



Final Report

University of Illinois South Campus Wind Farm

July 30, 2007

Prepared for:

University of Illinois

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Executive Summary

The University of Illinois received funding to build a 4.5 MW wind farm south of the campus at Champaign-Urbana, IL. EAPC Architects Engineers was hired to provide wind energy consulting services to assist the University in implementing project.

Services to be provided included performing a wind resource analysis and determining the best location for the wind farm as well as specifying the exact locations of the wind turbines. Various turbine models were considered to determine which were best suited for the wind regime in terms of maximizing annual energy production. The annual average energy production was calculated for a variety of wind turbines.

Environmental impacts including noise emission and shadow flicker were calculated in order to determine the potential impacts on occupied residences in the near vicinity of the wind turbines. The turbine locations were adjusted in order to minimize any potential impacts due to noise or shadow flicker. A microwave beam study was performed in order to identify any beam paths in the vicinity of the wind turbines.

Once the turbine locations were finalized, the information was submitted to the Federal Aviation Administration for evaluation of potential obstruction or hazard to air navigation, in which case the wind farm could not be built at the chosen location. The final FAA determination was made that the turbines did not pose a potential hazard to air navigation. Based on the favorable determination, the project then proceeded forward with planning and design.

A site plan was developed which included existing buried utilities, new turbine access roads and the new buried electrical collection system.

In addition, soil borings were taken and the geotechnical report was submitted in order to be included in the bid solicitation

Wind Resource Assessment

Using data collected at the Automated Surface Observation System (ASOS) station at the University of Illinois Willard Airport, an overview was performed to find the average wind speeds near the tower and for the surrounding area. Research was done to find other sources of publicly available wind data in the area, but there was no other suitable data available at the time of this study.

Methodology

Each wind farm application is unique. Each will have a different set of variables to work with including available land, utility provider, utility rates and rate structure, wind resource, and location relative to the surrounding cities, roads, and airports.

Information gathered for this study included the following:

- Industry-quality wind data
- Local air density
- Digital height information describing the topography within a 5-kilometer (km) radius of the wind monitoring station and the selected wind turbine site
- Aerial photographs (1 m per pixel resolution)
- Topographic maps (1:24,000)
- Topographic maps (1:100,000)

Wind Data Analysis

Long-term wind data was available for the Willard Airport ASOS Station. The ASOS station is located on the southwest side of the University of Illinois Willard Airport. The airport is located south of the community of Savoy. The tower's exact location is 40.0333° North latitude and 88.02833° West longitude. The ASOS station location is shown in Figure 1 below.

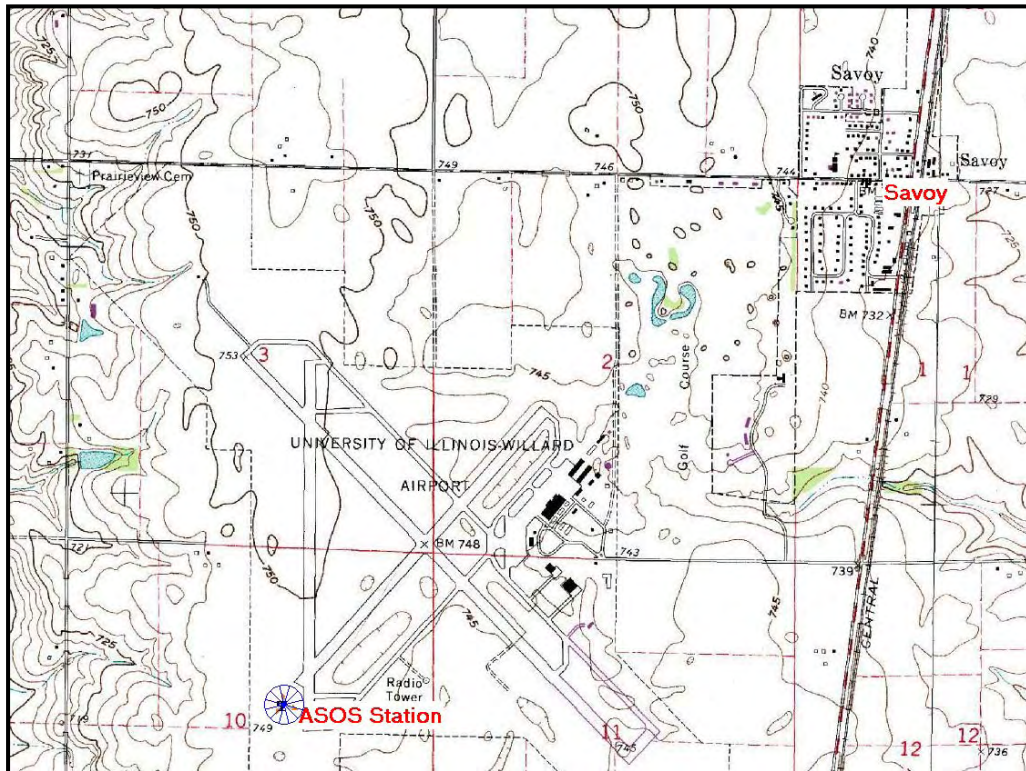


Figure 1 – Location of ASOS station

Met Mast Components and Configuration

The ASOS station at the airport is a standard ASOS station that is setup and distributed by the National Weather Service and the Federal Aviation Administration. The ASOS station anemometer and wind direction vane recorded data at the height of 10 meters.

Data Collection and Maintenance

The ASOS data for this project was available and obtained from the National Climate and Data Center (NCDC). NCDC maintains the ASOS sites in the United States and collects the data. The data collection started on May 1st, 1997 and was available up to July 28th, 2006 at the time of this project.

Data Recovery and Validation

The data set was selected as a basis for wind review starting on May 1st, 1997 and ending on July 28th, 2006. ASOS stations record data every hour between 50 minutes past the hour to the top of the hour. There were a total of 97,849 observations for the site. There are times where the ASOS stations will record additional data during the hour to monitor the local weather for incoming and outgoing flight, and during hazardous or severe weather. In order to have a consistent data set, those additional observations were removed to create a uniform data set. Once the irregular observations were removed the total recovery rate for the site was 81%, and the availability was 98% for the site.

10 m Data Summary

A comprehensive 10 m wind data report is located in Appendix A, which includes monthly mean wind speeds, diurnal and monthly wind speed and direction graphs, time series graphs, frequency and Weibull distribution. The mean wind speed at the site was 4.7 m/s. The mean wind speed and frequency roses shown in Figure 2 identify the prevailing wind and dominant energy sectors.

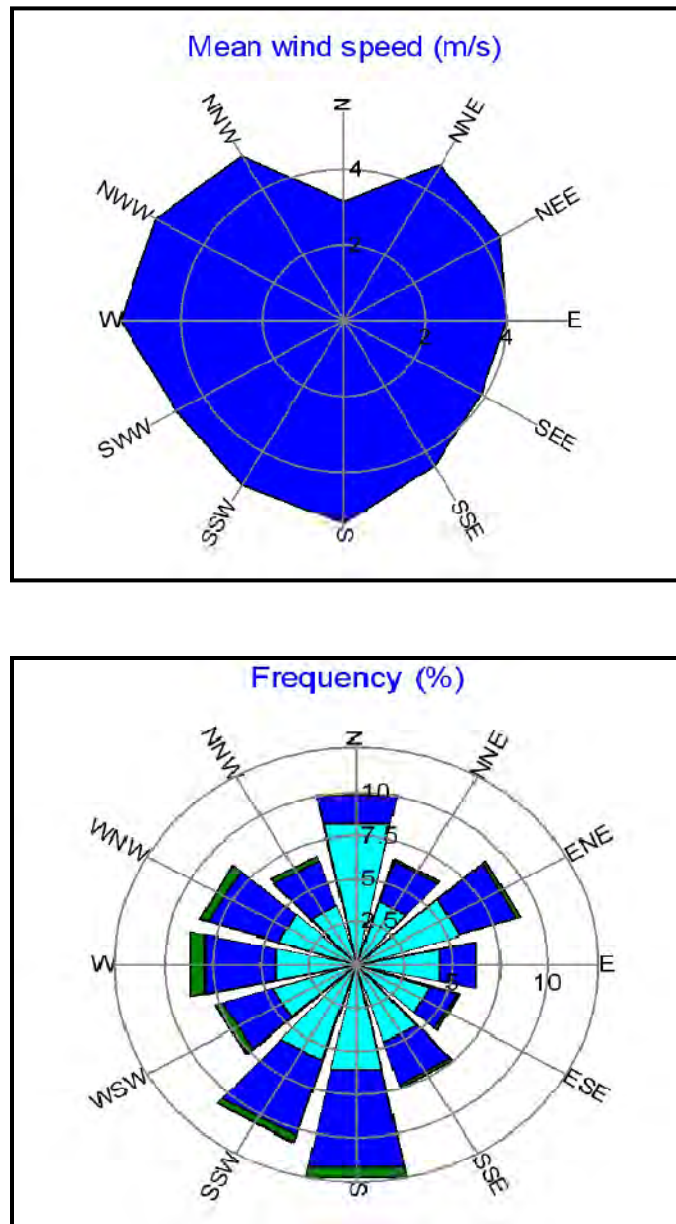


Figure 2 – 10m ASOS mean wind speed, and frequency rose

80 m Scaled Data Summary

Since there was no wind data available at any higher levels, the 10 meter wind data had a wind shear value of 0.20 applied to it, in order to scale the data up to 80 meters. The resulting mean wind speed at the 80 meter height was 7.1 m/s. The mean wind speed and frequency roses shown in Figure 3 identify the prevailing wind and dominant energy sectors.

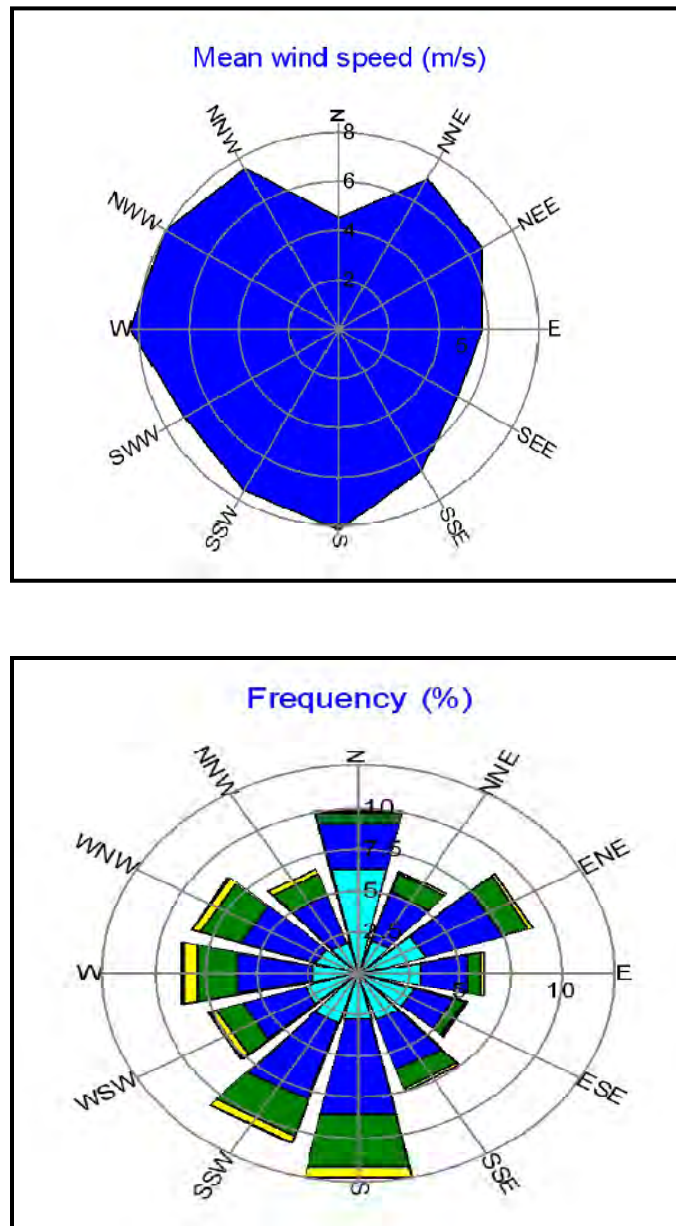


Figure 3 – 80m Scaled ASOS mean wind speed, and frequency rose

Wind Farm Energy Production

The location of the wind farm is to the south and east of Champaign. The wind farm consists of three wind turbine generators on the Yankee Ridge in the Urbana Township. For this project two wind turbine models were analyzed for the wind farm site. The two turbine models that were considered in the analysis were the General Electric 1.5 sle 1.5 MW wind turbine and the Vestas V82 1.65MW wind turbine. These turbines were chosen because of their suitability for lower wind regimes. A setback of four rotor diameters was used between each turbine to optimize the wind farm layout. The annual energy production was calculated along with the park efficiency, and capacity factors.

The results from the calculations are shown below in Table 1. The full production reports can be found in Appendix B.

Table 1 – Park AEP Calculation Results

WTG Layout	Gross Annual Energy	Net Annual Energy	Park Efficiency	Gross Capacity Factor	Net Capacity Factor
	<i>MWh</i>	<i>MWh</i>	<i>%</i>	<i>%</i>	<i>%</i>
3-GE 1.5sle's	14,076.1	12,668.5	98.5	35.7	32.1
3-Vestas V82's	15,590.5	14,031.5	98.5	35.9	32.3

Environmental Impacts

Introduction

Wind turbines create both noise and shadow flickering that can be disruptive to nearby residents. Typically this is remedied by identifying areas which will have a high shadow flicker or noise impact using a software tool like WindPRO to construct the decibel and shadow flicker maps. These maps will then indicate which residential areas are in a high impact zone. Wind turbines also can interfere with microwave beams that are used for communication purposes. A microwave beam study must also be performed to prevent placing wind turbines in the direct path of a microwave beam. The Federal Aviation Administration (FAA) also requires that wind turbines be placed so far from an airport to prevent possible interference with air navigation or radar equipment. An application was sent to the FAA for hazard determination and approval of the layout.

Study Methodology

Shadow Calculation

SHADOW is the WindPRO calculation module that calculates how often and in which intervals a specific neighbor or area will be affected by shadows generated by one or more WTG's. These calculations are worst case scenarios (i.e. calculations which are solely based on the positions of the sun relative to the WTG). Shadow impact may occur when the blades of a WTG pass through the sun's rays seen from a specific spot (e.g. a window in an adjacent building). If the weather is overcast or calm, or if the wind forces the rotor plane of the WTG to be positioned in parallel with the line between the sun and the neighbor, the WTG will not produce shadow impacts, but the impact will still appear in the calculations. In other words, the calculation is a worst case scenario, which represents the maximum potential risk of shadow impact. A calendar can be printed for any specific point of observation, which indicates the exact days and time periods where shadow impact may occur. Maps were created with isolines indicating the shadow impact for any spot within the project area.

The guidelines used to calculate the shadow impact (German model) are as follows:

- The angle of the sun over the horizon must be at least 3 degrees.
- The blade of the WTG must cover at least 20% of the sun.

The calculation of the potential shadow impact at a given shadow receptor is carried out simulating the situation. The position of the sun relative to the WTG rotor disk and the resulting shadow is calculated in steps of 1 minute throughout a complete year. If the shadow of the rotor disk (which in the calculation is assumed solid) at any time casts a shadow reflection on a surface, then this step will be registered as 1 minute of potential shadow impact. The following information is required for the shadow calculation:

- The position of the WTG's (x,y,z coordinates)
- The hub height and rotor diameter of the WTG's
- The topography of the map being evaluated
- The size of the shadow window and its orientation, both directional (relative to south) and tilt (angle of window plane to the horizontal).
- The geographic position, time zone and daylight savings information
- A simulation model, which holds information about the earth's orbit and rotation relative to the sun.

Noise Calculation

The calculation of the noise impact generated by one or more WTG's at a specific location (e.g. a neighbor) requires the following information:

- The position of the WTG's (x,y,z coordinates)
- WTG hub height and noise emission at one or more wind speeds
- Any pure tones in the WTG noise.
- The coordinates for the noise sensitive locations/areas (not included).
- The maximum noise level accepted inside the noise sensitive area (not included)
- The required calculation model (Danish standard)

The Danish standard was used to specify the noise calculation. The calculation is based on a fixed wind speed where the calculation will be made for only one wind speed, selected to be 8.0 meters per second. Using the aforementioned specifications a decibel calculation was produced and the output of the calculation in 2 dimensions was overlaid on a map.

Site Overview

The project areas where the turbines would potentially be located are shown in Figure 4 below. The wind turbines are displayed by the red symbols on the map.

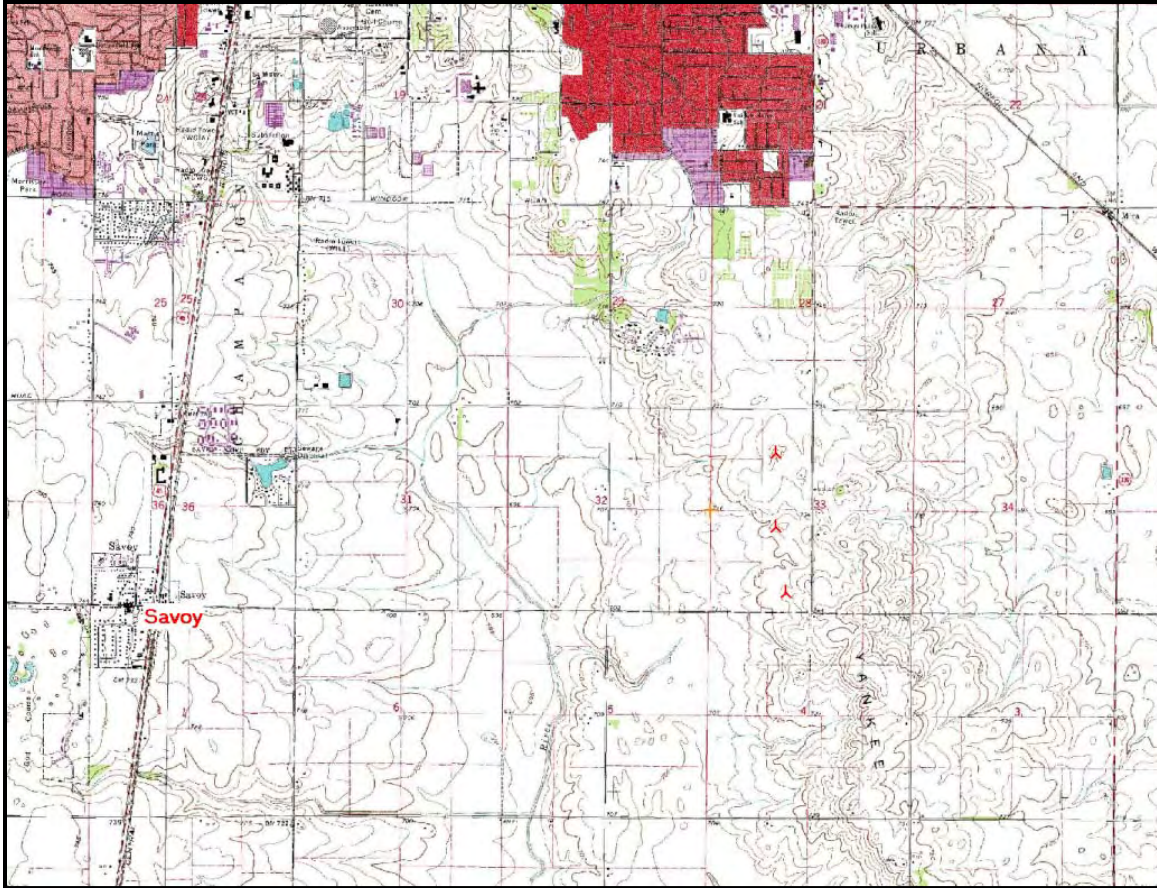


Figure 4 – Project Site Location

Shadow Flicker

As the blades of a wind turbine rotate, they cast a moving shadow on the ground and on nearby buildings. This moving shadow creates a flickering phenomenon that can be irritating to some people. The zone where shadow flicker will occur has been calculated and the actual amount of time and time of occurrence has been measured and is shown in Figure 5 and Figure 6. The different colors indicate the number of hours per year that shadow flicker occur in the respective areas. Note that the model assumes 100% sunshine and no cloud interference so it represents a worst case scenario for shadow flickering. The actual shadow flickering effect will be reduced from this. Notice that some of properties have shadow for more than 100 hours up to 200 hours per year. A further study may need to be performed to find the actual shadow hours that will be produced from the wind farm. The shadow calculations for the wind farm layouts are located in Appendix C.

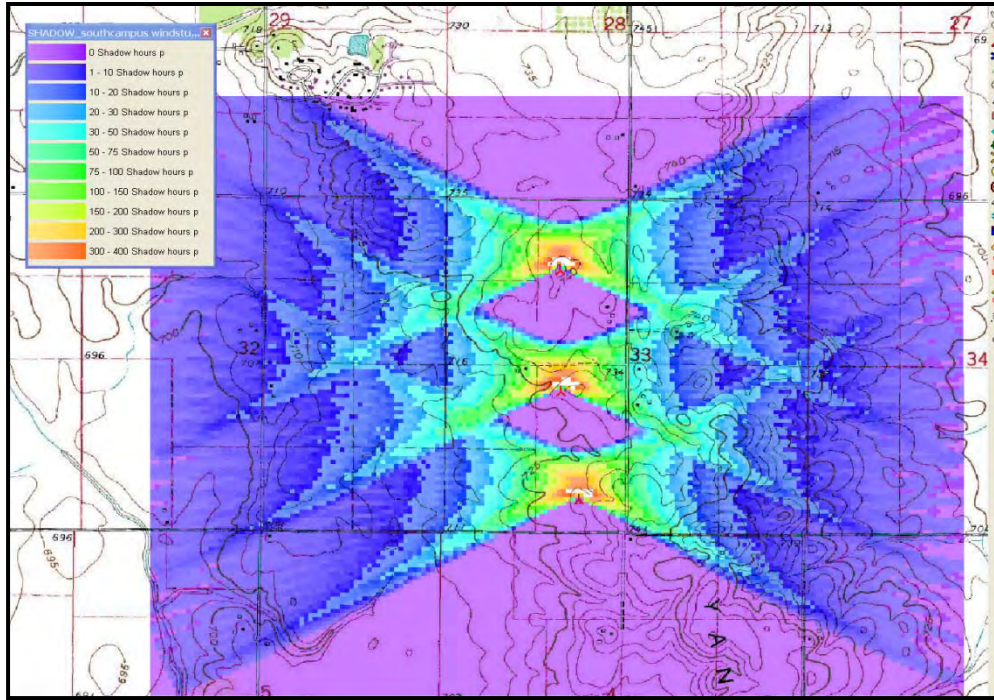


Figure 5 – GE1.5s Shadow Flicker

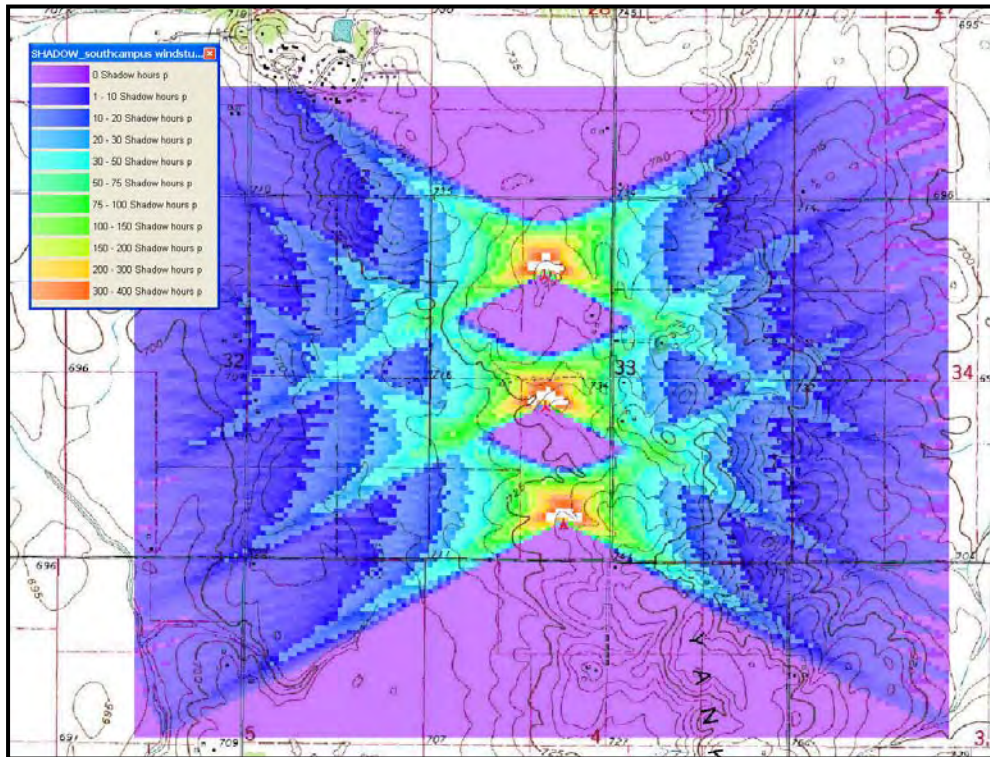


Figure 6 – V82 Shadow Flicker

Noise

Today’s modern wind turbines are relatively quiet. In most cases, the wind rushing past a person’s ears will prevent them from actually hearing the wind turbine. Noise standards vary across the country, but a maximum level of 45 to 50 decibels in a residential area at night is a typical limit enforced by ordinance. Figure 7 and Figure 8 show the noise levels of the turbines between 35 and 55 dB. Further noise work may have to be performed to verify the model. The noise calculation reports for the study are located in D.

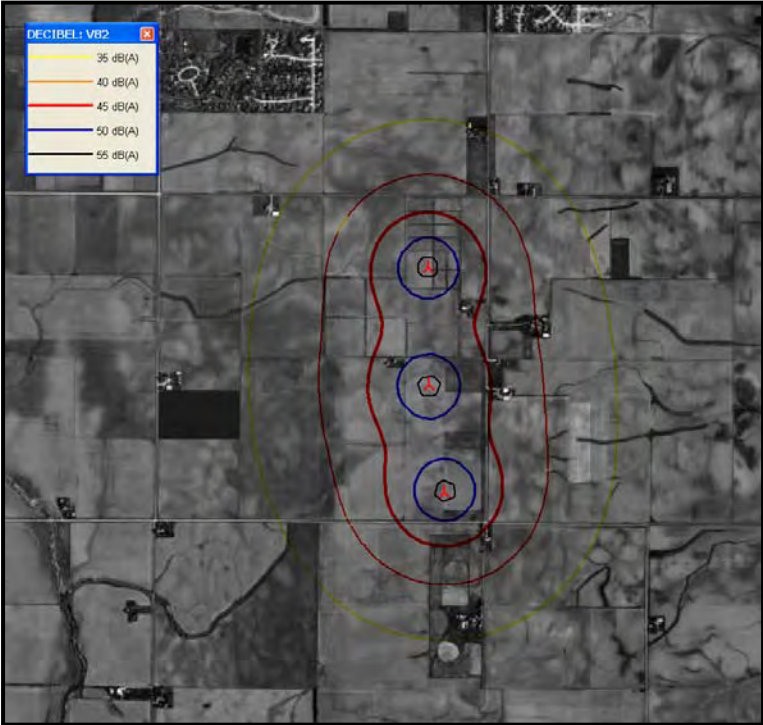


Figure 7 – V82 Decibel Plot

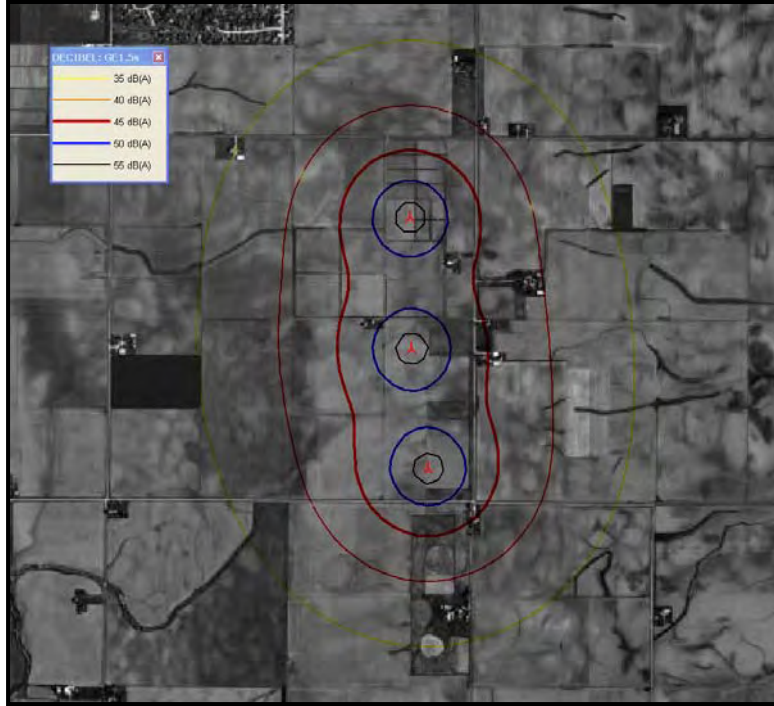


Figure 8 – GE1.5s Decibel Plot

Microwave Beam Paths

The purpose of microwave beams is to transmit signals that are vital to communication world, from emergency services to television signals. A microwave beam study was performed to determine if any of the wind turbines would interfere with any of the beam paths. The results from the microwave beam study are shown in Figure 9. The microwave beam paths are indicated by the blue dashed lines and the project site is indicated by the letter “A”. It was determined that there are no beam paths near the project so microwave beam path interference is not anticipated.

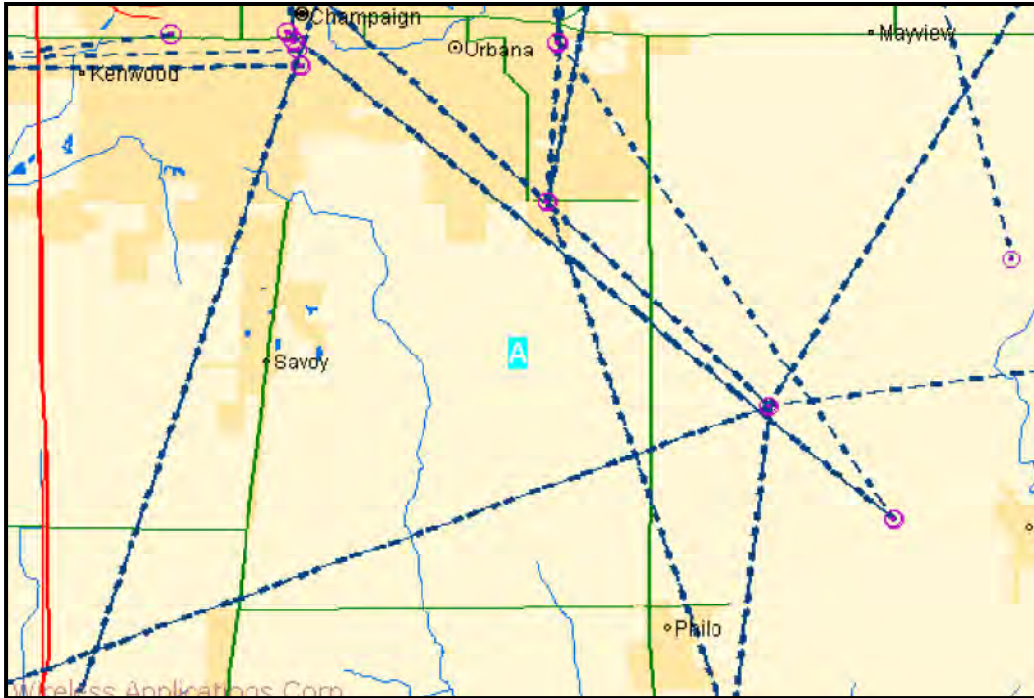


Figure 9 – Microwave Beam Path Results

FAA Review

The proposed wind farm is approximately 4.1 nautical miles east of the University of Illinois Willard airport.

The proposed wind turbines are approximately 398 feet tall. The Federal Aviation Administration (FAA) requires that any structure taller than 200 feet above ground level must be reviewed by the FAA to determine if the structure would pose a hazard to air navigation. The required forms (Notice of Proposed Construction or Alteration Form 7460-1) were submitted online at the FAA's Obstruction Evaluation website.

Initial findings indicated that the wind turbines exceeded FAA's obstruction standards and were presumed to be a hazard to air navigation. Further investigation and study was requested on behalf of the University. The results of the additional investigation indicated that the turbines were not within current or future flight paths and that they would not pose a hazard to air navigation. The FAA Determinations of No Hazard to Air Navigation letters were issued on February 28, 2007 with the condition that the determinations would become final on April 9th following a waiting period to allow any interested parties to file petitions. No petitions were filed and the determinations became final on April 9th, 2007.

All FAA submittals and reports are in Appendix E.

Conclusions and Recommendations

An overview of the noise, shadow, microwave beam, and airport issues were reviewed. A further study by an environmental group may need to be performed to review the noise and shadow impacts for the properties near the wind farm. The FAA has determined that the turbines will not cause a hazard to air navigation.

This project is technically feasible in our opinion and the necessary siting work has been completed. Soil borings have been completed and the geotechnical report has been submitted. Once a turbine supplier is identified, the foundation design work can be completed, as well as the detailed electrical interconnection design.

Appendix A

Wind Data Report

Project:
southcampus windstudy

Description:
Data from file(s)
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\06_2003-04 mph.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\2005-2006 MPH.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

Printed/Page
10/12/2007 9:54 AM / 1
Licensed user:
EAPC Architects Engineers
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 5507
Jay Haley
Calculated:
10/12/2007 9:54 AM/

Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	05/97	06/97	07/97	08/97	09/97	10/97	11/97	12/97	01/98	02/98	03/98	04/98	05/98	06/98	07/98	08/98	09/98	10/98	11/98	12/98	01/99	02/99	03/99	04/99	05/99	06/99	07/99	08/99	09/99
1	(22)	(25)	(22)	(20)	(20)	(22)	(25)	(24)	24	(24)	(25)	(24)	(24)	(22)	(19)	(24)	(22)	(23)	(24)	(24)	(25)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(14)
2	(24)	(24)	(24)	24	(23)	24	(24)	(23)	(24)	(22)	(24)	(21)	(24)	(23)	(21)	(23)	(22)	24	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(22)	(24)	(23)	(21)
3	(25)	(24)	(25)	(23)	(23)	24	(24)	(24)	(24)	24	(24)	(24)	(27)	(24)	24	(20)	(23)	(25)	(7)	(24)	(27)	(24)	(24)	(24)	(24)	(23)	(24)	(20)	(19)
4	(24)	(24)	(24)	(24)	(21)	24	(24)	(24)	(24)	24	(25)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(14)	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(23)
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17	(24)	(23)	(18)	(24)	(23)	24	24	(23)	(24)	(24)	(24)	(22)	(18)	24	(23)	(24)	(22)	(24)	(22)	(23)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(20)
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29	(25)	24	24	(20)	(23)	(23)	(24)	(24)	(24)		24	(25)	(26)	(26)	(20)	(24)	(23)	(24)	(24)	(24)		(23)	(24)	(21)	(22)	(21)	(24)	(24)	(24)
30	(24)	(24)	24	(25)	(23)	(24)	(25)	(24)	(24)		24	(24)	(24)	(25)	(22)	(24)	(22)	(24)	(24)	(22)	(24)		(24)	(24)	(24)	(22)	(24)	(24)	(24)
31	(24)		(22)	(24)		(24)		(24)	(24)		(25)		24		24	(21)		(24)		(24)	(25)		(24)		(24)		(24)		(21)
%	(101)	(97)	(97)	(98)	(92)	(99)	(100)	(99)	100	(99)	(101)	(99)	(87)	100	(96)	(97)	(94)	(98)	(92)	(99)	(100)	(99)	(97)	(101)	(98)	(98)	(94)	(97)	(94)

Project:
southcampus windstudy

Description:
Data from file(s)
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\06_2003-04 mph.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\2005-2006 MPH.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

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10/12/2007 9:54 AM / 2
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US-GRAND FORKS, ND 58201
+1 701 775 5507
Jay Haley
Calculated:
10/12/2007 9:54 AM/

Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	10/99	11/99	12/99	01/00	02/00	03/00	04/00	05/00	06/00	07/00	08/00	09/00	10/00	11/00	12/00	01/01	02/01	03/01	04/01	05/01	06/01	07/01	08/01	09/01	10/01	11/01	12/01	01/02	02/02
1	(18)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(21)	(24)	24	24	(24)	(22)	(24)	
2	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(25)	(20)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	(25)	24	(24)	
3	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(21)	(23)	(23)	(25)	(24)	(24)	(24)	(21)	(24)	(24)	(22)	(24)	(25)	(24)	24	24	24	24	(24)
4	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(23)	(19)	(24)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	24	(24)	24	(24)
5	(23)	(23)	(24)	(24)	(24)	(24)	24	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(26)	(24)	(23)	(24)	(24)	24	(24)	(25)	24
6	(22)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(21)	(23)	(24)	24	(23)	(24)	(25)	24
7	(24)	(24)	(19)	(24)	(23)	(24)	(24)	(24)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(21)	(23)	24	24	(26)	(24)	(25)
8	(24)	(24)	(13)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(23)	(25)	24	(24)	(24)	24	(24)	
9	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(22)	(24)	(22)	(26)	24	24	24	24	24
10	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(23)	(24)	(23)	(23)	(27)	(24)	(25)	(24)	(23)	(22)	(24)	(26)	(24)	(24)	(24)	(24)	(24)	(24)	24	24	24	(24)
11	(25)	(24)	(23)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(22)	(24)	(22)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(22)	(21)	(24)	24	(23)	24	(24)
12	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(22)	(19)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(21)	(24)	24	(24)	(24)	24
13	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(20)	(22)	(18)	(24)	(24)	(24)	(26)	(24)	(25)	(24)	(21)	(24)	(20)	(24)	(24)	(27)	24	(24)	24	24
14	(23)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(25)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	24	(24)	(24)	(24)	24
15	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(22)	(24)	(22)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(19)	(20)	(24)	(25)	24	(24)	(24)	(24)
16	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(21)	(22)	(19)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(23)	(24)	(24)	(24)	(24)	24
17	(24)	(24)	(23)	(24)	(24)	(24)	(25)	(24)	(23)	(24)	(26)	(24)	(24)	(24)	(26)	(24)	(24)	(24)	(24)	(24)	(20)	(23)	(22)	(23)	(23)	(22)	(24)	(24)	(23)
18	(21)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(23)	(19)	(23)	(22)	(22)	(24)	(25)	(25)	(24)	(23)	(23)	(23)	(24)	(23)	(20)	(22)	24	24	(24)	(23)	24
19	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	24	(23)	(24)	(23)	(24)	(24)	(24)	24	(24)	(24)	(25)	(24)
20	(24)	(23)	(24)	(24)	(24)	(26)	(26)	(23)	(26)	(22)	24	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(23)	(23)	(24)	(22)	(23)	24	(24)	(25)
21	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(22)	(25)	(22)	(24)	(20)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	24	24	(24)	(24)	(24)
22	(24)	(24)	(24)	(24)	24	(22)	(23)	(24)	(24)	(18)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(22)	(24)	24	(24)	(24)	24
23	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	(23)	(24)	(24)	(24)	(24)	(23)	(23)	(24)	(24)	(24)	(22)	(24)	(23)	(24)	(24)	(24)	(24)	24
24	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(17)	24	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(21)	(21)	(25)	(24)	(23)	(24)	(24)	(24)	24
25	(24)	(24)	(25)	(26)	(24)	(24)	(24)	(23)	(21)	(23)	(23)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(20)	(24)	(23)	(24)	(23)	(24)	(24)	24	(24)
26	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(22)	(21)	(24)	(24)	(24)	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(24)	(23)	(24)	24	(24)	(24)	24	(24)
27	(24)	(22)	(24)	(24)	(24)	(21)	(27)	(24)	(24)	(22)	24	(24)	(22)	(24)	(24)	(24)	(20)	(24)	(24)	(24)	(20)	(24)	(26)	(22)	24	(24)	(24)	24	(24)
28	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(26)	(23)	(23)	(24)	(21)	(24)	(18)	(24)	(25)	(24)	(24)	(24)	(21)	(19)	(24)	(24)	24	(25)	(24)	24	24	24
29	(24)	(24)	(24)	(25)	(24)	(22)	(24)	(22)	(25)	(22)	(23)	(23)	(24)	(24)	(25)	(24)		(23)	(24)	(22)	(23)	(25)	(24)	24	24	(24)	(25)	(24)	
30	(24)	(23)	(24)	(26)		(24)	(20)	(24)	(21)	(24)	24	(24)	(24)	(24)	(24)		(21)	(24)	(24)	(23)	(22)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	
31	(23)		(23)	(24)		(19)		(24)		(22)	(22)		(22)		(24)	(24)		(24)		(24)		(18)	(24)		(24)		(24)	(22)	
%	(98)	(99)	(98)	(101)	(100)	(99)	(99)	(99)	(99)	(95)	(95)	(96)	(99)	(99)	(101)	(101)	(100)	(98)	100	(99)	(96)	(95)	(97)	(98)	(100)	(100)	(100)	(100)	(100)

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Calculated:
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Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	03/02	04/02	05/02	06/02	07/02	08/02	09/02	10/02	11/02	12/02	01/03	02/03	03/03	04/03	05/03	06/03	07/03	08/03	09/03	10/03	11/03	12/03	01/04	02/04	03/04	04/04	05/04	06/04	07/04		
1	24	24	(26)	(24)	24	24	(22)	24	24	24	(24)	(24)	(24)	24	(24)	(19)	(22)	(23)	(24)	(25)	(22)	24	(24)	24	(24)	(24)	(24)	(24)	24	(23)	
2	(25)	(24)	(24)	24	(22)	(22)	24	(25)	24	(24)	(25)	(24)	(25)	24	(24)	24	(22)	(24)	(24)	(20)	(23)	24	(24)	(25)	(24)	(24)	(24)	24	(23)	24	(24)
3	(24)	(24)	(21)	24	(23)	(22)	(24)	(23)	(24)	24	(24)	(25)	(24)	24	(23)	(24)	(24)	(24)	(22)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(22)	24	(24)	(24)	
4	(24)	(23)	(22)	(24)	(19)	(23)	(22)	(24)	(24)	24	(24)	(24)	(24)	(24)	(24)	24	24	(20)	24	(24)	(24)	(24)	(24)	(17)	(24)	24	(24)	24	(24)	(24)	
5	24	(24)	24	(27)	24	(24)	(23)	(19)	(26)	(24)	(24)	24	(24)	(24)	24	24	(24)	(19)	(19)	(20)	(24)	(24)	(26)	(24)	(24)	(20)	(24)	(23)	(24)		
6	24	24	(23)	(24)	24	24	(21)	(24)	(24)	24	(24)	(24)	(23)	(24)	(23)	(24)	(24)	(22)	24	(22)	(24)	24	(24)	(24)	(24)	24	24	24	(24)		
7	(24)	24	(24)	(22)	(21)	24	24	(22)	(24)	24	24	(24)	(24)	(25)	(25)	(20)	24	(21)	(19)	(22)	24	(24)	24	(24)	24	(22)	(24)	(24)	(24)		
8	24	(25)	(24)	(20)	(23)	24	(20)	24	24	24	24	(24)	(25)	(24)	(25)	(24)	(25)	24	(23)	(22)	24	(24)	(24)	(24)	(24)	24	24	(24)	(22)		
9	(23)	(24)	(24)	(25)	24	(22)	(20)	(22)	(24)	(22)	24	(21)	(24)	(24)	(24)	24	(21)	(24)	(23)	24	24	(25)	(24)	(24)	(24)	(22)	24	24	(24)		
10	(18)	(24)	(23)	(24)	(24)	(23)	(24)	24	(24)	24	(24)	(24)	(22)	24	(25)	(24)	(24)	(21)	(19)	(22)	(25)	(27)	24	(24)	24	(22)	24	(26)	(24)		
11	(10)	24	(25)	(24)	24	24	24	(24)	(24)	(22)	24	(24)	24	(18)	(24)	(23)	24	(24)	(24)	(23)	(26)	(24)	24	24	(24)	(23)	(24)	(25)	(24)		
12	(23)	(24)	(26)	(23)	(24)	24	(22)	(24)	(24)	(24)	24	24	(24)	24	(23)	24	(24)	(23)	(24)	(24)	(25)	(23)	(24)	(24)	(24)	24	(24)	(23)	(24)		
13	(23)	(24)	(24)	(24)	24	(24)	(23)	24	24	(24)	24	24	(25)	(23)	(23)	(24)	(20)	(24)	(24)	(23)	24	(24)	(24)	(24)	24	24	24	(25)	(24)	(26)	
14	(24)	(24)	(25)	(24)	(20)	(23)	24	24	(24)	(24)	(24)	(24)	(24)	24	(24)	(24)	(21)	(22)	(22)	(24)	(24)	(24)	(24)	24	(24)	(23)	(24)	(23)	24		
15	(24)	24	(24)	(24)	(18)	(25)	(25)	24	(24)	24	(23)	(24)	(24)	24	(24)	24	(24)	(22)	24	24	(24)	(24)	(21)	(24)	(24)	24	(24)	(24)	(23)		
16	(24)	24	(25)	24	(21)	(24)	(20)	(22)	24	(24)	(24)	(24)	(24)	24	(24)	24	(22)	(24)	(22)	(23)	(25)	(24)	24	24	(24)	(24)	(23)	(24)	(22)		
17	(22)	24	(24)	24	(20)	(24)	(24)	24	(23)	(24)	24	(24)	(24)	(25)	(24)	(23)	(23)	(24)	24	(22)	(24)	(24)	(24)	(24)	(24)	24	(24)	(24)	(24)		
18	(24)	24	24	24	(21)	(23)	(24)	(25)	(24)	(24)	(25)	(24)	24	(21)	(24)	(23)	(24)	(23)	(19)	24	(25)	(26)	(23)	(24)	(24)	24	(28)	(24)	(25)		
19	(25)	(26)	(24)	24	(24)	(26)	(24)	(24)	(24)	(24)	24	(24)	(26)	(24)	(24)	(25)	(19)	(22)	(24)	24	24	(24)	(24)	24	24	24	(24)	24	(23)		
20	(24)	(24)	24	24	(21)	(24)	(25)	(23)	24	24	24	24	(26)	(24)	(25)	(23)	(25)	(22)	(18)	24	24	24	24	24	(24)	(24)	(24)	(20)	24		
21	(24)	(23)	(21)	(22)	(24)	(24)	(22)	(23)	(24)	24	24	(24)	(25)	(24)	24	(18)	(25)	24	24	24	24	24	24	(24)	24	(24)	24	(24)	(24)		
22	24	(24)	24	(22)	(25)	(24)	(21)	(24)	24	(24)	24	(24)	(22)	24	24	(23)	(24)	24	(26)	(24)	(24)	(24)	24	(24)	(19)	(24)	(25)	(23)	(24)		
23	24	(24)	24	(23)	(24)	(24)	(20)	(24)	24	24	(23)	(22)	24	24	24	24	(24)	24	(22)	(26)	(24)	24	(24)	(23)	(24)	(24)	(24)	(23)	(24)		
24	(24)	(24)	(24)	(24)	(24)	(25)	(21)	24	(22)	(24)	24	(24)	24	(24)	(19)	24	(21)	(19)	(24)	24	(24)	(24)	(24)	(24)	(24)	24	(24)	(25)	(24)	24	
25	(23)	24	(24)	(24)	24	(21)	(22)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	24	(24)	(23)	(22)	(22)	(25)	24	(23)	(25)	(24)	(24)	(24)	(24)	(24)	24		
26	(24)	(21)	(19)	24	(24)	(24)	(21)	(24)	(25)	(24)	(23)	24	24	24	(23)	(25)	24	(22)	(25)	(24)	(24)	24	(24)	24	(26)	24	(22)	24	24		
27	(24)	(25)	(21)	(24)	(24)	24	(24)	(24)	(24)	(24)	24	24	24	24	24	24	(24)	(23)	(24)	(24)	(24)	24	(24)	(23)	(25)	24	(25)	24	(20)		
28	(24)	(24)	(24)	(20)	(24)	24	(20)	(24)	24	(24)	(25)	24	(24)	24	(25)	24	(20)	24	(24)	(24)	(25)	(24)	(24)	(23)	(24)	24	(22)	24	(22)		
29	(24)	(24)	24	(23)	(25)	24	(24)	(24)	24	24	(24)		(27)	(20)	(24)	(23)	(22)	(27)	24	24	(24)	(24)	(24)	24	(24)	24	24	(22)	(23)		
30	(24)	24	(24)	24	(22)	24	24	(24)	(24)	(24)	(24)		24	24	(24)	(23)	(18)	(24)	(23)	24	24	24	(24)	(24)	(24)	(24)	(24)	(20)	(24)		
31	(23)		(23)		(23)	(23)		(24)		24	(24)		24	(24)		(21)	(25)		(24)		24	24			(24)		(25)		(24)		
%	(97)	(100)	(98)	(98)	(95)	(99)	(94)	(98)	100	(99)	(100)	(99)	(100)	(98)	(99)	(97)	(95)	(96)	(95)	(97)	(101)	(101)	(100)	(99)	(100)	(98)	(100)	(98)	(99)		

