



Barr Engineering Company
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Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO • Bismarck, ND

September 7, 2011

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 - Bison 3 Wind Project (Case Number PU-11-162)

Dear Mr. Lein:

On behalf of Jim Atkinson and Minnesota Power, enclosed please find several supplemental materials that are being submitted in support of Minnesota Power's Certificate of Site Compatibility application for the proposed Bison 3 Wind Project in Morton and Oliver Counties. Included in this submittal are agency consultation letters, project layout maps with final turbine locations, a wetlands summary memo, a cultural resources survey summary report, applications for county special and conditional use permits, and sound and shadow flicker reports. All documents are submitted as hard copies as well as electronic copies on compact disk.

Please feel free to contact Jim Atkinson at 218-355-3561 (office), 218-343-9119 (mobile), or electronically at jbatkinson@allete.com if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Daniel Flo", written in a cursive style.

Daniel Flo
Environmental Scientist

***Supplemental Materials Submitted in Support of the
Application to the North Dakota Public Service
Commission for a Certificate of Site Compatibility to
Construct the Bison 3 Wind Project***

Case #PU-11-162

September 2011

***By
Minnesota Power***



Prepared by Barr Engineering



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Appendix A

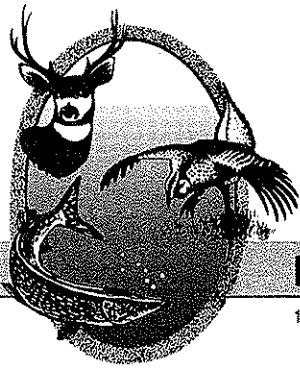
Minnesota Power's Bison 3 Wind Energy Project

Late-Filed Agency Correspondence and Comment Summary

Public agencies were contacted and invited to comment on the Project. A summary of comments received after the initial filing to the NDPSC in July, 2011, is below, and copies of the late-filed agency response letters are included in Appendix A.

Agency	Summary of Comments
<p>North Dakota Game and Fish Department (NDGFD)</p> <p>Letter dated July 7, 2011</p>	<p>The NDGFD's primary concern is the disturbance of native prairie by construction activities and asks that work within native prairie be avoided to the extent possible. In addition, the NDGFD indicates that wetlands exist within the proposed project area and recommends that impacts to wetlands be avoided if possible or replaced if avoidance is not possible. Finally, NDGFD recommends routine monitoring for avian and bat mortality as part of the facility maintenance plan.</p>
<p>Natural Resources Conservation Service (NRCS)</p> <p>Letter dated July 7, 2011</p>	<p>The NRCS has a responsibility under the Farmland Protection Policy Act (FPPA) to document the conversion of certain classifications of farmland to non-agricultural use for projects using federal funds. If federal funds are used for the project, a form is provided to help evaluate the classifications and conversions of farmland in the project area.</p> <p>The NRCS also recommends avoiding impacts to wetlands.</p>
<p>United States Fish and Wildlife Service (USFWS)</p> <p>Letter dated July 18, 2011</p>	<p>The USFWS provided comments in accordance with its authority under the Migratory Bird Treaty Act (MBTA); the Bald and Golden Eagle Protection Act (BGEPA); the Endangered Species Act (ESA); and the National Wildlife Refuge System Improvement Act (NWRSI).</p> <p>USFWS encourages the project to conduct a Potential Impact Index (PII) analysis to assist in the selection of wind power sites that minimizes impacts to migratory birds.</p> <p>The MBTA prohibits the taking of migratory birds, and the Office of Law Enforcement focuses its resources on investigating and prosecuting individuals and companies that take migratory birds without regard for their actions or without following USFWS recommendations to avoid takings. The USFWS strongly encourages wind developers to investigate the formulation of an Avian Protection Plan (APP) or Avian and Bat Protection Plan (ABPP).</p> <p>The USFWS recommends that overhead power lines be constructed in accordance with the "2006 Suggested Practices for Avian Protection on Power Lines." The agency also recommends construction during late summer, fall and early winter to avoid the breeding season for migratory birds.</p> <p>The USFWS recommends pre-construction wildlife surveys to quantify</p>

	<p>bird and bat use of the project area. In addition, they recommend up to three years of post-construction collision monitoring studies.</p> <p>The USFWS also has authority under the Bald and Golden Eagle Protection Act (BGEPA) and the Endangered Species Act (ESA). Species that could occur in the project area include the whooping crane (endangered), the piping plover (threatened), and the Sprague's pipit (candidate species).</p> <p>The USFWS also recommends avoiding native prairie, wetlands, and other high value wildlife habitat.</p>
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"VARIETY IN HUNTING AND FISHING"

NORTH DAKOTA GAME AND FISH DEPARTMENT

100 NORTH BISMARCK EXPRESSWAY BISMARCK, NORTH DAKOTA 58501-5095 PHONE 701-328-6300 FAX 701-328-6352

RECEIVED

JUL 11 2011

BARR
ENGINEERING CO.

July 7, 2011

Daniel Flo
Environmental Scientist
Barr Engineering Co.
4700 West 77th Street, Suite 200
Minneapolis, MN 55435

Dear Mr. Flo:

RE: Minnesota Power – Bison 3 Wind Energy Project

The North Dakota Game and Fish Department has reviewed this project for wildlife concerns.

Our primary concern with wind power development is the disturbance of native prairie associated with construction of turbines, access roads, and other associated facilities. We ask that work within native prairie be avoided to the extent possible. This could include micro-siting turbines onto adjacent previously disturbed land, locating access roads on existing section line trails rather than across undisturbed native prairie, etc.

The National Wetland Inventory indicates numerous wetlands within the proposed project area. We recommend that any unavoidable wetland impacts be replaced in kind, above-ground appurtenances not be placed in wetland areas, and no alterations be made to existing drainage patterns.

We also recommend that routine monitoring for avian and bat mortality be included as part of the facility maintenance plan for the life of the project. We would appreciate being kept informed as this project progresses, and if possible, we would like the GPS coordinates for each turbine after the site has been established.

Sincerely,

Paul Schadewald
Chief
Conservation & Communication Division

js



Natural Resources Conservation Service
P.O. Box 1458
Bismarck, ND 58502-1458

July 11, 2011

Daniel Flo
BARR Engineering Co.
4700 West 77th Street, Suite 200
Minneapolis, MN 55435

RE: Minnesota Power's Bison 3 Wind Energy Project
Morton and Oliver Counties, ND

Dear Mr. Flo:

The Natural Resources Conservation Service (NRCS) has reviewed your letter dated June 10, 2011, concerning a plan to construct a wind energy conversion facility – the Bison 3 Wind Energy Project – in Morton and Oliver Counties, North Dakota.

Important Farmlands - NRCS has a major responsibility with (Farmland Protection Policy Act) FPPA in documenting conversion of farmland (i.e., prime, statewide, and local importance) to non-agricultural use when the project utilizes federal funds. Your proposed project consists of activities that are subject to FPPA. New transmission towers may remove farmland from production; therefore, these sites may be subject to FPPA, and an AD-1006 must be completed. Activities that do not enact FPPA include the burying of electrical lines or activities within city limits. Below are instructions for completing the AD-1006 for those areas affected by FPPA, provided federal funds are used.

For those areas subject to FPPA, the following form must be completed. You may utilize a fillable, web based form at http://www.nrcs.usda.gov/Programs/fppa/pdf_files/AD1006.PDF to record the following. Please complete Part I and Part III and return to Fred Aziz, Area Resource Soil Scientist, 208 2nd Avenue SW, PO Box 2096, Jamestown, ND, 58402-2096 or call 701-252-1460 ext.115. If applicable, you may email the information to fred.aziz@nd.usda.gov. We will also need a map of the site at an appropriate scale so we can accurately assess the area (e.g., 1:20,000 or 1:24,000). If the farmland (i.e., prime, statewide, and local importance) is determined to be subject to the FPPA, we will then complete Parts II and IV. NRCS will measure the relative value of the site as farmland on a scale of 0 to 100, according to the information sources listed in CFR, Sec. 658.5(a). If FPPA applies to this site, Form AD-1006 will be returned to your agency for completion of Part VI, Site Assessment Criteria.

Mr. Flo
Page 2

NRCS is monitoring Farmland Conversion Impact Ratings (Form AD-1006, Form AD-106) and are concerned with how some of the forms are being completed, particularly Part IV – Site Assessment Criteria, which is being scored below 60 points. As a general rule, if FPPA applies and the site is in agricultural production, rarely will it be appropriate for it to have a score of less than 60 points. If you have questions concerning the Farmland Conversion Impact Ratings or assessment factors, please call Steve Sieler, State Soil Liaison, NRCS, Bismarck, ND, (701) 530-2019.

Wetlands – The Wetland Conservation Provisions of the 1985 Food Security Act, as amended, provide that if a USDA participant converts a wetland for the purpose of, or to have the effect of, making agricultural production possible, loss of USDA benefits could occur. NRCS has developed the following guidelines for the installation of buried utilities. If these guidelines are followed, the impacts to the wetland(s) will be considered minimal allowing USDA participants to continue to receive USDA benefits. Following are the requirements: 1) Disturbance to the wetland(s) must be temporary, 2) no drainage of the wetland(s) is allowed (temporary or permanent), 3) mechanized landscaping necessary for installation is kept to a minimum and preconstruction contours are maintained, 4) temporary side cast material must be placed in such a manner not to be dispersed in the wetland, and 5) all trenches must be backfilled to the original wetland bottom elevation.

NRCS would recommend that impacts to wetlands be avoided. If the alignment of the project requires passage through a wetland, NRCS can complete a certified wetland determination, if requested by the landowner/operator.

Sincerely,



JEROME SCHAAR

State Soil Scientist/MO 7 Leader

Enclosure

cc:

Fred Aziz, ARSS, NRCS, Jamestown, ND

cc: w/o encl.

Michele Doyle, DC, NRCS, Mandan, ND

David Pfliiger, DC, NRCS, Center, ND

Stuart Blotter, ASTC (FO), NRCS, Jamestown, ND

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I (To be completed by Federal Agency)	Date Of Land Evaluation Request
Name Of Project	Federal Agency Involved
Proposed Land Use	County And State

PART II (To be completed by SCS)	Date Request Received By SCS
Does the site contain prime, unique, statewide or local important farmland? (If no, the FPPA does not apply - do not complete additional parts of this form).	Yes <input type="checkbox"/> No <input type="checkbox"/>
Major Crop(s)	Acres Irrigated
Name Of Land Evaluation System Used	Average Farm Size
Farmable Land In Govt. Jurisdiction Acres: %	Amount Of Farmland As Defined in FPPA Acres: %
Name Of Local Site Assessment System	Date Land Evaluation Returned By SCS

PART III (To be completed by Federal Agency)	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site				

PART IV (To be completed by SCS) Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				

PART V (To be completed by SCS) Land Evaluation Criterion Relative Value Of Farmland To Be Converted (Scale of 0 to 100 Points)				
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PART VI (To be completed by Federal Agency) Site Assessment Criteria (These criteria are explained in 7 CFR 658.5(b))	Maximum Points			
1. Area In Nonurban Use				
2. Perimeter In Nonurban Use				
3. Percent Of Site Being Farmed				
4. Protection Provided By State And Local Government				
5. Distance From Urban Builtup Area				
6. Distance To Urban Support Services				
7. Size Of Present Farm Unit Compared To Average				
8. Creation Of Nonfarmable Farmland				
9. Availability Of Farm Support Services				
10. On-Farm Investments				
11. Effects Of Conversion On Farm Support Services				
12. Compatibility With Existing Agricultural Use				
TOTAL SITE ASSESSMENT POINTS	160			

PART VII (To be completed by Federal Agency)				
Relative Value Of Farmland (From Part V)	100			
Total Site Assessment (From Part VI above or a local site assessment)	160			
TOTAL POINTS (Total of above 2 lines)	260			

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes <input type="checkbox"/> No <input type="checkbox"/>
Reason For Selection:		



United States Department of the Interior



FISH AND WILDLIFE SERVICE

Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

JUL 18 2011

Mr. Daniel Flo
Environmental Scientist
Barr Engineering Co.
4700 West 77th Street, Suite 200
Minneapolis, Minnesota 55435

Re: Minnesota Power's Bison 3 Wind Energy Project

Dear Mr. Flo:

This is in response to your letter dated June 10, 2011, requesting environmental information in relation to an investigation into a potential wind energy development project in Morton and Oliver Counties, North Dakota. Minnesota Power proposes to construct and operate the 105 MW Bison 3 Wind Energy Project. You indicate your company has been retained by Minnesota Power to assist with the environmental permitting process for the project. The proposed project will interconnect with the 230kV Bison Substation and then the Square Butte Substation. The wind-generated electricity will be transmitted to Minnesota Power's transmission system via an existing 250kV DC Line and existing AC transmission system as available and is intended to be used to meet Minnesota Power's share of State of Minnesota renewable energy and Integrated Resource Plan requirements. No information was provided as to the specific type or location of wind turbines that may be constructed. Therefore, our comments are general in nature.

Minnesota Power will seek a Certificate of Site Compatibility from 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. Minnesota Power plans to file the Certificate application in June 2011, in order to obtain Commission approval by the fall of 2011. Minnesota Power plans to begin construction in the spring of 2012.

The location for the proposed project is approximately 7 miles northwest of New Salem, North Dakota, in the following sections:

T. 140 N., R. 85 W., Sections 5 and 8
T. 140 N., R. 86 W., Sections 2-5, 7-11, 15-20, and 30
T. 140 N., R. 87 W., Sections 2-5, 9-15, 22-25, and 27
T. 141 N., R. 85 W., Sections 29-34
T. 141 N., R. 86 W., Sections 25, 26, 35, and 36
T. 141 N., R. 87 W., Sections 35 and 36

We offer the following comments under the authority of and in accordance with the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703 et seq.), Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668d, 54 Stat. 250), the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.), and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

General Comments

The U.S. Fish and Wildlife Service (Service) holds certain resources in trust and manages them for the benefit of the American people. These resources include migratory birds, inter-jurisdictional fish, federally-listed threatened and endangered species of plants and animals and their habitats, and units of the National Wildlife Refuge system. One goal of Service policy is that conservation of fish and wildlife resources receive equal consideration with other features of resource development, and that conservation actions are coordinated with those other forms of development. Another goal is to conserve, protect, and enhance fish and wildlife and their habitats to facilitate the balanced development of the Nation's natural resources.

Adequate consideration for avian and other wildlife resources early in the site evaluation process can help to minimize impacts and facilitate project review. Informed site selection is possibly the most important step in avoiding and minimizing impacts to wildlife. Although current wind turbine technology and proper siting can help to minimize the incidence of avian and bat deaths due to blade, aerial line, and turbine strikes, the potential for direct mortality of some migratory birds and bats will remain. Wind power developers, in concert with the Service, can help to ensure that projects proceed with as little impact to migratory birds as possible. This can be accomplished by gathering information on avian resources as they relate to project siting and by implementing measures to minimize impacts to migratory birds from the construction and operation of the wind facility. The Service's Interim Wind Turbine Siting Guidelines are enclosed to assist in project planning (enclosure 1). We encourage the project proponents to conduct a Potential Impact Index (PII) analysis on several potential sites within wind resource areas to assist in the selection of a wind power site that minimizes the potential to impact migratory birds. Please inform this office whether or not you plan to use the Service's 2003 Guidelines in selecting your site and if not, whether you intend to use a different method to assess potential impacts to avian and other wildlife resources, and if so, what that method consists of.

Migratory Birds

The MBTA prohibits the taking, killing, possession, and transportation (among other actions), of migratory birds, their eggs, parts, and nests, except when specifically permitted. While the Act has no provision for allowing unintentional take, the Service realizes that some birds may be killed during wind project construction and operation, even if all known reasonable and effective measures to protect birds are used. The Service's Office of Law Enforcement (OLE) carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and agencies that have taken effective steps to avoid take of migratory birds and by encouraging others to implement measures to avoid take of

migratory birds. It is not possible to absolve individuals, companies, or agencies from liability even if they implement bird mortality avoidance or other similar protective measures. However, OLE focuses its resources on investigating and prosecuting individuals, companies, and agencies that take migratory birds without identifying and implementing all reasonable, prudent and effective measures to avoid that take. Companies are encouraged to work closely with Service biologists to identify available protective measures when developing project plans and/or avian protection plans, and to implement those measures prior to/during project construction and operation.

The Service has coordinated with the Avian Power Line Interaction Committee (APLIC) to develop guidelines to assist companies in formulating Avian Protection Plans (APP). The guidelines can be accessed from APLIC's website at <http://www.aplic.org/>. These plans are utility specific and designed to reduce operational risks that result from avian interactions with electric utility facilities, but we suggest they may be adapted to wind energy facilities. Wind energy projects have the potential to negatively affect bats, as well as avian species. Therefore, we encourage project developers to formulate an Avian and Bat Protection Plan (ABPP) if bats migrate through or may be present in the project area.

Some of the things that the Service looks for in an APP or ABPP are typically a statement of company policy confirming the company's commitment to work cooperatively towards the protection of migratory birds and bats; identification of the process under which the company will obtain and comply with all necessary permits, including, but not limited to, nest relocation, temporary possession, depredation, salvage/disposal, and scientific collection; discussion of the company's plan for monitoring and reporting all incidents of avian or bat injury or mortality; a commitment to make all reasonable efforts to construct and modify infrastructure to reduce the incidence of avian and bat mortality; a mechanism to review existing practices, ensuring quality control and allowing for adaptive management; and a plan for providing adequate training for all appropriate utility personnel. An APP or ABPP reporting system is important to help the company pinpoint areas of concern by tracking both the specific locations where mortalities may be occurring, as well as the extent of such mortalities and the remedial actions taken/planned to address identified problem areas. Following the 2003 voluntary Guidelines and involving the Service prior to selecting a project site are key components to obtaining prosecutorial discretion in the event of bird injuries and mortalities due to project construction and operation.

To minimize the electrocution hazard to birds, the Service, with support from the Rural Utilities Service, recommends that new or updated overhead power lines be constructed in accordance with the current guidelines for preventing raptor electrocutions. The recommended guidelines can be found in "2006 Suggested Practices for Avian Protection on Power Lines". To increase power line visibility and reduce bird fatalities resulting from collisions with power lines, the Service recommends all new power lines that cross or run adjacent to rivers or large wetlands be modified according to "Mitigating Bird Collisions with Power Lines: The State of the Art in 1994". Both publications can be obtained by writing or calling the Edison Electric Institute, P.O. Box 266, Waldorf, Maryland 20604-0266, (1-800-334-5453) or visiting their website at www.eei.org.

To the extent practicable, construction should be scheduled for late summer or fall/early winter so as not to disrupt waterfowl or other wildlife during the breeding season (February 1 to July 15). If work is proposed to take place during the breeding season or at any other time which may result in the take of migratory birds, their eggs, or active nests, the Service recommends that the project proponent take all practicable measures to avoid and minimize take, such as maintaining adequate buffers to protect the birds until the young have fledged. The Service further recommends that if field surveys for nesting birds are contemplated, that survey plans be shared with and coordinated with this office, and that if surveys are conducted with the intent of avoiding take, that any documentation of the presence of migratory birds, eggs, and active nests, along with information regarding the qualifications of the biologist(s) performing the surveys and any avoidance measures implemented at the project site be maintained. Should surveys or other available information indicate a significant impact to migratory birds, the Service requests that this office be contacted for further consultation on the extent of the impact and the long-term implications of the intended use of the project on migratory bird populations.

Bald and Golden Eagles

The BGEPA prohibits anyone without a permit issued by the Secretary of the Interior from taking bald or golden eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof. The Act defines take as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb. "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available; 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously-used nest site during a time when eagles are not present; if, upon the eagles return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause a loss of productivity or nest abandonment. A permit is required for any take of bald or golden eagles or their nests. Permits to take eagles or their nests are available only for legitimate emergencies or as part of a program to protect eagles.

Threatened, Endangered, and Candidate Species

A list of federally threatened and endangered species, and candidate species that may occur within the proposed project's potential area of influence is enclosed, i.e. a list of threatened, endangered, and candidate species for Morton and Oliver Counties (enclosure 2). This list fulfills requirements of the Service under the ESA.

Section 10(a)(1)(B) of the ESA allows non-Federal parties planning activities that have no Federal nexus, but which could result in the incidental taking of listed animals, to apply for an incidental

take permit. (A Federal nexus exists whenever an activity is conducted, funded, or licensed or permitted by a Federal agency). The application must include a habitat conservation plan (HCP) laying out the proposed actions, determining the effects of those actions on federally-listed plant and wildlife species and their habitats (and may include proposed or candidate species), and defining measures to minimize and mitigate adverse effects.

If a Federal agency authorizes, funds, or carries out a proposed action, the responsible Federal agency, or its delegated agent, is required to evaluate whether the action "may affect" listed species or critical habitat. If the Federal agency or its designated agent determines the action "may affect, is likely to adversely affect" listed species or result in destruction or adverse modification of critical habitat, the responsible Federal agency shall request formal section 7 consultation with this office. If the evaluation shows a "no effect" determination for listed species or critical habitat, further consultation is not necessary. If a private entity receives Federal funding for a construction project or if any Federal permit or license is required, the Federal agency may designate the fund recipient or permittee as its agent for purposes of informal section 7 consultation. The funding, permitting, or licensing Federal agency is responsible to ensure that its actions comply with the ESA, including obtaining concurrence from the Service for any action that may affect a threatened or endangered species or designated critical habitat.

The Aransas Wood Buffalo Population (AWBP) of whooping cranes is the only self sustaining migratory population of whooping cranes remaining in the wild. These birds breed in the wetlands of Wood Buffalo National Park in Alberta and the Northwest Territories of northern Canada, and overwinter on the Texas coast. Whooping cranes in the AWBP annually migrate through North Dakota during their spring and fall migrations.

Endangered whooping cranes have been documented using stopover habitat throughout North Dakota. The proposed project site is located within the whooping crane migration corridor that includes 95% of all confirmed whooping crane sightings in North Dakota (enclosure 3). Wind energy projects in this wind resource area have the potential to affect whooping cranes during their annual spring and fall migrations. Potential effects may be direct (e.g. collision mortality) or indirect (e.g. avoidance of the site resulting in cranes seeking alternate habitat). The best available information indicates that whooping cranes avoid stopover habitat that is developed with wind energy appurtenances, particularly wind turbines. This avoidance may deny them the use of important habitat, and thus may result in an adverse effect in the form of harm by significant habitat modification. Whooping cranes use migration stopover habitat opportunistically and may not use the same stopovers annually. Whooping cranes often stop wherever they happen to be late in the day when they find conditions no longer suitable for migration. This tendency can make for a very unpredictable pattern of stopover use, depending on daily weather conditions. The loss of such habitat due to the presence of wind turbines is a substantial indirect impact that is anticipated to increase with the growth in wind energy development in the whooping crane migration corridor.

The interactions of whooping cranes with wind turbines and wind facilities are currently not fully known, although it is expected that these large birds with relatively low maneuverability are

susceptible to mortality via collisions with turbines. Other species of large birds such as raptors, white pelicans, and sandhill cranes have been documented colliding with wind turbine blades. Direct mortality or injury of whooping cranes may occur as they encounter turbines in bad weather or low-light conditions at the beginning or end of migration flights, or when flying between roosts and foraging areas at stopover sites. The highest known source of direct mortality to fledged whooping cranes is from striking power lines. Currently, collisions with power lines have accounted for the death or serious injury of at least 46 whooping cranes since 1956.

Minnesota Power is currently participating in the Great Plains Wind Energy (GPWE) Programmatic Habitat Conservation Plan (HCP). The preliminary proposed plan area for that HCP includes the potential project site described above. Given that project-specific HCPs are costly and time-consuming both for the project proponent and the Service, if Minnesota Power believes that incidental take of any federally-listed species, including the whooping crane, piping plover, or interior least tern is likely to occur, we suggest that Minnesota Power seek coverage (i.e. incidental take permit) under the GPWE HCP.

Fish and Wildlife Service Property Interests

The Service administers Waterfowl Production Areas owned in fee title, as well as wetland and grassland easements throughout North Dakota. A review of Service realty records for the proposed project area indicates no Service property interests are located in the proposed project area.

High Value Habitat Avoidance

High value wildlife habitat types in North Dakota include native prairie, wetlands, wooded draws and riparian forests. We recommend that construction of wind towers and appurtenant facilities in these habitat types be avoided whenever possible.

Our review of NWI maps indicates that wetland areas are located within the project area. NWI data can be accessed directly by visiting their website at (wetlands.fws.gov). Section 404 of the Clean Water Act regulates placement of fill materials in certain wetlands. A Corps of Engineers' 404 permit may be required if fill material will be placed in aquatic sites including wetlands. The project proponent should contact Mr. Dan Cimarosti, Regulatory Office, Corps of Engineers, 1513 South 12th Street, Bismarck, North Dakota 58504 (701-255-0015), to determine their permit requirements. If a 404 permit is required, the Service will also provide recommendations on this project to the Corps.

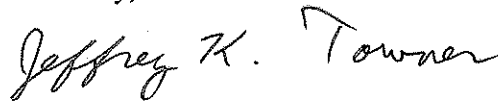
Research, Monitoring, and Assessment

We recommend project proponents, in coordination with the Service, implement pre-construction wildlife surveys to quantify bird and bat use of the project area. Up to 3 years of post-construction collision monitoring studies are recommended (based on the level of risk identified during pre-construction surveys) to determine the effect of several factors, such as site

selection, turbine designs, the layout of wind plants, wind plant operations, habitat alteration, and changes in available perching and nesting sites, on bird and bat deaths. Annual reports outlining the results of these monitoring studies should be submitted to this office. The Avian Subcommittee of the National Wind Coordinating Committee (NWCC) has developed a guidance document to assist wind energy developers in designing studies that will produce credible and comparable results of avian interaction with wind power plants. The NWCC document, "Studying Wind Energy/Bird Interactions: A Guidance Document. Metrics and methods for determining or monitoring potential impacts on birds at existing and proposed wind energy sites," can be obtained by contacting the National Wind Coordination Committee, c/o RESOLVE, 1255 23rd Street, Suite 275, Washington, D.C. 20037, or by visiting their website at (www.nationalwind.org).

If you have any questions, please contact Terry Ellsworth of my staff or myself at (701) 250-4481, or at the letterhead address.

