LUTELANDET VINDPARK

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RAPPORT STØY OG SKYGGEKAST

LUTELANDET VINDPARK

STØY OG SKYGGEKASTANALYSE

Denne rapporten beskriver metode og resultater for støy og skyggekastanalysene for Lutelandet Vindpark.

Beregningene er utført av Meventus AS, med bistand fra Stormvind AS.

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1 SKYGGEKAST

Skyggekast oppstår når en vindturbin i drift blir stående mellom solen og et mottakerpunkt, og det dannes roterende skygger fra rotorbladenes bevegelser. Hvor og når skyggekast inntreffer avhenger blant annet av lokal topografi, tidspunkt på dagen, sesong og mottakerpunktets lokalisering i forhold til vindturbinen. Skyggekast kan defineres inn i tre hovedgrupper (1) teoretisk skyggekast, (2) sannsynlig skyggekast og (3) faktisk skyggekast. Forskjellen på disse er:

1) Teoretisk skyggekast beregnes under følgende forutsetninger:
   - Solen skinner konstant i alle timer med dagslys
   - Turbinene står aldri stille; de er i konstant bevegelse
   - Vindretningen er slik at turbinene alltid står vendt mot skyggekastmottaker

2) Sannsynlig skyggekast (real case):

Som grunnlag for beregningen av sannsynlig skyggekastomfang er følgende meteorologiske/driftstekniske data tatt inn som del av forutsetningene:

- Solskinnssannsynlighet fordelt over årets måneder
- Årlig samlet driftstid for turbinene
- Fordeling av driftstimer på ulike vindretninger

3) Faktisk skyggekast:

Dette defineres som reelt omfang av skyggekast fra et vindkraftverk i drift. Faktisk skyggekast skiller seg fra sannsynlig skyggekast ved at sistnevnte bare er en prognose for omfang og mønster for reelt skyggekast.

NVE anbefaler at bygninger med skyggekastfølsomt bruk ikke skal utsettes for faktisk skyggekast i mer enn 8 timer per år eller for teoretisk skyggekast i mer enn 30 timer per år eller 30 minutter per dag.

1.1 Retningslinjer og metode

Skyggekastberegningen for Lutelandet vindkraftverk er gjennomført i henhold til NVE sin veileder; «Veileder for beregning av skyggekast og presentasjon av NVEs forvaltnings-praksis, nr. 2 2014». Beregningene er utført av Meventus AS med beregningsmodulen SHADOW i programpakken WindPRO versjon 3.2.712. Resultatet av disse beregningene viser hvor mange timers skyggekast per år som forventes for hvert punkt i et område rundt vindkraftverket.

Skyggekastmottakerne er lokalisert basert på N50 kartdata fra kartverket. Samtlige bygninger med skyggekastfølsomt bruk som ligger inntil 1500 m fra nærmeste vindturbin er kategorisert som skyggekastmottakere. Basert på dette er det identifisert 50 skyggekastmottakere i nærområdet til Lutelandet vindkraftverk. For to av disse er det inngått minnelige avtaler med eier. Dette gjelder et fritidsbygg på sørsiden av Lammetun

like nord for vindkraftverket (Gnr. 272/7) og et gårdsbruk som er lokalisert like øst for vindkraftverket (Gnr. 274/3).

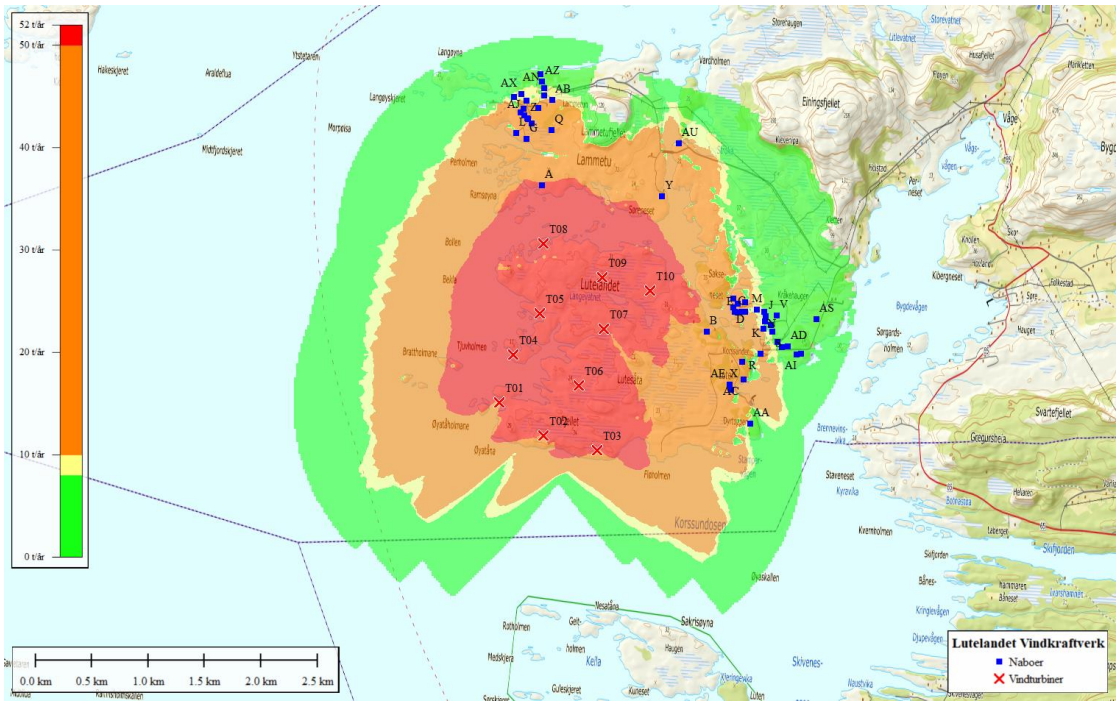
I henhold til NVEs veileder for skyggekastberegninger har mottakerne en størrelse på 2×2 meter, hevet 2 meter over bakken, og beregningene er basert på en drivhustilstand, som vil si at bygningene ikke har én bestemt retning mot turbinene og at mottakeren har vinduer i alle retninger. I tråd med veilederen er det gjort beregninger av både teoretisk og sannsynlig skyggekast. For beregningene av sannsynlig skyggekast er det brukt en konstant solskinnssannsynlighet på 50 %, i henhold til veilederen. Det er videre brukt en retningsfordeling for vind over 12 sektorer basert på langtidskorrigerte vindmålinger fra mast M80 i beregningene. I henhold til retningslinjen er den årlige driftstiden for turbinene satt til 7000 timer, og det er antatt at skyggekast ikke inntreffer når solen står lavere enn 3 grader over horisonten.

Det er tatt hensyn til terrengets høydeprofil, høyde for skyggekastmottaker og skjermingseffekt av mellomliggende terreng. Det er benyttet en terrengmodell (DTM data fra Statens Kartverk) med 10 meters oppløsning.

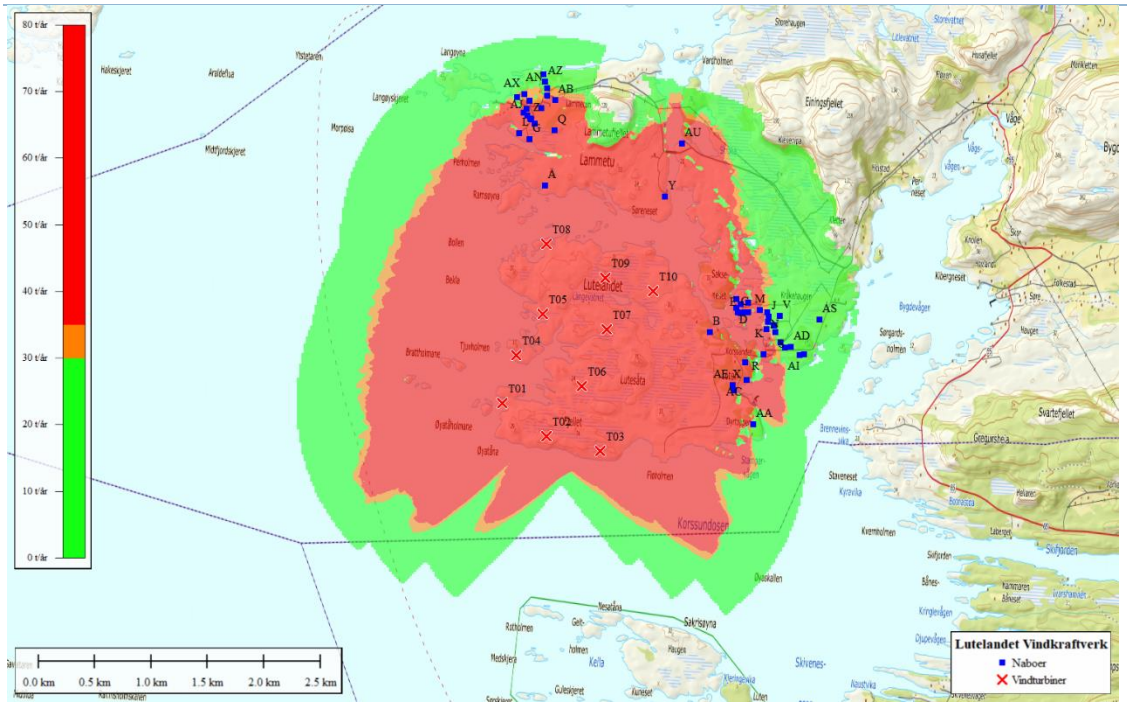
Beregningene er utført for et utbyggingsalternativ med 10 vindturbiner av typen Vestas V150 5.6MW med 105 m navhøyde.

1.2 Resultater

Nedenfor vises resultatet av skyggekastberegningene i form av skyggekastkart for sannsynlig skyggekast (Figur 1) og teoretisk maksimalt skyggekast (Figur 2). Navngivning av anleggets nabobebyggelse er basert på beregnet støynivå, hvor beregnet støy er høyest for nabo A, nest høyest for nabo B osv.



FIGUR 1 – SKYGGEKASTKART FOR SANNSYNLIG SKYGGEKAST FRA LUTELANDET VINDKRAFTVERK



FIGUR 2 – SKYGGEKASTKART FOR TEORETISK MAKSIMALT SKYGGEKAST FRA LUTELANDET VINDKRAFTVERK

Beregningene viser at 36 av de 50 skyggekastmottakerne forventes å bli eksponert for skyggekast over anbefalt grenseverdi på 8 timer med faktisk skyggekast per år. For teoretisk maksimalt skyggekast er det beregnet verdier over grenseverdien på 30 timer per år for 37 naboer, og verdier over grenseverdien på 30 minutter per dag for 41 naboer.

Beregnede verdier for samtlige 50 skyggekastmottakere innenfor 1500 m fra nærmeste turbin er presentert i Tabell 1 under. Fullstendig beregningsrapport for skyggekast er lagt ved denne rapporten som vedlegg 1.1.

TABELL 1 – FORVENTET OMFANG AV SKYGGEKAST FOR SAMTLIGE SKYGGEKASTMOTTAKERE INNENFOR 1500 M FRA NÆRMESTE TURBIN

Bygg (som navngitt i skyggekast-kartene)	Avstand til nærmeste turbin [m]	Beregnet sannsynlig skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [timer: minutter/år]	Beregne teoretisk maksimalt skyggekast [minutter/dag]	Merknad
A	512	58:56	210:16	02:05	MA
B	625	42:34	158:21	01:03	MA
C	776	17:28	71:49	01:01	
D	751	17:56	74:35	01:05	
E	802	15:46	65:06	00:44	
F	742	17:29	74:10	01:09	
G	937	21:30	75:14	01:03	
H	782	15:55	66:54	01:03	
I	828	14:38	60:43	00:43	
J	1046	07:44	31:44	00:34	*

K	1051	08:06	32:48	00:34	
L	1003	19:07	66:09	00:56	
M	960	09:10	38:06	00:40	
N	1029	07:48	32:17	00:37	*
O	1112	06:59	28:11	00:32	*
P	864	12:43	52:58	00:41	
Q	1000	22:27	79:49	01:19	
R	1126	12:36	48:02	00:36	
S	1140	07:23	29:26	00:32	*
T	846	11:19	47:45	00:48	
U	1273	05:17	19:51	00:28	
V	1143	05:13	21:06	00:33	*
W	1059	08:26	33:35	00:34	
X	1032	21:20	77:11	00:39	
Y	842	35:16	148:36	01:39	
Z	1113	13:02	45:50	00:52	
AA	1374	06:43	26:07	00:26	
AB	1225	10:28	37:36	00:52	
AC	1141	19:59	72:18	00:35	
AD	1313	04:39	17:34	00:27	
AE	1091	20:45	77:32	00:33	
AF	1136	18:35	69:27	00:29	
AG	1066	16:08	56:27	00:57	
AH	1103	13:27	47:17	00:54	
AI	1448	03:26	12:53	00:24	
AJ	1141	12:29	43:49	00:50	
AK	1174	11:52	41:35	00:47	
AL	1216	06:59	27:18	00:30	
AM	1198	11:34	40:51	00:52	
AN	1372	08:09	28:53	00:46	
AO	1303	09:39	34:13	00:49	
AP	1413	03:49	14:15	00:25	
AS	1492	01:41	06:36	00:23	
AT	1200	10:41	37:24	00:47	
AU	1324	16:21	69:47	01:09	
AV	1320	09:56	34:49	00:46	
AX	1335	09:03	31:42	00:42	
AZ	1427	07:43	27:15	00:44	*
BF	1271	09:59	34:38	00:43	
BJ	1881	00:00	00:00	00:00	

** Beregningen for sannsynlig skyggekast viser under 8 timer det er derfor antatt at avbøtende tiltak ikke vil være nødvendig for dette bygg selv om beregningen for teoretisk maksimalt skyggekast ligger over anbefalt grenseverdi.*

MA – Minnelig avtale er inngått

1.3 Forslag til avbøtende tiltak

For to av naboene, skyggekastmottaker A og B, er det inngått minnelig avtale mellom eier og tiltakshaver. For de øvrige naboene vil det gjøres tiltak for å redusere den forventede skyggekastbelastningen.

Som et eksempel på avbøtende tiltak er det vurdert styring av spesifikke turbiner der turbinene blir stengt ned i perioder der det finnes risiko for at det vil oppstå skyggekast på bygningene der det er forventet overskridelse. Gjennom å analysere beregningene som er utført er det funnet at det er turbinene T05 – T10 som er tydelige bidragsytere til skyggekast som oppstår for de mest utsatte skyggekastmottakerne. I programmet er det brukt en innstilling der turbiner kan stenges ned i de perioder der det er risiko for skyggekast.

Forventet omfang av skyggekast etter dette avbøtende tiltak er presentert i Tabell 2. Behov for tidsperiode med nedstengning av turbiner vil være avhengig av eksakt plassering og vil bli avklart endelig før anlegget settes i drift. En mer nøyaktig beskrivelse av antall timer vindturbinene er nedstengt vises i vedlegg 1.2.

TABELL 2 – FORVENTET SKYGGEKAST ETTER FORSLAG TIL AVBØTENDE TILTAK

Bygg (som navngitt i skyggekast-kartene)	Avstand til nærmeste turbin [m]	Beregnet sannsynlig skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [minutter/dag]
C	776	05:21	24:02	00:33
D	751	05:53	25:25	00:23
E	802	04:44	21:50	00:35
F	742	07:50	34:33	00:28
G	937	05:10	17:31	00:30
H	782	05:45	25:06	00:23
I	828	04:30	20:46	00:31
J	1046	02:41	12:05	00:21
K	1051	03:12	14:15	00:25
L	1003	07:09	24:52	00:20
M	960	02:39	11:38	00:20
N	1029	02:34	11:25	00:19
O	1112	03:11	13:49	00:24
P	864	03:47	17:28	00:21
Q	1000	07:23	25:38	00:36
R	1126	06:16	25:01	00:25
S	1140	05:21	21:51	00:24
T	846	03:34	15:13	00:23
U	1273	05:07	19:12	00:28
V	1143	01:39	07:08	00:20
W	1059	05:49	23:50	00:25
X	1032	07:04	27:22	00:28
Y	842	04:41	22:09	00:31
Z	1113	05:01	17:00	00:26
AA	1374	06:41	26:02	00:26
AB	1225	02:41	09:17	00:13
AC	1141	05:49	24:33	00:24
AD	1313	04:38	17:31	00:27
AE	1091	06:04	26:31	00:27
AF	1136	07:09	29:07	00:27
AG	1066	07:52	27:11	00:35
AH	1103	05:40	19:18	00:28
AI	1448	03:26	12:53	00:24
AJ	1141	03:47	12:42	00:23
AK	1174	03:07	10:28	00:20
AL	1216	06:44	26:10	00:28
AM	1198	05:35	20:10	00:27
AN	1372	02:30	08:58	00:17
AO	1303	02:36	09:29	00:16
AP	1413	03:39	13:38	00:25
AS	1492	00:05	00:22	00:06

AT	1200	03:16	10:52	00:23
AU	1324	06:51	29:14	00:35
AV	1320	03:20	11:22	00:18
AX	1335	02:37	08:44	00:18
AZ	1427	02:50	10:14	00:19
BF	1271	03:42	12:30	00:22
BJ	1881	00:00	00:00	00:00

Som det fremgår i Tabell 2 er det etter foreslåtte avbøtende tiltak beregnet sannsynlig skyggekast under 8 timer per år for alle skyggekastfølsomme bygg som det ikke er inngått avtale med. For 8 av byggene er det fortsatt forventet et teoretisk maksimalt skyggekast som ligger noe over anbefalte grenseverdier. Tiltakshaver mener at siden forventet omfang av faktisk skyggekast ligger under grenseverdien på 8 timer med de foreslåtte avbøtende tiltak, burde dette være tilstrekkelig uten at det må gjøres ytterligere avbøtende tiltak for disse byggene.

Foreslåtte tiltak vil påvirke produksjonen i anlegget, ettersom turbinene må stenges ned i korte perioder. Beregning basert på årsproduksjon per turbin og tilhørende omfang av turbinstans viser at tiltakene som kreves for å overholde grenseverdien på 8 timer med faktisk skyggekast vil kunne medføre et produksjonstap i størrelsesorden 0.2 %.

2 STØY I ANLEGGSFASEN

Anleggsarbeidet vil medføre støy, spesielt i forbindelse med bygging og utbedring av veier og oppstillingsplasser. I tillegg vil det være støy knyttet til transporten av turbinkomponenter og annet materiell til byggeplass.

Miljøverndepartementets retningslinjer for støy i arealplanlegging gir anbefalte grenseverdier. I tillegg kan kommunen stille egne krav. Forbigående støy over anbefalte grenseverdier kan tolereres, men det stilles krav til varsling og eventuelt avbøtende tiltak. Omfanget og konsekvens av sprenging er vanskelig å forutsi. Arbeidet vil medføre sjenerende støy, men må kunne betraktes som enkelthendelser.