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V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\06_2003-04 mph.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\2005-2006 MPH.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

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10/12/2007 9:54 AM/

Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	08/04	09/04	10/04	11/04	12/04	01/05	02/05	03/05	04/05	05/05	06/05	07/05	08/05	09/05	10/05	11/05	12/05	01/06	02/06	03/06	04/06	05/06	06/06	07/06	08/06
1	(25)	(22)	24	(25)	(24)	(24)	(24)	(24)	(24)	24	24	24	(22)	24	(23)	(24)	(24)	(24)	(24)	(25)	(24)	(28)	(24)	24	
2	(23)	24	(24)	(24)	(23)	(25)	(24)	24	(24)	24	(24)	(25)	(21)	(20)	(22)	(24)	(25)	24	(24)	(25)	(24)	(25)	(30)	(21)	(23)
3	(24)	(21)	(23)	(24)	(24)	(25)	(24)	(22)	(23)	24	(23)	(21)	(21)	(19)	(24)	24	(24)	(24)	24	(25)	(24)	24	(24)	(23)	
4	(23)	(22)	24	(24)	24	(24)	(24)	(23)	24	(17)	(24)	(23)	(24)	(17)	(23)	24	(24)	(24)	(24)	(22)	24	(24)	(22)	(29)	
5	24	(24)	(23)	24	(24)	(23)	(24)	24	(21)	(24)	(22)	(20)	(20)	(24)	(24)	(24)	(24)	(24)	(26)	(23)	24	(21)	(23)		
6	(23)	(24)	24	24	(26)	(16)	24	24	(24)	24	(23)	(20)	(23)	(15)	(24)	(24)	(24)	24	(29)	(28)	(23)	(24)	(22)		
7	(22)	24	24	24	(24)	(25)	(24)	(24)	(24)	24	24	(23)	(19)	(21)	(24)	(25)	(23)	24	24	(24)	(24)	(21)	(22)	(20)	
8	(21)	24	(24)	(22)	(24)	(25)	(22)	24	(23)	24	(24)	(21)	(21)	(20)	24	(23)	(25)	24	24	(30)	(24)	(23)	(23)	(21)	
9	(24)	(22)	(23)	24	(24)	(24)	(18)	24	(21)	24	(22)	(21)	(21)	(21)	(22)	(24)	(24)	(23)	(32)	(23)	(25)	24	(23)		
10	24	(22)	24	24	(26)	(24)	(24)	(23)	24	24	(23)	(23)	(21)	(19)	(22)	(23)	(25)	(25)	(24)	(26)	24	(24)	(28)	(21)	
11	(24)	(21)	24	(24)	(24)	(24)	24	(24)	24	(24)	(24)	(24)	(21)	(18)	(21)	24	(24)	(24)	(25)	(28)	24	(24)	(27)	(29)	
12	24	(22)	(24)	24	(24)	(25)	24	(24)	24	(25)	(24)	(24)	(23)	(23)	(21)	(24)	(24)	(24)	(24)	(26)	24	(26)	(21)	(31)	
13	24	(24)	(25)	24	(24)	(24)	(24)	(20)	(24)	(24)	(25)	(25)	(26)	(23)	(20)	24	(24)	(24)	24	(30)	(24)	(25)	24	(23)	
14	(21)	(24)	(24)	24	24	(19)	(24)	24	24	(24)	(24)	(23)	(23)	(23)	(24)	(24)	(24)	(23)	24	(25)	(27)	(29)	(22)	(26)	
15	(23)	24	(24)	24	24	24	(24)	(21)	(22)	(24)	(24)	(23)	(23)	(23)	24	(25)	(24)	24	(25)	(20)	24	(29)	24	(24)	
16	(22)	(24)	24	(24)	24	(24)	(22)	(23)	24	(20)	(23)	(21)	(24)	(25)	24	(24)	(24)	(24)	(28)	(23)	(25)	(25)	24	(23)	
17	(24)	(24)	24	(24)	(22)	(23)	(24)	24	(20)	24	24	(23)	(22)	(19)	24	(24)	24	(25)	(25)	(24)	(26)	(26)	24	24	
18	(24)	24	(26)	(24)	(24)	24	(23)	24	(23)	24	24	(24)	(24)	(22)	(22)	24	(24)	(24)	24	(23)	(25)	24	(28)	(23)	
19	(24)	24	(24)	(25)	(24)	(24)	(24)	(24)	24	(24)	24	(23)	(24)	(25)	24	24	24	(24)	(23)	(23)	(21)	(22)	(25)	(24)	
20	(24)	(22)	(24)	(24)	24	(24)	(24)	(23)	(25)	(24)	(16)	(20)	24	(21)	(24)	(24)	24	(24)	24	24	24	(23)	(21)	(27)	
21	(20)	(21)	(24)	(24)	(24)	24	(24)	24	(25)	24	(23)	(24)	(23)	(21)	(24)	(24)	(25)	(22)	24	(28)	(21)	(24)	24	(28)	
22	(25)	(23)	(24)	(24)	24	(27)	(24)	(24)	(24)	24	(22)	(22)	(18)	(23)	24	24	(24)	24	(24)	24	(23)	(23)	(23)	(25)	
23	24	(23)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	24	(23)	(22)	24	(25)	(24)	24	(24)	(24)	24	(23)	(24)	(20)	(23)	(22)	
24	(24)	(23)	24	(25)	24	24	(23)	(24)	24	(24)	24	(24)	24	(22)	(24)	(24)	(24)	(24)	24	(27)	(21)	(26)	(22)	24	
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26	(24)	24	(24)	24	(24)	(24)	24	(24)	(24)	24	(20)	(24)	(19)	(24)	24	(24)	(24)	24	(22)	(21)	(23)	(25)	(25)	(24)	
27	(24)	(23)	(24)	(25)	(24)	24	24	(24)	24	24	(23)	(23)	(25)	(18)	(22)	(24)	(24)	24	24	(27)	24	(23)	(24)	(25)	
28	(24)	(24)	(24)	(24)	24	24	(25)	24	24	24	24	(23)	(21)	(20)	(24)	(21)	(24)	(24)	(24)	24	(30)	(23)	24	(24)	
29	(24)	24	(24)	(24)	(24)	(24)		24	(24)	24	(21)	(19)	(21)	(21)	24	(24)	(24)	(24)		(28)	24	24	(23)		
30	(23)	(22)	(24)	(24)	(24)	(24)		(24)	24	(22)	(23)	(19)	(24)	(22)	24	(22)	(24)	(24)		(24)	(26)	(25)	(24)		
31	24		24		(24)	24		(24)		(23)		(17)	24		(26)		(24)	(24)		(25)		(26)			
%	(98)	(96)	(100)	100	(100)	(99)	(98)	(98)	(99)	(98)	(96)	(92)	(93)	(89)	(97)	(100)	(100)	(100)	(101)	(106)	(100)	(103)	(98)	(88)	(0)

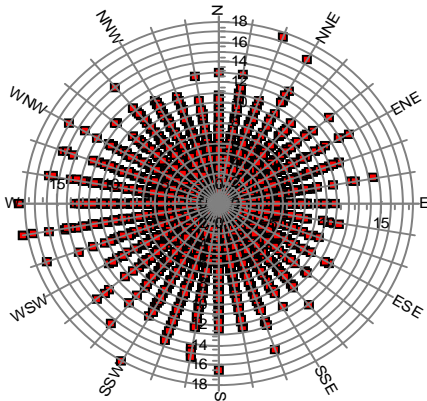
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Description:
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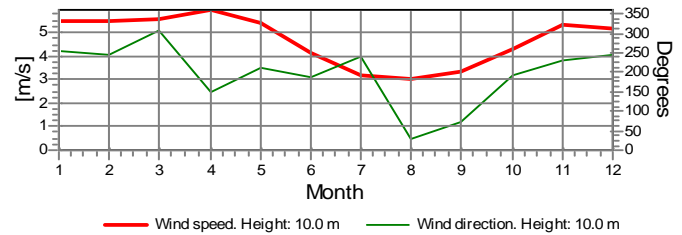
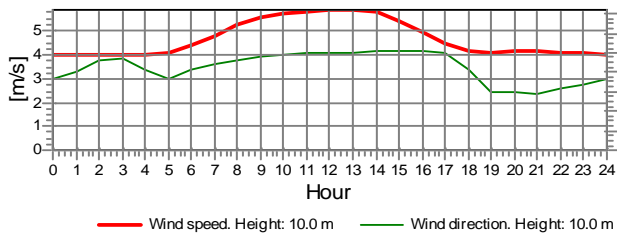
Name of meteo object: ASOS data- Hourly



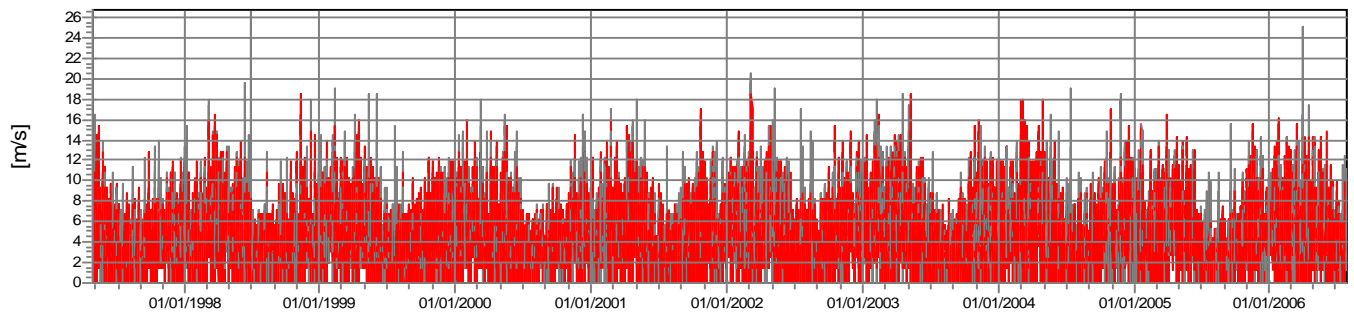
Monthly mean values of wind speed in m/s

Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	mean	mean of months
Jan		4.9	6.2	5.6	4.8	5.4	5.4	5.7	5.2	5.9	5.5	5.5
Feb		4.9	6.0	5.7	5.5	6.0	5.6	5.6	4.9	5.3	5.5	5.5
Mar		6.3	5.3	5.3	5.0	5.8	5.3	5.9	5.7	5.6	5.6	5.6
Apr		5.6	6.3	5.6	6.4	5.8	6.3	6.2	5.9	5.6	6.0	6.0
May		6.0	4.8	5.3	5.6	5.3	5.6	5.6	5.2	4.9	5.4	5.4
Jun		4.5	4.7	3.9	4.4	3.7	4.0	4.0	3.9	4.1	4.0	4.1
Jul		3.5	2.9	3.2	2.8	2.7	3.5	3.3	3.4	2.9	3.5	3.2
Aug		3.1	3.1	3.1	3.2	2.3	3.7	2.8	3.2	2.6	3.0	3.0
Sep		3.4	3.2	3.5	3.7	3.0	3.4	2.9	3.6	3.1	3.3	3.3
Oct		4.5	4.1	4.3	3.9	4.8	4.3	4.0	4.9	3.9	4.3	4.3
Nov		4.9	5.6	4.9	5.2	5.0	5.4	5.6	5.0	6.1	5.3	5.3
Dec		5.0	4.6	5.2	5.3	5.0	5.6	5.4	5.7	4.8	5.2	5.2
mean, all data		4.4	4.5	4.8	4.7	4.5	4.8	4.7	4.9	4.6	5.0	4.7
mean of months		4.4	4.5	4.8	4.7	4.5	4.8	4.7	4.9	4.5	5.0	4.7

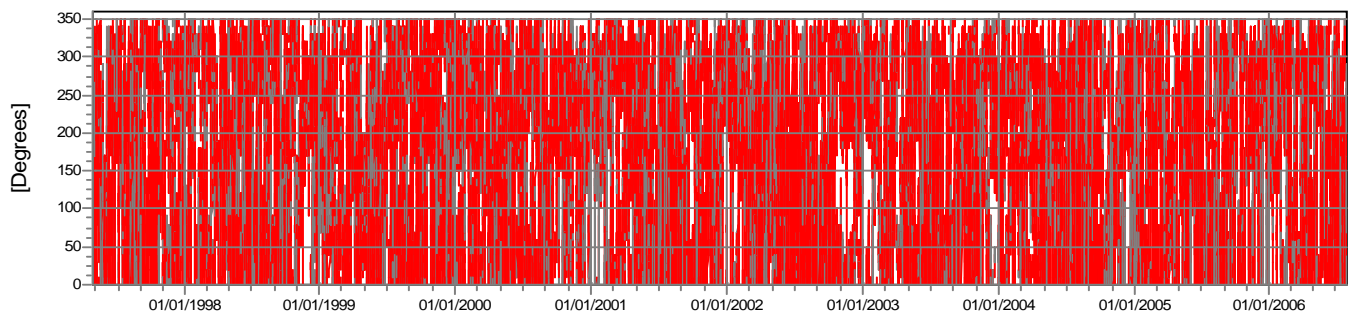
Wind speed [m/s]



Wind speed



Wind direction



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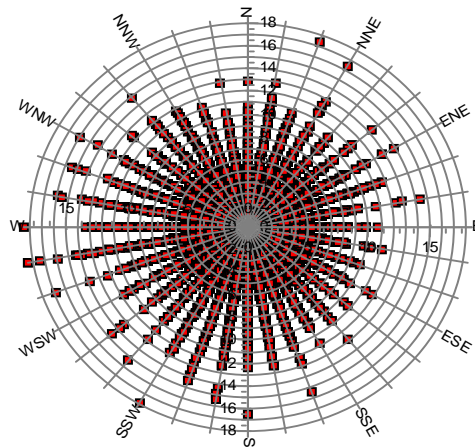
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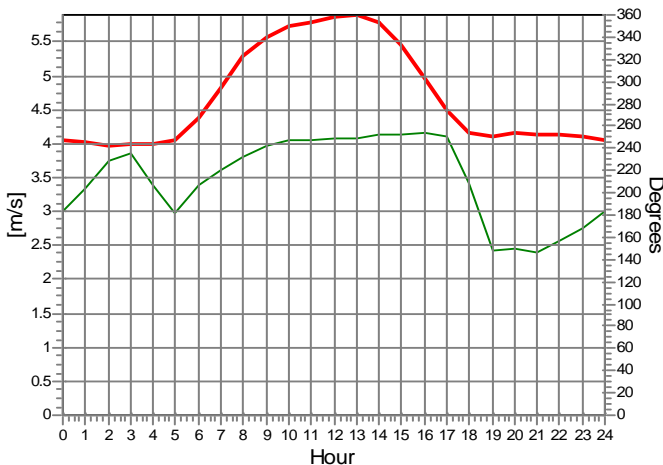
Name of meteo object: ASOS data- Hourly

Monthly mean values of wind speed in m/s

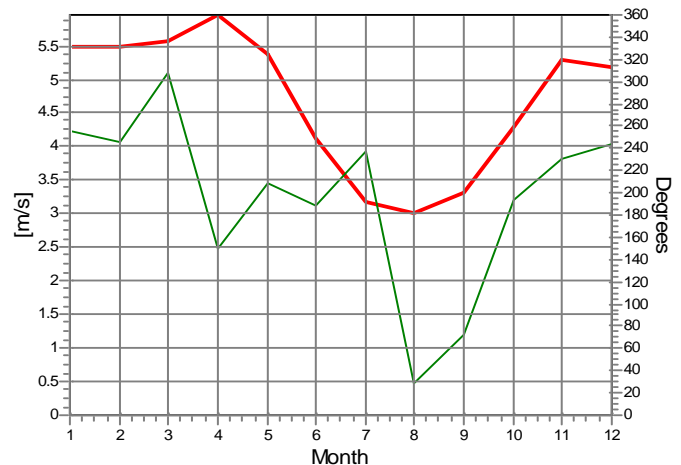
Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	mean	mean of months
Jan		4.9	6.2	5.6	4.8	5.4	5.4	5.7	5.2	5.9	5.5	5.5
Feb		4.9	6.0	5.7	5.5	6.0	5.6	5.6	4.9	5.3	5.5	5.5
Mar		6.3	5.3	5.3	5.0	5.8	5.3	5.9	5.7	5.6	5.6	5.6
Apr		5.6	6.3	5.6	6.4	5.8	6.3	6.2	5.9	5.6	6.0	6.0
May	6.0	4.8	5.3	5.6	5.3	5.3	5.6	5.6	5.2	4.9	5.4	5.4
Jun	4.5	4.7	3.9	4.4	3.7	4.0	4.0	3.9	4.1	4.0	4.1	4.1
Jul	3.5	2.9	3.2	2.8	2.7	3.5	3.3	3.4	2.9	3.5	3.2	3.2
Aug	3.1	3.1	3.1	3.2	2.3	3.7	2.8	3.2	2.6		3.0	3.0
Sep	3.4	3.2	3.5	3.7	3.0	3.4	2.9	3.6	3.1		3.3	3.3
Oct	4.5	4.1	4.3	3.9	4.8	4.3	4.0	4.9	3.9		4.3	4.3
Nov	4.9	5.6	4.9	5.2	5.0	5.4	5.6	5.0	6.1		5.3	5.3
Dec	5.0	4.6	5.2	5.3	5.0	5.6	5.4	5.7	4.8		5.2	5.2
mean, all data	4.4	4.5	4.8	4.7	4.5	4.8	4.7	4.9	4.6	5.0	4.7	
mean of months	4.4	4.5	4.8	4.7	4.5	4.8	4.7	4.9	4.5	5.0		4.7



Wind speed [m/s]



— Wind speed. Height: 10.0 m — Wind direction. Height: 10.0 m



— Wind speed. Height: 10.0 m — Wind direction. Height: 10.0 m

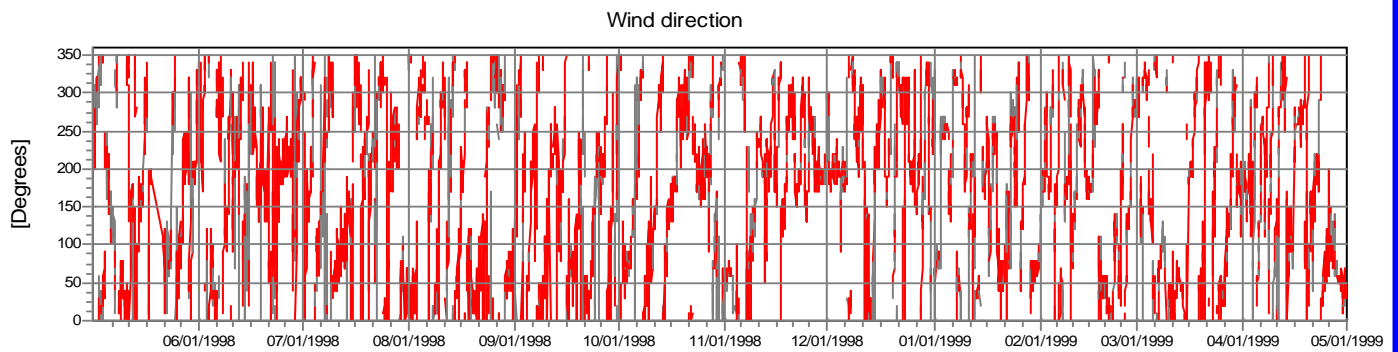
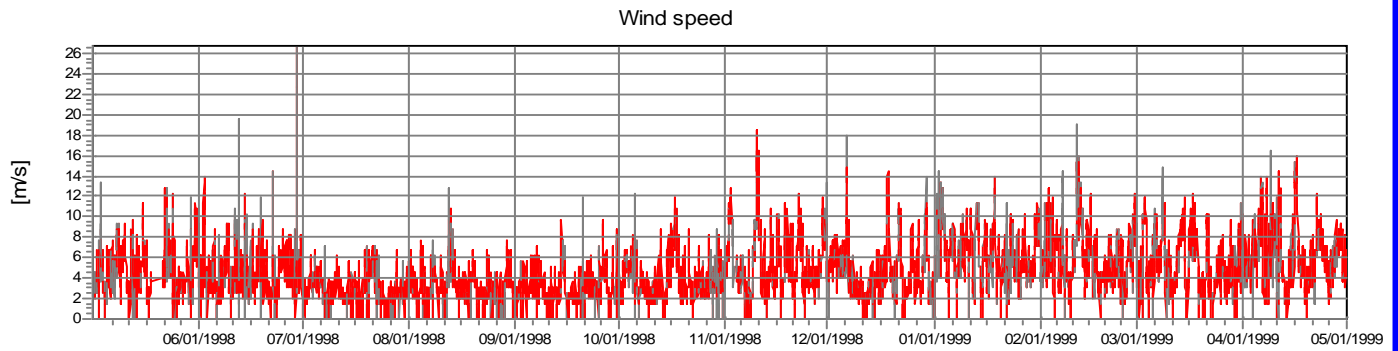
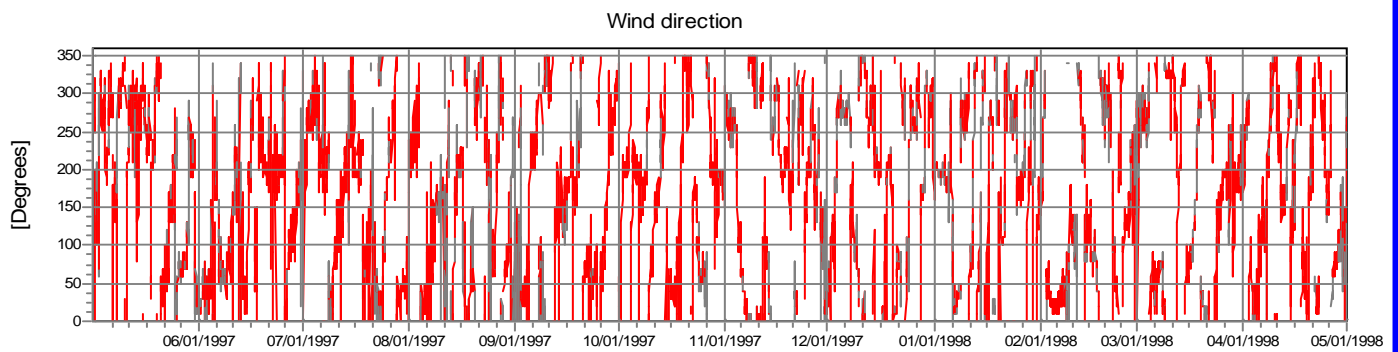
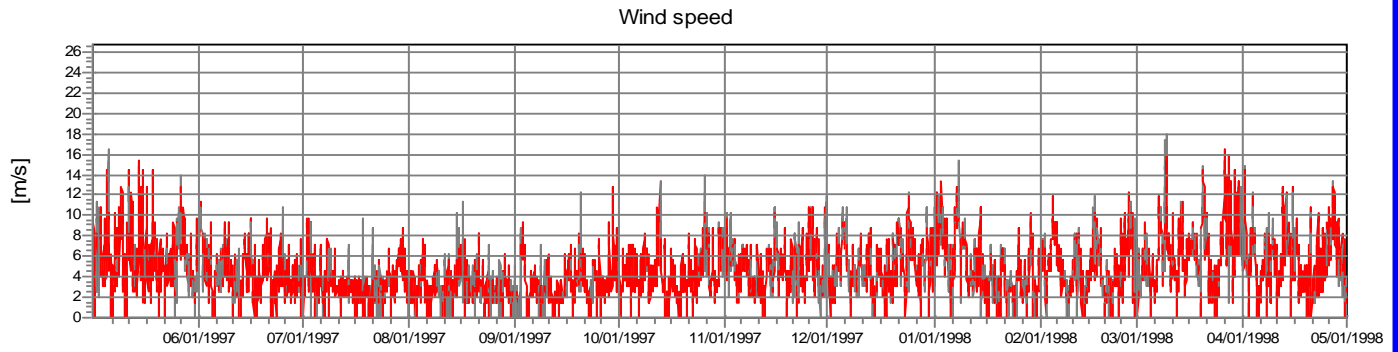
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Wind Data\2005-2006 MPH.csv
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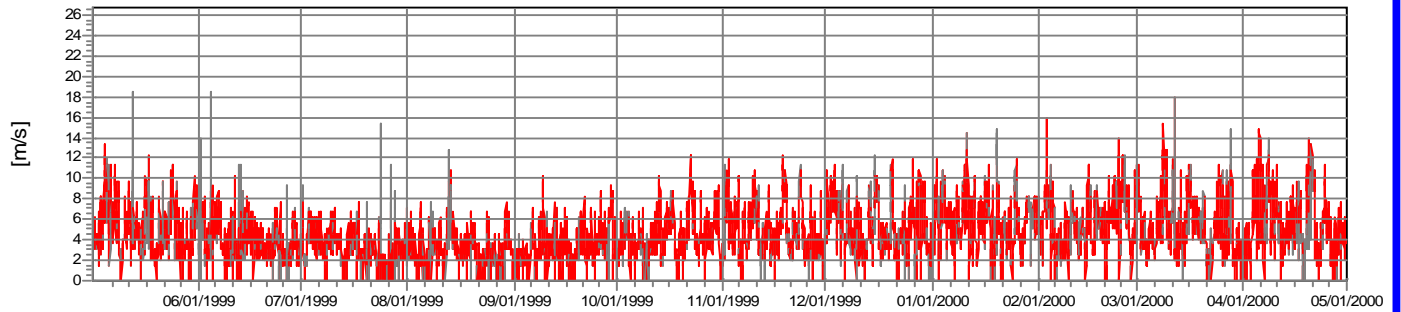
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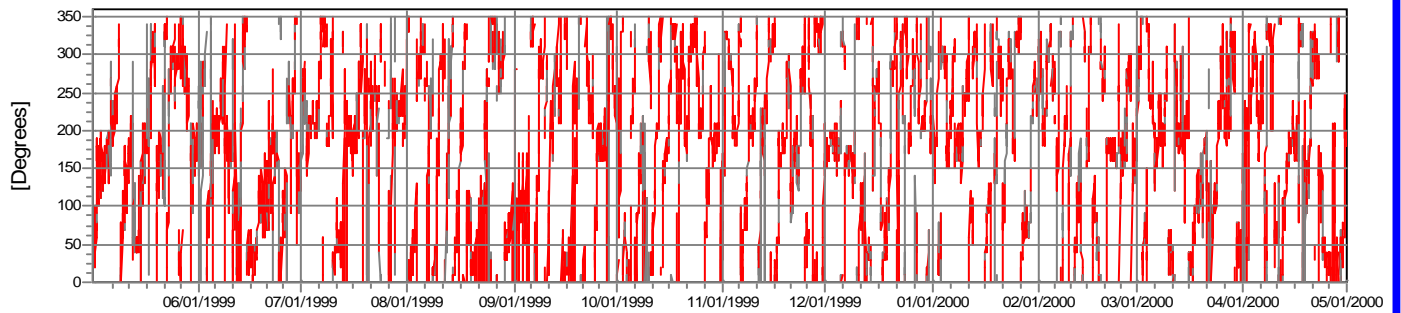
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Name of meteo object: ASOS data- Hourly

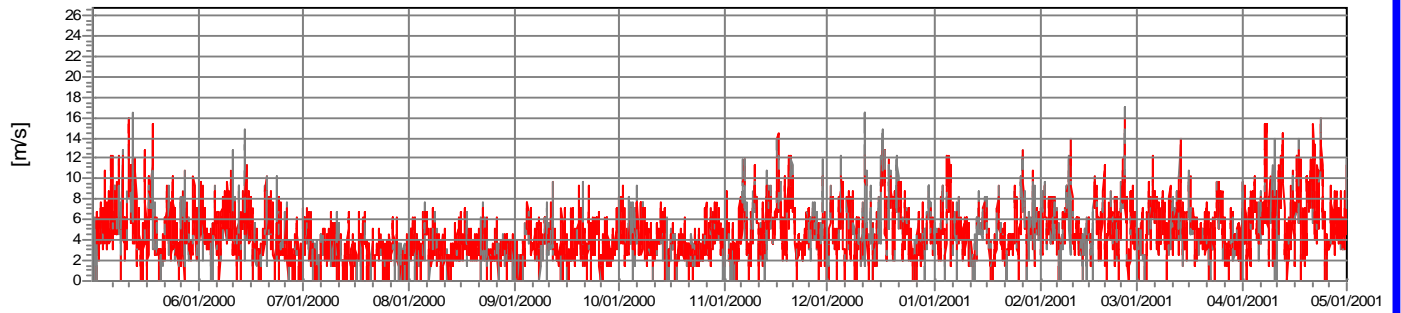
Wind speed



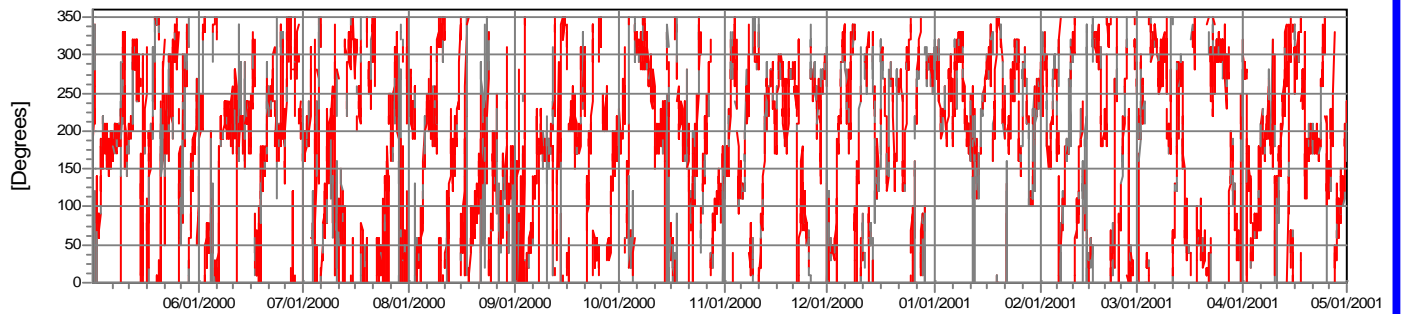
Wind direction



Wind speed



Wind direction



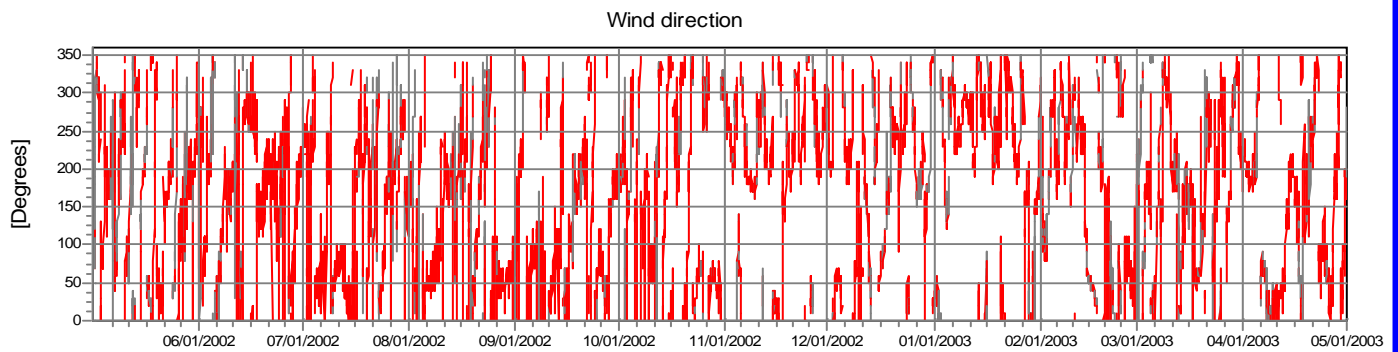
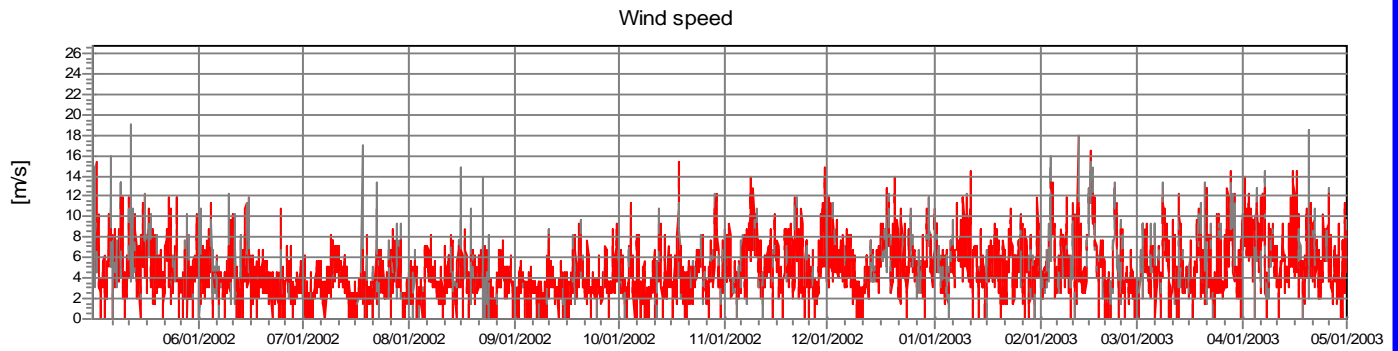
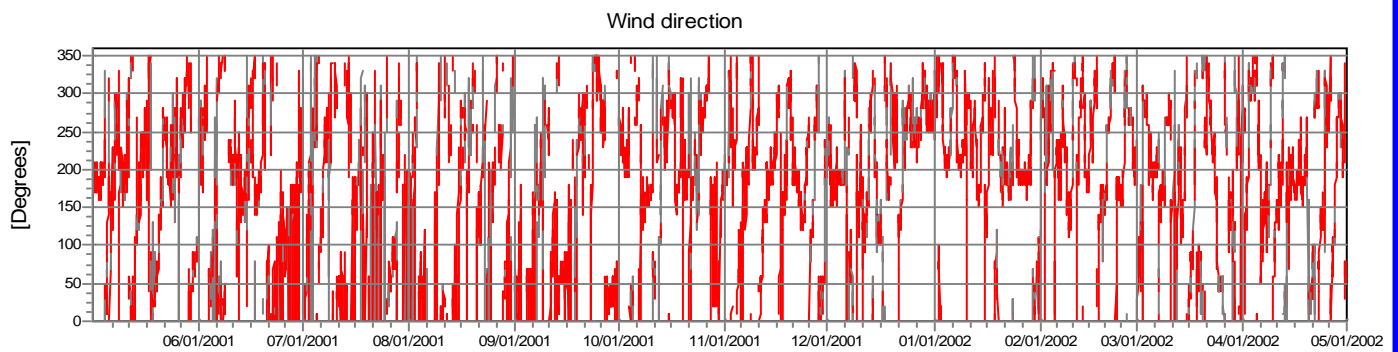
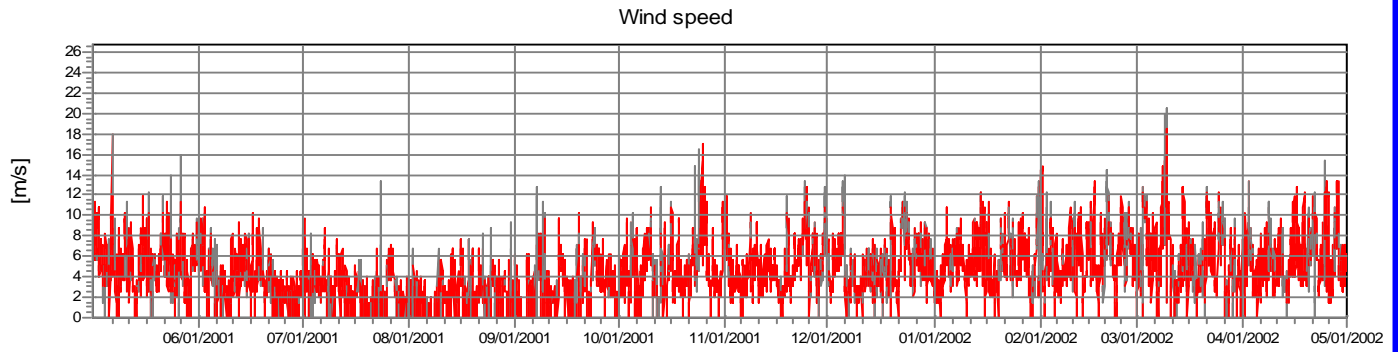
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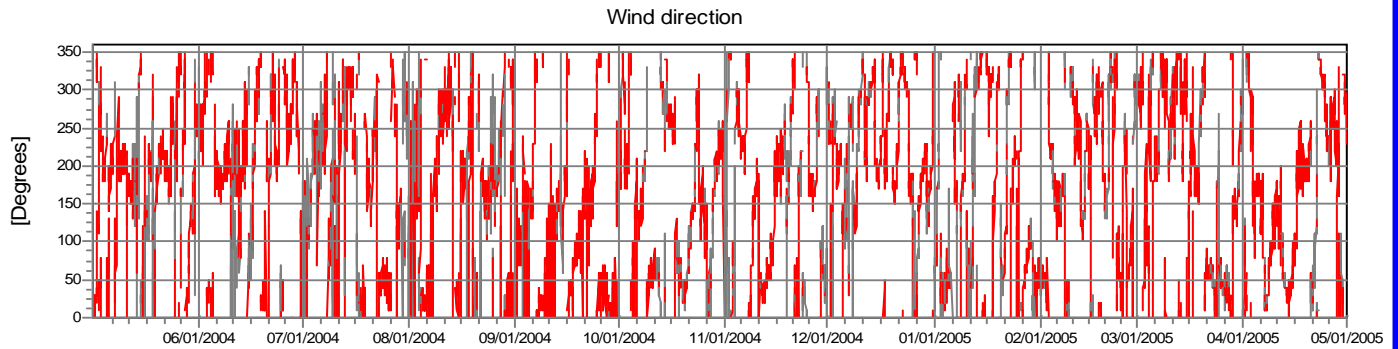
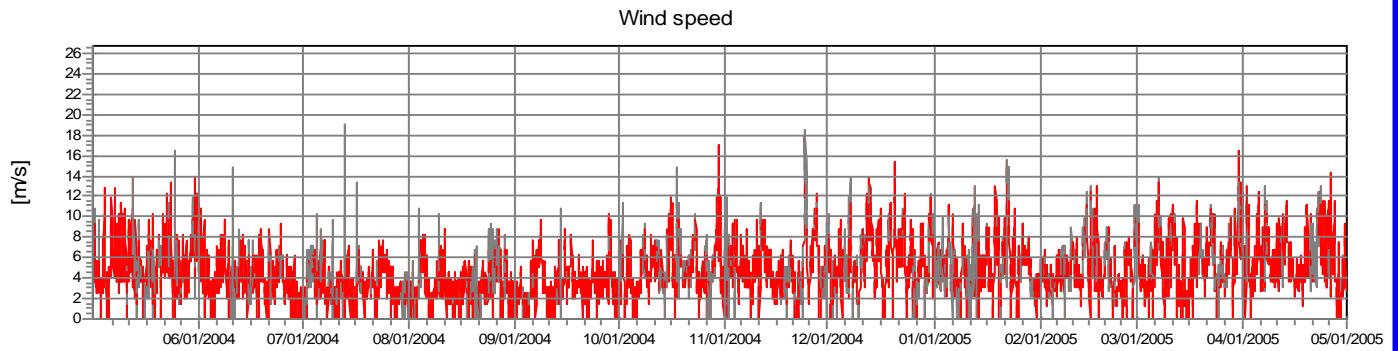
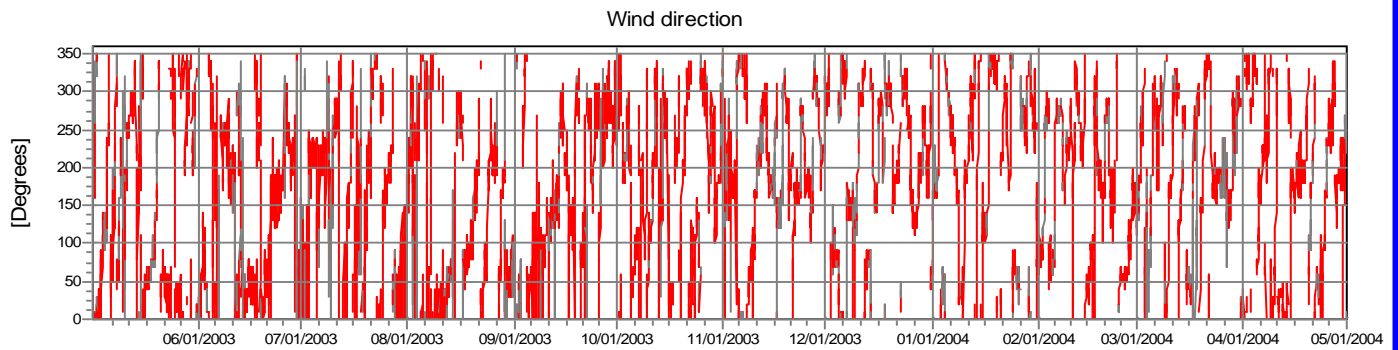
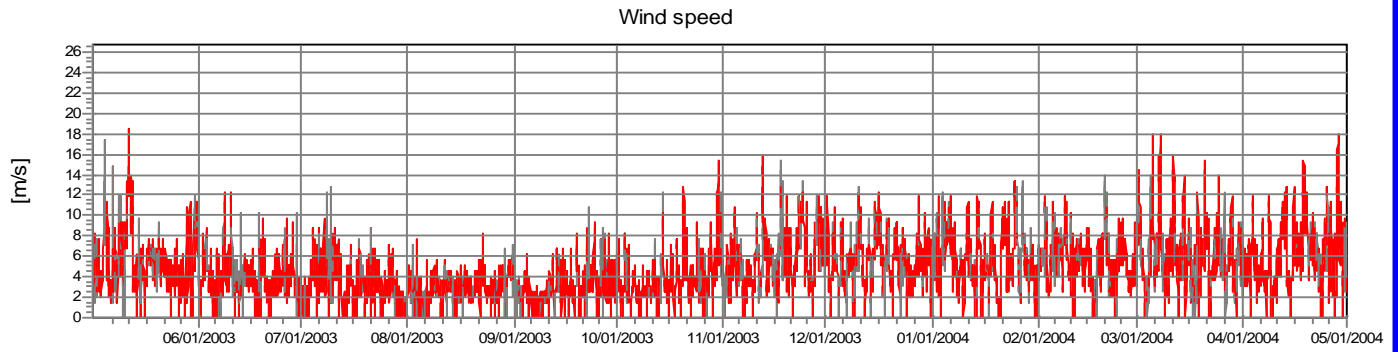
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Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly



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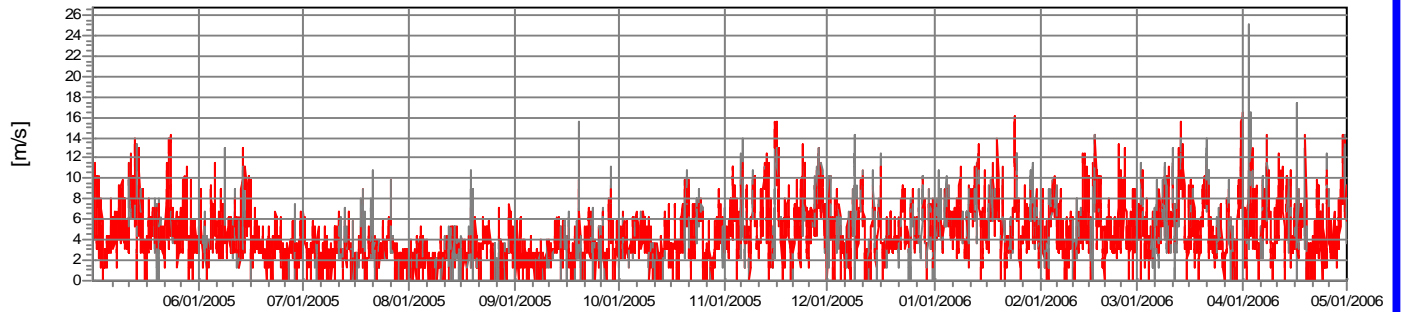
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Wind Data\2005-2006 MPH.csv
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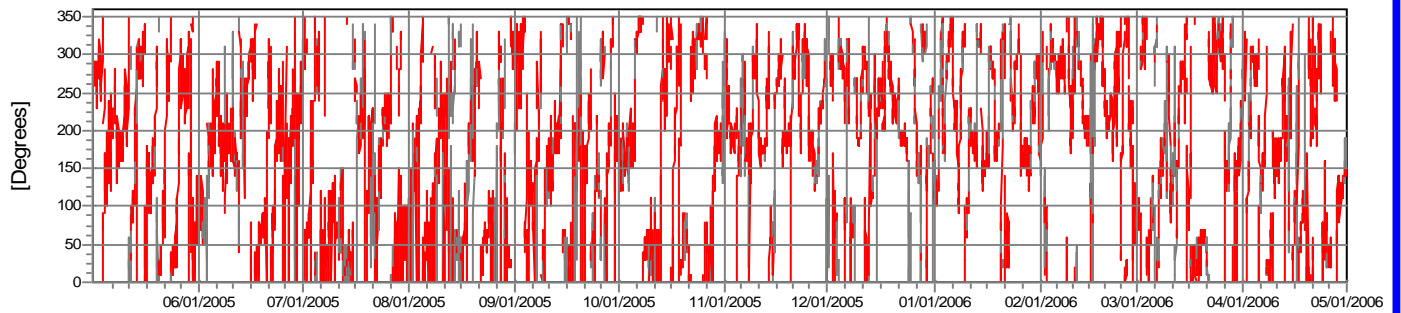
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Name of meteo object: ASOS data- Hourly

