (88)	0:00
6	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (89)	0:00
7	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (90)	0:00
8	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (91)	0:00
9	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)	0:00
T1	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	3:38
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:02
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	2:09
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	8:55
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	2:09
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	3:39
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:51
T2	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	3:51
T3	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	1:39
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
T7	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	2:53
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus



WTCs

T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T14: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (258)

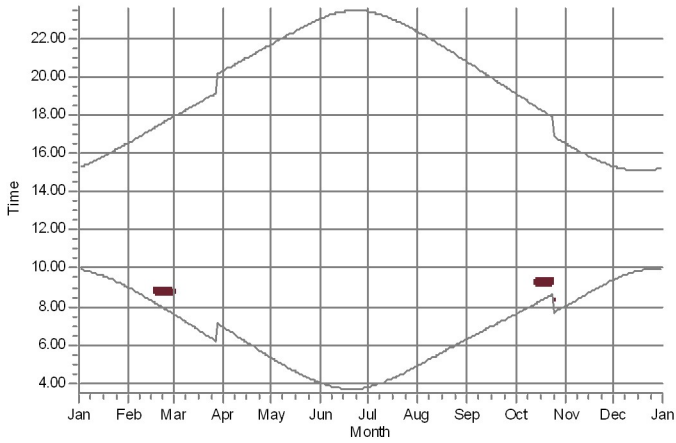
T15: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (259)
T2: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (248)

T3: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (249)

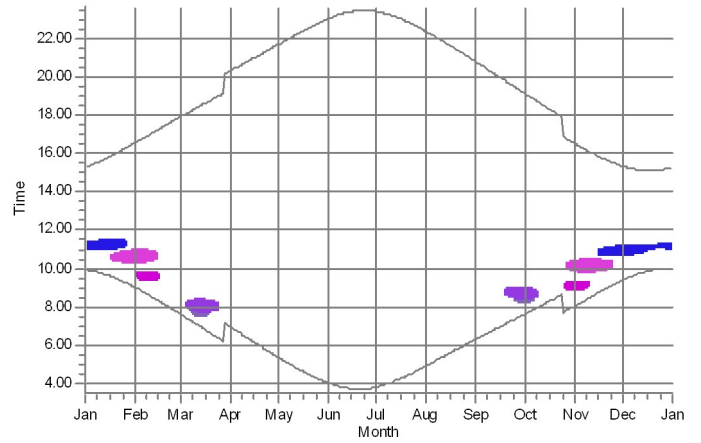
SHADOW - Calendar, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

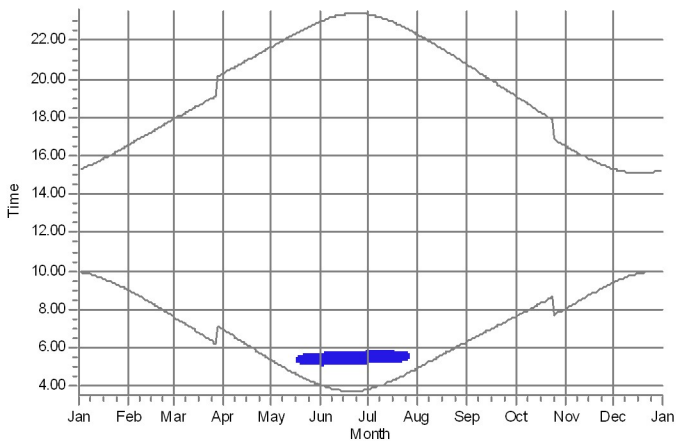
G: G - Asuinrakennus



H: H - Asuinrakennus



I: I - Asuinrakennus



WTGs

T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T11: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (255)

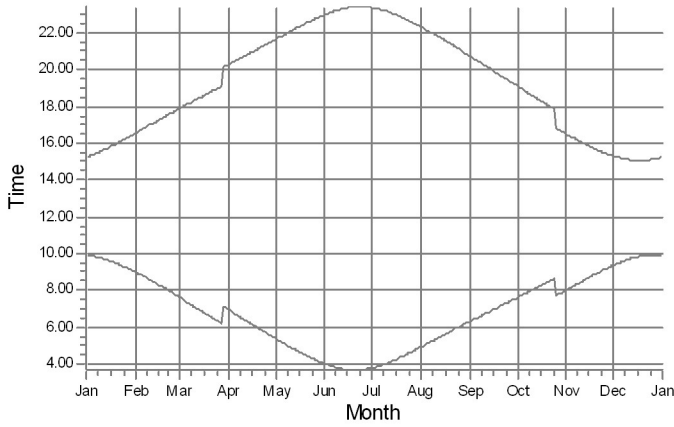
T12: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (256)
T13: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (257)

T18: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (261)
T8: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (252)

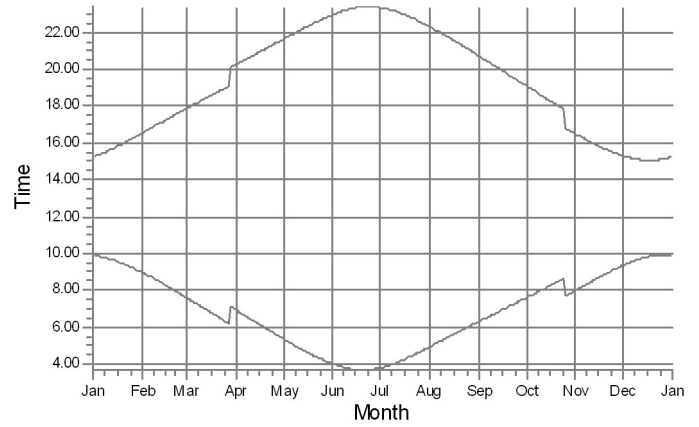
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

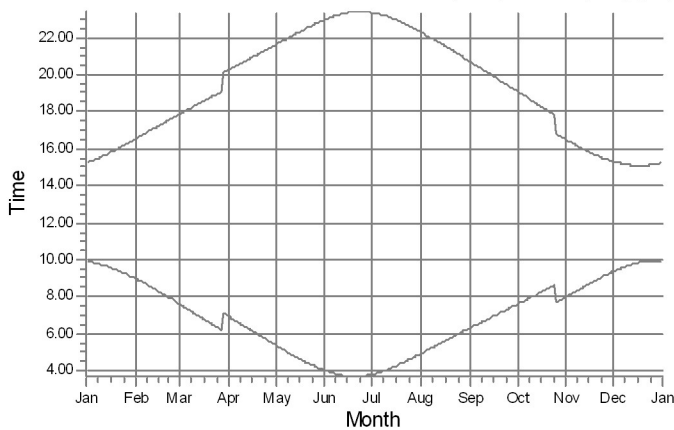
1: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)



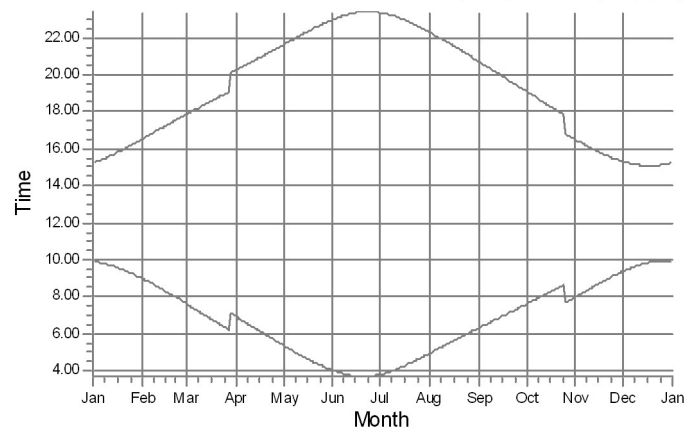
10: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)



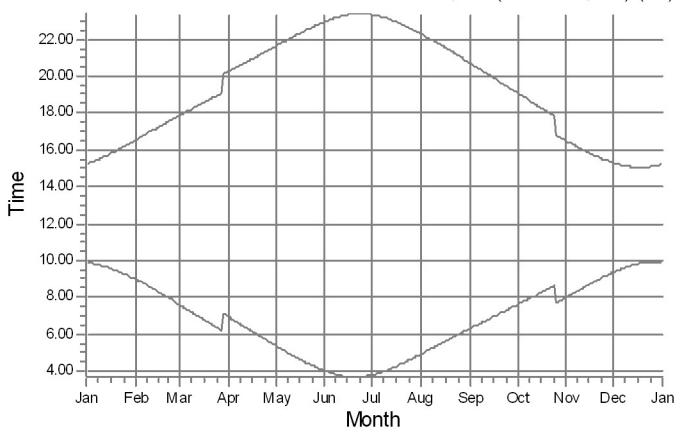
11: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)



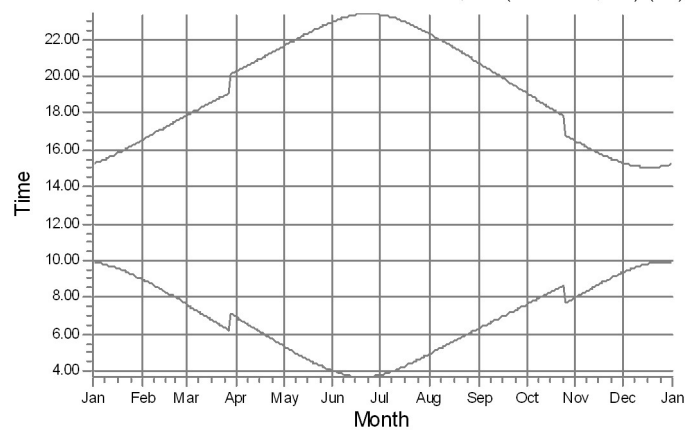
12: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)



13: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)



14: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)

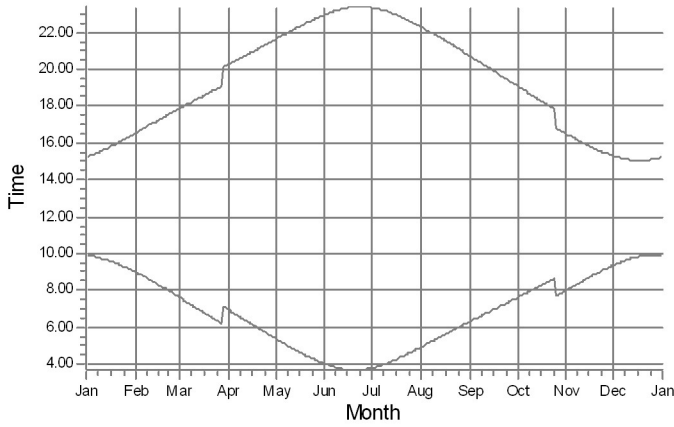


Shadow receptors

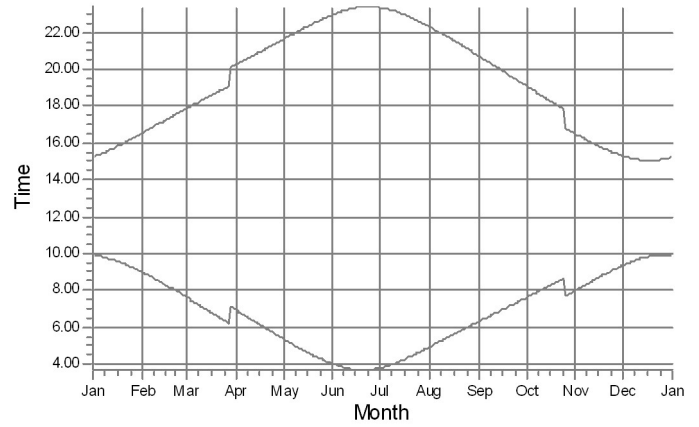
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

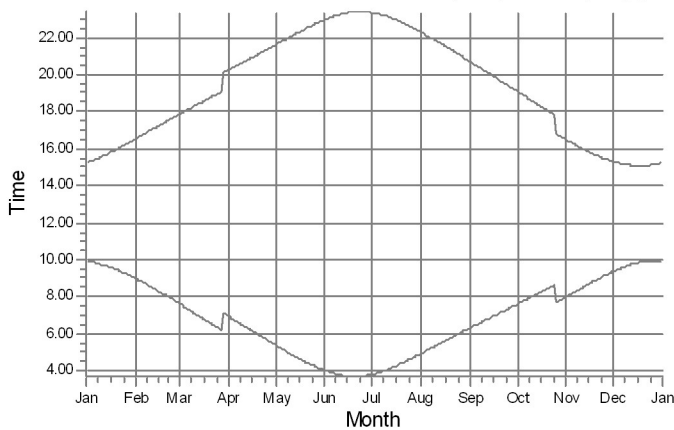
15: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)



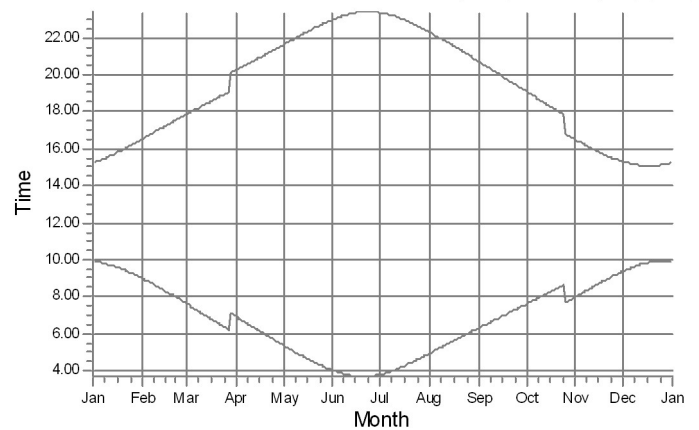
16: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)



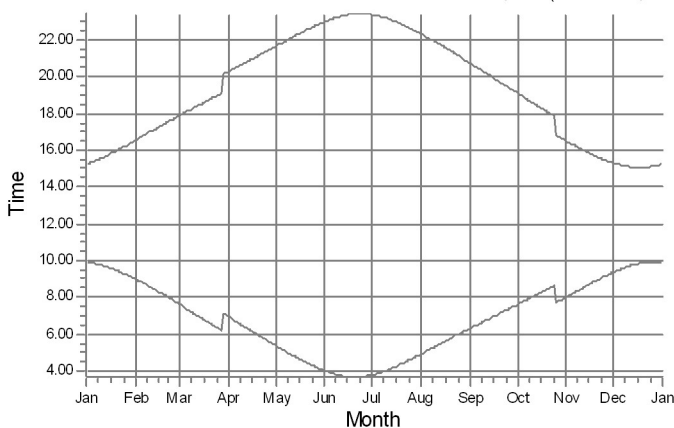
17: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)



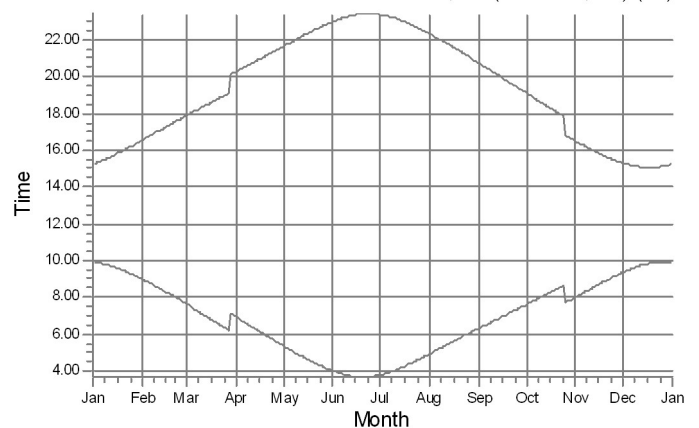
18: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)



19: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



2: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)

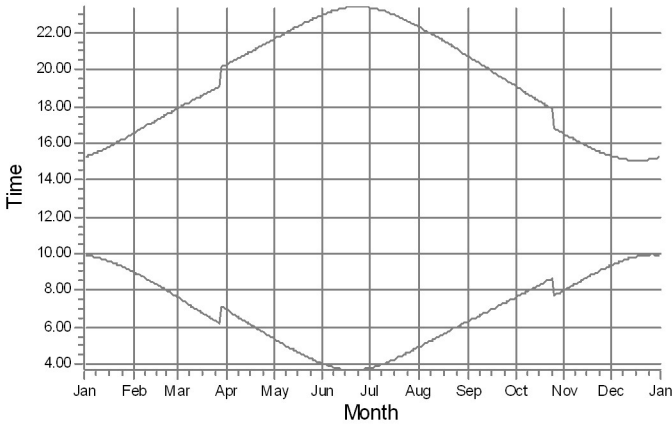


Shadow receptors

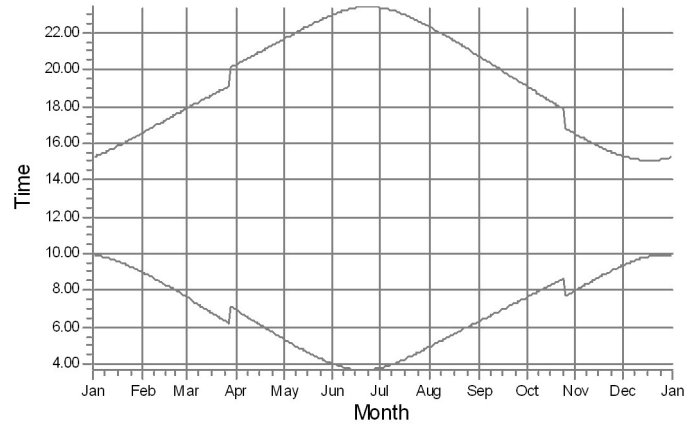
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

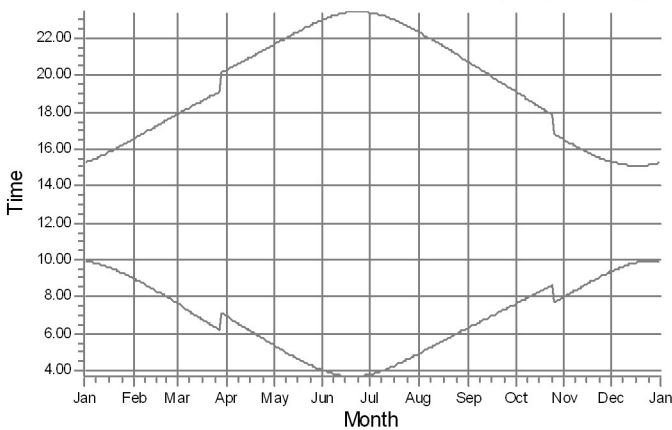
20: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



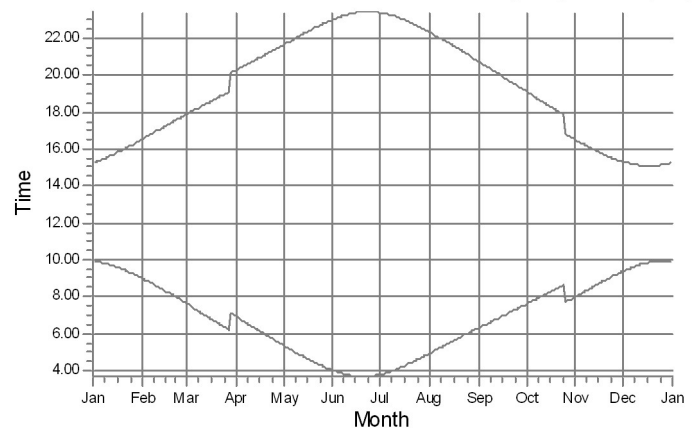
21: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



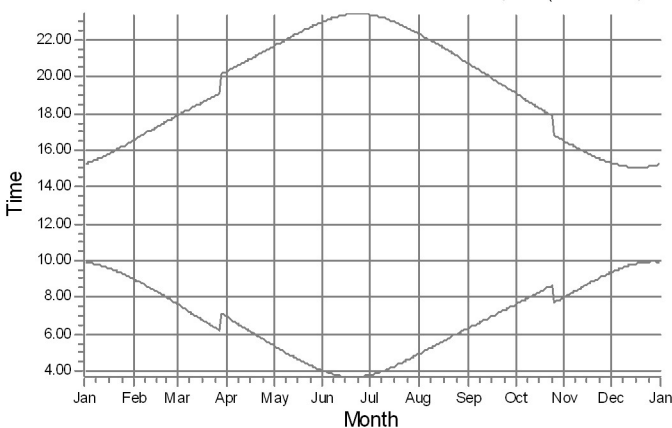
22: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



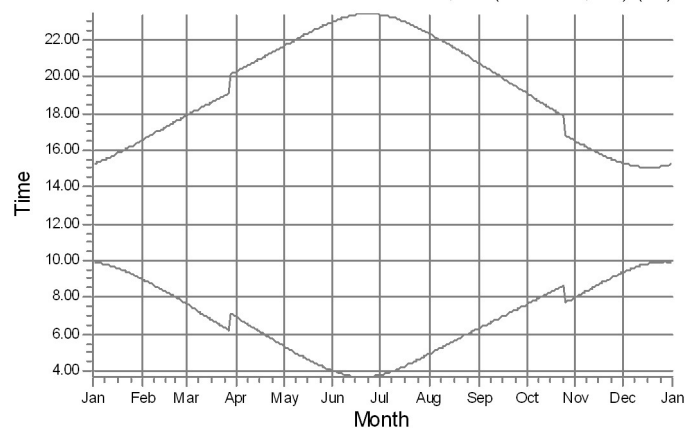
23: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



24: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



3: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)

