

Shadow Flicker Report

Groton Wind Project Groton, New Hampshire

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1.0 PROJECT OVERVIEW

Groton Wind, LLC, a wholly-owned subsidiary of Iberdrola Renewables, is proposing to develop a wind-powered generating facility in Grafton County New Hampshire (Figure 1). The Project will consist of 25 wind turbines, with a total generating capacity of approximately 50 megawatts (MW). It will also include associated support facilities, such as access roads buried/overhead electrical lines, a permanent meteorological tower, a switchyard, and an Operations and Maintenance building (Figure 2).

The Project site includes approximately 4,180 acres of leased private forestland in the Town of Groton, New Hampshire. The site is located approximately 3.7 miles west of the Village of Plymouth, 7.7 miles north of the Village of Bristol, and 8.6 miles northwest of the Village of Ashland. It is approximately 0.5 mile south of State Route 25 and 4.6 miles west of Interstate Route 93 (as measured to the nearest proposed turbine).

The Project site is located in an area characterized by mountainous topography with elevation ranging from approximately 600 to 2,350 feet above mean sea level (amsl). Land use within the Project site is primarily managed forest land that abuts a developed recreational facility (Tenney Mountain Ski Area) and private forest land with widely-scattered single-family rural residences

The wind turbines proposed for this Project will be in the 2.0 MW range. For the purpose of this study, it was assumed that the Gamesa G-87 2.0 MW turbine will be utilized on the Project. Each wind turbine consists of three major components; the tower, the nacelle, and the rotor, all of which will be white in color. The height of the tower, or “hub height” (height from foundation to top of tower) will be approximately 256 feet (78 m). The nacelle sits atop the tower, and the rotor hub is mounted to the nacelle. Assuming a 87 m rotor diameter, the total turbine height (i.e., height at the highest blade tip position) will be approximately 399 feet (121.5 m).

2.0 INTRODUCTION

Shadow flicker refers to the shadows that a wind turbine casts over structures and observers at times of the day when the sun is directly behind the turbine rotor from an observer's position. Shadow flicker is most pronounced in northern latitudes during winter months because of the lower angle of the sun in the winter sky. However, it is possible to encounter shadow flicker anywhere for brief periods after sunrise and before sunset (U.S. Department of Interior, 2005). During intervals of sunshine, wind turbine generators will cast a shadow on surrounding areas as the rotor blades pass in front of the sun, causing a flickering effect while the rotor is in motion. Shadow flicker does not occur when fog or clouds obscure the sun, or when turbines are not operating.

Shadow flicker can be experienced by residents living near wind turbines when the turbine is located in proximity to a residence, and the turbine rotor is between low angle sunlight and the residence. While shadow flicker is recognized as an important issue in Europe, it is generally not considered as significant in the United States (Gipe, 1995). Specifically, in northern Europe the sun shines at an oblique angle for more hours of the day and more days of the year than in the U.S. However, it is appropriate to analyze the potential effects of shadow flicker from proposed wind power projects on nearby residences, regardless of where a wind power project is proposed. The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct and focused. This is because a greater proportion of the sun's disc is intermittently blocked by the turbine (BERR, 2009). Obstacles such as terrain, vegetation, and/or buildings occurring between residences and wind turbines may significantly reduce or eliminate shadow flicker effects.

The location of shadow flicker can be predicted quite accurately using computer modeling programs and input data defining a "worst case" scenario. A worst case scenario would occur only when there are no clouds or fog, wind conditions allow continuous turbine operation, and the turbine rotor is continuously perpendicular to the sun and between the observer/residence and the sun. However, this worst case condition is not what residents would actually experience, as turbines are not in continuous operation, are not always aligned perpendicular to the sun, and are not always between the residence and the sun. In addition, sunlight conditions vary daily and seasonally, sun intensity and duration varies seasonally, and obstacles that block shadows (terrain, vegetation and buildings) exist in the landscape.

Shadow flicker effects are expressed in terms of frequency (hours per year) on receptors. Effects are not expressed in terms of potential health-related impacts, as blade pass frequencies for modern commercial scale wind turbines are so low they are considered harmless. According to the British

Epilepsy Association, approximately five percent of individuals with epilepsy have sensitivity to light, and most people with photosensitive epilepsy are sensitive to flickering around 16-25 Hz (Hertz or Hz = 1 flash per second), although some people may be sensitive to rates as low as 3 Hz and as high as 60 Hz (British Epilepsy Association, 2007). Specific to wind power projects, the British Epilepsy Association (2007) states that there is no evidence that wind turbines can trigger seizures, and newer wind turbines are usually built to operate at a frequency of 1 Hz or less. Therefore, health effects due to projected shadow flicker are not anticipated or further evaluated. The primary concern with shadow flicker is the annoyance it could cause for adjacent homeowners.

3.0 METHODS

This shadow-flicker modeling analysis was conducted using *WindPRO 2.6 Basis* software (WindPro), and associated shadow module, which is a widely accepted modeling software package developed specifically for the design and evaluation of wind power projects. Input variables and assumptions used for shadow flicker modeling calculations for the proposed Groton Wind Project include:

- Turbine coordinates provided by the Project Sponsor.
- Coordinates for residential structures located within 1,000 m of a turbine (provided by the Project Sponsor).
- USGS 1:100,000 topographic mapping and USGS digital elevation model (DEM).
- The rotor diameter and hub height for the Gamesa G87/2000 (i.e. 78 m hub height and 87 m rotor diameter).
- The annual wind rose depicted in Table 1 of Attachment A was used to determine the directional frequency with which the proposed wind turbines would be oriented throughout the year.
- The average monthly percent of available sunshine values obtained from the weather station at Concord, New Hampshire (see Table 2 of Attachment A).
- No allowance was made for wind being below or above generation speeds. Blades are assumed to be moving during all daylight hours, thereby creating a more conservative estimate of the amount of time when shadow flicker could occur.
- There is no shadow impact when the sun's elevation is less than 3 degrees above the horizon (due to the scattering effect of the atmosphere on low angle sunlight).
- There is no shadow impact when less than 20 percent of the sun is masked by the turbine blades because this is not enough masking to create a detectable shadow.
- Shadow isolines (i.e., contours indicating total number of hours of shadowing per average year) were calculated based on the data and assumptions outlined above, using a 10 m x 10 m grid from the USGS DEM.
- The shadow isolines were used to illustrate the predicted shadow flicker (see Attachment B).

Based on these variables, WindPro was used to calculate the theoretical number of hours per year that shadow flicker would occur at any given location in the vicinity of the proposed Project. It should be noted that at a distance beyond 10 rotor diameters (maximum of 870 m [2,854 feet] for this Project), shadow flicker effects are essentially undetectable (U.S. Department of Interior, 2005;

BERR, 2008). Therefore, the analysis presented herein is expected to be an inclusive (and conservative) projection of the shadow flicker effects of the proposed Groton Wind Project.

The model calculation includes the cumulative sum of shadow hours for all turbines and is accurate to a 10-meter grid cell resolution. This omni-directional approach reports total shadow-flicker results at a receptor regardless of the presence or orientation of windows at the receptor residence. This “greenhouse mode” assumes shadows from all directions can be perceived at a residence, which may or may not be true. A receptor in the model is defined as a one square meter area, one meter above ground level; the actual dimensions of the house are not taken into consideration.

4.0 RESULTS

Output from the model includes the following information:

- Calculated shadow-flicker time (hours per year) at receptors within 1,000 m of a proposed turbine.
- Tabulated and plotted time of day that receptors receive shadow flicker.
- Map showing turbine locations, identified shadow-flicker receptors, and projected shadow-flicker time (hours per year).

Each inventoried structure was evaluated to determine projected shadow flicker. Of the 207 structures identified and evaluated in this study:

- 204 (98.5%) will experience no shadow flicker
- 1 (.5%) may be affected less than 1 hr/yr
- 2 (1%) may be affected 1-3 hrs/yr
- none will be affected more than 3 hrs/yr

As indicated by these results, the shadow flicker impact for this project is almost non-existent. This can be attributed to the fact the shadow receptors are, for the most part, quite distant from the proposed wind turbines, and shadows are often blocked by the mountainous terrain.

5.0 DISCUSSION

As described above, this analysis focuses on receptors within 1,000 meters of proposed turbine sites, since shadow flicker effects are essentially undetectable beyond that distance (U.S. Department of Interior, 2005; BERR, 2008). This is because shadow flicker intensity diminishes as the distance between receptors and turbines increases. There are no schools, hospitals, libraries, golf courses, parks, registered historic sites, scenic byways, or scenic rivers within 1,000 meters of any turbine site (EDR, 2009). Therefore, no shadow flicker affects are anticipated at any of these visually sensitive resources.

As previously indicated, the shadow flicker assumptions applied to the model for this Project are conservative, and as such, the analysis is expected to over-predict the actual impacts. Trees and nearby buildings (such as garages) will likely further reduce or eliminate shadow flicker impacts at these receptor locations.

No national, state, county, or local standards exist for frequency or duration of shadow flicker from wind turbines at the Project site. However, international regulations, studies, and guidelines from Europe and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance. For example, a court in Germany ruled that the maximum allowable flicker would be 30 hours per year (Klepinger, 2007). In Austria, Dobesch and Kury (2001) recommended that shadow flicker should not exceed 30 hours per year. Guidelines for wind power development in the State of Victoria, Australia specify that shadow flicker may not exceed 30 hours per year at any dwelling in the surrounding area (Sustainable Energy Authority Victoria, 2003).

Accordingly, a threshold of 30 hours of shadow flicker per year was used in this analysis to evaluate potential shadow flicker impacts to area residences from the proposed Facility. As indicated above, none of the 204 receptors are predicted to approach this threshold. Of the three receptors predicted to receive any impact, none will exceed 3 hour per year. Table 1 summarizes the characteristics of the shadow flicker anticipated at the three affected receptors. Also refer to Attachment C, which contains graphic calendars produced by WindPRO that illustrate the times of year and day when receptors are anticipated to receive shadow flicker effects.

Table 1. Shadow Flicker Summary for Structures Projected to Experience any Impact

Receptor ID	Shadow Hours (conservative) [hh:mm/year]	Maximum Shadow Hours per Day [hh:mm/day]	Turbines Contributing Shadow Flicker	Approximate Times of Day Affected by Shadow Flicker¹
EB	2:51	0:18	N1, N2, N3	11:00 AM -1:30 PM
EC	0:51	0:15	N1	11:30 AM -12:30 PM
EH	1:38	0:16	N1	10:15 - 10:45 AM

¹The time of day and duration of shadow flicker experienced by each receptor varies throughout the calendar year based on the position of the sun in the sky and the direction of prevailing winds. The times of day presented here represent the range of times during which each receptor could experience shadow flicker at various times throughout the year; no receptors will experience shadow flicker every day during those hours. See Attachment C for graphical calendars that illustrate the specific times of day and year that each receptor will experience shadow flicker.

It should also be reiterated that these calculations do not take into account the screening effects associated with existing site-specific conditions such as vegetation and/or buildings. Furthermore, this analysis assumes that there are windows on every side of the identified structures, and all identified structures are receptors/residences. Therefore, although already very low, the predicted levels of shadow flicker at these three receptors are almost certainly higher than the actual level that will be experienced.