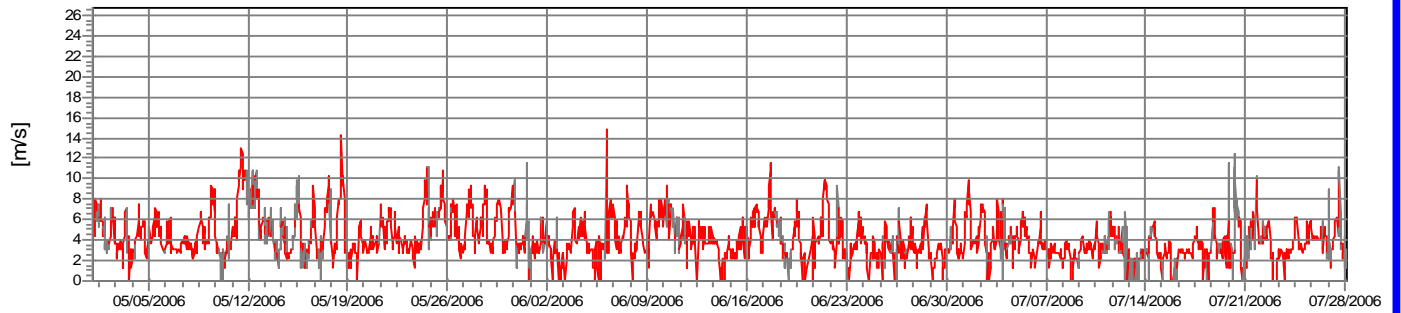
Wind speed



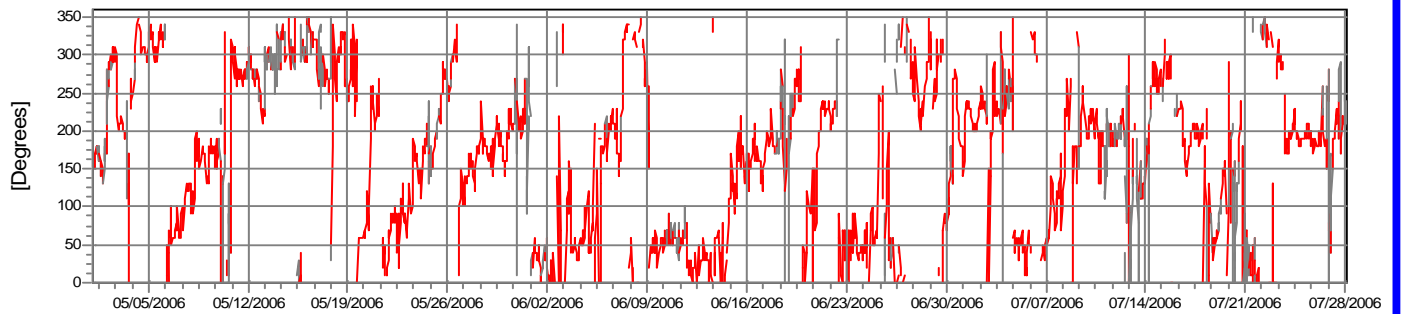
Wind direction



Wind speed



Wind direction



Project:

southcampus windstudy

Description:

Data from file(s)
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 Wind Data\2005-2006 MPH.csv
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Name of meteo object: ASOS data- Hourly

Frequency

Wind speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
0.00 - 0.49	3,665	3,665	0	0	0	0	0	0	0	0	0	0	0
0.50 - 1.49	532	32	35	54	57	44	42	41	54	37	49	49	38
1.50 - 2.49	7,908	517	409	674	831	784	742	620	637	666	728	697	603
2.50 - 3.49	15,036	853	968	1,594	1,384	1,261	1,385	1,474	1,555	1,333	1,157	1,138	934
3.50 - 4.49	15,387	1,028	1,200	1,679	1,024	923	1,222	1,988	1,773	1,202	1,186	1,188	974
4.50 - 5.49	10,254	639	885	1,066	583	528	754	1,469	1,249	779	823	817	662
5.50 - 6.49	8,673	528	665	791	429	374	629	1,297	1,097	664	721	821	657
6.50 - 7.49	6,551	334	429	527	315	237	484	1,105	794	465	640	681	540
7.50 - 8.49	4,473	179	251	301	200	148	286	767	566	349	555	519	352
8.50 - 9.49	2,918	106	158	196	98	69	183	555	367	235	366	373	212
9.50 - 10.49	1,869	74	94	102	59	34	107	310	216	155	312	263	143
10.50 - 11.49	1,082	40	45	66	23	21	52	182	122	88	213	139	91
11.50 - 12.49	556	13	26	34	13	6	29	82	75	50	125	69	34
12.50 - 13.49	317	11	12	20	3	2	13	43	33	32	92	43	13
13.50 - 14.49	159	2	3	5	1	1	8	27	26	23	33	23	7
14.50 - 15.49	67	0	3	1	0	1	3	15	14	5	12	7	6
15.50 - 16.49	37	0	2	1	0	0	0	5	5	8	11	3	2
16.50 - 17.49	14	0	2	0	0	0	0	4	0	2	6	0	0
17.50 - 18.49	8	0	1	0	0	1	0	1	1	1	2	1	0
18.50 - 19.49	7	0	1	0	0	0	0	0	0	1	5	0	0
19.50 - 20.49	0	0	0	0	0	0	0	0	0	0	0	0	0
20.50 - 21.49	0	0	0	0	0	0	0	0	0	0	0	0	0
21.50 - 22.49	0	0	0	0	0	0	0	0	0	0	0	0	0
22.50 - 23.49	1	0	0	0	0	0	0	0	0	1	0	0	0
23.50 - 24.49	0	0	0	0	0	0	0	0	0	0	0	0	0
24.50 - 25.49	0	0	0	0	0	0	0	0	0	0	0	0	0
25.50 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.50 - 27.49	1	0	0	0	0	0	0	0	0	0	0	1	0
Sum	79,515	8,021	5,189	7,111	5,020	4,434	5,939	9,985	8,584	6,096	7,036	6,832	5,268

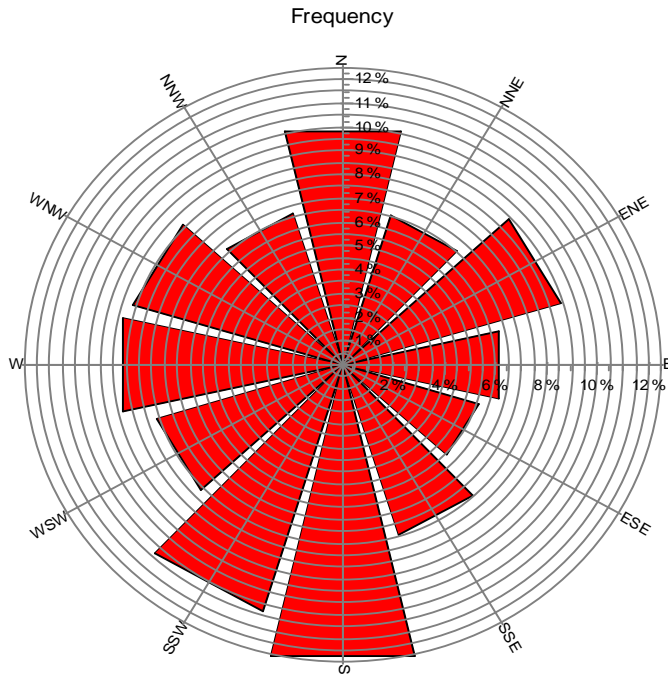
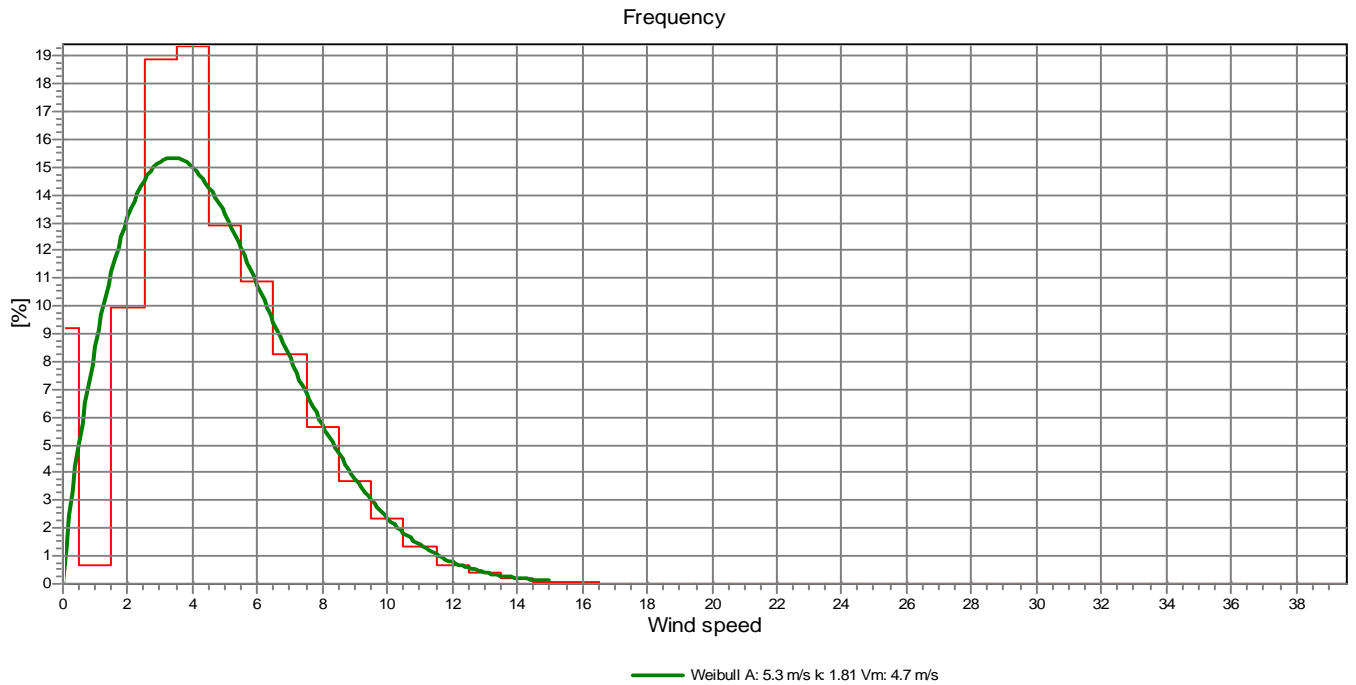
Project:
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Description:
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Name of meteo object: ASOS data- Hourly



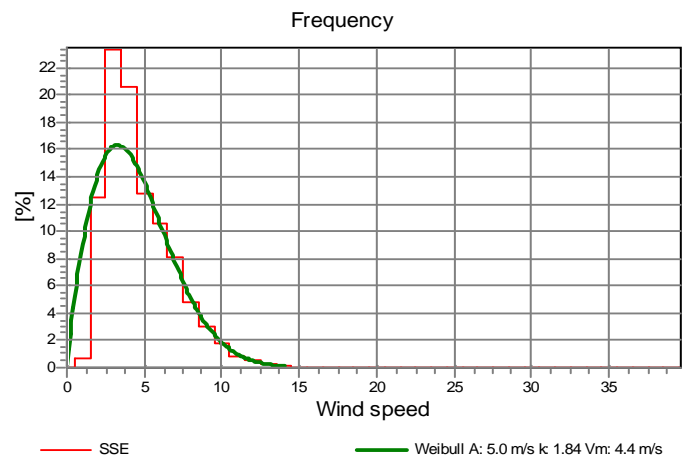
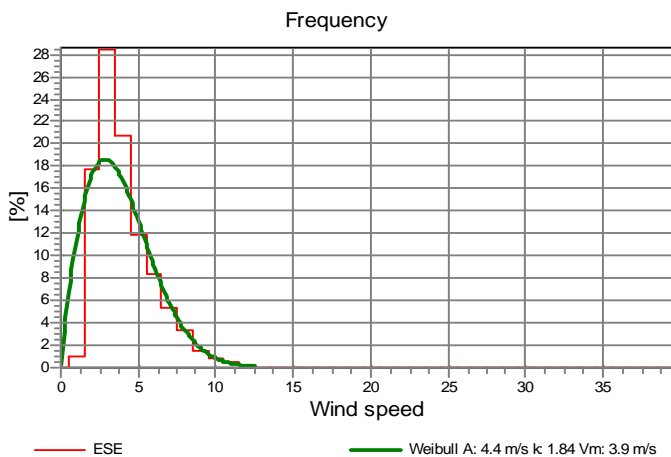
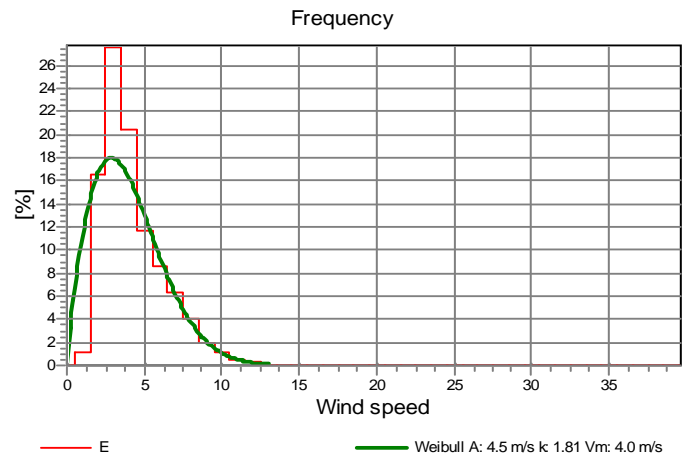
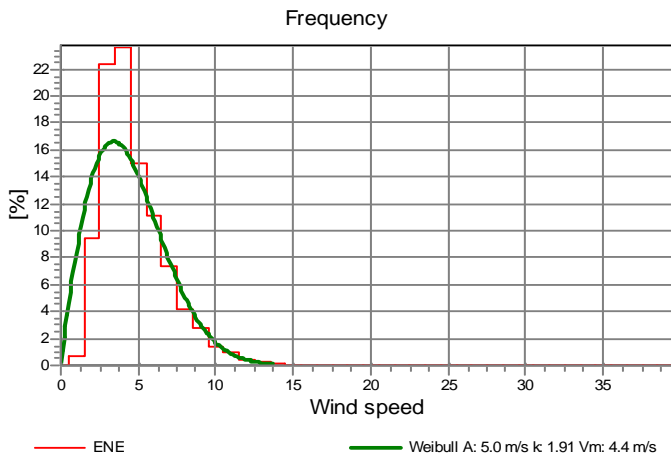
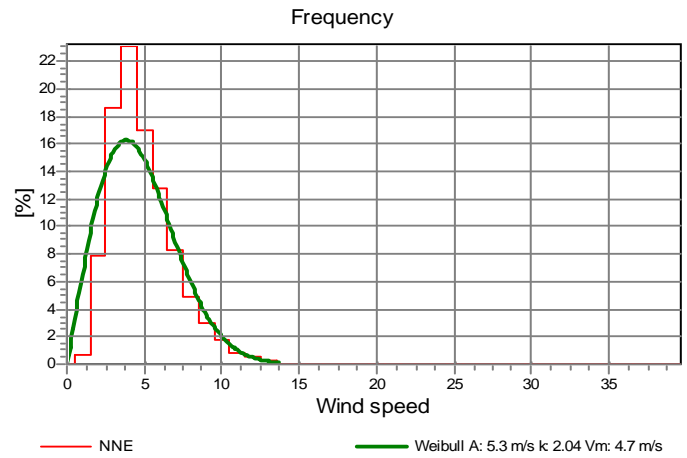
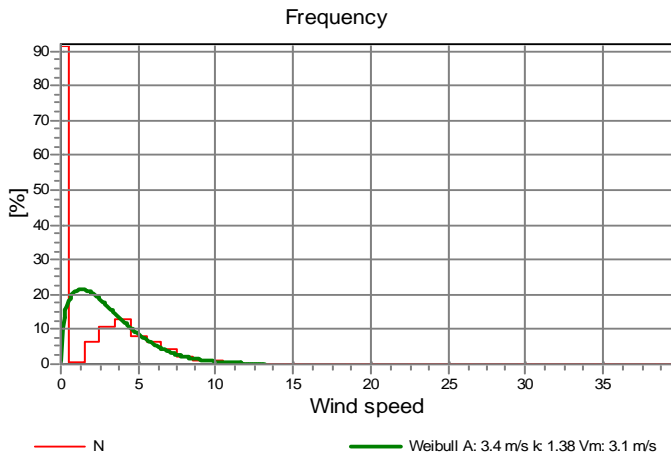
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Name of meteo object: ASOS data- Hourly



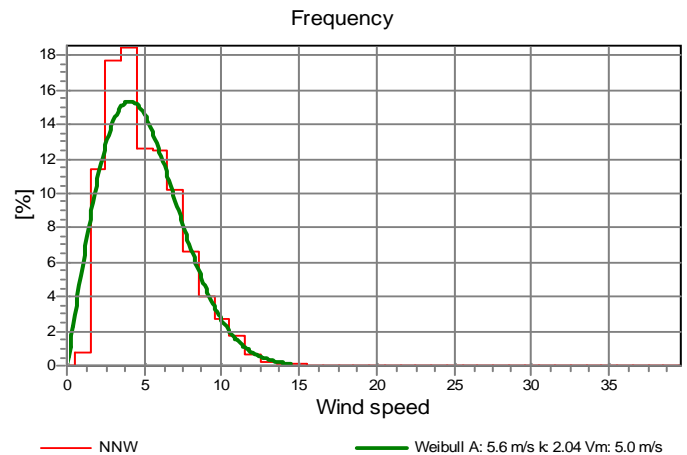
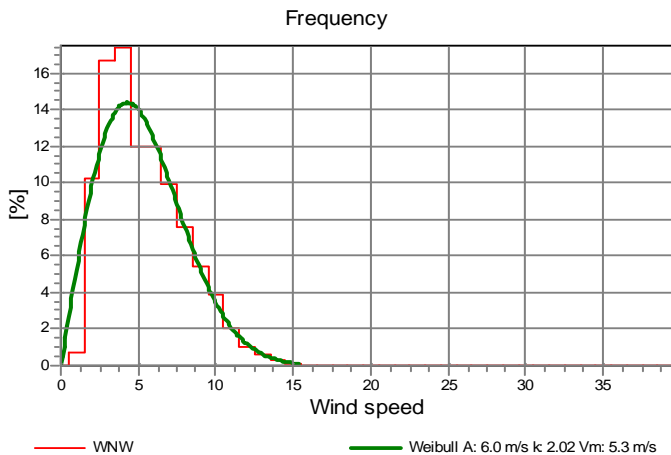
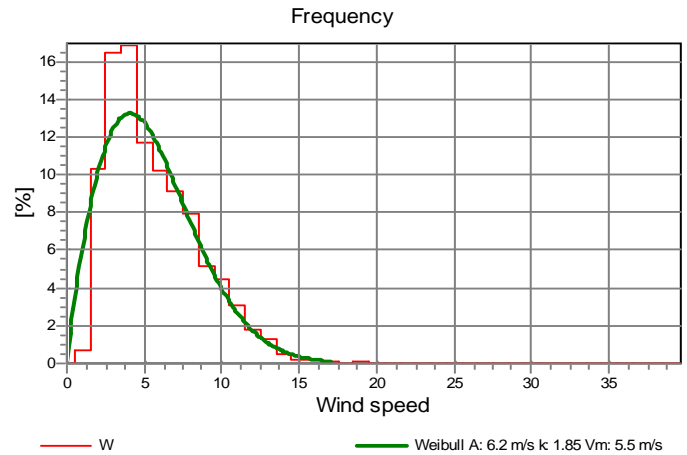
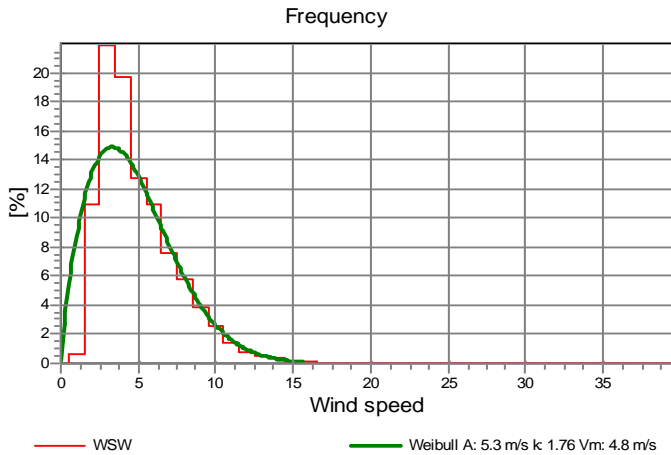
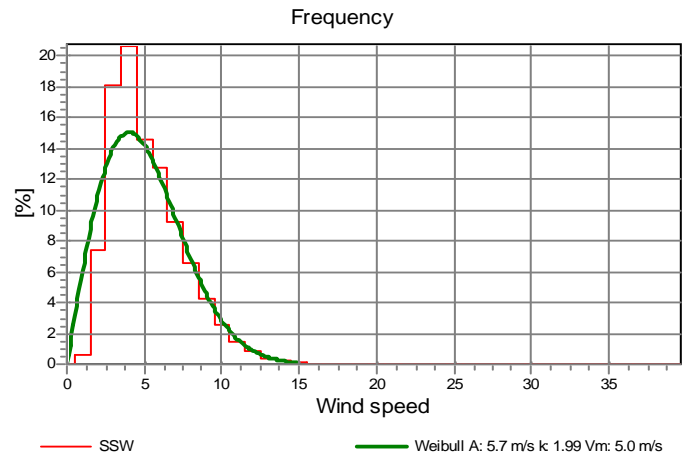
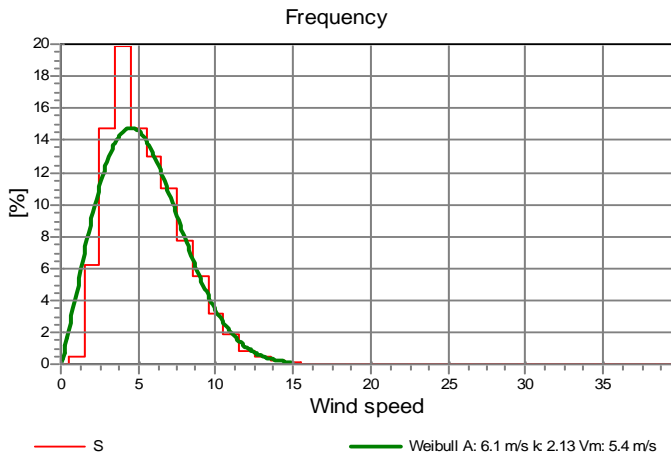
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Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly



Project:

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Description:

Data from file(s)
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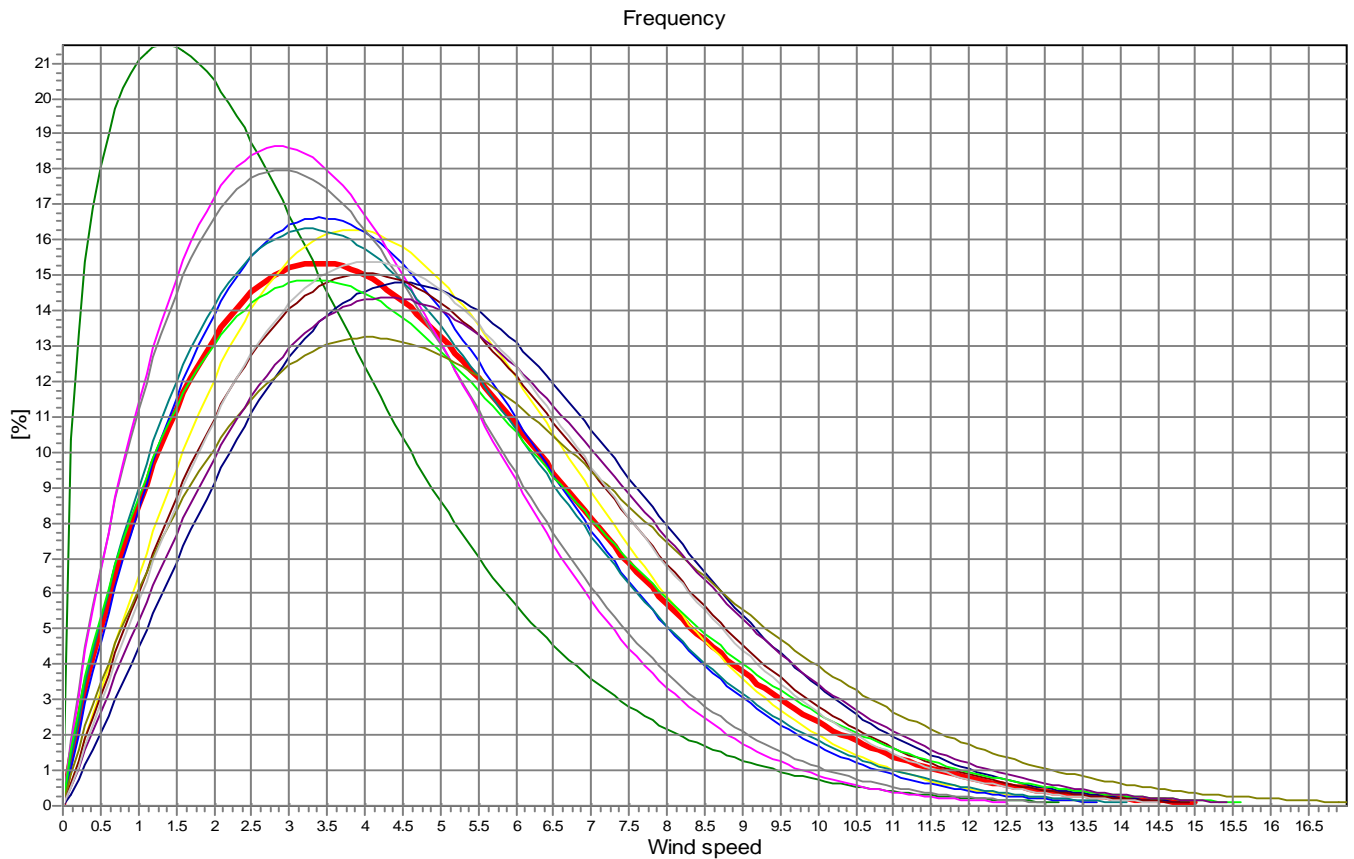
Meteo data report, height: 10.0 m

Name of meteo object: ASOS data- Hourly

Weibull Data

k-parameter correction: 0.0080/m

Sector	A- parameter [m/s]	Mean wind speed [m/s]	k- parameter	Frequency	Frequency [%]	Wind shear
0-N	3.42	3.12	1.384	10.09	10.1	0.00
1-NNE	5.33	4.72	2.038	6.53	6.5	0.00
2-ENE	5.01	4.45	1.911	8.94	8.9	0.00
3-E	4.49	3.99	1.808	6.31	6.3	0.00
4-ESE	4.37	3.89	1.841	5.58	5.6	0.00
5-SSE	5.00	4.44	1.843	7.47	7.5	0.00
6-S	6.06	5.37	2.134	12.56	12.6	0.00
7-SSW	5.69	5.04	1.993	10.80	10.8	0.00
8-WSW	5.35	4.76	1.760	7.67	7.7	0.00
9-W	6.18	5.49	1.854	8.85	8.8	0.00
10-WNW	6.01	5.33	2.022	8.59	8.6	0.00
11-NNW	5.65	5.00	2.039	6.63	6.6	0.00
mean	5.26	4.68	1.811	100.00	100.0	0.00



- Total A: 5.3 m/s k: 1.81 Vm: 4.7 m/s
- N A: 3.4 m/s k: 1.38 Vm: 3.1 m/s
- NNE A: 5.3 m/s k: 2.04 Vm: 4.7 m/s
- ENE A: 5.0 m/s k: 1.91 Vm: 4.4 m/s
- E A: 4.5 m/s k: 1.81 Vm: 4.0 m/s
- ESE A: 4.4 m/s k: 1.84 Vm: 3.9 m/s
- SSE A: 5.0 m/s k: 1.84 Vm: 4.4 m/s
- S A: 6.1 m/s k: 2.13 Vm: 5.4 m/s
- SSW A: 5.7 m/s k: 1.99 Vm: 5.0 m/s
- WSW A: 5.3 m/s k: 1.76 Vm: 4.8 m/s
- W A: 6.2 m/s k: 1.85 Vm: 5.5 m/s
- WNW A: 6.0 m/s k: 2.02 Vm: 5.3 m/s
- NNW A: 5.6 m/s k: 2.04 Vm: 5.0 m/s

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STATGEN - Overview

Calculation: 10m Wind Statistic Hourly File: V:\EAPC WIND PROJECTS\20063390 - University of Illinois\US 10.00 m ASOS data- Hourly.wws

Name

10.00 m ASOS data- Hourly

Source

USER

Country

United States

Site Coordinates

UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

Site Data

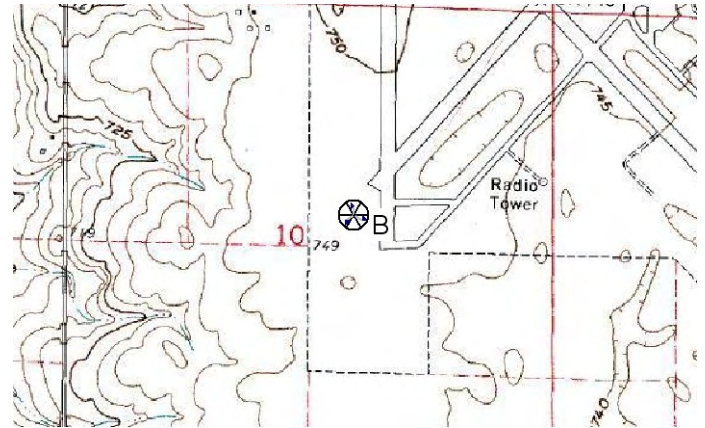
10m ASOS data

Meteorological Data

ASOS data- Hourly

Comments

Shear value of .20



Scale 1:25,000

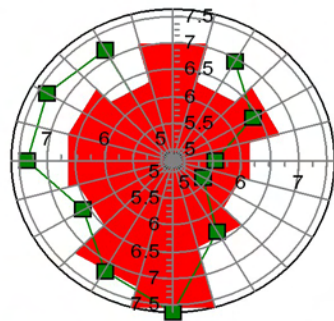
Site Data

Meteorological Data

Mean wind speed [m/s]

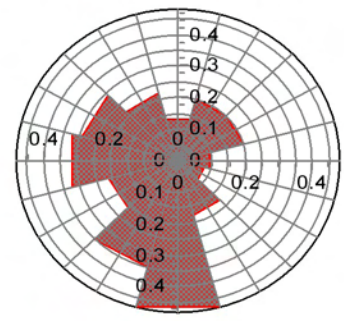
Height [m]	Roughness class/Length			
	0	1	2	3
10.0	6.9	4.8	4.2	3.3
25.0	7.6	5.8	5.2	4.3
50.0	8.1	6.6	6.1	5.2
100.0	8.8	7.8	7.2	6.3
200.0	9.7	9.7	8.8	7.7

Mean wind speed [m/s]
Roughness class: 1; Height: 50 m



Frequency Wind speed

Energy [MWh/m2/year]
Roughness class: 1; Height: 50 m



Energy

Wind energy [kWh/m2/year]

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	3,176	1,268	835	404
25.0	4,059	2,003	1,461	866
50.0	4,912	2,783	2,147	1,409
100.0	6,370	4,356	3,329	2,217
200.0	8,901	8,457	6,327	4,088

WTG energy [kWh/m2/year]

Normal rated WTG (0.45 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	1,044	-	-	-
25.0	1,252	679	511	-
50.0	1,425	954	769	530
100.0	1,612	1,340	1,133	850
200.0	1,842	1,842	1,621	1,286

High wind rated WTG (0.55 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	1,130	-	-	-
25.0	1,382	709	518	-
50.0	1,591	1,026	812	540
100.0	1,812	1,489	1,237	905
200.0	2,087	2,086	1,822	1,423

Low wind rated WTG (0.35 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	967	-	-	-
25.0	1,138	643	488	-
50.0	1,271	889	726	505
100.0	1,385	1,210	1,041	797
200.0	1,592	1,592	1,390	1,166

Key numbers

Wind energy is relative to 3300 kWh/m2/year for roughness class 1 and 50 m hub height

WTG energy is relative to 1025 kWh/m2/year for roughness class 1 and 50 m hub height

Name	Distance [km]	Wind energy [%]	WTG energy [%]	Name	Distance [km]	Wind energy [%]	WTG energy [%]
Current wind statistic		84.3	93.1	10.00 m Peoria 02to04	128.4	36.9	45.4
80.00 m ASOS data- Hourly	0.0	90.5	76.9	10.00 m Peoria IL Measure and Weibull data	128.9	40.6	47.6
80.01 m ASOS data- Hourly	0.0	104.5	88.4	10.00 m Peoria Measure and Weibull data	128.9	40.6	47.6
80.01 m ASOS data	0.0	111.5	92.7	50.0 m Princeton Met mast	172.2	91.4	104.8
80.00 m scaled ASOS data	0.0	96.4	80.3	50.0 m Princeton Met mast	172.2	91.4	104.8
10.00 m ASOS data	0.4	87.4	94.9	50.0 m Princeton Met mast	172.2	91.4	104.8
				25.00 m Matt Kauffman 25m mast May04 to May05	176.6	95.6	106.9

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STATGEN - Terrain

Calculation: 10m Wind Statistic Hourly Site Data: A - 10m ASOS data

Obstacles:

0 Obstacles used

Roughness:

Calculation uses following MAP files:

\\hera\EAPC\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\ROUGHNESSLINE_southcampus windstudy_0.wpo

Min X: 370,595, Max X: 425,278, Min Y: 4,408,292, Max Y: 4,463,470, Width: 54,683 m, Height: 55,178 m

Limited by a square on 40.0 km x 40.0 km around the current site

Orography:

Calculation uses following MAP files:

\\hera\EAPC\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\3m_HCL GM South Campus.WPO

Min X: 382,783, Max X: 414,721, Min Y: 4,414,326, Max Y: 4,456,022, Width: 31,938 m, Height: 41,696 m

Limited by a square on 10.0 km x 10.0 km around the current site

Project:

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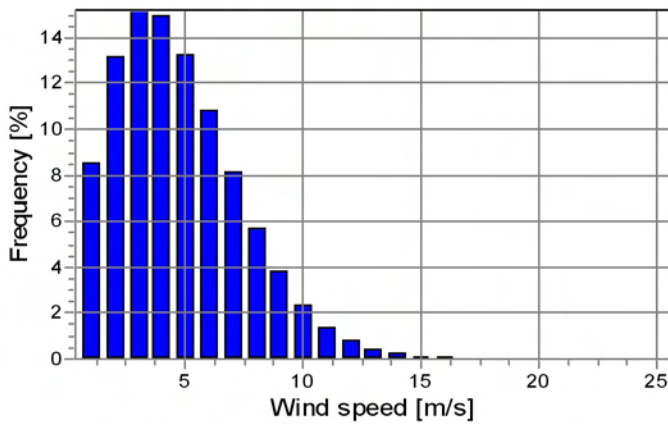
STATGEN - Wind Data Analysis

Calculation: 10m Wind Statistic Hourly Wind data: B - ASOS data- Hourly; Hub height: 10.0

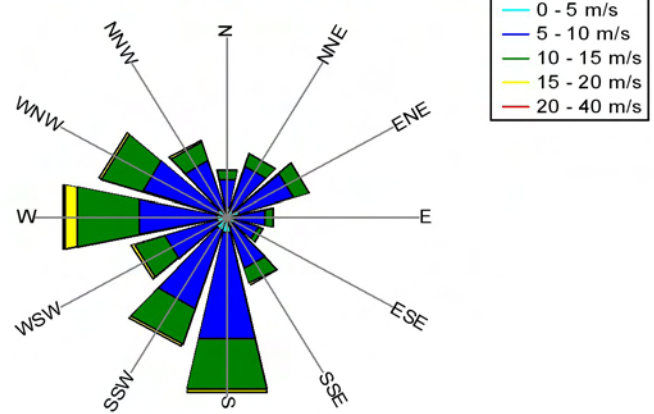
Weibull Data

Sector	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]	Wind gradient exponent
0 N	3.42	3.12	1.384	10.1	0.000
1 NNE	5.33	4.72	2.038	6.5	0.000
2 ENE	5.01	4.45	1.911	8.9	0.000
3 E	4.49	3.99	1.808	6.3	0.000
4 ESE	4.37	3.89	1.841	5.6	0.000
5 SSE	5.00	4.44	1.843	7.5	0.000
6 S	6.06	5.37	2.134	12.6	0.000
7 SSW	5.69	5.04	1.993	10.8	0.000
8 WSW	5.35	4.76	1.760	7.7	0.000
9 W	6.18	5.49	1.854	8.8	0.000
10 WNW	6.01	5.33	2.022	8.6	0.000
11 NNW	5.65	5.00	2.039	6.6	0.000
All	5.26	4.68	1.811	100.0	

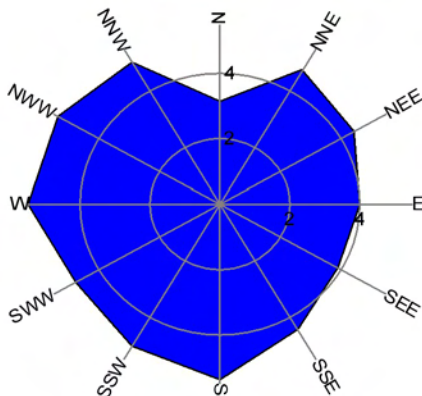
Weibull Distribution



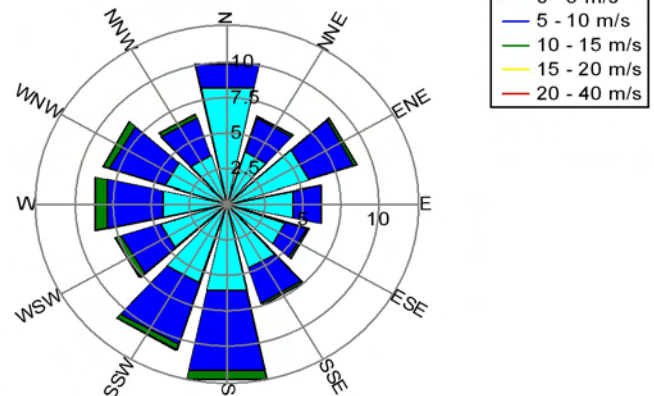
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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STATGEN - 24K TOPO

Calculation: 10m Wind Statistic Hourly File: 24K TOPO.jpg



0 250 500 750 1000m
Map: , Print scale 1:25,000, Map center UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

⊗ Site Data

⚡ Meteorological Data

Project:
southcampus windstudy

Description:
Data from file(s)
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\06_2003-04 mph.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\2005-2006 MPH.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

Printed/Page
10/12/2007 9:53 AM / 1
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EAPC Architects Engineers
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 5507
Jay Haley
Calculated:
10/12/2007 9:53 AM/

Meteo data report, height: 80.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	05/97	06/97	07/97	08/97	09/97	10/97	11/97	12/97	01/98	02/98	03/98	04/98	05/98	06/98	07/98	08/98	09/98	10/98	11/98	12/98	01/99	02/99	03/99	04/99	05/99	06/99	07/99	08/99	09/99
1	(22)	(25)	(22)	(20)	(20)	(22)	(25)	(24)	24	(24)	(25)	(24)	(24)	(22)	(19)	(24)	(22)	(23)	(24)	(24)	(25)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)
2	(24)	(24)	(24)	24	(23)	24	(24)	(23)	(24)	(22)	(24)	(21)	(24)	(23)	(21)	(23)	(22)	24	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(22)	(24)	(23)	(21)
3	(25)	(24)	(25)	(23)	(23)	24	(24)	(24)	(24)	24	(24)	(24)	(27)	(24)	24	(20)	(23)	(25)	(7)	(24)	(27)	(24)	(24)	(24)	(24)	(23)	(24)	(20)	(19)
4	(24)	(24)	(24)	(24)	(21)	24	(24)	(24)	(24)	24	(25)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(14)	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(23)
5	(24)	(22)	(23)	24	(23)	24	24	(24)	(24)	24	(24)	(21)	(23)	(24)	(24)	(23)	(23)	(24)	(14)	(24)	(23)	(24)	(25)	(24)	(24)	(24)	(24)	(23)	(24)
6	(20)	(25)	(24)	(21)	(23)	(23)	(24)	(24)	(24)	24	(22)	24	(24)	(23)	(25)	(23)	(25)	(23)	(14)	(25)	(25)	(23)	(24)	(24)	(25)	(24)	(24)	(23)	(23)
7	24	(24)	(20)	(21)	(23)	24	(24)	(24)	(24)	24	(24)	(24)	(24)	24	(24)	(24)	24	(24)	(16)	(24)	(25)	(24)	(24)	(24)	24	(24)	(21)	(24)	(23)
8	(25)	(25)	(24)	24	(24)	24	(24)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	(25)	(24)	(21)	(24)	(23)	(24)	(25)	(24)	(24)	(24)	(24)	(23)	(22)	(24)	(24)
9	(24)	(25)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(23)	(26)	(25)	24	(24)	(24)	(20)	(21)	(21)	(25)	(24)	(24)	(23)	(24)	(24)	(19)	(23)	(24)	(20)	(24)
10	24	(24)	24	(20)	(22)	(23)	(25)	(24)	(24)	(24)	24	24	24	(22)	(23)	(24)	(17)	(21)	(24)	(24)	(24)	(22)	(18)	(24)	(24)	(24)	(24)	(24)	(23)
11	(24)	(24)	(22)	(20)	(23)	24	24	(24)	(24)	(24)	(24)	24	(22)	(25)	24	(24)	(21)	(24)	(24)	(22)	(25)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(20)
12	(24)	(24)	(22)	(27)	(19)	24	(23)	(24)	(24)	(24)	24	24	(24)	(25)	(20)	(25)	(21)	(22)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)
13	(26)	(22)	24	(24)	(21)	(24)	(24)	(24)	(24)	(24)	24	(24)	(23)	24	(21)	(27)	(22)	(24)	(24)	(23)	(18)	(24)	(24)	(24)	(25)	(24)	(20)	(27)	(24)
14	24	24	(26)	(23)	(20)	(23)	(24)	(21)	(24)	(24)	(24)	(24)	(23)	(26)	(24)	(24)	(24)	(17)	(25)	(24)	(18)	(24)	(24)	(24)	24	(24)	(23)	(24)	(25)
15	24	(23)	(23)	(24)	(22)	(22)	(25)	(24)	(24)	24	24	(24)	(24)	(24)	(22)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(22)	(26)	(24)	(24)	(24)	(24)	(22)
16	(25)	(25)	24	(24)	(23)	24	(24)	24	(23)	(24)	24	(24)	(24)	(24)	(24)	(22)	(20)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(22)	(24)
17	(24)	(23)	(18)	(24)	(23)	24	24	(23)	(24)	(24)	(24)	(22)	(18)	24	(23)	(24)	(22)	(24)	(22)	(23)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(20)
18	(24)	(22)	(22)	(25)	(23)	(21)	24	(24)	(24)	(24)	(25)	(23)	(0)	(25)	(22)	(22)	(19)	(25)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(22)	(22)	(21)
19	(26)	(23)	(23)	(26)	(23)	(23)	24	(23)	(24)	(25)	(25)	(23)	(0)	24	(23)	(24)	24	(24)	(24)	(24)	(24)	(24)	(22)	(24)	(22)	(24)	(24)	(24)	24
20	(23)	24	(22)	(25)	(23)	24	(24)	(24)	(24)	(24)	(24)	(25)	(0)	24	(24)	(23)	(28)	(24)	(24)	(24)	(24)	(24)	(23)	(23)	(24)	(23)	(23)	(23)	(22)
21	24	(24)	(24)	(24)	(23)	24	(24)	(24)	(24)	(25)	(25)	(22)	(11)	24	(24)	(24)	(22)	(24)	24	(25)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	(24)	(24)
22	(24)	(19)	(24)	(24)	(15)	24	(25)	(25)	(24)	(20)	24	(24)	(24)	(24)	(26)	(21)	(24)	(23)	(24)	(24)	(26)	(24)	(23)	(24)	(26)	(24)	(23)	(21)	(24)
23	(24)	(21)	(26)	(20)	(23)	24	24	(24)	(25)	24	(24)	24	(24)	(22)	(22)	(22)	(26)	(24)	(24)	(24)	(26)	(20)	(24)	(24)	(24)	(22)	(22)	(24)	(24)
24	(24)	(23)	(22)	(26)	(23)	(24)	(23)	(25)	(24)	(24)	(24)	24	(25)	24	24	(25)	(24)	(23)	(23)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(18)	(25)	(21)
25	(25)	(24)	(21)	(24)	(22)	(25)	24	(24)	(24)	(23)	24	(24)	(21)	24	(21)	(24)	(26)	(24)	(24)	(24)	(24)	(23)	(22)	(24)	(24)	(23)	(19)	(24)	(23)
26	(25)	(23)	(24)	(24)	(21)	(27)	(23)	(24)	(24)	24	24	(24)	24	24	24	(24)	(22)	(24)	(24)	(24)	(21)	(24)	(24)	(22)	(23)	(17)	(24)	(24)	
27	24	(19)	24	(25)	(21)	(24)	(24)	(24)	(24)	(24)	(24)	24	(24)	24	(20)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(21)	(27)	(22)	(21)	(22)	(24)	(24)
28	(24)	24	24	(23)	(23)	24	(24)	(24)	(25)	(24)	(24)	(24)	24	(24)	(24)	(23)	(18)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(23)
29	(25)	24	24	(20)	(23)	(23)	(24)	(24)	(24)		24	(25)	(26)	(26)	(20)	(24)	(23)	(24)	(24)	(24)		(23)	(24)	(21)	(22)	(21)	(24)	(24)	
30	(24)	(24)	24	(25)	(23)	(24)	(25)	(24)	(24)		24	(24)	(24)	(25)	(22)	(24)	(22)	(24)	(24)	(22)	(24)		(24)	(24)	(24)	(22)	(24)	(24)	(24)
31	(24)		(22)	(24)		(24)		(24)	(24)		(25)		24		24	(21)		(24)		(24)	(25)		(24)		(24)		(24)		(21)
%	(101)	(97)	(97)	(98)	(92)	(99)	(100)	(99)	100	(99)	(101)	(99)	(87)	100	(96)	(97)	(94)	(98)	(92)	(99)	(100)	(99)	(97)	(101)	(98)	(98)	(94)	(97)	(94)

