

# BILAGA 3 - SKUGGBERÄKNING

WindPRO version 2.7.486 Jan 2011

Project:  
**Skakeltorp**

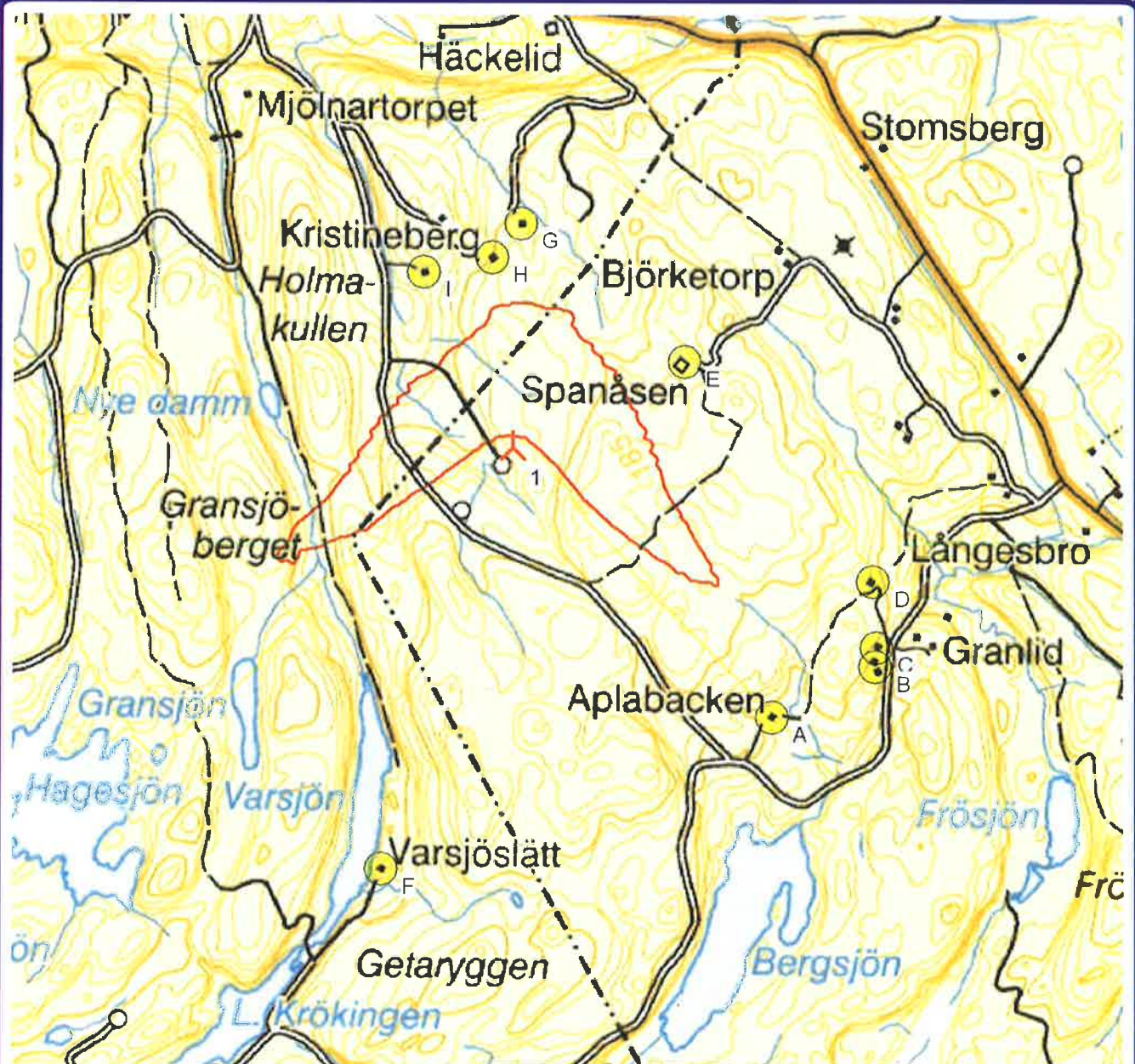
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Calculated:  
2011-10-03 12:03/2.7.486



## SHADOW - Map

Calculation: Skuggberäkning SkakeltorpWTG: 1 - VESTAS V90 2000 90.0 IO! hub: 105.0 m (14)



Map: , Print scale 1:18 000, Map center Rikets Net (SE) East: 1 307 697 North: 6 435 174  
New WTG  
Shadow receptor  
Isolines showing shadow in Hours per year, real case  
0 8

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## SHADOW - Main Result

Calculation: Skuggberäkning Skakeltorp

### Assumptions for shadow calculations

Maximum distance for influence

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

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) [GOTEBORG]

| Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 1,32 | 2,16 | 3,42 | 6,08 | 9,24 | 8,56 | 7,23 | 5,77 | 4,73 | 3,30 | 1,75 | 1,23 |

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

WAsP

Operational time

| N   | NNE | ENE | E   | ESE | SSE | S   | SSW | WSW | W   | WNW | NNW | Sum  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 508 | 610 | 609 | 501 | 514 | 602 | 795 | 923 | 784 | 667 | 357 | 344 | 7214 |

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values.