Sincerely,



Jeffrey K. Towner
Field Supervisor
North Dakota Field Office

Enclosures (3)

cc: N. Dakota Public Service Commission
North Dakota Game and Fish Department (Attn: John Schumacher)

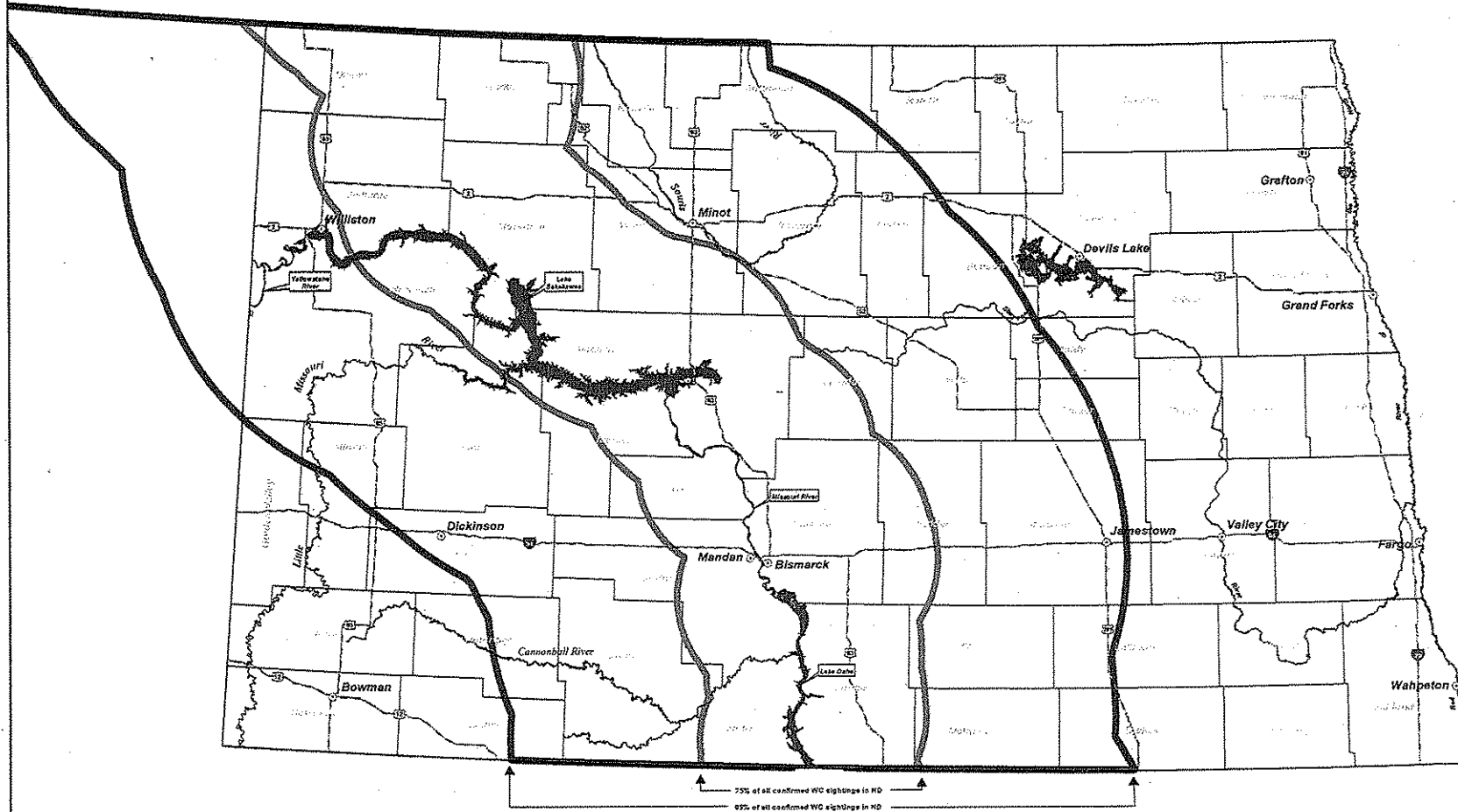
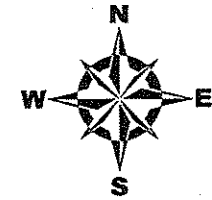
**U. S. Fish and Wildlife Service Interim Guidelines For
Communications Tower Siting, Construction, Operation, and Decommissioning**

1. We strongly encourage any company/applicant/licensee proposing to construct a new communications tower to collocate the communications equipment on an existing communication tower or other structure (e.g., billboard, water tower, or building mount). Depending on tower load factors, from 6 to 10 providers may collocate on an existing tower.
2. If collocation is not feasible and a new tower or towers are to be constructed, we strongly encourage communications service providers to construct towers no more than 199 feet above ground level, using construction techniques which do not require guy wires (e.g., use a lattice structure, monopole, etc.). Such towers should be unlighted if Federal Aviation Administration regulations permit.
3. If constructing multiple towers, providers should consider the cumulative impacts of all of those towers to migratory birds and threatened and endangered species, as well as the impacts of each individual tower.
4. If at all possible, new towers should be sited within existing "antenna farms" (clusters of towers). Towers should not be sited in or near wetlands, other known bird concentration areas (e.g., State or Federal refuges, staging areas, rookeries), in known migratory or daily movement flyways, or in habitat of threatened or endangered species. Towers should not be sited in areas with a high incidence of fog, mist, and low ceilings.
5. If taller (>199 feet AGL) towers requiring lights for aviation safety must be constructed, the minimum amount of pilot warning and obstruction avoidance lighting required by the FAA should be used. Unless otherwise required by the FAA, only white (preferable) or red strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. The use of solid red or pulsating red warning lights at night should be avoided. Current research indicates that solid or pulsating (beacon) red lights attract night-migrating birds at a much higher rate than white strobe lights. Red strobe lights have not yet been studied.
6. Tower designs using guy wires for support which are proposed to be located in known raptor or waterbird concentration areas or daily movement routes, or in major diurnal migratory bird movement routes or stopover sites, should have daytime visual markers on the wires to prevent collisions by these diurnally moving species. (For guidance on markers, see *Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington, D.C., 78 pp.* and *Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines. Edison Electric Institute /Raptor Research Foundation, Washington, D.C., 128pp.* Copies can be obtained via the Internet at <http://www.eei.org/resources/pubcat/enviro/>, or by calling 1-800-334-5433).

7. Towers and appendant facilities should be sited, designed and constructed so as to avoid or minimize habitat loss within and adjacent to the tower "footprint." However, a larger tower footprint is preferable to the use of guy wires in construction. Road access and fencing should be minimized to reduce or prevent habitat fragmentation and disturbance, and to reduce above-ground obstacles to birds in flight.
8. If significant numbers of breeding, feeding, or roosting birds are known to habitually use the proposed tower construction area, relocation to an alternate site is recommended. If this is not an option, seasonal restrictions on construction may be advisable in order to avoid disturbance during periods of high bird activity.
9. In order to reduce the number of towers needed in the future, providers are encouraged to design new towers structurally and electrically to accommodate the applicant/licensee's antennas and comparable antennas for at least two additional users (minimum of three users for each tower structure), unless this design would require the addition of lights or guy wires to an otherwise unlighted and /or unguyed tower.
10. Security lighting for on-ground facilities and equipment should be down-shielded to keep light within the boundaries of the site.
11. If a tower is constructed or proposed for construction, Service personnel or researchers from the Communication Tower Working Group should be allowed access to the site to evaluate bird use; conduct dead-bird searches; to place net catchments below the towers but above the ground; and to place radar, Global Positioning System, and infrared, thermal imagery and acoustical monitoring equipment as necessary to assess and verify bird movements and to gain information on the impacts of various tower sizes, configurations, and lighting systems.
12. Towers no longer in use or determined to be obsolete should be removed within 12 months of cessation of use.





North Dakota Whooping Crane Migration Corridor

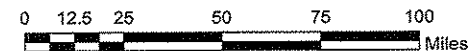


DISCLAIMER:

The USFWS makes no claim as to the accuracy or completeness of the displayed information. Species occurrence and habitat information is provided for illustrative purposes only. Federal action agencies and project proponents should contact the USFWS North Dakota Field Office for more detailed species information and technical assistance in evaluating potential project impacts to fish and wildlife resources.

Map produced 04/21/2010 by USFWS Ecological Services, Bismarck, ND.

-  75% Whooping Crane Migration Corridor
-  95% Whooping Crane Migration Corridor



FEDERAL THREATENED, ENDANGERED, AND CANDIDATE SPECIES
AND DESIGNATED CRITICAL HABITAT FOUND IN
MORTON AND OLIVER COUNTIES, NORTH DAKOTA

ENDANGERED SPECIES

Birds

Interior least tern (*Sterna antillarum*): Nests along midstream sandbars of the Missouri and Yellowstone Rivers.

Whooping crane (*Grus Americana*): Aransas-Wood Buffalo Population (264 birds) occurs in North Dakota counties during spring and fall migration between breeding and wintering areas. Whooping cranes prefer to roost overnight in shallow open water wetland habitat with good visibility during migration stopovers.

Fish

Pallid sturgeon (*Scaphirhynchus albus*): Known only from the Missouri and Yellowstone Rivers. No reproduction has been documented in 15 years.

Mammals

Black-footed ferret (*Mustela nigripes*): Exclusively associated with prairie dog towns. No records of occurrence in recent years, although there is potential for reintroduction in the future.

Gray wolf (*Canis lupus*): Occasional visitor in North Dakota. Most frequently observed in the Turtle Mountains area.

THREATENED SPECIES

Birds

Piping plover (*Charadrius melodus*): Nests on midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands. More nest in North Dakota than any other state.

CANDIDATE SPECIES

Birds

Sprague's Pipit (Anthus spragueii): Nests in native and planted grassland. Prefers patches of grassland at least 72 acres (29 hectares).

Invertebrates

Dakota skipper (Hesperia dactotae): Found in native prairie containing a high diversity of wildflowers and grasses. Habitat includes two prairie types: 1) low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas; 2) upland (dry) prairie on ridges and hillsides dominated by bluestem grasses, needlegrass, pale purple and upright coneflowers and blanketflower.

DESIGNATED CRITICAL HABITAT

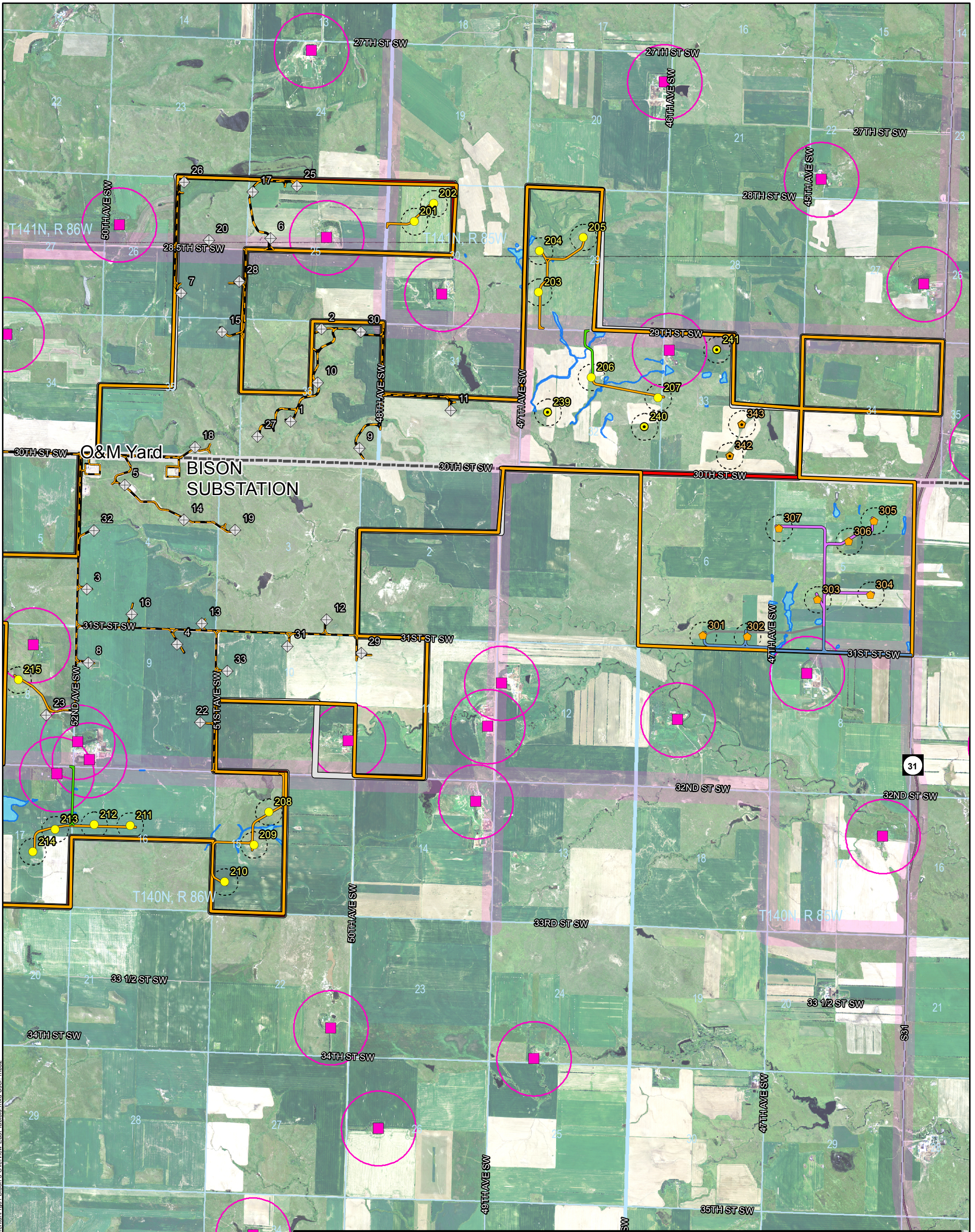
Birds

Piping Plover - Alkali Lakes and Wetlands - Critical habitat includes: (1) shallow, seasonally to permanently flooded, mixosaline to hypersaline wetlands with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; (2) springs and fens along edges of alkali lakes and wetlands; and (3) adjacent uplands 200 feet (61 meters) above the high water mark of the alkali lake or wetland.

Piping Plover - Missouri River - Critical habitat includes sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river.

Piping Plover - Lake Sakakawea and Oahe - Critical habitat includes sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies.

Appendix B



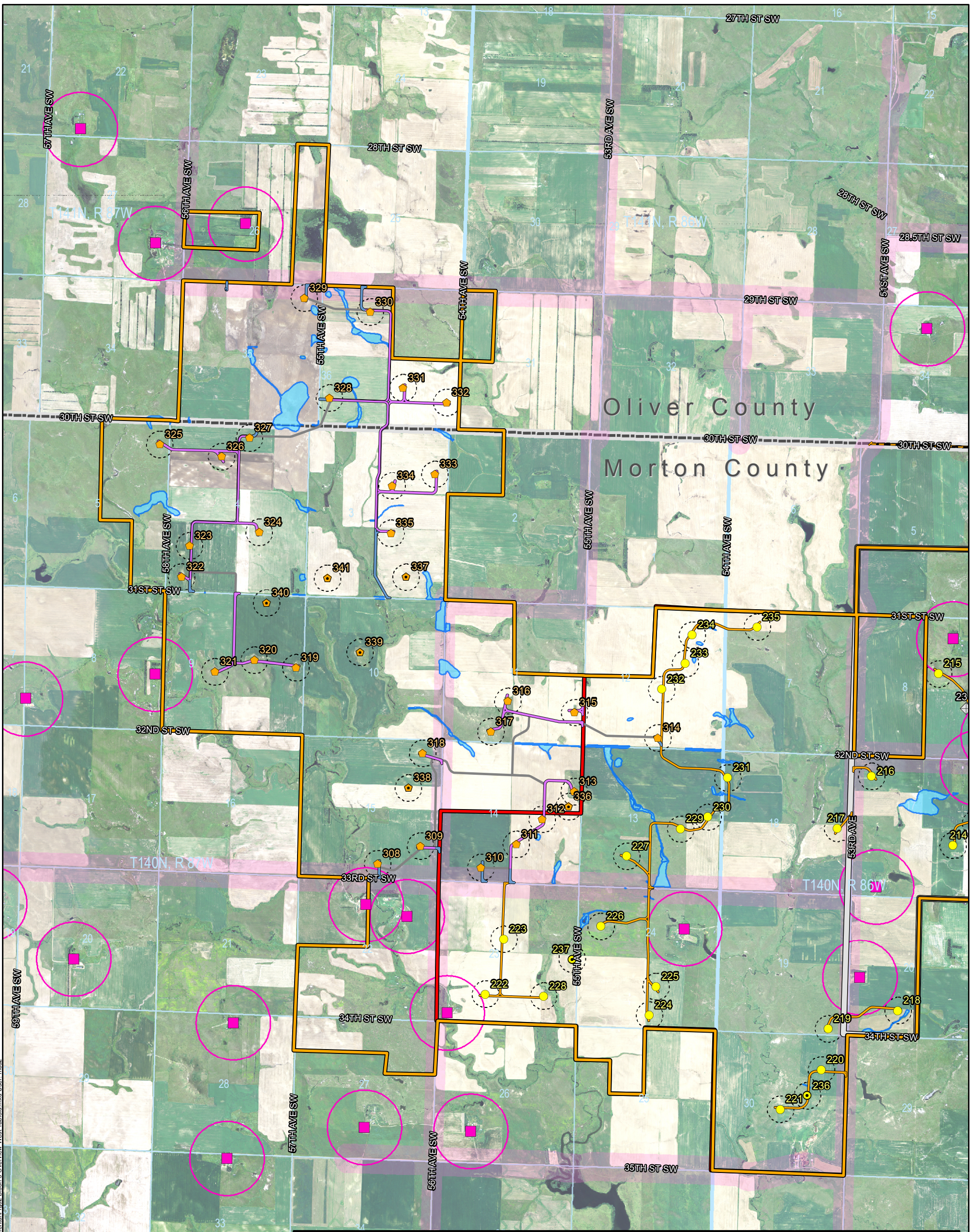
<ul style="list-style-type: none"> Bison 3 Turbine Location (7/15/2011 Coords.) Bison 3 Alternate Location Bison 2 Turbine Location Bison 2 Alternate Location Bison 1 Turbine Location Bison 3 Access Road/Crane Path (Barr, 9/1/2011) Bison 3 Access Road Only (Barr, 9/1/2011) Bison 3 Temporary Crane Path (Barr, 9/1/2011) Bison 2 Access Road/Crane Path Bison 2 Access Road Only Bison 1 Access Road 	<ul style="list-style-type: none"> Field Verified Residence 1400ft Occupied Dwelling Setback Bison 3 Wetland Determination 500ft Turbine Setback 550ft Road Setback Bison 3 Project Boundary (Area: 22,812 Acres) Bison 2 Project Boundary Bison 1 Project Boundary County Boundary 	<p style="text-align: center;"></p> <p style="text-align: center;">Feet</p> <p style="text-align: center;">3,500 0 3,500</p> <p style="text-align: center;"></p>
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Data Sources:
 Project Layout - MP
 Residential Structures, Setbacks - Barr/MP
 Wetlands - Barr
 Imagery - NAIP, 2010

A WIND ENERGY INITIATIVE OF MINNESOTA POWER IN NORTH DAKOTA

Figure 1
 9/1/2011 -
**OVERVIEW, EXCLUSION,
 AND AVOIDANCE AREAS MAP**
 - EASTERN PORTION -
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

Barr, Foster, ArcGIS 10.0, 2011-09-06 15:35 File: I:\Projects\34301\003\Mapas\Report\NDPSC_Supplemental\Fig01_Bison_3_Overview_East_Tabled.mxd User: mbsz



<ul style="list-style-type: none"> Bison 3 Turbine Location (7/15/2011 Coords.) Bison 3 Alternate Location Bison 2 Turbine Location Bison 2 Alternate Location Bison 1 Turbine Location Bison 3 Access Road/Crane Path (Barr, 9/1/2011) Bison 3 Access Road Only (Barr, 9/1/2011) Bison 3 Temporary Crane Path (Barr, 9/1/2011) Bison 2 Access Road/Crane Path Bison 2 Access Road Only Bison 1 Access Road 	<ul style="list-style-type: none"> Field Verified Residence 1400ft Occupied Dwelling Setback Bison 3 Wetland Determination 500ft Turbine Setback 550ft Road Setback Bison 3 Project Boundary (Area: 22,812 Acres) Bison 2 Project Boundary Bison 1 Project Boundary County Boundary 	<p style="text-align: center;"></p> <p style="text-align: center;">Feet</p> <p style="text-align: center;">3,500 0 3,500</p>
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Data Sources:
 Project Layout - MP
 Residential Structures, Setbacks - Barr/MP
 Wetlands - Barr
 Imagery - NAIP, 2010



Figure 2
 9/1/2011 -
**OVERVIEW, EXCLUSION,
 AND AVOIDANCE AREAS MAP**
 - WESTERN PORTION -
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

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Appendix C

Technical Memorandum

To: Jim Atkinson, Minnesota Power
From: Cheryl Feigum, Mike Strong
Subject: Wetland Determination Methods for the Bison 3 Wind Energy Project
Date: September 6, 2011
Project: 34301006.00
c: Dan Flo, John Wachtler

The purpose of this memorandum is to identify jurisdictional wetlands that will be impacted by the Minnesota Power (MP) Bison 3 Wind Energy Project (Bison 2) (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 and alternate locations for the wind turbines, combined permanent crane paths/access roads, permanent access roads and temporary crane paths (Figure 2). Based on the project design (on September 1, 2011), there will be six crossings where wetlands will be permanently impacted by combined permanent crane paths/ access roads; however, two of the six crossings are isolated, non-jurisdictional wetlands. Two additional wetlands will be crossed by temporary crane paths and will result in no permanent wetland impacts. The permanent wetland impacts are less than 4,281 square feet per jurisdictional wetland crossing.

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 ArcView 9.3[®] and 10.0[®] Geographic Information System (GIS) software to display environmental data (soils, hydrography, topography) for the study area. The following datasets were obtained and reviewed for the Bison 3 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 Oliver counties
- USDA-FSA color infrared (CIR) aerial photographs 2009 and 2010 Statewide
- LiDAR aerial true color imagery provided by MP
- LiDAR topography data (two-foot contour intervals) partial coverage of the project area provided by MP
- Five-foot topography data (5-ft contour intervals) provided by MP
- United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Data
- Natural Resources Conservation Service (NRCS) SSURGO Soil Survey Data for Morton and Oliver 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 22,812-acre project area was evaluated for wetlands, typically at a scale of 1:2000. All areas within the Bison 3 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. However, the high-resolution topography data were not available for all areas of the Bison 3 project area. For those areas, the five-foot contours were used. Using GIS, wetland polygons were created for use in the on-site field review within the Bison 3 project boundary.

Phase II: On-site Determination Methods

Field review was completed during on-site visits May 4-5 and May 17-18, and June 22, 2011. The purpose of the site visits was to evaluate the potential locations for the turbine sites, access roads and crane paths for wetlands. 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 first May site visit, there was a blizzard that deposited significant snow. During the field visit, most of the snow had melted, but standing water remained on the landscape. The day before the June site visit, there was a 2- to 3-inch rainfall event, so there was a lot of water left on the landscape again. As a result of the snowmelt and 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 7,523 acres were evaluated (the “wetland survey extents area”) for wetlands within the 22,812-acre project area. The jurisdictional status of the wetlands was reviewed in the field as well. Originally, the NWI identified 15 acres of wetland within the wetland survey extents area. After completion of fieldwork, the wetland boundaries were adjusted using GIS, resulting in approximately 217 acres of wetland identified within the wetland survey extents area (Figure 4). The delineated wetlands were classified using the U.S. Fish and Wildlife Service Circular 39 Classification System (Types 1, 2, 3, etc.; Shaw and Fredine, 1956) and the U.S. Fish and Wildlife Service Cowardin System (PEMB, PSSC, PFOB, etc.; Cowardin et. al., 1979).

Wetland Summary

There were 7,523 acres evaluated within the wetland survey extents area for Bison 3. Of these, approximately 217 acres were identified as wetland (Figure 4) and are classified as temporarily flooded basins (Type 1; PFOA), saturated wet meadows (Type 2; PEMB), seasonally flooded shallow marshes (Type 3; PEMC), semipermanently flooded deep marshes (Type 4; PEMF) and deep-water wetlands (Type 5; PUBG/H).

Table 1. Wetland summary for the wetland survey extents area

Wetland Type	Circular 39 Type	Cowardin Type	Wetland (ac)	Percent of Total Wetland Area
Temporary flooded basin	1	PEMA	53.7	24.7%
Wet (fresh) meadow	2	PEMB	149.2	68.8%
Shallow marsh	3	PEMC	2.9	1.3%
Deep marsh	4	PEMF	1.5	0.7%
Deep water	5	PUBG/H	9.7	4.5%
Total			217.0	100%

Wet meadows (69 percent) and temporarily flooded basins (25 percent) were the dominant wetland types present in the survey extents area. Other wetland types included shallow marsh, deep marsh, and deep water. Representative photographs of wetland types are shown in Appendix A.

There were no wetlands identified within the proposed or alternate wind turbine locations (Figures 5). Based on the project design (on September 1, 2011), there will be six crossings where wetlands will be permanently impacted by combined permanent crane paths/access roads; however, two of the six crossings are isolated, non-jurisdictional wetlands. Two additional wetlands will be crossed by temporary crane paths and will result in no permanent wetland impacts.

The road surface width will be 37 feet for the combined permanent crane paths/access roads and temporary crane paths. The road surface will be 20 feet wide for the permanent access roads. 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?	Permanent Wetland Impact (sq ft)	Temporary Wetland Impact (sq ft)
Permanent Crane Path/Access Road	330-331	PEMB	Type 2	yes	4,281	0
Permanent Crane Path/Access Road	328-331	PEMA	Type 1	yes	1,398	0
Permanent Crane Path/Access Road	331-334	PEMA	Type 1	yes	3,852	0
Permanent Crane Path/Access Road	334-335	PEMA	Type 1	yes	2,492	0
Permanent Access Road	302-303 west	PEMB	Type 2	no	2,906	0
Permanent Access Road	302-303 east	PEMB	Type 2	no	3,593	0
Temporary Crane Path	302-303	PEMB	Type 2	no	0	980
Temporary Crane Path	329-330	PEMB	Type 2	yes	0	5,717

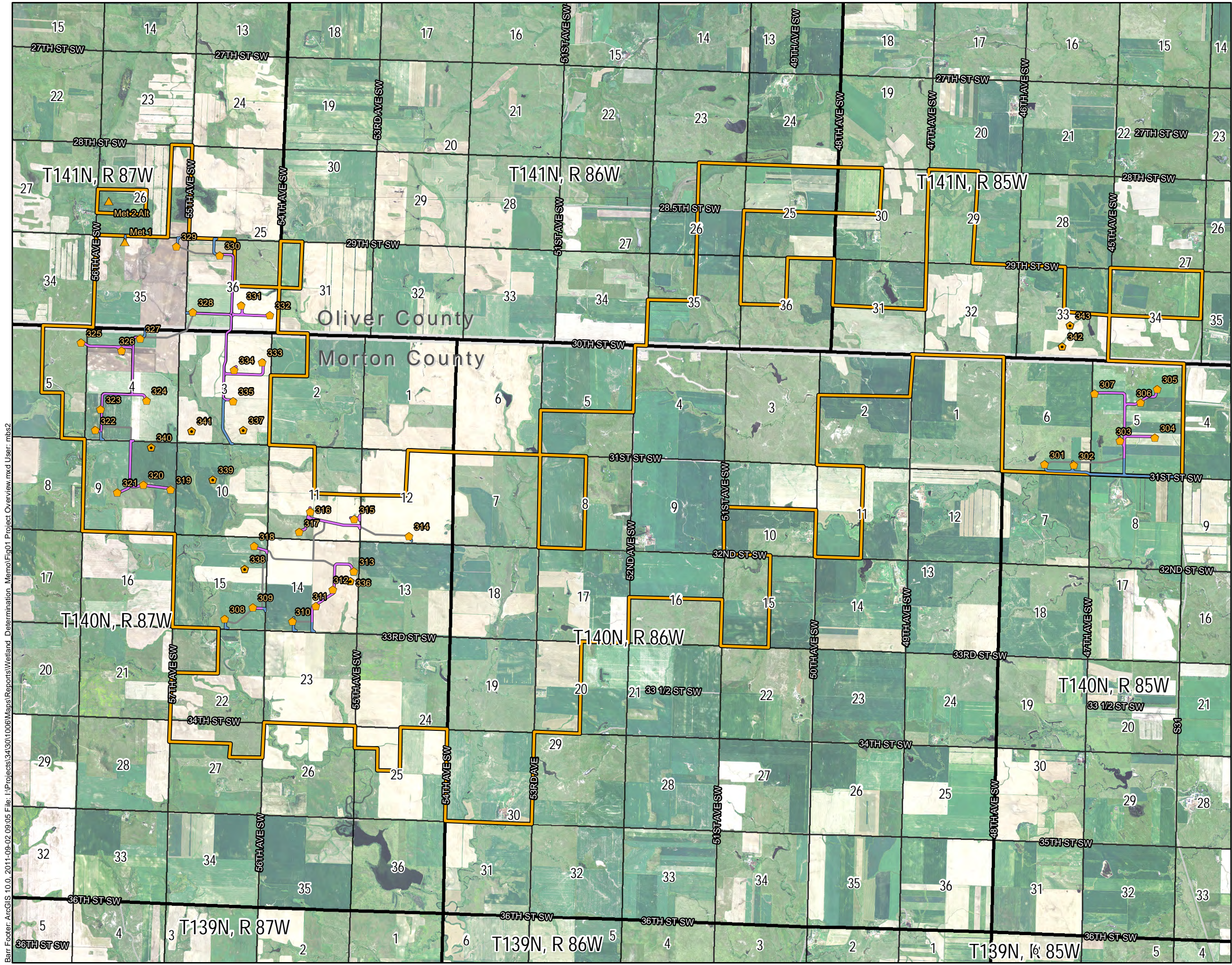
Wetland types that will be impacted include temporarily flooded basins (Type 1; PFOA) and saturated wet meadows (Type 2; PEMB). Two crane paths will have temporary impacts during construction; however, there will be no permanent wetland impacts at these crossings. There were six wetland crossings that will permanently impact less than 4,281 square feet of jurisdictional wetland per crossing.