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Meteo data report, height: 80.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	10/99	11/99	12/99	01/00	02/00	03/00	04/00	05/00	06/00	07/00	08/00	09/00	10/00	11/00	12/00	01/01	02/01	03/01	04/01	05/01	06/01	07/01	08/01	09/01	10/01	11/01	12/01	01/02	02/02
1	(18)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(21)	(24)	24	24	(24)	(22)	(24)	
2	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(25)	(20)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	(25)	24	(24)
3	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(21)	(23)	(23)	(25)	(24)	(24)	(24)	(21)	(24)	(24)	(22)	(24)	(25)	(24)	24	24	24	24	(24)
4	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(23)	(19)	(24)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	24	(24)	24	(24)
5	(23)	(23)	(24)	(24)	(24)	(24)	24	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(26)	(24)	(23)	(24)	(24)	24	(24)	(25)	24
6	(22)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(21)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(21)	(23)	(24)	24	(23)	(24)	(25)	24
7	(24)	(24)	(19)	(24)	(23)	(24)	(24)	(24)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(21)	(23)	24	24	(26)	(24)	(25)
8	(24)	(24)	(13)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(23)	(25)	24	(24)	(24)	24	(24)	
9	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(22)	(24)	(22)	(26)	24	24	24	24	24
10	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(23)	(24)	(23)	(23)	(27)	(24)	(25)	(24)	(23)	(22)	(24)	(26)	(24)	(24)	(24)	(24)	(24)	(24)	24	24	24	(24)
11	(25)	(24)	(23)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(22)	(24)	(22)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(22)	(21)	(24)	24	(23)	24	(24)
12	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(22)	(19)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(21)	(24)	24	(24)	(24)	24
13	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	(20)	(22)	(18)	(24)	(24)	(24)	(26)	(24)	(25)	(24)	(21)	(24)	(20)	(24)	(24)	(27)	24	(24)	24	24
14	(23)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(25)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	24	(24)	(24)	(24)	24
15	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(22)	(24)	(22)	(24)	(24)	(23)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(19)	(20)	(24)	(25)	24	(24)	(24)	(24)
16	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(21)	(22)	(19)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(23)	(24)	(24)	(24)	(24)	24
17	(24)	(24)	(23)	(24)	(24)	(24)	(25)	(24)	(23)	(24)	(26)	(24)	(24)	(24)	(26)	(24)	(24)	(24)	(24)	(24)	(20)	(23)	(22)	(23)	(23)	(22)	(24)	(24)	(23)
18	(21)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(23)	(19)	(23)	(22)	(22)	(24)	(25)	(25)	(24)	(23)	(23)	(23)	(24)	(23)	(20)	(22)	24	24	(24)	(23)	24
19	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	24	(23)	(24)	(23)	(24)	(24)	(24)	24	(24)	(24)	(25)	(24)
20	(24)	(23)	(24)	(24)	(24)	(26)	(26)	(23)	(26)	(22)	24	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(23)	(23)	(24)	(22)	(23)	24	(24)	(25)
21	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(22)	(25)	(22)	(24)	(20)	(24)	(24)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(24)	(24)	24	24	(24)	(24)	(24)
22	(24)	(24)	(24)	(24)	24	(22)	(23)	(24)	(24)	(18)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(22)	(24)	24	(24)	(24)	24
23	(24)	(24)	(24)	(24)	(24)	(24)	(25)	(24)	(24)	24	(24)	(23)	(24)	(24)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	(22)	(24)	(23)	(24)	(24)	(24)	(24)	24
24	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(24)	(21)	(17)	24	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(21)	(21)	(25)	(24)	(23)	(24)	(24)	(24)	24
25	(24)	(24)	(25)	(26)	(24)	(24)	(24)	(23)	(21)	(23)	(23)	(25)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(24)	(20)	(24)	(23)	(24)	(23)	(24)	(24)	24	(24)
26	(24)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(23)	(22)	(21)	(24)	(24)	(24)	(24)	(25)	(24)	(23)	(24)	(24)	(24)	(24)	(23)	(24)	24	(24)	(24)	24	(24)
27	(24)	(22)	(24)	(24)	(24)	(21)	(27)	(24)	(24)	(22)	24	(24)	(22)	(24)	(24)	(24)	(20)	(24)	(24)	(24)	(20)	(24)	(26)	(22)	24	(24)	(24)	24	(24)
28	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(26)	(23)	(23)	(24)	(21)	(24)	(18)	(24)	(25)	(24)	(24)	(24)	(21)	(19)	(24)	(24)	24	(25)	(24)	24	24	24
29	(24)	(24)	(24)	(25)	(24)	(22)	(24)	(22)	(25)	(22)	(23)	(23)	(24)	(24)	(25)	(24)		(23)	(24)	(22)	(23)	(25)	(24)	24	24	(24)	(25)	(24)	
30	(24)	(23)	(24)	(26)		(24)	(20)	(24)	(21)	(24)	24	(24)	(24)	(24)	(24)		(21)	(24)	(24)	(23)	(22)	(24)	(23)	(23)	(24)	(24)	(24)	(24)	
31	(23)		(23)	(24)		(19)		(24)		(22)	(22)		(22)		(24)	(24)		(24)		(24)		(18)	(24)		(24)		(24)	(22)	
%	(98)	(99)	(98)	(101)	(100)	(99)	(99)	(99)	(99)	(95)	(95)	(96)	(99)	(99)	(101)	(101)	(100)	(98)	100	(99)	(96)	(95)	(97)	(98)	(100)	(100)	(100)	(100)	(100)

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V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\06_2003-04 mph.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\2005-2006 MPH.csv
V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

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US-GRAND FORKS, ND 58201
+1 701 775 5507
Jay Haley
Calculated:
10/12/2007 9:53 AM/

Meteo data report, height: 80.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	03/02	04/02	05/02	06/02	07/02	08/02	09/02	10/02	11/02	12/02	01/03	02/03	03/03	04/03	05/03	06/03	07/03	08/03	09/03	10/03	11/03	12/03	01/04	02/04	03/04	04/04	05/04	06/04	07/04	
1	24	24	(26)	(24)	24	24	(22)	24	24	24	(24)	(24)	(24)	24	(24)	(19)	(22)	(23)	(24)	(25)	(22)	24	(24)	24	(24)	(24)	(24)	24	(23)	
2	(25)	(24)	(24)	24	(22)	(22)	24	(25)	24	(24)	(25)	(24)	(25)	24	(24)	24	(22)	(24)	(24)	(20)	(23)	24	(24)	(25)	(24)	(24)	(24)	24	(24)	
3	(24)	(24)	(21)	24	(23)	(22)	(24)	(23)	(24)	24	(24)	(25)	(24)	24	(23)	(24)	(24)	(24)	(22)	(24)	(24)	(24)	(24)	(24)	(24)	(23)	(22)	24	(24)	
4	(24)	(23)	(22)	(24)	(19)	(23)	(22)	(24)	(24)	24	(24)	(24)	(24)	(24)	(24)	24	24	(20)	24	(24)	(24)	(24)	(24)	(17)	(24)	24	(24)	24	(24)	
5	24	(24)	24	(27)	24	(24)	(23)	(19)	(26)	(24)	(24)	24	(24)	24	24	24	(24)	(19)	(19)	(20)	(24)	(24)	(26)	(24)	(24)	(20)	(24)	(23)	(24)	
6	24	24	(23)	(24)	24	24	(21)	(24)	(24)	24	(24)	(24)	(23)	(24)	(23)	(24)	(24)	(22)	24	(22)	(24)	24	(24)	(24)	(24)	24	24	24	(24)	
7	(24)	24	(24)	(22)	(21)	24	24	(22)	(24)	24	24	(24)	(24)	(25)	(25)	(20)	24	(21)	(19)	(22)	24	(24)	24	(24)	24	(22)	(24)	(24)	(24)	
8	24	(25)	(24)	(20)	(23)	24	(20)	24	24	24	24	(24)	(25)	(24)	(25)	(24)	(25)	24	(23)	(22)	24	(24)	(24)	(24)	24	24	(24)	(22)	(24)	
9	(23)	(24)	(24)	(25)	24	(22)	(20)	(22)	(24)	(22)	24	(21)	(24)	(24)	(24)	24	(21)	(24)	(23)	24	24	(25)	(24)	(24)	(24)	(22)	24	24	(24)	
10	(18)	(24)	(23)	(24)	(24)	(23)	(24)	24	(24)	24	(24)	(24)	(22)	24	(25)	(24)	(24)	(21)	(19)	(22)	(25)	(27)	24	(24)	24	(22)	24	(26)	(24)	
11	(10)	24	(25)	(24)	24	24	24	(24)	(24)	(22)	24	(24)	24	(18)	(24)	(23)	24	(24)	(24)	(23)	(26)	(24)	24	24	(24)	(23)	(24)	(25)	(24)	
12	(23)	(24)	(26)	(23)	(24)	24	(22)	(24)	(24)	(24)	24	24	(24)	24	(23)	24	(24)	(23)	(24)	(24)	(25)	(23)	(24)	(24)	(24)	24	(24)	(23)	(24)	
13	(23)	(24)	(24)	(24)	24	(24)	(23)	24	24	(24)	24	24	(25)	(23)	(23)	(24)	(20)	(24)	(24)	(23)	24	(24)	(24)	(24)	24	24	(24)	(25)	(24)	(26)
14	(24)	(24)	(25)	(24)	(20)	(23)	24	24	(24)	(24)	(24)	(24)	(24)	24	(24)	(24)	(21)	(22)	(22)	(24)	(24)	(24)	(24)	24	(24)	(23)	(24)	(23)	24	
15	(24)	24	(24)	(24)	(18)	(25)	(25)	24	(24)	24	(23)	(24)	(24)	24	(24)	24	(24)	(22)	24	24	(24)	(24)	(21)	(24)	(24)	24	(24)	(24)	(23)	
16	(24)	24	(25)	24	(21)	(24)	(20)	(22)	24	(24)	(24)	(24)	(24)	24	(24)	24	(22)	(24)	(22)	(23)	(25)	(24)	24	24	(24)	(24)	(23)	(24)	(22)	
17	(22)	24	(24)	24	(20)	(24)	(24)	24	(23)	(24)	24	(24)	(24)	(25)	(24)	(23)	(23)	(24)	24	(22)	(24)	(24)	(24)	(24)	(24)	24	(24)	(24)	(24)	
18	(24)	24	24	24	(21)	(23)	(24)	(25)	(24)	(24)	(25)	(24)	24	(21)	(24)	(23)	(24)	(23)	(19)	24	(25)	(26)	(23)	(24)	(24)	24	(28)	(24)	(25)	
19	(25)	(26)	(24)	24	(24)	(26)	(24)	(24)	(24)	(24)	24	(24)	(26)	(24)	(24)	(25)	(19)	(22)	(24)	24	24	(24)	(24)	24	24	24	(24)	24	(23)	
20	(24)	(24)	24	24	(21)	(24)	(25)	(23)	24	24	24	24	(26)	(24)	(25)	(23)	(25)	(22)	(18)	24	24	24	24	24	(24)	(24)	(24)	(20)	24	
21	(24)	(23)	(21)	(22)	(24)	(24)	(22)	(23)	(24)	24	24	(24)	(25)	(24)	24	(18)	(25)	24	24	24	24	24	24	(24)	24	(24)	24	(24)	(24)	
22	24	(24)	24	(22)	(25)	(24)	(21)	(24)	24	(24)	24	(24)	(22)	24	24	(23)	(24)	24	(26)	(24)	(24)	(24)	24	(24)	(19)	(24)	(25)	(23)	(24)	
23	24	(24)	24	(23)	(24)	(24)	(20)	(24)	24	24	(23)	(22)	24	24	24	24	(24)	24	(22)	(26)	(24)	24	(24)	(23)	(24)	(24)	(24)	(23)	(24)	
24	(24)	(24)	(24)	(24)	(24)	(25)	(21)	24	(22)	(24)	24	(24)	24	(24)	(19)	24	(21)	(19)	(24)	24	(24)	(24)	(24)	(24)	24	(24)	(24)	(25)	(24)	24
25	(23)	24	(24)	(24)	24	(21)	(22)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	24	(24)	(23)	(22)	(22)	(25)	24	(23)	(25)	(24)	(24)	(24)	(24)	(24)	24	
26	(24)	(21)	(19)	24	(24)	(24)	(21)	(24)	(25)	(24)	(23)	24	24	24	(23)	(25)	24	(22)	(25)	(24)	(24)	24	(24)	24	(26)	24	(22)	24	24	
27	(24)	(25)	(21)	(24)	(24)	24	(24)	(24)	(24)	(24)	24	24	24	24	24	24	(24)	(23)	(24)	(24)	(24)	24	(24)	(23)	(25)	24	(25)	24	(20)	
28	(24)	(24)	(24)	(20)	(24)	24	(20)	(24)	24	(24)	(25)	24	(24)	24	(25)	24	(20)	24	(24)	(24)	(25)	(24)	(24)	(23)	(24)	24	(22)	24	(22)	
29	(24)	(24)	24	(23)	(25)	24	(24)	(24)	24	24	(24)		(27)	(20)	(24)	(23)	(22)	(27)	24	24	(24)	(24)	24	24	(24)	24	24	(22)	(23)	
30	(24)	24	(24)	24	(22)	24	24	(24)	(24)	(24)	(24)		24	24	(24)	(23)	(18)	(24)	(23)	24	24	24	(24)	(24)	(24)	(24)	(24)	(20)	(24)	
31	(23)		(23)		(23)	(23)		(24)		24	(24)		24	(24)		(21)	(25)		(24)		24	24		(24)		(24)	(25)	(24)	(24)	
%	(97)	(100)	(98)	(98)	(95)	(99)	(94)	(98)	100	(99)	(100)	(99)	(100)	(98)	(99)	(97)	(95)	(96)	(95)	(97)	(101)	(101)	(100)	(99)	(100)	(98)	(100)	(98)	(99)	

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Description:
Data from file(s)
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Calculated:
10/12/2007 9:53 AM/

Meteo data report, height: 80.0 m

Name of meteo object: ASOS data- Hourly

Data from: 05/01/1997 1:53 AM Data to: 07/28/2006 2:53 AM Observations: 97849 Observations per day: 24 Recovery rate: 121%

day	08/04	09/04	10/04	11/04	12/04	01/05	02/05	03/05	04/05	05/05	06/05	07/05	08/05	09/05	10/05	11/05	12/05	01/06	02/06	03/06	04/06	05/06	06/06	07/06	08/06
1	(25)	(22)	24	(25)	(24)	(24)	(24)	(24)	(24)	24	24	24	(22)	24	(23)	(24)	(24)	(24)	(24)	(25)	(24)	(28)	(24)	24	
2	(23)	24	(24)	(24)	(23)	(25)	(24)	24	(24)	24	(24)	(25)	(21)	(20)	(22)	(24)	(25)	24	(24)	(24)	(25)	(30)	(21)	(23)	
3	(24)	(21)	(23)	(24)	(24)	(25)	(24)	(22)	(23)	24	(23)	(21)	(21)	(19)	(24)	24	(24)	(24)	24	(25)	(24)	24	(23)	(23)	
4	(23)	(22)	24	(24)	24	(24)	(24)	(23)	24	(17)	(24)	(23)	(24)	(17)	(23)	24	(24)	(24)	(24)	(22)	24	(24)	(22)	(29)	
5	24	(24)	(23)	24	(24)	(24)	(23)	(24)	24	(21)	(24)	(22)	(20)	(20)	(24)	(24)	(24)	(24)	(24)	(26)	(23)	24	(21)	(23)	
6	(23)	(24)	24	24	(26)	(16)	24	24	(24)	24	(23)	(20)	(23)	(15)	(24)	(24)	(24)	24	(29)	(28)	(23)	(24)	(24)	(22)	
7	(22)	24	24	24	(24)	(25)	(24)	(24)	(24)	24	24	(23)	(19)	(21)	(24)	(25)	(23)	24	24	(24)	(24)	(21)	(22)	(20)	
8	(21)	24	(24)	(22)	(24)	(25)	(22)	24	(23)	24	(24)	(21)	(21)	(20)	24	(23)	(25)	24	24	(30)	(24)	(23)	(23)	(21)	
9	(24)	(22)	(23)	24	(24)	(24)	(18)	24	(21)	24	(22)	(21)	(21)	(21)	(22)	(24)	(24)	(23)	(32)	(23)	(25)	24	(23)	(23)	
10	24	(22)	24	24	(26)	(24)	(24)	(23)	24	24	(23)	(23)	(21)	(19)	(22)	(23)	(25)	(25)	(24)	(26)	24	(24)	(28)	(21)	
11	(24)	(21)	24	(24)	(24)	(24)	24	(24)	24	(24)	(24)	(24)	(21)	(18)	(21)	24	(24)	(24)	(25)	(28)	24	(24)	(27)	(29)	
12	24	(22)	(24)	24	(24)	(25)	24	24	(25)	(24)	(24)	(23)	(23)	(23)	(21)	(24)	(24)	(24)	(24)	(26)	24	(26)	(21)	(31)	
13	24	(24)	(25)	24	(24)	(24)	(24)	(20)	(24)	(24)	(25)	(25)	(26)	(23)	(20)	24	(24)	(24)	24	(30)	(24)	(25)	24	(23)	
14	(21)	(24)	(24)	24	24	(19)	(24)	24	24	(24)	(24)	(23)	(23)	(23)	(24)	(24)	(24)	(23)	24	(25)	(27)	(29)	(22)	(26)	
15	(23)	24	(24)	24	24	24	(24)	(21)	(22)	(24)	(24)	(23)	(23)	(23)	24	(25)	(24)	24	(25)	(20)	24	(29)	24	(24)	
16	(22)	(24)	24	(24)	24	(24)	(22)	(23)	24	(20)	(23)	(21)	(24)	(25)	24	(24)	(24)	(28)	(23)	(25)	(25)	24	24	(23)	
17	(24)	(24)	24	(24)	(22)	(23)	(24)	24	(20)	24	24	(23)	(22)	(19)	24	(24)	24	(25)	(25)	(24)	(26)	(26)	24	24	
18	(24)	24	(26)	(24)	(24)	24	(23)	24	(23)	24	24	(24)	(24)	(22)	(22)	24	(24)	(24)	24	(23)	(25)	24	(28)	(23)	
19	(24)	24	(24)	(25)	(24)	(24)	(24)	(24)	24	(24)	24	(23)	(24)	(25)	24	24	24	(24)	(23)	(23)	(21)	(22)	(25)	(24)	
20	(24)	(22)	(24)	(24)	24	(24)	(24)	(23)	(25)	(24)	(16)	(20)	24	(21)	(24)	(24)	24	(24)	24	24	24	(23)	(21)	(27)	
21	(20)	(21)	(24)	(24)	(24)	24	(24)	24	(25)	24	(23)	(24)	(23)	(21)	(24)	(24)	(25)	(22)	24	(28)	(21)	(24)	24	(28)	
22	(25)	(23)	(24)	(24)	24	(27)	(24)	(24)	(24)	24	(22)	(22)	(18)	(23)	24	24	(24)	24	(24)	24	(23)	(23)	(23)	(25)	
23	24	(23)	(24)	(24)	(24)	(24)	(23)	(24)	(24)	24	(23)	(22)	24	(25)	(24)	24	(24)	(24)	24	(23)	(24)	(20)	(23)	(22)	
24	(24)	(23)	24	(25)	24	24	(23)	(24)	24	(24)	24	(24)	24	(22)	(24)	(24)	(24)	(24)	24	(27)	(21)	(26)	(22)	24	
25	(24)	24	(23)	(22)	(24)	24	(24)	(24)	24	24	(20)	(21)	(21)	(22)	(24)	24	(24)	(24)	24	(25)	(24)	(25)	(21)	24	
26	(24)	24	(24)	24	(24)	(24)	24	(24)	(24)	24	(20)	(24)	(19)	(24)	24	(24)	(24)	24	(22)	(21)	(23)	(25)	(25)	(24)	
27	(24)	(23)	(24)	(25)	(24)	24	24	(24)	24	24	(23)	(23)	(25)	(18)	(22)	(24)	(24)	24	24	(27)	24	(23)	(24)	(25)	
28	(24)	(24)	(24)	(24)	24	24	(25)	24	24	24	(23)	(21)	(20)	(24)	(21)	(24)	(24)	(24)	24	(30)	(23)	24	(24)	(2)	
29	(24)	24	(24)	(24)	(24)	(24)		24	(24)	24	(21)	(19)	(21)	(21)	24	(24)	(24)	(24)		(28)	24	24	(23)		
30	(23)	(22)	(24)	(24)	(24)	(24)		(24)	24	(22)	(23)	(19)	(24)	(22)	24	(22)	(24)	(24)		(24)	(26)	(25)	(24)		
31	24		24		(24)	24		(24)		(23)		(17)	24		(26)		(24)	(24)		(25)		(26)			
%	(98)	(96)	(100)	100	(100)	(99)	(98)	(98)	(99)	(98)	(96)	(92)	(93)	(89)	(97)	(100)	(100)	(100)	(101)	(106)	(100)	(103)	(98)	(88)	(0)

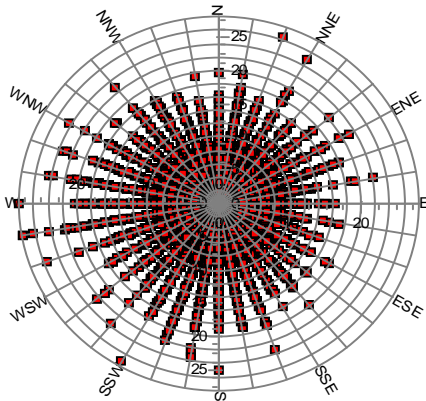
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southcampus windstudy

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Meteo data report, height: 80.0 m

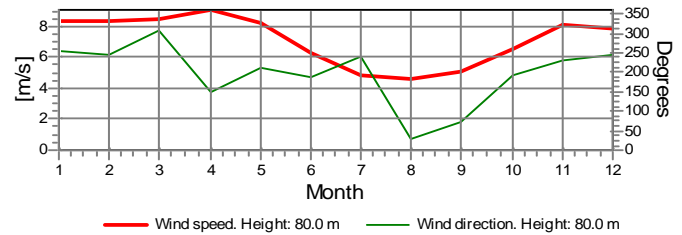
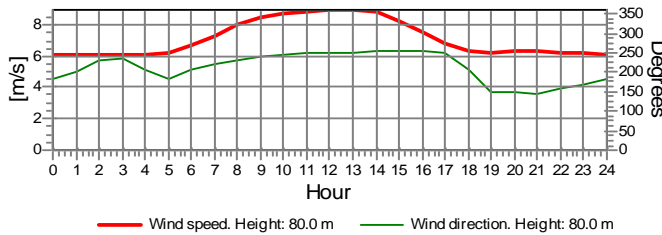
Name of meteo object: ASOS data- Hourly



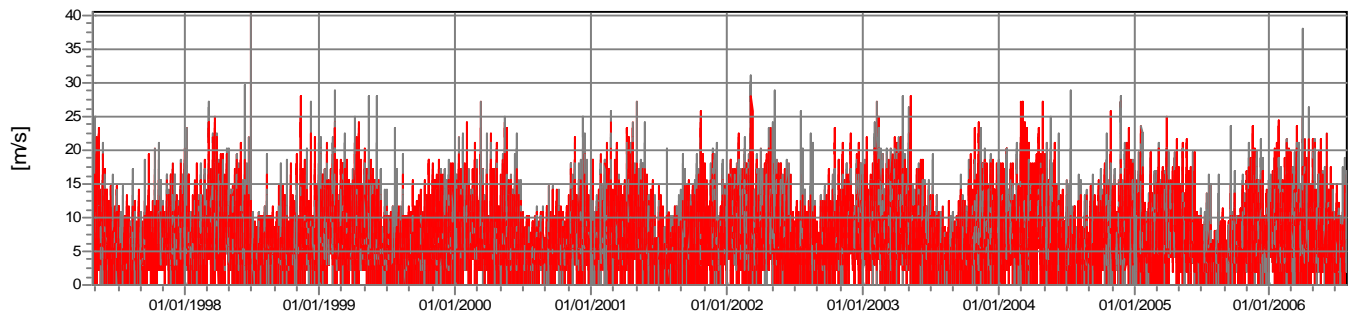
Wind speed [m/s]

Monthly mean values of wind speed in m/s

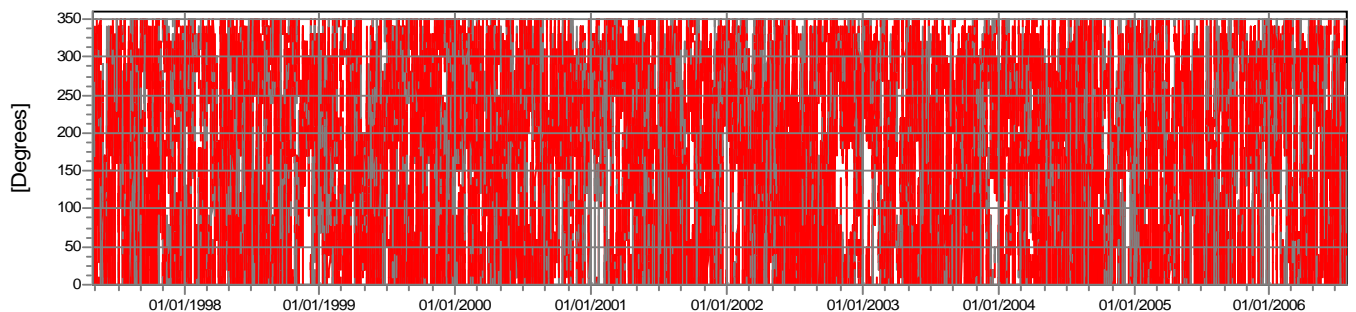
Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	mean	mean of months
Jan		7.4	9.4	8.6	7.3	8.2	8.3	8.7	8.0	9.0	8.3	8.3
Feb		7.4	9.1	8.6	8.3	9.1	8.5	8.4	7.5	8.0	8.3	8.3
Mar		9.5	8.1	8.0	7.6	8.8	8.1	9.0	8.6	8.5	8.5	8.5
Apr		8.5	9.5	8.5	9.7	8.7	9.6	9.4	9.0	8.4	9.0	9.0
May		9.1	7.3	8.1	8.4	8.0	8.0	8.5	8.6	7.9	7.5	8.1
Jun		6.8	7.1	5.9	6.7	5.6	6.1	6.1	5.9	6.2	6.1	6.3
Jul		5.3	4.4	4.9	4.3	4.2	5.3	4.9	5.1	4.4	5.4	4.8
Aug		4.8	4.7	4.7	4.9	3.4	5.6	4.3	4.9	3.9	4.6	4.6
Sep		5.1	4.8	5.3	5.6	4.6	5.1	4.5	5.4	4.7	5.0	5.0
Oct		6.8	6.2	6.5	6.0	7.3	6.5	6.0	7.4	5.8	6.5	6.5
Nov		7.5	8.5	7.4	7.8	7.6	8.2	8.5	7.6	9.2	8.0	8.0
Dec		7.6	6.9	7.9	8.1	7.6	8.5	8.1	8.6	7.3	7.8	7.8
mean, all data		6.6	6.9	7.2	7.1	6.8	7.3	7.1	7.4	6.9	7.6	7.1
mean of months		6.6	6.9	7.2	7.1	6.8	7.3	7.1	7.4	6.9	7.5	7.1



Wind speed



Wind direction



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Data from file(s)
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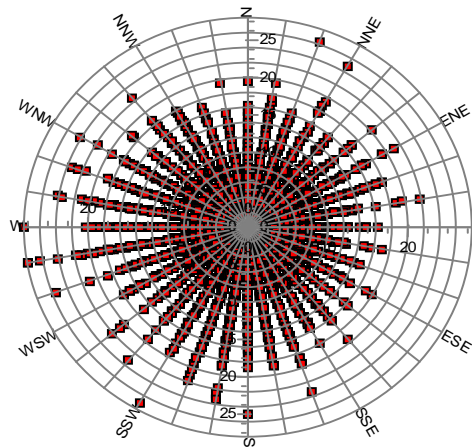
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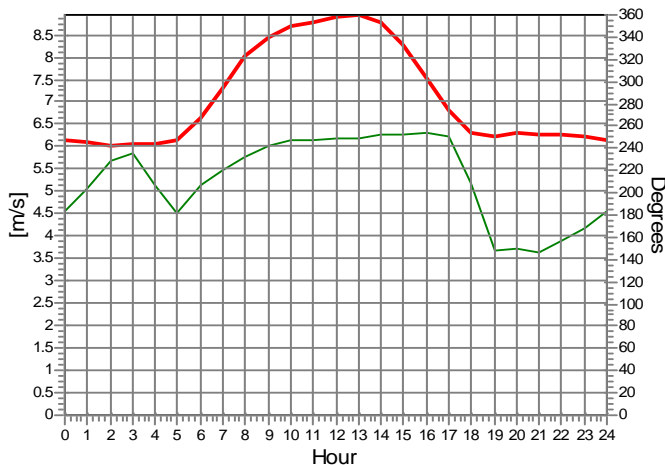
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Monthly mean values of wind speed in m/s

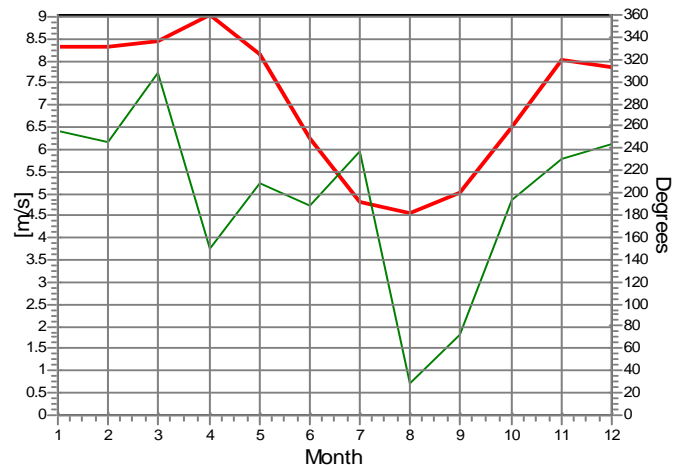
Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	mean	mean of months
Jan		7.4	9.4	8.6	7.3	8.2	8.3	8.7	8.0	9.0	8.3	8.3
Feb		7.4	9.1	8.6	8.3	9.1	8.5	8.4	7.5	8.0	8.3	8.3
Mar		9.5	8.1	8.0	7.6	8.8	8.1	9.0	8.6	8.5	8.5	8.5
Apr		8.5	9.5	8.5	9.7	8.7	9.6	9.4	9.0	8.4	9.0	9.0
May	9.1	7.3	8.1	8.4	8.0	8.0	8.5	8.6	7.9	7.5	8.1	8.1
Jun	6.8	7.1	5.9	6.7	5.6	6.1	6.1	5.9	6.2	6.1	6.3	6.3
Jul	5.3	4.4	4.9	4.3	4.2	5.3	4.9	5.1	4.4	5.4	4.8	4.8
Aug	4.8	4.7	4.7	4.9	3.4	5.6	4.3	4.9	3.9		4.6	4.6
Sep	5.1	4.8	5.3	5.6	4.6	5.1	4.5	5.4	4.7		5.0	5.0
Oct	6.8	6.2	6.5	6.0	7.3	6.5	6.0	7.4	5.8		6.5	6.5
Nov	7.5	8.5	7.4	7.8	7.6	8.2	8.5	7.6	9.2		8.0	8.0
Dec	7.6	6.9	7.9	8.1	7.6	8.5	8.1	8.6	7.3		7.8	7.8
mean, all data	6.6	6.9	7.2	7.1	6.8	7.3	7.1	7.4	6.9	7.6	7.1	
mean of months	6.6	6.9	7.2	7.1	6.8	7.3	7.1	7.4	6.9	7.5		7.1



Wind speed [m/s]



— Wind speed. Height: 80.0 m — Wind direction. Height: 80.0 m



— Wind speed. Height: 80.0 m — Wind direction. Height: 80.0 m

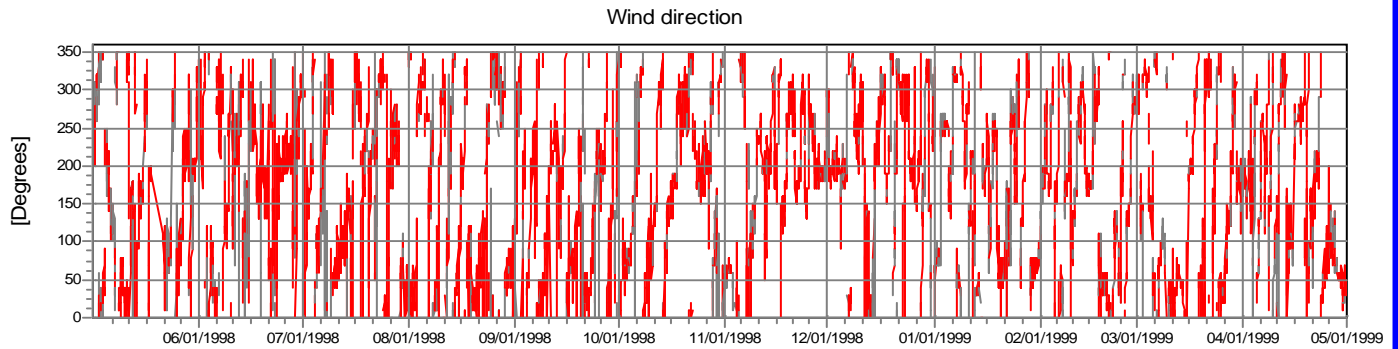
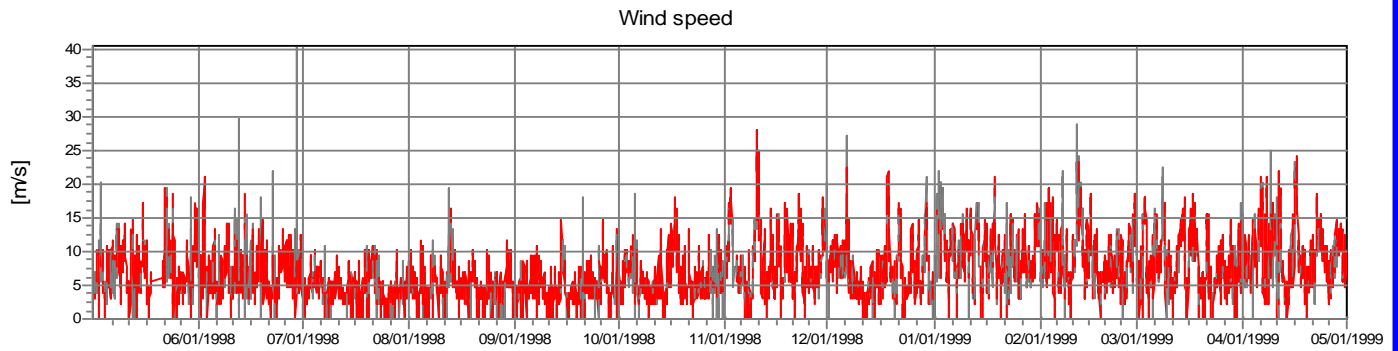
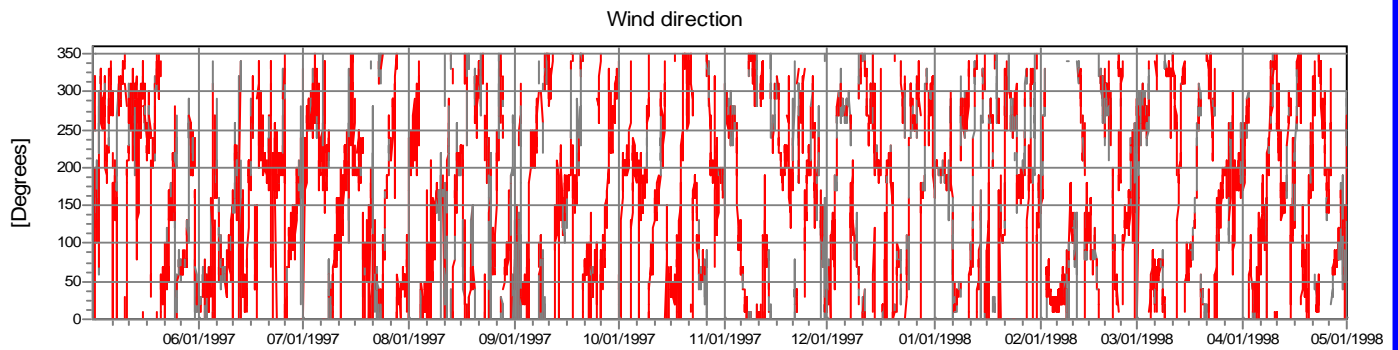
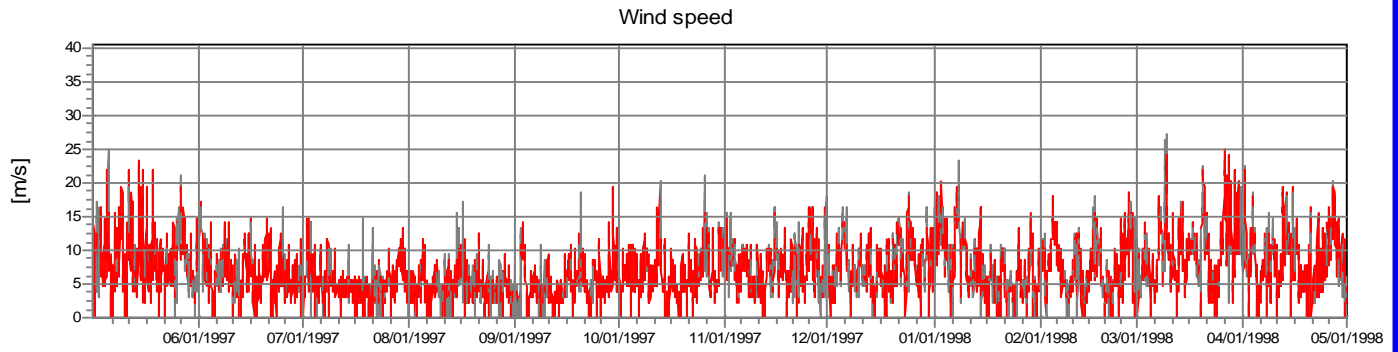
Project:
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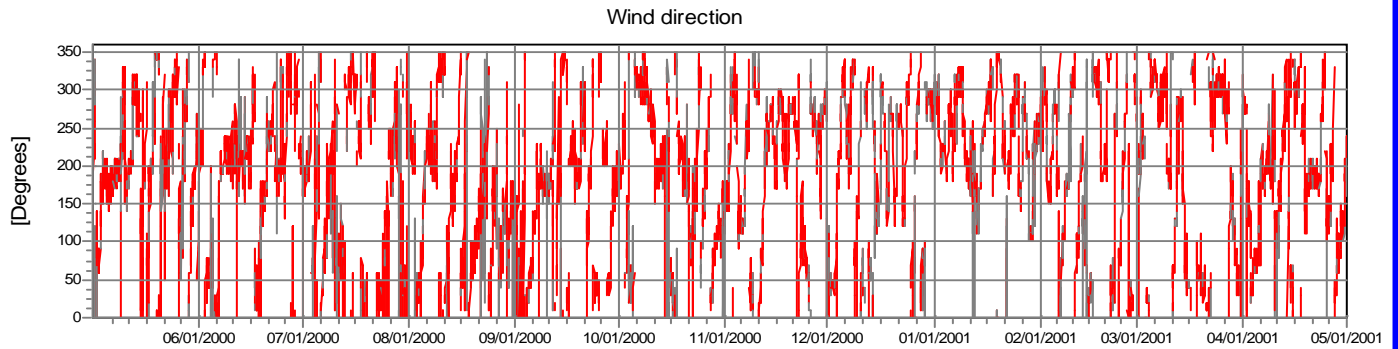
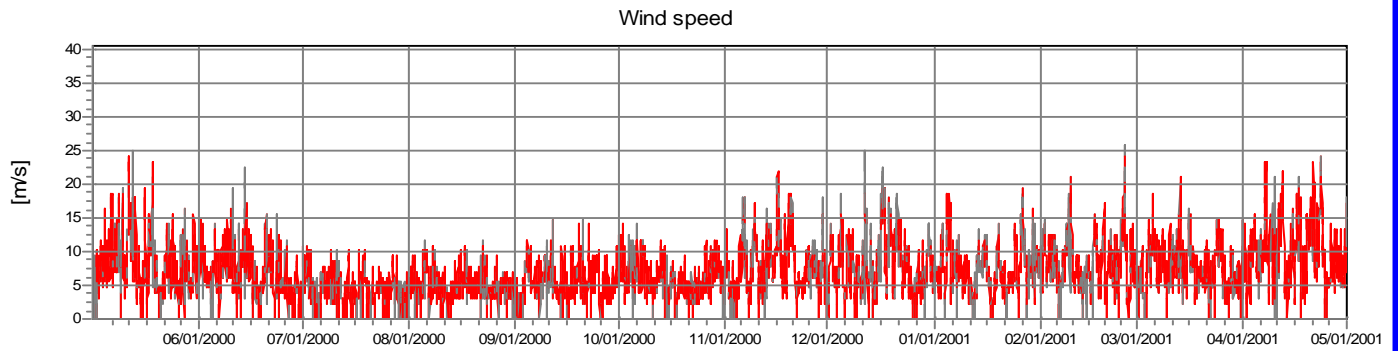
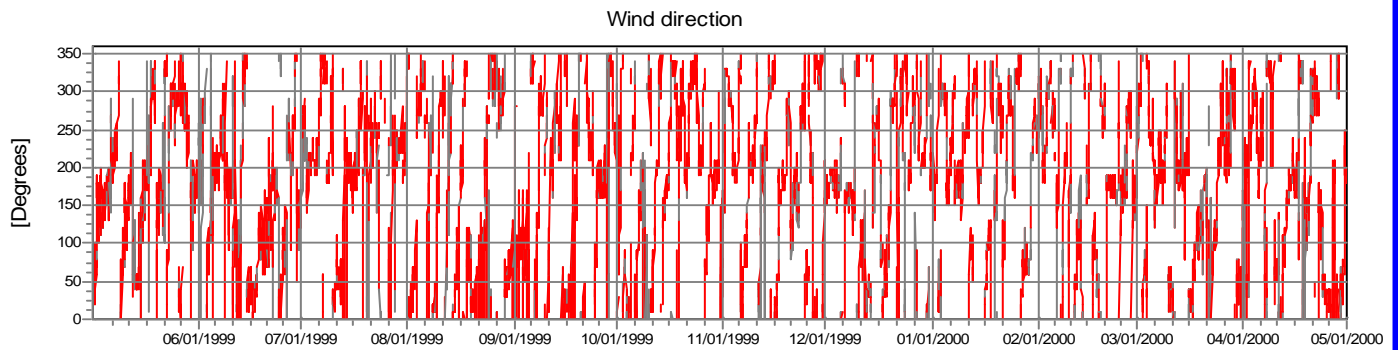
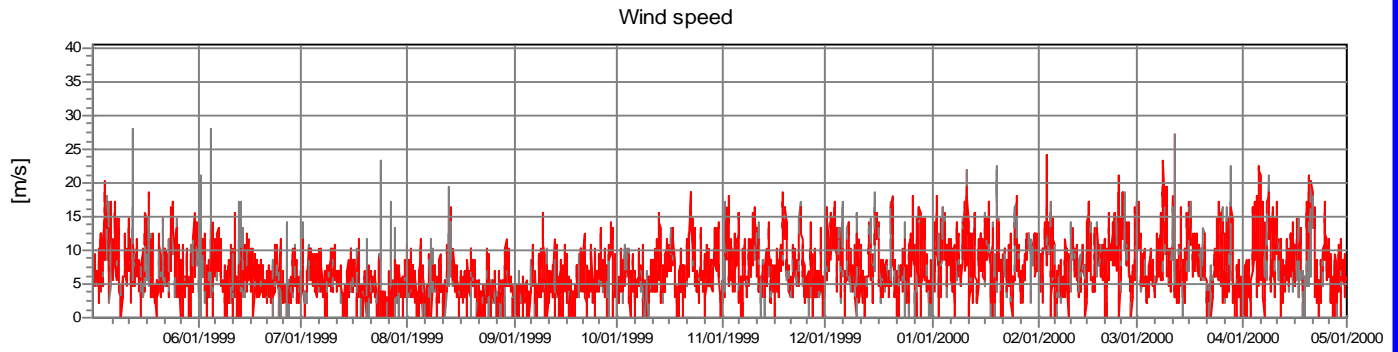
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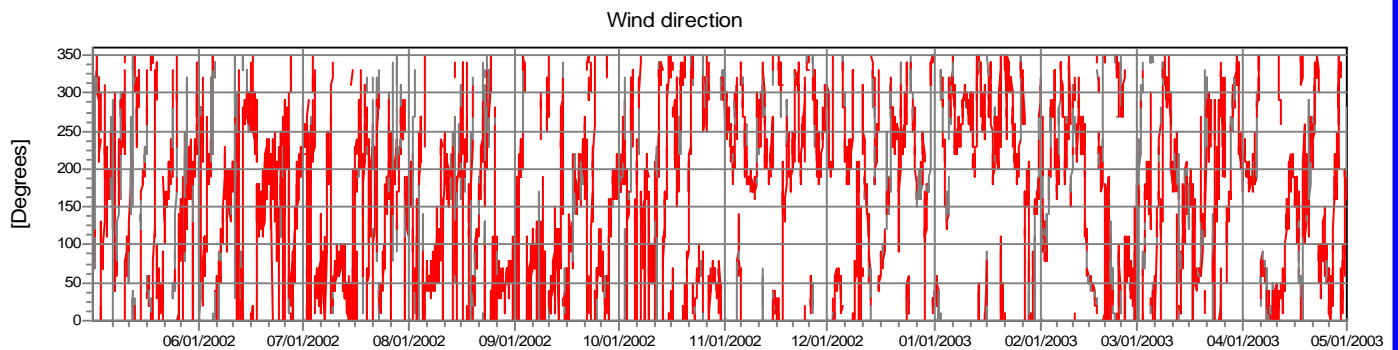
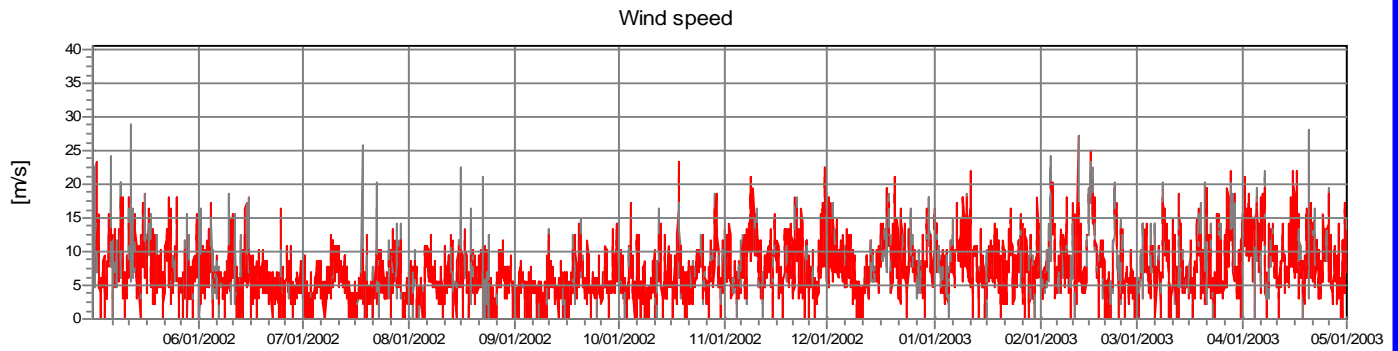
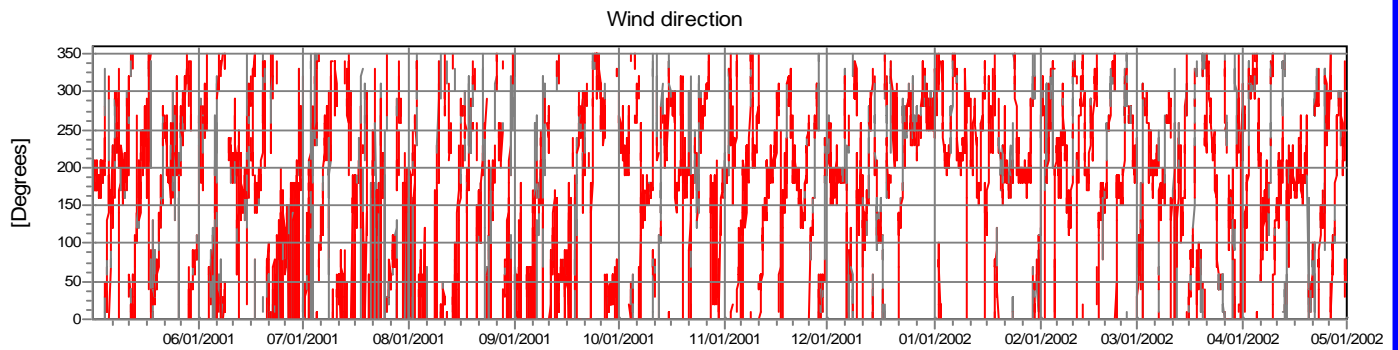
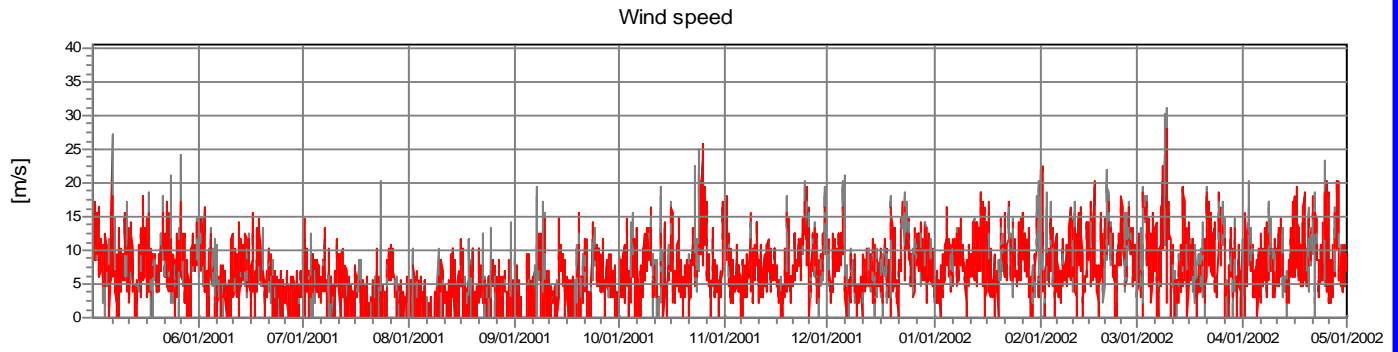
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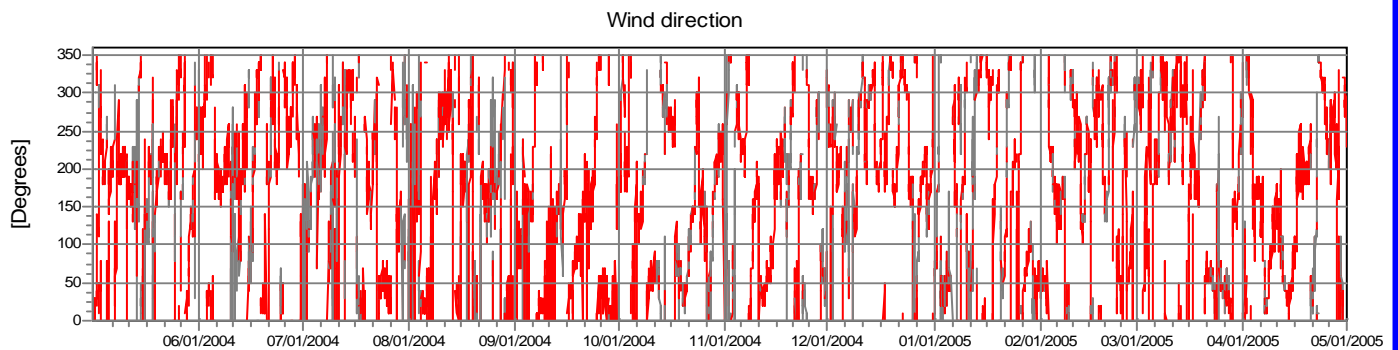
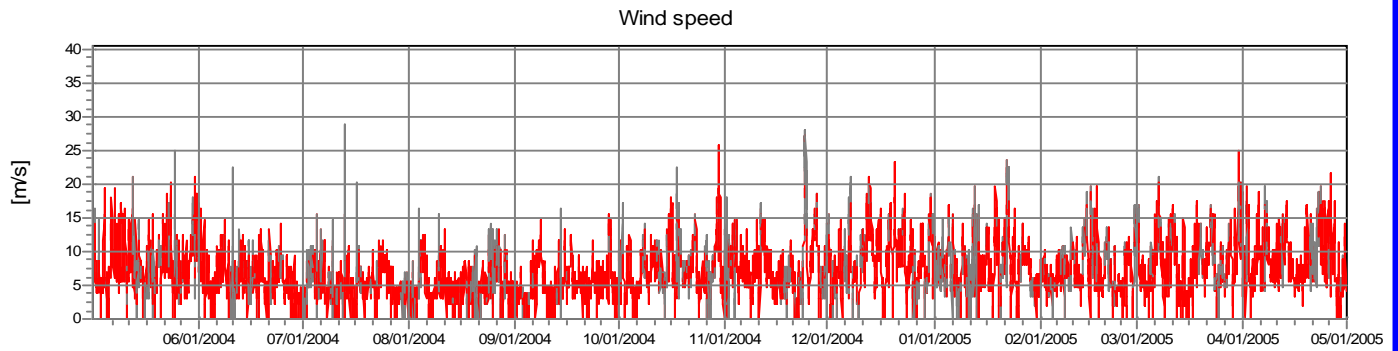
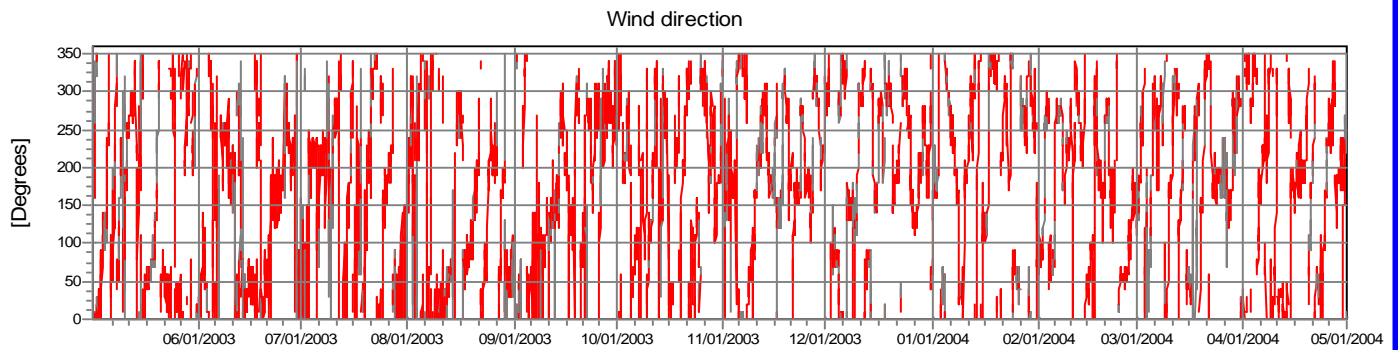
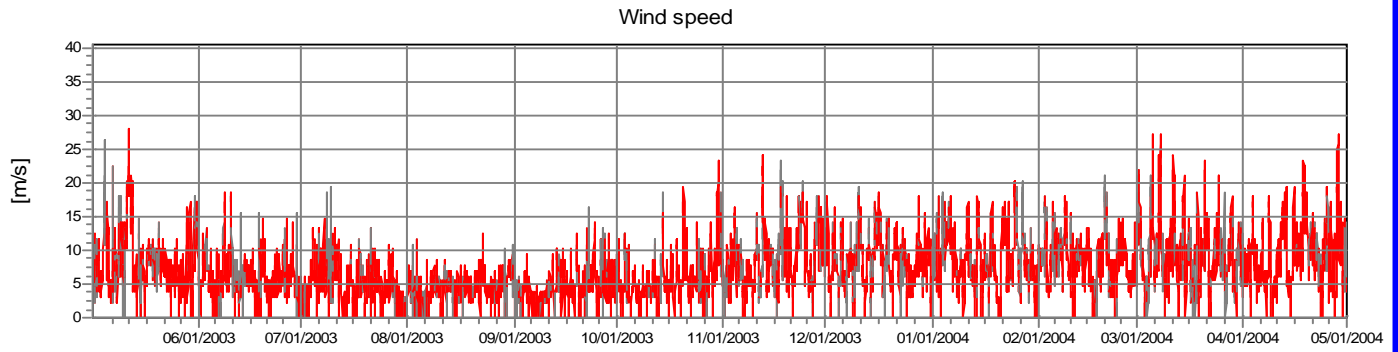
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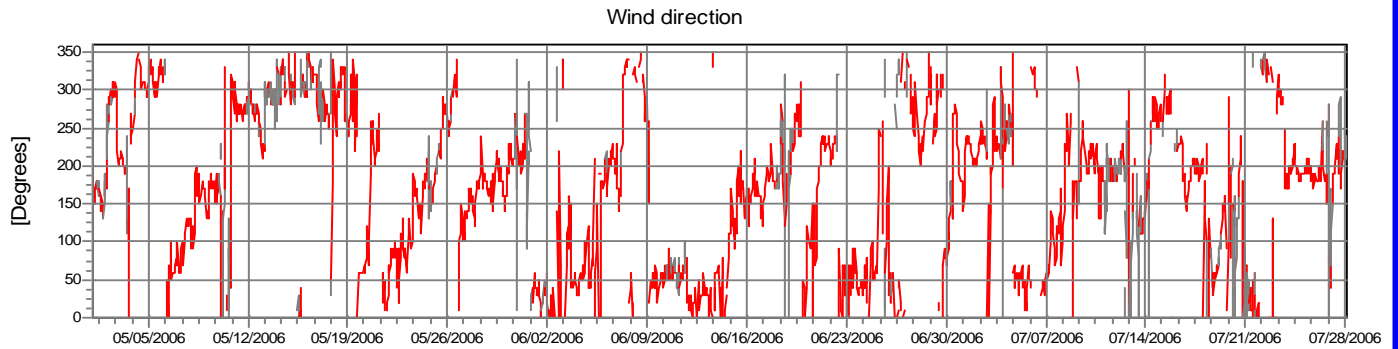
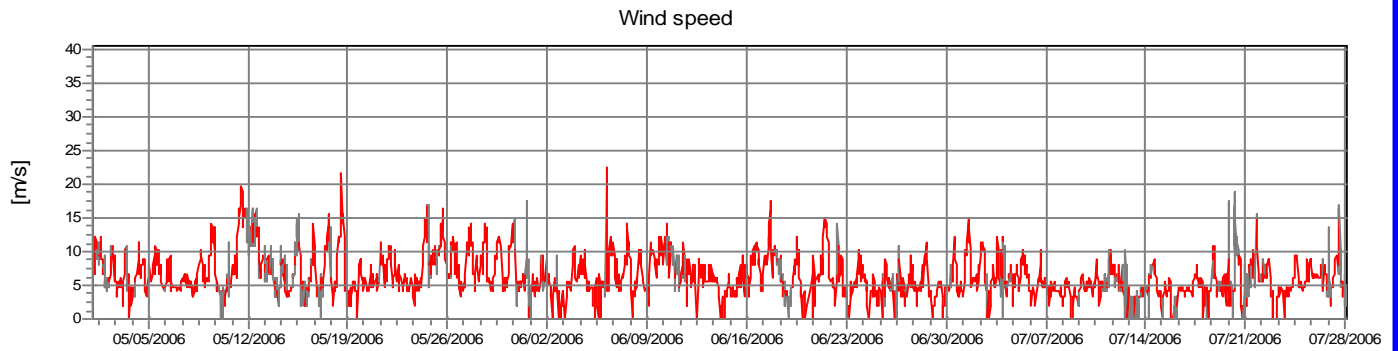
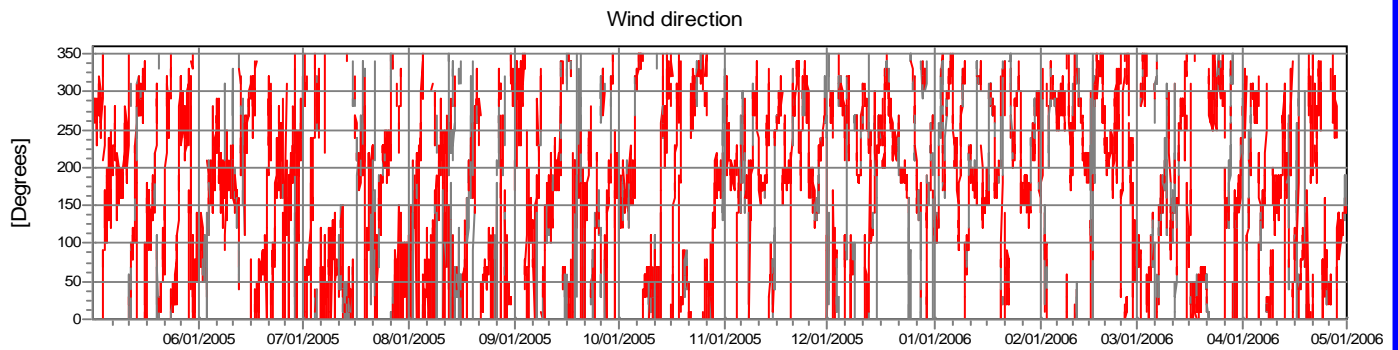
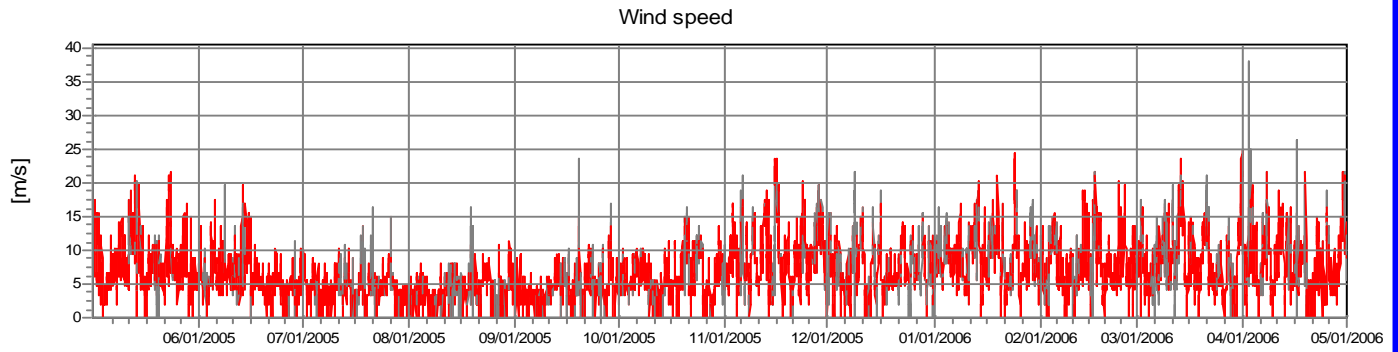
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Name of meteo object: ASOS data- Hourly