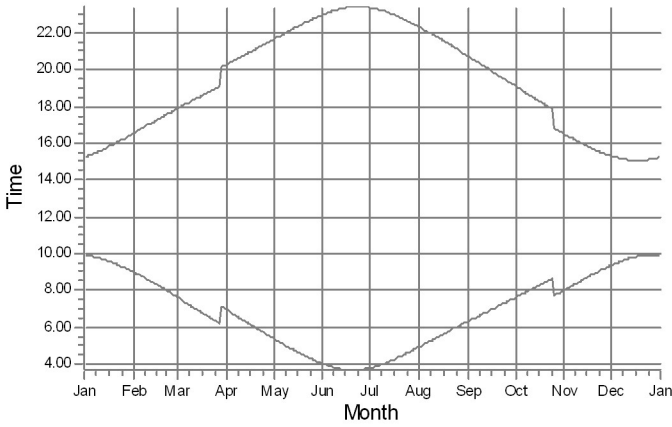


Shadow receptors

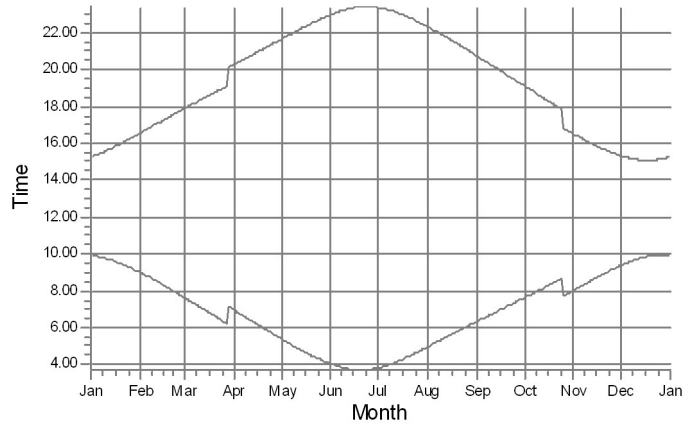
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

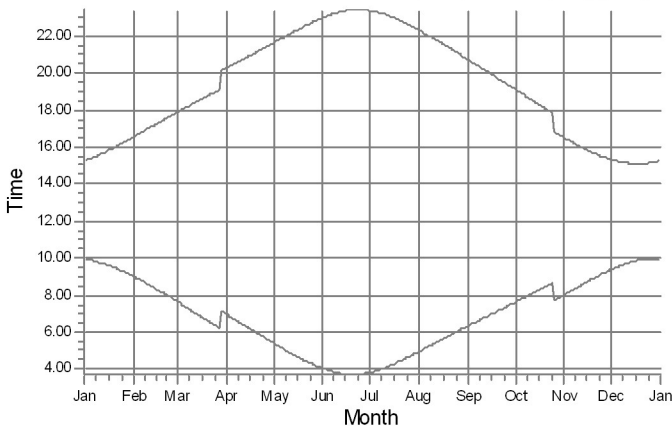
4: NORDEX N117/2400 2400 116.8 !O!hub: 120,0 m (TOT: 178,4 m) (87)



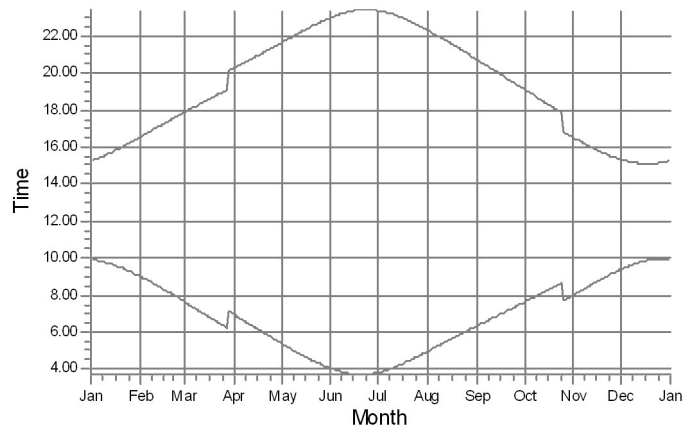
41: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (292)



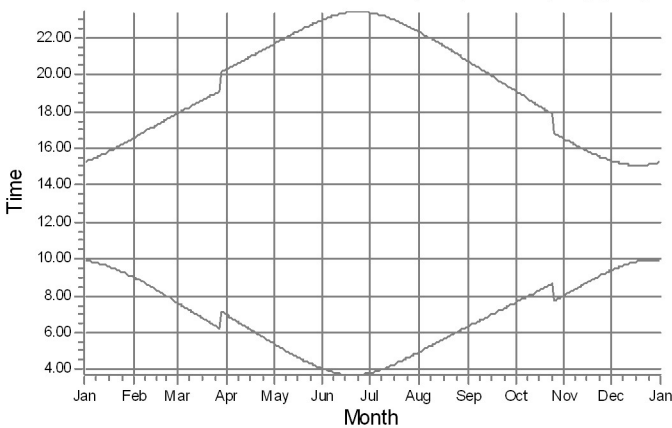
42: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (293)



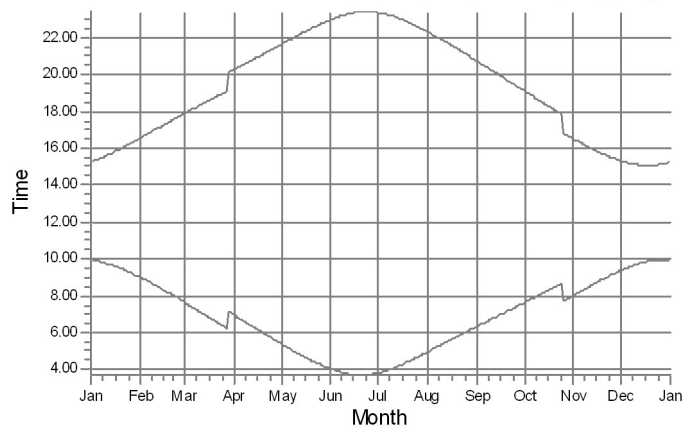
43: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (294)



44: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (295)



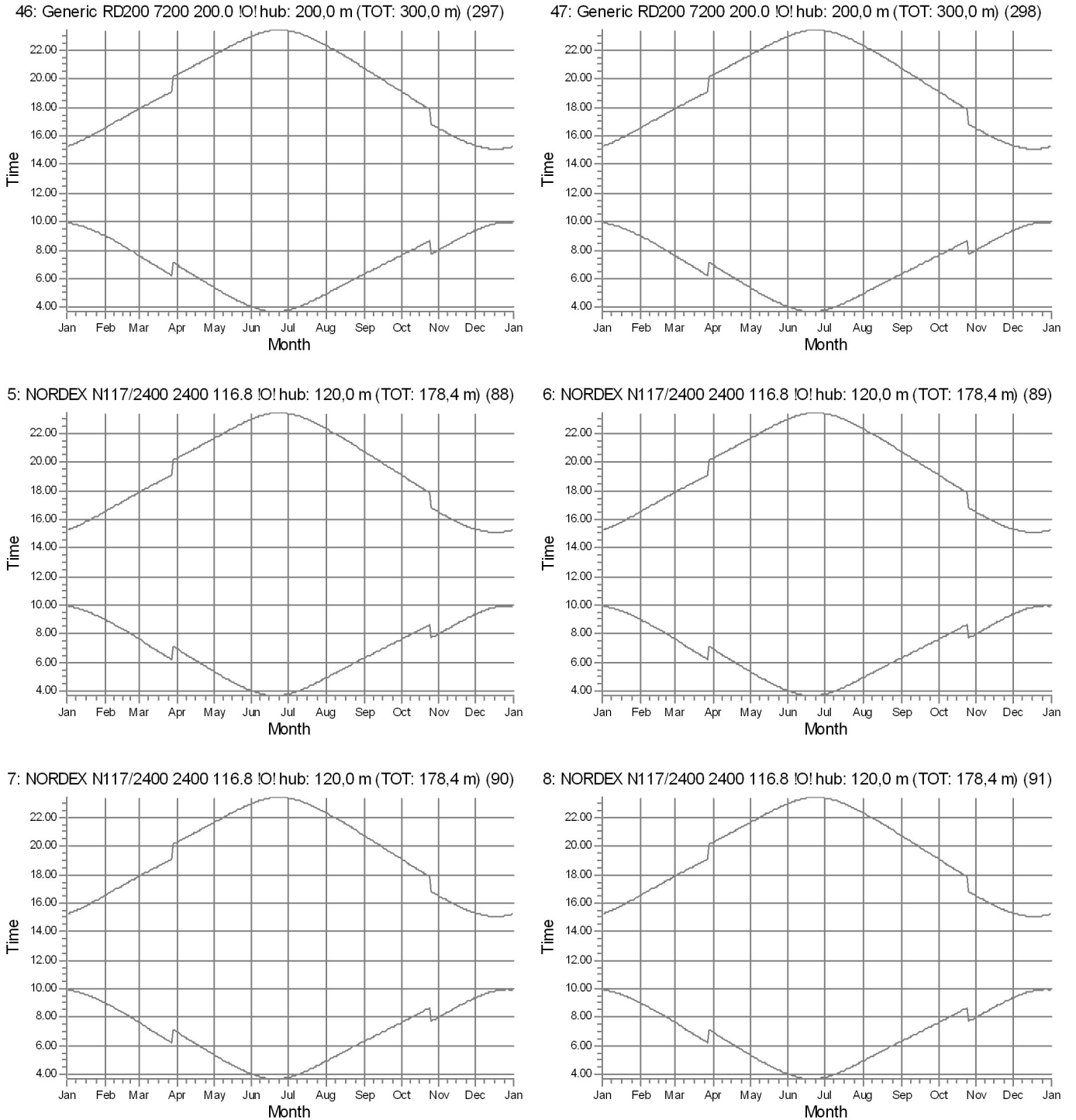
45: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (296)



Shadow receptors

SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

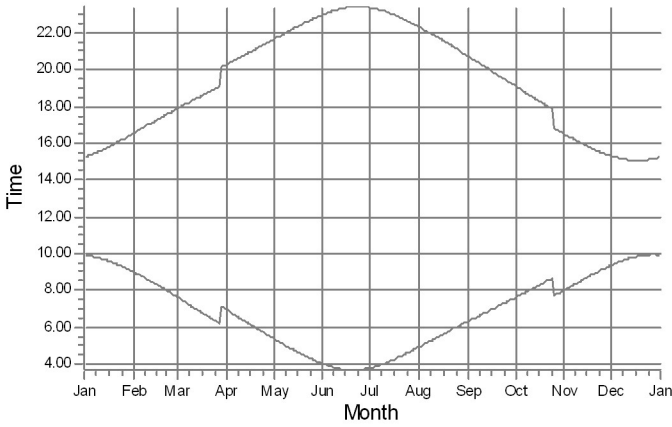


Shadow receptors

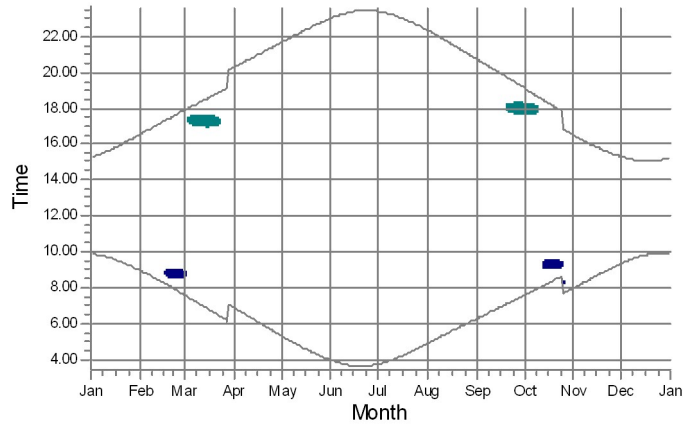
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

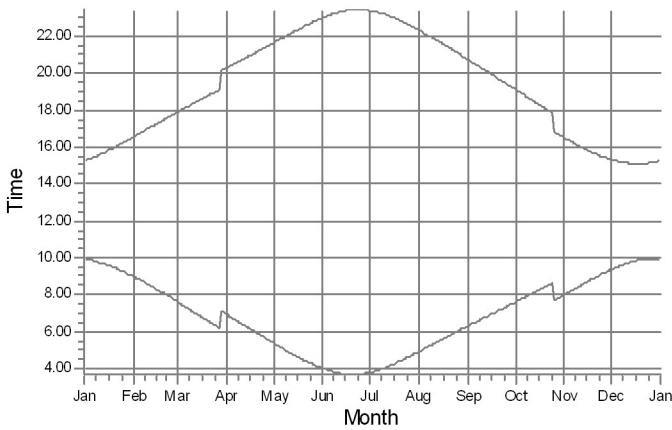
9: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)



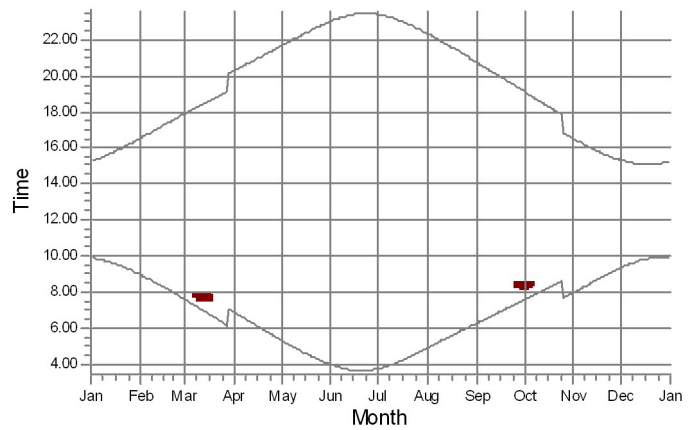
T1: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)



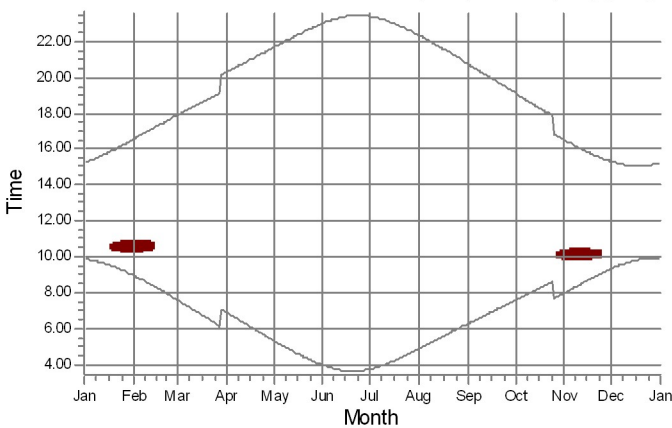
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)



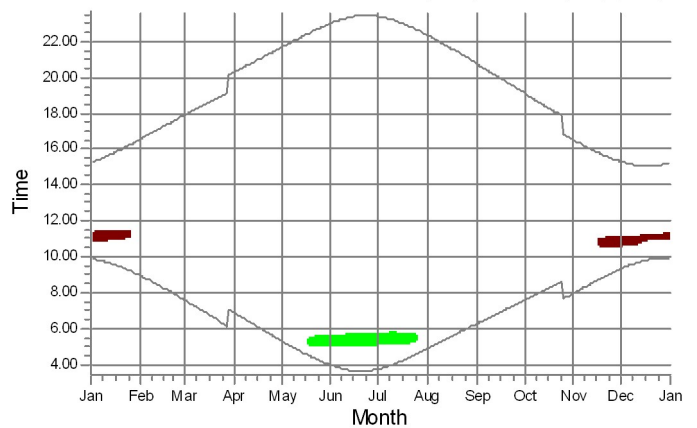
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)





T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)



T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)



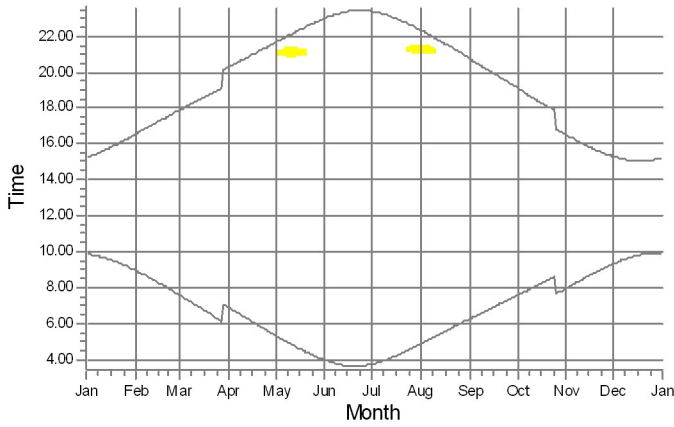
Shadow receptors

- | | | | |
|---|----------------------|---|----------------------|
|  | F: F - Asuinrakennus |  | H: H - Asuinrakennus |
|  | G: G - Asuinrakennus |  | I: I - Asuinrakennus |

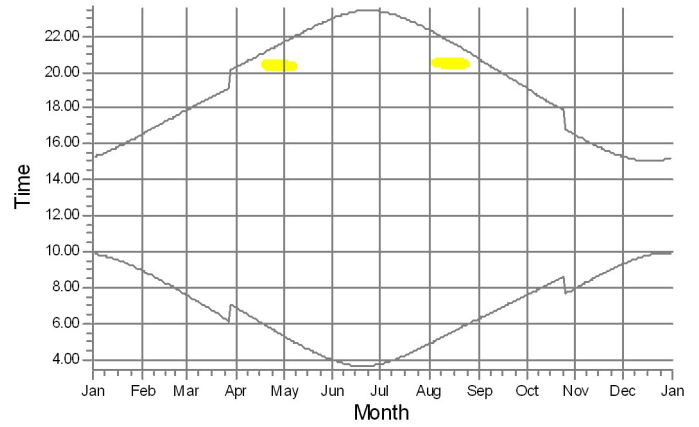
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

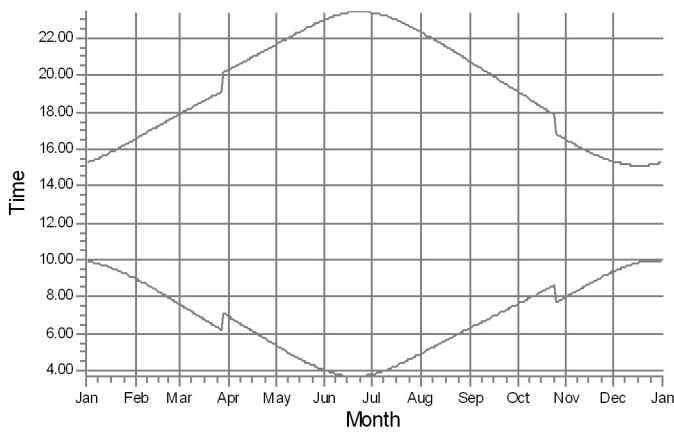
T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)



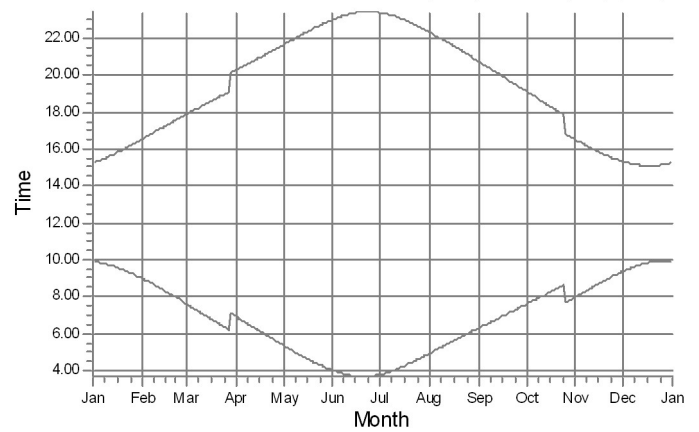
T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)



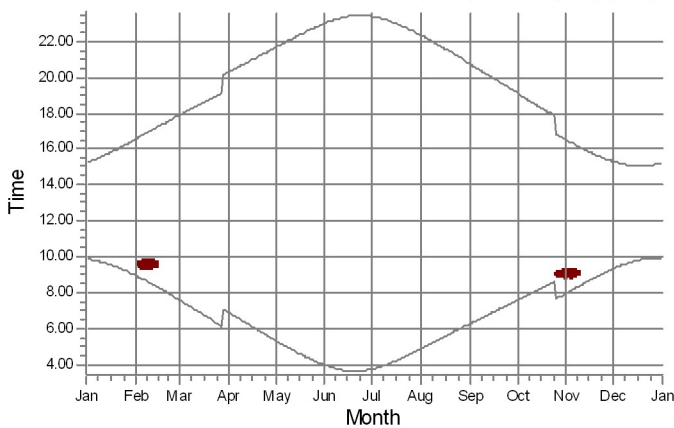
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)



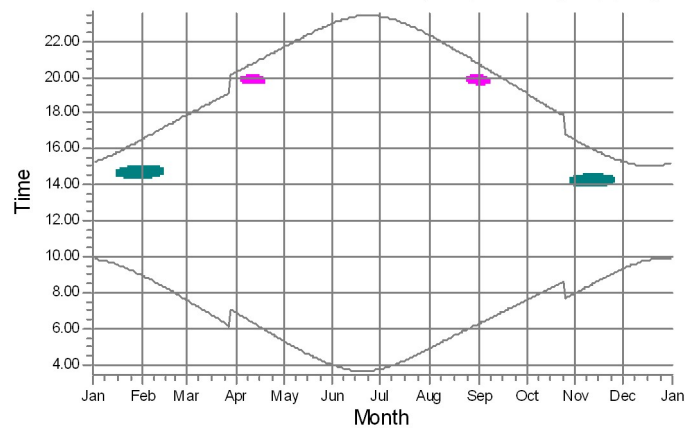
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)



T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)



T2: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)



