

April 23, 2012

Mr. Jerry Lein
North Dakota Public Service Commission
12th Floor, Dept. 408
State Capitol Building
600 E. Blvd. Ave.
Bismarck, ND 58505

**Re: Compiled Supplemental Materials supporting the Application for a
Certificate of Site Compatibility – Clean Energy #1 Project
(Case Number PU-11-662)**

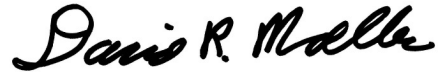
Dear Mr. Lein:

On behalf ALLETE Clean Energy, enclosed please find several supplemental materials that are being submitted in support of ALLETE Clean Energy's Certificate of Site Compatibility application for the proposed Clean Energy #1 Project in Morton and Mercer Counties. Included in this submittal are project layout maps with proposed turbine locations, a wetlands summary memo, a cultural resources survey summary report, the previously-submitted application for a Morton County special use permit, and sound and shadow flicker reports. All documents are submitted as hard copies as well as electronic copies on compact disk.

Public agencies were contacted and invited to comment on the Project. ALLETE Clean Energy has not received any agency response letters since the original application was submitted to the NDPSC in January, 2012. The Mercer County conditional use and rezoning permit applications will be submitted after the public hearing, and copies of the submittals will be provided to the NDPSC.

Please call me at 218-723-3963 with any questions.

Yours truly,

A handwritten signature in black ink that reads "David R. Moeller". The signature is written in a cursive style with a large, prominent 'D' and 'M'.

David R. Moeller

c: Eric Norberg, ALLETE Clean Energy
Dwight Anderson, ALLETE Clean Energy
Steve Peluso, ALLETE Clean Energy
Jim Atkinson, ALLETE
Daniel McCartney, ALLETE

***Supplemental Materials Submitted in Support of the
Application to the North Dakota Public Service
Commission for a Certificate of Site Compatibility to
Construct the Clean Energy #1 Project***

Case #PU-11-662

April 2012

***By
ALLETE Clean Energy***



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**Appendix A - Agency Correspondence Received after the Original Application Filing in January, 2012:
NONE RECEIVED**

Appendix B - Clean Energy #1 Project – Proposed Project Layout

Turbine Layout	542ft Turbine Setback
Cemetery	1400ft Occupied Dwelling Setback
Church Location	542ft Maintained Roads Setback
Occupied Residence	542ft Transmission Line Setback
Uncertain Residence	250ft Microwave Beam Path Setback
Preliminary Access Road	ND State Land Dept. Administered Property
Preliminary Crane Path	Private Land Open to Sportsmen (PLOTS)
Preliminary Turbine Pad	Public Land Survey Section
Local Road	Preliminary Project Boundary
State Highway	County Boundary
Transmission Line	
Approximate Microwave Beam Path	
Field Verified Wetland Boundary	

Data Sources:
 Project Boundary, Layouts, Residences - Allete Clean Energy
 Transmission Line, Wetlands, Setbacks - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

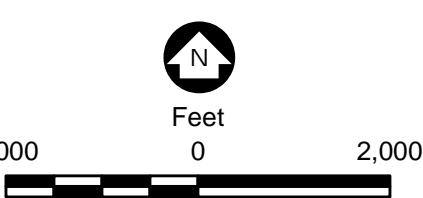
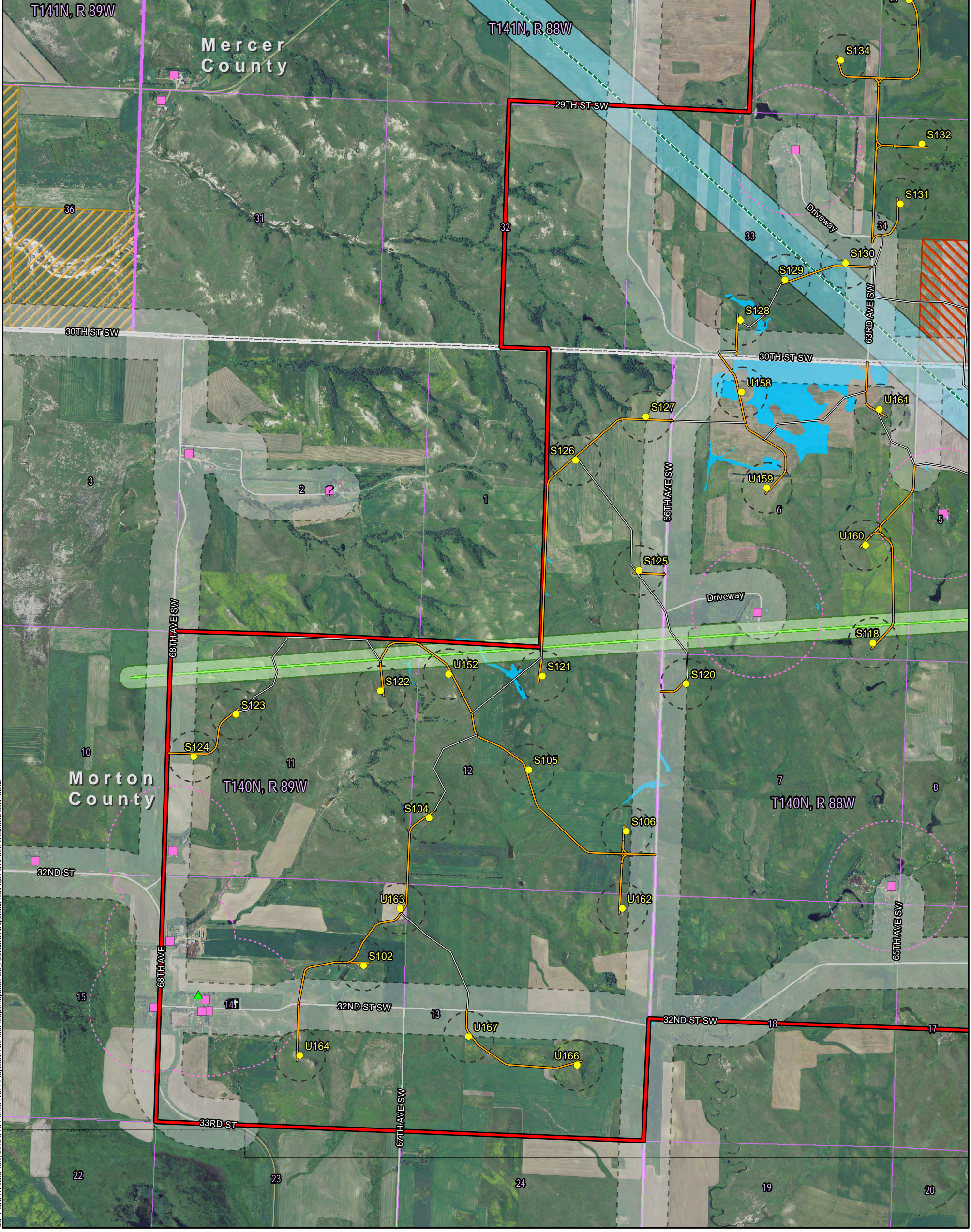


Figure 1
 OVERVIEW, EXCLUSION, AND AVOIDANCE
 AREAS MAP - WESTERN PORTION -
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota



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- Turbine Layout
 - Cemetery
 - ▲ Church Location
 - Occupied Residence
 - Uncertain Residence
 - Preliminary Access Road
 - Preliminary Crane Path
 - Preliminary Turbine Pad
 - Local Road
 - State Highway
 - Transmission Line
 - Approximate Microwave Beam Path
 - Field Verified Wetland Boundary
 - 542ft Turbine Setback
 - 1400ft Occupied Dwelling Setback
 - 542ft Maintained Roads Setback
 - 542ft Transmission Line Setback
 - 250ft Microwave Beam Path Setback
 - ND State Land Dept. Administered Property
 - Private Land Open to Sportsmen (PLOTS)
 - Public Land Survey Section
 - Preliminary Project Boundary
 - County Boundary
- Data Sources:
 Project Boundary, Layouts, Residences - Allete Clean Energy
 Transmission Line, Wetlands, Setbacks - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

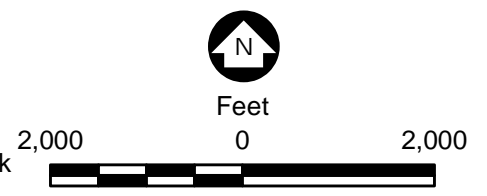
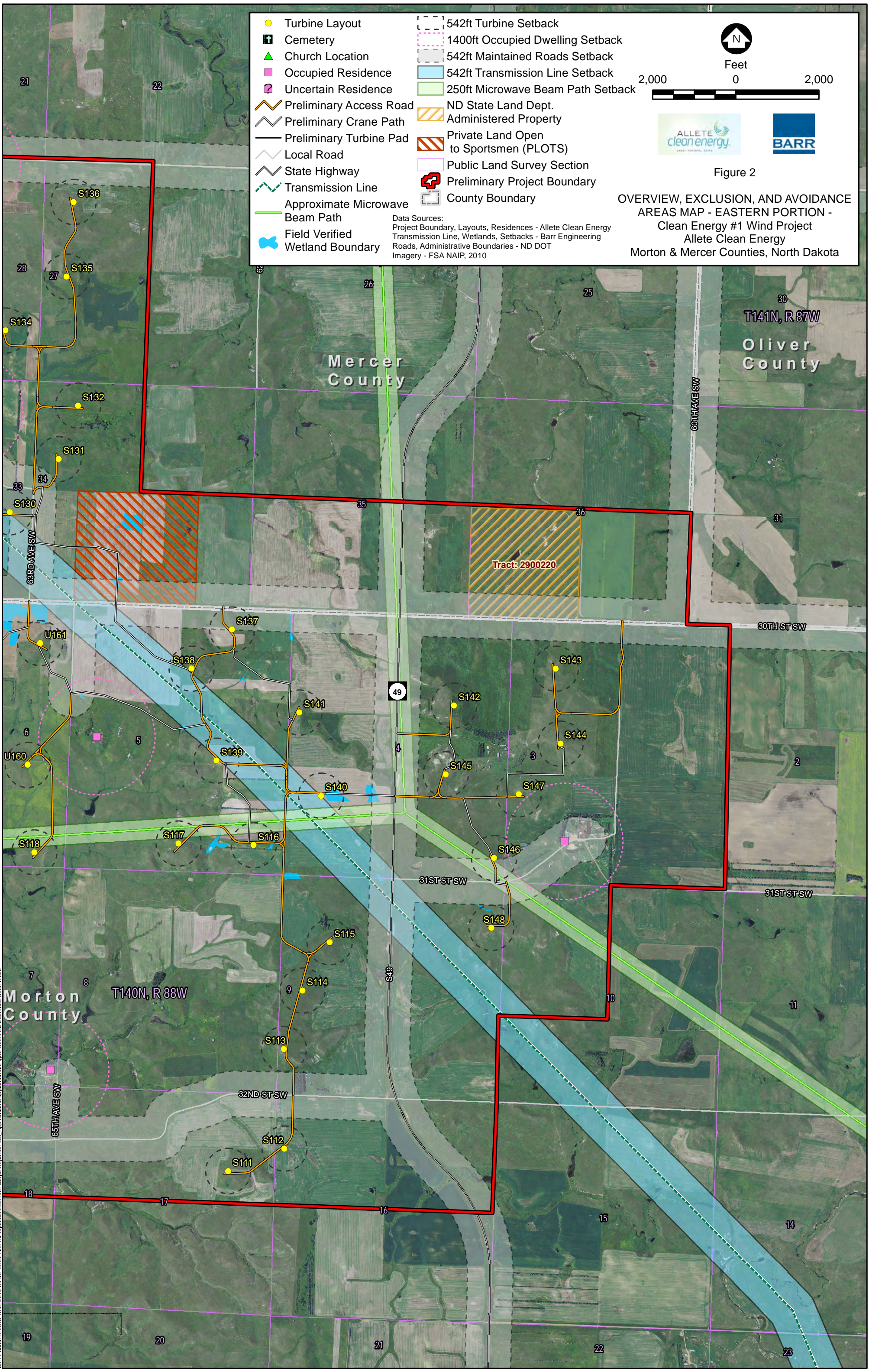


Figure 2

OVERVIEW, EXCLUSION, AND AVOIDANCE
 AREAS MAP - EASTERN PORTION -
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota



Appendix C - Wetlands Summary

Technical Memorandum

To: Jim Atkinson, Allete
From: Cheryl Feigum, Mike Strong
Subject: Wetland Determination Methods for the Allete Clean Energy #1 Wind Energy Project
Date: April 16, 2012
Project: 34301007.00
c: Dan Flo, John Wachtler

The purpose of this memorandum is to identify jurisdictional wetlands that will be impacted by the Allete Clean Energy #1 Wind Energy Project (Project; Figure 1). The U.S. Army Corps of Engineers (Corps) regulates the placement of dredge or fill material into wetlands that are hydraulically connected or adjacent to a navigable water or interstate water under the authority of Section 404 of the Clean Water Act. Wetlands were evaluated for the jurisdiction determination using both off-site and on-site review methods.

Conclusions:

Our wetland review evaluated the potential impacts of the proposed locations for the wind turbines, combined permanent crane paths/access roads, and temporary crane paths (Figure 2). Based on the project design (April 4, 2012), there will be six crossings where wetlands will be permanently impacted by combined permanent crane paths/access roads; however, one of the six crossings is an isolated, non-jurisdictional wetland. The permanent wetland impacts will be less than 2,929 square feet per jurisdictional wetland crossing. Ten additional wetlands will be crossed by temporary crane paths and will result in no permanent wetland impacts.

Wetland Review:

Wetlands were identified within the proposed project area using a two-phased approach. The first phase was an off-site review of wetland areas using public and private geographic digital datasets. The second phase involved the on-site review of wetlands and subsequent revisions of the wetland boundaries.

Phase I: Off-site Determination Methods

For the off-site wetland determinations, wetland boundaries were estimated and mapped using Esri's ArcGIS 10.0[®] software to display environmental data (soils, hydrography, topography) for the study area.

The following datasets were obtained and reviewed for the Project area; each dataset was examined at its maximum resolution.

- U.S. Geological Survey (USGS) 7.5-minute (1:24,000 scale) quadrangle map
- USGS 7.5-minute (1:100,000 scale) quadrangle map
- U.S. Department of Agriculture (USDA) - Farm Services Administration (FSA) true color aerial photographs 2010, 2006, 2005, 2004, 2003, 1995-1998 Statewide
- USDA-FSA true color aerial photographs (1:3600) from 2003, 2005, 2009, 2010 for Morton and Mercer counties
- USDA-FSA color infrared (CIR) aerial photographs 2009 and 2010 Statewide
- LiDAR aerial true color imagery from 2011 provided by Allete
- LiDAR topography data (two-foot contour intervals) from 2011 provided by Allete
- Five-foot topography data (5-ft contour intervals) provided by Allete
- United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Data
- Natural Resources Conservation Service (NRCS) SSURGO Soil Survey Data for Morton and Mercer counties including attributes for the hydric soil map units
- USGS Linear Hydrologic Features (1:100,000) compilation of perennial/intermittent flow types for rivers, streams, ditches, etc.
- USGS Aerial Hydrologic Features (1:100,000) compilation of major rivers, lakes, ponds, etc.
- USGS Gap Analysis Program (GAP) data 2004
- USGS National Land Cover Dataset (NLCD) 2001

Using the GIS data described above, the 11,864-acre project area was evaluated for wetlands, typically at a scale of 1:2000. All areas within the Project boundary were reviewed; however, the following areas were given higher priority during the off-site review:

- Areas previously mapped as NWI wetlands (Figure 3)
- Areas exhibiting a signature for inundation or surface saturation

- Low-lying areas adjacent to fluvial features, such as rivers, ditches, and perennial streams
- Depressional areas with concave slopes, either linear or fully enclosed features (potholes, swales, etc.)
- Areas upstream and downstream of stock ponds
- Areas where the topographic contours indicated minimal slopes (contour lines are widely spaced) or a flow line

The public datasets (mapped at a smaller scale), such as the GAP and NLCD data, were useful for identifying large or open-water wetlands, but were not sufficient for many of the smaller, less obvious wetland areas. The most useful datasets were the high-resolution topography (two-foot contour lines) and aerial imagery data created using the LiDAR information. Using GIS, wetland polygons were created for use in the on-site field review within the Project boundary.

Phase II: On-site Determination Methods

Field review was completed during an on-site visit from September 27-28, 2011. The purpose of the on-site visit was to evaluate whether wetlands were present at the potential locations for the turbine sites, access roads and crane paths. Alternative locations were also reviewed in order to avoid wetland impacts. Field maps were prepared at a scale of 1:12,000 and included the following layers: wetlands identified from the off-site review, two-foot or five-foot contour intervals, linear flow lines and hydric soil map units. The week before the September site visit, there was a 1- to 2-inch rainfall event, resulting in standing water on the landscape. As a result of the rainfall, the wetland boundaries for the project are conservative. Based on the field review, the impacts to wetlands were avoided and minimized to the extent feasible.

During the field review, approximately 2,017 acres were evaluated (the “wetland survey extents area”) for wetlands within the 11,864-acre project area. The jurisdictional status of the wetlands was reviewed in the field as well. Originally, the NWI identified 0.2 acres of wetland within the wetland survey extents area. After completion of fieldwork, the wetland boundaries were adjusted using GIS, resulting in approximately 116 acres of wetland identified within the wetland survey extents area (Table 1; Figure 4). The delineated wetlands were classified using the USFWS Circular 39 Classification System (Types 1, 2, 3, etc.; Shaw and Fredine, 1956) and the USFWS Cowardin System (PEMB, PSSC, PFOB, etc.; Cowardin et. al., 1979).

Wetland Summary

There were 2,017 acres evaluated within the wetland survey extents area for Project. Of these, approximately 116 acres were identified as wetland (Table 1; Figure 4). These wetlands are classified as temporarily flooded basins (Type 1; PEMA), saturated wet meadows (Type 2; PEMB), seasonally flooded shallow marshes (Type 3; PEMC) and saturated forested wetlands (Type 7; PFOB) (Table 1).

Table 1. Wetland summary for the wetland survey extents area

Wetland Type	Circular 39 Type	Cowardin Type	Wetland (ac)	Percent of Total Wetland in Survey Extents Area
Temporary flooded basin	1	PEMA	95.2	82.0%
Wet (fresh) meadow	2	PEMB	16.0	13.7%
Shallow marsh	3	PEMC	4.0	3.5%
Forested	7	PFOB	0.9	0.8%
Total			116.1	100%

Temporary flooded basins (82 percent) and wet meadows (13.7 percent) were the dominant wetland types present in the wetland survey extents area. Other wetland types included shallow marsh and forested wetlands. Representative photographs of wetland types are provided in Appendix A.

There were no wetlands identified within the proposed wind turbine sites (Figure 4). Based on the Project design (April 4, 2012), there will be six crossings where wetlands will be permanently impacted by combined permanent crane paths/access roads; however, one of the six crossings is an isolated, non-jurisdictional wetland (Crossing #4; Figure 5). Wetland types that will be permanently impacted include temporarily flooded basins (Type 1; PEMA) and saturated wet meadows (Type 2; PEMB). Six wetland crossings will permanently impact less than 2,929 square feet of jurisdictional wetland per crossing. Ten crane paths will have temporary wetland impacts during construction; however, there will be no permanent wetland impacts at these crossings.

The road surface width will be 37 feet for the combined permanent crane paths/access roads and temporary crane paths. Construction of these roads requires shoulders and tie-in fill so the total width of the roads will range from approximately 45 to 55 feet. Table 2 identifies the wetland crossings and the wetland impact per crossing (in square feet).

Table 2. Summary of wetland crossings

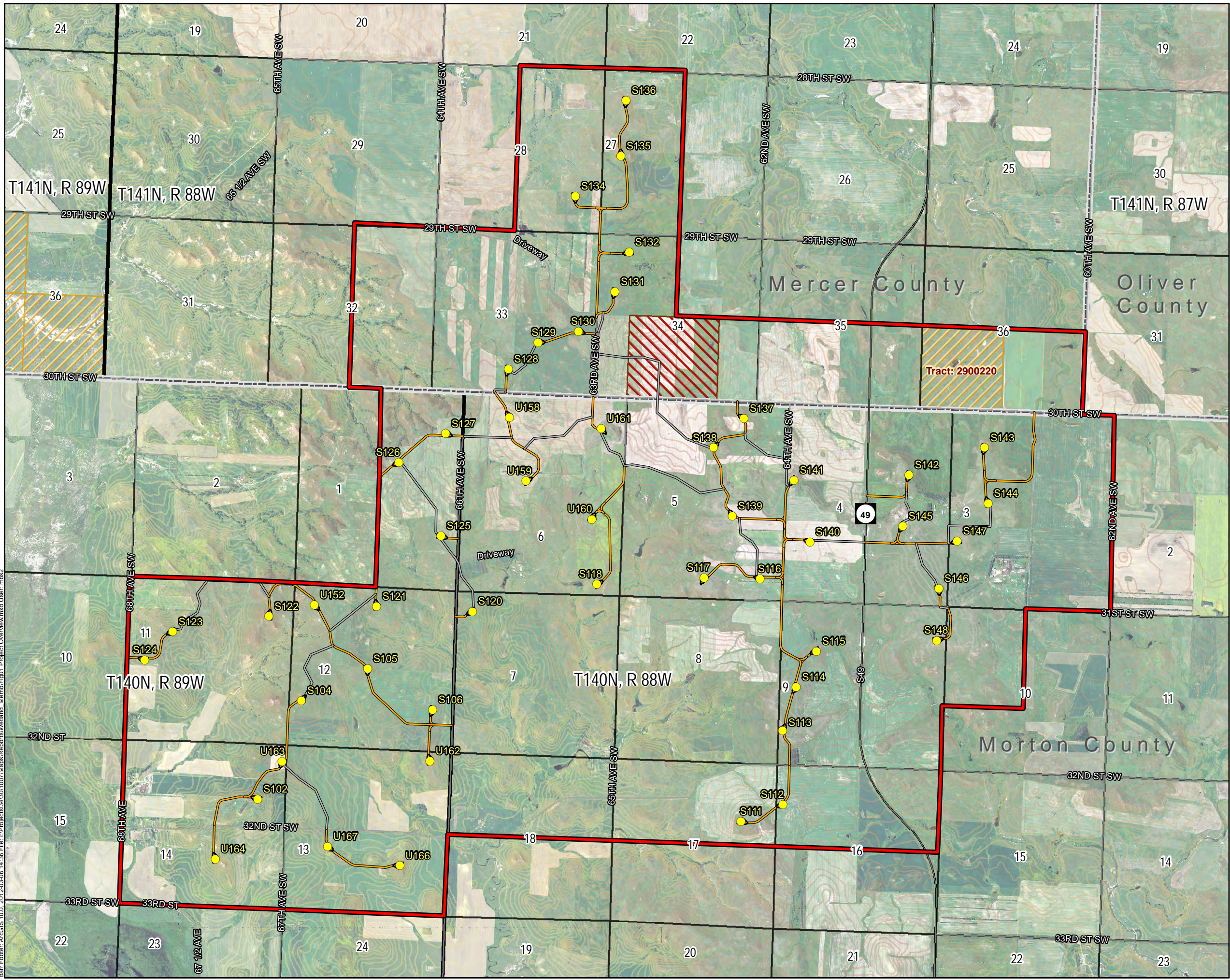
Crossing Type	Located Between Wind Turbine ID(s)	Cowardin Type	Circular 39 Type	Jurisdictional Wetland?	Wetland Impact Assuming 45 ft Total Impact Width (sq ft)	Wetland Impact Assuming 55 ft Total Impact Width (sq ft)
Permanent Crane Path and Access Road	S105 - S106	PEMB	2	Yes	445	546
	S121 - S126	PEMA	1	Yes	1,152	1,422
	North of U161	PEMA	1	Yes	1,404	2,093
	S105 - S106	PEMA	1	No	1,631	1,866
	S116 - S140	PEMB	2	Yes	2,329	2,828
	North of U158	PEMB	2	Yes	2,929	3,596
Temporary Crane Path	S137 - S141	PEMB	2	Yes	717	849
	U159 - U161	PEMA	1	Yes	3,452	4,260
	U139 - U161	PEMB	2	Yes	4,547	5,584
	S121 - U152	PEMB	2	Yes	4,612	5,735
	S128 - S129	PEMB	2	Yes	5,125	6,267
	U159 - U161	PEMA	1	Yes	5,778	7,053
	S140 - S145	PEMA	1	Yes	10,105	12,389
	S131 - S138	PEMA	1	Yes	10,444	12,735
	U159 - U161	PEMA	1	Yes	16,209	19,830
	S140 - S145	PEMA	1	Yes	17,005	20,792

References

Cowardin, L.M., V. Carter, F.C. Golet, R.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, FWS/OBS079/31, 103 pp.

U.S. Fish and Wildlife Service. 1956. *Wetlands of the United States Circular 39*. U.S. Government Printing Office, Washington, D.C.

Figures



- Turbine Layout
- Prelim. Access Road (12/21/2011)
- Prelim. Crane Path (2/14/2011)
- Prelim. Turbine Pad (12/21/2011)
- 10 ft Contour
- Local Road
- Public Land Survey Section
- Public Land Survey Township
- Private Land Open to Sportsmen (PLOTS)
- ND State Land Dept. Administered Property
- ACE Project Boundary (1/3/2012)
- County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

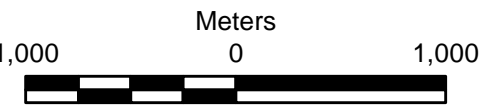
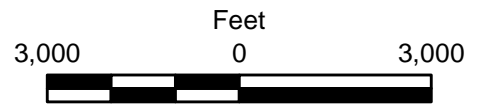
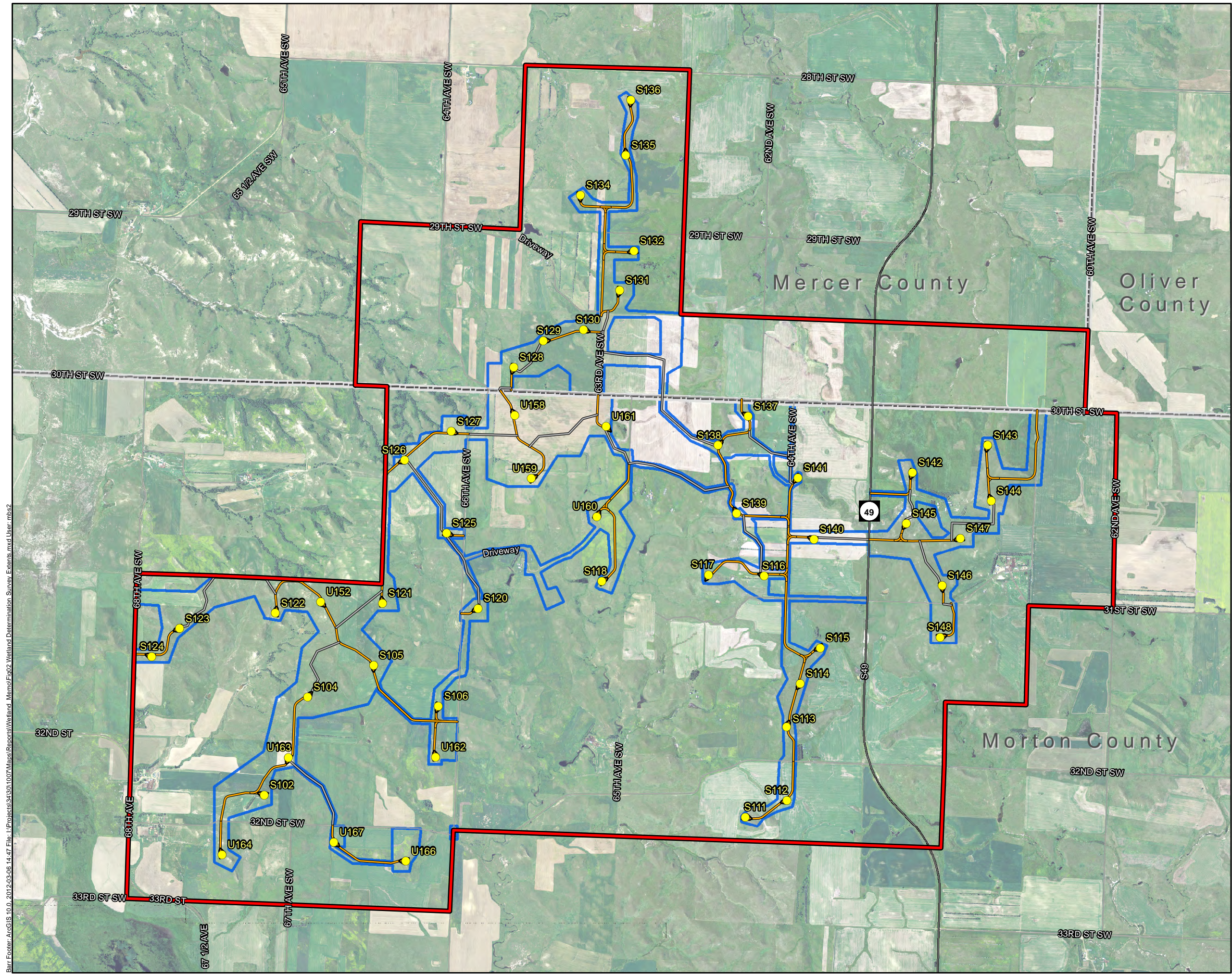


Figure 1
 PROJECT OVERVIEW
 North Dakota I Wind Project
 Allete Clean Energy
 Morton and Mercer Counties, ND

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- Turbine Layout
- Prelim. Access Road (12/21/2011)
- Prelim. Crane Path (2/14/2011)
- Prelim. Turbine Pad (12/21/2011)
- Local Road
- + Wetland Survey Extents
- + ACE Project Boundary (1/3/2012)
- + County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Roads, Administrative Boundaries - ND DOT
 Survey Extents - Barr Engineering
 Imagery - FSA NAIP, 2010

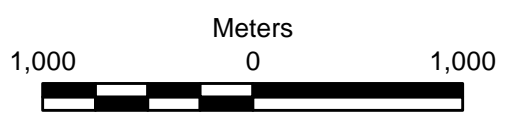
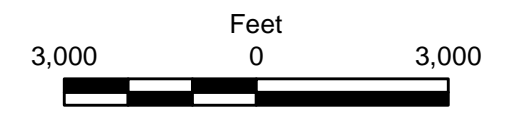
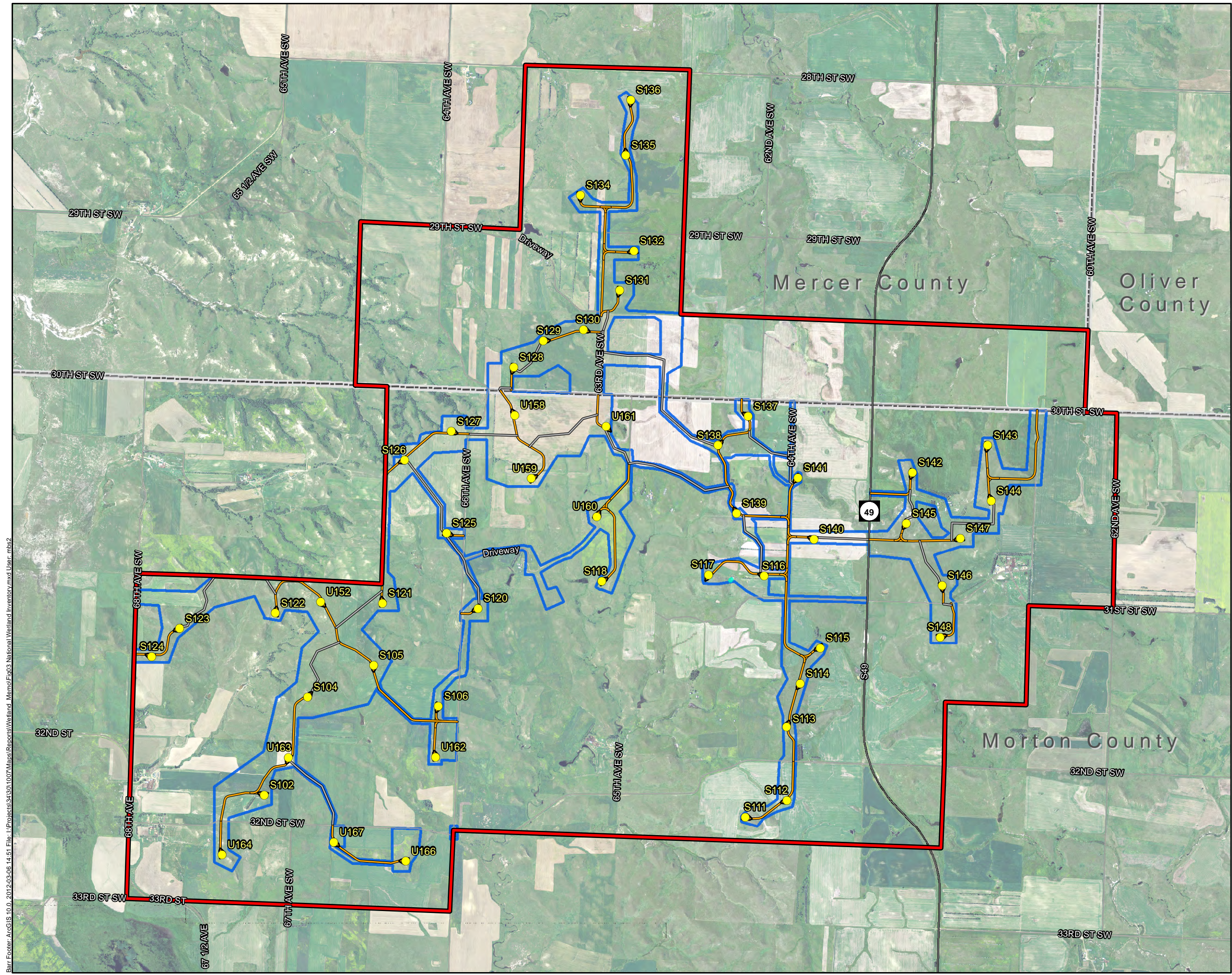


Figure 2

WETLAND DETERMINATION
 SURVEY EXTENTS
 North Dakota I Wind Project
 Allete Clean Energy
 Morton and Mercer Counties, ND

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- Turbine Layout
- Prelim. Access Road (12/21/2011)
- Prelim. Crane Path (2/14/2011)
- Prelim. Turbine Pad (12/21/2011)
- Local Road
- National Wetland Inventory
- Wetland Survey Extents
- ACE Project Boundary (1/3/2012)
- County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 National Wetland Inventory - USFWS
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

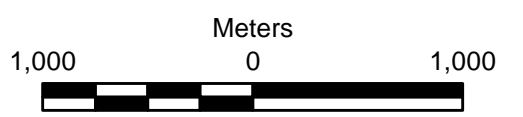
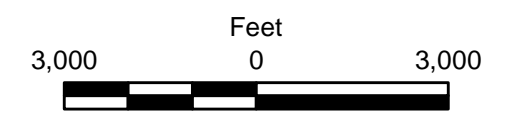
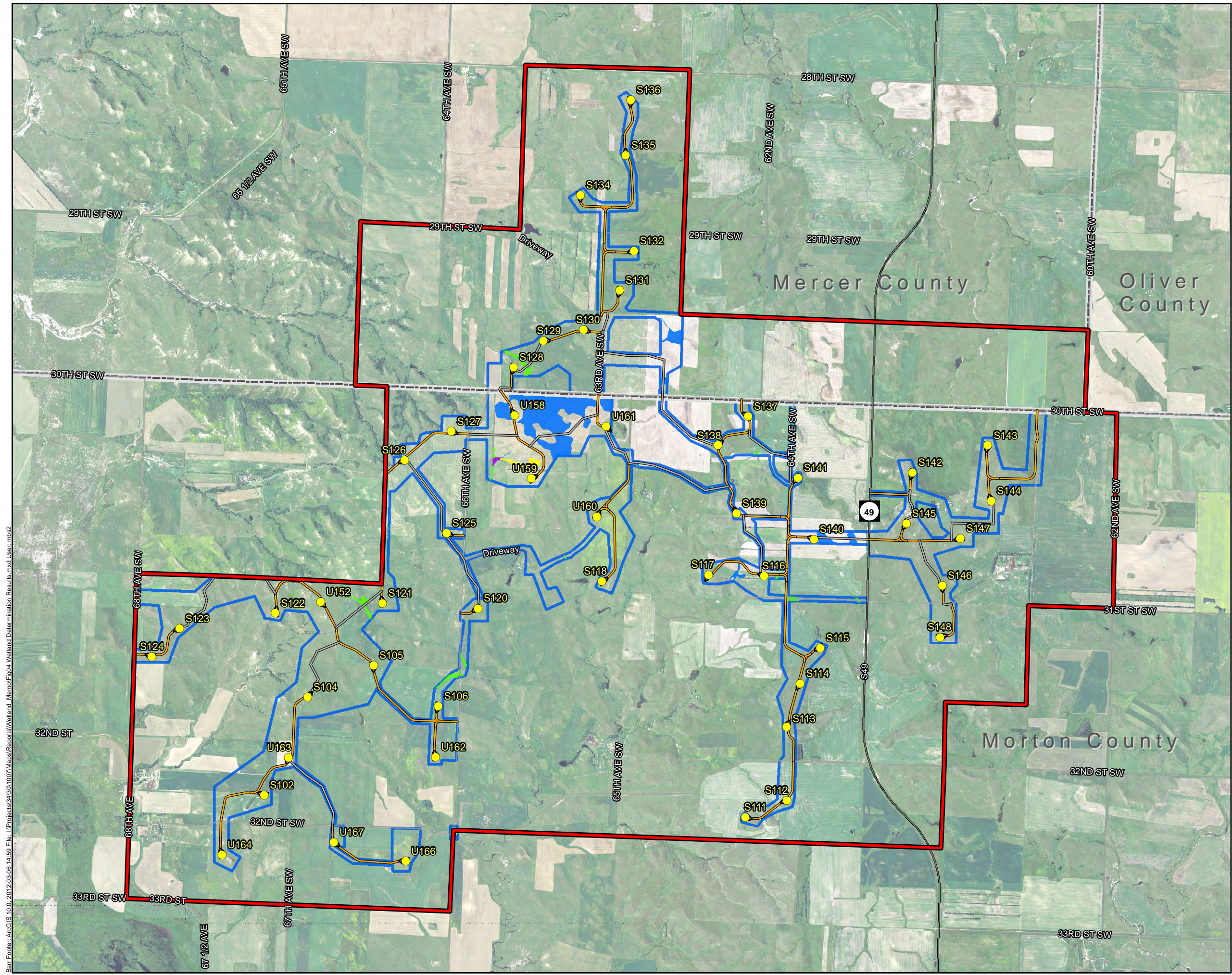


Figure 3

NATIONAL WETLAND INVENTORY
 North Dakota I Wind Project
 Allete Clean Energy
 Morton and Mercer Counties, ND

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- Turbine Layout
- Prelim. Access Road (12/21/2011)
- Prelim. Crane Path (2/14/2011)
- Prelim. Turbine Pad (12/21/2011)
- Local Road
- Field Verified Wetland Boundary
- PEMA
- PEMB
- PEMC
- PFOB
- Wetland Survey Extents
- ACE Project Boundary (1/3/2012)
- County Boundary

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 Wetlands - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

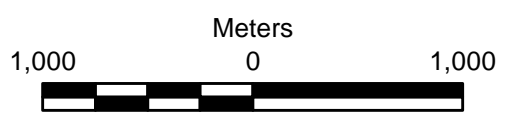
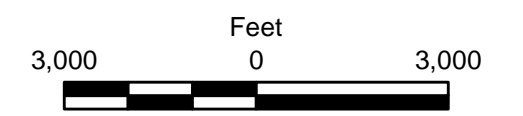
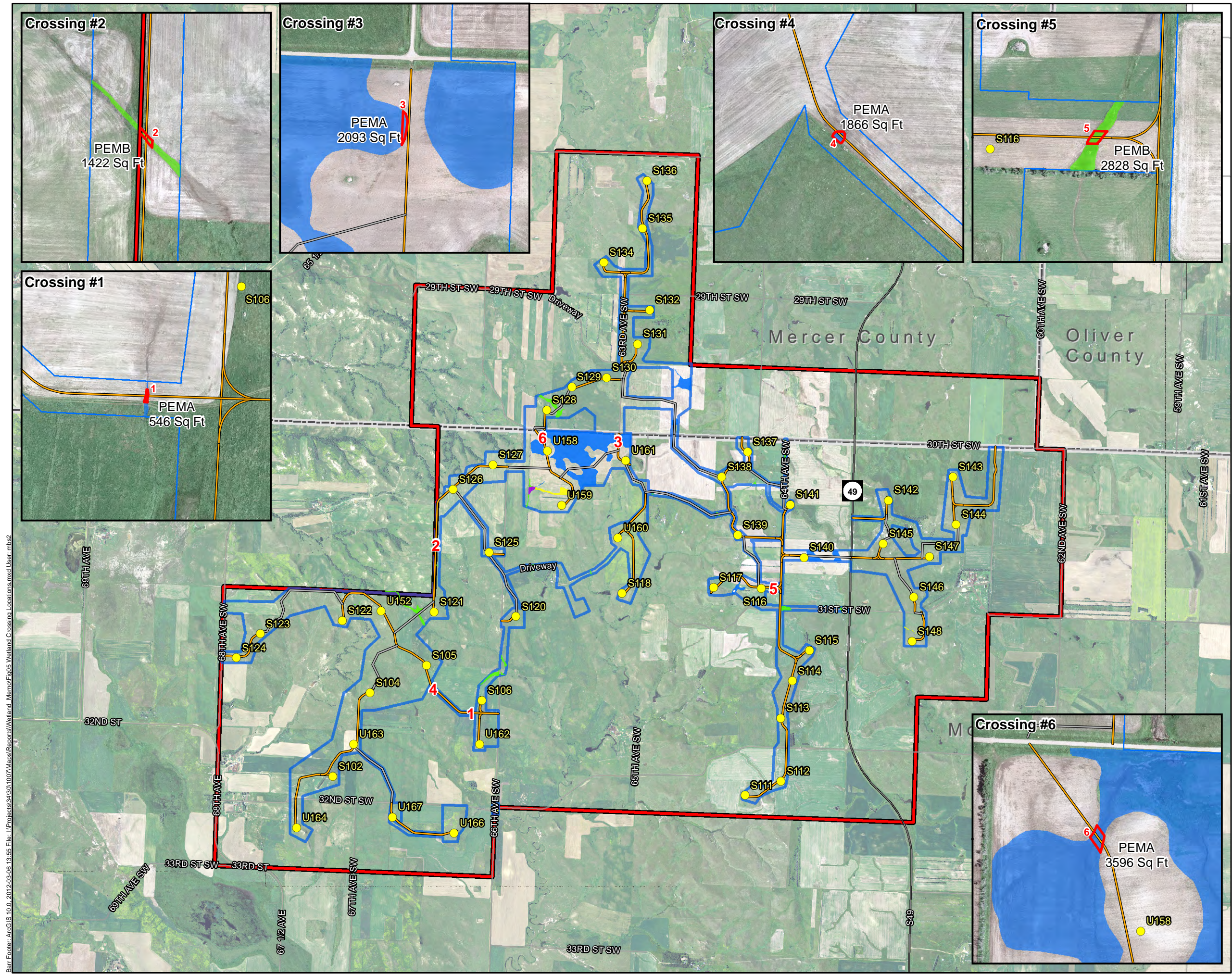


Figure 4

WETLAND DETERMINATION RESULTS
 North Dakota I Wind Project
 Allete Clean Energy
 Morton and Mercer Counties, ND

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- Turbine Layout
- Prelim. Access Road (12/21/2011)
- Prelim. Crane Path (2/14/2011)
- Local Road
- ⊞ Wetland Intersection Area (Shown at 55 ft Total Width)
- ⊞ Field Verified Wetland Boundary
- ⊞ PEMA
- ⊞ PEMB
- ⊞ PEMC
- ⊞ PFOB
- ⊞ Wetland Survey Extents
- ⊞ ACE Project Boundary (1/3/2012)
- ⊞ County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Wetlands - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
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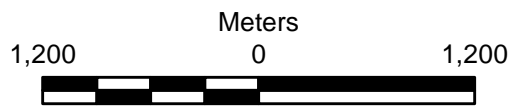
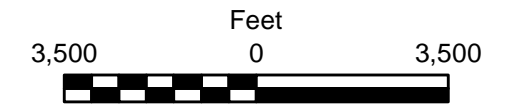


Figure 5
WETLAND CROSSING LOCATIONS
 North Dakota I Wind Project
 Allete Clean Energy
 Morton and Mercer Counties, ND

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Appendix A:
Wetland Photographs



Seasonally Flooded Basin/Flat (Type 1)



Seasonally Flooded Basin/Flat (Type 1)



Wet Meadow (Type 2)



Wet Meadow (Type 2)



Shallow Marsh (Type 3)



Shallow Marsh (Type 3)



Forested Wetland (Type 7)



Forested Wetland (Type 7)

Appendix D - Class III Cultural Resources Inventory Report (non-privileged summary)

Appendix E - North Dakota State Historic Preservation Office Concurrence: PENDING; Concurrence expected prior to May 4th hearing.

Appendix F - Morton County, ND, Special Use Permit Application

COMMISSIONERS:

BRUCE STRINDEN, Chairman
Mandan, ND

ANDY ZACHMEIER Vice Chairman
Mandan, ND

MARK BITZ
Mandan, ND

JAMES BOEHM,
Mandan, ND

DICK TOKACH
Mandan, ND

MORTON COUNTY

STATE OF NORTH DAKOTA

210 2nd AVENUE NW
MANDAN, NORTH DAKOTA 58554

DAWN R. RHONE, County Auditor



Morton County Conditional Use Permit for ALLETE Clean Energy's Clean Energy #1 Project.

Daniel McCourtney
Environmental Compliance Planner
Allete/Minnesota Power
30 West Superior St
Duluth MN 55802

Dear Mr. McCourtney

The Morton County Commissioners have granted on April 10, 2012 a Conditional Use Permit for the construction of a utility scale (up to 100MW) wind project in Morton and Mercer Counties in North Dakota, out of 50 total turbines up to 42 turbines are proposed in Morton County located in Section 3,4,5,6,7,8,9,10,16,17,18, Twp -140 Rng-88 and Section 1,11,12,13,14 Twp-140 Rng-89

If you have any questions or comments, please do not hesitate to call me.

Sincerely,

A handwritten signature in black ink, appearing to read "Belinda Eckroth". The signature is fluid and cursive, written over a light background.

Belinda Eckroth
Planning & Zoning Director

April 17, 2012



March 6, 2012

Ms. Dawn Rhone
Morton County Auditor
Morton County Courthouse
210 2nd Ave. NW
Mandan, ND 58554

**Re: ALLETE Clean Energy's Clean Energy #1 Project
Special Use Permit Application**

Dear Ms. Rhone:

ALLETE Clean Energy, a subsidiary of ALLETE Inc. is planning to construct a wind energy conversion facility—the Clean Energy #1 Project—in Morton and Mercer Counties in North Dakota. ALLETE Clean Energy has retained Barr Engineering Co. (Barr) to assist with the environmental permitting process for the project.

Enclosed please find an application and supporting materials for a Morton County Special Use Permit for the Clean Energy #1 Project. Barr Engineering is submitting this application on behalf of Dan McCartney, Environmental Siting and Permitting at Minnesota Power (ALLETE). The approximately 100 MW Clean Energy #1 Project will interconnect with a proposed Minnesota Power substation in Mercer County, and then a proposed 230 kV transmission line that will connect with Minnesota Power's existing 230 kV Bison – Square Butte Line No. 84 to interconnect at the Square Butte 230 kV Substation. The wind-generated electricity will then be transmitted to Minnesota Power's transmission system via an existing 250kV DC Line and existing AC transmission system as available.

Leases from landowners have been obtained within the preliminary Project boundary. The Project site encompasses approximately 12,000 acres and is located approximately 7 miles east of the City of Hebron. The turbines will be placed throughout the Project site and in compliance with Morton County Planning and Zoning Resolutions, Appendix I, Wind Energy Facilities. The Project's location is shown in Exhibit 1 and the preliminary Project boundary, with aerial photo and topographical map backgrounds, is shown in Exhibit 2 and Exhibit 3, respectively. Applicable setbacks are shown in Exhibit 4. Detailed locations of wind turbine generators, access roads, and collector lines will be provided to Morton County upon request. However, of the 11,864 acres within the preliminary Project boundary, approximately 11,800 acres will be untouched by the project, or, if temporarily disturbed for such uses as crane paths, will be allowed to revert to their former condition after project construction. In all, approximately .05 percent of the land within the preliminary Project boundary will be permanently occupied by Clean Energy #1 wind turbines and access roads.

ALLETE Clean Energy has submitted an application for a Certificate of Site Compatibility to the North Dakota Public Service Commission (Commission) pursuant to Chapter 49-22 of the North Dakota Century Code and Article 69-06 of the North Dakota Administrative Code. ALLETE Clean Energy plans to obtain Commission approval by April, 2011 and may begin construction in the spring of 2012, with turbine construction and project potentially complete in 2012.

The application fee will be sent to the Morton County Auditor within a week following this application.

If you have comments regarding this Special Use Permit application, you are encouraged to contact Dan McCourtney at 218-355-3515, or Daniel Flo at the address listed below, by e-mail (dflo@barr.com), or by phone (952-832-2975).

Sincerely,

A handwritten signature in black ink, appearing to read "Daniel Flo". The signature is stylized with large, rounded letters and a prominent loop at the end.

Daniel Flo
Environmental Scientist

Enclosures

MORTON COUNTY
UNIFIED DEVELOPMENT APPLICATION

Application submitted for (check all that apply):

- Preliminary Plat
 Final Plat
 Plat Vacation
 Road Vacation
 Zoning Change
 Variance
 Special Use Permit
 Lot Split

PROPERTY INFORMATION

Name of plat: NA

Legal description of property (lot, block, addition):

County	Township	Range	Section
Morton	140N	88W	3, 4, 5, 6, 7, 8, 9, 10, 16, 18
		89W	1, 11, 12, 13, 14

Street address of property: NA

Existing Zoning: _____ Proposed Zoning: _____

Acres: 54 acres for project facilities Number of Lots: _____

Description of development proposal, including reason(s) for the request: Construction of a utility scale (up to 100MW) wind project in Morton and Mercer Counties, North Dakota. Out of 51 total turbines, 42 turbines are proposed for Morton County. See Exhibit 1 for the project area and Exhibit 2 for the preliminary project boundary.

APPLICANT/DEVELOPER

Name: ALLETE Clean Energy – Dan McCourtney Mailing Address: 30 W. Superior St., Duluth, MN 55803

Telephone number: (218) 355-3515 FAX#: (218) 723-3916

E-mail address: dmccourtney@allete.com

PROPERTY OWNER (IF DIFFERENT THAN APPLICANT/DEVELOPER)

Name: See attached landowner list Mailing Address: _____

Telephone number: _____ FAX#: _____

E-mail address: _____

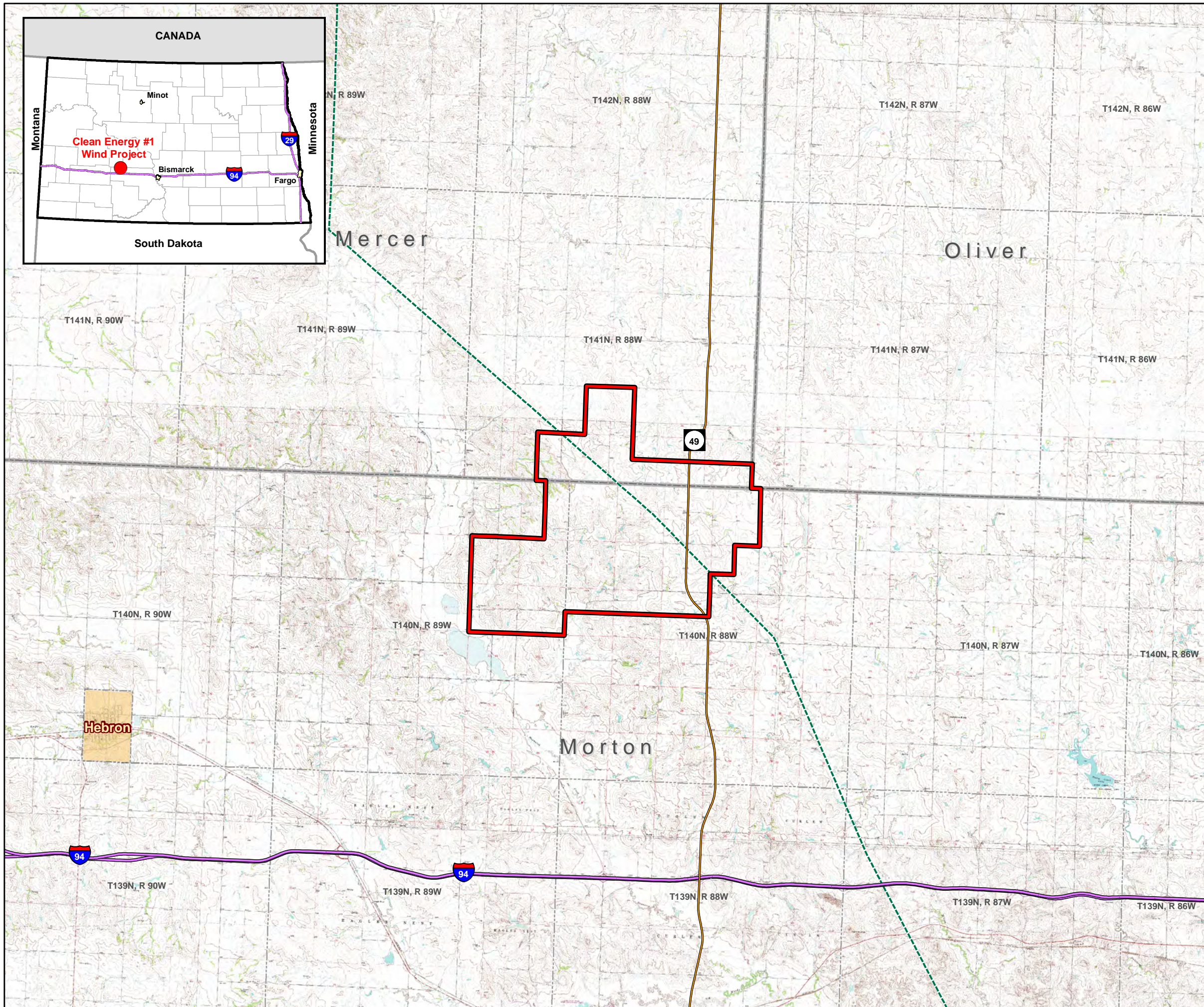
CONTACT PERSON/AGENT:





Name/Firm: Daniel Flo, Barr Engineering Co. Mailing Address: 4700 W. 77th St., Mpls, MN 55435

Telephone number: (952) 832-2975 FAX#: _____

E-mail address: dflo@barr.com

NOTE: APPLICATIONS ARE NOT COMPLETE UNTIL ALL REQUIRED SUBMITTALS HAVE BEEN RECEIVED



-  Transmission Line
-  State Highway
-  Interstate Highway
-  Preliminary Project Boundary
-  Municipality
-  County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Transmission Line - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Topo Map - USGS DRG

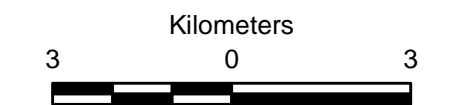
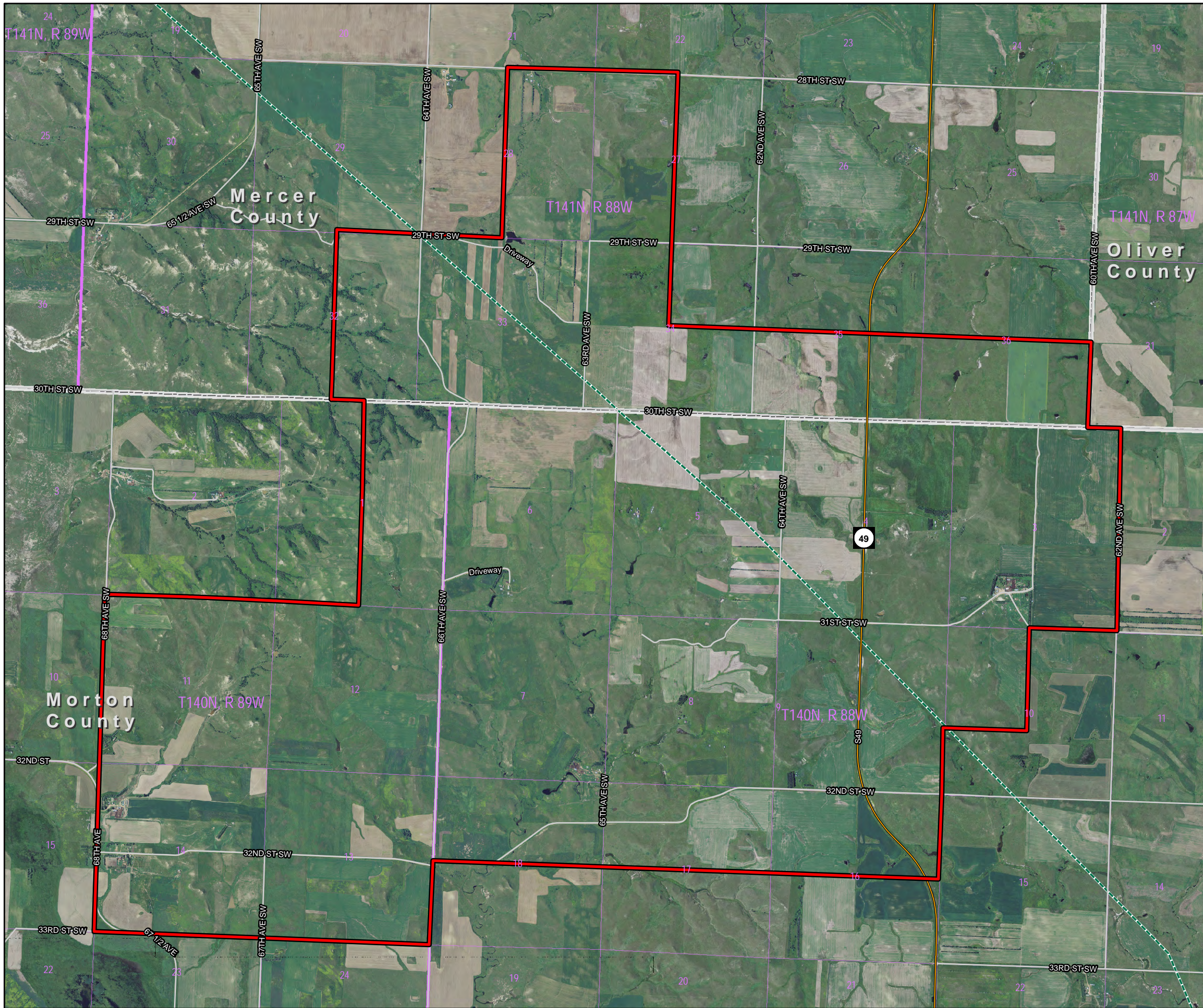







Exhibit 1

PROJECT OVERVIEW MAP
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota



-  Local Road
-  State Highway
-  Transmission Line
-  Public Land Survey Section
-  Public Land Survey Township
-  Preliminary Project Boundary
-  County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Transmission Line - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Imagery - FSA NAIP, 2010

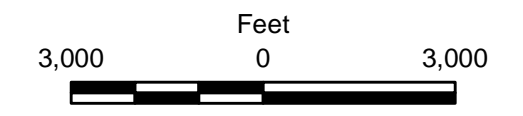
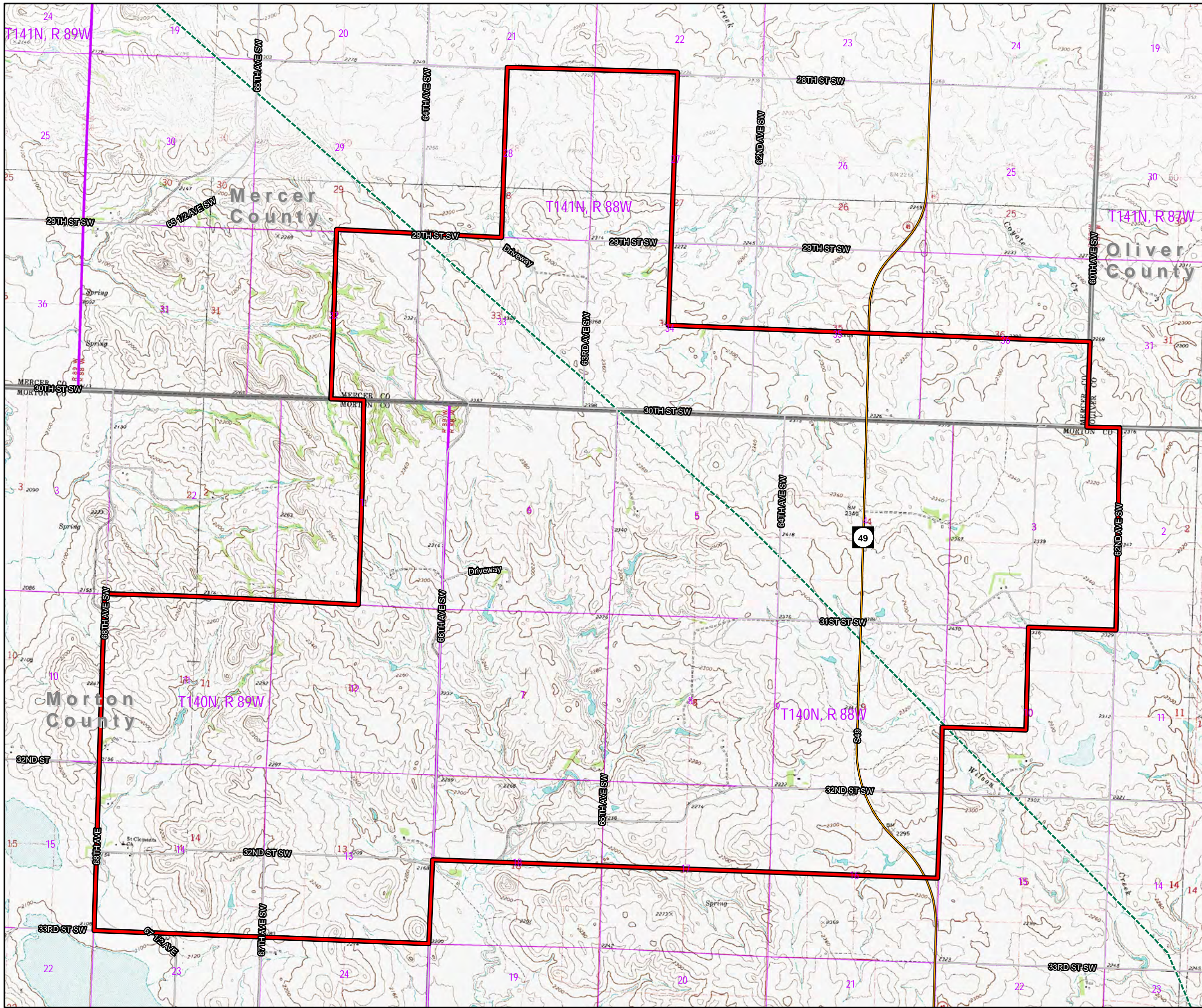







Exhibit 2

PRELIMINARY PROJECT
 BOUNDARY (2010 IMAGERY)
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota



-  Local Road
-  State Highway
-  Transmission Line
-  Public Land Survey Section
-  Public Land Survey Township
-  Preliminary Project Boundary
-  County Boundary

Data Sources:
 Project Boundary - Allete Clean Energy
 Transmission Line - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 Topography - USGS DRG

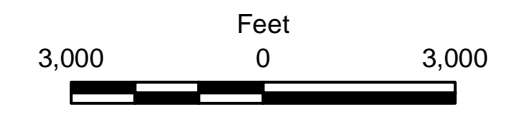
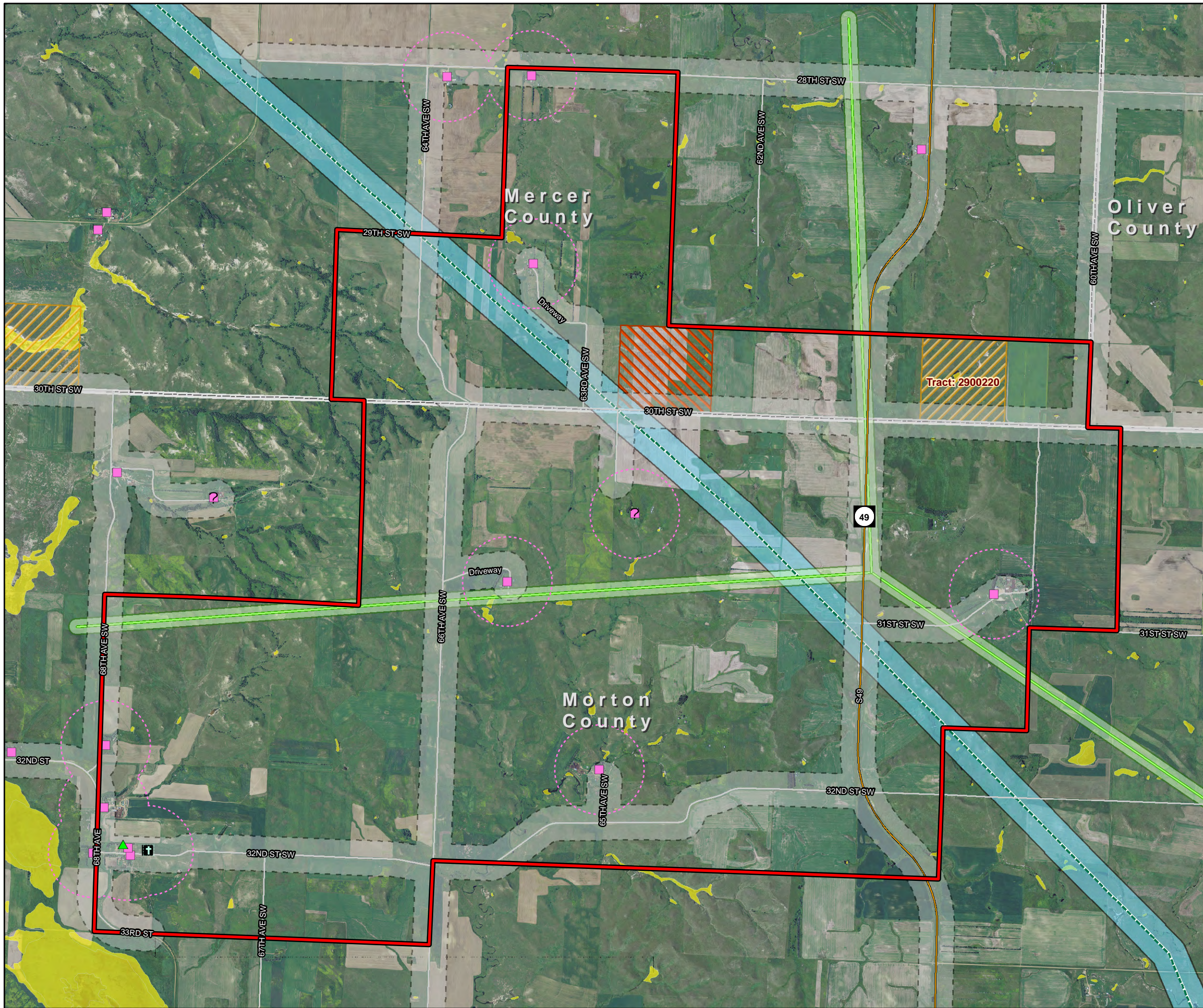



















Exhibit 3

PRELIMINARY PROJECT
 BOUNDARY (TOPOGRAPHY)
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota



-  Cemetery
-  Church Location
-  Occupied Residence Location
-  Uncertain Residence Location
-  Local Road
-  State Highway
-  Transmission Line
-  Approximate Microwave Beam Path
-  National Wetland Inventory (USFWS)
-  1400ft Occupied Dwelling Setback
-  542ft Maintained Roads Setback
-  542ft Transmission Line Setback
-  250ft Microwave Beam Path Setback
-  ND State Land Dept. Administered Property
-  Private Land Open to Sportsmen (PLOTS)
-  Preliminary Project Boundary
-  County Boundary

Data Sources:
 Project Boundary, Residences - Allete Clean Energy
 Transmission Line - Barr Engineering
 Roads, Administrative Boundaries - ND DOT
 National Wetland Inventory - USFWS
 Imagery - FSA NAIP, 2010

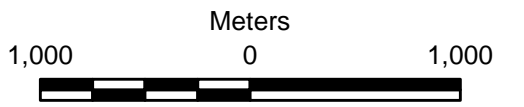
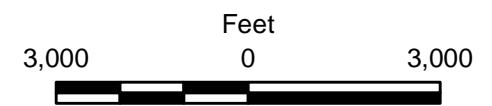


Exhibit 4

EXCLUSION AND AVOIDANCE AREAS MAP
 Clean Energy #1 Wind Project
 Allete Clean Energy
 Morton & Mercer Counties, North Dakota

MORTON COUNTY LANDOWNER LIST – ACE CLEAN ENERGY #1 PROJECT

Eugene and Viola Weinhardt 305 W Ash Ave Glen Ullin, ND 58631	Waldo Wehri 202 S Third St Glen Ullin, ND 58631	Rodney and Arlene Unruh 4617 British Dr. Bismarck, ND 58105
Leroy Thomas 112 N Elk St Hebron, ND 58638	Marlene Staudinger (Elizabeth Kottre) 1776 Prairie Ave #8 Dickinson, ND 58601	Harry Dean Schirado 203 E Curlew Ave Glen Ullin, ND 58631
Richard and Deborah Schirado 6275 31 st St Glen Ullin, ND 58631	Helmuth and LeaPfennig 6148 Third St NW Beulah, ND 58523	Trice and Joyce Miller 3090 66 th Ave Glen Ullin, ND 58631
Mark and Lori Kottre 6325 29 St Glen Ullin, ND 58631	Oliver and Delaine 701 W Ash Ave Glen Ullin, ND 58631	Ida Kottenbrock 514 8 th St #6 Bismarck, ND 58501
Bernice (Life Estate) Kinnischtzke 107 Elm Ave Glen Ullin, ND 58631	Allan Kinnischtzke(Joan Kinnischtzke) 114 S 4 th St Glen Ullin, ND 58631 Joan Kinnischtzke 301 6 th St S Glen Ullin, ND 58631	John and Kaylen Kessler 114 s 4 th St Glen Ullin, ND 58631
Monica and Andrew Jacobson 3818 10 th St N Fargo, ND 58102	William and Be Ba ThiGietzen 6780 County Rd 140 Glen Ullin, ND 58631	Delores Focht 3400 NW 147 th Place Portland, OR 97229
William Duppong 6920 34 th St Glen Ullin, ND 58361	Kenneth and Mary Ann Duppong 3320 County Rd 88 Glen Ullin, ND 58631	Glen Beierlein 6102 30 th St Glen Ullin, ND 58631
Clarence Wilhelm 303 E St S Glen Ullin, ND 58631	Michael & Amanda Evinger 316 D Street S Glen Ullin, ND 58631	Church of St. Ann Hebron 204 Park St. Hebron, ND 58638

Appendix G - Mercer County, ND, Conditional Use Permit Application – to be submitted

Appendix H - Shadow Flicker Report

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Main Result

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

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

SDO for PARK #1

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW
 514 268 214 273 371 417 806 820 553 328 242 422

W WNW NW NNW Sum
 667 1,016 1,021 703 8,635

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

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

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

Height contours used: Height Contours: 110603_ACE_10ft_30ft_HCLs_reduced

Obstacles not used in calculation

Eye height: 1.5 m

Grid resolution: 10 m



Scale 1:200,000

▲ New WTG

● Shadow receptor

WTGs

UTM WGS84 Zone: 14				WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]	
East	North	Z	Row data/Description	Valid	Manufact.						
UTM WGS84 Zone: 14				[m]							
S102	281,637	5,202,998	694.9	S102	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S104	282,068	5,203,967	713.2	S104	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S105	282,721	5,204,284	719.2	S105	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S106	283,362	5,203,879	701.0	S106	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S111	286,402	5,202,780	719.3	S111	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S112	286,814	5,202,945	713.2	S112	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S113	286,811	5,203,675	737.6	S113	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S114	286,947	5,204,103	733.1	S114	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S115	287,146	5,204,457	725.4	S115	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S116	286,589	5,205,169	729.0	S116	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S117	286,038	5,205,181	733.1	S117	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S118	284,980	5,205,116	699.2	S118	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S120	283,754	5,204,847	701.0	S120	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S121	282,809	5,204,899	713.2	S121	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S122	281,747	5,204,801	719.3	S122	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S123	280,800	5,204,647	694.9	S123	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S124	280,522	5,204,370	688.8	S124	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S125	283,443	5,205,591	713.2	S125	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S126	283,028	5,206,315	725.4	S126	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S127	283,490	5,206,600	719.3	S127	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S128	284,109	5,207,234	719.3	S128	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S129	284,402	5,207,499	719.3	S129	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S130	284,800	5,207,609	720.0	S130	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S131	285,159	5,207,998	725.4	S131	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0

To be continued on next page...