Frequency

Wind speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
0.00 - 0.49	3,665	3,665	0	0	0	0	0	0	0	0	0	0	0
0.50 - 1.49	0	0	0	0	0	0	0	0	0	0	0	0	0
1.50 - 2.49	3,088	223	163	260	301	266	267	237	254	266	303	287	261
2.50 - 3.49	5,352	326	281	468	587	562	517	424	437	437	474	459	380
3.50 - 4.49	7,211	428	438	729	736	673	679	665	693	662	568	535	405
4.50 - 5.49	15,430	912	1,116	1,711	1,187	1,088	1,302	1,739	1,749	1,265	1,170	1,167	1,024
5.50 - 6.49	6,795	474	534	721	424	383	538	922	788	534	530	537	410
6.50 - 7.49	5,972	382	503	648	340	301	468	831	735	449	462	476	377
7.50 - 8.49	5,269	324	462	530	304	267	374	774	612	404	436	428	354
8.50 - 9.49	8,673	528	665	791	429	374	629	1,297	1,097	664	721	821	657
9.50 - 10.49	3,561	197	246	289	178	138	269	595	418	267	334	354	276
10.50 - 11.49	2,990	137	183	238	137	99	215	510	376	198	306	327	264
11.50 - 12.49	4,473	179	251	301	200	148	286	767	566	349	555	519	352
12.50 - 13.49	1,325	47	77	94	45	29	82	262	184	110	137	153	105
13.50 - 14.49	1,593	59	81	102	53	40	101	293	183	125	229	220	107
14.50 - 15.49	1,043	41	46	61	36	20	61	169	135	82	173	138	81
15.50 - 16.49	1,439	56	72	73	33	28	79	250	154	115	269	199	111
16.50 - 17.49	469	17	21	34	13	7	19	73	49	46	83	65	42
17.50 - 18.49	343	8	17	20	9	6	21	50	47	26	74	43	22
18.50 - 19.49	249	8	10	16	4	0	11	35	30	27	61	32	15
19.50 - 20.49	281	8	11	18	3	2	10	40	31	29	82	37	10
20.50 - 21.49	77	0	0	2	0	0	5	12	14	9	17	14	4
21.50 - 22.49	87	2	3	3	1	1	3	17	12	15	18	9	3
22.50 - 23.49	62	0	3	1	0	1	3	13	14	4	10	7	6
23.50 - 24.49	28	0	0	0	0	0	0	3	3	6	11	3	2
24.50 - 25.49	11	0	2	1	0	0	0	3	2	3	0	0	0
25.50 - 26.49	7	0	0	0	0	0	0	2	0	1	4	0	0
26.50 - 27.49	13	0	3	0	0	1	0	2	1	1	4	1	0
27.50 - 28.49	7	0	1	0	0	0	0	0	0	1	5	0	0
28.50 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.50 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
30.50 - 31.49	0	0	0	0	0	0	0	0	0	0	0	0	0
31.50 - 32.49	0	0	0	0	0	0	0	0	0	0	0	0	0
32.50 - 33.49	0	0	0	0	0	0	0	0	0	0	0	0	0
33.50 - 34.49	1	0	0	0	0	0	0	0	0	1	0	0	0
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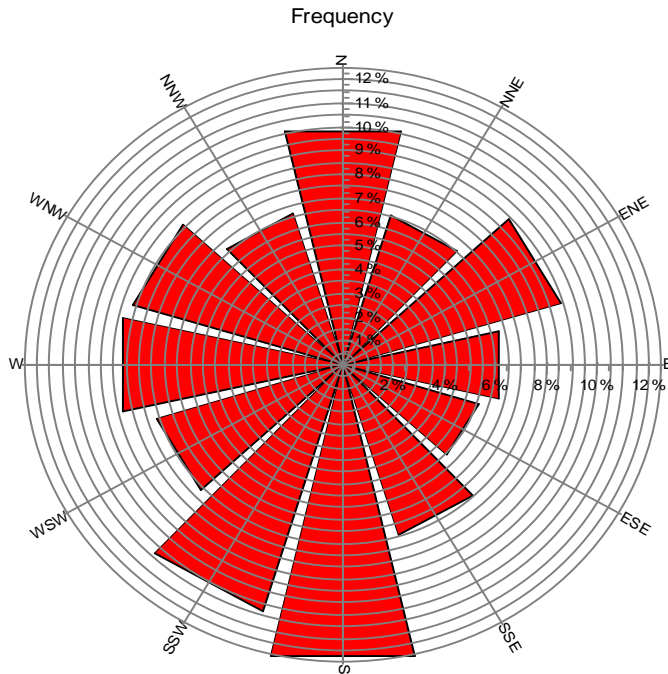
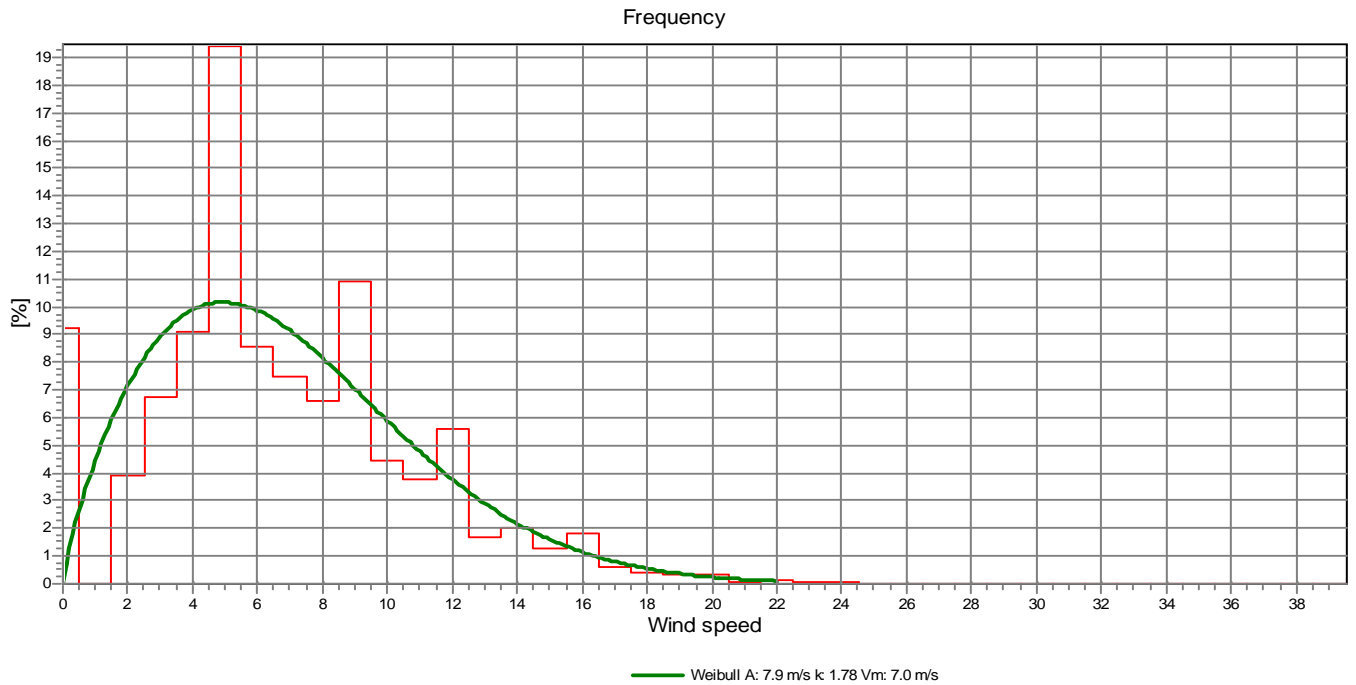
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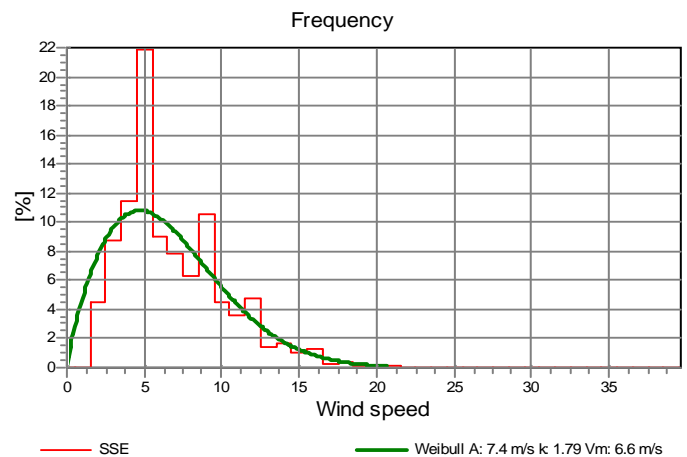
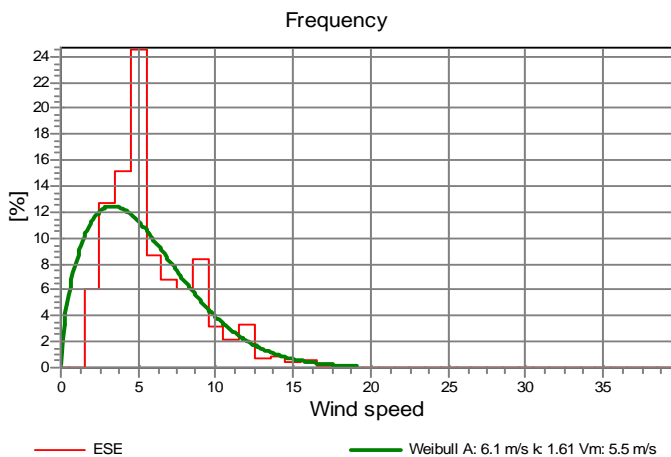
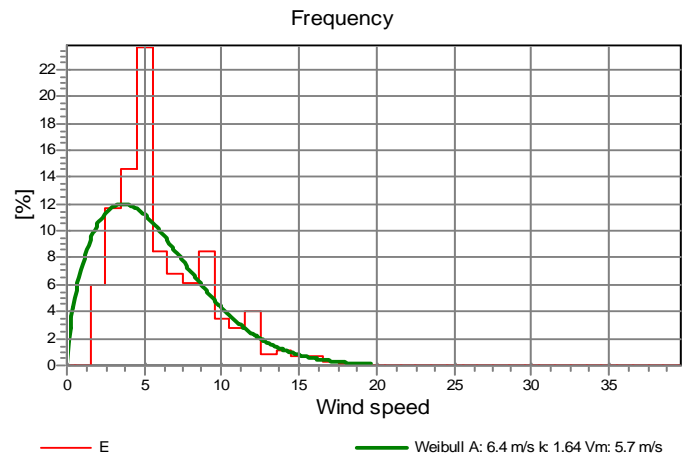
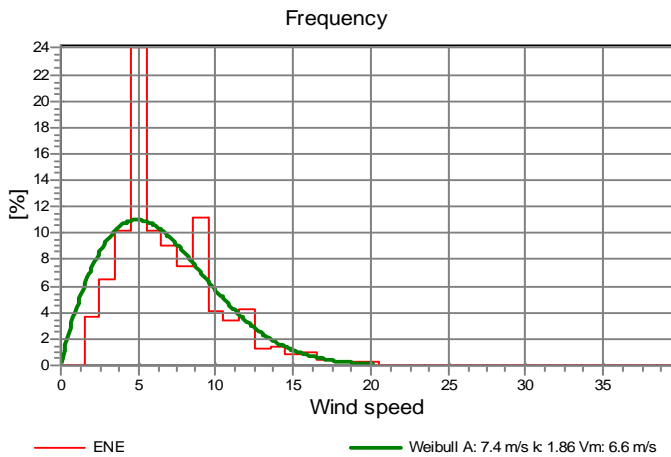
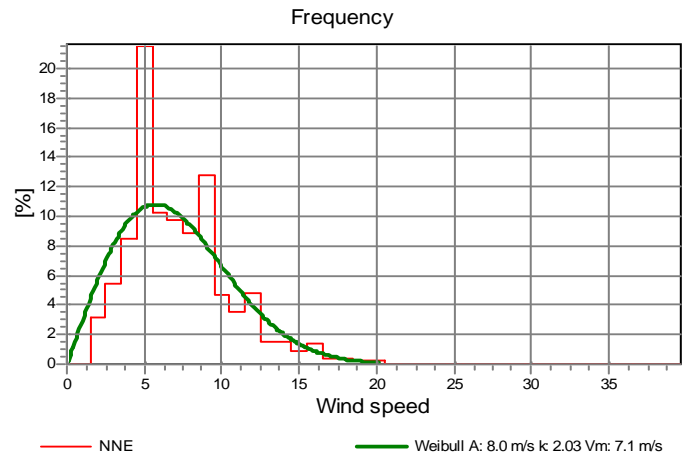
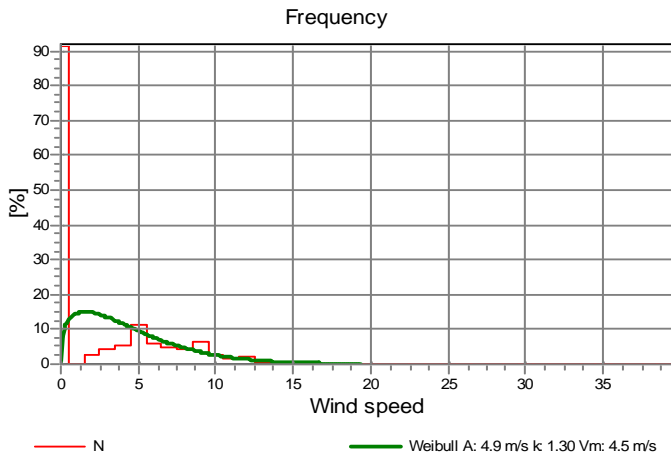
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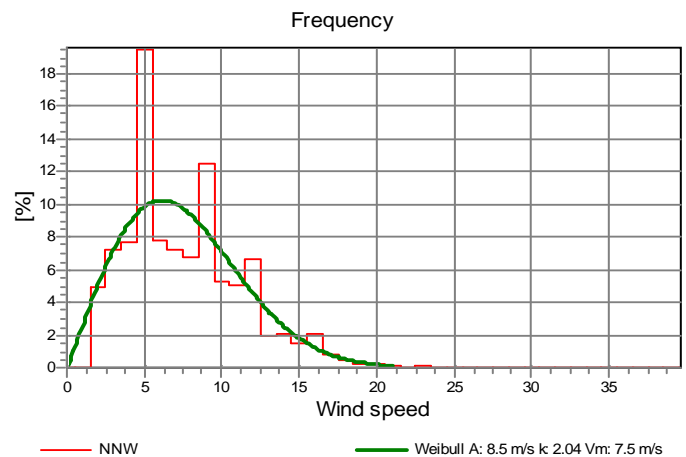
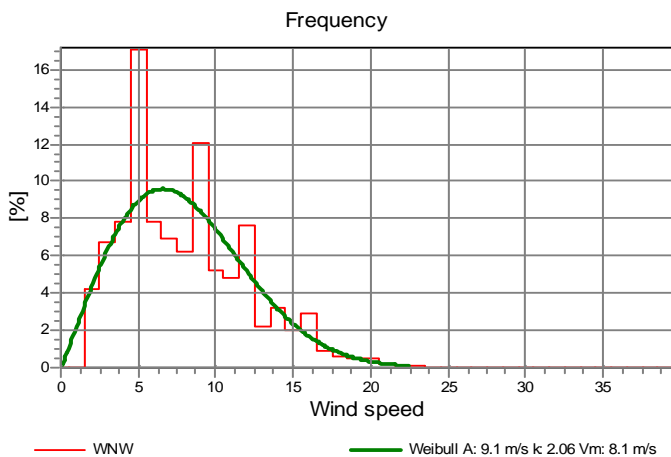
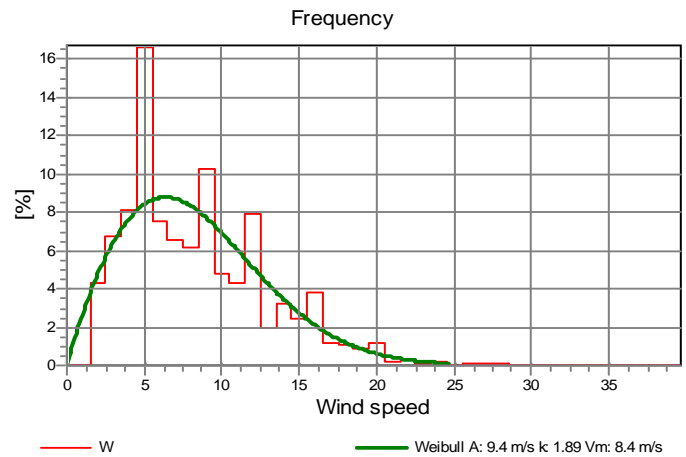
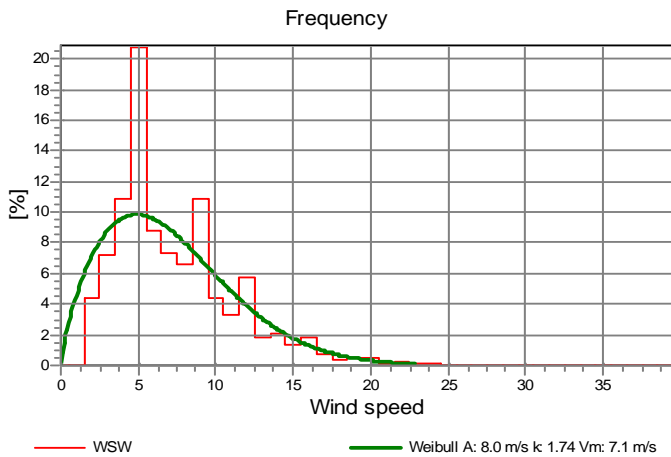
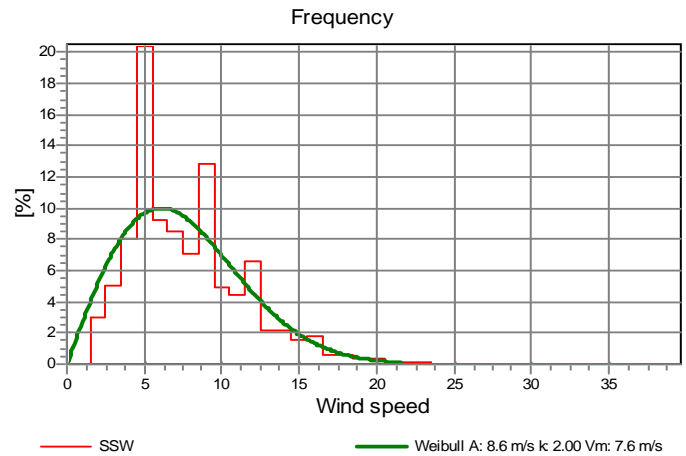
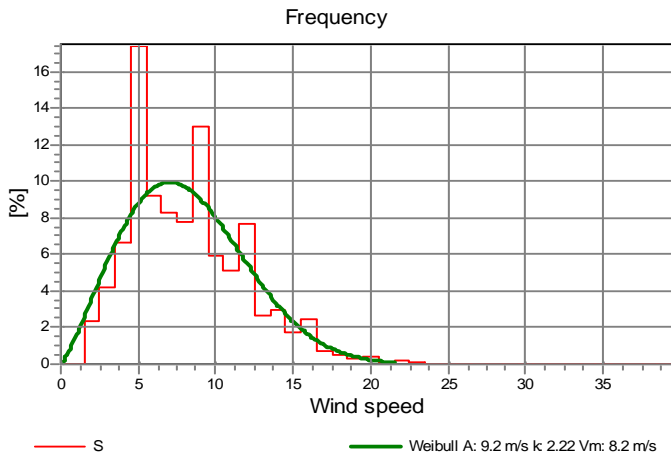
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V:\EAPC WIND PROJECTS\20063390 - University of Illinois\Wind Data\Long-Term Wind Data\97-05_2003 mph.csv

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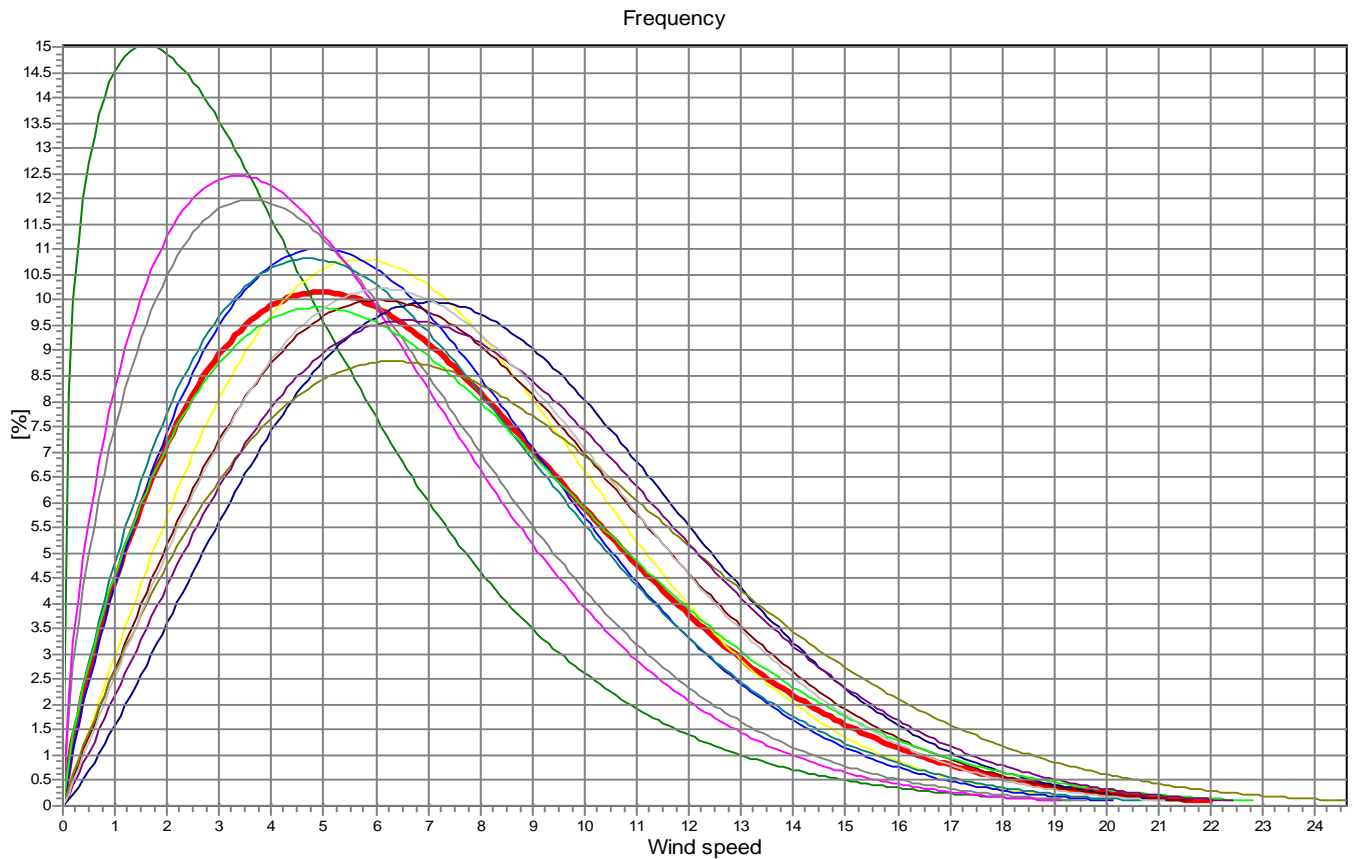
Meteo data report, height: 80.0 m

Name of meteo object: ASOS data- Hourly

Weibull Data

k-parameter correction: 0.0080/m

Sector	A- parameter [m/s]	Mean wind speed [m/s]	k- parameter	Frequency	Frequency [%]	Wind shear
0-N	4.89	4.52	1.302	10.09	10.1	0.00
1-NNE	8.00	7.09	2.026	6.53	6.5	0.00
2-ENE	7.44	6.61	1.859	8.94	8.9	0.00
3-E	6.40	5.73	1.635	6.31	6.3	0.00
4-ESE	6.12	5.49	1.609	5.58	5.6	0.00
5-SSE	7.42	6.60	1.792	7.47	7.5	0.00
6-S	9.24	8.18	2.215	12.56	12.6	0.00
7-SSW	8.57	7.59	1.997	10.80	10.8	0.00
8-WSW	8.01	7.14	1.736	7.67	7.7	0.00
9-W	9.43	8.37	1.893	8.85	8.8	0.00
10-WNW	9.10	8.06	2.056	8.59	8.6	0.00
11-NNW	8.51	7.54	2.044	6.63	6.6	0.00
mean	7.86	7.00	1.775	100.00	100.0	0.00



- Total A: 7.9 m/s k: 1.78 Vm: 7.0 m/s
- N A: 4.9 m/s k: 1.30 Vm: 4.5 m/s
- NNE A: 8.0 m/s k: 2.03 Vm: 7.1 m/s
- ENE A: 7.4 m/s k: 1.86 Vm: 6.6 m/s
- E A: 6.4 m/s k: 1.64 Vm: 5.7 m/s
- ESE A: 6.1 m/s k: 1.61 Vm: 5.5 m/s
- SSE A: 7.4 m/s k: 1.79 Vm: 6.6 m/s
- S A: 9.2 m/s k: 2.22 Vm: 8.2 m/s
- SSW A: 8.6 m/s k: 2.00 Vm: 7.6 m/s
- WSW A: 8.0 m/s k: 1.74 Vm: 7.1 m/s
- W A: 9.4 m/s k: 1.89 Vm: 8.4 m/s
- WNW A: 9.1 m/s k: 2.06 Vm: 8.1 m/s
- NNW A: 8.5 m/s k: 2.04 Vm: 7.5 m/s

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STATGEN - Overview

Calculation: 80m Wind Statistic using .20 shear-Hourly File: V:\EAPC WIND PROJECTS\20063390 - University of Illinois\US 80.01 m ASOS data- Hourly.wvs

Name

80.01 m ASOS data- Hourly

Source

USER

Country

United States

Site Coordinates

UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

Site Data

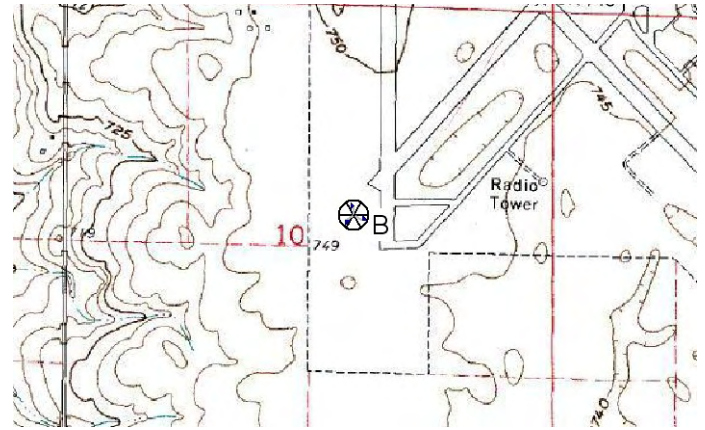
10m ASOS data

Meteorological Data

ASOS data- Hourly

Comments

Shear value of .20



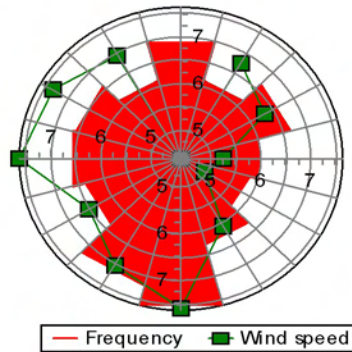
Site Data

Scale 1:25,000
Meteorological Data

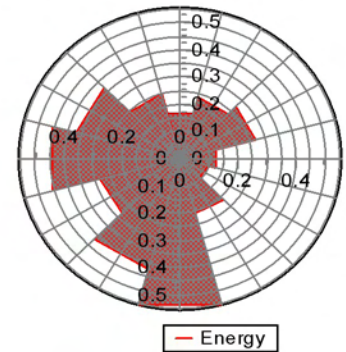
Mean wind speed [m/s]

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	6.8	4.8	4.2	3.3
25.0	7.4	5.7	5.1	4.3
50.0	8.0	6.5	5.9	5.2
100.0	8.6	7.6	7.0	6.2
200.0	9.4	9.2	8.4	7.4

Mean wind speed [m/s]
Roughness class: 1; Height: 50 m



Energy [MWh/m2/year]
Roughness class: 1; Height: 50 m



Wind energy [kWh/m2/year]

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	3,992	1,682	1,104	538
25.0	5,059	2,588	1,894	1,131
50.0	6,021	3,448	2,684	1,786
100.0	7,744	5,026	3,888	2,667
200.0	10,624	9,234	7,059	4,714

WTG energy [kWh/m2/year]

Normal rated WTG (0.45 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	1,008	-	-	-
25.0	1,210	654	490	-
50.0	1,379	906	730	505
100.0	1,554	1,250	1,059	799
200.0	1,769	1,708	1,501	1,197

High wind rated WTG (0.55 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	1,088	-	-	-
25.0	1,330	681	494	-
50.0	1,536	970	768	512
100.0	1,743	1,379	1,147	847
200.0	1,998	1,925	1,680	1,315

Low wind rated WTG (0.35 kW/m2)

Height [m]	Roughness class/Length			
	0	1	2	3
10.0	936	-	-	-
25.0	1,104	621	468	-
50.0	1,241	847	692	482
100.0	1,350	1,136	980	753
200.0	1,519	1,458	1,317	1,093

Key numbers

Wind energy is relative to 3300 kWh/m2/year for roughness class 1 and 50 m hub height

WTG energy is relative to 1025 kWh/m2/year for roughness class 1 and 50 m hub height

Name	Distance [km]	Wind energy [%]	WTG energy [%]	Name	Distance [km]	Wind energy [%]	WTG energy [%]
Current wind statistic		104.5	88.4	10.00 m Peoria 02to04	128.4	36.9	45.4
80.00 m ASOS data- Hourly	0.0	90.5	76.9	10.00 m Peoria IL Measure and Weibull data	128.9	40.6	47.6
80.01 m ASOS data	0.0	111.5	92.7	10.00 m Peoria Measure and Weibull data	128.9	40.6	47.6
10.00 m ASOS data- Hourly	0.0	84.3	93.1	50.0 m Princeton Met mast	172.2	91.4	104.8
80.00 m scaled ASOS data	0.0	96.4	80.3	50.0 m Princeton Met mast	172.2	91.4	104.8
10.00 m ASOS data	0.4	87.4	94.9	50.0 m Princeton Met mast	172.2	91.4	104.8
				25.00 m Matt Kauffman 25m mast May04 to May05	176.6	95.6	106.9

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STATGEN - Terrain

Calculation: 80m Wind Statistic using .20 shear-Hourly **Site Data:** A - 10m ASOS data

Obstacles:

0 Obstacles used

Roughness:

Calculation uses following MAP files:

\\hera\EAPC\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\ROUGHNESSLINE_southcampus windstudy_0.wpo

Min X: 370,595, Max X: 425,278, Min Y: 4,408,292, Max Y: 4,463,470, Width: 54,683 m, Height: 55,178 m

Limited by a square on 40.0 km x 40.0 km around the current site

Orography:

Calculation uses following MAP files:

\\hera\EAPC\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\3m_HCL GM South Campus.WPO

Min X: 382,783, Max X: 414,721, Min Y: 4,414,326, Max Y: 4,456,022, Width: 31,938 m, Height: 41,696 m

Limited by a square on 10.0 km x 10.0 km around the current site

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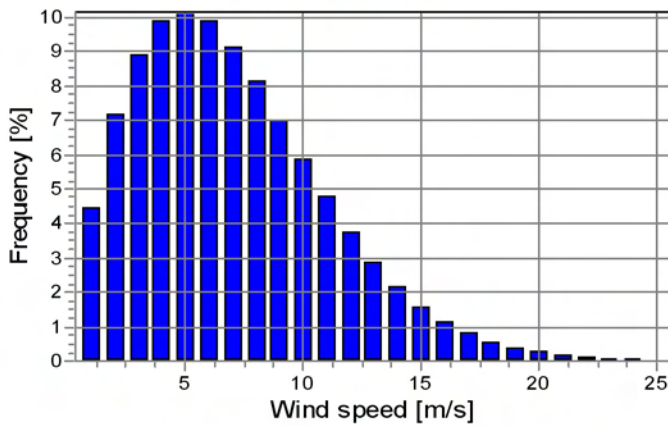
STATGEN - Wind Data Analysis

Calculation: 80m Wind Statistic using .20 shear-Hourly Wind data: B - ASOS data- Hourly; Hub height: 80.0

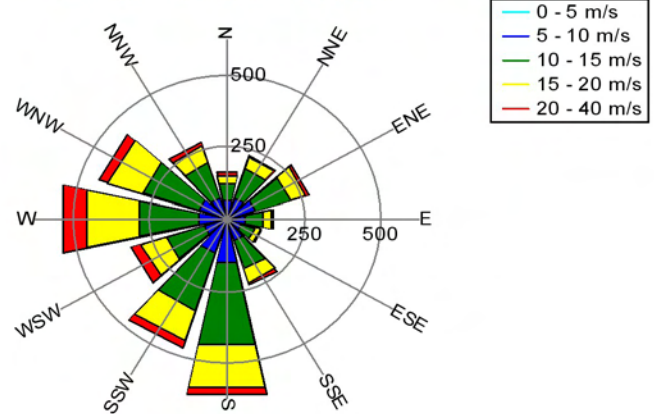
Weibull Data

Sector	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]	Wind gradient exponent
0 N	4.89	4.52	1.302	10.1	0.000
1 NNE	8.00	7.09	2.026	6.5	0.000
2 ENE	7.44	6.61	1.859	8.9	0.000
3 E	6.40	5.73	1.635	6.3	0.000
4 ESE	6.12	5.49	1.609	5.6	0.000
5 SSE	7.42	6.60	1.792	7.5	0.000
6 S	9.24	8.18	2.215	12.6	0.000
7 SSW	8.57	7.59	1.997	10.8	0.000
8 WSW	8.01	7.14	1.736	7.7	0.000
9 W	9.43	8.37	1.893	8.8	0.000
10 WNW	9.10	8.06	2.056	8.6	0.000
11 NNW	8.51	7.54	2.044	6.6	0.000
All	7.86	7.00	1.775	100.0	