Støv fra anleggsarbeidet antas ikke å være sjenerende utenfor planområdet, bortsett fra byggingen av tilkomstveien som vil omfatte mindre sprenginger.

I anleggsfasen vil prosjektet innføre følgende tiltak for å redusere ulempene knyttet til støy:

- Kommune, lokalbefolkning og grunneiere skal varsles før anleggsstart
- De samme interessenter varsles 1 uke før sprengningsarbeid eller annet spesielt støyende arbeid
- Entreprenørens utstyr skal tilfredsstille forskriftskrav mht. lydeffekt
- Ved støyende anleggsarbeider nært opp til bebyggelse skal man søke å unngå arbeider utenfor tidsrommet 22:00 til 06:30

3 STØY I DRIFTSFASEN

Meventus AS har utført en støyutredning i forbindelse med MTA/Detaljplan for Lutelandet vindkraftverk. Utredningen gjør rede for gjeldende regelverk hjemlet i norsk lovverk, forskrifter, veiledninger og standarder, samt beskriver grenseverdier, aktuelle begrep og prinsipper. Videre blir de viktigste inngangsverdiene, tekniske data og parametere som ligger til grunn for støyberegningene presentert. Resultater er presentert i form av støysonekart.

Vedlagt denne rapporten (vedlegg 2.1) finnes selve beregningene som har blitt utført med beregningsverktøyet WindPRO versjon 3.2.712 i beregningsmodulen Nord2000.

3.1 Regelverk og grenseverdier

Støyutredningen for driftsfasen har tatt utgangspunkt i Plan- og bygningsloven, som viser videre til T-1442 (2016) som skal legges til grunn av kommunene, regionale myndigheter og berørte statlige etater ved behandling av enkeltsaker. T-1442 (2016) er koordinert med forurensningsloven og teknisk forskrift, og anbefaler at det skal beregnes to støysoner rundt viktige støykilder (rød og gul sone).

Veilederen til T-1442 (2016) heter M-128 i 2014. M-128 ble sist oppdatert i august 2018 og utførte beregninger har tatt utgangspunkt i denne siste oppdaterte veilederen. Veilederen beskriver mer i detalj hvordan ulike støykilder, herunder vindturbiner, skal håndteres og angir hvilke parametere som skal legges til grunn ved beregning av støy fra vindturbiner.

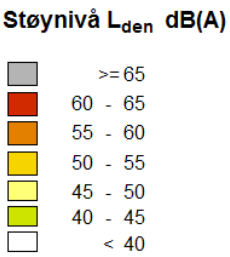
I detaljplanleggingsfasen av et vindkraftprosjekt, når det også finnes tilgjengelig data fra vindmålinger, er det i veilederen anbefalt å legge beregningsmetoden Nord2000 til grunn for støyberegningene. I henhold til retningslinjen og veilederen skal støysonekart som viser gul og rød sone legges til grunn for støyvurderingen.

TABELL 3 – GUL OG RØD STØYSONE VED BEREGNING AV STØY FRA VINDKRAFT

Støykilde	**Støysone**			
	Gul sone		**Rød sone**	
	Utendørs støynivå	Utendørs støynivå i nattperioden kl. 23 - 07	Utendørs støynivå	Utendørs støynivå i nattperioden kl. 23 - 07
Vindturbiner	45 L_{den}	-	55 L_{den}	-

- Rød sone: Angir et område som ikke er egnet til støyfølsomme bruksformål.
- Gul sone: Vurderingssone.

I støysonekartene er det benyttet soneinndeling som angitt til høyre. Denne inndelingen legger til rette for en noe mer nyansert analyse enn ved kun å benytte rød og gul sone. Grå, rød og oransje sone tilsvarer rød sone iht. T-1442. Lysegul og gul sone tilsvarer gul sone iht. grenseverdien i T-1442. Grønn sone er et område med opptil 5 dB lavere nivåer enn grenseverdi for gul sone, men er inkludert for å synliggjøre områder og støyfølsomme bygninger som ligger i nærheten av gul sone.



Tiltakshaver forholder seg i utredningen til gjeldende retningslinje hvor det fremgår at støynivået ved bebyggelse med støyfølsomt bruk ikke skal overstige L_{den}=45 dB.

Lokalisering av bygninger i nærheten av planområdet er innhentet fra N50 kartdata fra Statens Kartverk. Samtlige bygg med støyfølsomt bruk innenfor en radius på 2 km fra turbinene er inkludert i beregningene, dette omfatter 73 bygninger. For to av disse er det inngått minnelige avtaler med eier. Dette gjelder et fritidsbygg på sørsiden av Lammetun like nord for vindkraftverket (Gnr. 272/7) og et gårdsbruk som er lokalisert like øst for vindkraftverket (Gnr. 274/3).

3.2 Grunnlag og parametervalg i beregningsmodellen

I henhold til oppdatert veileder M-128 er det utført worst case-beregninger av støynivået fra vindkraftanlegget. Med god kjennskap til vindforholdene i området er det også utført kompletterende beregning som tar høyde for lokale vindforhold. Beregningene for begge scenarier er utført i Nord2000-modulen i WindPRO.

For beregning av verste scenario er de fleste av parametervalgene forhåndsinnstilt i beregningsverktøyet. Ved beregning av sannsynlig scenario er muligheten for parametervalg noe større. I henhold til M-128 er parametervalgene som har mest betydning for resultatet beskrevet og begrunnet.

Både for worst case- og for real case-beregningene er det tatt utgangspunkt i 10 turbiner av typen Vestas V150 5.6MW med navhøyde på 105 m. Støydata som angir kildestøy fra turbinen har blitt formidlet fra den respektive turbinleverandøren. Kildestøyen er oppgitt i lydeffektnivå i hvert 1/3 frekvensbånd mellom 10 Hz og 10 000 Hz. Høyeste lydeffektnivå for turbinen er angitt ved vindhastighet i navhøyde på 11 - 20 m/s med et lydeffektnivå (LWA) på 104.9 dB(A). Oppgitt kildestøy er forutsatt bruk av blader med «serrated trailing edges».

For beskrivelse av terrenget er det benyttet digitale terrengdata (DTM) fra Statens kartverk med 10 m oppløsning, samt ruhetsdata fra Corine Landdekke (EEA) med 100 m oppløsning.

I henhold til retningslinjen er beregningshøyden for støymottakerne satt til 4.0 m over terrenget.

3.3 Parametervalg og antagelser for worst case-beregning

Flere av parameterinnstillingene ved worst case-beregning i WindPRO er forhåndsdefinert. De valg som er forhåndsdefinert har gjennom tidligere prøveberegninger blitt konkludert som worst case. For worst case-beregningen gjelder blant annet at det kun er den høyeste kildestøyen (104.9 dB(A)) som blir lagt til grunn, samt at det blir beregnet medvind i alle retninger. I tillegg er stabilitetsparameterne satt til gjeldende forhold ved klarvær nattestid.

De parametervalg som ikke er forhåndsdefinert og som har betydning for resultatet er følgende; marktype og hardhet (refleksjon/demping) for gitt marktype, samt luftfuktighet og temperatur. Valg/innstilling av disse parameterne er beskrevet nedenfor.

Marktype og hardhet for marktype

Marktypene som forekommer i og i nærheten av Lutelandet vindpark er identifisert ut i fra datasettet arealdekke fra Statens kartverk (N50). De forskjellige marktypene er deretter gitt en hardhet i forhold til forhåndsdefinerte hardhetstyper i WindPRO. Høy hardhet gir mindre demping (mer støyrefleksjon). Av marktypene som er identifisert i det aktuelle området er det skog som gir mest demping og hav/innsjø som gir minst demping. Følgende marktyper og korresponderende hardhet ligger til grunn for beregningene.

Skog, Myr = 31.5 (B)

Dyrket mark/Gravplass = 200 (D)

Åpent område/Steinbrudd = 2000 (F)

Havflate/Innsjø = 20000 (G)

Siden det skal beregnes verste scenario er det ikke lagt inn variasjon av marktype over året med snø om vinteren. Hvis snø skulle blitt lagt inn som marktype under vinteren ville dette økt markarpsopsjonen. Et kart som viser marktypene som er inkludert i støyberegningsrapporten er presentert i vedlegg 2.5.

Luftfuktighet og temperatur

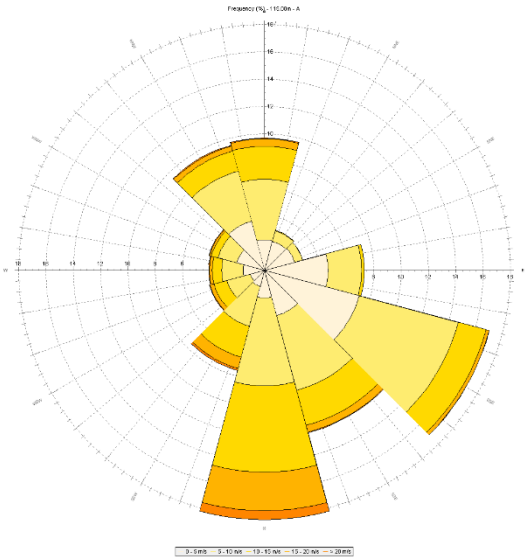
Både luftfuktighet og temperatur har innvirkning på demping av støy i atmosfæren. Luftfuktigheten er i beregningene satt til 70 % og temperaturen til 7 grader Celsius i 95 m høyde. 70 % luftfuktighet anses som et representativt nivå for norske områder. Temperaturen på 7 grader er hentet fra turbinleverandørens produksjonsrapport («Vestas, Wind Power Plan Assessment Report», 18.08.18) hvor gjennomsnittlig temperatur er oppgitt i navhøyde.

3.4 Parametervalg og antagelser for real case beregning

De fleste av innstillingene som er valgt for worst case-beregningen i WindPRO er også benyttet for real case-beregning av støynivået. Dette gjelder både stabilitetsforhold, temperatur, fuktighet og valg av marktype/hardhet. Forskjellen går på valg av vindfordeling, hvor man i en worst case-beregning antar at vindhastigheten alltid er 8 m/s

i 10 m høyde og at vinden alltid blåser mot støymottaker (medvind fra alle retninger). En real case-beregning er derimot basert på informasjon om de reelle vindforholdene.

Real case-beregningen for Lutelandet vindpark er basert på langtidskorrigerte måledata fra området. Det er tidligere gjennomført vindmålinger i to posisjoner innenfor planområdet. Målingene fra de to mastene dekker perioder på 6.9 år (50 m mast) og 3.0 år (80 m mast). Langtidskorrigert vindfordeling basert på dataene fra 80 m-masten er vist i Figur 3.



FIGUR 3 – LANGTIDSKORRIGERT VINDFORDELING PÅ LUTELANDET (BASERT PÅ DATA FRA M80)

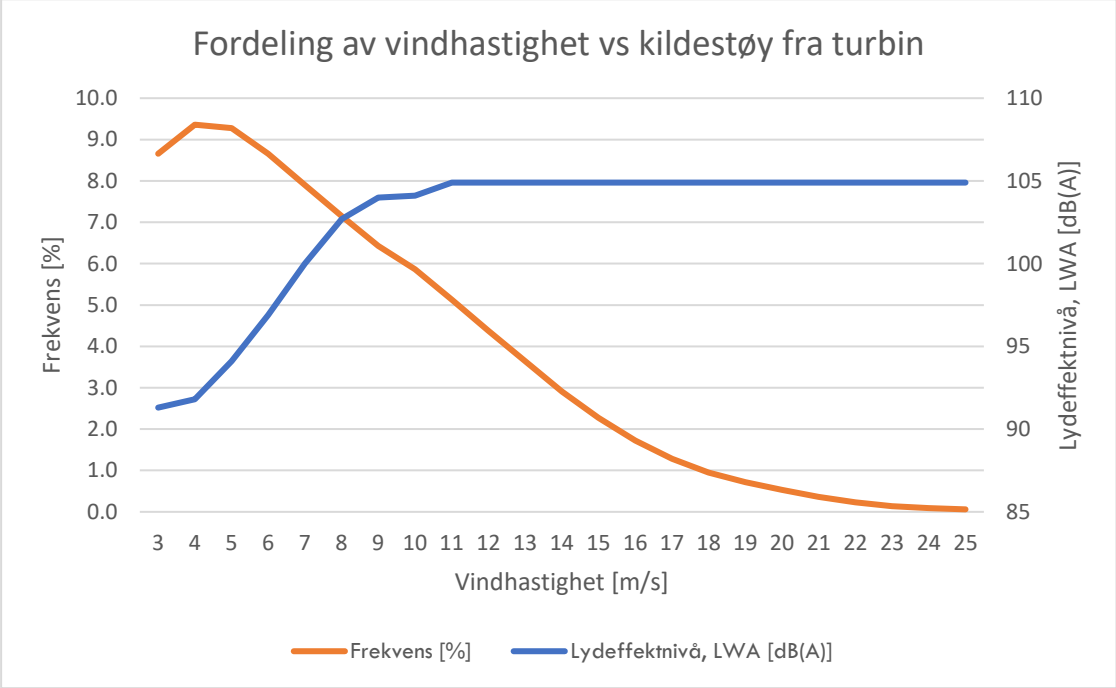
Som det fremgår av vindrosen er fremherskende vindretning i dette området øst-sørøst til sør, samt nord-nordvest til nord. Ettersom de aller fleste naboene ligger øst eller nordøst for parken er det i realiteten sjelden nabobebyggelsen blir liggende nedstrøms vindturbinene. Dette vil medføre en reduksjon i støynivå i forhold til verste scenario beregning.

I henhold til veilederen M-128 vil bruk av vindhastigheter i støyberegningene ofte få enda større utslag på beregningsresultatene. Grunnen til reduksjonen det medfører er at vindhastigheten i realiteten i stor grad er lavere enn vindhastighetene som gir maksimal støy. I Vestas vindressursberegninger for aktuell utbyggingsløsning er langtidskorrigert middelvind i navhøyde 7.3 m/s for turbinene på Lutelandet. Ettersom vindturbinene først kommer opp i maksimal kildestøy ved en vindhastighet i navhøyde på 11 m/s er det sjelden turbinene opererer med maksimal støy. En oversikt over lydeffektnivå for de aktuelle vindturbinene på Lutelandet er presentert i Tabell 4. Kun utvalgte vindhastigheter rundt middelvinden er inkludert i tabellen, for høyere vindhastigheter er lydeffektnivået på maksimal verdi.

TABELL 4 – GARANTERT LYDEFFEKTNIVÅ FOR AKTUELLE VINDTURBINER PÅ LUTELANDET (VINDHASTIGHET I NAVHØYDE)

Vindhastighet [m/s]	6	7	8	9	10	11	12
Lydeffektnivå, L_{WA} [dB(A)]	96.9	100.0	102.7	104.0	104.1	104.9	104.9

Frekvensfordeling av vindhastighetene innenfor intervallet turbinene opererer innenfor og tilhørende lydeffektnivå (LWA) er presentert i Figur 4 under.



FIGUR 4 – OVERSIKT OVER FORDELING AV VINDHASTIGHET I NAVHØYDE OG TILHØRENDE KILDESTØY FRA TURBINENE

Som det fremgår av figuren vil vinden store deler av tiden ligge på nivåer som gir mindre enn maksimal støy fra turbinene. Dette medfører en stor differanse mellom beregningsresultater fra worst case- og real case-beregninger av støynivået.

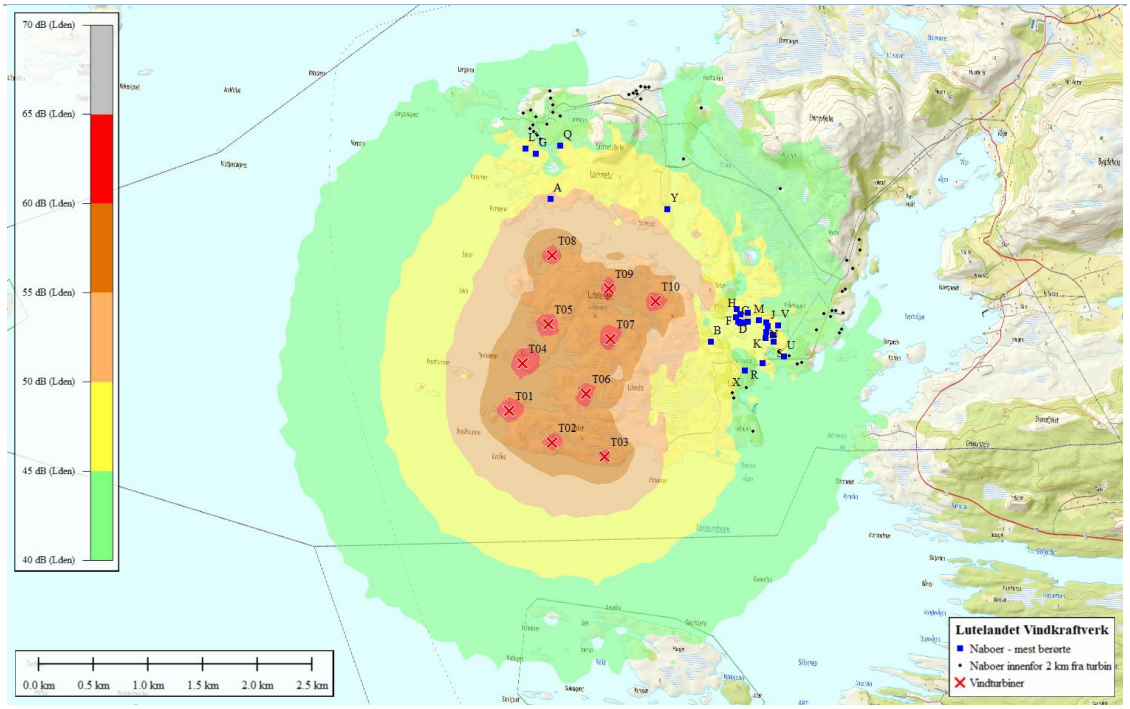
Det påpekes også at det i Nord2000-beregningen er antatt en uniform vindhastighet i parken, mens beregninger viser en forskjell på 7.1 til 7.6 m/s i middelvind mellom ulike turbinposisjoner i dette området. Ettersom det er turbinene som ligger lengst fra bebyggelsen som har høyest middelvind, er beregnet støynivå da noe overestimert for turbinene som ligger nærmere støymottakerne.

3.5 Resultat og forslag til avbøtende tiltak

3.5.1 Resultat worst case-beregning

Et støysonekart basert på worst case-beregning (medvind fra alle retninger) av støynivået er presentert i Figur 5. Støymottakerne er navngitt slik at beregnet støynivå er høyest for nabo A, nest høyest for nabo B etc.

Fullstendig beregningsrapport for worst case-beregning av støy er lagt ved denne plan som vedlegg 2.1.