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Main Result

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

...continued from previous page

UTM WGS84 Zone: 14			WTG type		Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]
East	North	Z	Row data/Description								
UTM WGS84 Zone: 14			[m]								
S132	285,301	5,208,390	711.3	S132	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S134	284,769	5,208,941	713.2	S134	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S135	285,217	5,209,335	713.2	S135	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S136	285,268	5,209,882	707.1	S136	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S137	286,430	5,206,749	719.3	S137	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S138	286,133	5,206,463	723.8	S138	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S139	286,316	5,205,788	743.7	S139	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S140	287,083	5,205,531	733.8	S140	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S141	286,924	5,206,141	737.6	S141	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S142	288,058	5,206,192	719.8	S142	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S143	288,803	5,206,462	719.3	S143	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S144	288,839	5,205,912	725.4	S144	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S145	287,997	5,205,688	737.6	S145	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S146	288,351	5,205,074	743.7	S146	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S147	288,533	5,205,542	731.5	S147	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
S148	288,332	5,204,562	737.6	S148	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U152	282,195	5,204,910	710.7	U152	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U158	284,118	5,206,761	725.4	U158	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U159	284,284	5,206,133	725.4	U159	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U160	284,932	5,205,757	719.3	U160	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U161	285,023	5,206,649	737.6	U161	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U162	283,335	5,203,373	701.0	U162	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U163	281,877	5,203,371	704.5	U163	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U164	281,219	5,202,407	688.7	U164	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U166	283,039	5,202,343	701.0	U166	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0
U167	282,326	5,202,530	688.8	U167	No	Generic Turbine	FRKN-120-90-3,000	3,000	120.0	90.0	16.0

Shadow receptor-Input

UTM WGS84 Zone: 14			Z	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
No.	Name	East							
SR001	SR001	280,259	5,202,727	655.9	1.0	1.0	-180.0	90.0	"Green house mode"
SR002	SR002	280,306	5,208,683	646.9	1.0	1.0	-180.0	90.0	"Green house mode"
SR003	SR003	280,380	5,203,755	665.4	1.0	1.0	-180.0	90.0	"Green house mode"
SR004	SR004	280,408	5,203,197	655.7	1.0	1.0	-180.0	90.0	"Green house mode"
SR005	SR005	280,441	5,208,837	650.8	1.0	1.0	-180.0	90.0	"Green house mode"
SR006	SR006	280,532	5,200,318	643.3	1.0	1.0	-180.0	90.0	"Green house mode"
SR007	SR007	280,544	5,206,367	648.6	1.0	1.0	-180.0	90.0	"Green house mode"
SR008	SR008	280,593	5,202,779	652.3	1.0	1.0	-180.0	90.0	"Green house mode"
SR009	SR009	280,616	5,202,702	652.2	1.0	1.0	-180.0	90.0	"Green house mode"
SR010	SR010	281,412	5,206,118	668.8	1.0	1.0	-180.0	90.0	"Green house mode"
SR011	SR011	282,058	5,200,444	646.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR012	SR012	283,260	5,200,102	651.8	1.0	1.0	-180.0	90.0	"Green house mode"
SR013	SR013	283,607	5,210,191	685.8	1.0	1.0	-180.0	90.0	"Green house mode"
SR014	SR014	284,213	5,205,317	697.5	1.0	1.0	-180.0	90.0	"Green house mode"
SR015	SR015	284,464	5,208,355	695.5	1.0	1.0	-180.0	90.0	"Green house mode"
SR016	SR016	285,098	5,203,523	672.3	1.0	1.0	-180.0	90.0	"Green house mode"
SR017	SR017	285,461	5,205,987	719.3	1.0	1.0	-180.0	90.0	"Green house mode"
SR018	SR018	285,498	5,212,429	655.3	1.0	1.0	-180.0	90.0	"Green house mode"
SR019	SR019	285,720	5,211,547	660.1	1.0	1.0	-180.0	90.0	"Green house mode"
SR020	SR020	285,779	5,200,835	678.7	1.0	1.0	-180.0	90.0	"Green house mode"
SR021	SR021	288,176	5,209,442	676.6	1.0	1.0	-180.0	90.0	"Green house mode"

To be continued on next page...

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EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Main Result

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

...continued from previous page

UTM WGS84 Zone: 14

No.	Name	East	North	Z	Width	Height	Height	Degrees from	Slope of	Direction mode
					[m]	[m]	a.g.l.	south cw	window	
					[m]	[m]	[m]	[°]	[°]	
SR022	SR022	288,923	5,205,145	717.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR023	SR023	288,929	5,201,018	693.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR024	SR024	289,799	5,201,470	683.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR025	SR025	291,595	5,206,797	715.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR026	SR026	291,781	5,206,427	713.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR027	SR027	284,451	5,210,149	679.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

Shadow, expected values

No.	Name	Shadow hours
		per year
		[h/year]
SR001	SR001	8:29
SR002	SR002	0:00
SR003	SR003	2:29
SR004	SR004	15:51
SR005	SR005	0:00
SR006	SR006	0:00
SR007	SR007	0:00
SR008	SR008	25:15
SR009	SR009	24:31
SR010	SR010	0:00
SR011	SR011	0:00
SR012	SR012	0:00
SR013	SR013	0:00
SR014	SR014	36:18
SR015	SR015	17:27
SR016	SR016	0:00
SR017	SR017	28:28
SR018	SR018	0:00
SR019	SR019	0:00
SR020	SR020	0:00
SR021	SR021	0:00
SR022	SR022	36:23
SR023	SR023	0:00
SR024	SR024	0:00
SR025	SR025	0:00
SR026	SR026	0:00
SR027	SR027	15:02

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

No.	Name	Worst case	Expected
		[h/year]	[h/year]
S102	S102	46:22	19:30
S104	S104	0:00	0:00
S105	S105	0:00	0:00
S106	S106	0:00	0:00
S111	S111	0:00	0:00
S112	S112	0:00	0:00
S113	S113	0:00	0:00
S114	S114	0:00	0:00

To be continued on next page...

Project:

ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Main Result**Calculation:** ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
S115	S115	0:00	0:00
S116	S116	8:26	3:03
S117	S117	0:00	0:00
S118	S118	19:18	8:26
S120	S120	48:14	11:40
S121	S121	4:53	1:33
S122	S122	0:00	0:00
S123	S123	0:00	0:00
S124	S124	0:00	0:00
S125	S125	30:14	15:40
S126	S126	0:00	0:00
S127	S127	0:00	0:00
S128	S128	0:00	0:00
S129	S129	0:00	0:00
S130	S130	0:00	0:00
S131	S131	22:45	8:50
S132	S132	19:35	8:30
S134	S134	0:00	0:00
S135	S135	22:13	7:37
S136	S136	17:20	7:23
S137	S137	0:00	0:00
S138	S138	0:00	0:00
S139	S139	16:18	7:15
S140	S140	0:00	0:00
S141	S141	5:08	2:14
S142	S142	0:00	0:00
S143	S143	0:00	0:00
S144	S144	0:00	0:00
S145	S145	24:47	13:21
S146	S146	37:07	15:33
S147	S147	0:00	0:00
S148	S148	34:34	8:21
U152	U152	0:00	0:00
U158	U158	0:00	0:00
U159	U159	7:48	3:27
U160	U160	41:45	12:36
U161	U161	0:00	0:00
U162	U162	0:00	0:00
U163	U163	33:05	13:39
U164	U164	82:59	31:41
U166	U166	0:00	0:00
U167	U167	0:00	0:00

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR001 - SR001**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	
1	08:34	08:14	07:29	07:55 (U164)	07:29		
	17:09	17:50	18:31	24 08:19 (U164)	20:15	06:34	
2	08:34	08:12	07:27	07:54 (U164)	07:27	06:32	
	17:10	17:52	18:33	25 08:19 (U164)	20:17	20:58	
3	08:34	08:11	07:25	07:53 (U164)	07:25	06:31	
	17:11	17:53	18:34	26 08:19 (U164)	20:18	20:59	
4	08:34	08:10	07:24	07:52 (U164)	07:23	06:29	
	17:12	17:55	18:36	27 08:19 (U164)	20:19	21:00	
5	08:34	08:09	07:22	07:52 (U164)	07:21	06:28	
	17:13	17:56	18:37	27 08:19 (U164)	20:21	21:02	
6	08:33	08:07	07:20	07:52 (U164)	07:19	06:26	
	17:14	17:58	18:39	27 08:19 (U164)	20:22	21:03	
7	08:33	08:06	07:18	07:52 (U164)	07:17	06:25	
	17:16	17:59	18:40	26 08:18 (U164)	20:23	21:04	
8	08:33	08:04	08:16	08:52 (U164)	07:15	06:23	
	17:17	18:01	18:41	26 09:18 (U164)	20:25	21:06	
9	08:33	08:03	08:14	08:52 (U164)	07:13	06:22	
	17:18	18:01	19:43	25 09:17 (U164)	20:26	21:07	
10	08:32	08:01	08:12	08:53 (U164)	07:11	06:20	
	17:19	18:02	19:44	23 09:16 (U164)	20:28	21:08	
11	08:32	08:00	08:10	08:54 (U164)	07:09	06:19	
	17:20	18:04	19:46	20 09:14 (U164)	20:29	21:10	
12	08:31	07:58	08:08	08:56 (U164)	07:07	06:18	
	17:22	18:06	19:47	17 09:13 (U164)	20:30	21:11	
13	08:31	07:57	08:06	08:58 (U164)	07:05	06:16	
	17:23	18:07	19:49	12 09:10 (U164)	20:32	21:12	
14	08:30	07:55	08:04	07:04	06:15	06:15	
	17:24	18:09	19:50	20:33	21:13	21:43	
15	08:30	07:54	08:02	07:02	06:14	06:14	
	17:25	18:10	19:51	20:34	21:15	21:44	
16	08:29	07:52	08:00	07:00	06:13	06:13	
	17:27	18:12	19:53	20:36	21:16	21:44	
17	08:28	07:50	07:58	06:58	07:19 (S102)	06:11	
	17:28	18:13	19:54	20:37	6 07:25 (S102)	21:17	
18	08:28	07:49	07:56	06:56	07:17 (S102)	06:10	
	17:30	18:15	19:56	20:39	10 07:27 (S102)	21:18	
19	08:27	07:47	07:54	06:54	07:16 (S102)	06:09	
	17:31	18:16	19:57	20:40	13 07:29 (S102)	21:20	
20	08:26	07:45	07:52	06:53	07:14 (S102)	06:08	
	17:32	18:18	19:58	20:41	16 07:30 (S102)	21:21	
21	08:25	07:44	07:50	06:51	07:12 (S102)	06:07	
	17:34	18:19	20:00	20:43	18 07:30 (S102)	21:22	
22	08:24	07:42	07:48	06:49	07:11 (S102)	06:06	
	17:35	18:21	20:01	20:44	19 07:30 (S102)	21:23	
23	08:24	07:40	07:47	06:47	07:11 (S102)	06:05	
	17:37	18:22	20:03	20:45	20 07:31 (S102)	21:24	
24	08:23	07:38	07:45	06:45	07:10 (S102)	06:04	
	17:38	18:24	20:04	20:47	20 07:30 (S102)	21:25	
25	08:22	07:36	07:43	06:44	07:10 (S102)	06:03	
	17:40	18:25	10 08:12 (U164)	20:05	20:48	20 07:30 (S102)	21:26
26	08:21	07:35	07:59 (U164)	07:41	06:42	07:11 (S102)	06:02
	17:41	18:27	16 08:15 (U164)	20:07	20:49	19 07:30 (S102)	21:28
27	08:20	07:33	07:58 (U164)	07:39	06:40	07:11 (S102)	06:01
	17:43	18:28	19 08:17 (U164)	20:08	20:51	18 07:29 (S102)	21:29
28	08:18	07:31	07:56 (U164)	07:37	06:39	07:12 (S102)	06:00
	17:44	18:30	22 08:18 (U164)	20:10	20:52	17 07:29 (S102)	21:30
29	08:17		07:35	06:37	07:12 (S102)	06:00	05:56
	17:46		20:11	20:54	15 07:27 (S102)	21:31	21:47
30	08:16		07:33	06:35	07:13 (S102)	05:59	05:56
	17:47		20:12	20:55	12 07:25 (S102)	21:32	21:47
31	08:15		07:31	06:34		05:58	
	17:49		20:14			21:33	
Potential sun hours	279	288	368	407	466	474	
Total, worst case		67	305	223	8		
Sun reduction		0.50	0.63	0.59	0.68		
Oper. time red.		0.99	0.99	0.99	0.99		
Wind dir. red.		0.75	0.75	0.63	0.63		
Total reduction		0.37	0.46	0.37	0.42		
Total, real		25	142	82	3		

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)

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ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802		Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR001 - SR001**

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Minimum sun height over horizon for influence	3 °	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Day step for calculation	1 days	4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Time step for calculation	1 minutes	Operational time
		N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
		514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	July	August	September	October	November	December	
1	05:57	06:27	07:07	07:46	08:35 (U164)	07:30	08:12
	21:47	21:23	20:31	19:31	16 08:51 (U164)	17:33	17:01
2	05:57	06:28	07:08	07:47	08:33 (U164)	07:31	08:13
	21:47	21:21	20:29	19:29	19 08:52 (U164)	17:32	17:01
3	05:58	06:29	07:09	07:49	08:32 (U164)	07:33	08:15
	21:46	21:20	20:27	19:27	22 08:54 (U164)	17:30	17:01
4	05:59	06:30	07:10	07:50	08:30 (U164)	07:34	08:16
	21:46	21:19	20:25	19:25	24 08:54 (U164)	17:29	17:00
5	05:59	06:32	07:12	07:51	08:29 (U164)	07:36	08:17
	21:46	21:17	20:23	19:23	25 08:54 (U164)	17:27	17:00
6	06:00	06:33	07:13	07:53	08:29 (U164)	07:37	08:18
	21:45	21:16	20:21	19:21	26 08:55 (U164)	17:26	17:00
7	06:01	06:34	07:14	07:54	08:28 (U164)	07:39	08:19
	21:45	21:14	20:19	19:19	27 08:55 (U164)	17:24	16:59
8	06:02	06:35	07:16	07:55	08:28 (U164)	07:40	08:20
	21:45	21:13	20:17	19:17	27 08:55 (U164)	17:23	16:59
9	06:02	06:37	07:17	07:57	08:27 (U164)	07:42	08:21
	21:44	21:11	20:15	19:15	27 08:54 (U164)	17:22	16:59
10	06:03	06:38	07:18	07:58	08:27 (U164)	07:43	08:22
	21:44	21:10	20:13	19:13	27 08:54 (U164)	17:20	16:59
11	06:04	06:39	07:20	08:00	08:27 (U164)	07:44	08:23
	21:43	21:08	20:11	19:12	26 08:53 (U164)	17:19	16:59
12	06:05	06:41	07:21 (S102)	08:01	08:27 (U164)	07:46	08:24
	21:42	21:06	10 07:33 (S102)	19:10	25 08:52 (U164)	17:18	16:59
13	06:06	06:42	07:21 (S102)	08:02	08:28 (U164)	07:47	08:25
	21:42	21:05	13 07:34 (S102)	19:08	24 08:52 (U164)	17:17	16:59
14	06:07	06:43	07:19 (S102)	08:04	08:29 (U164)	07:49	08:26
	21:41	21:03	16 07:35 (S102)	19:06	21 08:50 (U164)	17:16	16:59
15	06:08	06:44	07:18 (S102)	08:05	08:31 (U164)	07:50	08:26
	21:40	21:02	18 07:36 (S102)	19:04	18 08:49 (U164)	17:14	16:59
16	06:09	06:46	07:18 (S102)	08:07	08:32 (U164)	07:52	08:27
	21:40	21:00	19 07:37 (S102)	19:02	14 08:46 (U164)	17:13	17:00
17	06:10	06:47	07:17 (S102)	08:08	08:36 (U164)	07:53	08:28
	21:39	20:58	20 07:37 (S102)	19:00	7 08:43 (U164)	17:12	17:00
18	06:11	06:48	07:17 (S102)	08:09		07:55	08:29
	21:38	20:56	20 07:37 (S102)	18:57		17:11	17:00
19	06:12	06:50	07:16 (S102)	08:11		07:56	08:29
	21:37	20:55	20 07:36 (S102)	18:55		17:10	17:01
20	06:13	06:51	07:17 (S102)	08:12		07:57	08:30
	21:36	20:53	20 07:37 (S102)	18:53		17:09	17:01
21	06:14	06:52	07:16 (S102)	08:14		07:59	08:30
	21:35	20:51	20 07:36 (S102)	18:51		17:08	17:01
22	06:15	06:54	07:17 (S102)	08:15		08:00	08:31
	21:34	20:49	18 07:35 (S102)	18:49		17:07	17:02
23	06:16	06:55	07:18 (S102)	08:17		08:02	08:31
	21:33	20:48	16 07:34 (S102)	18:48		17:07	17:02
24	06:17	06:56	07:20 (S102)	08:18		08:03	08:32
	21:32	20:46	13 07:33 (S102)	18:46		17:06	17:03
25	06:18	06:57	07:21 (S102)	08:19		08:04	08:32
	21:31	20:44	10 07:31 (S102)	18:44		17:05	17:04
26	06:20	06:59	07:22 (S102)	08:21		08:06	08:33
	21:30	20:42	5 07:27 (S102)	18:43		17:04	17:04
27	06:21	07:00		08:22		08:07	08:33
	21:29	20:40		18:41		17:04	17:05
28	06:22	07:01		08:24		08:08	08:33
	21:28	20:38		18:39		17:03	17:06
29	06:23	07:03		08:25		08:10	08:33
	21:26	20:37		18:38		17:03	17:07
30	06:24	07:04		08:27	08:39 (U164)	08:11	08:34
	21:25	20:35		18:36	10 08:49 (U164)	17:02	17:07
31	06:25	07:05		08:28		08:11	08:34
	21:24	20:33		18:35		17:04	17:08
Potential sun hours	480	441	378	339		282	267
Total, worst case					375		
Sun reduction		0.73	0.69		0.52		
Oper. time red.		0.99	0.99		0.99		
Wind dir. red.		0.63	0.75		0.75		
Total reduction		0.45	0.51		0.39		
Total, real		108	5		145		

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR002 - SR002

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:57	05:57	06:27	07:07	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:13	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:14
	17:10	17:52	18:33	20:17	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:26	07:25	06:30	05:56	05:58	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:36	21:47	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:24	07:23	06:29	05:56	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:37	21:46	21:19	20:25	19:25	17:28	17:00
5	08:34	08:09	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:34	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:39	20:22	21:03	21:38	21:46	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:41	21:44	21:11	20:15	19:15	17:22	16:59
10	08:32	08:02	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:28	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:20	08:00	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:32	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:43	21:07	20:09	19:10	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:48	08:25
	17:23	18:07	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:31	07:55	08:04	07:03	06:15	05:52	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:09	19:50	20:33	21:14	21:44	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:02	06:14	05:52	06:08	06:44	07:25	08:05	07:51	08:27
	17:25	18:10	19:51	20:34	21:15	21:44	21:41	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:09	06:46	07:26	08:07	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:45	21:40	21:00	20:01	19:02	17:13	16:59
17	08:29	07:50	07:58	06:58	06:11	05:52	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:52	06:11	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:39	21:19	21:45	21:38	20:57	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:58	08:30
	17:32	18:18	19:59	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:26	07:44	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	07:59	08:31
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:47	21:34	20:50	19:49	18:49	17:07	17:02
23	08:24	07:40	07:47	06:47	06:05	05:53	06:16	06:55	07:35	08:17	08:02	08:32
	17:37	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:06	17:02
24	08:23	07:38	07:45	06:45	06:04	05:54	06:17	06:56	07:37	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:26	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:37	07:43	06:44	06:03	05:54	06:18	06:57	07:38	08:20	08:05	08:33
	17:39	18:25	20:05	20:48	21:27	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:41	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:50	21:28	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:20	07:33	07:39	06:40	06:01	05:55	06:21	07:00	07:41	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:19	07:31	07:37	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:09	08:33
	17:44	18:30	20:10	20:52	21:30	21:47	21:28	20:39	19:37	18:39	17:03	17:06
29	08:17	07:35	07:35	06:37	05:59	05:56	06:23	07:03	07:43	08:25	08:10	08:34
	17:45	18:31	20:11	20:54	21:31	21:47	21:27	20:37	19:35	18:38	17:02	17:06
30	08:16	07:33	07:33	06:35	05:59	05:56	06:24	07:04	07:45	08:27	08:11	08:34
	17:47	18:33	20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15	07:31	07:31	06:33	05:58	05:58	06:25	07:05	07:45	08:28	08:11	08:34
	17:48	18:34	20:14	20:57	21:33	21:48	21:24	20:33	19:31	18:35	17:02	17:08
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 8
 Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR003 - SR003**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	08:37 (S102)	07:29	07:29	06:34	05:57	05:57	06:27	07:07	07:46	08:12
	17:09	17:50	11 08:48 (S102)	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33
2	08:34	08:13	08:36 (S102)	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	08:13
	17:10	17:52	14 08:50 (S102)	18:33	20:17	20:58	21:35	21:47	21:21	20:29	19:29	17:32
3	08:34	08:11	08:34 (S102)	07:25	07:25	06:31	05:56	05:58	06:29	07:09	07:49	08:15
	17:11	17:53	16 08:50 (S102)	18:34	20:18	20:59	21:36	21:46	21:20	20:27	19:27	17:30
4	08:34	08:10	08:33 (S102)	07:24	07:23	06:29	05:56	05:59	06:30	07:10	07:50	08:16
	17:12	17:55	17 08:50 (S102)	18:36	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:29
5	08:34	08:09	08:31 (S102)	07:22	07:21	06:28	05:55	05:59	06:32	07:12	07:51	08:17
	17:13	17:56	19 08:50 (S102)	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27
6	08:33	08:07	08:31 (S102)	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	08:18
	17:14	17:58	20 08:51 (S102)	18:39	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26
7	08:33	08:06	08:32 (S102)	07:18	07:17	06:25	05:54	06:01	06:34	07:14	07:54	08:19
	17:16	17:59	19 08:51 (S102)	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24
8	08:33	08:04	08:32 (S102)	08:16	07:15	06:23	05:54	06:02	06:35	07:16	07:55	08:20
	17:17	18:01	18 08:50 (S102)	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23
9	08:33	08:03	08:32 (S102)	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	08:21
	17:18	18:01	18 08:50 (S102)	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:22
10	08:32	08:01	08:33 (S102)	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	08:22
	17:19	18:02	16 08:49 (S102)	19:44	20:28	21:08	21:41	21:44	21:10	20:13	19:13	17:20
11	08:32	08:00	08:34 (S102)	08:10	07:09	06:19	05:53	06:04	06:39	07:20	08:00	08:23
	17:20	18:04	14 08:48 (S102)	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:12	17:19
12	08:31	07:58	08:36 (S102)	08:08	07:07	06:18	05:53	06:05	06:41	07:21	08:01	08:24
	17:22	18:06	11 08:47 (S102)	19:47	20:30	21:11	21:42	21:42	21:07	20:09	19:10	17:18
13	08:31	07:57	08:40 (S102)	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	08:25
	17:23	18:07	2 08:42 (S102)	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17
14	08:30	07:55	08:04	07:04	06:15	05:53	06:07	06:43	07:23	08:04	08:26	08:26
	17:24	18:09	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	18:06	17:15
15	08:30	07:54	08:02	07:02	06:14	05:53	06:08	06:44	07:25	08:05	08:26	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	18:04	17:14
16	08:29	07:52	08:00	07:00	06:12	05:53	06:09	06:46	07:26	08:07	08:27	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	18:02	17:13
17	08:28	07:50	07:58	06:58	06:11	05:53	06:10	06:47	07:27	08:08	08:28	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	18:00	17:12
18	08:28	07:49	07:56	06:56	06:10	05:53	06:11	06:48	07:29	08:09	08:29	08:29
	17:30	18:15	19:56	20:39	21:18	21:45	21:38	20:57	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	08:29	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:01
20	08:26	07:45	07:52	06:53	06:08	05:53	06:13	06:51	07:31	08:12	08:30	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:44	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	08:30	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:06	05:53	06:15	06:54	07:34	08:15	08:31	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:24	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:17	08:32	08:31
	17:37	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:07	17:02
24	08:23	07:38	07:45	06:45	06:04	05:54	06:17	06:56	07:37	08:18	08:32	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:43	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:34	08:32
	17:40	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:04
26	08:21	07:35	07:41	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:36	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:20	07:33	07:39	06:40	06:01	05:55	06:21	07:00	07:41	08:22	08:37	08:33
	17:43	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:37	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:38	08:33
	17:44	18:30	20:10	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17	08:41 (S102)	07:35	06:37	06:00	05:56	06:23	07:03	07:43	08:25	09:08 (S102)	08:10
	17:46	2 08:43 (S102)	20:11	20:54	21:31	21:47	21:26	20:37	19:35	18:38	5 09:13 (S102)	17:02
30	08:16	08:40 (S102)	07:33	06:35	05:59	05:56	06:24	07:04	07:45	08:27	09:06 (S102)	08:11
	17:47	6 08:46 (S102)	20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	11 09:17 (S102)	17:02
31	08:15	08:38 (S102)	07:31	06:33	05:58	05:58	06:25	07:05	07:45	08:28	09:04 (S102)	08:34
	17:49	9 08:47 (S102)	20:14	20:57	21:33	21:47	21:24	20:33	19:35	18:35	14 09:18 (S102)	17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case	17	195								30	182	
Sun reduction	0.55	0.50								0.52	0.43	
Oper. time red.	0.99	0.99								0.99	0.99	
Wind dir. red.	0.76	0.76								0.76	0.76	
Total reduction	0.41	0.37								0.39	0.32	
Total, real	7	73								12	58	

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 9
 Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR004 - SR004**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June
1	08:34	09:06 (U164)	08:14	07:29	06:34	05:58
	17:09	26 09:32 (U164)	17:50	18:31	20:15	21:34
2	08:34	09:07 (U164)	08:12	07:27	06:32	05:57
	17:10	25 09:32 (U164)	17:52	18:33	20:17	21:35
3	08:34	09:07 (U164)	08:11	07:25	06:31	05:56
	17:11	26 09:33 (U164)	17:53	18:34	20:18	21:35
4	08:34	09:08 (U164)	08:10	07:24	06:29	05:56
	17:12	26 09:34 (U164)	17:55	18:36	20:19	21:36
5	08:34	09:07 (U164)	08:09	07:22	06:28	05:55
	17:13	26 09:33 (U164)	17:56	18:37	20:21	21:37
6	08:33	09:08 (U164)	08:07	07:20	06:26	05:55
	17:14	26 09:34 (U164)	17:58	18:39	20:22	21:38
7	08:33	09:09 (U164)	08:06	07:18	06:25	05:54
	17:16	26 09:35 (U164)	17:59	18:40	20:23	21:39
8	08:33	09:08 (U164)	08:04	07:16	06:23	05:54
	17:17	27 09:35 (U164)	18:01	18:41	20:25	21:40
9	08:33	09:09 (U164)	08:03	07:13	06:22	05:54
	17:18	27 09:36 (U164)	18:01	19:43	20:26	21:40
10	08:32	09:10 (U164)	08:01	07:11	06:20	05:53
	17:19	26 09:36 (U164)	18:02	19:44	20:28	21:41
11	08:32	09:10 (U164)	08:00	07:09	06:19	05:53
	17:20	26 09:36 (U164)	18:04	19:46	20:29	21:42
12	08:31	09:11 (U164)	07:58	07:07	06:18	05:53
	17:22	26 09:37 (U164)	18:06	19:47	20:30	21:42
13	08:31	09:11 (U164)	07:57	07:05	06:16	05:53
	17:23	26 09:37 (U164)	18:07	19:49	20:32	21:43
14	08:30	09:12 (U164)	07:55	07:04	06:15	05:53
	17:24	25 09:37 (U164)	18:09	19:50	20:33	21:43
15	08:30	09:13 (U164)	07:54	07:02	06:14	05:53
	17:25	24 09:37 (U164)	18:10	19:51	20:34	21:44
16	08:29	09:13 (U164)	07:52	07:00	06:12	05:53
	17:27	24 09:37 (U164)	18:12	19:53	20:36	21:44
17	08:28	09:14 (U164)	07:50	06:58	06:11	05:53
	17:28	23 09:37 (U164)	18:13	19:54	20:37	21:45
18	08:28	09:14 (U164)	07:49	06:56	06:10	05:53
	17:30	22 09:36 (U164)	18:15	19:56	20:39	21:45
19	08:27	09:15 (U164)	07:47	06:54	06:09	05:53
	17:31	21 09:36 (U164)	18:16	19:57	20:40	21:46
20	08:26	09:16 (U164)	07:45	06:52	06:08	05:53
	17:32	19 09:35 (U164)	18:18	19:58	20:41	21:46
21	08:25	09:18 (U164)	07:44	06:51	06:07	05:53
	17:34	18 09:36 (U164)	18:19	20:00	20:43	21:46
22	08:24	09:20 (U164)	07:42	06:49	06:06	05:53
	17:35	14 09:34 (U164)	18:21	20:01	20:44	21:46
23	08:24	09:22 (U164)	07:40	06:47	06:05	05:53
	17:37	11 09:33 (U164)	18:22	20:03	20:45	21:47
24	08:23	09:25 (U164)	07:38	06:45	06:04	05:54
	17:38	5 09:30 (U164)	18:24	20:04	20:47	21:47
25	08:22		07:36	06:43	06:03	05:54
	17:40		18:25	20:05	20:48	21:47
26	08:21		07:35	06:41	06:02	05:54
	17:41		18:27	20:07	20:49	21:47
27	08:20		07:33	06:39	06:01	05:55
	17:43		18:28	20:08	20:51	21:47
28	08:18		07:31	06:37	06:00	05:55
	17:44		18:30	20:10	20:52	21:47
29	08:17		07:35	06:37	06:00	05:56
	17:46		20:11	20:54	21:31	21:47
30	08:16		07:33	06:35	05:59	05:56
	17:47		20:12	20:55	21:32	21:47
31	08:15		07:31	06:33	05:58	
	17:49		20:14		21:33	
Potential sun hours	279	287	368	407	466	474
Total, worst case	545		243	193		
Sun reduction	0.55		0.63	0.59		
Oper. time red.	0.99		0.99	0.99		
Wind dir. red.	0.75		0.72	0.66		
Total reduction	0.41		0.45	0.39		
Total, real	223		109	74		

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR004 - SR004

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December			
1	05:57	06:27	07:07	07:29 (U163)	07:46	08:10 (S102)	07:30	08:12	08:52 (U164)
	21:47	21:23	20:31	13 07:42 (U163)	19:31	7 08:17 (S102)	17:33	17:01	26 09:18 (U164)
2	05:57	06:28	07:08	07:31 (U163)	07:47		07:31	08:13	08:52 (U164)
	21:47	21:21	20:29	10 07:41 (U163)	19:29		17:32	17:01	26 09:18 (U164)
3	05:58	06:29	07:09		07:49		07:33	08:15	08:53 (U164)
	21:46	21:20	20:27		19:27		17:30	17:01	27 09:20 (U164)
4	05:59	06:30	07:10		07:50		07:34	08:16	08:53 (U164)
	21:46	21:19	20:25		19:25		17:29	17:00	27 09:20 (U164)
5	05:59	06:32	07:12		07:51		07:36	08:17	08:54 (U164)
	21:46	21:17	20:23		19:23		17:27	17:00	26 09:20 (U164)
6	06:00	06:33	07:13		07:53		07:37	08:18	08:54 (U164)
	21:45	21:16	20:21		19:21		17:26	17:00	26 09:20 (U164)
7	06:01	06:34	07:14		07:54		07:39	08:19	08:54 (U164)
	21:45	21:14	20:19		19:19		17:24	16:59	26 09:20 (U164)
8	06:02	06:35	07:16		07:55		07:40	08:20	08:55 (U164)
	21:45	21:13	20:17		19:17		17:23	16:59	26 09:21 (U164)
9	06:02	06:37	07:17		07:57		07:42	08:21	08:55 (U164)
	21:44	21:11	20:15		19:15		17:22	16:59	26 09:21 (U164)
10	06:03	06:38	07:18		07:58		07:43	08:22	08:56 (U164)
	21:44	21:10	20:13		19:13		17:20	16:59	25 09:21 (U164)
11	06:04	06:39	07:20		08:00		07:44	08:23	08:56 (U164)
	21:43	21:08	20:11		19:12		17:19	16:59	26 09:22 (U164)
12	06:05	06:41	07:21		08:01		07:46	08:24	08:57 (U164)
	21:42	21:06	20:09		19:10		17:18	16:59	25 09:22 (U164)
13	06:06	06:42	07:22		08:02		07:47	08:25	08:57 (U164)
	21:42	21:05	20:07		19:08		17:17	16:59	26 09:23 (U164)
14	06:07	06:43	07:23		08:04		07:49	08:26	08:58 (U164)
	21:41	21:03	20:05		19:06		17:15	16:59	25 09:23 (U164)
15	06:08	06:44	07:25		08:05		07:50	08:26	08:59 (U164)
	21:40	21:02	20:03		19:04		17:14	16:59	25 09:24 (U164)
16	06:09	06:46	07:26		08:07		07:52	08:27	08:59 (U164)
	21:40	21:00	20:01		19:02		17:13	17:00	24 09:23 (U164)
17	06:10	06:47	07:27		08:08		07:53	08:28	09:00 (U164)
	21:39	20:58	19:59		19:00		17:12	17:00	24 09:24 (U164)
18	06:11	06:48	07:29	08:13 (S102)	08:09		07:55	08:29	09:00 (U164)
	21:38	20:56	19:57	10 08:23 (S102)	18:57		17:11	5 09:04 (U164)	17:00 25 09:25 (U164)
19	06:12	06:50	07:30	08:10 (S102)	08:11		07:56	08:56 (U164)	08:29 09:00 (U164)
	21:37	20:55	19:55	15 08:25 (S102)	18:55		17:10	11 09:07 (U164)	17:01 25 09:25 (U164)
20	06:13	06:51	07:31	08:08 (S102)	08:12		07:58	08:55 (U164)	08:30 09:01 (U164)
	21:36	20:53	19:53	18 08:26 (S102)	18:53		17:09	14 09:09 (U164)	17:01 24 09:25 (U164)
21	06:14	06:52	07:33	08:07 (S102)	08:14		07:59	08:53 (U164)	08:30 09:02 (U164)
	21:35	20:51	5 07:42 (U163)	19:51	20 08:27 (S102)	18:51	17:08	18 09:11 (U164)	17:01 24 09:26 (U164)
22	06:15	06:54	07:33 (U163)	07:34	08:06 (S102)	08:15	08:00	08:53 (U164)	08:31 09:02 (U164)
	21:34	20:49	12 07:45 (U163)	19:49	21 08:27 (S102)	18:49	17:07	19 09:12 (U164)	17:02 24 09:26 (U164)
23	06:16	06:55	07:31 (U163)	07:35	08:05 (S102)	08:17	08:02	08:52 (U164)	08:31 09:02 (U164)
	21:33	20:48	15 07:46 (U163)	19:47	22 08:27 (S102)	18:48	17:07	21 09:13 (U164)	17:02 24 09:26 (U164)
24	06:17	06:56	07:30 (U163)	07:37	08:05 (S102)	08:18	08:03	08:52 (U164)	08:32 09:03 (U164)
	21:32	20:46	16 07:46 (U163)	19:45	22 08:27 (S102)	18:46	17:06	21 09:13 (U164)	17:03 24 09:27 (U164)
25	06:18	06:57	07:30 (U163)	07:38	08:05 (S102)	08:19	08:04	08:52 (U164)	08:32 09:03 (U164)
	21:31	20:44	17 07:47 (U163)	19:43	22 08:27 (S102)	18:44	17:05	23 09:15 (U164)	17:04 25 09:28 (U164)
26	06:20	06:59	07:29 (U163)	07:39	08:04 (S102)	08:21	08:06	08:51 (U164)	08:33 09:03 (U164)
	21:30	20:42	18 07:47 (U163)	19:41	22 08:26 (S102)	18:43	17:04	24 09:15 (U164)	17:04 25 09:28 (U164)
27	06:21	07:00	07:28 (U163)	07:41	08:05 (S102)	08:22	08:07	08:52 (U164)	08:33 09:05 (U164)
	21:29	20:40	19 07:47 (U163)	19:39	20 08:25 (S102)	18:41	17:04	24 09:16 (U164)	17:05 24 09:29 (U164)
28	06:22	07:01	07:27 (U163)	07:42	08:05 (S102)	08:24	08:08	08:52 (U164)	08:33 09:05 (U164)
	21:28	20:38	19 07:46 (U163)	19:37	19 08:24 (S102)	18:39	17:03	25 09:17 (U164)	17:06 25 09:30 (U164)
29	06:23	07:03	07:28 (U163)	07:43	08:06 (S102)	08:25	08:10	08:51 (U164)	08:33 09:05 (U164)
	21:26	20:37	19 07:47 (U163)	19:35	16 08:22 (S102)	18:38	17:02	26 09:17 (U164)	17:07 25 09:30 (U164)
30	06:24	07:04	07:28 (U163)	07:45	08:08 (S102)	08:27	08:11	08:52 (U164)	08:34 09:05 (U164)
	21:25	20:35	18 07:46 (U163)	19:33	13 08:21 (S102)	18:36	17:02	26 09:18 (U164)	17:07 25 09:30 (U164)
31	06:25	07:05	07:28 (U163)			08:28			08:34 09:06 (U164)
	21:24	20:33	16 07:44 (U163)			18:35			17:08 25 09:31 (U164)
Potential sun hours	480	441	378	338	282	267			
Total, worst case		174	263	7	257	780			
Sun reduction		0.73	0.69	0.52	0.43	0.43			
Oper. time red.		0.99	0.99	0.99	0.99	0.99			
Wind dir. red.		0.66	0.71	0.72	0.75	0.75			
Total reduction		0.47	0.49	0.37	0.32	0.32			
Total, real		82	128	3	82	250			

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:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR006 - SR006

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and rows for days 1-31, showing sunrise and sunset times for each day. Includes a summary row at the bottom for Potential sun hours and various reductions.

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

Matrix with 4 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: ALLETE Wind
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Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR007 - SR007

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January-December) and rows for each day of the month, showing sun rise and set times (hh:mm) and potential sun hours. Summary rows include Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

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

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ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802		

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR008 - SR008**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June
1	08:34	08:14	07:29	08:41 (U164)	07:29	06:34
	17:09	17:50	18:31	21 09:02 (U164)	20:15	20:56
2	08:34	08:12	07:27	08:44 (U164)	07:27	06:32
	17:10	17:52	18:33	15 08:59 (U164)	20:16	20:58
3	08:34	08:11	07:25	08:50 (U164)	07:25	06:31
	17:11	17:53	18:34	2 08:52 (U164)	20:18	20:59
4	08:34	08:10	07:24		07:23	06:29
	17:12	17:55	18:36		20:19	21:00
5	08:34	08:09	08:47 (U164)	07:22	07:21	06:28
	17:13	17:56	11 08:58 (U164)	18:37	20:21	21:02
6	08:33	08:07	08:44 (U164)	07:20	07:19	06:26
	17:14	17:58	18 09:02 (U164)	18:39	20:22	21:03
7	08:33	08:06	08:42 (U164)	07:18	07:17	06:25
	17:16	17:59	22 09:04 (U164)	18:40	20:23	21:04
8	08:33	08:04	08:41 (U164)	08:16	07:15	06:23
	17:17	18:01	25 09:06 (U164)	18:41	20:25	21:06
9	08:33	08:03	08:39 (U164)	08:14	07:13	06:22
	17:18	18:01	28 09:07 (U164)	19:43	20:26	21:07
10	08:32	08:01	08:38 (U164)	08:12	07:11	06:20
	17:19	18:02	31 09:09 (U164)	19:44	20:28	21:08
11	08:32	08:00	08:37 (U164)	08:10	07:09	06:19
	17:20	18:04	32 09:09 (U164)	19:46	20:29	21:10
12	08:31	07:58	08:37 (U164)	08:08	07:07	06:18
	17:22	18:06	34 09:11 (U164)	19:47	20:30	21:11
13	08:31	07:57	08:36 (U164)	08:06	07:05	06:16
	17:23	18:07	35 09:11 (U164)	19:49	20:32	21:12
14	08:30	07:55	08:35 (U164)	08:04	07:04	06:15
	17:24	18:09	36 09:11 (U164)	19:50	20:33	21:13
15	08:30	07:54	08:35 (U164)	08:02	07:02	06:14
	17:25	18:10	37 09:12 (U164)	19:51	20:34	21:15
16	08:29	07:52	08:34 (U164)	08:00	07:00	06:12
	17:27	18:12	38 09:12 (U164)	19:53	20:36	21:16
17	08:28	07:50	08:34 (U164)	07:58	06:58	06:11
	17:28	18:13	38 09:12 (U164)	19:54	20:37	21:17
18	08:28	07:49	08:34 (U164)	07:56	06:56	06:10
	17:30	18:15	39 09:13 (U164)	19:56	20:38	21:18
19	08:27	07:47	08:34 (U164)	07:54	06:54	06:09
	17:31	18:16	38 09:12 (U164)	19:57	20:40	21:20
20	08:26	07:45	08:34 (U164)	07:52	06:53	06:08
	17:32	18:18	38 09:12 (U164)	19:58	20:41	7 07:28 (S102)
21	08:25	07:44	08:34 (U164)	07:50	06:51	7 07:17 (S102)
	17:34	18:19	37 09:11 (U164)	20:00	20:43	14 07:31 (S102)
22	08:24	07:42	08:35 (U164)	07:48	06:49	14 07:15 (S102)
	17:35	18:21	36 09:11 (U164)	20:01	20:44	17 07:32 (S102)
23	08:24	07:40	08:35 (U164)	07:46	06:47	17 07:14 (S102)
	17:37	18:22	36 09:11 (U164)	20:03	20:45	20 07:34 (S102)
24	08:23	07:38	08:35 (U164)	07:44	06:45	20 07:12 (S102)
	17:38	18:24	35 09:10 (U164)	20:04	20:47	23 07:35 (S102)
25	08:22	07:36	08:36 (U164)	07:43	06:44	23 07:11 (S102)
	17:40	18:25	32 09:08 (U164)	20:05	20:48	24 07:35 (S102)
26	08:21	07:35	08:37 (U164)	07:41	06:42	24 07:11 (S102)
	17:41	18:27	30 09:07 (U164)	20:07	20:49	25 07:36 (S102)
27	08:20	07:33	08:39 (U164)	07:39	06:40	25 07:10 (S102)
	17:43	18:28	27 09:06 (U164)	20:08	20:51	26 07:36 (S102)
28	08:18	07:31	08:40 (U164)	07:37	06:39	26 07:10 (S102)
	17:44	18:30	24 09:04 (U164)	20:10	20:52	26 07:36 (S102)
29	08:17			07:35	06:37	27 07:09 (S102)
	17:46			20:11	20:54	27 07:36 (S102)
30	08:16			07:33	06:35	27 07:09 (S102)
	17:47			20:12	20:55	26 07:35 (S102)
31	08:15			07:31	06:34	26 07:09 (S102)
	17:49			20:14	20:58	26 07:35 (S102)
Potential sun hours	279	288	368	407	466	474
Total, worst case						
Sun reduction		757	38	235	404	589
Oper. time red.		0.50	0.63	0.59	0.68	0.71
Wind dir. red.		0.99	0.99	0.99	0.99	0.99
Total reduction		0.76	0.76	0.63	0.61	0.58
Total, real		0.38	0.48	0.37	0.41	0.42
		289	18	88	167	245

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

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR008 - SR008**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December
1	05:57 21:47	06:35 (U163) 21:23		07:07 19:31	07:46 17:33	08:12 17:01
2	05:57 21:47	06:35 (U163) 21:21	07:29 (S102) 20:29	07:08 19:29	07:47 17:32	08:13 17:01
3	05:58 21:46	06:35 (U163) 21:20	07:26 (S102) 20:27	07:09 19:27	07:49 17:30	08:14 17:01
4	05:59 21:46	06:36 (U163) 21:19	07:24 (S102) 20:25	07:10 19:25	07:50 17:29	08:16 17:00
5	05:59 21:46	06:35 (U163) 21:17	07:22 (S102) 20:23	07:12 19:23	07:51 17:27	08:17 17:00
6	06:00 21:45	06:36 (U163) 21:16	07:21 (S102) 20:21	07:13 19:21	07:53 17:26	08:18 17:00
7	06:01 21:45	06:36 (U163) 21:14	07:21 (S102) 20:19	07:14 19:19	07:54 17:24	08:19 16:59
8	06:02 21:45	06:35 (U163) 21:13	07:20 (S102) 20:17	07:16 19:17	07:55 17:23	08:20 16:59
9	06:02 21:44	06:36 (U163) 21:11	07:19 (S102) 20:15	07:17 19:15	07:57 17:22	08:21 16:59
10	06:03 21:44	06:36 (U163) 21:10	07:18 (S102) 20:13	07:18 19:13	07:58 17:20	08:22 16:59
11	06:04 21:43	06:36 (U163) 21:08	07:17 (S102) 20:11	08:00 19:12	09:20 (U164) 17:19	07:44 16:59
12	06:05 21:42	06:37 (U163) 21:06	07:18 (S102) 20:09	08:01 19:10	09:16 (U164) 17:18	07:46 16:59
13	06:06 21:42	06:37 (U163) 21:05	07:17 (S102) 20:07	08:02 19:08	09:14 (U164) 17:17	07:47 16:59
14	06:07 21:41	06:37 (U163) 21:03	07:17 (S102) 20:05	08:04 19:06	09:11 (U164) 17:15	07:49 16:59
15	06:08 21:40	06:37 (U163) 21:02	07:17 (S102) 20:03	08:05 19:04	09:10 (U164) 17:14	07:50 16:59
16	06:09 21:40	06:37 (U163) 21:00	07:18 (S102) 20:01	08:06 19:02	09:09 (U164) 17:13	07:52 17:00
17	06:10 21:39	06:38 (U163) 20:58	07:18 (S102) 19:59	08:08 19:00	09:08 (U164) 17:12	07:53 17:00
18	06:11 21:38	06:38 (U163) 20:56	07:18 (S102) 19:57	08:09 18:57	09:07 (U164) 17:11	07:55 17:00
19	06:12 21:37	06:39 (U163) 20:55	07:18 (S102) 19:55	08:11 18:55	09:06 (U164) 17:10	07:56 17:01
20	06:13 21:36	06:40 (U163) 20:53	07:20 (S102) 19:53	08:12 18:53	09:05 (U164) 17:09	07:57 17:01
21	06:14 21:35	06:41 (U163) 20:51	07:21 (S102) 19:51	08:14 18:51	09:05 (U164) 17:08	07:59 17:01
22	06:15 21:34	06:42 (U163) 20:49	07:22 (S102) 19:49	08:15 18:49	09:04 (U164) 17:07	08:00 17:02
23	06:16 21:33	06:43 (U163) 20:48	07:22 (S102) 19:47	08:16 18:48	09:05 (U164) 17:07	08:02 17:02
24	06:17 21:32	06:46 (U163) 20:46	07:26 (S102) 19:45	08:18 18:46	09:04 (U164) 17:06	08:03 17:03
25	06:18 21:31	06:49 (U163) 20:44	07:31 (S102) 19:43	08:19 18:44	09:04 (U164) 17:05	08:04 17:04
26	06:20 21:30	06:59 20:42	07:39 19:41	08:21 18:43	09:04 (U164) 17:04	08:06 17:04
27	06:21 21:29	07:00 20:40	07:41 19:39	08:22 18:41	09:05 (U164) 17:04	08:07 17:05
28	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	09:05 (U164) 17:03	08:08 17:06
29	06:23 21:26	07:03 20:37	07:43 19:35	08:25 18:38	09:05 (U164) 17:02	08:10 17:07
30	06:24 21:25	07:04 20:35	07:45 19:33	08:27 18:36	09:06 (U164) 17:02	08:11 17:07
31	06:25 21:24	07:05 20:33	07:45 19:33	08:28 18:36	09:07 (U164) 17:02	08:11 17:07
Potential sun hours	480	441	378	339	282	267
Total, worst case	436	447		676	130	
Sun reduction	0.76	0.73		0.52	0.43	
Oper. time red.	0.99	0.99		0.99	0.99	
Wind dir. red.	0.58	0.63		0.76	0.76	
Total reduction	0.44	0.46		0.40	0.33	
Total, real	193	205		269	42	

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: ALLETE Wind ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802	Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.	Printed/Page: 4/16/2012 2:31 PM / 16 Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490
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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR009 - SR009

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June
1	08:34 17:09	08:14 17:50	07:29 18:31	08:19 (U164) 09:00 (U164)	07:29 20:15	06:34 20:56
2	08:34 17:10	08:12 17:52	07:27 18:33	08:19 (U164) 08:59 (U164)	07:27 20:16	06:32 20:58
3	08:34 17:11	08:11 17:53	07:25 18:34	08:19 (U164) 08:59 (U164)	07:25 20:18	06:31 20:59
4	08:34 17:12	08:10 17:55	07:24 18:36	08:19 (U164) 08:58 (U164)	07:23 20:19	06:29 21:00
5	08:34 17:13	08:09 17:56	07:22 18:37	08:20 (U164) 08:57 (U164)	07:21 20:21	06:28 21:02
6	08:33 17:14	08:07 17:58	07:20 18:39	08:20 (U164) 08:56 (U164)	07:19 20:22	06:26 21:03
7	08:33 17:16	08:06 17:59	07:18 18:40	08:21 (U164) 08:55 (U164)	07:17 20:23	06:25 21:04
8	08:33 17:17	08:04 18:01	07:16 18:41	09:21 (U164) 09:53 (U164)	07:15 20:25	06:23 21:06
9	08:33 17:18	08:03 18:01	07:14 18:43	09:23 (U164) 09:51 (U164)	07:13 20:26	06:22 21:07
10	08:32 17:19	08:01 18:02	07:12 18:44	09:24 (U164) 09:49 (U164)	07:11 20:28	06:20 21:08
11	08:32 17:20	08:00 18:04	07:10 18:46	09:26 (U164) 09:47 (U164)	07:09 20:29	06:19 21:10
12	08:31 17:22	07:58 18:06	07:08 18:47	09:29 (U164) 09:43 (U164)	07:07 20:30	06:18 21:11
13	08:31 17:23	07:57 18:07	07:06 18:49	09:29 (U164) 09:43 (U164)	07:05 20:32	06:16 21:12
14	08:30 17:24	07:55 18:09	07:04 18:51	08:38 (U164) 08:43 (U164)	07:04 20:33	06:15 21:13
15	08:30 17:25	07:54 18:10	07:02 18:53	08:33 (U164) 08:49 (U164)	07:02 20:34	06:14 21:15
16	08:29 17:27	07:52 18:12	07:00 18:55	08:30 (U164) 08:51 (U164)	07:00 20:36	06:12 21:16
17	08:28 17:28	07:50 18:13	06:58 18:57	08:28 (U164) 08:53 (U164)	06:58 20:37	06:11 21:17
18	08:28 17:30	07:49 18:15	06:56 18:59	08:27 (U164) 08:55 (U164)	06:56 20:38	06:10 21:18
19	08:27 17:31	07:47 18:16	06:54 19:00	08:25 (U164) 08:56 (U164)	06:54 20:40	06:09 21:20
20	08:26 17:32	07:45 18:18	06:52 19:02	08:24 (U164) 08:57 (U164)	06:53 20:41	06:08 21:21
21	08:25 17:34	07:44 18:19	06:50 19:04	08:22 (U164) 08:58 (U164)	06:51 20:43	06:07 21:22
22	08:24 17:35	07:42 18:21	06:48 19:06	08:22 (U164) 08:59 (U164)	06:49 20:44	06:06 21:23
23	08:24 17:37	07:40 18:22	06:46 19:08	08:21 (U164) 09:00 (U164)	06:47 20:45	06:05 21:24
24	08:23 17:38	07:38 18:24	06:44 19:10	08:21 (U164) 09:00 (U164)	06:45 20:47	06:04 21:25
25	08:22 17:40	07:36 18:25	06:42 19:12	08:20 (U164) 09:00 (U164)	06:44 20:48	06:03 21:26
26	08:21 17:41	07:35 18:27	06:40 19:14	08:19 (U164) 09:00 (U164)	06:42 20:49	06:02 21:28
27	08:20 17:43	07:33 18:28	06:38 19:16	08:20 (U164) 09:01 (U164)	06:40 20:51	06:01 21:29
28	08:18 17:44	07:31 18:30	06:36 19:18	08:19 (U164) 09:00 (U164)	06:39 20:52	06:00 21:30
29	08:17 17:46	07:30 18:31	06:34 19:20	08:19 (U164) 09:00 (U164)	06:37 20:53	06:00 21:31
30	08:16 17:47	07:29 18:32	06:32 19:22	08:18 (U164) 09:00 (U164)	06:35 20:54	06:00 21:32
31	08:15 17:49	07:28 18:33	06:30 19:24	08:18 (U164) 09:00 (U164)	06:34 20:55	06:00 21:33
Potential sun hours	279	288	368	407	466	474
Total, worst case		473	387	22	518	529
Sun reduction		0.50	0.63	0.59	0.68	0.71
Oper. time red.		0.99	0.99	0.99	0.99	0.99
Wind dir. red.		0.76	0.76	0.62	0.62	0.57
Total reduction		0.38	0.48	0.37	0.42	0.40
Total, real		180	185	8	217	213

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:
ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR009 - SR009

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Minimum sun height over horizon for influence	3 °	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Day step for calculation	1 days	4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Time step for calculation	1 minutes	Operational time
		N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
		514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	July	August	September	October	November	December
1	05:57	06:25 (U163)	06:27	07:05 (S102)	07:07	07:46
	19	06:44 (U163)	21:23	27 07:32 (S102)	20:31	19:31
2	05:47	06:25 (U163)	06:28	07:06 (S102)	07:08	07:47
	18	06:43 (U163)	21:21	27 07:33 (S102)	20:29	19:29
3	05:58	06:26 (U163)	06:29	07:05 (S102)	07:09	07:49
	18	06:44 (U163)	21:20	28 07:33 (S102)	20:27	19:27
4	05:59	06:27 (U163)	06:30	07:05 (S102)	07:10	07:50
	17	06:44 (U163)	21:19	27 07:32 (S102)	20:25	19:25
5	05:59	06:27 (U163)	06:32	07:05 (S102)	07:12	07:51
	16	06:43 (U163)	21:17	27 07:32 (S102)	20:23	19:23
6	06:00	06:28 (U163)	06:33	07:05 (S102)	07:13	07:53
	15	06:43 (U163)	21:16	26 07:31 (S102)	20:21	19:21
7	06:01	06:29 (U163)	06:34	07:06 (S102)	07:14	07:54
	14	06:43 (U163)	21:14	26 07:32 (S102)	20:19	19:19
8	06:02	06:28 (U163)	06:35	07:06 (S102)	07:16	07:55
	14	06:42 (U163)	21:13	25 07:31 (S102)	20:17	19:17
9	06:02	06:30 (U163)	06:37	07:07 (S102)	07:17	07:57
	12	06:42 (U163)	21:11	23 07:30 (S102)	20:15	19:15
10	06:03	06:31 (U163)	06:38	07:07 (S102)	07:18	07:58
	10	06:41 (U163)	21:10	22 07:29 (S102)	20:13	19:13
11	06:04	06:32 (U163)	06:39	07:08 (S102)	07:20	08:00
	9	06:41 (U163)	21:08	19 07:27 (S102)	20:11	19:12
12	06:05	06:34 (U163)	06:41	07:10 (S102)	07:21	08:01
	5	06:39 (U163)	21:06	16 07:26 (S102)	20:09	19:10
13	06:06	06:42 (U163)	06:42	07:12 (S102)	07:22	08:02
	12	06:41 (U163)	21:05	12 07:24 (S102)	20:07	19:08
14	06:07	06:43 (U163)	06:43	07:15 (S102)	07:23	08:04
	11	06:40 (U163)	21:03	5 07:20 (S102)	20:05	19:06
15	06:08	06:44 (U163)	06:44	07:16 (S102)	07:24	08:05
	10	06:39 (U163)	21:02	4 07:19 (S102)	20:03	19:04
16	06:09	06:45 (U163)	06:45	07:17 (S102)	07:25	08:06
	9	06:38 (U163)	21:00	3 07:18 (S102)	20:01	19:02
17	06:10	06:46 (U163)	06:46	07:18 (S102)	07:26	08:07
	8	06:37 (U163)	20:58	2 07:17 (S102)	19:59	19:00
18	06:11	06:47 (U163)	06:47	07:19 (S102)	07:27	08:08
	7	06:36 (U163)	20:56	1 07:16 (S102)	19:57	19:00
19	06:12	06:48 (U163)	06:48	07:20 (S102)	07:28	08:09
	6	06:35 (U163)	20:55	0 07:15 (S102)	19:55	19:00
20	06:13	06:49 (U163)	06:49	07:21 (S102)	07:29	08:10
	5	06:34 (U163)	20:53	0 07:14 (S102)	19:53	19:00
21	06:14	06:50 (U163)	06:50	07:22 (S102)	07:30	08:11
	4	06:33 (U163)	20:51	0 07:13 (S102)	19:51	19:00
22	06:15	06:51 (U163)	06:51	07:23 (S102)	07:31	08:12
	3	06:32 (U163)	20:49	0 07:12 (S102)	19:49	19:00
23	06:16	06:52 (U163)	06:52	07:24 (S102)	07:32	08:13
	2	06:31 (U163)	20:47	0 07:11 (S102)	19:47	19:00
24	06:17	06:53 (U163)	06:53	07:25 (S102)	07:33	08:14
	1	06:30 (U163)	20:45	0 07:10 (S102)	19:45	19:00
25	06:18	06:54 (U163)	06:54	07:26 (S102)	07:34	08:15
	0	06:29 (U163)	20:43	0 07:09 (S102)	19:43	19:00
26	06:19	06:55 (U163)	06:55	07:27 (S102)	07:35	08:16
	0	06:28 (U163)	20:41	0 07:08 (S102)	19:41	19:00
27	06:20	06:56 (U163)	06:56	07:28 (S102)	07:36	08:17
	0	06:27 (U163)	20:39	0 07:07 (S102)	19:39	19:00
28	06:21	06:57 (U163)	06:57	07:29 (S102)	07:37	08:18
	0	06:26 (U163)	20:37	0 07:06 (S102)	19:37	19:00
29	06:22	06:58 (U163)	06:58	07:30 (S102)	07:38	08:19
	0	06:25 (U163)	20:35	0 07:05 (S102)	19:35	19:00
30	06:23	06:59 (U163)	06:59	07:31 (S102)	07:39	08:20
	0	06:24 (U163)	20:33	0 07:04 (S102)	19:33	19:00
31	06:24	07:00 (U163)	07:00	07:32 (S102)	07:40	08:21
	0	06:25 (U163)	20:31	0 07:03 (S102)	19:31	19:00
Potential sun hours	480	441	378	339	282	267
Total, worst case	405	310	274	246	204	194
Sun reduction	0.76	0.73	0.71	0.72	0.71	0.71
Oper. time red.	0.99	0.99	0.99	0.99	0.99	0.99
Wind dir. red.	0.60	0.62	0.62	0.62	0.62	0.62
Total reduction	0.45	0.45	0.45	0.45	0.45	0.45
Total, real	183	139	139	139	139	139