6.0 REFERENCES

British Epilepsy Association. 2007. *Photosensitive Epilepsy*. Epilepsy Action, Yeadon Leeds, UK.

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Department for Business Enterprise & Regulatory Reform (BERR). Accessed online in January 2009 at <http://www.berr.gov.uk/whatwedo/energy/sources/renewables/planning/onshore-wind/>

Dobesch and Kury. 2001. *Basic Meteorological Concepts and Recommendations for the Exploration of Wind Energy in the Atmospheric Boundary Layer*. Central Institute for Meteorology and Geodynamics (ZAMG), Vienna, Austria.

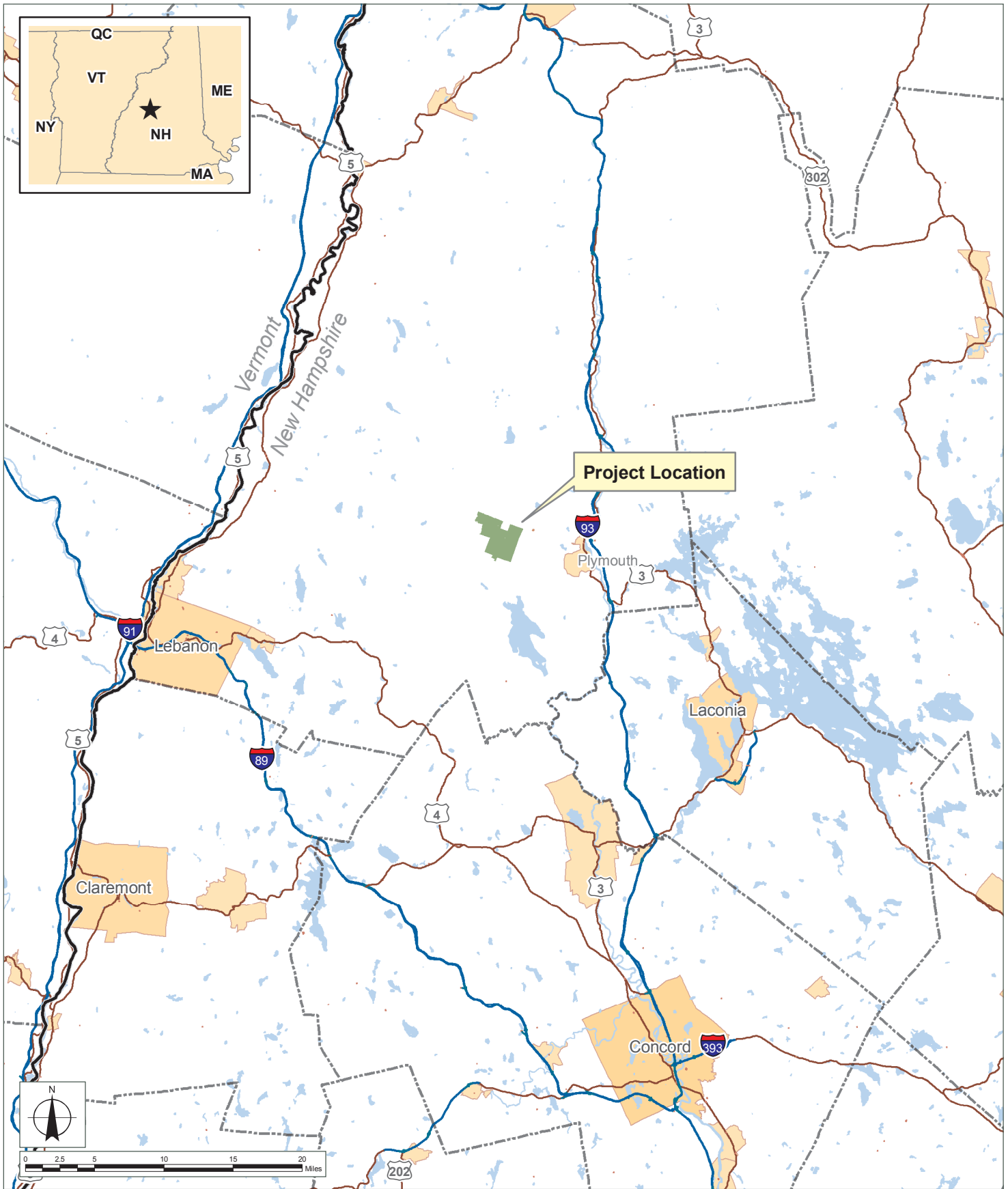
Gipe, P.B. 1995. *Wind Energy Comes Alive*. John Wiley & Sons, Inc. New York, NY.

Klepinger, M. 2007. *Michigan Land Use Guidelines for Siting Wind Energy Systems*. Michigan State Extension Bulletin WO-1053. Revised October 2007.

Sustainable Energy Authority Victoria. 2003. *Policy Planning and Guidelines for Development of Wind Energy Facilities in Victoria*. Sustainable Energy Authority Victoria, Melbourne Victoria, Australia.

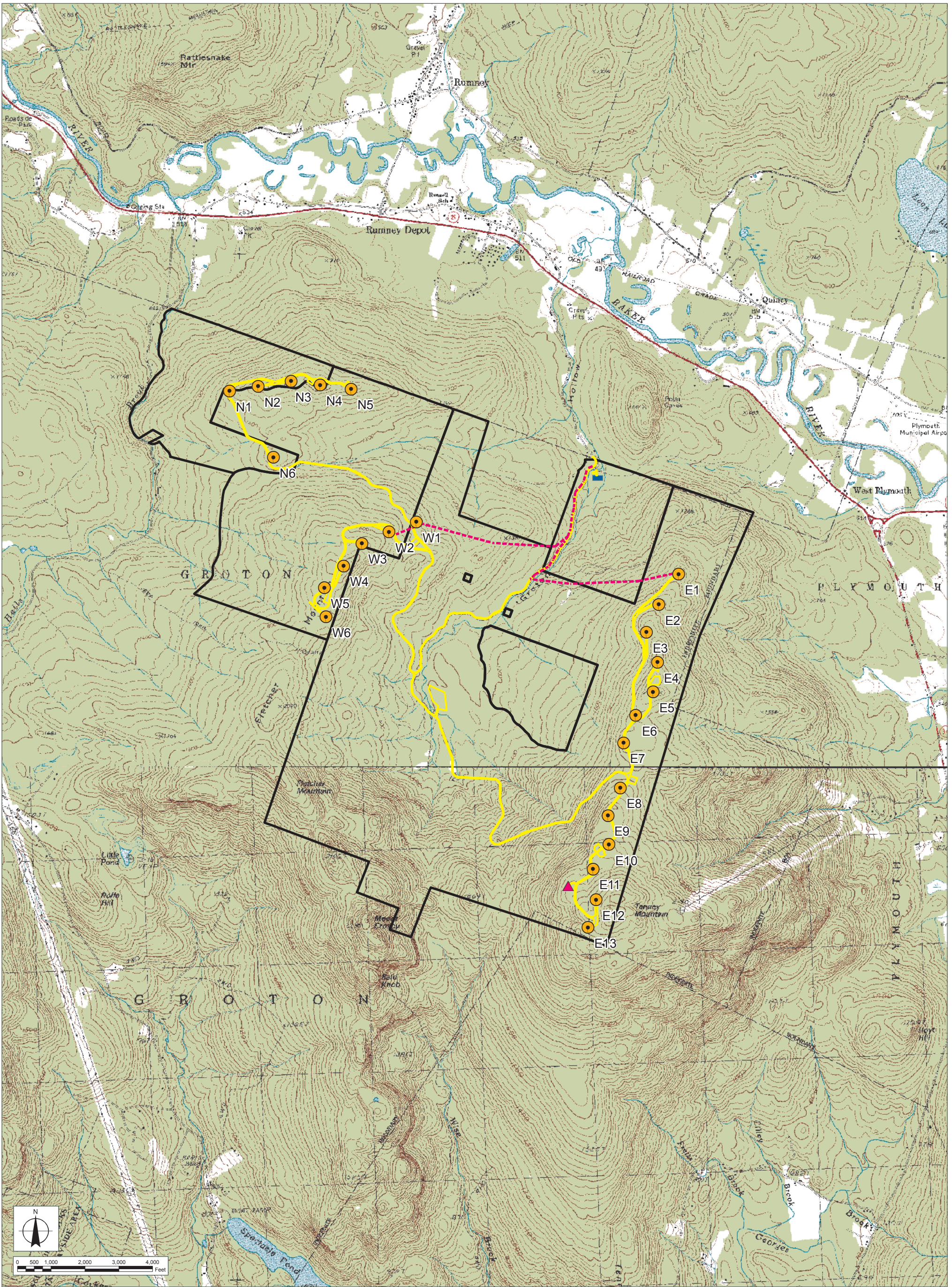
U.S. Department of Interior. 2005. *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. Bureau of Land Management.

Figures









Groton Wind Project
 Town of Groton - Grafton County, New Hampshire
 Figure 1: Regional Project Location

Project Area



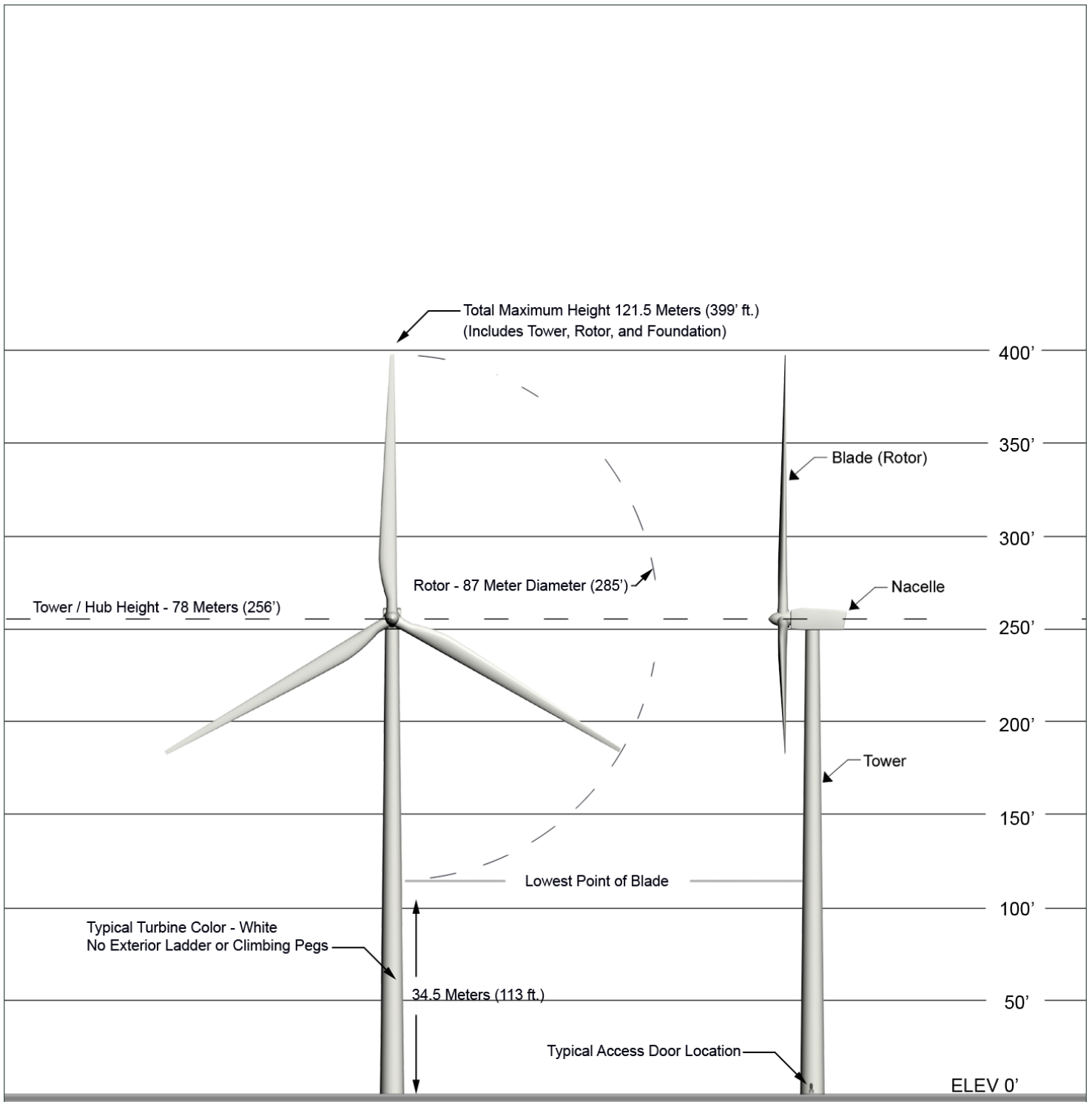
Groton Wind Project
 Town of Groton - Grafton County, New Hampshire
 Figure 2: Proposed Project Layout