FIGUR 5 – STØYSONEKART BASERT PÅ BEREGNET STØYNIVÅ (L_{DEN}) FOR WORST CASE (MEDVIND FRA ALLE RETNINGER)

Beregningene viser at 51 støymottakere vil eksponeres for støyverdier over 40 dB (L_{den}) ved worst case-beregning. 22 av disse vil eksponeres for støyverdier over grenseverdien på 45 dB (L_{den}) (gul vurderingssone). Som det fremgår av kartet i Figur 5 vil 1 av disse støymottakerne eksponeres for støyverdier rett over 50 dB (L_{den}). Minnelige avtaler er inngått mellom tiltakshaver og eierne av de to mest eksponerte byggene (A og B).

3.5.2 Resultat real case-beregning

Basert på kjennskap til vindforholdene på Lutelandet er det også utført beregning av sannsynlig scenario (real case) av støynivået for nærliggende bebyggelse.

En detaljert oversikt over beregnede støyverdier for de 22 mest utsatte naboene er presentert i Tabell 5, mens et støysonekart for sannsynlig støyscenario (real case) er vist i Figur 6. Støyverdier som overstiger den gjeldende grenseverdien på 45 dB er markert med farge i tabellen. Som det fremgår av tabellen reduseres støynivået markant når det i beregningene tas hensyn til de reelle vindforholdene. Hvor stor andel av reduksjonen som skyldes bruk av reell vindretningsfordeling og hvor stor andel som skyldes bruk av reell vindhastighetsfordeling varierer avhengig av støymottakernes plassering i forhold til turbinene, men for samtlige støymottakere er det bruk av vindhastighetsfordeling som påvirker resultatet i størst grad (80-90 %).

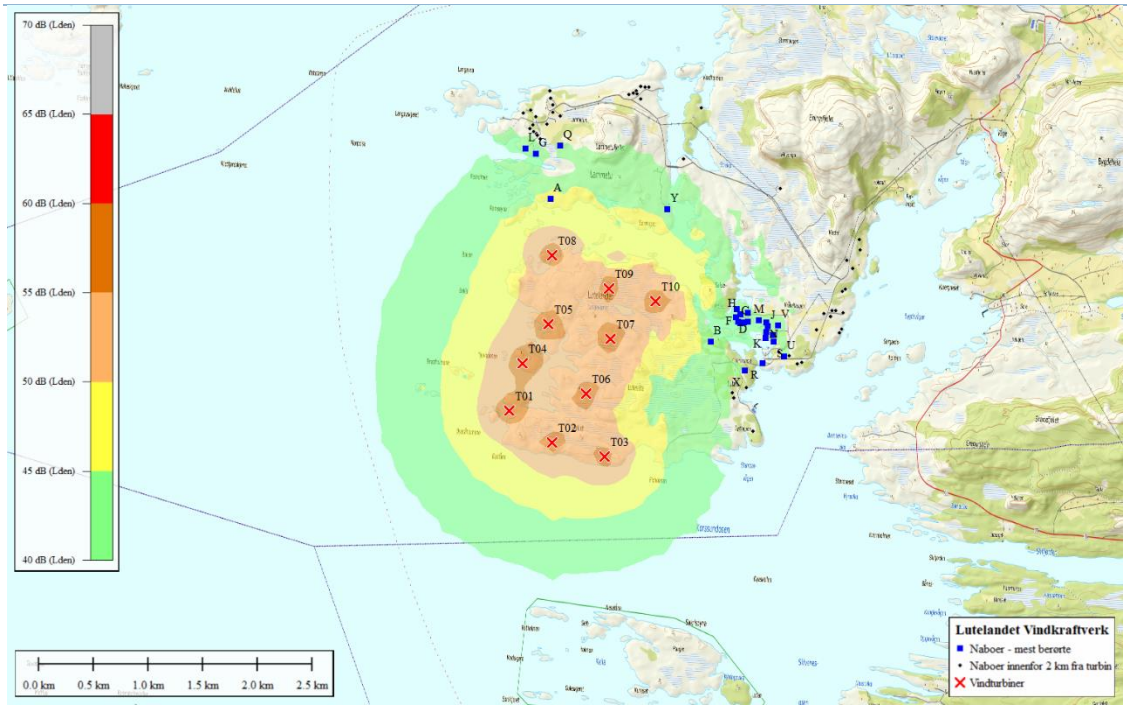
Én støymottaker ligger imidlertid fortsatt innenfor gul vurderingssone ved beregning basert på lokale vindforhold. Dette gjelder en fritidsbolig (A) beliggende på sørsiden av Lammetun, like nord for parken. Overskridelsen av grenseverdien er på 1.1 dB(A). For både denne og støymottaker B (som ligger like øst for vindkraftverket) er det inngått minnelige avtaler mellom tiltakshaver og eier.

Fullstendig beregningsrapport for real case-beregning av støy er lagt ved denne plan som vedlegg 2.2.

TABELL 5 – BEREGNEDE STØYVERDIER FOR DE MEST UTSATTE NABOENE (> 45 DB (L_{DEN}) VED BEREGNING MED MEDVIND FRA ALLE RETNINGER)

Angivelse på kart	**Avstand til nærmeste turbin [m]**	**Støynivå L_{den} [dB(A)]** Worst case	**Støynivå L_{den} [dB(A)]** Real case	**Differanse mellom worst case- og real case- beregning [dB(A)]**	**Merknad**
A	512	50.2	46.1	4.1	MA
B	625	49.4	44.4	5.0	MA
C	776	49.8	44.2	5.6	
D	751	49.5	44.2	5.3	
E	802	49.3	44.4	4.9	
F	742	48.1	43.3	4.8	
G	937	48.2	43.2	5.0	
H	782	48.0	42.1	5.9	
I	1226	48.2	43.0	5.2	
J	1046	47.9	42.5	5.4	
K	1051	47.8	42.3	5.5	
L	1003	47.4	42.1	5.3	
M	1367	47.4	42.0	5.4	
N	1029	47.3	42.0	5.3	
O	1112	46.3	41.7	4.6	
P	864	46.7	41.8	4.9	
Q	1000	46.5	42.0	4.5	
R	1126	46.1	38.2	7.9	
S	1140	46.1	40.2	5.9	
T	1273	46.1	40.5	5.6	
U	1273	45.7	40.6	5.1	
V	1143	45.5	41.0	4.5	

MA – Minnelig avtale er inngått



FIGUR 6 - STØYSONEKART BASERT PÅ BEREGNET STØYNIVÅ (L_{DEN}) FOR REAL CASE (BASERT PÅ LOKALE VINDFORHOLD)

3.6 Forslag til avbøtende tiltak

Basert på flere år med vindmålinger fra to målemaster i området har tiltakshaver god kjennskap til vindforholdene på Lutelandet. Vindfordelingen i dette området er slik at de fleste av naboene i liten grad ligger nedstrøms vindturbinene og vindhastigheten er i stor grad under nivået som gir maksimal støy fra turbinene. Vi mener derfor at det i dette tilfellet er riktig å basere vurderingene på sannsynlig scenario, ettersom verste scenario beskriver en situasjon som her er langt fra det som vil være reelt. Det er imidlertid viktig å påpeke at L_{den} er et årsmidlet mål på støynivået, mens støynivået i perioder vil kunne ligge over dette.

Basert på støyberegningene som er utført, samt inngåtte avtaler med de nærmeste naboene, vil det ikke være nødvendig med tiltak for å redusere støynivået.

Project:
Lutelandet

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Meventus AS
Konsgård Allé 59
NO-4632 Kristiansand
+47 3860 7115
Data / data@meventus.com
Calculated:
02.04.2019 10:57/3.2.743

SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

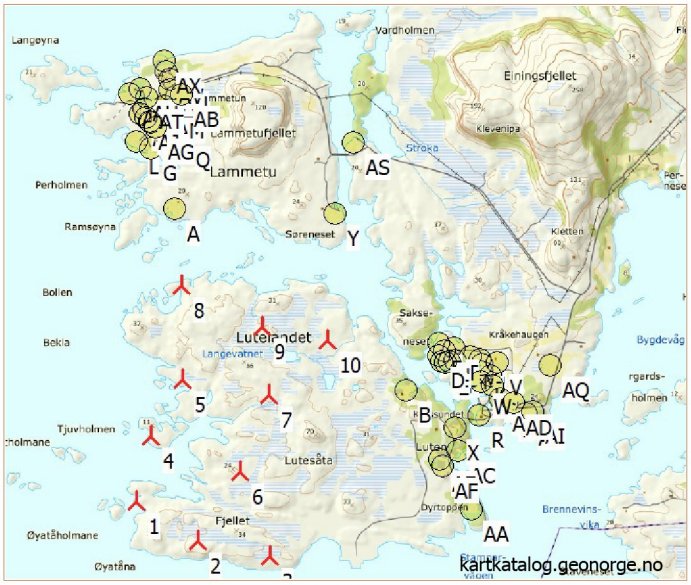
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
678	211	203	511	1,191	862	1,277	530	293	286	295	662	6,999

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: DTM Lutelandet
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:50,000

New WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	282,703	6,797,192	4.6	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
2	283,094	6,796,904	26.1	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
3	283,568	6,796,772	16.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
4	282,824	6,797,621	2.8	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
5	283,061	6,797,982	5.1	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
6	283,401	6,797,348	19.5	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
7	283,624	6,797,848	25.8	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
8	283,089	6,798,606	5.2	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
9	283,610	6,798,301	20.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
10	284,036	6,798,186	14.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
A	283,078	6,799,118	5.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
B	284,541	6,797,818	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
C	284,789	6,797,999	10.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
D	284,773	6,798,039	10.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
E	284,814	6,797,989	8.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
F	284,775	6,798,117	11.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
G	282,940	6,799,531	7.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
H	284,809	6,798,066	12.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
I	284,842	6,797,994	8.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
J	285,058	6,797,959	6.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
K	285,050	6,797,909	5.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
L	282,848	6,799,580	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
M	284,981	6,798,017	4.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
N	285,047	6,797,994	7.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
O	285,105	6,797,879	9.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
P	284,880	6,797,999	6.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Q	283,164	6,799,604	15.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
R	285,013	6,797,626	6.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
S	285,115	6,797,818	3.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0

To be continued on next page...

Project:
Lutelandet

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Calculated:
02.04.2019 10:57/3.2.743

SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
T	284,876	6,798,082	8.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
U	285,206	6,797,683	13.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
V	285,158	6,797,965	11.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
W	285,040	6,797,849	6.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
X	284,851	6,797,552	20.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Y	284,142	6,799,022	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Z	282,947	6,799,710	13.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AA	284,923	6,797,005	9.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AB	283,168	6,799,875	14.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AC	284,863	6,797,399	3.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AD	285,253	6,797,692	13.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AE	284,739	6,797,351	5.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AF	284,752	6,797,304	7.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AG	282,986	6,799,667	10.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AH	282,956	6,799,701	11.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AI	285,372	6,797,627	14.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AJ	282,921	6,799,735	15.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AK	282,888	6,799,763	16.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AL	285,163	6,797,727	5.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AM	283,047	6,799,804	13.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AN	283,100	6,799,979	18.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AO	283,095	6,799,910	16.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AP	285,331	6,797,618	13.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AQ	285,506	6,797,929	14.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AR	282,913	6,799,794	15.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AS	284,290	6,799,486	0.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AT	282,940	6,799,865	11.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AU	282,896	6,799,928	9.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AV	283,079	6,800,034	15.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AW	282,828	6,799,901	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AX	283,068	6,800,103	3.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0

Calculation Results

Shadow receptor

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	210:16	130	2:05	58:56
B	158:21	279	1:03	42:34
C	71:49	158	1:01	17:28
D	74:35	158	1:05	17:56
E	65:06	155	0:44	15:46
F	74:10	157	1:09	17:29
G	75:14	98	1:03	21:30
H	66:54	151	1:03	15:55
I	60:43	149	0:43	14:38
J	31:44	98	0:34	7:44
K	32:48	98	0:34	8:06
L	66:09	88	0:56	19:07
M	38:06	105	0:40	9:10
N	32:17	97	0:37	7:48
O	28:11	91	0:32	6:59
P	52:58	143	0:41	12:43
Q	79:49	82	1:19	22:27
R	48:02	149	0:36	12:36
S	29:26	96	0:32	7:23
T	47:45	114	0:48	11:19
U	19:51	68	0:28	5:17
V	21:06	66	0:33	5:13
W	33:35	103	0:34	8:26
X	77:11	195	0:39	21:20
Y	148:36	154	1:39	35:16
Z	45:50	74	0:52	13:02

To be continued on next page...

Project:
Lutelandet

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Data / data@meventus.com
Calculated:
02.04.2019 10:57/3.2.743

SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
AA	26:07	101	0:26	6:43
AB	37:36	54	0:52	10:28
AC	72:18	187	0:35	19:59
AD	17:34	64	0:27	4:39
AE	77:32	217	0:33	20:45
AF	69:27	204	0:29	18:35
AG	56:27	88	0:57	16:08
AH	47:17	75	0:54	13:27
AI	12:53	53	0:24	3:26
AJ	43:49	74	0:50	12:29
AK	41:35	74	0:47	11:52
AL	27:18	95	0:30	6:59
AM	40:51	64	0:52	11:34
AN	28:53	50	0:46	8:09
AO	34:13	55	0:49	9:39
AP	14:15	56	0:25	3:49
AQ	6:36	28	0:23	1:41
AR	37:24	70	0:47	10:41
AS	69:47	110	1:09	16:21
AT	34:49	66	0:46	9:56
AU	31:42	66	0:42	9:03
AV	27:15	50	0:44	7:43
AW	34:38	72	0:43	9:59
AX	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (108)	0:00	0:00
2	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (109)	12:44	2:40
3	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)	43:49	9:16
4	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (111)	15:04	3:43
5	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)	74:17	19:17
6	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)	68:44	16:04
7	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)	179:58	45:58
8	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)	228:32	61:27
9	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)	237:47	65:26
10	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)	305:16	84:39

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.

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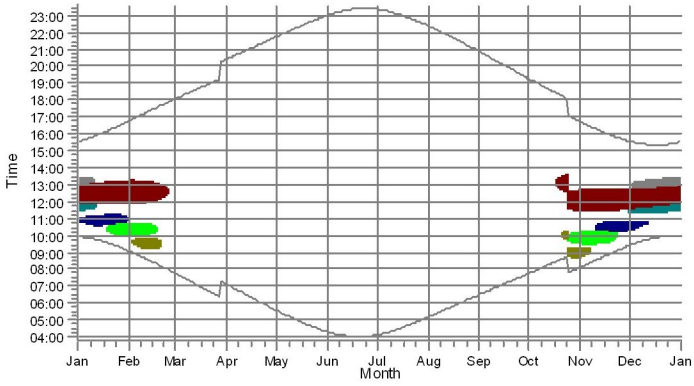
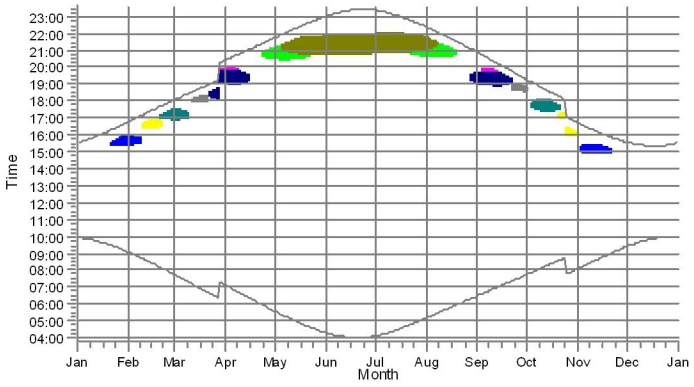
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

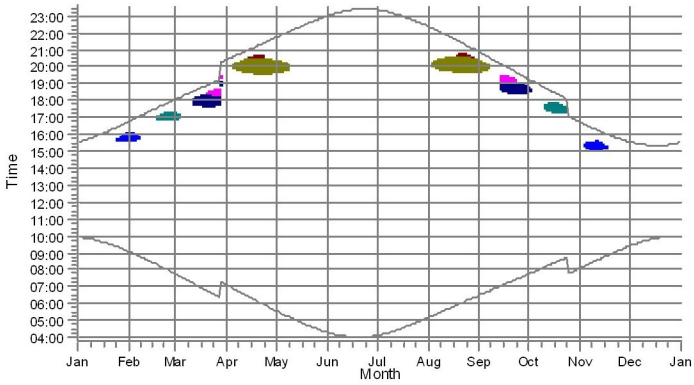
A: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (603)



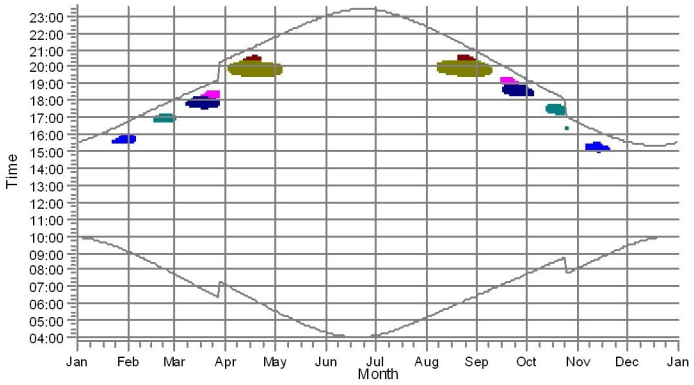
B: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (604)



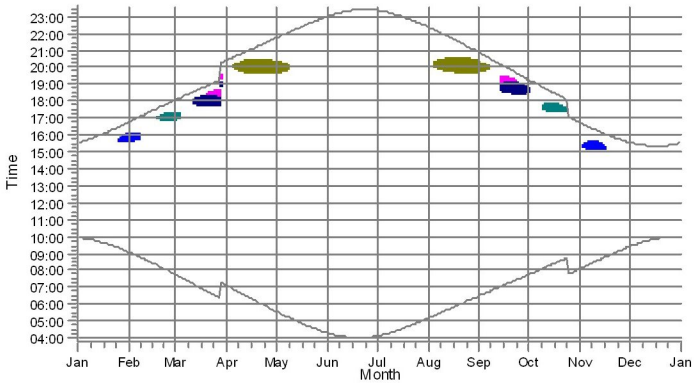
C: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (605)



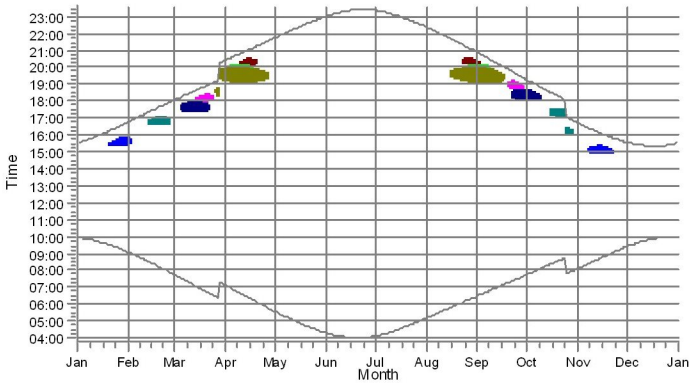
D: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (606)



E: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (607)