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

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR010 - SR010

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:29 20:15	06:34 20:56	05:57 21:34	05:57 21:47	06:27 21:23	07:06 20:31	07:46 19:31	07:30 17:33	08:12 17:01
2	08:34 17:10	08:13 17:52	07:27 18:33	07:27 20:16	06:32 20:58	05:57 21:35	05:57 21:47	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:25 20:18	06:30 20:59	05:56 21:36	05:58 21:46	06:29 21:20	07:09 20:27	07:49 19:27	07:33 17:30	08:15 17:00
4	08:34 17:12	08:10 17:55	07:24 18:36	07:23 20:19	06:29 21:00	05:56 21:36	05:58 21:46	06:30 21:19	07:10 20:25	07:50 19:25	07:34 17:28	08:16 17:00
5	08:34 17:13	08:09 17:56	07:22 18:37	07:21 20:21	06:27 21:02	05:55 21:37	05:59 21:46	06:32 21:17	07:12 20:23	07:51 19:23	07:36 17:27	08:17 17:00
6	08:33 17:14	08:07 17:58	07:20 18:38	07:19 20:22	06:26 21:03	05:55 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:53 19:21	07:37 17:26	08:18 17:00
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:01 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:39 17:24	08:19 16:59
8	08:33 17:17	08:04 18:01	07:16 18:41	07:15 20:25	06:23 21:06	05:54 21:40	06:01 21:45	06:35 21:13	07:16 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:33 17:18	08:03 18:01	08:14 19:43	07:13 20:26	06:22 21:07	05:54 21:40	06:02 21:44	06:37 21:11	07:17 20:15	07:57 19:15	07:42 17:22	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	07:11 20:28	06:20 21:08	05:53 21:41	06:03 21:44	06:38 21:10	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:46	07:09 20:29	06:19 21:10	05:53 21:42	06:04 21:43	06:39 21:08	07:20 20:11	08:00 19:11	07:45 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	07:07 20:30	06:17 21:11	05:53 21:42	06:05 21:43	06:40 21:07	07:21 20:09	08:01 19:10	07:46 17:18	08:24 16:59
13	08:31 17:23	07:57 18:07	08:06 19:49	07:05 20:32	06:16 21:12	05:53 21:43	06:06 21:42	06:42 21:05	07:22 20:07	08:02 19:08	07:47 17:17	08:25 16:59
14	08:30 17:24	07:55 18:09	08:04 19:50	07:03 20:33	06:15 21:13	05:53 21:43	06:07 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59
15	08:30 17:25	07:54 18:10	08:02 19:51	07:02 20:34	06:14 21:15	05:52 21:44	06:08 21:40	06:44 21:02	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:27	07:52 18:12	08:00 19:53	07:00 20:36	06:12 21:16	05:52 21:44	06:09 21:40	06:46 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59
17	08:29 17:28	07:50 18:13	07:58 19:54	06:58 20:37	06:11 21:17	05:52 21:45	06:10 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:28 17:29	07:49 18:15	07:56 19:56	06:56 20:39	06:10 21:18	05:52 21:45	06:11 21:38	06:48 20:57	07:29 19:57	08:09 18:57	07:55 17:11	08:29 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	06:54 20:40	06:09 21:20	05:53 21:46	06:12 21:37	06:50 20:55	07:30 19:55	08:11 18:55	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:18	07:52 19:58	06:52 20:41	06:08 21:21	05:53 21:46	06:13 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:58 17:09	08:30 17:01
21	08:25 17:34	07:44 18:19	07:50 20:00	06:51 20:43	06:07 21:22	05:53 21:46	06:14 21:35	06:52 20:51	07:33 19:51	08:14 18:51	07:59 17:08	08:31 17:01
22	08:25 17:35	07:42 18:21	07:48 20:01	06:49 20:44	06:06 21:23	05:53 21:47	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:02
23	08:24 17:37	07:40 18:22	07:46 20:03	06:47 20:45	06:05 21:24	05:53 21:47	06:16 21:33	06:55 20:48	07:35 19:47	08:17 18:48	08:02 17:06	08:32 17:02
24	08:23 17:38	07:38 18:24	07:44 20:04	06:45 20:47	06:04 21:25	05:54 21:47	06:17 21:32	06:56 20:46	07:37 19:45	08:18 18:46	08:03 17:06	08:32 17:03
25	08:22 17:39	07:36 18:25	07:42 20:05	06:44 20:48	06:03 21:27	05:54 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:21 17:41	07:35 18:27	07:40 20:07	06:42 20:49	06:02 21:28	05:54 21:47	06:19 21:30	06:59 20:42	07:39 19:41	08:21 18:43	08:06 17:04	08:33 17:04
27	08:20 17:42	07:33 18:28	07:38 20:08	06:40 20:51	06:01 21:29	05:55 21:47	06:21 21:29	07:00 20:40	07:41 19:39	08:22 18:41	08:07 17:04	08:33 17:05
28	08:18 17:44	07:31 18:30	07:36 20:10	06:39 20:52	06:00 21:30	05:55 21:47	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:06
29	08:17 17:45	07:30 20:11	07:35 20:54	06:37 21:31	05:59 21:47	05:56 21:47	06:23 21:27	07:03 20:37	07:43 19:35	08:25 18:38	08:10 17:02	08:33 17:06
30	08:16 17:47	07:33 20:12	07:33 20:55	06:35 21:32	05:59 21:47	05:56 21:47	06:24 21:25	07:04 20:35	07:45 19:33	08:27 18:36	08:11 17:02	08:34 17:07
31	08:15 17:48	07:31 20:14	07:31 20:55	06:35 21:33	05:58 21:48	05:58 21:48	06:25 21:24	07:05 20:33	07:46 19:33	08:28 18:35	08:12 17:03	08:34 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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:

ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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Licensed user:

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wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR011 - SR011**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:58	05:57	06:27	07:07	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:47	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:32	17:01
3	08:34	08:11	07:25	07:25	06:31	05:56	05:58	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:01
4	08:34	08:10	07:23	07:23	06:29	05:56	05:59	06:30	07:10	07:50	07:34	08:15
	17:12	17:55	18:36	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:29	17:00
5	08:33	08:08	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:35	08:17
	17:13	17:56	18:37	20:21	21:01	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:25	05:54	06:01	06:34	07:14	07:54	07:38	08:19
	17:16	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
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	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:20	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:18	05:53	06:05	06:41	07:21	08:01	07:46	08:24
	17:22	18:06	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:10	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:30	07:55	08:04	07:03	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:02	06:14	05:53	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:53	06:09	06:46	07:26	08:06	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:39	21:00	20:01	19:02	17:13	17:00
17	08:28	07:50	07:58	06:58	06:11	05:53	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:53	06:11	06:48	07:29	08:09	07:54	08:28
	17:30	18:15	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:55	19:55	18:55	17:10	17:01
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	07:59	08:30
	17:34	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:54	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:37	18:22	20:03	20:45	21:24	21:46	21:33	20:48	19:47	18:48	17:07	17:02
24	08:22	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:21	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:40	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:04
26	08:20	07:35	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:32
	17:41	18:27	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:55	06:21	07:00	07:40	08:22	08:07	08:33
	17:43	18:28	20:08	20:51	21:28	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:36	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:09	20:52	21:29	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17	07:34	07:34	06:37	06:00	05:56	06:23	07:03	07:43	08:25	08:09	08:33
	17:46	20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:38	17:02	17:07	
30	08:16	07:33	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:33	
	17:47	20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07	
31	08:15	07:31	06:31	05:58	05:58	06:25	07:05	07:45	08:28	08:11	08:33	
	17:49	20:14	21:33	21:47	21:24	20:33	19:31	18:35	17:02	17:07	17:07	
Potential sun hours	279	288	368	407	466	474	480	441	378	339	282	267
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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Licensed user: EAPC Wind Energy
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US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR012 - SR012

Assumptions for shadow calculations

Maximum distance for influence: 1,500 m
Minimum sun height over horizon for influence: 3 degrees
Day step for calculation: 1 days
Time step for calculation: 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns (January to December) and multiple rows showing sunrise/sunset times and shadow calculations for each day. Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

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

Matrix layout table with 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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 21
Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR013 - SR013

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:13	07:27	07:26	06:32	05:56	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:36	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:23	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:28	17:00
5	08:34	08:09	07:22	07:21	06:27	05:55	05:59	06:31	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:54	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:46	21:16	20:21	19:21	17:25	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:43	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:52	06:05	06:42	07:22	08:02	07:47	08:25
	17:22	18:07	19:48	20:32	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:04	07:49	08:26
	17:24	18:08	19:50	20:33	21:13	21:44	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:01	06:13	05:52	06:07	06:44	07:25	08:05	07:50	08:27
	17:25	18:10	19:51	20:34	21:15	21:44	21:41	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
	17:26	18:11	19:53	20:36	21:16	21:45	21:40	21:00	20:01	19:02	17:13	16:59
17	08:29	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	16:59
18	08:28	07:49	07:56	06:56	06:10	05:52	06:10	06:48	07:29	08:09	07:55	08:29
	17:29	18:14	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:52	06:12	06:51	07:31	08:12	07:58	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:06	05:53	06:13	06:52	07:32	08:14	07:59	08:31
	17:33	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:05	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:47	21:34	20:49	19:49	18:49	17:07	17:01
23	08:24	07:40	07:46	06:47	06:04	05:53	06:16	06:55	07:35	08:16	08:02	08:32
	17:36	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:47	17:06	17:02
24	08:23	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:03
25	08:22	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:27	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:20	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:05
29	08:17	07:34	07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:10	08:34
	17:45	18:31	20:10	20:54	21:31	21:47	21:27	20:37	19:35	18:37	17:02	17:06
30	08:16	07:32	07:32	06:35	05:58	05:56	06:24	07:04	07:44	08:27	08:11	08:34
	17:47	18:32	20:11	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15	07:30	07:30	06:33	05:58	05:58	06:25	07:05	07:44	08:28	08:12	08:34
	17:48	18:33	20:12	20:56	21:33	21:48	21:24	20:33	19:31	18:34	17:02	17:08
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR014 - SR014**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	January	February	March	April	May	June
1	08:34	15:33 (S120)	08:14	07:29	07:51 (S118)	07:28
	17:09	46 16:19 (S120)	17:50	18:31	23 17:59 (S121)	20:15
2	08:34	15:34 (S120)	08:12	07:27	07:49 (S118)	07:26
	17:10	45 16:19 (S120)	17:51	18:32	19 17:55 (S121)	20:16
3	08:34	15:35 (S120)	08:11	07:25	07:47 (S118)	07:24
	17:11	45 16:20 (S120)	17:53	18:34	20 08:07 (S118)	20:18
4	08:34	15:35 (S120)	08:10	07:23	07:45 (S118)	07:23
	17:12	45 16:20 (S120)	17:55	18:35	23 08:08 (S118)	20:19
5	08:33	15:35 (S120)	08:08	07:22	07:43 (S118)	07:21
	17:13	45 16:20 (S120)	17:56	18:37	26 08:09 (S118)	20:20
6	08:33	15:36 (S120)	08:07	07:20	07:41 (S118)	07:19
	17:14	44 16:20 (S120)	17:58	18:38	28 08:09 (S118)	20:22
7	08:33	15:37 (S120)	08:06	07:18	07:39 (S118)	07:17
	17:15	44 16:21 (S120)	17:59	18:40	31 08:10 (S118)	20:23
8	08:33	15:37 (S120)	08:04	08:16	08:37 (S118)	07:15
	17:16	44 16:21 (S120)	18:01	18:41	33 09:10 (S118)	20:25
9	08:32	15:38 (S120)	08:03	08:14	08:35 (S118)	07:13
	17:18	43 16:21 (S120)	18:01	19:43	35 09:10 (S118)	20:26
10	08:32	15:38 (S120)	08:01	08:12	08:35 (S118)	07:11
	17:19	43 16:21 (S120)	18:02	19:44	35 09:10 (S118)	20:27
11	08:32	15:39 (S120)	08:00	08:10	08:35 (S118)	07:09
	17:20	43 16:22 (S120)	18:04	19:46	34 09:09 (S118)	20:29
12	08:31	15:39 (S120)	07:58	08:08	08:34 (S118)	07:07
	17:21	42 16:21 (S120)	18:05	19:47	35 09:09 (S118)	20:30
13	08:31	15:41 (S120)	07:57	08:06	08:34 (S118)	07:05
	17:23	41 16:22 (S120)	18:07	19:48	34 09:08 (S118)	20:31
14	08:30	15:41 (S120)	07:55	08:04	08:34 (S118)	07:03
	17:24	41 16:22 (S120)	18:08	19:50	34 09:08 (S118)	20:33
15	08:30	15:41 (S120)	07:53	08:02	08:35 (S118)	07:01
	17:25	40 16:21 (S120)	18:10	19:51	32 09:07 (S118)	20:34
16	08:29	15:43 (S120)	07:52	08:00	08:35 (S118)	07:00
	17:27	39 16:22 (S120)	18:11	19:53	31 09:06 (S118)	20:36
17	08:28	15:44 (S120)	07:50	07:58	08:36 (S118)	06:58
	17:28	38 16:22 (S120)	18:13	19:54	28 09:04 (S118)	20:37
18	08:28	15:44 (S120)	07:48	07:56	08:37 (S118)	06:56
	17:29	37 16:21 (S120)	18:14	19:55	26 09:03 (S118)	20:38
19	08:27	15:45 (S120)	07:47	07:54	08:38 (S118)	06:54
	17:31	36 16:21 (S120)	18:16	19:57	23 09:01 (S118)	20:40
20	08:26	15:46 (S120)	07:45	07:52	08:40 (S118)	06:52
	17:32	34 16:20 (S120)	18:18	19:58	19 08:59 (S118)	20:41
21	08:25	15:48 (S120)	07:43	07:50	08:42 (S118)	06:50
	17:33	32 16:20 (S120)	18:19	10 17:55 (S121)	20:00	13 08:55 (S118)
22	08:24	15:49 (S120)	07:42	07:48	06:49	
	17:35	30 16:19 (S120)	18:21	12 17:58 (S121)	20:01	
23	08:23	15:51 (S120)	07:40	07:46	06:47	
	17:36	27 16:18 (S120)	18:22	14 17:59 (S121)	20:02	
24	08:22	15:52 (S120)	07:38	07:44	06:45	
	17:38	25 16:17 (S120)	18:24	16 18:01 (S121)	20:04	
25	08:22	15:55 (S120)	07:36	07:42	06:43	
	17:39	20 16:15 (S120)	18:25	18 18:02 (S121)	20:05	
26	08:20	15:57 (S120)	07:35	07:40	06:42	
	17:41	16 16:13 (S120)	18:27	18 18:03 (S121)	20:07	
27	08:19	16:02 (S120)	07:33	07:38	06:40	
	17:42	8 16:10 (S120)	18:28	17 18:02 (S121)	20:08	
28	08:18		07:31	07:36	06:38	
	17:44		18:30	21 18:01 (S121)	20:09	
29	08:17			07:34	06:37	
	17:45			20:11	20:53	
30	08:16			07:32	06:35	
	17:47			20:12	20:55	
31	08:15			07:30	29 20:30 (S125)	
	17:48			20:14	05:58	
Potential sun hours	279	287	368	407	466	474
Total, worst case	993	140	582	126	778	
Sun reduction	0.55	0.50	0.63	0.59	0.68	
Oper. time red.	0.99	0.99	0.99	0.99	0.99	
Wind dir. red.	0.52	0.62	0.73	0.75	0.75	
Total reduction	0.27	0.30	0.44	0.42	0.49	
Total, real	272	42	256	53	378	

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)

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR014 - SR014

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	July	August	September	October	November	December					
1	05:57	06:26	20:08 (S125)	07:06	07:46	08:14 (S118)	07:30	08:12	15:21 (S120)		
2	05:57	06:28	20:07 (S125)	07:08	07:47	08:13 (S118)	07:31	08:13	15:21 (S120)		
3	05:58	06:29	20:08 (S125)	07:09	07:48	08:13 (S118)	07:33	08:14	15:21 (S120)		
4	05:58	06:30	20:08 (S125)	07:10	07:50	08:13 (S118)	07:34	08:16	15:22 (S120)		
5	05:59	06:31	20:07 (S125)	07:12	07:51	08:13 (S118)	07:35	08:17	15:22 (S120)		
6	06:00	06:33	20:07 (S125)	07:13	07:52	08:15 (S118)	07:37	08:18	15:22 (S120)		
7	06:00	06:34	20:07 (S125)	07:14	07:54	08:16 (S118)	07:38	08:19	15:22 (S120)		
8	06:01	06:35	20:08 (S125)	07:15	07:55	08:17 (S118)	07:40	08:20	15:22 (S120)		
9	06:02	06:36	20:08 (S125)	07:17	07:57	08:19 (S118)	07:41	08:21	15:23 (S120)		
10	06:03	06:38	20:08 (S125)	07:18	07:58	08:20 (S118)	07:43	08:22	15:23 (S120)		
11	06:04	06:39	20:08 (S125)	07:19	07:59	08:22 (S118)	07:44	08:23	15:23 (S120)		
12	06:05	06:40	20:09 (S125)	07:21	08:01	08:23 (S118)	07:46	08:24	15:24 (S120)		
13	06:06	06:42	20:10 (S125)	07:22	08:02	08:25 (S118)	07:47	08:25	15:24 (S120)		
14	06:06	06:43	20:11 (S125)	07:23	08:04	08:26 (S118)	07:49	08:26	15:25 (S120)		
15	06:07	06:44	20:12 (S125)	07:25	08:05	18:17 (S121)	07:50	15:34 (S120)	08:26	15:26 (S120)	
16	06:08	06:46	20:13 (S125)	07:26	08:06	18:17 (S121)	07:52	15:30 (S120)	08:27	15:25 (S120)	
17	06:09	06:47	20:16 (S125)	07:27	08:08	18:16 (S121)	07:53	15:29 (S120)	08:28	15:26 (S120)	
18	06:10	06:48	20:19 (S125)	07:28	08:09	18:16 (S121)	07:55	15:26 (S120)	08:29	15:27 (S120)	
19	06:11	06:49	20:27 (S125)	07:30	08:11	18:31 (S121)	07:56	15:51 (S120)	08:30	15:28 (S120)	
20	06:13	06:51	20:31 (S125)	07:31	08:12	18:29 (S121)	07:57	15:53 (S120)	08:30	15:28 (S120)	
21	06:14	06:52	20:35 (S125)	07:32	08:13	18:28 (S121)	07:59	15:54 (S120)	08:30	15:28 (S120)	
22	06:15	06:53	20:36 (S125)	07:34	08:15	18:25 (S121)	08:00	15:56 (S120)	08:31	15:28 (S120)	
23	06:16	06:55	20:37 (S125)	07:35	08:16	18:24 (S121)	08:02	15:52 (S120)	08:31	15:29 (S120)	
24	06:17	06:56	20:38 (S125)	07:36	08:18	18:22 (S121)	08:03	15:58 (S120)	08:32	15:30 (S120)	
25	06:18	06:57	20:39 (S125)	07:38	08:21	18:18 (S121)	08:04	15:58 (S120)	08:32	15:30 (S120)	
26	06:19	06:59	20:40 (S125)	07:39	08:22	18:19 (S121)	08:06	15:58 (S120)	08:33	15:30 (S120)	
27	06:20	07:00	20:41 (S125)	07:40	08:24	18:17 (S121)	08:07	16:00 (S120)	08:33	15:31 (S120)	
28	06:22	07:01	20:42 (S125)	07:42	08:26	18:16 (S121)	08:08	16:01 (S120)	08:33	15:31 (S120)	
29	06:23	07:02	20:43 (S125)	07:43	08:27	18:15 (S121)	08:10	16:02 (S120)	08:33	15:32 (S120)	
30	06:24	07:04	20:44 (S125)	07:44	08:28	18:14 (S121)	08:11	16:03 (S120)	08:33	15:32 (S120)	
31	06:25	07:05	20:45 (S125)	07:45	08:29	18:13 (S121)	08:12	16:04 (S120)	08:33	15:33 (S120)	
Potential sun hours	480	441	378	338	282	266	1395	0.43	0.99	0.52	0.22
Total, worst case	386	524	231	499	506	1395	0.43	0.99	0.52	0.22	0.22
Sun reduction	0.76	0.73	0.69	0.52	0.43	0.43	0.43	0.99	0.52	0.22	0.22
Oper. time red.	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Wind dir. red.	0.75	0.75	0.73	0.70	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Total reduction	0.54	0.52	0.48	0.35	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Total, real	209	273	112	174	108	300	300	300	300	300	300

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

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR015 - SR015**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June		
1	08:34	08:14	07:29	08:24 (S131)	07:28	07:50 (S132)	06:33	05:57
	17:09	17:50	18:31	28 08:52 (S131)	20:15	14 08:04 (S132)	20:56	21:34
2	08:34	08:12	07:27	08:25 (S131)	07:26	07:47 (S132)	06:32	05:57
	17:10	17:51	18:32	26 08:51 (S131)	20:16	20 08:07 (S132)	20:58	21:35
3	08:34	08:11	07:25	08:26 (S131)	07:24	07:45 (S132)	06:30	05:56
	17:11	17:53	18:34	23 08:49 (S131)	20:18	23 08:08 (S132)	20:59	21:35
4	08:34	08:10	07:23	08:28 (S131)	07:22	07:44 (S132)	06:29	05:55
	17:12	17:54	18:35	18 08:46 (S131)	20:19	26 08:10 (S132)	21:00	21:36
5	08:34	08:08	07:22	08:31 (S131)	07:21	07:43 (S132)	06:27	05:55
	17:13	17:56	18:37	11 08:42 (S131)	20:20	28 08:11 (S132)	21:02	21:37
6	08:33	08:07	07:20	07:19	07:19	07:42 (S132)	06:26	05:54
	17:14	17:58	18:38	20:22	29 08:11 (S132)	21:03	21:38	
7	08:33	08:06	07:18	07:17	07:17	07:40 (S132)	06:24	05:54
	17:15	17:59	18:40	20:23	32 08:12 (S132)	21:04	21:39	
8	08:33	08:04	08:16	07:15	07:15	07:40 (S132)	06:23	05:54
	17:16	18:01	18:41	20:25	32 08:12 (S132)	21:06	21:40	
9	08:33	08:03	08:14	07:13	07:13	07:39 (S132)	06:21	05:53
	17:18	18:01	19:43	20:26	33 08:12 (S132)	21:07	21:40	
10	08:32	08:01	08:34 (S131)	08:12	07:11	07:38 (S132)	06:20	05:53
	17:19	18:02	11 08:45 (S131)	19:44	20:27	33 08:11 (S132)	21:08	21:41
11	08:32	08:00	08:31 (S131)	08:10	07:09	07:38 (S132)	06:19	05:53
	17:20	18:04	17 08:48 (S131)	19:46	20:29	33 08:11 (S132)	21:09	21:42
12	08:31	07:58	08:29 (S131)	08:08	07:07	07:38 (S132)	06:17	05:53
	17:21	18:05	21 08:50 (S131)	19:47	20:30	33 08:11 (S132)	21:11	21:42
13	08:31	07:57	08:27 (S131)	08:06	07:05	07:37 (S132)	06:16	05:52
	17:22	18:07	25 08:52 (S131)	19:48	20:32	33 08:10 (S132)	21:12	21:43
14	08:30	07:55	08:25 (S131)	08:04	07:03	07:37 (S132)	06:15	05:52
	17:24	18:08	28 08:53 (S131)	19:50	20:33	32 08:09 (S132)	21:13	21:43
15	08:30	07:53	08:25 (S131)	08:02	07:01	07:38 (S132)	06:13	05:52
	17:25	18:10	29 08:54 (S131)	19:51	20:34	31 08:09 (S132)	21:15	21:44
16	08:29	07:52	08:24 (S131)	08:00	07:00	07:39 (S132)	06:12	05:52
	17:26	18:11	31 08:55 (S131)	19:53	20:36	29 08:08 (S132)	21:16	21:44
17	08:28	07:50	08:23 (S131)	07:58	06:58	07:39 (S132)	06:11	05:52
	17:28	18:13	32 08:55 (S131)	19:54	20:37	28 08:07 (S132)	21:17	21:45
18	08:28	07:49	08:23 (S131)	07:56	06:56	07:40 (S132)	06:10	05:52
	17:29	18:14	33 08:56 (S131)	19:55	20:38	25 08:05 (S132)	21:18	21:45
19	08:27	07:47	08:22 (S131)	07:54	06:54	07:40 (S132)	06:09	05:52
	17:31	18:16	35 08:57 (S131)	19:57	20:40	23 08:03 (S132)	21:20	21:46
20	08:26	07:45	08:21 (S131)	07:52	06:52	07:42 (S132)	06:08	05:52
	17:32	18:17	36 08:57 (S131)	19:58	20:41	20 08:02 (S132)	21:21	21:46
21	08:25	07:43	08:21 (S131)	07:50	06:50	07:44 (S132)	06:06	05:53
	17:33	18:19	35 08:56 (S131)	20:00	20:43	15 07:59 (S132)	21:22	21:46
22	08:24	07:42	08:21 (S131)	07:48	06:49	07:47 (S132)	06:05	05:53
	17:35	18:21	36 08:57 (S131)	20:01	20:44	8 07:55 (S132)	21:23	21:46
23	08:24	07:40	08:21 (S131)	07:46	06:47	06:04	06:04	05:53
	17:36	18:22	36 08:57 (S131)	20:02	20:45	21:24	21:47	
24	08:23	07:38	08:21 (S131)	07:44	06:45	06:03	05:53	
	17:38	18:24	35 08:56 (S131)	20:04	20:47	21:25	21:47	
25	08:22	07:36	08:21 (S131)	07:42	06:43	06:03	05:54	
	17:39	18:25	35 08:56 (S131)	20:05	20:48	21:26	21:47	
26	08:21	07:35	08:21 (S131)	07:40	06:42	06:02	05:54	
	17:41	18:27	34 08:55 (S131)	20:07	20:49	21:28	21:47	
27	08:19	07:33	08:22 (S131)	07:38	06:40	06:01	05:54	
	17:42	18:28	32 08:54 (S131)	20:08	20:51	21:29	21:47	
28	08:18	07:31	08:23 (S131)	07:36	06:38	06:00	05:55	
	17:44	18:29	31 08:54 (S131)	20:09	20:52	21:30	21:47	
29	08:17		07:34		06:37	05:59	05:55	
	17:45		20:11		20:53	21:31	21:47	
30	08:16		07:32		06:35	05:58	05:56	
	17:47		20:12		20:55	21:32	21:47	
31	08:15		07:30	07:56 (S132)		05:58		
	17:48		20:14	4 08:00 (S132)		21:33		
Potential sun hours	279	287	368		407	466	475	
Total, worst case		572	110	580				
Sun reduction		0.50	0.63	0.59				
Oper. time red.		0.99	0.99	0.99				
Wind dir. red.		0.76	0.76	0.68				
Total reduction		0.38	0.47	0.40				
Total, real		215	52	231				

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

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR015 - SR015**

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Minimum sun height over horizon for influence	3 °	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Day step for calculation	1 days	4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Time step for calculation	1 minutes	Operational time
		N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
		514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	July	August	September	October	November	December
1	05:56	06:26	07:06	07:37 (S132)	07:46	07:30
	21:47	21:23	20:31	33 08:10 (S132)	19:31	17:33
2	05:57	06:28	07:08	07:36 (S132)	07:47	07:31
	21:47	21:21	20:29	33 08:09 (S132)	19:29	17:31
3	05:58	06:29	07:09	07:37 (S132)	07:48	07:33
	21:46	21:20	20:27	33 08:10 (S132)	19:27	17:30
4	05:58	06:30	07:10	07:37 (S132)	07:50	07:34
	21:46	21:18	20:25	32 08:09 (S132)	19:25	17:28
5	05:59	06:31	07:12	07:37 (S132)	07:51	07:36
	21:46	21:17	20:23	31 08:08 (S132)	19:23	17:27
6	06:00	06:33	07:13	07:37 (S132)	07:52	07:37
	21:45	21:16	20:21	29 08:06 (S132)	19:21	17:25
7	06:00	06:34	07:14	07:38 (S132)	07:54	07:39
	21:45	21:14	20:19	28 08:06 (S132)	19:19	17:24
8	06:01	06:35	07:15	07:38 (S132)	07:55	09:09 (S131)
	21:45	21:13	20:17	26 08:04 (S132)	19:17	5 09:14 (S131)
9	06:02	06:36	07:17	07:39 (S132)	07:57	09:04 (S131)
	21:44	21:11	20:15	23 08:02 (S132)	19:15	15 09:19 (S131)
10	06:03	06:38	07:18	07:40 (S132)	07:58	09:01 (S131)
	21:44	21:10	20:13	20 08:00 (S132)	19:13	20 09:21 (S131)
11	06:04	06:39	07:19	07:43 (S132)	07:59	09:00 (S131)
	21:43	21:08	20:11	15 07:58 (S132)	19:11	24 09:24 (S131)
12	06:05	06:40	07:21	07:47 (S132)	08:01	08:58 (S131)
	21:42	21:06	20:09	6 07:53 (S132)	19:09	26 09:24 (S131)
13	06:05	06:42	07:22	08:02	08:07 (S131)	07:47
	21:42	21:05	20:07	19:07	29 09:26 (S131)	17:16
14	06:06	06:43	07:23	08:04	08:55 (S131)	07:49
	21:41	21:03	20:05	19:06	31 09:26 (S131)	17:15
15	06:07	06:44	07:25	08:05	08:55 (S131)	07:50
	21:40	21:01	20:03	19:04	32 09:27 (S131)	17:14
16	06:08	06:45	07:26	08:06	08:53 (S131)	07:52
	21:40	21:00	20:01	19:02	34 09:27 (S131)	17:13
17	06:09	06:47	07:27	08:08	08:52 (S131)	07:53
	21:39	20:58	19:59	19:00	35 09:27 (S131)	17:12
18	06:10	06:48	07:28	08:09	08:52 (S131)	07:55
	21:38	20:56	19:57	18:56	36 09:28 (S131)	17:11
19	06:11	06:49	07:30	08:11	08:52 (S131)	07:56
	21:37	20:55	19:55	18:55	35 09:27 (S131)	17:10
20	06:12	06:51	07:31	08:12	08:52 (S131)	07:57
	21:36	20:53	19:53	18:53	36 09:28 (S131)	17:09
21	06:14	06:52	07:51 (S132)	07:32	08:13	08:51 (S131)
	21:35	20:51	10 08:01 (S132)	19:51	18:51	36 09:27 (S131)
22	06:15	06:53	07:49 (S132)	07:34	08:15	08:52 (S131)
	21:34	20:49	16 08:05 (S132)	19:49	18:49	35 09:27 (S131)
23	06:16	06:55	07:46 (S132)	07:35	08:16	08:53 (S131)
	21:33	20:48	20 08:06 (S132)	19:47	18:47	34 09:27 (S131)
24	06:17	06:56	07:44 (S132)	07:36	08:18	08:52 (S131)
	21:32	20:46	23 08:07 (S132)	19:45	18:46	34 09:26 (S131)
25	06:18	06:57	07:42 (S132)	07:38	08:19	08:53 (S131)
	21:31	20:44	26 08:08 (S132)	19:43	18:44	33 09:26 (S131)
26	06:19	06:58	07:42 (S132)	07:39	08:21	08:53 (S131)
	21:30	20:42	28 08:10 (S132)	19:41	18:42	31 09:24 (S131)
27	06:20	07:00	07:40 (S132)	07:40	08:22	08:55 (S131)
	21:29	20:40	30 08:10 (S132)	19:39	18:41	29 09:24 (S131)
28	06:21	07:01	07:39 (S132)	07:42	08:24	08:55 (S131)
	21:28	20:38	31 08:10 (S132)	19:37	18:39	27 09:22 (S131)
29	06:23	07:02	07:38 (S132)	07:43	08:25	08:57 (S131)
	21:26	20:36	32 08:10 (S132)	19:35	18:37	24 09:21 (S131)
30	06:24	07:04	07:38 (S132)	07:44	08:27	08:58 (S131)
	21:25	20:35	33 08:11 (S132)	19:33	18:36	21 09:19 (S131)
31	06:25	07:05	07:37 (S132)		08:28	09:01 (S131)
	21:24	20:33	33 08:10 (S132)		18:34	16 09:17 (S131)
Potential sun hours	480	441	378	338	282	266
Total, worst case		282	309	678		9
Sun reduction		0.73	0.69	0.52		0.43
Oper. time red.		0.99	0.99	0.99		0.99
Wind dir. red.		0.68	0.68	0.76		0.76
Total reduction		0.49	0.46	0.39		0.32
Total, real		138	143	266		3

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

Project: **ALLETE Wind**
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR016 - SR016

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:57	06:26	07:06	07:46	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:47	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:33	08:10	07:23	07:22	06:29	05:56	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:21	06:27	05:55	05:59	06:31	07:12	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:52	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:25	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:57	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:03	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
	17:27	18:11	19:53	20:36	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:07	05:53	06:14	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:04	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:46	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:21	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:32
	17:41	18:27	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:55	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17	07:34	07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45	18:30	20:10	20:53	21:30	21:47	21:26	20:36	19:35	18:38	17:02	17:06
30	08:16	07:32	07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:33
	17:47	18:32	20:12	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:02	17:07
31	08:15	07:30	07:30	06:33	05:58	05:58	06:25	07:05	07:45	08:28	08:11	08:33
	17:48	18:33	20:14	20:57	21:32	21:48	21:24	20:33	19:32	18:34	17:02	17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR017 - SR017

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to June) and rows for time slots (e.g., 08:34, 17:09, etc.). Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, Total, real.

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

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR017 - SR017

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	July	August	September	October	November	December
1	05:56	06:26	07:06	07:29 (S141)	07:46	08:14 (S139)
	21:47	21:22	20:31	35 19:59 (U159)	19:31	30 08:44 (S139)
2	05:57	06:28	07:08	07:30 (S141)	07:47	08:14 (S139)
	21:46	21:21	20:29	34 19:59 (U159)	19:29	29 08:43 (S139)
3	05:58	06:29	07:09	07:32 (S141)	07:48	08:14 (S139)
	21:46	21:20	20:27	33 20:00 (U159)	19:27	28 08:42 (S139)
4	05:58	06:30	07:10	07:33 (S141)	07:50	08:15 (S139)
	21:46	21:18	20:25	31 19:59 (U159)	19:25	26 08:41 (S139)
5	05:59	06:31	07:11	07:34 (S141)	07:51	08:16 (S139)
	21:46	21:17	20:23	27 19:57 (U159)	19:23	35 08:16 (S139)
6	06:00	06:33	07:13	07:35 (S141)	07:52	08:17 (S139)
	21:45	21:16	20:21	21 19:55 (U159)	19:21	41 08:06 (U160)
7	06:00	06:34	07:14	19:36 (U159)	07:54	08:19 (S139)
	21:45	21:14	20:19	17 19:53 (U159)	19:19	42 08:08 (U160)
8	06:01	06:35	07:15	19:36 (U159)	07:55	08:22 (S139)
	21:44	21:13	20:17	15 19:51 (U159)	19:17	38 08:09 (U160)
9	06:02	06:36	07:17	19:36 (U159)	07:57	17:38 (U160)
	21:44	21:11	20:15	13 19:49 (U159)	19:15	33 08:11 (U160)
10	06:03	06:38	07:18	19:37 (U159)	07:58	17:36 (U160)
	21:43	21:09	20:13	10 19:47 (U159)	19:13	36 08:12 (U160)
11	06:04	06:39	07:19	19:38 (U159)	07:59	17:35 (U160)
	21:43	21:08	20:11	8 19:46 (U159)	19:11	39 08:14 (U160)
12	06:05	06:40	07:21	19:40 (U159)	08:01	17:33 (U160)
	21:42	21:06	20:09	3 19:43 (U159)	19:09	41 08:14 (U160)
13	06:05	06:42	07:22	19:42 (U159)	08:02	17:31 (U160)
	21:42	21:05	20:07	19:07	43 18:14 (U160)	17:16
14	06:06	06:43	07:23	19:43 (U159)	08:03	17:31 (U160)
	21:41	21:03	20:05	19:06	44 18:15 (U160)	17:15
15	06:07	06:44	07:25	19:45 (U159)	08:05	17:30 (U160)
	21:40	21:01	20:03	19:04	45 18:15 (U160)	17:14
16	06:08	06:45	07:26	19:46 (U159)	08:06	17:29 (U160)
	21:39	21:00	20:01	19:02	47 18:16 (U160)	17:13
17	06:09	06:47	07:27	19:47 (U159)	08:08	17:28 (U160)
	21:39	20:58	19:59	19:00	47 18:15 (U160)	17:12
18	06:10	06:48	07:28	19:48 (U159)	08:09	17:28 (U160)
	21:38	20:56	19:57	18:56	48 18:16 (U160)	17:11
19	06:11	06:49	07:30	19:49 (U159)	08:11	17:27 (U160)
	21:37	20:55	19:55	12 08:39 (S139)	18:54	48 18:15 (U160)
20	06:12	06:51	07:31	19:50 (U159)	08:12	17:28 (U160)
	21:36	20:53	19:53	17 08:41 (S139)	18:53	48 18:16 (U160)
21	06:14	06:52	07:32	19:54 (U159)	08:13	17:27 (U160)
	21:35	20:51	19:51	21 08:42 (S139)	18:51	48 18:15 (U160)
22	06:15	06:53	07:34	19:55 (U159)	08:15	17:27 (U160)
	21:34	20:49	19:49	24 08:44 (S139)	18:49	48 18:15 (U160)
23	06:16	06:55	07:35	19:56 (U159)	08:16	17:27 (U160)
	21:33	20:47	19:47	27 08:45 (S139)	18:47	48 18:15 (U160)
24	06:17	06:56	07:36	19:57 (U159)	08:18	17:27 (U160)
	21:32	20:46	19:45	28 08:45 (S139)	18:46	48 18:15 (U160)
25	06:18	06:57	07:38	19:58 (U159)	08:19	17:27 (U160)
	21:31	20:44	5 07:39 (S141)	19:43	30 08:46 (S139)	18:44
26	06:19	06:58	07:32 (S141)	07:39	08:15 (S139)	08:21
	21:30	20:42	11 07:43 (S141)	19:41	31 08:46 (S139)	18:42
27	06:20	07:00	07:29 (S141)	07:40	08:14 (S139)	08:22
	21:29	20:40	15 07:44 (S141)	19:39	31 08:45 (S139)	18:41
28	06:22	07:01	07:28 (S141)	07:42	08:14 (S139)	08:24
	21:28	20:38	16 07:44 (S141)	19:37	32 08:46 (S139)	18:39
29	06:23	07:02	07:27 (S141)	07:43	08:14 (S139)	08:25
	21:26	20:36	27 19:55 (U159)	19:35	31 08:45 (S139)	18:37
30	06:24	07:04	07:27 (S141)	07:44	08:13 (S139)	08:27
	21:25	20:34	33 19:58 (U159)	19:33	31 08:44 (S139)	18:36
31	06:25	07:05	07:28 (S141)	07:45	08:28	17:31 (U160)
	21:24	20:33	35 19:59 (U159)	19:34	38 18:09 (U160)	17:08
Potential sun hours	480	441	378	338	282	266
Total, worst case		142	562	1280	422	
Sun reduction		0.73	0.69	0.52	0.43	
Oper. time red.		0.99	0.99	0.99	0.99	
Wind dir. red.		0.68	0.72	0.61	0.69	
Total reduction		0.48	0.48	0.31	0.29	
Total, real		68	272	398	122	

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		

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR018 - SR018

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Minimum sun height over horizon for influence	3 °	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Day step for calculation	1 days	4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Time step for calculation	1 minutes	Operational time
		N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
		514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
		Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:56	05:57	06:27	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:00
3	08:34	08:11	07:25	07:24	06:30	05:56	05:57	06:29	07:09	07:48	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:36	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:28	17:00
5	08:34	08:08	07:22	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:36	08:17
	17:13	17:56	18:37	20:20	21:02	21:37	21:46	21:17	20:23	19:23	17:27	16:59
6	08:33	08:07	07:20	07:19	06:26	05:54	05:59	06:32	07:13	07:52	07:37	08:18
	17:14	17:57	18:38	20:22	21:03	21:38	21:46	21:16	20:21	19:21	17:25	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:53	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:00	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:57	07:42	08:21
	17:17	18:00	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:18	05:53	06:03	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:45	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:58
12	08:31	07:58	08:08	07:07	06:17	05:52	06:04	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:43	21:06	20:09	19:09	17:17	16:59
13	08:31	07:57	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:25
	17:22	18:07	19:48	20:32	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:14	05:52	06:06	06:43	07:23	08:04	07:49	08:26
	17:24	18:08	19:50	20:33	21:13	21:44	21:41	21:03	20:05	19:05	17:15	16:59
15	08:30	07:54	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:27
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
	17:26	18:11	19:53	20:36	21:16	21:45	21:40	21:00	20:01	19:02	17:13	16:59
17	08:29	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	16:59
18	08:28	07:49	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:55	08:29
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:08	05:52	06:11	06:49	07:30	08:11	07:56	08:29
	17:30	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:51	07:31	08:12	07:58	08:30
	17:32	18:17	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:52	07:32	08:14	07:59	08:31
	17:33	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:05	05:53	06:14	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:47	21:34	20:49	19:49	18:49	17:07	17:01
23	08:24	07:40	07:46	06:47	06:04	05:53	06:16	06:54	07:35	08:16	08:02	08:32
	17:36	18:22	20:02	20:45	21:24	21:47	21:33	20:48	19:47	18:47	17:06	17:02
24	08:23	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:23	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:02
25	08:22	07:36	07:42	06:43	06:02	05:53	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:27	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:40	06:42	06:01	05:54	06:19	06:58	07:39	08:21	08:06	08:33
	17:41	18:26	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:20	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:03	17:04
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:42	08:24	08:08	08:33
	17:44	18:29	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:05
29	08:17	07:34	07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:10	08:33
	17:45	18:31	20:11	20:53	21:31	21:47	21:27	20:36	19:35	18:37	17:02	17:06
30	08:16	07:32	07:32	06:35	05:58	05:56	06:24	07:04	07:44	08:27	08:11	08:34
	17:47	18:33	20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:01	17:07
31	08:15	07:30	07:30	06:33	05:58	05:58	06:25	07:05	07:46	08:29	08:13	08:34
	17:48	18:35	20:14	20:57	21:33	21:48	21:24	20:33	19:31	18:34	17:02	17:08
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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

Project:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR019 - SR019

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns (January to December) and multiple rows showing sunrise and sunset times (hh:mm) for each day. Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

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

Project: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR020 - SR020

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns (January to December) and multiple rows showing sunrise/sunset times, potential sun hours, and reduction factors for each day of the year.

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

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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR021 - SR021

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:29	08:12
2	17:09	17:50	18:31	20:15	20:56	21:33	21:47	21:22	20:31	19:31	17:33	17:01
3	08:34	08:12	07:27	07:26	06:32	05:56	05:57	06:27	07:07	07:47	07:31	08:13
4	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:00
5	08:34	08:11	07:25	07:24	06:30	05:56	05:57	06:29	07:09	07:48	07:32	08:14
6	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
7	08:34	08:10	07:23	07:22	06:28	05:55	05:58	06:30	07:10	07:50	07:34	08:16
8	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
9	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:17
10	17:13	17:56	18:37	20:20	21:01	21:37	21:46	21:17	20:23	19:23	17:27	16:59
11	08:33	08:07	07:19	07:18	06:25	05:54	05:59	06:32	07:13	07:52	07:37	08:18
12	17:14	17:57	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
13	08:33	08:05	07:18	07:16	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
14	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
15	08:33	08:04	08:16	07:15	06:23	05:53	06:01	06:35	07:15	07:55	07:40	08:20
16	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:22	16:59
17	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
18	17:17	18:00	19:42	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
19	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:37	07:18	07:58	07:43	08:22
20	17:18	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:58
21	08:32	08:00	08:10	07:09	06:18	05:53	06:03	06:39	07:19	07:59	07:44	08:23
22	17:20	18:03	19:45	20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:19	16:58
23	08:31	07:58	08:08	07:07	06:17	05:52	06:04	06:40	07:20	08:01	07:46	08:24
24	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:17	16:58
25	08:31	07:57	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:25
26	17:22	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
27	08:30	07:55	08:04	07:03	06:14	05:52	06:06	06:43	07:23	08:03	07:49	08:25
28	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
29	08:30	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
30	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:03	17:14	16:59
31	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
32	17:26	18:11	19:52	20:35	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
33	08:28	07:50	07:58	06:57	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
34	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	16:59
35	08:28	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
36	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
37	08:27	07:47	07:54	06:54	06:08	05:52	06:11	06:49	07:30	08:10	07:56	08:29
38	17:30	18:16	19:57	20:40	21:19	21:45	21:37	20:54	19:55	18:54	17:10	17:00
39	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:12	07:57	08:30
40	17:32	18:17	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:00
41	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:52	07:32	08:13	07:59	08:30
42	17:33	18:19	19:59	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
43	08:24	07:41	07:48	06:48	06:05	05:53	06:14	06:53	07:34	08:15	08:00	08:31
44	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
45	08:23	07:40	07:46	06:47	06:04	05:53	06:15	06:54	07:35	08:16	08:01	08:31
46	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
47	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
48	17:38	18:23	20:04	20:46	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:02
49	08:21	07:36	07:42	06:43	06:02	05:53	06:18	06:57	07:37	08:19	08:04	08:32
50	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:04	17:03
51	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:39	08:21	08:06	08:32
52	17:40	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
53	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
54	17:42	18:28	20:08	20:51	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:04
55	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:41	08:24	08:08	08:33
56	17:43	18:29	20:09	20:52	21:30	21:47	21:27	20:38	19:37	18:39	17:02	17:05
57	08:17		07:34	06:36	05:59	05:55	06:22	07:02	07:43	08:25	08:09	08:33
58	17:45		20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:37	17:02	17:06
59	08:16		07:32	06:35	05:58	05:56	06:24	07:03	07:44	08:26	08:11	08:33
60	17:47		20:12	20:55	21:32	21:47	21:25	20:34	19:33	18:36	17:01	17:07
61	08:15		07:30		05:58		06:25	07:05		08:28		08:34
62	17:48		20:13		21:33		21:24	20:32		18:34		17:08
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR022 - SR022

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Minimum sun height over horizon for influence	3 °		4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69					
Day step for calculation	1 days	Operational time																	
Time step for calculation	1 minutes		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
			514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June	
1	08:33	15:43 (S148)	08:13	07:29	18:33 (S146)	06:33	
	17:09	36 16:19 (S148)	17:50	18:31	20:15	42 19:15 (S146)	
2	08:33	15:44 (S148)	08:12	07:27	18:33 (S146)	06:32	
	17:10	36 16:20 (S148)	17:51	18:32	20:16	41 19:14 (S146)	
3	08:33	15:44 (S148)	08:11	07:25	18:34 (S146)	06:30	
	17:11	36 16:20 (S148)	17:53	18:34	20:17	39 19:13 (S146)	
4	08:33	15:44 (S148)	08:09	07:23	18:35 (S146)	06:29	
	17:12	36 16:20 (S148)	17:54	18:35	20:19	36 19:11 (S146)	
5	08:33	15:45 (S148)	08:08	07:21	18:36 (S146)	06:27	
	17:13	35 16:20 (S148)	17:56	18:37	20:20	34 19:10 (S146)	
6	08:33	15:46 (S148)	08:07	07:19	18:37 (S146)	06:26	
	17:14	35 16:21 (S148)	17:57	18:38	20:22	31 19:08 (S146)	
7	08:33	15:46 (S148)	08:05	07:17	18:39 (S146)	06:24	
	17:15	34 16:20 (S148)	17:59	18:40	20:23	27 19:06 (S146)	
8	08:33	15:47 (S148)	08:04	08:16	18:42 (S146)	06:23	
	17:16	34 16:21 (S148)	18:00	18:41	20:24	22 19:04 (S146)	
9	08:32	15:48 (S148)	08:02	08:14	18:45 (S146)	06:21	
	17:17	34 16:22 (S148)	18:00	19:42	20:26	16 19:01 (S146)	
10	08:32	15:48 (S148)	08:01	08:12	18:45 (S146)	06:20	
	17:19	33 16:21 (S148)	18:02	19:44	20:27	12 19:00 (S146)	
11	08:31	15:49 (S148)	07:59	08:10	18:56 (S146)	07:09	
	17:20	33 16:22 (S148)	18:04	19:45	8 19:04 (S146)	20:28	
12	08:31	15:49 (S148)	07:58	08:08	18:50 (S146)	07:07	
	17:21	33 16:22 (S148)	18:05	19:47	19 19:09 (S146)	20:30	
13	08:31	15:51 (S148)	07:56	08:06	18:47 (S146)	07:05	
	17:22	31 16:22 (S148)	18:07	19:48	25 19:12 (S146)	20:31	
14	08:30	15:51 (S148)	07:55	08:04	18:44 (S146)	07:03	
	17:24	31 16:22 (S148)	18:08	19:50	30 19:14 (S146)	20:33	
15	08:29	15:52 (S148)	07:53	08:02	18:42 (S146)	07:01	
	17:25	29 16:21 (S148)	18:10	19:51	33 19:15 (S146)	20:34	
16	08:29	15:52 (S148)	07:52	08:00	18:41 (S146)	06:59	
	17:26	29 16:21 (S148)	18:11	19:52	35 19:16 (S146)	20:35	
17	08:28	15:54 (S148)	07:50	07:58	18:39 (S146)	06:57	
	17:28	27 16:21 (S148)	18:13	19:54	38 19:17 (S146)	20:37	
18	08:27	15:55 (S148)	07:48	07:56	18:38 (S146)	06:56	
	17:29	26 16:21 (S148)	18:14	19:55	40 19:18 (S146)	20:38	
19	08:27	15:56 (S148)	07:47	07:54	18:37 (S146)	06:54	
	17:30	24 16:20 (S148)	18:16	19:57	42 19:19 (S146)	20:39	
20	08:26	15:58 (S148)	07:45	07:52	18:36 (S146)	06:52	
	17:32	21 16:19 (S148)	18:17	19:58	43 19:19 (S146)	20:41	
21	08:25	15:59 (S148)	07:43	07:50	18:35 (S146)	06:50	
	17:33	19 16:18 (S148)	18:19	19:59	44 19:19 (S146)	20:42	
22	08:24	16:02 (S148)	07:41	07:48	18:34 (S146)	06:48	
	17:35	14 16:16 (S148)	18:20	20:01	46 19:20 (S146)	20:44	
23	08:23	16:05 (S148)	07:40	07:46	18:33 (S146)	06:47	
	17:36	9 16:14 (S148)	18:22	20:02	47 19:20 (S146)	20:45	
24	08:22		07:38	07:44	18:33 (S146)	06:45	
	17:38		18:23	20:04	47 19:20 (S146)	20:46	
25	08:21		07:36	07:42	18:32 (S146)	06:43	
	17:39		18:25	20:05	47 19:19 (S146)	20:48	
26	08:20		07:34	07:40	18:32 (S146)	06:42	
	17:41		18:26	20:06	47 19:19 (S146)	20:49	
27	08:19		07:32	07:38	18:32 (S146)	06:40	
	17:42		18:28	20:08	47 19:19 (S146)	20:50	
28	08:18		07:31	07:36	18:32 (S146)	06:38	
	17:44		18:29	20:09	46 19:18 (S146)	20:52	
29	08:17		07:34	07:34	18:32 (S146)	06:36	
	17:45		20:11	20:11	46 19:18 (S146)	20:53	
30	08:16		07:32	07:32	18:32 (S146)	06:35	
	17:47		20:12	20:12	45 19:17 (S146)	20:54	
31	08:15		07:30	07:30	18:32 (S146)	06:33	
	17:48		20:13	20:13	44 19:16 (S146)	20:54	
Potential sun hours	279	287	368	407	466	474	
Total, worst case	675			819	288	175	829
Sun reduction	0.55			0.63	0.59	0.68	0.71
Oper. time red.	0.99			0.99	0.99	0.99	0.99
Wind dir. red.	0.53			0.65	0.65	0.76	0.76
Total reduction	0.28			0.39	0.37	0.50	0.52
Total, real	186			323	107	87	429

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)

<p>Project: ALLETE Wind</p> <p>ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802</p>	<p>Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.</p>	<p>Printed/Page: 4/16/2012 2:31 PM / 34</p> <p>Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490</p>
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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR022 - SR022

Assumptions for shadow calculations

Maximum distance for influence	1,500 m	Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Minimum sun height over horizon for influence	3 °	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Day step for calculation	1 days	4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Time step for calculation	1 minutes	Operational time
		N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
		514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	July	August	September	October	November	December
1	05:56	20:46 (S145)	06:26	07:06	18:28 (S146)	07:29
2	21:46	28 21:14 (S145)	21:22	20:30	21 18:49 (S146)	17:33
3	05:57	20:46 (S145)	06:29	07:09	13 18:45 (S146)	17:31
4	21:46	27 21:14 (S145)	21:21	20:29		17:31
5	05:59	20:47 (S145)	06:31	07:11		17:31
6	21:45	28 21:15 (S145)	21:17	20:23		17:27
7	06:00	20:47 (S145)	06:32	07:13		17:25
8	21:45	27 21:14 (S145)	21:15	20:21		17:25
9	06:01	20:48 (S145)	06:34	07:14		17:24
10	21:44	27 21:15 (S145)	21:14	20:19		17:24
11	06:02	20:48 (S145)	06:36	07:15		17:22
12	21:44	26 21:15 (S145)	21:11	20:15		17:22
13	06:03	20:48 (S145)	06:38	07:18		17:21
14	21:43	26 21:14 (S145)	21:09	20:13		17:21
15	06:04	20:49 (S145)	06:39	07:19		17:20
16	21:43	25 21:14 (S145)	21:08	20:11		17:20
17	06:04	20:49 (S145)	06:40	07:20		17:19
18	21:42	24 21:13 (S145)	21:06	20:09		17:19
19	06:05	20:50 (S145)	06:41	07:22		17:18
20	21:41	23 21:13 (S145)	21:04	20:07		17:18
21	06:06	20:51 (S145)	06:43	07:23		17:17
22	21:41	21 21:12 (S145)	21:03	20:05		17:17
23	06:07	20:51 (S145)	06:44	07:24		17:16
24	21:40	21 21:12 (S145)	21:01	20:03		17:16
25	06:08	20:52 (S145)	06:45	07:26		17:15
26	21:39	19 21:11 (S145)	21:00	20:01		17:15
27	06:09	20:53 (S145)	06:47	07:27		17:15
28	21:38	17 21:10 (S145)	20:58	19:59		17:14
29	06:10	20:53 (S145)	06:48	07:28		17:14
30	21:38	17 21:10 (S145)	20:56	19:57		17:13
31	06:11	20:54 (S145)	06:49	07:30		17:13
1	21:37	15 21:09 (S145)	20:54	19:55		17:11
2	06:12	20:56 (S145)	06:50	07:31		17:11
3	21:36	12 21:08 (S145)	20:53	19:53		17:10
4	06:13	20:57 (S145)	06:52	07:32		17:10
5	21:35	10 21:07 (S145)	20:51	19:51		17:09
6	06:14	20:59 (S145)	06:53	07:33		17:09
7	21:34	7 21:06 (S145)	20:49	19:49		17:08
8	06:16	20:54 (S145)	06:54	07:35		17:08
9	21:33	20:47	19:47	18:20 (S146)		17:07
10	06:17	06:56	07:36	18:20 (S146)		17:06
11	21:32	20:45	19:45	18:20 (S146)		17:06
12	06:18	06:57	07:37	18:20 (S146)		17:05
13	21:31	20:44	19:43	18:21 (S146)		17:05
14	06:19	06:58	07:39	18:21 (S146)		17:05
15	21:30	20:42	19:41	18:22 (S146)		17:05
16	06:20	07:00	07:40	18:22 (S146)		17:04
17	21:29	20:40	19:39	18:22 (S146)		17:04
18	06:21	07:01	07:41	18:22 (S146)		17:03
19	21:27	20:38	19:37	18:22 (S146)		17:03
20	06:23	07:02	07:43	18:24 (S146)		17:03
21	21:26	20:36	19:35	18:25 (S146)		17:02
22	06:24	07:03	07:44	18:26 (S146)		17:02
23	21:25	20:34	19:33	18:26 (S146)		17:01
24	06:25	07:05		18:27 (S146)		17:01
25	21:24	20:32		18:28 (S146)		17:00
26	Potential sun hours	480	441	378	338	282
27	Total, worst case	483		1086	34	293
28	Sun reduction	0.76		0.69	0.52	0.43
29	Oper. time red.	0.99		0.99	0.99	0.99
30	Wind dir. red.	0.76		0.65	0.65	0.53
31	Total reduction	0.55		0.43	0.33	0.22
32	Total, real	267		470	11	63
33						240

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

Project:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR023 - SR023

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns (January to December) and 33 rows of shadow data including sunrise/sunset times, potential sun hours, and reduction factors.

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

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR024 - SR024

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:46	21:22	20:30	19:31	17:33	17:01
2	08:33	08:12	07:27	07:26	06:32	05:56	05:57	06:27	07:07	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:28	19:29	17:31	17:01
3	08:33	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:17	20:58	21:35	21:46	21:19	20:27	19:27	17:30	17:00
4	08:33	08:09	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:49	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:16
	17:13	17:56	18:37	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:27	16:59
6	08:33	08:07	07:19	07:18	06:26	05:54	06:00	06:32	07:13	07:52	07:37	08:17
	17:14	17:57	18:38	20:22	21:02	21:37	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:17	07:16	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:18
	17:15	17:59	18:40	20:23	21:04	21:38	21:44	21:14	20:19	19:19	17:24	16:59
8	08:32	08:04	08:15	07:14	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:02	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
	17:17	18:00	19:42	20:26	21:06	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:42	08:22
	17:19	18:02	19:44	20:27	21:08	21:40	21:43	21:09	20:13	19:13	17:20	16:59
11	08:31	07:59	08:10	07:09	06:18	05:53	06:04	06:39	07:19	07:59	07:44	08:22
	17:20	18:04	19:45	20:28	21:09	21:41	21:42	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:04	06:40	07:20	08:00	07:45	08:23
	17:21	18:05	19:47	20:30	21:10	21:42	21:42	21:06	20:09	19:09	17:17	16:59
13	08:30	07:56	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:24
	17:22	18:07	19:48	20:31	21:12	21:42	21:41	21:04	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:03	07:48	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:43	21:40	21:01	20:03	19:03	17:14	16:59
16	08:29	07:51	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:51	08:27
	17:26	18:11	19:52	20:35	21:15	21:44	21:39	20:59	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:57	06:11	05:52	06:09	06:47	07:27	08:07	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:38	20:58	19:59	19:00	17:12	16:59
18	08:27	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:37	20:56	19:57	18:56	17:11	17:00
19	08:26	07:46	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:10	07:56	08:29
	17:30	18:16	19:57	20:39	21:19	21:45	21:37	20:54	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:12	07:57	08:29
	17:32	18:17	19:58	20:41	21:20	21:45	21:36	20:52	19:53	18:53	17:09	17:00
21	08:25	07:43	07:50	06:50	06:06	05:53	06:13	06:52	07:32	08:13	07:58	08:30
	17:33	18:19	19:59	20:42	21:21	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:48	06:05	05:53	06:15	06:53	07:33	08:15	08:00	08:30
	17:35	18:20	20:01	20:43	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:54	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:17	08:03	08:31
	17:38	18:23	20:04	20:46	21:25	21:46	21:32	20:45	19:45	18:46	17:05	17:03
25	08:21	07:36	07:42	06:43	06:02	05:54	06:18	06:57	07:37	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:46	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:20	08:05	08:32
	17:41	18:26	20:06	20:49	21:27	21:46	21:29	20:42	19:41	18:42	17:04	17:04
27	08:19	07:32	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:32
	17:42	18:28	20:08	20:50	21:28	21:46	21:28	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:41	08:23	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:46	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45		20:10	20:53	21:30	21:46	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:58	05:56	06:24	07:03	07:44	08:26	08:10	08:33
	17:47		20:12	20:54	21:31	21:46	21:25	20:34	19:33	18:36	17:01	17:07
31	08:14		07:30		05:58		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:23	20:32		18:34		17:08
Potential sun hours	279	288	368	407	466	474	480	441	378	339	282	267
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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:
ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:
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US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor:** SR025 - SR025

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:12
	17:09	17:49	18:31	20:15	20:56	21:33	21:46	21:22	20:30	19:30	17:32	17:01
2	08:33	08:12	07:27	07:26	06:31	05:56	05:57	06:27	07:07	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:28	19:28	17:31	17:00
3	08:33	08:11	07:25	07:24	06:30	05:56	05:57	06:28	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:17	20:58	21:35	21:46	21:19	20:26	19:27	17:29	17:00
4	08:33	08:09	07:23	07:22	06:28	05:55	05:58	06:30	07:10	07:49	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:16
	17:13	17:56	18:36	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:26	16:59
6	08:33	08:07	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:37	08:17
	17:14	17:57	18:38	20:21	21:02	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:17	07:16	06:24	05:54	06:00	06:34	07:14	07:53	07:38	08:19
	17:15	17:59	18:39	20:23	21:04	21:38	21:45	21:14	20:19	19:19	17:24	16:59
8	08:32	08:04	08:15	07:14	06:22	05:53	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:22	16:59
9	08:32	08:02	08:14	07:12	06:21	05:53	06:02	06:36	07:16	07:56	07:41	08:21
	17:17	18:00	19:42	20:26	21:06	21:40	21:44	21:11	20:15	19:15	17:21	16:58
10	08:32	08:01	08:12	07:10	06:20	05:53	06:02	06:37	07:18	07:58	07:43	08:22
	17:18	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:58
11	08:31	07:59	08:10	07:09	06:18	05:52	06:03	06:39	07:19	07:59	07:44	08:23
	17:20	18:03	19:45	20:28	21:09	21:41	21:43	21:08	20:11	19:11	17:18	16:58
12	08:31	07:58	08:08	07:07	06:17	05:52	06:04	06:40	07:20	08:00	07:45	08:23
	17:21	18:05	19:47	20:30	21:10	21:42	21:42	21:06	20:09	19:09	17:17	16:58
13	08:30	07:56	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:24
	17:22	18:06	19:48	20:31	21:12	21:42	21:41	21:04	20:07	19:07	17:16	16:58
14	08:30	07:55	08:04	07:03	06:14	05:52	06:06	06:42	07:23	08:03	07:48	08:25
	17:23	18:08	19:49	20:32	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:09	19:51	20:34	21:14	21:43	21:40	21:01	20:03	19:03	17:14	16:59
16	08:29	07:51	08:00	06:59	06:12	05:52	06:08	06:45	07:25	08:06	07:51	08:27
	17:26	18:11	19:52	20:35	21:15	21:44	21:39	20:59	20:01	19:01	17:13	16:59
17	08:28	07:50	07:58	06:57	06:11	05:52	06:09	06:46	07:27	08:07	07:53	08:28
	17:27	18:13	19:54	20:37	21:17	21:44	21:38	20:58	19:59	19:00	17:12	16:59
18	08:27	07:48	07:56	06:55	06:09	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:10	16:59
19	08:27	07:46	07:54	06:54	06:08	05:52	06:11	06:49	07:29	08:10	07:56	08:29
	17:30	18:16	19:57	20:39	21:19	21:45	21:37	20:54	19:55	18:54	17:09	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:12	07:57	08:29
	17:32	18:17	19:58	20:41	21:20	21:45	21:36	20:53	19:53	18:52	17:09	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:52	07:32	08:13	07:58	08:30
	17:33	18:19	19:59	20:42	21:21	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:15	08:00	08:31
	17:35	18:20	20:01	20:43	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
23	08:23	07:40	07:46	06:47	06:04	05:53	06:15	06:54	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:16	06:56	07:36	08:17	08:03	08:31
	17:37	18:23	20:03	20:46	21:25	21:46	21:32	20:45	19:45	18:45	17:05	17:02
25	08:21	07:36	07:42	06:43	06:02	05:53	06:18	06:57	07:37	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:46	21:31	20:44	19:43	18:44	17:04	17:03
26	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:39	08:20	08:05	08:32
	17:40	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:40	18:42	17:04	17:04
27	08:19	07:32	07:38	06:40	06:00	05:54	06:20	06:59	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:50	21:28	21:47	21:28	20:40	19:38	18:40	17:03	17:04
28	08:18	07:30	07:36	06:38	06:00	05:55	06:21	07:01	07:41	08:23	08:08	08:33
	17:43	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:36	18:39	17:02	17:05
29	08:17		07:34	06:36	05:59	05:55	06:22	07:02	07:43	08:25	08:09	08:33
	17:45		20:10	20:53	21:30	21:47	21:26	20:36	19:34	18:37	17:02	17:06
30	08:16		07:32	06:35	05:58	05:56	06:24	07:03	07:44	08:26	08:10	08:33
	17:46		20:12	20:54	21:31	21:46	21:25	20:34	19:32	18:36	17:01	17:07
31	08:14		07:30		05:57		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:23	20:32		18:34		17:07
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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:
ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:
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3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR026 - SR026**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:12
	17:09	17:49	18:31	20:15	20:56	21:33	21:46	21:22	20:30	19:30	17:32	17:01
2	08:33	08:12	07:27	07:26	06:31	05:56	05:57	06:27	07:07	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:28	19:28	17:31	17:00
3	08:33	08:11	07:25	07:24	06:30	05:56	05:57	06:28	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:17	20:58	21:35	21:46	21:19	20:26	19:26	17:29	17:00
4	08:33	08:09	07:23	07:22	06:28	05:55	05:58	06:30	07:10	07:49	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:16
	17:13	17:56	18:36	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:26	16:59
6	08:33	08:07	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:37	08:17
	17:14	17:57	18:38	20:21	21:02	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:17	07:16	06:24	05:54	06:00	06:34	07:14	07:53	07:38	08:19
	17:15	17:59	18:39	20:23	21:04	21:38	21:45	21:14	20:19	19:19	17:24	16:59
8	08:32	08:04	08:15	07:14	06:22	05:53	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:22	16:59
9	08:32	08:02	08:13	07:12	06:21	05:53	06:02	06:36	07:16	07:56	07:41	08:21
	17:17	18:00	19:42	20:26	21:06	21:40	21:44	21:11	20:15	19:15	17:21	16:58
10	08:32	08:01	08:12	07:10	06:20	05:53	06:02	06:37	07:18	07:58	07:43	08:22
	17:18	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:58
11	08:31	07:59	08:10	07:09	06:18	05:52	06:03	06:39	07:19	07:59	07:44	08:23
	17:20	18:03	19:45	20:28	21:09	21:41	21:43	21:08	20:11	19:11	17:18	16:58
12	08:31	07:58	08:08	07:07	06:17	05:52	06:04	06:40	07:20	08:00	07:45	08:23
	17:21	18:05	19:47	20:30	21:10	21:42	21:42	21:06	20:09	19:09	17:17	16:58
13	08:30	07:56	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:24
	17:22	18:06	19:48	20:31	21:12	21:42	21:41	21:04	20:07	19:07	17:16	16:58
14	08:30	07:55	08:04	07:03	06:14	05:52	06:06	06:42	07:23	08:03	07:48	08:25
	17:23	18:08	19:49	20:32	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:09	19:51	20:34	21:14	21:43	21:40	21:01	20:03	19:03	17:14	16:59
16	08:29	07:51	08:00	06:59	06:12	05:52	06:08	06:45	07:25	08:06	07:51	08:27
	17:26	18:11	19:52	20:35	21:15	21:44	21:39	20:59	20:01	19:01	17:13	16:59
17	08:28	07:50	07:58	06:57	06:11	05:52	06:09	06:46	07:27	08:07	07:53	08:27
	17:27	18:13	19:54	20:37	21:17	21:44	21:38	20:58	19:59	19:00	17:12	16:59
18	08:27	07:48	07:56	06:55	06:09	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:10	16:59
19	08:27	07:46	07:54	06:54	06:08	05:52	06:11	06:49	07:29	08:10	07:56	08:29
	17:30	18:16	19:56	20:39	21:19	21:45	21:37	20:54	19:55	18:54	17:09	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:12	07:57	08:29
	17:32	18:17	19:58	20:41	21:20	21:45	21:36	20:52	19:53	18:52	17:09	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:52	07:32	08:13	07:58	08:30
	17:33	18:19	19:59	20:42	21:21	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:15	08:00	08:31
	17:35	18:20	20:01	20:43	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
23	08:23	07:40	07:46	06:47	06:04	05:53	06:15	06:54	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:55	07:36	08:17	08:03	08:31
	17:37	18:23	20:03	20:46	21:25	21:46	21:32	20:45	19:45	18:45	17:05	17:02
25	08:21	07:36	07:42	06:43	06:02	05:53	06:18	06:57	07:37	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:46	21:31	20:43	19:43	18:44	17:04	17:03
26	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:39	08:20	08:05	08:32
	17:40	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:40	18:42	17:04	17:04
27	08:19	07:32	07:38	06:40	06:00	05:54	06:20	06:59	07:40	08:22	08:07	08:32
	17:42	18:28	20:08	20:50	21:28	21:47	21:28	20:40	19:38	18:40	17:03	17:04
28	08:18	07:30	07:36	06:38	06:00	05:55	06:21	07:01	07:41	08:23	08:08	08:33
	17:43	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:36	18:39	17:02	17:05
29	08:17		07:34	06:36	05:59	05:55	06:22	07:02	07:43	08:25	08:09	08:33
	17:45		20:10	20:53	21:30	21:47	21:26	20:36	19:34	18:37	17:02	17:06
30	08:16		07:32	06:35	05:58	05:56	06:24	07:03	07:44	08:26	08:10	08:33
	17:46		20:12	20:54	21:31	21:46	21:25	20:34	19:32	18:36	17:01	17:07
31	08:14		07:30		05:57		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:23	20:32		18:34		17:07
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **Shadow receptor: SR027 - SR027**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June		
1	08:34	09:15 (S135)	08:14	07:29	07:56 (S136)	07:28	06:33	05:57
	17:09	26 09:41 (S135)	17:50	18:31	25 08:21 (S136)	20:15	20:56	21:34
2	08:34	09:15 (S135)	08:12	07:27	07:54 (S136)	07:26	06:32	05:56
	17:10	27 09:42 (S135)	17:51	18:32	27 08:21 (S136)	20:16	20:58	21:35
3	08:34	09:16 (S135)	08:11	07:25	07:53 (S136)	07:24	06:30	05:56
	17:11	26 09:42 (S135)	17:53	18:34	29 08:22 (S136)	20:18	20:59	21:36
4	08:34	09:17 (S135)	08:10	07:23	07:52 (S136)	07:22	06:29	05:55
	17:12	26 09:43 (S135)	17:54	18:35	30 08:22 (S136)	20:19	21:00	21:36
5	08:34	09:17 (S135)	08:08	07:22	07:51 (S136)	07:21	06:27	05:55
	17:13	26 09:43 (S135)	17:56	18:37	32 08:23 (S136)	20:21	21:02	21:37
6	08:33	09:17 (S135)	08:07	07:20	07:51 (S136)	07:19	06:26	05:54
	17:14	26 09:43 (S135)	17:57	18:38	32 08:23 (S136)	20:22	21:03	21:38
7	08:33	09:18 (S135)	08:06	07:18	07:50 (S136)	07:17	06:24	05:54
	17:15	26 09:44 (S135)	17:59	18:40	32 08:22 (S136)	20:23	21:04	21:39
8	08:33	09:19 (S135)	08:04	08:16	08:50 (S136)	07:15	06:23	05:54
	17:16	25 09:44 (S135)	18:01	18:41	32 09:22 (S136)	20:25	21:06	21:40
9	08:33	09:19 (S135)	08:03	08:14	08:50 (S136)	07:13	06:21	05:53
	17:17	25 09:44 (S135)	18:01	19:43	32 09:22 (S136)	20:26	21:07	21:40
10	08:32	09:21 (S135)	08:01	08:12	08:50 (S136)	07:11	06:20	05:53
	17:19	23 09:44 (S135)	18:02	19:44	31 09:21 (S136)	20:27	21:08	21:41
11	08:32	09:21 (S135)	08:00	08:10	08:50 (S136)	07:09	06:19	05:53
	17:20	23 09:44 (S135)	18:04	19:46	30 09:20 (S136)	20:29	21:10	21:42
12	08:31	09:22 (S135)	07:58	08:08	08:51 (S136)	07:07	06:17	05:53
	17:21	22 09:44 (S135)	18:05	19:47	28 09:19 (S136)	20:30	21:11	21:42
13	08:31	09:23 (S135)	07:57	08:06	08:51 (S136)	07:05	06:16	05:52
	17:22	21 09:44 (S135)	18:07	19:48	27 09:18 (S136)	20:32	21:12	21:43
14	08:30	09:23 (S135)	07:55	08:04	08:52 (S136)	07:03	06:15	05:52
	17:24	20 09:43 (S135)	18:08	19:50	24 09:16 (S136)	20:33	21:13	21:43
15	08:30	09:25 (S135)	07:54	08:02	08:53 (S136)	07:01	06:13	05:52
	17:25	18 09:43 (S135)	18:10	19:51	21 09:14 (S136)	20:34	21:15	21:44
16	08:29	09:26 (S135)	07:52	08:00	08:55 (S136)	07:00	06:12	05:52
	17:26	16 09:42 (S135)	18:11	19:53	17 09:12 (S136)	20:36	21:16	21:44
17	08:28	09:28 (S135)	07:50	07:58	08:58 (S136)	06:58	06:11	05:52
	17:28	13 09:41 (S135)	18:13	19:54	11 09:09 (S136)	20:37	21:17	21:45
18	08:28	09:30 (S135)	07:49	07:56	06:56	06:10	05:52	
	17:29	9 09:39 (S135)	18:14	19:55	20:38	21:18	21:45	
19	08:27	09:34 (S135)	07:47	07:54	06:54	06:09	05:52	
	17:31	2 09:35 (S135)	18:16	19:57	20:40	21:20	21:46	
20	08:26	07:45	07:52	07:52	06:52	06:07	05:52	
	17:32	18:17	19:58	20:41	21:21	21:46		
21	08:25	07:43	07:50	06:50	06:06	05:53		
	17:33	18:19	20:00	20:43	21:22	21:46		
22	08:24	07:42	07:48	06:49	06:05	05:53		
	17:35	18:20	20:01	20:44	21:23	21:47		
23	08:24	07:40	07:46	06:47	06:04	05:53		
	17:36	18:22	20:02	20:45	21:24	21:47		
24	08:23	07:38	07:44	06:45	06:03	05:53		
	17:38	18:23	20:04	20:47	21:25	21:47		
25	08:22	07:36	08:08 (S136)	07:42	06:43	06:02	05:54	
	17:39	18:25	2 08:09 (S136)	20:05	20:48	21:27	21:47	
26	08:21	07:35	08:01 (S136)	07:40	06:42	06:02	05:54	
	17:41	18:26	14 08:15 (S136)	20:07	20:49	21:28	21:47	
27	08:20	07:33	07:58 (S136)	07:38	06:40	06:01	05:54	
	17:42	18:28	19 08:17 (S136)	20:08	20:51	21:29	21:47	
28	08:18	07:31	07:57 (S136)	07:36	06:38	06:00	05:55	
	17:44	18:29	23 08:20 (S136)	20:09	20:52	21:30	21:47	
29	08:17	07:34	07:34	07:34	06:37	05:59	05:55	
	17:45	20:11	20:53	21:31	21:31	21:47		
30	08:16	07:32	07:32	06:35	05:58	05:56		
	17:47	20:12	20:55	21:32	21:32	21:47		
31	08:15	07:30	07:30	05:58	05:58			
	17:48	20:14	21:33					
Potential sun hours	279	287	368	407	466	475		
Total, worst case	400	58	460					
Sun reduction	0.55	0.50	0.63					
Oper. time red.	0.99	0.99	0.99					
Wind dir. red.	0.75	0.74	0.74					
Total reduction	0.40	0.37	0.46					
Total, real	162	21	212					