December 2009

-  Proposed Wind Turbine
-  Proposed Permanent Meteorological Tower
-  Access Road
-  Electrical Collection Lines
-  O&M Building
-  Leased Land

Notes:
 Base Map: USGS 1:24,000 Rumney and Newfound Lake
 Quadrangles.





Gamesa G-87 with 78 Meter Tower

Groton Wind Project

Town of Groton - Grafton County, New Hampshire

Figure 3: Computer Model of Proposed Turbine
Gamesa G-87 with 78 Meter Tower

Attachment A

Wind Rose & Sunshine Data

Table 1: Wind Rose (Frequency -% of time- wind comes from a given sector).

Windrose Data (used to determine hours of operation)								
Sector	N	NNE	NE	ENE	E	ESE	SE	SSE
Frequency	1.02	0.78	0.74	1.77	6.56	8.3	3.32	4.58
Hours of Operation	89.352	68.328	64.824	155.052	574.656	727.08	290.832	401.208

Sector	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Frequency	3.31	3.02	3.1	6.34	10.57	17.98	23.76	4.85	100
Hours of Operation	289.956	264.552	271.56	555.384	925.932	1575.04	2081.37	424.86	8760

Table 2: Sunshine Probability

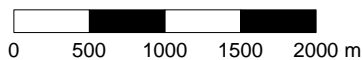
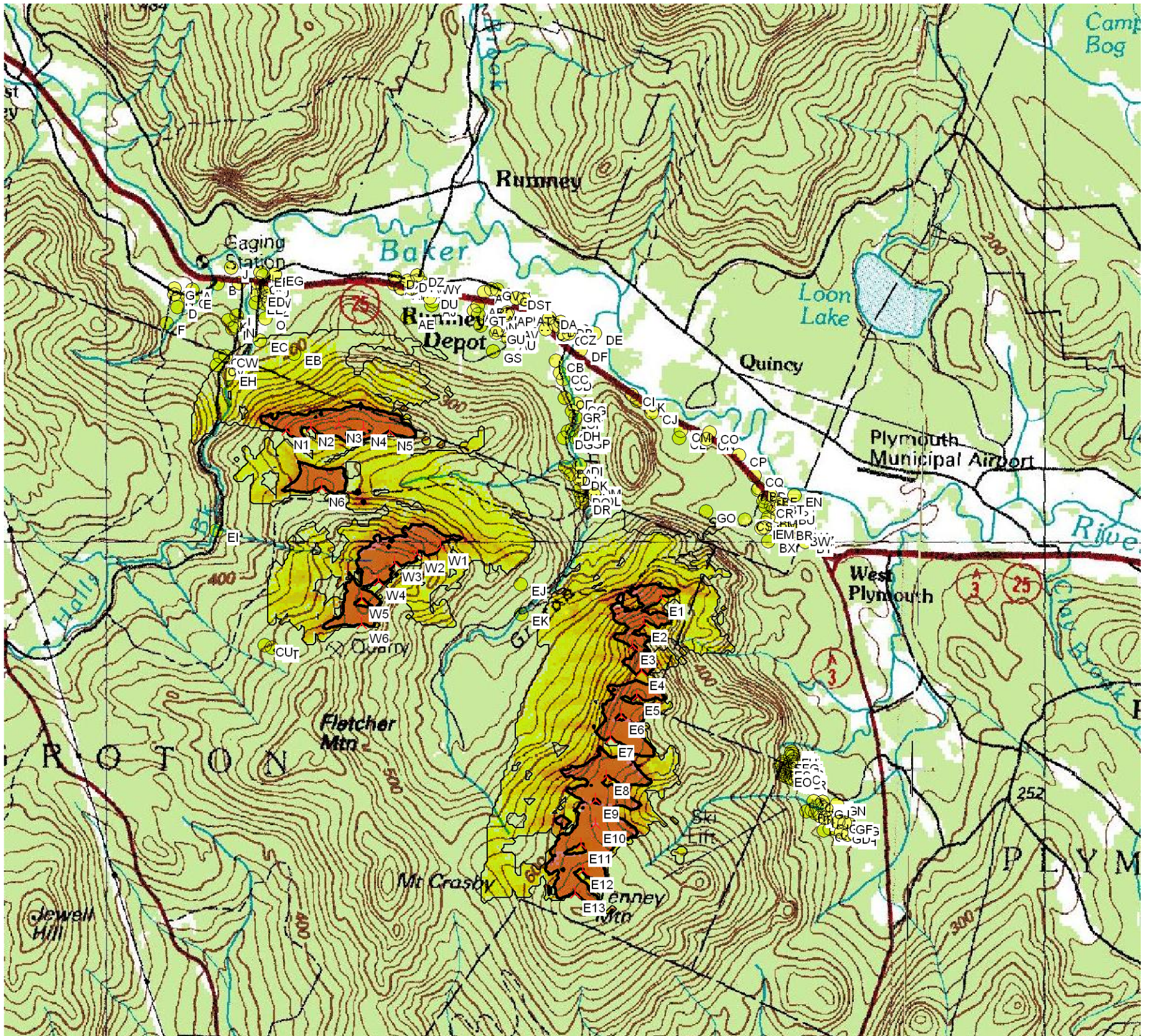
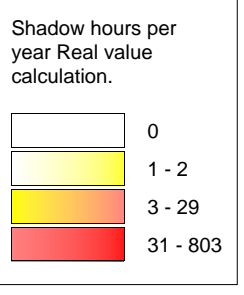
Sunshine Probability (Concord, NH Weather station)												
Month	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
% of Sunshine	.52	.55	.53	.53	.55	.58	.62	.60	.56	.53	.42	.47

Attachment B

Projected Shadow Flicker Maps

SHADOW - Groton USGS map

Calculation: Groton NH VIA Shadow Flicker Analysis [4] File: 100k USGS.jpg



Map: , Print scale 1:50,000, Map center UTM NAD 83 Zone: 19 East: 275,012 North: 4,850,448

- New WTG
- Shadow receptor
- 0
- 30
- 0

Isolines showing shadow in Shadow hours per year. Real value calculation.

Attachment C

WindPRO Shadow Flicker Reports

Project:

Groton NH VIA Shadow Flicker Analysis

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EDR
217 Montgomery St.
US-SYRACUSE, NY 13202
(315) 471 0688

Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result

Calculation: Groton NH VIA Shadow Flicker Analysis [4]

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

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.52	0.55	0.53	0.53	0.55	0.58	0.62	0.60	0.56	0.53	0.42	0.47

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
89	68	65	155	575	727	291	401	290	265	272	555

W	WNW	NW	NNW	Sum
926	1,575	2,081	425	8,760

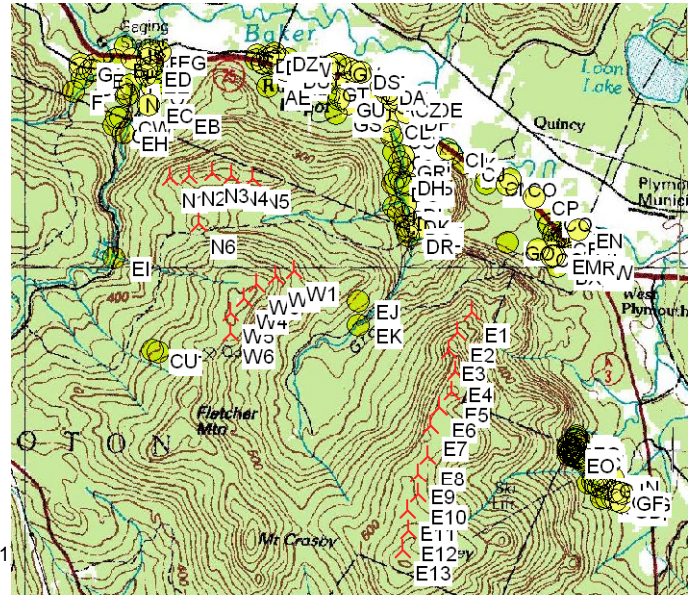
To avoid flicker from WTGs not visible a ZVI calculation is performed before the flicker calculation. The ZVI calculation is based on the following assumptions

Height contours used: Height Contours: Groton Height Contours for WP.WPO (1

Obstacles not used in calculation

Eye height: 1.5 m

Grid resolution: 10 m



Scale 1:100,000
▲ New WTG ● Shadow receptor

WTGs

UTM NAD83 Zone: 19	East	North	Z	Row data/Description	WTG type				Shadow data			
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
UTM NAD83 Zone: 19			[m]									
E1	275,958	4,849,618	1,554.1	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E2	275,771	4,849,349	1,732.5	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E3	275,651	4,849,104	1,900.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E4	275,744	4,848,830	2,000.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E5	275,694	4,848,562	2,100.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E6	275,529	4,848,359	2,000.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E7	275,414	4,848,114	2,000.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E8	275,371	4,847,709	2,007.9	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E9	275,252	4,847,460	2,100.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E10	275,251	4,847,199	2,123.1	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E11	275,102	4,846,982	2,144.4	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E12	275,120	4,846,706	2,238.4	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
E13	275,038	4,846,459	2,210.8	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N1	271,958	4,851,402	1,400.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N2	272,217	4,851,435	1,549.4	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N3	272,516	4,851,471	1,595.7	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N4	272,778	4,851,430	1,600.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N5	273,058	4,851,385	1,500.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
N6	272,335	4,850,791	1,400.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W1	273,605	4,850,166	1,553.3	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W2	273,355	4,850,084	1,732.8	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W3	273,109	4,849,990	1,900.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W4	272,938	4,849,792	2,000.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W5	272,758	4,849,599	1,900.0	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7
W6	272,764	4,849,335	1,889.3	WTG	Yes	GAMESA	G87/2000-2,000	2,000	87.0	78.0	1,000	16.7