F: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (608)



WTGs

- 2: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (109)
- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 4: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (111)
- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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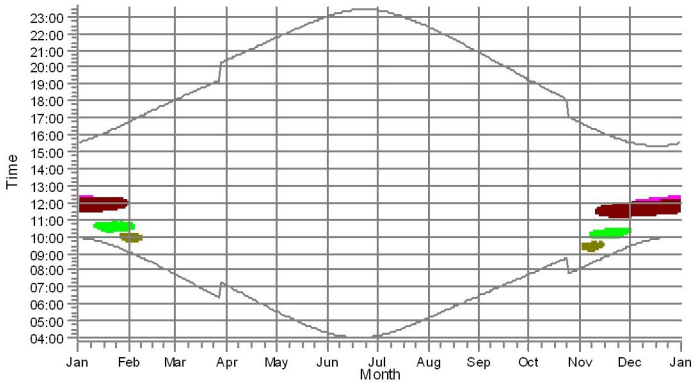
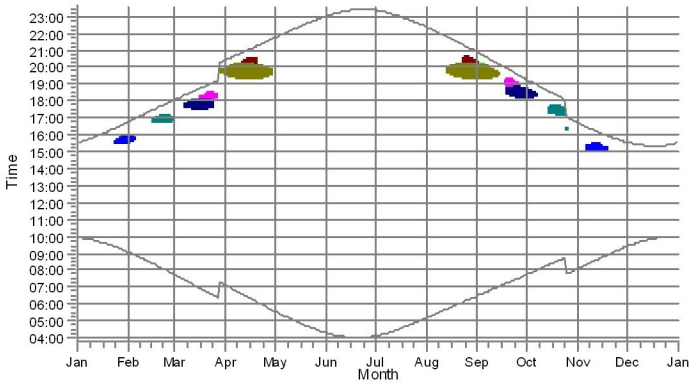
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

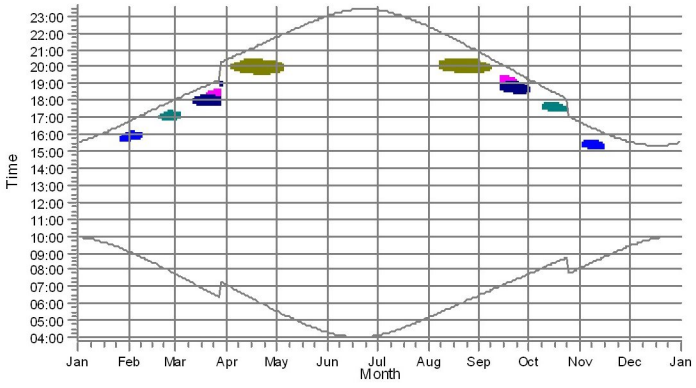
G: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (609)



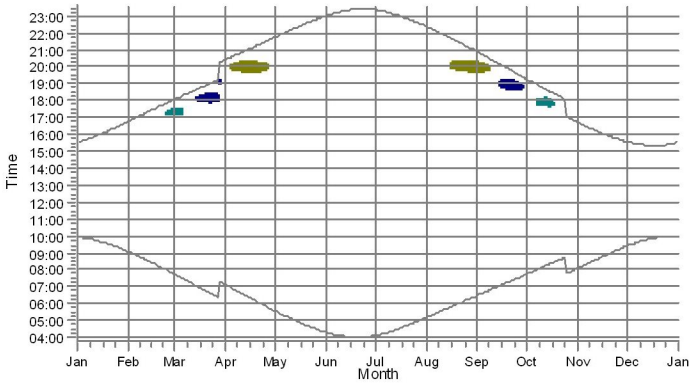
H: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (610)



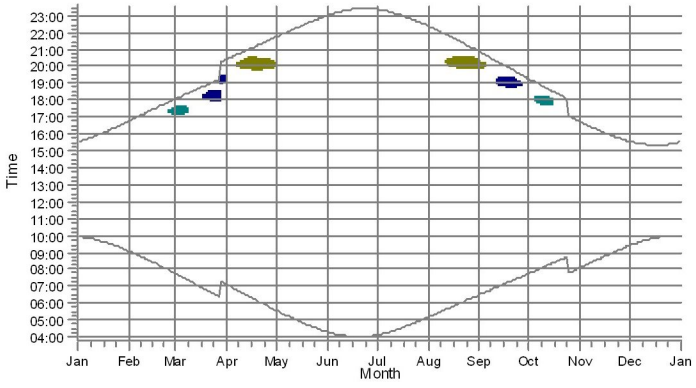
I: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (611)



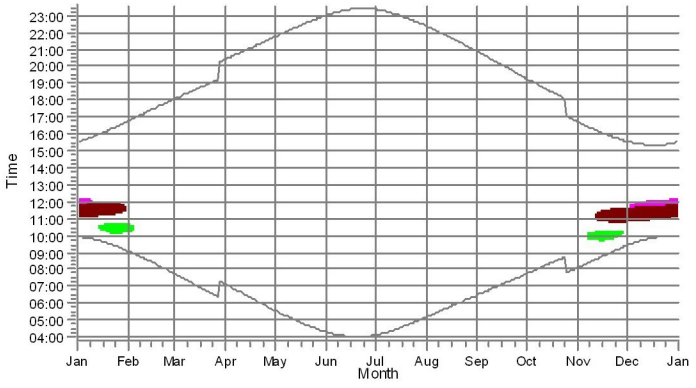
J: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (612)



K: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (613)



L: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (614)



WTGs

- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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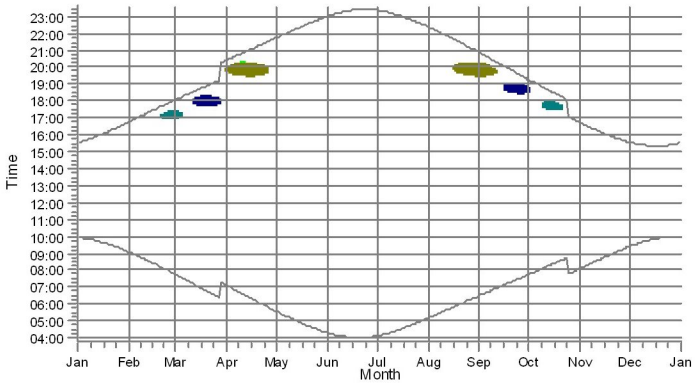
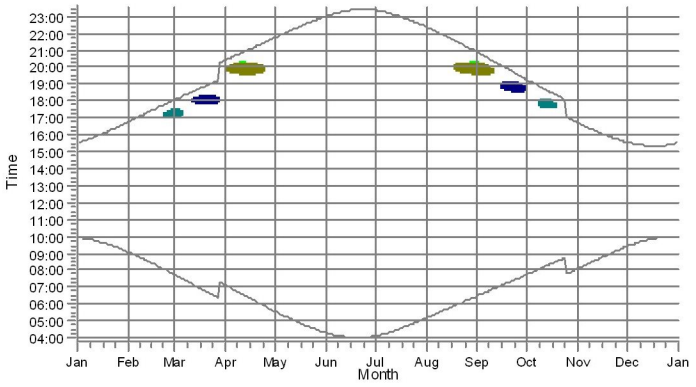
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

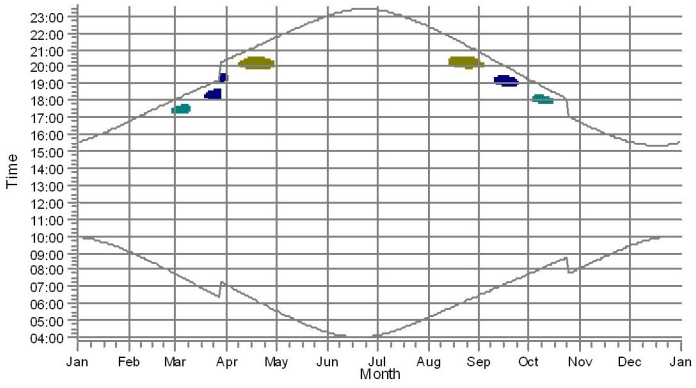
M: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (615)



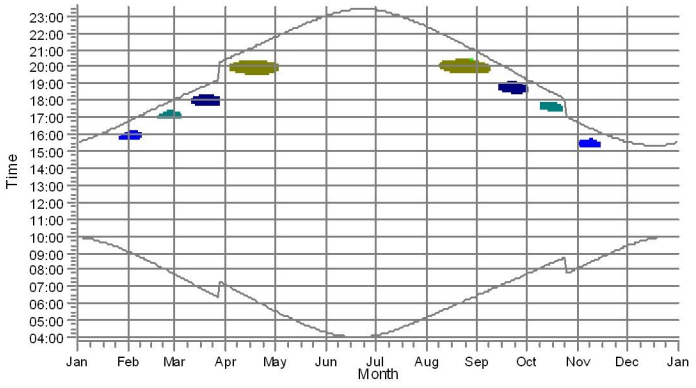
N: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (616)



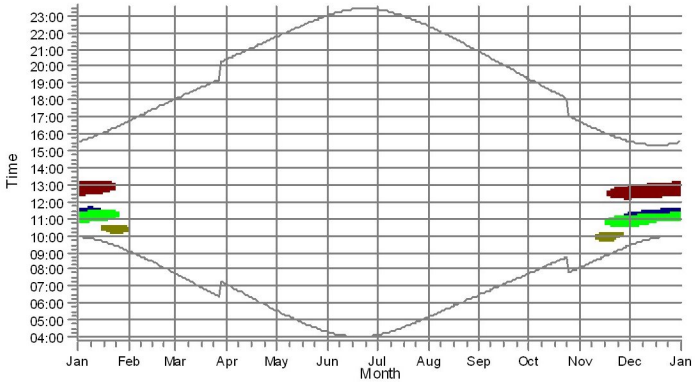
O: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (617)



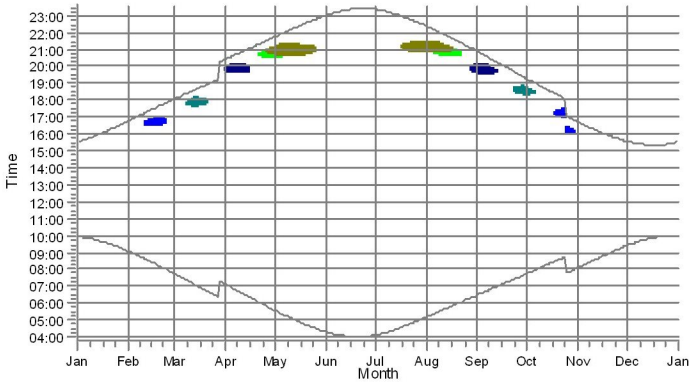
P: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (618)



Q: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (619)



R: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (620)



WTGs

- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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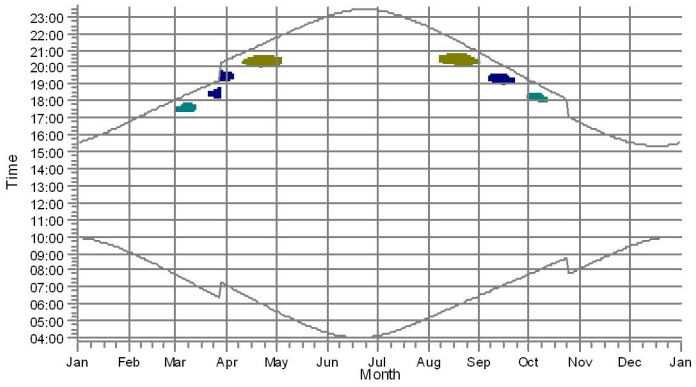
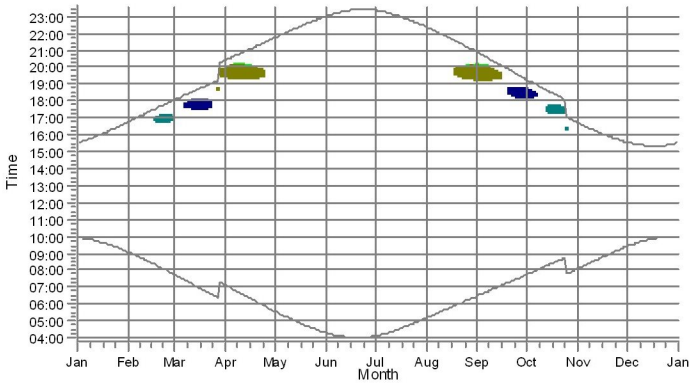
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

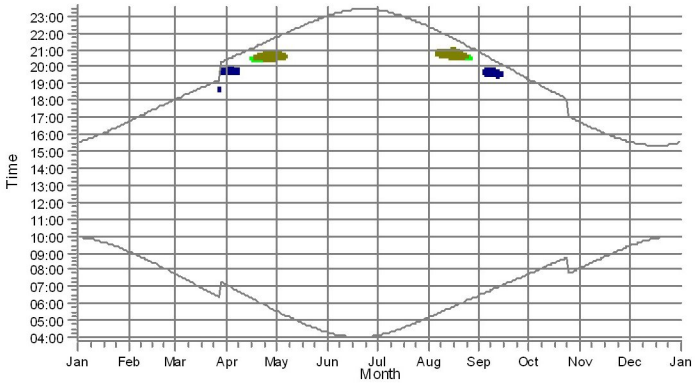
S: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (621)



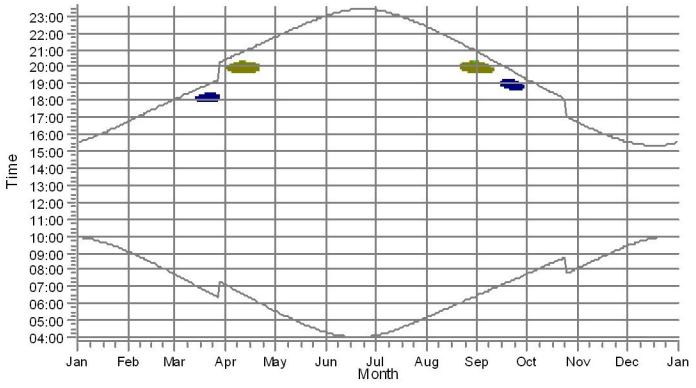
T: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (622)



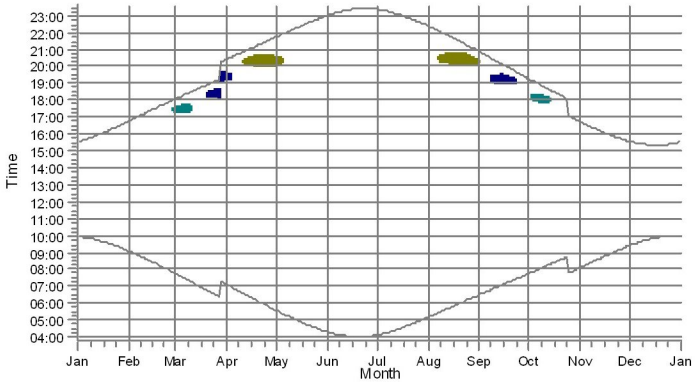
U: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (623)



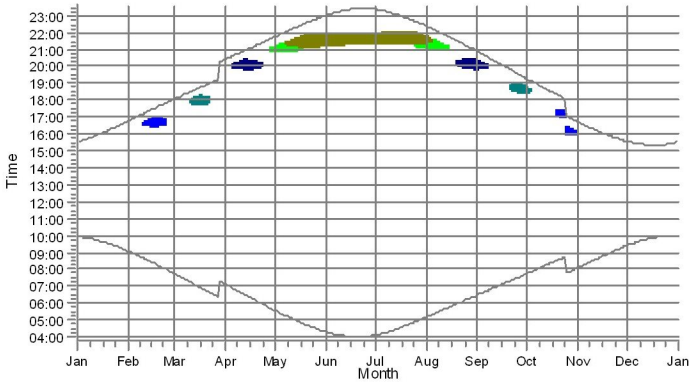
V: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (624)



W: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (625)



X: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (626)



WTGs

- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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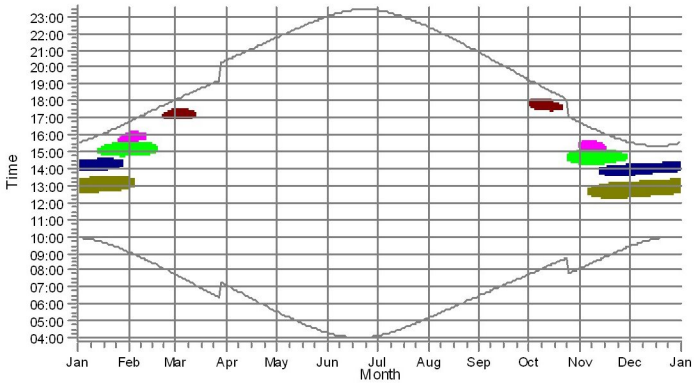
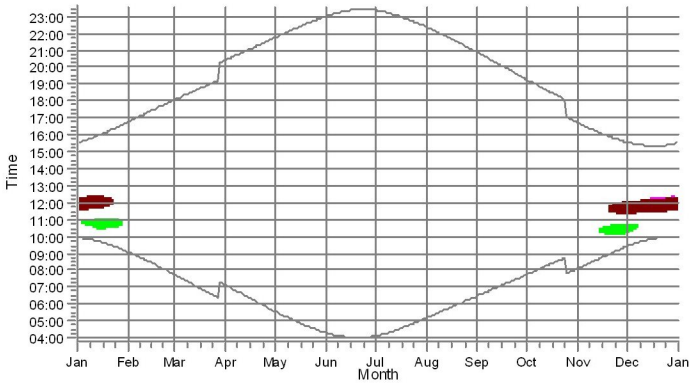
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

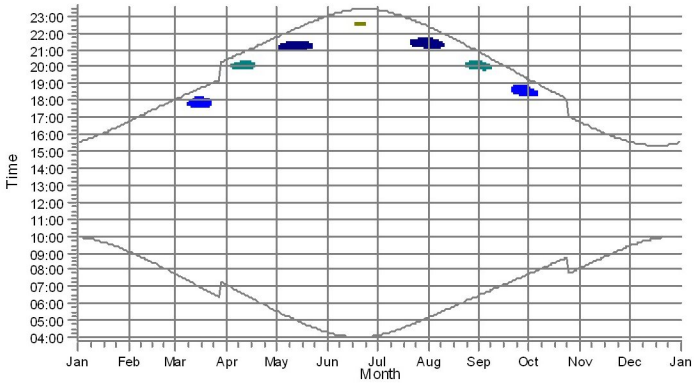
Y: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (627)