To: Jim Atkinson, Minnesota Power
Date: September 6, 2011
Page: 6 of 5

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.



- Bison 3 Turbine Location (7/15/2011 Coords.)
- Bison 3 Alternate Location
- Bison 3 Met Tower Location
- Bison 3 Access Road/Crane Path (Barr, 9/1/2011)
- Bison 3 Access Road Only (Barr, 9/1/2011)
- Bison 3 Temporary Crane Path (Barr, 9/1/2011)
- Local Road
- Public Land Survey Township
- Public Land Survey Section
- Bison 3 Project Boundary
- County Boundary

Imagery Source: NAIP, 2010

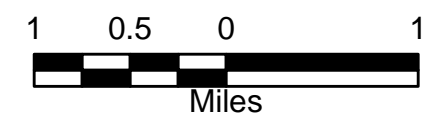
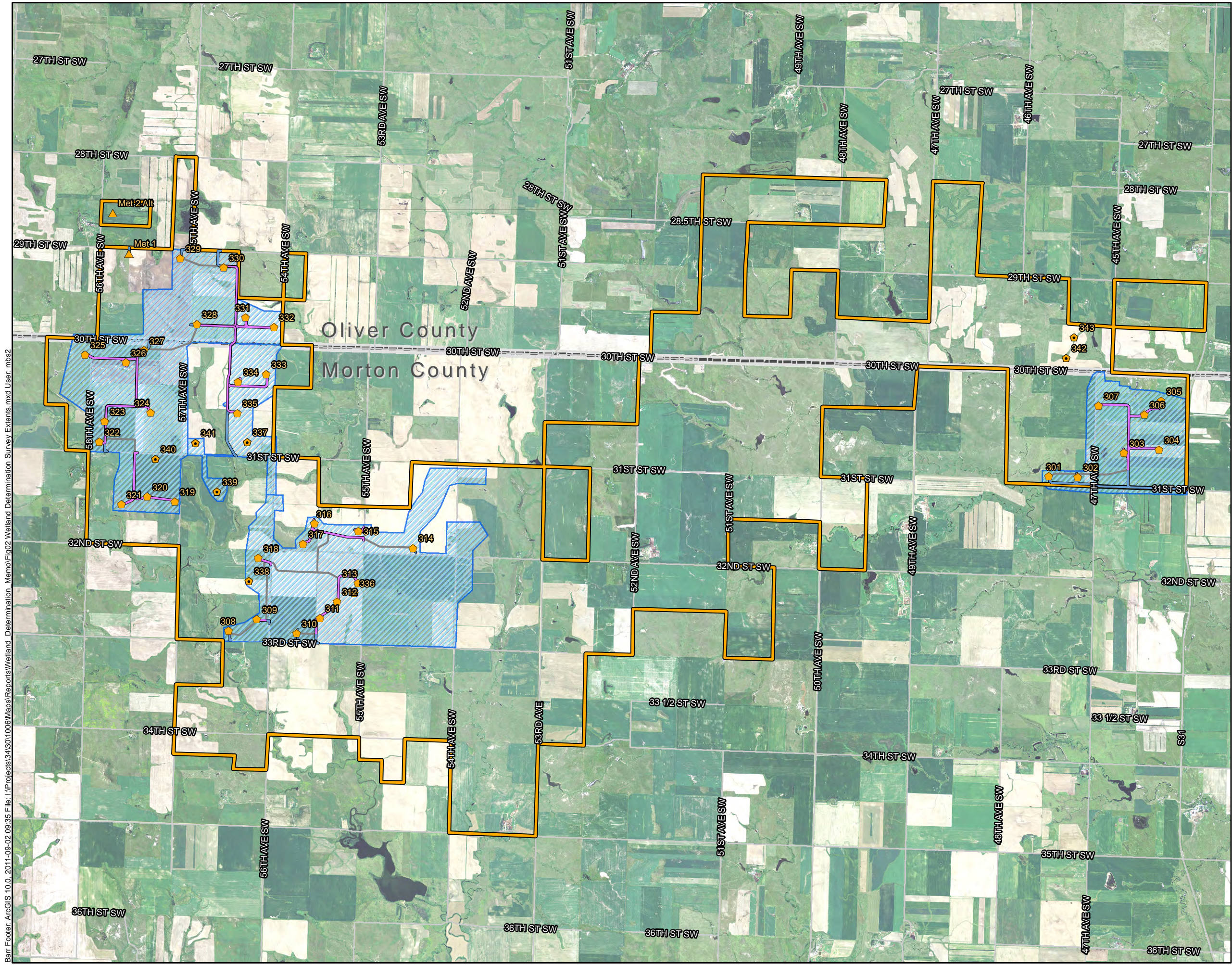











Figure 1

PROJECT OVERVIEW
 Wetland Determination Methods
 Bison 3 Wind Project
 MN Power
 Morton & Oliver Counties, ND

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-  Bison 3 Turbine Location (7/15/2011 Coords.)
-  Bison 3 Alternate Location
-  Bison 3 Met Tower Location
-  Bison 3 Access Road/Crane Path (Barr, 9/1/2011)
-  Bison 3 Access Road Only (Barr, 9/1/2011)
-  Bison 3 Temporary Crane Path (Barr, 9/1/2011)
-  Local Road
-  Wetland Survey Extents
-  County Boundary

Imagery Source: NAIP, 2010

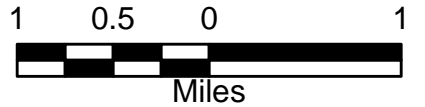
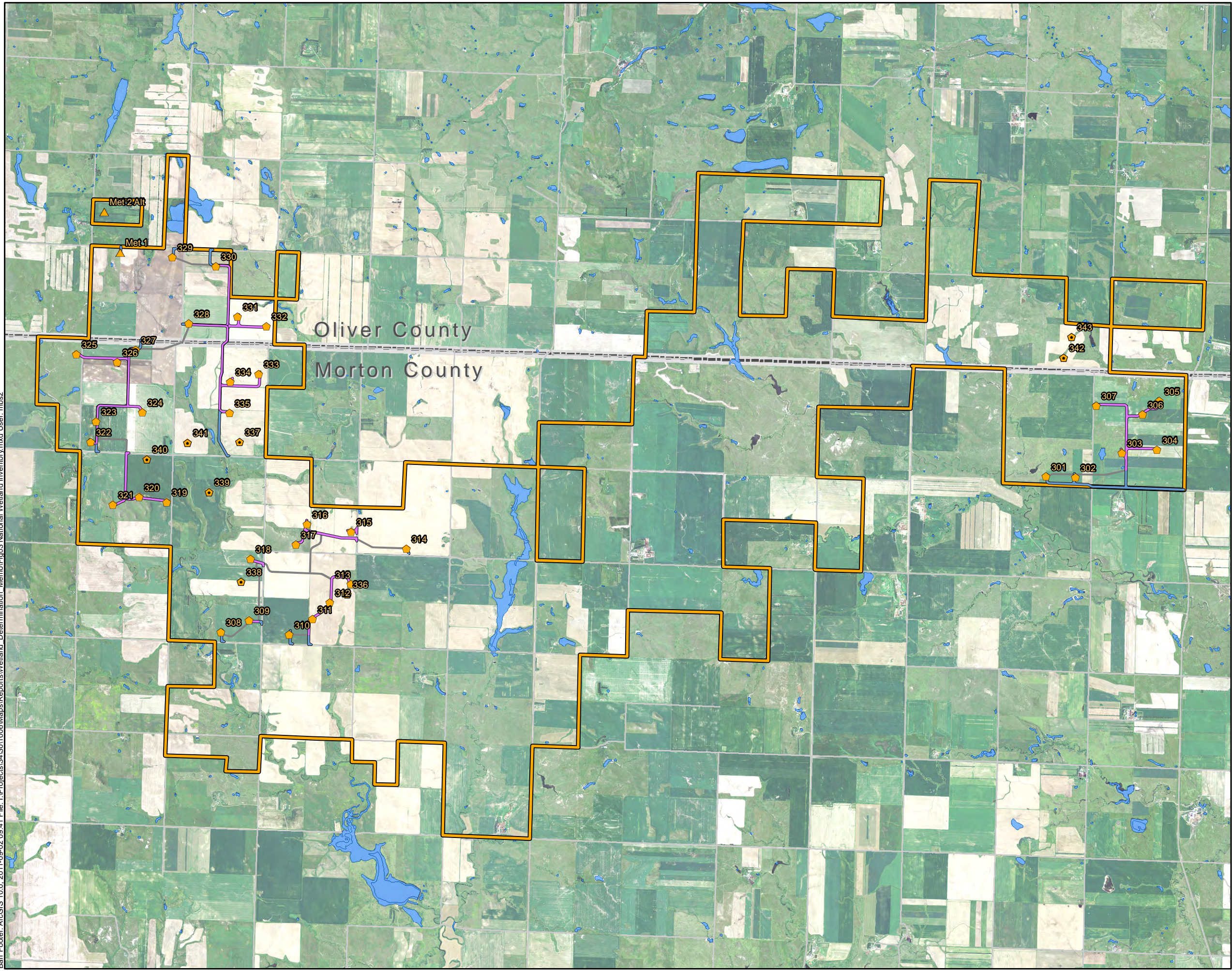












Figure 2

WETLAND DETERMINATION
 SURVEY EXTENTS
 Wetland Determination Methods
 Bison 3 Wind Project
 MN Power
 Morton & Oliver Counties, ND

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Barr Footer: ArcGIS 10.0_2011-09-02 09:41 File: I:\Projects\34301006\Maps\Reports\Wetland_Determination_Memo\Fig03 National Wetland Inventory.mxd User: mbs2



-  Bison 3 Turbine Location (7/15/2011 Coords.)
-  Bison 3 Alternate Location
-  Bison 3 Met Tower Location
-  Bison 3 Access Road/Crane Path (Barr, 9/1/2011)
-  Bison 3 Access Road Only (Barr, 9/1/2011)
-  Bison 3 Temporary Crane Path (Barr, 9/1/2011)
-  Local Road
-  National Wetland Inventory
-  Bison 3 Project Boundary
-  County Boundary

Imagery Source: NAIP, 2010
NWI Source: USFWS

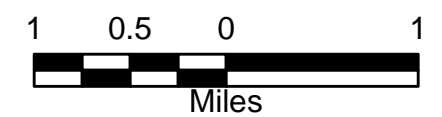
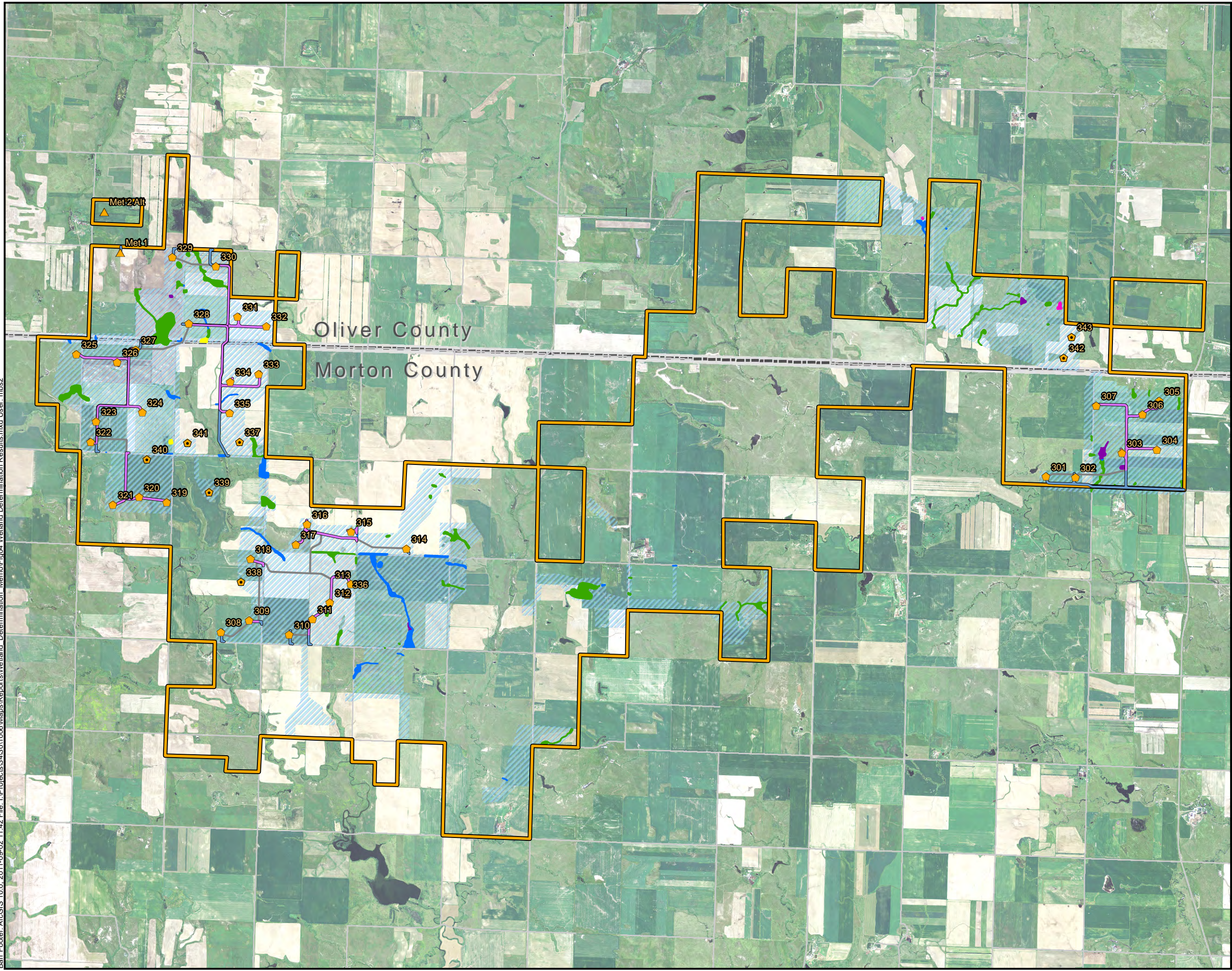


Figure 3

NATIONAL WETLAND INVENTORY
Wetland Determination Methods
Bison 3 Wind Project
MN Power
Morton & Oliver Counties, ND

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- Bison 3 Turbine Location (7/15/2011 Coords.)
- Bison 3 Alternate Location
- Bison 3 Met Tower Location
- Bison 3 Access Road/Crane Path (Barr, 9/1/2011)
- Bison 3 Access Road Only (Barr, 9/1/2011)
- Bison 3 Temporary Crane Path (Barr, 9/1/2011)
- Local Road
- Wetland Survey Extents
- Wetland Determination Results**
- Type 1, PEMA
- Type 2, PEMB
- Type 3, PEMC
- Type 4, PEMF
- Type 5, PUBG/H
- Bison 3 Project Boundary
- County Boundary

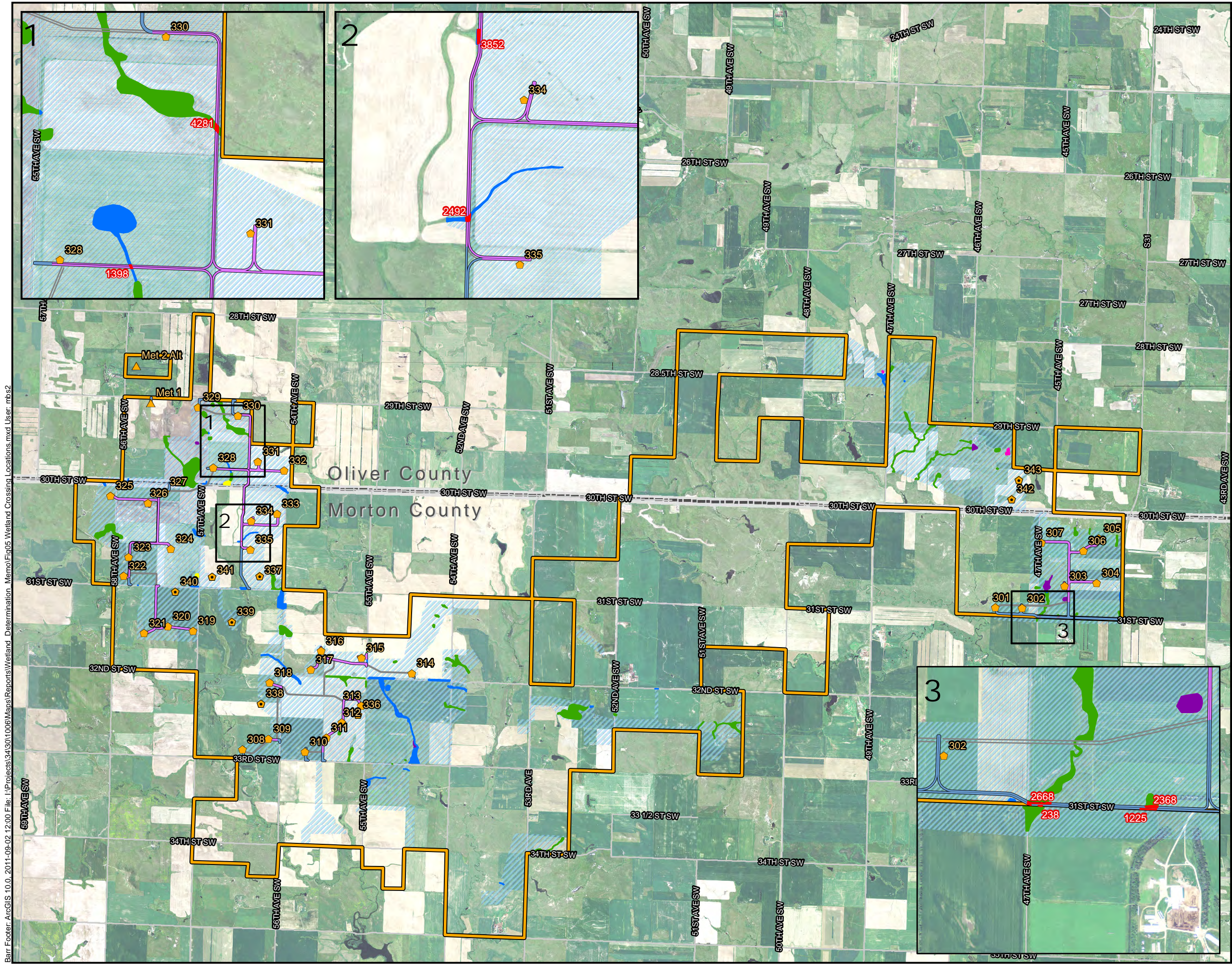
Note: Only wetlands within Barr wetland survey extents are shown on this figure.

Imagery Source: NAIP, 2010



Figure 4

WETLAND DETERMINATION RESULTS
 Wetland Determination Methods
 Bison 3 Wind Project
 MN Power
 Morton & Oliver Counties, ND



- Bison 3 Turbine Location (7/15/2011 Coords.)
- Bison 3 Alternate Location
- Bison 3 Met Tower Location
- Bison 3 Access Road/Crane Path (Barr, 9/1/2011)
- Bison 3 Access Road Only (Barr, 9/1/2011)
- Bison 3 Temporary Crane Path (Barr, 9/1/2011)
- Local Road
- Wetland Crossing Extent (Labeled in Square Feet)
- Wetland Survey Extents
- Wetland Determination Results**
- Type 1, PEMA
- Type 2, PEMB
- Type 3, PEMC
- Type 4, PEMF
- Type 5, PUBG/H
- Bison 3 Project Boundary
- County Boundary

Note: Only wetlands within Barr wetland survey extents are shown on this figure.

Imagery Source: NAIP, 2010

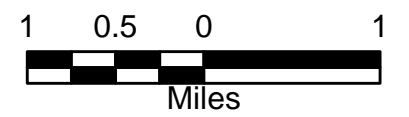


Figure 5

WETLAND CROSSING LOCATIONS
 Wetland Determination Methods
 Bison 3 Wind Project
 MN Power
 Morton & Oliver Counties, ND

Barr Footer: ArcGIS 10.0_2011-09-02 12:00 File: I:\Projects\3413011006\Maps\Reports\Wetland Determination_Memo\Fig05 Wetland Crossing Locations.mxd User: mbs2

Appendix A:
Wetland Photographs



Seasonally Flooded Basin/Flat (Type 1)



Seasonally Flooded Basin/Flat (Type 1)



Wet Meadow (Type 2)



Wet Meadow (Type 2)



Deep Marsh (Type 4)



Deep Marsh (Type 4)



Open Water Wetland (Type 5)



Open Water Wetland (Type 5)

Appendix D

Appendix E

Pending

Appendix F



August 1, 2011

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

**Re: Minnesota Power's Bison 3 Wind Energy Project
Special Use Permit Application**

Dear Ms. Rhone:

Minnesota Power is planning to construct a wind energy conversion facility—the Bison 3 Wind Energy Project—in Morton and Oliver Counties in North Dakota. Minnesota Power 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 Bison 3 Project. Barr Engineering is submitting this application on behalf of Jim Atkinson, Supervisor, Environmental Siting and Permitting at Minnesota Power (Allete). The 105 MW Bison 3 Wind Energy Project will interconnect with the existing 230kV Bison Substation and then the Square Butte 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 and is intended to be used to meet Minnesota Power's share of State of Minnesota renewable energy requirements.

Leases from landowners have been obtained within the preliminary Project boundary. The Project site encompasses approximately 22,812 acres (36 mi²) and is located approximately 10 miles northwest of the City of New Salem. 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 22,812 acres within the preliminary Project boundary, approximately 22,716 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, only .1 percent of the land within the preliminary Project boundary will be permanently occupied by Bison 3 wind turbines and access roads.

Minnesota Power 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. Minnesota Power plans to obtain Commission approval by September, 2011 and to begin construction in the fall of 2011, with turbine construction and project completion in 2012.

If you have comments regarding this Special Use Permit application, you are encouraged to contact Jim Atkinson at 218-355-3561, 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', with a stylized, cursive script.

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	85W	5, 6
		86W	2, 3, 4, 5, 8, 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, 30
		87W	2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 22, 23, 24, 25, 27

Street address of property: NA

Existing Zoning: _____ Proposed Zoning: _____

Acreage: 37.5 acres for project facilities Number of Lots: _____

Description of development proposal, including reason(s) for the request: Construction of a utility scale (105MW) wind project in Morton and Oliver Counties, North Dakota. Out of 35 total turbines, 30 turbines (90 MW) are proposed for Morton County. See Exhibit 1 for the project area and Exhibit 2 for the preliminary project boundary.

APPLICANT/DEVELOPER

Name: Minnesota Power – Jim Atkinson Mailing Address: 30 W. Superior St., Duluth, MN 55803
 Telephone number: (218) 355-3561 FAX#: (218) 723-3916
 E-mail address: jbtkinson@allete.com

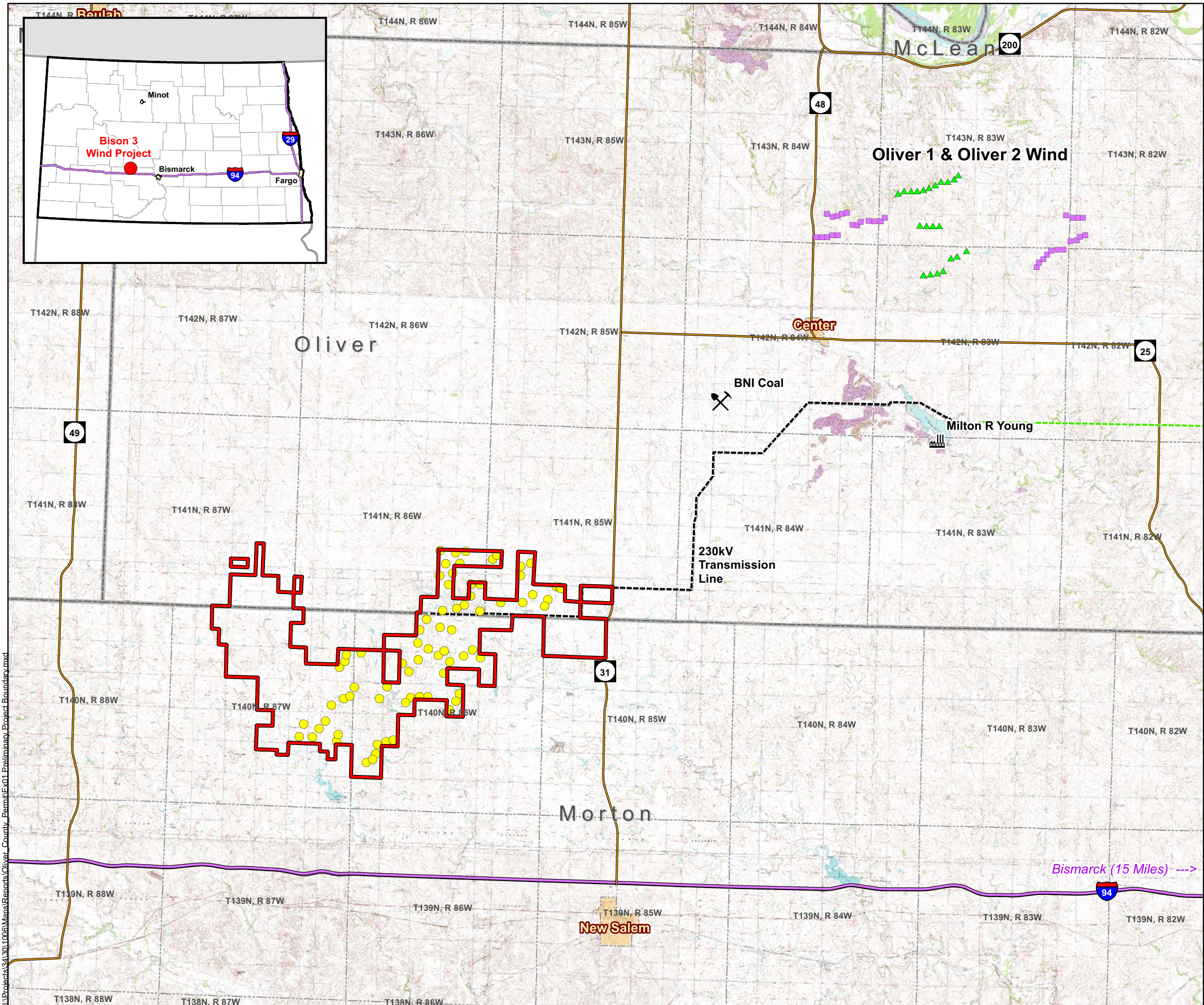
PROPERTY OWNER (IF DIFFERENT THAN APPLICANT/DEVELOPER)

Name: See attached landowner list Mailing Address: _____
 Telephone number: _____ FAX#: _____
 E-mail address: _____

CONTACT PERSON/AGENT:

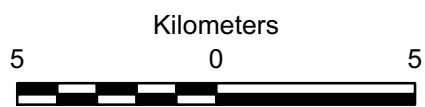
Name/Firm: Daniel Flo, Barr Engineering Co. Mailing Address: 4700 W. 77th St., Mpls, MN 55435
 Telephone number: (952) 832-2975 FAX#: _____
 E-mail address: dflo@barr.com