Project:

Groton NH VIA Shadow Flicker Analysis

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Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result

Calculation: Groton NH VIA Shadow Flicker Analysis [4]

Shadow receptor-Input

No.	Name	UTM NAD83 Zone: 19			Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
		East	North	Z						
			[m]	[m]	[m]	[m]	[°]	[°]		
A	Shadow Receptor (1)	270,959	4,852,897	585.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
B	Shadow Receptor (2)	271,225	4,852,961	536.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
C	Shadow Receptor (3)	270,903	4,852,819	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
D	Shadow Receptor (4)	270,797	4,852,712	603.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
E	Shadow Receptor (5)	270,954	4,852,817	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
F	Shadow Receptor (6)	270,685	4,852,541	667.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
G	Shadow Receptor (7)	270,767	4,852,914	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
H	Shadow Receptor (8)	270,765	4,852,844	602.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
I	Shadow Receptor (9)	271,457	4,852,967	527.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
J	Shadow Receptor (10)	271,369	4,853,135	500.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
K	Shadow Receptor (11)	271,340	4,852,576	609.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
L	Shadow Receptor (12)	271,427	4,852,624	590.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
M	Shadow Receptor (13)	271,386	4,852,483	628.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
N	Shadow Receptor (14)	271,413	4,852,507	603.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
O	Shadow Receptor (15)	271,731	4,852,595	578.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
P	Shadow Receptor (16)	271,683	4,853,083	510.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
Q	Shadow Receptor (17)	271,656	4,852,971	524.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
R	Shadow Receptor (18)	271,725	4,852,873	536.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
S	Shadow Receptor (19)	271,710	4,852,922	530.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
T	Shadow Receptor (20)	271,750	4,852,944	530.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
U	Shadow Receptor (21)	271,783	4,852,937	533.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
V	Shadow Receptor (22)	271,747	4,852,897	534.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
W	Shadow Receptor (23)	271,758	4,852,830	542.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
X	Shadow Receptor (24)	271,725	4,852,754	554.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
Y	Shadow Receptor (25)	271,763	4,852,771	550.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
Z	Shadow Receptor (26)	271,792	4,852,735	554.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AA	Shadow Receptor (27)	273,107	4,852,961	542.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AB	Shadow Receptor (28)	273,299	4,852,914	540.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AC	Shadow Receptor (29)	273,342	4,852,932	533.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AD	Shadow Receptor (30)	273,191	4,852,913	555.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AE	Shadow Receptor (31)	273,252	4,852,601	587.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AF	Shadow Receptor (32)	273,506	4,852,884	547.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AG	Shadow Receptor (33)	273,175	4,852,919	556.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AH	Shadow Receptor (34)	273,277	4,852,918	543.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AI	Shadow Receptor (35)	273,521	4,852,780	554.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AJ	Shadow Receptor (36)	273,505	4,852,734	558.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AK	Shadow Receptor (37)	274,067	4,852,871	514.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AL	Shadow Receptor (38)	274,027	4,852,516	550.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AM	Shadow Receptor (39)	274,190	4,852,644	533.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AN	Shadow Receptor (40)	274,134	4,852,567	543.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AO	Shadow Receptor (41)	274,317	4,852,658	529.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AP	Shadow Receptor (42)	274,306	4,852,629	532.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AQ	Shadow Receptor (43)	274,211	4,852,473	550.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AR	Shadow Receptor (44)	273,998	4,852,727	530.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AS	Shadow Receptor (45)	273,960	4,852,676	536.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AT	Shadow Receptor (46)	274,512	4,852,629	528.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AU	Shadow Receptor (47)	274,331	4,852,373	559.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AV	Shadow Receptor (48)	274,369	4,852,483	547.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AW	Shadow Receptor (49)	274,449	4,852,579	535.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AX	Shadow Receptor (50)	274,287	4,852,405	556.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AY	Shadow Receptor (51)	274,350	4,852,391	558.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
AZ	Shadow Receptor (52)	275,034	4,851,323	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
BA	Shadow Receptor (53)	274,933	4,851,007	690.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"

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Project:

Groton NH VIA Shadow Flicker Analysis

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Calculated:

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SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

...continued from previous page

No.	Name	UTM NAD83 Zone: 19			Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
		East	North								
				[m]	[m]	[m]	[m]	[°]	[°]		
BB	Shadow Receptor (54)	275,081	4,851,302	622.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BC	Shadow Receptor (55)	276,994	4,850,779	546.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BD	Shadow Receptor (56)	276,986	4,850,762	549.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BE	Shadow Receptor (57)	277,062	4,850,680	538.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BF	Shadow Receptor (58)	277,121	4,850,706	523.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BG	Shadow Receptor (59)	277,047	4,850,643	543.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BH	Shadow Receptor (60)	277,127	4,850,598	529.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BI	Shadow Receptor (61)	277,156	4,850,574	527.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BJ	Shadow Receptor (62)	277,242	4,850,563	513.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BK	Shadow Receptor (63)	277,176	4,850,561	525.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BL	Shadow Receptor (64)	277,197	4,850,481	528.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BM	Shadow Receptor (65)	277,094	4,850,471	548.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BN	Shadow Receptor (66)	277,066	4,850,413	558.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BO	Shadow Receptor (67)	277,264	4,850,540	512.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BP	Shadow Receptor (68)	277,316	4,850,403	514.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BQ	Shadow Receptor (69)	277,289	4,850,392	520.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BR	Shadow Receptor (70)	277,276	4,850,345	526.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BS	Shadow Receptor (71)	277,236	4,850,601	511.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BT	Shadow Receptor (72)	277,199	4,850,621	516.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BU	Shadow Receptor (73)	277,297	4,850,511	508.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BV	Shadow Receptor (74)	277,382	4,850,326	524.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BW	Shadow Receptor (75)	277,423	4,850,283	527.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BX	Shadow Receptor (76)	277,098	4,850,213	568.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BY	Shadow Receptor (77)	277,489	4,850,208	533.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
BZ	Shadow Receptor (78)	277,514	4,850,288	502.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CA	Shadow Receptor (79)	277,472	4,850,328	501.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CB	Shadow Receptor (80)	274,833	4,852,138	529.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CC	Shadow Receptor (81)	274,877	4,852,013	549.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CD	Shadow Receptor (82)	274,906	4,851,944	573.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CE	Shadow Receptor (83)	274,930	4,851,741	595.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CF	Shadow Receptor (84)	275,043	4,851,532	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CG	Shadow Receptor (85)	275,058	4,851,678	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CH	Shadow Receptor (86)	274,727	4,852,475	531.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CI	Shadow Receptor (87)	275,642	4,851,779	501.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CJ	Shadow Receptor (88)	275,856	4,851,587	539.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CK	Shadow Receptor (89)	275,698	4,851,715	529.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CL	Shadow Receptor (90)	276,147	4,851,319	521.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CM	Shadow Receptor (91)	276,165	4,851,396	500.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CN	Shadow Receptor (92)	276,436	4,851,306	533.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CO	Shadow Receptor (93)	276,474	4,851,372	504.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CP	Shadow Receptor (94)	276,786	4,851,134	526.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CQ	Shadow Receptor (95)	276,947	4,850,918	525.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CR	Shadow Receptor (96)	277,067	4,850,581	542.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CS	Shadow Receptor (97)	276,848	4,850,447	597.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CT	Shadow Receptor (98)	271,804	4,849,082	1,649.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CU	Shadow Receptor (99)	271,726	4,849,103	1,628.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CV	Shadow Receptor (100)	271,217	4,852,094	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CW	Shadow Receptor (101)	271,310	4,852,192	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CX	Shadow Receptor (102)	271,250	4,852,189	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CY	Shadow Receptor (103)	274,918	4,852,422	525.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
CZ	Shadow Receptor (104)	274,975	4,852,432	515.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
DA	Shadow Receptor (105)	274,763	4,852,600	516.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"	
DB	Shadow Receptor (106)	274,928	4,852,506	515.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"	

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Project:

Groton NH VIA Shadow Flicker Analysis

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Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

...continued from previous page

UTM NAD83 Zone: 19

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
DC	Shadow Receptor (107)	274,883	4,852,556	513.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DD	Shadow Receptor (108)	274,835	4,852,515	520.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DE	Shadow Receptor (109)	275,247	4,852,432	500.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DF	Shadow Receptor (110)	275,092	4,852,254	500.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DG	Shadow Receptor (111)	274,918	4,851,315	603.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DH	Shadow Receptor (112)	275,007	4,851,408	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DI	Shadow Receptor (113)	275,087	4,851,033	694.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DJ	Shadow Receptor (114)	274,990	4,850,930	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DK	Shadow Receptor (115)	275,087	4,850,878	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DL	Shadow Receptor (116)	275,243	4,850,714	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DM	Shadow Receptor (117)	275,208	4,850,795	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DN	Shadow Receptor (118)	275,164	4,850,746	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DO	Shadow Receptor (119)	275,075	4,850,757	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DP	Shadow Receptor (120)	275,113	4,850,674	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DQ	Shadow Receptor (121)	275,103	4,850,700	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DR	Shadow Receptor (122)	275,114	4,850,619	710.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DS	Shadow Receptor (123)	274,414	4,852,809	511.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DT	Shadow Receptor (124)	274,495	4,852,794	510.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DU	Shadow Receptor (125)	273,489	4,852,815	554.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DV	Shadow Receptor (126)	273,350	4,852,993	526.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DW	Shadow Receptor (127)	273,405	4,852,973	521.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DX	Shadow Receptor (128)	273,119	4,853,028	528.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DY	Shadow Receptor (129)	273,254	4,852,996	538.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
DZ	Shadow Receptor (130)	273,351	4,853,050	520.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EA	Shadow Receptor (131)	273,301	4,852,985	533.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EB	Shadow Receptor (132)	272,041	4,852,214	694.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EC	Shadow Receptor (133)	271,679	4,852,355	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
ED	Shadow Receptor (134)	271,644	4,852,839	545.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EE	Shadow Receptor (135)	271,631	4,852,759	558.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EF	Shadow Receptor (136)	271,711	4,853,054	516.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EG	Shadow Receptor (137)	271,834	4,853,067	521.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EH	Shadow Receptor (138)	271,348	4,851,992	700.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EI	Shadow Receptor (139)	271,210	4,850,332	1,064.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EJ	Shadow Receptor (140)	274,455	4,849,753	1,153.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EK	Shadow Receptor (141)	274,460	4,849,436	1,100.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EL	Shadow Receptor (142)	277,026	4,850,356	570.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EM	Shadow Receptor (143)	277,059	4,850,361	563.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EN	Shadow Receptor (144)	277,378	4,850,706	500.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EO	Shadow Receptor (145)	277,253	4,847,716	991.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EP	Shadow Receptor (146)	277,269	4,847,724	981.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EQ	Shadow Receptor (147)	277,262	4,847,745	984.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
ER	Shadow Receptor (148)	277,256	4,847,764	987.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
ES	Shadow Receptor (149)	277,258	4,847,786	985.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
ET	Shadow Receptor (150)	277,246	4,847,814	989.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EU	Shadow Receptor (151)	277,245	4,847,836	985.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EV	Shadow Receptor (152)	277,256	4,847,860	973.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EW	Shadow Receptor (153)	277,300	4,847,766	959.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EX	Shadow Receptor (154)	277,287	4,847,798	966.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EY	Shadow Receptor (155)	277,310	4,847,698	955.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
EZ	Shadow Receptor (156)	277,332	4,847,688	938.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FA	Shadow Receptor (157)	277,360	4,847,677	918.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FB	Shadow Receptor (158)	277,380	4,847,690	909.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FC	Shadow Receptor (159)	277,363	4,847,741	921.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"