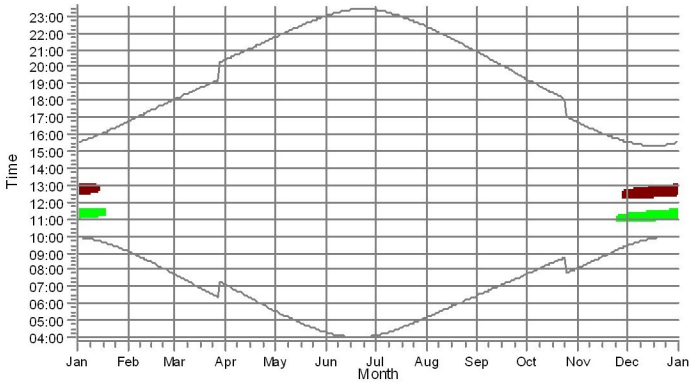
Z: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (628)



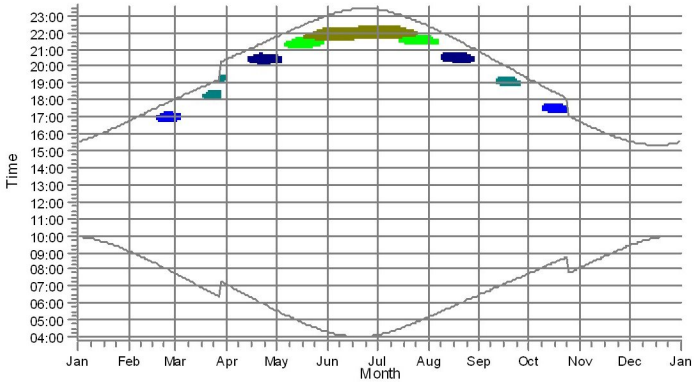
AA: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (629)



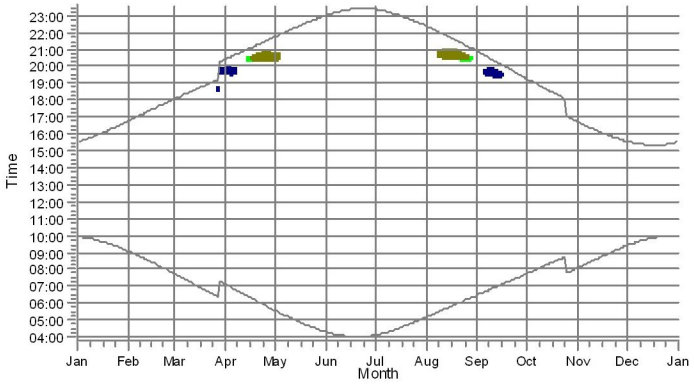
AB: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (630)



AC: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (631)



AD: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (632)



WTGs

- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

Project:
Lutelandet

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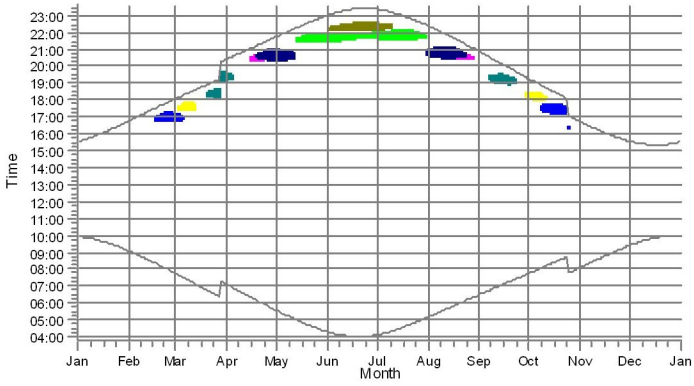
Calculated:
02.04.2019 10:57/3.2.743

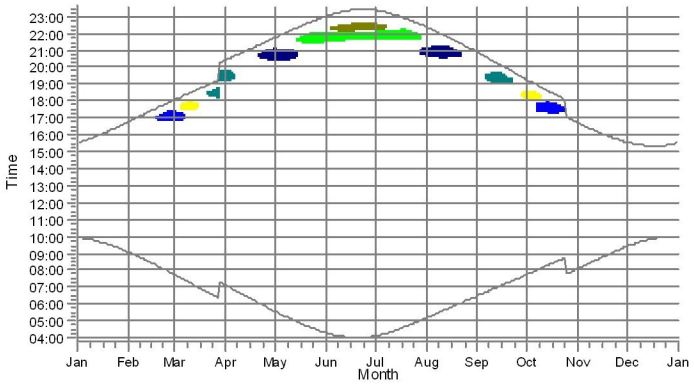
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

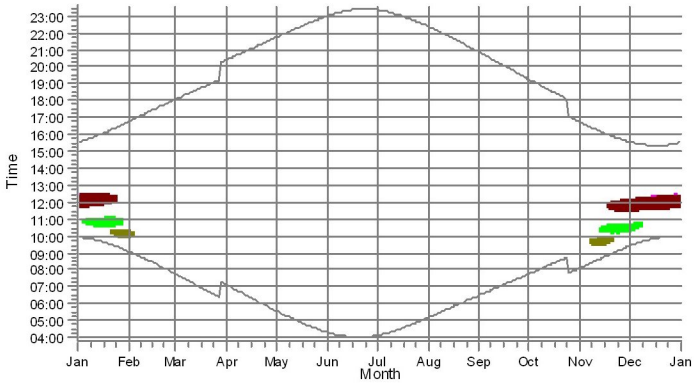
AE: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (633)



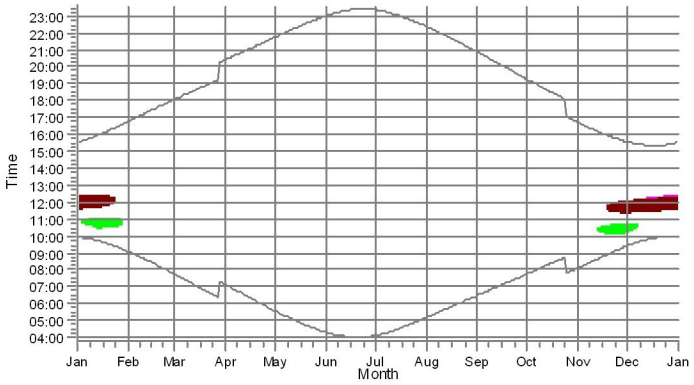
AF: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (634)



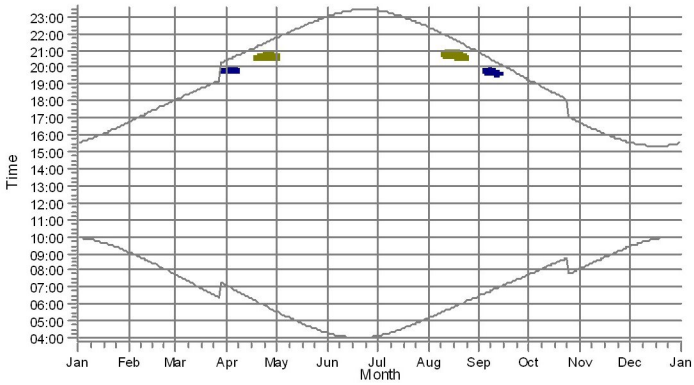
AG: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (635)



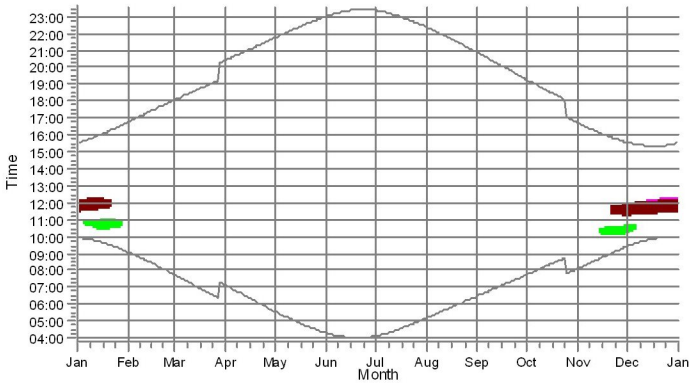
AH: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (636)



AI: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (637)



AJ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (638)



WTGs

- 2: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (109)
- 3: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)
- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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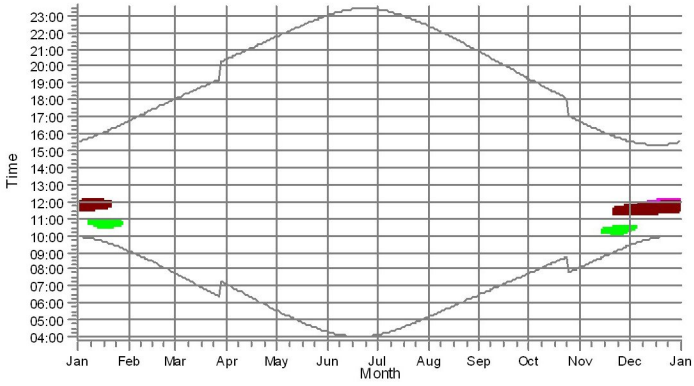
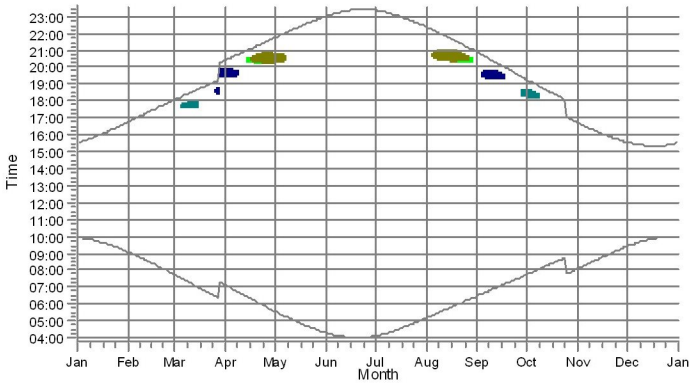
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

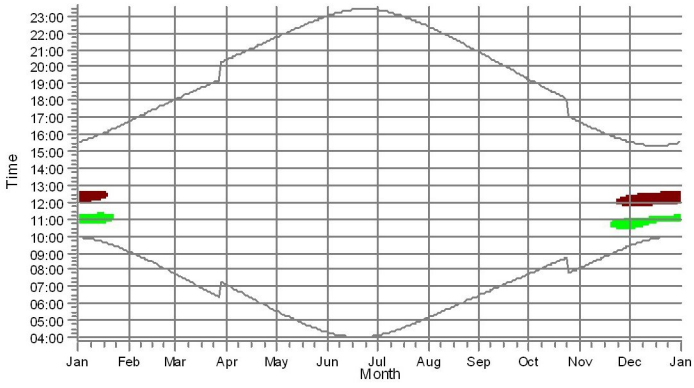
AK: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (639)



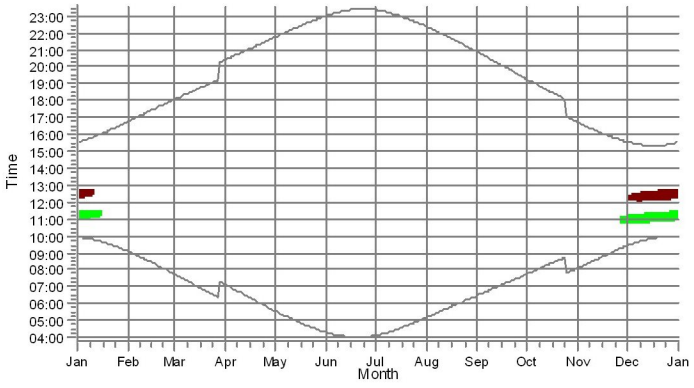
AL: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (640)



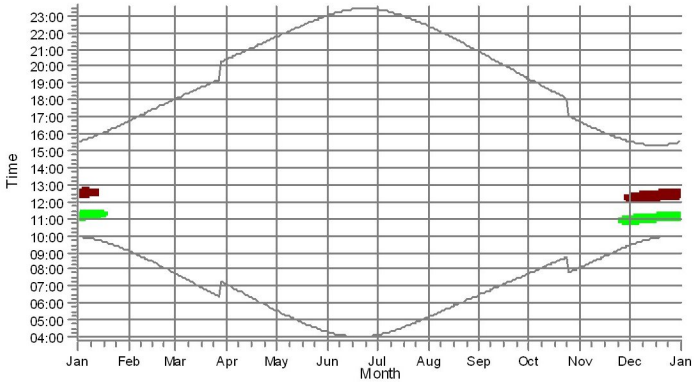
AM: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (641)



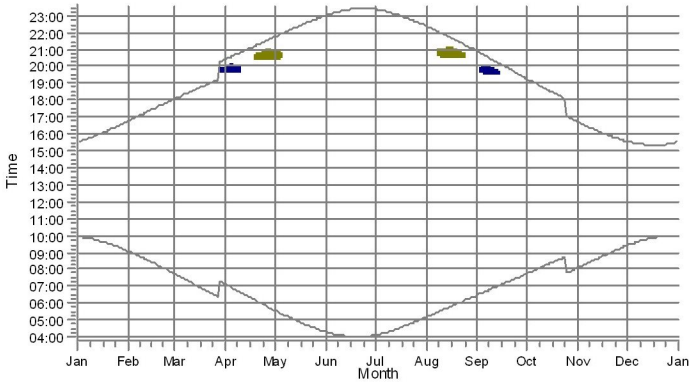
AN: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (642)



AO: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (643)



AP: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (644)



WTGs

- 5: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)
- 6: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)
- 7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
- 8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
- 9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
- 10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

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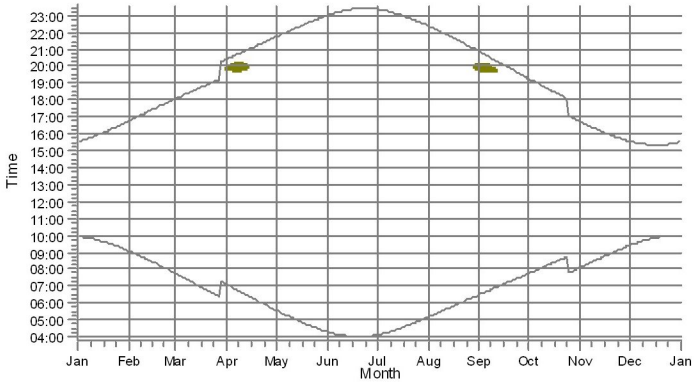
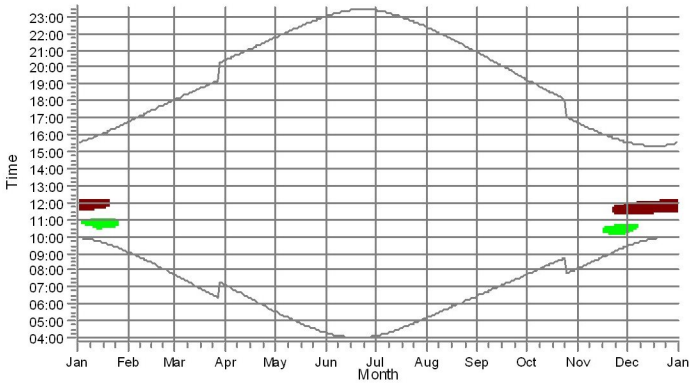
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

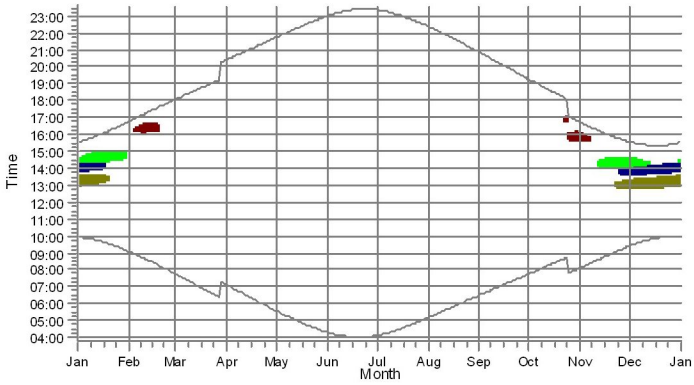
AQ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (645)



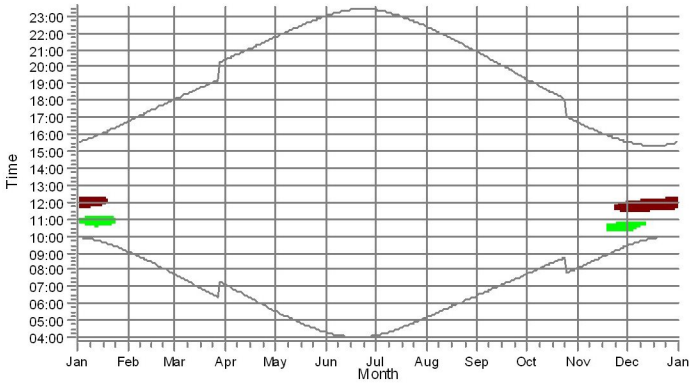
AR: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (646)



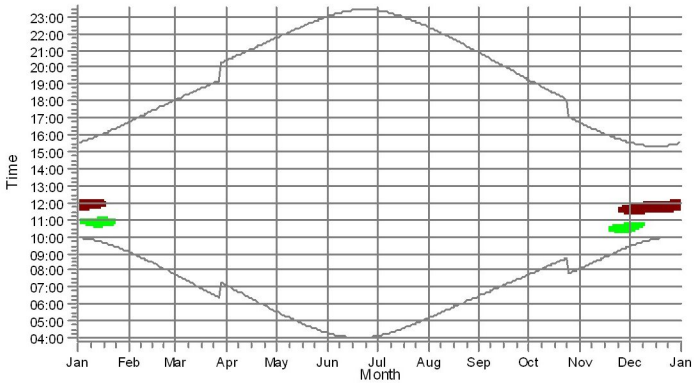
AS: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (647)



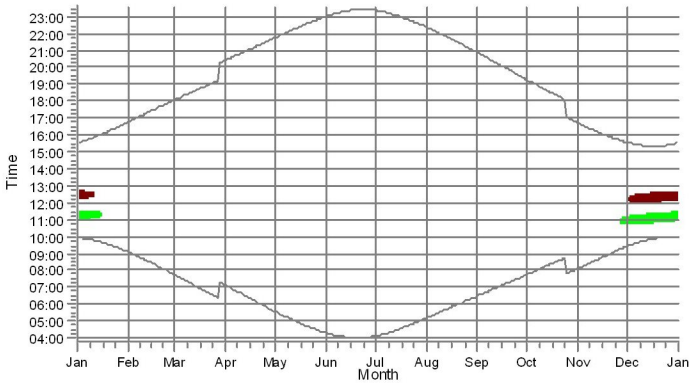
AT: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (648)



AU: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (649)



AV: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (650)



WTGs

7: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)
8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)
9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)
10: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)

Project:
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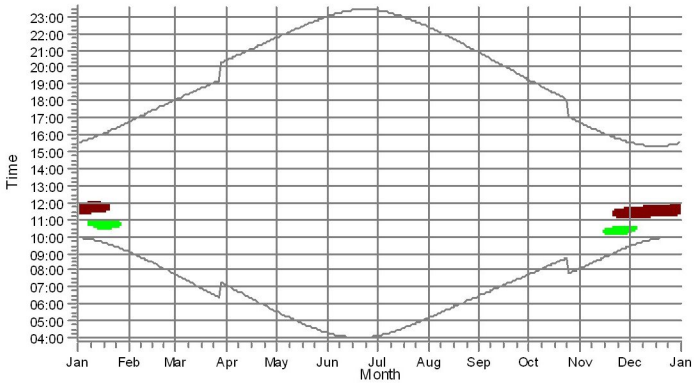
Calculated:
02.04.2019 10:57/3.2.743