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 wind@eapc.net
Calculated:
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SHADOW - Calendar

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout Shadow receptor: SR027 - SR027

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	July	August	September	October	November	December
1	05:56	06:26	07:06	07:46	08:31 (S136)	07:30
	21:47	21:23	20:31	19:31	27 08:58 (S136)	17:33
2	05:57	06:28	07:08	07:47	08:29 (S136)	07:31
	21:47	21:21	20:29	19:29	30 08:59 (S136)	17:31
3	05:58	06:29	07:09	07:48	08:28 (S136)	07:33
	21:46	21:20	20:27	19:27	31 08:59 (S136)	17:30
4	05:58	06:30	07:10	07:50	08:28 (S136)	07:34
	21:46	21:19	20:25	19:25	31 08:59 (S136)	17:28
5	05:59	06:31	07:12	07:51	08:27 (S136)	07:36
	21:46	21:17	20:23	19:23	32 08:59 (S136)	17:27
6	06:00	06:33	07:13	07:53	08:27 (S136)	07:37
	21:45	21:16	20:21	19:21	32 08:59 (S136)	17:25
7	06:00	06:34	07:14	07:54	08:27 (S136)	07:39
	21:45	21:14	20:19	19:19	31 08:58 (S136)	17:24
8	06:01	06:35	07:15	07:55	08:26 (S136)	07:40
	21:45	21:13	20:17	19:17	32 08:58 (S136)	17:23
9	06:02	06:36	07:17	07:57	08:27 (S136)	07:42
	21:44	21:11	20:15	19:15	31 08:58 (S136)	17:21
10	06:03	06:38	07:18	07:58	08:27 (S136)	07:43
	21:44	21:10	20:13	19:13	29 08:56 (S136)	17:20
11	06:04	06:39	07:19	07:59	08:28 (S136)	07:44
	21:43	21:08	20:11	19:11	28 08:56 (S136)	17:19
12	06:04	06:40	07:21	08:01	08:28 (S136)	07:46
	21:43	21:06	20:09	19:09	26 08:54 (S136)	17:17
13	06:05	06:42	07:22	08:02	08:29 (S136)	07:47
	21:42	21:05	20:07	19:07	24 08:53 (S136)	17:16
14	06:06	06:43	07:23	08:04	08:30 (S136)	07:49
	21:41	21:03	20:05	19:06	21 08:51 (S136)	17:15
15	06:07	06:44	07:25	08:05	08:33 (S136)	07:50
	21:40	21:02	20:03	19:04	17 08:50 (S136)	17:14
16	06:08	06:45	07:26	08:06	08:35 (S136)	07:52
	21:40	21:00	20:01	19:02	11 08:46 (S136)	17:13
17	06:09	06:47	07:27	08:08	07:53	08:28
	21:39	20:58	19:59	19:00	17:12	16:59
18	06:10	06:48	07:28	08:09	07:55	08:29
	21:38	20:56	19:57	18:56	17:11	17:00
19	06:11	06:49	07:30	08:11	07:56	08:29
	21:37	20:55	19:55	18:55	17:10	17:00
20	06:12	06:51	07:31	08:12	07:58	08:30
	21:36	20:53	19:53	18:53	17:09	17:00
21	06:13	06:52	07:32	08:14	07:59	08:31
	21:35	20:51	19:51	18:51	17:08	17:01
22	06:15	06:53	07:34	08:15	08:00	08:31
	21:34	20:49	19:49	18:49	17:07	17:01
23	06:16	06:55	07:35	08:16	08:02	08:32
	21:33	20:48	19:47	18:47	17:06	17:02
24	06:17	06:56	07:36	08:18	08:03	09:08 (S136)
	21:32	20:46	19:45	18:46	17:05	9 09:17 (S136)
25	06:18	06:57	07:38	08:19	08:04	09:06 (S136)
	21:31	20:44	19:43	18:44	17:05	13 09:19 (S136)
26	06:19	06:58	07:39	08:42 (S136)	08:06	09:04 (S136)
	21:30	20:42	19:41	7 08:49 (S136)	17:04	16 09:20 (S136)
27	06:20	07:00	07:40	08:38 (S136)	08:07	09:04 (S136)
	21:29	20:40	19:39	15 08:53 (S136)	17:03	18 09:22 (S136)
28	06:21	07:01	07:42	08:36 (S136)	08:08	09:04 (S136)
	21:28	20:38	19:37	19 08:55 (S136)	17:03	19 09:23 (S136)
29	06:23	07:02	07:43	08:33 (S136)	08:10	09:04 (S136)
	21:26	20:36	19:35	23 08:56 (S136)	17:02	21 09:25 (S136)
30	06:24	07:04	07:44	08:31 (S136)	08:11	09:03 (S136)
	21:25	20:35	19:33	26 08:57 (S136)	17:02	22 09:25 (S136)
31	06:25	07:05		08:28		08:34
	21:24	20:33		18:34		17:08
Potential sun hours	480	441	378	338	282	266
Total, worst case			90	433	118	816
Sun reduction			0.69	0.52	0.43	0.43
Oper. time red.			0.99	0.99	0.99	0.99
Wind dir. red.			0.74	0.74	0.75	0.75
Total reduction			0.51	0.38	0.32	0.32
Total, real			45	166	37	259

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:

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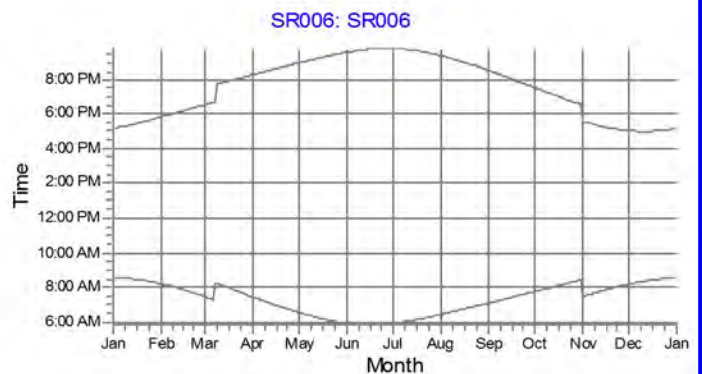
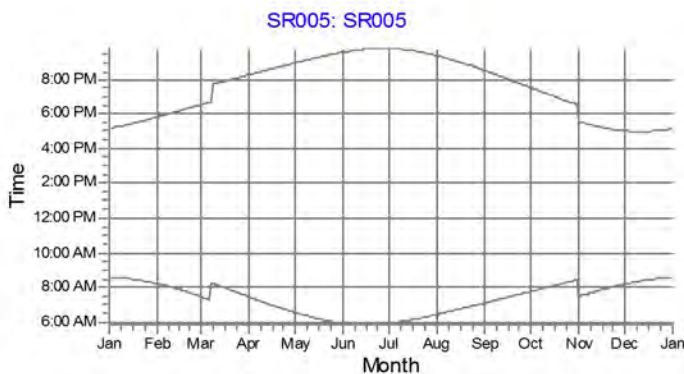
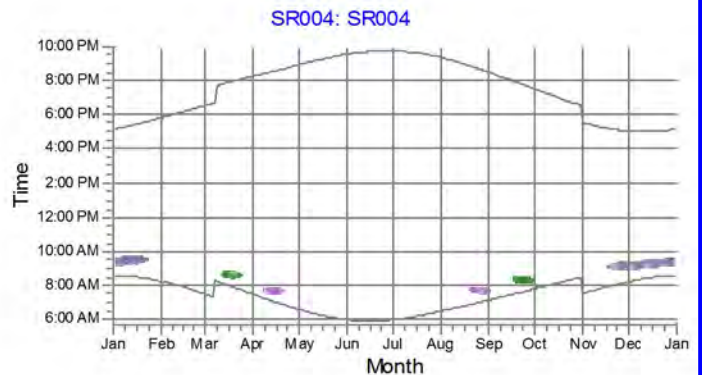
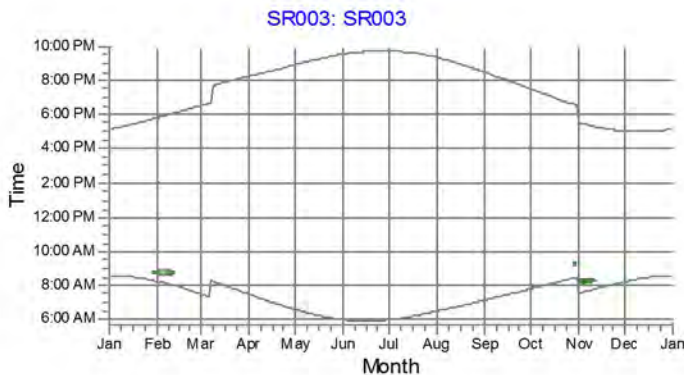
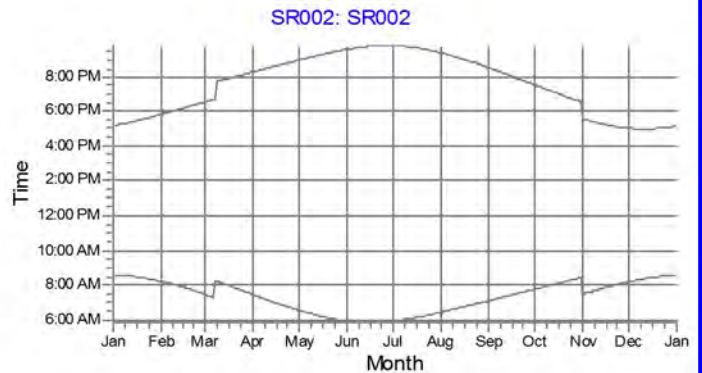
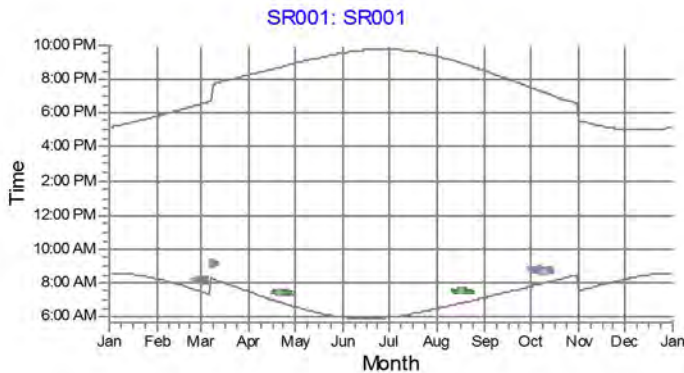
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SHADOW - Calendar, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



WTGs

■ S102: S102 ■ U163: U163 ■ U164: U164

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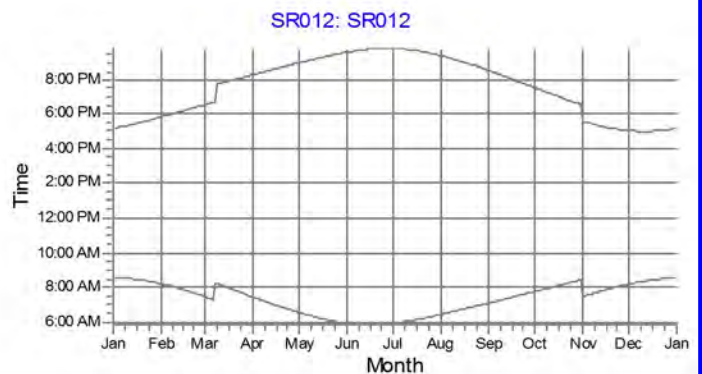
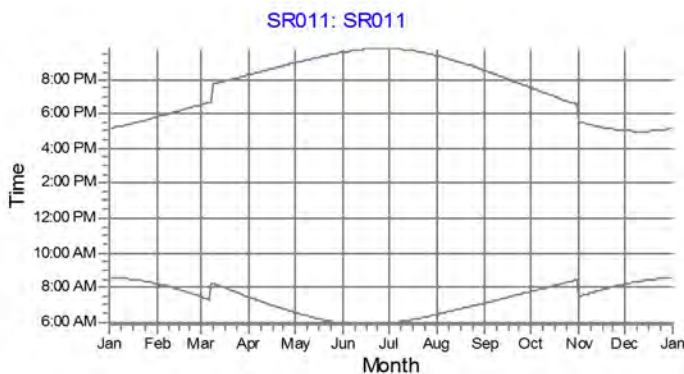
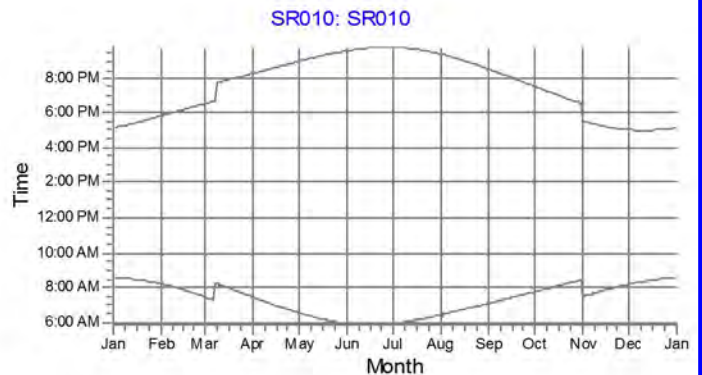
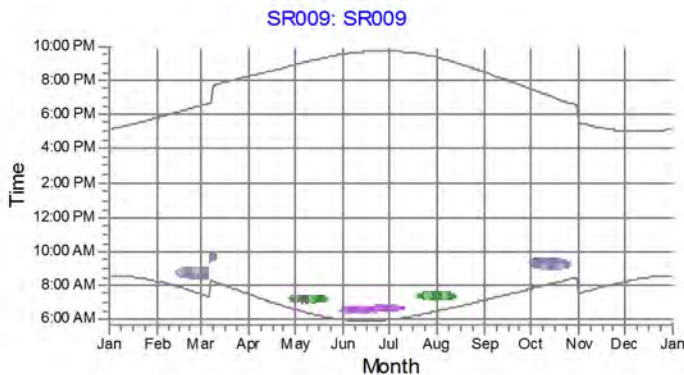
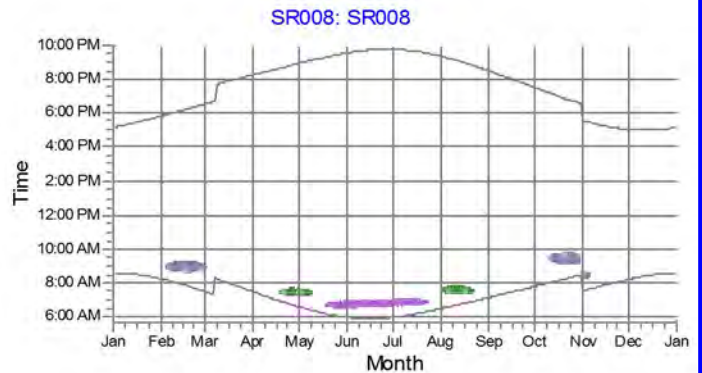
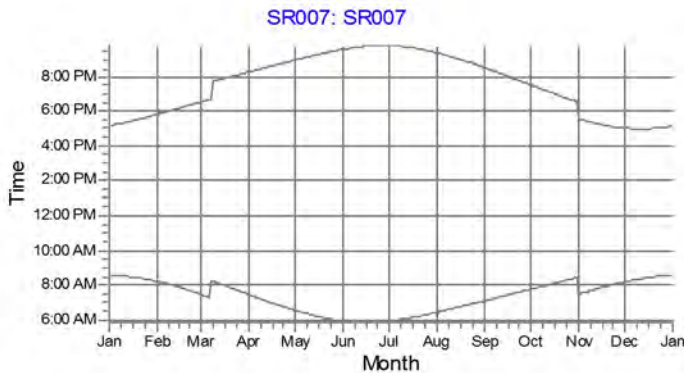
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SHADOW - Calendar, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



WTGs

■ S102: S102 ■ U163: U163 ■ U164: U164

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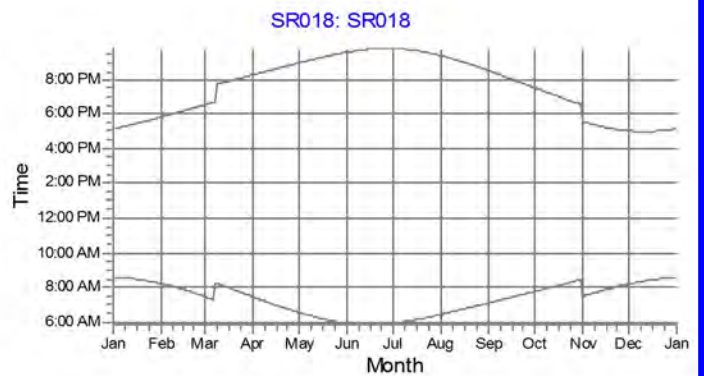
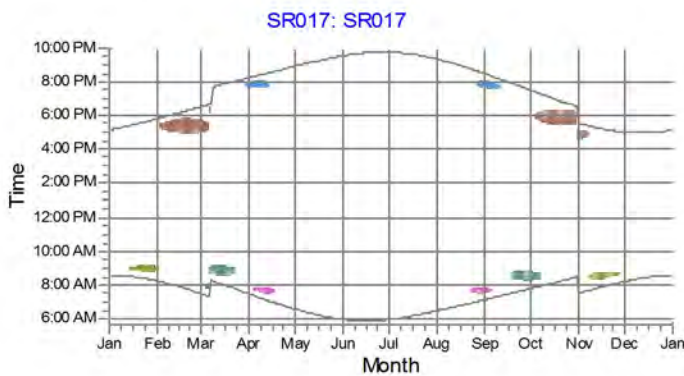
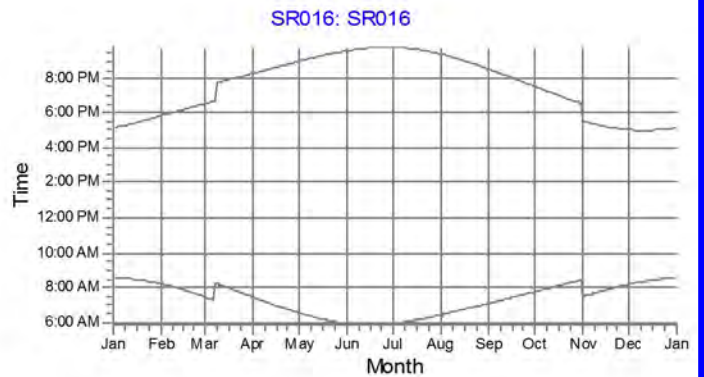
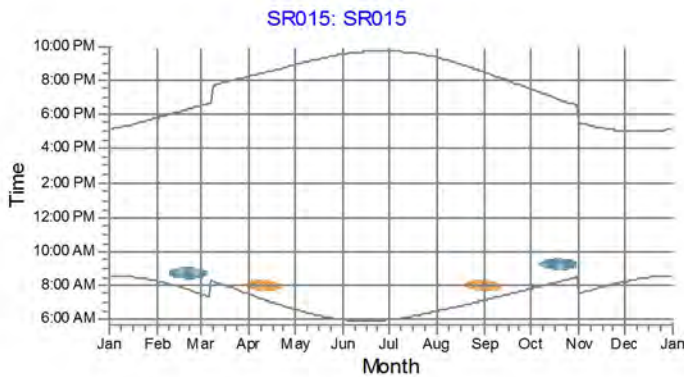
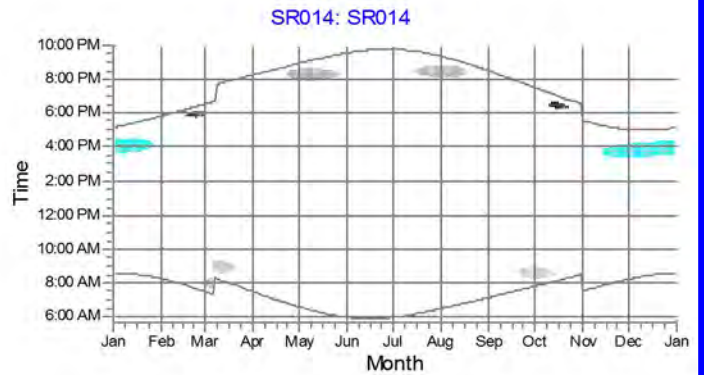
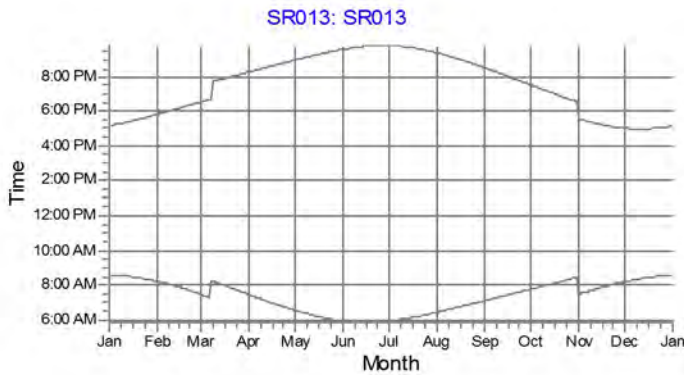
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



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SHADOW - Calendar, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



WTGs

- | | | | | | |
|--|--|--|--|---|--|
|  S116: S116 |  S120: S120 |  S125: S125 |  S132: S132 |  S141: S141 |  U160: U160 |
|  S118: S118 |  S121: S121 |  S131: S131 |  S139: S139 |  U159: U159 | |

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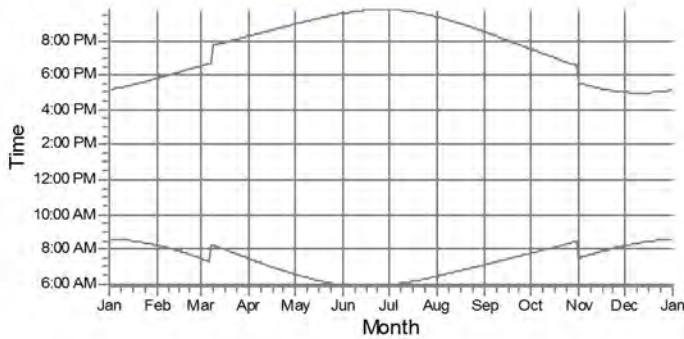
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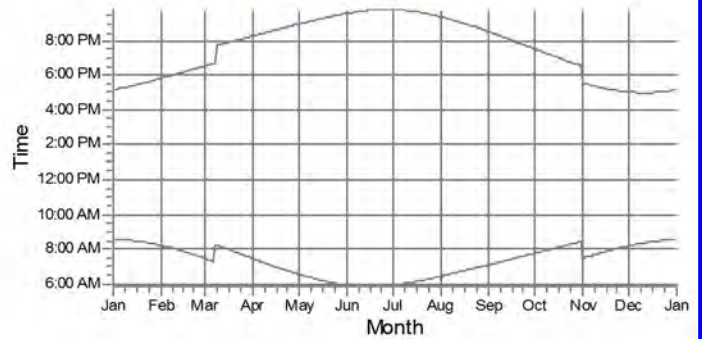
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Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

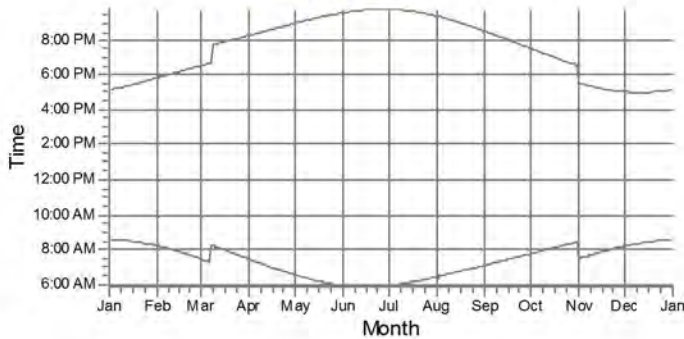
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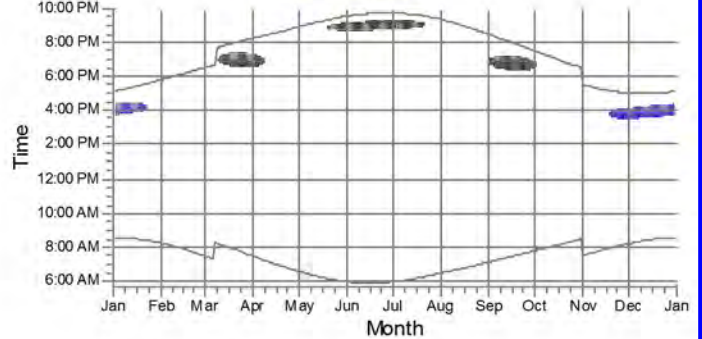
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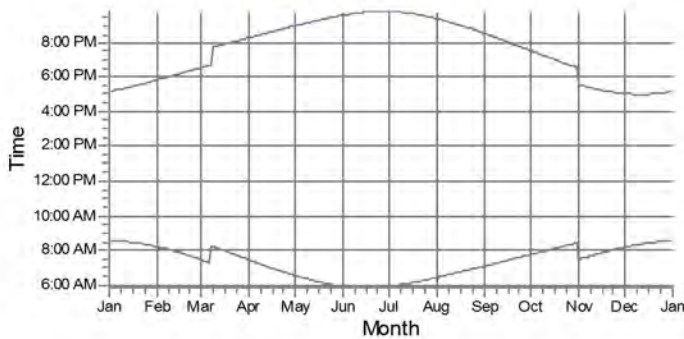
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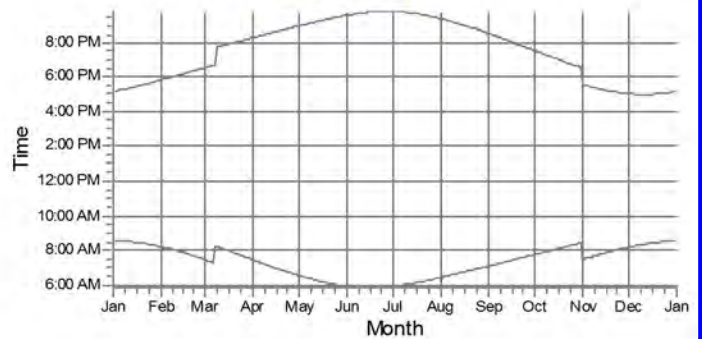
SR022: SR022



SR023: SR023



SR024: SR024



WTGs

■ S145: S145 ■ S146: S146 ■ S148: S148

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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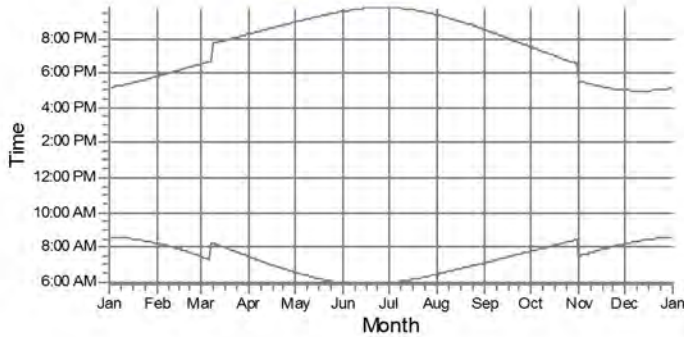
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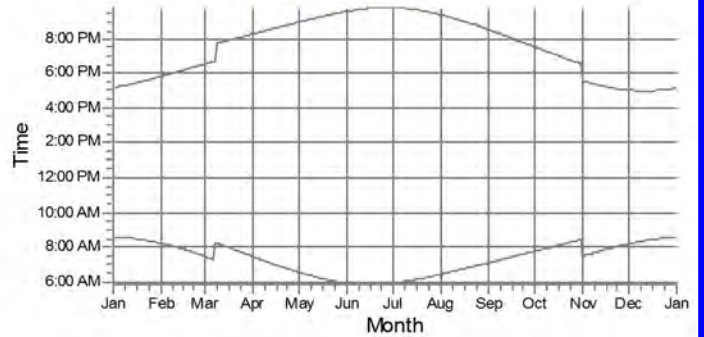
SHADOW - Calendar, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout

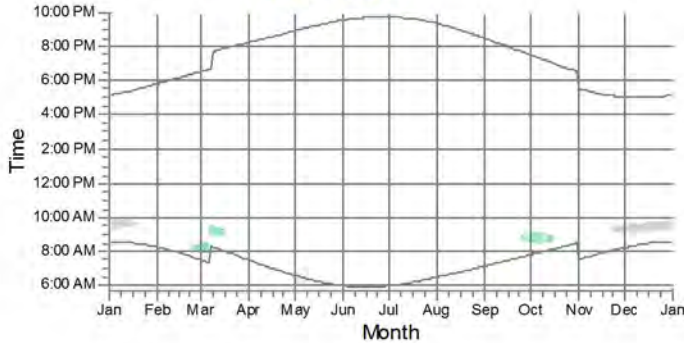
SR025: SR025



SR026: SR026



SR027: SR027



WTGs

S135: S135 S136: S136

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S102 - S102**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June
1	08:34 17:09	08:14 08:37-08:48/11 17:50	07:29 18:31	07:29 20:15	06:34 07:01-07:20/19 20:56 07:19-07:36/17	05:57 21:34
2	08:34 17:10	08:12 08:36-08:50/14 17:52	07:27 18:33	07:27 20:16	06:32 06:59-07:20/21 20:58 07:20-07:35/15	05:57 21:35
3	08:34 17:11	08:11 08:34-08:50/16 17:53	07:25 18:34	07:25 20:18	06:31 06:58-07:21/23 20:59 07:21-07:35/14	05:56 21:35
4	08:34 17:12	08:10 08:33-08:50/17 17:55	07:24 18:36	07:23 20:19	06:29 06:57-07:21/24 21:00 07:21-07:34/13	05:56 21:36
5	08:34 17:13	08:08 08:31-08:50/19 17:56	07:22 18:37	07:21 20:21	06:27 06:57-07:22/25 21:02 07:22-07:33/11	05:55 21:37
6	08:33 17:14	08:07 08:31-08:51/20 17:58	07:20 18:38	07:19 20:22	06:26 06:55-07:22/27 21:03 07:22-07:32/10	05:55 21:38
7	08:33 17:16	08:06 08:32-08:51/19 17:59	07:18 18:40	07:17 20:23	06:24 06:55-07:23/28 21:04 07:23-07:31/8	05:54 21:39
8	08:33 17:17	08:04 08:32-08:50/18 18:01	07:15 18:41	07:15 20:25	06:23 06:56-07:23/27 21:06 07:23-07:30/7	05:54 21:40
9	08:33 17:18	08:03 08:32-08:50/18 18:01	07:13 19:43	07:13 20:26	06:22 06:55-07:23/28 21:07 07:23-07:28/5	05:54 21:40
10	08:32 17:19	08:01 08:33-08:49/16 18:02	07:11 19:44	07:11 20:27	06:20 06:55-07:23/28 21:08 07:23-07:26/3	05:53 21:41
11	08:32 17:20	08:00 08:34-08:48/14 18:04	07:09 19:46	07:09 20:29	06:19 06:55-07:22/27 21:09	05:53 21:42
12	08:31 17:22	07:58 08:36-08:47/11 18:05	07:07 19:47	07:07 20:30	06:18 06:56-07:22/26 21:11	05:53 21:42
13	08:31 17:23	07:57 08:40-08:42/2 18:07	07:05 08:29-08:40/11 19:49	07:05 20:32	06:16 06:55-07:21/26 21:12	05:53 21:43
14	08:30 17:24	07:55 18:09	07:03 08:27-08:42/15 19:50	07:03 20:33	06:15 06:55-07:21/26 21:13	05:53 21:43
15	08:30 17:25	07:54 18:10	07:02 08:25-08:43/18 19:51	07:02 20:34	06:14 06:56-07:21/25 21:15	05:53 21:44
16	08:29 17:27	07:52 18:12	07:00 08:24-08:44/20 19:53	07:00 20:36	06:12 06:57-07:20/23 21:16	05:53 21:44
17	08:28 17:28	07:50 18:13	06:58 08:23-08:44/21 19:54	06:58 07:19-07:25/6 20:37	06:11 06:57-07:20/23 21:17	05:53 21:45
18	08:28 17:29	07:49 18:15	06:56 08:22-08:44/22 19:56	06:56 07:17-07:27/10 20:38	06:10 06:58-07:19/21 21:18	05:53 21:45
19	08:27 17:31	07:47 18:16	06:54 08:22-08:44/22 19:57	06:54 07:16-07:29/13 20:40	06:09 06:59-07:19/20 21:19	05:53 21:46
20	08:26 17:32	07:45 18:18	06:52 08:21-08:43/22 19:58	06:52 07:14-07:29/15 20:41 07:29-07:30/1	06:08 07:00-07:18/18 21:21	05:53 21:46
21	08:25 17:34	07:43 18:19	06:50 08:21-08:43/22 20:00	06:51 07:12-07:31/19 20:43	06:07 07:01-07:17/16 21:22	05:53 21:46
22	08:24 17:35	07:42 18:21	06:48 08:22-08:42/20 20:01	06:49 07:11-07:32/21 20:44	06:06 07:02-07:15/13 21:23	05:53 21:46
23	08:24 17:37	07:40 18:22	06:46 08:22-08:41/19 20:03	06:47 07:11-07:34/23 20:45	06:05 07:04-07:14/10 21:24	05:53 21:47
24	08:23 17:38	07:38 18:24	06:44 08:23-08:39/16 20:04	06:45 07:10-07:35/25 20:47	06:04 07:07-07:10/3 21:25	05:54 21:47
25	08:22 17:40	07:36 18:25	06:42 08:25-08:37/12 20:05	06:44 07:10-07:35/25 20:48	06:03 21:26	05:54 21:47
26	08:21 17:41	07:35 18:27	06:40 08:29-08:32/3 20:07	06:42 07:11-07:36/25 20:49	06:02 21:27	05:54 21:47
27	08:19 17:43	07:33 18:28	06:38 20:08	06:40 07:10-07:36/26 20:51	06:01 21:29	05:55 21:47
28	08:18 17:44	07:31 18:30	06:36 20:10	06:39 07:10-07:36/26 20:52	06:00 21:30	05:55 21:47
29	08:17 08:41-08:43/2 17:46	 17:46	06:35 20:11	06:37 07:06-07:16/10 20:53 07:15-07:36/21	06:00 21:31	05:56 21:47
30	08:16 08:40-08:46/6 17:47	 17:47	06:33 20:12	06:35 07:02-07:18/16 20:55 07:17-07:35/18	05:59 21:32	05:56 21:47
31	08:15 08:38-08:47/9 17:49	 17:49	06:31 20:14	 20:55	05:58 21:33	 21:47
Potential sun hours	279	287	368	407	466	474
Sum of minutes with flicker	17	195	243	299	629	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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 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S102 - S102**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	July	August	September	October	November	December
1	05:57	06:27 07:05-07:32/27	07:07	07:46 08:10-08:17/7	07:30 08:03-08:19/16	08:12
	21:47	21:23	20:31	19:31	17:33	17:01
2	05:57	06:28 07:06-07:34/28	07:08	07:47	07:31 08:02-08:19/17	08:13
	21:46	21:21 07:34-07:35/1	20:29	19:29	17:31	17:01
3	05:58	06:29 07:05-07:34/29	07:09	07:49	07:33 08:02-08:20/18	08:14
	21:46	21:20 07:34-07:38/4	20:27	19:27	17:30	17:01
4	05:59	06:30 07:05-07:33/28	07:10	07:50	07:34 08:01-08:20/19	08:16
	21:46	21:18 07:33-07:39/6	20:25	19:25	17:29	17:00
5	05:59	06:32 07:05-07:33/28	07:12	07:51	07:36 08:01-08:21/20	08:17
	21:46	21:17 07:33-07:40/7	20:23	19:23	17:27	17:00
6	06:00	06:33 07:05-07:32/27	07:13	07:53	07:37 08:02-08:21/19	08:18
	21:45	21:16 07:32-07:41/9	20:21	19:21	17:26	17:00
7	06:01	06:34 07:06-07:33/27	07:14	07:54	07:39 08:03-08:20/17	08:19
	21:45	21:14 07:33-07:43/10	20:19	19:19	17:24	16:59
8	06:01	06:35 07:06-07:32/26	07:16	07:55	07:40 08:05-08:20/15	08:20
	21:45	21:13 07:32-07:43/11	20:17	19:17	17:23	16:59
9	06:02	06:37 07:07-07:31/24	07:17	07:57	07:41 08:06-08:19/13	08:21
	21:44	21:11 07:31-07:43/12	20:15	19:15	17:22	16:59
10	06:03	06:38 07:07-07:30/23	07:18	07:58	07:43 08:08-08:19/11	08:22
	21:44	21:10 07:30-07:44/14	20:13	19:13	17:20	16:59
11	06:04	06:39 07:08-07:28/20	07:20	07:59	07:44 08:10-08:19/9	08:23
	21:43	21:08 07:28-07:43/15	20:11	19:11	17:19	16:59
12	06:05	06:41 07:10-07:28/18	07:21	08:01	07:46 08:11-08:17/6	08:24
	21:42	21:06 07:27-07:44/17	20:09	19:10	17:18	16:59
13	06:06	06:42 07:12-07:26/14	07:22	08:02	07:47 08:13-08:15/2	08:25
	21:42	21:05 07:25-07:44/19	20:07	19:08	17:17	16:59
14	06:07	06:43 07:15-07:22/7	07:23	08:04	07:49	08:26
	21:41	21:03 07:21-07:44/23	20:05	19:06	17:15	16:59
15	06:08	06:44 07:17-07:43/26	07:25	08:05	07:50	08:26
	21:40	21:02	20:03	19:04	17:14	16:59
16	06:09	06:46 07:18-07:43/25	07:26	08:06	07:52	08:27
	21:40	21:00	20:01	19:02	17:13	17:00
17	06:10	06:47 07:17-07:42/25	07:27	08:08	07:53	08:28
	21:39	20:58	19:59	19:00	17:12	17:00
18	06:11	06:48 07:17-07:41/24	07:29 08:13-08:23/10	08:09	07:55	08:29
	21:38	20:56	19:57	18:57	17:11	17:00
19	06:12	06:50 07:16-07:40/24	07:30 08:10-08:25/15	08:11	07:56	08:29
	21:37	20:55	19:55	18:55	17:10	17:00
20	06:13 07:15-07:22/7	06:51 07:17-07:40/23	07:31 08:08-08:26/18	08:12	07:57	08:30
	21:36	20:53	19:53	18:53	17:09	17:01
21	06:14 07:13-07:24/11	06:52 07:16-07:38/22	07:33 08:07-08:27/20	08:14	07:59	08:30
	21:35	20:51	19:51	18:51	17:08	17:01
22	06:15 07:11-07:26/15	06:53 07:17-07:35/18	07:34 08:06-08:27/21	08:15	08:00	08:31
	21:34	20:49	19:49	18:49	17:07	17:02
23	06:16 07:10-07:27/17	06:55 07:18-07:32/14	07:35 08:05-08:27/22	08:16	08:02	08:31
	21:33	20:48 07:32-07:34/2	19:47	18:48	17:07	17:02
24	06:17 07:09-07:28/19	06:56 07:20-07:33/13	07:37 08:05-08:27/22	08:18	08:03	08:32
	21:32	20:46	19:45	18:46	17:06	17:03
25	06:18 07:08-07:29/21	06:57 07:21-07:31/10	07:38 08:05-08:27/22	08:19	08:04	08:32
	21:31	20:44	19:43	18:44	17:05	17:04
26	06:19 07:08-07:30/22	06:59 07:22-07:27/5	07:39 08:04-08:26/22	08:21	08:06	08:33
	21:30	20:42	19:41	18:43	17:04	17:04
27	06:21 07:08-07:31/23	07:00	07:40 08:05-08:25/20	08:22	08:07	08:33
	21:29	20:40	19:39	18:41	17:04	17:05
28	06:22 07:07-07:31/24	07:01	07:42 08:05-08:24/19	08:24	08:08	08:33
	21:28	20:38	19:37	18:39	17:03	17:06
29	06:23 07:06-07:32/26	07:03	07:43 08:06-08:22/16	08:25 09:08-09:13/5	08:10	08:33
	21:26	20:37	19:35	18:38	17:02	17:06
30	06:24 07:06-07:32/26	07:04	07:44 08:08-08:21/13	08:27 09:06-09:17/11	08:11	08:33
	21:25	20:35	19:33	18:36	17:02	17:07
31	06:25 07:05-07:32/27	07:05		08:28 09:04-09:18/14		08:34
	21:24	20:33		18:35		17:08
Potential sun hours	480	441	378	338	282	267
Sum of minutes with flicker	238	703	240	37	182	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: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S104 - S104

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and multiple rows for each day, showing sun rise and set times in hh:mm format. Includes summary rows for Potential sun hours and Sum of minutes with flicker.

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: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S105 - S105**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:57	05:57	06:27	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:58	21:35	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:25	06:30	05:56	05:58	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:23	06:29	05:56	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:06	21:39	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:22	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:48	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:30	07:55	08:04	07:03	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:02	06:14	05:52	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:09	06:46	07:26	08:06	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:52	06:11	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:51	06:07	05:53	06:14	06:52	07:32	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:36	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:06	17:02
24	08:23	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:55	06:21	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17		07:34	06:37	05:59	05:56	06:23	07:03	07:43	08:25	08:10	08:33
	17:45		20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:38	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:33
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:34
	17:48		20:14		21:33		21:24	20:33		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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Licensed user:

EAPC Wind Energy
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
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wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S106 - S106

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability data.

Operational time

Table with 17 columns (N to Sum) and 2 rows of operational time data.

Main shadow calculation table with columns for months (January-December) and rows for each day of the year (1-31), showing sunrise and sunset times.

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

Matrix layout table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, Minutes with flicker.

Project:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S111 - S111

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for minutes of the day (0 to 1440). It shows sunrise and sunset times for each minute, along with potential sun hours and minutes with flicker at the bottom.

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 wind@eapc.net
Calculated:
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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG:** S112 - S112

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:46	21:22	20:31	19:31	17:33	17:01
2	08:33	08:12	07:27	07:26	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:33	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:33	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:16
	17:13	17:56	18:37	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:19	07:19	06:26	05:55	06:00	06:33	07:13	07:52	07:37	08:18
	17:14	17:57	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:38	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:31	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:45	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:10	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:56	08:06	07:05	06:16	05:52	06:05	06:42	07:22	08:02	07:47	08:24
	17:23	18:07	19:48	20:31	21:12	21:43	21:41	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:03	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:51	08:27
	17:26	18:11	19:53	20:35	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:44	21:39	20:58	19:59	19:00	17:12	17:00
18	08:27	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:10	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:54	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:52	06:12	06:51	07:31	08:12	07:57	08:30
	17:32	18:17	19:58	20:41	21:20	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:06	05:53	06:14	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:49	06:05	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:55	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:04	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:23	20:04	20:46	21:25	21:46	21:32	20:46	19:45	18:46	17:05	17:03
25	08:21	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:05	08:32
	17:41	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:50	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:23	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45		20:11	20:53	21:30	21:47	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:26	08:11	08:33
	17:47		20:12	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:24	20:32		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	267
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

<p>Project: ALLETE Wind</p> <p>ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802</p>	<p>Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.</p>	<p>Printed/Page 4/16/2012 2:31 PM / 53</p> <p>Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490</p>
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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S113 - S113

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33 17:09	08:13 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:33	05:56 21:46	06:26 21:22	07:06 20:31	07:46 19:31	07:29 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:57	05:57 21:34	05:57 21:46	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:33 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:32 17:30	08:14 17:00
4	08:33 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:15 17:00
5	08:33 17:13	08:08 17:56	07:21 18:37	07:20 20:20	06:27 21:01	05:55 21:37	05:59 21:45	06:31 21:17	07:11 20:23	07:51 19:23	07:35 17:27	08:17 17:00
6	08:33 17:14	08:07 17:57	07:19 18:38	07:18 20:22	06:26 21:03	05:54 21:38	06:00 21:45	06:33 21:15	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:05 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:24	08:16 21:05	08:16 21:39	06:01 21:44	06:35 21:12	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:32 17:18	08:03 18:01	08:14 18:43	08:14 20:26	08:14 21:07	08:14 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:56 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 18:44	08:12 20:27	08:12 21:08	08:12 21:41	06:03 21:43	06:38 21:09	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 18:45	08:10 20:29	08:10 21:09	08:10 21:41	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 18:47	08:07 20:30	08:07 21:11	08:07 21:42	06:05 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:18	08:24 16:59
13	08:31 17:22	07:56 18:07	08:06 18:48	08:05 20:31	08:05 21:12	08:05 21:43	06:05 21:41	06:42 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:24 16:59
14	08:30 17:24	07:55 18:08	08:04 18:50	08:03 20:33	08:03 21:13	08:03 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:03 19:05	07:49 17:15	08:25 16:59
15	08:29 17:25	07:53 18:10	08:02 18:51	08:02 20:34	08:02 21:14	08:02 21:44	06:07 21:40	06:44 21:01	07:24 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 18:53	08:00 20:35	08:00 21:16	08:00 21:44	06:08 21:39	06:45 21:00	07:26 20:01	08:06 19:02	07:51 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 18:54	07:58 20:37	07:58 21:17	07:58 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:27 17:29	07:48 18:14	07:56 18:55	07:56 20:38	07:56 21:18	07:56 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:54 17:11	08:28 17:00
19	08:27 17:31	07:47 18:16	07:54 18:57	07:54 20:40	07:54 21:19	07:54 21:45	06:11 21:37	06:49 20:54	07:30 19:55	08:10 18:54	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 18:58	07:52 20:41	07:52 21:20	07:52 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:33	07:43 18:19	07:50 20:00	07:50 20:42	07:50 21:22	07:50 21:46	06:14 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:41 18:20	07:48 20:01	07:48 20:44	07:48 21:23	07:48 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:02
23	08:23 17:36	07:40 18:22	07:46 20:02	07:46 20:45	07:46 21:24	07:46 21:46	06:16 21:33	06:54 20:47	07:35 19:47	08:16 18:47	08:01 17:06	08:31 17:02
24	08:22 17:38	07:38 18:23	07:44 20:04	07:44 20:46	07:44 21:25	07:44 21:46	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:03
25	08:21 17:39	07:36 18:25	07:42 20:05	07:42 20:48	07:42 21:26	07:42 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:20 17:41	07:34 18:26	07:40 20:07	07:40 20:49	07:40 21:27	07:40 21:47	06:19 21:30	06:58 20:42	07:39 19:41	08:21 18:42	08:05 17:04	08:32 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	07:38 20:50	07:38 21:28	07:38 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:29	07:36 20:09	07:36 20:52	07:36 21:29	07:36 21:47	06:21 21:27	07:01 20:38	07:42 19:37	08:23 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 18:20	07:34 20:09	07:34 20:53	07:34 21:30	07:34 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:37	08:09 17:02	08:33 17:06
30	08:16 17:47	07:29 18:12	07:32 20:09	07:32 20:55	07:32 21:31	07:32 21:47	06:24 21:25	07:04 20:34	07:44 19:33	08:26 18:36	08:11 17:02	08:33 17:07
31	08:15 17:48	07:28 18:03	07:30 20:09	07:30 20:55	07:30 21:32	07:30 21:47	06:25 21:24	07:05 20:32	07:45 19:33	08:28 18:34	08:10 17:02	08:33 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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Printed/Page
 4/16/2012 2:31 PM / 54
 Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S114 - S114

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:13 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:33	05:56 21:46	06:26 21:22	07:06 20:31	07:46 19:31	07:29 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:57	05:57 21:34	05:57 21:46	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:33 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:32 17:30	08:14 17:00
4	08:33 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:15 17:00
5	08:33 17:13	08:08 17:56	07:21 18:37	07:20 20:20	06:27 21:01	05:55 21:37	05:59 21:45	06:31 21:17	07:11 20:23	07:51 19:23	07:35 17:27	08:17 17:00
6	08:33 17:14	08:07 17:57	07:19 18:38	07:18 20:22	06:26 21:03	05:54 21:38	06:00 21:45	06:33 21:15	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:05 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:24	07:15 21:05	06:23 21:39	06:01 21:44	06:35 21:12	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:32 17:18	08:03 18:01	08:14 19:43	08:14 20:26	07:13 21:07	06:21 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:56 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	08:12 20:27	07:11 21:08	06:20 21:41	06:03 21:43	06:38 21:09	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:45	08:10 20:29	07:09 21:09	06:19 21:41	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	08:07 20:30	07:07 21:11	06:17 21:42	06:05 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:17	08:24 16:59
13	08:31 17:22	07:56 18:07	08:06 19:48	08:06 20:31	07:05 21:12	06:16 21:43	06:05 21:42	06:42 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:24 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	08:04 20:33	07:03 21:13	06:15 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:03 19:05	07:49 17:15	08:25 16:59
15	08:29 17:25	07:53 18:10	08:02 19:51	08:02 20:34	07:01 21:14	06:13 21:44	06:07 21:40	06:44 21:01	07:24 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 19:53	08:00 20:35	06:59 21:16	06:12 21:44	06:08 21:39	06:45 21:00	07:26 20:01	08:06 19:02	07:51 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	07:58 20:37	06:58 21:17	06:11 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:27 17:29	07:48 18:14	07:56 19:55	07:56 20:38	06:56 21:18	06:10 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:54 17:11	08:28 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	07:54 20:40	06:54 21:19	06:09 21:45	06:11 21:37	06:49 20:54	07:30 19:55	08:10 18:54	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 19:58	07:52 20:41	06:52 21:20	06:08 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:33	07:43 18:19	07:50 20:00	07:50 20:42	06:50 21:22	06:06 21:46	06:13 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:41 18:20	07:48 20:01	07:48 20:44	06:49 21:23	06:05 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:01
23	08:23 17:36	07:40 18:22	07:46 20:02	07:46 20:45	06:47 21:24	06:04 21:46	06:16 21:33	06:54 20:47	07:35 19:47	08:16 18:47	08:01 17:06	08:31 17:02
24	08:22 17:38	07:38 18:23	07:44 20:04	07:44 20:46	06:45 21:25	06:03 21:46	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:03
25	08:21 17:39	07:36 18:25	07:42 20:05	07:42 20:48	06:43 21:26	06:03 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:20 17:41	07:34 18:26	07:40 20:06	07:40 20:49	06:42 21:27	06:02 21:47	06:19 21:30	06:58 20:42	07:39 19:41	08:21 18:42	08:05 17:04	08:32 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	07:38 20:50	06:40 21:28	06:01 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:29	07:36 20:09	07:36 20:52	06:38 21:29	06:00 21:47	06:21 21:27	07:01 20:38	07:42 19:37	08:23 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 18:29	07:34 20:11	07:34 20:53	06:37 21:30	05:59 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:37	08:09 17:02	08:33 17:06
30	08:16 17:47	07:29 18:29	07:32 20:12	07:32 20:55	06:35 21:31	05:58 21:47	06:24 21:25	07:04 20:34	07:44 19:33	08:26 18:36	08:11 17:02	08:33 17:07
31	08:15 17:48	07:28 18:29	07:30 20:13	07:30 20:56	06:34 21:32	05:57 21:48	06:25 21:24	07:05 20:32	07:45 19:34	08:27 18:34	08:10 17:02	08:33 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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Printed/Page:
 4/16/2012 2:31 PM / 55
Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG:** S115 - S115

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:46	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:56	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:33	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:33	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:19	07:18	06:26	05:54	06:00	06:33	07:13	07:52	07:37	08:18
	17:14	17:57	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
	17:17	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:45	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:17	16:59
13	08:31	07:56	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:24
	17:22	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:03	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:51	08:27
	17:26	18:11	19:53	20:35	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	16:59
18	08:27	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:10	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:54	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:52	06:12	06:51	07:31	08:12	07:57	08:30
	17:32	18:17	19:58	20:41	21:20	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:06	05:53	06:13	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:49	06:05	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:54	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:23	20:04	20:46	21:25	21:46	21:32	20:46	19:45	18:46	17:05	17:03
25	08:21	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:05	08:32
	17:41	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:50	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:42	08:23	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45		20:11	20:53	21:30	21:47	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:58	05:56	06:24	07:04	07:44	08:26	08:11	08:33
	17:47		20:12	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:24	20:32		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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wind@eapc.net
Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S116 - S116

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 degrees
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Table with 12 columns (Jan-Dec) and 1 row of values: 4.92, 5.13, 7.45, 8.03, 10.20, 11.21, 11.69, 10.35, 8.68, 5.69, 4.02, 3.69

Operational time table with 16 columns (N to Sum) and 1 row of values: 514, 268, 214, 273, 371, 417, 806, 820, 553, 328, 242, 422, 667, 1,016, 1,021, 703, 8,635

Main shadow calendar table with columns for months (January-December) and rows for days (1-31). Includes potential sun hours and sum of minutes with flicker at the bottom.

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

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

Project: ALLETE Wind ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802	Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.	Printed/Page 4/16/2012 2:31 PM / 57 Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490
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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S117 - S117**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:47	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:33	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:54	06:00	06:33	07:13	07:52	07:37	08:18
	17:14	17:57	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:25	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:45	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:52	06:05	06:42	07:22	08:02	07:47	08:25
	17:22	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:03	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
	17:26	18:11	19:53	20:36	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:55	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:52	06:12	06:51	07:31	08:12	07:57	08:30
	17:32	18:17	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:06	05:53	06:14	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:05	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:55	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:23	20:04	20:46	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:03
25	08:21	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:06	08:32
	17:41	18:26	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:42	08:24	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45		20:11	20:53	21:30	21:47	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:26	08:11	08:33
	17:47		20:12	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:24	20:33		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG:** S121 - S121

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	17:48-17:59/11	07:29	06:34	05:57	05:57	06:27	07:06	07:46	08:12
	17:09	17:50	18:31		20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:01
2	08:34	08:12	07:27	17:52-17:55/3	07:27	06:32	05:57	05:57	06:28	07:08	07:47	08:13
	17:10	17:52	18:33		20:16	20:58	21:35	21:46	21:21	20:29	19:29	17:01
3	08:34	08:11	07:25		07:25	06:30	05:56	05:58	06:29	07:09	07:48	08:14
	17:11	17:53	18:34		20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:00
4	08:34	08:10	07:23		07:23	06:29	05:56	05:58	06:30	07:10	07:50	08:16
	17:12	17:55	18:35		20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:00
5	08:34	08:08	07:22		07:21	06:27	05:55	05:59	06:31	07:12	07:51	08:17
	17:13	17:56	18:37		20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:00
6	08:33	08:07	07:20		07:19	06:26	05:55	06:00	06:33	07:13	07:53	08:18
	17:14	17:58	18:38		20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:00
7	08:33	08:06	07:18		07:17	06:24	05:54	06:01	06:34	07:14	07:54	08:19
	17:15	17:59	18:40		20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:00
8	08:33	08:04	08:16		07:15	06:23	05:54	06:01	06:35	07:16	07:55	08:20
	17:17	18:01	18:41		20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:00
9	08:33	08:03	08:14		07:13	06:22	05:54	06:02	06:37	07:17	07:57	08:21
	17:18	18:01	19:43		20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:00
10	08:32	08:01	08:12		07:11	06:20	05:53	06:03	06:38	07:18	07:58	08:22
	17:19	18:02	19:44		20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:00
11	08:32	08:00	08:10		07:09	06:19	05:53	06:04	06:39	07:19	07:59	08:23
	17:20	18:04	19:46		20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:00
12	08:31	07:58	08:08		07:07	06:17	05:53	06:05	06:40	07:21	08:01	18:23-18:30/7
	17:21	18:05	19:47		20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18
13	08:31	07:57	08:06		07:05	06:16	05:53	06:06	06:42	07:22	08:02	18:21-18:33/12
	17:23	18:07	19:48		20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:16
14	08:30	07:55	08:04		07:03	06:15	05:52	06:07	06:43	07:23	08:04	18:19-18:34/15
	17:24	18:08	19:50		20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15
15	08:30	07:54	08:02		07:02	06:14	05:52	06:08	06:44	07:25	08:05	18:17-18:34/17
	17:25	18:10	19:51		20:34	21:15	21:44	21:40	21:01	20:03	19:04	17:14
16	08:29	07:52	08:00		07:00	06:12	05:52	06:09	06:46	07:26	08:06	18:17-18:35/18
	17:27	18:12	19:53		20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13
17	08:28	07:50	07:58		06:58	06:11	05:52	06:10	06:47	07:27	08:08	18:16-18:33/17
	17:28	18:13	19:54		20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12
18	08:28	07:49	17:50-17:51/1		06:56	06:10	05:52	06:11	06:48	07:29	08:09	18:16-18:31/15
	17:29	18:15	19:56		20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11
19	08:27	07:47	17:48-17:53/5		06:54	06:09	05:52	06:12	06:49	07:30	08:11	18:15-18:29/14
	17:31	18:16	19:57		20:40	21:19	21:46	21:37	20:55	19:55	18:55	17:10
20	08:26	07:45	17:47-17:54/7		06:52	06:08	05:53	06:13	06:51	07:31	08:12	18:16-18:28/12
	17:32	18:18	19:58		20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09
21	08:25	07:43	17:45-17:55/10		06:51	06:07	05:53	06:14	06:52	07:32	08:14	18:16-18:25/9
	17:34	18:19	20:00		20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08
22	08:24	07:42	17:46-17:58/12		06:49	06:06	05:53	06:15	06:53	07:34	08:15	18:17-18:24/7
	17:35	18:21	20:01		20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07
23	08:24	07:40	17:45-17:59/14		06:47	06:05	05:53	06:16	06:55	07:35	08:16	18:18-18:22/4
	17:36	18:22	20:03		20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:06
24	08:23	07:38	17:45-18:01/16		06:45	06:04	05:54	06:17	06:56	07:36	08:18	18:03
	17:38	18:24	20:04		20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06
25	08:22	07:36	17:44-18:02/18		06:44	06:03	05:54	06:18	06:57	07:38	08:19	18:04
	17:39	18:25	20:05		20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05
26	08:21	07:35	17:45-18:03/18		06:42	06:02	05:54	06:19	06:59	07:39	08:21	18:06
	17:41	18:27	20:07		20:49	21:27	21:47	21:30	20:42	19:41	18:43	17:04
27	08:19	07:33	17:45-18:02/17		06:40	06:01	05:55	06:20	07:00	07:40	08:22	18:07
	17:42	18:28	20:08		20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04
28	08:18	07:31	17:47-18:01/14		06:38	06:00	05:55	06:22	07:01	07:42	08:24	18:08
	17:44	18:30	20:09		20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03
29	08:17		07:34		06:37	05:59	05:56	06:23	07:03	07:43	08:25	18:01
	17:45		20:11		20:53	21:31	21:47	21:26	20:36	19:35	18:38	17:02
30	08:16		07:32		06:35	05:59	05:56	06:24	07:04	07:44	08:27	18:01
	17:47		20:12		20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02
31	08:15		07:30			05:58		06:25	07:05		08:28	
	17:48		20:14			21:33		21:24	20:33		18:34	
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Sum of minutes with flicker	0	132	14	0	0	0	0	0	0	147	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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 61
 Licensed user:
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 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S122 - S122**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:57	05:57	06:27	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:25	06:30	05:56	05:58	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:24	07:23	06:29	05:56	05:59	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:28	17:00
5	08:34	08:09	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:22	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:20	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:10	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:30	07:55	08:04	07:03	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:09	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:02	06:14	05:52	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:09	06:46	07:26	08:06	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	17:00
17	08:28	07:50	07:58	06:58	06:11	05:52	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:52	06:11	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:24	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:37	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:06	17:02
24	08:23	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:37	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:20	07:33	07:38	06:40	06:01	05:55	06:21	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:36	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:10	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17		07:34	06:37	05:59	05:56	06:23	07:03	07:43	08:25	08:10	08:33
	17:45		20:11	20:54	21:31	21:47	21:26	20:37	19:35	18:38	17:02	17:06
30	08:16		07:33	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:34
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:31		05:58		06:25	07:05		08:28		08:34
	17:49		20:14		21:33		21:24	20:33		18:35		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 62
 Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S123 - S123**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:57	05:57	06:27	07:07	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:13	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:25	06:31	05:56	05:58	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:36	21:46	21:20	20:27	19:27	17:30	17:01
4	08:34	08:10	07:24	07:23	06:29	05:56	05:59	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:29	17:00
5	08:34	08:09	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:39	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:39	08:19
	17:16	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:22	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:28	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:20	08:00	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:18	05:53	06:05	06:41	07:21	08:01	07:46	08:24
	17:22	18:05	19:47	20:30	21:11	21:42	21:42	21:07	20:09	19:10	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:30	07:55	08:04	07:04	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:09	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:02	06:14	05:53	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:09	06:46	07:26	08:07	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	17:00
17	08:28	07:50	07:58	06:58	06:11	05:52	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:53	06:11	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:39	21:18	21:45	21:38	20:57	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:58	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:44	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:06	05:53	06:15	06:54	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:24	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:17	08:02	08:31
	17:37	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:07	17:02
24	08:23	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:37	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:40	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:04
26	08:21	07:35	07:41	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:20	07:33	07:39	06:40	06:01	05:55	06:21	07:00	07:41	08:22	08:07	08:33
	17:43	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:37	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:10	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17		07:35	06:37	06:00	05:56	06:23	07:03	07:43	08:25	08:10	08:33
	17:46		20:11	20:54	21:31	21:47	21:26	20:37	19:35	18:38	17:02	17:06
30	08:16		07:33	06:35	05:59	05:56	06:24	07:04	07:45	08:27	08:11	08:34
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:31		05:58		06:25	07:05		08:28		08:34
	17:49		20:14		21:33		21:24	20:33		18:35		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:31 PM / 63
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EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S124 - S124**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:29	06:34	05:57	05:57	06:27	07:07	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:13	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:17	20:58	21:35	21:47	21:21	20:29	19:29	17:32	17:01
3	08:34	08:11	07:25	07:25	06:31	05:56	05:58	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:36	21:46	21:20	20:27	19:27	17:30	17:01
4	08:34	08:10	07:24	07:23	06:29	05:56	05:59	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:29	17:00
5	08:34	08:09	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:39	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:25	05:54	06:01	06:34	07:14	07:54	07:39	08:19
	17:16	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:02	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:22	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:28	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:20	08:00	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:18	05:53	06:05	06:41	07:21	08:01	07:46	08:24
	17:22	18:06	19:47	20:30	21:11	21:42	21:42	21:07	20:09	19:10	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:49	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:17	16:59
14	08:30	07:55	08:04	07:04	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:09	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:02	06:14	05:53	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:53	06:09	06:46	07:26	08:07	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	17:00
17	08:28	07:50	07:58	06:58	06:11	05:53	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:53	06:11	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:39	21:18	21:45	21:38	20:57	19:57	18:57	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:01
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:58	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:44	07:50	06:51	06:07	05:53	06:14	06:52	07:33	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:25	07:42	07:48	06:49	06:06	05:53	06:15	06:54	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:24	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:17	08:02	08:31
	17:37	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:07	17:02
24	08:23	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:37	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:43	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:40	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:04
26	08:21	07:35	07:41	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:20	07:33	07:39	06:40	06:01	05:55	06:21	07:00	07:41	08:22	08:07	08:33
	17:43	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:37	06:39	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:10	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17		07:35	06:37	06:00	05:56	06:23	07:03	07:43	08:25	08:10	08:33
	17:46		20:11	20:54	21:31	21:47	21:27	20:37	19:35	18:38	17:02	17:06
30	08:16		07:33	06:35	05:59	05:56	06:24	07:04	07:45	08:27	08:11	08:34
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:31		05:58		06:25	07:05		08:28		08:34
	17:49		20:14		21:33		21:24	20:33		18:35		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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Licensed user: EAPC Wind Energy
3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S125 - S125

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains sun rise and set times. Summary rows at the bottom show Potential sun hours and Sum of minutes with flicker for each month.