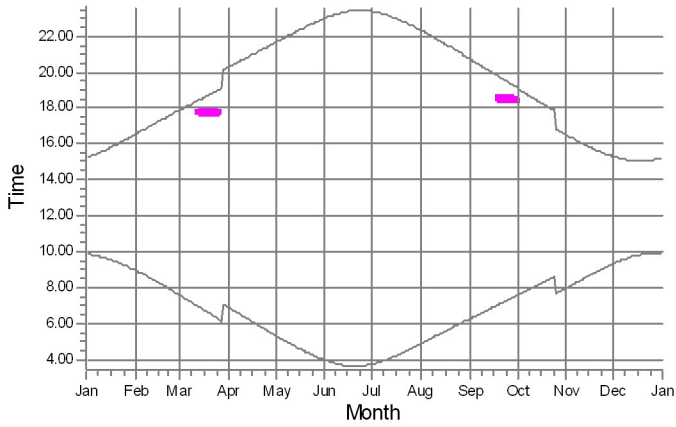
Shadow receptors

	B: B - Asuinrakennus		F: F - Asuinrakennus
	E: E - Asuinrakennus		H: H - Asuinrakennus

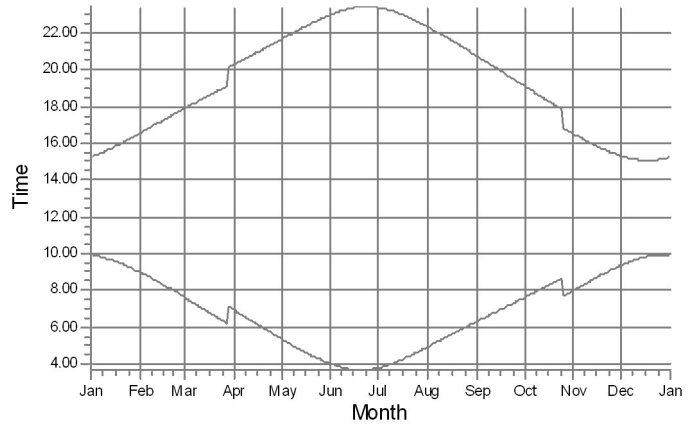
SHADOW - Calendar per WTG, graphical

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

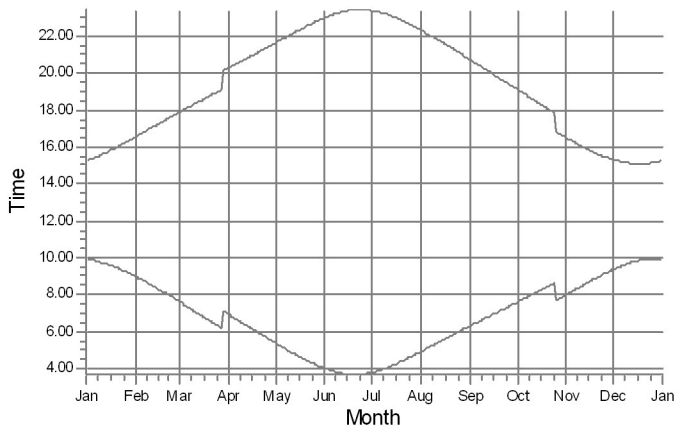
T3: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (249)



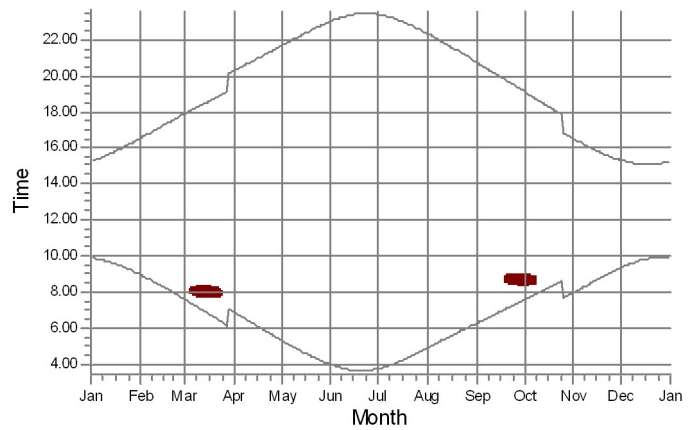
T6: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (250)



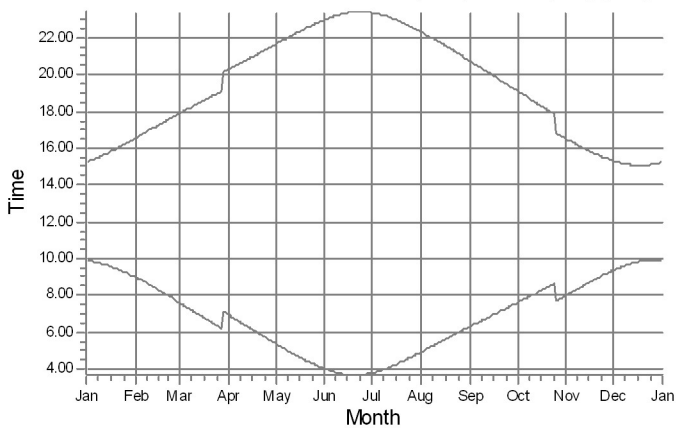
T7: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (251)



T8: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (252)



T9: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (253)

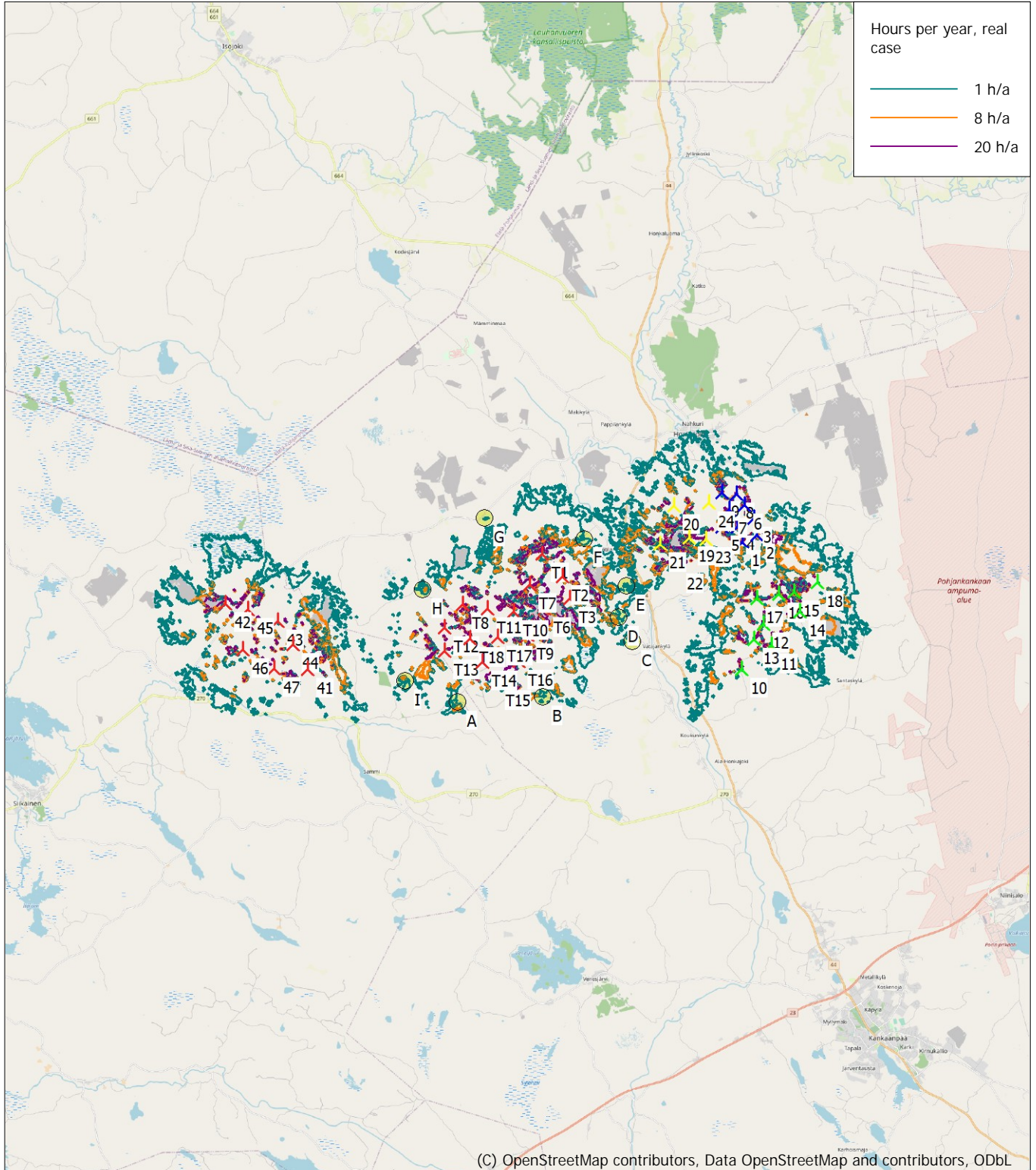


Shadow receptors

E: E - Asuinrakennus H: H - Asuinrakennus

SHADOW - Map

Calculation: Copy of Haukkasalo_VE1_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 280 North: 6 877 290
 ▲ New WTG ● Shadow receptor
 Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
 Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 15. Yhteisvaikutus varjostusmallinnuksen tulokset "Real Case, No Forest" - VE2

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
601	492	438	473	592	753	967	1 132	882	732	634	578	8 274

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

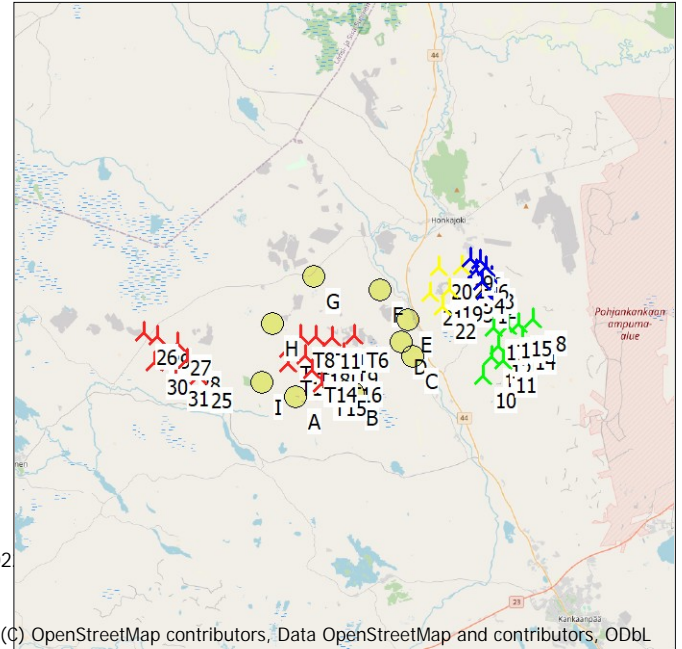
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Haukkasalo_0605202
Obstacles used in calculation
Receptor grid resolution: 1,0 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	253 616	6 878 546	105,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
10	253 256	6 874 085	105,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
11	254 378	6 874 820	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
12	254 139	6 875 605	109,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
13	253 765	6 875 081	106,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
14	255 464	6 875 947	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
15	255 305	6 876 650	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
16	254 745	6 876 621	107,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
17	253 975	6 876 541	107,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
18	256 142	6 876 896	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
19	251 747	6 878 810	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
2	254 154	6 878 757	112,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
20	251 304	6 879 975	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
21	250 727	6 878 659	100,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
22	251 315	6 877 881	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
23	252 334	6 878 721	102,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
24	252 523	6 879 987	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
25	238 078	6 875 215	80,3	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
26	235 391	6 877 752	80,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
27	237 182	6 877 006	80,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
28	237 630	6 876 111	79,3	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
29	236 137	6 877 454	78,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
3	254 073	6 879 328	112,6	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
30	235 851	6 876 098	77,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
31	236 884	6 875 364	75,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
4	253 487	6 879 084	110,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
5	252 957	6 879 121	107,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
6	253 775	6 879 840	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
7	253 252	6 879 721	117,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
8	253 525	6 880 225	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
9	253 026	6 880 328	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
T10	245 421	6 876 704	92,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T12	242 968	6 876 299	90,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

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(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

...continued from previous page

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
T13	242 898	6 875 520	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 641	6 876 974	93,6	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200....Yes	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	a.g.l. [m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values
		Shadow hours per year [h/year]
A	A - Asuinrakennus	9:00
B	B - Asuinrakennus	5:49
C	C - Asuinrakennus	0:00
D	D - Lomarakennus	0:00
E	E - Asuinrakennus	2:13
F	F - Asuinrakennus	0:00
G	G - Asuinrakennus	0:00
H	H - Asuinrakennus	8:14
I	I - Asuinrakennus	7:47

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

No.	Name	Expected [h/year]
1	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)	0:00
11	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)	0:00
12	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)	0:00
17	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)	0:00
19	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
2	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)	0:00
20	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
21	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
22	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	2:13
23	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
24	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

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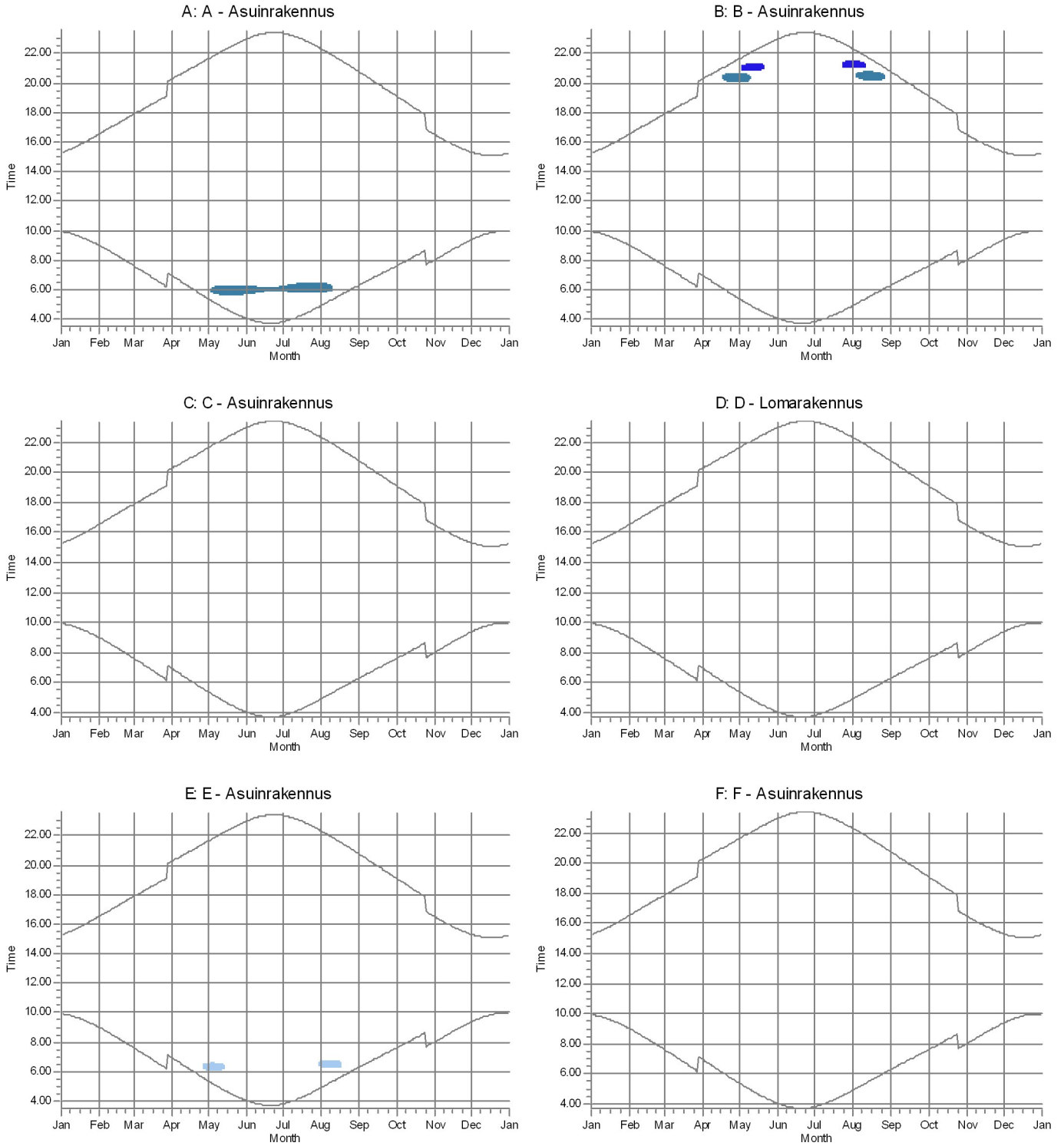
No.	Name	Expected [h/year]
25	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	0:00
26	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
27	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	0:00
28	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	0:00
29	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (296)	0:00
3	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)	0:00
30	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (297)	0:00
31	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (298)	0:00
4	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (87)	0:00
5	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (88)	0:00
6	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (89)	0:00
7	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (90)	0:00
8	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (91)	0:00
9	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)	0:00
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)	1:02
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)	2:10
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)	8:57
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)	2:09
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)	12:40
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)	0:51
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)	2:50
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (302)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus



WTGs

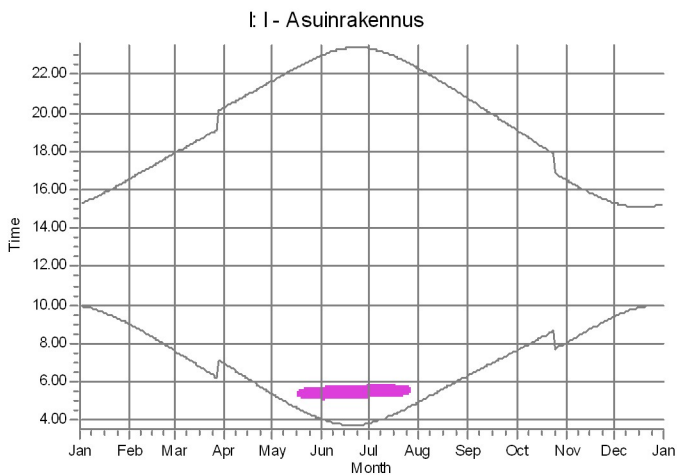
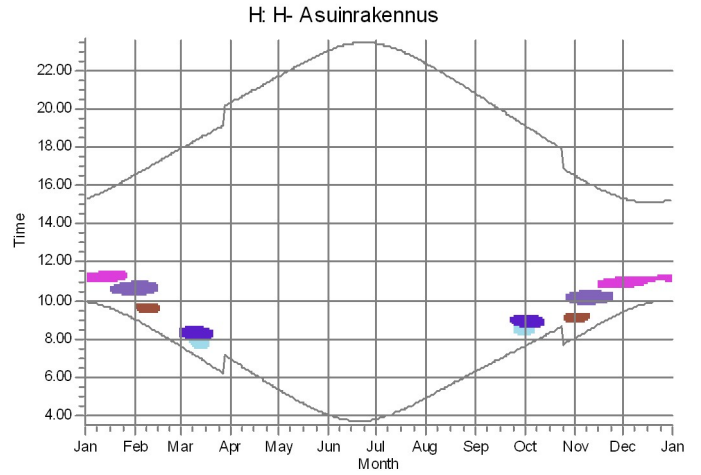
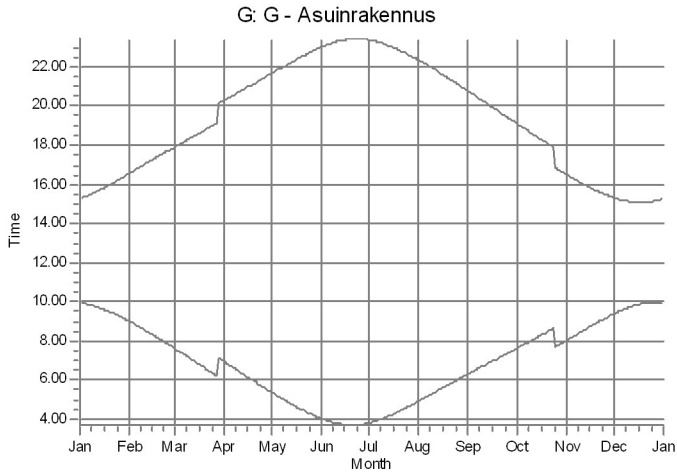
22: VESTAS V162-6.0 HH169 6000 162.0 I0I hub: 219.0 m (TOT: 300.0 m)

T14: Generic RD200 7200 200.0 I0I hub: 200.0 m (TOT: 300.0 m) (307)

T15: Generic RD200 7200 200.0 I0I hub: 200.0 m (TOT: 300.0 m) (308)

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus



WTGs

T11: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (304)
T12: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (305)

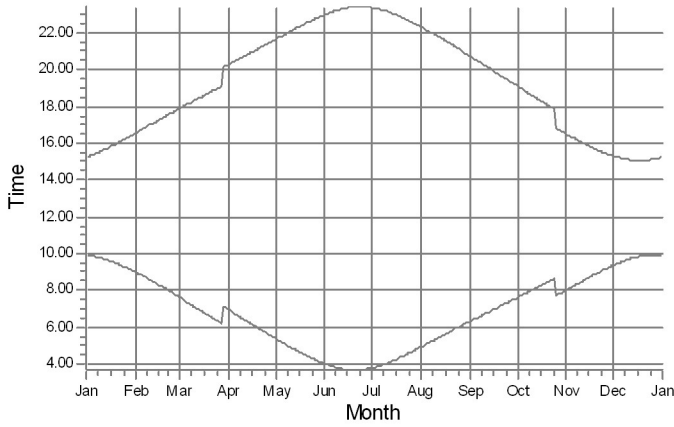
T13: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (306)
T18: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (310)