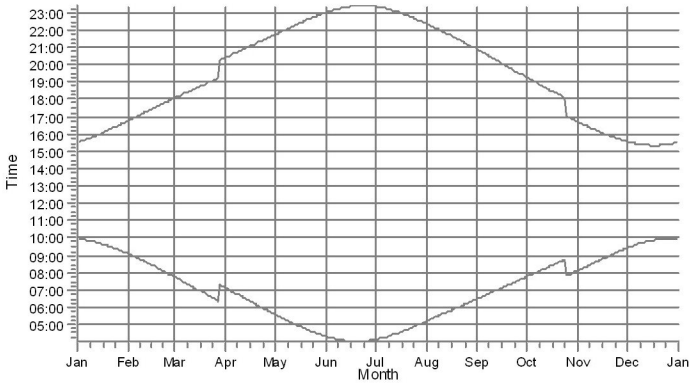
SHADOW - Calendar, graphical

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH

AW: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (651)



AX: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (652)



WTGs

8: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)

9: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)

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Calculated:
02.04.2019 11:05/3.2.743

SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH (with curtailment)

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

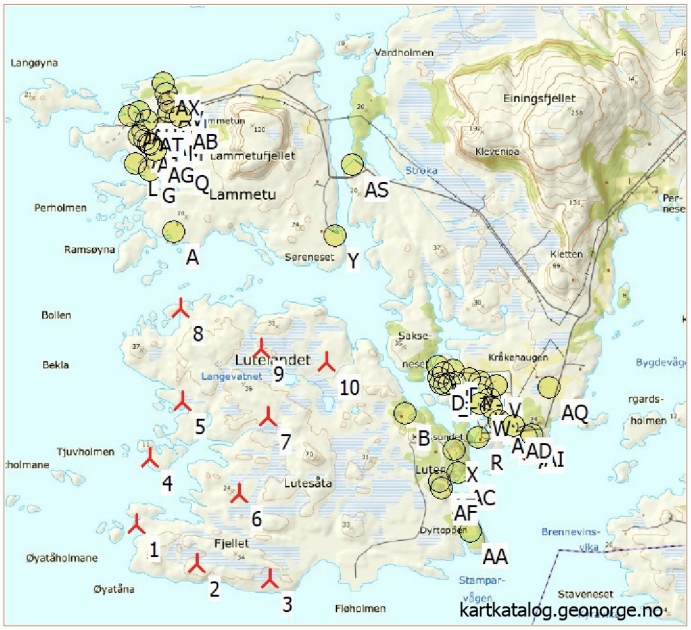
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
678	211	203	511	1,191	862	1,277	530	293	286	295	662	6,999

Flicker curtailment by stopping specific turbines

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: DTM Lutelandet
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:50,000

New WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	282,703	6,797,192	4.6	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
2	283,094	6,796,904	26.1	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
3	283,568	6,796,772	16.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
4	282,824	6,797,621	2.8	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
5	283,061	6,797,982	5.1	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
6	283,401	6,797,348	19.5	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
7	283,624	6,797,848	25.8	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
8	283,089	6,798,606	5.2	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
9	283,610	6,798,301	20.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7
10	284,036	6,798,186	14.0	VESTAS V150-5.6-PO-Luteland 5600 150....	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	1,816	11.7

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
A	283,078	6,799,118	5.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
B	284,541	6,797,818	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
C	284,789	6,797,999	10.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
D	284,773	6,798,039	10.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
E	284,814	6,797,989	8.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
F	284,775	6,798,117	11.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
G	282,940	6,799,531	7.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
H	284,809	6,798,066	12.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
I	284,842	6,797,994	8.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
J	285,058	6,797,959	6.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
K	285,050	6,797,909	5.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
L	282,848	6,799,580	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
M	284,981	6,798,017	4.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
N	285,047	6,797,994	7.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
O	285,105	6,797,879	9.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
P	284,880	6,797,999	6.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Q	283,164	6,799,604	15.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0

To be continued on next page...

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SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH (with curtailment)

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
R	285,013	6,797,626	6.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
S	285,115	6,797,818	3.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
T	284,876	6,798,082	8.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
U	285,206	6,797,683	13.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
V	285,158	6,797,965	11.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
W	285,040	6,797,849	6.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
X	284,851	6,797,552	20.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Y	284,142	6,799,022	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Z	282,947	6,799,710	13.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AA	284,923	6,797,005	9.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AB	283,168	6,799,875	14.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AC	284,863	6,797,399	3.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AD	285,253	6,797,692	13.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AE	284,739	6,797,351	5.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AF	284,752	6,797,304	7.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AG	282,986	6,799,667	10.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AH	282,956	6,799,701	11.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AI	285,372	6,797,627	14.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AJ	282,921	6,799,735	15.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AK	282,888	6,799,763	16.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AL	285,163	6,797,727	5.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AM	283,047	6,799,804	13.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AN	283,100	6,799,979	18.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AO	283,095	6,799,910	16.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AP	285,331	6,797,618	13.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AQ	285,506	6,797,929	14.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AR	282,913	6,799,794	15.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AS	284,290	6,799,486	0.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AT	282,940	6,799,865	11.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AU	282,896	6,799,928	9.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AV	283,079	6,800,034	15.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AW	282,828	6,799,901	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AX	283,068	6,800,103	3.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0

Calculation Results

Shadow receptor

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Avoided hours per year [h/year]	Avoided days per year [days/year]	Shadow, expected values: Shadow hours per year [h/year]	Avoided hours per year [h/year]
A*	176:12	130	2:05	34:04		49:21	9:34
AA*	26:02	96	0:26	0:05	5	6:41	0:01
AB*	9:17	54	0:13	28:19		2:41	7:46
AC*	24:19	95	0:24	47:59	92	5:46	14:12
AD*	17:31	64	0:27	0:03		4:38	0:00
AE*	25:31	102	0:27	52:01	115	5:52	14:52
AF*	29:07	162	0:27	40:20	42	7:09	11:25
AG*	27:11	76	0:35	29:16	12	7:52	8:16
AH*	19:18	75	0:28	27:59		5:40	7:47
AI	12:53	53	0:24			3:26	
AJ*	12:42	66	0:23	31:07	8	3:47	8:42
AK*	10:28	61	0:20	31:07	13	3:07	8:44
AL*	26:58	95	0:28	0:20		6:54	0:05
AM*	20:10	64	0:27	20:41		5:35	5:59
AN*	8:58	46	0:17	19:55	4	2:30	5:39
AO*	9:29	46	0:16	24:44	9	2:36	7:03
AP*	13:38	56	0:25	0:37		3:39	0:10
AQ*	0:22	8	0:06	6:14	20	0:05	1:35
AR*	10:52	42	0:23	26:32	28	3:16	7:24
AS*	29:14	80	0:35	40:33	30	6:51	9:29
AT*	11:22	66	0:18	23:27		3:20	6:35
AU*	8:44	40	0:18	22:58	26	2:37	6:26
AV*	10:14	44	0:19	17:01	6	2:50	4:52
AW*	12:30	72	0:22	22:08		3:42	6:17

To be continued on next page...

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SHADOW - Main Result

Calculation: 201904_Lutelandet_10xV150_5.6MW_105mHH (with curtailment)

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Avoided hours per year [h/year]	Avoided days per year [days/year]	Shadow, expected values: Shadow hours per year [h/year]	Avoided hours per year [h/year]
AX	0:00	0	0:00			0:00	
B*	110:35	279	0:52	47:46		28:25	14:08
C*	24:02	101	0:33	47:47	57	5:21	12:07
D*	25:25	136	0:23	49:10	22	5:53	12:03
E*	21:50	96	0:35	43:16	59	4:44	11:01
F*	34:33	131	0:28	39:37	26	7:50	9:39
G*	17:31	96	0:30	57:43	2	5:10	16:19
H*	25:06	134	0:23	41:48	17	5:45	10:10
I*	20:46	100	0:31	39:57	49	4:30	10:07
J*	12:05	68	0:21	19:39	30	2:41	5:03
K*	14:15	71	0:25	18:33	27	3:12	4:53
L*	24:52	80	0:20	41:17	8	7:09	11:58
M*	11:38	80	0:20	26:28	25	2:39	6:31
N*	11:25	74	0:19	20:52	23	2:34	5:13
O*	13:49	76	0:24	14:22	15	3:11	3:48
P*	17:28	109	0:21	35:30	34	3:47	8:56
Q*	25:38	80	0:36	54:11	2	7:23	15:05
R*	23:36	101	0:25	24:26	48	5:57	6:38
S*	21:51	92	0:24	7:35	4	5:21	2:01
T*	15:13	85	0:23	32:32	29	3:34	7:45
U*	19:12	68	0:28	0:39		5:07	0:10
V*	7:08	46	0:20	13:58	20	1:39	3:34
W*	23:50	97	0:25	9:45	6	5:49	2:36
X*	27:13	100	0:28	49:58	95	7:03	14:16
Y*	22:09	70	0:31	126:27	84	4:41	30:35
Z*	17:00	74	0:26	28:50		5:01	8:01

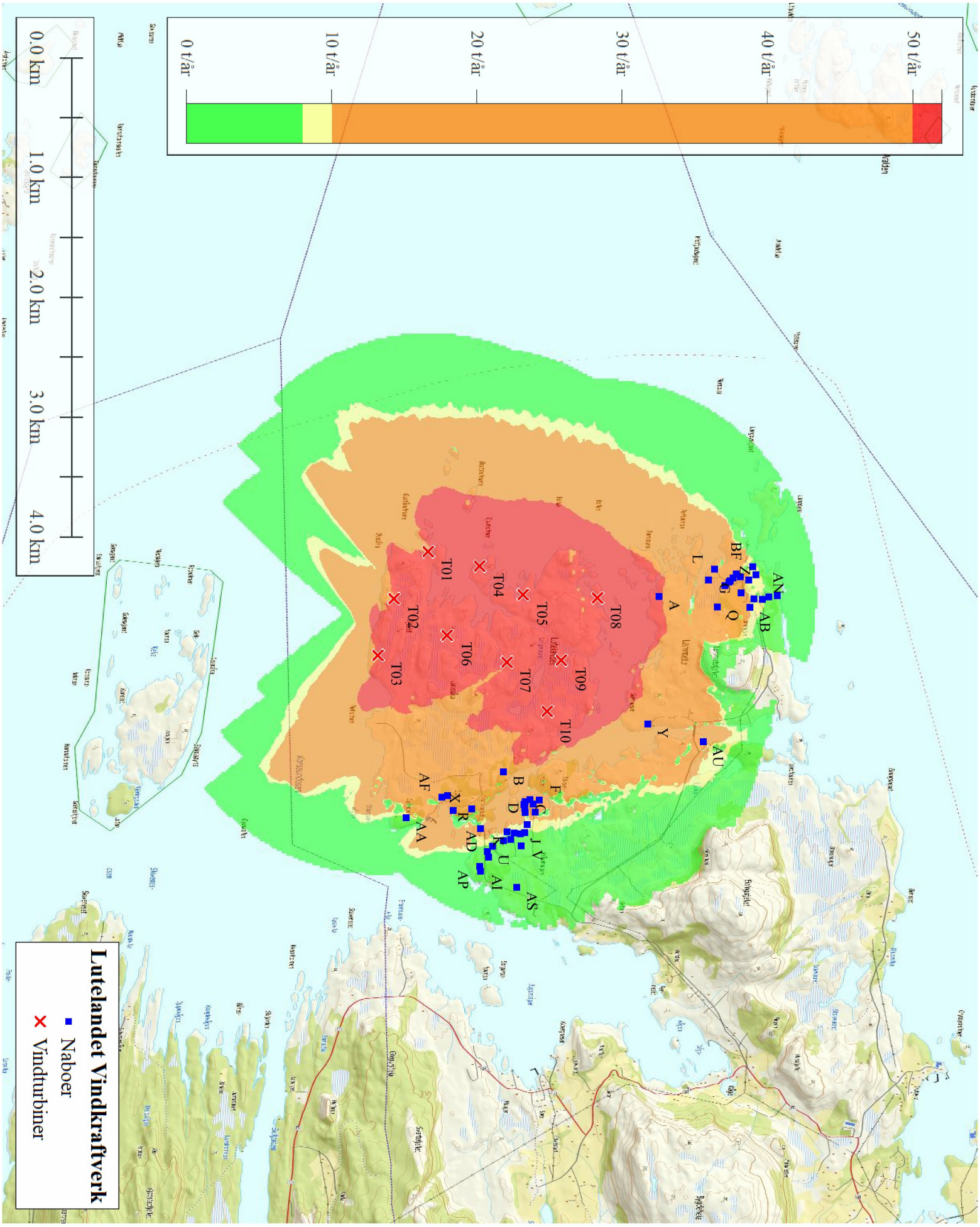
** Receptors where shadow flicker is reduced by curtailment*

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

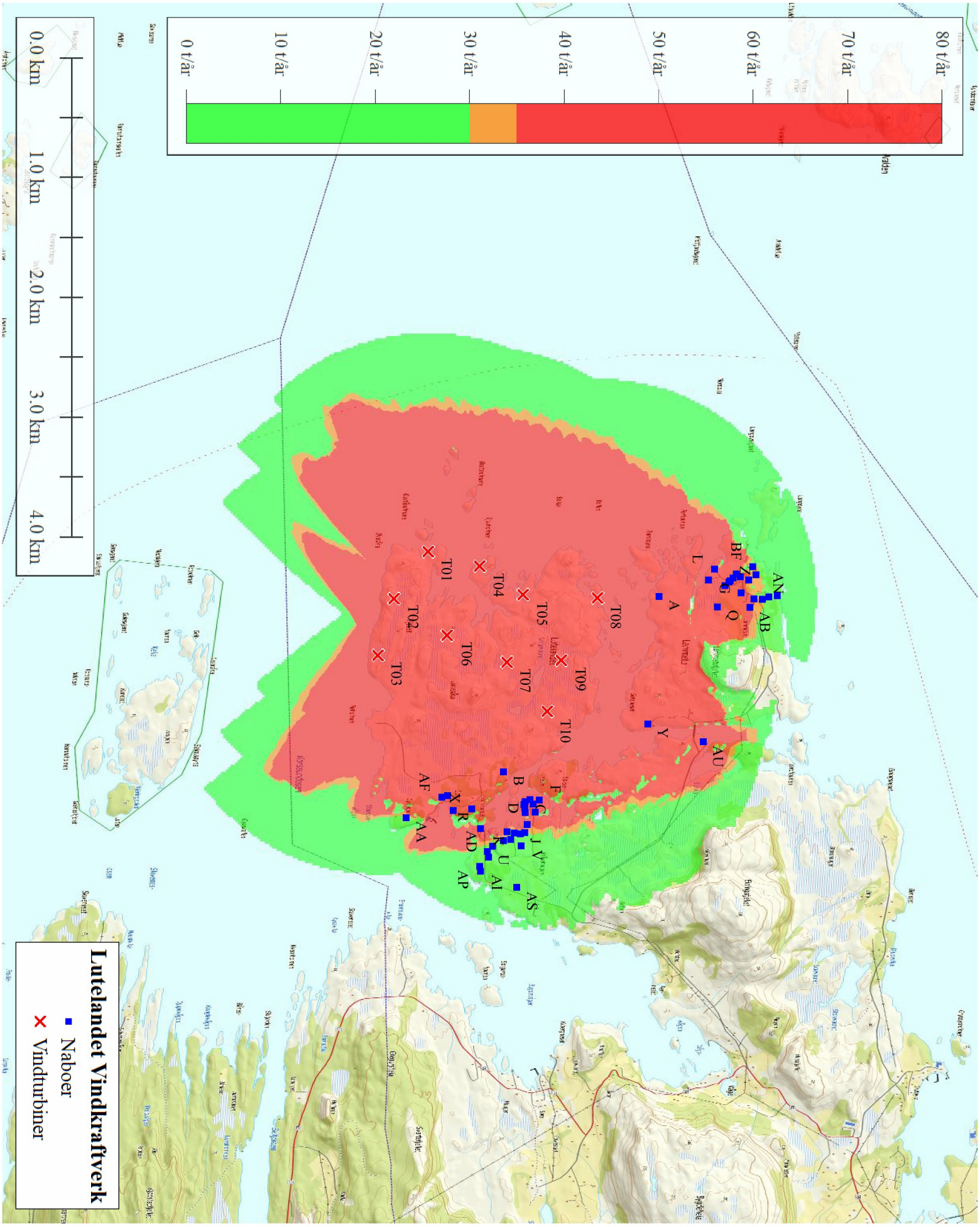
No.	Name	Worst case [h/year]	Stopped due to flicker curtailment [h/year]	Expected [h/year]
1	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (108)	0:00		0:00
2	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (109)	7:33	5:11	1:35
3	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (110)	37:08	6:41	7:51
4	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (111)	15:04		3:43
5	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (112)	57:32	16:45	14:38
6	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (113)	68:44		16:04
7	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (114)	117:30	62:28	31:01
8	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (115)	131:40	96:52	35:35
9	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (116)	118:11	119:36	32:57
10	VESTAS V150-5.6-PO-Luteland 5600 150.0 !O! hub: 105.0 m (TOT: 180.0 m) (117)	78:02	227:14	22:23

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.