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 4/16/2012 2:31 PM / 65
 Licensed user:
EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S126 - S126**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:34	05:57	05:57	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:33	20:16	20:58	21:35	21:47	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:25	06:30	05:56	05:58	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:23	06:29	05:56	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:35	20:19	21:00	21:36	21:46	21:19	20:25	19:25	17:28	17:00
5	08:34	08:08	07:22	07:21	06:27	05:55	05:59	06:31	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:16	18:01	18:41	20:25	21:06	21:40	21:45	21:13	20:17	19:17	17:23	16:59
9	08:33	08:03	08:14	07:13	06:21	05:53	06:02	06:37	07:17	07:57	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:48	20:32	21:12	21:43	21:42	21:05	20:07	19:08	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:07	06:43	07:23	08:04	07:49	08:26
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:54	08:02	07:01	06:13	05:52	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:02	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:08	06:46	07:26	08:06	07:52	08:27
	17:27	18:11	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:52	06:10	06:48	07:29	08:09	07:55	08:29
	17:29	18:15	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:12	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:46	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:51	06:07	05:53	06:14	06:52	07:32	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:24	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:36	18:22	20:03	20:45	21:24	21:47	21:33	20:48	19:47	18:48	17:06	17:02
24	08:23	07:38	07:44	06:45	06:04	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:22	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:21	07:35	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:33
	17:41	18:27	20:07	20:49	21:28	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:20	07:33	07:38	06:40	06:01	05:55	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:10	08:33
	17:45		20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:38	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:34
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:34
	17:48		20:14		21:33		21:24	20:33		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:
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+1 701 775 3000
wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: S127 - S127**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	06:34 20:56	05:57 21:34	05:56 21:47	06:26 21:23	07:06 20:31	07:46 19:31	07:30 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:33	07:26 20:16	06:32 20:58	05:57 21:35	05:57 21:47	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:25 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:33 17:30	08:14 17:00
4	08:34 17:12	08:10 17:55	07:23 18:35	07:23 20:19	06:29 21:00	05:56 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:16 17:00
5	08:34 17:13	08:08 17:56	07:22 18:37	07:21 20:21	06:27 21:02	05:55 21:37	05:59 21:46	06:31 21:17	07:12 20:23	07:51 19:23	07:36 17:27	08:17 17:00
6	08:33 17:14	08:07 17:58	07:20 18:38	07:19 20:22	06:26 21:03	05:55 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:53 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:39 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:25	08:16 21:06	05:54 21:40	06:01 21:45	06:35 21:13	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:33 17:18	08:03 18:01	08:14 18:43	08:14 20:26	08:14 21:07	05:53 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:57 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 18:44	08:12 20:27	08:12 21:08	05:53 21:41	06:03 21:44	06:38 21:10	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:46	07:09 20:29	06:19 21:09	05:53 21:42	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	07:07 20:30	06:17 21:11	05:53 21:42	06:05 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:18	08:24 16:59
13	08:31 17:23	07:57 18:07	08:06 19:48	07:05 20:32	06:16 21:12	05:53 21:43	06:06 21:42	06:42 21:05	07:22 20:07	08:02 19:08	07:47 17:16	08:25 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	07:03 20:33	06:15 21:13	05:52 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59
15	08:30 17:25	07:53 18:10	08:02 19:51	07:01 20:34	06:13 21:15	05:52 21:44	06:07 21:40	06:44 21:01	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:27	07:52 18:11	08:00 19:53	07:00 20:36	06:12 21:16	05:52 21:44	06:08 21:40	06:46 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	06:58 20:37	06:11 21:17	05:52 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:28 17:29	07:49 18:15	07:56 19:56	06:56 20:38	06:10 21:18	05:52 21:45	06:10 21:38	06:48 20:56	07:29 19:57	08:09 18:56	07:55 17:11	08:29 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	06:54 20:40	06:09 21:19	05:52 21:46	06:11 21:37	06:49 20:55	07:30 19:55	08:11 18:55	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:18	07:52 19:58	06:52 20:41	06:08 21:21	05:53 21:46	06:13 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:34	07:43 18:19	07:50 20:00	06:51 20:43	06:07 21:22	05:53 21:46	06:14 21:35	06:52 20:51	07:32 19:51	08:14 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:42 18:21	07:48 20:01	06:49 20:44	06:06 21:23	05:53 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:02
23	08:24 17:36	07:40 18:22	07:46 20:03	06:47 20:45	06:05 21:24	05:53 21:47	06:16 21:33	06:55 20:48	07:35 19:47	08:16 18:48	08:02 17:06	08:31 17:02
24	08:23 17:38	07:38 18:24	07:44 20:04	06:45 20:47	06:04 21:25	05:53 21:47	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:06	08:32 17:03
25	08:22 17:39	07:36 18:25	07:42 20:05	06:43 20:48	06:03 21:26	05:54 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:21 17:41	07:35 18:27	07:40 20:07	06:42 20:49	06:02 21:28	05:54 21:47	06:19 21:30	06:59 20:42	07:39 19:41	08:21 18:42	08:06 17:04	08:33 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	06:40 20:51	06:01 21:29	05:55 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:30	07:36 20:09	06:38 20:52	06:00 21:30	05:55 21:47	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 19:11	07:34 20:11	06:37 20:53	05:59 21:31	05:55 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:38	08:10 17:02	08:33 17:06
30	08:16 17:47	07:29 19:12	07:32 20:12	06:35 20:55	05:59 21:32	05:56 21:47	06:24 21:25	07:04 20:35	07:44 19:33	08:27 18:36	08:11 17:02	08:34 17:07
31	08:15 17:48	07:28 19:13	07:30 20:14	06:34 20:54	05:58 21:33	05:56 21:47	06:25 21:24	07:05 20:33	07:44 19:33	08:28 18:34	08:11 17:02	08:34 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:

Description:

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ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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US-GRAND FORKS, ND 58201
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wind@eapc.net
Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S129 - S129

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns (January to December) and multiple rows of shadow data including start and end times in hh:mm format.

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

Matrix for table layout with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, Minutes with flicker.

Project: ALLETE Wind

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US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S130 - S130

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains a time range (hh:mm) representing shadow periods. Summary rows at the bottom show 'Potential sun hours' and 'Sum of minutes with flicker' for each month and overall.

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: ALLETE Wind ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802	Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.	Printed/Page: 4/16/2012 2:31 PM / 71 Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net Calculated: 4/16/2012 2:28 PM/2.7.490
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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S132 - S132

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	07:50-08:04/14 20:56	05:57 21:34	05:56 21:47	06:26 21:23	07:06 20:31	07:37-08:10/33 19:31	07:46 17:33	08:12 17:01			
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	07:47-08:07/20 20:57	05:56 21:35	05:57 21:47	06:28 21:21	07:08 20:29	07:36-08:09/33 19:29	07:47 17:11	08:13 17:01			
3	08:34 17:11	08:11 17:53	07:25 18:34	07:24 20:18	07:45-08:08/23 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:37-08:10/33 19:27	07:48 17:30	08:14 17:00			
4	08:34 17:12	08:10 17:54	07:23 18:35	07:22 20:19	07:44-08:10/26 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:37-08:09/32 19:25	07:50 17:28	08:16 17:00			
5	08:34 17:13	08:08 17:56	07:22 18:37	07:20 20:20	07:43-08:11/28 21:02	05:55 21:37	05:59 21:46	06:31 21:17	07:11 20:23	07:37-08:08/31 19:23	07:51 17:27	08:17 17:00			
6	08:33 17:14	08:07 17:57	07:20 18:38	07:19 20:22	07:42-08:11/29 21:03	05:54 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:37-08:06/29 19:21	07:52 17:25	08:18 16:59			
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	07:40-08:12/32 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:38-08:06/28 19:19	07:54 17:24	08:19 16:59			
8	08:33 17:16	08:04 18:01	08:16 18:41	07:15 20:25	07:40-08:12/32 21:06	05:54 21:40	06:01 21:45	06:35 21:13	07:15 20:17	07:38-08:04/26 19:17	07:55 17:23	08:20 16:59			
9	08:33 17:17	08:03 18:01	08:14 18:43	07:13 20:26	07:39-08:12/33 21:07	05:53 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:39-08:02/23 19:15	07:57 17:21	08:21 16:59			
10	08:32 17:19	08:01 18:02	08:12 18:44	07:11 20:27	07:38-08:11/33 21:08	05:53 21:41	06:03 21:44	06:38 21:10	07:18 20:13	07:40-08:00/20 19:13	07:58 17:20	08:22 16:59			
11	08:32 17:20	08:00 18:04	08:10 18:45	07:09 20:29	07:38-08:11/33 21:09	05:53 21:42	06:04 21:43	06:39 21:08	07:19 20:11	07:43-07:58/15 19:11	07:59 17:19	08:23 16:59			
12	08:31 17:21	07:58 18:05	08:08 18:47	07:07 20:30	07:38-08:11/33 21:11	05:53 21:42	06:04 21:42	06:40 21:06	07:21 20:09	07:47-07:53/6 19:09	08:01 17:17	08:24 16:59			
13	08:31 17:22	07:57 18:07	08:06 18:48	07:05 20:31	07:37-08:10/33 21:12	05:52 21:43	06:05 21:42	06:42 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:25 16:59			
14	08:30 17:24	07:55 18:08	08:04 18:50	07:03 20:33	07:37-08:09/32 21:13	05:52 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59			
15	08:30 17:25	07:53 18:10	08:02 18:51	07:01 20:34	07:38-08:09/31 21:15	05:52 21:44	06:07 21:40	06:44 21:01	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59			
16	08:29 17:26	07:52 18:11	08:00 18:53	06:59 20:36	07:39-08:08/29 21:16	05:52 21:44	06:08 21:40	06:45 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59			
17	08:28 17:28	07:50 18:13	07:58 18:54	06:58 20:37	07:39-08:07/28 21:17	05:52 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 16:59			
18	08:28 17:29	07:48 18:14	07:56 18:55	06:56 20:38	07:40-08:05/25 21:18	05:52 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:55 17:11	08:29 17:00			
19	08:27 17:31	07:47 18:16	07:54 18:57	06:54 20:40	07:40-08:03/23 21:19	05:52 21:46	06:11 21:37	06:49 20:55	07:30 19:55	08:11 18:54	07:56 17:10	08:29 17:00			
20	08:26 17:32	07:45 18:17	07:52 18:58	06:52 20:41	07:42-08:02/20 21:21	05:52 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01			
21	08:25 17:33	07:43 18:19	07:50 19:00	06:50 20:42	07:44-07:59/15 21:22	05:53 21:46	06:13 21:35	07:51-08:01/10 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01			
22	08:24 17:35	07:42 18:20	07:48 19:01	06:49 20:44	07:47-07:55/8 21:23	05:53 21:46	06:15 21:34	07:49-08:05/16 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:01			
23	08:23 17:36	07:40 18:22	07:46 19:02	06:47 20:45	07:46 21:24	05:53 21:47	06:16 21:33	07:46-08:06/20 20:48	07:35 19:47	08:16 18:47	08:02 17:06	08:31 17:02			
24	08:23 17:38	07:38 18:23	07:44 19:04	06:45 20:47	07:44-08:07/23 21:25	05:53 21:47	06:17 21:32	07:44-08:07/23 20:46	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:03			
25	08:22 17:39	07:36 18:25	07:42 19:05	06:43 20:48	07:42-08:08/26 21:26	05:54 21:47	06:18 21:31	07:42-08:08/26 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03			
26	08:21 17:41	07:34 18:26	07:40 19:07	06:42 20:49	07:42-08:02/20 21:27	05:54 21:47	06:19 21:30	07:42-08:10/28 20:42	07:39 19:41	08:21 18:42	08:06 17:04	08:33 17:04			
27	08:19 17:42	07:33 18:28	07:38 19:08	06:40 20:51	07:42-08:02/20 21:29	05:54 21:47	06:20 21:29	07:40-08:10/30 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05			
28	08:18 17:44	07:31 18:29	07:36 19:09	06:38 20:52	07:42-08:02/20 21:30	05:55 21:47	06:21 21:28	07:39-08:10/31 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:05			
29	08:17 17:45	07:34 18:21	07:34 19:05	06:37 20:53	07:42-08:02/20 21:31	05:55 21:47	06:23 21:26	07:38-08:10/32 20:36	07:43 19:35	08:25 18:37	08:10 17:02	08:33 17:06			
30	08:16 17:47	07:33 18:22	07:32 19:02	06:35 20:52	07:42-08:02/20 21:32	05:56 21:47	06:24 21:25	07:38-08:11/33 20:35	07:44 19:33	08:27 18:36	08:11 17:02	08:34 17:07			
31	08:15 17:48	07:30 18:24	07:56-08:00/4 20:14	06:34 20:55	07:42-08:02/20 21:33	05:58 21:47	06:25 21:24	07:37-08:10/33 20:33	07:44 19:33	08:28 18:34	08:10 17:02	08:34 17:08			
Potential sun hours	279	287	368	407	580	466	475	480	441	378	309	338	282	266	0
Sum of minutes with flicker	0	0	4	580	0	0	0	282	309	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 <td>Last time (hh:mm) with flicker <td>Minutes with flicker</td> </td>	Last time (hh:mm) with flicker <td>Minutes with flicker</td>	Minutes with flicker

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S134 - S134

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:34	05:56 21:47	06:26 21:23	07:06 20:31	07:46 19:31	07:30 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:58	05:56 21:35	05:57 21:47	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:33 17:30	08:14 17:00
4	08:34 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:16 17:00
5	08:34 17:13	08:08 17:56	07:22 18:37	07:21 20:20	06:27 21:02	05:55 21:37	05:59 21:46	06:31 21:17	07:12 20:23	07:51 19:23	07:36 17:27	08:17 17:00
6	08:33 17:14	08:07 17:57	07:20 18:38	07:19 20:22	06:26 21:03	05:54 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:39 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:25	08:16 21:06	08:16 21:40	06:01 21:45	06:35 21:13	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:33 17:17	08:03 18:01	08:14 19:43	08:14 20:26	08:14 21:07	08:14 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:57 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	08:12 20:27	08:12 21:08	08:12 21:41	06:03 21:44	06:38 21:10	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:46	08:10 20:29	08:10 21:09	08:10 21:42	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	08:07 20:30	08:07 21:11	08:07 21:42	06:04 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:17	08:24 16:59
13	08:31 17:22	07:57 18:07	08:06 19:48	08:05 20:32	08:05 21:12	08:05 21:43	06:05 21:42	06:42 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:25 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	08:03 20:33	08:03 21:13	08:03 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59
15	08:30 17:25	07:53 18:10	08:02 19:51	08:02 20:34	08:02 21:15	08:02 21:44	06:07 21:40	06:44 21:01	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 19:53	08:00 20:36	08:00 21:16	08:00 21:44	06:08 21:40	06:45 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	07:58 20:37	07:58 21:17	07:58 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 16:59
18	08:28 17:29	07:49 18:14	07:56 19:55	07:56 20:38	07:56 21:18	07:56 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:55 17:11	08:29 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	07:54 20:40	07:54 21:20	07:54 21:46	06:11 21:37	06:49 20:55	07:30 19:55	08:11 18:54	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 19:58	07:52 20:41	07:52 21:21	07:52 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:33	07:43 18:19	07:50 20:00	07:50 20:43	07:50 21:22	07:50 21:46	06:13 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:42 18:20	07:48 20:01	07:48 20:44	07:48 21:23	07:48 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:01
23	08:24 17:36	07:40 18:22	07:46 20:02	07:46 20:45	07:46 21:24	07:46 21:47	06:16 21:33	06:55 20:48	07:35 19:47	08:16 18:47	08:02 17:06	08:31 17:02
24	08:23 17:38	07:38 18:23	07:44 20:04	07:44 20:47	07:44 21:25	07:44 21:47	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:03
25	08:22 17:39	07:36 18:25	07:42 20:05	07:42 20:48	07:42 21:26	07:42 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:21 17:41	07:35 18:26	07:40 20:07	07:40 20:49	07:40 21:28	07:40 21:47	06:19 21:30	06:58 20:42	07:39 19:41	08:21 18:42	08:06 17:04	08:33 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	07:38 20:51	07:38 21:29	07:38 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:29	07:36 20:09	07:36 20:52	07:36 21:30	07:36 21:47	06:21 21:28	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 18:25	07:34 20:11	07:34 20:53	07:34 21:31	07:34 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:37	08:10 17:02	08:33 17:06
30	08:16 17:47	07:29 18:24	07:32 20:12	07:32 20:55	07:32 21:32	07:32 21:47	06:24 21:25	07:04 20:35	07:44 19:33	08:27 18:36	08:11 17:02	08:34 17:07
31	08:15 17:48	07:28 18:23	07:30 20:14	07:30 20:57	07:30 21:33	07:30 21:48	06:25 21:24	07:05 20:33	07:45 18:34	08:28 18:34	08:12 17:03	08:34 17:08
Potential sun hours 279 287 368 407 466 475 480 441 378 338 282 266												
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) Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
--------------	-------------------------------------	---

Project: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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+1 701 775 3000
wind@eapc.net
Calculated: 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S135 - S135

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January-December) and rows for shadow calculations (1-31). Includes potential sun hours and sum of minutes with flicker.

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 +1 701 775 3000
 wind@eapc.net
Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S136 - S136

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:34	05:56 21:47	06:26 21:23	07:06 21:08	07:46 20:31	08:31-08:58/27 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:58	05:56 21:35	05:57 21:47	06:27 21:21	07:08 20:29	07:47 21:29	08:29-08:59/30 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:57 21:46	06:29 21:20	07:09 20:27	07:48 21:27	08:28-08:59/31 17:30	08:15 17:00
4	08:34 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 21:25	08:28-08:59/31 17:28	08:16 17:00
5	08:34 17:13	08:08 17:56	07:22 18:37	07:20 20:20	06:27 21:02	05:55 21:37	05:59 21:46	06:31 21:17	07:11 20:23	07:51 21:23	08:27-08:59/32 17:27	08:17 16:59
6	08:33 17:14	08:07 17:57	07:20 18:38	07:19 20:22	06:26 21:03	05:54 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:52 21:21	08:27-08:59/32 17:25	08:18 16:59
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 21:19	08:27-08:58/31 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:15 20:25	08:50-09:22/32 21:06	07:15 21:20	06:23 21:40	06:01 21:13	07:15 20:17	07:55 21:17	08:26-08:58/32 17:23	08:20 16:59
9	08:33 17:17	08:03 18:01	08:14 19:43	08:13 20:26	08:50-09:22/32 21:07	07:13 21:07	06:21 21:40	06:02 21:11	07:17 20:15	07:57 21:15	08:27-08:58/31 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	08:12 20:27	08:50-09:21/31 21:08	07:11 21:08	06:20 21:41	06:03 21:10	06:38 20:13	07:58 21:13	08:27-08:56/29 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:45	08:10 20:29	08:50-09:20/30 21:09	07:09 21:09	06:18 21:42	06:04 21:10	06:39 20:11	07:59 21:11	08:28-08:56/28 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	08:08 20:30	08:51-09:19/28 21:11	07:07 21:11	06:17 21:42	06:04 21:06	06:40 20:09	08:01 21:09	08:28-08:54/26 17:17	08:24 16:59
13	08:31 17:22	07:57 18:07	08:06 19:48	08:06 20:31	08:51-09:18/27 21:12	07:05 21:12	06:16 21:43	06:05 21:10	06:41 20:07	08:02 21:05	08:29-08:53/24 17:16	08:25 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	08:04 20:33	08:52-09:16/24 21:13	07:03 21:13	06:15 21:43	06:06 21:11	06:43 20:03	08:04 21:03	08:30-08:51/21 17:15	08:26 16:59
15	08:30 17:25	07:53 18:10	08:02 19:51	08:02 20:34	08:53-09:14/21 21:15	07:01 21:15	06:13 21:44	06:07 21:10	06:44 20:03	08:05 21:04	08:33-08:50/17 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 19:53	08:00 20:36	08:55-09:12/17 21:16	06:59 21:16	06:12 21:44	06:08 21:10	06:45 20:01	08:06 21:02	08:35-08:46/11 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	07:58 20:37	08:58-09:09/11 21:17	06:58 21:17	06:11 21:45	06:09 21:39	06:47 20:58	08:08 21:00	08:35-08:46/11 17:12	08:28 16:59
18	08:28 17:29	07:49 18:14	07:56 19:55	07:56 20:38	08:58-09:09/11 21:18	06:56 21:18	06:10 21:45	06:08 21:38	06:48 20:56	08:09 21:06	08:35-08:46/11 17:11	08:29 17:00
19	08:27 17:30	07:47 18:16	07:54 19:57	07:54 20:40	08:58-09:09/11 21:19	06:54 21:19	06:09 21:46	06:11 21:37	06:49 20:55	08:11 21:05	08:35-08:46/11 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 19:58	07:52 20:41	08:58-09:09/11 21:20	06:52 21:21	06:07 21:46	06:12 21:36	06:51 20:53	08:12 21:03	08:35-08:46/11 17:09	08:30 17:00
21	08:25 17:33	07:43 18:19	07:50 19:58	07:50 20:42	08:58-09:09/11 21:21	06:50 21:22	06:06 21:46	06:13 21:35	06:52 20:51	08:13 21:01	08:35-08:46/11 17:08	08:30 17:01
22	08:24 17:35	07:42 18:20	07:48 19:58	07:48 20:44	08:58-09:09/11 21:22	06:49 21:23	06:05 21:46	06:15 21:36	06:53 20:51	08:15 21:01	08:35-08:46/11 17:07	08:31 17:01
23	08:24 17:36	07:40 18:22	07:46 19:59	07:46 20:45	08:58-09:09/11 21:23	06:47 21:24	06:04 21:47	06:16 21:33	06:54 20:48	08:16 21:02	08:35-08:46/11 17:06	08:31 17:02
24	08:23 17:38	07:38 18:23	07:44 19:59	07:44 20:47	08:58-09:09/11 21:24	06:45 21:25	06:03 21:47	06:17 21:32	06:56 20:46	08:18 21:03	08:35-08:46/11 17:05	08:32 17:02
25	08:22 17:39	07:36 18:25	08:08-08:09/1 20:05	07:42 20:48	08:58-09:09/11 21:25	06:43 21:26	06:02 21:47	06:18 21:31	06:57 20:44	08:19 21:04	08:35-08:46/11 17:05	08:32 17:03
26	08:21 17:41	07:35 18:26	08:01-08:15/14 20:07	07:40 20:49	08:58-09:09/11 21:26	06:42 21:28	06:02 21:47	06:19 21:30	06:58 20:42	08:21 21:05	08:35-08:46/11 17:04	08:33 17:04
27	08:20 17:42	07:33 18:28	07:58-08:17/19 20:08	07:38 20:51	08:58-09:09/11 21:27	06:40 21:29	06:01 21:47	06:20 21:29	07:00 20:40	08:22 21:06	08:35-08:46/11 17:03	08:33 17:04
28	08:18 17:44	07:31 18:29	07:57-08:20/23 20:09	07:36 20:52	08:58-09:09/11 21:28	06:38 21:30	06:00 21:47	06:21 21:28	07:01 20:38	08:24 21:07	08:35-08:46/11 17:03	08:33 17:05
29	08:17 17:45	07:30 18:29	07:57-08:20/23 20:11	07:34 20:53	08:58-09:09/11 21:29	06:37 21:31	06:00 21:47	06:23 21:26	07:02 20:36	08:25 21:08	08:35-08:46/11 17:02	08:33 17:06
30	08:16 17:47	07:30 18:29	07:57-08:20/23 20:12	07:32 20:55	08:58-09:09/11 21:30	06:36 21:32	06:00 21:47	06:24 21:25	07:04 20:35	08:27 21:09	08:35-08:46/11 17:01	08:34 17:07
31	08:15 17:48	07:30 18:29	07:57-08:20/23 20:14	07:30 20:55	08:58-09:09/11 21:31	06:35 21:33	06:00 21:47	06:25 21:24	07:05 20:33	08:28 21:10	08:35-08:46/11 17:00	08:34 17:08
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266
Sum of minutes with flicker	0	57	460	0	0	0	0	0	90	433	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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 wind@eapc.net
Calculated:
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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG:** S137 - S137

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:33	05:56 21:47	06:26 21:22	07:06 20:31	07:46 19:31	07:29 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:57	05:56 21:34	05:57 21:46	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:32 17:30	08:14 17:00
4	08:34 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:15 17:00
5	08:33 17:13	08:08 17:56	07:21 18:37	07:20 20:20	06:27 21:01	05:55 21:37	05:59 21:46	06:31 21:17	07:11 20:23	07:51 19:23	07:35 17:27	08:17 17:00
6	08:33 17:14	08:07 17:57	07:20 18:38	07:18 20:22	06:26 21:03	05:54 21:38	06:00 21:45	06:33 21:15	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:25	08:16 21:05	08:16 21:39	06:01 21:44	06:35 21:13	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:32 17:17	08:03 18:01	08:14 18:43	08:14 20:26	08:14 21:07	08:14 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:56 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 18:44	08:12 20:27	08:12 21:08	08:12 21:41	06:03 21:43	06:38 21:09	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 18:45	08:10 20:29	08:10 21:09	08:10 21:41	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 18:47	08:07 20:30	08:07 21:11	08:07 21:42	06:04 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:17	08:24 16:59
13	08:31 17:22	07:57 18:07	08:06 18:48	08:05 20:31	08:05 21:12	08:05 21:43	06:05 21:42	06:41 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:25 16:59
14	08:30 17:24	07:55 18:08	08:04 18:50	08:03 20:33	08:03 21:13	08:03 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:03 19:05	07:49 17:15	08:25 16:59
15	08:30 17:25	07:53 18:10	08:02 18:51	08:02 20:34	08:02 21:14	08:02 21:44	06:07 21:40	06:44 21:01	07:24 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 18:53	08:00 20:36	08:00 21:16	08:00 21:44	06:08 21:39	06:45 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 18:54	07:58 20:37	07:58 21:17	07:58 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 16:59
18	08:28 17:29	07:48 18:14	07:56 18:55	07:56 20:38	07:56 21:18	07:56 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:54 17:11	08:28 17:00
19	08:27 17:31	07:47 18:16	07:54 18:57	07:54 20:40	07:54 21:19	07:54 21:45	06:11 21:37	06:49 20:55	07:30 19:55	08:11 18:54	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 18:58	07:52 20:41	07:52 21:21	07:52 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:00
21	08:25 17:33	07:43 18:19	07:50 19:00	07:50 20:42	07:50 21:22	07:50 21:46	06:13 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:42 18:20	07:48 19:01	07:48 20:44	07:48 21:23	07:48 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:01
23	08:23 17:36	07:40 18:22	07:46 19:02	07:46 20:45	07:46 21:24	07:46 21:46	06:16 21:33	06:54 20:47	07:35 19:47	08:16 18:47	08:01 17:06	08:31 17:02
24	08:22 17:38	07:38 18:23	07:44 19:04	07:44 20:46	07:44 21:25	07:44 21:47	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:03
25	08:21 17:39	07:36 18:25	07:42 19:05	07:42 20:48	07:42 21:26	07:42 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:20 17:41	07:34 18:26	07:40 19:07	07:40 20:49	07:40 21:27	07:40 21:47	06:19 21:30	06:58 20:42	07:39 19:41	08:21 18:42	08:06 17:04	08:32 17:04
27	08:19 17:42	07:33 18:28	07:38 19:08	07:38 20:51	07:38 21:28	07:38 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:29	07:36 19:09	07:36 20:52	07:36 21:29	07:36 21:47	06:21 21:27	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 18:20	07:34 19:00	07:34 20:53	07:34 21:31	07:34 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:37	08:09 17:02	08:33 17:06
30	08:16 17:47	07:29 18:12	07:32 19:02	07:32 20:55	07:32 21:32	07:32 21:47	06:24 21:25	07:04 20:34	07:44 19:33	08:27 18:36	08:11 17:02	08:33 17:07
31	08:15 17:48	07:28 18:03	07:30 19:03	07:30 20:58	07:30 21:33	07:30 21:47	06:25 21:24	07:05 20:33	07:45 18:34	08:28 17:34	08:11 17:02	08:34 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S138 - S138

Assumptions for shadow calculations

Maximum distance for influence: 1,500 m
Minimum sun height over horizon for influence: 3 °
Day step for calculation: 1 days
Time step for calculation: 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time:
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for turbine numbers (1 to 31) showing sunrise and sunset times. Includes summary rows for 'Potential sun hours' and 'Sum of minutes with flicker'.

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: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S140 - S140

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months and rows for specific times of day, showing sunrise and sunset times for each month from January to December. Includes a summary row for 'Potential sun hours' and 'Sum of minutes with flicker'.

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

Matrix showing Day in month, Sun rise (hh:mm), Sun set (hh:mm), and First/Last time with flicker/Minutes with flicker.

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S141 - S141

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and multiple rows for days. Each cell contains a day number and a time range (e.g., 08:34-17:09). Summary rows at the bottom show 'Potential sun hours' and 'Sum of minutes with flicker' for each month.

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:
ALLETE Wind

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S142 - S142

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:13	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:29	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:46	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:56	05:57	06:27	07:07	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:24	06:30	05:56	05:57	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:33	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:20	06:27	05:55	05:59	06:31	07:11	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:45	21:17	20:23	19:23	17:27	16:59
6	08:33	08:07	07:19	07:18	06:26	05:54	06:00	06:32	07:13	07:52	07:37	08:18
	17:14	17:57	18:38	20:22	21:03	21:38	21:45	21:15	20:21	19:21	17:25	16:59
7	08:33	08:05	07:18	07:16	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:56	07:41	08:21
	17:17	18:00	19:42	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:18	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:45	20:29	21:09	21:41	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:52	06:04	06:40	07:20	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:17	16:59
13	08:31	07:56	08:06	07:05	06:16	05:52	06:05	06:41	07:22	08:02	07:47	08:25
	17:22	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:14	05:52	06:06	06:43	07:23	08:03	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:05	17:15	16:59
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	06:59	06:12	05:52	06:08	06:45	07:26	08:06	07:51	08:27
	17:26	18:11	19:52	20:35	21:16	21:44	21:39	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	16:59
18	08:27	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:10	07:56	08:29
	17:30	18:16	19:57	20:40	21:19	21:45	21:37	20:54	19:55	18:54	17:10	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:12	07:57	08:30
	17:32	18:17	19:58	20:41	21:20	21:46	21:36	20:53	19:53	18:53	17:09	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	19:59	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:41	07:48	06:48	06:05	05:53	06:14	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:01
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:54	07:35	08:16	08:01	08:31
	17:36	18:22	20:02	20:45	21:24	21:46	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:23	20:04	20:46	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:02
25	08:21	07:36	07:42	06:43	06:02	05:54	06:18	06:57	07:37	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:05	08:32
	17:41	18:26	20:06	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:50	21:28	21:47	21:29	20:40	19:39	18:41	17:03	17:04
28	08:18	07:31	07:36	06:38	06:00	05:55	06:21	07:01	07:41	08:23	08:08	08:33
	17:44	18:29	20:09	20:52	21:29	21:47	21:27	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:09	08:33
	17:45		20:11	20:53	21:30	21:47	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:58	05:56	06:24	07:04	07:44	08:26	08:11	08:33
	17:47		20:12	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:01	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:33
	17:48		20:13		21:32		21:24	20:32		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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: ALLETE Wind
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Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S143 - S143

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for individual days (1-31), showing sun rise and set times in hh:mm format. Includes summary rows for potential sun hours and minutes with flicker.

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: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S144 - S144

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33 17:09	08:13 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:33	05:56 21:46	06:26 21:22	07:06 20:30	07:45 19:31	07:29 17:33	08:12 17:01
2	08:33 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:57	05:56 21:34	05:57 21:46	06:27 21:21	07:07 20:29	07:47 19:29	07:31 17:31	08:13 17:00
3	08:33 17:11	08:11 17:53	07:25 18:34	07:24 20:17	06:30 20:59	05:56 21:35	05:57 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:32 17:30	08:14 17:00
4	08:33 17:12	08:10 17:54	07:23 18:35	07:22 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:15 17:00
5	08:33 17:13	08:08 17:56	07:21 18:37	07:20 20:20	06:27 21:01	05:55 21:37	05:59 21:45	06:31 21:17	07:11 20:23	07:51 19:23	07:35 17:27	08:16 16:59
6	08:33 17:14	08:07 17:57	07:19 18:38	07:18 20:22	06:26 21:03	05:54 21:38	05:59 21:45	06:32 21:15	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:05 17:59	07:17 18:40	07:16 20:23	06:24 21:04	05:54 21:38	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:16	08:04 18:00	08:16 18:41	08:16 20:24	07:14 21:05	05:53 21:39	06:01 21:44	06:35 21:12	07:15 20:17	07:55 19:17	07:40 17:22	08:20 16:59
9	08:32 17:17	08:02 18:01	08:14 18:42	08:14 20:26	07:13 21:07	05:53 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:56 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	08:11 20:27	07:11 21:08	05:53 21:41	06:03 21:43	06:38 21:09	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:31 17:20	07:59 18:04	08:10 19:45	08:09 20:28	06:18 21:09	05:53 21:41	06:03 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	08:07 20:30	06:17 21:10	05:52 21:42	06:04 21:42	06:40 21:06	07:20 20:09	08:01 19:09	07:46 17:17	08:24 16:59
13	08:31 17:22	07:56 18:07	08:06 19:48	08:05 20:31	06:16 21:12	05:52 21:43	06:05 21:41	06:41 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:24 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	08:03 20:33	06:14 21:13	05:52 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:03 19:05	07:49 17:15	08:25 16:59
15	08:29 17:25	07:53 18:10	08:02 19:51	08:01 20:34	07:01 21:14	05:52 21:44	06:07 21:40	06:44 21:01	07:24 20:03	08:05 19:03	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 19:52	07:59 20:35	06:59 21:16	05:52 21:44	06:08 21:39	06:45 21:00	07:26 20:01	08:06 19:02	07:51 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	07:57 20:37	06:57 21:17	05:52 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 16:59
18	08:27 17:29	07:48 18:14	07:56 19:55	07:55 20:38	06:10 21:18	05:52 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:54 17:11	08:28 17:00
19	08:27 17:30	07:47 18:16	07:54 19:57	07:54 20:39	06:08 21:19	05:52 21:45	06:11 21:37	06:49 20:54	07:30 19:55	08:10 18:54	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:17	07:52 19:58	07:52 20:41	06:07 21:20	05:52 21:46	06:12 21:36	06:50 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:00
21	08:25 17:33	07:43 18:19	07:50 19:59	07:49 20:42	06:06 21:22	05:52 21:46	06:13 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:41 18:20	07:48 20:01	07:48 20:44	06:05 21:23	05:53 21:46	06:14 21:34	06:53 20:49	07:33 19:49	08:15 18:49	08:00 17:07	08:31 17:01
23	08:23 17:36	07:40 18:22	07:46 20:02	07:46 20:45	06:04 21:24	05:53 21:46	06:16 21:33	06:54 20:47	07:35 19:47	08:16 18:47	08:01 17:06	08:31 17:02
24	08:22 17:38	07:38 18:23	07:44 20:04	07:44 20:46	06:03 21:25	05:53 21:46	06:17 21:32	06:56 20:45	07:36 19:45	08:18 18:46	08:03 17:05	08:32 17:02
25	08:21 17:39	07:36 18:25	07:42 20:05	07:42 20:48	06:02 21:26	05:53 21:47	06:18 21:31	06:57 20:44	07:37 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:20 17:41	07:34 18:26	07:40 20:06	07:40 20:49	06:02 21:27	05:54 21:47	06:19 21:30	06:58 20:42	07:39 19:41	08:20 18:42	08:05 17:04	08:32 17:04
27	08:19 17:42	07:32 18:28	07:38 20:08	07:38 20:50	06:01 21:28	05:54 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:04
28	08:18 17:44	07:31 18:29	07:36 20:09	07:36 20:52	06:00 21:29	05:55 21:47	06:21 21:27	07:01 20:38	07:41 19:37	08:23 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 18:20	07:34 20:11	07:34 20:53	06:36 21:30	05:59 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:37	08:09 17:02	08:33 17:06
30	08:16 17:47	07:29 18:12	07:32 20:12	07:32 20:55	06:35 21:31	05:56 21:47	06:24 21:25	07:03 20:34	07:44 19:33	08:26 18:36	08:11 17:01	08:33 17:07
31	08:15 17:48	07:28 18:03	07:30 20:13	07:30 20:56	06:34 21:32	05:55 21:47	06:25 21:24	07:05 20:32	07:45 19:34	08:28 18:34	08:10 17:02	08:33 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S146 - S146

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3°
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Calendar table showing shadow calculations for each day from January to December. Columns include months and specific times of day. Summary rows at the bottom show Potential sun hours and Sum of minutes with flicker for each month.

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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Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S147 - S147

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability data.

Operational time

Table with 16 columns (N to Sum) and 2 rows of operational time data.

Main shadow calculation table with columns for months (January-December) and rows for individual days, showing sun rise/set times and minutes with flicker.

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

Matrix defining table layout: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, Minutes with flicker.

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Dwight Anderson
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Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: S148 - S148

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Table with 12 columns (Jan-Dec) and 1 row of values: 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time table with 17 columns (N-S) and 2 rows of values: 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635

Main shadow calculation table with columns for months (January-December) and rows for each day of the month, listing sun rise/set times and shadow flicker minutes.

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

Matrix layout table with 2 rows: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, Minutes with flicker.

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Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: U152 - U152

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January-December) and multiple rows for time slots (1-31). Columns contain sunrise and sunset times. Bottom row shows 'Potential sun hours' and 'Sum of minutes with flicker' for each month.

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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U158 - U158**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:28 20:15	06:33 20:56	05:57 21:34	05:56 21:47	06:26 21:23	07:06 20:31	07:46 19:31	07:30 17:33	08:12 17:01
2	08:34 17:10	08:12 17:51	07:27 18:32	07:26 20:16	06:32 20:57	05:57 21:35	05:57 21:47	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:24 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:33 17:30	08:14 17:00
4	08:34 17:12	08:10 17:54	07:23 18:35	07:23 20:19	06:29 21:00	05:55 21:36	05:58 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:16 17:00
5	08:34 17:13	08:08 17:56	07:22 18:37	07:21 20:20	06:27 21:02	05:55 21:37	05:59 21:46	06:31 21:17	07:12 20:23	07:51 19:23	07:36 17:27	08:17 17:00
6	08:33 17:14	08:07 17:58	07:20 18:38	07:19 20:22	06:26 21:03	05:55 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:52 19:21	07:37 17:25	08:18 16:59
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:00 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:16	08:04 18:01	08:16 18:41	08:16 20:25	08:16 21:06	08:16 21:40	06:01 21:45	06:35 21:13	07:15 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:33 17:18	08:03 18:01	08:14 19:43	08:14 20:26	08:14 21:07	08:14 21:40	06:02 21:44	06:36 21:11	07:17 20:15	07:57 19:15	07:41 17:21	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	08:12 20:27	08:12 21:08	08:12 21:41	06:03 21:44	06:38 21:10	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:46	08:10 20:29	08:10 21:09	08:10 21:42	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	08:08 20:30	08:08 21:11	08:08 21:42	06:05 21:42	06:40 21:06	07:21 20:09	08:01 19:09	07:46 17:18	08:24 16:59
13	08:31 17:23	07:57 18:07	08:06 19:48	08:06 20:32	08:06 21:12	08:06 21:43	06:06 21:42	06:42 21:05	07:22 20:07	08:02 19:07	07:47 17:16	08:25 16:59
14	08:30 17:24	07:55 18:08	08:04 19:50	08:04 20:33	08:04 21:13	08:04 21:43	06:06 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59
15	08:30 17:25	07:53 18:10	08:02 19:51	08:02 20:34	08:02 21:15	08:02 21:44	06:07 21:40	06:44 21:01	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:26	07:52 18:11	08:00 19:53	08:00 20:36	08:00 21:16	08:00 21:44	06:08 21:40	06:45 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 16:59
17	08:28 17:28	07:50 18:13	07:58 19:54	07:58 20:37	07:58 21:17	07:58 21:45	06:09 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:28 17:29	07:49 18:14	07:56 19:55	07:56 20:38	07:56 21:18	07:56 21:45	06:10 21:38	06:48 20:56	07:28 19:57	08:09 18:56	07:55 17:11	08:29 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	07:54 20:40	07:54 21:19	07:54 21:46	06:11 21:37	06:49 20:55	07:30 19:55	08:11 18:55	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:18	07:52 19:58	07:52 20:41	07:52 21:21	07:52 21:46	06:12 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:33	07:43 18:19	07:50 20:00	07:50 20:42	07:50 21:22	07:50 21:46	06:14 21:35	06:52 20:51	07:32 19:51	08:13 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:42 18:21	07:48 20:01	07:48 20:44	07:48 21:23	07:48 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:02
23	08:23 17:36	07:40 18:22	07:46 20:02	07:46 20:45	07:46 21:24	07:46 21:47	06:16 21:33	06:55 20:48	07:35 19:47	08:16 18:48	08:02 17:06	08:31 17:02
24	08:23 17:38	07:38 18:24	07:44 20:04	07:44 20:47	07:44 21:25	07:44 21:47	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:06	08:32 17:03
25	08:22 17:39	07:36 18:25	07:42 20:05	07:42 20:48	07:42 21:26	07:42 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:03
26	08:21 17:41	07:35 18:27	07:40 20:07	07:40 20:49	07:40 21:27	07:40 21:47	06:19 21:30	06:59 20:42	07:39 19:41	08:21 18:42	08:06 17:04	08:33 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	07:38 20:51	07:38 21:29	07:38 21:47	06:20 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:03	08:33 17:05
28	08:18 17:44	07:31 18:30	07:36 20:09	07:36 20:52	07:36 21:30	07:36 21:47	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:05
29	08:17 17:45	07:30 20:11	07:34 20:53	07:34 21:31	07:34 21:47	07:34 21:47	06:23 21:26	07:02 20:36	07:43 19:35	08:25 18:38	08:10 17:02	08:33 17:06
30	08:16 17:47	07:32 20:12	07:36 20:55	07:36 21:32	07:36 21:47	07:36 21:47	06:24 21:25	07:04 20:35	07:44 19:33	08:27 18:36	08:11 17:02	08:34 17:07
31	08:15 17:48	07:30 20:14	07:30 20:55	07:30 21:33	07:30 21:47	07:30 21:47	06:25 21:24	07:05 20:33	07:45 18:34	08:28 17:02	08:11 17:02	08:34 17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:

ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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Calculated:
4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: U159 - U159

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

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

Table with 12 columns (Jan-Dec) and 2 rows of data for sunshine probability.

Operational time

Table with 17 columns (N to Sum) and 2 rows of data for operational time.

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

Main shadow calculation table with columns for months (January-December) and rows for days (1-31), showing sun rise/set times and shadow flicker minutes.

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

Matrix layout table with columns: Day in month, Sun rise (hh:mm), 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: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: U160 - U160

Assumptions for shadow calculations

Table of assumptions: Maximum distance for influence (1,500 m), Minimum sun height over horizon for influence (3 °), Day step for calculation (1 days), Time step for calculation (1 minutes). Also includes Sunshine probability S and Operational time details.

Main shadow calculation table with columns for months (January to December) and rows for individual days. Columns contain sunrise and sunset times, and rows contain times when shadows occur. Summary rows at the bottom show potential sun hours and minutes with flicker per month and overall.

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

Matrix defining table layout columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, Minutes with flicker.

Project:
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 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U161 - U161**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:33	05:57	05:56	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:23	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:26	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:51	18:32	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:24	06:30	05:56	05:58	06:29	07:09	07:48	07:32	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:22	06:29	05:55	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:54	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:21	07:21	06:27	05:55	05:59	06:31	07:12	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:54	06:00	06:33	07:13	07:52	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:25	16:59
7	08:33	08:06	07:18	07:17	06:24	05:54	06:00	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	18:41	20:25	21:05	21:39	21:44	21:13	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:21	05:53	06:02	06:36	07:17	07:57	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:44	21:09	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:52	06:05	06:42	07:22	08:02	07:47	08:25
	17:22	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:07	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:52	06:06	06:43	07:23	08:04	07:49	08:26
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:15	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:08	06:45	07:26	08:06	07:52	08:27
	17:26	18:11	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:09	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:48	07:56	06:56	06:10	05:52	06:10	06:48	07:28	08:09	07:55	08:29
	17:29	18:14	19:55	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:52	06:11	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:52	06:12	06:51	07:31	08:12	07:57	08:30
	17:32	18:17	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:50	06:06	05:53	06:14	06:52	07:32	08:13	07:59	08:30
	17:33	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:05	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:20	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:04	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:36	18:22	20:02	20:45	21:24	21:47	21:33	20:47	19:47	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:05	17:03
25	08:22	07:36	07:42	06:43	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:34	07:40	06:42	06:02	05:54	06:19	06:58	07:39	08:21	08:06	08:33
	17:41	18:26	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:42	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:54	06:20	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:29	21:47	21:29	20:40	19:39	18:41	17:03	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:29	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:05
29	08:17		07:34	06:37	05:59	05:55	06:23	07:02	07:43	08:25	08:10	08:33
	17:45		20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:37	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:33
	17:47		20:12	20:55	21:32	21:47	21:25	20:34	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:34
	17:48		20:14		21:33		21:24	20:33		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
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:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 wind@eapc.net
 Calculated:
 4/16/2012 2:28 PM/2.7.490

SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U162 - U162**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34	08:14	07:29	07:28	06:34	05:57	05:57	06:27	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:34	21:47	21:22	20:31	19:31	17:33	17:01
2	08:34	08:12	07:27	07:27	06:32	05:57	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:57	21:34	21:46	21:21	20:29	19:29	17:31	17:01
3	08:34	08:11	07:25	07:25	06:30	05:56	05:58	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:46	21:20	20:27	19:27	17:30	17:00
4	08:34	08:10	07:23	07:23	06:29	05:56	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:35	20:19	21:00	21:36	21:46	21:18	20:25	19:25	17:28	17:00
5	08:33	08:08	07:22	07:21	06:27	05:55	05:59	06:32	07:12	07:51	07:35	08:17
	17:13	17:56	18:37	20:20	21:01	21:37	21:46	21:17	20:23	19:23	17:27	17:00
6	08:33	08:07	07:20	07:19	06:26	05:55	06:00	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:45	21:16	20:21	19:21	17:26	17:00
7	08:33	08:06	07:18	07:17	06:24	05:54	06:01	06:34	07:14	07:54	07:38	08:19
	17:15	17:59	18:40	20:23	21:04	21:39	21:45	21:14	20:19	19:19	17:24	16:59
8	08:33	08:04	08:16	07:15	06:23	05:54	06:01	06:35	07:16	07:55	07:40	08:20
	17:17	18:01	18:41	20:25	21:05	21:39	21:44	21:13	20:17	19:17	17:23	16:59
9	08:32	08:03	08:14	07:13	06:22	05:54	06:02	06:37	07:17	07:57	07:41	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:44	21:11	20:15	19:15	17:21	16:59
10	08:32	08:01	08:12	07:11	06:20	05:53	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:27	21:08	21:41	21:43	21:10	20:13	19:13	17:20	16:59
11	08:32	08:00	08:10	07:09	06:19	05:53	06:04	06:39	07:19	07:59	07:44	08:23
	17:20	18:04	19:46	20:29	21:09	21:42	21:43	21:08	20:11	19:11	17:19	16:59
12	08:31	07:58	08:08	07:07	06:17	05:53	06:05	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:42	21:06	20:09	19:09	17:18	16:59
13	08:31	07:57	08:06	07:05	06:16	05:53	06:06	06:42	07:22	08:02	07:47	08:25
	17:23	18:07	19:48	20:31	21:12	21:43	21:42	21:05	20:07	19:08	17:16	16:59
14	08:30	07:55	08:04	07:03	06:15	05:53	06:07	06:43	07:23	08:04	07:49	08:25
	17:24	18:08	19:50	20:33	21:13	21:43	21:41	21:03	20:05	19:06	17:15	16:59
15	08:30	07:53	08:02	07:02	06:14	05:52	06:08	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:44	21:40	21:01	20:03	19:04	17:14	16:59
16	08:29	07:52	08:00	07:00	06:12	05:52	06:09	06:46	07:26	08:06	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:40	21:00	20:01	19:02	17:13	16:59
17	08:28	07:50	07:58	06:58	06:11	05:52	06:10	06:47	07:27	08:08	07:53	08:28
	17:28	18:13	19:54	20:37	21:17	21:45	21:39	20:58	19:59	19:00	17:12	17:00
18	08:28	07:49	07:56	06:56	06:10	05:52	06:11	06:48	07:29	08:09	07:55	08:28
	17:29	18:15	19:56	20:38	21:18	21:45	21:38	20:56	19:57	18:56	17:11	17:00
19	08:27	07:47	07:54	06:54	06:09	05:53	06:12	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:19	21:45	21:37	20:55	19:55	18:55	17:10	17:00
20	08:26	07:45	07:52	06:52	06:08	05:53	06:13	06:51	07:31	08:12	07:57	08:30
	17:32	18:18	19:58	20:41	21:21	21:46	21:36	20:53	19:53	18:53	17:09	17:01
21	08:25	07:43	07:50	06:51	06:07	05:53	06:14	06:52	07:32	08:13	07:59	08:30
	17:34	18:19	20:00	20:42	21:22	21:46	21:35	20:51	19:51	18:51	17:08	17:01
22	08:24	07:42	07:48	06:49	06:06	05:53	06:15	06:53	07:34	08:15	08:00	08:31
	17:35	18:21	20:01	20:44	21:23	21:46	21:34	20:49	19:49	18:49	17:07	17:02
23	08:23	07:40	07:46	06:47	06:05	05:53	06:16	06:55	07:35	08:16	08:02	08:31
	17:36	18:22	20:03	20:45	21:24	21:46	21:33	20:48	19:47	18:48	17:06	17:02
24	08:22	07:38	07:44	06:45	06:04	05:54	06:17	06:56	07:36	08:18	08:03	08:32
	17:38	18:24	20:04	20:47	21:25	21:47	21:32	20:46	19:45	18:46	17:06	17:03
25	08:21	07:36	07:42	06:44	06:03	05:54	06:18	06:57	07:38	08:19	08:04	08:32
	17:39	18:25	20:05	20:48	21:26	21:47	21:31	20:44	19:43	18:44	17:05	17:03
26	08:20	07:35	07:40	06:42	06:02	05:54	06:19	06:59	07:39	08:21	08:06	08:32
	17:41	18:27	20:07	20:49	21:27	21:47	21:30	20:42	19:41	18:43	17:04	17:04
27	08:19	07:33	07:38	06:40	06:01	05:55	06:21	07:00	07:40	08:22	08:07	08:33
	17:42	18:28	20:08	20:51	21:28	21:47	21:29	20:40	19:39	18:41	17:04	17:05
28	08:18	07:31	07:36	06:38	06:00	05:55	06:22	07:01	07:42	08:24	08:08	08:33
	17:44	18:30	20:09	20:52	21:30	21:47	21:28	20:38	19:37	18:39	17:03	17:06
29	08:17		07:34	06:37	05:59	05:56	06:23	07:03	07:43	08:25	08:09	08:33
	17:45		20:11	20:53	21:31	21:47	21:26	20:36	19:35	18:38	17:02	17:06
30	08:16		07:32	06:35	05:59	05:56	06:24	07:04	07:44	08:27	08:11	08:33
	17:47		20:12	20:55	21:32	21:47	21:25	20:35	19:33	18:36	17:02	17:07
31	08:15		07:30		05:58		06:25	07:05		08:28		08:34
	17:48		20:14		21:33		21:24	20:33		18:34		17:08
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	267
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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: U163 - U163

Assumptions for shadow calculations

Maximum distance for influence: 1,500 m
Minimum sun height over horizon for influence: 3 degrees
Day step for calculation: 1 days
Time step for calculation: 1 minutes

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

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability data. Includes a row for 'Operational time' with directional breakdown (N, NNE, etc.) and a row for 'Idle start wind speed: Cut in wind speed from power curve'.

Main shadow calculation table with 12 columns for months (January-December) and 31 rows for days. Columns contain start and end times for shadow events. Summary rows at the bottom show 'Potential sun hours' and 'Sum of minutes with flicker' for each month.

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

Matrix defining columns for 'Day in month', 'Sun rise (hh:mm)', 'Sun set (hh:mm)', 'First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker', and 'First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker'.

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U164 - U164**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.20	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
514	268	214	273	371	417	806	820	553	328	242	422	667	1,016	1,021	703	8,635

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

	January	February	March	April	May	June
1	08:34 09:06-09:32/26	08:14	07:29 07:55-09:01/66	07:29	06:34	05:58
	17:09	17:50	18:31 09:01-09:02/1	20:15	20:56	21:34
2	08:34 09:07-09:32/25	08:12	07:27 07:54-08:59/65	07:27	06:32	05:57
	17:10	17:52	18:33	20:16	20:58	21:35
3	08:34 09:07-09:33/26	08:11	07:25 07:53-08:59/66	07:25	06:31	05:56
	17:11	17:53	18:34	20:18	20:59	21:35
4	08:34 09:08-09:34/26	08:10	07:24 07:52-08:58/66	07:23	06:29	05:56
	17:12	17:55	18:36	20:19	21:00	21:36
5	08:34 09:07-09:33/26	08:08 08:47-08:58/11	07:22 07:52-08:19/27	07:21	06:27	05:55
	17:13	17:56	18:37 08:20-08:57/37	20:21	21:02	21:37
6	08:33 09:08-09:34/26	08:07 08:44-09:02/18	07:20 07:52-08:19/27	07:19	06:26	05:55
	17:14	17:58	18:39 08:20-08:56/36	20:22	21:03	21:38
7	08:33 09:09-09:35/26	08:06 08:42-09:04/22	07:18 07:52-08:18/26	07:17	06:25	05:54
	17:16	17:59	18:40 08:21-08:55/34	20:23	21:04	21:39
8	08:33 09:08-09:35/27	08:04 08:41-09:06/25	08:16 08:52-09:18/26	07:15	06:23	05:54
	17:17	18:01	18:41 09:21-09:53/32	20:25	21:06	21:40
9	08:33 09:09-09:36/27	08:03 08:39-09:07/28	08:14 08:52-09:17/25	07:13	06:22	05:54
	17:18	18:01	19:43 09:23-09:51/28	20:26	21:07	21:40
10	08:32 09:10-09:36/26	08:01 08:38-09:09/31	08:12 08:53-09:16/23	07:11	06:20	05:53
	17:19	18:02	19:44 09:24-09:49/25	20:27	21:08	21:41
11	08:32 09:10-09:36/26	08:00 08:37-09:09/32	08:10 08:54-09:14/20	07:09	06:19	05:53
	17:20	18:04	19:46 09:26-09:47/21	20:29	21:09	21:42
12	08:31 09:11-09:37/26	07:58 08:37-09:11/34	08:08 08:56-09:13/17	07:07	06:18	05:53
	17:22	18:06	19:47 09:29-09:43/14	20:30	21:11	21:42
13	08:31 09:11-09:37/26	07:57 08:36-09:11/35	08:06 08:58-09:10/12	07:05	06:16	05:53
	17:23	18:07	19:49	20:32	21:12	21:43
14	08:30 09:12-09:37/25	07:55 08:35-08:44/9	08:04	07:04	06:15	05:53
	17:24	18:09 08:44-09:11/27	19:50	20:33	21:13	21:43
15	08:30 09:13-09:37/24	07:54 08:33-08:50/17	08:02	07:02	06:14	05:53
	17:25	18:10 08:50-09:12/22	19:51	20:34	21:15	21:44
16	08:29 09:13-09:37/24	07:52 08:30-08:52/22	08:00	07:00	06:12	05:53
	17:27	18:12 08:52-09:12/20	19:53	20:36	21:16	21:44
17	08:28 09:14-09:37/23	07:50 08:28-08:54/26	07:58	06:58	06:11	05:53
	17:28	18:13 08:54-09:12/18	19:54	20:37	21:17	21:45
18	08:28 09:14-09:36/22	07:49 08:27-08:56/29	07:56	06:56	06:10	05:53
	17:30	18:15 08:56-09:13/17	19:56	20:38	21:18	21:45
19	08:27 09:15-09:36/21	07:47 08:25-08:57/32	07:54	06:54	06:09	05:53
	17:31	18:16 08:57-09:12/15	19:57	20:40	21:19	21:46
20	08:26 09:16-09:35/19	07:45 08:24-08:58/34	07:52	06:52	06:08	05:53
	17:32	18:18 08:58-09:12/14	19:58	20:41	21:21	21:46
21	08:25 09:18-09:36/18	07:43 08:22-08:59/37	07:50	06:51	06:07	05:53
	17:34	18:19 08:59-09:11/12	20:00	20:43	21:22	21:46
22	08:24 09:20-09:34/14	07:42 08:22-09:00/38	07:48	06:49	06:06	05:53
	17:35	18:21 09:00-09:11/11	20:01	20:44	21:23	21:46
23	08:24 09:22-09:33/11	07:40 08:21-09:01/40	07:46	06:47	06:05	05:53
	17:37	18:22 09:01-09:11/10	20:03	20:45	21:24	21:47
24	08:23 09:25-09:30/5	07:38 08:21-09:01/40	07:44	06:45	06:04	05:54
	17:38	18:24 09:01-09:10/9	20:04	20:47	21:25	21:47
25	08:22	07:36 08:02-08:12/10 09:01-09:08/7	07:42	06:44	06:03	05:54
	17:40	18:25 08:20-09:01/41	20:05	20:48	21:26	21:47
26	08:21	07:35 07:59-08:15/16 09:01-09:07/6	07:40	06:42	06:02	05:54
	17:41	18:27 08:19-09:01/42	20:07	20:49	21:27	21:47
27	08:19	07:33 07:58-08:17/19 09:02-09:06/4	07:38	06:40	06:01	05:55
	17:43	18:28 08:20-09:02/42	20:08	20:51	21:29	21:47
28	08:18	07:31 07:56-08:18/22 09:01-09:04/3	07:37	06:39	06:00	05:55
	17:44	18:30 08:19-09:01/42	20:10	20:52	21:30	21:47
29	08:17		07:35	06:37	06:00	05:56
	17:46		20:11	20:53	21:31	21:47
30	08:16		07:33	06:35	05:59	05:56
	17:47		20:12	20:55	21:32	21:47
31	08:15		07:31		05:58	
	17:49		20:14		21:33	
Potential sun hours	279	288	368	407	466	474
Sum of minutes with flicker	545	989	694	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:
ALLETE Wind
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 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U164 - U164**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December
1	05:57 21:47	06:27 21:23	07:07 20:31	07:46 19:31	08:35-08:51/16 09:10-09:21/11	07:30 17:01
2	05:57 21:46	06:28 21:21	07:08 20:29	07:47 19:29	08:33-08:52/19 09:06-09:24/18	07:31 17:01
3	05:58 21:46	06:29 21:20	07:09 20:27	07:49 19:27	08:32-08:54/22 09:04-09:27/23	07:33 17:01
4	05:59 21:46	06:30 21:18	07:10 20:25	07:50 19:25	08:30-08:54/24 09:01-09:28/27	07:34 17:00
5	05:59 21:46	06:32 21:17	07:12 20:23	07:51 19:23	08:29-08:54/25 08:59-09:29/30	07:36 17:00
6	06:00 21:45	06:33 21:16	07:13 20:21	07:53 19:21	08:29-08:55/26 08:58-09:31/33	07:37 17:00
7	06:01 21:45	06:34 21:14	07:14 20:19	07:54 19:19	08:28-08:55/27 08:56-09:31/35	07:39 16:59
8	06:02 21:45	06:35 21:13	07:16 20:17	07:55 19:17	08:28-08:55/27 08:56-09:32/36	07:40 16:59
9	06:02 21:44	06:37 21:11	07:17 20:15	07:57 19:15	08:27-09:33/66 08:27-09:32/65	07:41 16:59
10	06:03 21:44	06:38 21:10	07:18 20:13	07:58 19:13	08:27-09:33/66 08:27-09:33/66	07:43 16:59
11	06:04 21:43	06:39 21:08	07:20 20:11	07:59 19:11	08:27-09:33/66 08:27-09:33/66	07:44 16:59
12	06:05 21:42	06:41 21:06	07:21 20:09	08:01 19:10	08:27-09:33/66 08:28-09:34/66	07:46 16:59
13	06:06 21:42	06:42 21:05	07:22 20:07	08:02 19:08	08:28-09:34/66 09:34-09:37/3	07:47 16:59
14	06:07 21:41	06:43 21:03	07:23 20:05	08:04 19:06	08:29-08:50/21 08:52-09:34/42	07:49 16:59
15	06:08 21:40	06:44 21:02	07:25 20:03	08:05 19:04	08:31-08:49/18 08:52-09:34/42	07:50 16:59
16	06:09 21:40	06:46 21:00	07:26 20:01	08:06 19:02	08:32-08:46/14 08:52-09:33/41	07:52 16:59
17	06:10 21:39	06:47 20:58	07:27 19:59	08:08 19:00	08:36-08:43/7 08:52-09:33/41	07:53 16:59
18	06:11 21:38	06:48 20:56	07:29 19:57	08:09 18:57	08:52-09:32/40 09:32-09:41/9	07:55 16:59
19	06:12 21:37	06:50 20:55	07:30 19:55	08:11 18:55	08:53-09:32/39 09:32-09:42/10	07:56 16:59
20	06:13 21:36	06:51 20:53	07:31 19:53	08:12 18:53	08:53-09:31/38 09:31-09:42/11	07:57 16:59
21	06:14 21:35	06:52 20:51	07:33 19:51	08:14 18:51	08:54-09:30/36 09:30-09:43/13	07:59 16:59
22	06:15 21:34	06:54 20:49	07:34 19:49	08:15 18:49	08:54-09:28/34 09:28-09:42/14	08:00 16:59
23	06:16 21:33	06:55 20:48	07:35 19:47	08:16 18:48	08:56-09:28/32 09:28-09:43/15	08:02 16:59
24	06:17 21:32	06:56 20:46	07:37 19:45	08:18 18:46	08:57-09:26/29 09:26-09:42/16	08:03 16:59
25	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:59-09:24/25 09:24-09:42/18	08:04 16:59
26	06:19 21:30	06:59 20:42	07:39 19:41	08:21 18:43	09:00-09:21/21 09:21-09:42/21	08:06 16:59
27	06:21 21:29	07:00 20:40	07:41 19:39	08:22 18:41	09:04-09:19/15 09:19-09:42/23	08:07 16:59
28	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	09:05-09:41/36 09:05-09:41/36	08:08 16:59
29	06:23 21:26	07:03 20:37	07:43 19:35	08:25 18:38	09:05-09:40/35 09:05-09:40/35	08:10 16:59
30	06:24 21:25	07:04 20:35	07:45 19:33	08:27 18:36	09:06-09:39/33 09:06-09:39/33	08:11 16:59
31	06:25 21:24	07:05 20:33		08:28 18:35	09:07-09:39/32 09:07-09:39/32	08:12 16:59
Potential sun hours	480	441	378	339	282	267
Sum of minutes with flicker	0	0	10	1574	387	780

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: ALLETE Wind
ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout WTG: U166 - U166

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and rows for each day of the month, showing sun rise and set times in hh:mm format. Includes summary rows for Potential sun hours and Sum of minutes with flicker.