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



- Bison 1/Bison 2 Turbine Location
- ▲ Oliver 1 Wind Project Turbine Location
- Oliver 2 Wind Project Turbine Location
- BNI Coal Mine
- Milton R. Young Generation Station
- 230kV Transmission Line
- DC Transmission Line
- Interstate Highway
- State Highway
- Preliminary Bison 3 Project Boundary
- Municipality
- County Boundary

Data Sources:
 Project Boundary - Minnesota Power
 Utilities - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Topo Map - USGS DRG

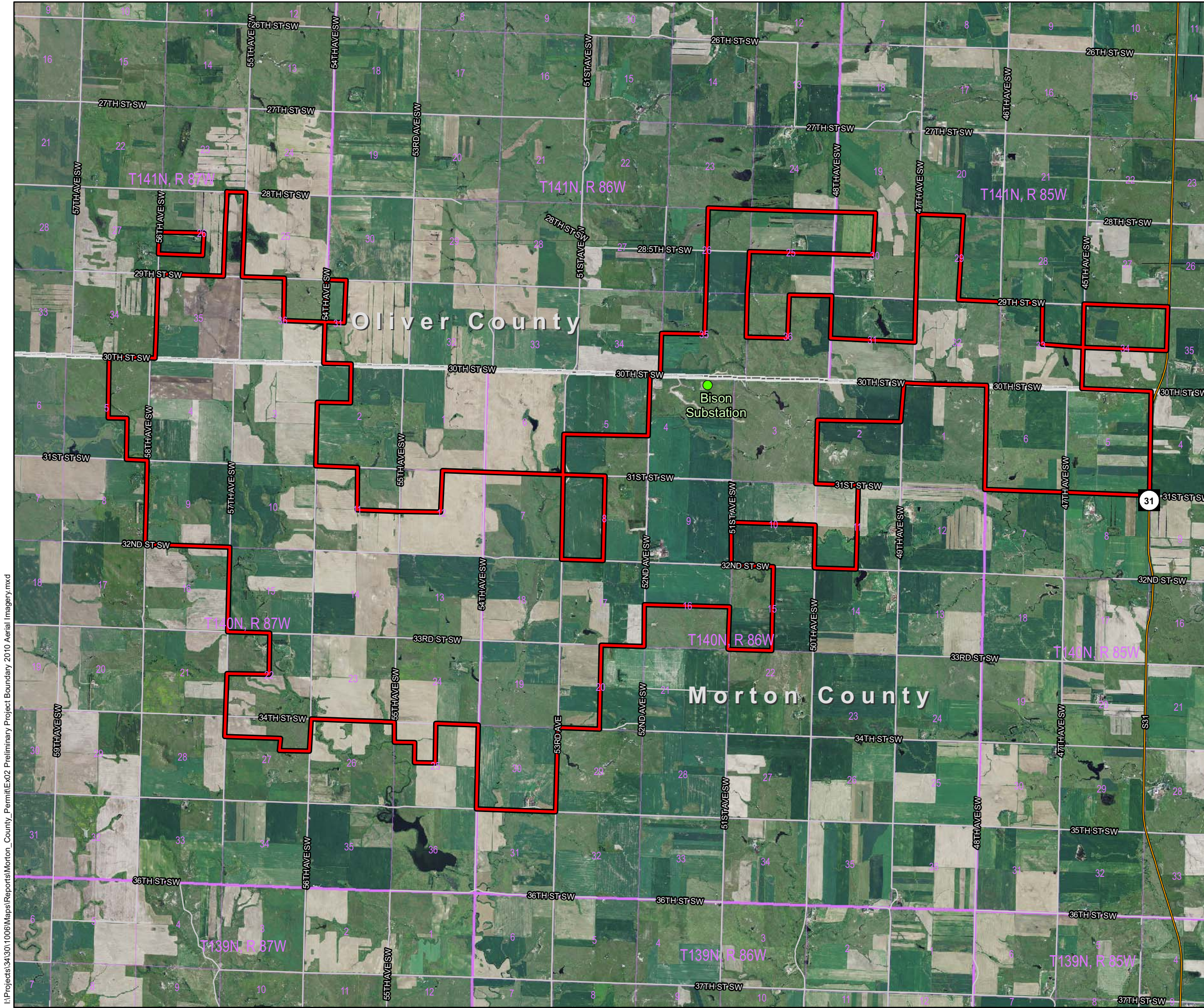









Bismarck (15 Miles) --->

Exhibit 1

PROJECT LOCATION
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\24130\10061\Maps\Reports\Oliver_County_Permit\Ex01_Preliminary_Project_Boundary.mxd



-  Bison Substation
-  Preliminary Bison 3 Project Boundary
-  State Highway
-  Local Road
-  Public Land Survey Township
-  Public Land Survey Section
-  County Boundary

Data Sources:
 Preliminary Project Data - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Imagery - NAIP, 2010

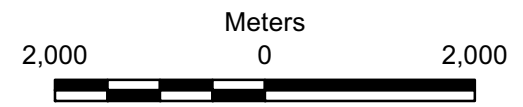
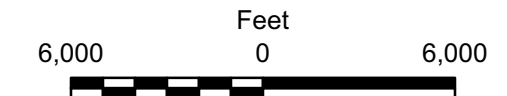
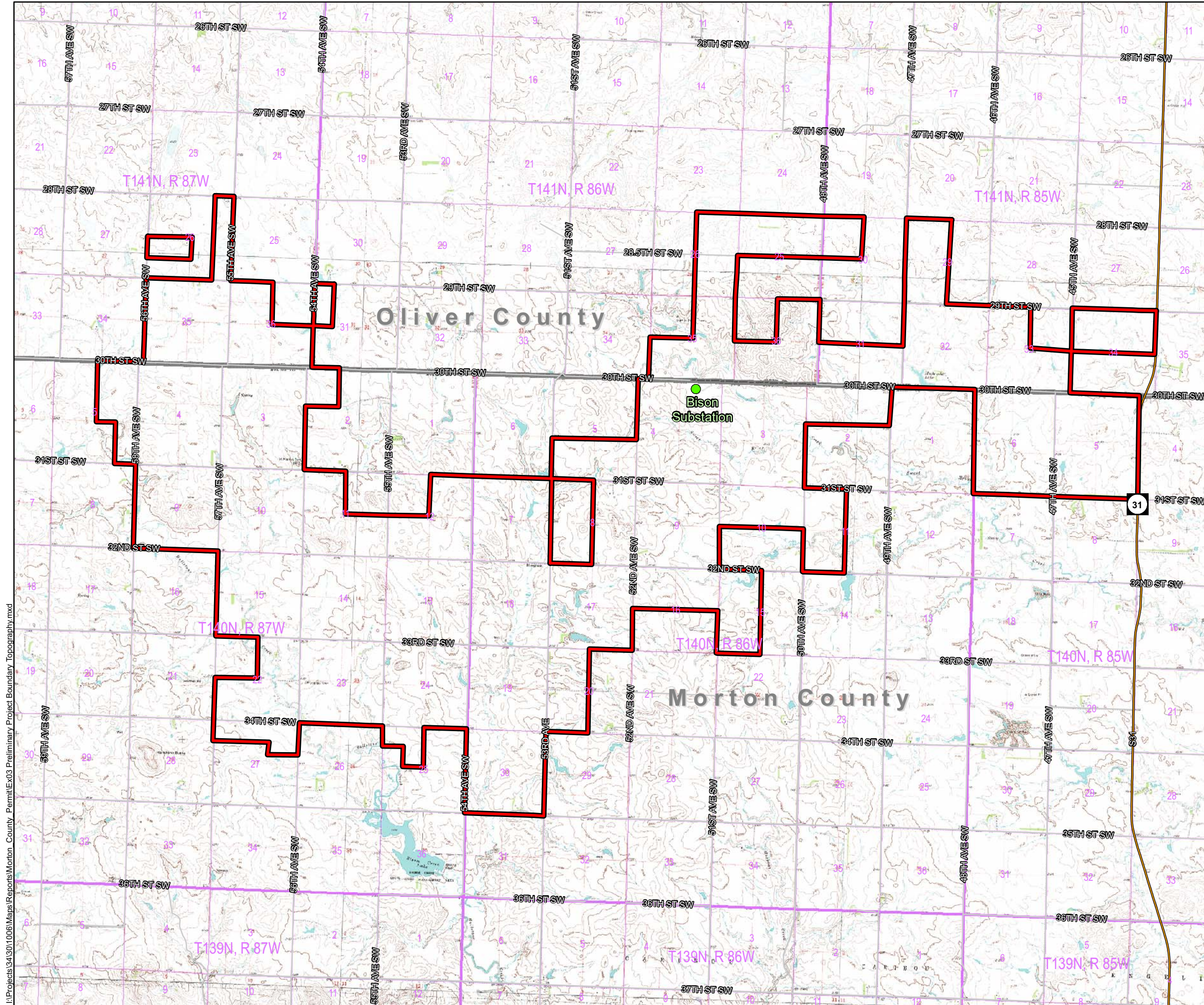









Exhibit 2

PRELIMINARY PROJECT
 BOUNDARY (2010 IMAGERY)
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\3413011006\Reports\Morton_County_Permit\Ex02_Preliminary Project Boundary 2010 Aerial Imagery.mxd



-  Bison Substation
-  Preliminary Bison 3 Project Boundary
-  Local Road
-  State Highway
-  Public Land Survey Section
-  Public Land Survey Township
-  County Boundary

Data Sources:
 Preliminary Project Data - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Topography - USGS DRG

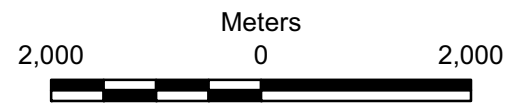
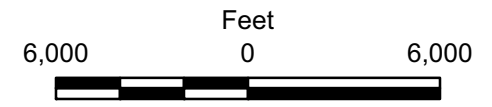
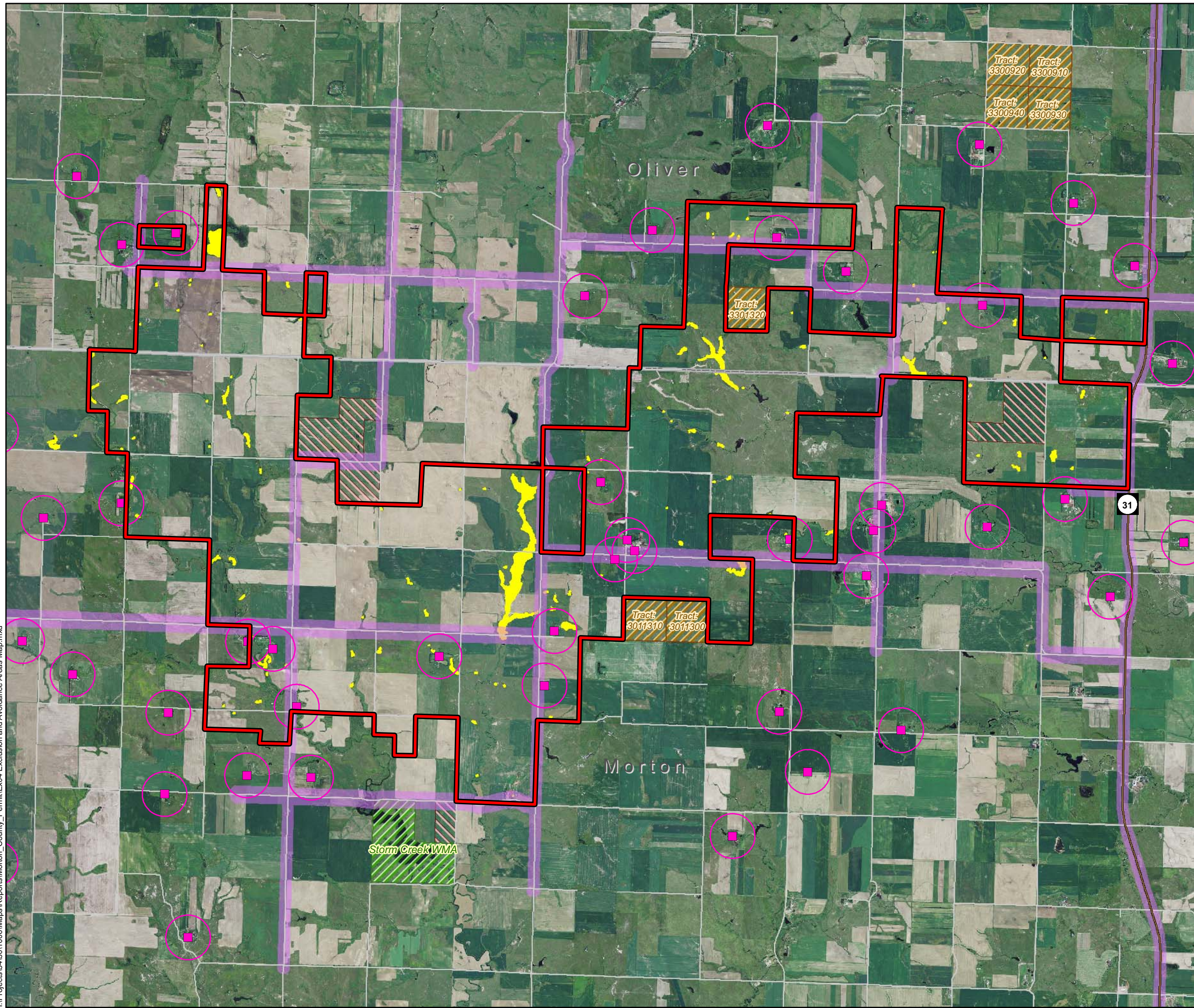


Exhibit 3

PRELIMINARY PROJECT
 BOUNDARY (TOPOGRAPHY)
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\343011006\Maps\Reports\Morton_County_Permit\Ex03_Preliminary Project Boundary_Topography.mxd

I:\Projects\34\3011006\Maps\Reports\Morton_County_Permit\Ex04_Exclusion and Avoidance Areas Map.mxd



- Occupied Dwelling (Field Verified)
- ⬮ Preliminary Bison 3 Project Boundary
- ⬮ National Wetland Inventory (USFWS)
- 1400ft Occupied Dwelling Setback*
- ⬮ Maintained Road 550ft Setback
- ⬮ ND Fish and Game Wildlife Management Area
- ⬮ ND State Land Department Administered Property
- ⬮ Private Land Open to Sportsmen (PLOTS)
- ⬮ County Boundary

Data Sources:
 Preliminary Project Data - Minnesota Power
 Residential Structures - Minnesota Power
 Setbacks - Barr Engineering
 Wetlands - USFWS
 Roads - NDOT, Minnesota Power
 Administrative Boundaries - NDSL, NDFG
 Imagery - NAIP, 2010

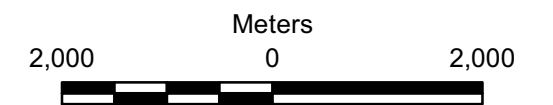
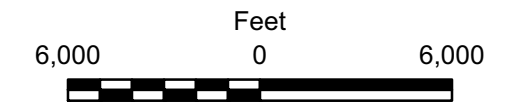


Exhibit 4

EXCLUSION AND AVOIDANCE AREAS MAP
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

MORTON COUNTY LANDOWNER LIST – BISON 3 WIND ENERGY PROJECT

Hilda Peltz 210 South E Street Glen Ullin, ND 58631	Ronald & Martha Peltz 3390 County Road 87 New Salem, ND 58563 (701) 226-2341	Roger and Elaine Kulsman 1710 Ash Avenue New Salem, ND 58563 (701) 843-8542
David Klusman 4670 31 st Street New Salem, ND 58563 (701) 843-7439	Hoffman Family Lt. Partnership 4600 N 68 th St, Unit 331 Scottsdale, AZ 85251 (701) 222-2234	Terrance and Diane Mosbrucker 2952 Highway 31 New Salem, ND 58563 (701) 843-7248
Kevin Opp 605 West Ash Ave. Glen Ullin, ND 58631 (701) 391-6868	Ross & Cheryl Schroeder 311 Lake Street New Salem, ND 58563 (701) 843-8276	Daryl & Brenda Winckler 5620 County Road 140 New Salem, ND 58563 (701) 391-5463
Jeffery and Julie Schroeder 206 N 8 th Street New Salem, ND 58563 (701) 843-8659	Mary Lou Peltz 206 E. St. S Glen Ullin, ND 58631	Lyle and Linda Peltz 6455 Hwy 49 Glen Ullin, ND 58631
James and Darlene Swenson 1941 62 nd Ave. SW Beulah, ND 58523 (701) 873-5720	Trent and Dawn Martin 1943 62 nd Ave SW Beulah, ND 58523 (701) 873-4130	Andrew and Heidi Peltz 5870 County Rd 140 New Salem, ND 58561 (701) 843-7312
Daniel and Shana Peltz 3190 59 th Ave New Salem, ND 58561 (701) 843-7312		

Appendix G



August 1, 2011

Mr. John Wicklund
Oliver County Zoning Administrator
Oliver County Courthouse
P.O. Box 188
Center, ND 58530

**Re: Minnesota Power's Bison 3 Wind Energy Project
Conditional Use Permit Application**

Dear Mr. Wicklund:

Minnesota Power is planning to construct a wind energy conversion facility—the Bison 3 Wind Energy Project—in Morton and Oliver Counties in North Dakota. Minnesota Power 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 an Oliver County Conditional Use Permit for the Bison 3 Project. Barr Engineering is submitting this application on behalf of Jim Atkinson, Supervisor, Environmental Siting and Permitting at Minnesota Power (Allete). The 105 MW Bison 3 Wind Energy Project will interconnect with the existing 230kV Bison Substation and then the Square Butte 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 and is intended to be used to meet Minnesota Power's share of State of Minnesota renewable energy requirements.

Leases from landowners have been obtained within the preliminary Project boundary. The Project site encompasses approximately 22,812 acres (36 mi²) and is located approximately 10 miles northwest of the City of New Salem. The turbines will be placed throughout the Project site. 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. Detailed locations of wind turbine generators, access roads, and collector lines will be provided to Oliver County upon request. However, of the 22,812 acres within the preliminary Project boundary, approximately 22,716 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, only .1 percent of the land within the preliminary Project boundary will be permanently occupied by Bison 3 wind turbines and access roads.

Minnesota Power 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. Minnesota Power plans to obtain Commission approval by September, 2011 and to begin construction in the fall of 2011, with turbine construction and project completion in 2012.

Mr. John Wicklund

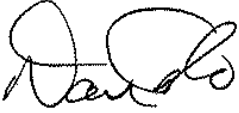
Re: Minnesota Power's Bison 3 Wind Energy Project – Conditional Use Permit Application

August 1, 2011

Page 2

If you have comments regarding this Conditional Use Permit application, you are encouraged to contact Jim Atkinson at 218-355-3561, 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, overlapping loops and a cursive style.

Daniel Flo
Environmental Scientist

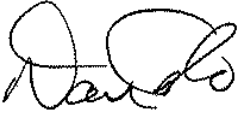
Enclosures

OLIVER COUNTY: CONDITIONAL USE PERMIT APPLICATION

1. NAME OF APPLICANT: Minnesota Power, an operating division of Allete, Inc.
2. MAILING ADDRESS: 30 W. Superior St. , Duluth, MN 55803
3. TELEPHONE NUMBER: Jim Atkinson (218) 355-3561
4. PROPERTY IS LOCATED IN:

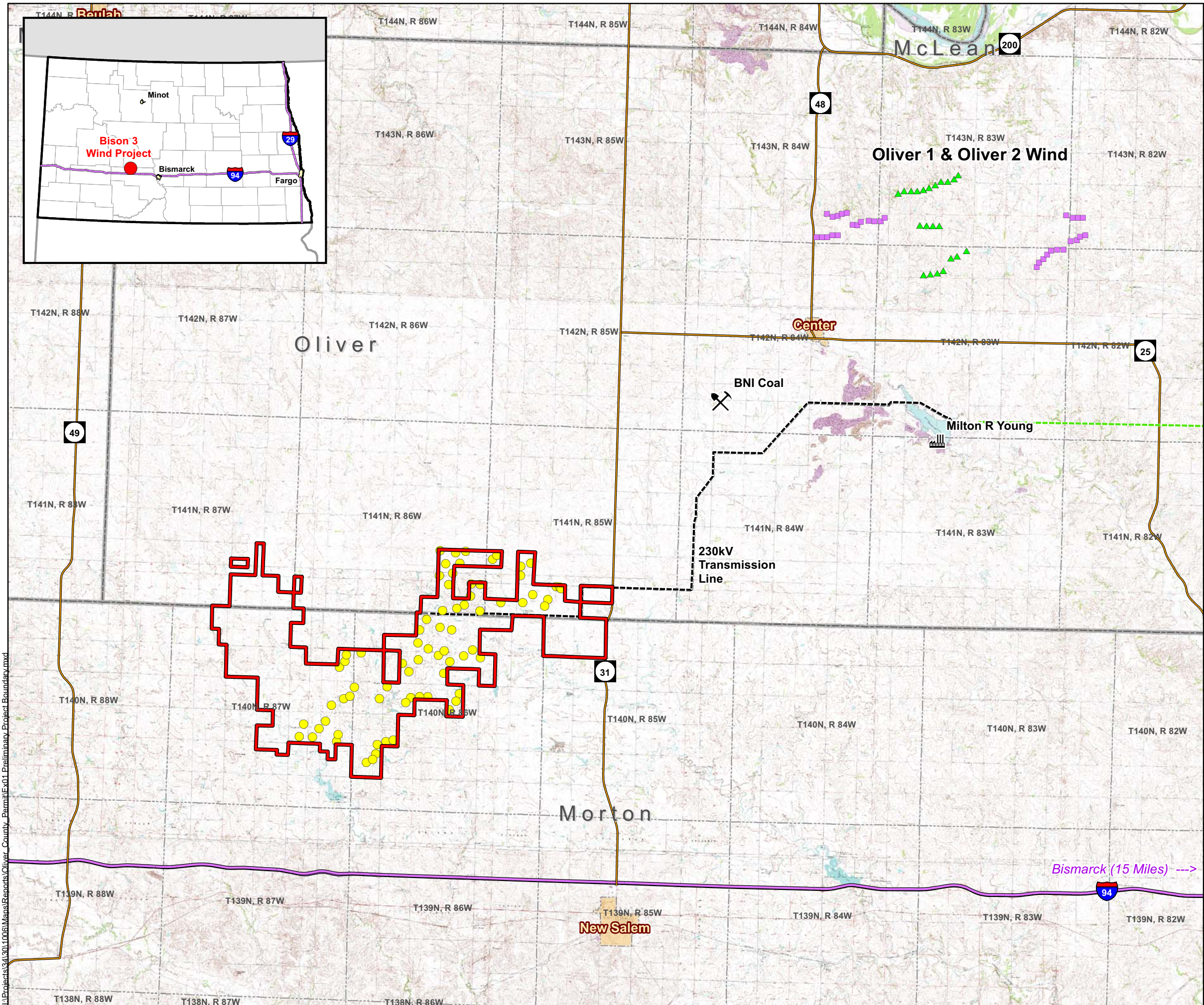
County	Township	Range	Section
Oliver	141N	85W	29, 30, 31, 32, 33, 34
		86W	25, 26, 31, 35, 36
		87W	26, 35, 36

5. CONDITIONAL USE REQUESTED: Construction of a utility scale (105MW) wind project in Morton and Oliver Counties. Out of 35 total turbines, 5 turbines (15 MW) will be located in Oliver County. See Exhibit 1 for the project area and Exhibit 2 for the preliminary project boundary.
6. PRESENT LAND USE: Rural/agricultural used primarily for cultivated crops and grazing cattle
7. PROPOSED LAND USE: Overall land use would remain unchanged. Approximately 12.5 acres will be converted to access roads and turbine foundations in Oliver County.
8. ADJACENT LANDOWNERS DESCRIPTION
See attached landowner list.
9. ADDITIONAL INFORMATION (TO BE ATTACHED)
 - A. MAP OF THE AREA (see Exhibit 1, attached)
 - B. BOUNDARY LINE SURVEY OR ACCURATE PLAT OF SITE (see Exhibit 2, attached)
 - C. DESCRIPTION OF SURROUNDING AREA (see Cover Letter)
 - D. PRELIMINARY MAP SHOWING LOCATION OF THE STRUCTURES TO BE DEVELOPED ON THE SITE AND DISTANCES BETWEEN STRUCTURES (To be provided in fall, 2011)
 - E. TOPOGRAPHICAL MAP IN FIVE (5) FOOT CONTOURS OF SITE (see Exhibit 3, attached)
 - F. GENERAL SOILS OF THE SITE (see Exhibit 4, Attached)
 - G. LOCATION OF EXISTING UTILITIES AND PROPOSED UTILITY EXTENSIONS AND/OR ALTERATIONS (see Exhibit 1, attached)
 - H. PARKING PLAN SHOWING OFF-STREET PARKING AREA, LOADING AREAS AND/OR TRANSFER STATIONS (n/a)
 - I. A TIMING SCHEDULE INDICATING ANTICIPATED STARTING AND COMPLETION DATES OF THE SITE (see Cover Letter)
 - J. WRITTEN APPROVAL OF RESPECTIVE HIGHWAY AUTHORITY FOR NEW ACCESS ROADS AND/OR APPROACHES (To be provided in fall, 2011)
 - K. ANY ADDITIONAL INFORMATION THE PLANNING AND ZONING COMMISSION DEEMS NECESSARY

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

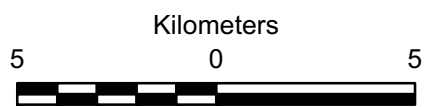
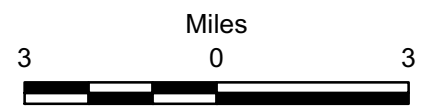
for Jim Atkinson, Minnesota Power

(SIGNATURE OF APPLICANT)



- Bison 1/Bison 2 Turbine Location
- ▲ Oliver 1 Wind Project Turbine Location
- Oliver 2 Wind Project Turbine Location
- BNI Coal Mine
- Milton R. Young Generation Station
- 230kV Transmission Line
- DC Transmission Line
- Interstate Highway
- State Highway
- Preliminary Bison 3 Project Boundary
- Municipality
- County Boundary

Data Sources:
 Project Boundary - Minnesota Power
 Utilities - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Topo Map - USGS DRG