Vedlegg 1.3 Skyggekastkart for sannsynlig skyggekast



Vedlegg 1.4 Skyggekastkart for teoretisk maksimalt skyggekast



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02.04.2019 11:10/3.2.743

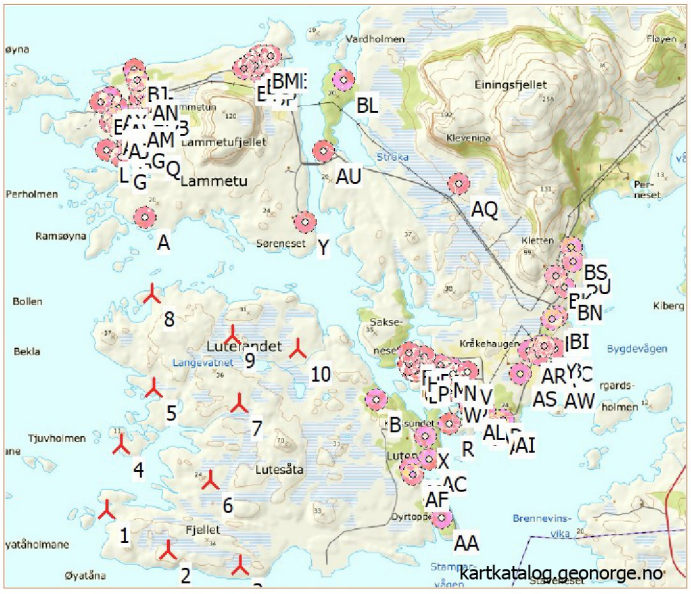
NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	7.0 °C
Height for air temperature	95.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
DTM Lutelandet	
Roughness based on line object	
Roughness lines (online)	
Terrain type based on area object	
Terrain Hardness	
Month for calculation	January
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed	Max noise wind speed
Max noise wind speed	All receptors downwind
Wind direction	4.0 m
Height above ground level for receiver	
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	5.022
Version	

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:50,000

New WTG Noise sensitive area

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Setting	Creator	Name
			[m]					[kW]	[m]	[m]			
1	282,703	6,797,192	4.6	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
2	283,094	6,796,904	26.1	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
3	283,568	6,796,772	16.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
4	282,824	6,797,621	2.8	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
5	283,061	6,797,982	5.1	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
6	283,401	6,797,348	19.5	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
7	283,624	6,797,848	25.8	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
8	283,089	6,798,606	5.2	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
9	283,610	6,798,301	20.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
10	284,036	6,798,186	14.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB

Calculation Results

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Calculated:
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NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

Sound level

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
A Noise sensitive point: Norwegian - Yellow zone (2183)	283,078	6,799,118	5.0	4.0	45.0	50.2	No
A Day						43.8	
A Evening						43.8	
A Night						43.8	
B Noise sensitive point: Norwegian - Yellow zone (2184)	284,541	6,797,818	14.3	4.0	45.0	49.4	No
B Day						43.0	
B Evening						43.0	
B Night						43.0	
C Noise sensitive point: Norwegian - Yellow zone (2185)	284,789	6,797,999	10.0	4.0	45.0	49.8	No
C Day						43.4	
C Evening						43.4	
C Night						43.4	
D Noise sensitive point: Norwegian - Yellow zone (2186)	284,773	6,798,039	10.0	4.0	45.0	49.5	No
D Day						43.1	
D Evening						43.1	
D Night						43.1	
E Noise sensitive point: Norwegian - Yellow zone (2187)	284,814	6,797,989	8.6	4.0	45.0	49.3	No
E Day						42.9	
E Evening						42.9	
E Night						42.9	
F Noise sensitive point: Norwegian - Yellow zone (2188)	284,775	6,798,117	11.4	4.0	45.0	48.1	No
F Day						41.7	
F Evening						41.7	
F Night						41.7	
G Noise sensitive point: Norwegian - Yellow zone (2189)	282,940	6,799,531	7.4	4.0	45.0	48.2	No
G Day						41.8	
G Evening						41.8	
G Night						41.8	
H Noise sensitive point: Norwegian - Yellow zone (2190)	284,809	6,798,066	12.1	4.0	45.0	48.0	No
H Day						41.6	
H Evening						41.6	
H Night						41.6	
I Noise sensitive point: Norwegian - Yellow zone (2191)	284,842	6,797,994	8.3	4.0	45.0	48.2	No
I Day						41.8	
I Evening						41.8	
I Night						41.8	
J Noise sensitive point: Norwegian - Yellow zone (2192)	285,058	6,797,959	6.8	4.0	45.0	47.9	No
J Day						41.5	
J Evening						41.5	
J Night						41.5	
K Noise sensitive point: Norwegian - Yellow zone (2193)	285,050	6,797,909	5.2	4.0	45.0	47.8	No
K Day						41.4	
K Evening						41.4	
K Night						41.4	
L Noise sensitive point: Norwegian - Yellow zone (2194)	282,848	6,799,580	10.5	4.0	45.0	47.4	No
L Day						41.1	
L Evening						41.1	
L Night						41.1	
M Noise sensitive point: Norwegian - Yellow zone (2195)	284,981	6,798,017	4.6	4.0	45.0	47.4	No
M Day						41.0	
M Evening						41.0	
M Night						41.0	
N Noise sensitive point: Norwegian - Yellow zone (2196)	285,047	6,797,994	7.5	4.0	45.0	47.3	No
N Day						40.9	
N Evening						40.9	
N Night						40.9	
O Noise sensitive point: Norwegian - Yellow zone (2197)	285,105	6,797,879	9.5	4.0	45.0	46.3	No
O Day						39.9	
O Evening						39.9	
O Night						39.9	
P Noise sensitive point: Norwegian - Yellow zone (2198)	284,880	6,797,999	6.2	4.0	45.0	46.7	No
P Day						40.3	
P Evening						40.3	
P Night						40.3	
Q Noise sensitive point: Norwegian - Yellow zone (2199)	283,164	6,799,604	15.5	4.0	45.0	46.5	No

To be continued on next page...

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NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

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Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
Q Day						40.1	
Q Evening						40.1	
Q Night						40.1	
R Noise sensitive point: Norwegian - Yellow zone (2200)	285,013	6,797,626	6.9	4.0	45.0	46.1	No
R Day						39.7	
R Evening						39.7	
R Night						39.7	
S Noise sensitive point: Norwegian - Yellow zone (2201)	285,115	6,797,818	3.9	4.0	45.0	46.1	No
S Day						39.7	
S Evening						39.7	
S Night						39.7	
T Noise sensitive point: Norwegian - Yellow zone (2202)	284,876	6,798,082	8.9	4.0	45.0	46.1	No
T Day						39.7	
T Evening						39.7	
T Night						39.7	
U Noise sensitive point: Norwegian - Yellow zone (2203)	285,206	6,797,683	13.2	4.0	45.0	45.7	No
U Day						39.3	
U Evening						39.3	
U Night						39.3	
V Noise sensitive point: Norwegian - Yellow zone (2204)	285,158	6,797,965	11.4	4.0	45.0	45.5	No
V Day						39.1	
V Evening						39.1	
V Night						39.1	
W Noise sensitive point: Norwegian - Yellow zone (2205)	285,040	6,797,849	6.6	4.0	45.0	45.0	Yes
W Day						38.6	
W Evening						38.6	
W Night						38.6	
X Noise sensitive point: Norwegian - Yellow zone (2206)	284,851	6,797,552	20.0	4.0	45.0	44.9	Yes
X Day						38.5	
X Evening						38.5	
X Night						38.5	
Y Noise sensitive point: Norwegian - Yellow zone (2207)	284,142	6,799,022	4.7	4.0	45.0	45.0	Yes
Y Day						38.6	
Y Evening						38.6	
Y Night						38.6	
Z Noise sensitive point: Norwegian - Yellow zone (2208)	282,947	6,799,710	13.9	4.0	45.0	44.8	Yes
Z Day						38.4	
Z Evening						38.4	
Z Night						38.4	
AA Noise sensitive point: Norwegian - Yellow zone (2209)	284,923	6,797,005	9.8	4.0	45.0	44.9	Yes
AA Day						38.5	
AA Evening						38.5	
AA Night						38.5	
AB Noise sensitive point: Norwegian - Yellow zone (2210)	283,168	6,799,875	14.1	4.0	45.0	44.3	Yes
AB Day						37.9	
AB Evening						37.9	
AB Night						37.9	
AC Noise sensitive point: Norwegian - Yellow zone (2211)	284,863	6,797,399	3.7	4.0	45.0	44.2	Yes
AC Day						37.8	
AC Evening						37.8	
AC Night						37.8	
AD Noise sensitive point: Norwegian - Yellow zone (2212)	285,253	6,797,692	13.7	4.0	45.0	44.3	Yes
AD Day						37.9	
AD Evening						37.9	
AD Night						37.9	
AE Noise sensitive point: Norwegian - Yellow zone (2213)	284,739	6,797,351	5.1	4.0	45.0	44.2	Yes
AE Day						37.8	
AE Evening						37.8	
AE Night						37.8	
AF Noise sensitive point: Norwegian - Yellow zone (2214)	284,752	6,797,304	7.5	4.0	45.0	44.0	Yes
AF Day						37.6	
AF Evening						37.6	
AF Night						37.6	
AG Noise sensitive point: Norwegian - Yellow zone (2215)	282,986	6,799,667	10.1	4.0	45.0	43.5	Yes
AG Day						37.1	

To be continued on next page...

Project:
Lutelandet

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02.04.2019 11:10/3.2.743

NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
AG Evening						37.1	
AG Night						37.1	
AH Noise sensitive point: Norwegian - Yellow zone (2216)	282,956	6,799,701	11.9	4.0	45.0	44.1	Yes
AH Day						37.7	
AH Evening						37.7	
AH Night						37.7	
AI Noise sensitive point: Norwegian - Yellow zone (2217)	285,372	6,797,627	14.4	4.0	45.0	43.7	Yes
AI Day						37.3	
AI Evening						37.3	
AI Night						37.3	
AJ Noise sensitive point: Norwegian - Yellow zone (2218)	282,921	6,799,735	15.1	4.0	45.0	43.8	Yes
AJ Day						37.4	
AJ Evening						37.4	
AJ Night						37.4	
AK Noise sensitive point: Norwegian - Yellow zone (2219)	282,888	6,799,763	16.8	4.0	45.0	43.8	Yes
AK Day						37.4	
AK Evening						37.4	
AK Night						37.4	
AL Noise sensitive point: Norwegian - Yellow zone (2220)	285,163	6,797,727	5.4	4.0	45.0	43.3	Yes
AL Day						36.9	
AL Evening						36.9	
AL Night						36.9	
AM Noise sensitive point: Norwegian - Yellow zone (2221)	283,047	6,799,804	13.5	4.0	45.0	43.4	Yes
AM Day						37.0	
AM Evening						37.0	
AM Night						37.0	
AN Noise sensitive point: Norwegian - Yellow zone (2222)	283,100	6,799,979	18.9	4.0	45.0	43.0	Yes
AN Day						36.6	
AN Evening						36.6	
AN Night						36.6	
AO Noise sensitive point: Norwegian - Yellow zone (2223)	283,095	6,799,910	16.9	4.0	45.0	42.7	Yes
AO Day						36.3	
AO Evening						36.3	
AO Night						36.3	
AP Noise sensitive point: Norwegian - Yellow zone (2224)	285,331	6,797,618	13.1	4.0	45.0	43.1	Yes
AP Day						36.7	
AP Evening						36.7	
AP Night						36.7	
AQ Noise sensitive point: Norwegian - Yellow zone (2225)	285,174	6,799,214	19.8	4.0	45.0	42.4	Yes
AQ Day						36.0	
AQ Evening						36.0	
AQ Night						36.0	
AR Noise sensitive point: Norwegian - Yellow zone (2226)	285,575	6,798,076	25.4	4.0	45.0	42.1	Yes
AR Day						35.7	
AR Evening						35.7	
AR Night						35.7	
AS Noise sensitive point: Norwegian - Yellow zone (2227)	285,506	6,797,929	14.2	4.0	45.0	42.1	Yes
AS Day						35.7	
AS Evening						35.7	
AS Night						35.7	
AT Noise sensitive point: Norwegian - Yellow zone (2228)	282,913	6,799,794	15.8	4.0	45.0	41.6	Yes
AT Day						35.2	
AT Evening						35.2	
AT Night						35.2	
AU Noise sensitive point: Norwegian - Yellow zone (2229)	284,290	6,799,486	0.8	4.0	45.0	41.3	Yes
AU Day						34.9	
AU Evening						34.9	
AU Night						34.9	
AV Noise sensitive point: Norwegian - Yellow zone (2230)	282,940	6,799,865	11.3	4.0	45.0	41.3	Yes
AV Day						34.9	
AV Evening						34.9	
AV Night						34.9	
AW Noise sensitive point: Norwegian - Yellow zone (2231)	285,717	6,797,901	11.2	4.0	45.0	41.2	Yes
AW Day						34.8	
AW Evening						34.8	

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02.04.2019 11:10/3.2.743

NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
AW Night						34.8	
AX Noise sensitive point: Norwegian - Yellow zone (2232)	282,896	6,799,928	9.4	4.0	45.0	40.9	Yes
AX Day						34.5	
AX Evening						34.5	
AX Night						34.5	
AY Noise sensitive point: Norwegian - Yellow zone (2233)	285,649	6,798,104	23.0	4.0	45.0	40.2	Yes
AY Day						33.8	
AY Evening						33.8	
AY Night						33.8	
AZ Noise sensitive point: Norwegian - Yellow zone (2234)	283,079	6,800,034	15.2	4.0	45.0	39.7	Yes
AZ Day						33.3	
AZ Evening						33.3	
AZ Night						33.3	
BA Noise sensitive point: Norwegian - Yellow zone (2235)	285,633	6,798,050	16.8	4.0	45.0	39.6	Yes
BA Day						33.2	
BA Evening						33.2	
BA Night						33.2	
BB Noise sensitive point: Norwegian - Yellow zone (2236)	285,681	6,798,104	19.7	4.0	45.0	39.5	Yes
BB Day						33.1	
BB Evening						33.1	
BB Night						33.1	
BC Noise sensitive point: Norwegian - Yellow zone (2237)	285,746	6,798,080	15.5	4.0	45.0	39.6	Yes
BC Day						33.2	
BC Evening						33.2	
BC Night						33.2	
BD Noise sensitive point: Norwegian - Yellow zone (2238)	285,742	6,798,278	16.3	4.0	45.0	39.2	Yes
BD Day						32.8	
BD Evening						32.8	
BD Night						32.8	
BE Noise sensitive point: Norwegian - Yellow zone (2239)	283,977	6,800,139	13.2	4.0	45.0	39.1	Yes
BE Day						32.7	
BE Evening						32.7	
BE Night						32.7	
BF Noise sensitive point: Norwegian - Yellow zone (2240)	282,828	6,799,901	4.7	4.0	45.0	38.3	Yes
BF Day						31.9	
BF Evening						31.9	
BF Night						31.9	
BG Noise sensitive point: Norwegian - Yellow zone (2241)	285,737	6,797,930	7.3	4.0	45.0	38.9	Yes
BG Day						32.5	
BG Evening						32.5	
BG Night						32.5	
BH Noise sensitive point: Norwegian - Yellow zone (2242)	283,942	6,800,137	14.6	4.0	45.0	37.7	Yes
BH Day						31.3	
BH Evening						31.3	
BH Night						31.3	
BI Noise sensitive point: Norwegian - Yellow zone (2243)	285,770	6,798,298	12.2	4.0	45.0	37.1	Yes
BI Day						30.7	
BI Evening						30.7	
BI Night						30.7	
BJ Noise sensitive point: Norwegian - Yellow zone (2244)	283,068	6,800,103	3.7	4.0	45.0	35.5	Yes
BJ Day						29.1	
BJ Evening						29.1	
BJ Night						29.1	
BK Noise sensitive point: Norwegian - Yellow zone (2245)	285,780	6,798,562	40.5	4.0	45.0	35.6	Yes
BK Day						29.2	
BK Evening						29.2	
BK Night						29.2	
BL Noise sensitive point: Norwegian - Yellow zone (2246)	284,452	6,799,947	5.0	4.0	45.0	33.8	Yes
BL Day						27.4	
BL Evening						27.4	
BL Night						27.4	
BM Noise sensitive point: Norwegian - Yellow zone (2247)	283,904	6,800,145	15.0	4.0	45.0	33.9	Yes
BM Day						27.5	
BM Evening						27.5	
BM Night						27.5	

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NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_wc

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
BN	Noise sensitive point: Norwegian - Yellow zone (2248)	285,834	6,798,486	23.6	4.0	45.0	33.4	Yes
BN	Day						27.0	
BN	Evening						27.0	
BN	Night						27.0	
BO	Noise sensitive point: Norwegian - Yellow zone (2249)	283,859	6,800,105	18.2	4.0	45.0	33.7	Yes
BO	Day						27.3	
BO	Evening						27.3	
BO	Night						27.3	
BP	Noise sensitive point: Norwegian - Yellow zone (2250)	283,901	6,800,027	11.9	4.0	45.0	31.3	Yes
BP	Day						24.9	
BP	Evening						24.9	
BP	Night						24.9	
BQ	Noise sensitive point: Norwegian - Yellow zone (2251)	283,869	6,800,079	18.6	4.0	45.0	31.2	Yes
BQ	Day						24.8	
BQ	Evening						24.8	
BQ	Night						24.8	
BR	Noise sensitive point: Norwegian - Yellow zone (2252)	283,836	6,800,086	20.0	4.0	45.0	23.9	Yes
BR	Day						17.5	
BR	Evening						17.5	
BR	Night						17.5	
BS	Noise sensitive point: Norwegian - Yellow zone (2253)	285,895	6,798,751	29.1	4.0	45.0	23.0	Yes
BS	Day						16.7	
BS	Evening						16.7	
BS	Night						16.7	
BT	Noise sensitive point: Norwegian - Yellow zone (2254)	283,792	6,800,068	21.1	4.0	45.0	21.1	Yes
BT	Day						14.7	
BT	Evening						14.7	
BT	Night						14.7	
BU	Noise sensitive point: Norwegian - Yellow zone (2255)	285,903	6,798,653	14.2	4.0	45.0	20.3	Yes
BU	Day						13.9	
BU	Evening						13.9	
BU	Night						13.9	

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

Assumptions

Weather stability
Relative humidity 70.0 %
Air temperature 7.0 °C
Height for air temperature 95.0 m
Stability parameters Night;Clear sky
Inverse Monin Obukhov lenght 0.0100
Temperature scale T* 0.0500

Terrain
Elevation based on object
DTM Lutelandet
Roughness based on line object
Roughness lines (online)
Terrain type based on area object
Terrain Hardness
Month for calculation January

Wind speed criteria
Uniform wind speed at 10 m agl.
Wind speed Max noise wind speed
Max noise wind speed All receptors downwind
Wind direction 4.0 m
Height above ground level for receiver
Wind speed has been extrapolated to calculation height using
IEC profile shear (z0 = 0.05m)
No stability correction 5.022
Version

All coordinates are in
UTM (north)-WGS84 Zone: 32

Setup for Lden calculation

Variant	Name	From hour	To hour	Hours	Penalty [dB]	Days per year
1	Day	7	19	12	0	365
2	Evening	19	23	4	5	365
3	Night	23	7	8	10	365

WTG: VESTAS V150-5.6-PO-Luteland 5600 150.0 !O!
Noise: Level 00 - Mode 0 - 104.9dB

Source	Source/Date	Creator	Edited
Vestas	24.01.2019	USER	02.04.2019 10:48

DMS no: 0079-5099_01. Blades with serrated edges.