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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 Duluth, Minnesota 55802

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SHADOW - Calendar per WTG

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout **WTG: U167 - U167**

Assumptions for shadow calculations

Maximum distance for influence 1,500 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69
 Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 514 268 214 273 371 417 806 820 553 328 242 422 667 1,016 1,021 703 8,635
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:34 17:09	08:14 17:50	07:29 18:31	07:29 20:15	06:34 20:56	05:57 21:34	05:57 21:47	06:27 21:23	07:06 20:31	07:46 19:31	07:30 17:33	08:12 17:01
2	08:34 17:10	08:12 17:52	07:27 18:33	07:27 20:16	06:32 20:57	05:57 21:34	05:57 21:46	06:28 21:21	07:08 20:29	07:47 19:29	07:31 17:31	08:13 17:01
3	08:34 17:11	08:11 17:53	07:25 18:34	07:25 20:18	06:30 20:59	05:56 21:35	05:58 21:46	06:29 21:20	07:09 20:27	07:48 19:27	07:33 17:30	08:14 17:01
4	08:34 17:12	08:10 17:55	07:23 18:36	07:23 20:19	06:29 21:00	05:56 21:36	05:59 21:46	06:30 21:18	07:10 20:25	07:50 19:25	07:34 17:28	08:16 17:00
5	08:33 17:13	08:08 17:56	07:22 18:37	07:21 20:21	06:27 21:02	05:55 21:37	05:59 21:46	06:32 21:17	07:12 20:23	07:51 19:23	07:36 17:27	08:17 17:00
6	08:33 17:14	08:07 17:58	07:20 18:38	07:19 20:22	06:26 21:03	05:55 21:38	06:00 21:45	06:33 21:16	07:13 20:21	07:53 19:21	07:37 17:26	08:18 17:00
7	08:33 17:15	08:06 17:59	07:18 18:40	07:17 20:23	06:24 21:04	05:54 21:39	06:01 21:45	06:34 21:14	07:14 20:19	07:54 19:19	07:38 17:24	08:19 16:59
8	08:33 17:17	08:04 18:01	08:16 18:41	07:15 20:25	06:23 21:05	05:54 21:39	06:01 21:44	06:35 21:13	07:16 20:17	07:55 19:17	07:40 17:23	08:20 16:59
9	08:32 17:18	08:03 18:01	08:14 19:43	07:13 20:26	06:22 21:07	05:54 21:40	06:02 21:44	06:37 21:11	07:17 20:15	07:57 19:15	07:41 17:22	08:21 16:59
10	08:32 17:19	08:01 18:02	08:12 19:44	07:11 20:27	06:20 21:08	05:53 21:41	06:03 21:43	06:38 21:10	07:18 20:13	07:58 19:13	07:43 17:20	08:22 16:59
11	08:32 17:20	08:00 18:04	08:10 19:46	07:09 20:29	06:19 21:09	05:53 21:42	06:04 21:43	06:39 21:08	07:19 20:11	07:59 19:11	07:44 17:19	08:23 16:59
12	08:31 17:21	07:58 18:05	08:08 19:47	07:07 20:30	06:17 21:11	05:53 21:42	06:05 21:42	06:40 21:06	07:21 20:09	08:01 19:10	07:46 17:18	08:24 16:59
13	08:31 17:23	07:57 18:07	08:06 19:49	07:05 20:32	06:16 21:12	05:53 21:43	06:06 21:42	06:42 21:05	07:22 20:07	08:02 19:08	07:47 17:17	08:25 16:59
14	08:30 17:24	07:55 18:09	08:04 19:50	07:03 20:33	06:15 21:13	05:53 21:43	06:07 21:41	06:43 21:03	07:23 20:05	08:04 19:06	07:49 17:15	08:26 16:59
15	08:30 17:25	07:53 18:10	08:02 19:51	07:02 20:34	06:14 21:15	05:53 21:44	06:08 21:40	06:44 21:01	07:25 20:03	08:05 19:04	07:50 17:14	08:26 16:59
16	08:29 17:27	07:52 18:12	08:00 19:53	07:00 20:36	06:12 21:16	05:52 21:44	06:09 21:40	06:46 21:00	07:26 20:01	08:06 19:02	07:52 17:13	08:27 17:00
17	08:28 17:28	07:50 18:13	07:58 19:54	06:58 20:37	06:11 21:17	05:52 21:45	06:10 21:39	06:47 20:58	07:27 19:59	08:08 19:00	07:53 17:12	08:28 17:00
18	08:28 17:29	07:49 18:15	07:56 19:56	06:56 20:38	06:10 21:18	05:53 21:45	06:11 21:38	06:48 20:56	07:29 19:57	08:09 18:56	07:55 17:11	08:29 17:00
19	08:27 17:31	07:47 18:16	07:54 19:57	06:54 20:40	06:09 21:19	05:53 21:45	06:12 21:37	06:50 20:55	07:30 19:55	08:11 18:55	07:56 17:10	08:29 17:00
20	08:26 17:32	07:45 18:18	07:52 19:58	06:52 20:41	06:08 21:21	05:53 21:46	06:13 21:36	06:51 20:53	07:31 19:53	08:12 18:53	07:57 17:09	08:30 17:01
21	08:25 17:34	07:43 18:19	07:50 20:00	06:51 20:43	06:07 21:22	05:53 21:46	06:14 21:35	06:52 20:51	07:33 19:51	08:14 18:51	07:59 17:08	08:30 17:01
22	08:24 17:35	07:42 18:21	07:48 20:01	06:49 20:44	06:06 21:23	05:53 21:46	06:15 21:34	06:53 20:49	07:34 19:49	08:15 18:49	08:00 17:07	08:31 17:02
23	08:23 17:37	07:40 18:22	07:46 20:03	06:47 20:45	06:05 21:24	05:53 21:47	06:16 21:33	06:55 20:48	07:35 19:47	08:16 18:48	08:02 17:07	08:31 17:02
24	08:23 17:38	07:38 18:24	07:44 20:04	06:45 20:47	06:04 21:25	05:54 21:47	06:17 21:32	06:56 20:46	07:36 19:45	08:18 18:46	08:03 17:06	08:32 17:03
25	08:22 17:39	07:36 18:25	07:42 20:05	06:44 20:48	06:03 21:26	05:54 21:47	06:18 21:31	06:57 20:44	07:38 19:43	08:19 18:44	08:04 17:05	08:32 17:04
26	08:21 17:41	07:35 18:27	07:40 20:07	06:42 20:49	06:02 21:27	05:54 21:47	06:19 21:30	06:59 20:42	07:39 19:41	08:21 18:43	08:06 17:04	08:33 17:04
27	08:19 17:42	07:33 18:28	07:38 20:08	06:40 20:51	06:01 21:29	05:55 21:47	06:21 21:29	07:00 20:40	07:40 19:39	08:22 18:41	08:07 17:04	08:33 17:05
28	08:18 17:44	07:31 18:30	07:36 20:09	06:39 20:52	06:00 21:30	05:55 21:47	06:22 21:28	07:01 20:38	07:42 19:37	08:24 18:39	08:08 17:03	08:33 17:06
29	08:17 17:45	07:30 18:20	07:34 20:11	06:37 20:53	06:00 21:31	05:56 21:47	06:23 21:26	07:03 20:36	07:43 19:35	08:25 18:38	08:10 17:02	08:33 17:06
30	08:16 17:47	07:29 18:12	07:32 20:12	06:35 20:55	05:59 21:32	05:56 21:47	06:24 21:25	07:04 20:35	07:44 19:33	08:27 18:36	08:11 17:02	08:33 17:07
31	08:15 17:49	07:28 18:04	07:31 20:14	06:34 20:55	05:58 21:33	05:56 21:47	06:25 21:24	07:05 20:33	07:45 19:35	08:28 18:35	08:10 17:02	08:34 17:08
Potential sun hours	279	288	368	407	466	474	480	441	378	339	282	267
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:

ALLETE Wind
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 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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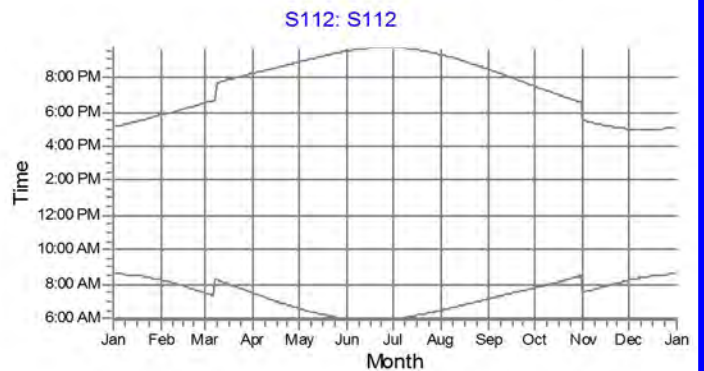
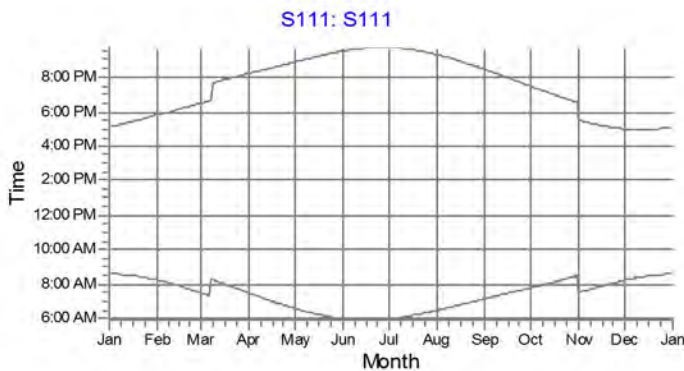
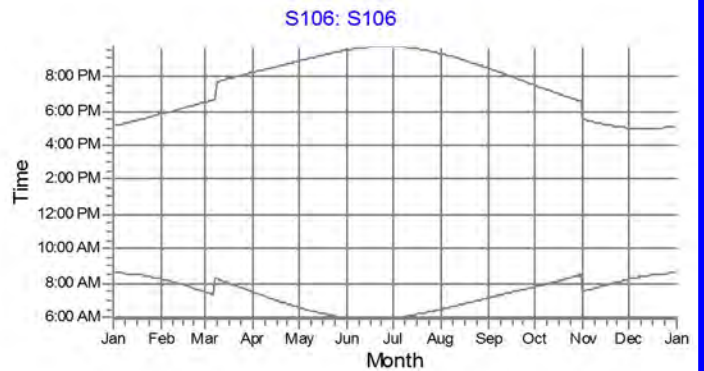
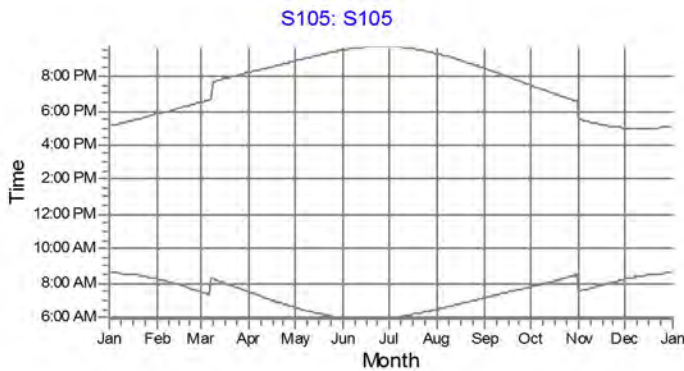
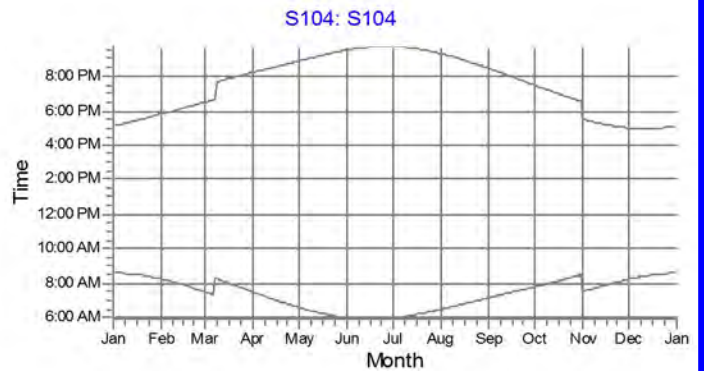
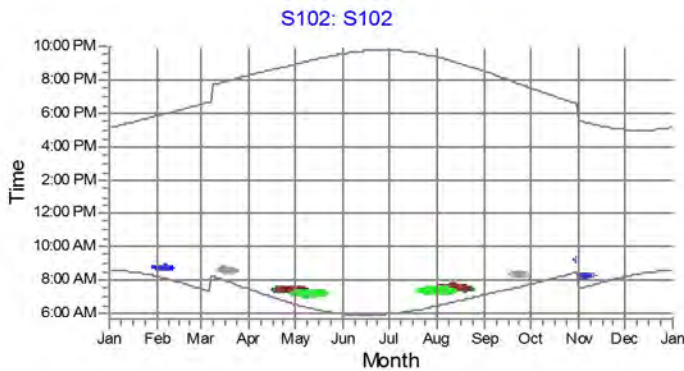
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

- SR001: SR001
- SR003: SR003
- SR004: SR004
- SR008: SR008
- SR009: SR009

Project:

ALLETE Wind

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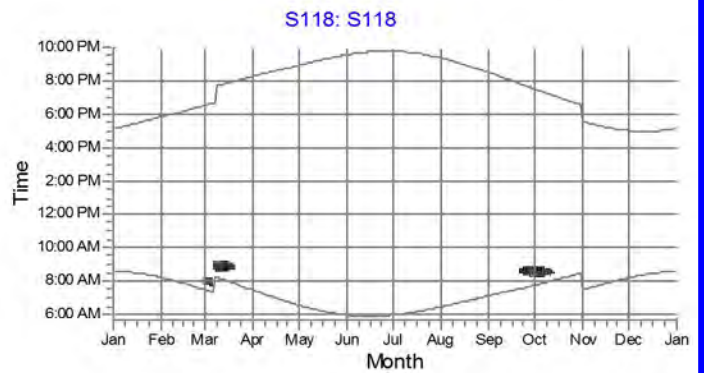
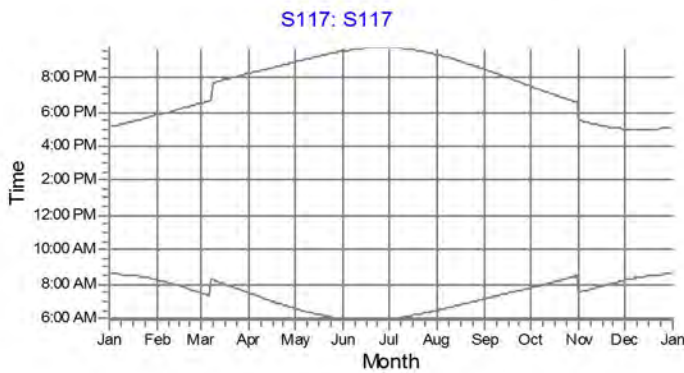
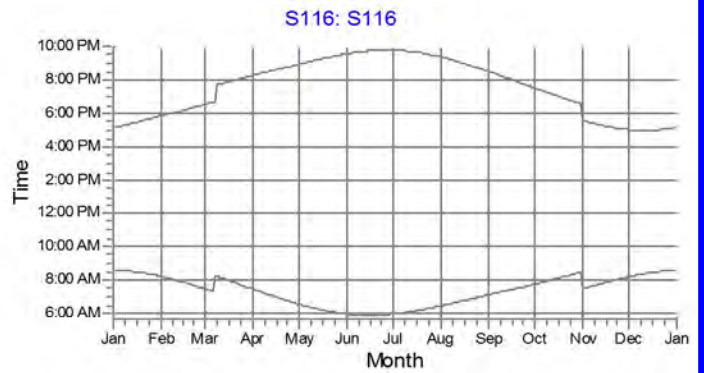
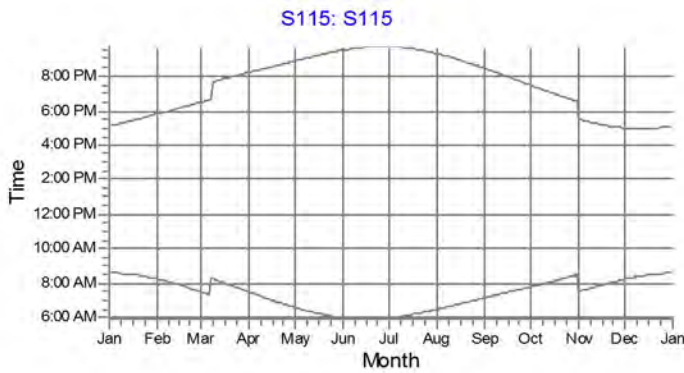
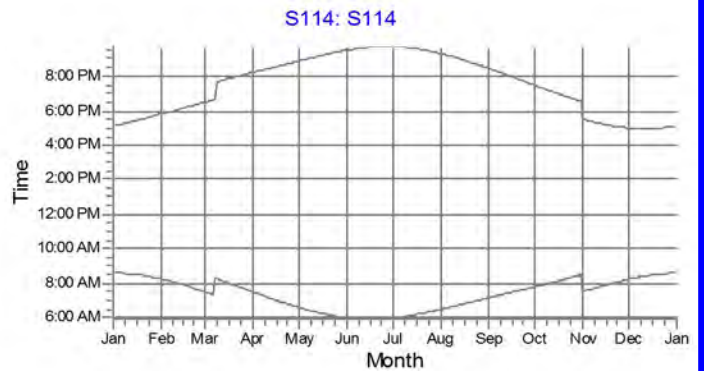
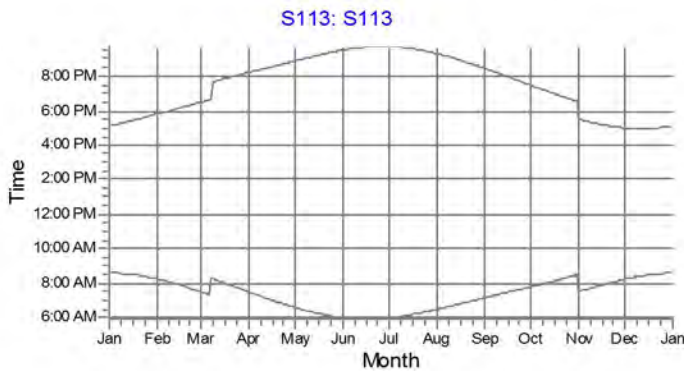
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

SR014: SR014 SR017: SR017

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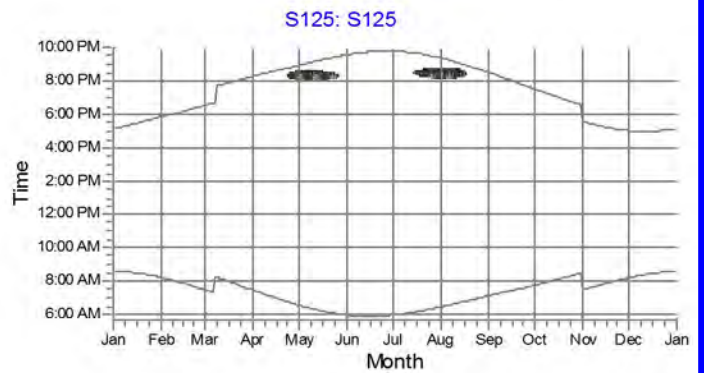
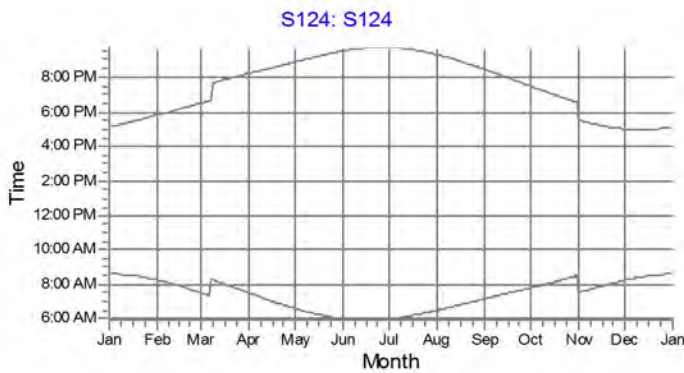
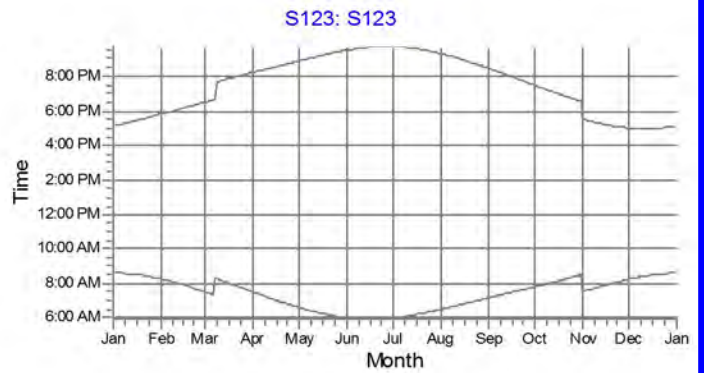
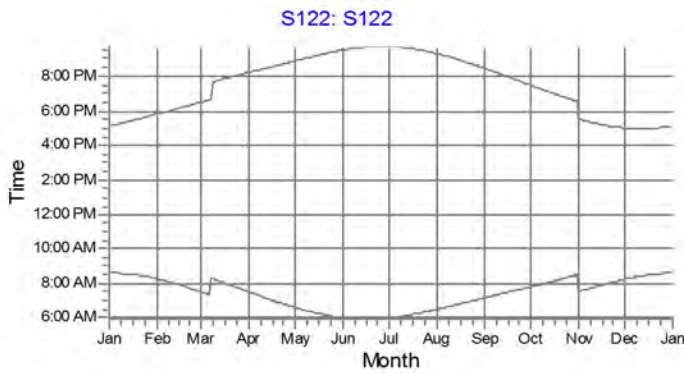
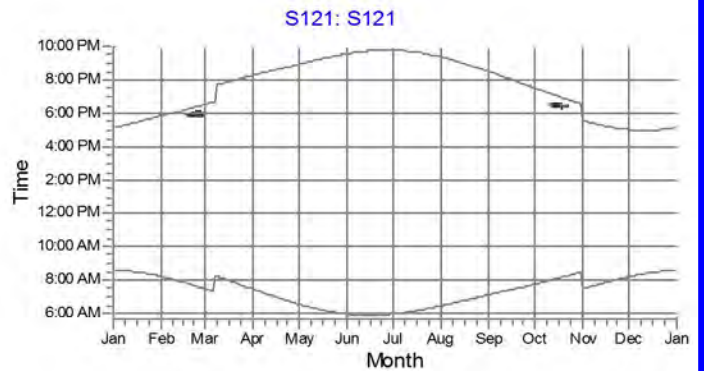
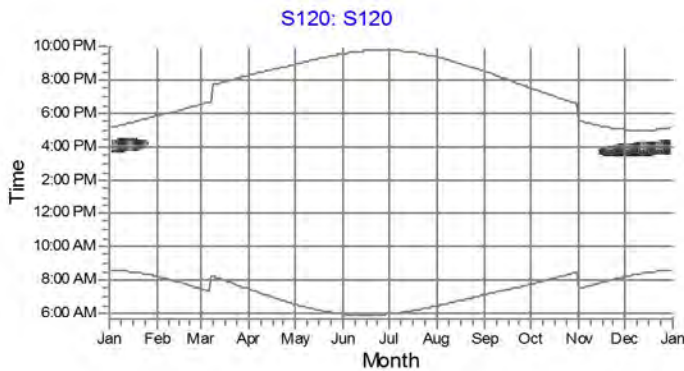
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

SR014: SR014

Project:

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 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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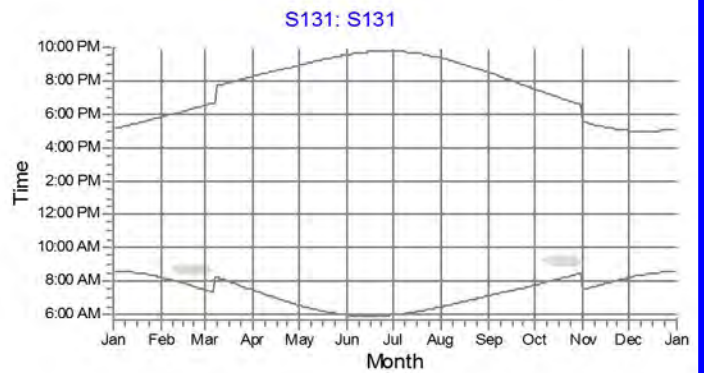
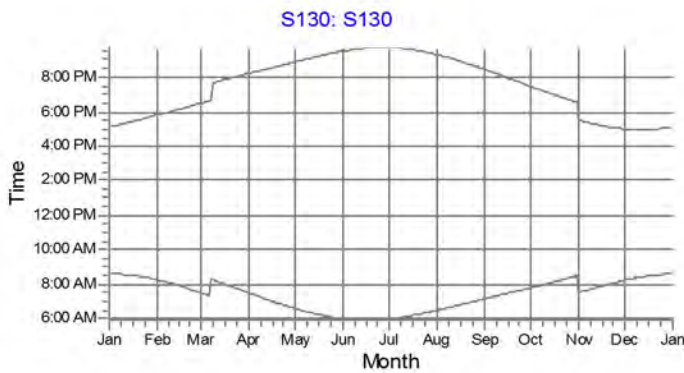
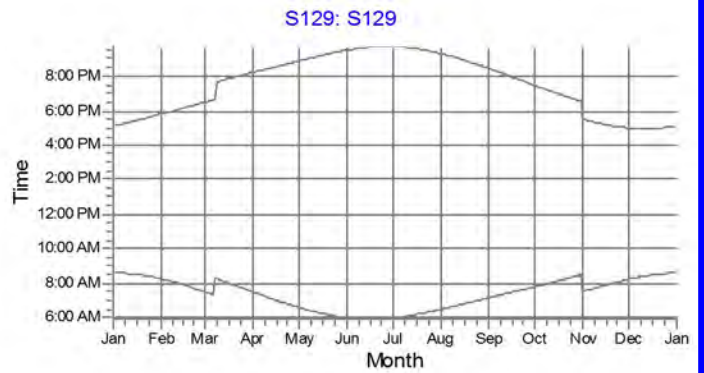
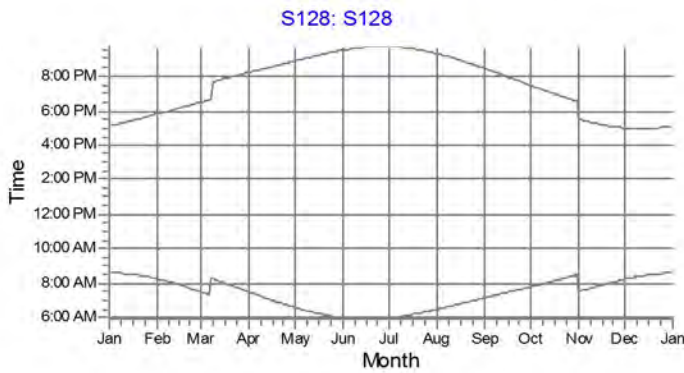
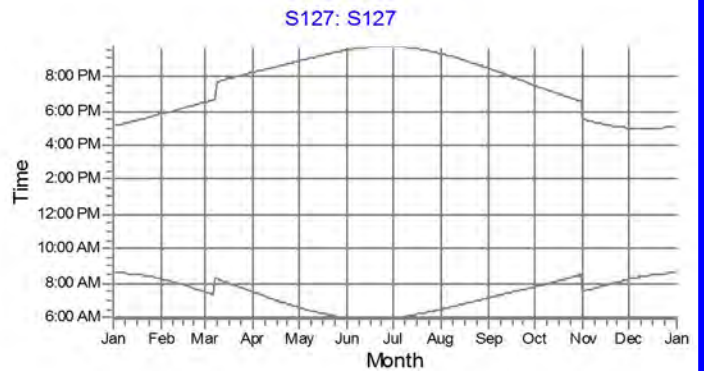
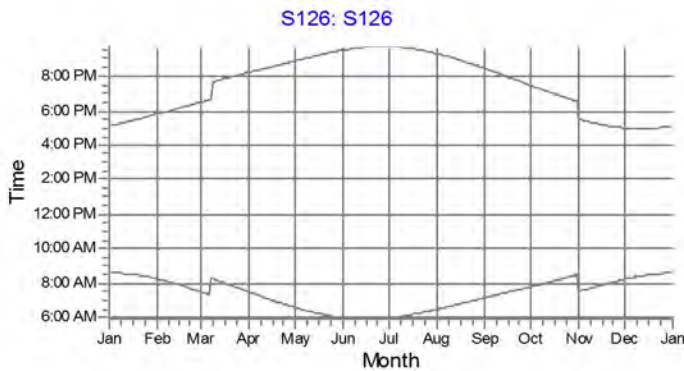
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

SR015: SR015

Project:

ALLETE Wind

ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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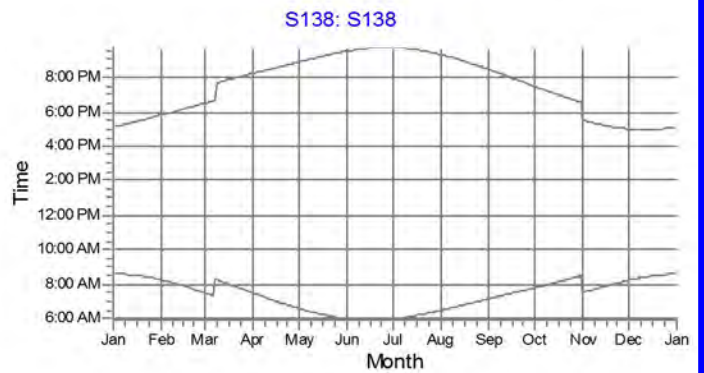
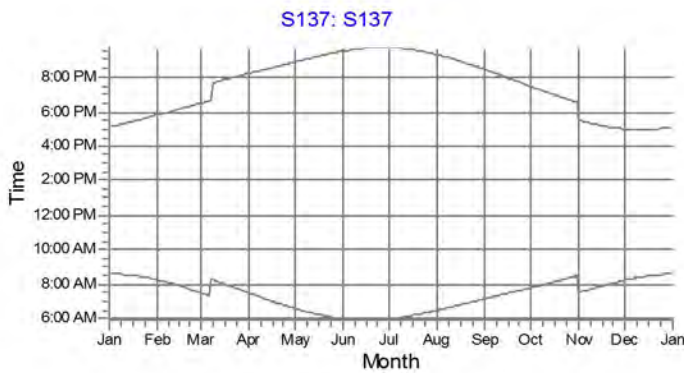
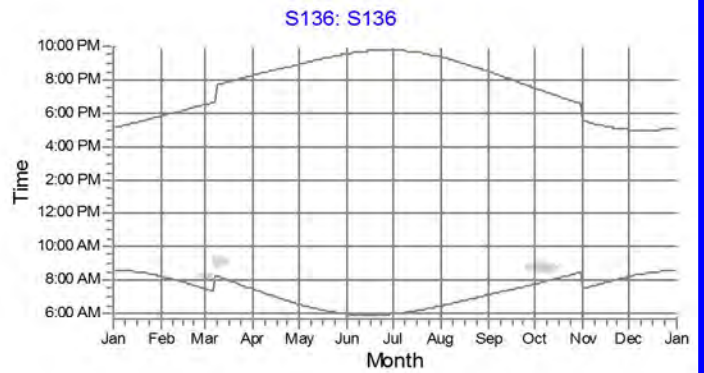
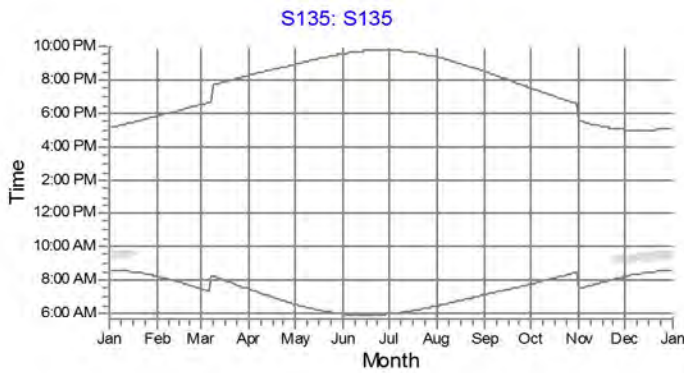
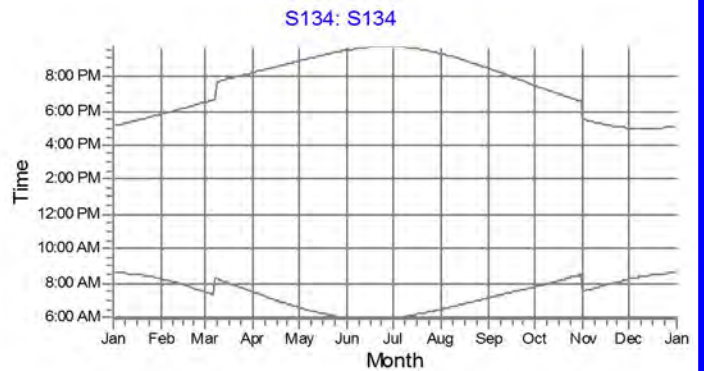
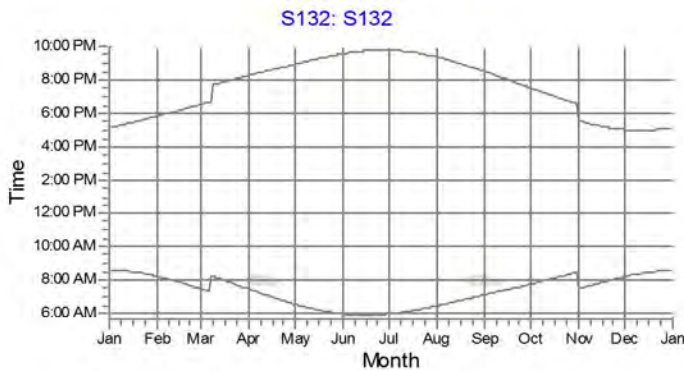
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

SR015: SR015 SR027: SR027

Project:

ALLETE Wind

ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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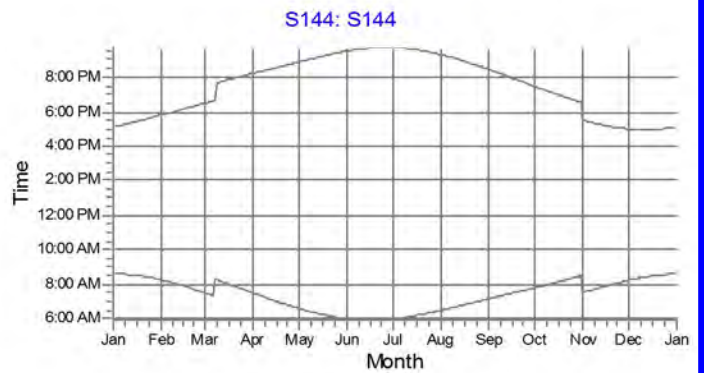
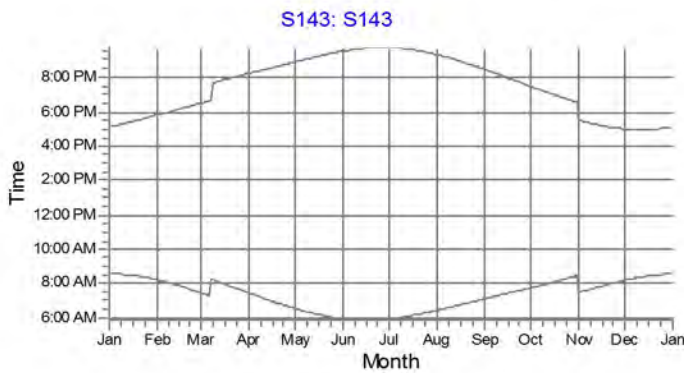
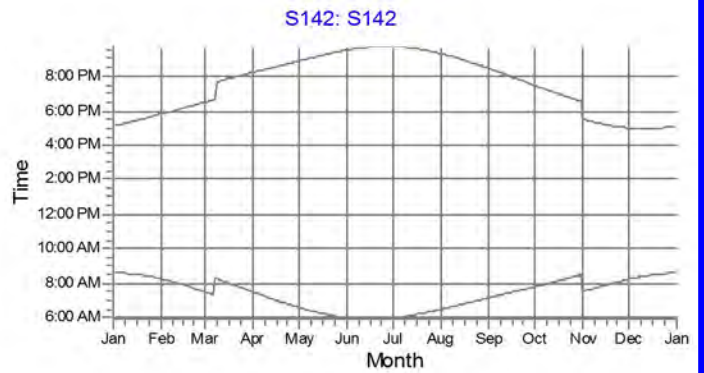
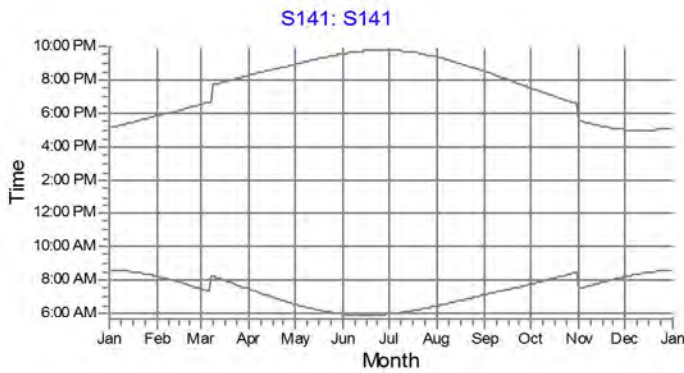
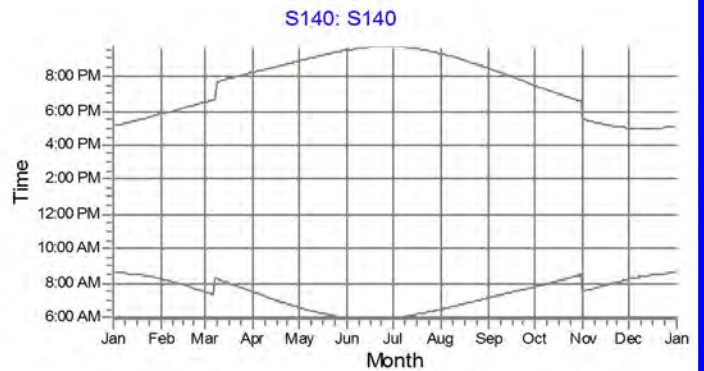
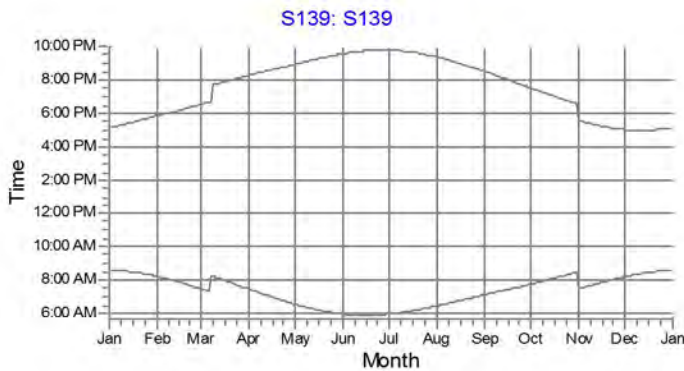
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

SR017: SR017

Project:

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 ALLETE Wind
 Dwight Anderson
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 Duluth, Minnesota 55802

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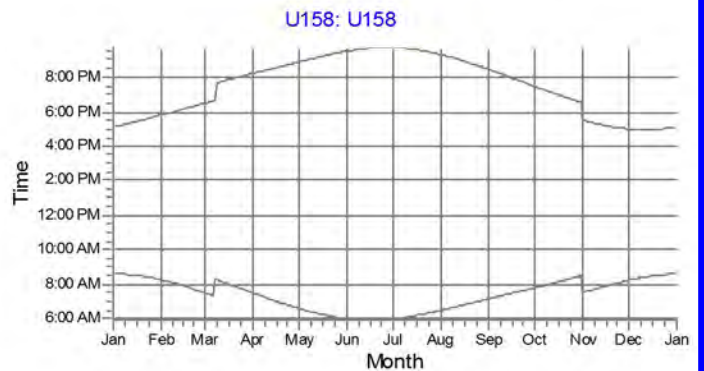
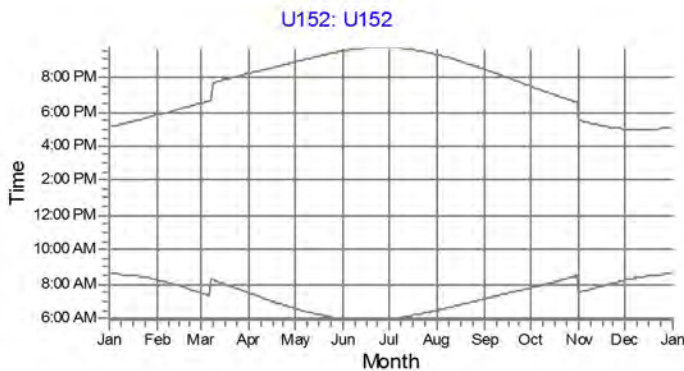
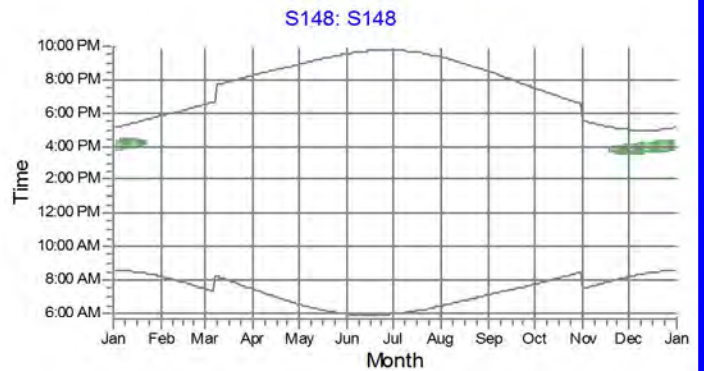
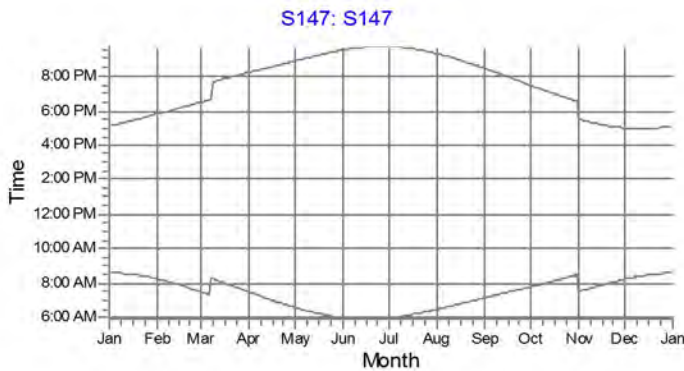
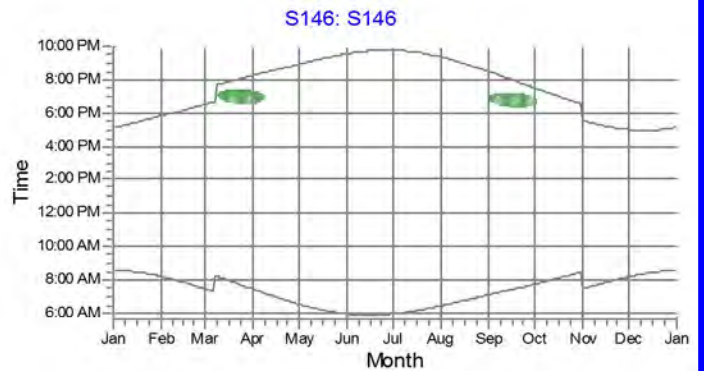
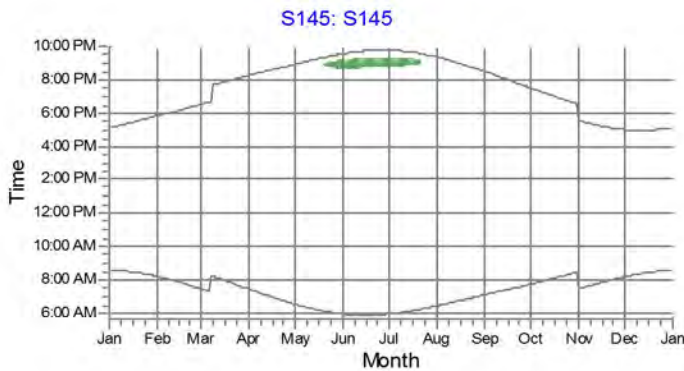
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

 SR022: SR022

Project:

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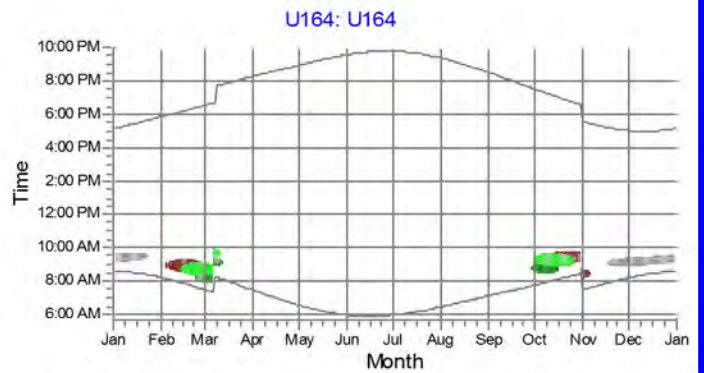
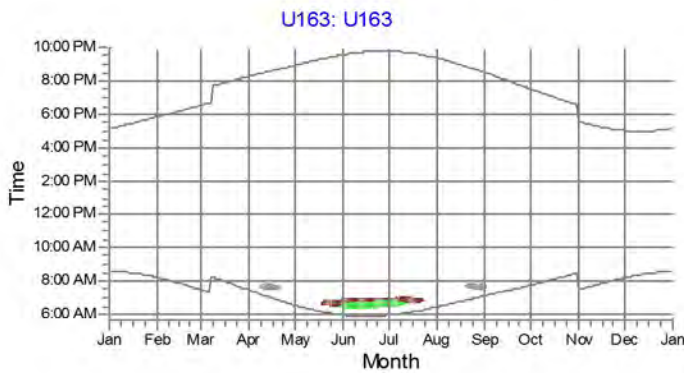
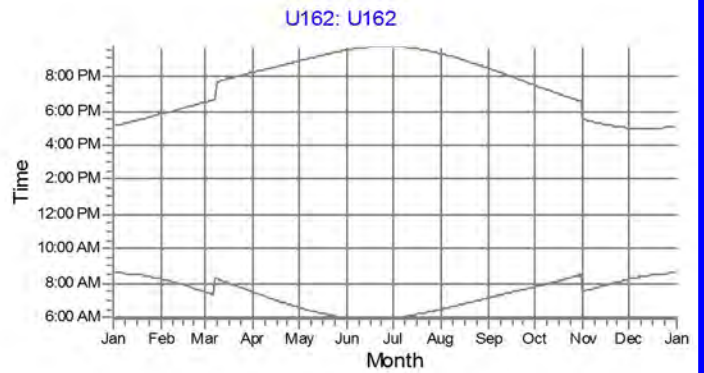
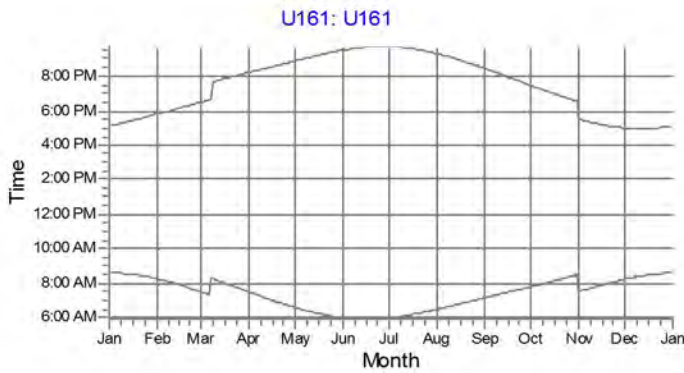
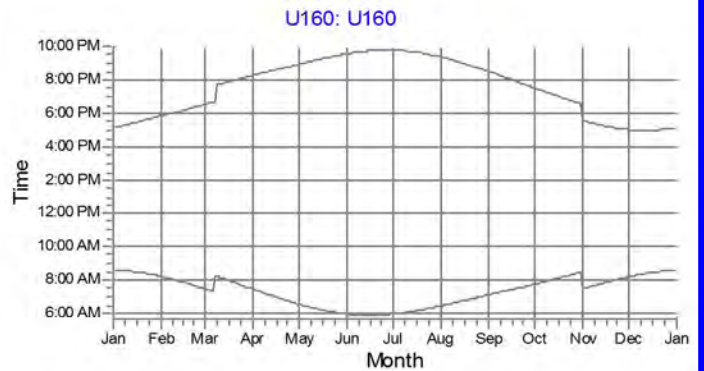
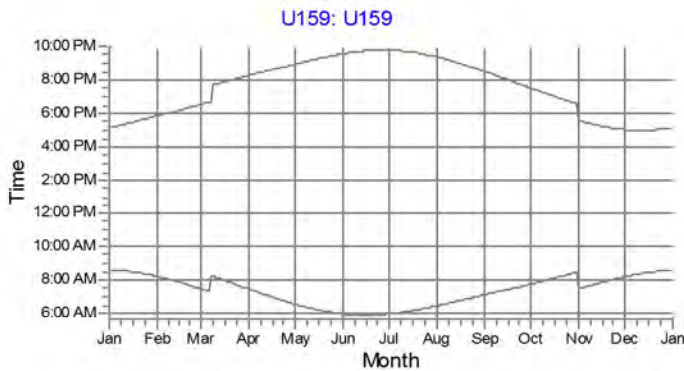
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

- SR001: SR001
- SR004: SR004
- SR008: SR008
- SR009: SR009
- SR017: SR017

Project:

ALLETE Wind
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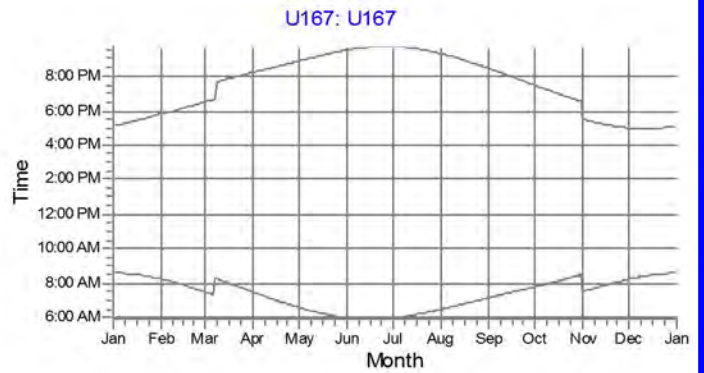
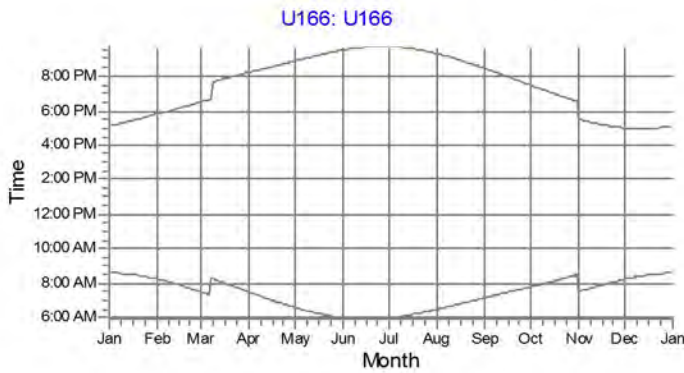
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SHADOW - Calendar per WTG, graphical

Calculation: ACE #1 - Generic Turbine - 120 m Rotor/90 m Hub - 110 m Class Layout



Shadow receptor

Appendix I - Sound Report

Project:
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Duluth, Minnesota 55802

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DECIBEL - Main Result

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout

...continued from previous page

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S131	7197	4901	6391	6754	4792	8966	4895	6944	6978	4192	8166	8121	2687	2843	781	4475	2034	4444	3593	7190	3345	4647
S132	7582	5004	6760	7135	4881	9376	5169	7333	7369	4504	8582	8536	2473	3260	838	4871	2408	4044	3185	7570	3061	4786
S134	7678	4470	6794	7212	4329	9608	4947	7446	7495	4386	8919	8967	1707	3666	661	5428	3034	3563	2774	8169	3444	5551
S135	8261	4954	7385	7798	4802	10161	5536	8026	8073	4983	9436	9438	1823	4142	1236	5813	3357	3107	2268	8519	2961	5518
S136	8734	5105	7838	8265	4939	10672	5888	8505	8555	5389	9969	9984	1689	4685	1726	6361	3900	2557	1725	9061	2941	5908
S137	7366	6422	6750	6991	6343	8726	5898	7082	7084	5058	7672	7364	4452	2639	2539	3490	1233	5756	4850	5950	3210	2889
S138	6961	6236	6358	6591	6167	8315	5590	6676	6677	4734	7269	6980	4503	2236	2523	3117	823	6000	5101	5639	3612	3012
S139	6787	6671	6274	6451	6619	7961	5801	6494	6482	4915	6833	6455	5170	2155	3165	2572	878	6691	5790	4982	4100	2617
S140	7378	7474	6934	7071	7419	8372	6592	7081	7059	5701	7150	6640	5814	2878	3852	2824	1685	7078	6168	4874	4061	1813
S141	7488	7089	6965	7150	7021	8647	6384	7196	7185	5512	7492	7064	5235	2833	3310	3192	1471	6448	5538	5428	3530	2159
S142	8534	8142	8055	8215	8063	9547	7516	8239	8220	6646	8309	7753	5984	3943	4195	3986	2605	6742	5843	5822	3252	1283
S143	9325	8782	8847	9008	8693	10303	8260	9029	9009	7399	9039	8436	6396	4731	4734	4729	3376	6821	5947	6388	3045	1268
S144	9152	8972	8730	8857	8893	10015	8307	8855	8827	7430	8711	8055	6759	4664	5011	4439	3379	7324	6441	5928	3592	717
S145	8285	8254	7858	7987	8186	9196	7484	7988	7962	6599	7923	7324	6289	3802	4427	3618	2554	7189	6286	5336	3758	998
S146	8425	8817	8079	8162	8759	9152	7913	8127	8091	7017	7813	7116	6978	4145	5087	3604	3031	7889	6987	4958	4372	528
S147	8740	8806	8347	8457	8737	9555	8031	8442	8411	7144	8241	7576	6773	4326	4947	3984	3104	7526	6631	5453	3916	480
S148	8279	9022	7993	8041	8975	8880	7994	7981	7937	7093	7505	6754	7349	4188	5417	3397	3205	8362	7457	4518	4883	828
U152	2918	4219	2151	2475	4301	4884	2202	2672	2714	1440	4468	4925	5467	2059	4125	3217	3439	8213	7515	5427	7504	6676
U158	5583	4269	4797	5145	4223	7374	3596	5328	5361	2781	6644	4174	3468	1447	1631	3383	1550	5834	5047	6154	4864	4999
U159	5273	4725	4571	4862	4699	6920	3747	5003	5023	2872	6109	6117	4114	819	2229	2734	1186	6412	5601	5505	5109	4676
U160	5569	5474	4973	5198	5446	6996	4430	5285	5288	3538	6040	5897	4628	843	2640	2240	577	6696	5843	4994	4909	3973
U161	6171	5137	5471	5763	5078	7762	4488	5899	5916	3650	6877	6780	3815	1559	1795	3127	794	5800	4947	5863	4212	4108
U162	3143	6113	2980	2932	6183	4146	4093	2846	2801	3352	3195	3272	6823	2133	5108	1769	3369	9311	8515	3523	7763	5822
U163	1741	5539	1545	1479	5652	3336	3279	1445	1427	2786	2933	3549	7036	3040	5615	3225	4437	9755	9034	4654	8748	7222
U164	1012	6342	1588	1132	6477	2199	4017	783	671	3716	2135	3079	8142	4175	6776	4036	5551	10897	10188	4823	9894	8138
U166	2806	6904	3011	2766	6994	3223	4735	2536	2449	4111	2137	2252	7869	3197	6179	2373	4376	10381	9587	3128	8763	6487
U167	2076	6476	2299	2031	6583	2848	4231	1802	1719	3703	2103	2601	7767	3366	6205	2945	4667	10395	9635	3847	9055	7061

WTG	NSP023	NSP024	NSP025	NSP026	NSP027
S102	7556	8304	10658	10708	7685
S104	7468	8124	9938	10020	6625
S105	7015	7617	9223	9310	6115
S106	6259	6873	8735	8796	6364
S111	3081	3641	6565	6499	7623
S112	2861	3330	6140	6066	7582
S113	3398	3713	5713	5681	6891
S114	3667	3882	5372	5364	6541
S115	3874	3995	5027	5036	6298
S116	4765	4898	5264	5342	5420
S117	5068	5284	5787	5877	5215
S118	5691	6043	6825	6926	5061
S120	6438	6924	8080	8181	5348
S121	7247	7786	8989	9101	5501
S122	8117	8714	10048	10165	5993
S123	8902	9543	11007	11124	6603
S124	9051	9720	11336	11445	6988
S125	7142	7575	8241	8380	4668
S126	7930	8326	8581	8754	4089
S127	7794	8131	8107	8293	3677
S128	7866	8099	7499	7714	2935
S129	7905	8092	7227	7456	2650
S130	7778	7917	6843	7080	2564
S131	7933	8009	6547	6806	2265
S132	8216	8253	6492	6771	1954
S134	8949	9006	7155	7449	1249
S135	9108	9102	6864	7179	1118
S136	9590	9555	7039	7373	860
S137	6252	6262	5165	5361	3934
S138	6121	6194	5472	5648	4052
S139	5439	5548	5375	5502	4743
S140	4876	4886	4686	4783	5316
S141	5501	5485	4717	4865	4710
S142	5247	5033	3588	3730	5354
S143	5445	5090	2812	2978	5704
S144	4895	4545	2895	2987	6100
S145	4762	4587	3765	3855	5699
S146	4097	3884	3673	3687	6401

To be continued on next page...

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DECIBEL - Main Result**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout

...continued from previous page

WTG	NSP023	NSP024	NSP025	NSP026	NSP027
S147	4541	4264	3309	3366	6155
S148	3594	3422	3955	3921	6803
U152	7778	8346	9588	9705	5704
U158	7492	7763	7477	7670	3404
U159	6909	7222	7341	7503	4019
U160	6200	6486	6744	6882	4418
U161	6853	7045	6574	6762	3546
U162	6069	6738	8942	8981	6867
U163	7434	8147	10304	10365	7250
U164	7834	8631	11266	11301	8389
U166	6037	6816	9646	9649	7933
U167	6774	7548	10204	10227	7910

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s

Assumptions

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

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

Calculation Results

Noise sensitive area: NSP001 NSP001

WTG

Wind speed: 8.0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	1,404	1,409	27.89	108.0	0.00	73.98	-	-	0.00	0.00	-	0.00
S104	2,193	2,197	22.71	108.0	0.00	77.84	-	-	0.00	0.00	-	0.00
S105	2,913	2,917	19.48	108.0	0.00	80.30	-	-	0.00	0.00	-	0.00
S106	3,310	3,312	18.01	108.0	0.00	81.40	-	-	0.00	0.00	-	0.00
S111	6,143	6,145	10.16	108.0	0.00	86.77	-	-	0.00	0.00	-	0.00
S112	6,559	6,560	9.27	108.0	0.00	87.34	-	-	0.00	0.00	-	0.00
S113	6,620	6,622	9.14	108.0	0.00	87.42	-	-	0.00	0.00	-	0.00
S114	6,828	6,830	8.72	108.0	0.00	87.69	-	-	0.00	0.00	-	0.00
S115	7,101	7,103	8.18	108.0	0.00	88.03	-	-	0.00	0.00	-	0.00
S116	6,785	6,786	8.81	108.0	0.00	87.63	-	-	0.00	0.00	-	0.00
S117	6,278	6,280	9.87	108.0	0.00	86.96	-	-	0.00	0.00	-	0.00
S118	5,291	5,292	12.16	108.0	0.00	85.47	-	-	0.00	0.00	-	0.00
S120	4,088	4,090	15.45	108.0	0.00	83.23	-	-	0.00	0.00	-	0.00
S121	3,350	3,352	17.87	108.0	0.00	81.51	-	-	0.00	0.00	-	0.00
S122	2,553	2,557	20.95	108.0	0.00	79.15	-	-	0.00	0.00	-	0.00
S123	1,995	1,998	23.85	108.0	0.00	77.01	-	-	0.00	0.00	-	0.00
S124	1,664	1,668	25.97	108.0	0.00	75.44	-	-	0.00	0.00	-	0.00
S125	4,283	4,285	14.87	108.0	0.00	83.64	-	-	0.00	0.00	-	0.00
S126	4,532	4,535	14.15	108.0	0.00	84.13	-	-	0.00	0.00	-	0.00
S127	5,044	5,046	12.78	108.0	0.00	85.06	-	-	0.00	0.00	-	0.00
S128	5,928	5,929	10.64	108.0	0.00	86.46	-	-	0.00	0.00	-	0.00
S129	6,320	6,321	9.78	108.0	0.00	87.02	-	-	0.00	0.00	-	0.00
S130	6,667	6,669	9.05	108.0	0.00	87.48	-	-	0.00	0.00	-	0.00
S131	7,197	7,198	7.99	108.0	0.00	88.14	-	-	0.00	0.00	-	0.00
S132	7,582	7,583	7.26	108.0	0.00	88.60	-	-	0.00	0.00	-	0.00
S134	7,678	7,679	7.09	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
S135	8,261	8,262	6.05	108.0	0.00	89.34	-	-	0.00	0.00	-	0.00
S136	8,734	8,735	5.26	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
S137	7,366	7,367	7.67	108.0	0.00	88.35	-	-	0.00	0.00	-	0.00
S138	6,961	6,963	8.45	108.0	0.00	87.86	-	-	0.00	0.00	-	0.00
S139	6,787	6,789	8.80	108.0	0.00	87.64	-	-	0.00	0.00	-	0.00
S140	7,378	7,379	7.64	108.0	0.00	88.36	-	-	0.00	0.00	-	0.00
S141	7,488	7,490	7.44	108.0	0.00	88.49	-	-	0.00	0.00	-	0.00
S142	8,534	8,535	5.59	108.0	0.00	89.62	-	-	0.00	0.00	-	0.00
S143	9,325	9,326	4.31	108.0	0.00	90.39	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S144	9,152	9,153	4.58	108.0	0.00	90.23	-	-	0.00	0.00	-	0.00
S145	8,285	8,287	6.01	108.0	0.00	89.37	-	-	0.00	0.00	-	0.00
S146	8,425	8,427	5.77	108.0	0.00	89.51	-	-	0.00	0.00	-	0.00
S147	8,740	8,741	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
S148	8,279	8,280	6.02	108.0	0.00	89.36	-	-	0.00	0.00	-	0.00
U152	2,918	2,921	19.47	108.0	0.00	80.31	-	-	0.00	0.00	-	0.00
U158	5,583	5,585	11.44	108.0	0.00	85.94	-	-	0.00	0.00	-	0.00
U159	5,273	5,275	12.20	108.0	0.00	85.44	-	-	0.00	0.00	-	0.00
U160	5,569	5,571	11.48	108.0	0.00	85.92	-	-	0.00	0.00	-	0.00
U161	6,171	6,173	10.10	108.0	0.00	86.81	-	-	0.00	0.00	-	0.00
U162	3,143	3,146	18.61	108.0	0.00	80.95	-	-	0.00	0.00	-	0.00
U163	1,741	1,746	25.44	108.0	0.00	75.84	-	-	0.00	0.00	-	0.00
U164	1,012	1,018	31.48	108.0	0.00	71.16	-	-	0.00	0.00	-	0.00
U166	2,806	2,809	19.91	108.0	0.00	79.97	-	-	0.00	0.00	-	0.00
U167	2,076	2,079	23.38	108.0	0.00	77.36	-	-	0.00	0.00	-	0.00
Sum	36.40											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP002 NSP002

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	5,839	5,840	10.85	108.0	0.00	86.33	-	-	0.00	0.00	-	0.00
S104	5,034	5,037	12.80	108.0	0.00	85.04	-	-	0.00	0.00	-	0.00
S105	5,018	5,021	12.84	108.0	0.00	85.02	-	-	0.00	0.00	-	0.00
S106	5,694	5,695	11.18	108.0	0.00	86.11	-	-	0.00	0.00	-	0.00
S111	8,486	8,487	5.67	108.0	0.00	89.58	-	-	0.00	0.00	-	0.00
S112	8,676	8,678	5.35	108.0	0.00	89.77	-	-	0.00	0.00	-	0.00
S113	8,209	8,211	6.14	108.0	0.00	89.29	-	-	0.00	0.00	-	0.00
S114	8,067	8,069	6.39	108.0	0.00	89.14	-	-	0.00	0.00	-	0.00
S115	8,040	8,042	6.43	108.0	0.00	89.11	-	-	0.00	0.00	-	0.00
S116	7,199	7,201	7.99	108.0	0.00	88.15	-	-	0.00	0.00	-	0.00
S117	6,717	6,719	8.94	108.0	0.00	87.55	-	-	0.00	0.00	-	0.00
S118	5,880	5,881	10.75	108.0	0.00	86.39	-	-	0.00	0.00	-	0.00
S120	5,158	5,160	12.49	108.0	0.00	85.25	-	-	0.00	0.00	-	0.00
S121	4,537	4,539	14.14	108.0	0.00	84.14	-	-	0.00	0.00	-	0.00
S122	4,141	4,144	15.29	108.0	0.00	83.35	-	-	0.00	0.00	-	0.00
S123	4,066	4,068	15.52	108.0	0.00	83.19	-	-	0.00	0.00	-	0.00
S124	4,318	4,320	14.77	108.0	0.00	83.71	-	-	0.00	0.00	-	0.00
S125	4,405	4,407	14.52	108.0	0.00	83.88	-	-	0.00	0.00	-	0.00
S126	3,608	3,611	16.98	108.0	0.00	82.15	-	-	0.00	0.00	-	0.00
S127	3,805	3,808	16.33	108.0	0.00	82.61	-	-	0.00	0.00	-	0.00
S128	4,070	4,073	15.51	108.0	0.00	83.20	-	-	0.00	0.00	-	0.00
S129	4,264	4,266	14.92	108.0	0.00	83.60	-	-	0.00	0.00	-	0.00
S130	4,621	4,623	13.91	108.0	0.00	84.30	-	-	0.00	0.00	-	0.00
S131	4,901	4,904	13.15	108.0	0.00	84.81	-	-	0.00	0.00	-	0.00
S132	5,004	5,006	12.88	108.0	0.00	84.99	-	-	0.00	0.00	-	0.00
S134	4,470	4,473	14.33	108.0	0.00	84.01	-	-	0.00	0.00	-	0.00
S135	4,954	4,956	13.01	108.0	0.00	84.90	-	-	0.00	0.00	-	0.00
S136	5,105	5,107	12.62	108.0	0.00	85.16	-	-	0.00	0.00	-	0.00
S137	6,422	6,424	9.56	108.0	0.00	87.16	-	-	0.00	0.00	-	0.00
S138	6,236	6,238	9.96	108.0	0.00	86.90	-	-	0.00	0.00	-	0.00
S139	6,671	6,673	9.04	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
S140	7,474	7,476	7.46	108.0	0.00	88.47	-	-	0.00	0.00	-	0.00

To be continued on next page...

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DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S141	7,089	7,091	8.20	108.0	0.00	88.01	-	-	0.00	0.00	-	0.00
S142	8,142	8,144	6.26	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
S143	8,782	8,784	5.18	108.0	0.00	89.87	-	-	0.00	0.00	-	0.00
S144	8,972	8,973	4.87	108.0	0.00	90.06	-	-	0.00	0.00	-	0.00
S145	8,254	8,255	6.06	108.0	0.00	89.33	-	-	0.00	0.00	-	0.00
S146	8,817	8,819	5.12	108.0	0.00	89.91	-	-	0.00	0.00	-	0.00
S147	8,806	8,808	5.14	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
S148	9,022	9,024	4.79	108.0	0.00	90.11	-	-	0.00	0.00	-	0.00
U152	4,219	4,222	15.06	108.0	0.00	83.51	-	-	0.00	0.00	-	0.00
U158	4,269	4,272	14.91	108.0	0.00	83.61	-	-	0.00	0.00	-	0.00
U159	4,725	4,728	13.62	108.0	0.00	84.49	-	-	0.00	0.00	-	0.00
U160	5,474	5,476	11.71	108.0	0.00	85.77	-	-	0.00	0.00	-	0.00
U161	5,137	5,140	12.54	108.0	0.00	85.22	-	-	0.00	0.00	-	0.00
U162	6,113	6,115	10.23	108.0	0.00	86.73	-	-	0.00	0.00	-	0.00
U163	5,539	5,541	11.55	108.0	0.00	85.87	-	-	0.00	0.00	-	0.00
U164	6,342	6,343	9.73	108.0	0.00	87.05	-	-	0.00	0.00	-	0.00
U166	6,904	6,905	8.57	108.0	0.00	87.78	-	-	0.00	0.00	-	0.00
U167	6,476	6,477	9.45	108.0	0.00	87.23	-	-	0.00	0.00	-	0.00
Sum	29.05											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP003 NSP003

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	1,467	1,471	27.41	108.0	0.00	74.35	-	-	0.00	0.00	-	0.00
S104	1,701	1,706	25.71	108.0	0.00	75.64	-	-	0.00	0.00	-	0.00
S105	2,400	2,404	21.62	108.0	0.00	78.62	-	-	0.00	0.00	-	0.00
S106	2,985	2,987	19.21	108.0	0.00	80.50	-	-	0.00	0.00	-	0.00
S111	6,100	6,102	10.26	108.0	0.00	86.71	-	-	0.00	0.00	-	0.00
S112	6,485	6,486	9.43	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
S113	6,431	6,433	9.54	108.0	0.00	87.17	-	-	0.00	0.00	-	0.00
S114	6,576	6,578	9.24	108.0	0.00	87.36	-	-	0.00	0.00	-	0.00
S115	6,802	6,804	8.77	108.0	0.00	87.65	-	-	0.00	0.00	-	0.00
S116	6,368	6,370	9.67	108.0	0.00	87.08	-	-	0.00	0.00	-	0.00
S117	5,835	5,837	10.86	108.0	0.00	86.32	-	-	0.00	0.00	-	0.00
S118	4,797	4,798	13.43	108.0	0.00	84.62	-	-	0.00	0.00	-	0.00
S120	3,546	3,548	17.19	108.0	0.00	82.00	-	-	0.00	0.00	-	0.00
S121	2,685	2,688	20.40	108.0	0.00	79.59	-	-	0.00	0.00	-	0.00
S122	1,721	1,726	25.57	108.0	0.00	75.74	-	-	0.00	0.00	-	0.00
S123	986	992	31.77	108.0	0.00	70.93	-	-	0.00	0.00	-	0.00
S124	631	640	36.41	108.0	0.00	67.12	-	-	0.00	0.00	-	0.00
S125	3,571	3,573	17.10	108.0	0.00	82.06	-	-	0.00	0.00	-	0.00
S126	3,683	3,686	16.73	108.0	0.00	82.33	-	-	0.00	0.00	-	0.00
S127	4,215	4,217	15.07	108.0	0.00	83.50	-	-	0.00	0.00	-	0.00
S128	5,100	5,102	12.64	108.0	0.00	85.15	-	-	0.00	0.00	-	0.00
S129	5,495	5,497	11.66	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
S130	5,864	5,866	10.79	108.0	0.00	86.37	-	-	0.00	0.00	-	0.00
S131	6,391	6,392	9.63	108.0	0.00	87.11	-	-	0.00	0.00	-	0.00
S132	6,760	6,761	8.86	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
S134	6,794	6,795	8.79	108.0	0.00	87.64	-	-	0.00	0.00	-	0.00
S135	7,385	7,386	7.63	108.0	0.00	88.37	-	-	0.00	0.00	-	0.00
S136	7,838	7,839	6.80	108.0	0.00	88.89	-	-	0.00	0.00	-	0.00
S137	6,750	6,752	8.88	108.0	0.00	87.59	-	-	0.00	0.00	-	0.00

To be continued on next page...