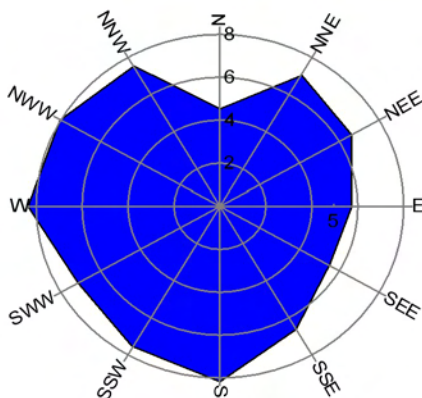
Weibull Distribution



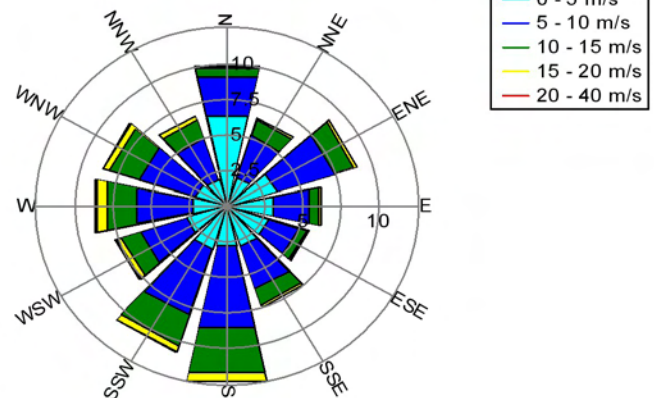
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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STATGEN - 24K TOPO

Calculation: 80m Wind Statistic using .20 shear-Hourly File: 24K TOPO.jpg



0 250 500 750 1000m

Map: , Print scale 1:25,000, Map center UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

⊗ Site Data

▲ Meteorological Data

Appendix B

Production Reports

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PARK - Main Result

Calculation: GE 1.5 sle-80 Preferred Modified

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode Individual per WTG
Result for WTG at hub altitude 1.186 kg/m3 to 1.186 kg/m3
Hub altitude above sea level (asl) 304.6 m to 307.0 m
Annual mean temperature at hub alt. 13.9 °C to 13.9 °C
Pressure at WTGs 977.0 hPa to 977.3 hPa

Wake Model Parameters

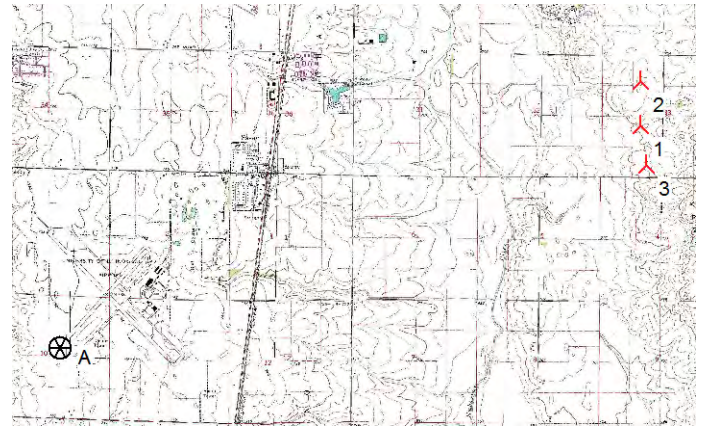
Wake Decay Constant 0.075

Wind statistics US 80.01 m ASOS data.wws

WTG siting

UTM WGS84 Zone: 16

	East	North	Z	Row data/Description
	[m]			
1 New	398,208	4,435,187	224.6	1
2 New	398,203	4,435,770	227.0	2
3 New	398,282	4,434,657	225.0	3



Scale 1:100,000

▲ New WTG

⊗ Site Data

Key results for height 50.0 m above ground level

Terrain UTM WGS84 Zone: 16

East	North	Name of wind distribution	Type	Wind energy [kWh/m2]	Mean wind speed [m/s]	Equivalent roughness	
A	390,507	4,432,246	80m scaled ASOS data w/.20 shear	WAsP (RVEA0011 1, 0, 0, 13)	3,329	6.5	1.3

Calculated Annual Energy for Wind Farm

WTG combination	Annual Energy		Park Efficiency [%]	Mean WTG energy [MWh]	Capacity Factor for	
	Result [MWh]	Result-10.0% [MWh]			Result [%]	Result-10.0% [%]
Wind farm	14,076.1	12,668.5	98.5	4,692.0	35.7	32.1

Calculated Annual Energy for each of 3 new WTG's with total 4.5 MW rated power

Terrain	WTG type		Type	Power [kW]	Diam. [m]	Height [m]	Circle radius [m]	Circle radius [m]	Power curve Creator Name	Annual Energy		Park		Mean wind speed [m/s]
	Valid	Manufact.								Result [MWh]	Result-10.0% [MWh]	Efficiency [%]	Mean wind speed [m/s]	
1 A	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - Calculated - Standard operation - 12-2004	4,647.4	4,183	97.9	7.1
2 A	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - Calculated - Standard operation - 12-2004	4,664.4	4,198	98.4	7.1
3 A	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - Calculated - Standard operation - 12-2004	4,764.3	4,288	99.2	7.1

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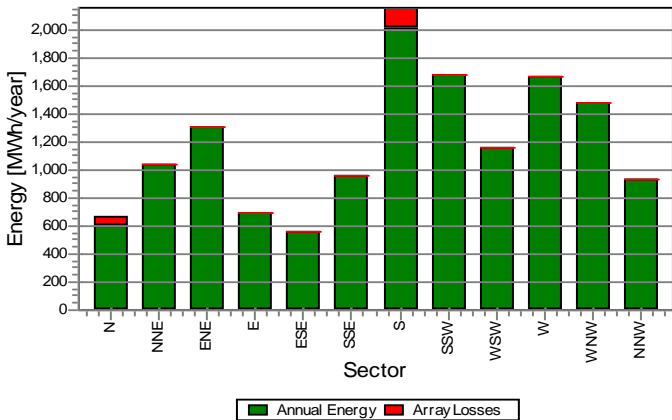
PARK - Production Analysis

Calculation: GE 1.5 sle-80 Preferred Modified **WTG:** All new WTG's, Air density 1.186 kg/m3

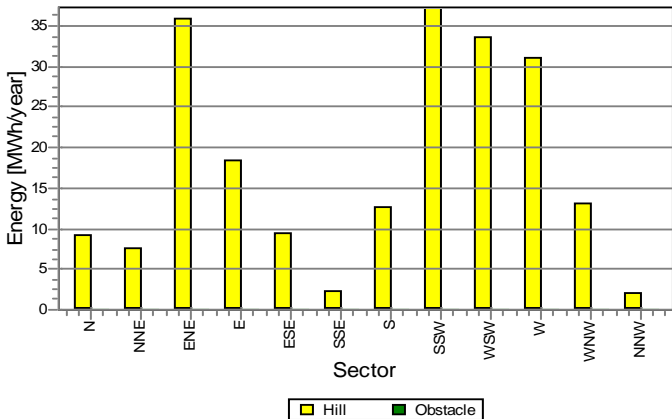
Directional Analysis

Sector	0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy [MWh]	660.7	1,036.5	1,267.9	672.7	544.6	956.6	2,146.4	1,636.5	1,122.4	1,633.1	1,466.8	933.3	14,077.5
+Increase due to hills [MWh]	9.2	7.5	35.9	18.3	9.5	2.4	12.7	37.3	33.6	30.9	13.1	2.1	212.7
-Decrease due to array losses [MWh]	64.8	0.0	0.0	0.0	0.0	3.7	141.7	0.0	0.0	0.0	0.0	3.9	214.1
Resulting energy [MWh]	605.1	1,044.0	1,303.8	691.0	554.1	955.4	2,017.4	1,673.8	1,156.0	1,664.1	1,479.8	931.6	14,076.1
Specific energy [kWh/m2]													1,008
Specific energy [kWh/kW]													3,128
Increase due to hills [%]	1.4	0.7	2.8	2.7	1.7	0.2	0.6	2.3	3.0	1.9	0.9	0.2	1.5
Decrease due to array losses [%]	9.7	0.0	0.0	0.0	0.0	0.4	6.6	0.0	0.0	0.0	0.0	0.4	1.5
Utilization [%]	24.7	25.1	24.3	27.0	28.1	25.7	22.8	24.8	22.3	20.8	25.3	28.9	24.2
Operational [Hours/year]	748	504	639	467	411	529	853	752	566	660	632	522	7,283
Full Load Equivalent [Hours/year]	134	232	290	154	123	212	448	372	257	370	329	207	3,128

Energy vs. sector



Impact of hills and obstacles vs. sector



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PARK - Power Curve Analysis

Calculation: GE 1.5 sle-80 Preferred Modified **WTG:** 1 - GE WIND ENERGY GE 1.5sle 1500 77.0 !O! Level 0 - Calculated - Standard operation - 12-2004, Hub height: 80.0 m

Name: Level 0 - Calculated - Standard operation - 12-2004

Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type
12/23/2004	EMD	11/21/2000	06/24/2005	25.0	Pitch	User defined

Based on release 4Q04

HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean [m/s]	5	6	7	8	9	10
HP value [MWh]	2,147	3,366	4,628	5,833	6,826	7,716
1 [MWh]	2,230	3,492	4,738	5,867	6,837	7,627
Check value [%]	-4	-4	-2	-1	0	1

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTG's performs quite similar - only specific power loading (kW/m²) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see WindPRO manual chapter 3.5.2.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.

Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

Original data from Windcat, Air density: 1.225 kg/m³

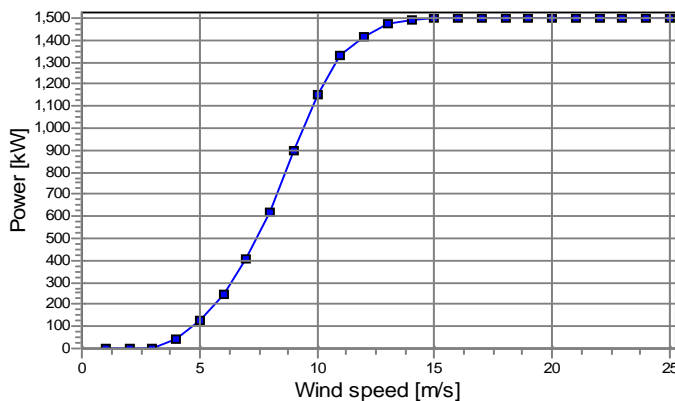
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
4.0	43.0	0.24	4.0	1.09
5.0	131.0	0.37	5.0	0.94
6.0	250.0	0.41	6.0	0.87
7.0	416.0	0.43	7.0	0.85
8.0	640.0	0.44	8.0	0.85
9.0	924.0	0.44	9.0	0.83
10.0	1,181.0	0.42	10.0	0.75
11.0	1,359.0	0.36	11.0	0.62
12.0	1,436.0	0.30	12.0	0.50
13.0	1,481.0	0.24	13.0	0.39
14.0	1,494.0	0.20	14.0	0.30
15.0	1,500.0	0.16	15.0	0.24
16.0	1,500.0	0.13	16.0	0.20
17.0	1,500.0	0.11	17.0	0.16
18.0	1,500.0	0.09	18.0	0.14
19.0	1,500.0	0.08	19.0	0.12
20.0	1,500.0	0.07	20.0	0.10
21.0	1,500.0	0.06	21.0	0.09
22.0	1,500.0	0.05	22.0	0.07
23.0	1,500.0	0.04	23.0	0.07
24.0	1,500.0	0.04	24.0	0.06
25.0	1,500.0	0.03	25.0	0.06

Power, Efficiency and energy vs. wind speed

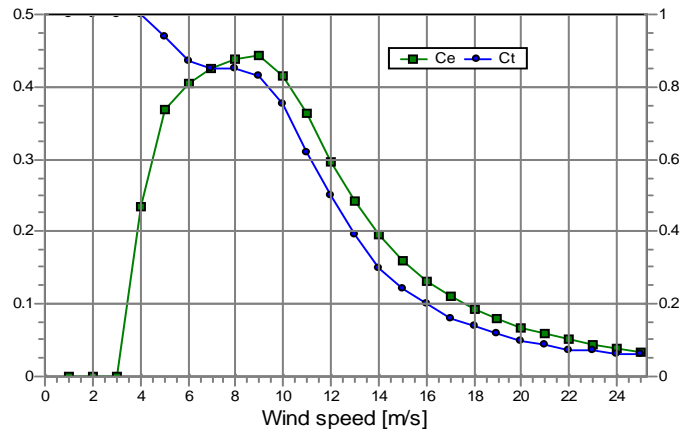
Data used in calculation, Air density: 1.186 kg/m³

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50-1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50-2.50	0.0	0.0	0.0
3.0	0.0	0.00	2.50-3.50	0.0	0.0	0.0
4.0	41.6	0.24	3.50-4.50	34.5	34.5	0.7
5.0	126.8	0.37	4.50-5.50	110.0	144.5	3.1
6.0	242.1	0.41	5.50-6.50	201.5	346.0	7.4
7.0	402.8	0.43	6.50-7.50	310.0	656.0	14.1
8.0	619.7	0.44	7.50-8.50	426.6	1,082.6	23.3
9.0	894.7	0.44	8.50-9.50	525.1	1,607.6	34.6
10.0	1,149.4	0.42	9.50-10.50	570.2	2,177.8	46.9
11.0	1,331.7	0.36	10.50-11.50	547.7	2,725.5	58.6
12.0	1,416.8	0.30	11.50-12.50	476.9	3,202.5	68.9
13.0	1,471.1	0.24	12.50-13.50	389.3	3,591.8	77.3
14.0	1,494.0	0.20	13.50-14.50	303.8	3,895.5	83.8
15.0	1,500.0	0.16	14.50-15.50	228.4	4,123.9	88.7
16.0	1,500.0	0.13	15.50-16.50	166.8	4,290.7	92.3
17.0	1,500.0	0.11	16.50-17.50	119.0	4,409.7	94.9
18.0	1,500.0	0.09	17.50-18.50	83.0	4,492.7	96.7
19.0	1,500.0	0.08	18.50-19.50	56.7	4,549.4	97.9
20.0	1,500.0	0.07	19.50-20.50	38.0	4,587.4	98.7
21.0	1,500.0	0.06	20.50-21.50	24.9	4,612.3	99.2
22.0	1,500.0	0.05	21.50-22.50	16.1	4,628.4	99.6
23.0	1,500.0	0.04	22.50-23.50	10.2	4,638.6	99.8
24.0	1,500.0	0.04	23.50-24.50	6.4	4,645.0	99.9
25.0	1,500.0	0.03	24.50-25.50	2.4	4,647.4	100.0

Power curve
Data used in calculation



Ce and Ct curve



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PARK - Terrain

Calculation: GE 1.5 sle-80 Preferred Modified **Site Data:** A - 80m scaled ASOS data w/.20 shear

Obstacles:

0 Obstacles used

Roughness:

Calculation uses following MAP files:

\\HERA\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\ROUGHNESSLINE_southcampus windstudy_0.wpo

Min X: 370,595, Max X: 425,278, Min Y: 4,408,292, Max Y: 4,463,470, Width: 54,683 m, Height: 55,178 m

Limited by a square on 40.0 km x 40.0 km around the current site

Orography:

Calculation uses following MAP files:

\\HERA\Wind Data\EAPC WIND PROJECTS\20063390 - University of Illinois\3m_HCL GM South Campus.WPO

Min X: 382,783, Max X: 414,721, Min Y: 4,414,326, Max Y: 4,456,022, Width: 31,938 m, Height: 41,696 m

Limited by a square on 10.0 km x 10.0 km around the current site

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PARK - Wind Data Analysis

Calculation: GE 1.5 sle-80 Preferred Modified **Wind data:** A - 80m scaled ASOS data w/.20 shear; Hub height: 50.0

Site Coordinates

UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

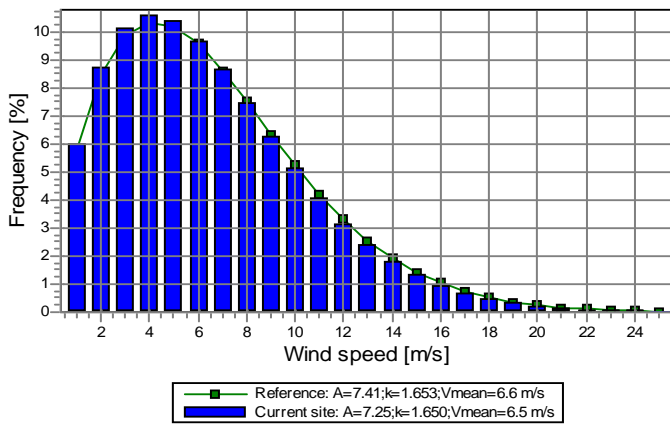
Wind statistics

US 80.01 m ASOS data.wvs

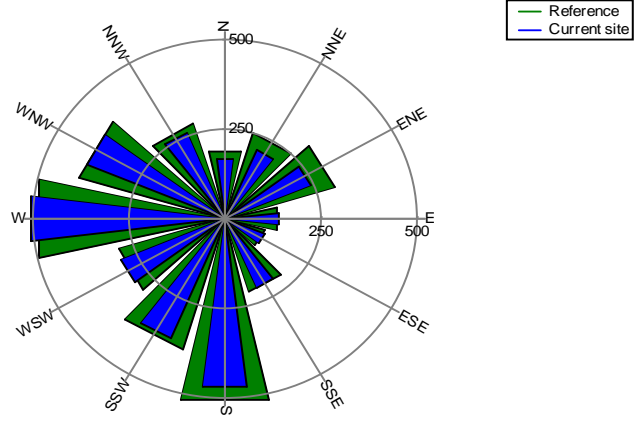
Weibull Data

Sector	Current site			Frequency [%]	Reference: Roughness class 1		
	A- parameter [m/s]	Wind speed [m/s]	k- parameter		A- parameter [m/s]	k- parameter	Frequency [%]
0 N	4.57	4.30	1.201	10.2	4.78	1.213	10.5
1 NNE	7.29	6.49	1.768	6.8	7.72	1.775	6.9
2 ENE	6.87	6.14	1.686	8.7	7.41	1.705	8.7
3 E	5.98	5.39	1.518	6.5	6.02	1.533	6.4
4 ESE	5.71	5.15	1.498	5.7	5.70	1.502	5.7
5 SSE	6.83	6.11	1.646	7.3	6.91	1.643	7.3
6 S	8.39	7.44	2.010	11.6	8.62	2.014	11.8
7 SSW	7.74	6.88	1.834	10.2	7.87	1.842	10.3
8 WSW	7.41	6.65	1.604	7.8	7.41	1.600	7.6
9 W	8.89	7.91	1.791	9.2	8.88	1.791	9.0
10 WNW	8.52	7.56	1.936	8.8	8.57	1.936	8.8
11 NNW	7.90	7.01	1.865	7.0	8.15	1.900	7.0
All	7.25	6.48	1.650	100.0	7.41	1.653	100.0

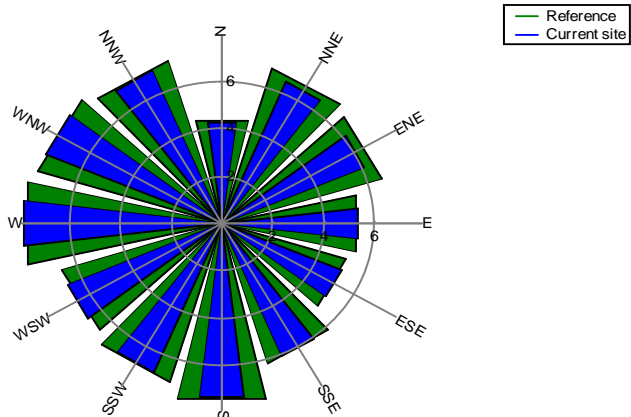
Weibull Distribution



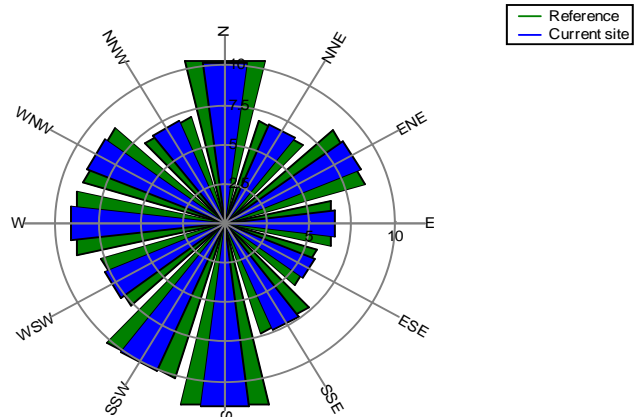
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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PARK - Park power curve

Calculation: GE 1.5 sle-80 Preferred Modified

Wind speed [m/s]	Power														
	Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]	
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4.5	254	233	166	253	253	253	253	248	165	253	253	253	253	248	
5.5	555	530	450	553	553	553	553	548	450	553	553	553	553	548	
6.5	970	934	821	967	967	967	967	959	821	967	967	967	967	959	
7.5	1,539	1,484	1,315	1,534	1,534	1,534	1,534	1,522	1,314	1,534	1,534	1,534	1,534	1,522	
8.5	2,279	2,200	1,959	2,271	2,271	2,271	2,271	2,255	1,958	2,271	2,271	2,271	2,271	2,255	
9.5	3,072	2,983	2,713	3,062	3,062	3,062	3,062	3,046	2,712	3,062	3,062	3,062	3,062	3,046	
10.5	3,730	3,660	3,453	3,720	3,720	3,720	3,720	3,710	3,453	3,720	3,720	3,720	3,720	3,710	
11.5	4,129	4,093	3,992	4,122	4,122	4,122	4,122	4,118	3,992	4,122	4,122	4,122	4,122	4,118	
12.5	4,336	4,319	4,277	4,331	4,331	4,331	4,331	4,329	4,277	4,331	4,331	4,331	4,331	4,329	
13.5	4,449	4,443	4,428	4,448	4,448	4,448	4,448	4,447	4,428	4,448	4,448	4,448	4,448	4,447	
14.5	4,491	4,490	4,487	4,491	4,491	4,491	4,491	4,491	4,487	4,491	4,491	4,491	4,491	4,491	
15.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
16.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
17.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
18.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
19.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
20.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
21.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
22.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
23.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
24.5	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
25.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Description:

The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.

Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in WindPRO.

The park power curve can be used for:

- Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
- Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
- Calculation of wind energy index based on the PARK production (see below).
- Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in WindPRO (PPV-model).

Note:

From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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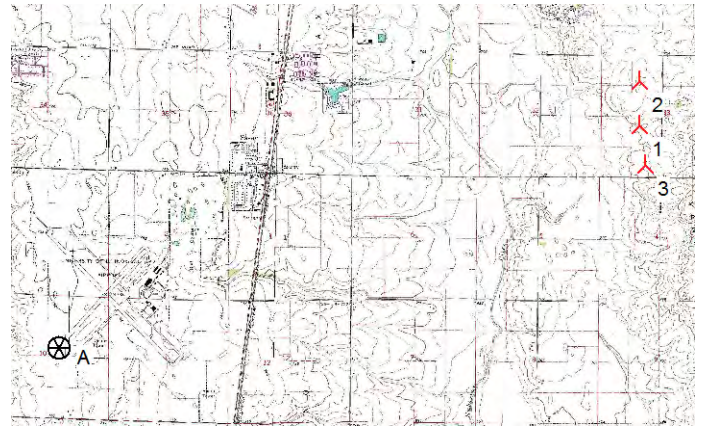
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PARK - WTG distances

Calculation: GE 1.5 sle-80 Preferred Modified

WTG distances

Z	Nearest WTG	Z	Horizontal distance	Distance in
[m]		[m]	[m]	rotor diameters
1 224.6	3	225.0	535	6.9
2 227.0	1	224.6	583	7.6
3 225.0	1	224.6	535	6.9



Scale 1:100,000

New WTG

Site Data

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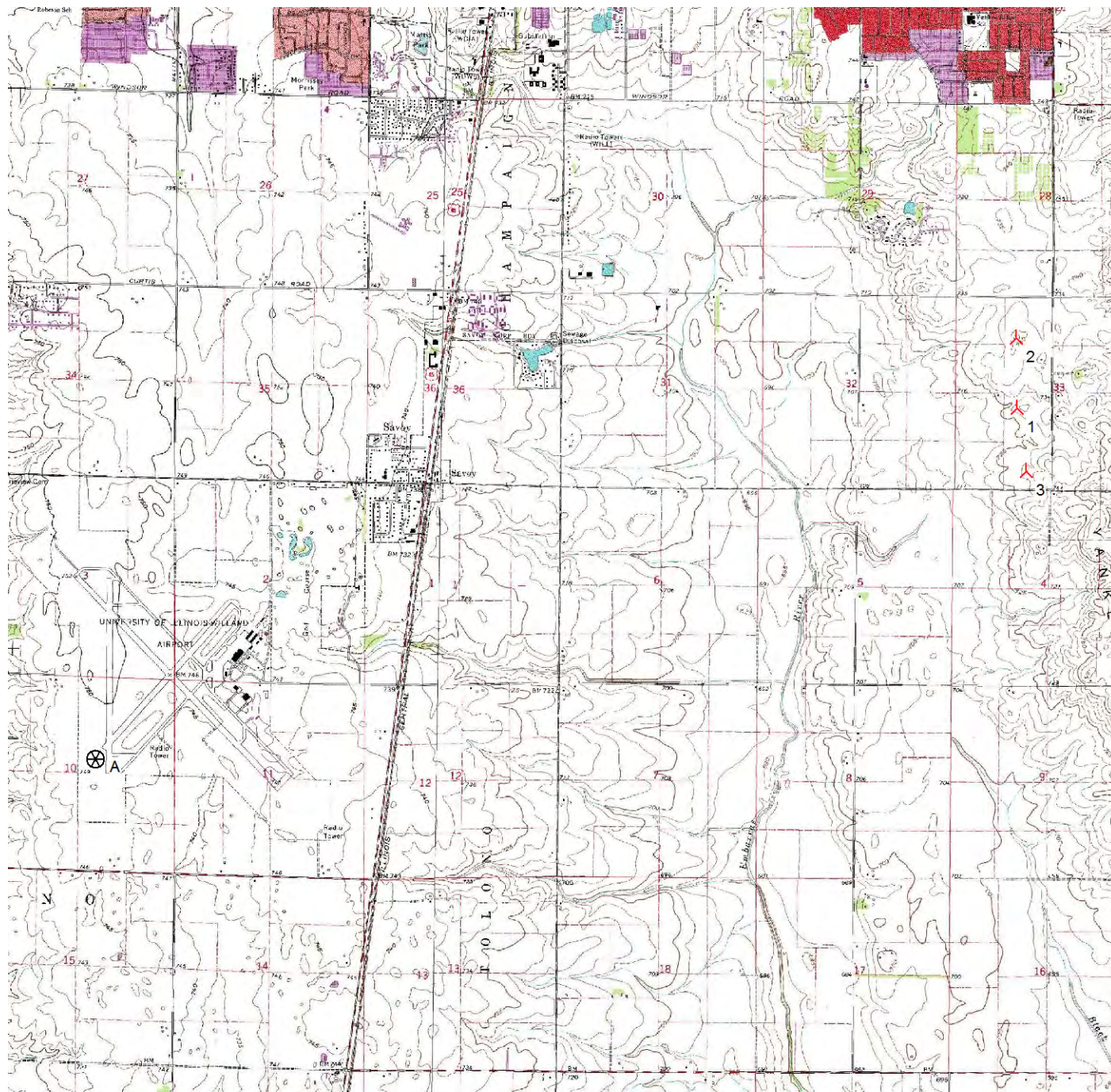
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PARK - 24K TOPO

Calculation: GE 1.5 sle-80 Preferred Modified File: 24K TOPO.jpg



0 500 1000 1500 2000 m

Map: , Print scale 1:50,000, Map center UTM WGS 84 Zone: 16 East: 394,394 North: 4,434,008

▲ New WTG

⊗ Site Data

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PARK - Main Result

Calculation: V82's Preferred Modified

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode Individual per WTG
Result for WTG at hub altitude 1.186 kg/m3 to 1.186 kg/m3
Hub altitude above sea level (asl) 304.0 m to 307.0 m
Annual mean temperature at hub alt. 13.9 °C to 13.9 °C
Pressure at WTGs 977.0 hPa to 977.4 hPa

Wake Model Parameters

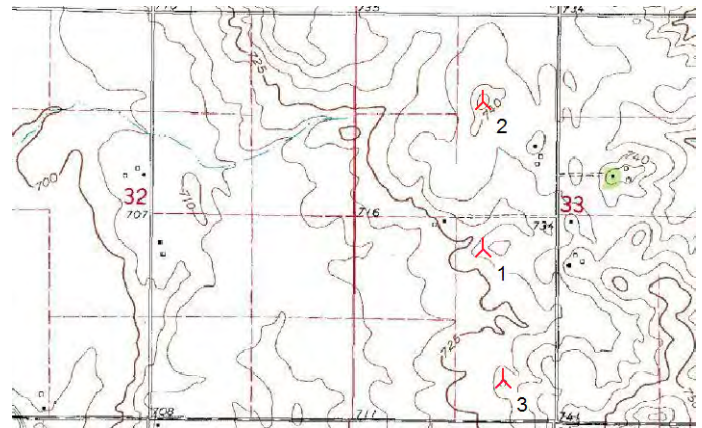
Wake Decay Constant 0.075

Wind statistics US 80.01 m ASOS data.wws

WTG siting

UTM WGS84 Zone: 16

	East	North	Z	Row data/Description
	[m]			
1 New	398,203	4,435,182	224.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 ...
2 New	398,202	4,435,769	227.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 ...
3 New	398,283	4,434,662	225.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 ...



New WTG

Site Data

Scale 1:30,000

Key results for height 50.0 m above ground level

Terrain UTM WGS84 Zone: 16

East	North	Name of wind distribution	Type	Wind energy [kWh/m2]	Mean wind speed [m/s]	Equivalent roughness	
A	390,507	4,432,246	80m scaled ASOS data w/.20 shear	WAsP (RVEA0011 1, 0, 0, 13)	3,329	6.5	1.3

Calculated Annual Energy for Wind Farm

WTG combination	Annual Energy		Park Efficiency [%]	Mean WTG energy [MWh]	Capacity Factor for	
	Result [MWh]	Result-10.0% [MWh]			Result [%]	Result-10.0% [%]
Wind farm	15,590.5	14,031.5	98.5	5,196.8	35.9	32.3

Calculated Annual Energy for each of 3 new WTG's with total 4.9 MW rated power

Terrain	WTG type		Type	Power [kW]	Diam. [m]	Height [m]	Circle radius [m]	Power curve		Annual Energy		Park Efficiency [%]	Mean wind speed [m/s]
	Valid	Manufact.						Creator	Name	Result [MWh]	Result-10.0% [MWh]		
1 A	Yes	VESTAS	NM82V82	1,650	82.0	80.0	135.0	EMD	Level 0 --- 11-2004	5,145.5	4,631	97.9	7.1
2 A	Yes	VESTAS	NM82V82	1,650	82.0	80.0	135.0	EMD	Level 0 --- 11-2004	5,171.3	4,654	98.4	7.1
3 A	Yes	VESTAS	NM82V82	1,650	82.0	80.0	135.0	EMD	Level 0 --- 11-2004	5,273.6	4,746	99.1	7.1

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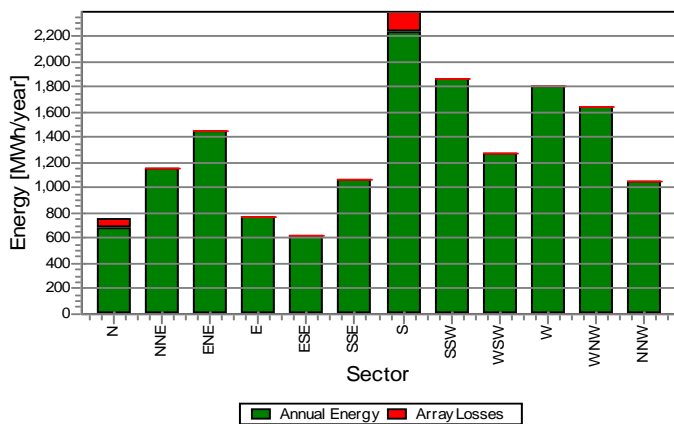
PARK - Production Analysis

Calculation: V82's Preferred Modified WTG: All new WTG's, Air density 1.186 kg/m3

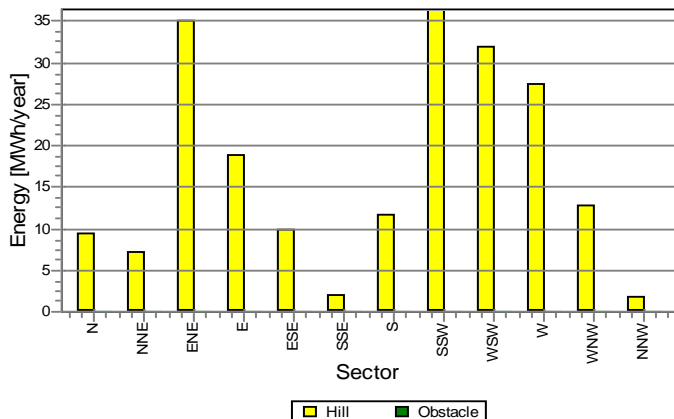
Directional Analysis

Sector	0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy [MWh]	740.4	1,151.7	1,406.7	753.4	611.7	1,065.7	2,381.2	1,819.9	1,234.4	1,781.0	1,633.5	1,049.9	15,629.6
+Increase due to hills [MWh]	9.4	7.1	35.2	18.9	9.9	2.1	11.7	36.4	31.9	27.4	12.8	1.9	204.6
-Decrease due to array losses [MWh]	75.1	0.0	0.0	0.0	0.0	6.5	155.3	0.0	0.0	0.0	0.0	6.9	243.7
Resulting energy [MWh]	674.7	1,158.8	1,441.9	772.3	621.6	1,061.3	2,237.7	1,856.4	1,266.3	1,808.4	1,646.2	1,044.9	15,590.5
Specific energy [kWh/m2]													984
Specific energy [kWh/kW]													3,150
Increase due to hills [%]	1.3	0.6	2.5	2.5	1.6	0.2	0.5	2.0	2.6	1.5	0.8	0.2	1.3
Decrease due to array losses [%]	10.0	0.0	0.0	0.0	0.0	0.6	6.5	0.0	0.0	0.0	0.0	0.7	1.5
Utilization [%]	24.3	24.6	23.7	26.6	27.8	25.2	22.3	24.3	21.6	20.0	24.9	28.6	23.7
Operational [Hours/year]	742	500	634	463	408	525	846	746	561	655	627	518	7,225
Full Load Equivalent [Hours/year]	136	234	291	156	126	214	452	375	256	365	333	211	3,150

Energy vs. sector



Impact of hills and obstacles vs. sector



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PARK - Power Curve Analysis

Calculation: V82's Preferred Modified WTG: 1 - VESTAS NM82V82 1650 82.0 !O! Level 0 - - - 11-2004, Hub height: 80.0 m

Name: Level 0 - - - 11-2004

Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type
11/30/2004	EMD	07/31/2003	06/24/2005	20.0	Active stall	User defined

Power- and Ct-curve based on item no: TSD 4000256-01 EN dated 2004-10-07

HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean [m/s]	5	6	7	8	9	10
HP value [MWh]	2,435	3,788	5,194	6,528	7,624	8,607
VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (10) [MWh]	2,543	3,956	5,327	6,524	7,467	8,129
Check value [%]	-4	-4	-3	0	2	6

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTG's performs quite similar - only specific power loading (kW/m²) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see WindPRO manual chapter 3.5.2.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.

Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

Original data from Windcat, Air density: 1.225 kg/m³

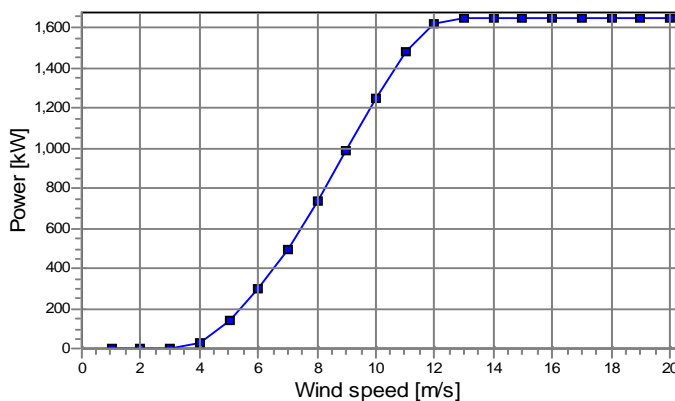
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
4.0	28.0	0.14	4.0	1.11
5.0	144.0	0.36	5.0	1.01
6.0	309.0	0.44	6.0	0.93
7.0	511.0	0.46	7.0	0.84
8.0	758.0	0.46	8.0	0.77
9.0	1,017.0	0.43	9.0	0.70
10.0	1,285.0	0.40	10.0	0.64
11.0	1,504.0	0.35	11.0	0.58
12.0	1,637.0	0.30	12.0	0.51
13.0	1,650.0	0.24	13.0	0.44
14.0	1,650.0	0.19	14.0	0.38
15.0	1,650.0	0.16	15.0	0.33
16.0	1,650.0	0.13	16.0	0.30
17.0	1,650.0	0.11	17.0	0.27
18.0	1,650.0	0.09	18.0	0.25
19.0	1,650.0	0.08	19.0	0.23
20.0	1,650.0	0.07	20.0	0.22

Power, Efficiency and energy vs. wind speed

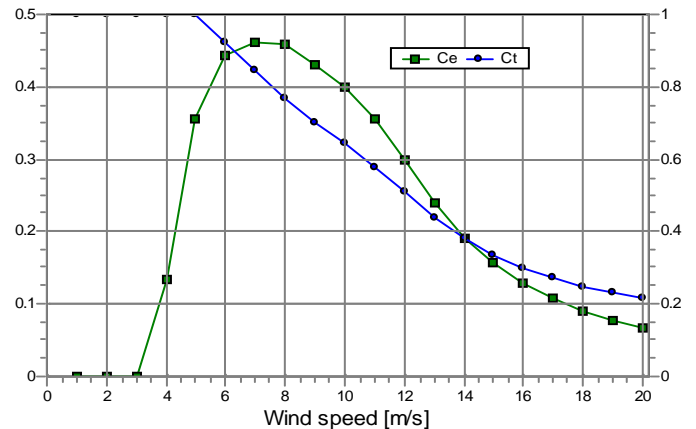
Data used in calculation, Air density: 1.186 kg/m³

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc. Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50-1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50-2.50	0.0	0.0	0.0
3.0	0.0	0.00	2.50-3.50	0.0	0.0	0.0
4.0	27.1	0.14	3.50-4.50	34.2	34.2	0.7
5.0	139.4	0.36	4.50-5.50	123.9	158.1	3.1
6.0	299.2	0.44	5.50-6.50	244.9	403.0	7.8
7.0	494.8	0.46	6.50-7.50	376.3	779.3	15.1
8.0	734.0	0.46	7.50-8.50	496.4	1,275.6	24.8
9.0	984.8	0.43	8.50-9.50	584.0	1,859.6	36.1
10.0	1,252.2	0.40	9.50-10.50	625.0	2,484.6	48.3
11.0	1,478.4	0.35	10.50-11.50	609.1	3,093.7	60.1
12.0	1,623.1	0.30	11.50-12.50	538.2	3,631.9	70.6
13.0	1,650.0	0.24	12.50-13.50	436.7	4,068.6	79.1
14.0	1,650.0	0.19	13.50-14.50	335.6	4,404.2	85.6
15.0	1,650.0	0.16	14.50-15.50	250.6	4,654.8	90.5
16.0	1,650.0	0.13	15.50-16.50	182.7	4,837.6	94.0
17.0	1,650.0	0.11	16.50-17.50	130.2	4,967.8	96.5
18.0	1,650.0	0.09	17.50-18.50	90.8	5,058.6	98.3
19.0	1,650.0	0.08	18.50-19.50	62.0	5,120.6	99.5
20.0	1,650.0	0.07	19.50-20.50	25.0	5,145.5	100.0

Power curve
Data used in calculation



Ce and Ct curve



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PARK - Wind Data Analysis

Calculation: V82's Preferred Modified Wind data: A - 80m scaled ASOS data w/.20 shear; Hub height: 50.0

Site Coordinates

UTM WGS 84 Zone: 16 East: 390,507 North: 4,432,246

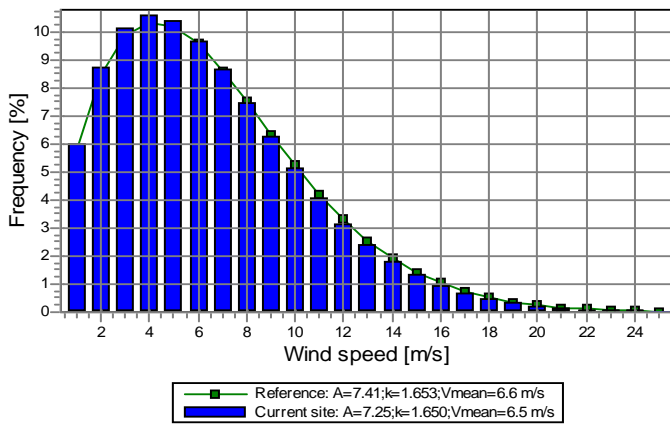
Wind statistics

US 80.01 m ASOS data.wvs

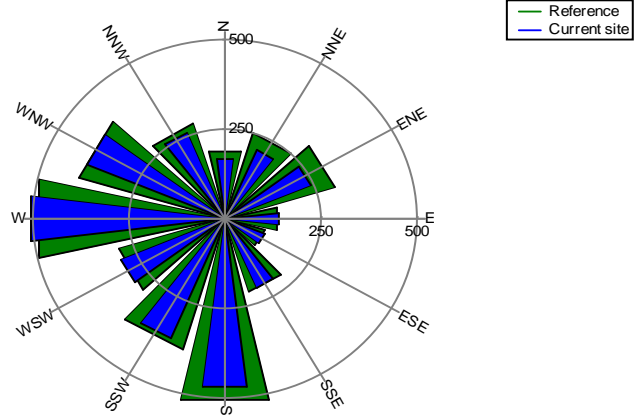
Weibull Data

Sector	Current site				Reference: Roughness class 1			
	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]	A- parameter [m/s]	k- parameter	Frequency [%]	
0 N	4.57	4.30	1.201	10.2	4.78	1.213	10.5	
1 NNE	7.29	6.49	1.768	6.8	7.72	1.775	6.9	
2 ENE	6.87	6.14	1.686	8.7	7.41	1.705	8.7	
3 E	5.98	5.39	1.518	6.5	6.02	1.533	6.4	
4 ESE	5.71	5.15	1.498	5.7	5.70	1.502	5.7	
5 SSE	6.83	6.11	1.646	7.3	6.91	1.643	7.3	
6 S	8.39	7.44	2.010	11.6	8.62	2.014	11.8	
7 SSW	7.74	6.88	1.834	10.2	7.87	1.842	10.3	
8 WSW	7.41	6.65	1.604	7.8	7.41	1.600	7.6	
9 W	8.89	7.91	1.791	9.2	8.88	1.791	9.0	
10 WNW	8.52	7.56	1.936	8.8	8.57	1.936	8.8	
11 NNW	7.90	7.01	1.865	7.0	8.15	1.900	7.0	
All	7.25	6.48	1.650	100.0	7.41	1.653	100.0	

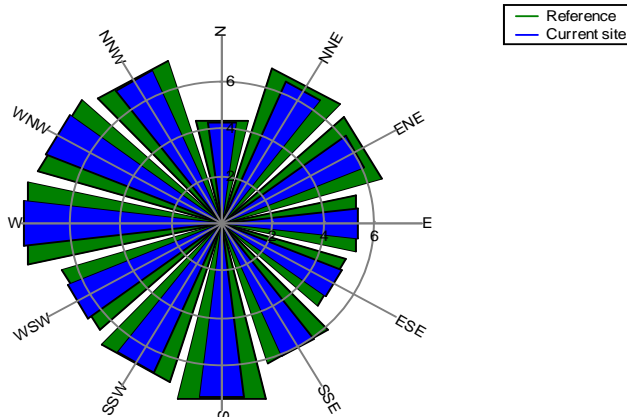
Weibull Distribution



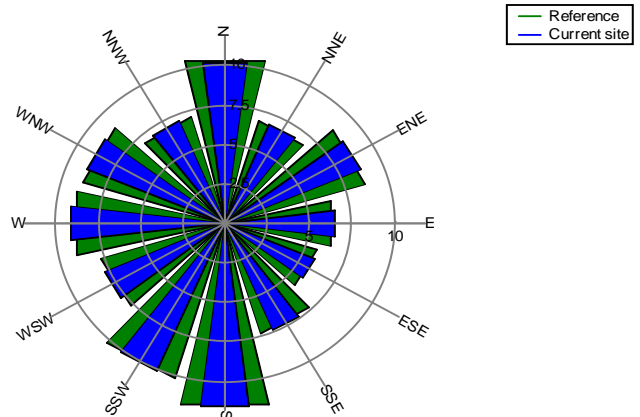
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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PARK - Park power curve

Calculation: V82's Preferred Modified

Wind speed [m/s]	Power														
	Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]	
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4.5	251	227	153	250	250	250	250	240	153	250	250	250	250	240	
5.5	660	618	487	658	658	658	658	644	487	658	658	658	658	644	
6.5	1,195	1,141	977	1,191	1,191	1,191	1,191	1,174	975	1,191	1,191	1,191	1,191	1,174	
7.5	1,849	1,784	1,587	1,843	1,843	1,843	1,843	1,823	1,587	1,843	1,843	1,843	1,843	1,823	
8.5	2,586	2,513	2,296	2,578	2,578	2,578	2,578	2,557	2,295	2,578	2,578	2,578	2,578	2,557	
9.5	3,360	3,283	3,059	3,350	3,350	3,350	3,350	3,328	3,058	3,350	3,350	3,350	3,350	3,328	
10.5	4,103	4,032	3,824	4,094	4,094	4,094	4,094	4,075	3,823	4,094	4,094	4,094	4,094	4,075	
11.5	4,657	4,608	4,464	4,651	4,651	4,651	4,651	4,639	4,463	4,651	4,651	4,651	4,651	4,639	
12.5	4,912	4,894	4,840	4,909	4,909	4,909	4,909	4,907	4,840	4,909	4,909	4,909	4,909	4,907	
13.5	4,950	4,948	4,942	4,950	4,950	4,950	4,950	4,950	4,942	4,950	4,950	4,950	4,950	4,950	
14.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
15.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
16.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
17.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
18.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
19.5	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	4,950	
20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
23.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
24.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Description:

The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.

Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in WindPRO.

The park power curve can be used for:

- Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
- Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
- Calculation of wind energy index based on the PARK production (see below).
- Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in WindPRO (PPV-model).