A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: CONTOURLINE\_ONLINEDATA\_0.wpo

Obstacles not used in calculation

Eye height: 1,5 m

Grid resolution: 10 m



New WTG

Shadow receptor

### WTGs

| RN | East      | North     | Z     | Row data/Description                  | WTG type |           |                | Shadow data       |                    |                |                          |           |
|----|-----------|-----------|-------|---------------------------------------|----------|-----------|----------------|-------------------|--------------------|----------------|--------------------------|-----------|
|    |           |           |       |                                       | Valid    | Manufact. | Type-generator | Power, rated [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM [RPM] |
| 1  | 1 307 404 | 6 435 432 | 160,3 | VESTAS V90 2000 90.0 IO! hub: 105,... | Yes      | VESTAS    | V90-2 000      | 2 000             | 90,0               | 105,0          | 1 424                    | 14,9      |

### Shadow receptor-Input

| No. | Name                       | RN        |           |       | Width [m] | Height [m] | Height a.g.l. [m] | Degrees from south cw [°] | Slope of window [°] | Direction mode     |
|-----|----------------------------|-----------|-----------|-------|-----------|------------|-------------------|---------------------------|---------------------|--------------------|
|     |                            | East      | North     | Z     |           |            |                   |                           |                     |                    |
| A   | Vårgårda - Skakeltorp 2:5  | 1 308 187 | 6 434 623 | 156,7 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| B   | Vårgårda - Gisslatorp 1:15 | 1 308 498 | 6 434 774 | 152,3 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| C   | Vårgårda - Gisslatorp 1:14 | 1 308 503 | 6 434 831 | 154,2 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| D   | Vårgårda - Strömsberg 1:7  | 1 308 490 | 6 435 028 | 153,4 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| E   | Vårgårda - Vittene 3:10    | 1 307 923 | 6 435 688 | 185,0 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| F   | Alingsås - Rödene 2:5      | 1 307 007 | 6 434 166 | 154,0 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| G   | Alingsås - Börta 1:12      | 1 307 428 | 6 436 103 | 160,3 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| H   | Alingsås - Börta 3:7       | 1 307 340 | 6 436 001 | 160,9 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |
| I   | Alingsås - Börta 3:27      | 1 307 133 | 6 435 958 | 146,1 | 5,0       | 5,0        | 2,0               | -180,0                    | 0,0                 | "Green house mode" |

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**SHADOW - Main Result**

Calculation: Skuggberäkning Skakeltorp

**Calculation Results**

Shadow receptor

| No. | Name                       | Shadow, worst case                   |  |  | Shadow, expected values              |
|-----|----------------------------|--------------------------------------|--|--|--------------------------------------|
|     |                            | Shadow hours<br>per year<br>[h/year] | Shadow days<br>per year<br>[days/year] | Max shadow<br>hours per day<br>[h/day] | Shadow hours<br>per year<br>[h/year] |
| A   | Vårgårda - Skakeltorp 2:5  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| B   | Vårgårda - Gisslatorp 1:15 | 8:18                                 | 36                                     | 0:18                                   | 1:56                                 |
| C   | Vårgårda - Gisslatorp 1:14 | 7:45                                 | 33                                     | 0:18                                   | 1:46                                 |
| D   | Vårgårda - Strömsberg 1:7  | 7:16                                 | 29                                     | 0:20                                   | 1:25                                 |
| E   | Vårgårda - Vittene 3:10    | 23:51                                | 48                                     | 0:38                                   | 3:41                                 |
| F   | Alingsås - Rödene 2:5      | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| G   | Alingsås - Börta 1:12      | 33:12                                | 64                                     | 0:35                                   | 3:32                                 |
| H   | Alingsås - Börta 3:7       | 49:53                                | 84                                     | 0:41                                   | 5:15                                 |
| I   | Alingsås - Börta 3:27      | 30:22                                | 62                                     | 0:38                                   | 3:29                                 |

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

| No. | Name                                       | Worst case | Expected |
|-----|--|------------|----------|
|     |  | [h/year]   | [h/year] |
| 1   | VESTAS V90 2000 90.0 IO! hub: 105,0 m (14) | 157:26     | 20:25    |