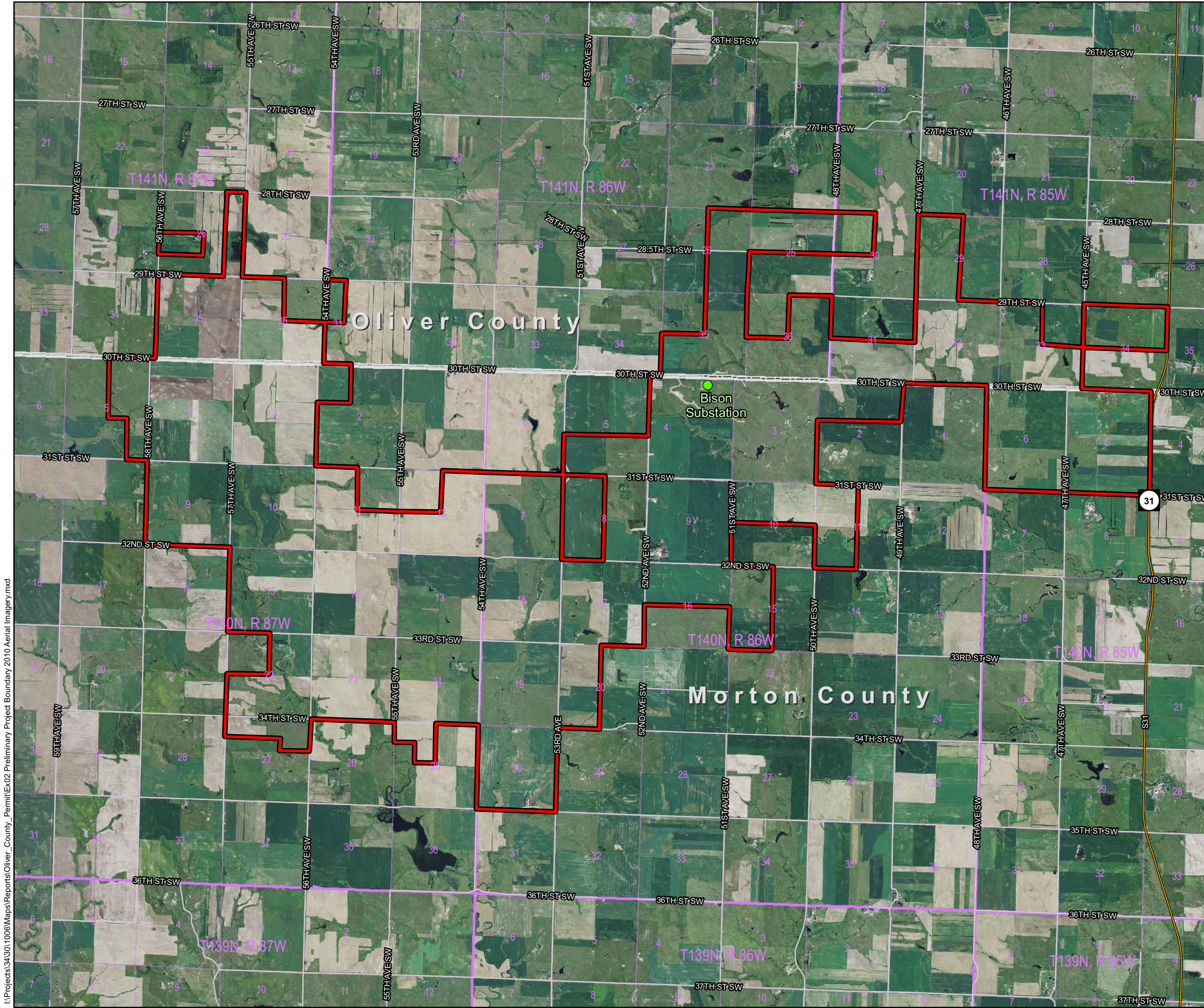









Bismarck (15 Miles) --->

Exhibit 1

PROJECT LOCATION
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\24130\10061\Maps\Reports\Oliver_County_Permit\Ex01_Preliminary_Project_Boundary.mxd



-  Bison Substation
-  Preliminary Bison 3 Project Boundary
-  State Highway
-  Local Road
-  Public Land Survey Township
-  Public Land Survey Section
-  County Boundary

Data Sources:
 Preliminary Project Data - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Imagery - NAIP, 2010

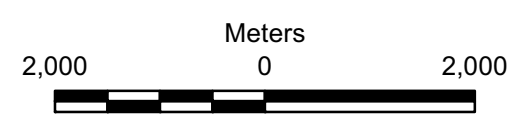
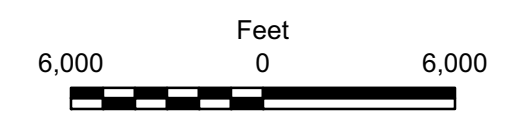
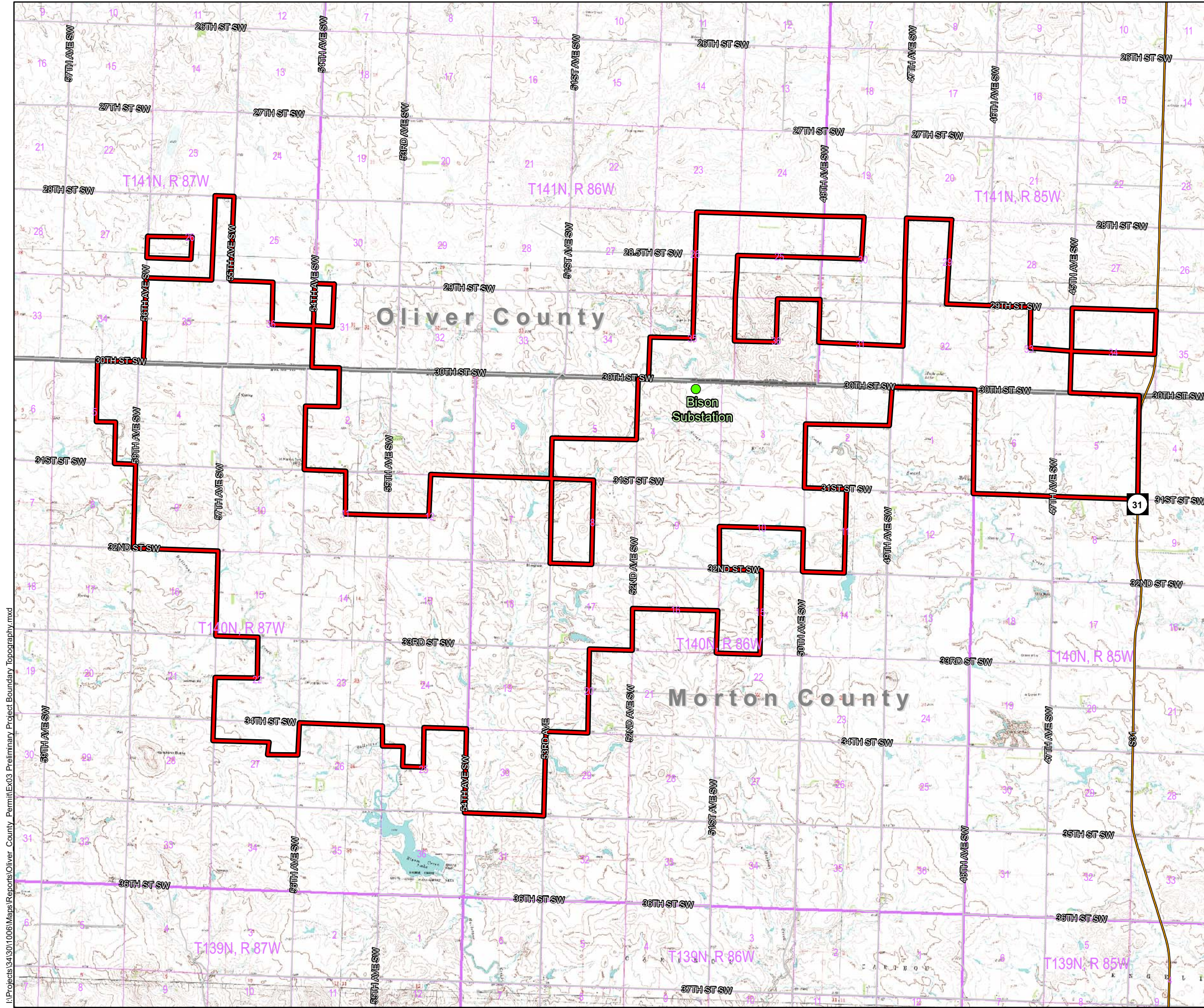









Exhibit 2

PRELIMINARY PROJECT
 BOUNDARY (2010 IMAGERY)
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\3413011006\Maps\Reports\Oliver_County_Permit\Ex02 Preliminary Project Boundary 2010 Aerial Imagery.mxd



-  Bison Substation
-  Preliminary Bison 3 Project Boundary
-  Local Road
-  State Highway
-  Public Land Survey Section
-  Public Land Survey Township
-  County Boundary

Data Sources:
 Preliminary Project Data - Minnesota Power
 Roads, Administrative Boundaries - ND DOT
 Topography - USGS DRG

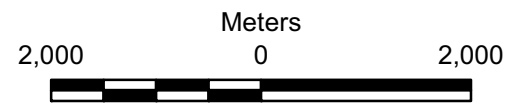
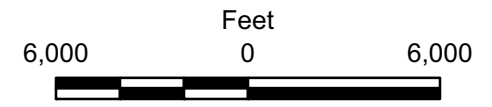
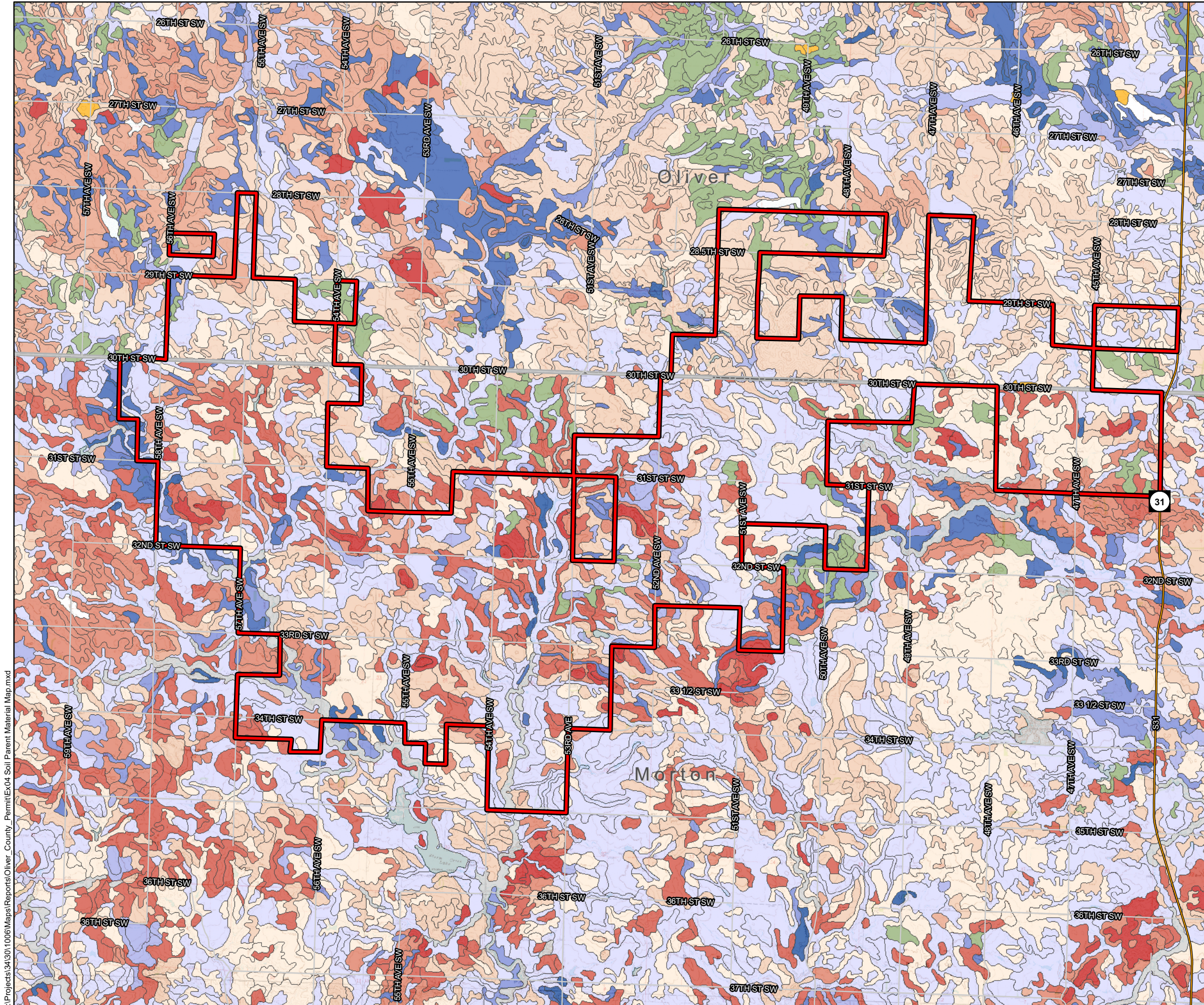



Exhibit 3

PRELIMINARY PROJECT
 BOUNDARY (TOPOGRAPHY)
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\343011006\Maps\Reports\Oliver County_PermitEx03 Preliminary Project Boundary Topography.mxd



-  Preliminary Bison 3 Project Boundary
-  County Boundary
- Soil Parent Material**
-  Unknown
-  Eolian Deposits
-  Fine-Loamy Till
-  Clayey Alluvium
-  Fine-Silty Alluvium
-  Fine-Loamy Alluvium
-  Loamy Alluvium
-  Coarse-Loamy Alluvium
-  Sandy and Gravelly Alluvium
-  Clayey Residuum
-  Fine-Silty Residuum
-  Fine-Loamy Residuum
-  Coarse-Loamy Residuum
-  Coarse-Loamy Residuum From Sandstone
-  Loamy Residuum
-  Sandy Residuum
-  Fine-Loamy Residuum From Sandstone

Data Sources:
 Preliminary Project Data - Minnesota Power
 Soil Parent Material - USDA NRCS SSURGO Soils Database
 Roads, Administrative Boundaries - NDDOT
 Topography - USGS DRG

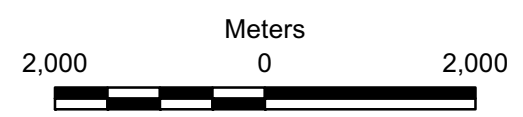


Exhibit 4

SOIL PARENT MATERIAL MAP
 Bison 3 Wind Project
 Minnesota Power
 Morton & Oliver Counties, North Dakota

I:\Projects\34\30\1006\Maps\Reports\Oliver_County_Permit\Ex04 Soil Parent Material Map.mxd

OLIVER COUNTY LANDOWNER LIST – BISON 3 WIND PROJECT

Gary and Carol Hicks 7511 Keystone Drive Bismarck, ND 58503 (701) 223-1713	Keith and Shannon Becher 850 North Randolph, Apt 320 Ballston, VA 22203 (571)389-0858	William L. Chase Living Trust 116 E 8 th Street Newberg, OR 97132 (206) 484-0070
Emma Peltz 409 D Street South Glen Ullin, ND 58631 (701) 348-3011	Tim and Jeanne Peltz 13564 Hunters Crossing Bath, MI 48808 (517) 641-6195	Steven and Cheryl Pletz 1020 Laurel St Broomfield, CO 80020 (303) 465-4125
Verlyn and Joyce Dalbak 5078 South Old Oak Way Springfield, MO 65810 (417) 883-9715	Greg and Jeanne Voegele 2860 56 th Ave New Salem, ND 58563 (701) 843-7094	

Appendix H

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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

6/21/2011 8:45 AM / 1

Licensed user:

EAPC Wind Energy
 3100 DeMers Avenue
 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Main Result

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

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

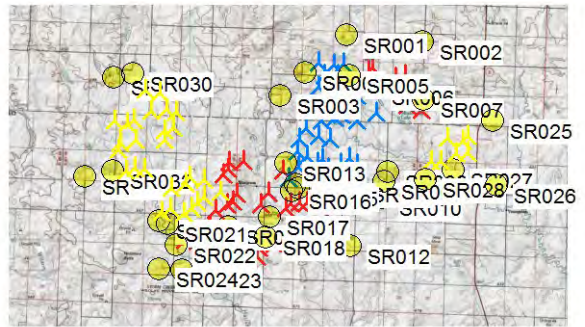
Operational hours are calculated from WTGs in calculation and wind distribution:

SDO for PARK 8643

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW
 460 248 266 220 303 505 763 770 523 378 415 371

W WNW NW NNW Sum
 577 907 1,032 796 8,534

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: 20110421_BISON_nested_HCLs_v2_re

Obstacles not used in calculation

Eye height: 1.5 m

Grid resolution: 10 m

Scale 1:400,000
 New WTG (red triangle icon)
 Shadow receptor (yellow circle icon)

WTGs

UTM WGS84 Zone: 14				WTG type		Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	RPM
East	North	Z	Row data/Description	Valid								
UTM WGS84 Zone: 14				[m]		[kW]	[m]	[m]	[RPM]			
1	308,045	5,206,621	710.2	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
2	308,398	5,207,681	712.8	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
3	305,708	5,204,697	697.2	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
4	306,742	5,204,066	684.1	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
5	306,144	5,205,889	687.5	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
6	307,814	5,208,723	699.8	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
7	306,789	5,208,091	697.9	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
8	305,723	5,203,854	694.7	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
9	308,835	5,206,312	686.8	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
10	308,356	5,207,066	704.4	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
11	309,883	5,206,747	665.7	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
12	308,458	5,204,347	662.0	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
13	307,026	5,204,302	678.5	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
14	306,821	5,205,492	674.2	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
15	307,258	5,207,647	696.1	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
16	306,222	5,204,408	682.6	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
17	307,611	5,209,252	691.9	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
18	306,948	5,206,325	663.9	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
19	307,408	5,205,372	666.1	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
20	307,108	5,208,697	698.3	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
22	307,008	5,203,168	670.0	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
23	305,241	5,203,255	705.6	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0	
25	308,117	5,209,319	675.4	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
26	306,823	5,209,364	689.1	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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SHADOW - Main Result

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

...continued from previous page

UTM WGS84 Zone: 14				WTG type		Type-generator	Power, rated	Rotor diameter	Hub height	RPM	
East	North	Z	Row data/Description	Valid	Manufact.						
UTM WGS84 Zone: 14			[m]			[kW]	[m]	[m]	[RPM]		
27	307,666	5,206,450	684.1	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
28	307,454	5,208,223	699.8	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
29	308,855	5,203,961	659.6	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0
30	308,850	5,207,651	682.8	BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
31	308,007	5,204,045	659.6	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0
32	305,787	5,205,371	676.0	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0
33	307,319	5,208,760	676.0	BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	16.0
201	309,464	5,208,918	677.3	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
202	309,685	5,209,120	676.7	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
203	310,887	5,208,104	665.3	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
204	310,897	5,208,576	676.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
205	311,399	5,208,734	691.6	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
206	311,493	5,207,129	663.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
207	312,259	5,206,895	682.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
208	307,794	5,202,144	666.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
209	307,622	5,201,766	676.7	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
210	307,287	5,201,341	678.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
211	306,204	5,201,988	691.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
212	305,792	5,201,997	687.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
213	305,343	5,201,946	685.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
214	305,086	5,201,688	683.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
215	304,921	5,203,659	700.3	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
216	304,151	5,202,483	677.3	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
217	303,760	5,201,883	670.6	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
218	304,453	5,199,790	684.6	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
219	303,654	5,199,579	680.9	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
220	303,574	5,199,109	668.2	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
221	303,104	5,198,656	658.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
222	299,716	5,199,978	657.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
223	299,930	5,200,609	665.1	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
224	301,600	5,199,737	677.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
225	301,676	5,200,064	678.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
226	301,044	5,200,758	684.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
227	301,339	5,201,562	683.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
228	300,385	5,199,954	656.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
229	301,958	5,201,876	689.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
230	302,272	5,202,012	695.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
231	302,500	5,202,464	685.2	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
232	301,742	5,203,479	692.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
233	302,013	5,203,777	696.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
234	302,093	5,204,102	699.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
235	302,838	5,204,194	681.1	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
301	312,774	5,204,170	646.1	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
302	313,282	5,204,157	646.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
303	314,088	5,204,579	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
304	314,697	5,204,634	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
305	314,736	5,205,482	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
306	314,446	5,205,246	670.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
307	313,645	5,205,400	663.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
308	298,480	5,201,477	664.5	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
309	298,972	5,201,680	670.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
310	299,665	5,201,434	671.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
311	300,072	5,201,700	677.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0
312	300,370	5,201,989	679.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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SHADOW - Main Result

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

...continued from previous page

UTM WGS84 Zone: 14				WTG type		Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	RPM
East	North	Z	Row data/Description									
UTM WGS84 Zone: 14			[m]					[kW]	[m]	[m]	[RPM]	
313	300,736	5,202,308	705.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
314	301,586	5,202,532	685.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
315	300,740	5,203,215	690.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
316	299,975	5,203,346	696.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
317	299,780	5,202,993	707.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
318	298,996	5,202,746	677.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
319	297,558	5,203,763	688.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
320	297,064	5,203,816	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
321	296,612	5,203,683	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
322	296,227	5,204,772	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
323	296,321	5,205,129	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
324	297,120	5,205,284	690.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
325	295,979	5,206,293	691.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
326	296,688	5,206,154	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
327	297,008	5,206,367	690.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
328	297,927	5,206,824	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
329	297,639	5,207,972	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
330	298,396	5,207,813	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
331	298,772	5,206,941	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
332	299,272	5,206,774	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
333	299,137	5,205,950	701.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
334	298,647	5,205,816	693.1	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	
335	298,632	5,205,272	684.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	16.0	

Shadow receptor-Input

UTM WGS84 Zone: 14										
No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
		[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	
SR001	SR001	308,281	5,210,878	684.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR002	SR002	312,331	5,210,518	667.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR003	SR003	304,789	5,207,620	679.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR004	SR004	306,077	5,208,878	691.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR005	SR005	308,456	5,208,732	677.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR006	SR006	309,777	5,208,086	658.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR007	SR007	312,386	5,207,439	674.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR008	SR008	310,463	5,203,623	650.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR009	SR009	310,303	5,203,128	643.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR010	SR010	310,167	5,202,263	676.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR011	SR011	308,704	5,202,962	655.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR012	SR012	308,504	5,199,667	674.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR013	SR013	305,091	5,204,059	680.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR014	SR014	305,600	5,202,951	680.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR015	SR015	305,735	5,202,742	681.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR016	SR016	305,362	5,202,580	681.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR017	SR017	304,204	5,201,211	671.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR018	SR018	304,015	5,200,169	672.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR019	SR019	302,002	5,200,728	663.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR020	SR020	298,345	5,201,007	658.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR021	SR021	298,817	5,200,870	660.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR022	SR022	299,277	5,199,763	649.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR023	SR023	299,548	5,198,404	658.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR024	SR024	298,327	5,198,450	669.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
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 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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SHADOW - Main Result

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

...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]	[m]	[°]	[°]	
SR025	SR025	316,022	5,206,330	640.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR026	SR026	316,240	5,202,903	634.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR027	SR027	313,965	5,203,735	643.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR028	SR028	312,483	5,203,203	631.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR029	SR029	295,930	5,208,602	690.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR030	SR030	296,963	5,208,823	695.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR031	SR031	294,437	5,203,372	677.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
SR032	SR032	295,924	5,203,653	667.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case			Shadow, expected values	
		Shadow hours per year	Shadow days per year	Max shadow hours per day	Shadow hours per year	
		[h/year]	[days/year]	[h/day]	[h/year]	
SR001	SR001	0:00	0	0:00	0:00	
SR002	SR002	0:00	0	0:00	0:00	
SR003	SR003	0:00	0	0:00	0:00	
SR004	SR004	12:26	54	0:22	4:50	
SR005	SR005	63:53	199	0:36	27:02	
SR006	SR006	34:08	137	0:24	12:14	
SR007	SR007	7:54	32	0:23	2:21	
SR008	SR008	0:00	0	0:00	0:00	
SR009	SR009	0:00	0	0:00	0:00	
SR010	SR010	0:00	0	0:00	0:00	
SR011	SR011	8:15	34	0:18	1:54	
SR012	SR012	0:00	0	0:00	0:00	
SR013	SR013	58:27	127	0:46	18:31	
SR014	SR014	2:11	18	0:11	0:53	
SR015	SR015	3:31	25	0:13	1:27	
SR016	SR016	23:52	93	0:24	8:19	
SR017	SR017	15:05	51	0:24	5:56	
SR018	SR018	47:18	92	0:42	16:35	
SR019	SR019	10:04	32	0:25	4:21	
SR020	SR020	5:05	28	0:17	2:06	
SR021	SR021	12:08	55	0:20	4:24	
SR022	SR022	43:53	89	0:46	17:42	
SR023	SR023	0:00	0	0:00	0:00	
SR024	SR024	0:00	0	0:00	0:00	
SR025	SR025	0:00	0	0:00	0:00	
SR026	SR026	0:00	0	0:00	0:00	
SR027	SR027	25:58	85	0:30	13:24	
SR028	SR028	0:00	0	0:00	0:00	
SR029	SR029	0:00	0	0:00	0:00	
SR030	SR030	0:00	0	0:00	0:00	
SR031	SR031	0:00	0	0:00	0:00	
SR032	SR032	28:31	49	0:50	12:01	

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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SHADOW - Main Result**Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)**

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	BISON 1B	0:00	0:00
2	BISON 1B	4:43	1:29
3	BISON 1A	0:00	0:00
4	BISON 1A	0:00	0:00
5	BISON 1A	0:00	0:00
6	BISON 1B	22:12	9:28
7	BISON 1B	5:18	1:40
8	BISON 1A	20:41	8:35
9	BISON 1B	0:00	0:00
10	BISON 1B	0:00	0:00
11	BISON 1B	0:00	0:00
12	BISON 1A	0:00	0:00
13	BISON 1A	0:00	0:00
14	BISON 1A	0:00	0:00
15	BISON 1B	0:00	0:00
16	BISON 1A	6:50	2:49
17	BISON 1B	17:29	9:06
18	BISON 1A	0:00	0:00
19	BISON 1A	0:00	0:00
20	BISON 1B	11:13	4:54
22	BISON 1A	5:41	2:20
23	BISON 1A	0:00	0:00
25	BISON 1B	0:00	0:00
26	BISON 1B	0:00	0:00
27	BISON 1B	0:00	0:00
28	BISON 1B	8:50	2:20
29	BISON 1A	0:00	0:00
30	BISON 1B	10:25	2:53
31	BISON 1A	0:00	0:00
32	BISON 1A	0:00	0:00
33	BISON 1A	0:00	0:00
201	BISON 2	8:09	3:17
202	BISON 2	4:56	2:02
203	BISON 2	6:17	2:39
204	BISON 2	12:42	5:12
205	BISON 2	0:00	0:00
206	BISON 2	7:54	2:21
207	BISON 2	0:00	0:00
208	BISON 2	8:15	1:54
209	BISON 2	0:00	0:00
210	BISON 2	0:00	0:00
211	BISON 2	11:57	4:09
212	BISON 2	8:09	2:33
213	BISON 2	0:00	0:00
214	BISON 2	15:05	5:56
215	BISON 2	30:56	7:24
216	BISON 2	3:46	1:34
217	BISON 2	0:00	0:00
218	BISON 2	47:18	16:35
219	BISON 2	0:00	0:00
220	BISON 2	0:00	0:00
221	BISON 2	0:00	0:00
222	BISON 2	43:38	17:01
223	BISON 2	5:31	2:15
224	BISON 2	0:00	0:00
225	BISON 2	0:00	0:00

To be continued on next page...