T8: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (301)

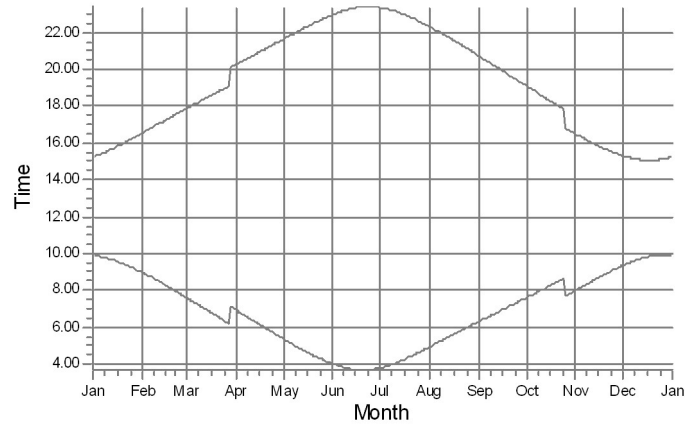
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

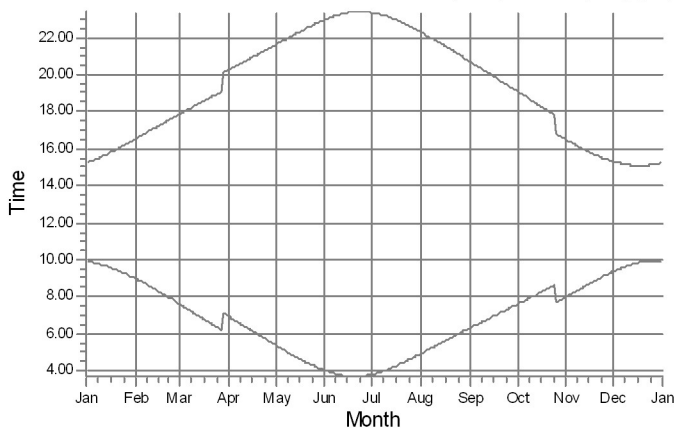
1: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)



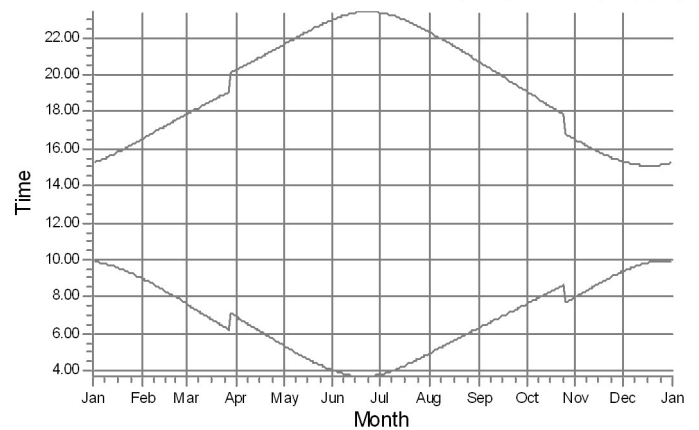
10: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)



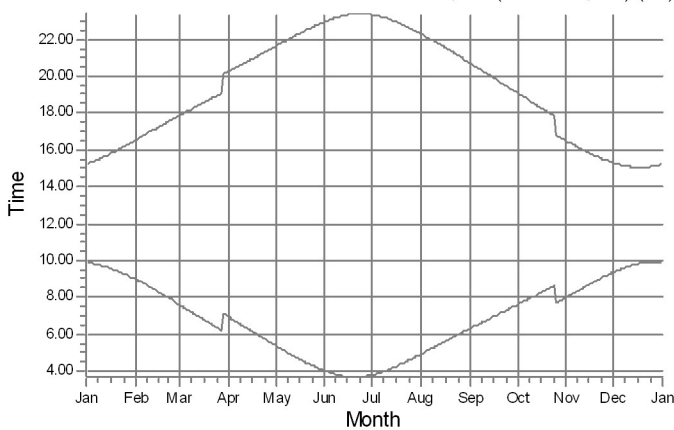
11: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)



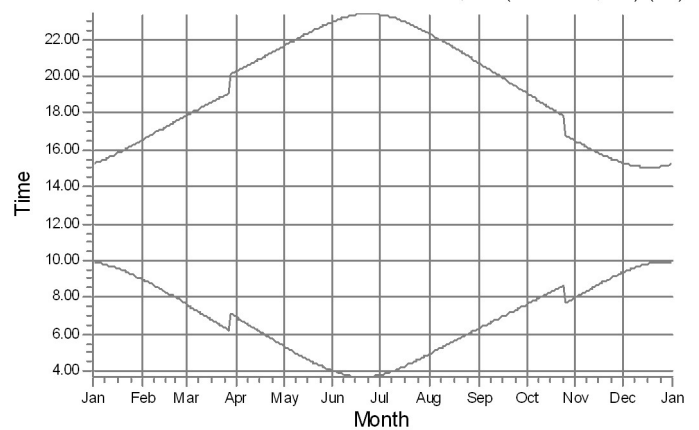
12: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)



13: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)



14: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)

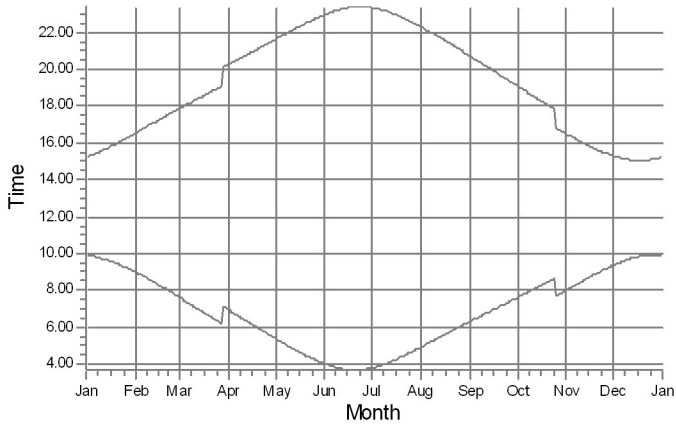


Shadow receptors

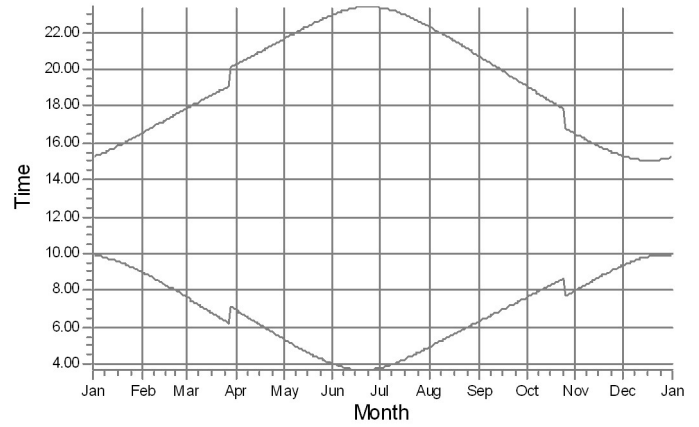
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

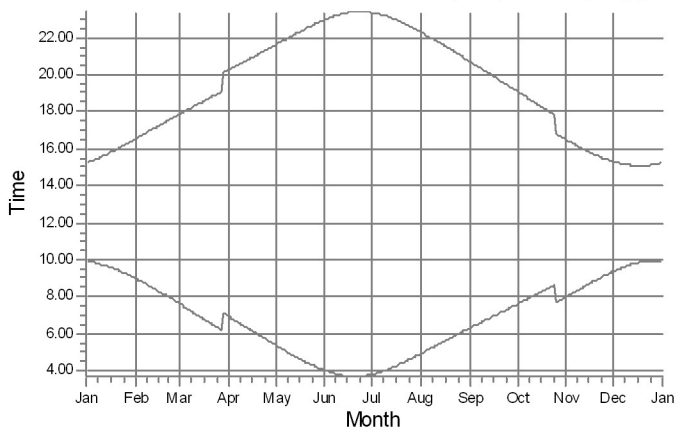
15: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)



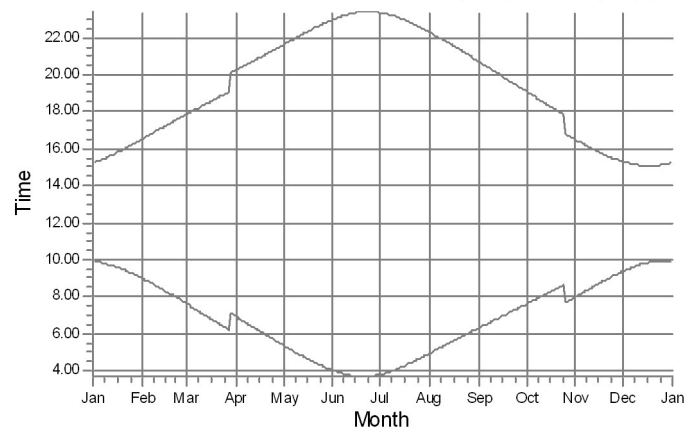
16: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)



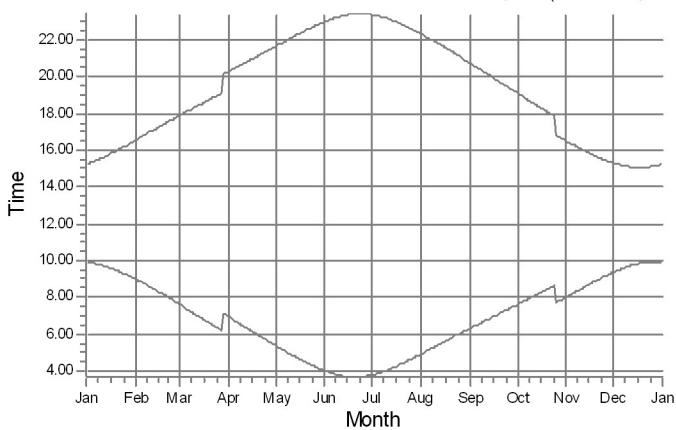
17: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)



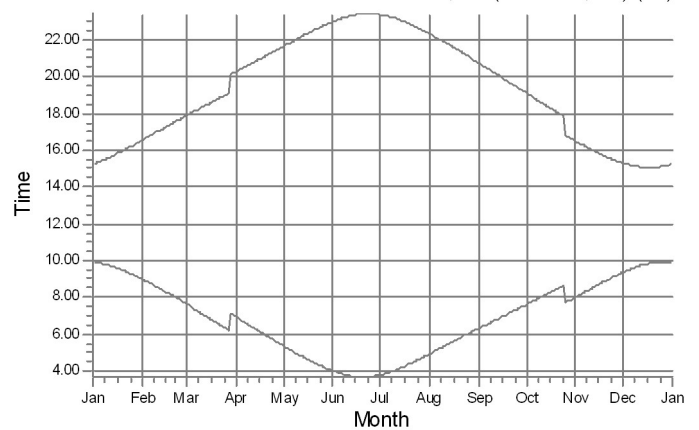
18: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)



19: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



2: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)

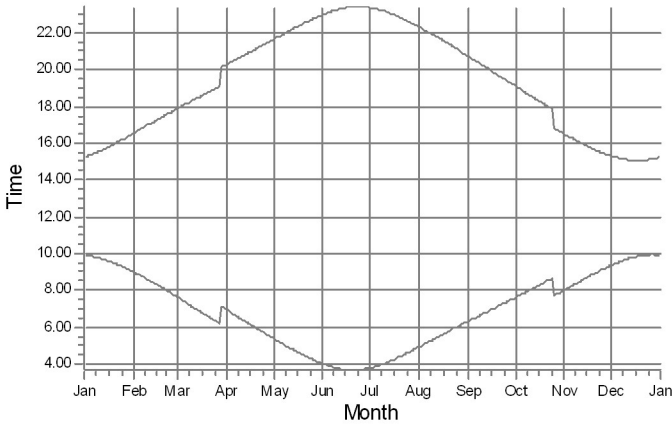


Shadow receptors

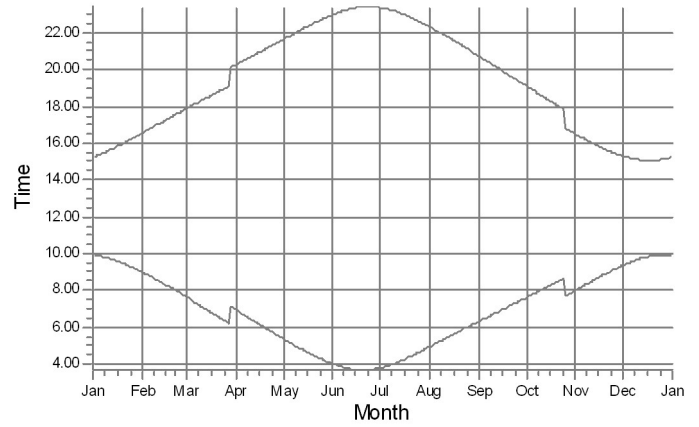
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

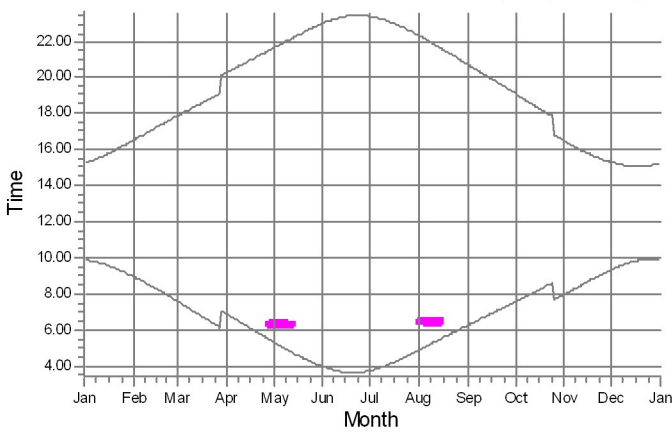
20: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



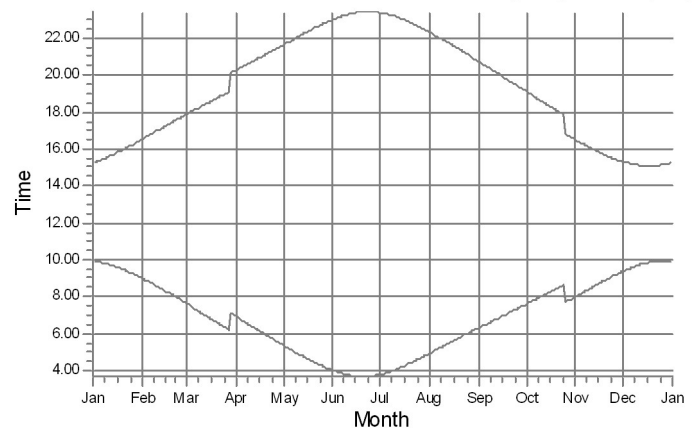
21: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



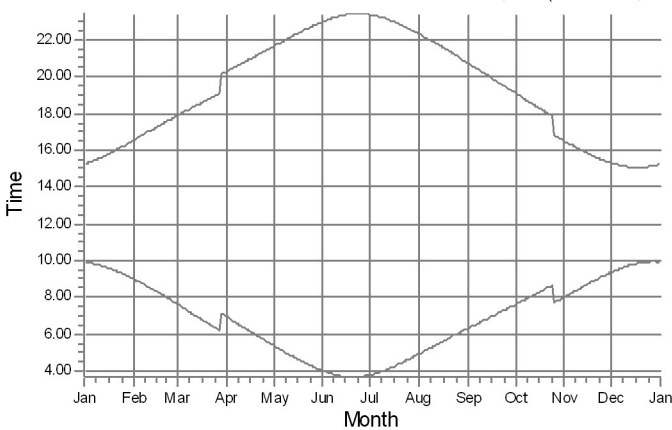
22: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



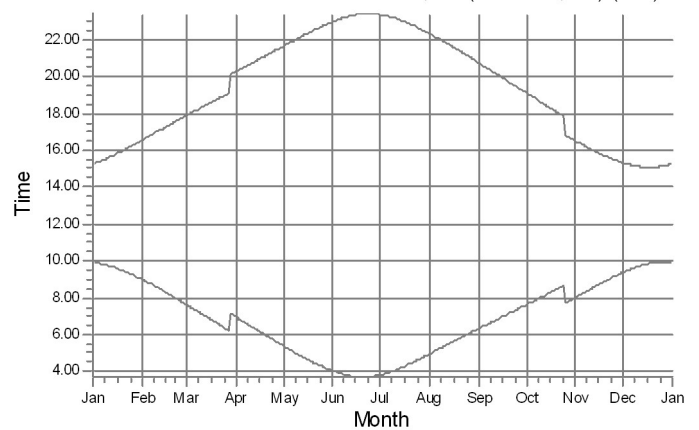
23: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



24: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



25: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)



Shadow receptors

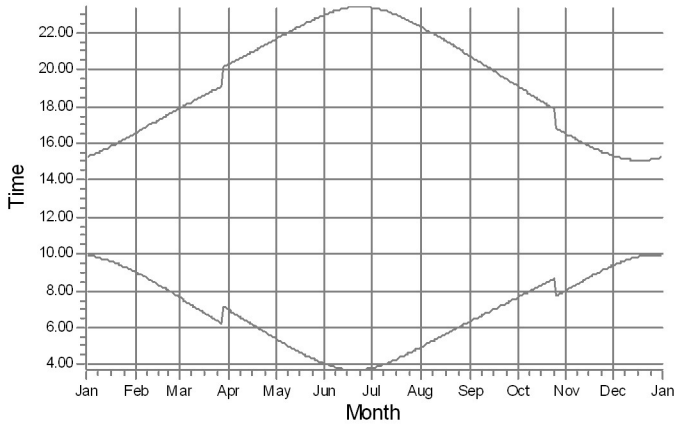


E: E - Asuinrakennus

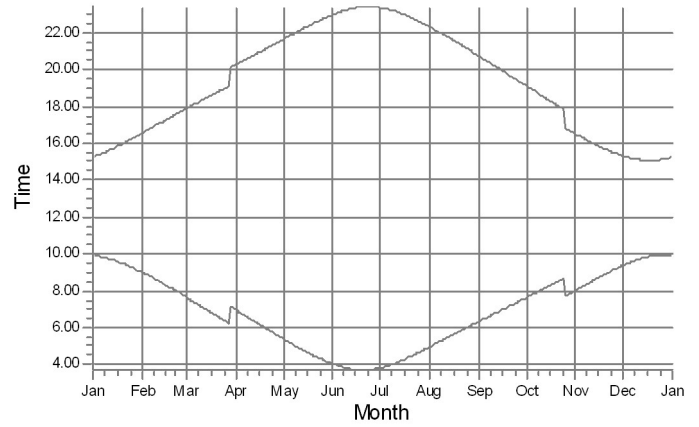
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

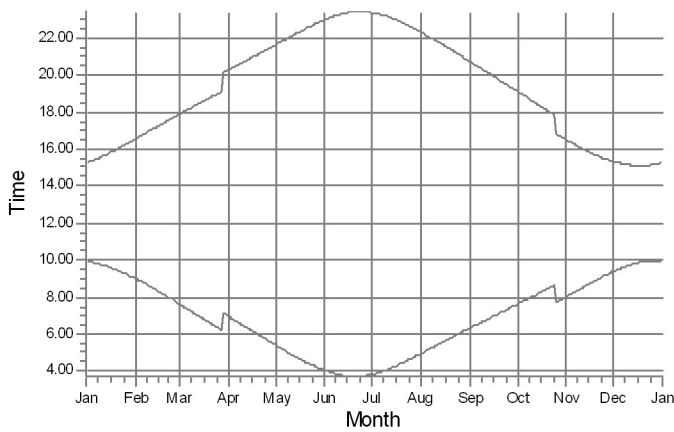
26: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (293)



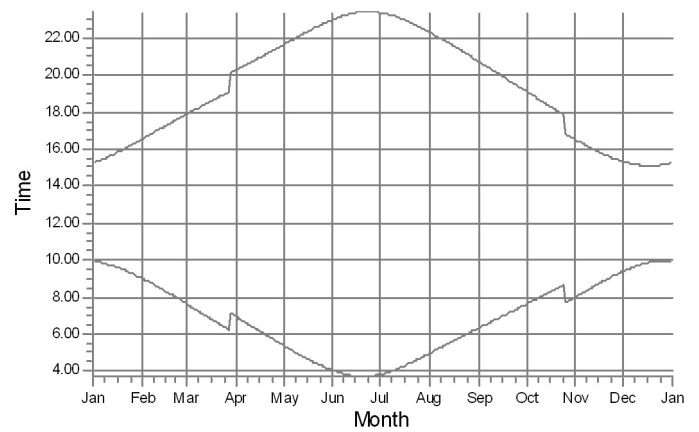
27: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (294)



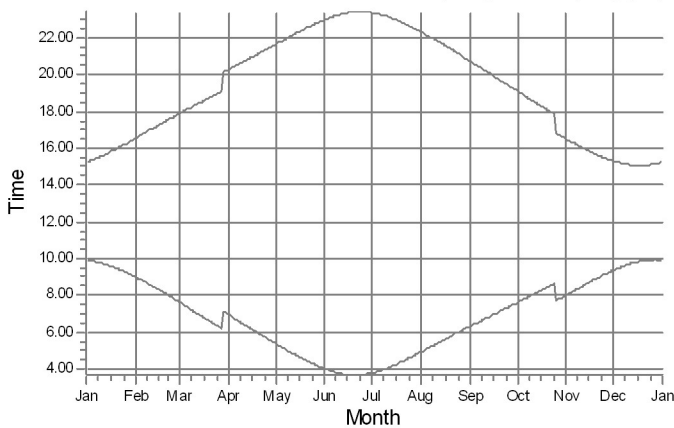
28: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (295)