Note:

From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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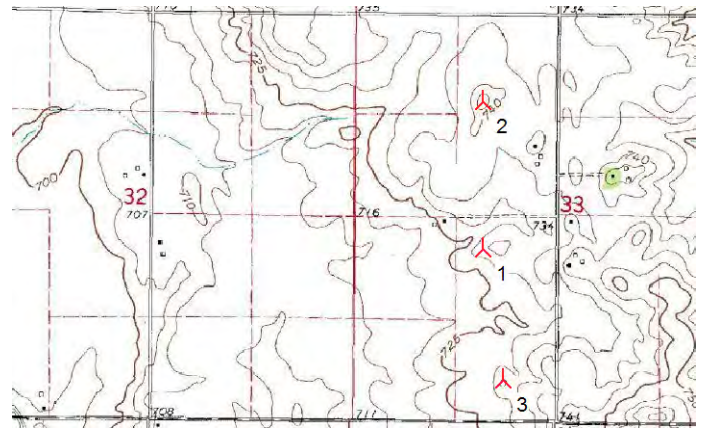
10/12/2007 10:00 AM/2.5.7.83

PARK - WTG distances

Calculation: V82's Preferred Modified

WTG distances

Z	Nearest WTG	Z	Horizontal distance	Distance in rotor diameters
[m]		[m]	[m]	
1 224.0	3	225.0	526	6.4
2 227.0	1	224.0	587	7.2
3 225.0	1	224.0	526	6.4



New WTG

Scale 1:30,000
Site Data

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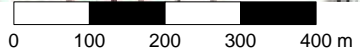
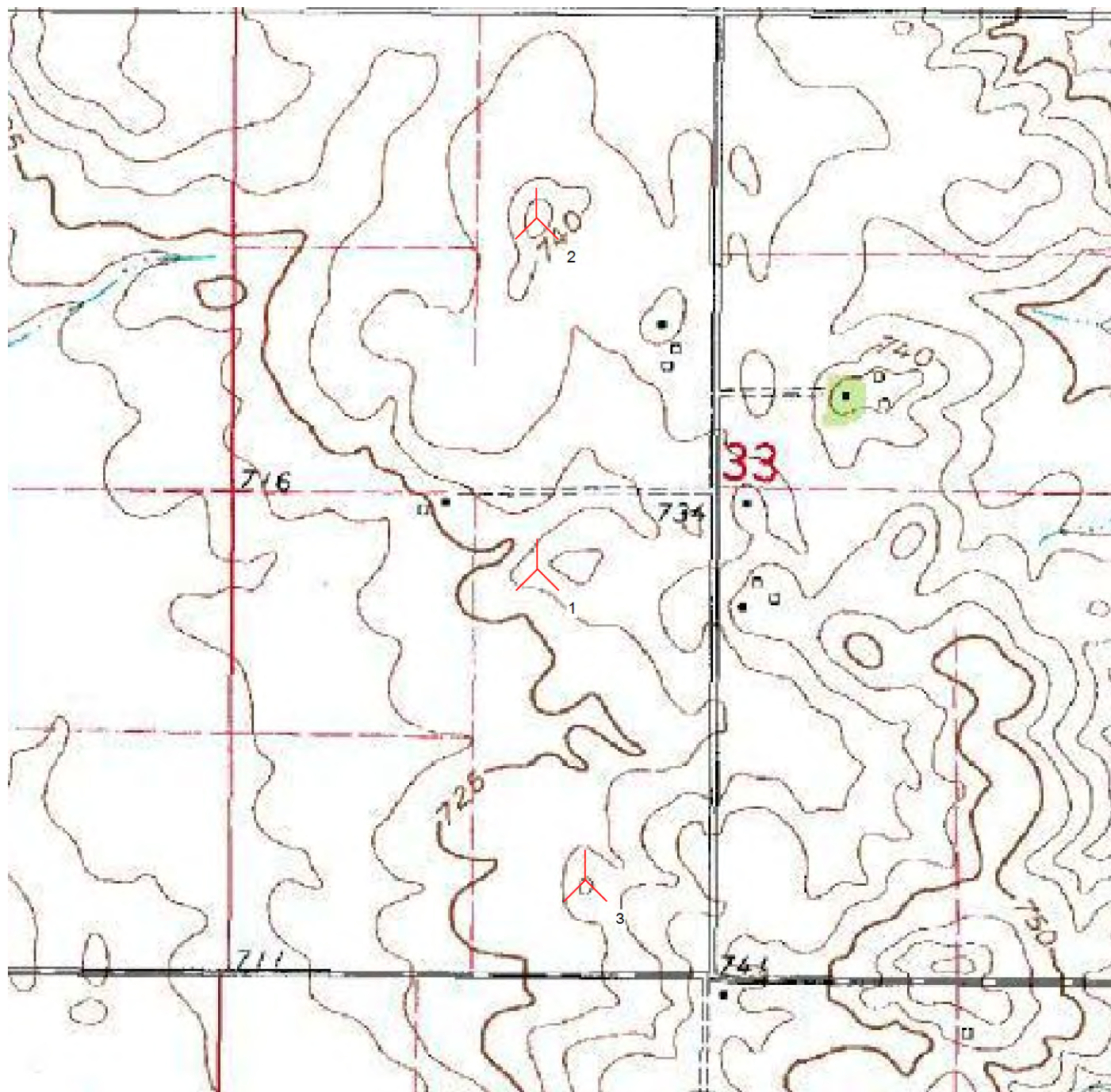
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Calculated:

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PARK - 24K TOPO

Calculation: V82's Preferred Modified File: 24K TOPO.jpg



Map: , Print scale 1:10,000, Map center UTM WGS 84 Zone: 16 East: 398,242 North: 4,435,215

New WTG

Appendix C

Shadow Calculation Reports

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SHADOW - Main Result

Calculation: GE1.5s

Assumptions for shadow calculations

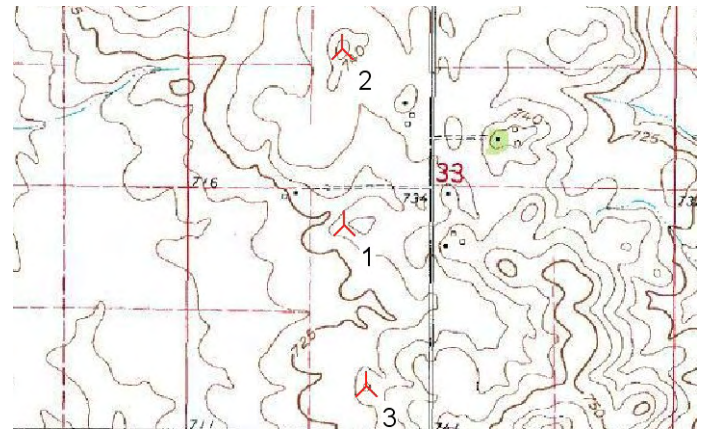
Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

To avoid flicker from WTGs not visible a ZVI calculation is performed before the flicker calculation. The ZVI calculation is based on the following assumptions

Height contours used: HC
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



New WTG

WTGs

	UTM WGS84 Zone: 16			Row data/Description	WTG type		Type	Power [kW]	Diam. [m]	Height [m]	Shadow data	
	East	North	Z [m]		Valid	Manufact.					Calculation distance [m]	RPM [RPM]
1	398,208	4,435,187	224.6	1	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	2,000	20.0
2	398,203	4,435,770	227.0	2	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	2,000	20.0
3	398,282	4,434,657	225.0	3	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	2,000	20.0

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

No.	Name	Worst case [h/year]
1	1	0:00
2	2	0:00
3	3	0:00

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SHADOW - Calendar per WTG

Calculation: GE1.5s WTG: 1 - 1

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:16	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:04	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:44	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
8	07:16	06:56	06:17	06:27	05:46	05:24	05:31	05:57	06:27	06:56	06:30	07:02
	16:44	17:20	17:52	19:23	19:53	20:20	20:25	20:01	19:16	18:26	16:44	16:28
9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
	16:45	17:21	17:53	19:24	19:54	20:20	20:25	20:00	19:15	18:24	16:43	16:28
10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:47	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
	16:49	17:25	17:56	19:27	19:57	20:22	20:24	19:56	19:10	18:19	16:40	16:28
13	07:15	06:50	06:09	06:20	05:41	05:24	05:35	06:02	06:32	07:01	06:36	07:06
	16:50	17:26	17:57	19:28	19:58	20:22	20:23	19:55	19:08	18:18	16:39	16:28
14	07:14	06:48	06:08	06:18	05:40	05:24	05:36	06:03	06:33	07:02	06:37	07:07
	16:51	17:27	17:58	19:29	19:59	20:23	20:23	19:54	19:07	18:16	16:38	16:28
15	07:14	06:47	06:06	06:17	05:39	05:24	05:36	06:04	06:33	07:03	06:38	07:08
	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
16	07:13	06:46	06:04	06:15	05:38	05:24	05:37	06:05	06:34	07:04	06:39	07:08
	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
	16:54	17:31	18:01	19:32	20:02	20:24	20:21	19:50	19:02	18:12	16:36	16:29
18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:20	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
	16:57	17:34	18:04	19:35	20:05	20:25	20:19	19:45	18:55	18:07	16:34	16:30
21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:18	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:12
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
	17:02	17:39	18:08	19:39	20:09	20:26	20:16	19:40	18:48	18:02	16:31	16:32
25	07:08	06:34	05:50	06:02	05:30	05:25	05:44	06:14	06:43	06:14	06:49	07:13
	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
26	07:08	06:32	05:48	06:01	05:30	05:26	05:45	06:15	06:44	06:15	06:50	07:14
	17:04	17:41	18:10	19:41	20:10	20:26	20:15	19:37	18:45	16:59	16:30	16:34
27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
	17:07	17:43	18:12	19:43	20:12	20:26	20:13	19:34	18:42	16:57	16:30	16:35
29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
	17:08		18:13	19:44	20:13	20:26	20:12	19:32	18:40	16:55	16:29	16:36
30	07:04		05:42	05:55	05:28	05:27	05:49	06:18	06:48	06:19	06:54	07:15
	17:09		18:14	19:45	20:14	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	445	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

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+1 701 775 5507

Calculated:

09/21/2007 8:19 AM/2.5.7.80

SHADOW - Calendar per WTG

Calculation: GE1.5s WTG: 2 - 2

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:17	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:04	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:43	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
8	07:16	06:56	06:17	06:27	05:46	05:24	05:31	05:57	06:27	06:56	06:30	07:02
	16:44	17:20	17:52	19:23	19:53	20:20	20:25	20:01	19:16	18:26	16:44	16:28
9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
	16:45	17:21	17:53	19:24	19:54	20:20	20:25	20:00	19:15	18:24	16:43	16:28
10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:47	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
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13	07:15	06:50	06:09	06:20	05:40	05:24	05:35	06:02	06:32	07:01	06:36	07:06
	16:50	17:26	17:57	19:28	19:58	20:23	20:23	19:55	19:08	18:18	16:39	16:28
14	07:14	06:48	06:08	06:18	05:40	05:24	05:36	06:03	06:33	07:02	06:37	07:07
	16:51	17:27	17:58	19:29	19:59	20:23	20:23	19:54	19:07	18:16	16:38	16:28
15	07:14	06:47	06:06	06:17	05:39	05:24	05:36	06:04	06:33	07:03	06:38	07:08
	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
16	07:13	06:46	06:04	06:15	05:38	05:24	05:37	06:05	06:34	07:04	06:39	07:08
	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
	16:54	17:31	18:01	19:32	20:02	20:24	20:21	19:50	19:02	18:12	16:36	16:29
18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:21	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
	16:57	17:34	18:04	19:35	20:05	20:25	20:19	19:45	18:55	18:07	16:34	16:30
21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:19	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:13
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
	17:02	17:39	18:08	19:39	20:09	20:26	20:16	19:40	18:48	18:02	16:31	16:32
25	07:08	06:34	05:50	06:02	05:30	05:25	05:44	06:14	06:43	06:14	06:49	07:13
	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
26	07:08	06:32	05:48	06:01	05:30	05:26	05:45	06:15	06:44	06:15	06:50	07:14
	17:04	17:41	18:10	19:41	20:10	20:26	20:15	19:37	18:45	16:59	16:30	16:34
27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
	17:07	17:43	18:12	19:43	20:12	20:26	20:13	19:34	18:42	16:57	16:30	16:35
29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
	17:08		18:13	19:44	20:13	20:26	20:12	19:32	18:40	16:55	16:29	16:36
30	07:04		05:42	05:55	05:28	05:27	05:49	06:18	06:48	06:19	06:54	07:15
	17:09		18:14	19:45	20:14	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	446	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

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Calculated:

09/21/2007 8:19 AM/2.5.7.80

SHADOW - Calendar per WTG

Calculation: GE1.5s WTG: 3 - 3

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:16	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:03	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:44	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
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9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
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10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:48	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
	16:49	17:25	17:56	19:27	19:57	20:22	20:24	19:56	19:10	18:19	16:40	16:28
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	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
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	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
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18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:20	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
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21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:18	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:12
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
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	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
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27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
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29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
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	17:09		18:14	19:45	20:13	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	445	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

Project:

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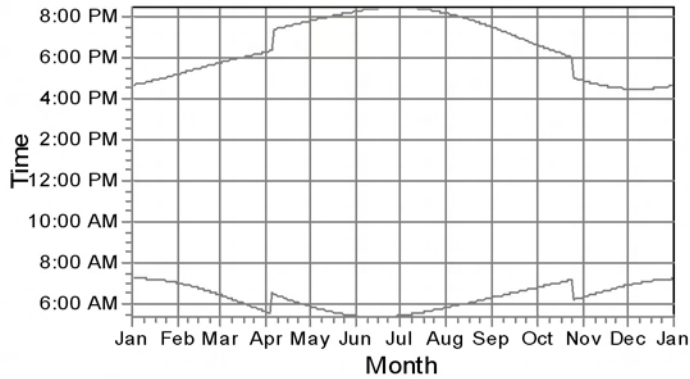
Calculated:

09/21/2007 8:19 AM/2.5.7.80

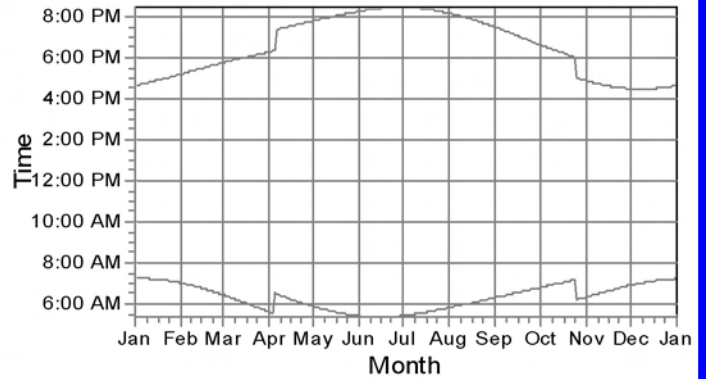
SHADOW - Calendar per WTG, graphical

Calculation: GE1.5s

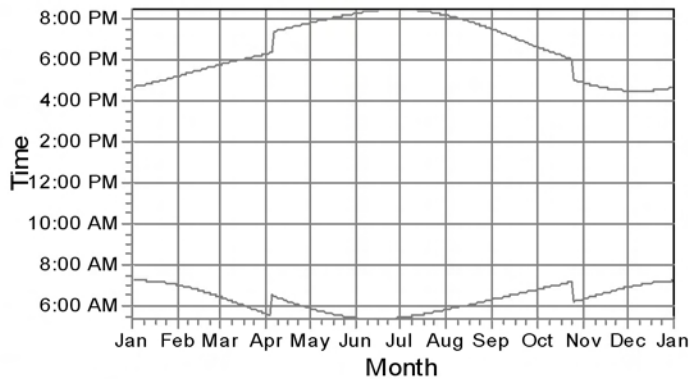
1: 1



2: 2



3: 3



Shadow receptor

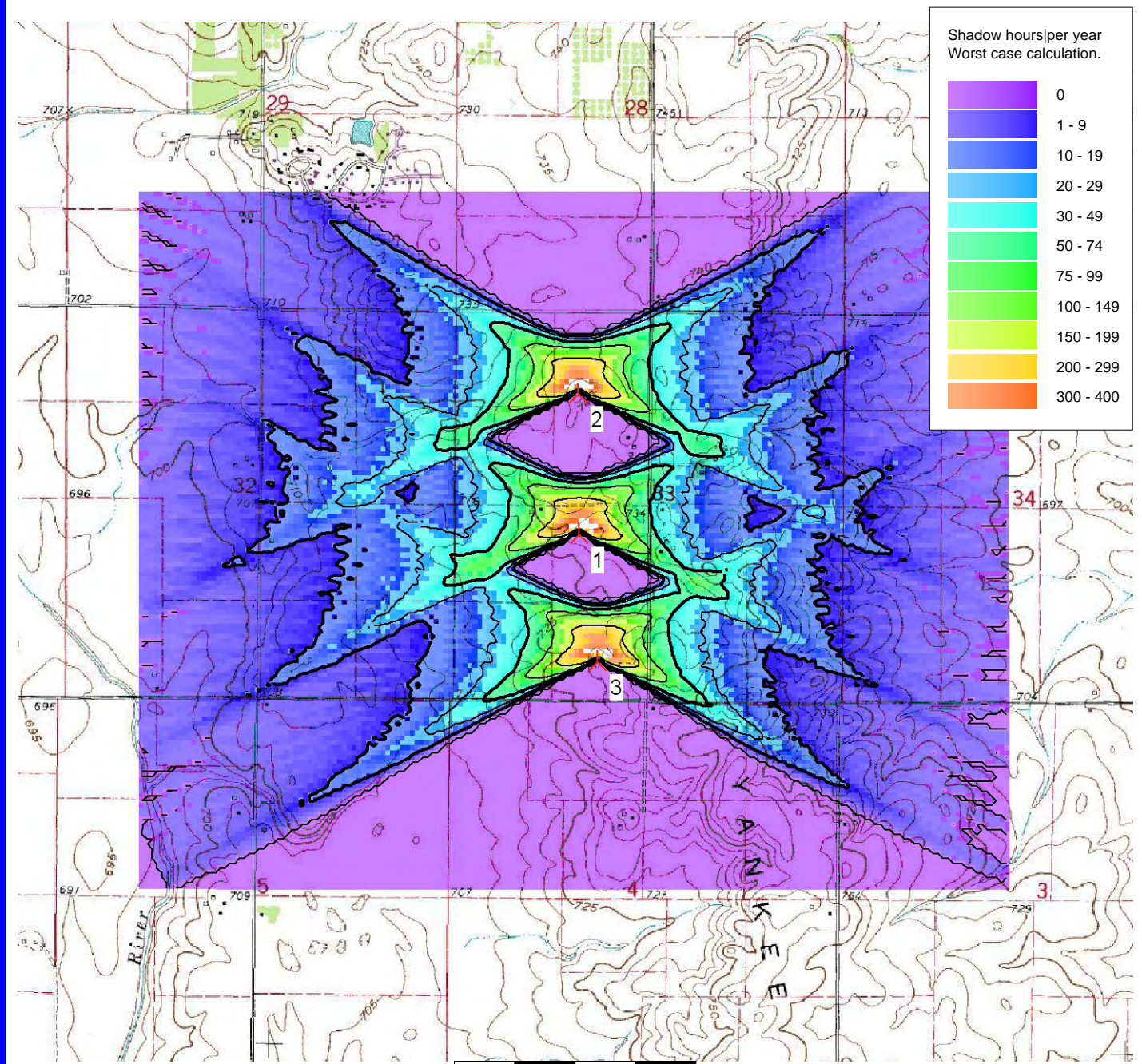
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SHADOW - 24K TOPO

Calculation: GE1.5s File: 24K TOPO.jpg



0 250 500 750 1000m

Map: , Print scale 1:25,000, Map center UTM WGS 84 Zone: 16 East: 398,187 North: 4,435,162

New WTG

Isolines showing shadow in Shadow hours per year. Worst case calculation.

0 10 25 50 100 200

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SHADOW - Main Result

Calculation: V82

Assumptions for shadow calculations

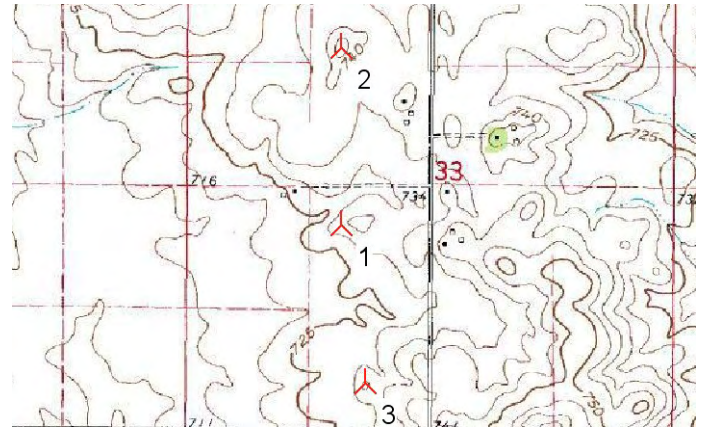
Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

To avoid flicker from WTGs not visible a ZVI calculation is performed before the flicker calculation. The ZVI calculation is based on the following assumptions

Height contours used: HC
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



New WTG

WTGs

UTM WGS84 Zone: 16				Row data/Description
East	North	Z [m]		
1	398,203	4,435,182	224.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (10)
2	398,202	4,435,769	227.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (11)
3	398,283	4,434,662	225.0	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (12)

WTG type			Shadow data				
Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	Calculation distance [m]	RPM [RPM]
Yes	VESTAS	NM82V82	1,650	82.0	80.0	2,000	14.4
Yes	VESTAS	NM82V82	1,650	82.0	80.0	2,000	14.4
Yes	VESTAS	NM82V82	1,650	82.0	80.0	2,000	14.4

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

No.	Name	Worst case [h/year]
1	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (10)	0:00
2	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (11)	0:00
3	VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (12)	0:00

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SHADOW - Calendar per WTG

Calculation: V82 WTG: 1 - VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (10)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:16	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:04	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:44	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
8	07:16	06:56	06:17	06:27	05:46	05:24	05:31	05:57	06:27	06:56	06:30	07:02
	16:44	17:20	17:52	19:23	19:53	20:20	20:25	20:01	19:16	18:26	16:44	16:28
9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
	16:45	17:21	17:53	19:24	19:54	20:20	20:25	20:00	19:15	18:24	16:43	16:28
10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:47	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
	16:49	17:25	17:56	19:27	19:57	20:22	20:24	19:56	19:10	18:19	16:40	16:28
13	07:15	06:50	06:09	06:20	05:41	05:24	05:35	06:02	06:32	07:01	06:36	07:06
	16:50	17:26	17:57	19:28	19:58	20:22	20:23	19:55	19:08	18:18	16:39	16:28
14	07:14	06:48	06:08	06:18	05:40	05:24	05:36	06:03	06:33	07:02	06:37	07:07
	16:51	17:27	17:58	19:29	19:59	20:23	20:23	19:54	19:07	18:16	16:38	16:28
15	07:14	06:47	06:06	06:17	05:39	05:24	05:36	06:04	06:33	07:03	06:38	07:08
	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
16	07:13	06:46	06:04	06:15	05:38	05:24	05:37	06:05	06:34	07:04	06:39	07:08
	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
	16:54	17:31	18:01	19:32	20:02	20:24	20:21	19:50	19:02	18:12	16:36	16:29
18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:20	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
	16:57	17:34	18:04	19:35	20:05	20:25	20:19	19:45	18:55	18:07	16:34	16:30
21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:18	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:12
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
	17:02	17:39	18:08	19:39	20:09	20:26	20:16	19:40	18:48	18:02	16:31	16:32
25	07:08	06:34	05:50	06:02	05:30	05:25	05:44	06:14	06:43	06:14	06:49	07:13
	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
26	07:08	06:32	05:48	06:01	05:30	05:26	05:45	06:15	06:44	06:15	06:50	07:14
	17:04	17:41	18:10	19:41	20:10	20:26	20:15	19:37	18:45	16:59	16:30	16:34
27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
	17:07	17:43	18:12	19:43	20:12	20:26	20:13	19:34	18:42	16:57	16:30	16:35
29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
	17:08		18:13	19:44	20:13	20:26	20:12	19:32	18:40	16:55	16:29	16:36
30	07:04		05:42	05:55	05:28	05:27	05:49	06:18	06:48	06:19	06:54	07:15
	17:09		18:14	19:45	20:14	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	445	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

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SHADOW - Calendar per WTG

Calculation: V82 WTG: 2 - VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (11)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:17	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:04	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:43	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
8	07:16	06:56	06:17	06:27	05:46	05:24	05:31	05:57	06:27	06:56	06:30	07:02
	16:44	17:20	17:52	19:23	19:53	20:20	20:25	20:01	19:16	18:26	16:44	16:28
9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
	16:45	17:21	17:53	19:24	19:54	20:20	20:25	20:00	19:15	18:24	16:43	16:28
10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:47	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
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	16:50	17:26	17:57	19:28	19:58	20:23	20:23	19:55	19:08	18:18	16:39	16:28
14	07:14	06:48	06:08	06:18	05:40	05:24	05:36	06:03	06:33	07:02	06:37	07:07
	16:51	17:27	17:58	19:29	19:59	20:23	20:23	19:54	19:07	18:16	16:38	16:28
15	07:14	06:47	06:06	06:17	05:39	05:24	05:36	06:04	06:33	07:03	06:38	07:08
	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
16	07:13	06:46	06:04	06:15	05:38	05:24	05:37	06:05	06:34	07:04	06:39	07:08
	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
	16:54	17:31	18:01	19:32	20:02	20:24	20:21	19:50	19:02	18:12	16:36	16:29
18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:21	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
	16:57	17:34	18:04	19:35	20:05	20:25	20:19	19:45	18:55	18:07	16:34	16:30
21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:19	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:13
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
	17:02	17:39	18:08	19:39	20:09	20:26	20:16	19:40	18:48	18:02	16:31	16:32
25	07:08	06:34	05:50	06:02	05:30	05:25	05:44	06:14	06:43	06:14	06:49	07:13
	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
26	07:08	06:32	05:48	06:01	05:30	05:26	05:45	06:15	06:44	06:15	06:50	07:14
	17:04	17:41	18:10	19:41	20:10	20:26	20:15	19:37	18:45	16:59	16:30	16:34
27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
	17:07	17:43	18:12	19:43	20:12	20:26	20:13	19:34	18:42	16:57	16:30	16:35
29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
	17:08		18:13	19:44	20:13	20:26	20:12	19:32	18:40	16:55	16:29	16:36
30	07:04		05:42	05:55	05:28	05:27	05:49	06:18	06:48	06:19	06:54	07:15
	17:09		18:14	19:45	20:14	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	446	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

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09/21/2007 9:34 AM / 4

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EAPC Architects Engineers
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 5507

Calculated:

09/21/2007 8:28 AM/2.5.7.80

SHADOW - Calendar per WTG

Calculation: V82 WTG: 3 - VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (12)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:15	07:03	06:28	05:38	05:54	05:27	05:28	05:51	06:20	06:49	06:22	06:55
	16:38	17:12	17:44	18:16	19:46	20:15	20:26	20:09	19:28	18:37	16:52	16:29
2	07:16	07:02	06:26	05:37	05:53	05:26	05:28	05:52	06:21	06:50	06:23	06:56
	16:39	17:13	17:46	18:17	19:47	20:16	20:26	20:08	19:26	18:35	16:50	16:28
3	07:16	07:01	06:25	05:35	05:52	05:26	05:29	05:53	06:22	06:51	06:24	06:57
	16:40	17:14	17:47	18:18	19:48	20:16	20:26	20:07	19:24	18:34	16:49	16:28
4	07:16	07:00	06:23	05:34	05:50	05:25	05:29	05:54	06:23	06:52	06:25	06:58
	16:41	17:15	17:48	18:19	19:49	20:17	20:26	20:06	19:23	18:32	16:48	16:28
5	07:16	06:59	06:22	06:32	05:49	05:25	05:30	05:55	06:24	06:53	06:26	06:59
	16:42	17:16	17:49	18:20	19:50	20:18	20:26	20:05	19:21	18:30	16:47	16:28
6	07:16	06:58	06:20	06:30	05:48	05:25	05:30	05:55	06:25	06:54	06:27	07:00
	16:43	17:18	17:50	19:21	19:51	20:19	20:26	20:03	19:20	18:29	16:46	16:28
7	07:16	06:57	06:19	06:29	05:47	05:25	05:31	05:56	06:26	06:55	06:29	07:01
	16:44	17:19	17:51	19:22	19:52	20:19	20:25	20:02	19:18	18:27	16:45	16:28
8	07:16	06:56	06:17	06:27	05:46	05:24	05:31	05:57	06:27	06:56	06:30	07:02
	16:44	17:20	17:52	19:23	19:53	20:20	20:25	20:01	19:16	18:26	16:44	16:28
9	07:15	06:54	06:16	06:26	05:45	05:24	05:32	05:58	06:28	06:57	06:31	07:03
	16:45	17:21	17:53	19:24	19:54	20:20	20:25	20:00	19:15	18:24	16:43	16:28
10	07:15	06:53	06:14	06:24	05:44	05:24	05:33	05:59	06:29	06:58	06:32	07:04
	16:46	17:22	17:54	19:25	19:55	20:21	20:24	19:59	19:13	18:22	16:42	16:28
11	07:15	06:52	06:12	06:23	05:43	05:24	05:33	06:00	06:30	06:59	06:33	07:05
	16:48	17:24	17:55	19:26	19:56	20:21	20:24	19:58	19:11	18:21	16:41	16:28
12	07:15	06:51	06:11	06:21	05:42	05:24	05:34	06:01	06:31	07:00	06:34	07:05
	16:49	17:25	17:56	19:27	19:57	20:22	20:24	19:56	19:10	18:19	16:40	16:28
13	07:14	06:50	06:09	06:20	05:41	05:24	05:35	06:02	06:32	07:01	06:35	07:06
	16:50	17:26	17:57	19:28	19:58	20:22	20:23	19:55	19:08	18:18	16:39	16:28
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	16:51	17:27	17:58	19:29	19:59	20:23	20:23	19:54	19:07	18:16	16:38	16:28
15	07:14	06:47	06:06	06:17	05:39	05:24	05:36	06:04	06:33	07:03	06:38	07:08
	16:52	17:28	17:59	19:30	20:00	20:23	20:22	19:52	19:05	18:15	16:37	16:29
16	07:13	06:46	06:04	06:15	05:38	05:24	05:37	06:05	06:34	07:04	06:39	07:08
	16:53	17:30	18:01	19:31	20:01	20:24	20:22	19:51	19:03	18:13	16:37	16:29
17	07:13	06:45	06:03	06:14	05:37	05:24	05:38	06:06	06:35	07:05	06:40	07:09
	16:54	17:31	18:01	19:32	20:02	20:24	20:21	19:50	19:02	18:12	16:36	16:29
18	07:13	06:43	06:01	06:12	05:36	05:24	05:39	06:07	06:36	07:06	06:41	07:10
	16:55	17:32	18:02	19:33	20:03	20:25	20:20	19:48	19:00	18:10	16:35	16:30
19	07:12	06:42	06:00	06:11	05:35	05:24	05:39	06:08	06:37	07:07	06:42	07:10
	16:56	17:33	18:03	19:34	20:04	20:25	20:20	19:47	18:57	18:09	16:34	16:30
20	07:12	06:41	05:58	06:09	05:34	05:24	05:40	06:09	06:38	07:08	06:44	07:11
	16:57	17:34	18:04	19:35	20:05	20:25	20:19	19:45	18:55	18:07	16:34	16:30
21	07:11	06:39	05:56	06:08	05:33	05:24	05:41	06:10	06:39	07:09	06:45	07:11
	16:59	17:35	18:05	19:36	20:06	20:25	20:18	19:44	18:53	18:06	16:33	16:31
22	07:10	06:38	05:55	06:06	05:33	05:24	05:42	06:11	06:40	07:11	06:46	07:12
	17:00	17:37	18:06	19:37	20:07	20:26	20:18	19:43	18:52	18:05	16:32	16:31
23	07:10	06:37	05:53	06:05	05:32	05:25	05:43	06:12	06:41	07:12	06:47	07:12
	17:01	17:38	18:07	19:38	20:08	20:26	20:17	19:41	18:50	18:03	16:32	16:32
24	07:09	06:35	05:51	06:03	05:31	05:25	05:44	06:13	06:42	07:13	06:48	07:13
	17:02	17:39	18:08	19:39	20:09	20:26	20:16	19:40	18:48	18:02	16:31	16:32
25	07:08	06:34	05:50	06:02	05:31	05:25	05:44	06:14	06:43	06:14	06:49	07:13
	17:03	17:40	18:09	19:40	20:09	20:26	20:15	19:38	18:47	17:01	16:31	16:33
26	07:08	06:32	05:48	06:01	05:30	05:26	05:45	06:15	06:44	06:15	06:50	07:14
	17:04	17:41	18:10	19:41	20:10	20:26	20:15	19:37	18:45	16:59	16:30	16:34
27	07:07	06:31	05:47	05:59	05:29	05:26	05:46	06:16	06:45	06:16	06:51	07:14
	17:06	17:42	18:11	19:42	20:11	20:26	20:14	19:35	18:43	16:58	16:30	16:34
28	07:06	06:29	05:45	05:58	05:29	05:26	05:47	06:16	06:46	06:17	06:52	07:14
	17:07	17:43	18:12	19:43	20:12	20:26	20:13	19:34	18:42	16:57	16:30	16:35
29	07:05		05:43	05:57	05:28	05:27	05:48	06:17	06:47	06:18	06:53	07:15
	17:08		18:13	19:44	20:13	20:26	20:12	19:32	18:40	16:55	16:29	16:36
30	07:04		05:42	05:55	05:28	05:27	05:49	06:18	06:48	06:19	06:54	07:15
	17:09		18:14	19:45	20:13	20:26	20:11	19:31	18:38	16:54	16:29	16:36
31	07:04		05:40		05:27		05:50	06:19		06:21		07:15
	17:10		18:15		20:14		20:10	19:29		16:53		16:37
Potential sun hours	300	299	370	397	445	449	456	426	375	346	300	291
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	Minutes with flicker

Project:

southcampus windstudy

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09/21/2007 9:34 AM / 5

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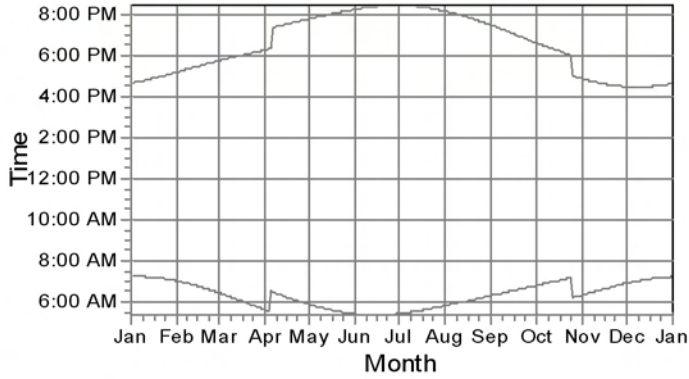
Calculated:

09/21/2007 8:28 AM/2.5.7.80

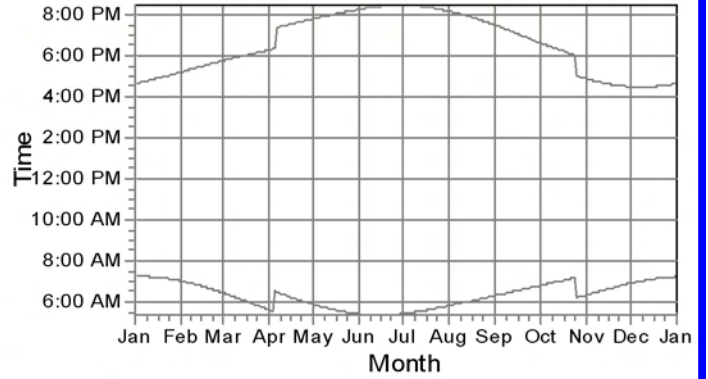
SHADOW - Calendar per WTG, graphical

Calculation: V82

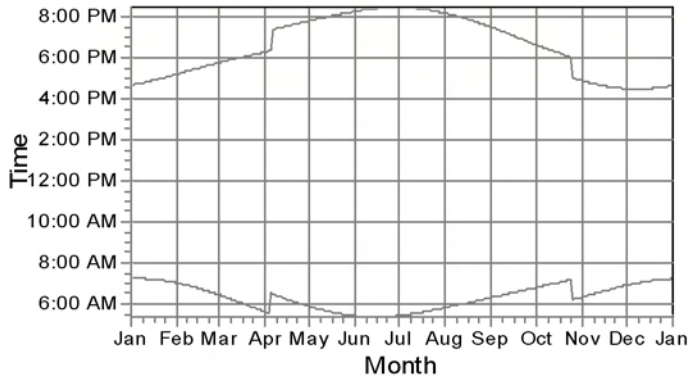
1: VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (10)



2: VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (11)



3: VESTAS NM82V82 1650 82.0 !O! hub: 80.0 m (12)



Shadow receptor

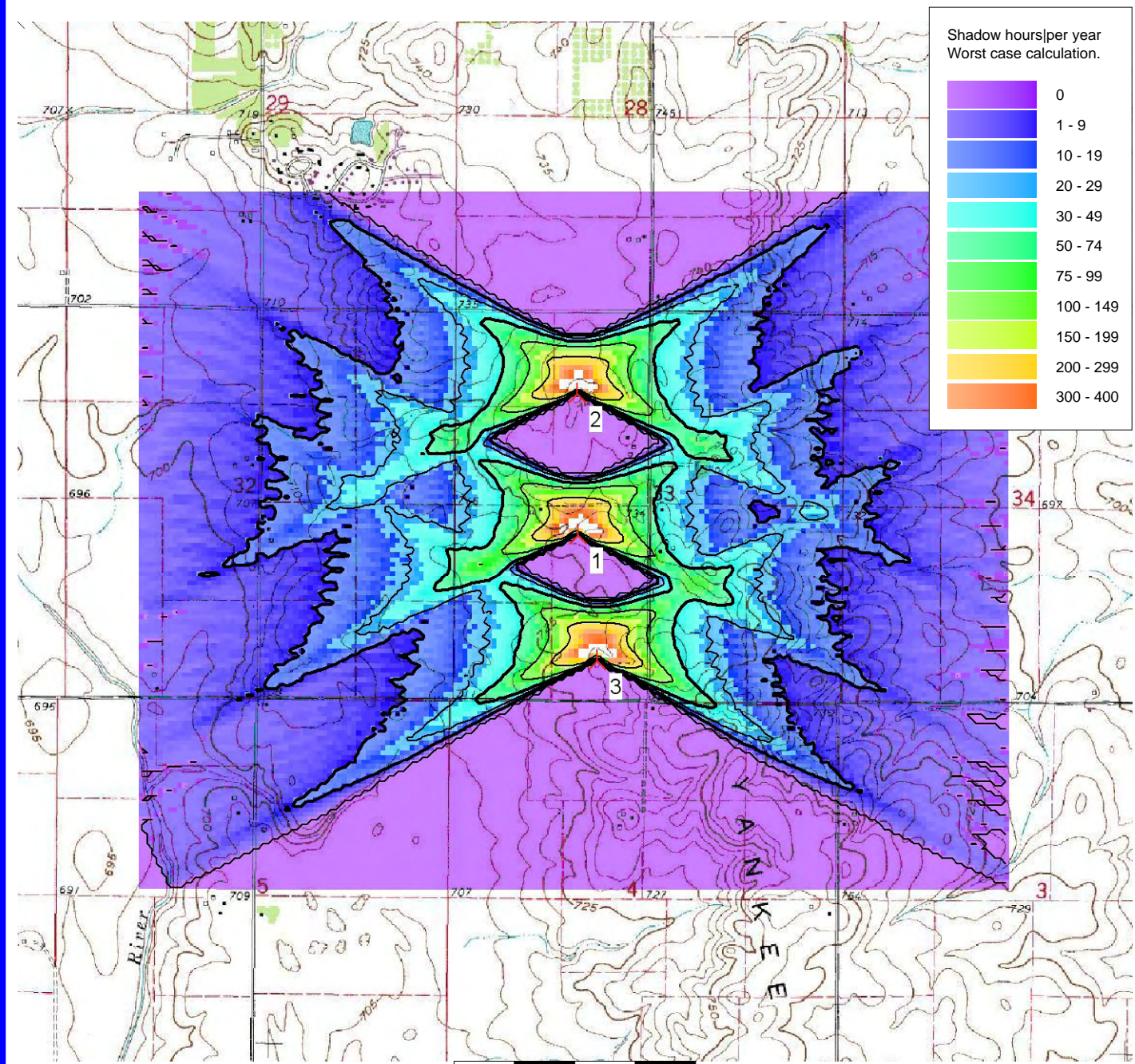
Project:
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09/21/2007 9:34 AM / 6
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Calculated:
09/21/2007 8:28 AM/2.5.7.80

SHADOW - 24K TOPO

Calculation: V82 File: 24K TOPO.jpg



0 250 500 750 1000m

Map: , Print scale 1:25,000, Map center UTM WGS 84 Zone: 16 East: 398,187 North: 4,435,162

New WTG

Isolines showing shadow in Shadow hours per year. Worst case calculation.

0 10 25 50 100 200

Appendix D

Noise Study

Project:

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10/12/2007 9:40 AM / 1

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Jay Haley

Calculated:

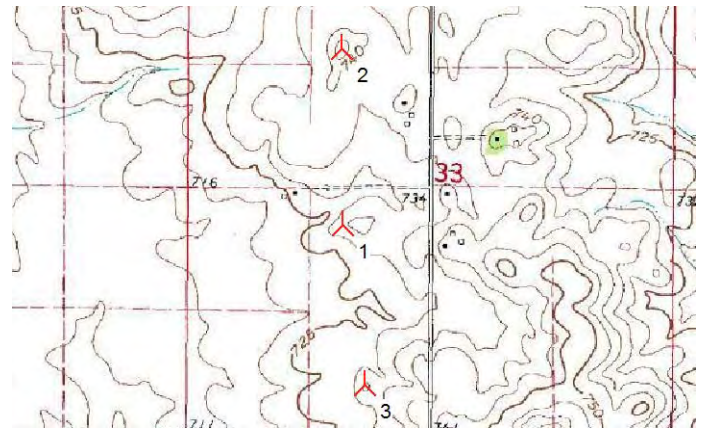
09/21/2007 8:42 AM/2.5.7.80

DECIBEL - Main Result

Calculation: GE1.5s

DANISH RULES FOR NOISE CALCULATION.

The calculation is based on the "Bekendtgørelse nr. 304 af 14. maj 91" from the Danish Environmental Agency.



Scale 1:25,000

New WTG

WTGs

UTM WGS84 Zone: 16				WTG type		Noise data											
East	North	Z	Row data/Description	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	Circle radius [m]	Circle radius [m]	Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data
1 398,208	4,435,187	224.6	1	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - - Standard operation - 01-2005	8.0	104.0	No	No
2 398,203	4,435,770	227.0	2	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - - Standard operation - 01-2005	8.0	104.0	No	No
3 398,282	4,434,657	225.0	3	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	304.0	135.0	EMD	Level 0 - - Standard operation - 01-2005	8.0	104.0	No	No

Calculation Results

Distances (m)

WTG
 1
 2
 3

Project:

southcampus windstudy

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10/12/2007 9:40 AM / 2

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Jay Haley

Calculated:

09/21/2007 8:42 AM/2.5.7.80

DECIBEL - Assumptions for noise calculation

Calculation: GE1.5s

Noise calculation model:

Danish Codes

Wind speed:

8.0 m/s

Ground attenuation:

None

Meteorological coefficient, C0:

0.0 dB

Type of demand in calculation:

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

Noise values in calculation:

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

Pure tones:

Pure tone penalty are added to demand: 5.0 m/s

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

0.0 m Don't allow override of model height with height from NSA object

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

0.0 dB(A)

Octave data not required

Air absorption: 5.0 dB/km

WTG: GE WIND ENERGY GE 1.5sle 1500 77.0 !O!**Noise:** Level 0 - - Standard operation - 01-2005

Source	Source/Date	Creator	Edited
Manufacturer	01/07/2005	EMD	06/27/2005 11:37 AM

+/- 2dB per IEC 61400-14 CDV

Status	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
From Windcat	8.0	104.0	No

Project:

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10/12/2007 9:40 AM / 3

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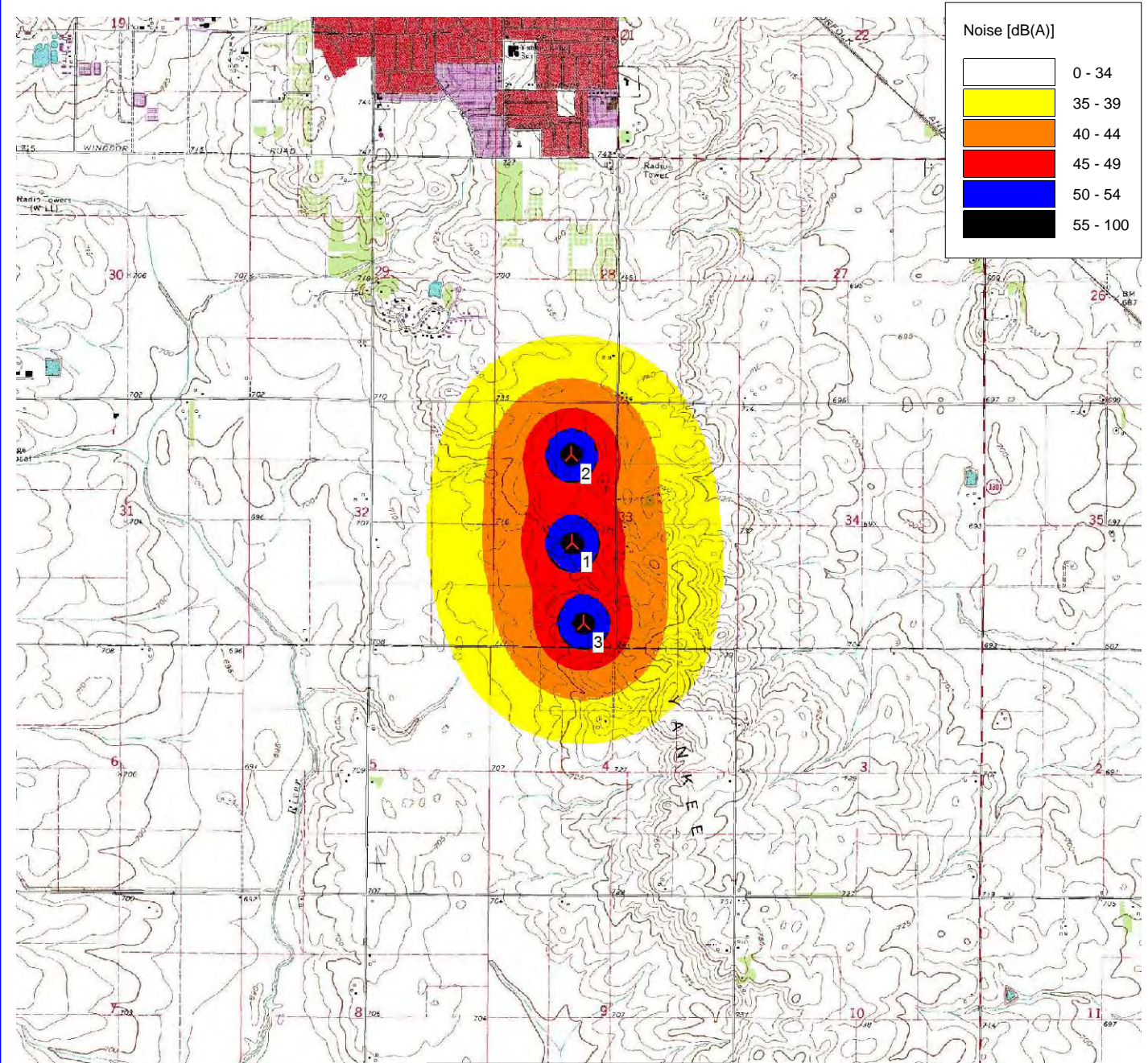
Jay Haley

Calculated:

09/21/2007 8:42 AM/2.5.7.80

DECIBEL - 24K TOPO

Calculation: GE1.5s File: 24K TOPO.jpg



0 500 1000 1500 2000 m

Map: , Print scale 1:40,000, Map center UTM WGS 84 Zone: 16 East: 398,242 North: 4,435,214

Noise calculation model: Danish Codes. Wind speed: 8.0 m/s

▲ New WTG

— 35.0 dB(A)

— 40.0 dB(A)

Height above sea level from active line object

— 45.0 dB(A)

— 50.0 dB(A)

— 55.0 dB(A)

Project:

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12/06/2006 12:56 PM / 1

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 +1 701 775 5507

Calculated:

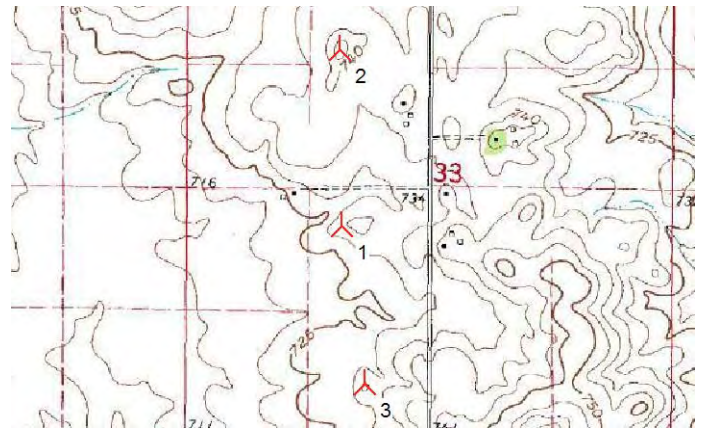
12/06/2006 9:39 AM/2.5.5.74

DECIBEL - Main Result

Calculation: Preferred Modified

DANISH RULES FOR NOISE CALCULATION.