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SHADOW - Main Result**Calculation:** BISON 3 Shadow Flicker (with existing BISON 1, 2)

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
226	BISON 2	10:04	4:21
227	BISON 2	0:00	0:00
228	BISON 2	6:52	2:47
229	BISON 2	0:00	0:00
230	BISON 2	0:00	0:00
231	BISON 2	0:00	0:00
232	BISON 2	0:00	0:00
233	BISON 2	0:00	0:00
234	BISON 2	0:00	0:00
235	BISON 2	0:00	0:00
301	BISON 3	5:14	2:35
302	BISON 3	20:44	10:48
303	BISON 3	0:00	0:00
304	BISON 3	0:00	0:00
305	BISON 3	0:00	0:00
306	BISON 3	0:00	0:00
307	BISON 3	0:00	0:00
308	BISON 3	0:00	0:00
309	BISON 3	0:00	0:00
310	BISON 3	5:04	2:06
311	BISON 3	0:00	0:00
312	BISON 3	0:00	0:00
313	BISON 3	0:00	0:00
314	BISON 3	0:00	0:00
315	BISON 3	0:00	0:00
316	BISON 3	0:00	0:00
317	BISON 3	0:00	0:00
318	BISON 3	0:00	0:00
319	BISON 3	0:00	0:00
320	BISON 3	7:53	3:20
321	BISON 3	20:58	8:49
322	BISON 3	0:00	0:00
323	BISON 3	0:00	0:00
324	BISON 3	0:00	0:00
325	BISON 3	0:00	0:00
326	BISON 3	0:00	0:00
327	BISON 3	0:00	0:00
328	BISON 3	0:00	0:00
329	BISON 3	0:00	0:00
330	BISON 3	0:00	0:00
331	BISON 3	0:00	0:00
332	BISON 3	0:00	0:00
333	BISON 3	0:00	0:00
334	BISON 3	0:00	0:00
335	BISON 3	0:00	0:00

Project:

Minnesota Power - BISON Wind Energy Center

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:44	07:28	08:11
	17:08	17:48	18:30	20:14	20:55	21:33	21:46	21:21	20:30	19:30	17:31	17:00
2	08:33	08:11	07:26	07:25	06:31	05:55	05:56	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:28	19:28	17:30	16:59
3	08:33	08:10	07:24	07:23	06:29	05:55	05:56	06:27	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:58	21:34	21:45	21:19	20:26	19:26	17:28	16:59
4	08:33	08:09	07:22	07:21	06:27	05:54	05:57	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:35	21:45	21:17	20:24	19:24	17:27	16:59
5	08:32	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:45	21:16	20:22	19:22	17:26	16:58
6	08:32	08:06	07:18	07:17	06:24	05:53	05:58	06:31	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:44	21:14	20:20	19:20	17:24	16:58
7	08:32	08:04	07:17	07:15	06:23	05:53	05:59	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:38	20:22	21:03	21:38	21:44	21:13	20:18	19:18	17:23	16:58
8	08:32	08:03	07:15	07:13	06:21	05:52	06:00	06:34	07:14	07:54	07:39	08:19
	17:15	17:59	18:40	20:23	21:04	21:38	21:43	21:11	20:16	19:16	17:21	16:58
9	08:31	08:02	08:13	07:11	06:20	05:52	06:01	06:35	07:15	07:55	07:40	08:20
	17:16	18:01	19:41	20:25	21:06	21:39	21:43	21:10	20:14	19:14	17:20	16:57
10	08:31	08:00	08:11	07:10	06:19	05:52	06:01	06:36	07:17	07:57	07:42	08:21
	17:17	18:01	19:43	20:26	21:07	21:40	21:42	21:08	20:12	19:12	17:19	16:57
11	08:31	07:59	08:09	07:08	06:17	05:51	06:02	06:38	07:18	07:58	07:43	08:22
	17:19	18:02	19:44	20:28	21:08	21:41	21:42	21:07	20:10	19:10	17:17	16:57
12	08:30	07:57	08:07	07:06	06:16	05:51	06:03	06:39	07:19	08:00	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:41	21:41	21:05	20:08	19:08	17:16	16:57
13	08:30	07:55	08:05	07:04	06:15	05:51	06:04	06:40	07:21	08:01	07:46	08:24
	17:21	18:05	19:47	20:30	21:11	21:42	21:41	21:04	20:06	19:06	17:15	16:57
14	08:29	07:54	08:03	07:02	06:13	05:51	06:05	06:42	07:22	08:02	07:48	08:24
	17:22	18:07	19:49	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58
15	08:29	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:13	21:43	21:39	21:00	20:02	19:02	17:13	16:58
16	08:28	07:51	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	07:51	08:26
	17:25	18:10	19:51	20:34	21:15	21:43	21:39	20:59	20:00	19:01	17:12	16:58
17	08:27	07:49	07:57	06:56	06:10	05:51	06:08	06:45	07:26	08:07	07:52	08:27
	17:26	18:12	19:53	20:36	21:16	21:44	21:38	20:57	19:58	18:57	17:11	16:58
18	08:27	07:47	07:55	06:55	06:08	05:51	06:09	06:47	07:27	08:08	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:37	20:55	19:56	18:55	17:09	16:58
19	08:26	07:46	07:53	06:53	06:07	05:51	06:10	06:48	07:29	08:09	07:55	08:28
	17:29	18:15	19:56	20:39	21:18	21:44	21:36	20:53	19:54	18:53	17:08	16:59
20	08:25	07:44	07:51	06:51	06:06	05:51	06:11	06:49	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:45	21:35	20:52	19:52	18:51	17:08	16:59
21	08:24	07:42	07:49	06:49	06:05	05:51	06:12	06:51	07:31	08:12	07:58	08:29
	17:32	18:18	19:58	20:41	21:21	21:45	21:34	20:50	19:50	18:50	17:07	17:00
22	08:23	07:40	07:47	06:47	06:04	05:51	06:13	06:52	07:32	08:14	07:59	08:30
	17:33	18:19	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:00
23	08:22	07:39	07:45	06:46	06:03	05:52	06:14	06:53	07:34	08:15	08:00	08:30
	17:35	18:21	20:01	20:44	21:23	21:46	21:32	20:46	19:46	18:46	17:05	17:01
24	08:21	07:37	07:43	06:44	06:02	05:52	06:15	06:55	07:35	08:17	08:02	08:31
	17:36	18:22	20:03	20:45	21:24	21:46	21:31	20:45	19:44	18:44	17:04	17:01
25	08:20	07:35	07:41	06:42	06:01	05:52	06:17	06:56	07:36	08:18	08:03	08:31
	17:38	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	18:43	17:03	17:02
26	08:19	07:33	07:39	06:40	06:00	05:53	06:18	06:57	07:38	08:20	08:05	08:31
	17:39	18:25	20:05	20:48	21:26	21:46	21:29	20:41	19:40	18:41	17:03	17:03
27	08:18	07:32	07:37	06:39	05:59	05:53	06:19	06:58	07:39	08:21	08:06	08:32
	17:41	18:27	20:07	20:50	21:27	21:46	21:28	20:39	19:38	18:39	17:02	17:03
28	08:17	07:30	07:35	06:37	05:59	05:53	06:20	07:00	07:40	08:23	08:07	08:32
	17:42	18:28	20:08	20:51	21:29	21:46	21:27	20:37	19:36	18:38	17:01	17:04
29	08:16		07:33	06:35	05:58	05:54	06:21	07:01	07:42	08:24	08:08	08:32
	17:44		20:10	20:52	21:30	21:46	21:25	20:35	19:34	18:36	17:01	17:05
30	08:15		07:31	06:34	05:57	05:54	06:23	07:02	07:43	08:25	08:10	08:32
	17:45		20:11	20:54	21:31	21:46	21:24	20:33	19:32	18:35	17:00	17:06
31	08:14		07:29		05:56		06:24	07:04		08:27		08:33
	17:47		20:12		21:32		21:23	20:31		18:33		17:06
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:

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

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

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:

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3100 DeMers Avenue
US-GRAND FORKS, ND 58201
+1 701 775 3000
wind@eapc.net
Calculated:
6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:45	07:29	08:11
	17:08	17:49	18:30	20:14	20:55	21:33	21:46	21:22	20:30	19:30	17:32	17:00
2	08:33	08:11	07:26	07:25	06:31	05:55	05:56	06:27	07:07	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:28	19:28	17:30	17:00
3	08:33	08:10	07:24	07:23	06:29	05:55	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:17	20:58	21:34	21:45	21:19	20:26	19:26	17:29	16:59
4	08:33	08:09	07:22	07:21	06:28	05:54	05:57	06:29	07:09	07:49	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:35	21:45	21:17	20:24	19:24	17:27	16:59
5	08:32	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:50	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:45	21:16	20:22	19:22	17:26	16:58
6	08:32	08:06	07:19	07:18	06:25	05:53	05:59	06:32	07:12	07:51	07:36	08:17
	17:13	17:56	18:37	20:21	21:02	21:37	21:44	21:15	20:20	19:20	17:24	16:58
7	08:32	08:05	07:17	07:16	06:23	05:53	05:59	06:33	07:13	07:53	07:37	08:18
	17:14	17:58	18:39	20:22	21:03	21:38	21:44	21:13	20:18	19:18	17:23	16:58
8	08:32	08:03	08:15	07:14	06:22	05:53	06:00	06:34	07:14	07:54	07:39	08:19
	17:15	18:00	18:40	20:24	21:04	21:39	21:44	21:12	20:16	19:16	17:22	16:58
9	08:31	08:02	08:13	07:12	06:20	05:52	06:01	06:35	07:16	07:56	07:40	08:20
	17:16	18:00	19:42	20:25	21:06	21:39	21:43	21:10	20:14	19:14	17:20	16:58
10	08:31	08:00	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:01	19:43	20:26	21:07	21:40	21:43	21:09	20:12	19:12	17:19	16:58
11	08:31	07:59	08:09	07:08	06:17	05:52	06:03	06:38	07:18	07:58	07:43	08:22
	17:19	18:03	19:44	20:28	21:08	21:41	21:42	21:07	20:10	19:10	17:18	16:58
12	08:30	07:57	08:07	07:06	06:16	05:51	06:03	06:39	07:20	08:00	07:45	08:23
	17:20	18:04	19:46	20:29	21:10	21:41	21:41	21:05	20:08	19:08	17:16	16:58
13	08:30	07:56	08:05	07:04	06:15	05:51	06:04	06:40	07:21	08:01	07:46	08:24
	17:21	18:06	19:47	20:30	21:11	21:42	21:41	21:04	20:06	19:06	17:15	16:58
14	08:29	07:54	08:03	07:02	06:14	05:51	06:05	06:42	07:22	08:02	07:48	08:25
	17:23	18:07	19:49	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58
15	08:29	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:14	21:43	21:39	21:00	20:02	19:03	17:13	16:58
16	08:28	07:51	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	07:51	08:26
	17:25	18:10	19:52	20:35	21:15	21:43	21:39	20:59	20:00	19:01	17:12	16:58
17	08:27	07:49	07:57	06:57	06:10	05:51	06:08	06:46	07:26	08:07	07:52	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:38	20:57	19:58	18:57	17:11	16:58
18	08:27	07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	08:08	07:54	08:28
	17:28	18:13	19:54	20:37	21:17	21:44	21:37	20:55	19:56	18:55	17:10	16:59
19	08:26	07:46	07:53	06:53	06:08	05:51	06:10	06:48	07:29	08:10	07:55	08:28
	17:29	18:15	19:56	20:39	21:18	21:45	21:36	20:54	19:54	18:53	17:09	16:59
20	08:25	07:44	07:51	06:51	06:06	05:51	06:11	06:50	07:30	08:11	07:56	08:29
	17:31	18:16	19:57	20:40	21:20	21:45	21:35	20:52	19:52	18:52	17:08	16:59
21	08:24	07:42	07:49	06:49	06:05	05:52	06:12	06:51	07:31	08:12	07:58	08:29
	17:32	18:18	19:59	20:41	21:21	21:45	21:34	20:50	19:50	18:50	17:07	17:00
22	08:23	07:41	07:47	06:48	06:04	05:52	06:14	06:52	07:33	08:14	07:59	08:30
	17:34	18:19	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:00
23	08:22	07:39	07:45	06:46	06:03	05:52	06:15	06:53	07:34	08:15	08:01	08:30
	17:35	18:21	20:01	20:44	21:23	21:46	21:32	20:46	19:46	18:46	17:05	17:01
24	08:22	07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	08:17	08:02	08:31
	17:37	18:22	20:03	20:46	21:24	21:46	21:31	20:45	19:44	18:45	17:04	17:02
25	08:21	07:35	07:41	06:42	06:01	05:53	06:17	06:56	07:37	08:18	08:03	08:31
	17:38	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	18:43	17:04	17:02
26	08:19	07:33	07:39	06:41	06:01	05:53	06:18	06:57	07:38	08:20	08:05	08:32
	17:40	18:25	20:06	20:48	21:26	21:46	21:29	20:41	19:40	18:41	17:03	17:03
27	08:18	07:32	07:37	06:39	06:00	05:53	06:19	06:59	07:39	08:21	08:06	08:32
	17:41	18:27	20:07	20:50	21:28	21:46	21:28	20:39	19:38	18:40	17:02	17:04
28	08:17	07:30	07:35	06:37	05:59	05:54	06:20	07:00	07:41	08:23	08:07	08:32
	17:43	18:28	20:08	20:51	21:29	21:46	21:27	20:37	19:36	18:38	17:02	17:04
29	08:16		07:33	06:36	05:58	05:54	06:22	07:01	07:42	08:24	08:09	08:32
	17:44		20:10	20:52	21:30	21:46	21:25	20:35	19:34	18:36	17:01	17:05
30	08:15		07:31	06:34	05:57	05:55	06:23	07:03	07:43	08:26	08:10	08:32
	17:46		20:11	20:54	21:31	21:46	21:24	20:33	19:32	18:35	17:01	17:06
31	08:14		07:29		05:57		06:24	07:04		08:27		08:33
	17:47		20:13		21:32		21:23	20:32		18:33		17:07
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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:

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wind@eapc.net
Calculated:
6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	09:23 (7)	08:13	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:45	08:07 (20)	07:28	08:11
	17:08	10 09:33 (7)	17:49	18:30	20:14	20:55	21:33	21:46	21:21	20:30	19:30	15 08:22 (20)	17:32	17:00
2	08:33	09:25 (7)	08:11	07:26	07:25	06:31	05:55	05:56	06:26	07:06	07:46	08:08 (20)	07:30	08:12
	17:09	7 09:32 (7)	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:28	19:28	13 08:21 (20)	17:30	16:59
3	08:33	09:27 (7)	08:10	07:24	07:23	06:29	05:55	05:56	06:28	07:08	07:47	08:09 (20)	07:31	08:13
	17:10	4 09:31 (7)	17:52	18:33	20:17	20:58	21:34	21:45	21:19	20:26	19:26	10 08:19 (20)	17:29	16:59
4	08:33	08:09	07:22	07:21	06:28	05:54	05:57	06:29	07:09	07:09	07:49	08:11 (20)	07:33	08:15
	17:11	17:53	18:34	20:18	20:59	21:35	21:45	21:17	20:24	19:24	7 08:18 (20)	17:27	16:59	
5	08:32	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:10	07:50	08:12 (20)	07:34	08:16
	17:12	17:55	18:36	20:19	21:00	21:36	21:45	21:16	20:22	19:22	2 08:14 (20)	17:26	16:58	
6	08:32	08:06	07:19	07:17	06:25	05:53	05:58	06:31	07:12	07:12	07:51	07:36	08:17	
	17:13	17:56	18:37	20:21	21:02	21:37	21:44	21:15	20:20	19:20		17:24	16:58	
7	08:32	08:05	07:17	07:15	06:23	05:53	05:59	06:33	07:13	07:13	07:53	07:37	08:18	
	17:14	17:58	18:39	20:22	21:03	21:38	21:44	21:13	20:18	19:18		17:23	16:58	
8	08:32	08:03	08:15	07:14	06:22	05:52	06:00	06:34	07:14	07:14	07:54	07:39	08:19	
	17:15	17:59	18:40	20:24	21:04	21:38	21:44	21:12	20:16	19:16		17:21	16:58	
9	08:31	08:02	08:13	07:12	06:20	05:52	06:01	06:35	07:16	07:16	07:55	07:40	08:20	09:15 (7)
	17:16	18:01	19:42	5 08:39 (20)	20:25	21:06	21:39	21:43	21:10	20:14	19:14	17:20	16:58	4 09:19 (7)
10	08:31	08:00	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:17	07:57	07:42	08:21	09:14 (7)
	17:18	18:01	19:43	9 08:41 (20)	20:26	21:07	21:40	21:43	21:08	20:12	19:12	17:19	16:58	7 09:21 (7)
11	08:31	07:59	08:09	07:08	06:17	05:52	06:02	06:38	07:18	07:18	07:58	07:43	08:22	09:13 (7)
	17:19	18:03	19:44	12 08:42 (20)	20:28	21:08	21:41	21:42	21:07	20:10	19:10	17:18	16:57	10 09:23 (7)
12	08:30	07:57	08:07	07:06	06:16	05:51	06:03	06:39	07:19	07:19	08:00	07:45	08:23	09:13 (7)
	17:20	18:04	19:46	14 08:42 (20)	20:29	21:10	21:41	21:41	21:05	20:08	19:08	17:16	16:58	11 09:24 (7)
13	08:30	07:56	08:05	07:04	06:15	05:51	06:04	06:40	07:21	07:21	08:01	07:46	08:24	09:13 (7)
	17:21	18:06	19:47	17 08:43 (20)	20:30	21:11	21:42	21:41	21:04	20:06	19:06	17:15	16:58	12 09:25 (7)
14	08:29	07:54	08:03	07:02	06:13	05:51	06:05	06:42	07:22	07:22	08:02	07:48	08:25	09:13 (7)
	17:23	18:07	19:49	19 08:43 (20)	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58	13 09:26 (7)
15	08:29	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	07:23	08:04	07:49	08:25	09:14 (7)
	17:24	18:09	19:50	21 08:43 (20)	20:33	21:13	21:43	21:39	21:00	20:02	19:03	17:13	16:58	13 09:27 (7)
16	08:28	07:51	07:59	06:58	06:11	05:51	06:07	06:44	07:25	07:25	08:05	07:51	08:26	09:13 (7)
	17:25	18:10	19:52	22 08:42 (20)	20:35	21:15	21:43	21:39	20:59	20:00	19:01	17:12	16:58	14 09:27 (7)
17	08:27	07:49	07:57	06:57	06:10	05:51	06:08	06:46	07:26	07:26	08:07	07:52	08:27	09:14 (7)
	17:27	18:12	19:53	22 08:42 (20)	20:36	21:16	21:44	21:38	20:57	19:58	18:57	17:11	16:58	14 09:28 (7)
18	08:27	07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	07:27	08:08	07:54	08:28	09:14 (7)
	17:28	18:13	19:54	21 08:41 (20)	20:37	21:17	21:44	21:37	20:55	19:56	18:55	17:10	16:59	15 09:29 (7)
19	08:26	07:46	07:53	06:53	06:07	05:51	06:10	06:48	07:29	07:29	08:10	07:55	08:28	09:14 (7)
	17:29	18:15	19:56	19 08:40 (20)	20:39	21:18	21:45	21:36	20:54	19:54	18:53	17:09	16:59	15 09:29 (7)
20	08:25	07:44	07:51	06:51	06:06	05:51	06:11	06:49	07:30	07:30	08:11	07:56	08:29	09:15 (7)
	17:31	18:16	19:57	16 08:38 (20)	20:40	21:20	21:45	21:35	20:52	19:52	18:52	17:08	16:59	15 09:30 (7)
21	08:24	07:42	07:49	06:49	06:05	05:51	06:12	06:51	07:31	07:31	08:12	07:58	08:29	09:16 (7)
	17:32	18:18	19:59	13 08:36 (20)	20:41	21:21	21:45	21:34	20:50	19:50	18:50	17:07	17:00	15 09:31 (7)
22	08:23	07:41	07:47	06:47	06:04	05:52	06:13	06:52	07:33	07:33	08:14	07:59	08:30	09:16 (7)
	17:34	18:19	20:00	5 08:32 (20)	20:43	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:00	15 09:31 (7)
23	08:22	07:39	07:45	06:46	06:03	05:52	06:15	06:53	07:34	07:34	08:15	08:01	08:30	09:16 (7)
	17:35	18:21	20:01	20:44	21:23	21:46	21:32	20:46	19:46	18:46	17:46	17:05	17:01	15 09:31 (7)
24	08:21	07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	07:35	08:17	08:02	08:31	09:17 (7)
	17:37	18:22	20:03	20:46	21:24	21:46	21:31	20:45	19:44	18:44	17:44	17:04	17:01	15 09:32 (7)
25	08:20	07:35	07:41	06:42	06:01	05:52	06:17	06:56	07:37	07:37	08:18	08:03	08:31	09:17 (7)
	17:38	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	20 08:24 (20)	18:43	17:04	17:02	15 09:32 (7)
26	08:19	07:33	07:39	06:41	06:00	05:53	06:18	06:57	07:38	07:38	08:20	08:05	08:32	09:17 (7)
	17:40	18:25	20:06	20:48	21:26	21:46	21:29	20:41	19:40	21 08:24 (20)	18:41	17:03	17:03	15 09:32 (7)
27	08:18	07:32	07:37	06:39	06:00	05:53	06:19	06:59	07:39	07:39	08:22 (20)	08:21	08:32	09:19 (7)
	17:41	18:27	20:07	20:50	21:28	21:46	21:28	20:39	19:38	22 08:24 (20)	18:40	17:02	17:03	14 09:33 (7)
28	08:17	07:30	07:35	06:37	05:59	05:54	06:20	07:00	07:41	07:41	08:23 (20)	08:23	08:32	09:19 (7)
	17:43	17:43	20:08	20:51	21:29	21:46	21:27	20:37	19:36	21 08:24 (20)	18:39	17:02	17:04	14 09:33 (7)
29	08:16	07:29	07:33	06:36	05:58	05:54	06:22	07:01	07:42	07:42	08:24 (20)	08:24	08:32	09:20 (7)
	17:44	17:44	20:10	20:52	21:30	21:46	21:25	20:35	19:34	20 08:24 (20)	18:36	17:01	17:05	13 09:33 (7)
30	08:15	07:31	07:31	06:34	05:57	05:55	06:23	07:03	07:43	07:43	08:25 (20)	08:26	08:32	09:21 (7)
	17:46	17:46	20:11	20:54	21:31	21:46	21:24	20:33	19:32	18 08:23 (20)	18:35	17:00	17:06	12 09:33 (7)
31	08:14	07:29	07:29	06:31	05:57	05:57	06:24	07:04	07:44	07:44	08:27	08:33	08:33	09:22 (7)
	17:47	17:47	20:12	20:54	21:32	21:47	21:23	20:32	19:31	17 08:23 (20)	18:33	17:01	17:07	11 09:33 (7)
Potential sun hours	279	287	368	407	466	475	480	441	378	338	282	266		
Total, worst case		21		215					166		47			297
Sun reduction		0.55		0.63					0.69		0.52			0.43
Oper. time red.		0.97		0.97					0.97		0.97			0.97
Wind dir. red.		0.74		0.71					0.71		0.71			0.74
Total reduction		0.40		0.43					0.48		0.36			0.31
Total, real		8		93					79		17			93

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net
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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) Shadow receptor: SR005 - SR005

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June
1	08:33 17:08	08:12 17:49	17:11 (28) 07:28	07:27 20:14	19:00 (6) 06:32	05:56 20:50 (17)
2	08:33 17:09	08:11 17:50	17:09 (28) 07:26	07:25 20:15	18:59 (6) 06:31	05:55 20:49 (17)
3	08:33 17:10	08:10 17:52	17:09 (28) 07:24	07:23 20:16	18:59 (6) 06:29	05:55 20:49 (17)
4	08:32 17:11	08:09 17:53	17:09 (28) 07:22	07:21 20:18	18:59 (6) 06:27	05:54 20:48 (17)
5	08:32 17:12	08:07 17:55	17:08 (28) 07:20	07:19 20:19	18:59 (6) 06:26	05:54 20:49 (17)
6	08:32 17:13	08:06 17:56	17:08 (28) 07:18	07:17 20:21	19:00 (6) 06:24	05:53 20:48 (17)
7	08:32 17:14	08:04 17:58	17:08 (28) 07:16	07:15 20:22	19:00 (6) 06:23	05:53 20:48 (17)
8	08:32 17:15	08:03 17:59	17:08 (28) 08:15	07:13 20:23	19:01 (6) 06:21	05:52 20:49 (17)
9	08:31 17:16	08:02 18:01	17:08 (28) 08:13	07:12 20:25	19:02 (6) 06:20	05:52 20:48 (17)
10	08:31 17:17	08:00 18:01	17:09 (28) 08:11	07:10 20:26	19:03 (6) 06:19	05:52 20:48 (17)
11	08:31 17:19	07:59 18:02	17:09 (28) 08:09	07:08 20:28	19:05 (6) 06:17	05:51 20:49 (17)
12	08:30 17:20	07:57 18:04	17:10 (28) 08:07	07:06 20:29	19:07 (6) 06:16	05:51 20:49 (17)
13	08:30 17:21	07:55 18:05	17:11 (28) 08:05	07:04 20:30	19:25 (201) 06:15	05:51 20:49 (17)
14	08:29 17:22	07:54 18:07	17:13 (28) 08:03	07:02 20:32	07:23 (201) 06:13	05:51 20:49 (17)
15	08:29 17:24	07:52 18:09	17:16 (28) 08:01	07:00 20:33	07:21 (201) 06:12	05:51 20:49 (17)
16	08:28 17:25	07:51 18:10	17:23 (28) 07:59	06:58 20:34	07:20 (201) 06:11	05:51 20:50 (17)
17	08:27 17:26	07:49 18:12	07:57 19:53	06:56 20:36	07:18 (201) 06:10	05:51 20:50 (17)
18	08:26 17:28	07:47 18:13	07:55 19:54	06:55 19:28 (20)	07:16 (201) 06:08	05:51 20:50 (17)
19	08:26 17:29	07:46 18:15	07:53 19:56	06:53 19:32 (20)	07:14 (201) 06:07	05:51 20:50 (17)
20	08:25 17:31	07:44 18:16	07:51 19:57	06:51 19:25 (20)	07:12 (201) 06:06	05:51 20:50 (17)
21	08:24 17:32	07:42 18:18	07:49 19:58	06:49 19:35 (20)	07:11 (201) 06:05	05:51 20:50 (17)
22	08:23 17:34	07:40 18:19	07:47 20:00	06:47 19:36 (20)	07:09 (201) 06:04	05:51 20:50 (17)
23	08:22 17:35	07:39 18:21	07:45 20:01	06:46 19:38 (20)	07:09 (201) 06:03	05:52 20:51 (17)
24	08:21 17:36	07:37 18:22	07:43 20:02	06:44 19:08 (6)	07:10 (201) 06:02	05:52 20:51 (17)
25	08:20 17:38	07:35 18:24	07:41 20:03	06:42 19:40 (20)	07:10 (201) 06:01	05:52 20:51 (17)
26	08:19 17:39	07:33 18:25	07:39 20:04	06:40 19:05 (6)	07:09 (201) 06:00	05:53 20:52 (17)
27	08:18 17:41	07:31 18:27	07:37 20:05	06:39 19:37 (20)	07:12 (201) 06:00	05:53 20:52 (17)
28	08:17 17:42	07:30 18:28	07:35 20:06	06:37 19:03 (6)	06:59 (202) 05:59	05:54 20:52 (17)
29	08:16 17:44	07:28 18:29	07:33 20:07	06:35 19:36 (6)	07:24 (201) 05:58	05:54 20:52 (17)
30	08:15 17:45	17:14 (28) 17:18 (28)	07:31 20:11	06:34 19:02 (6)	06:57 (202) 05:57	05:55 20:53 (17)
31	08:14 17:47	17:12 (28) 17:20 (28)	07:29 20:12	06:32 19:00 (6)	07:03 (202) 05:56	05:55 20:53 (17)
Potential sun hours	279	287	368	407	466	475
Total, worst case	12	255	354	629	195	692
Sun reduction	0.55	0.50	0.63	0.59	0.68	0.71
Oper. time red.	0.97	0.97	0.97	0.97	0.97	0.97
Wind dir. red.	0.57	0.57	0.67	0.66	0.65	0.74
Total reduction	0.30	0.27	0.41	0.38	0.43	0.51
Total, real	4	70	145	236	83	352

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) Shadow receptor: SR005 - SR005