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Project:

Groton NH VIA Shadow Flicker Analysis

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SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

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UTM NAD83 Zone: 19

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
FD	Shadow Receptor (160)	277,328	4,847,771	942.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FE	Shadow Receptor (161)	277,331	4,847,794	938.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FF	Shadow Receptor (162)	277,321	4,847,812	942.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FG	Shadow Receptor (163)	277,340	4,847,864	927.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FH	Shadow Receptor (164)	277,329	4,847,919	929.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FI	Shadow Receptor (165)	277,346	4,847,972	910.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FJ	Shadow Receptor (166)	277,353	4,847,944	913.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FK	Shadow Receptor (167)	277,358	4,847,917	916.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FL	Shadow Receptor (168)	277,371	4,847,885	912.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FM	Shadow Receptor (169)	277,371	4,847,860	911.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FN	Shadow Receptor (170)	277,383	4,847,825	905.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FO	Shadow Receptor (171)	277,394	4,847,798	897.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FP	Shadow Receptor (172)	277,415	4,847,737	879.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FQ	Shadow Receptor (173)	277,421	4,847,709	871.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FR	Shadow Receptor (174)	277,426	4,847,681	880.1	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FS	Shadow Receptor (175)	277,433	4,847,652	873.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FT	Shadow Receptor (176)	277,439	4,847,628	866.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FU	Shadow Receptor (177)	277,506	4,847,334	827.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FV	Shadow Receptor (178)	277,563	4,847,347	800.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FW	Shadow Receptor (179)	277,602	4,847,310	796.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FX	Shadow Receptor (180)	277,648	4,847,280	776.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FY	Shadow Receptor (181)	277,700	4,847,264	753.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
FZ	Shadow Receptor (182)	277,750	4,847,262	739.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GA	Shadow Receptor (183)	277,687	4,847,131	776.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GB	Shadow Receptor (184)	277,750	4,847,148	753.5	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GC	Shadow Receptor (185)	277,825	4,847,142	734.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GD	Shadow Receptor (186)	277,871	4,847,108	726.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GE	Shadow Receptor (187)	277,843	4,847,219	725.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GF	Shadow Receptor (188)	277,913	4,847,211	705.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GG	Shadow Receptor (189)	277,962	4,847,193	690.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GH	Shadow Receptor (190)	277,942	4,847,084	696.7	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GI	Shadow Receptor (191)	277,721	4,847,351	747.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GJ	Shadow Receptor (192)	277,681	4,847,372	764.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GK	Shadow Receptor (193)	277,648	4,847,401	779.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GL	Shadow Receptor (194)	277,581	4,847,440	800.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GM	Shadow Receptor (195)	277,676	4,847,437	768.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GN	Shadow Receptor (196)	277,831	4,847,406	700.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GO	Shadow Receptor (197)	276,432	4,850,532	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GP	Shadow Receptor (198)	275,108	4,851,325	632.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GQ	Shadow Receptor (199)	274,960	4,851,388	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GR	Shadow Receptor (200)	275,007	4,851,602	600.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GS	Shadow Receptor (201)	274,165	4,852,245	574.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GT	Shadow Receptor (202)	274,005	4,852,637	539.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GU	Shadow Receptor (203)	274,196	4,852,438	554.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GV	Shadow Receptor (204)	274,144	4,852,905	509.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GW	Shadow Receptor (205)	274,210	4,852,898	506.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GX	Shadow Receptor (206)	274,326	4,852,840	509.9	1.0	1.0	1.0	0.0	90.0	"Green house mode"
GY	Shadow Receptor (207)	273,520	4,852,972	525.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"

Project:

Groton NH VIA Shadow Flicker Analysis

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11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]**Calculation Results**

Shadow receptor

No.	Name	Shadow, worst case		Max shadow hours per day [h/day]	Shadow, expected values
		Shadow hours per year [h/year]	Shadow days per year [days/year]		Shadow hours per year [h/year]
A	Shadow Receptor (1)	0:00	0	0:00	0:00
B	Shadow Receptor (2)	0:00	0	0:00	0:00
C	Shadow Receptor (3)	0:00	0	0:00	0:00
D	Shadow Receptor (4)	0:00	0	0:00	0:00
E	Shadow Receptor (5)	0:00	0	0:00	0:00
F	Shadow Receptor (6)	0:00	0	0:00	0:00
G	Shadow Receptor (7)	0:00	0	0:00	0:00
H	Shadow Receptor (8)	0:00	0	0:00	0:00
I	Shadow Receptor (9)	0:00	0	0:00	0:00
J	Shadow Receptor (10)	0:00	0	0:00	0:00
K	Shadow Receptor (11)	0:00	0	0:00	0:00
L	Shadow Receptor (12)	0:00	0	0:00	0:00
M	Shadow Receptor (13)	0:00	0	0:00	0:00
N	Shadow Receptor (14)	0:00	0	0:00	0:00
O	Shadow Receptor (15)	0:00	0	0:00	0:00
P	Shadow Receptor (16)	0:00	0	0:00	0:00
Q	Shadow Receptor (17)	0:00	0	0:00	0:00
R	Shadow Receptor (18)	0:00	0	0:00	0:00
S	Shadow Receptor (19)	0:00	0	0:00	0:00
T	Shadow Receptor (20)	0:00	0	0:00	0:00
U	Shadow Receptor (21)	0:00	0	0:00	0:00
V	Shadow Receptor (22)	0:00	0	0:00	0:00
W	Shadow Receptor (23)	0:00	0	0:00	0:00
X	Shadow Receptor (24)	0:00	0	0:00	0:00
Y	Shadow Receptor (25)	0:00	0	0:00	0:00
Z	Shadow Receptor (26)	0:00	0	0:00	0:00
AA	Shadow Receptor (27)	0:00	0	0:00	0:00
AB	Shadow Receptor (28)	0:00	0	0:00	0:00
AC	Shadow Receptor (29)	0:00	0	0:00	0:00
AD	Shadow Receptor (30)	0:00	0	0:00	0:00
AE	Shadow Receptor (31)	0:00	0	0:00	0:00
AF	Shadow Receptor (32)	0:00	0	0:00	0:00
AG	Shadow Receptor (33)	0:00	0	0:00	0:00
AH	Shadow Receptor (34)	0:00	0	0:00	0:00
AI	Shadow Receptor (35)	0:00	0	0:00	0:00
AJ	Shadow Receptor (36)	0:00	0	0:00	0:00
AK	Shadow Receptor (37)	0:00	0	0:00	0:00
AL	Shadow Receptor (38)	0:00	0	0:00	0:00
AM	Shadow Receptor (39)	0:00	0	0:00	0:00
AN	Shadow Receptor (40)	0:00	0	0:00	0:00
AO	Shadow Receptor (41)	0:00	0	0:00	0:00
AP	Shadow Receptor (42)	0:00	0	0:00	0:00
AQ	Shadow Receptor (43)	0:00	0	0:00	0:00
AR	Shadow Receptor (44)	0:00	0	0:00	0:00
AS	Shadow Receptor (45)	0:00	0	0:00	0:00
AT	Shadow Receptor (46)	0:00	0	0:00	0:00
AU	Shadow Receptor (47)	0:00	0	0:00	0:00
AV	Shadow Receptor (48)	0:00	0	0:00	0:00
AW	Shadow Receptor (49)	0:00	0	0:00	0:00
AX	Shadow Receptor (50)	0:00	0	0:00	0:00
AY	Shadow Receptor (51)	0:00	0	0:00	0:00
AZ	Shadow Receptor (52)	0:00	0	0:00	0:00

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Project:

Groton NH VIA Shadow Flicker Analysis

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SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

...continued from previous page

No.	Name	Shadow, worst case		Max shadow hours per day [h/day]	Shadow, expected values
		Shadow hours per year [h/year]	Shadow days per year [days/year]		Shadow hours per year [h/year]
BA	Shadow Receptor (53)	0:00	0	0:00	0:00
BB	Shadow Receptor (54)	0:00	0	0:00	0:00
BC	Shadow Receptor (55)	0:00	0	0:00	0:00
BD	Shadow Receptor (56)	0:00	0	0:00	0:00
BE	Shadow Receptor (57)	0:00	0	0:00	0:00
BF	Shadow Receptor (58)	0:00	0	0:00	0:00
BG	Shadow Receptor (59)	0:00	0	0:00	0:00
BH	Shadow Receptor (60)	0:00	0	0:00	0:00
BI	Shadow Receptor (61)	0:00	0	0:00	0:00
BJ	Shadow Receptor (62)	0:00	0	0:00	0:00
BK	Shadow Receptor (63)	0:00	0	0:00	0:00
BL	Shadow Receptor (64)	0:00	0	0:00	0:00
BM	Shadow Receptor (65)	0:00	0	0:00	0:00
BN	Shadow Receptor (66)	0:00	0	0:00	0:00
BO	Shadow Receptor (67)	0:00	0	0:00	0:00
BP	Shadow Receptor (68)	0:00	0	0:00	0:00
BQ	Shadow Receptor (69)	0:00	0	0:00	0:00
BR	Shadow Receptor (70)	0:00	0	0:00	0:00
BS	Shadow Receptor (71)	0:00	0	0:00	0:00
BT	Shadow Receptor (72)	0:00	0	0:00	0:00
BU	Shadow Receptor (73)	0:00	0	0:00	0:00
BV	Shadow Receptor (74)	0:00	0	0:00	0:00
BW	Shadow Receptor (75)	0:00	0	0:00	0:00
BX	Shadow Receptor (76)	0:00	0	0:00	0:00
BY	Shadow Receptor (77)	0:00	0	0:00	0:00
BZ	Shadow Receptor (78)	0:00	0	0:00	0:00
CA	Shadow Receptor (79)	0:00	0	0:00	0:00
CB	Shadow Receptor (80)	0:00	0	0:00	0:00
CC	Shadow Receptor (81)	0:00	0	0:00	0:00
CD	Shadow Receptor (82)	0:00	0	0:00	0:00
CE	Shadow Receptor (83)	0:00	0	0:00	0:00
CF	Shadow Receptor (84)	0:00	0	0:00	0:00
CG	Shadow Receptor (85)	0:00	0	0:00	0:00
CH	Shadow Receptor (86)	0:00	0	0:00	0:00
CI	Shadow Receptor (87)	0:00	0	0:00	0:00
CJ	Shadow Receptor (88)	0:00	0	0:00	0:00
CK	Shadow Receptor (89)	0:00	0	0:00	0:00
CL	Shadow Receptor (90)	0:00	0	0:00	0:00
CM	Shadow Receptor (91)	0:00	0	0:00	0:00
CN	Shadow Receptor (92)	0:00	0	0:00	0:00
CO	Shadow Receptor (93)	0:00	0	0:00	0:00
CP	Shadow Receptor (94)	0:00	0	0:00	0:00
CQ	Shadow Receptor (95)	0:00	0	0:00	0:00
CR	Shadow Receptor (96)	0:00	0	0:00	0:00
CS	Shadow Receptor (97)	0:00	0	0:00	0:00
CT	Shadow Receptor (98)	0:00	0	0:00	0:00
CU	Shadow Receptor (99)	0:00	0	0:00	0:00
CV	Shadow Receptor (100)	0:00	0	0:00	0:00
CW	Shadow Receptor (101)	0:00	0	0:00	0:00
CX	Shadow Receptor (102)	0:00	0	0:00	0:00
CY	Shadow Receptor (103)	0:00	0	0:00	0:00
CZ	Shadow Receptor (104)	0:00	0	0:00	0:00
DA	Shadow Receptor (105)	0:00	0	0:00	0:00