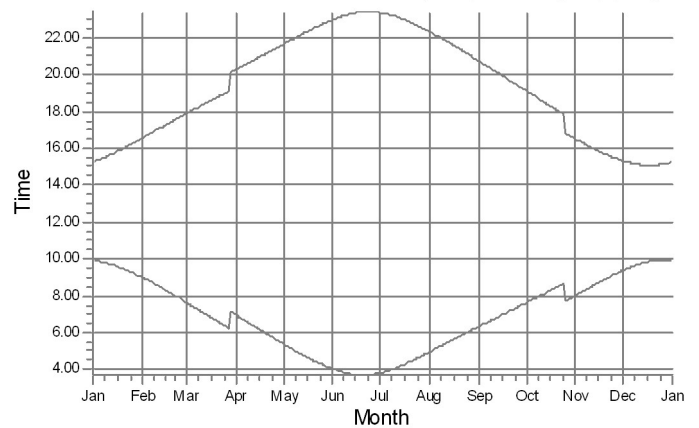
29: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (296)



3: NORDEX N117/2400 2400 116.8 !O!hub: 120,0 m (TOT: 178,4 m) (86)



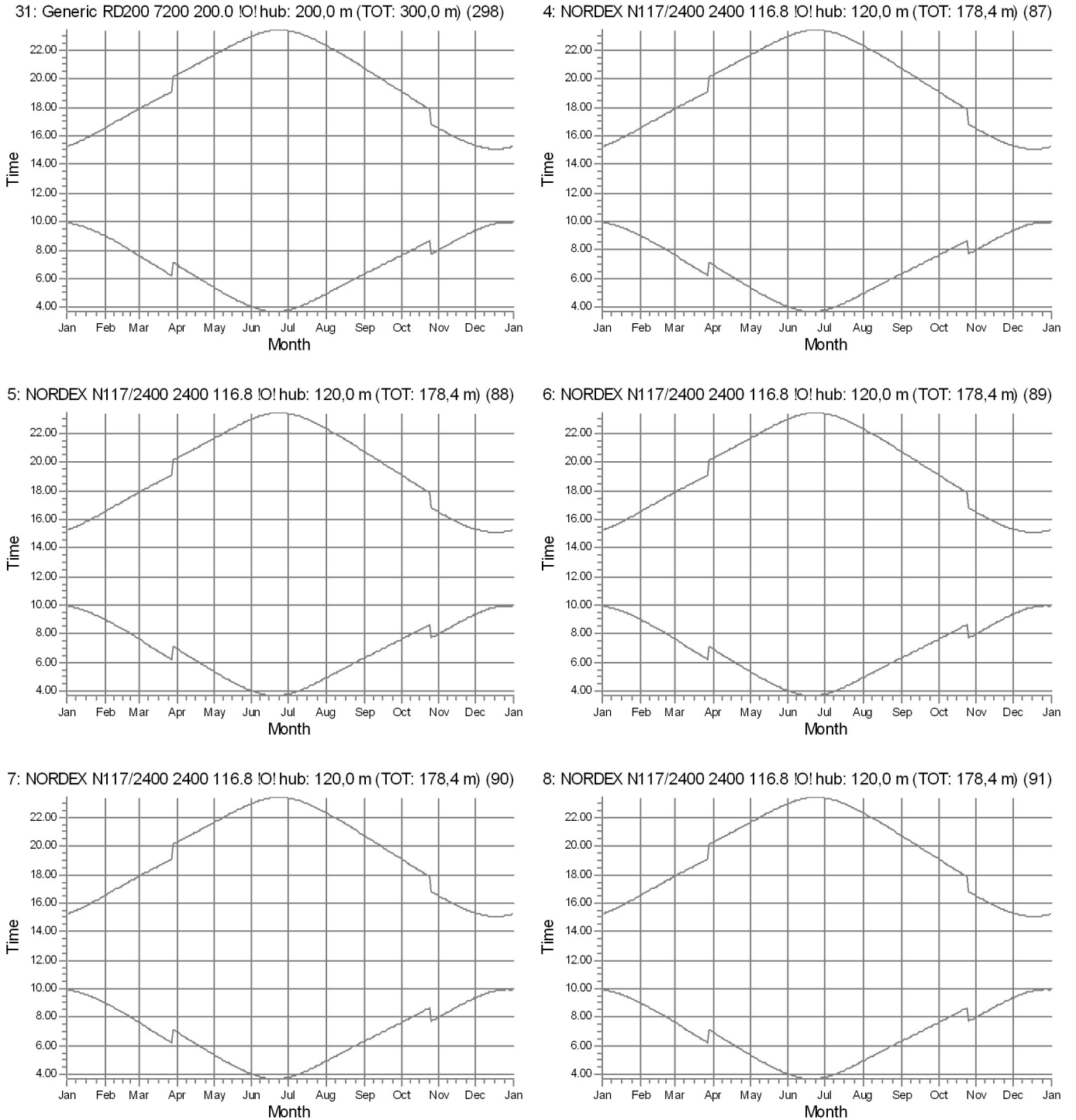
30: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (297)



Shadow receptors

SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

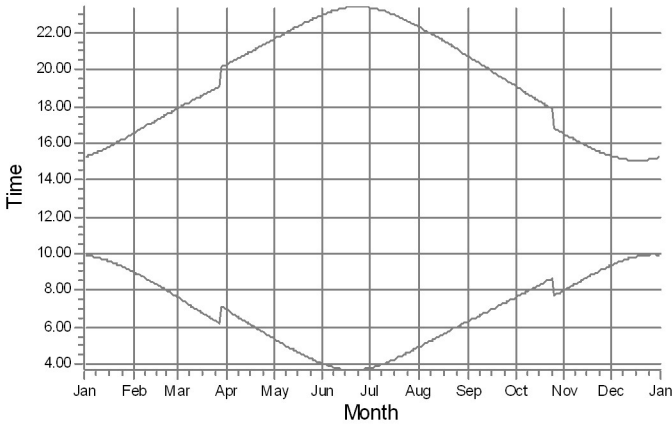


Shadow receptors

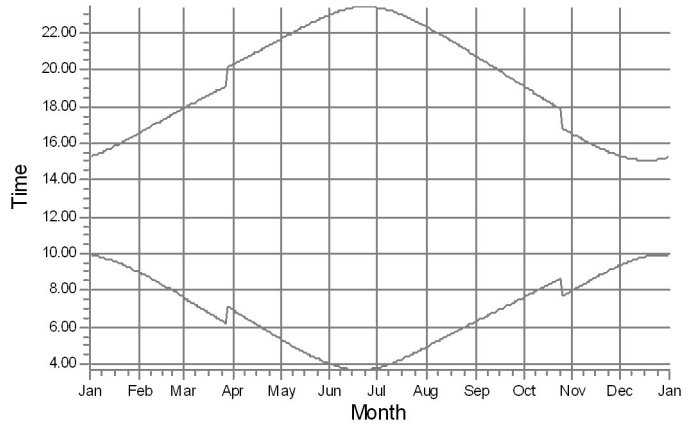
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

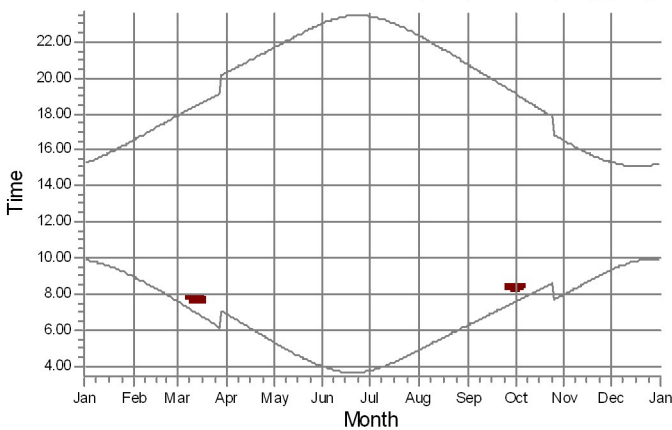
9: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)



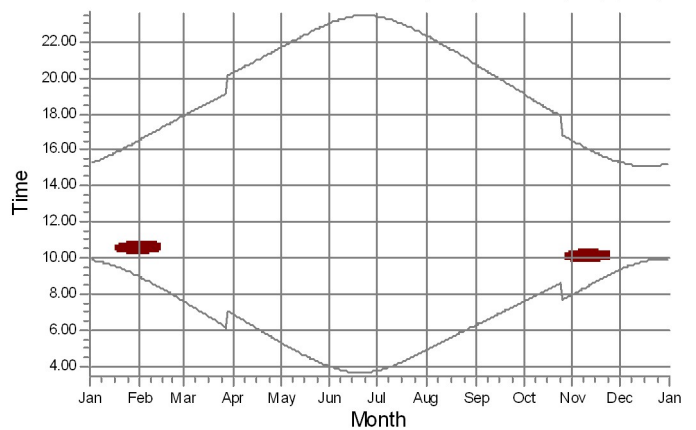
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (303)



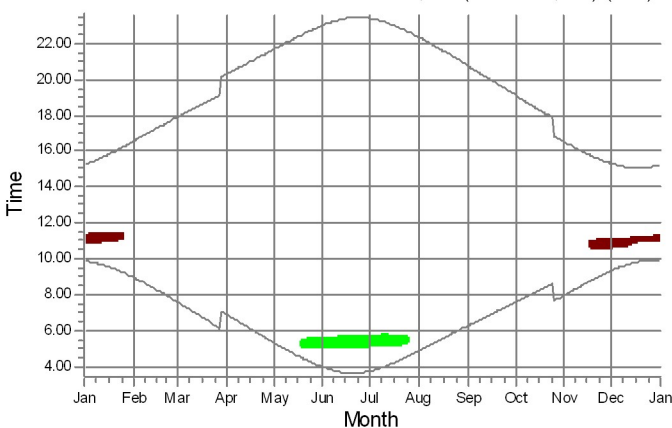
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (304)



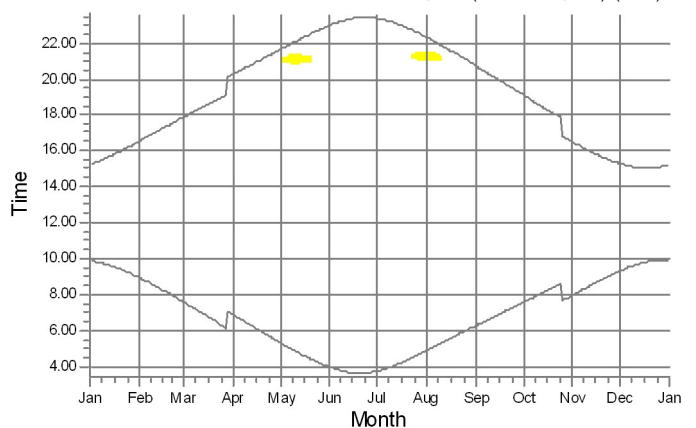
T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (305)



T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (306)



T14: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (307)



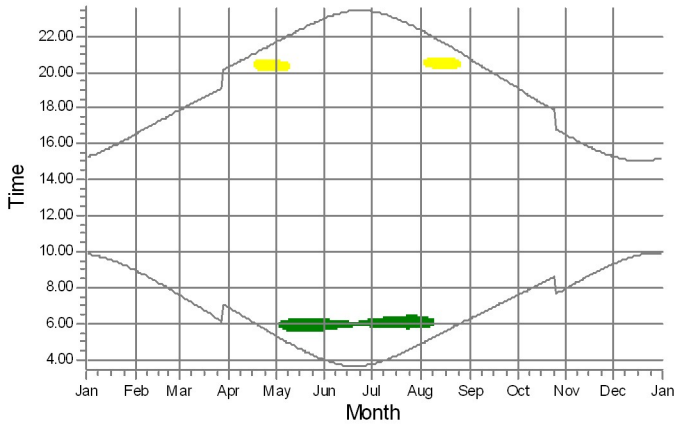
Shadow receptors

B: B - Asuinrakennus H: H - Asuinrakennus I: I - Asuinrakennus

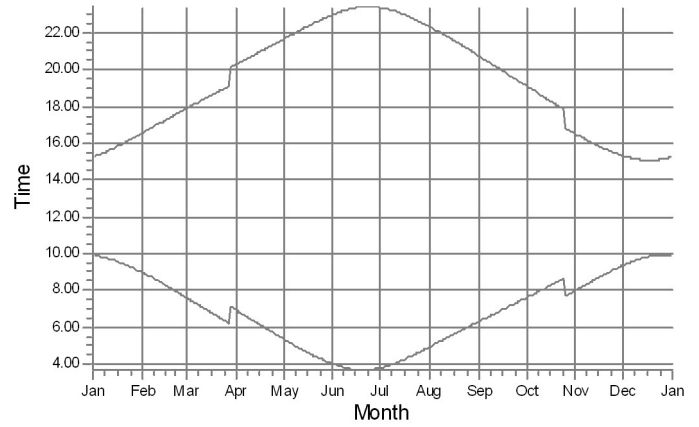
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus

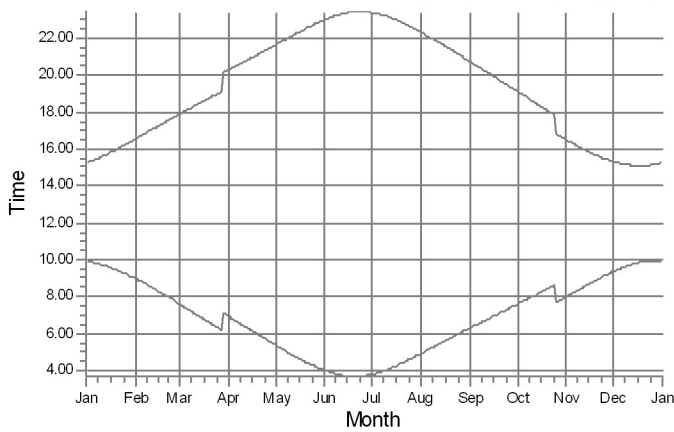
T15: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (308)



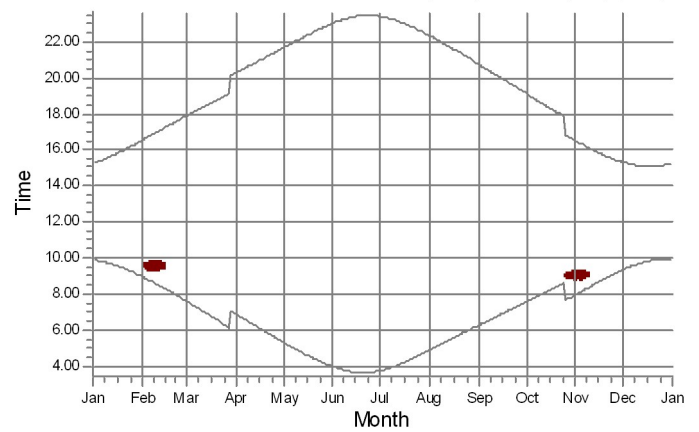
T16: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (309)



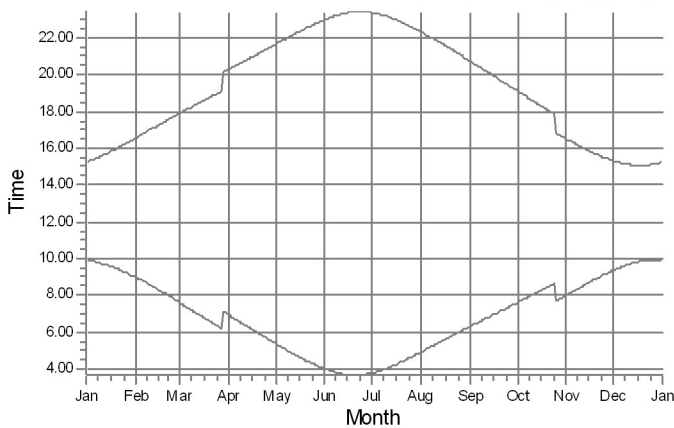
T17: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (311)



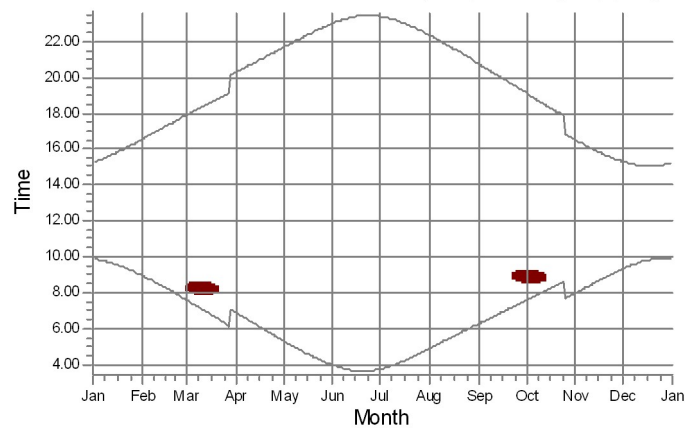
T18: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (310)



T6: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (300)



T8: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (301)

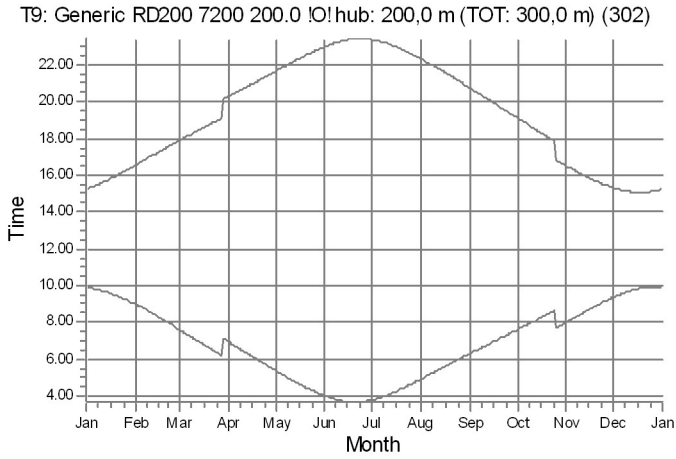


Shadow receptors

A: A - Asuinrakennus B: B - Asuinrakennus H: H - Asuinrakennus

SHADOW - Calendar per WTG, graphical

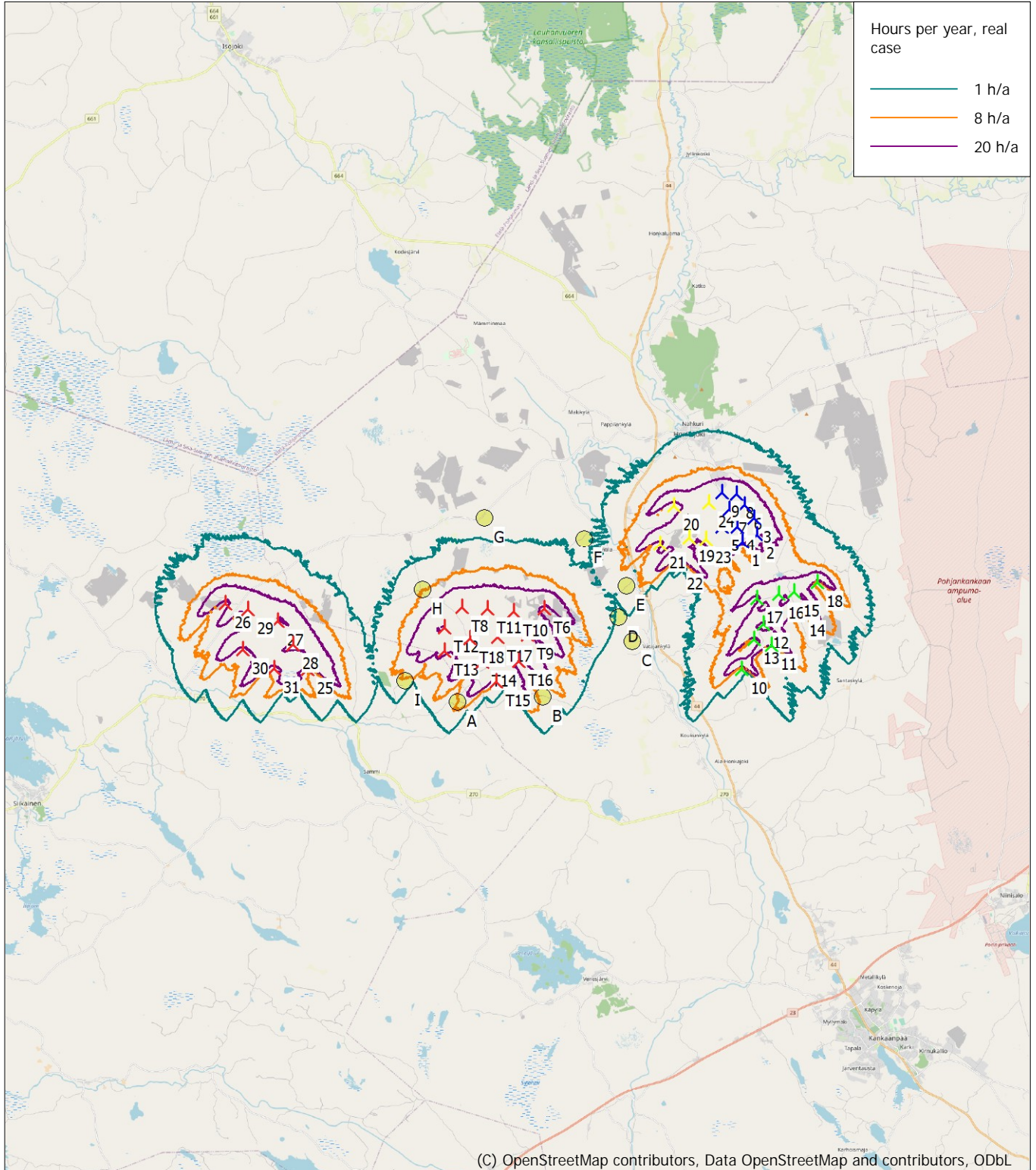
Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus