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	July	August	September	October	November	December
1	05:55 21:46	20:53 (17) 21:16 (17)	06:25 21:21	07:05 20:29	19:04 (6) 19:25 (6)	07:44 17:31
2	05:56 21:45	20:53 (17) 21:17 (17)	06:26 21:20	07:06 20:28	19:01 (6) 19:26 (6)	07:46 17:30
3	05:56 21:45	20:53 (17) 21:16 (17)	06:28 21:19	07:08 20:26	18:59 (6) 19:27 (6)	07:47 17:28
4	05:57 21:45	20:54 (17) 21:16 (17)	06:29 21:17	07:09 20:24	18:59 (6) 19:28 (6)	07:49 17:27
5	05:58 21:45	20:54 (17) 21:16 (17)	06:30 21:16	07:10 20:22	18:57 (6) 19:29 (6)	07:50 17:26
6	05:58 21:44	20:54 (17) 21:15 (17)	06:31 21:14	07:12 20:20	18:56 (6) 19:29 (6)	07:51 17:24
7	05:59 21:44	20:55 (17) 21:15 (17)	06:33 21:13	07:13 20:18	18:54 (6) 19:29 (6)	07:53 17:23
8	06:00 21:43	20:56 (17) 21:15 (17)	06:34 21:11	07:14 20:16	18:54 (6) 19:29 (6)	07:54 17:21
9	06:01 21:43	20:56 (17) 21:14 (17)	06:35 21:10	07:15 20:14	18:53 (6) 19:29 (6)	07:55 17:20
10	06:01 21:42	20:56 (17) 21:13 (17)	06:36 21:08	07:17 20:12	18:53 (6) 19:29 (6)	07:57 17:19
11	06:02 21:42	20:57 (17) 21:13 (17)	06:38 21:07	07:18 20:10	18:52 (6) 19:28 (6)	07:58 17:17
12	06:03 21:41	20:57 (17) 21:12 (17)	06:39 21:05	07:19 20:08	18:52 (6) 19:28 (6)	08:00 17:16
13	06:04 21:41	20:58 (17) 21:12 (17)	06:40 21:04	07:21 20:06	18:52 (6) 19:27 (6)	08:01 17:15
14	06:05 21:40	20:59 (17) 21:11 (17)	06:42 21:02	07:22 20:04	18:52 (6) 19:26 (6)	08:02 17:14
15	06:06 21:39	21:00 (17) 21:11 (17)	06:43 21:00	07:23 20:02	18:53 (6) 19:26 (6)	08:04 17:13
16	06:07 21:38	21:02 (17) 21:10 (17)	06:44 20:59	07:25 20:00	18:53 (6) 19:25 (6)	08:05 17:12
17	06:08 21:38	21:03 (17) 21:10 (17)	06:45 20:57	07:26 19:58	18:53 (6) 19:25 (20)	08:07 17:11
18	06:09 21:37	21:06 (17) 21:09 (17)	06:47 20:55	07:27 19:56	18:53 (6) 19:26 (20)	08:08 17:10
19	06:10 21:36	21:08 (17) 20:53	06:48 20:53	07:29 19:54	18:55 (6) 19:27 (20)	08:09 17:09
20	06:11 21:35	21:09 (17) 20:52	06:49 20:52	07:30 19:52	18:56 (6) 19:26 (20)	08:11 17:08
21	06:12 21:34	21:10 (17) 20:50	06:51 20:50	07:31 19:50	18:58 (6) 19:24 (20)	08:12 17:07
22	06:13 21:33	21:11 (17) 20:48	06:52 20:48	07:32 19:48	19:03 (6) 19:22 (20)	08:14 17:06
23	06:14 21:32	21:12 (17) 20:46	06:53 20:46	07:34 19:46	19:09 (20) 19:20 (20)	08:15 17:05
24	06:16 21:31	21:13 (17) 20:44	06:55 20:44	07:35 19:44	19:09 (20) 19:17 (20)	08:17 17:04
25	06:17 21:30	21:14 (17) 20:43	06:56 20:43	07:36 19:42	19:10 (20) 19:15 (20)	08:18 17:03
26	06:18 21:29	21:15 (17) 20:41	06:57 20:41	07:38 19:40	19:13 (20) 19:14 (20)	08:20 18:41
27	06:19 21:28	21:16 (17) 20:39	06:58 20:39	07:39 19:38	08:21 18:39	17:44 (28) 17:52 (28)
28	06:20 21:26	21:17 (17) 20:37	07:00 20:37	07:40 19:36	08:22 18:38	17:42 (28) 17:55 (28)
29	06:21 21:25	21:18 (17) 20:35	07:01 20:35	07:42 19:34	08:24 18:36	17:41 (28) 17:57 (28)
30	06:23 21:24	21:19 (17) 20:33	07:02 20:33	07:43 19:32	08:25 18:35	17:39 (28) 17:57 (28)
31	06:24 21:23	21:20 (17) 20:31	07:04 19:31	19:30 (6) 19:23 (6)	18:35 18:33	17:39 (28) 17:58 (28)
Potential sun hours	480	441	378	338	282	266
Total, worst case	295	424	714	74	189	
Sun reduction	0.75	0.73	0.69	0.52	0.43	
Oper. time red.	0.97	0.97	0.97	0.97	0.97	
Wind dir. red.	0.74	0.62	0.68	0.57	0.57	
Total reduction	0.54	0.44	0.45	0.29	0.24	
Total, real	160	186	321	21	44	

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June								
1	08:32	08:12	07:28	17:42 (2)	07:27	07:48 (203)	06:32	05:56	06:31 (204)					
	17:08	17:48	18:30	16	17:58 (2)	20:14	16	08:04 (203)	20:55	21:32	15	06:46 (204)		
2	08:32	08:11	07:26	17:43 (2)	07:25	07:46 (203)	06:30	05:55	06:32 (204)					
	17:09	17:50	18:31	13	17:56 (2)	20:15	18	08:04 (203)	20:56	21:33	14	06:46 (204)		
3	08:32	08:10	07:24	17:45 (2)	07:23	07:44 (203)	06:29	05:55	06:33 (204)					
	17:10	17:52	18:33	11	17:56 (2)	20:16	20	08:04 (203)	20:58	21:34	13	06:46 (204)		
4	08:32	08:08	17:18 (30)	07:22	17:47 (2)	07:21	07:42 (203)	06:27	05:54	06:33 (204)				
	17:11	17:53	8	17:26 (30)	18:34	6	17:53 (2)	20:18	21	08:03 (203)	20:59	21:35	12	06:45 (204)
5	08:32	08:07	17:16 (30)	07:20	07:19	07:42 (203)	06:26	05:54	06:34 (204)					
	17:12	17:55	12	17:28 (30)	18:36	20	17:28 (30)	18:36	20	08:02 (203)	21:00	21:36	10	06:44 (204)
6	08:32	08:06	17:15 (30)	07:18	07:17	07:43 (203)	06:24	05:53	06:35 (204)					
	17:13	17:56	15	17:30 (30)	18:37	18	08:01 (203)	21:02	21:37	8	06:43 (204)			
7	08:32	08:04	17:13 (30)	07:16	07:15	07:44 (203)	06:23	05:53	06:37 (204)					
	17:14	17:58	18	17:31 (30)	18:38	15	07:59 (203)	21:03	21:38	5	06:42 (204)			
8	08:32	08:03	17:13 (30)	08:14	07:13	07:45 (203)	06:21	05:52						
	17:15	17:59	20	17:33 (30)	18:40	13	07:58 (203)	21:04	21:38					
9	08:31	08:01	17:12 (30)	08:13	07:11	07:48 (203)	06:20	05:52						
	17:16	18:01	22	17:34 (30)	19:41	7	07:55 (203)	21:06	21:39					
10	08:31	08:00	17:12 (30)	08:11	07:10	06:19		05:52						
	17:17	18:01	23	17:35 (30)	19:43	21:07		21:40						
11	08:30	07:58	17:11 (30)	08:09	07:08	06:17		05:51						
	17:19	18:02	24	17:35 (30)	19:44	21:08		21:40						
12	08:30	07:57	17:11 (30)	08:07	07:06	06:16		05:51						
	17:20	18:04	23	17:34 (30)	19:46	21:09	2	06:40 (204)	21:41					
13	08:30	07:55	17:12 (30)	08:05	07:04	06:15		05:51						
	17:21	18:05	23	17:35 (30)	19:47	21:11	5	06:43 (204)	21:42					
14	08:29	07:54	17:12 (30)	08:03	07:02	06:13		05:51						
	17:22	18:07	22	17:34 (30)	19:48	21:12	7	06:43 (204)	21:42					
15	08:28	07:52	17:12 (30)	08:01	07:00	06:12		05:51						
	17:24	18:09	22	17:34 (30)	19:50	21:13	9	06:44 (204)	21:43					
16	08:28	07:51	17:13 (30)	07:59	06:58	06:11		05:51						
	17:25	18:10	21	17:34 (30)	19:51	21:15	11	06:45 (204)	21:43					
17	08:27	07:49	17:13 (30)	07:57	06:56	06:10		05:51						
	17:26	18:12	20	17:33 (30)	19:53	21:16	13	06:46 (204)	21:44					
18	08:26	07:47	17:14 (30)	07:55	06:55	06:08		05:51						
	17:28	18:13	17	17:31 (30)	19:54	21:17	15	06:47 (204)	21:44					
19	08:26	07:46	17:17 (30)	07:53	06:53	06:07		05:51						
	17:29	18:15	13	17:30 (30)	19:56	21:18	16	06:47 (204)	21:44					
20	08:25	07:44	17:19 (30)	07:51	06:51	06:06		05:51						
	17:31	18:16	8	17:27 (30)	19:57	21:19	17	06:47 (204)	21:45					
21	08:24	07:42	07:49	06:49	06:05	06:29 (204)		05:51						
	17:32	18:18	19:58	20:41	21:21	19	06:48 (204)	21:45						
22	08:23	07:40	17:48 (2)	07:47	06:47	06:04		05:51						
	17:33	18:19	6	17:54 (2)	20:00	21:22	20	06:48 (204)	21:45					
23	08:22	07:39	17:45 (2)	07:45	06:46	06:03		05:52						
	17:35	18:21	11	17:56 (2)	20:01	21:23	21	06:48 (204)	21:45					
24	08:21	07:37	17:45 (2)	07:43	06:44	06:02		05:52						
	17:36	18:22	13	17:58 (2)	20:03	21:24	20	06:47 (204)	21:45					
25	08:20	07:35	17:43 (2)	07:41	06:42	06:01		05:52						
	17:38	18:24	16	17:59 (2)	20:04	21:25	20	06:47 (204)	21:46					
26	08:19	07:33	17:43 (2)	07:39	06:40	06:00		05:53						
	17:39	18:25	16	17:59 (2)	20:05	21:26	20	06:48 (204)	21:46					
27	08:18	07:31	17:42 (2)	07:37	06:39	05:59		05:53						
	17:41	18:27	17	17:59 (2)	20:07	21:27	20	06:48 (204)	21:46					
28	08:17	07:30	17:42 (2)	07:35	07:56 (203)	06:37		05:53						
	17:42	18:28	16	17:58 (2)	20:08	5	08:01 (203)	20:51	21:46					
29	08:16		07:33	06:35	07:54 (203)	06:35		05:54						
	17:44		20:09	9	08:03 (203)	20:52		21:29	18	06:47 (204)	21:46			
30	08:15		07:31	06:34	07:52 (203)	06:34		05:57						
	17:45		20:11	11	08:03 (203)	20:53		21:30	17	06:47 (204)	21:46			
31	08:14		07:29		07:50 (203)			05:56						
	17:47		20:12	14	08:04 (203)			21:31	16	06:46 (204)				
Potential sun hours	279	287	368	407	466	475								
Total, worst case		406	85	148	304	77								
Sun reduction		0.50	0.63	0.59	0.68	0.71								
Oper. time red.		0.97	0.97	0.97	0.97	0.97								
Wind dir. red.		0.59	0.64	0.68	0.58	0.58								
Total reduction		0.28	0.39	0.39	0.39	0.40								
Total, real		116	33	58	117	31								

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
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Description:

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	July	August	September	October	November	December
1	05:55	06:25	07:05	07:44	07:28	16:41 (30)
	21:45	21:21	20:29	19:30	17:31	22 17:03 (30)
2	05:56	06:26	07:06	07:46	07:30	16:42 (30)
	21:45	21:20	20:27	19:28	17:30	21 17:03 (30)
3	05:56	06:27	07:07	07:47	07:31	16:42 (30)
	21:45	21:19	20:26	19:26	17:28	20 17:02 (30)
4	05:57	06:29	07:09	07:48	07:33	16:43 (30)
	21:45	21:17	20:24	19:24	17:27	18 17:01 (30)
5	05:58	06:44 (204)	06:30	07:10	07:34	16:45 (30)
	21:44	06:48 (204)	21:16	20:22	17:25	15 17:00 (30)
6	05:58	06:42 (204)	06:31	07:11	07:36	16:46 (30)
	21:44	06:49 (204)	21:14	20:20	17:24	12 16:58 (30)
7	05:59	06:41 (204)	06:33	07:13	07:37	16:49 (30)
	21:44	06:50 (204)	21:13	20:18	17:23	7 16:56 (30)
8	06:00	06:41 (204)	06:34	07:14	07:39	08:19
	21:43	06:51 (204)	21:11	20:16	17:21	16:58
9	06:01	06:39 (204)	06:35	07:15	07:40	08:20
	21:43	06:52 (204)	21:10	20:14	17:20	16:57
10	06:01	06:39 (204)	06:36	07:17	07:39 (203)	07:57
	21:42	06:53 (204)	21:08	20:12	18 07:57 (203)	19:12
11	06:02	06:39 (204)	06:38	07:18	07:40 (203)	07:58
	21:42	06:54 (204)	21:07	20:10	16 07:56 (203)	19:10
12	06:03	06:39 (204)	06:39	07:19	07:42 (203)	07:59
	21:41	06:54 (204)	21:05	20:08	14 07:56 (203)	19:08
13	06:04	06:38 (204)	06:40	07:21	07:43 (203)	08:01
	21:40	06:55 (204)	21:03	20:06	12 07:55 (203)	19:06
14	06:05	06:38 (204)	06:42	07:22	07:44 (203)	08:02
	21:40	06:56 (204)	21:02	20:04	9 07:53 (203)	19:04
15	06:06	06:38 (204)	06:43	07:23	07:45 (203)	08:04
	21:39	06:56 (204)	21:00	20:02	6 07:51 (203)	19:02
16	06:07	06:38 (204)	06:44	07:25	07:47 (203)	08:05
	21:38	06:57 (204)	20:58	20:00	2 07:49 (203)	19:00
17	06:08	06:38 (204)	06:45	07:26	08:06	18:15 (2)
	21:38	06:57 (204)	20:57	19:58	18:57	15 18:30 (2)
18	06:09	06:37 (204)	06:47	07:27	08:08	18:16 (2)
	21:37	06:57 (204)	20:55	19:56	18:55	13 18:29 (2)
19	06:10	06:37 (204)	06:48	07:28	08:09	18:17 (2)
	21:36	06:57 (204)	20:53	19:54	18:53	10 18:27 (2)
20	06:11	06:38 (204)	06:49	07:30	08:11	18:21 (2)
	21:35	06:58 (204)	20:52	19:52	18:51	3 18:24 (2)
21	06:12	06:38 (204)	06:51	07:31	08:12	17:07
	21:34	06:58 (204)	20:50	19:50	18:50	17:07
22	06:13	06:39 (204)	06:52	07:32	08:14	17:48 (30)
	21:33	06:58 (204)	20:48	19:48	18:48	11 17:59 (30)
23	06:14	06:40 (204)	06:53	07:34	08:15	17:46 (30)
	21:32	06:58 (204)	20:46	19:46	18:46	14 18:00 (30)
24	06:15	06:41 (204)	06:55	07:35	08:17	17:44 (30)
	21:31	06:58 (204)	20:44	19:44	18:44	18 18:02 (30)
25	06:17	06:42 (204)	06:56	07:36	08:18	17:43 (30)
	21:30	06:57 (204)	20:43	19:42	18:43	19 18:02 (30)
26	06:18	06:43 (204)	06:57	07:38	08:19	17:42 (30)
	21:29	06:57 (204)	20:41	19:40	18:41	22 18:04 (30)
27	06:19	06:44 (204)	06:58	07:39	08:21	17:41 (30)
	21:28	06:56 (204)	20:39	19:38	18:39	22 18:03 (30)
28	06:20	06:45 (204)	07:00	07:40	08:22	17:41 (30)
	21:26	06:56 (204)	20:37	19:36	18:38	23 18:04 (30)
29	06:21	06:46 (204)	07:01	07:42	08:24	17:41 (30)
	21:25	06:55 (204)	20:35	19:34	18:36	24 18:05 (30)
30	06:23	06:47 (204)	07:02	07:43	08:25	17:41 (30)
	21:24	06:53 (204)	20:33	19:32	18:35	23 18:04 (30)
31	06:24	06:49 (204)	07:04	07:44	08:27	17:41 (30)
	21:23	06:52 (204)	20:31	19:30	18:33	23 18:04 (30)
Potential sun hours	480	441	378	338	282	266
Total, worst case	382		190	341	115	
Sun reduction	0.76		0.69	0.52	0.43	
Oper. time red.	0.97		0.97	0.97	0.97	
Wind dir. red.	0.58		0.68	0.59	0.58	
Total reduction	0.43		0.45	0.30	0.24	
Total, real	164		86	102	28	

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: Minnesota Power - BISON Wind Energy Center

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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]

Table with 12 columns for months (Jan-Dec) and 10 rows of wind directions (N, NNE, NE, etc.) and a 'Sum' row. Values represent hours per month.

Main shadow calculation table with columns for months (January-December) and rows for each day of the year (1-31). Includes sun rise/set times, potential sun hours, and various reduction factors.

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

Matrix defining the layout of data for each day in each month, including sun rise/set times, minutes with flicker, and WTG causing flicker first/last time.

Project:

Minnesota Power - BISON Wind Energy Center

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

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

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:32	08:12	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:44	07:28	08:11
	17:08	17:49	18:30	20:14	20:55	21:32	21:45	21:21	20:29	19:30	17:31	17:00
2	08:32	08:11	07:26	07:25	06:31	05:55	05:56	06:26	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:27	19:28	17:30	16:59
3	08:32	08:10	07:24	07:23	06:29	05:55	05:56	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:57	21:34	21:45	21:18	20:25	19:26	17:28	16:59
4	08:32	08:08	07:22	07:21	06:27	05:54	05:57	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:45	21:17	20:24	19:24	17:27	16:59
5	08:32	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:55	18:36	20:19	21:00	21:36	21:44	21:16	20:22	19:22	17:26	16:58
6	08:32	08:06	07:18	07:17	06:24	05:53	05:58	06:31	07:12	07:51	07:36	08:16
	17:13	17:56	18:37	20:20	21:01	21:36	21:44	21:14	20:20	19:20	17:24	16:58
7	08:32	08:04	07:16	07:15	06:23	05:53	05:59	06:33	07:13	07:52	07:37	08:17
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8	08:31	08:03	08:14	07:13	06:22	05:52	06:00	06:34	07:14	07:54	07:39	08:19
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9	08:31	08:01	08:12	07:11	06:20	05:52	06:01	06:35	07:15	07:55	07:40	08:20
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14	08:29	07:54	08:03	07:02	06:13	05:51	06:05	06:42	07:22	08:02	07:47	08:24
	17:23	18:07	19:48	20:31	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58
15	08:28	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:13	21:42	21:39	21:00	20:02	19:02	17:13	16:58
16	08:28	07:50	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:43	21:38	20:58	20:00	19:01	17:12	16:58
17	08:27	07:49	07:57	06:56	06:10	05:51	06:08	06:45	07:26	08:06	07:52	08:26
	17:27	18:12	19:53	20:36	21:16	21:43	21:37	20:57	19:58	18:57	17:11	16:58
18	08:26	07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	08:08	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:36	20:55	19:56	18:55	17:10	16:59
19	08:25	07:45	07:53	06:53	06:07	05:51	06:10	06:48	07:28	08:09	07:55	08:28
	17:29	18:15	19:56	20:38	21:18	21:44	21:36	20:53	19:54	18:53	17:09	16:59
20	08:25	07:44	07:51	06:51	06:06	05:51	06:11	06:49	07:30	08:11	07:56	08:28
	17:31	18:16	19:57	20:40	21:19	21:44	21:35	20:51	19:52	18:51	17:08	16:59
21	08:24	07:42	07:49	06:49	06:05	05:51	06:12	06:51	07:31	08:12	07:57	08:29
	17:32	18:18	19:58	20:41	21:20	21:45	21:34	20:50	19:50	18:50	17:07	17:00
22	08:23	07:40	07:47	06:47	06:04	05:52	06:13	06:52	07:32	08:14	07:59	08:29
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23	08:22	07:38	07:45	06:46	06:03	05:52	06:14	06:53	07:34	08:15	08:00	08:30
	17:35	18:21	20:01	20:44	21:23	21:45	21:32	20:46	19:46	18:46	17:05	17:01
24	08:21	07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	08:16	08:02	08:30
	17:37	18:22	20:02	20:45	21:24	21:45	21:31	20:44	19:44	18:44	17:04	17:01
25	08:20	07:35	07:41	06:42	06:01	05:52	06:17	06:56	07:36	08:18	08:03	08:31
	17:38	18:24	20:04	20:47	21:25	21:45	21:30	20:42	19:42	18:43	17:03	17:02
26	08:19	07:33	07:39	06:40	06:00	05:53	06:18	06:57	07:38	08:19	08:04	08:31
	17:39	18:25	20:05	20:48	21:26	21:45	21:28	20:41	19:40	18:41	17:03	17:03
27	08:18	07:31	07:37	06:39	06:00	05:53	06:19	06:58	07:39	08:21	08:06	08:31
	17:41	18:27	20:07	20:49	21:27	21:45	21:27	20:39	19:38	18:39	17:02	17:03
28	08:17	07:29	07:35	06:37	05:59	05:54	06:20	07:00	07:40	08:22	08:07	08:32
	17:42	18:28	20:08	20:51	21:28	21:45	21:26	20:37	19:35	18:38	17:01	17:04
29	08:16		07:33	06:35	05:58	05:54	06:21	07:01	07:42	08:24	08:08	08:32
	17:44		20:09	20:52	21:29	21:45	21:25	20:35	19:33	18:36	17:01	17:05
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31	08:13		07:29		05:57		06:24	07:04		08:27		08:32
	17:47		20:12		21:31		21:22	20:31		18:33		17:07
Potential sun hours	279	288	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:
Minnesota Power - BISON Wind Energy Center
 Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:32	08:12	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:44	07:28	08:11
	17:08	17:49	18:30	20:14	20:55	21:32	21:45	21:21	20:29	19:30	17:31	17:00
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14	08:29	07:54	08:03	07:02	06:13	05:51	06:05	06:42	07:22	08:02	07:47	08:24
	17:23	18:07	19:48	20:31	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58
15	08:28	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:13	21:42	21:39	21:00	20:02	19:02	17:13	16:58
16	08:28	07:50	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:43	21:38	20:58	20:00	19:01	17:12	16:58
17	08:27	07:49	07:57	06:56	06:10	05:51	06:08	06:45	07:26	08:06	07:52	08:26
	17:27	18:12	19:53	20:36	21:16	21:43	21:37	20:57	19:58	18:57	17:11	16:58
18	08:26	07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	08:08	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:36	20:55	19:56	18:55	17:10	16:59
19	08:25	07:45	07:53	06:53	06:07	05:51	06:10	06:48	07:28	08:09	07:55	08:28
	17:29	18:15	19:56	20:38	21:18	21:44	21:36	20:53	19:54	18:53	17:09	16:59
20	08:25	07:44	07:51	06:51	06:06	05:51	06:11	06:49	07:30	08:11	07:56	08:28
	17:31	18:16	19:57	20:40	21:19	21:44	21:35	20:51	19:52	18:51	17:08	16:59
21	08:24	07:42	07:49	06:49	06:05	05:51	06:12	06:51	07:31	08:12	07:57	08:29
	17:32	18:18	19:58	20:41	21:20	21:45	21:34	20:50	19:50	18:50	17:07	17:00
22	08:23	07:40	07:47	06:47	06:04	05:52	06:13	06:52	07:32	08:14	07:59	08:29
	17:34	18:19	20:00	20:42	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:00
23	08:22	07:38	07:45	06:46	06:03	05:52	06:15	06:53	07:34	08:15	08:00	08:30
	17:35	18:21	20:01	20:44	21:23	21:45	21:32	20:46	19:46	18:46	17:05	17:01
24	08:21	07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	08:16	08:01	08:30
	17:37	18:22	20:02	20:45	21:24	21:45	21:31	20:44	19:44	18:44	17:04	17:01
25	08:20	07:35	07:41	06:42	06:01	05:52	06:17	06:56	07:36	08:18	08:03	08:31
	17:38	18:24	20:04	20:47	21:25	21:45	21:30	20:42	19:42	18:43	17:03	17:02
26	08:19	07:33	07:39	06:40	06:00	05:53	06:18	06:57	07:38	08:19	08:04	08:31
	17:40	18:25	20:05	20:48	21:26	21:45	21:28	20:41	19:40	18:41	17:03	17:03
27	08:18	07:31	07:37	06:39	06:00	05:53	06:19	06:58	07:39	08:21	08:05	08:31
	17:41	18:27	20:07	20:49	21:27	21:45	21:27	20:39	19:38	18:39	17:02	17:03
28	08:17	07:29	07:35	06:37	05:59	05:54	06:20	07:00	07:40	08:22	08:07	08:32
	17:42	18:28	20:08	20:51	21:28	21:45	21:26	20:37	19:36	18:38	17:01	17:04
29	08:16		07:33	06:35	05:58	05:54	06:21	07:01	07:42	08:24	08:08	08:32
	17:44		20:09	20:52	21:29	21:45	21:25	20:35	19:34	18:36	17:01	17:05
30	08:15		07:31	06:34	05:57	05:55	06:23	07:02	07:43	08:25	08:09	08:32
	17:46		20:11	20:53	21:30	21:45	21:24	20:33	19:32	18:35	17:00	17:06
31	08:13		07:29		05:57		06:24	07:04		08:27		08:32
	17:47		20:12		21:31		21:22	20:31		18:33		17:07
Potential sun hours	279	288	368	407	466	474	480	441	378	338	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)	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: **Minnesota Power - BISON Wind Energy Center**