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Project:

Groton NH VIA Shadow Flicker Analysis

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SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

...continued from previous page

No.	Name	Shadow, worst case		Max shadow hours per day [h/day]	Shadow, expected values
		Shadow hours per year [h/year]	Shadow days per year [days/year]		Shadow hours per year [h/year]
DB	Shadow Receptor (106)	0:00	0	0:00	0:00
DC	Shadow Receptor (107)	0:00	0	0:00	0:00
DD	Shadow Receptor (108)	0:00	0	0:00	0:00
DE	Shadow Receptor (109)	0:00	0	0:00	0:00
DF	Shadow Receptor (110)	0:00	0	0:00	0:00
DG	Shadow Receptor (111)	0:00	0	0:00	0:00
DH	Shadow Receptor (112)	0:00	0	0:00	0:00
DI	Shadow Receptor (113)	0:00	0	0:00	0:00
DJ	Shadow Receptor (114)	0:00	0	0:00	0:00
DK	Shadow Receptor (115)	0:00	0	0:00	0:00
DL	Shadow Receptor (116)	0:00	0	0:00	0:00
DM	Shadow Receptor (117)	0:00	0	0:00	0:00
DN	Shadow Receptor (118)	0:00	0	0:00	0:00
DO	Shadow Receptor (119)	0:00	0	0:00	0:00
DP	Shadow Receptor (120)	0:00	0	0:00	0:00
DQ	Shadow Receptor (121)	0:00	0	0:00	0:00
DR	Shadow Receptor (122)	0:00	0	0:00	0:00
DS	Shadow Receptor (123)	0:00	0	0:00	0:00
DT	Shadow Receptor (124)	0:00	0	0:00	0:00
DU	Shadow Receptor (125)	0:00	0	0:00	0:00
DV	Shadow Receptor (126)	0:00	0	0:00	0:00
DW	Shadow Receptor (127)	0:00	0	0:00	0:00
DX	Shadow Receptor (128)	0:00	0	0:00	0:00
DY	Shadow Receptor (129)	0:00	0	0:00	0:00
DZ	Shadow Receptor (130)	0:00	0	0:00	0:00
EA	Shadow Receptor (131)	0:00	0	0:00	0:00
EB	Shadow Receptor (132)	9:49	45	0:18	2:51
EC	Shadow Receptor (133)	2:53	14	0:15	0:51
ED	Shadow Receptor (134)	0:00	0	0:00	0:00
EE	Shadow Receptor (135)	0:00	0	0:00	0:00
EF	Shadow Receptor (136)	0:00	0	0:00	0:00
EG	Shadow Receptor (137)	0:00	0	0:00	0:00
EH	Shadow Receptor (138)	3:59	20	0:16	1:38
EI	Shadow Receptor (139)	0:00	0	0:00	0:00
EJ	Shadow Receptor (140)	0:00	0	0:00	0:00
EK	Shadow Receptor (141)	0:00	0	0:00	0:00
EL	Shadow Receptor (142)	0:00	0	0:00	0:00
EM	Shadow Receptor (143)	0:00	0	0:00	0:00
EN	Shadow Receptor (144)	0:00	0	0:00	0:00
EO	Shadow Receptor (145)	0:00	0	0:00	0:00
EP	Shadow Receptor (146)	0:00	0	0:00	0:00
EQ	Shadow Receptor (147)	0:00	0	0:00	0:00
ER	Shadow Receptor (148)	0:00	0	0:00	0:00
ES	Shadow Receptor (149)	0:00	0	0:00	0:00
ET	Shadow Receptor (150)	0:00	0	0:00	0:00
EU	Shadow Receptor (151)	0:00	0	0:00	0:00
EV	Shadow Receptor (152)	0:00	0	0:00	0:00
EW	Shadow Receptor (153)	0:00	0	0:00	0:00
EX	Shadow Receptor (154)	0:00	0	0:00	0:00
EY	Shadow Receptor (155)	0:00	0	0:00	0:00
EZ	Shadow Receptor (156)	0:00	0	0:00	0:00
FA	Shadow Receptor (157)	0:00	0	0:00	0:00
FB	Shadow Receptor (158)	0:00	0	0:00	0:00

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Project:

Groton NH VIA Shadow Flicker Analysis

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Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

...continued from previous page

No.	Name	Shadow, worst case		Max shadow hours per day [h/day]	Shadow, expected values
		Shadow hours per year [h/year]	Shadow days per year [days/year]		Shadow hours per year [h/year]
FC	Shadow Receptor (159)	0:00	0	0:00	0:00
FD	Shadow Receptor (160)	0:00	0	0:00	0:00
FE	Shadow Receptor (161)	0:00	0	0:00	0:00
FF	Shadow Receptor (162)	0:00	0	0:00	0:00
FG	Shadow Receptor (163)	0:00	0	0:00	0:00
FH	Shadow Receptor (164)	0:00	0	0:00	0:00
FI	Shadow Receptor (165)	0:00	0	0:00	0:00
FJ	Shadow Receptor (166)	0:00	0	0:00	0:00
FK	Shadow Receptor (167)	0:00	0	0:00	0:00
FL	Shadow Receptor (168)	0:00	0	0:00	0:00
FM	Shadow Receptor (169)	0:00	0	0:00	0:00
FN	Shadow Receptor (170)	0:00	0	0:00	0:00
FO	Shadow Receptor (171)	0:00	0	0:00	0:00
FP	Shadow Receptor (172)	0:00	0	0:00	0:00
FQ	Shadow Receptor (173)	0:00	0	0:00	0:00
FR	Shadow Receptor (174)	0:00	0	0:00	0:00
FS	Shadow Receptor (175)	0:00	0	0:00	0:00
FT	Shadow Receptor (176)	0:00	0	0:00	0:00
FU	Shadow Receptor (177)	0:00	0	0:00	0:00
FV	Shadow Receptor (178)	0:00	0	0:00	0:00
FW	Shadow Receptor (179)	0:00	0	0:00	0:00
FX	Shadow Receptor (180)	0:00	0	0:00	0:00
FY	Shadow Receptor (181)	0:00	0	0:00	0:00
FZ	Shadow Receptor (182)	0:00	0	0:00	0:00
GA	Shadow Receptor (183)	0:00	0	0:00	0:00
GB	Shadow Receptor (184)	0:00	0	0:00	0:00
GC	Shadow Receptor (185)	0:00	0	0:00	0:00
GD	Shadow Receptor (186)	0:00	0	0:00	0:00
GE	Shadow Receptor (187)	0:00	0	0:00	0:00
GF	Shadow Receptor (188)	0:00	0	0:00	0:00
GG	Shadow Receptor (189)	0:00	0	0:00	0:00
GH	Shadow Receptor (190)	0:00	0	0:00	0:00
GI	Shadow Receptor (191)	0:00	0	0:00	0:00
GJ	Shadow Receptor (192)	0:00	0	0:00	0:00
GK	Shadow Receptor (193)	0:00	0	0:00	0:00
GL	Shadow Receptor (194)	0:00	0	0:00	0:00
GM	Shadow Receptor (195)	0:00	0	0:00	0:00
GN	Shadow Receptor (196)	0:00	0	0:00	0:00
GO	Shadow Receptor (197)	0:00	0	0:00	0:00
GP	Shadow Receptor (198)	0:00	0	0:00	0:00
GQ	Shadow Receptor (199)	0:00	0	0:00	0:00
GR	Shadow Receptor (200)	0:00	0	0:00	0:00
GS	Shadow Receptor (201)	0:00	0	0:00	0:00
GT	Shadow Receptor (202)	0:00	0	0:00	0:00
GU	Shadow Receptor (203)	0:00	0	0:00	0:00
GV	Shadow Receptor (204)	0:00	0	0:00	0:00
GW	Shadow Receptor (205)	0:00	0	0:00	0:00
GX	Shadow Receptor (206)	0:00	0	0:00	0:00
GY	Shadow Receptor (207)	0:00	0	0:00	0:00

Project:

Groton NH VIA Shadow Flicker Analysis

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Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Main Result**Calculation:** Groton NH VIA Shadow Flicker Analysis [4]

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

No.	Name	Worst case [h/year]
E1	WTG	0:00
E2	WTG	0:00
E3	WTG	0:00
E4	WTG	0:00
E5	WTG	0:00
E6	WTG	0:00
E7	WTG	0:00
E8	WTG	0:00
E9	WTG	0:00
E10	WTG	0:00
E11	WTG	0:00
E12	WTG	0:00
E13	WTG	0:00
N1	WTG	10:49
N2	WTG	3:01
N3	WTG	2:51
N4	WTG	0:00
N5	WTG	0:00
N6	WTG	0:00
W1	WTG	0:00
W2	WTG	0:00
W3	WTG	0:00
W4	WTG	0:00
W5	WTG	0:00
W6	WTG	0:00

Project:

Groton NH VIA Shadow Flicker Analysis

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(315) 471 0688

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11/12/2009 2:19 PM/2.6.0.235

SHADOW - Calendar

Calculation: Groton NH VIA Shadow Flicker Analysis [4] Shadow receptor: EB - Shadow Receptor (132)

Assumptions for shadow calculations

Maximum distance for influence 1,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
Sun shine probabilities (part of time from sun rise to sun set with sun shine)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.55 0.53 0.53 0.55 0.58 0.62 0.60 0.56 0.53 0.42 0.47
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
89 68 65 155 575 727 291 401 290 265 272 555 926 1,575 2,081 425 8,760

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains sun rise and set times (hh:mm) and potential sun hours. Summary rows at the bottom show total, worst case, and reduction values.