Shadow receptors

SHADOW - Map

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_No_Forest_yhteisvaikutus



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 280 North: 6 877 290
 ▲ New WTG ● Shadow receptor
 Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
 Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m

Liite 16. Yhteisvaikutus varjostusmallinnuksen tulokset "Real Case, Luke Forest" - VE2

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

Assumptions for shadow calculations

Maximum distance for influence 2 500 m
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
0,80	2,30	4,40	6,00	7,40	8,10	8,40	6,70	4,10	1,90	0,70	0,30

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

MERRA-2_N62,00_E022,50 (12)

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
599	491	437	472	590	751	965	1 129	879	730	633	576	8 252

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: CONTOURLINE_Haukkasalo_06052022

Area object(s) used in calculation:

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Area object (Heights a.g.l. for e.g. Forest (ORA tool) or ZVI obstructions): REG

Obstacles used in calculation

Receptor grid resolution: 1,0 m

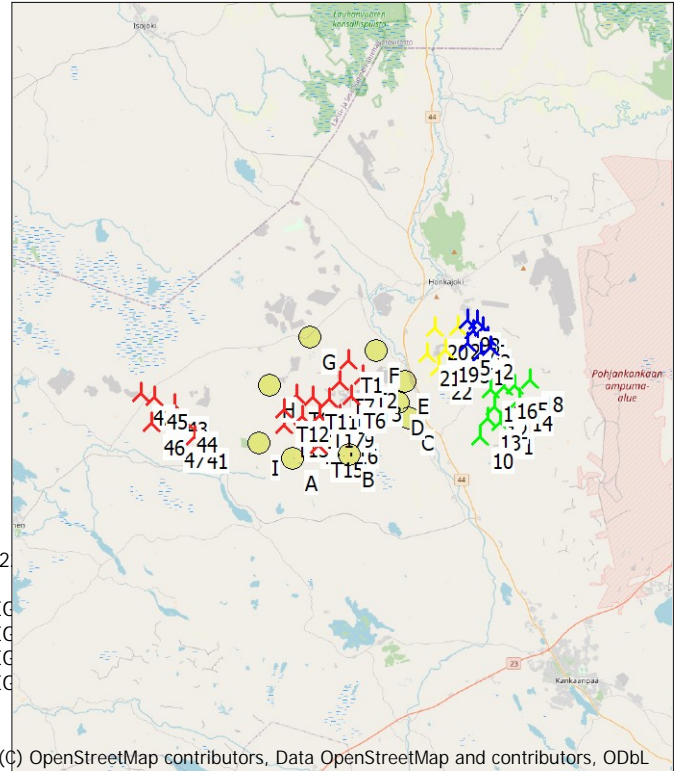
All coordinates are in

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	253 616	6 878 546	105,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
10	253 256	6 874 085	105,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
11	254 378	6 874 820	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
12	254 139	6 875 605	109,4	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
13	253 765	6 875 081	106,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
14	255 464	6 875 947	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
15	255 305	6 876 650	112,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
16	254 745	6 876 621	107,5	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
17	253 975	6 876 541	107,1	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
18	256 142	6 876 896	110,0	NORDEX N131/3000 300...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	144,0	2 500	10,3
19	251 747	6 878 810	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
2	254 154	6 878 757	112,2	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
20	251 304	6 879 975	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
21	250 727	6 878 659	100,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
22	251 315	6 877 881	105,0	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
23	252 334	6 878 721	102,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
24	252 523	6 879 987	107,5	VESTAS V162-6.0 HH169 ...	Yes	VESTAS	V162-6.0 HH219-6 000	6 000	162,0	219,0	2 500	10,4
3	254 073	6 879 328	112,6	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
4	253 487	6 879 084	110,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
41	238 078	6 875 215	80,3	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
42	235 391	6 877 752	80,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
43	237 182	6 877 006	80,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
44	237 630	6 876 111	79,3	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
45	236 137	6 877 454	78,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
46	235 851	6 876 098	77,5	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
47	236 884	6 875 364	75,0	Generic RD200 7200 200...	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
5	252 957	6 879 121	107,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
6	253 775	6 879 840	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
7	253 252	6 879 721	117,5	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8

To be continued on next page...



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:400 000
New WTG Shadow receptor

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

...continued from previous page

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM
			[m]									
8	253 525	6 880 225	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
9	253 026	6 880 328	115,0	NORDEX N117/2400 240...	Yes	NORDEX	N117/2400-2 400	2 400	116,8	120,0	2 500	11,8
T1	246 582	6 878 619	95,6	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T10	245 421	6 876 704	92,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T11	244 530	6 876 852	90,9	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T12	242 968	6 876 299	90,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T13	242 898	6 875 520	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T14	244 202	6 875 018	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T15	244 645	6 874 295	83,7	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T16	245 483	6 874 938	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T17	244 829	6 875 835	90,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T18	243 855	6 875 881	87,5	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T2	247 257	6 877 777	97,6	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T3	247 430	6 877 022	96,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T6	246 523	6 876 714	95,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T7	246 054	6 877 590	94,8	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T8	243 691	6 877 054	93,7	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4
T9	245 882	6 875 817	92,0	Generic RD200 7200 200....	Yes	Generic	RD200-7 200	7 200	200,0	200,0	2 500	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	A - Asuinrakennus	243 235	6 873 658	80,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	B - Asuinrakennus	246 258	6 873 632	87,4	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	C - Asuinrakennus	249 534	6 875 344	92,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	D - Lomarakennus	249 068	6 876 198	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	E - Asuinrakennus	249 460	6 877 291	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	F - Asuinrakennus	248 080	6 879 034	96,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	G - Asuinrakennus	244 657	6 880 019	94,1	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	H - Asuinrakennus	242 301	6 877 666	90,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	I - Asuinrakennus	241 468	6 874 582	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	A - Asuinrakennus	0:00
B	B - Asuinrakennus	5:48
C	C - Asuinrakennus	0:00
D	D - Lomarakennus	0:00
E	E - Asuinrakennus	3:18
F	F - Asuinrakennus	5:03
G	G - Asuinrakennus	0:52
H	H - Asuinrakennus	7:57
I	I - Asuinrakennus	7:46

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

No.	Name	Expected [h/year]
1	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)	0:00
11	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)	0:00
12	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

...continued from previous page

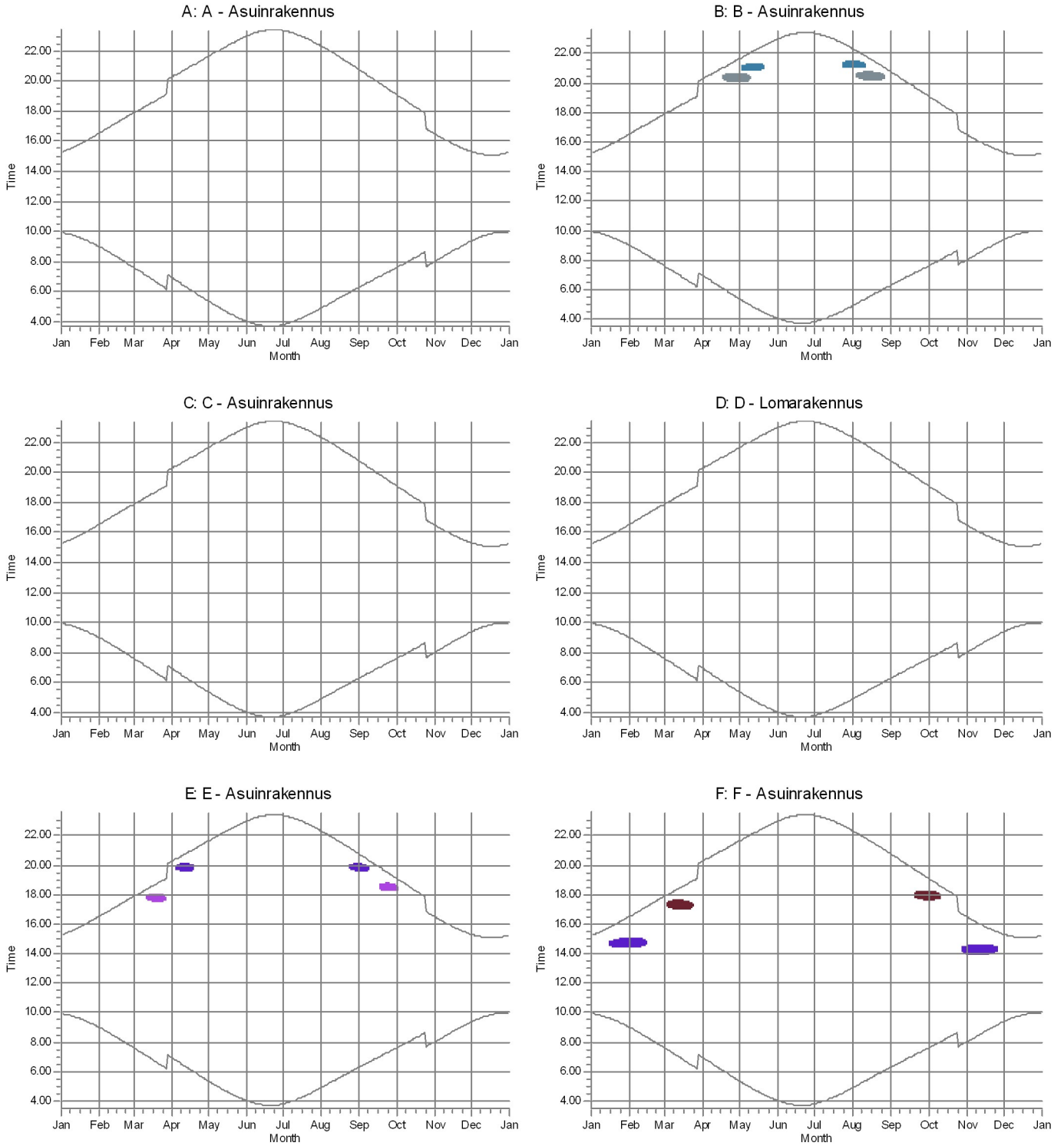
No.	Name	Expected [h/year]
17	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)	0:00
19	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
2	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)	0:00
20	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
21	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
22	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
23	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
24	VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)	0:00
3	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)	0:00
4	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (87)	0:00
41	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	0:00
42	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
43	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	0:00
44	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	0:00
45	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (296)	0:00
46	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (297)	0:00
47	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (298)	0:00
5	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (88)	0:00
6	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (89)	0:00
7	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (90)	0:00
8	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (91)	0:00
9	NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)	0:00
T1	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	3:38
T10	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
T11	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:02
T12	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	2:09
T13	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	8:55
T14	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	2:09
T15	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	3:39
T16	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
T17	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
T18	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:51
T2	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	3:51
T3	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	1:39
T6	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
T7	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
T8	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	2:53
T9	Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus



WTGs

T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T14: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (258)

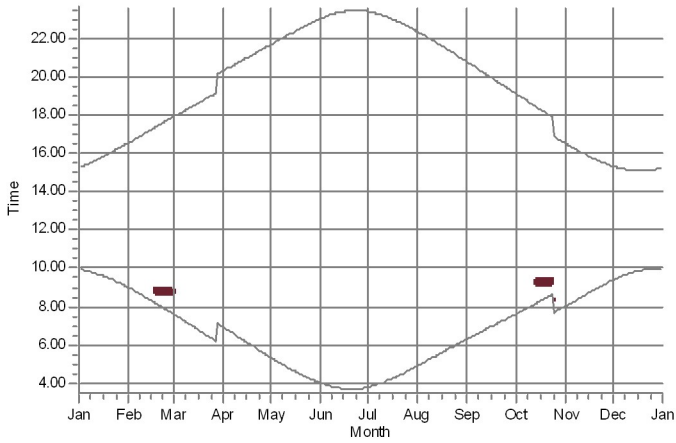
T15: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (259)
T2: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (248)

T3: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (249)

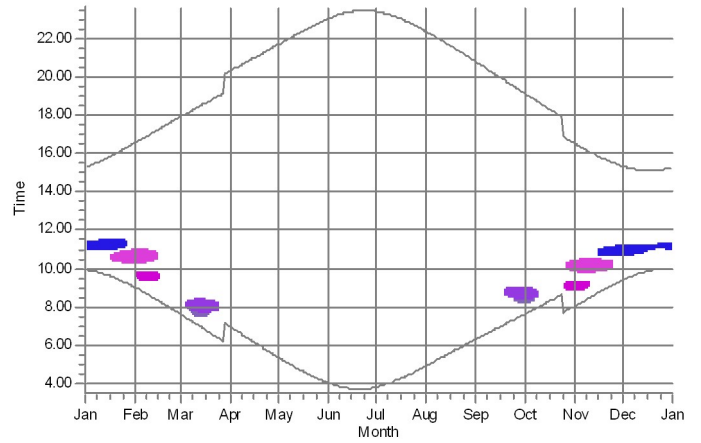
SHADOW - Calendar, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

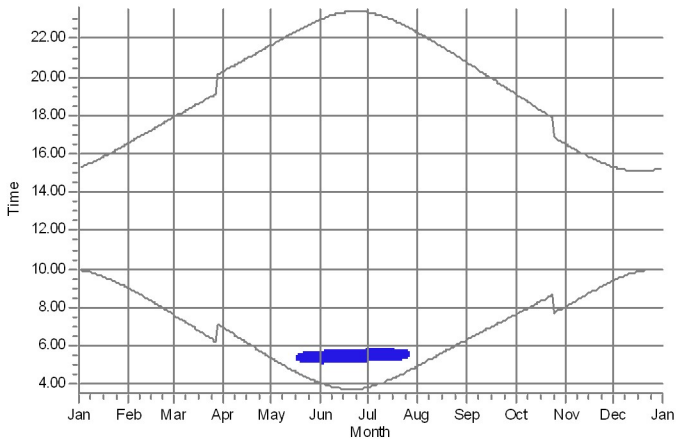
G: G - Asuinrakennus



H: H - Asuinrakennus



I: I - Asuinrakennus



WTGs

T1: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (247)
T11: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (255)

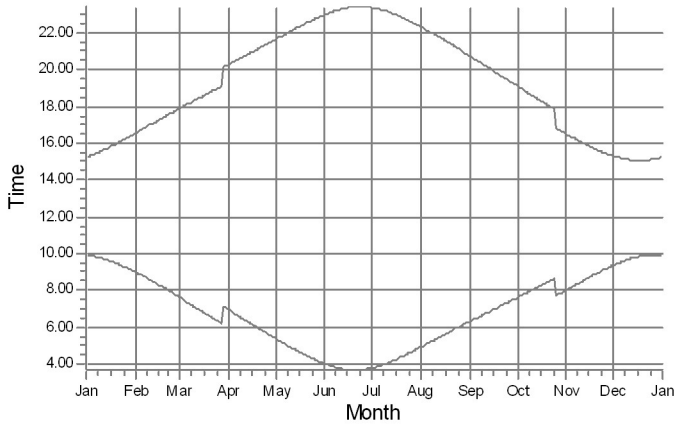
T12: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (256)
T13: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (257)

T18: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (261)
T8: Generic RD200 7200 200.0 IOI hub: 200.0 m (TOT: 300.0 m) (252)

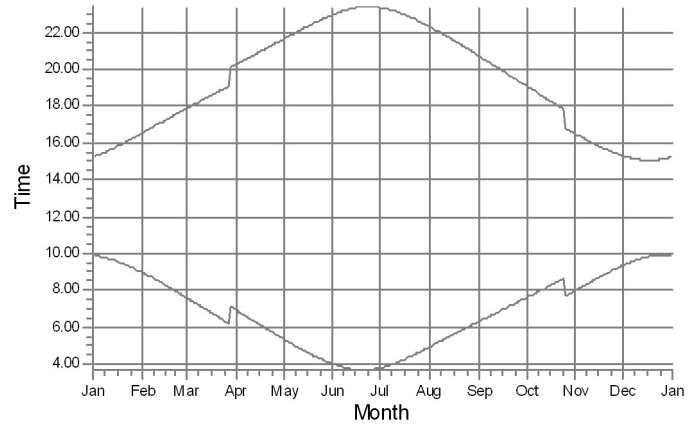
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

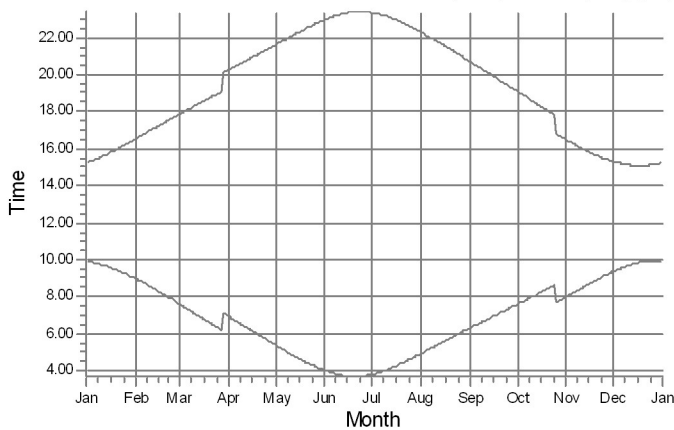
1: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (84)



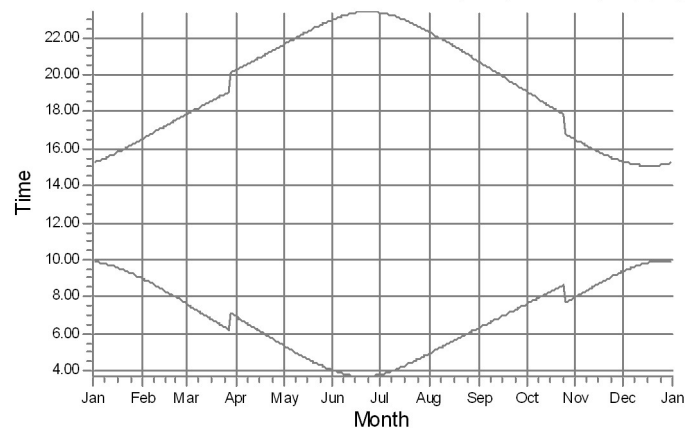
10: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (93)



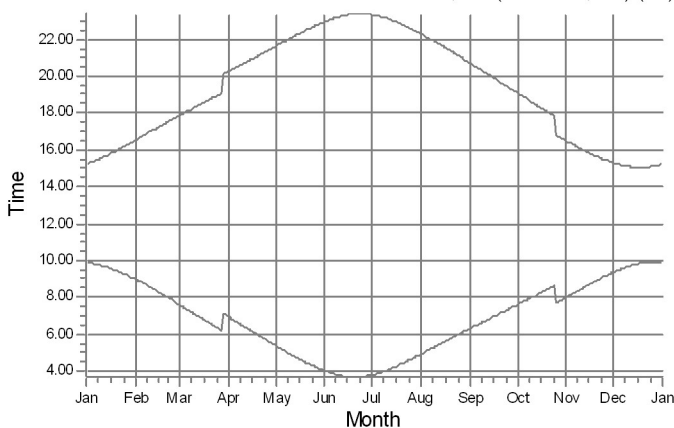
11: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (94)



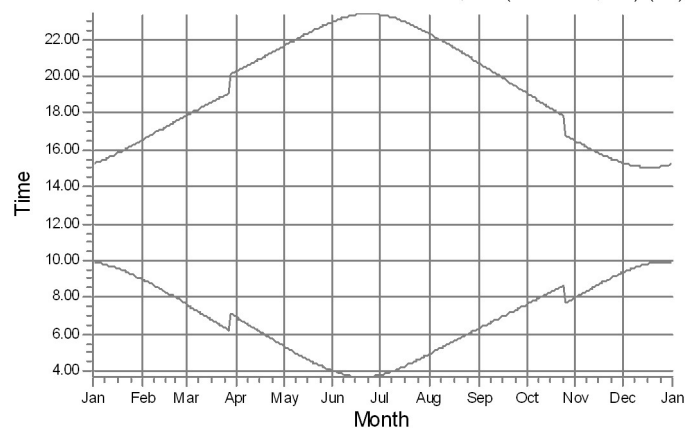
12: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (95)



13: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (96)



14: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (97)

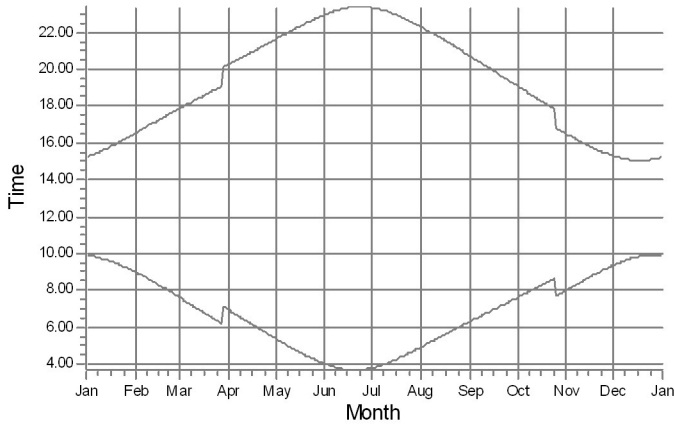


Shadow receptors

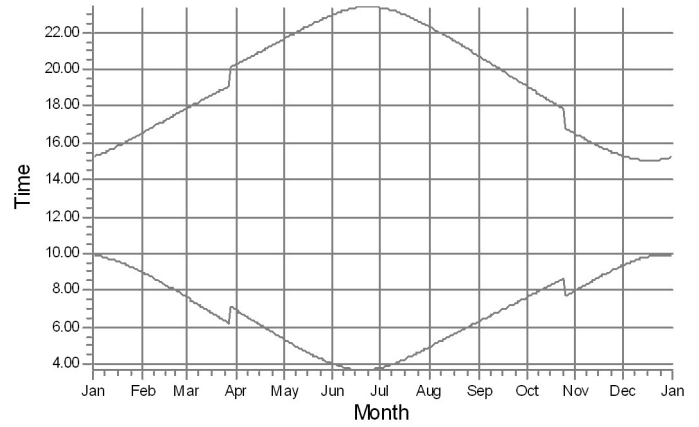
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