The calculation is based on the "Bekendtgørelse nr. 304 af 14. maj 91" from the Danish Environmental Agency.



X New WTG

WTGs

UTM WGS84 Zone: 16			WTG type			Noise data												
East	North	Z	Row data/Description	Valid	Manufact.	Type	Power	Diam.	Height	Circle radius	Circle radius	Creator	Name	Wind speed	Hub height	LwA,ref	Pure tones	Octave data
[m]						[kW]	[m]	[m]	[m]	[m]	[m]			[m/s]	[m]	[dB(A)]		
1	398,207	4,435,186	225 VESTAS NM82V82 165...	Yes	VESTAS	NM82V82	1,650	82.0	80.0	304.0	135.0	EMD	Level 0 --- 11-2004	8.0	80.0	103.2	No	No
2	398,202	4,435,769	227 VESTAS NM82V82 165...	Yes	VESTAS	NM82V82	1,650	82.0	80.0	304.0	135.0	EMD	Level 0 --- 11-2004	8.0	80.0	103.2	No	No
3	398,283	4,434,662	225 VESTAS NM82V82 165...	Yes	VESTAS	NM82V82	1,650	82.0	80.0	304.0	135.0	EMD	Level 0 --- 11-2004	8.0	80.0	103.2	No	No

Calculation Results

Distances (m)

- WTG
- 1
- 2
- 3

Project:

southcampus windstudy

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Calculated:

12/06/2006 9:39 AM/2.5.5.74

DECIBEL - Assumptions for noise calculation

Calculation: Preferred Modified

Noise calculation model:

Danish Codes

Wind speed:

8.0 m/s

Ground attenuation:

None

Meteorological coefficient, C0:

0.0 dB

Type of demand in calculation:

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

Noise values in calculation:

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

Pure tones:

Pure tone penalty are added to demand: 5.0 m/s

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

0.0 m Don't allow override of model height with height from NSA object

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

0.0 dB(A)

Octave data not required

Air absorption: 5.0 dB/km

WTG: VESTAS NM82V82 1650 82.0 !O!

Noise: Level 0 - - - 11-2004

Source	Source/Date	Creator	Edited
Manufacturer	11/30/2004	EMD	06/24/2005 3:40 PM

Verification Report: WTSE03007B2

Status	Hub height	Wind speed	LwA,ref	Pure tones
	[m]	[m/s]	[dB(A)]	
Original	80.0	8.0	103.2	No

Project:

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12/06/2006 12:56 PM / 3

Licensed user:

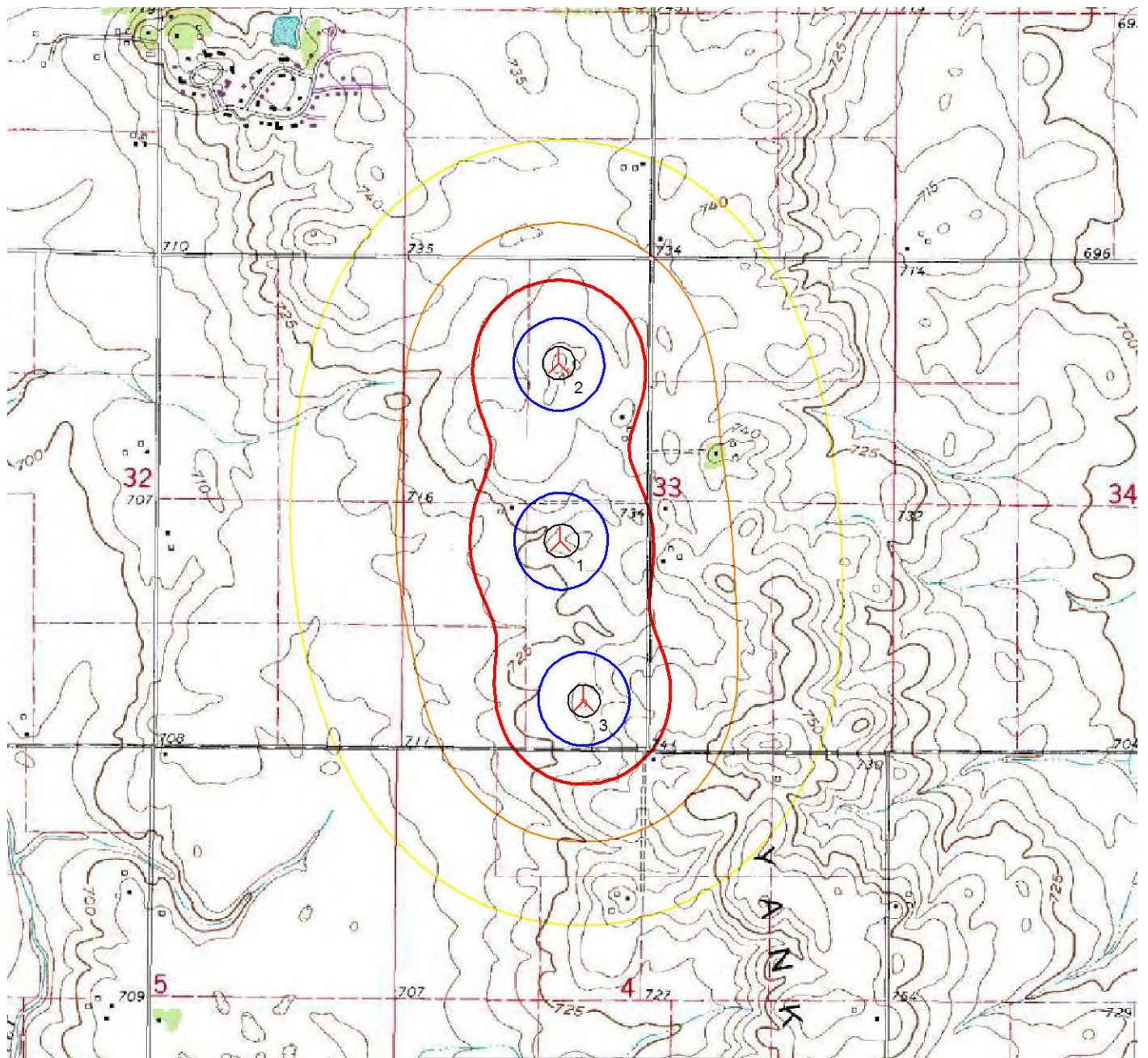
EAPC Architects Engineers
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 5507

Calculated:

12/06/2006 9:39 AM/2.5.5.74

DECIBEL - 24K TOPO

Calculation: Preferred Modified File: 24K TOPO.jpg



Map: , Print scale 1:20,000, Map center UTM WGS 84 Zone: 16 East: 398,242 North: 4,435,215
Noise calculation model: Danish Codes. Wind speed: 8.0 m/s

▲ New WTG

— 35.0 dB(A)

— 40.0 dB(A)

Height above sea level from active line object

— 45.0 dB(A)

— 50.0 dB(A)

— 55.0 dB(A)

Appendix E

FAA Submittals

My Cases in ACCEPTED Status

All Cases	Filter by Case Status	Cases Requiring Action
Show All Cases (144)	Draft (0) Accepted (3) Work in Progress (0) Determined (141) Circularized (0) Terminated (0)	7460-2 Required (71) Add Letter (0)

Records 1 to 3 of 3

Page 1 of 1

Project Name	Structure Name	ASN	Status	Date Accepted	Date Determined	City	State
UNIVE-000056400-06	South Campus11	2006-AGL-10179-OE	Accepted	12/21/2006		Champaign	IL
UNIVE-000056400-06	South Campus10	2006-AGL-10178-OE	Accepted	12/21/2006		Champaign	IL
UNIVE-000056400-06	South Campus12	2006-AGL-10180-OE	Accepted	12/21/2006		Champaign	IL

Rows per Page: 20

Records 1 to 3 of 3

Page: 1

Page 1 of 1

Notice of Proposed Construction or Alteration (7460-1)

Project Name: UNIVE-000056400-06

Sponsor: University of Illinois

Details for Case : South Campus10

[Show Project Summary](#)

Case Status		Date Accepted: 12/21/2006	
ASN: 2006-AGL-10178-OE		Date Determined:	
Status: Accepted		Letters:	None
Construction / Alteration Information		Structure Summary	
Notice Of: Construction		Structure Name: South Campus10	
Duration: Permanent		Structure Type: Wind Turbine	
<i>if Temporary :</i> Months: Days:		<i>Other :</i>	
Work Schedule - Start: 08/01/2007		FCC Number:	
Work Schedule - End: 12/31/2007		Prior ASN:	
State Filing: Not filed with State			
Structure Details		Common Frequency Bands	
Latitude: 40° 3' 38.69" N		Low Freq	High Freq Freq Unit ERP ERP Unit
Longitude: 88° 11' 36.99" W		Specific Frequencies	
Horizontal Datum: NAD83			
Site Elevation (SE): 735 (nearest foot)			
Structure Height (AGL): 398 (nearest foot)			
Marking/Lighting: Dual-red and medium intensity			
<i>Other :</i>			
Nearest City: Champaign			
Nearest State: Illinois			
Traverseway: Public Highway			
Description of Location: Farm land			
Description of Proposal: One of three wind turbines			

Notice of Proposed Construction or Alteration (7460-1)

Project Name: UNIVE-000056400-06

Sponsor: University of Illinois

Details for Case : South Campus11

[Show Project Summary](#)

Case Status		Date Accepted: 12/21/2006	
ASN: 2006-AGL-10179-OE		Date Determined:	
Status: Accepted		Letters:	None
Construction / Alteration Information		Structure Summary	
Notice Of: Construction		Structure Name: South Campus11	
Duration: Permanent		Structure Type: Wind Turbine	
<i>if Temporary :</i> Months: Days:		<i>Other :</i>	
Work Schedule - Start: 08/01/2007		FCC Number:	
Work Schedule - End: 12/31/2007		Prior ASN:	
State Filing: Not filed with State			
Structure Details		Common Frequency Bands	
Latitude: 40° 3' 57.72" N		Low Freq	High Freq Freq Unit ERP ERP Unit
Longitude: 88° 11' 37.37" W		Specific Frequencies	
Horizontal Datum: NAD83			
Site Elevation (SE): 745 (nearest foot)			
Structure Height (AGL): 398 (nearest foot)			
Marking/Lighting: Dual-red and medium intensity			
<i>Other :</i>			
Nearest City: Champaign			
Nearest State: Illinois			
Traverseway: Public Highway			
Description of Location: Farm land			
Description of Proposal: One of three wind turbines			

Notice of Proposed Construction or Alteration (7460-1)

Project Name: UNIVE-000056400-06

Sponsor: University of Illinois

Details for Case : South Campus12

[Show Project Summary](#)

Case Status		Date Accepted: 12/21/2006	
ASN: 2006-AGL-10180-OE		Date Determined:	
Status: Accepted		Letters:	None
Construction / Alteration Information		Structure Summary	
Notice Of: Construction		Structure Name: South Campus12	
Duration: Permanent		Structure Type: Wind Turbine	
<i>if Temporary :</i> Months: Days:		<i>Other :</i>	
Work Schedule - Start: 08/01/2007		FCC Number:	
Work Schedule - End: 12/31/2007		Prior ASN:	
State Filing: Not filed with State			
Structure Details		Common Frequency Bands	
Latitude: 40° 3' 21.86" N		Low Freq	High Freq Freq Unit ERP ERP Unit
Longitude: 88° 11' 33.32" W		Specific Frequencies	
Horizontal Datum: NAD83			
Site Elevation (SE): 738 (nearest foot)			
Structure Height (AGL): 398 (nearest foot)			
Marking/Lighting: Dual-red and medium intensity			
<i>Other :</i>			
Nearest City: Champaign			
Nearest State: Illinois			
Traverseway: Public Highway			
Description of Location: Farm land			
Description of Proposal: One of three wind turbines			



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AGL-10178-0F

Issued Date: 02/20/2007

Richard Drew
University of Illinois
1501 S. Oak St., MC-800
Champaign, IL 61820

**** NOTICE OF PRESUMED HAZARD ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 10
Location: Champaign, IL
Latitude: 40-3-38.69 N NAD 83
Longitude: 88-11-36.99 W
Heights: 398 feet above ground level (AGL)
1133 feet above mean sea level (AMSL)

Initial findings of this study indicated that the structure as described exceeds obstruction standards and/or would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities. Pending resolution of the issues described below, the structure is presumed to be a hazard to air navigation.

If the structure were reduced in height so as not to exceed 328 feet above ground level (1063 feet above mean sea level), it would not exceed obstruction standards and a favorable determination could subsequently be issued.

To receive a favorable determination at the originally submitted height, further study would be necessary.

Further study entails distribution to the public for comment, and may extend the study period up to 120 days.

The outcome cannot be predicted prior to public circularization.

If you would like the FAA to conduct further study, you must make the request within 60 days from the date of issuance of this letter.

NOTE: PENDING RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE, THE STRUCTURE IS PRESUMED TO BE A HAZARD TO AIR NAVIGATION. THIS LETTER DOES NOT AUTHORIZE CONSTRUCTION OF THE STRUCTURE EVEN AT A REDUCED HEIGHT. ANY RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE MUST BE COMMUNICATED TO THE FAA SO THAT A FAVORABLE DETERMINATION CAN SUBSEQUENTLY BE ISSUED.

IF MORE THAN 60 DAYS FROM THE DATE OF THIS LETTER HAS ELAPSED WITHOUT ATTEMPTED RESOLUTION, IT WILL BE NECESSARY FOR YOU TO REACTIVATE THE STUDY BY FILING A NEW FAA FORM 7460-1, NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION.

If we can be of further assistance, please contact our office at (718)553-2560.
On any future correspondence concerning this matter, please refer to
Aeronautical Study Number 2006-AGL-10178-OE.

Signature Control No: 496931-529699

(NPH)

William Merritt
Specialist



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AGL-10179-0F

Issued Date: 02/20/2007

Richard Drew
University of Illinois
1501 S. Oak St., MC-800
Champaign, IL 61820

**** NOTICE OF PRESUMED HAZARD ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 11
Location: Champaign, IL
Latitude: 40-3-57.72 N NAD 83
Longitude: 88-11-37.37 W
Heights: 398 feet above ground level (AGL)
1143 feet above mean sea level (AMSL)

Initial findings of this study indicated that the structure as described exceeds obstruction standards and/or would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities. Pending resolution of the issues described below, the structure is presumed to be a hazard to air navigation.

If the structure were reduced in height so as not to exceed 329 feet above ground level (1074 feet above mean sea level), it would not exceed obstruction standards and a favorable determination could subsequently be issued.

To receive a favorable determination at the originally submitted height, further study would be necessary.

Further study entails distribution to the public for comment, and may extend the study period up to 120 days.

The outcome cannot be predicted prior to public circularization.

If you would like the FAA to conduct further study, you must make the request within 60 days from the date of issuance of this letter.

See attachment for additional information.

NOTE: PENDING RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE, THE STRUCTURE IS PRESUMED TO BE A HAZARD TO AIR NAVIGATION. THIS LETTER DOES NOT AUTHORIZE CONSTRUCTION OF THE STRUCTURE EVEN AT A REDUCED HEIGHT. ANY RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE MUST BE COMMUNICATED TO THE FAA SO THAT A FAVORABLE DETERMINATION CAN SUBSEQUENTLY BE ISSUED.

IF MORE THAN 60 DAYS FROM THE DATE OF THIS LETTER HAS ELAPSED WITHOUT ATTEMPTED RESOLUTION, IT WILL BE NECESSARY FOR YOU TO REACTIVATE THE STUDY BY FILING A NEW FAA FORM 7460-1, NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION.

If we can be of further assistance, please contact our office at (718)553-2560.
On any future correspondence concerning this matter, please refer to
Aeronautical Study Number 2006-AGL-10179-OE.

Signature Control No: 496932-529700

(NPH)

William Merritt
Specialist

Attachment(s)
Additional Information

Additional Information for ASN 2006-AGL-10179-OE

Exceeds Part 77.23a(2) by 69 feet.



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AGL-10180-0F

Issued Date: 02/20/2007

Richard Drew
University of Illinois
1501 S. Oak St., MC-800
Champaign, IL 61820

**** NOTICE OF PRESUMED HAZARD ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 12
Location: Champaign, IL
Latitude: 40-3-21.86 N NAD 83
Longitude: 88-11-33.32 W
Heights: 398 feet above ground level (AGL)
1136 feet above mean sea level (AMSL)

Initial findings of this study indicated that the structure as described exceeds obstruction standards and/or would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities. Pending resolution of the issues described below, the structure is presumed to be a hazard to air navigation.

If the structure were reduced in height so as not to exceed 322 feet above ground level (1060 feet above mean sea level), it would not exceed obstruction standards and a favorable determination could subsequently be issued.

To receive a favorable determination at the originally submitted height, further study would be necessary.

Further study entails distribution to the public for comment, and may extend the study period up to 120 days.

The outcome cannot be predicted prior to public circularization.

If you would like the FAA to conduct further study, you must make the request within 60 days from the date of issuance of this letter.

See attachment for additional information.

NOTE: PENDING RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE, THE STRUCTURE IS PRESUMED TO BE A HAZARD TO AIR NAVIGATION. THIS LETTER DOES NOT AUTHORIZE CONSTRUCTION OF THE STRUCTURE EVEN AT A REDUCED HEIGHT. ANY RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE MUST BE COMMUNICATED TO THE FAA SO THAT A FAVORABLE DETERMINATION CAN SUBSEQUENTLY BE ISSUED.

IF MORE THAN 60 DAYS FROM THE DATE OF THIS LETTER HAS ELAPSED WITHOUT ATTEMPTED RESOLUTION, IT WILL BE NECESSARY FOR YOU TO REACTIVATE THE STUDY BY FILING A NEW FAA FORM 7460-1, NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION.

If we can be of further assistance, please contact our office at (718)553-2560.
On any future correspondence concerning this matter, please refer to
Aeronautical Study Number 2006-AGL-10180-OE.

Signature Control No: 496933-529701

(NPH)

William Merritt
Specialist

Attachment(s)
Additional Information

Additional Information for ASN 2006-AGL-10180-OE

Exceeds Part 77.23a(2) by 76 feet.



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AGL-10179-0F

Issued Date: 02/28/2007

Richard Drew
University of Illinois
1501 S. Oak St., MC-800
Champaign, IL 61820

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has completed an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 11
Location: Champaign, IL
Latitude: 40-3-57.72 N NAD 83
Longitude: 88-11-37.37 W
Heights: 398 feet above ground level (AGL)
1143 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4, 12 & 13

It is required that the enclosed FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

At least 10 days prior to start of construction
(7460-2, Part I)

Within 5 days after the construction reaches its greatest height
(7460-2, Part II)

See attachment for additional condition(s) or information.

This determination expires on 08/28/2008 unless:

- (a) extended, revised or terminated by the issuing office.
- (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 30, 2007. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted in triplicate to the Manager, Airspace and Rules Division - Room 423, Federal Aviation Administration, 800 Independence Ave, Washington, D.C. 20591.

This determination becomes final on April 9, 2007 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Office of Airspace and Rules via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact our office at (202)267-9219. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AGL-10179-OE.

Signature Control No: 496932-532049

(DNH)

Kevin P. Haggerty
Manager, Obstruction Evaluation Service

Attachment(s)
Additional Information
Map
7460-2 Attached

Additional Information for ASN 2006-AGL-10179-OE

Aeronautical study numbers:

2006-AGL-10178-OE, 2006-AGL-10179-OE and 2006-AGL-10180-OE

Proposal: To construct three wind turbines (WT) to a height of 398 feet above ground level (AGL), 1143 feet above mean sea level (AMSL).

Location: The proposed wind turbines would be 4.08 nautical miles (NM) east of University of Illinois - Willard Airport (CMI), Champaign/Urbana, Illinois.

Federal Aviation Regulation (FAR) Part 77 Obstruction Standards Exceeded:

Section 77.23(a)(2) by 76 feet - a height that exceeds a specified height within 5 NM of an airport reference point (ARP), as applied to CMI.

Negotiation: Negotiation was attempted with the proponent but land availability and local wind patterns dictated this location and height.

Circularization: This study is not being circularized as aviation impact is known.

Aeronautical Study Results:

The University of Illinois - Willard Airport is located 5 miles southwest of Champaign/Urbana, Illinois. The airport currently has four hard-surfaced runways with plans on file for numerous upgrades/additions. The primary instrument and calm wind runway is Runway 32R. Runway 32R/14L is 8100 feet in length, with precision markings, high intensity runway lights with MALSR's on the 32R end. Runway 32R has a precision ILS approach available and there is an operational control tower from 0600 hours to 2200 hours daily. The airport is served by commercial airlines and charter services. The airport has 337 daily average operations.

The proposed wind turbines at 4.08 NM east of the airport are to be set in a linear pattern, running north/south. The southern end (2006-AGL-10180-OE) is 4.08 NM on a bearing of 074 degrees from the CMI airport reference point (ARP) (N40-02-17.32 W088-16-40.69) while the northern end (2006-AGL-10179-OE) will be 067 degrees bearing at 4.23 NM from the CMI ARP. There would not be any adverse impact to any plan on file, including all plans for additional runways/extensions/approach procedures.

The proposed structure would not adversely impact the University of Illinois - Willard Airport traffic pattern airspace as it is beyond the traffic pattern airspace dimensions for Category A, B, C, and D type aircraft, as defined in FAA Handbook 7400.2F, Procedures for Handling Airspace Matters, Part 2, Chapter 6, paragraph 6-3-8d. There would not be a substantial adverse effect to VFR operations at Willard Airport and when these structures are properly obstruction marked and/or lighted, they will be able to be visually acquired and avoided.

The proposed structures would not adversely impact any present or future VFR or IFR terminal procedure. There is no impact to any current or future IFR procedure, arrival or departure, at University of Illinois - Willard Airport.

The proposed structures would not impact any VFR or IFR en route procedure.

The proposed structures would not have a cumulative impact on any existing or

planned airport.

These structures would exceed obstruction standards and should be obstruction marked and/or lighted as indicated and in accordance with FAA AC 70/7460-1K, Chapters 4, 12, and 13, white paint/synchronized flashing red light.





Federal Aviation Administration
 Air Traffic Airspace Branch, ASW-520
 2601 Meacham Blvd.
 Fort Worth, TX 76137-0520

Aeronautical Study No.
 2006-AGL-10178-0F

Issued Date: 02/28/2007

Richard Drew
 University of Illinois
 1501 S. Oak St., MC-800
 Champaign, IL 61820

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has completed an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 10
 Location: Champaign, IL
 Latitude: 40-3-38.69 N NAD 83
 Longitude: 88-11-36.99 W
 Heights: 398 feet above ground level (AGL)
 1133 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint only - Chapters 12 & 13

It is required that the enclosed FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

At least 10 days prior to start of construction
 (7460-2, Part I)

Within 5 days after the construction reaches its greatest height
 (7460-2, Part II)

See attachment for additional condition(s) or information.

This determination expires on 08/28/2008 unless:

- (a) extended, revised or terminated by the issuing office.
- (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION

MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 30, 2007. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted in triplicate to the Manager, Airspace and Rules Division - Room 423, Federal Aviation Administration, 800 Independence Ave, Washington, D.C. 20591.

This determination becomes final on April 9, 2007 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Office of Airspace and Rules via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact our office at (202)267-9219. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AGL-10178-OE.

Signature Control No: 496931-532053

(DNH)

Kevin P. Haggerty
Manager, Obstruction Evaluation Service

Attachment(s)
Additional Information
Map
7460-2 Attached

Additional Information for ASN 2006-AGL-10178-OE

Aeronautical study numbers:

2006-AGL-10178-OE, 2006-AGL-10179-OE and 2006-AGL-10180-OE

Proposal: To construct three wind turbines (WT) to a height of 398 feet above ground level (AGL), 1143 feet above mean sea level (AMSL).

Location: The proposed wind turbines would be 4.08 nautical miles (NM) east of University of Illinois - Willard Airport (CMI), Champaign/Urbana, Illinois.

Federal Aviation Regulation (FAR) Part 77 Obstruction Standards Exceeded:

Section 77.23(a)(2) by 76 feet - a height that exceeds a specified height within 5 NM of an airport reference point (ARP), as applied to CMI.

Negotiation: Negotiation was attempted with the proponent but land availability and local wind patterns dictated this location and height.

Circularization: This study is not being circularized as aviation impact is known.

Aeronautical Study Results:

The University of Illinois - Willard Airport is located 5 miles southwest of Champaign/Urbana, Illinois. The airport currently has four hard-surfaced runways with plans on file for numerous upgrades/additions. The primary instrument and calm wind runway is Runway 32R. Runway 32R/14L is 8100 feet in length, with precision markings, high intensity runway lights with MALSR's on the 32R end. Runway 32R has a precision ILS approach available and there is an operational control tower from 0600 hours to 2200 hours daily. The airport is served by commercial airlines and charter services. The airport has 337 daily average operations.

The proposed wind turbines at 4.08 NM east of the airport are to be set in a linear pattern, running north/south. The southern end (2006-AGL-10180-OE) is 4.08 NM on a bearing of 074 degrees from the CMI airport reference point (ARP) (N40-02-17.32 W088-16-40.69) while the northern end (2006-AGL-10179-OE) will be 067 degrees bearing at 4.23 NM from the CMI ARP. There would not be any adverse impact to any plan on file, including all plans for additional runways/extensions/approach procedures.

The proposed structure would not adversely impact the University of Illinois - Willard Airport traffic pattern airspace as it is beyond the traffic pattern airspace dimensions for Category A, B, C, and D type aircraft, as defined in FAA Handbook 7400.2F, Procedures for Handling Airspace Matters, Part 2, Chapter 6, paragraph 6-3-8d. There would not be a substantial adverse effect to VFR operations at Willard Airport and when these structures are properly obstruction marked and/or lighted, they will be able to be visually acquired and avoided.

The proposed structures would not adversely impact any present or future VFR or IFR terminal procedure. There is no impact to any current or future IFR procedure, arrival or departure, at University of Illinois - Willard Airport.

The proposed structures would not impact any VFR or IFR en route procedure.

The proposed structures would not have a cumulative impact on any existing or

planned airport.

These structures would exceed obstruction standards and should be obstruction marked and/or lighted as indicated and in accordance with FAA AC 70/7460-1K, Chapters 4, 12, and 13, white paint.





Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AGL-10180-0F

Issued Date: 02/28/2007

Richard Drew
University of Illinois
1501 S. Oak St., MC-800
Champaign, IL 61820

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has completed an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine SOUTH CAMPUS 12
Location: Champaign, IL
Latitude: 40-3-21.86 N NAD 83
Longitude: 88-11-33.32 W
Heights: 398 feet above ground level (AGL)
1136 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4, 12 & 13

It is required that the enclosed FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

At least 10 days prior to start of construction
(7460-2, Part I)

Within 5 days after the construction reaches its greatest height
(7460-2, Part II)

See attachment for additional condition(s) or information.

This determination expires on 08/28/2008 unless:

- (a) extended, revised or terminated by the issuing office.
- (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 30, 2007. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted in triplicate to the Manager, Airspace and Rules Division - Room 423, Federal Aviation Administration, 800 Independence Ave, Washington, D.C. 20591.

This determination becomes final on April 9, 2007 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Office of Airspace and Rules via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact our office at (202)267-9219. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AGL-10180-OE.

Signature Control No: 496933-532055

(DNH)

Kevin P. Haggerty
Manager, Obstruction Evaluation Service

Attachment(s)
Additional Information
Map
7460-2 Attached

Additional Information for ASN 2006-AGL-10180-OE

Aeronautical study numbers:

2006-AGL-10178-OE, 2006-AGL-10179-OE and 2006-AGL-10180-OE

Proposal: To construct three wind turbines (WT) to a height of 398 feet above ground level (AGL), 1143 feet above mean sea level (AMSL).

Location: The proposed wind turbines would be 4.08 nautical miles (NM) east of University of Illinois - Willard Airport (CMI), Champaign/Urbana, Illinois.

Federal Aviation Regulation (FAR) Part 77 Obstruction Standards Exceeded:

Section 77.23(a)(2) by 76 feet - a height that exceeds a specified height within 5 NM of an airport reference point (ARP), as applied to CMI.

Negotiation: Negotiation was attempted with the proponent but land availability and local wind patterns dictated this location and height.

Circularization: This study is not being circularized as aviation impact is known.

Aeronautical Study Results:

The University of Illinois - Willard Airport is located 5 miles southwest of Champaign/Urbana, Illinois. The airport currently has four hard-surfaced runways with plans on file for numerous upgrades/additions. The primary instrument and calm wind runway is Runway 32R. Runway 32R/14L is 8100 feet in length, with precision markings, high intensity runway lights with MALSR's on the 32R end. Runway 32R has a precision ILS approach available and there is an operational control tower from 0600 hours to 2200 hours daily. The airport is served by commercial airlines and charter services. The airport has 337 daily average operations.

The proposed wind turbines at 4.08 NM east of the airport are to be set in a linear pattern, running north/south. The southern end (2006-AGL-10180-OE) is 4.08 NM on a bearing of 074 degrees from the CMI airport reference point (ARP) (N40-02-17.32 W088-16-40.69) while the northern end (2006-AGL-10179-OE) will be 067 degrees bearing at 4.23 NM from the CMI ARP. There would not be any adverse impact to any plan on file, including all plans for additional runways/extensions/approach procedures.

The proposed structure would not adversely impact the University of Illinois - Willard Airport traffic pattern airspace as it is beyond the traffic pattern airspace dimensions for Category A, B, C, and D type aircraft, as defined in FAA Handbook 7400.2F, Procedures for Handling Airspace Matters, Part 2, Chapter 6, paragraph 6-3-8d. There would not be a substantial adverse effect to VFR operations at Willard Airport and when these structures are properly obstruction marked and/or lighted, they will be able to be visually acquired and avoided.

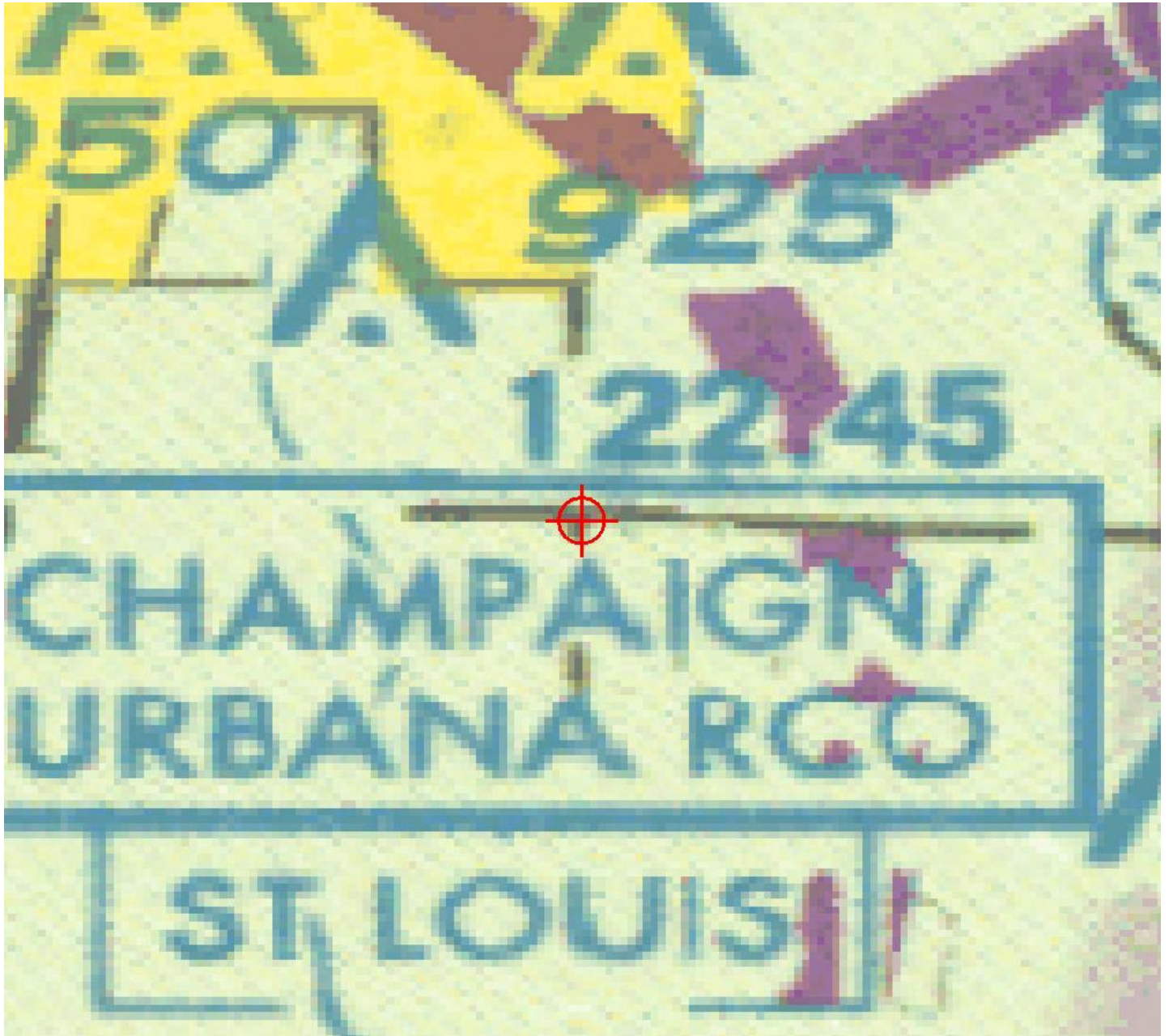
The proposed structures would not adversely impact any present or future VFR or IFR terminal procedure. There is no impact to any current or future IFR procedure, arrival or departure, at University of Illinois - Willard Airport.

The proposed structures would not impact any VFR or IFR en route procedure.

The proposed structures would not have a cumulative impact on any existing or

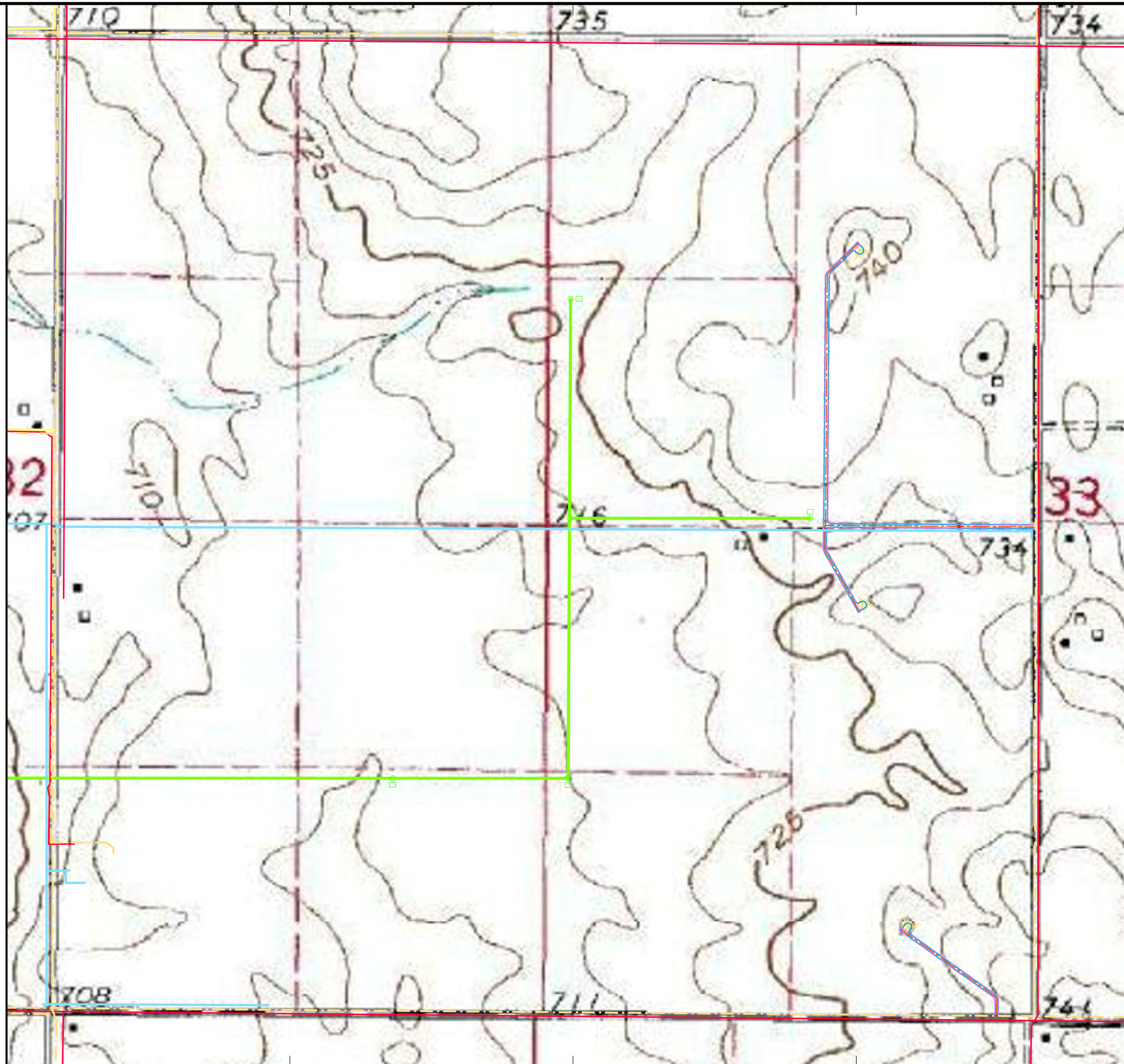
planned airport.

These structures would exceed obstruction standards and should be obstruction marked and/or lighted as indicated and in accordance with FAA AC 70/7460-1K, Chapters 4, 12, and 13, white paint/synchronized flashing red light.



Appendix F
Site Plan Drawings

File Location: P:\2006\20063390 - CHPCU South Campus Wind Farm\Drawings\20063390_T0FO.dwg
Plot Date: 19-Apr-07



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**UNIVERSITY OF
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Project Description
**SOUTH CAMPUS
WIND TURBINE
PROJECT**

CITY CHAMPAIGN
STATE ILLINOIS

Issue Dates

DD	DESCRIPTION	DATE
DD	DESIGN DEVELOPMENT	19 APR 07

MARK	DESCRIPTION	DATE

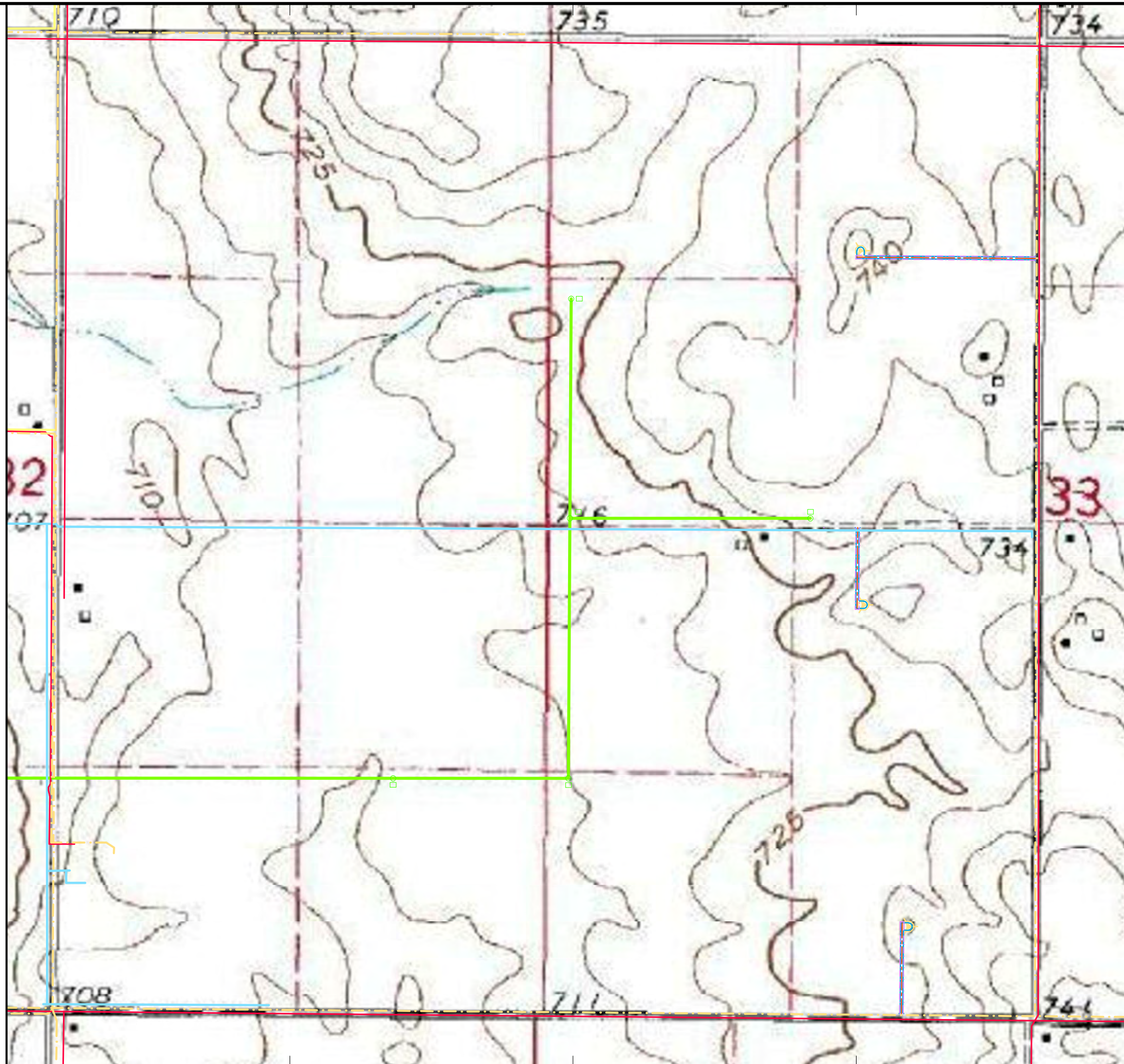
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**WIND TURBINE SITE
PLAN**

OPT 1

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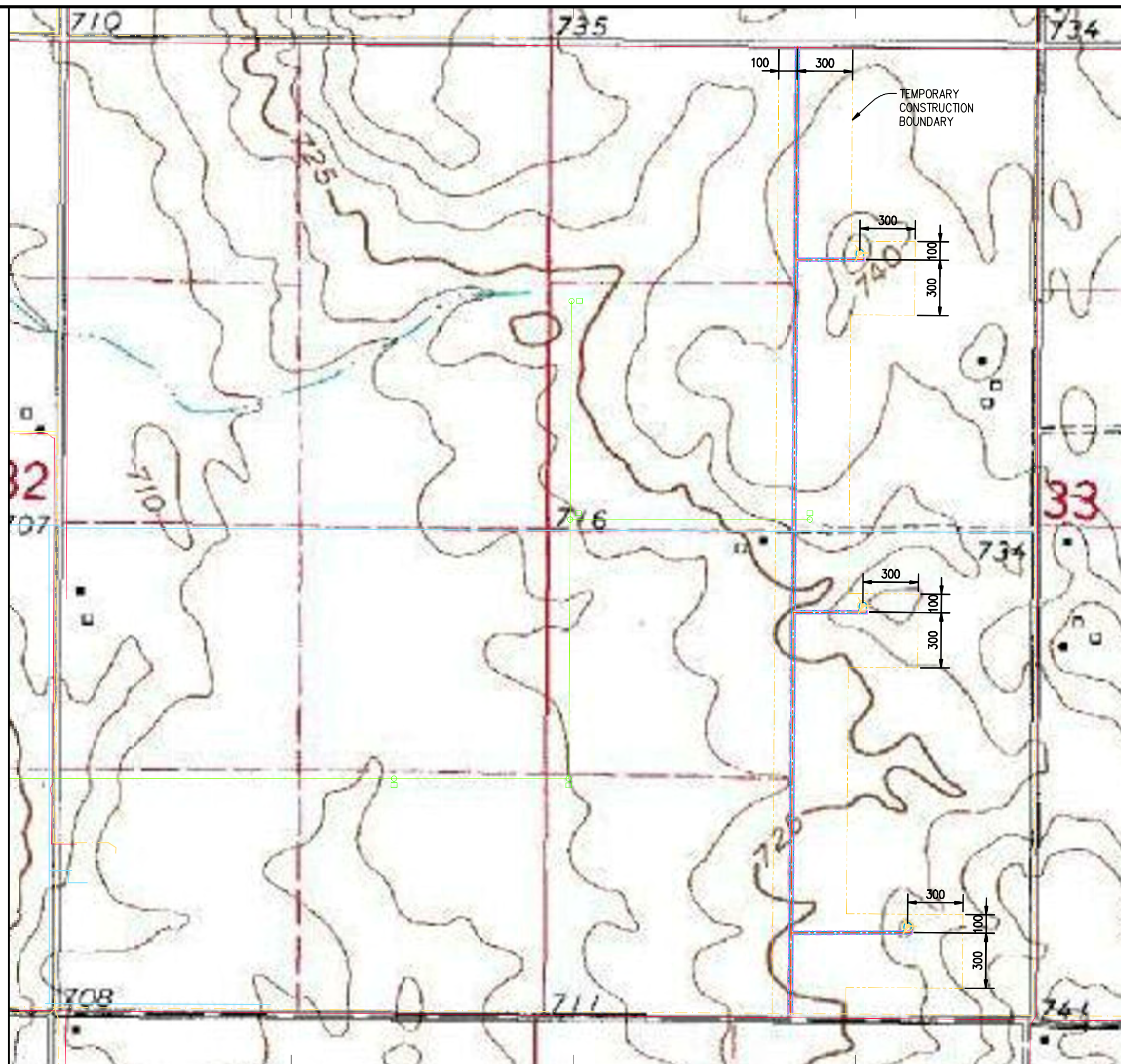
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Project Description
SOUTH CAMPUS WIND TURBINE PROJECT

CITY CHAMPAIGN
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Drawing Title
WIND TURBINE SITE PLAN

OPT 3

Client

**UNIVERSITY OF
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 URBANA**

Project Description

**SOUTH CAMPUS
 WIND TURBINE
 PROJECT**

CITY CHAMPAIGN

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Issue Dates

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**WIND TURBINE SITE
 PLAN**

OPT 4