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

Matrix with 5 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:

Groton NH VIA Shadow Flicker Analysis

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SHADOW - Calendar

Calculation: Groton NH VIA Shadow Flicker Analysis [4] **Shadow receptor:** EC - Shadow Receptor (133)

Assumptions for shadow calculations

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

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.52 0.55 0.53 0.53 0.55 0.58 0.62 0.60 0.56 0.53 0.42 0.47

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 89 68 65 155 575 727 291 401 290 265 272 555 926 1,575 2,081 425 8,760

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22	07:06	06:26	06:31	05:41	05:09	05:09	05:36	06:10	06:45	11:34 (N1)	06:23	07:01	
	16:21	16:58	17:36	19:14	19:50	20:22	20:34	20:13	19:25	18:30	15	11:49 (N1)	16:39	16:12
2	07:22	07:05	06:24	06:29	05:40	05:09	05:10	05:37	06:12	06:46	11:35 (N1)	06:24	07:02	
	16:22	16:59	17:37	19:15	19:51	20:22	20:34	20:12	19:23	18:28	15	11:50 (N1)	16:38	16:12
3	07:22	07:03	06:23	06:27	05:38	05:08	05:10	05:38	06:13	06:47	11:36 (N1)	06:26	07:03	
	16:23	17:01	17:38	19:16	19:52	20:23	20:34	20:11	19:21	18:27	13	11:49 (N1)	16:37	16:11
4	07:22	07:02	06:21	06:25	05:37	05:08	05:11	05:39	06:14	06:48	11:37 (N1)	06:27	07:04	
	16:23	17:02	17:39	19:18	19:53	20:24	20:33	20:10	19:20	18:25	10	11:47 (N1)	16:35	16:11
5	07:22	07:01	06:19	06:24	05:36	05:07	05:11	05:40	06:15	06:49	11:38 (N1)	06:28	07:05	
	16:24	17:03	17:41	19:19	19:54	20:25	20:33	20:08	19:18	18:23	10	11:47 (N1)	16:34	16:11
6	07:22	07:00	06:17	06:22	05:34	05:07	05:12	05:41	06:16	06:50	11:39 (N1)	06:30	07:06	
	16:25	17:05	17:42	19:20	19:56	20:26	20:33	20:07	19:16	18:21	10	11:47 (N1)	16:33	16:11
7	07:22	06:59	06:16	06:20	05:33	05:07	05:13	05:42	06:17	06:52	11:40 (N1)	06:31	07:07	
	16:26	17:06	17:43	19:21	19:57	20:26	20:33	20:06	19:14	18:19	10	11:47 (N1)	16:32	16:11
8	07:22	06:57	07:14	06:18	05:32	05:06	05:13	05:43	06:18	06:53	11:41 (N1)	06:32	07:08	
	16:28	17:07	18:45	19:22	19:58	20:27	20:32	20:04	19:12	18:18	10	11:47 (N1)	16:31	16:11
9	07:21	06:56	07:12	06:17	05:30	05:06	05:14	05:44	06:19	06:54	11:42 (N1)	06:34	07:09	
	16:29	17:09	18:46	19:24	19:59	20:28	20:32	20:03	19:11	18:16	10	11:47 (N1)	16:29	16:10
10	07:21	06:55	07:10	06:15	05:29	05:06	05:15	05:46	06:21	06:55	11:43 (N1)	06:35	07:10	
	16:30	17:10	18:47	19:25	20:00	20:28	20:31	20:02	19:09	18:14	10	11:47 (N1)	16:28	16:10
11	07:21	06:53	07:09	06:13	05:28	05:06	05:16	05:47	06:22	06:56	11:44 (N1)	06:36	07:11	
	16:31	17:12	18:48	19:26	20:00	20:29	20:31	20:00	19:07	18:12	10	11:47 (N1)	16:27	16:10
12	07:20	06:52	07:07	06:11	05:27	05:05	05:16	05:48	06:23	06:58	11:45 (N1)	06:37	07:12	
	16:32	17:13	18:50	19:27	20:01	20:29	20:30	19:57	19:05	18:11	10	11:47 (N1)	16:26	16:11
13	07:20	06:51	07:05	06:10	05:25	05:05	05:17	05:49	06:24	06:59	11:46 (N1)	06:39	07:13	
	16:33	17:14	18:51	19:28	20:03	20:30	20:30	19:56	19:03	18:09	10	11:47 (N1)	16:25	16:11
14	07:20	06:49	07:03	06:08	05:24	05:05	05:18	05:50	06:25	07:00	11:47 (N1)	06:40	07:14	
	16:34	17:16	18:52	19:29	20:04	20:30	20:29	19:54	19:01	18:07	10	11:47 (N1)	16:24	16:11
15	07:19	06:48	07:02	06:06	05:23	05:05	05:19	05:51	06:26	07:01	11:48 (N1)	06:41	07:14	
	16:36	17:17	18:53	19:31	20:05	20:31	20:29	19:53	19:00	18:06	10	11:47 (N1)	16:23	16:11
16	07:19	06:46	07:00	06:05	05:22	05:05	05:20	05:52	06:27	07:03	11:49 (N1)	06:43	07:15	
	16:37	17:18	18:54	19:32	20:06	20:31	20:28	19:51	18:58	18:04	10	11:47 (N1)	16:22	16:11
17	07:18	06:45	06:58	06:03	05:21	05:05	05:21	05:53	06:28	07:04	11:50 (N1)	06:44	07:16	
	16:38	17:20	18:56	19:33	20:07	20:32	20:27	19:50	18:56	18:02	10	11:47 (N1)	16:21	16:12
18	07:18	06:43	06:56	06:01	05:20	05:05	05:22	05:55	06:30	07:05	11:51 (N1)	06:45	07:17	
	16:39	17:21	18:57	19:34	20:08	20:32	20:27	19:48	18:54	18:01	10	11:47 (N1)	16:20	16:12
19	07:17	06:42	06:54	06:00	05:19	05:05	05:23	05:56	06:31	07:06	11:52 (N1)	06:47	07:17	
	16:40	17:22	18:58	19:35	20:09	20:33	20:26	19:47	18:52	17:59	10	11:47 (N1)	16:19	16:12
20	07:16	06:40	06:53	05:58	05:18	05:05	05:23	05:57	06:32	07:08	11:53 (N1)	06:48	07:18	
	16:42	17:24	18:59	19:37	20:10	20:33	20:25	19:45	18:50	17:57	10	11:47 (N1)	16:19	16:13
21	07:16	06:39	06:51	05:56	05:17	05:06	05:24	05:58	06:33	07:09	11:54 (N1)	06:49	07:18	
	16:43	17:25	19:01	19:38	20:11	20:33	20:24	19:43	18:49	17:56	10	11:47 (N1)	16:18	16:13
22	07:15	06:37	06:49	05:55	05:16	05:06	05:25	05:59	06:34	07:10	11:55 (N1)	06:50	07:19	
	16:44	17:26	19:02	19:39	20:12	20:33	20:23	19:42	18:47	17:54	10	11:47 (N1)	16:17	16:14
23	07:14	06:36	06:47	05:53	05:15	05:06	05:26	06:00	06:35	07:11	11:56 (N1)	06:52	07:19	
	16:46	17:28	19:03	19:40	20:13	20:34	20:23	19:40	18:45	17:53	10	11:47 (N1)	16:16	16:14
24	07:13	06:34	06:45	05:52	05:15	05:06	05:27	06:01	06:36	07:13	11:57 (N1)	06:53	07:20	
	16:47	17:29	19:04	19:41	20:14	20:34	20:22	19:39	18:43	17:51	10	11:47 (N1)	16:16	16:15
25	07:12	06:32	06:43	05:50	05:14	05:07	05:28	06:03	06:38	07:14	11:58 (N1)	06:54	07:20	
	16:48	17:30	19:05	19:43	20:15	20:34	20:21	19:37	18:41	17:50	10	11:47 (N1)	16:15	16:15
26	07:12	06:31	06:42	05:49	05:13	05:07	05:29	06:04	06:39	07:15	11:59 (N1)	06:55	07:21	
	16:50	17:32	19:07	19:44	20:16	20:34	20:20	19:35	18:39	17:48	10	11:47 (N1)	16:14	16:16
27	07:11	06:29	06:40	05:47	05:12	05:07	05:30	06:05	06:40	07:16	12:00 (N1)	06:56	07:21	
	16:51	17:33	19:08	19:45	20:17	20:34	20:19	19:34	18:37	17:47	10	11:47 (N1)	16:14	16:17
28	07:10	06:28	06:38	05:45	05:12	05:08	05:31	06:06	06:41	07:18	12:01 (N1)	06:58	07:21	
	16:52	17:34	19:09	19:46	20:18	20:34	20:18	19:32	18:36	17:45	8	11:46 (N1)	16:13	16:17
29	07:09	06:26	06:36	05:44	05:11	05:08	05:33	06:07	06:42	07:19	12:02 (N1)	06:59	07:21	
	16:54	19:10	19:10	19:47	20:19	20:34	20:17	19:30	18:34	17:44	12	11:48 (N1)	16:13	16:18
30	07:08	06:24	06:34	05:43	05:10	05:09	05:34	06:08	06:43	07:20	12:03 (N1)	07:00	07:22	
	16:55	19:11	19:11	19:49	20:20	20:34	20:16	19:28	18:32	17:42	14	11:49 (N1)	16:12	16:19
31	07:07	06:23	06:33	05:42	05:09	05:05	05:35	06:09	06:44	07:22	12:04 (N1)	07:02	07:22	
	16:56	19:13	19:13	19:50	20:21	20:35	20:14	19:27	18:31	17:41	10	11:47 (N1)	16:10	16:20
Potential sun hours	289	293	369	403	456	462	468	433	376	342	291	279		
Total, worst case			86						34	53				
Sun reduction			0.53						0.56	0.53				
Oper. time red.			1.00						1.00	1.00				
Wind dir. red.			0.56						0.56	0.56				
Total reduction			0.30						0.31	0.30				
Total, real			26						11	16				

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

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

Project:

Groton NH VIA Shadow Flicker Analysis

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(315) 471 0688

Calculated:

11/12/2009 2:19 PM/2.6.0.235

SHADOW - Calendar

Calculation: Groton NH VIA Shadow Flicker Analysis [4] **Shadow receptor:** EH - Shadow Receptor (138)

Assumptions for shadow calculations

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

Sun shine probabilities (part of time from sun rise to sun set with sun shine)
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.52 0.55 0.53 0.53 0.55 0.58 0.62 0.60 0.56 0.53 0.42 0.47

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 89 68 65 155 575 727 291 401 290 265 272 555 926 1,575 2,081 425 8,760