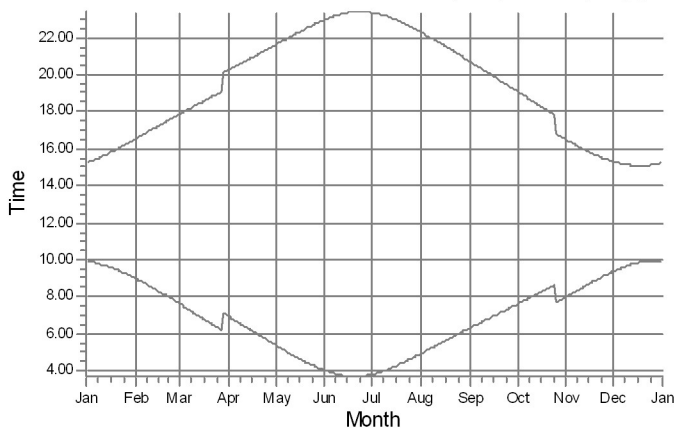
15: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (98)



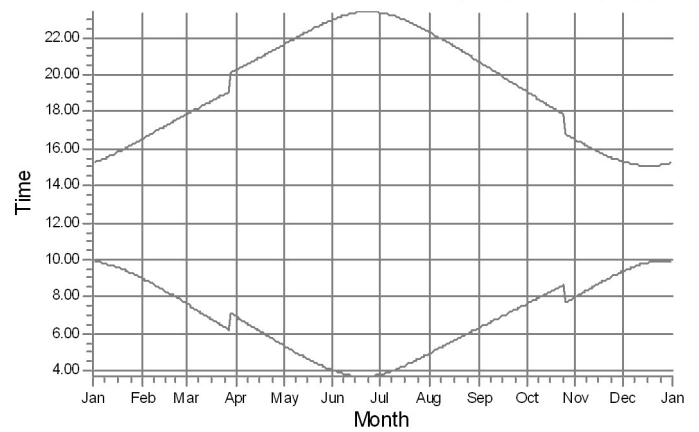
16: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (99)



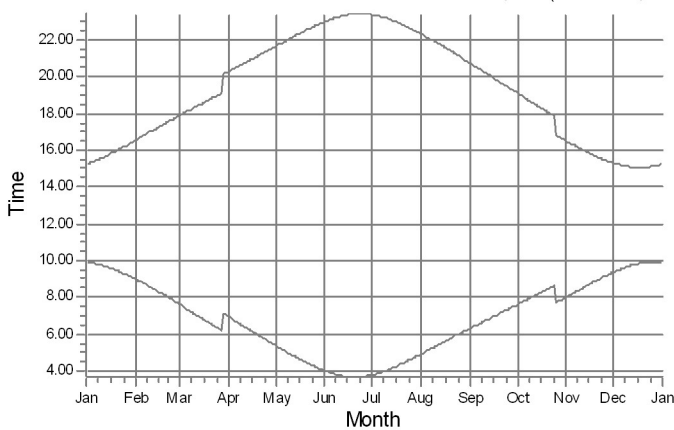
17: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (100)



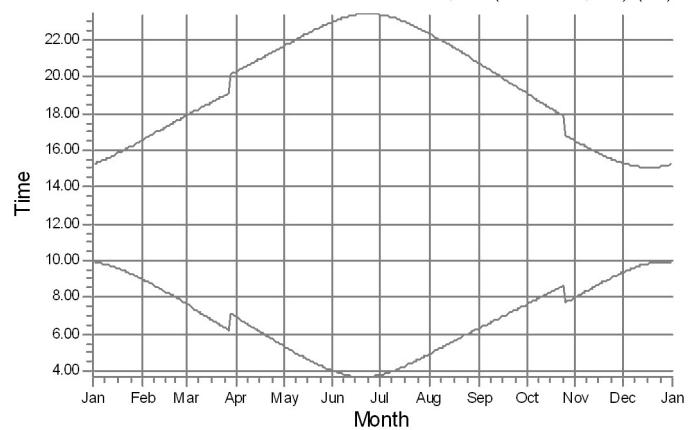
18: NORDEX N131/3000 3000 131.0 !O! hub: 144,0 m (TOT: 209,5 m) (101)



19: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



2: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (85)

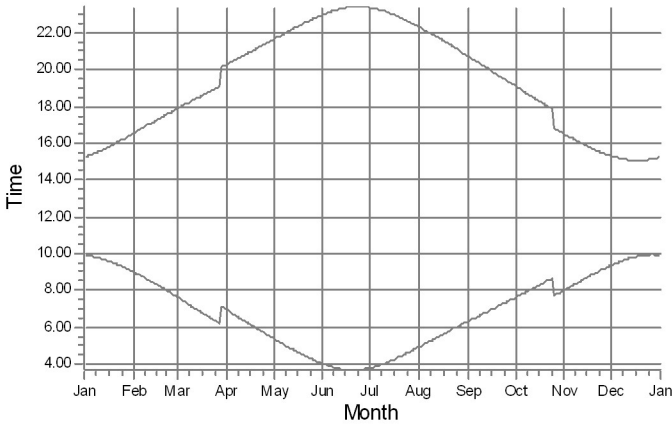


Shadow receptors

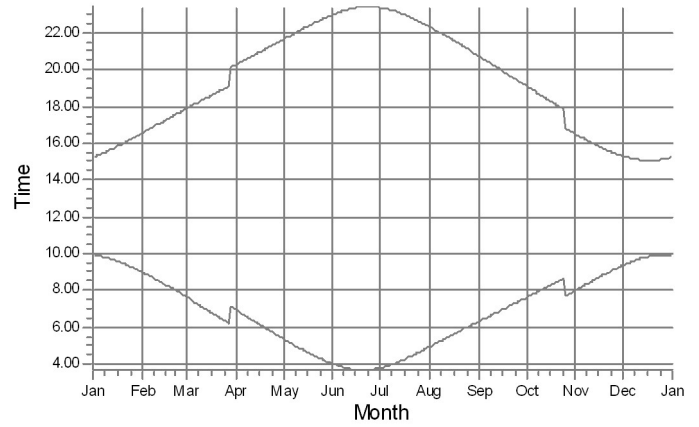
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

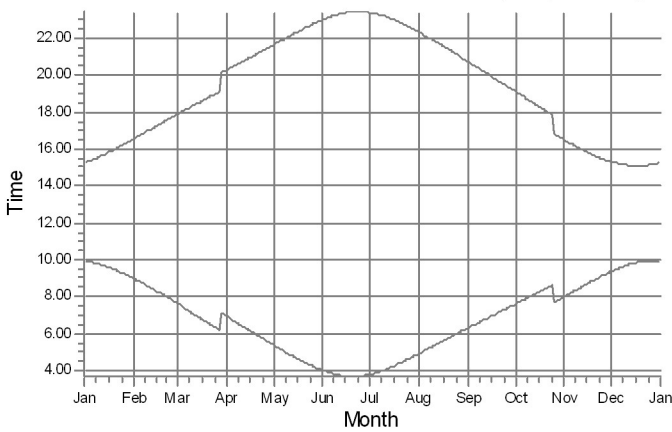
20: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



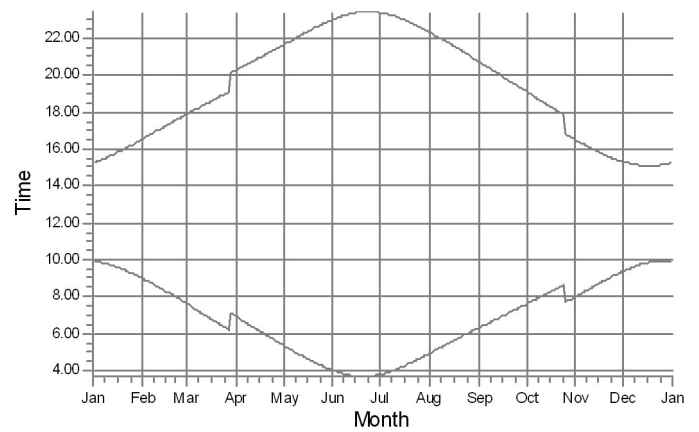
21: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



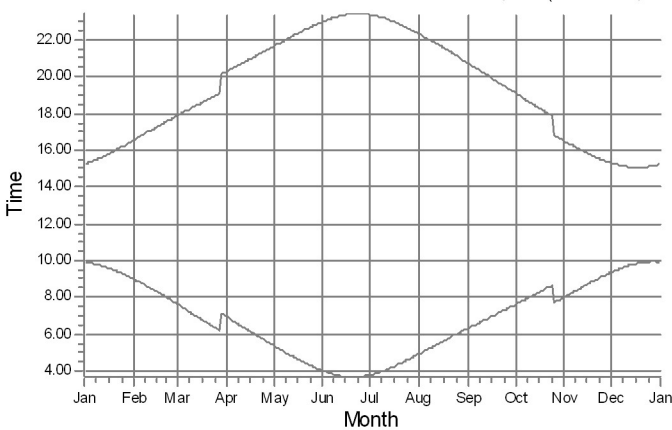
22: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



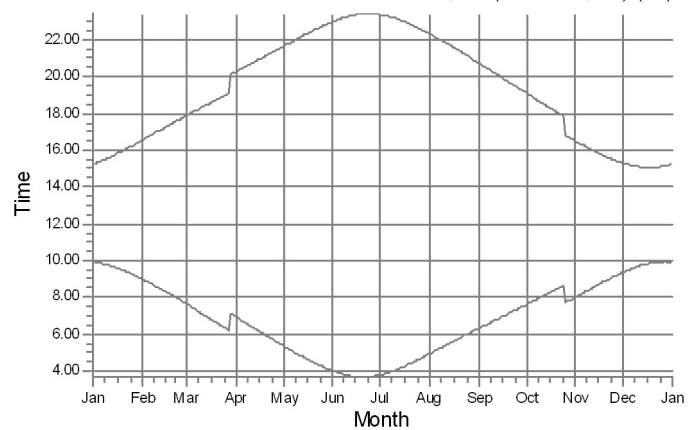
23: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



24: VESTAS V162-6.0 HH169 6000 162.0 !O! hub: 219,0 m (TOT: 300,0 m)



3: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (86)

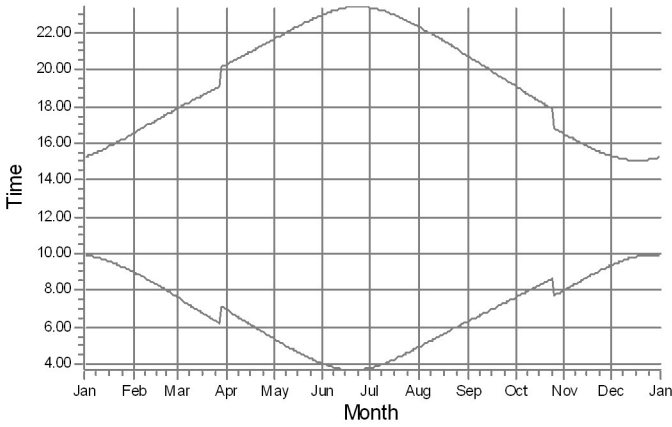


Shadow receptors

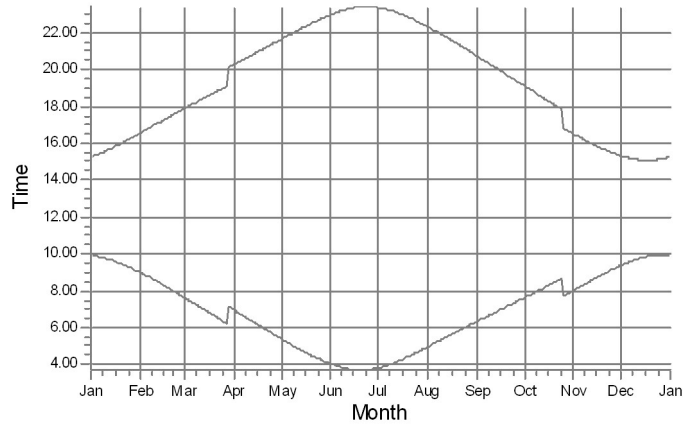
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

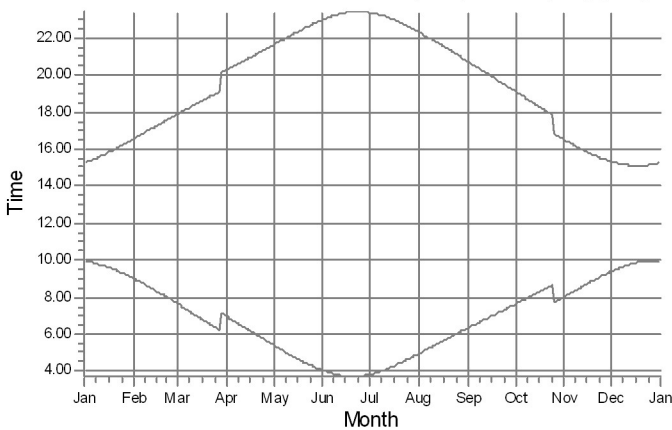
4: NORDEX N117/2400 2400 116.8 !O!hub: 120,0 m (TOT: 178,4 m) (87)



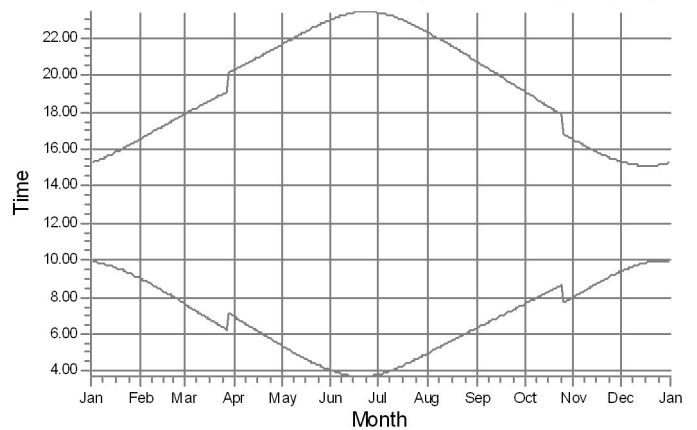
41: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (292)



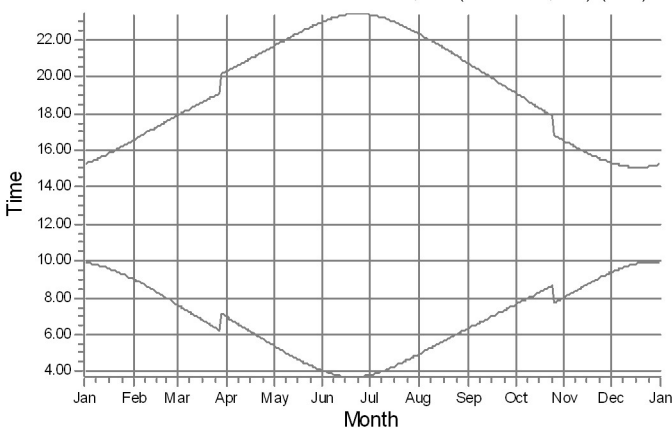
42: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (293)



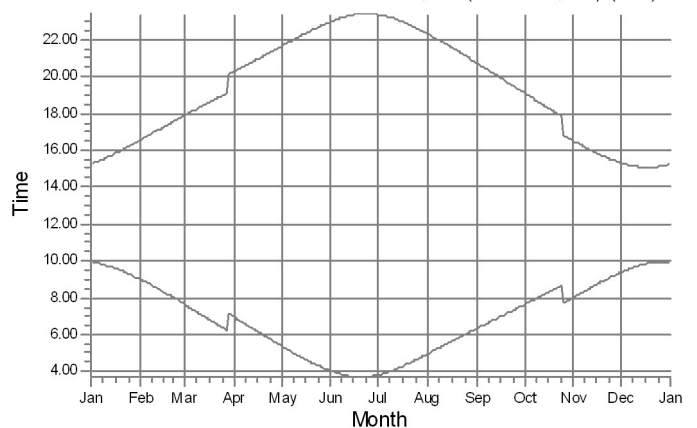
43: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (294)



44: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (295)



45: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (296)

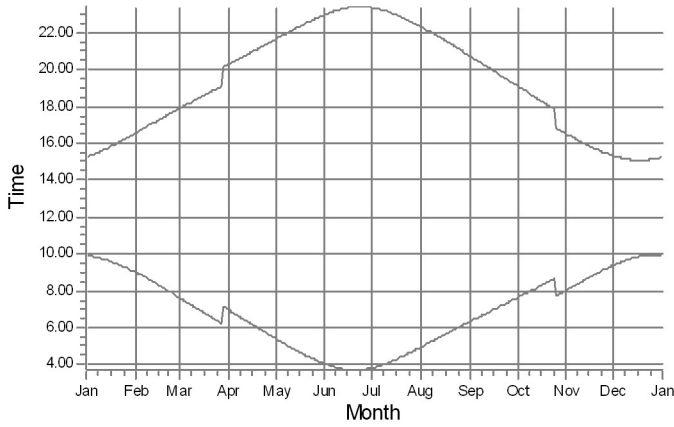


Shadow receptors

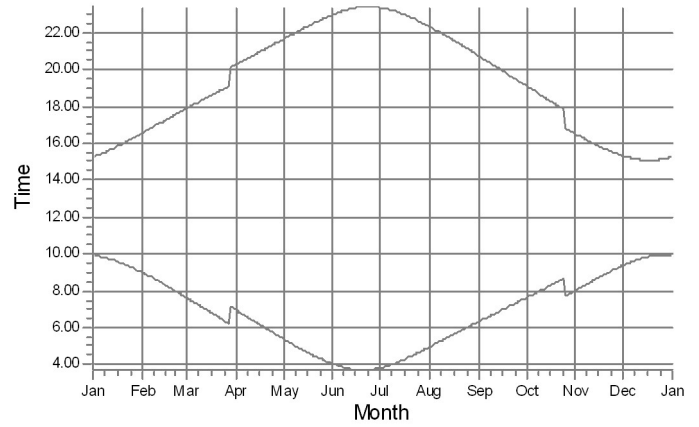
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

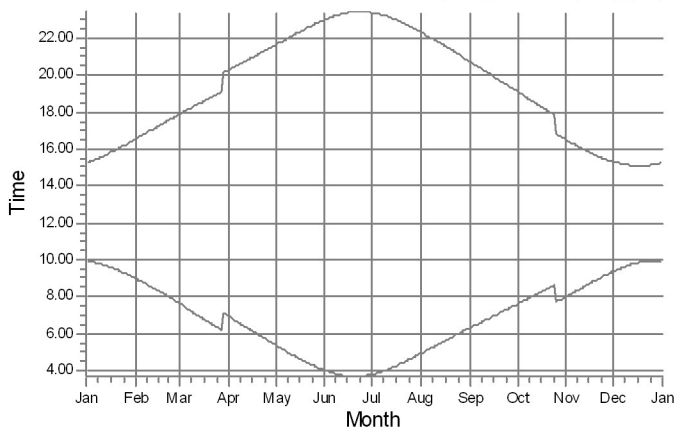
46: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (297)



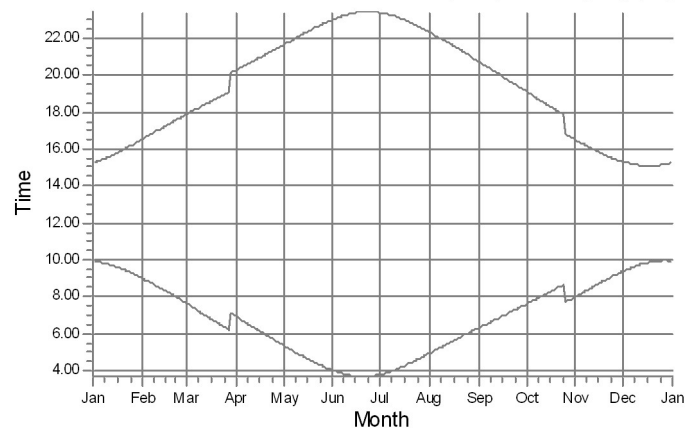
47: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (298)



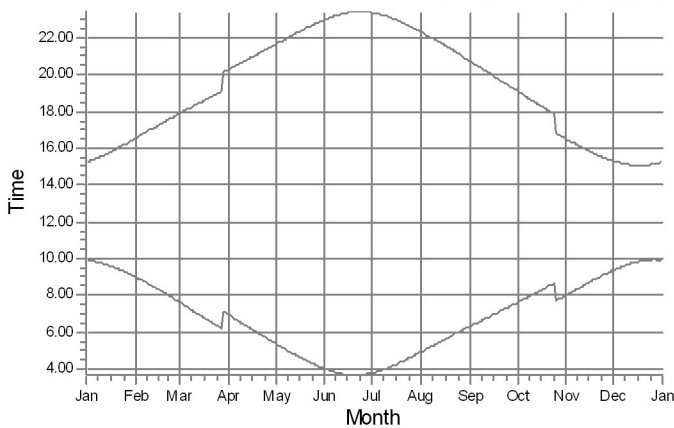
5: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (88)