Octave data

Wind speed [m/s]	LwA,ref [dB(A)]	63 [dB(A)]	125 [dB(A)]	250 [dB(A)]	500 [dB(A)]	1000 [dB(A)]	2000 [dB(A)]	4000 [dB(A)]	8000 [dB(A)]
3.0	91.3	72.6	80.1	84.7	86.4	85.3	81.1	74.2	64.3
4.0	91.8	72.8	80.5	85.2	87.0	85.7	81.6	74.4	64.3
5.0	94.1	75.1	82.8	87.5	89.2	88.1	83.9	76.8	66.6
6.0	96.9	77.9	85.6	90.3	92.0	90.9	86.7	79.6	69.5
7.0	100.0	81.0	88.7	93.4	95.1	94.0	89.8	82.8	72.7
8.0	102.7	83.6	91.3	96.1	97.8	96.7	92.6	85.5	75.4
9.0	104.0	84.5	92.4	97.3	99.2	98.1	93.9	86.9	76.7
10.0	104.1	84.6	92.5	97.4	99.3	98.2	94.0	87.0	76.8
11.0	104.9	85.6	93.4	98.2	100.1	98.9	94.8	87.7	77.6
12.0	104.9	86.2	93.7	98.3	100.0	98.9	94.8	87.9	78.0
13.0	104.9	86.3	93.7	98.2	100.0	98.9	94.9	88.1	78.4
14.0	104.9	86.1	93.6	98.1	100.0	98.9	95.1	88.4	78.9
15.0	104.9	86.0	93.4	98.1	99.9	99.0	95.2	88.7	79.2
16.0	104.9	85.7	93.2	97.9	99.9	99.1	95.5	89.1	79.9
17.0	104.9	85.3	92.9	97.7	99.9	99.1	95.7	89.4	80.3
18.0	104.9	84.9	92.7	97.6	99.8	99.2	95.9	89.8	80.8
19.0	104.9	84.5	92.4	97.4	99.8	99.3	96.1	90.1	81.3
20.0	104.9	83.6	91.8	97.1	99.7	99.5	96.5	90.7	82.1

Project:
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02.04.2019 11:10/3.2.743

NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2183)-A
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2184)-B
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2185)-C
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2186)-D
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2187)-E
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2188)-F
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2189)-G
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2190)-H
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2191)-I
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2192)-J
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2193)-K
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2194)-L
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2195)-M
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2196)-N
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2197)-O
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2198)-P
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2199)-Q
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2200)-R
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2201)-S
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2202)-T
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2203)-U
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2204)-V
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2205)-W
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2206)-X
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2207)-Y
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2208)-Z
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2209)-AA
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2210)-AB
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2211)-AC
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2212)-AD
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2213)-AE
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2214)-AF
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2215)-AG
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2216)-AH
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2217)-AI
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2218)-AJ
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2219)-AK
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2220)-AL
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2221)-AM
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2222)-AN
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2223)-AO
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2224)-AP
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2225)-AQ
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2226)-AR
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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Calculated:
02.04.2019 11:10/3.2.743

NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2227)-AS
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2228)-AT
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2229)-AU
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2230)-AV
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2231)-AW
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2232)-AX
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2233)-AY
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2234)-AZ
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2235)-BA
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2236)-BB
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2237)-BC
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2238)-BD
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2239)-BE
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2240)-BF
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2241)-BG
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2242)-BH
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2243)-BI
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2244)-BJ
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2245)-BK
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2246)-BL
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2247)-BM
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2248)-BN
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: 201904_10xV150_5.6MW_105mHH_wc

NSA: Noise sensitive point: Norwegian - Yellow zone (2249)-BO
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2250)-BP
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2251)-BQ
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2252)-BR
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2253)-BS
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2254)-BT
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Norwegian - Yellow zone (2255)-BU
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

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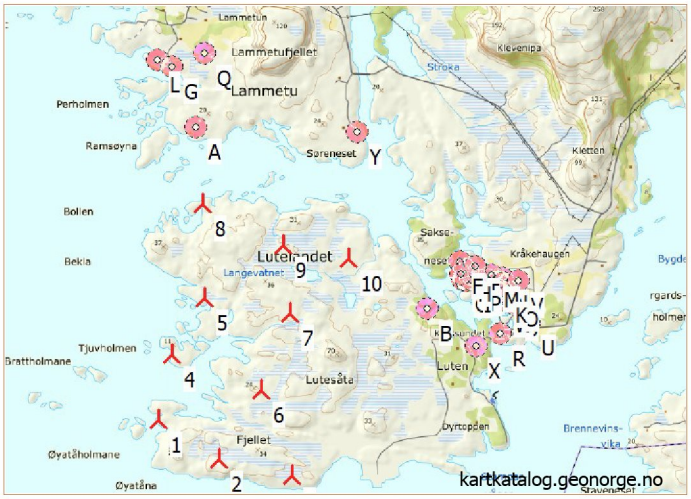
NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_rc

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	7.0 °C
Height for air temperature	95.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
DTM Lutelandet	
Roughness based on line object	
Roughness lines (online)	
Terrain type based on area object	
Terrain Hardness	
Month for calculation	January
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed distribution	Mast M80 - Wind Distribution.115.00m - A
Probability of exceedance	
Wind direction	0.0 ° - 330.0 ° - 30.0 °
Height above ground level for receiver	4.0 m
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	
Version	5.022

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:50,000

New WTG Noise sensitive area

WTGs

	Easting	Northing	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Setting	Creator	Name
1	282,703	6,797,192	4.6	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
2	283,094	6,796,904	26.1	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
3	283,568	6,796,772	16.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
4	282,824	6,797,621	2.8	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
5	283,061	6,797,982	5.1	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
6	283,401	6,797,348	19.5	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
7	283,624	6,797,848	25.8	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
8	283,089	6,798,606	5.2	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
9	283,610	6,798,301	20.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB
10	284,036	6,798,186	14.0	VESTAS V150-5.6-PO-...	Yes	VESTAS	V150-5.6-PO-Luteland-5,600	5,600	150.0	105.0	Day	USER	Level 00 - Mode 0 - 104.9dB
											Evening	USER	Level 00 - Mode 0 - 104.9dB
											Night	USER	Level 00 - Mode 0 - 104.9dB

Calculation Results

Sound level

Noise sensitive area No.	Name	Easting	Northing	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound level L50 [dB(A)]	Demands fulfilled? Noise [dB(A)]
A	Noise sensitive point: Norwegian - Yellow zone (2337)	283,078	6,799,118	5.0	4.0	45.0	46.1	No
A	Day						39.7	

To be continued on next page...

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NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_rc

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	L50 [dB(A)]	Noise [dB(A)]
A Evening						39.7	
A Night						39.7	
B Noise sensitive point: Norwegian - Yellow zone (2338)	284,541	6,797,818	14.3	4.0	45.0	44.4	Yes
B Day						38.0	
B Evening						38.0	
B Night						38.0	
C Noise sensitive point: Norwegian - Yellow zone (2339)	284,789	6,797,999	10.0	4.0	45.0	44.2	Yes
C Day						37.8	
C Evening						37.8	
C Night						37.8	
D Noise sensitive point: Norwegian - Yellow zone (2340)	284,773	6,798,039	10.0	4.0	45.0	44.2	Yes
D Day						37.8	
D Evening						37.8	
D Night						37.8	
E Noise sensitive point: Norwegian - Yellow zone (2341)	284,814	6,797,989	8.6	4.0	45.0	44.4	Yes
E Day						38.0	
E Evening						38.0	
E Night						38.0	
F Noise sensitive point: Norwegian - Yellow zone (2342)	284,775	6,798,117	11.4	4.0	45.0	43.3	Yes
F Day						36.9	
F Evening						36.9	
F Night						36.9	
G Noise sensitive point: Norwegian - Yellow zone (2343)	282,940	6,799,531	7.4	4.0	45.0	43.2	Yes
G Day						36.8	
G Evening						36.8	
G Night						36.8	
H Noise sensitive point: Norwegian - Yellow zone (2344)	284,809	6,798,066	12.1	4.0	45.0	42.1	Yes
H Day						35.7	
H Evening						35.7	
H Night						35.7	
I Noise sensitive point: Norwegian - Yellow zone (2345)	284,842	6,797,994	8.3	4.0	45.0	43.0	Yes
I Day						36.6	
I Evening						36.6	
I Night						36.6	
J Noise sensitive point: Norwegian - Yellow zone (2346)	285,058	6,797,959	6.8	4.0	45.0	42.5	Yes
J Day						36.1	
J Evening						36.1	
J Night						36.1	
K Noise sensitive point: Norwegian - Yellow zone (2347)	285,050	6,797,909	5.2	4.0	45.0	42.3	Yes
K Day						35.9	
K Evening						35.9	
K Night						35.9	
L Noise sensitive point: Norwegian - Yellow zone (2348)	282,848	6,799,580	10.5	4.0	45.0	42.1	Yes
L Day						35.7	
L Evening						35.7	
L Night						35.7	
M Noise sensitive point: Norwegian - Yellow zone (2349)	284,981	6,798,017	4.6	4.0	45.0	42.0	Yes
M Day						35.6	
M Evening						35.6	
M Night						35.6	
N Noise sensitive point: Norwegian - Yellow zone (2350)	285,047	6,797,994	7.5	4.0	45.0	42.0	Yes
N Day						35.6	
N Evening						35.6	
N Night						35.6	
O Noise sensitive point: Norwegian - Yellow zone (2351)	285,105	6,797,879	9.5	4.0	45.0	41.7	Yes
O Day						35.3	
O Evening						35.3	
O Night						35.3	
P Noise sensitive point: Norwegian - Yellow zone (2352)	284,880	6,797,999	6.2	4.0	45.0	41.8	Yes
P Day						35.4	
P Evening						35.4	
P Night						35.4	
Q Noise sensitive point: Norwegian - Yellow zone (2353)	283,164	6,799,604	15.5	4.0	45.0	42.0	Yes
Q Day						35.6	
Q Evening						35.6	

To be continued on next page...

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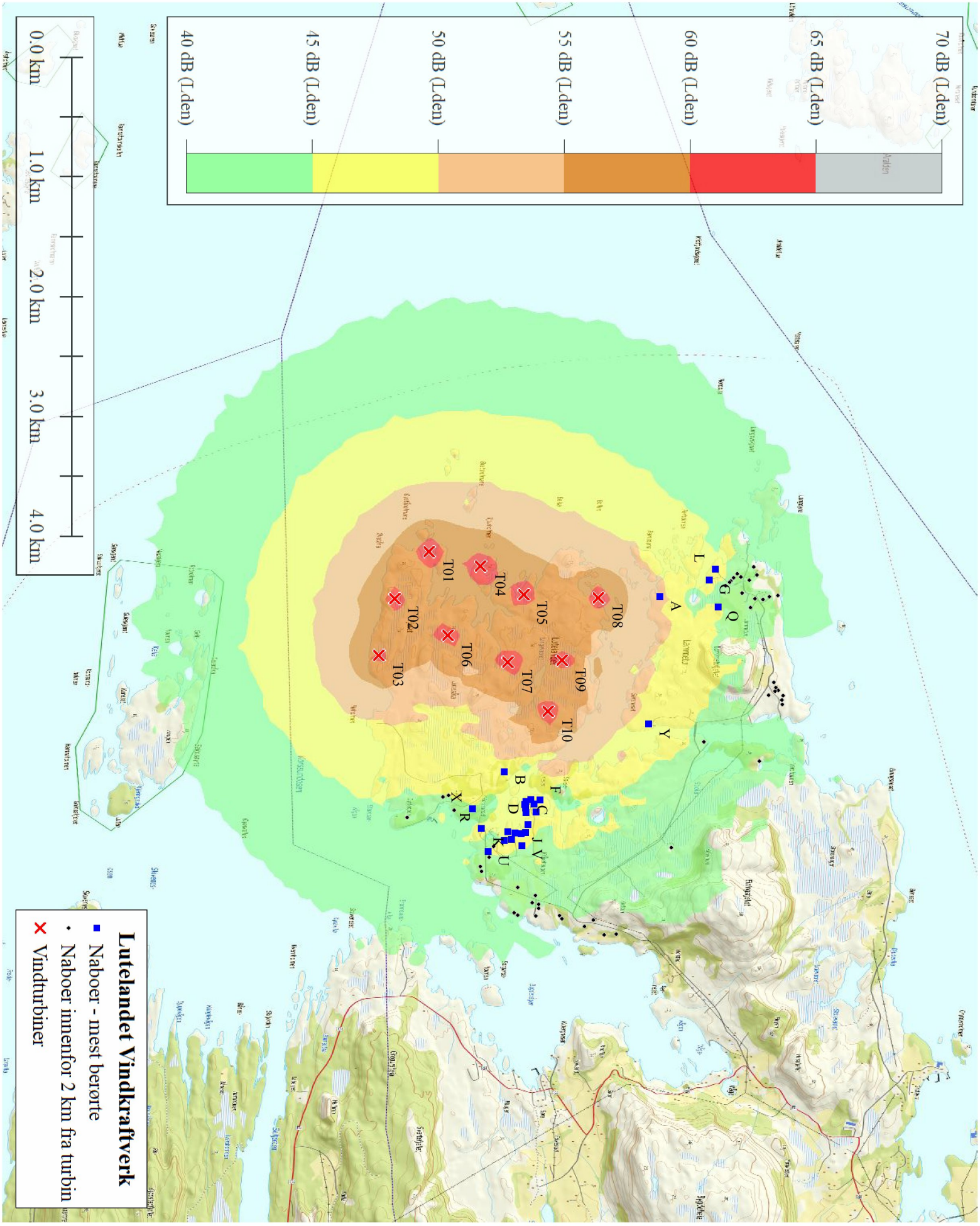
NORD2000 - Main Result

Calculation: 201904_10xV150_5.6MW_105mHH_rc

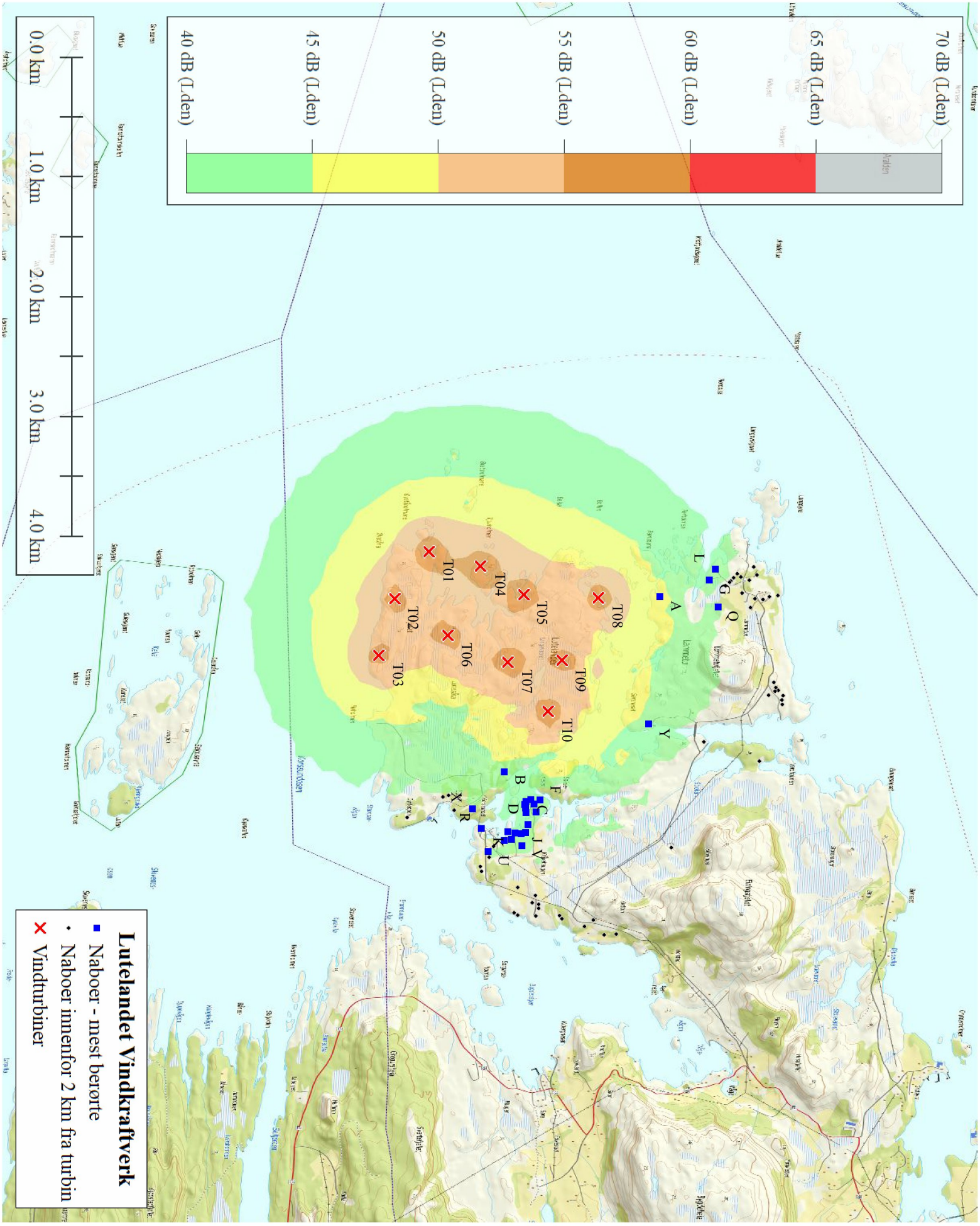
...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB(A)]	L50 [dB(A)]	Noise [dB(A)]
Q	Night						35.6	
R	Noise sensitive point: Norwegian - Yellow zone (2354)	285,013	6,797,626	6.9	4.0	45.0	38.2	Yes
R	Day						31.8	
R	Evening						31.8	
R	Night						31.8	
S	Noise sensitive point: Norwegian - Yellow zone (2355)	285,115	6,797,818	3.9	4.0	45.0	40.2	Yes
S	Day						33.8	
S	Evening						33.8	
S	Night						33.8	
T	Noise sensitive point: Norwegian - Yellow zone (2356)	284,876	6,798,082	8.9	4.0	45.0	40.5	Yes
T	Day						34.1	
T	Evening						34.1	
T	Night						34.1	
U	Noise sensitive point: Norwegian - Yellow zone (2357)	285,206	6,797,683	13.2	4.0	45.0	40.6	Yes
U	Day						34.2	
U	Evening						34.2	
U	Night						34.2	
V	Noise sensitive point: Norwegian - Yellow zone (2358)	285,158	6,797,965	11.4	4.0	45.0	41.0	Yes
V	Day						34.6	
V	Evening						34.6	
V	Night						34.6	
W	Noise sensitive point: Norwegian - Yellow zone (2359)	285,040	6,797,849	6.6	4.0	45.0	40.3	Yes
W	Day						33.9	
W	Evening						33.9	
W	Night						33.9	
X	Noise sensitive point: Norwegian - Yellow zone (2360)	284,851	6,797,552	20.0	4.0	45.0	40.3	Yes
X	Day						33.9	
X	Evening						33.9	
X	Night						33.9	
Y	Noise sensitive point: Norwegian - Yellow zone (2361)	284,142	6,799,022	4.7	4.0	45.0	39.1	Yes
Y	Day						32.7	
Y	Evening						32.7	
Y	Night						32.7	

Vedlegg 2.3 Støysonekart Worst Case



Vedlegg 2.4 Støysonekart Real Case



Vedlegg 2.5 Oversikt over terrengets akustiske hardhet