	January	February	March	April	May	June	July	August	September	October	November	December				
1	07:22	07:06	06:26	06:31	10:39 (N1)	05:41	05:09	05:09	05:36	06:10	06:45	07:01				
	16:21	16:58	17:36	19:14	2	10:41 (N1)	19:50	20:22	20:34	20:13	19:25	16:39	16:12			
2	07:22	07:05	06:24	06:29	10:34 (N1)	05:40	05:09	05:10	05:37	06:12	06:46	07:02				
	16:22	16:59	17:37	19:15	10	10:44 (N1)	19:51	20:22	20:34	20:12	19:23	6	10:34 (N1)	18:28	16:38	16:12
3	07:22	07:03	06:23	06:27	10:32 (N1)	05:38	05:08	05:10	05:38	06:13	06:47	07:03				
	16:23	17:01	17:38	19:16	13	10:45 (N1)	19:52	20:23	20:34	20:11	19:21	11	10:37 (N1)	18:27	16:37	16:11
4	07:22	07:02	06:21	06:25	10:30 (N1)	05:37	05:08	05:11	05:39	06:14	06:48	07:04				
	16:24	17:02	17:39	19:18	15	10:45 (N1)	19:53	20:24	20:33	20:10	19:20	14	10:38 (N1)	18:25	16:36	16:11
5	07:22	07:01	06:19	06:24	10:28 (N1)	05:36	05:07	05:12	05:40	06:15	06:49	07:05				
	16:24	17:03	17:41	19:19	16	10:44 (N1)	19:55	20:25	20:33	20:08	19:18	15	10:39 (N1)	18:23	16:34	16:11
6	07:22	07:00	06:17	06:22	10:28 (N1)	05:34	05:07	05:12	05:41	06:16	06:50	07:06				
	16:25	17:05	17:42	19:20	16	10:44 (N1)	19:56	20:26	20:33	20:07	19:16	16	10:39 (N1)	18:21	16:33	16:11
7	07:22	06:59	06:16	06:20	10:28 (N1)	05:33	05:07	05:13	05:42	06:17	06:51	07:07				
	16:27	17:06	17:43	19:21	15	10:43 (N1)	19:57	20:26	20:33	20:06	19:14	16	10:40 (N1)	18:19	16:32	16:11
8	07:22	06:57	07:14	06:18	10:27 (N1)	05:32	05:06	05:14	05:43	06:18	06:52	07:08				
	16:28	17:07	18:45	19:22	14	10:41 (N1)	19:58	20:27	20:32	20:04	19:12	15	10:40 (N1)	18:18	16:31	16:11
9	07:21	06:56	07:12	06:17	10:28 (N1)	05:30	05:06	05:14	05:45	06:19	06:54	07:09				
	16:29	17:09	18:46	19:24	11	10:39 (N1)	19:59	20:28	20:32	20:03	19:11	13	10:39 (N1)	18:16	16:29	16:10
10	07:21	06:55	07:10	06:15	10:30 (N1)	05:29	05:06	05:15	05:46	06:21	06:56	07:10				
	16:30	17:10	18:47	19:25	6	10:36 (N1)	20:00	20:28	20:31	20:02	19:09	11	10:38 (N1)	18:14	16:28	16:10
11	07:21	06:53	07:09	06:13	10:28 (N1)	05:28	05:06	05:16	05:47	06:22	06:57	07:11				
	16:31	17:12	18:48	19:26	20:00	20:29	20:31	20:00	19:07	10:34 (N1)	18:12	16:27	16:10			
12	07:20	06:52	07:07	06:11	10:27 (N1)	05:27	05:05	05:17	05:48	06:23	06:58	07:12				
	16:32	17:13	18:50	19:27	20:01	20:29	20:30	19:57	19:05	18:11	16:26	16:11				
13	07:20	06:51	07:05	06:10	10:26 (N1)	05:26	05:05	05:17	05:49	06:24	06:59	07:13				
	16:33	17:14	18:51	19:28	20:03	20:30	20:30	19:56	19:03	18:09	16:25	16:11				
14	07:20	06:49	07:03	06:08	10:25 (N1)	05:24	05:05	05:18	05:50	06:25	07:00	07:14				
	16:34	17:16	18:52	19:30	20:04	20:30	20:29	19:54	19:01	18:07	16:24	16:11				
15	07:19	06:48	07:02	06:06	10:24 (N1)	05:23	05:05	05:19	05:51	06:26	07:01	07:14				
	16:36	17:17	18:53	19:31	20:05	20:31	20:29	19:53	19:00	18:06	16:23	16:11				
16	07:19	06:46	07:00	06:05	10:23 (N1)	05:22	05:05	05:20	05:52	06:27	07:03	07:15				
	16:37	17:18	18:55	19:32	20:06	20:31	20:28	19:51	18:58	18:04	16:22	16:11				
17	07:18	06:45	06:58	06:03	10:22 (N1)	05:21	05:05	05:21	05:53	06:28	07:04	07:16				
	16:38	17:20	18:56	19:33	20:07	20:32	20:27	19:50	18:56	18:02	16:21	16:12				
18	07:18	06:43	06:56	06:01	10:21 (N1)	05:20	05:05	05:22	05:55	06:30	07:05	07:17				
	16:39	17:21	18:57	19:34	20:08	20:32	20:27	19:48	18:54	18:01	16:20	16:12				
19	07:17	06:42	06:54	06:00	10:20 (N1)	05:19	05:05	05:23	05:56	06:31	07:06	07:17				
	16:41	17:22	18:58	19:35	20:09	20:33	20:26	19:47	18:52	17:59	16:19	16:12				
20	07:16	06:40	06:53	05:58	10:19 (N1)	05:18	05:05	05:24	05:57	06:32	07:08	07:18				
	16:42	17:24	18:59	19:37	20:10	20:33	20:25	19:45	18:50	17:57	16:19	16:13				
21	07:16	06:39	06:51	05:56	10:18 (N1)	05:17	05:06	05:24	05:58	06:33	07:09	07:18				
	16:43	17:25	19:01	19:38	20:11	20:33	20:24	19:43	18:49	17:56	16:18	16:13				
22	07:15	06:37	06:49	05:55	10:17 (N1)	05:16	05:06	05:25	05:59	06:34	07:10	07:19				
	16:44	17:26	19:02	19:39	20:12	20:33	20:23	19:42	18:47	17:54	16:17	16:14				
23	07:14	06:36	06:47	05:53	10:16 (N1)	05:15	05:06	05:26	06:00	06:35	07:11	07:19				
	16:46	17:28	19:03	19:40	20:13	20:34	20:23	19:40	18:45	17:53	16:16	16:14				
24	07:13	06:34	06:45	05:52	10:15 (N1)	05:15	05:06	05:27	06:01	06:36	07:13	07:20				
	16:47	17:29	19:04	19:41	20:14	20:34	20:22	19:39	18:43	17:51	16:16	16:15				
25	07:12	06:32	06:43	05:50	10:14 (N1)	05:14	05:07	05:28	06:03	06:38	07:14	07:20				
	16:48	17:30	19:05	19:43	20:15	20:34	20:21	19:37	18:41	17:50	16:15	16:15				
26	07:12	06:31	06:42	05:49	10:13 (N1)	05:13	05:07	05:29	06:04	06:39	07:15	07:21				
	16:50	17:32	19:07	19:44	20:16	20:34	20:20	19:35	18:39	17:48	16:14	16:16				
27	07:11	06:29	06:40	05:47	10:12 (N1)	05:12	05:07	05:30	06:05	06:40	07:16	07:21				
	16:51	17:33	19:08	19:45	20:17	20:34	20:19	19:34	18:38	17:47	16:14	16:17				
28	07:10	06:28	06:38	05:45	10:11 (N1)	05:12	05:08	05:31	06:06	06:41	07:18	07:21				
	16:52	17:34	19:09	19:46	20:18	20:34	20:18	19:32	18:36	17:45	16:13	16:17				
29	07:09	06:26	06:36	05:44	10:10 (N1)	05:11	05:08	05:33	06:07	06:42	07:19	07:21				
	16:54	19:10	19:47	19:47	20:19	20:34	20:17	19:30	18:34	17:44	16:13	16:18				
30	07:08	06:24	06:34	05:43	10:09 (N1)	05:10	05:09	05:34	06:08	06:43	07:20	07:22				
	16:55	19:12	19:49	19:49	20:20	20:34	20:16	19:28	18:32	17:42	16:12	16:19				
31	07:07	06:23	06:33	05:42	10:08 (N1)	05:10	05:09	05:35	06:09	06:44	07:22	07:22				
	16:56	19:13	19:50	19:50	20:21	20:14	20:14	19:27	18:31	17:41	16:11	16:20				
Potential sun hours	289	293	369	403	456	462	468	433	376	342	291	279				
Total, worst case				118					121							
Sun reduction				0.53					0.56							
Oper. time red.				1.00					1.00							
Wind dir. red.				0.76					0.76							
Total reduction				0.40					0.42							
Total, real				47					51							

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	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		

Project:

Groton NH VIA Shadow Flicker Analysis

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11/12/2009 2:57 PM / 1

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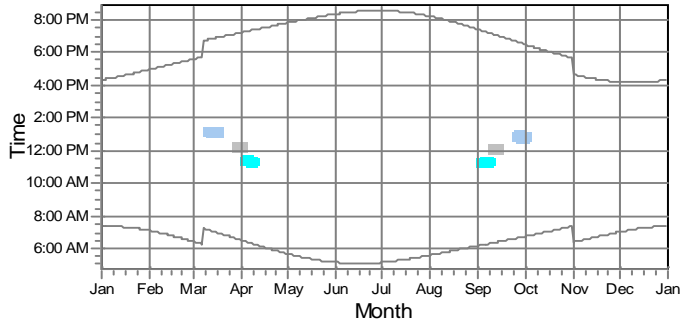
Calculated:

11/12/2009 2:19 PM/2.6.0.235

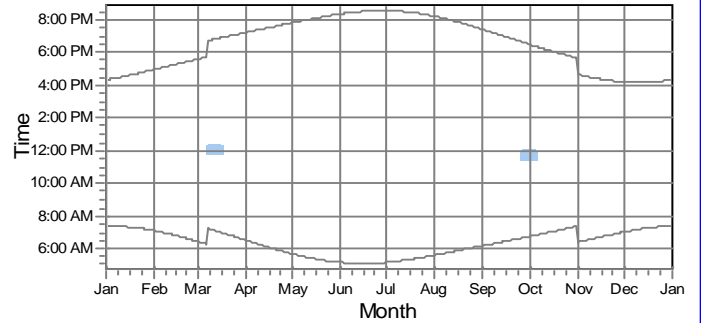
SHADOW - Calendar, graphical

Calculation: Groton NH VIA Shadow Flicker Analysis [4]

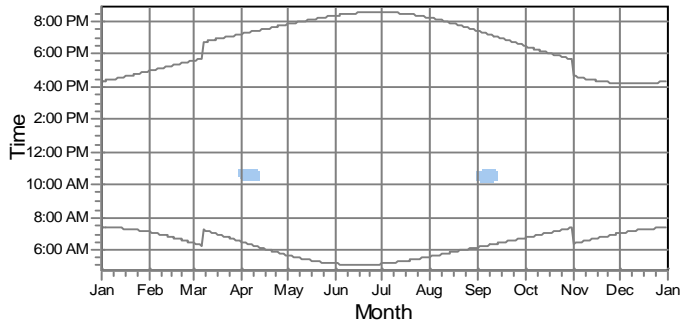
EB: Shadow Receptor (132)



EC: Shadow Receptor (133)



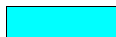
EH: Shadow Receptor (138)



WTGs



N2: WTG



N3: WTG



N1: WTG