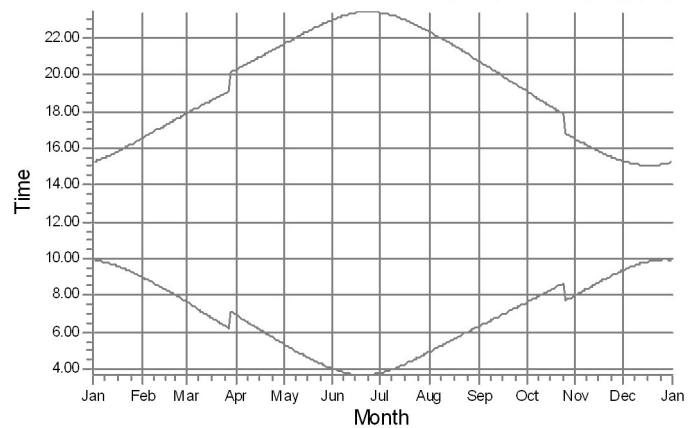
6: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (89)



7: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (90)



8: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (91)

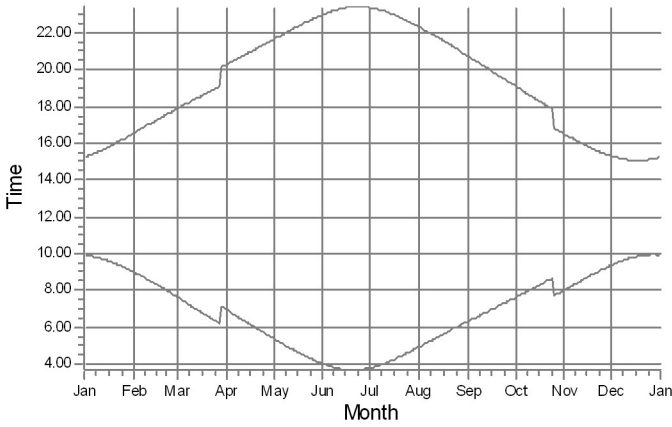


Shadow receptors

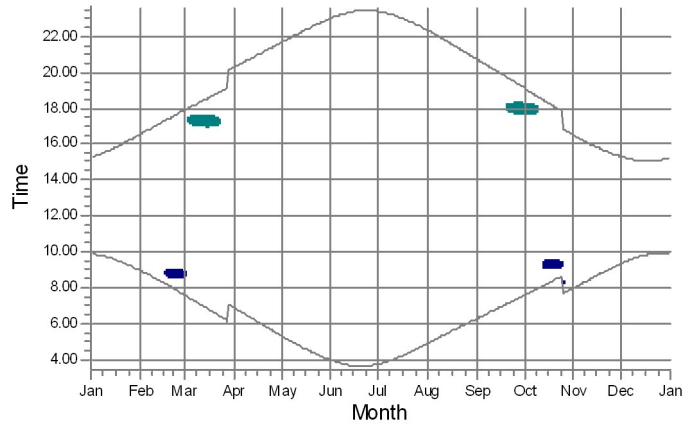
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

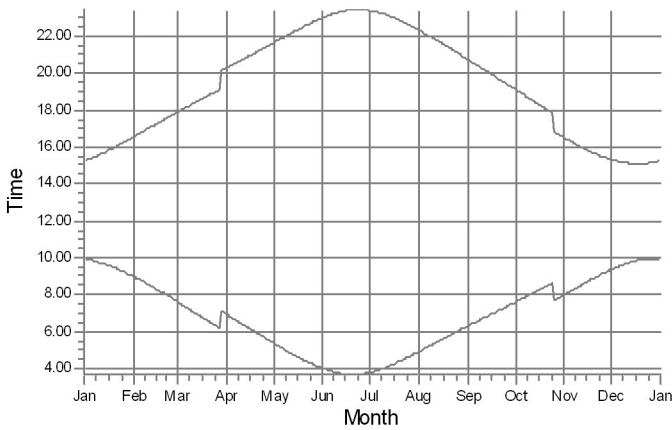
9: NORDEX N117/2400 2400 116.8 !O! hub: 120,0 m (TOT: 178,4 m) (92)



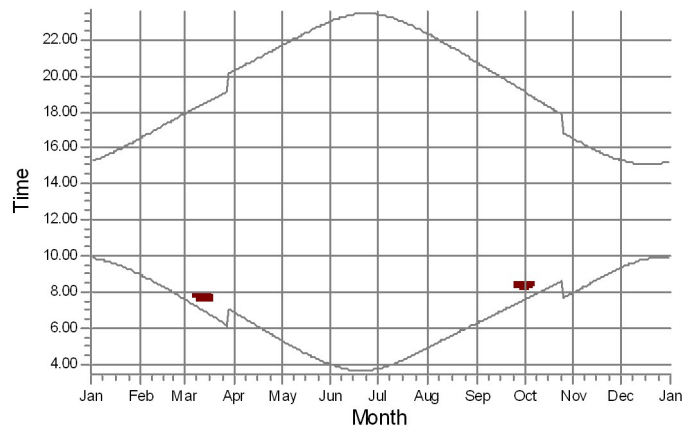
T1: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)



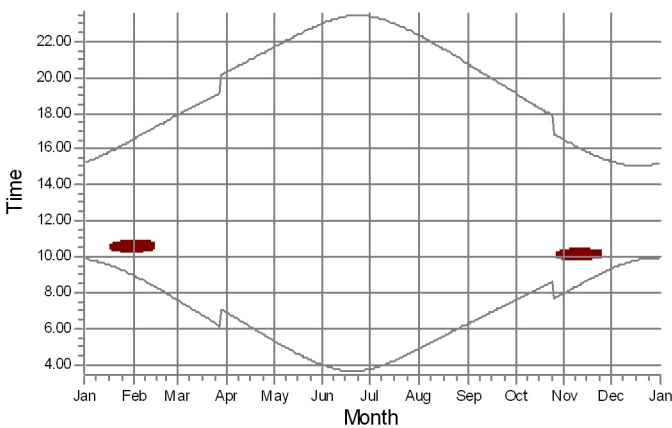
T10: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)



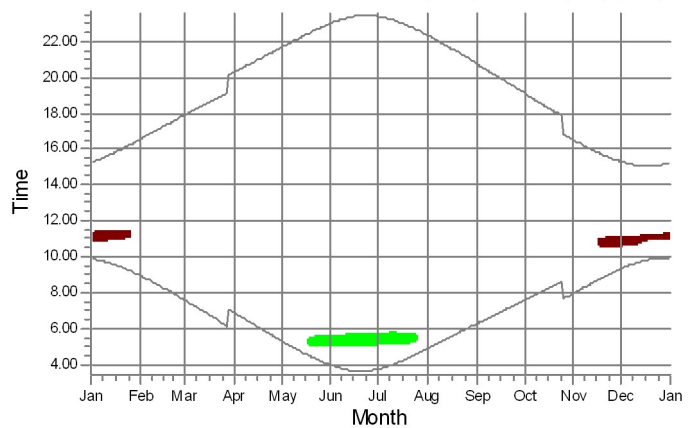
T11: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)





T12: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)



T13: Generic RD200 7200 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)



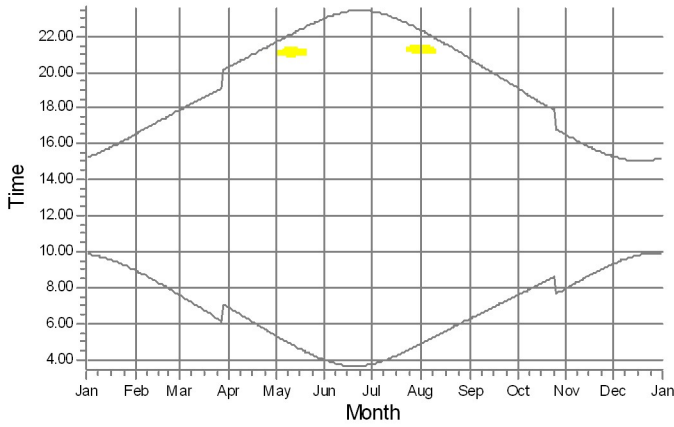
Shadow receptors

	F: F - Asuinrakennus		H: H - Asuinrakennus
	G: G - Asuinrakennus		I: I - Asuinrakennus

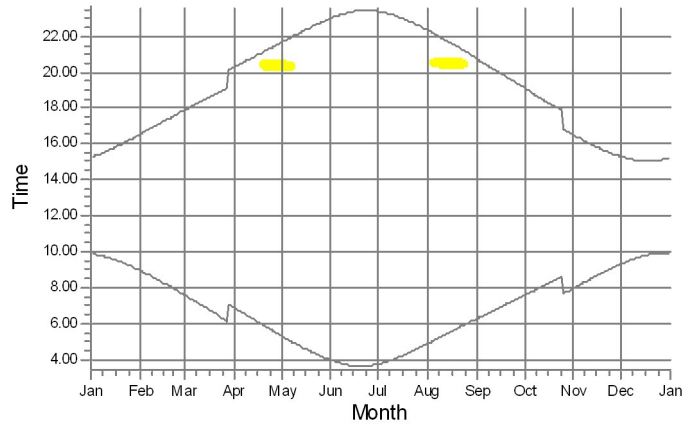
SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

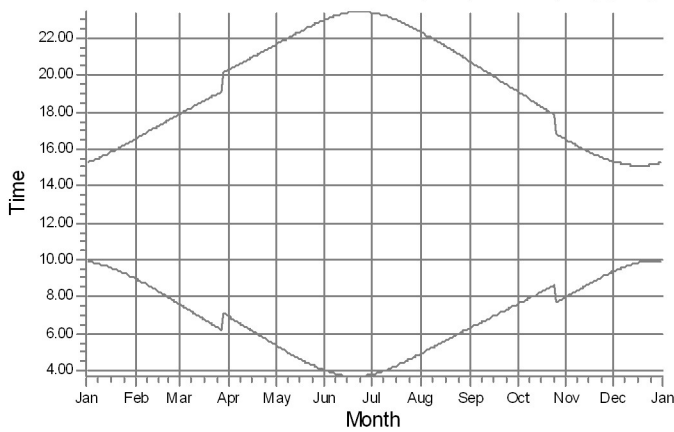
T14: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (258)



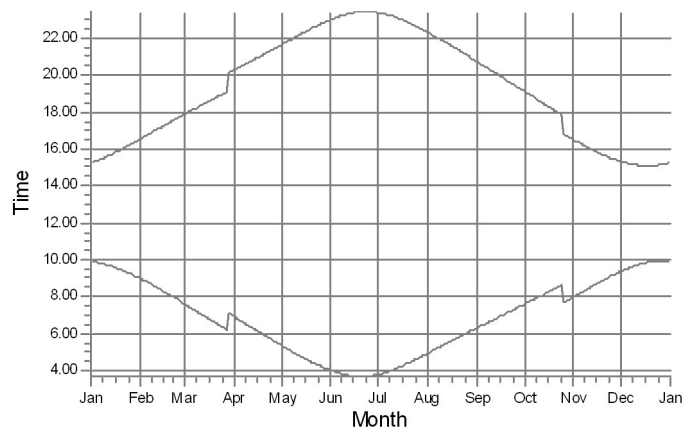
T15: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (259)



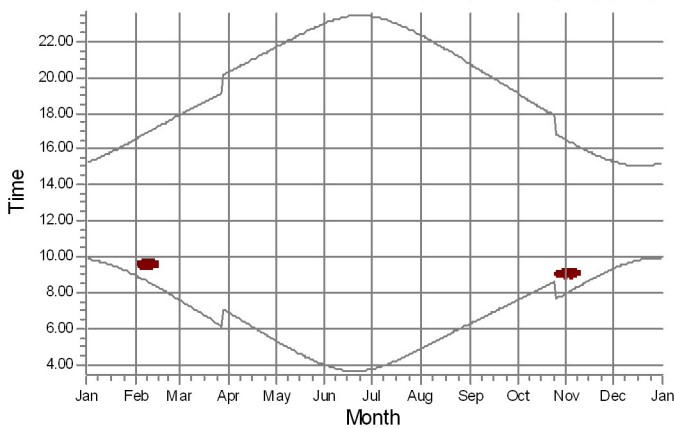
T16: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (260)



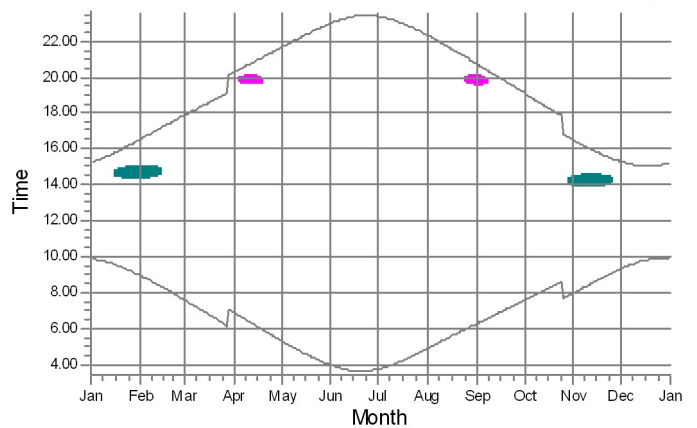
T17: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (262)



T18: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (261)



T2: Generic RD200 7200 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (248)



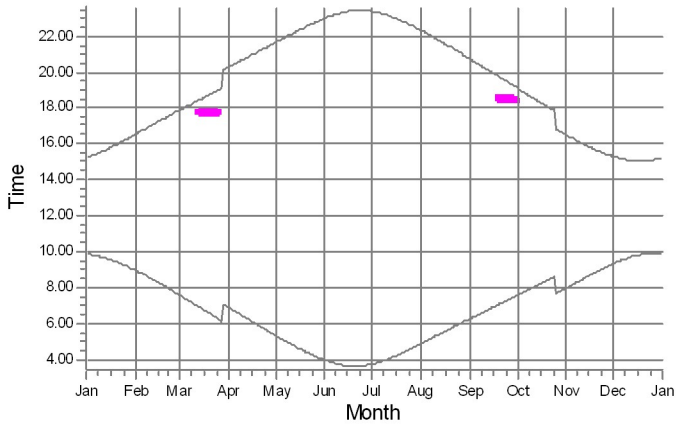
Shadow receptors

	B: B - Asuinrakennus		F: F - Asuinrakennus
	E: E - Asuinrakennus		H: H - Asuinrakennus

SHADOW - Calendar per WTG, graphical

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus

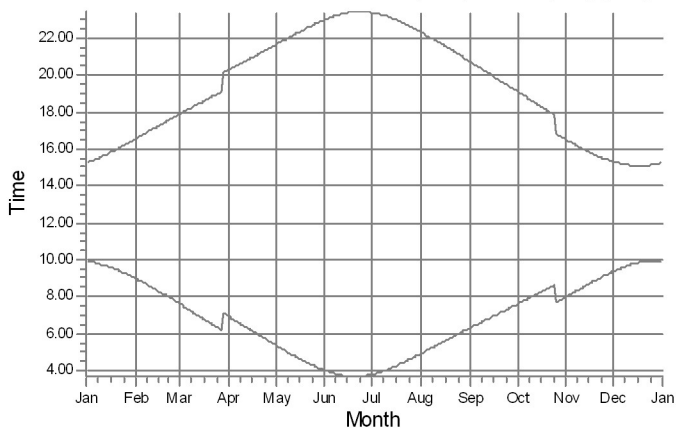
T3: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (249)



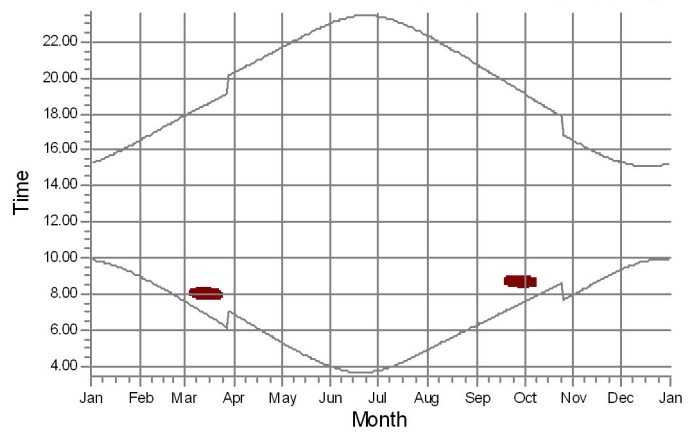
T6: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (250)



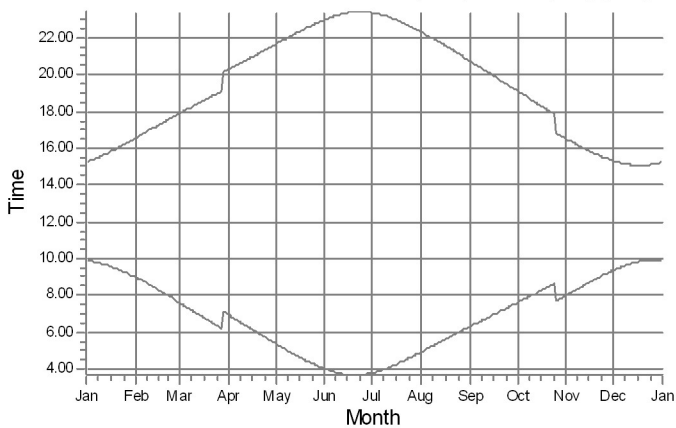
T7: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (251)



T8: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (252)



T9: Generic RD200 7200 200.0 !O!hub: 200,0 m (TOT: 300,0 m) (253)

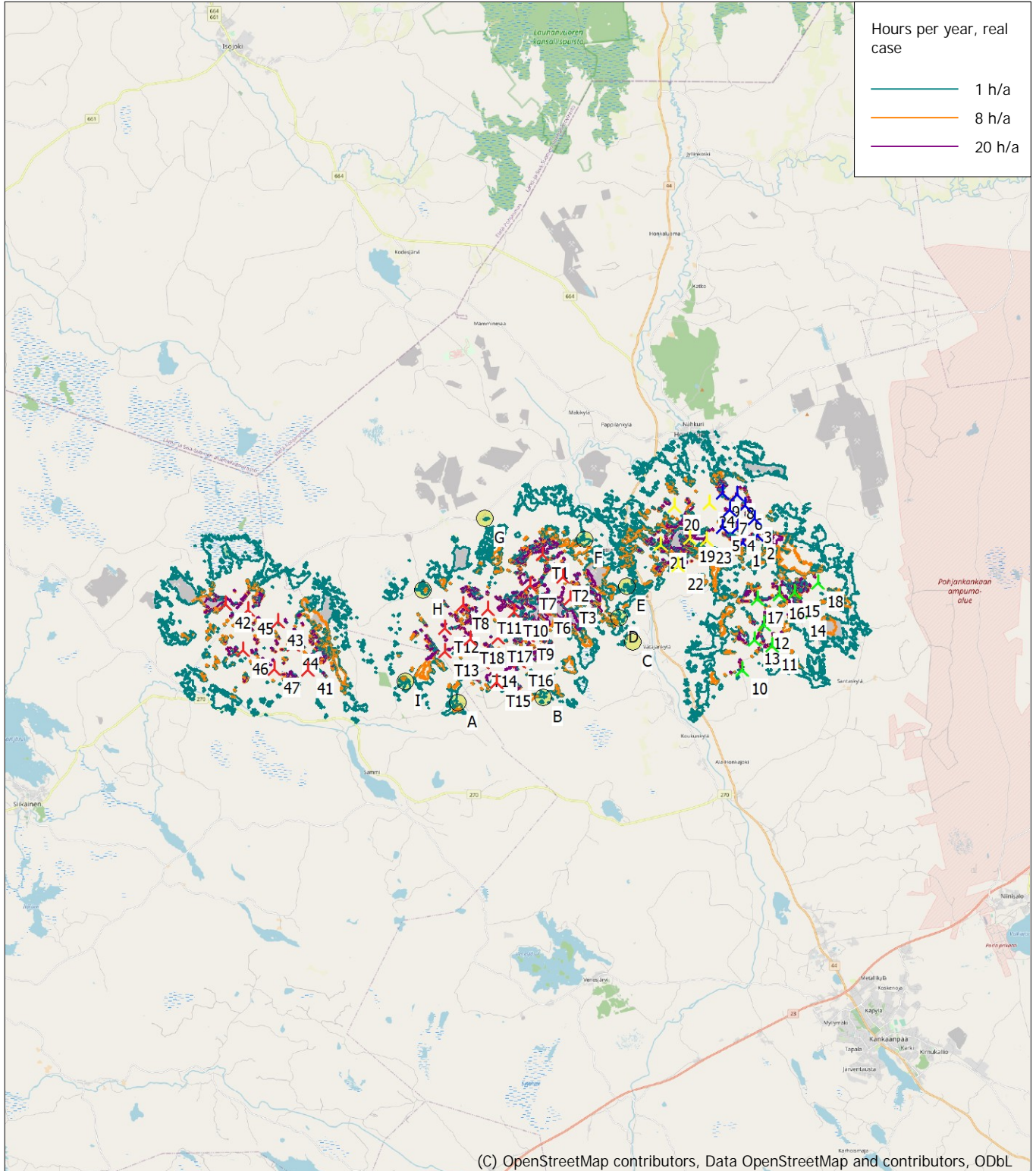


Shadow receptors

E: E - Asuinrakennus H: H- Asuinrakennus

SHADOW - Map

Calculation: Haukkasalo_VE2_Generic_RD200xHH200_Luke_Forest_yhteisvaikutus



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 245 280 North: 6 877 290
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Haukkasalo_06052022_0.wpo (1)
Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1,5 m