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DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

Wind speed: 8.0 m/s													
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S138	6,358	6,360	9.70	108.0	0.00	87.07	-	-	0.00	0.00	-	0.00
	S139	6,274	6,276	9.88	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
	S140	6,934	6,936	8.51	108.0	0.00	87.82	-	-	0.00	0.00	-	0.00
	S141	6,965	6,967	8.44	108.0	0.00	87.86	-	-	0.00	0.00	-	0.00
	S142	8,055	8,057	6.41	108.0	0.00	89.12	-	-	0.00	0.00	-	0.00
	S143	8,847	8,848	5.07	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
	S144	8,730	8,731	5.26	108.0	0.00	89.82	-	-	0.00	0.00	-	0.00
	S145	7,858	7,860	6.76	108.0	0.00	88.91	-	-	0.00	0.00	-	0.00
	S146	8,079	8,081	6.37	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
	S147	8,347	8,348	5.90	108.0	0.00	89.43	-	-	0.00	0.00	-	0.00
	S148	7,993	7,994	6.52	108.0	0.00	89.06	-	-	0.00	0.00	-	0.00
	U152	2,151	2,155	22.95	108.0	0.00	77.67	-	-	0.00	0.00	-	0.00
	U158	4,797	4,799	13.43	108.0	0.00	84.62	-	-	0.00	0.00	-	0.00
	U159	4,571	4,573	14.05	108.0	0.00	84.20	-	-	0.00	0.00	-	0.00
	U160	4,973	4,975	12.96	108.0	0.00	84.94	-	-	0.00	0.00	-	0.00
	U161	5,471	5,473	11.71	108.0	0.00	85.76	-	-	0.00	0.00	-	0.00
	U162	2,980	2,982	19.23	108.0	0.00	80.49	-	-	0.00	0.00	-	0.00
	U163	1,545	1,550	26.82	108.0	0.00	74.81	-	-	0.00	0.00	-	0.00
	U164	1,588	1,591	26.52	108.0	0.00	75.03	-	-	0.00	0.00	-	0.00
	U166	3,011	3,013	19.11	108.0	0.00	80.58	-	-	0.00	0.00	-	0.00
	U167	2,299	2,302	22.15	108.0	0.00	78.24	-	-	0.00	0.00	-	0.00
	Sum		39.76										

Sum 39.76

- Data undefined due to calculation with octave data

Noise sensitive area: NSP004 NSP004

Wind speed: 8.0 m/s													
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S102	1,245	1,251	29.23	108.0	0.00	72.94	-	-	0.00	0.00	-	0.00
	S104	1,830	1,835	24.86	108.0	0.00	76.27	-	-	0.00	0.00	-	0.00
	S105	2,556	2,560	20.94	108.0	0.00	79.16	-	-	0.00	0.00	-	0.00
	S106	3,032	3,034	19.03	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
	S111	6,008	6,010	10.46	108.0	0.00	86.58	-	-	0.00	0.00	-	0.00
	S112	6,411	6,412	9.58	108.0	0.00	87.14	-	-	0.00	0.00	-	0.00
	S113	6,421	6,423	9.56	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
	S114	6,601	6,603	9.18	108.0	0.00	87.40	-	-	0.00	0.00	-	0.00
	S115	6,855	6,856	8.66	108.0	0.00	87.72	-	-	0.00	0.00	-	0.00
	S116	6,488	6,490	9.42	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
	S117	5,969	5,971	10.55	108.0	0.00	86.52	-	-	0.00	0.00	-	0.00
	S118	4,958	4,960	13.00	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
	S120	3,731	3,733	16.58	108.0	0.00	82.44	-	-	0.00	0.00	-	0.00
	S121	2,943	2,946	19.37	108.0	0.00	80.39	-	-	0.00	0.00	-	0.00
	S122	2,089	2,094	23.29	108.0	0.00	77.42	-	-	0.00	0.00	-	0.00
	S123	1,502	1,507	27.14	108.0	0.00	74.56	-	-	0.00	0.00	-	0.00
	S124	1,178	1,184	29.84	108.0	0.00	72.47	-	-	0.00	0.00	-	0.00
	S125	3,866	3,868	16.14	108.0	0.00	82.75	-	-	0.00	0.00	-	0.00
	S126	4,073	4,075	15.50	108.0	0.00	83.20	-	-	0.00	0.00	-	0.00
	S127	4,591	4,593	13.99	108.0	0.00	84.24	-	-	0.00	0.00	-	0.00
	S128	5,477	5,479	11.70	108.0	0.00	85.77	-	-	0.00	0.00	-	0.00
	S129	5,870	5,872	10.77	108.0	0.00	86.38	-	-	0.00	0.00	-	0.00
	S130	6,225	6,227	9.98	108.0	0.00	86.89	-	-	0.00	0.00	-	0.00
	S131	6,754	6,756	8.87	108.0	0.00	87.59	-	-	0.00	0.00	-	0.00
	S132	7,135	7,136	8.11	108.0	0.00	88.07	-	-	0.00	0.00	-	0.00
	S134	7,212	7,213	7.96	108.0	0.00	88.16	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S135	7,798	7,799	6.87	108.0	0.00	88.84	-	-	0.00	0.00	-	0.00
S136	8,265	8,266	6.04	108.0	0.00	89.35	-	-	0.00	0.00	-	0.00
S137	6,991	6,993	8.39	108.0	0.00	87.89	-	-	0.00	0.00	-	0.00
S138	6,591	6,593	9.20	108.0	0.00	87.38	-	-	0.00	0.00	-	0.00
S139	6,451	6,453	9.50	108.0	0.00	87.20	-	-	0.00	0.00	-	0.00
S140	7,071	7,073	8.23	108.0	0.00	87.99	-	-	0.00	0.00	-	0.00
S141	7,150	7,152	8.08	108.0	0.00	88.09	-	-	0.00	0.00	-	0.00
S142	8,215	8,217	6.13	108.0	0.00	89.29	-	-	0.00	0.00	-	0.00
S143	9,008	9,009	4.81	108.0	0.00	90.09	-	-	0.00	0.00	-	0.00
S144	8,857	8,859	5.05	108.0	0.00	89.95	-	-	0.00	0.00	-	0.00
S145	7,987	7,989	6.53	108.0	0.00	89.05	-	-	0.00	0.00	-	0.00
S146	8,162	8,163	6.22	108.0	0.00	89.24	-	-	0.00	0.00	-	0.00
S147	8,457	8,458	5.72	108.0	0.00	89.55	-	-	0.00	0.00	-	0.00
S148	8,041	8,042	6.43	108.0	0.00	89.11	-	-	0.00	0.00	-	0.00
U152	2,475	2,479	21.29	108.0	0.00	78.89	-	-	0.00	0.00	-	0.00
U158	5,145	5,147	12.52	108.0	0.00	85.23	-	-	0.00	0.00	-	0.00
U159	4,862	4,865	13.25	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
U160	5,198	5,200	12.39	108.0	0.00	85.32	-	-	0.00	0.00	-	0.00
U161	5,763	5,765	11.02	108.0	0.00	86.22	-	-	0.00	0.00	-	0.00
U162	2,932	2,935	19.41	108.0	0.00	80.35	-	-	0.00	0.00	-	0.00
U163	1,479	1,485	27.31	108.0	0.00	74.43	-	-	0.00	0.00	-	0.00
U164	1,132	1,138	30.27	108.0	0.00	72.12	-	-	0.00	0.00	-	0.00
U166	2,766	2,769	20.07	108.0	0.00	79.85	-	-	0.00	0.00	-	0.00
U167	2,031	2,034	23.64	108.0	0.00	77.17	-	-	0.00	0.00	-	0.00
Sum	37.57											

Sum 37.57

- Data undefined due to calculation with octave data

Noise sensitive area: NSP005 NSP005

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	5,960	5,962	10.57	108.0	0.00	86.51	-	-	0.00	0.00	-	0.00
S104	5,135	5,137	12.55	108.0	0.00	85.21	-	-	0.00	0.00	-	0.00
S105	5,092	5,094	12.65	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
S106	5,754	5,756	11.04	108.0	0.00	86.20	-	-	0.00	0.00	-	0.00
S111	8,498	8,500	5.65	108.0	0.00	89.59	-	-	0.00	0.00	-	0.00
S112	8,679	8,681	5.35	108.0	0.00	89.77	-	-	0.00	0.00	-	0.00
S113	8,199	8,201	6.16	108.0	0.00	89.28	-	-	0.00	0.00	-	0.00
S114	8,046	8,048	6.42	108.0	0.00	89.11	-	-	0.00	0.00	-	0.00
S115	8,009	8,010	6.49	108.0	0.00	89.07	-	-	0.00	0.00	-	0.00
S116	7,159	7,161	8.06	108.0	0.00	88.10	-	-	0.00	0.00	-	0.00
S117	6,685	6,687	9.01	108.0	0.00	87.50	-	-	0.00	0.00	-	0.00
S118	5,869	5,871	10.78	108.0	0.00	86.37	-	-	0.00	0.00	-	0.00
S120	5,186	5,188	12.42	108.0	0.00	85.30	-	-	0.00	0.00	-	0.00
S121	4,595	4,597	13.98	108.0	0.00	84.25	-	-	0.00	0.00	-	0.00
S122	4,242	4,245	14.99	108.0	0.00	83.56	-	-	0.00	0.00	-	0.00
S123	4,205	4,207	15.10	108.0	0.00	83.48	-	-	0.00	0.00	-	0.00
S124	4,468	4,469	14.34	108.0	0.00	84.00	-	-	0.00	0.00	-	0.00
S125	4,421	4,424	14.47	108.0	0.00	83.92	-	-	0.00	0.00	-	0.00
S126	3,613	3,616	16.96	108.0	0.00	82.17	-	-	0.00	0.00	-	0.00
S127	3,782	3,785	16.41	108.0	0.00	82.56	-	-	0.00	0.00	-	0.00
S128	4,003	4,006	15.71	108.0	0.00	83.05	-	-	0.00	0.00	-	0.00
S129	4,181	4,184	15.17	108.0	0.00	83.43	-	-	0.00	0.00	-	0.00
S130	4,529	4,531	14.16	108.0	0.00	84.12	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S131	4,792	4,795	13.44	108.0	0.00	84.61	-	-	0.00	0.00	-	0.00
S132	4,881	4,883	13.21	108.0	0.00	84.77	-	-	0.00	0.00	-	0.00
S134	4,329	4,332	14.73	108.0	0.00	83.73	-	-	0.00	0.00	-	0.00
S135	4,802	4,804	13.42	108.0	0.00	84.63	-	-	0.00	0.00	-	0.00
S136	4,939	4,941	13.05	108.0	0.00	84.88	-	-	0.00	0.00	-	0.00
S137	6,343	6,344	9.73	108.0	0.00	87.05	-	-	0.00	0.00	-	0.00
S138	6,167	6,169	10.11	108.0	0.00	86.80	-	-	0.00	0.00	-	0.00
S139	6,619	6,621	9.14	108.0	0.00	87.42	-	-	0.00	0.00	-	0.00
S140	7,419	7,421	7.57	108.0	0.00	88.41	-	-	0.00	0.00	-	0.00
S141	7,021	7,023	8.33	108.0	0.00	87.93	-	-	0.00	0.00	-	0.00
S142	8,063	8,065	6.39	108.0	0.00	89.13	-	-	0.00	0.00	-	0.00
S143	8,693	8,694	5.32	108.0	0.00	89.78	-	-	0.00	0.00	-	0.00
S144	8,893	8,894	5.00	108.0	0.00	89.98	-	-	0.00	0.00	-	0.00
S145	8,186	8,188	6.18	108.0	0.00	89.26	-	-	0.00	0.00	-	0.00
S146	8,759	8,761	5.21	108.0	0.00	89.85	-	-	0.00	0.00	-	0.00
S147	8,737	8,739	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
S148	8,975	8,976	4.87	108.0	0.00	90.06	-	-	0.00	0.00	-	0.00
U152	4,301	4,303	14.82	108.0	0.00	83.68	-	-	0.00	0.00	-	0.00
U158	4,223	4,225	15.05	108.0	0.00	83.52	-	-	0.00	0.00	-	0.00
U159	4,699	4,702	13.69	108.0	0.00	84.44	-	-	0.00	0.00	-	0.00
U160	5,446	5,448	11.77	108.0	0.00	85.72	-	-	0.00	0.00	-	0.00
U161	5,078	5,080	12.69	108.0	0.00	85.12	-	-	0.00	0.00	-	0.00
U162	6,183	6,184	10.08	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
U163	5,652	5,653	11.28	108.0	0.00	86.05	-	-	0.00	0.00	-	0.00
U164	6,477	6,478	9.44	108.0	0.00	87.23	-	-	0.00	0.00	-	0.00
U166	6,994	6,996	8.39	108.0	0.00	87.90	-	-	0.00	0.00	-	0.00
U167	6,583	6,584	9.22	108.0	0.00	87.37	-	-	0.00	0.00	-	0.00
Sum	29.06											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP006 NSP006

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	2,899	2,902	19.54	108.0	0.00	80.25	-	-	0.00	0.00	-	0.00
S104	3,959	3,962	15.85	108.0	0.00	82.96	-	-	0.00	0.00	-	0.00
S105	4,530	4,533	14.16	108.0	0.00	84.13	-	-	0.00	0.00	-	0.00
S106	4,549	4,551	14.11	108.0	0.00	84.16	-	-	0.00	0.00	-	0.00
S111	6,365	6,367	9.68	108.0	0.00	87.08	-	-	0.00	0.00	-	0.00
S112	6,809	6,811	8.76	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
S113	7,120	7,122	8.14	108.0	0.00	88.05	-	-	0.00	0.00	-	0.00
S114	7,448	7,450	7.51	108.0	0.00	88.44	-	-	0.00	0.00	-	0.00
S115	7,802	7,804	6.86	108.0	0.00	88.85	-	-	0.00	0.00	-	0.00
S116	7,760	7,762	6.94	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
S117	7,346	7,348	7.70	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00
S118	6,543	6,544	9.31	108.0	0.00	87.32	-	-	0.00	0.00	-	0.00
S120	5,558	5,560	11.50	108.0	0.00	85.90	-	-	0.00	0.00	-	0.00
S121	5,116	5,118	12.59	108.0	0.00	85.18	-	-	0.00	0.00	-	0.00
S122	4,645	4,647	13.84	108.0	0.00	84.34	-	-	0.00	0.00	-	0.00
S123	4,337	4,339	14.71	108.0	0.00	83.75	-	-	0.00	0.00	-	0.00
S124	4,052	4,054	15.56	108.0	0.00	83.16	-	-	0.00	0.00	-	0.00
S125	6,023	6,025	10.43	108.0	0.00	86.60	-	-	0.00	0.00	-	0.00
S126	6,496	6,498	9.40	108.0	0.00	87.26	-	-	0.00	0.00	-	0.00
S127	6,944	6,945	8.49	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
ALLETE Wind
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 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S128	7,786	7,788	6.89	108.0	0.00	88.83	-	-	0.00	0.00	-	0.00
S129	8,157	8,159	6.23	108.0	0.00	89.23	-	-	0.00	0.00	-	0.00
S130	8,448	8,450	5.73	108.0	0.00	89.54	-	-	0.00	0.00	-	0.00
S131	8,966	8,968	4.88	108.0	0.00	90.05	-	-	0.00	0.00	-	0.00
S132	9,376	9,377	4.24	108.0	0.00	90.44	-	-	0.00	0.00	-	0.00
S134	9,608	9,609	3.88	108.0	0.00	90.65	-	-	0.00	0.00	-	0.00
S135	10,161	10,163	3.06	108.0	0.00	91.14	-	-	0.00	0.00	-	0.00
S136	10,672	10,673	2.35	108.0	0.00	91.57	-	-	0.00	0.00	-	0.00
S137	8,726	8,727	5.27	108.0	0.00	89.82	-	-	0.00	0.00	-	0.00
S138	8,315	8,316	5.96	108.0	0.00	89.40	-	-	0.00	0.00	-	0.00
S139	7,961	7,963	6.57	108.0	0.00	89.02	-	-	0.00	0.00	-	0.00
S140	8,372	8,374	5.86	108.0	0.00	89.46	-	-	0.00	0.00	-	0.00
S141	8,647	8,648	5.40	108.0	0.00	89.74	-	-	0.00	0.00	-	0.00
S142	9,547	9,548	3.97	108.0	0.00	90.60	-	-	0.00	0.00	-	0.00
S143	10,303	10,304	2.86	108.0	0.00	91.26	-	-	0.00	0.00	-	0.00
S144	10,015	10,016	3.28	108.0	0.00	91.01	-	-	0.00	0.00	-	0.00
S145	9,196	9,197	4.51	108.0	0.00	90.27	-	-	0.00	0.00	-	0.00
S146	9,152	9,154	4.58	108.0	0.00	90.23	-	-	0.00	0.00	-	0.00
S147	9,555	9,557	3.96	108.0	0.00	90.61	-	-	0.00	0.00	-	0.00
S148	8,880	8,882	5.02	108.0	0.00	89.97	-	-	0.00	0.00	-	0.00
U152	4,884	4,886	13.20	108.0	0.00	84.78	-	-	0.00	0.00	-	0.00
U158	7,374	7,375	7.65	108.0	0.00	88.36	-	-	0.00	0.00	-	0.00
U159	6,920	6,922	8.53	108.0	0.00	87.80	-	-	0.00	0.00	-	0.00
U160	6,996	6,998	8.38	108.0	0.00	87.90	-	-	0.00	0.00	-	0.00
U161	7,762	7,764	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
U162	4,146	4,148	15.28	108.0	0.00	83.36	-	-	0.00	0.00	-	0.00
U163	3,336	3,339	17.91	108.0	0.00	81.47	-	-	0.00	0.00	-	0.00
U164	2,199	2,203	22.69	108.0	0.00	77.86	-	-	0.00	0.00	-	0.00
U166	3,223	3,226	18.32	108.0	0.00	81.17	-	-	0.00	0.00	-	0.00
U167	2,848	2,851	19.74	108.0	0.00	80.10	-	-	0.00	0.00	-	0.00
Sum	29,70											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP007 NSP007

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	3,542	3,544	17.20	108.0	0.00	81.99	-	-	0.00	0.00	-	0.00
S104	2,843	2,847	19.76	108.0	0.00	80.09	-	-	0.00	0.00	-	0.00
S105	3,013	3,017	19.10	108.0	0.00	80.59	-	-	0.00	0.00	-	0.00
S106	3,759	3,761	16.48	108.0	0.00	82.51	-	-	0.00	0.00	-	0.00
S111	6,869	6,871	8.64	108.0	0.00	87.74	-	-	0.00	0.00	-	0.00
S112	7,143	7,145	8.09	108.0	0.00	88.08	-	-	0.00	0.00	-	0.00
S113	6,821	6,823	8.73	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
S114	6,791	6,793	8.79	108.0	0.00	87.64	-	-	0.00	0.00	-	0.00
S115	6,873	6,875	8.63	108.0	0.00	87.74	-	-	0.00	0.00	-	0.00
S116	6,163	6,165	10.12	108.0	0.00	86.80	-	-	0.00	0.00	-	0.00
S117	5,621	5,623	11.35	108.0	0.00	86.00	-	-	0.00	0.00	-	0.00
S118	4,609	4,611	13.94	108.0	0.00	84.28	-	-	0.00	0.00	-	0.00
S120	3,552	3,554	17.17	108.0	0.00	82.01	-	-	0.00	0.00	-	0.00
S121	2,699	2,703	20.34	108.0	0.00	79.64	-	-	0.00	0.00	-	0.00
S122	1,975	1,980	23.96	108.0	0.00	76.94	-	-	0.00	0.00	-	0.00
S123	1,739	1,744	25.46	108.0	0.00	75.83	-	-	0.00	0.00	-	0.00
S124	1,997	2,001	23.84	108.0	0.00	77.02	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S125	3,001	3,005	19.14	108.0	0.00	80.56	-	-	0.00	0.00	-	0.00
S126	2,485	2,489	21.24	108.0	0.00	78.92	-	-	0.00	0.00	-	0.00
S127	2,955	2,959	19.32	108.0	0.00	80.42	-	-	0.00	0.00	-	0.00
S128	3,669	3,672	16.78	108.0	0.00	82.30	-	-	0.00	0.00	-	0.00
S129	4,021	4,023	15.66	108.0	0.00	83.09	-	-	0.00	0.00	-	0.00
S130	4,434	4,436	14.43	108.0	0.00	83.94	-	-	0.00	0.00	-	0.00
S131	4,895	4,897	13.17	108.0	0.00	84.80	-	-	0.00	0.00	-	0.00
S132	5,169	5,171	12.46	108.0	0.00	85.27	-	-	0.00	0.00	-	0.00
S134	4,947	4,949	13.03	108.0	0.00	84.89	-	-	0.00	0.00	-	0.00
S135	5,536	5,538	11.56	108.0	0.00	85.87	-	-	0.00	0.00	-	0.00
S136	5,888	5,890	10.73	108.0	0.00	86.40	-	-	0.00	0.00	-	0.00
S137	5,898	5,900	10.71	108.0	0.00	86.42	-	-	0.00	0.00	-	0.00
S138	5,590	5,592	11.43	108.0	0.00	85.95	-	-	0.00	0.00	-	0.00
S139	5,801	5,804	10.93	108.0	0.00	86.27	-	-	0.00	0.00	-	0.00
S140	6,592	6,594	9.20	108.0	0.00	87.38	-	-	0.00	0.00	-	0.00
S141	6,384	6,386	9.64	108.0	0.00	87.10	-	-	0.00	0.00	-	0.00
S142	7,516	7,518	7.38	108.0	0.00	88.52	-	-	0.00	0.00	-	0.00
S143	8,260	8,261	6.05	108.0	0.00	89.34	-	-	0.00	0.00	-	0.00
S144	8,307	8,309	5.97	108.0	0.00	89.39	-	-	0.00	0.00	-	0.00
S145	7,484	7,486	7.44	108.0	0.00	88.48	-	-	0.00	0.00	-	0.00
S146	7,913	7,915	6.66	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
S147	8,031	8,033	6.45	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
S148	7,994	7,996	6.52	108.0	0.00	89.06	-	-	0.00	0.00	-	0.00
U152	2,202	2,207	22.66	108.0	0.00	77.87	-	-	0.00	0.00	-	0.00
U158	3,596	3,599	17.02	108.0	0.00	82.12	-	-	0.00	0.00	-	0.00
U159	3,747	3,751	16.52	108.0	0.00	82.48	-	-	0.00	0.00	-	0.00
U160	4,430	4,433	14.44	108.0	0.00	83.93	-	-	0.00	0.00	-	0.00
U161	4,488	4,491	14.28	108.0	0.00	84.05	-	-	0.00	0.00	-	0.00
U162	4,093	4,095	15.44	108.0	0.00	83.25	-	-	0.00	0.00	-	0.00
U163	3,279	3,282	18.12	108.0	0.00	81.32	-	-	0.00	0.00	-	0.00
U164	4,017	4,019	15.67	108.0	0.00	83.08	-	-	0.00	0.00	-	0.00
U166	4,735	4,737	13.60	108.0	0.00	84.51	-	-	0.00	0.00	-	0.00
U167	4,231	4,232	15.03	108.0	0.00	83.53	-	-	0.00	0.00	-	0.00
Sum	33.93											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP008 NSP008

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	1,107	1,114	30.50	108.0	0.00	71.94	-	-	0.00	0.00	-	0.00
S104	1,913	1,918	24.34	108.0	0.00	76.66	-	-	0.00	0.00	-	0.00
S105	2,629	2,633	20.63	108.0	0.00	79.41	-	-	0.00	0.00	-	0.00
S106	3,013	3,016	19.10	108.0	0.00	80.59	-	-	0.00	0.00	-	0.00
S111	5,856	5,858	10.81	108.0	0.00	86.35	-	-	0.00	0.00	-	0.00
S112	6,269	6,271	9.89	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
S113	6,325	6,327	9.77	108.0	0.00	87.02	-	-	0.00	0.00	-	0.00
S114	6,531	6,533	9.33	108.0	0.00	87.30	-	-	0.00	0.00	-	0.00
S115	6,803	6,805	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
S116	6,488	6,490	9.42	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
S117	5,983	5,985	10.52	108.0	0.00	86.54	-	-	0.00	0.00	-	0.00
S118	4,999	5,000	12.90	108.0	0.00	84.98	-	-	0.00	0.00	-	0.00
S120	3,801	3,803	16.35	108.0	0.00	82.60	-	-	0.00	0.00	-	0.00
S121	3,081	3,084	18.84	108.0	0.00	80.78	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 wind@eapc.net
 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

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		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S122	2,327	2,332	21.99	108.0	0.00	78.35	-	-	0.00	0.00	-	0.00
	S123	1,856	1,860	24.70	108.0	0.00	76.39	-	-	0.00	0.00	-	0.00
	S124	1,562	1,566	26.69	108.0	0.00	74.90	-	-	0.00	0.00	-	0.00
	S125	4,017	4,020	15.67	108.0	0.00	83.08	-	-	0.00	0.00	-	0.00
	S126	4,296	4,299	14.83	108.0	0.00	83.67	-	-	0.00	0.00	-	0.00
	S127	4,801	4,803	13.42	108.0	0.00	84.63	-	-	0.00	0.00	-	0.00
	S128	5,682	5,684	11.21	108.0	0.00	86.09	-	-	0.00	0.00	-	0.00
	S129	6,072	6,074	10.32	108.0	0.00	86.67	-	-	0.00	0.00	-	0.00
	S130	6,415	6,416	9.58	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
	S131	6,944	6,945	8.49	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
	S132	7,333	7,334	7.73	108.0	0.00	88.31	-	-	0.00	0.00	-	0.00
	S134	7,446	7,448	7.52	108.0	0.00	88.44	-	-	0.00	0.00	-	0.00
	S135	8,026	8,027	6.46	108.0	0.00	89.09	-	-	0.00	0.00	-	0.00
	S136	8,505	8,506	5.64	108.0	0.00	89.59	-	-	0.00	0.00	-	0.00
	S137	7,082	7,083	8.21	108.0	0.00	88.00	-	-	0.00	0.00	-	0.00
	S138	6,676	6,678	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
	S139	6,494	6,496	9.41	108.0	0.00	87.25	-	-	0.00	0.00	-	0.00
	S140	7,081	7,083	8.21	108.0	0.00	88.00	-	-	0.00	0.00	-	0.00
	S141	7,196	7,198	7.99	108.0	0.00	88.14	-	-	0.00	0.00	-	0.00
	S142	8,239	8,240	6.09	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
	S143	9,029	9,031	4.78	108.0	0.00	90.11	-	-	0.00	0.00	-	0.00
	S144	8,855	8,856	5.06	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
	S145	7,988	7,990	6.53	108.0	0.00	89.05	-	-	0.00	0.00	-	0.00
	S146	8,127	8,129	6.28	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
	S147	8,442	8,443	5.74	108.0	0.00	89.53	-	-	0.00	0.00	-	0.00
	S148	7,981	7,983	6.54	108.0	0.00	89.04	-	-	0.00	0.00	-	0.00
	U152	2,672	2,675	20.45	108.0	0.00	79.55	-	-	0.00	0.00	-	0.00
	U158	5,328	5,330	12.06	108.0	0.00	85.53	-	-	0.00	0.00	-	0.00
	U159	5,003	5,005	12.88	108.0	0.00	84.99	-	-	0.00	0.00	-	0.00
	U160	5,285	5,287	12.17	108.0	0.00	85.46	-	-	0.00	0.00	-	0.00
	U161	5,899	5,901	10.71	108.0	0.00	86.42	-	-	0.00	0.00	-	0.00
	U162	2,846	2,849	19.75	108.0	0.00	80.09	-	-	0.00	0.00	-	0.00
	U163	1,445	1,451	27.57	108.0	0.00	74.23	-	-	0.00	0.00	-	0.00
	U164	783	792	34.17	108.0	0.00	68.97	-	-	0.00	0.00	-	0.00
	U166	2,536	2,539	21.03	108.0	0.00	79.09	-	-	0.00	0.00	-	0.00
	U167	1,802	1,805	25.05	108.0	0.00	76.13	-	-	0.00	0.00	-	0.00
	Sum	38.35											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP009 NSP009

		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S102	1,063	1,070	30.94	108.0	0.00	71.59	-	-	0.00	0.00	-	0.00
	S104	1,926	1,931	24.26	108.0	0.00	76.72	-	-	0.00	0.00	-	0.00
	S105	2,633	2,637	20.61	108.0	0.00	79.42	-	-	0.00	0.00	-	0.00
	S106	2,988	2,990	19.20	108.0	0.00	80.51	-	-	0.00	0.00	-	0.00
	S111	5,787	5,788	10.97	108.0	0.00	86.25	-	-	0.00	0.00	-	0.00
	S112	6,203	6,204	10.03	108.0	0.00	86.85	-	-	0.00	0.00	-	0.00
	S113	6,271	6,273	9.88	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
	S114	6,484	6,486	9.43	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
	S115	6,762	6,763	8.85	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
	S116	6,462	6,464	9.47	108.0	0.00	87.21	-	-	0.00	0.00	-	0.00
	S117	5,962	5,964	10.57	108.0	0.00	86.51	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S118	4,987	4,989	12.93	108.0	0.00	84.96	-	-	0.00	0.00	-	0.00
	S120	3,801	3,803	16.35	108.0	0.00	82.60	-	-	0.00	0.00	-	0.00
	S121	3,104	3,107	18.75	108.0	0.00	80.85	-	-	0.00	0.00	-	0.00
	S122	2,384	2,389	21.70	108.0	0.00	78.56	-	-	0.00	0.00	-	0.00
	S123	1,954	1,958	24.10	108.0	0.00	76.83	-	-	0.00	0.00	-	0.00
	S124	1,671	1,675	25.93	108.0	0.00	75.48	-	-	0.00	0.00	-	0.00
	S125	4,042	4,044	15.59	108.0	0.00	83.14	-	-	0.00	0.00	-	0.00
	S126	4,344	4,347	14.69	108.0	0.00	83.76	-	-	0.00	0.00	-	0.00
	S127	4,843	4,845	13.31	108.0	0.00	84.71	-	-	0.00	0.00	-	0.00
	S128	5,722	5,724	11.12	108.0	0.00	86.15	-	-	0.00	0.00	-	0.00
	S129	6,111	6,113	10.23	108.0	0.00	86.72	-	-	0.00	0.00	-	0.00
	S130	6,449	6,450	9.50	108.0	0.00	87.19	-	-	0.00	0.00	-	0.00
	S131	6,978	6,979	8.42	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
	S132	7,369	7,370	7.66	108.0	0.00	88.35	-	-	0.00	0.00	-	0.00
	S134	7,495	7,496	7.42	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
	S135	8,073	8,074	6.38	108.0	0.00	89.14	-	-	0.00	0.00	-	0.00
	S136	8,555	8,556	5.55	108.0	0.00	89.65	-	-	0.00	0.00	-	0.00
	S137	7,084	7,085	8.21	108.0	0.00	88.01	-	-	0.00	0.00	-	0.00
	S138	6,677	6,679	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
	S139	6,482	6,484	9.43	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
	S140	7,059	7,061	8.26	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00
	S141	7,185	7,186	8.01	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
	S142	8,220	8,221	6.12	108.0	0.00	89.30	-	-	0.00	0.00	-	0.00
	S143	9,009	9,010	4.81	108.0	0.00	90.09	-	-	0.00	0.00	-	0.00
	S144	8,827	8,829	5.10	108.0	0.00	89.92	-	-	0.00	0.00	-	0.00
	S145	7,962	7,964	6.57	108.0	0.00	89.02	-	-	0.00	0.00	-	0.00
	S146	8,091	8,092	6.35	108.0	0.00	89.16	-	-	0.00	0.00	-	0.00
	S147	8,411	8,412	5.79	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
	S148	7,937	7,939	6.62	108.0	0.00	89.00	-	-	0.00	0.00	-	0.00
	U152	2,714	2,718	20.28	108.0	0.00	79.68	-	-	0.00	0.00	-	0.00
	U158	5,361	5,363	11.98	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00
	U159	5,023	5,025	12.83	108.0	0.00	85.02	-	-	0.00	0.00	-	0.00
	U160	5,288	5,290	12.16	108.0	0.00	85.47	-	-	0.00	0.00	-	0.00
	U161	5,916	5,918	10.67	108.0	0.00	86.44	-	-	0.00	0.00	-	0.00
	U162	2,801	2,804	19.93	108.0	0.00	79.95	-	-	0.00	0.00	-	0.00
	U163	1,427	1,434	27.70	108.0	0.00	74.13	-	-	0.00	0.00	-	0.00
	U164	671	681	35.75	108.0	0.00	67.67	-	-	0.00	0.00	-	0.00
	U166	2,449	2,453	21.40	108.0	0.00	78.79	-	-	0.00	0.00	-	0.00
	U167	1,719	1,723	25.60	108.0	0.00	75.72	-	-	0.00	0.00	-	0.00
	Sum	39.05											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP010 NSP010

		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S102	3,128	3,130	18.67	108.0	0.00	80.91	-	-	0.00	0.00	-	0.00
	S104	2,249	2,252	22.42	108.0	0.00	78.05	-	-	0.00	0.00	-	0.00
	S105	2,253	2,257	22.39	108.0	0.00	78.07	-	-	0.00	0.00	-	0.00
	S106	2,969	2,971	19.27	108.0	0.00	80.46	-	-	0.00	0.00	-	0.00
	S111	6,004	6,005	10.47	108.0	0.00	86.57	-	-	0.00	0.00	-	0.00
	S112	6,265	6,266	9.90	108.0	0.00	86.94	-	-	0.00	0.00	-	0.00
	S113	5,926	5,928	10.65	108.0	0.00	86.46	-	-	0.00	0.00	-	0.00
	S114	5,890	5,892	10.73	108.0	0.00	86.41	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

ALLETE Wind

ALLETE Wind
Dwight Anderson
30 West Superior Street
Duluth, Minnesota 55802

Description:

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4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S115	5,970	5,971	10.55	108.0	0.00	86.52	-	-	0.00	0.00	-	0.00
	S116	5,263	5,265	12.22	108.0	0.00	85.43	-	-	0.00	0.00	-	0.00
	S117	4,720	4,722	13.64	108.0	0.00	84.48	-	-	0.00	0.00	-	0.00
	S118	3,706	3,708	16.66	108.0	0.00	82.38	-	-	0.00	0.00	-	0.00
	S120	2,665	2,667	20.49	108.0	0.00	79.52	-	-	0.00	0.00	-	0.00
	S121	1,854	1,858	24.71	108.0	0.00	76.38	-	-	0.00	0.00	-	0.00
	S122	1,359	1,365	28.25	108.0	0.00	73.70	-	-	0.00	0.00	-	0.00
	S123	1,593	1,597	26.48	108.0	0.00	75.07	-	-	0.00	0.00	-	0.00
	S124	1,962	1,964	24.06	108.0	0.00	76.86	-	-	0.00	0.00	-	0.00
	S125	2,098	2,102	23.25	108.0	0.00	77.45	-	-	0.00	0.00	-	0.00
	S126	1,628	1,634	26.21	108.0	0.00	75.26	-	-	0.00	0.00	-	0.00
	S127	2,133	2,137	23.05	108.0	0.00	77.60	-	-	0.00	0.00	-	0.00
	S128	2,919	2,922	19.46	108.0	0.00	80.31	-	-	0.00	0.00	-	0.00
	S129	3,294	3,296	18.07	108.0	0.00	81.36	-	-	0.00	0.00	-	0.00
	S130	3,702	3,704	16.67	108.0	0.00	82.37	-	-	0.00	0.00	-	0.00
	S131	4,192	4,194	15.14	108.0	0.00	83.45	-	-	0.00	0.00	-	0.00
	S132	4,504	4,506	14.24	108.0	0.00	84.08	-	-	0.00	0.00	-	0.00
	S134	4,386	4,388	14.57	108.0	0.00	83.85	-	-	0.00	0.00	-	0.00
	S135	4,983	4,984	12.94	108.0	0.00	84.95	-	-	0.00	0.00	-	0.00
	S136	5,389	5,390	11.91	108.0	0.00	85.63	-	-	0.00	0.00	-	0.00
	S137	5,058	5,059	12.74	108.0	0.00	85.08	-	-	0.00	0.00	-	0.00
	S138	4,734	4,735	13.60	108.0	0.00	84.51	-	-	0.00	0.00	-	0.00
	S139	4,915	4,918	13.11	108.0	0.00	84.83	-	-	0.00	0.00	-	0.00
	S140	5,701	5,703	11.17	108.0	0.00	86.12	-	-	0.00	0.00	-	0.00
	S141	5,512	5,514	11.61	108.0	0.00	85.83	-	-	0.00	0.00	-	0.00
	S142	6,646	6,648	9.09	108.0	0.00	87.45	-	-	0.00	0.00	-	0.00
	S143	7,399	7,400	7.60	108.0	0.00	88.38	-	-	0.00	0.00	-	0.00
	S144	7,430	7,431	7.55	108.0	0.00	88.42	-	-	0.00	0.00	-	0.00
	S145	6,599	6,601	9.19	108.0	0.00	87.39	-	-	0.00	0.00	-	0.00
	S146	7,017	7,019	8.34	108.0	0.00	87.93	-	-	0.00	0.00	-	0.00
	S147	7,144	7,146	8.09	108.0	0.00	88.08	-	-	0.00	0.00	-	0.00
	S148	7,093	7,094	8.19	108.0	0.00	88.02	-	-	0.00	0.00	-	0.00
	U152	1,440	1,445	27.62	108.0	0.00	74.20	-	-	0.00	0.00	-	0.00
	U158	2,781	2,785	20.01	108.0	0.00	79.90	-	-	0.00	0.00	-	0.00
	U159	2,872	2,875	19.64	108.0	0.00	80.17	-	-	0.00	0.00	-	0.00
	U160	3,538	3,541	17.21	108.0	0.00	81.98	-	-	0.00	0.00	-	0.00
	U161	3,650	3,653	16.84	108.0	0.00	82.25	-	-	0.00	0.00	-	0.00
	U162	3,352	3,353	17.86	108.0	0.00	81.51	-	-	0.00	0.00	-	0.00
	U163	2,786	2,789	19.99	108.0	0.00	79.91	-	-	0.00	0.00	-	0.00
	U164	3,716	3,717	16.63	108.0	0.00	82.40	-	-	0.00	0.00	-	0.00
	U166	4,111	4,112	15.39	108.0	0.00	83.28	-	-	0.00	0.00	-	0.00
	U167	3,703	3,704	16.67	108.0	0.00	82.37	-	-	0.00	0.00	-	0.00
	Sum	36.88											

Sum 36.88

- Data undefined due to calculation with octave data

Noise sensitive area: NSP011 NSP011

		Wind speed: 8.0 m/s											
WTG	No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet
		[m]	[m]	[dB(A)]	[dB(A)]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
	S102	2,588	2,592	20.80	108.0	0.00	79.27	-	-	0.00	0.00	-	0.00
	S104	3,523	3,526	17.26	108.0	0.00	81.95	-	-	0.00	0.00	-	0.00
	S105	3,897	3,900	16.04	108.0	0.00	82.82	-	-	0.00	0.00	-	0.00
	S106	3,674	3,677	16.76	108.0	0.00	82.31	-	-	0.00	0.00	-	0.00
	S111	4,932	4,935	13.07	108.0	0.00	84.87	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

WTG**Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S112	5,373	5,376	11.95	108.0	0.00	85.61	-	-	0.00	0.00	-	0.00
S113	5,747	5,750	11.06	108.0	0.00	86.19	-	-	0.00	0.00	-	0.00
S114	6,107	6,109	10.24	108.0	0.00	86.72	-	-	0.00	0.00	-	0.00
S115	6,480	6,482	9.44	108.0	0.00	87.23	-	-	0.00	0.00	-	0.00
S116	6,546	6,548	9.30	108.0	0.00	87.32	-	-	0.00	0.00	-	0.00
S117	6,187	6,189	10.06	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
S118	5,510	5,512	11.62	108.0	0.00	85.83	-	-	0.00	0.00	-	0.00
S120	4,718	4,720	13.64	108.0	0.00	84.48	-	-	0.00	0.00	-	0.00
S121	4,518	4,520	14.19	108.0	0.00	84.10	-	-	0.00	0.00	-	0.00
S122	4,368	4,371	14.62	108.0	0.00	83.81	-	-	0.00	0.00	-	0.00
S123	4,387	4,389	14.57	108.0	0.00	83.85	-	-	0.00	0.00	-	0.00
S124	4,216	4,218	15.07	108.0	0.00	83.50	-	-	0.00	0.00	-	0.00
S125	5,330	5,332	12.06	108.0	0.00	85.54	-	-	0.00	0.00	-	0.00
S126	5,951	5,953	10.59	108.0	0.00	86.49	-	-	0.00	0.00	-	0.00
S127	6,320	6,322	9.78	108.0	0.00	87.02	-	-	0.00	0.00	-	0.00
S128	7,093	7,095	8.19	108.0	0.00	88.02	-	-	0.00	0.00	-	0.00
S129	7,434	7,436	7.54	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
S130	7,672	7,673	7.10	108.0	0.00	88.70	-	-	0.00	0.00	-	0.00
S131	8,166	8,167	6.22	108.0	0.00	89.24	-	-	0.00	0.00	-	0.00
S132	8,582	8,584	5.51	108.0	0.00	89.67	-	-	0.00	0.00	-	0.00
S134	8,919	8,920	4.96	108.0	0.00	90.01	-	-	0.00	0.00	-	0.00
S135	9,436	9,437	4.14	108.0	0.00	90.50	-	-	0.00	0.00	-	0.00
S136	9,969	9,970	3.34	108.0	0.00	90.97	-	-	0.00	0.00	-	0.00
S137	7,672	7,674	7.10	108.0	0.00	88.70	-	-	0.00	0.00	-	0.00
S138	7,269	7,270	7.85	108.0	0.00	88.23	-	-	0.00	0.00	-	0.00
S139	6,833	6,835	8.71	108.0	0.00	87.70	-	-	0.00	0.00	-	0.00
S140	7,150	7,152	8.08	108.0	0.00	88.09	-	-	0.00	0.00	-	0.00
S141	7,492	7,494	7.43	108.0	0.00	88.49	-	-	0.00	0.00	-	0.00
S142	8,309	8,310	5.97	108.0	0.00	89.39	-	-	0.00	0.00	-	0.00
S143	9,039	9,041	4.76	108.0	0.00	90.12	-	-	0.00	0.00	-	0.00
S144	8,711	8,712	5.29	108.0	0.00	89.80	-	-	0.00	0.00	-	0.00
S145	7,923	7,925	6.64	108.0	0.00	88.98	-	-	0.00	0.00	-	0.00
S146	7,813	7,815	6.84	108.0	0.00	88.86	-	-	0.00	0.00	-	0.00
S147	8,241	8,243	6.08	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
S148	7,505	7,507	7.40	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
U152	4,468	4,470	14.34	108.0	0.00	84.01	-	-	0.00	0.00	-	0.00
U158	6,644	6,646	9.09	108.0	0.00	87.45	-	-	0.00	0.00	-	0.00
U159	6,109	6,111	10.24	108.0	0.00	86.72	-	-	0.00	0.00	-	0.00
U160	6,040	6,042	10.39	108.0	0.00	86.62	-	-	0.00	0.00	-	0.00
U161	6,877	6,879	8.62	108.0	0.00	87.75	-	-	0.00	0.00	-	0.00
U162	3,195	3,198	18.42	108.0	0.00	81.10	-	-	0.00	0.00	-	0.00
U163	2,933	2,936	19.41	108.0	0.00	80.35	-	-	0.00	0.00	-	0.00
U164	2,135	2,138	23.04	108.0	0.00	77.60	-	-	0.00	0.00	-	0.00
U166	2,137	2,142	23.02	108.0	0.00	77.62	-	-	0.00	0.00	-	0.00
U167	2,103	2,107	23.22	108.0	0.00	77.47	-	-	0.00	0.00	-	0.00

Sum 31.66

- Data undefined due to calculation with octave data

Noise sensitive area: NSP012 NSP012**WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	3,320	3,322	17.97	108.0	0.00	81.43	-	-	0.00	0.00	-	0.00
S104	4,045	4,047	15.58	108.0	0.00	83.14	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S105	4,217	4,219	15.06	108.0	0.00	83.50	-	-	0.00	0.00	-	0.00
S106	3,778	3,781	16.42	108.0	0.00	82.55	-	-	0.00	0.00	-	0.00
S111	4,128	4,131	15.33	108.0	0.00	83.32	-	-	0.00	0.00	-	0.00
S112	4,551	4,553	14.10	108.0	0.00	84.17	-	-	0.00	0.00	-	0.00
S113	5,037	5,040	12.79	108.0	0.00	85.05	-	-	0.00	0.00	-	0.00
S114	5,441	5,443	11.78	108.0	0.00	85.72	-	-	0.00	0.00	-	0.00
S115	5,837	5,839	10.85	108.0	0.00	86.33	-	-	0.00	0.00	-	0.00
S116	6,063	6,065	10.34	108.0	0.00	86.66	-	-	0.00	0.00	-	0.00
S117	5,789	5,791	10.96	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
S118	5,301	5,302	12.13	108.0	0.00	85.49	-	-	0.00	0.00	-	0.00
S120	4,771	4,772	13.50	108.0	0.00	84.57	-	-	0.00	0.00	-	0.00
S121	4,818	4,820	13.37	108.0	0.00	84.66	-	-	0.00	0.00	-	0.00
S122	4,937	4,939	13.06	108.0	0.00	84.87	-	-	0.00	0.00	-	0.00
S123	5,168	5,170	12.46	108.0	0.00	85.27	-	-	0.00	0.00	-	0.00
S124	5,071	5,072	12.71	108.0	0.00	85.10	-	-	0.00	0.00	-	0.00
S125	5,492	5,494	11.66	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
S126	6,217	6,219	10.00	108.0	0.00	86.87	-	-	0.00	0.00	-	0.00
S127	6,502	6,504	9.39	108.0	0.00	87.26	-	-	0.00	0.00	-	0.00
S128	7,182	7,184	8.02	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
S129	7,485	7,486	7.44	108.0	0.00	88.49	-	-	0.00	0.00	-	0.00
S130	7,663	7,665	7.11	108.0	0.00	88.69	-	-	0.00	0.00	-	0.00
S131	8,121	8,123	6.29	108.0	0.00	89.19	-	-	0.00	0.00	-	0.00
S132	8,536	8,537	5.58	108.0	0.00	89.63	-	-	0.00	0.00	-	0.00
S134	8,967	8,968	4.88	108.0	0.00	90.05	-	-	0.00	0.00	-	0.00
S135	9,438	9,439	4.14	108.0	0.00	90.50	-	-	0.00	0.00	-	0.00
S136	9,984	9,985	3.32	108.0	0.00	90.99	-	-	0.00	0.00	-	0.00
S137	7,364	7,366	7.67	108.0	0.00	88.34	-	-	0.00	0.00	-	0.00
S138	6,980	6,981	8.42	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
S139	6,455	6,457	9.49	108.0	0.00	87.20	-	-	0.00	0.00	-	0.00
S140	6,640	6,642	9.10	108.0	0.00	87.45	-	-	0.00	0.00	-	0.00
S141	7,064	7,066	8.25	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00
S142	7,753	7,754	6.95	108.0	0.00	88.79	-	-	0.00	0.00	-	0.00
S143	8,436	8,438	5.75	108.0	0.00	89.52	-	-	0.00	0.00	-	0.00
S144	8,055	8,056	6.41	108.0	0.00	89.12	-	-	0.00	0.00	-	0.00
S145	7,324	7,326	7.75	108.0	0.00	88.30	-	-	0.00	0.00	-	0.00
S146	7,116	7,118	8.15	108.0	0.00	88.05	-	-	0.00	0.00	-	0.00
S147	7,576	7,578	7.27	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
S148	6,754	6,756	8.87	108.0	0.00	87.59	-	-	0.00	0.00	-	0.00
U152	4,925	4,926	13.09	108.0	0.00	84.85	-	-	0.00	0.00	-	0.00
U158	6,714	6,716	8.95	108.0	0.00	87.54	-	-	0.00	0.00	-	0.00
U159	6,117	6,119	10.22	108.0	0.00	86.73	-	-	0.00	0.00	-	0.00
U160	5,897	5,899	10.71	108.0	0.00	86.42	-	-	0.00	0.00	-	0.00
U161	6,780	6,782	8.81	108.0	0.00	87.63	-	-	0.00	0.00	-	0.00
U162	3,272	3,274	18.14	108.0	0.00	81.30	-	-	0.00	0.00	-	0.00
U163	3,549	3,552	17.18	108.0	0.00	82.01	-	-	0.00	0.00	-	0.00
U164	3,079	3,081	18.85	108.0	0.00	80.77	-	-	0.00	0.00	-	0.00
U166	2,252	2,256	22.40	108.0	0.00	78.07	-	-	0.00	0.00	-	0.00
U167	2,601	2,604	20.75	108.0	0.00	79.31	-	-	0.00	0.00	-	0.00
Sum	30.44											

- Data undefined due to calculation with octave data

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

Noise sensitive area: NSP013 NSP013

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	7,458	7,458	7.50	108.0	0.00	88.45	-	-	0.00	0.00	-	0.00
S104	6,411	6,412	9.58	108.0	0.00	87.14	-	-	0.00	0.00	-	0.00
S105	5,973	5,974	10.54	108.0	0.00	86.53	-	-	0.00	0.00	-	0.00
S106	6,317	6,317	9.79	108.0	0.00	87.01	-	-	0.00	0.00	-	0.00
S111	7,921	7,921	6.65	108.0	0.00	88.98	-	-	0.00	0.00	-	0.00
S112	7,924	7,925	6.64	108.0	0.00	88.98	-	-	0.00	0.00	-	0.00
S113	7,261	7,262	7.87	108.0	0.00	88.22	-	-	0.00	0.00	-	0.00
S114	6,944	6,945	8.49	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
S115	6,738	6,739	8.90	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
S116	5,841	5,842	10.84	108.0	0.00	86.33	-	-	0.00	0.00	-	0.00
S117	5,569	5,570	11.48	108.0	0.00	85.92	-	-	0.00	0.00	-	0.00
S118	5,257	5,258	12.24	108.0	0.00	85.42	-	-	0.00	0.00	-	0.00
S120	5,346	5,347	12.02	108.0	0.00	85.56	-	-	0.00	0.00	-	0.00
S121	5,352	5,353	12.01	108.0	0.00	85.57	-	-	0.00	0.00	-	0.00
S122	5,702	5,703	11.17	108.0	0.00	86.12	-	-	0.00	0.00	-	0.00
S123	6,214	6,215	10.01	108.0	0.00	86.87	-	-	0.00	0.00	-	0.00
S124	6,588	6,589	9.21	108.0	0.00	87.38	-	-	0.00	0.00	-	0.00
S125	4,603	4,604	13.96	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
S126	3,919	3,921	15.98	108.0	0.00	82.87	-	-	0.00	0.00	-	0.00
S127	3,593	3,595	17.03	108.0	0.00	82.11	-	-	0.00	0.00	-	0.00
S128	2,999	3,001	19.15	108.0	0.00	80.55	-	-	0.00	0.00	-	0.00
S129	2,807	2,809	19.91	108.0	0.00	79.97	-	-	0.00	0.00	-	0.00
S130	2,844	2,847	19.76	108.0	0.00	80.09	-	-	0.00	0.00	-	0.00
S131	2,687	2,689	20.40	108.0	0.00	79.59	-	-	0.00	0.00	-	0.00
S132	2,473	2,475	21.31	108.0	0.00	78.87	-	-	0.00	0.00	-	0.00
S134	1,707	1,710	25.68	108.0	0.00	75.66	-	-	0.00	0.00	-	0.00
S135	1,823	1,827	24.92	108.0	0.00	76.23	-	-	0.00	0.00	-	0.00
S136	1,689	1,693	25.80	108.0	0.00	75.57	-	-	0.00	0.00	-	0.00
S137	4,452	4,453	14.39	108.0	0.00	83.97	-	-	0.00	0.00	-	0.00
S138	4,503	4,505	14.24	108.0	0.00	84.07	-	-	0.00	0.00	-	0.00
S139	5,170	5,171	12.46	108.0	0.00	85.27	-	-	0.00	0.00	-	0.00
S140	5,814	5,815	10.91	108.0	0.00	86.29	-	-	0.00	0.00	-	0.00
S141	5,235	5,237	12.29	108.0	0.00	85.38	-	-	0.00	0.00	-	0.00
S142	5,984	5,985	10.52	108.0	0.00	86.54	-	-	0.00	0.00	-	0.00
S143	6,396	6,397	9.62	108.0	0.00	87.12	-	-	0.00	0.00	-	0.00
S144	6,759	6,760	8.86	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
S145	6,289	6,290	9.85	108.0	0.00	86.97	-	-	0.00	0.00	-	0.00
S146	6,978	6,979	8.42	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
S147	6,773	6,775	8.83	108.0	0.00	87.62	-	-	0.00	0.00	-	0.00
S148	7,349	7,350	7.70	108.0	0.00	88.33	-	-	0.00	0.00	-	0.00
U152	5,467	5,468	11.73	108.0	0.00	85.76	-	-	0.00	0.00	-	0.00
U158	3,468	3,470	17.46	108.0	0.00	81.81	-	-	0.00	0.00	-	0.00
U159	4,114	4,116	15.37	108.0	0.00	83.29	-	-	0.00	0.00	-	0.00
U160	4,628	4,629	13.89	108.0	0.00	84.31	-	-	0.00	0.00	-	0.00
U161	3,815	3,817	16.30	108.0	0.00	82.63	-	-	0.00	0.00	-	0.00
U162	6,823	6,824	8.73	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
U163	7,036	7,037	8.31	108.0	0.00	87.95	-	-	0.00	0.00	-	0.00
U164	8,142	8,143	6.26	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
U166	7,869	7,869	6.74	108.0	0.00	88.92	-	-	0.00	0.00	-	0.00
U167	7,767	7,768	6.92	108.0	0.00	88.81	-	-	0.00	0.00	-	0.00

Sum 33.48
 - Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s**Noise sensitive area: NSP014 NSP014****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	3,466	3,467	17.47	108.0	0.00	81.80	-	-	0.00	0.00	-	0.00
S104	2,534	2,536	21.04	108.0	0.00	79.08	-	-	0.00	0.00	-	0.00
S105	1,815	1,818	24.97	108.0	0.00	76.19	-	-	0.00	0.00	-	0.00
S106	1,671	1,673	25.94	108.0	0.00	75.47	-	-	0.00	0.00	-	0.00
S111	3,351	3,352	17.87	108.0	0.00	81.51	-	-	0.00	0.00	-	0.00
S112	3,520	3,521	17.28	108.0	0.00	81.93	-	-	0.00	0.00	-	0.00
S113	3,073	3,076	18.87	108.0	0.00	80.76	-	-	0.00	0.00	-	0.00
S114	2,991	2,994	19.18	108.0	0.00	80.52	-	-	0.00	0.00	-	0.00
S115	3,056	3,058	18.94	108.0	0.00	80.71	-	-	0.00	0.00	-	0.00
S116	2,381	2,383	21.73	108.0	0.00	78.54	-	-	0.00	0.00	-	0.00
S117	1,830	1,834	24.87	108.0	0.00	76.27	-	-	0.00	0.00	-	0.00
S118	793	797	34.11	108.0	0.00	69.03	-	-	0.00	0.00	-	0.00
S120	657	662	36.05	108.0	0.00	67.42	-	-	0.00	0.00	-	0.00
S121	1,465	1,468	27.44	108.0	0.00	74.33	-	-	0.00	0.00	-	0.00
S122	2,519	2,521	21.10	108.0	0.00	79.03	-	-	0.00	0.00	-	0.00
S123	3,478	3,479	17.43	108.0	0.00	81.83	-	-	0.00	0.00	-	0.00
S124	3,811	3,811	16.32	108.0	0.00	82.62	-	-	0.00	0.00	-	0.00
S125	817	823	33.77	108.0	0.00	69.31	-	-	0.00	0.00	-	0.00
S126	1,549	1,553	26.79	108.0	0.00	74.82	-	-	0.00	0.00	-	0.00
S127	1,473	1,476	27.37	108.0	0.00	74.38	-	-	0.00	0.00	-	0.00
S128	1,920	1,922	24.31	108.0	0.00	76.68	-	-	0.00	0.00	-	0.00
S129	2,190	2,192	22.74	108.0	0.00	77.82	-	-	0.00	0.00	-	0.00
S130	2,366	2,368	21.80	108.0	0.00	78.49	-	-	0.00	0.00	-	0.00
S131	2,843	2,845	19.76	108.0	0.00	80.08	-	-	0.00	0.00	-	0.00
S132	3,260	3,261	18.19	108.0	0.00	81.27	-	-	0.00	0.00	-	0.00
S134	3,666	3,668	16.79	108.0	0.00	82.29	-	-	0.00	0.00	-	0.00
S135	4,142	4,143	15.29	108.0	0.00	83.35	-	-	0.00	0.00	-	0.00
S136	4,685	4,686	13.73	108.0	0.00	84.42	-	-	0.00	0.00	-	0.00
S137	2,639	2,641	20.60	108.0	0.00	79.44	-	-	0.00	0.00	-	0.00
S138	2,236	2,238	22.49	108.0	0.00	78.00	-	-	0.00	0.00	-	0.00
S139	2,155	2,159	22.93	108.0	0.00	77.68	-	-	0.00	0.00	-	0.00
S140	2,878	2,880	19.63	108.0	0.00	80.19	-	-	0.00	0.00	-	0.00
S141	2,833	2,836	19.80	108.0	0.00	80.05	-	-	0.00	0.00	-	0.00
S142	3,943	3,945	15.90	108.0	0.00	82.92	-	-	0.00	0.00	-	0.00
S143	4,731	4,732	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
S144	4,664	4,665	13.79	108.0	0.00	84.38	-	-	0.00	0.00	-	0.00
S145	3,802	3,804	16.35	108.0	0.00	82.60	-	-	0.00	0.00	-	0.00
S146	4,145	4,147	15.28	108.0	0.00	83.35	-	-	0.00	0.00	-	0.00
S147	4,326	4,327	14.75	108.0	0.00	83.72	-	-	0.00	0.00	-	0.00
S148	4,188	4,189	15.15	108.0	0.00	83.44	-	-	0.00	0.00	-	0.00
U152	2,059	2,061	23.49	108.0	0.00	77.28	-	-	0.00	0.00	-	0.00
U158	1,447	1,451	27.57	108.0	0.00	74.23	-	-	0.00	0.00	-	0.00
U159	819	826	33.73	108.0	0.00	69.34	-	-	0.00	0.00	-	0.00
U160	843	849	33.44	108.0	0.00	69.58	-	-	0.00	0.00	-	0.00
U161	1,559	1,563	26.72	108.0	0.00	74.88	-	-	0.00	0.00	-	0.00
U162	2,133	2,135	23.06	108.0	0.00	77.59	-	-	0.00	0.00	-	0.00
U163	3,040	3,042	19.00	108.0	0.00	80.66	-	-	0.00	0.00	-	0.00
U164	4,175	4,176	15.19	108.0	0.00	83.41	-	-	0.00	0.00	-	0.00
U166	3,197	3,198	18.42	108.0	0.00	81.10	-	-	0.00	0.00	-	0.00
U167	3,366	3,366	17.82	108.0	0.00	81.54	-	-	0.00	0.00	-	0.00

Sum 43.12

- Data undefined due to calculation with octave data

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

Noise sensitive area: NSP015 NSP015

WTG **Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	6,057	6,058	10.36	108.0	0.00	86.65	-	-	0.00	0.00	-	0.00
S104	5,000	5,001	12.90	108.0	0.00	84.98	-	-	0.00	0.00	-	0.00
S105	4,428	4,430	14.45	108.0	0.00	83.93	-	-	0.00	0.00	-	0.00
S106	4,610	4,610	13.94	108.0	0.00	84.27	-	-	0.00	0.00	-	0.00
S111	5,902	5,903	10.70	108.0	0.00	86.42	-	-	0.00	0.00	-	0.00
S112	5,898	5,899	10.71	108.0	0.00	86.42	-	-	0.00	0.00	-	0.00
S113	5,236	5,237	12.29	108.0	0.00	85.38	-	-	0.00	0.00	-	0.00
S114	4,924	4,925	13.09	108.0	0.00	84.85	-	-	0.00	0.00	-	0.00
S115	4,732	4,733	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
S116	3,830	3,831	16.26	108.0	0.00	82.67	-	-	0.00	0.00	-	0.00
S117	3,543	3,545	17.20	108.0	0.00	81.99	-	-	0.00	0.00	-	0.00
S118	3,280	3,281	18.12	108.0	0.00	81.32	-	-	0.00	0.00	-	0.00
S120	3,579	3,580	17.08	108.0	0.00	82.08	-	-	0.00	0.00	-	0.00
S121	3,832	3,833	16.25	108.0	0.00	82.67	-	-	0.00	0.00	-	0.00
S122	4,474	4,475	14.32	108.0	0.00	84.02	-	-	0.00	0.00	-	0.00
S123	5,213	5,214	12.35	108.0	0.00	85.34	-	-	0.00	0.00	-	0.00
S124	5,605	5,606	11.39	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
S125	2,947	2,948	19.36	108.0	0.00	80.39	-	-	0.00	0.00	-	0.00
S126	2,495	2,497	21.21	108.0	0.00	78.95	-	-	0.00	0.00	-	0.00
S127	2,007	2,010	23.78	108.0	0.00	77.06	-	-	0.00	0.00	-	0.00
S128	1,176	1,180	29.87	108.0	0.00	72.44	-	-	0.00	0.00	-	0.00
S129	858	864	33.24	108.0	0.00	69.74	-	-	0.00	0.00	-	0.00
S130	818	825	33.74	108.0	0.00	69.33	-	-	0.00	0.00	-	0.00
S131	781	789	34.21	108.0	0.00	68.94	-	-	0.00	0.00	-	0.00
S132	838	843	33.51	108.0	0.00	69.52	-	-	0.00	0.00	-	0.00
S134	661	668	35.96	108.0	0.00	67.49	-	-	0.00	0.00	-	0.00
S135	1,236	1,240	29.33	108.0	0.00	72.87	-	-	0.00	0.00	-	0.00
S136	1,726	1,728	25.56	108.0	0.00	75.75	-	-	0.00	0.00	-	0.00
S137	2,539	2,541	21.02	108.0	0.00	79.10	-	-	0.00	0.00	-	0.00
S138	2,523	2,525	21.09	108.0	0.00	79.05	-	-	0.00	0.00	-	0.00
S139	3,165	3,168	18.53	108.0	0.00	81.02	-	-	0.00	0.00	-	0.00
S140	3,852	3,853	16.19	108.0	0.00	82.72	-	-	0.00	0.00	-	0.00
S141	3,310	3,312	18.01	108.0	0.00	81.40	-	-	0.00	0.00	-	0.00
S142	4,195	4,196	15.13	108.0	0.00	83.46	-	-	0.00	0.00	-	0.00
S143	4,734	4,735	13.60	108.0	0.00	84.51	-	-	0.00	0.00	-	0.00
S144	5,011	5,012	12.87	108.0	0.00	85.00	-	-	0.00	0.00	-	0.00
S145	4,427	4,428	14.46	108.0	0.00	83.92	-	-	0.00	0.00	-	0.00
S146	5,087	5,088	12.67	108.0	0.00	85.13	-	-	0.00	0.00	-	0.00
S147	4,947	4,948	13.03	108.0	0.00	84.89	-	-	0.00	0.00	-	0.00
S148	5,417	5,419	11.84	108.0	0.00	85.68	-	-	0.00	0.00	-	0.00
U152	4,125	4,126	15.34	108.0	0.00	83.31	-	-	0.00	0.00	-	0.00
U158	1,631	1,635	26.20	108.0	0.00	75.27	-	-	0.00	0.00	-	0.00
U159	2,229	2,232	22.52	108.0	0.00	77.97	-	-	0.00	0.00	-	0.00
U160	2,640	2,642	20.59	108.0	0.00	79.44	-	-	0.00	0.00	-	0.00
U161	1,795	1,799	25.09	108.0	0.00	76.10	-	-	0.00	0.00	-	0.00
U162	5,108	5,109	12.62	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
U163	5,615	5,616	11.37	108.0	0.00	85.99	-	-	0.00	0.00	-	0.00
U164	6,776	6,776	8.83	108.0	0.00	87.62	-	-	0.00	0.00	-	0.00
U166	6,179	6,179	10.09	108.0	0.00	86.82	-	-	0.00	0.00	-	0.00
U167	6,205	6,205	10.03	108.0	0.00	86.86	-	-	0.00	0.00	-	0.00

Sum 42.59

- Data undefined due to calculation with octave data

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

Noise sensitive area: NSP016 NSP016

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	3,501	3,502	17.35	108.0	0.00	81.89	-	-	0.00	0.00	-	0.00
S104	3,062	3,065	18.91	108.0	0.00	80.73	-	-	0.00	0.00	-	0.00
S105	2,496	2,499	21.20	108.0	0.00	78.96	-	-	0.00	0.00	-	0.00
S106	1,772	1,775	25.25	108.0	0.00	75.99	-	-	0.00	0.00	-	0.00
S111	1,501	1,506	27.14	108.0	0.00	74.56	-	-	0.00	0.00	-	0.00
S112	1,811	1,815	24.99	108.0	0.00	76.18	-	-	0.00	0.00	-	0.00
S113	1,720	1,726	25.58	108.0	0.00	75.74	-	-	0.00	0.00	-	0.00
S114	1,938	1,943	24.19	108.0	0.00	76.77	-	-	0.00	0.00	-	0.00
S115	2,251	2,255	22.40	108.0	0.00	78.06	-	-	0.00	0.00	-	0.00
S116	2,221	2,225	22.56	108.0	0.00	77.95	-	-	0.00	0.00	-	0.00
S117	1,906	1,911	24.38	108.0	0.00	76.63	-	-	0.00	0.00	-	0.00
S118	1,597	1,601	26.45	108.0	0.00	75.09	-	-	0.00	0.00	-	0.00
S120	1,887	1,890	24.52	108.0	0.00	76.53	-	-	0.00	0.00	-	0.00
S121	2,671	2,673	20.46	108.0	0.00	79.54	-	-	0.00	0.00	-	0.00
S122	3,586	3,589	17.05	108.0	0.00	82.10	-	-	0.00	0.00	-	0.00
S123	4,443	4,444	14.41	108.0	0.00	83.95	-	-	0.00	0.00	-	0.00
S124	4,654	4,655	13.82	108.0	0.00	84.36	-	-	0.00	0.00	-	0.00
S125	2,649	2,651	20.55	108.0	0.00	79.47	-	-	0.00	0.00	-	0.00
S126	3,476	3,478	17.43	108.0	0.00	81.83	-	-	0.00	0.00	-	0.00
S127	3,472	3,474	17.44	108.0	0.00	81.82	-	-	0.00	0.00	-	0.00
S128	3,841	3,843	16.22	108.0	0.00	82.69	-	-	0.00	0.00	-	0.00
S129	4,036	4,038	15.61	108.0	0.00	83.12	-	-	0.00	0.00	-	0.00
S130	4,097	4,099	15.43	108.0	0.00	83.25	-	-	0.00	0.00	-	0.00
S131	4,475	4,477	14.32	108.0	0.00	84.02	-	-	0.00	0.00	-	0.00
S132	4,871	4,873	13.23	108.0	0.00	84.76	-	-	0.00	0.00	-	0.00
S134	5,428	5,429	11.82	108.0	0.00	85.69	-	-	0.00	0.00	-	0.00
S135	5,813	5,814	10.91	108.0	0.00	86.29	-	-	0.00	0.00	-	0.00
S136	6,361	6,362	9.69	108.0	0.00	87.07	-	-	0.00	0.00	-	0.00
S137	3,490	3,492	17.38	108.0	0.00	81.86	-	-	0.00	0.00	-	0.00
S138	3,117	3,120	18.71	108.0	0.00	80.88	-	-	0.00	0.00	-	0.00
S139	2,572	2,576	20.87	108.0	0.00	79.22	-	-	0.00	0.00	-	0.00
S140	2,824	2,827	19.84	108.0	0.00	80.03	-	-	0.00	0.00	-	0.00
S141	3,192	3,195	18.43	108.0	0.00	81.09	-	-	0.00	0.00	-	0.00
S142	3,986	3,988	15.77	108.0	0.00	83.01	-	-	0.00	0.00	-	0.00
S143	4,729	4,731	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
S144	4,439	4,441	14.42	108.0	0.00	83.95	-	-	0.00	0.00	-	0.00
S145	3,618	3,621	16.94	108.0	0.00	82.18	-	-	0.00	0.00	-	0.00
S146	3,604	3,607	16.99	108.0	0.00	82.14	-	-	0.00	0.00	-	0.00
S147	3,984	3,987	15.77	108.0	0.00	83.01	-	-	0.00	0.00	-	0.00
S148	3,397	3,400	17.70	108.0	0.00	81.63	-	-	0.00	0.00	-	0.00
U152	3,217	3,219	18.34	108.0	0.00	81.16	-	-	0.00	0.00	-	0.00
U158	3,383	3,386	17.75	108.0	0.00	81.59	-	-	0.00	0.00	-	0.00
U159	2,734	2,737	20.20	108.0	0.00	79.75	-	-	0.00	0.00	-	0.00
U160	2,240	2,244	22.46	108.0	0.00	78.02	-	-	0.00	0.00	-	0.00
U161	3,127	3,130	18.67	108.0	0.00	80.91	-	-	0.00	0.00	-	0.00
U162	1,769	1,773	25.27	108.0	0.00	75.97	-	-	0.00	0.00	-	0.00
U163	3,225	3,227	18.32	108.0	0.00	81.17	-	-	0.00	0.00	-	0.00
U164	4,036	4,038	15.61	108.0	0.00	83.12	-	-	0.00	0.00	-	0.00
U166	2,373	2,376	21.76	108.0	0.00	78.52	-	-	0.00	0.00	-	0.00
U167	2,945	2,946	19.37	108.0	0.00	80.38	-	-	0.00	0.00	-	0.00

Sum 37.71
 - Data undefined due to calculation with octave data

Project:

ALLETE Wind

ALLETE Wind

Dwight Anderson

30 West Superior Street

Duluth, Minnesota 55802

Description:

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Calculated:

4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s****Noise sensitive area: NSP017 NSP017****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	4,854	4,854	13.28	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
S104	3,949	3,949	15.89	108.0	0.00	82.93	-	-	0.00	0.00	-	0.00
S105	3,226	3,227	18.31	108.0	0.00	81.18	-	-	0.00	0.00	-	0.00
S106	2,975	2,975	19.26	108.0	0.00	80.47	-	-	0.00	0.00	-	0.00
S111	3,342	3,343	17.90	108.0	0.00	81.48	-	-	0.00	0.00	-	0.00
S112	3,329	3,330	17.95	108.0	0.00	81.45	-	-	0.00	0.00	-	0.00
S113	2,677	2,679	20.44	108.0	0.00	79.56	-	-	0.00	0.00	-	0.00
S114	2,400	2,401	21.63	108.0	0.00	78.61	-	-	0.00	0.00	-	0.00
S115	2,276	2,278	22.28	108.0	0.00	78.15	-	-	0.00	0.00	-	0.00
S116	1,393	1,396	28.00	108.0	0.00	73.90	-	-	0.00	0.00	-	0.00
S117	991	996	31.73	108.0	0.00	70.96	-	-	0.00	0.00	-	0.00
S118	995	997	31.71	108.0	0.00	70.97	-	-	0.00	0.00	-	0.00
S120	2,053	2,054	23.53	108.0	0.00	77.25	-	-	0.00	0.00	-	0.00
S121	2,867	2,867	19.68	108.0	0.00	80.15	-	-	0.00	0.00	-	0.00
S122	3,899	3,900	16.04	108.0	0.00	82.82	-	-	0.00	0.00	-	0.00
S123	4,850	4,850	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
S124	5,197	5,197	12.39	108.0	0.00	85.32	-	-	0.00	0.00	-	0.00
S125	2,056	2,058	23.50	108.0	0.00	77.27	-	-	0.00	0.00	-	0.00
S126	2,455	2,457	21.39	108.0	0.00	78.81	-	-	0.00	0.00	-	0.00
S127	2,064	2,066	23.46	108.0	0.00	77.30	-	-	0.00	0.00	-	0.00
S128	1,839	1,841	24.82	108.0	0.00	76.30	-	-	0.00	0.00	-	0.00
S129	1,846	1,848	24.78	108.0	0.00	76.33	-	-	0.00	0.00	-	0.00
S130	1,751	1,753	25.39	108.0	0.00	75.88	-	-	0.00	0.00	-	0.00
S131	2,034	2,035	23.63	108.0	0.00	77.17	-	-	0.00	0.00	-	0.00
S132	2,408	2,409	21.60	108.0	0.00	78.64	-	-	0.00	0.00	-	0.00
S134	3,034	3,035	19.03	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
S135	3,357	3,358	17.85	108.0	0.00	81.52	-	-	0.00	0.00	-	0.00
S136	3,900	3,900	16.04	108.0	0.00	82.82	-	-	0.00	0.00	-	0.00
S137	1,233	1,235	29.37	108.0	0.00	72.84	-	-	0.00	0.00	-	0.00
S138	823	828	33.70	108.0	0.00	69.36	-	-	0.00	0.00	-	0.00
S139	878	884	33.00	108.0	0.00	69.93	-	-	0.00	0.00	-	0.00
S140	1,685	1,688	25.84	108.0	0.00	75.55	-	-	0.00	0.00	-	0.00
S141	1,471	1,474	27.39	108.0	0.00	74.37	-	-	0.00	0.00	-	0.00
S142	2,605	2,606	20.74	108.0	0.00	79.32	-	-	0.00	0.00	-	0.00
S143	3,376	3,377	17.78	108.0	0.00	81.57	-	-	0.00	0.00	-	0.00
S144	3,379	3,380	17.77	108.0	0.00	81.58	-	-	0.00	0.00	-	0.00
S145	2,554	2,555	20.96	108.0	0.00	79.15	-	-	0.00	0.00	-	0.00
S146	3,031	3,033	19.04	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
S147	3,104	3,105	18.76	108.0	0.00	80.84	-	-	0.00	0.00	-	0.00
S148	3,205	3,207	18.39	108.0	0.00	81.12	-	-	0.00	0.00	-	0.00
U152	3,439	3,440	17.56	108.0	0.00	81.73	-	-	0.00	0.00	-	0.00
U158	1,550	1,552	26.80	108.0	0.00	74.82	-	-	0.00	0.00	-	0.00
U159	1,186	1,189	29.79	108.0	0.00	72.50	-	-	0.00	0.00	-	0.00
U160	577	582	37.37	108.0	0.00	66.30	-	-	0.00	0.00	-	0.00
U161	794	800	34.07	108.0	0.00	69.06	-	-	0.00	0.00	-	0.00
U162	3,369	3,370	17.80	108.0	0.00	81.55	-	-	0.00	0.00	-	0.00
U163	4,437	4,438	14.43	108.0	0.00	83.94	-	-	0.00	0.00	-	0.00
U164	5,551	5,551	11.53	108.0	0.00	85.89	-	-	0.00	0.00	-	0.00
U166	4,376	4,376	14.61	108.0	0.00	83.82	-	-	0.00	0.00	-	0.00
U167	4,667	4,667	13.79	108.0	0.00	84.38	-	-	0.00	0.00	-	0.00

Sum 43.66

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s**Noise sensitive area: NSP018 NSP018**

WTG			Wind speed: 8.0 m/s									
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	10,191	10,191	3.02	108.0	0.00	91.16	-	-	0.00	0.00	-	0.00
S104	9,131	9,132	4.62	108.0	0.00	90.21	-	-	0.00	0.00	-	0.00
S105	8,605	8,607	5.47	108.0	0.00	89.70	-	-	0.00	0.00	-	0.00
S106	8,813	8,814	5.13	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
S111	9,691	9,692	3.76	108.0	0.00	90.73	-	-	0.00	0.00	-	0.00
S112	9,575	9,576	3.93	108.0	0.00	90.62	-	-	0.00	0.00	-	0.00
S113	8,852	8,853	5.06	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
S114	8,451	8,453	5.73	108.0	0.00	89.54	-	-	0.00	0.00	-	0.00
S115	8,141	8,142	6.26	108.0	0.00	89.21	-	-	0.00	0.00	-	0.00
S116	7,342	7,343	7.71	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00
S117	7,268	7,270	7.85	108.0	0.00	88.23	-	-	0.00	0.00	-	0.00
S118	7,331	7,332	7.73	108.0	0.00	88.30	-	-	0.00	0.00	-	0.00
S120	7,780	7,781	6.90	108.0	0.00	88.82	-	-	0.00	0.00	-	0.00
S121	7,996	7,997	6.51	108.0	0.00	89.06	-	-	0.00	0.00	-	0.00
S122	8,500	8,502	5.64	108.0	0.00	89.59	-	-	0.00	0.00	-	0.00
S123	9,090	9,091	4.68	108.0	0.00	90.17	-	-	0.00	0.00	-	0.00
S124	9,471	9,472	4.09	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
S125	7,140	7,141	8.10	108.0	0.00	88.08	-	-	0.00	0.00	-	0.00
S126	6,594	6,596	9.20	108.0	0.00	87.39	-	-	0.00	0.00	-	0.00
S127	6,165	6,167	10.11	108.0	0.00	86.80	-	-	0.00	0.00	-	0.00
S128	5,378	5,379	11.94	108.0	0.00	85.61	-	-	0.00	0.00	-	0.00
S129	5,050	5,052	12.76	108.0	0.00	85.07	-	-	0.00	0.00	-	0.00
S130	4,870	4,872	13.23	108.0	0.00	84.75	-	-	0.00	0.00	-	0.00
S131	4,444	4,447	14.40	108.0	0.00	83.96	-	-	0.00	0.00	-	0.00
S132	4,044	4,046	15.59	108.0	0.00	83.14	-	-	0.00	0.00	-	0.00
S134	3,563	3,566	17.13	108.0	0.00	82.04	-	-	0.00	0.00	-	0.00
S135	3,107	3,110	18.75	108.0	0.00	80.85	-	-	0.00	0.00	-	0.00
S136	2,557	2,561	20.93	108.0	0.00	79.17	-	-	0.00	0.00	-	0.00
S137	5,756	5,758	11.04	108.0	0.00	86.21	-	-	0.00	0.00	-	0.00
S138	6,000	6,002	10.48	108.0	0.00	86.57	-	-	0.00	0.00	-	0.00
S139	6,691	6,693	9.00	108.0	0.00	87.51	-	-	0.00	0.00	-	0.00
S140	7,078	7,080	8.22	108.0	0.00	88.00	-	-	0.00	0.00	-	0.00
S141	6,448	6,450	9.50	108.0	0.00	87.19	-	-	0.00	0.00	-	0.00
S142	6,742	6,744	8.89	108.0	0.00	87.58	-	-	0.00	0.00	-	0.00
S143	6,821	6,823	8.73	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
S144	7,324	7,325	7.75	108.0	0.00	88.30	-	-	0.00	0.00	-	0.00
S145	7,189	7,191	8.00	108.0	0.00	88.14	-	-	0.00	0.00	-	0.00
S146	7,889	7,891	6.70	108.0	0.00	88.94	-	-	0.00	0.00	-	0.00
S147	7,526	7,528	7.37	108.0	0.00	88.53	-	-	0.00	0.00	-	0.00
S148	8,362	8,363	5.88	108.0	0.00	89.45	-	-	0.00	0.00	-	0.00
U152	8,213	8,214	6.13	108.0	0.00	89.29	-	-	0.00	0.00	-	0.00
U158	5,834	5,836	10.86	108.0	0.00	86.32	-	-	0.00	0.00	-	0.00
U159	6,412	6,414	9.58	108.0	0.00	87.14	-	-	0.00	0.00	-	0.00
U160	6,696	6,698	8.99	108.0	0.00	87.52	-	-	0.00	0.00	-	0.00
U161	5,800	5,802	10.94	108.0	0.00	86.27	-	-	0.00	0.00	-	0.00
U162	9,311	9,312	4.34	108.0	0.00	90.38	-	-	0.00	0.00	-	0.00
U163	9,755	9,756	3.66	108.0	0.00	90.79	-	-	0.00	0.00	-	0.00
U164	10,897	10,898	2.04	108.0	0.00	91.75	-	-	0.00	0.00	-	0.00
U166	10,381	10,382	2.75	108.0	0.00	91.33	-	-	0.00	0.00	-	0.00
U167	10,395	10,395	2.73	108.0	0.00	91.34	-	-	0.00	0.00	-	0.00

Sum 27.81

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s**Noise sensitive area: NSP019 NSP019****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	9,474	9,475	4.08	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
S104	8,414	8,415	5.79	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
S105	7,858	7,859	6.76	108.0	0.00	88.91	-	-	0.00	0.00	-	0.00
S106	8,022	8,023	6.47	108.0	0.00	89.09	-	-	0.00	0.00	-	0.00
S111	8,794	8,795	5.16	108.0	0.00	89.88	-	-	0.00	0.00	-	0.00
S112	8,671	8,672	5.36	108.0	0.00	89.76	-	-	0.00	0.00	-	0.00
S113	7,947	7,949	6.60	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00
S114	7,544	7,546	7.33	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00
S115	7,232	7,233	7.92	108.0	0.00	88.19	-	-	0.00	0.00	-	0.00
S116	6,437	6,439	9.53	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
S117	6,374	6,376	9.66	108.0	0.00	87.09	-	-	0.00	0.00	-	0.00
S118	6,473	6,475	9.45	108.0	0.00	87.22	-	-	0.00	0.00	-	0.00
S120	6,983	6,984	8.41	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
S121	7,257	7,259	7.87	108.0	0.00	88.22	-	-	0.00	0.00	-	0.00
S122	7,829	7,830	6.81	108.0	0.00	88.88	-	-	0.00	0.00	-	0.00
S123	8,474	8,475	5.69	108.0	0.00	89.56	-	-	0.00	0.00	-	0.00
S124	8,862	8,862	5.05	108.0	0.00	89.95	-	-	0.00	0.00	-	0.00
S125	6,376	6,378	9.66	108.0	0.00	87.09	-	-	0.00	0.00	-	0.00
S126	5,884	5,886	10.74	108.0	0.00	86.40	-	-	0.00	0.00	-	0.00
S127	5,426	5,428	11.82	108.0	0.00	85.69	-	-	0.00	0.00	-	0.00
S128	4,604	4,606	13.95	108.0	0.00	84.27	-	-	0.00	0.00	-	0.00
S129	4,257	4,259	14.95	108.0	0.00	83.59	-	-	0.00	0.00	-	0.00
S130	4,044	4,047	15.59	108.0	0.00	83.14	-	-	0.00	0.00	-	0.00
S131	3,593	3,596	17.03	108.0	0.00	82.12	-	-	0.00	0.00	-	0.00
S132	3,185	3,187	18.46	108.0	0.00	81.07	-	-	0.00	0.00	-	0.00
S134	2,774	2,777	20.04	108.0	0.00	79.87	-	-	0.00	0.00	-	0.00
S135	2,268	2,272	22.31	108.0	0.00	78.13	-	-	0.00	0.00	-	0.00
S136	1,725	1,730	25.55	108.0	0.00	75.76	-	-	0.00	0.00	-	0.00
S137	4,850	4,852	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
S138	5,101	5,103	12.63	108.0	0.00	85.16	-	-	0.00	0.00	-	0.00
S139	5,790	5,792	10.96	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
S140	6,168	6,170	10.11	108.0	0.00	86.81	-	-	0.00	0.00	-	0.00
S141	5,538	5,541	11.55	108.0	0.00	85.87	-	-	0.00	0.00	-	0.00
S142	5,843	5,845	10.84	108.0	0.00	86.34	-	-	0.00	0.00	-	0.00
S143	5,947	5,948	10.60	108.0	0.00	86.49	-	-	0.00	0.00	-	0.00
S144	6,441	6,442	9.52	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
S145	6,286	6,288	9.85	108.0	0.00	86.97	-	-	0.00	0.00	-	0.00
S146	6,987	6,989	8.40	108.0	0.00	87.89	-	-	0.00	0.00	-	0.00
S147	6,631	6,633	9.12	108.0	0.00	87.43	-	-	0.00	0.00	-	0.00
S148	7,457	7,459	7.49	108.0	0.00	88.45	-	-	0.00	0.00	-	0.00
U152	7,515	7,516	7.39	108.0	0.00	88.52	-	-	0.00	0.00	-	0.00
U158	5,047	5,049	12.77	108.0	0.00	85.06	-	-	0.00	0.00	-	0.00
U159	5,601	5,603	11.40	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
U160	5,843	5,845	10.84	108.0	0.00	86.34	-	-	0.00	0.00	-	0.00
U161	4,947	4,950	13.03	108.0	0.00	84.89	-	-	0.00	0.00	-	0.00
U162	8,515	8,516	5.62	108.0	0.00	89.60	-	-	0.00	0.00	-	0.00
U163	9,034	9,035	4.77	108.0	0.00	90.12	-	-	0.00	0.00	-	0.00
U164	10,188	10,189	3.03	108.0	0.00	91.16	-	-	0.00	0.00	-	0.00
U166	9,587	9,587	3.91	108.0	0.00	90.63	-	-	0.00	0.00	-	0.00
U167	9,635	9,635	3.84	108.0	0.00	90.68	-	-	0.00	0.00	-	0.00

Sum 30.77

- Data undefined due to calculation with octave data

Project:

ALLETE Wind

ALLETE Wind

Dwight Anderson

30 West Superior Street
Duluth, Minnesota 55802

Description:

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Calculated:

4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s****Noise sensitive area: NSP020 NSP020****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	4,673	4,674	13.77	108.0	0.00	84.39	-	-	0.00	0.00	-	0.00
S104	4,856	4,857	13.27	108.0	0.00	84.73	-	-	0.00	0.00	-	0.00
S105	4,609	4,611	13.94	108.0	0.00	84.28	-	-	0.00	0.00	-	0.00
S106	3,887	3,888	16.08	108.0	0.00	82.79	-	-	0.00	0.00	-	0.00
S111	2,042	2,046	23.57	108.0	0.00	77.22	-	-	0.00	0.00	-	0.00
S112	2,350	2,353	21.88	108.0	0.00	78.43	-	-	0.00	0.00	-	0.00
S113	3,022	3,025	19.07	108.0	0.00	80.61	-	-	0.00	0.00	-	0.00
S114	3,470	3,473	17.45	108.0	0.00	81.81	-	-	0.00	0.00	-	0.00
S115	3,871	3,873	16.12	108.0	0.00	82.76	-	-	0.00	0.00	-	0.00
S116	4,409	4,411	14.51	108.0	0.00	83.89	-	-	0.00	0.00	-	0.00
S117	4,354	4,356	14.66	108.0	0.00	83.78	-	-	0.00	0.00	-	0.00
S118	4,355	4,356	14.66	108.0	0.00	83.78	-	-	0.00	0.00	-	0.00
S120	4,494	4,495	14.27	108.0	0.00	84.06	-	-	0.00	0.00	-	0.00
S121	5,034	5,035	12.81	108.0	0.00	85.04	-	-	0.00	0.00	-	0.00
S122	5,656	5,657	11.27	108.0	0.00	86.05	-	-	0.00	0.00	-	0.00
S123	6,271	6,271	9.89	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
S124	6,335	6,336	9.75	108.0	0.00	87.04	-	-	0.00	0.00	-	0.00
S125	5,299	5,300	12.14	108.0	0.00	85.49	-	-	0.00	0.00	-	0.00
S126	6,132	6,133	10.19	108.0	0.00	86.75	-	-	0.00	0.00	-	0.00
S127	6,203	6,204	10.03	108.0	0.00	86.85	-	-	0.00	0.00	-	0.00
S128	6,613	6,614	9.16	108.0	0.00	87.41	-	-	0.00	0.00	-	0.00
S129	6,805	6,806	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
S130	6,844	6,845	8.69	108.0	0.00	87.71	-	-	0.00	0.00	-	0.00
S131	7,190	7,191	8.00	108.0	0.00	88.14	-	-	0.00	0.00	-	0.00
S132	7,570	7,571	7.29	108.0	0.00	88.58	-	-	0.00	0.00	-	0.00
S134	8,169	8,169	6.21	108.0	0.00	89.24	-	-	0.00	0.00	-	0.00
S135	8,519	8,519	5.61	108.0	0.00	89.61	-	-	0.00	0.00	-	0.00
S136	9,061	9,062	4.73	108.0	0.00	90.14	-	-	0.00	0.00	-	0.00
S137	5,950	5,951	10.60	108.0	0.00	86.49	-	-	0.00	0.00	-	0.00
S138	5,639	5,640	11.31	108.0	0.00	86.03	-	-	0.00	0.00	-	0.00
S139	4,982	4,984	12.94	108.0	0.00	84.95	-	-	0.00	0.00	-	0.00
S140	4,874	4,876	13.22	108.0	0.00	84.76	-	-	0.00	0.00	-	0.00
S141	5,428	5,430	11.82	108.0	0.00	85.70	-	-	0.00	0.00	-	0.00
S142	5,822	5,823	10.89	108.0	0.00	86.30	-	-	0.00	0.00	-	0.00
S143	6,388	6,389	9.63	108.0	0.00	87.11	-	-	0.00	0.00	-	0.00
S144	5,928	5,929	10.64	108.0	0.00	86.46	-	-	0.00	0.00	-	0.00
S145	5,336	5,338	12.04	108.0	0.00	85.55	-	-	0.00	0.00	-	0.00
S146	4,958	4,960	13.00	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
S147	5,453	5,455	11.76	108.0	0.00	85.74	-	-	0.00	0.00	-	0.00
S148	4,518	4,520	14.20	108.0	0.00	84.10	-	-	0.00	0.00	-	0.00
U152	5,427	5,428	11.82	108.0	0.00	85.69	-	-	0.00	0.00	-	0.00
U158	6,154	6,156	10.14	108.0	0.00	86.79	-	-	0.00	0.00	-	0.00
U159	5,505	5,506	11.63	108.0	0.00	85.82	-	-	0.00	0.00	-	0.00
U160	4,994	4,996	12.91	108.0	0.00	84.97	-	-	0.00	0.00	-	0.00
U161	5,863	5,865	10.79	108.0	0.00	86.36	-	-	0.00	0.00	-	0.00
U162	3,523	3,525	17.27	108.0	0.00	81.94	-	-	0.00	0.00	-	0.00
U163	4,654	4,655	13.82	108.0	0.00	84.36	-	-	0.00	0.00	-	0.00
U164	4,823	4,824	13.36	108.0	0.00	84.67	-	-	0.00	0.00	-	0.00
U166	3,128	3,129	18.67	108.0	0.00	80.91	-	-	0.00	0.00	-	0.00
U167	3,847	3,848	16.21	108.0	0.00	82.70	-	-	0.00	0.00	-	0.00

Sum 31.44

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s**Noise sensitive area: NSP021 NSP021****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	9,181	9,181	4.54	108.0	0.00	90.26	-	-	0.00	0.00	-	0.00
S104	8,203	8,203	6.15	108.0	0.00	89.28	-	-	0.00	0.00	-	0.00
S105	7,507	7,508	7.40	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
S106	7,357	7,358	7.69	108.0	0.00	88.33	-	-	0.00	0.00	-	0.00
S111	6,894	6,895	8.59	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00
S112	6,638	6,639	9.11	108.0	0.00	87.44	-	-	0.00	0.00	-	0.00
S113	5,926	5,928	10.65	108.0	0.00	86.46	-	-	0.00	0.00	-	0.00
S114	5,479	5,480	11.69	108.0	0.00	85.78	-	-	0.00	0.00	-	0.00
S115	5,090	5,092	12.66	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
S116	4,558	4,560	14.08	108.0	0.00	84.18	-	-	0.00	0.00	-	0.00
S117	4,767	4,769	13.51	108.0	0.00	84.57	-	-	0.00	0.00	-	0.00
S118	5,379	5,380	11.94	108.0	0.00	85.61	-	-	0.00	0.00	-	0.00
S120	6,377	6,378	9.66	108.0	0.00	87.09	-	-	0.00	0.00	-	0.00
S121	7,032	7,033	8.31	108.0	0.00	87.94	-	-	0.00	0.00	-	0.00
S122	7,929	7,930	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
S123	8,798	8,798	5.15	108.0	0.00	89.89	-	-	0.00	0.00	-	0.00
S124	9,182	9,182	4.54	108.0	0.00	90.26	-	-	0.00	0.00	-	0.00
S125	6,102	6,103	10.26	108.0	0.00	86.71	-	-	0.00	0.00	-	0.00
S126	6,023	6,025	10.43	108.0	0.00	86.60	-	-	0.00	0.00	-	0.00
S127	5,480	5,482	11.69	108.0	0.00	85.78	-	-	0.00	0.00	-	0.00
S128	4,628	4,629	13.89	108.0	0.00	84.31	-	-	0.00	0.00	-	0.00
S129	4,245	4,247	14.98	108.0	0.00	83.56	-	-	0.00	0.00	-	0.00
S130	3,842	3,844	16.22	108.0	0.00	82.69	-	-	0.00	0.00	-	0.00
S131	3,345	3,347	17.88	108.0	0.00	81.49	-	-	0.00	0.00	-	0.00
S132	3,061	3,064	18.92	108.0	0.00	80.72	-	-	0.00	0.00	-	0.00
S134	3,444	3,446	17.54	108.0	0.00	81.75	-	-	0.00	0.00	-	0.00
S135	2,961	2,963	19.30	108.0	0.00	80.44	-	-	0.00	0.00	-	0.00
S136	2,941	2,943	19.38	108.0	0.00	80.38	-	-	0.00	0.00	-	0.00
S137	3,210	3,212	18.37	108.0	0.00	81.14	-	-	0.00	0.00	-	0.00
S138	3,612	3,614	16.97	108.0	0.00	82.16	-	-	0.00	0.00	-	0.00
S139	4,100	4,103	15.41	108.0	0.00	83.26	-	-	0.00	0.00	-	0.00
S140	4,061	4,063	15.53	108.0	0.00	83.18	-	-	0.00	0.00	-	0.00
S141	3,530	3,533	17.24	108.0	0.00	81.96	-	-	0.00	0.00	-	0.00
S142	3,252	3,255	18.22	108.0	0.00	81.25	-	-	0.00	0.00	-	0.00
S143	3,045	3,048	18.98	108.0	0.00	80.68	-	-	0.00	0.00	-	0.00
S144	3,592	3,594	17.03	108.0	0.00	82.11	-	-	0.00	0.00	-	0.00
S145	3,758	3,761	16.48	108.0	0.00	82.51	-	-	0.00	0.00	-	0.00
S146	4,372	4,374	14.61	108.0	0.00	83.82	-	-	0.00	0.00	-	0.00
S147	3,916	3,919	15.98	108.0	0.00	82.86	-	-	0.00	0.00	-	0.00
S148	4,883	4,885	13.20	108.0	0.00	84.78	-	-	0.00	0.00	-	0.00
U152	7,504	7,505	7.41	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
U158	4,864	4,865	13.25	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
U159	5,109	5,110	12.61	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
U160	4,909	4,911	13.13	108.0	0.00	84.82	-	-	0.00	0.00	-	0.00
U161	4,212	4,215	15.08	108.0	0.00	83.49	-	-	0.00	0.00	-	0.00
U162	7,763	7,764	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
U163	8,748	8,749	5.23	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
U164	9,894	9,894	3.45	108.0	0.00	90.91	-	-	0.00	0.00	-	0.00
U166	8,763	8,763	5.21	108.0	0.00	89.85	-	-	0.00	0.00	-	0.00
U167	9,055	9,056	4.74	108.0	0.00	90.14	-	-	0.00	0.00	-	0.00

Sum 31.33

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

Noise sensitive area: NSP022 NSP022**WTG**

Wind speed: 8.0 m/s

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	7,555	7,555	7.32	108.0	0.00	88.56	-	-	0.00	0.00	-	0.00
S104	6,907	6,907	8.56	108.0	0.00	87.79	-	-	0.00	0.00	-	0.00
S105	6,211	6,212	10.02	108.0	0.00	86.86	-	-	0.00	0.00	-	0.00
S106	5,658	5,659	11.27	108.0	0.00	86.05	-	-	0.00	0.00	-	0.00
S111	3,449	3,450	17.52	108.0	0.00	81.76	-	-	0.00	0.00	-	0.00
S112	3,045	3,045	18.99	108.0	0.00	80.67	-	-	0.00	0.00	-	0.00
S113	2,555	2,557	20.95	108.0	0.00	79.16	-	-	0.00	0.00	-	0.00
S114	2,207	2,209	22.65	108.0	0.00	77.88	-	-	0.00	0.00	-	0.00
S115	1,871	1,873	24.62	108.0	0.00	76.45	-	-	0.00	0.00	-	0.00
S116	2,276	2,278	22.28	108.0	0.00	78.15	-	-	0.00	0.00	-	0.00
S117	2,827	2,829	19.83	108.0	0.00	80.03	-	-	0.00	0.00	-	0.00
S118	3,886	3,886	16.08	108.0	0.00	82.79	-	-	0.00	0.00	-	0.00
S120	5,123	5,123	12.58	108.0	0.00	85.19	-	-	0.00	0.00	-	0.00
S121	6,063	6,064	10.34	108.0	0.00	86.65	-	-	0.00	0.00	-	0.00
S122	7,129	7,129	8.12	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
S123	8,084	8,084	6.36	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
S124	8,384	8,384	5.84	108.0	0.00	89.47	-	-	0.00	0.00	-	0.00
S125	5,436	5,437	11.80	108.0	0.00	85.71	-	-	0.00	0.00	-	0.00
S126	5,943	5,944	10.61	108.0	0.00	86.48	-	-	0.00	0.00	-	0.00
S127	5,556	5,556	11.51	108.0	0.00	85.90	-	-	0.00	0.00	-	0.00
S128	5,175	5,175	12.45	108.0	0.00	85.28	-	-	0.00	0.00	-	0.00
S129	5,023	5,023	12.84	108.0	0.00	85.02	-	-	0.00	0.00	-	0.00
S130	4,728	4,728	13.62	108.0	0.00	84.49	-	-	0.00	0.00	-	0.00
S131	4,647	4,647	13.84	108.0	0.00	84.34	-	-	0.00	0.00	-	0.00
S132	4,786	4,787	13.46	108.0	0.00	84.60	-	-	0.00	0.00	-	0.00
S134	5,551	5,551	11.52	108.0	0.00	85.89	-	-	0.00	0.00	-	0.00
S135	5,518	5,518	11.60	108.0	0.00	85.84	-	-	0.00	0.00	-	0.00
S136	5,908	5,909	10.69	108.0	0.00	86.43	-	-	0.00	0.00	-	0.00
S137	2,889	2,890	19.59	108.0	0.00	80.22	-	-	0.00	0.00	-	0.00
S138	3,012	3,013	19.11	108.0	0.00	80.58	-	-	0.00	0.00	-	0.00
S139	2,617	2,619	20.69	108.0	0.00	79.36	-	-	0.00	0.00	-	0.00
S140	1,813	1,816	24.98	108.0	0.00	76.18	-	-	0.00	0.00	-	0.00
S141	2,159	2,162	22.91	108.0	0.00	77.70	-	-	0.00	0.00	-	0.00
S142	1,283	1,285	28.93	108.0	0.00	73.18	-	-	0.00	0.00	-	0.00
S143	1,268	1,271	29.05	108.0	0.00	73.08	-	-	0.00	0.00	-	0.00
S144	717	723	35.13	108.0	0.00	68.18	-	-	0.00	0.00	-	0.00
S145	998	1,003	31.65	108.0	0.00	71.03	-	-	0.00	0.00	-	0.00
S146	528	539	38.17	108.0	0.00	65.62	-	-	0.00	0.00	-	0.00
S147	480	489	39.14	108.0	0.00	64.79	-	-	0.00	0.00	-	0.00
S148	828	833	33.63	108.0	0.00	69.42	-	-	0.00	0.00	-	0.00
U152	6,676	6,676	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
U158	4,999	4,999	12.90	108.0	0.00	84.98	-	-	0.00	0.00	-	0.00
U159	4,676	4,677	13.76	108.0	0.00	84.40	-	-	0.00	0.00	-	0.00
U160	3,973	3,974	15.81	108.0	0.00	82.98	-	-	0.00	0.00	-	0.00
U161	4,108	4,109	15.39	108.0	0.00	83.27	-	-	0.00	0.00	-	0.00
U162	5,822	5,823	10.89	108.0	0.00	86.30	-	-	0.00	0.00	-	0.00
U163	7,222	7,222	7.94	108.0	0.00	88.17	-	-	0.00	0.00	-	0.00
U164	8,138	8,139	6.27	108.0	0.00	89.21	-	-	0.00	0.00	-	0.00
U166	6,487	6,487	9.43	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
U167	7,061	7,061	8.26	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00

Sum 44.09

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
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 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 Calculated:
 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation:** ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s**Noise sensitive area: NSP023 NSP023****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	7,556	7,556	7.31	108.0	0.00	88.57	-	-	0.00	0.00	-	0.00
S104	7,468	7,469	7.48	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
S105	7,015	7,015	8.35	108.0	0.00	87.92	-	-	0.00	0.00	-	0.00
S106	6,259	6,260	9.91	108.0	0.00	86.93	-	-	0.00	0.00	-	0.00
S111	3,081	3,082	18.85	108.0	0.00	80.78	-	-	0.00	0.00	-	0.00
S112	2,861	2,863	19.69	108.0	0.00	80.14	-	-	0.00	0.00	-	0.00
S113	3,398	3,400	17.70	108.0	0.00	81.63	-	-	0.00	0.00	-	0.00
S114	3,667	3,669	16.79	108.0	0.00	82.29	-	-	0.00	0.00	-	0.00
S115	3,874	3,875	16.12	108.0	0.00	82.77	-	-	0.00	0.00	-	0.00
S116	4,765	4,767	13.52	108.0	0.00	84.56	-	-	0.00	0.00	-	0.00
S117	5,068	5,070	12.72	108.0	0.00	85.10	-	-	0.00	0.00	-	0.00
S118	5,691	5,692	11.19	108.0	0.00	86.10	-	-	0.00	0.00	-	0.00
S120	6,438	6,438	9.53	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
S121	7,247	7,247	7.90	108.0	0.00	88.20	-	-	0.00	0.00	-	0.00
S122	8,117	8,118	6.30	108.0	0.00	89.19	-	-	0.00	0.00	-	0.00
S123	8,902	8,903	4.98	108.0	0.00	89.99	-	-	0.00	0.00	-	0.00
S124	9,051	9,051	4.75	108.0	0.00	90.13	-	-	0.00	0.00	-	0.00
S125	7,142	7,143	8.10	108.0	0.00	88.08	-	-	0.00	0.00	-	0.00
S126	7,930	7,930	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
S127	7,794	7,794	6.88	108.0	0.00	88.84	-	-	0.00	0.00	-	0.00
S128	7,866	7,867	6.75	108.0	0.00	88.92	-	-	0.00	0.00	-	0.00
S129	7,905	7,906	6.68	108.0	0.00	88.96	-	-	0.00	0.00	-	0.00
S130	7,778	7,778	6.91	108.0	0.00	88.82	-	-	0.00	0.00	-	0.00
S131	7,933	7,934	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
S132	8,216	8,217	6.13	108.0	0.00	89.29	-	-	0.00	0.00	-	0.00
S134	8,949	8,949	4.91	108.0	0.00	90.04	-	-	0.00	0.00	-	0.00
S135	9,108	9,108	4.65	108.0	0.00	90.19	-	-	0.00	0.00	-	0.00
S136	9,590	9,591	3.91	108.0	0.00	90.64	-	-	0.00	0.00	-	0.00
S137	6,252	6,253	9.93	108.0	0.00	86.92	-	-	0.00	0.00	-	0.00
S138	6,121	6,122	10.21	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
S139	5,439	5,440	11.79	108.0	0.00	85.71	-	-	0.00	0.00	-	0.00
S140	4,876	4,877	13.22	108.0	0.00	84.76	-	-	0.00	0.00	-	0.00
S141	5,501	5,503	11.64	108.0	0.00	85.81	-	-	0.00	0.00	-	0.00
S142	5,247	5,248	12.27	108.0	0.00	85.40	-	-	0.00	0.00	-	0.00
S143	5,445	5,446	11.78	108.0	0.00	85.72	-	-	0.00	0.00	-	0.00
S144	4,895	4,896	13.17	108.0	0.00	84.80	-	-	0.00	0.00	-	0.00
S145	4,762	4,764	13.52	108.0	0.00	84.56	-	-	0.00	0.00	-	0.00
S146	4,097	4,099	15.43	108.0	0.00	83.25	-	-	0.00	0.00	-	0.00
S147	4,541	4,543	14.13	108.0	0.00	84.15	-	-	0.00	0.00	-	0.00
S148	3,594	3,596	17.03	108.0	0.00	82.12	-	-	0.00	0.00	-	0.00
U152	7,778	7,778	6.91	108.0	0.00	88.82	-	-	0.00	0.00	-	0.00
U158	7,492	7,493	7.43	108.0	0.00	88.49	-	-	0.00	0.00	-	0.00
U159	6,909	6,910	8.56	108.0	0.00	87.79	-	-	0.00	0.00	-	0.00
U160	6,200	6,200	10.04	108.0	0.00	86.85	-	-	0.00	0.00	-	0.00
U161	6,853	6,854	8.67	108.0	0.00	87.72	-	-	0.00	0.00	-	0.00
U162	6,069	6,070	10.33	108.0	0.00	86.66	-	-	0.00	0.00	-	0.00
U163	7,434	7,435	7.54	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
U164	7,834	7,834	6.80	108.0	0.00	88.88	-	-	0.00	0.00	-	0.00
U166	6,037	6,038	10.40	108.0	0.00	86.62	-	-	0.00	0.00	-	0.00
U167	6,774	6,774	8.83	108.0	0.00	87.62	-	-	0.00	0.00	-	0.00

Sum 29.06

- Data undefined due to calculation with octave data

Project:

ALLETE Wind

ALLETE Wind

Dwight Anderson

30 West Superior Street

Duluth, Minnesota 55802

Description:

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Calculated:

4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s****Noise sensitive area: NSP024 NSP024****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	8,304	8,304	5.98	108.0	0.00	89.39	-	-	0.00	0.00	-	0.00
S104	8,124	8,125	6.29	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
S105	7,617	7,618	7.20	108.0	0.00	88.64	-	-	0.00	0.00	-	0.00
S106	6,873	6,874	8.63	108.0	0.00	87.74	-	-	0.00	0.00	-	0.00
S111	3,641	3,643	16.87	108.0	0.00	82.23	-	-	0.00	0.00	-	0.00
S112	3,330	3,331	17.94	108.0	0.00	81.45	-	-	0.00	0.00	-	0.00
S113	3,713	3,716	16.63	108.0	0.00	82.40	-	-	0.00	0.00	-	0.00
S114	3,882	3,884	16.09	108.0	0.00	82.78	-	-	0.00	0.00	-	0.00
S115	3,995	3,997	15.74	108.0	0.00	83.03	-	-	0.00	0.00	-	0.00
S116	4,898	4,899	13.16	108.0	0.00	84.80	-	-	0.00	0.00	-	0.00
S117	5,284	5,285	12.17	108.0	0.00	85.46	-	-	0.00	0.00	-	0.00
S118	6,043	6,044	10.39	108.0	0.00	86.63	-	-	0.00	0.00	-	0.00
S120	6,924	6,925	8.53	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00
S121	7,786	7,787	6.89	108.0	0.00	88.83	-	-	0.00	0.00	-	0.00
S122	8,714	8,715	5.29	108.0	0.00	89.80	-	-	0.00	0.00	-	0.00
S123	9,543	9,544	3.98	108.0	0.00	90.59	-	-	0.00	0.00	-	0.00
S124	9,720	9,720	3.71	108.0	0.00	90.75	-	-	0.00	0.00	-	0.00
S125	7,575	7,576	7.28	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
S126	8,326	8,327	5.94	108.0	0.00	89.41	-	-	0.00	0.00	-	0.00
S127	8,131	8,132	6.28	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
S128	8,099	8,100	6.33	108.0	0.00	89.17	-	-	0.00	0.00	-	0.00
S129	8,092	8,093	6.35	108.0	0.00	89.16	-	-	0.00	0.00	-	0.00
S130	7,917	7,918	6.65	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
S131	8,009	8,010	6.49	108.0	0.00	89.07	-	-	0.00	0.00	-	0.00
S132	8,253	8,254	6.06	108.0	0.00	89.33	-	-	0.00	0.00	-	0.00
S134	9,006	9,007	4.82	108.0	0.00	90.09	-	-	0.00	0.00	-	0.00
S135	9,102	9,103	4.66	108.0	0.00	90.18	-	-	0.00	0.00	-	0.00
S136	9,555	9,555	3.96	108.0	0.00	90.60	-	-	0.00	0.00	-	0.00
S137	6,262	6,263	9.90	108.0	0.00	86.94	-	-	0.00	0.00	-	0.00
S138	6,194	6,195	10.05	108.0	0.00	86.84	-	-	0.00	0.00	-	0.00
S139	5,548	5,549	11.53	108.0	0.00	85.88	-	-	0.00	0.00	-	0.00
S140	4,886	4,887	13.19	108.0	0.00	84.78	-	-	0.00	0.00	-	0.00
S141	5,485	5,486	11.68	108.0	0.00	85.79	-	-	0.00	0.00	-	0.00
S142	5,033	5,034	12.81	108.0	0.00	85.04	-	-	0.00	0.00	-	0.00
S143	5,090	5,092	12.66	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
S144	4,545	4,546	14.12	108.0	0.00	84.15	-	-	0.00	0.00	-	0.00
S145	4,587	4,589	14.00	108.0	0.00	84.23	-	-	0.00	0.00	-	0.00
S146	3,884	3,887	16.08	108.0	0.00	82.79	-	-	0.00	0.00	-	0.00
S147	4,264	4,266	14.93	108.0	0.00	83.60	-	-	0.00	0.00	-	0.00
S148	3,422	3,425	17.61	108.0	0.00	81.69	-	-	0.00	0.00	-	0.00
U152	8,346	8,347	5.91	108.0	0.00	89.43	-	-	0.00	0.00	-	0.00
U158	7,763	7,764	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
U159	7,222	7,223	7.94	108.0	0.00	88.17	-	-	0.00	0.00	-	0.00
U160	6,486	6,487	9.43	108.0	0.00	87.24	-	-	0.00	0.00	-	0.00
U161	7,045	7,046	8.29	108.0	0.00	87.96	-	-	0.00	0.00	-	0.00
U162	6,738	6,739	8.90	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
U163	8,147	8,148	6.25	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
U164	8,631	8,631	5.43	108.0	0.00	89.72	-	-	0.00	0.00	-	0.00
U166	6,816	6,817	8.74	108.0	0.00	87.67	-	-	0.00	0.00	-	0.00
U167	7,548	7,548	7.33	108.0	0.00	88.56	-	-	0.00	0.00	-	0.00

Sum 28.54

- Data undefined due to calculation with octave data

Project:

ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:

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 4/16/2012 2:39 PM/2.7.490

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s****Noise sensitive area: NSP025 NSP025****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	10,658	10,658	2.37	108.0	0.00	91.55	-	-	0.00	0.00	-	0.00
S104	9,938	9,939	3.39	108.0	0.00	90.95	-	-	0.00	0.00	-	0.00
S105	9,223	9,223	4.47	108.0	0.00	90.30	-	-	0.00	0.00	-	0.00
S106	8,735	8,735	5.26	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
S111	6,565	6,566	9.26	108.0	0.00	87.35	-	-	0.00	0.00	-	0.00
S112	6,140	6,140	10.17	108.0	0.00	86.76	-	-	0.00	0.00	-	0.00
S113	5,713	5,714	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
S114	5,372	5,373	11.96	108.0	0.00	85.60	-	-	0.00	0.00	-	0.00
S115	5,027	5,028	12.83	108.0	0.00	85.03	-	-	0.00	0.00	-	0.00
S116	5,264	5,265	12.22	108.0	0.00	85.43	-	-	0.00	0.00	-	0.00
S117	5,787	5,788	10.97	108.0	0.00	86.25	-	-	0.00	0.00	-	0.00
S118	6,825	6,826	8.73	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
S120	8,080	8,080	6.37	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
S121	8,989	8,989	4.84	108.0	0.00	90.07	-	-	0.00	0.00	-	0.00
S122	10,048	10,049	3.23	108.0	0.00	91.04	-	-	0.00	0.00	-	0.00
S123	11,007	11,007	1.89	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
S124	11,336	11,336	1.46	108.0	0.00	92.09	-	-	0.00	0.00	-	0.00
S125	8,241	8,241	6.09	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
S126	8,581	8,581	5.51	108.0	0.00	89.67	-	-	0.00	0.00	-	0.00
S127	8,107	8,108	6.32	108.0	0.00	89.18	-	-	0.00	0.00	-	0.00
S128	7,499	7,499	7.42	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
S129	7,227	7,228	7.93	108.0	0.00	88.18	-	-	0.00	0.00	-	0.00
S130	6,843	6,844	8.69	108.0	0.00	87.71	-	-	0.00	0.00	-	0.00
S131	6,547	6,548	9.30	108.0	0.00	87.32	-	-	0.00	0.00	-	0.00
S132	6,492	6,493	9.41	108.0	0.00	87.25	-	-	0.00	0.00	-	0.00
S134	7,155	7,155	8.07	108.0	0.00	88.09	-	-	0.00	0.00	-	0.00
S135	6,864	6,865	8.65	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00
S136	7,039	7,039	8.30	108.0	0.00	87.95	-	-	0.00	0.00	-	0.00
S137	5,165	5,166	12.47	108.0	0.00	85.26	-	-	0.00	0.00	-	0.00
S138	5,472	5,473	11.71	108.0	0.00	85.76	-	-	0.00	0.00	-	0.00
S139	5,375	5,376	11.95	108.0	0.00	85.61	-	-	0.00	0.00	-	0.00
S140	4,686	4,687	13.73	108.0	0.00	84.42	-	-	0.00	0.00	-	0.00
S141	4,717	4,718	13.65	108.0	0.00	84.48	-	-	0.00	0.00	-	0.00
S142	3,588	3,589	17.05	108.0	0.00	82.10	-	-	0.00	0.00	-	0.00
S143	2,812	2,813	19.89	108.0	0.00	79.98	-	-	0.00	0.00	-	0.00
S144	2,895	2,896	19.56	108.0	0.00	80.24	-	-	0.00	0.00	-	0.00
S145	3,765	3,766	16.47	108.0	0.00	82.52	-	-	0.00	0.00	-	0.00
S146	3,673	3,675	16.77	108.0	0.00	82.30	-	-	0.00	0.00	-	0.00
S147	3,309	3,311	18.01	108.0	0.00	81.40	-	-	0.00	0.00	-	0.00
S148	3,955	3,956	15.86	108.0	0.00	82.95	-	-	0.00	0.00	-	0.00
U152	9,588	9,588	3.91	108.0	0.00	90.63	-	-	0.00	0.00	-	0.00
U158	7,477	7,478	7.46	108.0	0.00	88.48	-	-	0.00	0.00	-	0.00
U159	7,341	7,342	7.72	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00
U160	6,744	6,744	8.89	108.0	0.00	87.58	-	-	0.00	0.00	-	0.00
U161	6,574	6,574	9.24	108.0	0.00	87.36	-	-	0.00	0.00	-	0.00
U162	8,942	8,942	4.92	108.0	0.00	90.03	-	-	0.00	0.00	-	0.00
U163	10,304	10,304	2.86	108.0	0.00	91.26	-	-	0.00	0.00	-	0.00
U164	11,266	11,267	1.55	108.0	0.00	92.04	-	-	0.00	0.00	-	0.00
U166	9,646	9,646	3.82	108.0	0.00	90.69	-	-	0.00	0.00	-	0.00
U167	10,204	10,204	3.01	108.0	0.00	91.18	-	-	0.00	0.00	-	0.00

Sum 28.82

- Data undefined due to calculation with octave data

Project:
ALLETE Wind
 ALLETE Wind
 Dwight Anderson
 30 West Superior Street
 Duluth, Minnesota 55802

Description:
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 Calculated:
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DECIBEL - Detailed results

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s

Noise sensitive area: NSP026 NSP026

WTG		Wind speed: 8.0 m/s										
No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	10,708	10,708	2.30	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00
S104	10,020	10,020	3.27	108.0	0.00	91.02	-	-	0.00	0.00	-	0.00
S105	9,310	9,310	4.34	108.0	0.00	90.38	-	-	0.00	0.00	-	0.00
S106	8,796	8,796	5.16	108.0	0.00	89.89	-	-	0.00	0.00	-	0.00
S111	6,499	6,499	9.40	108.0	0.00	87.26	-	-	0.00	0.00	-	0.00
S112	6,066	6,066	10.34	108.0	0.00	86.66	-	-	0.00	0.00	-	0.00
S113	5,681	5,682	11.21	108.0	0.00	86.09	-	-	0.00	0.00	-	0.00
S114	5,364	5,365	11.98	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00
S115	5,036	5,037	12.80	108.0	0.00	85.04	-	-	0.00	0.00	-	0.00
S116	5,342	5,343	12.03	108.0	0.00	85.56	-	-	0.00	0.00	-	0.00
S117	5,877	5,877	10.76	108.0	0.00	86.38	-	-	0.00	0.00	-	0.00
S118	6,926	6,927	8.52	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00
S120	8,181	8,181	6.19	108.0	0.00	89.26	-	-	0.00	0.00	-	0.00
S121	9,101	9,102	4.67	108.0	0.00	90.18	-	-	0.00	0.00	-	0.00
S122	10,165	10,165	3.06	108.0	0.00	91.14	-	-	0.00	0.00	-	0.00
S123	11,124	11,125	1.74	108.0	0.00	91.93	-	-	0.00	0.00	-	0.00
S124	11,445	11,446	1.32	108.0	0.00	92.17	-	-	0.00	0.00	-	0.00
S125	8,380	8,380	5.85	108.0	0.00	89.47	-	-	0.00	0.00	-	0.00
S126	8,754	8,754	5.22	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
S127	8,293	8,293	6.00	108.0	0.00	89.37	-	-	0.00	0.00	-	0.00
S128	7,714	7,715	7.02	108.0	0.00	88.75	-	-	0.00	0.00	-	0.00
S129	7,456	7,457	7.50	108.0	0.00	88.45	-	-	0.00	0.00	-	0.00
S130	7,080	7,081	8.22	108.0	0.00	88.00	-	-	0.00	0.00	-	0.00
S131	6,806	6,806	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
S132	6,771	6,771	8.84	108.0	0.00	87.61	-	-	0.00	0.00	-	0.00
S134	7,449	7,449	7.51	108.0	0.00	88.44	-	-	0.00	0.00	-	0.00
S135	7,179	7,180	8.03	108.0	0.00	88.12	-	-	0.00	0.00	-	0.00
S136	7,373	7,373	7.66	108.0	0.00	88.35	-	-	0.00	0.00	-	0.00
S137	5,361	5,361	11.98	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00
S138	5,648	5,649	11.29	108.0	0.00	86.04	-	-	0.00	0.00	-	0.00
S139	5,502	5,503	11.64	108.0	0.00	85.81	-	-	0.00	0.00	-	0.00
S140	4,783	4,784	13.47	108.0	0.00	84.60	-	-	0.00	0.00	-	0.00
S141	4,865	4,867	13.25	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
S142	3,730	3,731	16.58	108.0	0.00	82.44	-	-	0.00	0.00	-	0.00
S143	2,978	2,979	19.24	108.0	0.00	80.48	-	-	0.00	0.00	-	0.00
S144	2,987	2,988	19.21	108.0	0.00	80.51	-	-	0.00	0.00	-	0.00
S145	3,855	3,857	16.18	108.0	0.00	82.72	-	-	0.00	0.00	-	0.00
S146	3,687	3,689	16.72	108.0	0.00	82.34	-	-	0.00	0.00	-	0.00
S147	3,366	3,368	17.81	108.0	0.00	81.55	-	-	0.00	0.00	-	0.00
S148	3,921	3,922	15.97	108.0	0.00	82.87	-	-	0.00	0.00	-	0.00
U152	9,705	9,706	3.74	108.0	0.00	90.74	-	-	0.00	0.00	-	0.00
U158	7,670	7,671	7.10	108.0	0.00	88.70	-	-	0.00	0.00	-	0.00
U159	7,503	7,503	7.41	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
U160	6,882	6,882	8.61	108.0	0.00	87.75	-	-	0.00	0.00	-	0.00
U161	6,762	6,762	8.86	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
U162	8,981	8,981	4.86	108.0	0.00	90.07	-	-	0.00	0.00	-	0.00
U163	10,365	10,365	2.78	108.0	0.00	91.31	-	-	0.00	0.00	-	0.00
U164	11,301	11,301	1.51	108.0	0.00	92.06	-	-	0.00	0.00	-	0.00
U166	9,649	9,649	3.82	108.0	0.00	90.69	-	-	0.00	0.00	-	0.00
U167	10,227	10,227	2.97	108.0	0.00	91.19	-	-	0.00	0.00	-	0.00

Sum 28.53

- Data undefined due to calculation with octave data

Project:

ALLETE Wind

Description:

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Dwight Anderson

30 West Superior Street
 Duluth, Minnesota 55802

DECIBEL - Detailed results**Calculation: ACE #1 - SWT-3.0-101 - 110 m Class LayoutNoise calculation model: ISO 9613-2 General 8.0 m/s****Noise sensitive area: NSP027 NSP027****WTG****Wind speed: 8.0 m/s**

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
S102	7,685	7,685	7.07	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
S104	6,625	6,626	9.13	108.0	0.00	87.43	-	-	0.00	0.00	-	0.00
S105	6,115	6,116	10.23	108.0	0.00	86.73	-	-	0.00	0.00	-	0.00
S106	6,364	6,365	9.69	108.0	0.00	87.08	-	-	0.00	0.00	-	0.00
S111	7,623	7,624	7.19	108.0	0.00	88.64	-	-	0.00	0.00	-	0.00
S112	7,582	7,583	7.26	108.0	0.00	88.60	-	-	0.00	0.00	-	0.00
S113	6,891	6,892	8.59	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00
S114	6,541	6,542	9.31	108.0	0.00	87.31	-	-	0.00	0.00	-	0.00
S115	6,298	6,299	9.83	108.0	0.00	86.99	-	-	0.00	0.00	-	0.00
S116	5,420	5,421	11.84	108.0	0.00	85.68	-	-	0.00	0.00	-	0.00
S117	5,215	5,217	12.34	108.0	0.00	85.35	-	-	0.00	0.00	-	0.00
S118	5,061	5,062	12.74	108.0	0.00	85.09	-	-	0.00	0.00	-	0.00
S120	5,348	5,349	12.02	108.0	0.00	85.56	-	-	0.00	0.00	-	0.00
S121	5,501	5,502	11.64	108.0	0.00	85.81	-	-	0.00	0.00	-	0.00
S122	5,993	5,994	10.50	108.0	0.00	86.55	-	-	0.00	0.00	-	0.00
S123	6,603	6,604	9.18	108.0	0.00	87.40	-	-	0.00	0.00	-	0.00
S124	6,988	6,988	8.40	108.0	0.00	87.89	-	-	0.00	0.00	-	0.00
S125	4,668	4,669	13.78	108.0	0.00	84.39	-	-	0.00	0.00	-	0.00
S126	4,089	4,091	15.45	108.0	0.00	83.24	-	-	0.00	0.00	-	0.00
S127	3,677	3,679	16.75	108.0	0.00	82.31	-	-	0.00	0.00	-	0.00
S128	2,935	2,937	19.40	108.0	0.00	80.36	-	-	0.00	0.00	-	0.00
S129	2,650	2,653	20.55	108.0	0.00	79.48	-	-	0.00	0.00	-	0.00
S130	2,564	2,567	20.91	108.0	0.00	79.19	-	-	0.00	0.00	-	0.00
S131	2,265	2,268	22.33	108.0	0.00	78.11	-	-	0.00	0.00	-	0.00
S132	1,954	1,957	24.10	108.0	0.00	76.83	-	-	0.00	0.00	-	0.00
S134	1,249	1,254	29.20	108.0	0.00	72.97	-	-	0.00	0.00	-	0.00
S135	1,118	1,124	30.41	108.0	0.00	72.01	-	-	0.00	0.00	-	0.00
S136	860	867	33.22	108.0	0.00	69.76	-	-	0.00	0.00	-	0.00
S137	3,934	3,936	15.93	108.0	0.00	82.90	-	-	0.00	0.00	-	0.00
S138	4,052	4,054	15.56	108.0	0.00	83.16	-	-	0.00	0.00	-	0.00
S139	4,743	4,745	13.57	108.0	0.00	84.53	-	-	0.00	0.00	-	0.00
S140	5,316	5,317	12.09	108.0	0.00	85.51	-	-	0.00	0.00	-	0.00
S141	4,710	4,712	13.66	108.0	0.00	84.46	-	-	0.00	0.00	-	0.00
S142	5,354	5,356	12.00	108.0	0.00	85.58	-	-	0.00	0.00	-	0.00
S143	5,704	5,705	11.16	108.0	0.00	86.13	-	-	0.00	0.00	-	0.00
S144	6,100	6,101	10.26	108.0	0.00	86.71	-	-	0.00	0.00	-	0.00
S145	5,699	5,701	11.17	108.0	0.00	86.12	-	-	0.00	0.00	-	0.00
S146	6,401	6,402	9.61	108.0	0.00	87.13	-	-	0.00	0.00	-	0.00
S147	6,155	6,157	10.14	108.0	0.00	86.79	-	-	0.00	0.00	-	0.00
S148	6,803	6,804	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
U152	5,704	5,705	11.16	108.0	0.00	86.13	-	-	0.00	0.00	-	0.00
U158	3,404	3,407	17.68	108.0	0.00	81.65	-	-	0.00	0.00	-	0.00
U159	4,019	4,021	15.66	108.0	0.00	83.09	-	-	0.00	0.00	-	0.00
U160	4,418	4,420	14.48	108.0	0.00	83.91	-	-	0.00	0.00	-	0.00
U161	3,546	3,549	17.19	108.0	0.00	82.00	-	-	0.00	0.00	-	0.00
U162	6,867	6,868	8.64	108.0	0.00	87.74	-	-	0.00	0.00	-	0.00
U163	7,250	7,251	7.89	108.0	0.00	88.21	-	-	0.00	0.00	-	0.00
U164	8,389	8,390	5.83	108.0	0.00	89.48	-	-	0.00	0.00	-	0.00
U166	7,933	7,933	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
U167	7,910	7,910	6.67	108.0	0.00	88.96	-	-	0.00	0.00	-	0.00

Sum 37.40

- Data undefined due to calculation with octave data

<p>Project: ALLETE Wind</p> <p>ALLETE Wind Dwight Anderson 30 West Superior Street Duluth, Minnesota 55802</p>	<p>Description: EAPC does not warrant, guarantee, or make any such representations regarding the contents of this report. EAPC cannot be held liable for erroneous results caused by errors or omissions in the delivered data, or inaccuracy, limitations, or malfunctioning of models or software used. For any claim whatsoever related to the subject matter of this report, the liability of EAPC for actual damages, regardless of the form of action, shall be limited to the total amount paid to EAPC for the services provided as part of this consultancy service.</p>	<p>Printed/Page 4/16/2012 2:43 PM / 33</p> <p>Licensed user: EAPC Wind Energy 3100 DeMers Avenue US-GRAND FORKS, ND 58201 +1 701 775 3000 wind@eapc.net</p> <p>Calculated: 4/16/2012 2:39 PM/2.7.490</p>
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DECIBEL - Assumptions for noise calculation

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s

Noise calculation model:

ISO 9613-2 General

Wind speed:

8.0 m/s

Ground attenuation:

General, Ground factor: 0.5

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 and Impulse tone penalty are added to WTG source noise

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 required

Air absorption

63	125	250	500	1,000	2,000	4,000	8,000
[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: Siemens SWT-3.0-101 60Hz 3000 101.0 !O!

Noise: SWT-3.0-101 Standard

Source	Source/Date	Creator	Edited
Siemens	5/17/2010	USER	12/23/2011 8:47 AM

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	80.0	8.0	108.0	No	82.8	94.7	101.4	104.7	101.4	93.5	82.6	79.3

NSA: NSP001-NSP001

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP002-NSP002

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP003-NSP003

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s

NSA: NSP004-NSP004

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP005-NSP005

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP006-NSP006

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP007-NSP007

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP008-NSP008

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP009-NSP009

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP010-NSP010

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP011-NSP011

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s

NSA: NSP012-NSP012

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP013-NSP013

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP014-NSP014

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP015-NSP015

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP016-NSP016

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP017-NSP017

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP018-NSP018

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP019-NSP019

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout **Noise calculation model:** ISO 9613-2 General 8.0 m/s

NSA: NSP020-NSP020

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP021-NSP021

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP022-NSP022

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP023-NSP023

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP024-NSP024

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP025-NSP025

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP026-NSP026

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

NSA: NSP027-NSP027

Predefined calculation standard:

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

Noise demand: 45.0 dB(A)

Distance demand: 427.0 m

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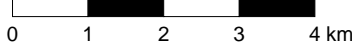
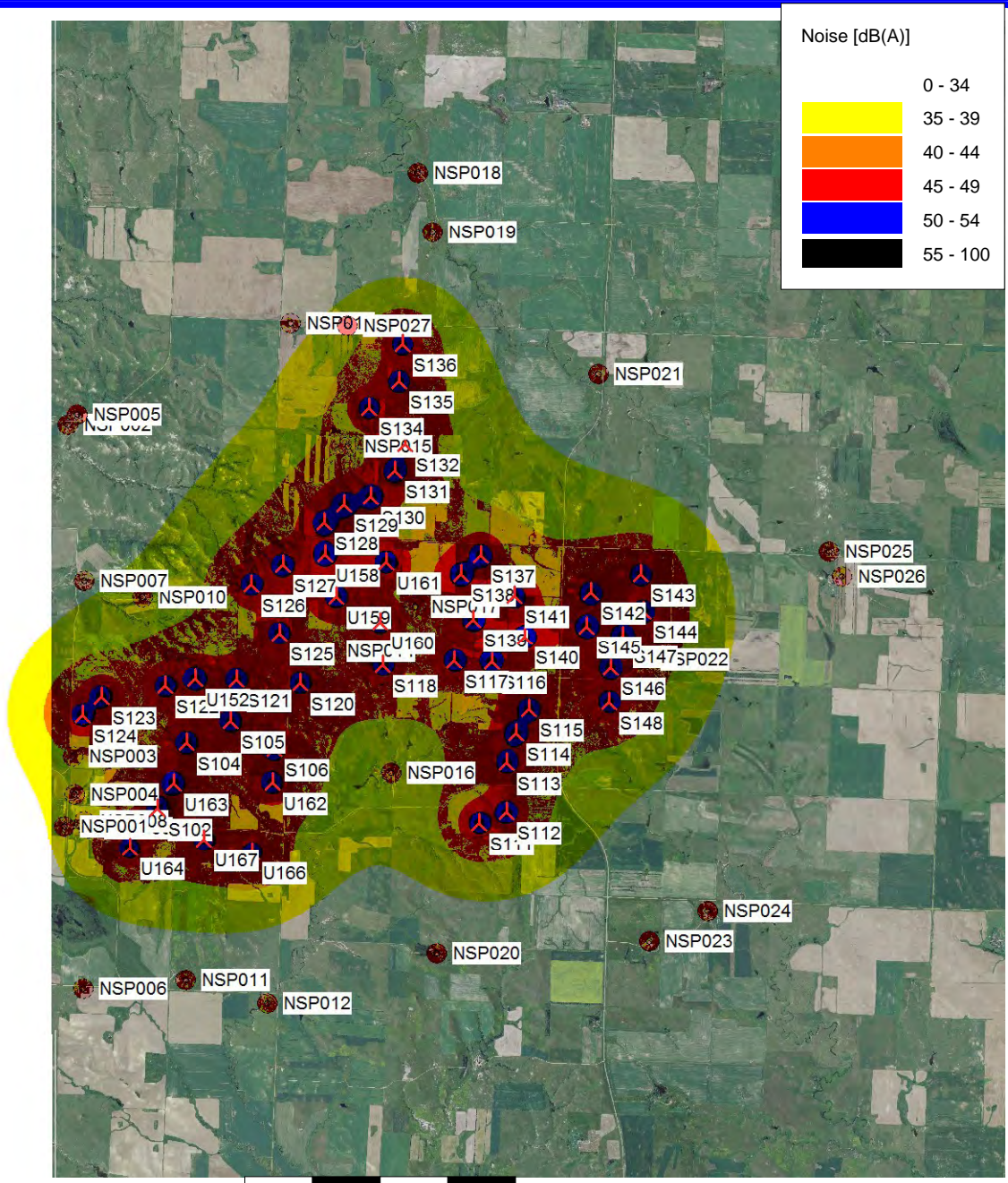
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DECIBEL - Map 8.0 m/s

Calculation: ACE #1 - SWT-3.0-101 - 110 m Class Layout Noise calculation model: ISO 9613-2 General 8.0 m/s



Map: , Print scale 1:100,000, Map center UTM WGS 84 Zone: 14 East: 284,901 North: 5,206,136
 Noise calculation model: ISO 9613-2 General. Wind speed: 8.0 m/s

- New WTG
- Noise sensitive area
- Height above sea level from active line object
- 35.0 dB(A)
- 40.0 dB(A)
- 45.0 dB(A)
- 50.0 dB(A)
- 55.0 dB(A)