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:32	16:11 (208)	08:12	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:44	08:11
	17:08	15 16:26 (208)	17:49	18:30	20:14	20:55	21:32	21:45	21:21	20:29	19:30	17:30
2	08:32	16:12 (208)	08:11	07:26	07:25	06:31	05:55	05:56	06:26	07:06	07:46	08:12
	17:09	14 16:26 (208)	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:27	19:28	17:30
3	08:32	16:12 (208)	08:10	07:24	07:23	06:29	05:55	05:56	06:28	07:08	07:47	08:13
	17:10	13 16:25 (208)	17:52	18:33	20:16	20:57	21:34	21:45	21:18	20:26	19:26	17:29
4	08:32	16:13 (208)	08:08	07:22	07:21	06:28	05:54	05:57	06:29	07:09	07:48	08:14
	17:11	12 16:25 (208)	17:53	18:34	20:18	20:59	21:35	21:45	21:17	20:24	19:24	17:27
5	08:32	16:15 (208)	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:50	08:15
	17:12	10 16:25 (208)	17:55	18:36	20:19	21:00	21:36	21:44	21:16	20:22	19:22	17:26
6	08:32	16:17 (208)	08:06	07:18	07:17	06:25	05:53	05:59	06:31	07:12	07:51	08:16
	17:13	8 16:25 (208)	17:56	18:37	20:21	21:01	21:37	21:44	21:14	20:20	19:20	17:24
7	08:32	16:18 (208)	08:04	07:16	07:15	06:23	05:53	05:59	06:33	07:13	07:53	08:18
	17:14	5 16:23 (208)	17:58	18:39	20:22	21:03	21:37	21:44	21:13	20:18	19:18	17:23
8	08:31		08:03	08:15	07:13	06:22	05:53	06:00	06:34	07:14	07:54	08:19
	17:15		17:59	18:40	20:23	21:04	21:38	21:43	21:11	20:16	19:16	17:21
9	08:31		08:01	08:13	07:12	06:20	05:52	06:01	06:35	07:15	07:55	08:20
	17:16		18:01	19:41	20:25	21:05	21:39	21:43	21:10	20:14	19:14	17:20
10	08:31		08:00	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:57	08:21
	17:18		18:01	19:43	20:26	21:07	21:40	21:42	21:08	20:12	19:12	17:19
11	08:30		07:58	08:09	07:08	06:17	05:52	06:03	06:38	07:18	07:58	08:22
	17:19		18:02	19:44	20:27	21:08	21:40	21:42	21:07	20:10	19:10	17:18
12	08:30		07:57	08:07	07:06	06:16	05:51	06:03	06:39	07:19	07:59	08:22
	17:20		18:04	19:46	20:29	21:09	21:41	21:41	21:05	20:08	19:08	17:16
13	08:29		07:55	08:05	07:04	06:15	05:51	06:04	06:40	07:21	08:01	08:23
	17:21		18:06	19:47	20:30	21:11	21:41	21:40	21:03	20:06	19:06	17:15
14	08:29		07:54	08:03	07:02	06:13	05:51	06:05	06:42	07:22	08:02	08:24
	17:23		18:07	19:49	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14
15	08:28		07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	08:25
	17:24		18:09	19:50	20:33	21:13	21:42	21:39	21:00	20:02	19:02	17:13
16	08:28		07:50	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	08:26
	17:25		18:10	19:51	20:34	21:14	21:43	21:38	20:58	20:00	19:01	17:12
17	08:27		07:49	07:57	06:56	06:10	05:51	06:08	06:46	07:26	08:06	08:26
	17:27		18:12	19:53	20:36	21:16	21:43	21:37	20:57	19:58	18:57	17:11
18	08:26		07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	08:08	08:27
	17:28		18:13	19:54	20:37	21:17	21:44	21:37	20:55	19:56	18:55	17:10
19	08:26		07:45	07:53	06:53	06:07	05:51	06:10	06:48	07:29	08:09	08:28
	17:29		18:15	19:56	20:38	21:18	21:44	21:36	20:53	19:54	18:53	17:09
20	08:25		07:44	07:51	06:51	06:06	05:51	06:11	06:49	07:30	08:11	08:28
	17:31		18:16	19:57	20:40	21:19	21:44	21:35	20:52	19:52	18:52	17:08
21	08:24		07:42	07:49	06:49	06:05	05:51	06:12	06:51	07:31	08:12	08:29
	17:32		18:18	19:58	20:41	21:20	21:45	21:34	20:50	19:50	18:50	17:07
22	08:23		07:40	07:47	06:47	06:04	05:52	06:13	06:52	07:32	08:14	08:30
	17:34		18:19	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:48	17:06
23	08:22		07:39	07:45	06:46	06:03	05:52	06:15	06:53	07:34	08:15	08:30
	17:35		18:21	20:01	20:44	21:23	21:45	21:32	20:46	19:46	18:46	17:05
24	08:21		07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	08:16	08:30
	17:37		18:22	20:03	20:45	21:24	21:45	21:31	20:44	19:44	18:45	17:04
25	08:20		07:35	07:41	06:42	06:01	05:53	06:17	06:56	07:36	08:18	08:30
	17:38		18:24	20:04	20:47	21:25	21:45	21:30	20:43	19:42	18:43	17:04
26	08:19		07:33	07:39	06:41	06:01	05:53	06:18	06:57	07:38	08:19	08:30
	17:40		18:25	20:05	20:48	21:26	21:46	21:29	20:41	19:40	18:41	17:03
27	08:18		07:31	07:37	06:39	06:00	05:53	06:19	06:59	07:39	08:21	08:30
	17:41		18:27	20:07	20:49	21:27	21:46	21:27	20:39	19:38	18:40	17:02
28	08:17		07:30	07:35	06:37	05:59	05:54	06:20	07:00	07:40	08:22	08:30
	17:43		18:28	20:08	20:51	21:28	21:46	21:26	20:37	19:36	18:38	17:02
29	08:16		07:33	06:35	05:58	05:58	05:54	06:22	07:01	07:42	08:24	08:30
	17:44		18:30	20:10	20:52	21:29	21:46	21:25	20:35	19:34	18:36	17:01
30	08:15		07:31	06:34	05:57	05:55	05:55	06:23	07:02	07:43	08:25	08:30
	17:46		18:31	20:11	20:53	21:30	21:45	21:24	20:33	19:32	18:35	17:00
31	08:14		07:29	06:32	05:55	05:57	05:57	06:24	07:04	07:44	08:27	08:30
	17:47		18:32	20:12	20:54	21:31	21:45	21:22	20:31	19:30	18:33	17:00
Potential sun hours	279	288	368	407	466	474	480	441	378	338	282	266
Total, worst case		77										418
Sun reduction		0.55										0.43
Oper. time red.		0.97										0.97
Wind dir. red.		0.53										0.53
Total reduction		0.28										0.22
Total, real		22										93

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **Shadow receptor:** SR012 - SR012

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:32	08:12	07:28	07:27	06:32	05:56	05:55	06:25	07:05	07:44	07:28	08:11
	17:08	17:49	18:30	20:14	20:55	21:32	21:45	21:21	20:29	19:30	17:32	17:00
2	08:32	08:11	07:26	07:25	06:31	05:56	05:56	06:27	07:06	07:46	07:30	08:12
	17:09	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:27	19:28	17:30	17:00
3	08:32	08:10	07:24	07:23	06:29	05:55	05:57	06:28	07:08	07:47	07:31	08:13
	17:10	17:52	18:33	20:16	20:57	21:34	21:45	21:18	20:26	19:26	17:29	16:59
4	08:32	08:08	07:22	07:21	06:28	05:54	05:57	06:29	07:09	07:48	07:33	08:14
	17:11	17:53	18:34	20:18	20:59	21:35	21:44	21:17	20:24	19:24	17:27	16:59
5	08:32	08:07	07:20	07:19	06:26	05:54	05:58	06:30	07:10	07:50	07:34	08:15
	17:12	17:55	18:36	20:19	21:00	21:36	21:44	21:16	20:22	19:22	17:26	16:59
6	08:32	08:06	07:18	07:17	06:25	05:53	05:59	06:32	07:12	07:51	07:36	08:16
	17:13	17:56	18:37	20:21	21:01	21:36	21:44	21:14	20:20	19:20	17:24	16:58
7	08:32	08:04	07:16	07:15	06:23	05:53	05:59	06:33	07:13	07:53	07:37	08:17
	17:14	17:58	18:39	20:22	21:03	21:37	21:43	21:13	20:18	19:18	17:23	16:58
8	08:31	08:03	08:14	07:14	06:22	05:53	06:00	06:34	07:14	07:54	07:39	08:18
	17:15	17:59	18:40	20:23	21:04	21:38	21:43	21:11	20:16	19:16	17:22	16:58
9	08:31	08:01	08:13	07:12	06:20	05:52	06:01	06:35	07:16	07:55	07:40	08:19
	17:16	18:01	19:41	20:25	21:05	21:39	21:43	21:10	20:14	19:14	17:20	16:58
10	08:31	08:00	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:57	07:41	08:20
	17:18	18:01	19:43	20:26	21:07	21:39	21:42	21:08	20:12	19:12	17:19	16:58
11	08:30	07:58	08:09	07:08	06:17	05:52	06:03	06:38	07:18	07:58	07:43	08:21
	17:19	18:03	19:44	20:27	21:08	21:40	21:41	21:07	20:10	19:10	17:18	16:58
12	08:30	07:57	08:07	07:06	06:16	05:52	06:04	06:39	07:19	07:59	07:44	08:22
	17:20	18:04	19:46	20:29	21:09	21:41	21:41	21:05	20:08	19:08	17:16	16:58
13	08:29	07:55	08:05	07:04	06:15	05:51	06:04	06:40	07:21	08:01	07:46	08:23
	17:21	18:06	19:47	20:30	21:11	21:41	21:40	21:03	20:06	19:06	17:15	16:58
14	08:29	07:54	08:03	07:02	06:14	05:51	06:05	06:42	07:22	08:02	07:47	08:24
	17:23	18:07	19:49	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58
15	08:28	07:52	08:01	07:00	06:12	05:51	06:06	06:43	07:23	08:04	07:49	08:25
	17:24	18:09	19:50	20:33	21:13	21:42	21:39	21:00	20:02	19:02	17:13	16:58
16	08:28	07:50	07:59	06:58	06:11	05:51	06:07	06:44	07:25	08:05	07:50	08:26
	17:25	18:10	19:51	20:34	21:14	21:43	21:38	20:58	20:00	19:01	17:12	16:58
17	08:27	07:49	07:57	06:57	06:10	05:51	06:08	06:46	07:26	08:06	07:52	08:26
	17:27	18:12	19:53	20:36	21:16	21:43	21:37	20:57	19:58	18:57	17:11	16:59
18	08:26	07:47	07:55	06:55	06:09	05:51	06:09	06:47	07:27	08:08	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:36	20:55	19:56	18:55	17:10	16:59
19	08:25	07:45	07:53	06:53	06:08	05:51	06:10	06:48	07:29	08:09	07:55	08:28
	17:30	18:15	19:56	20:38	21:18	21:44	21:36	20:53	19:54	18:53	17:09	16:59
20	08:25	07:44	07:51	06:51	06:07	05:51	06:11	06:50	07:30	08:11	07:56	08:28
	17:31	18:16	19:57	20:40	21:19	21:44	21:35	20:51	19:52	18:52	17:08	17:00
21	08:24	07:42	07:49	06:49	06:05	05:52	06:12	06:51	07:31	08:12	07:57	08:29
	17:32	18:18	19:58	20:41	21:20	21:45	21:34	20:50	19:50	18:50	17:07	17:00
22	08:23	07:40	07:47	06:48	06:04	05:52	06:14	06:52	07:32	08:14	07:59	08:29
	17:34	18:19	20:00	20:42	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:00
23	08:22	07:39	07:45	06:46	06:03	05:52	06:15	06:53	07:34	08:15	08:00	08:30
	17:35	18:21	20:01	20:44	21:23	21:45	21:32	20:46	19:46	18:46	17:05	17:01
24	08:21	07:37	07:43	06:44	06:02	05:52	06:16	06:55	07:35	08:16	08:01	08:30
	17:37	18:22	20:03	20:45	21:24	21:45	21:31	20:44	19:44	18:45	17:04	17:02
25	08:20	07:35	07:41	06:42	06:02	05:53	06:17	06:56	07:36	08:18	08:03	08:31
	17:38	18:24	20:04	20:47	21:25	21:45	21:30	20:42	19:42	18:43	17:04	17:02
26	08:19	07:33	07:39	06:41	06:01	05:53	06:18	06:57	07:38	08:19	08:04	08:31
	17:40	18:25	20:05	20:48	21:26	21:45	21:28	20:41	19:40	18:41	17:03	17:03
27	08:18	07:31	07:37	06:39	06:00	05:53	06:19	06:59	07:39	08:21	08:05	08:31
	17:41	18:27	20:07	20:49	21:27	21:45	21:27	20:39	19:38	18:40	17:02	17:04
28	08:17	07:30	07:35	06:37	05:59	05:54	06:20	07:00	07:40	08:22	08:07	08:32
	17:43	18:28	20:08	20:51	21:28	21:45	21:26	20:37	19:36	18:38	17:02	17:04
29	08:16		07:33	06:36	05:58	05:54	06:22	07:01	07:42	08:24	08:08	08:32
	17:44		20:09	20:52	21:29	21:45	21:25	20:35	19:34	18:36	17:01	17:05
30	08:15		07:31	06:34	05:57	05:55	06:23	07:03	07:43	08:25	08:09	08:32
	17:46		20:11	20:53	21:30	21:45	21:24	20:33	19:32	18:35	17:01	17:06
31	08:13		07:29		05:57		06:24	07:04		08:27		08:32
	17:47		20:12		21:31		21:22	20:31		18:33		17:07
Potential sun hours	279	288	368	407	466	474	480	441	378	338	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)	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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June
1	08:33	14:02 (215)	08:13	07:28	07:54 (8)	07:27
	17:08	42 14:44 (215)	17:49	18:30	28 08:22 (8)	20:14
2	08:33	14:03 (215)	08:11	07:26	07:53 (8)	07:25
	17:09	42 14:45 (215)	17:50	18:31	30 08:23 (8)	20:15
3	08:33	14:04 (215)	08:10	07:24	07:52 (8)	07:23
	17:10	41 14:45 (215)	17:52	18:33	31 08:23 (8)	20:17
4	08:32	14:04 (215)	08:09	07:22	07:51 (8)	07:21
	17:11	40 14:44 (215)	17:53	18:34	33 08:24 (8)	20:18
5	08:32	14:05 (215)	08:07	07:20	07:50 (8)	07:19
	17:12	39 14:44 (215)	17:55	18:36	34 08:24 (8)	20:19
6	08:32	14:06 (215)	08:06	07:19	07:49 (8)	07:18
	17:13	38 14:44 (215)	17:56	18:37	35 08:24 (8)	20:21
7	08:32	14:08 (215)	08:04	07:17	07:49 (8)	07:16
	17:14	36 14:44 (215)	17:58	18:39	35 08:24 (8)	20:22
8	08:32	14:09 (215)	08:03	08:15	08:49 (8)	07:14
	17:15	34 14:43 (215)	18:00	18:40	35 09:24 (8)	20:23
9	08:31	14:10 (215)	08:02	08:13	08:48 (8)	07:12
	17:17	33 14:43 (215)	18:00	19:42	35 09:23 (8)	20:25
10	08:31	14:11 (215)	08:00	08:11	08:48 (8)	07:10
	17:18	31 14:42 (215)	18:01	19:43	35 09:23 (8)	20:26
11	08:31	14:14 (215)	07:59	08:09	08:48 (8)	07:08
	17:19	28 14:42 (215)	18:03	19:44	34 09:22 (8)	20:28
12	08:30	14:15 (215)	07:57	08:07	08:49 (8)	07:06
	17:20	25 14:40 (215)	18:04	19:46	32 09:21 (8)	20:29
13	08:30	14:18 (215)	07:56	08:05	08:49 (8)	07:04
	17:21	22 14:40 (215)	18:06	19:47	31 09:20 (8)	20:30
14	08:29	14:20 (215)	07:54	08:03	08:50 (8)	07:02
	17:23	18 14:38 (215)	18:07	19:49	29 09:19 (8)	20:32
15	08:29	14:24 (215)	07:52	08:01	08:51 (8)	07:00
	17:24	10 14:34 (215)	18:09	19:50	26 09:17 (8)	20:33
16	08:28	07:51	07:59	07:59	08:52 (8)	06:58
	17:25	18:10	19:52	23 09:15 (8)	20:34	21:15
17	08:27	07:49	07:57	07:57	08:54 (8)	06:57
	17:27	18:12	19:53	19 09:13 (8)	20:36	21:16
18	08:27	07:47	07:55	07:55	08:56 (8)	06:55
	17:28	18:13	19:54	14 09:10 (8)	20:37	21:17
19	08:26	07:46	07:53	07:53	08:53	06:53
	17:30	18:15	19:56	20:39	21:18	21:18
20	08:25	07:44	07:51	07:51	06:51	06:07
	17:31	18:16	19:57	20:40	21:19	21:19
21	08:24	07:42	07:49	07:49	06:49	06:05
	17:32	18:18	19:59	20:41	21:21	21:21
22	08:23	07:41	07:47	07:47	06:48	06:04
	17:34	18:19	20:00	20:43	21:22	21:25
23	08:22	07:39	07:45	07:45	06:46	06:03
	17:35	18:21	20:01	20:44	21:23	21:25
24	08:21	07:37	07:43	07:43	06:44	06:03
	17:37	18:22	20:03	20:45	21:24	21:26
25	08:20	07:35	08:03 (8)	07:41	06:42	06:02
	17:38	18:24	11 08:14 (8)	20:04	20:47	21:25
26	08:19	07:33	07:59 (8)	07:39	06:41	06:01
	17:40	18:25	18 08:17 (8)	20:06	20:48	21:26
27	08:18	07:32	07:57 (8)	07:37	06:39	07:01 (16)
	17:41	18:27	22 08:19 (8)	20:07	20:50	3 07:04 (16)
28	08:17	07:30	07:55 (8)	07:35	06:37	06:59 (16)
	17:43	18:28	25 08:20 (8)	20:08	20:51	6 07:05 (16)
29	08:16	07:33	07:33	07:33	06:36	06:58 (16)
	17:44	20:10	20:10	20:52	8 07:06 (16)	21:29
30	08:15	07:31	07:31	07:31	06:34	06:56 (16)
	17:46	20:11	20:11	20:54	10 07:06 (16)	21:30
31	08:14	07:29	07:29	07:29	05:57	05:57
	17:47	20:12	20:12	21:31	466	474
Potential sun hours	279	287	368	407	466	474
Total, worst case	479	76	539	27	177	0.68
Sun reduction	0.55	0.50	0.63	0.59	0.68	0.97
Oper. time red.	0.97	0.97	0.97	0.97	0.61	0.61
Wind dir. red.	0.53	0.73	0.73	0.61	0.35	0.40
Total reduction	0.28	0.35	0.44	0.35	0.40	70
Total, real	134	27	237	9	70	

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net

Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	July	August	September	October	November	December
1	05:55 21:46	06:25 21:21	07:02 (16) 20:30	07:45 19:30	08:29 (8) 17:32	08:11 17:00
2	05:56 21:45	06:27 21:20	07:00 (16) 20:28	07:46 19:28	08:27 (8) 17:30	08:12 17:00
3	05:57 21:45	06:28 21:19	06:59 (16) 20:26	07:47 19:26	08:26 (8) 17:29	08:13 16:59
4	05:57 21:45	06:29 21:17	06:58 (16) 20:24	07:49 19:24	08:26 (8) 17:27	08:14 16:59
5	05:58 21:45	06:30 21:16	06:57 (16) 20:22	07:50 19:22	08:25 (8) 17:26	08:16 16:59
6	05:59 21:44	06:32 21:14	06:57 (16) 20:20	07:51 19:20	08:25 (8) 17:24	08:17 16:58
7	05:59 21:44	06:33 21:13	06:57 (16) 20:18	07:53 19:18	08:25 (8) 17:23	08:18 16:58
8	06:00 21:43	06:34 21:11	06:58 (16) 20:16	07:54 19:16	08:25 (8) 17:22	08:19 16:58
9	06:01 21:43	06:35 21:10	07:00 (16) 20:14	07:55 19:14	08:25 (8) 17:20	08:20 16:58
10	06:02 21:42	06:37 21:08	07:01 (16) 20:12	07:57 19:12	08:25 (8) 17:19	08:21 16:58
11	06:03 21:42	06:38 21:07	07:02 (16) 20:10	07:58 19:10	08:26 (8) 17:18	08:22 16:58
12	06:04 21:41	06:39 21:05	07:03 (16) 20:08	08:00 19:08	08:27 (8) 17:17	08:23 16:58
13	06:04 21:41	06:41 21:04	07:05 (16) 20:06	08:01 19:06	08:27 (8) 17:15	08:24 16:58
14	06:05 21:40	06:42 21:02	07:06 (16) 20:04	08:02 19:05	08:29 (8) 17:14	08:24 16:58
15	06:06 21:39	06:43 21:00	07:07 (16) 20:02	08:04 19:03	08:30 (8) 17:13	08:25 16:58
16	06:07 21:38	06:44 20:59	07:08 (16) 20:00	08:05 19:01	08:33 (8) 17:12	08:26 16:58
17	06:08 21:38	06:46 20:57	07:26 19:58	08:07 18:57	08:36 (8) 17:11	08:27 16:59
18	06:09 21:37	06:47 20:55	07:27 19:56	08:08 18:55	08:43 (8) 17:10	08:27 16:59
19	06:10 21:36	06:48 20:53	07:29 19:54	08:09 18:53	08:09 17:09	08:28 16:59
20	06:11 21:35	06:50 20:52	07:30 19:52	08:11 18:52	07:56 17:08	08:29 17:00
21	06:13 21:34	06:51 20:50	07:31 19:50	08:12 18:50	08:12 17:07	08:29 17:00
22	06:14 21:33	06:52 20:48	07:33 19:48	08:14 18:48	07:59 17:06	08:30 17:01
23	06:15 21:32	06:54 20:46	07:34 19:46	08:15 18:46	08:00 17:05	08:30 17:01
24	06:16 21:31	06:55 20:45	07:35 19:44	08:17 18:45	08:02 17:04	08:31 17:02
25	06:17 21:30	06:56 20:43	07:37 19:42	08:18 18:43	08:03 17:04	08:31 17:02
26	06:18 21:29	06:57 20:41	07:38 19:40	08:20 18:41	08:04 17:03	08:31 17:03
27	06:19 21:28	06:59 20:39	07:39 19:38	08:21 18:40	08:06 17:02	14:03 (215) 14:13 (215)
28	06:21 21:26	07:00 20:37	07:41 19:36	08:23 18:38	08:07 17:02	10 14:17 (215)
29	06:22 21:25	07:01 20:35	07:42 19:34	08:24 18:36	08:08 17:01	16 14:20 (215)
30	06:23 21:24	07:03 20:33	07:43 19:32	08:25 18:35	08:10 17:01	22 14:22 (215)
31	06:24 21:23	07:04 20:32	07:44 19:31	08:27 18:33	08:11 17:00	25 14:24 (215)
Potential sun hours	480	441	378	338	282	266
Total, worst case						
Sun reduction		0.73	0.69	0.52	0.43	0.43
Oper. time red.		0.97	0.97	0.97	0.97	0.97
Wind dir. red.		0.61	0.73	0.73	0.53	0.53
Total reduction		0.42	0.48	0.37	0.22	0.22
Total, real		87	65	180	16	287

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:

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Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
Idle start wind speed: Ctl in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:33 17:08	08:12 17:49	07:28 18:30	07:27 20:14	06:32 20:55	05:56 21:32	05:55 21:45	06:25 21:21	07:05 20:30	07:28 (22) 07:30 (22)	07:45 19:30	08:11 17:32
2	08:33 17:09	08:11 17:50	07:26 18:31	07:25 20:15	06:31 20:56	05:56 21:33	05:56 21:45	06:27 21:20	07:07 20:28	07:46 19:28	07:30 17:30	08:12 17:00
3	08:32 17:10	08:10 17:52	07:24 18:33	07:23 20:17	06:29 20:58	05:55 21:34	05:57 21:45	06:28 21:19	07:08 20:26	07:47 19:26	07:31 17:29	08:13 16:59
4	08:32 17:11	08:09 17:53	07:22 18:34	07:21 20:18	06:28 20:59	05:54 21:35	05:57 21:45	06:29 21:17	07:09 20:24	07:49 19:24	07:33 17:27	08:14 16:59
5	08:32 17:12	08:07 17:55	07:20 18:36	07:19 20:19	06:26 21:00	05:54 21:36	05:58 21:44	06:30 21:16	07:10 20:22	07:50 19:22	07:34 17:26	08:16 16:59
6	08:32 17:13	08:06 17:56	07:18 18:37	07:18 20:21	06:25 21:02	05:53 21:37	05:59 21:44	06:32 21:14	07:12 20:20	07:51 19:20	07:36 17:24	08:17 16:58
7	08:32 17:14	08:04 17:58	07:17 18:39	07:16 20:22	06:23 21:03	05:53 21:38	05:59 21:44	06:33 21:13	07:13 20:18	07:53 19:18	07:37 17:23	08:18 16:58
8	08:32 17:15	08:03 18:00	08:15 18:40	07:14 20:23	06:22 21:04	05:53 21:38	06:00 21:43	06:34 21:11	07:14 20:16	07:54 19:16	07:39 17:22	08:19 16:58
9	08:31 17:17	08:02 18:00	08:13 19:42	07:12 20:25	06:20 21:06	05:52 21:39	06:01 21:43	06:35 21:10	07:16 20:14	07:55 19:14	07:40 17:20	08:20 16:58
10	08:31 17:18	08:00 18:01	08:11 19:43	07:10 20:26	06:19 21:07	05:52 21:40	06:02 21:42	06:37 21:08	07:17 20:12	07:57 19:12	07:42 17:19	08:21 16:58
11	08:31 17:19	07:59 18:03	08:09 19:44	07:08 20:28	06:18 21:08	05:52 21:40	06:03 21:42	06:38 21:07	07:18 20:10	07:58 19:10	07:43 17:18	08:22 16:58
12	08:30 17:20	07:57 18:04	08:07 19:46	07:06 20:29	06:16 21:10	05:52 21:41	06:04 21:41	06:39 21:05	07:20 20:08	08:00 19:08	07:45 17:17	08:23 16:58
13	08:30 17:22	07:55 18:06	08:05 19:47	07:04 20:30	06:15 21:11	05:51 21:42	06:04 21:41	06:41 21:04	07:21 20:06	08:01 19:06	07:46 17:15	08:23 16:58
14	08:29 17:23	07:54 18:07	08:03 19:49	07:02 20:32	06:14 21:12	05:51 21:42	06:05 21:40	06:42 21:02	07:22 20:04	08:02 19:04	07:48 17:14	08:24 16:58
15	08:28 17:24	07:52 18:09	08:01 19:50	07:00 20:33	06:12 21:13	05:51 21:43	06:06 21:39	06:43 21:00	07:23 20:02	08:04 19:03	07:49 17:13	08:25 16:58
16	08:28 17:25	07:51 18:10	07:59 19:52	06:58 20:34	06:11 21:15	05:51 21:43	06:07 21:38	06:44 20:59	07:25 20:00	08:05 19:01	07:50 17:12	08:26 16:58
17	08:27 17:27	07:49 18:12	07:57 19:53	06:57 20:36	06:10 21:16	05:51 21:44	06:08 21:38	06:46 20:57	07:26 19:58	08:07 18:57	07:52 17:11	08:27 16:59
18	08:26 17:28	07:47 18:13	07:55 19:54	06:55 20:37	06:09 21:17	05:51 21:44	06:09 21:37	06:47 20:55	07:27 19:56	08:08 18:55	07:53 17:10	08:27 16:59
19	08:26 17:30	07:46 18:15	07:53 19:56	06:53 20:39	06:08 21:18	05:51 21:44	06:10 21:36	06:48 20:53	07:29 19:54	08:09 18:53	07:55 17:09	08:28 16:59
20	08:25 17:31	07:44 18:16	07:51 19:57	06:51 20:40	06:07 21:19	05:51 21:45	06:11 21:35	06:50 20:52	07:30 19:52	08:11 18:52	07:56 17:08	08:29 17:00
21	08:24 17:32	07:42 18:18	07:49 19:59	06:49 20:41	06:05 21:21	05:52 21:45	06:13 21:34	06:51 20:50	07:31 19:50	08:12 18:50	07:58 17:07	08:29 17:00
22	08:23 17:34	07:40 18:19	07:47 20:00	06:48 20:43	06:04 21:22	05:52 21:45	06:14 21:33	06:52 20:48	07:33 19:48	08:14 18:48	07:59 17:06	08:30 17:01
23	08:22 17:35	07:39 18:21	07:45 20:01	06:46 20:44	06:03 21:23	05:52 21:45	06:15 21:32	06:54 20:46	07:34 19:46	08:15 18:46	08:00 17:05	08:30 17:01
24	08:21 17:37	07:37 18:22	07:43 20:03	06:44 20:45	06:03 21:24	05:52 21:45	06:16 21:31	06:56 20:45	07:35 19:44	08:17 18:45	08:02 17:04	08:31 17:02
25	08:20 17:38	07:35 18:24	07:41 20:04	06:42 20:47	06:02 21:25	05:53 21:46	06:17 21:30	06:56 20:43	07:37 19:42	08:18 18:43	08:03 17:04	08:31 17:02
26	08:19 17:40	07:33 18:25	07:39 20:06	06:41 20:48	06:01 21:26	05:53 21:46	06:18 21:29	06:57 20:41	07:38 19:40	08:20 18:41	08:04 17:03	08:31 17:03
27	08:18 17:41	07:32 18:27	07:37 20:07	06:39 20:49	06:00 21:27	05:53 21:46	06:19 21:28	06:59 20:39	07:39 19:38	08:21 18:40	08:06 17:02	08:32 17:04
28	08:17 17:43	07:30 18:28	07:35 20:08	06:37 20:51	05:59 21:28	05:54 21:46	06:21 21:26	07:00 20:37	07:41 19:36	08:22 18:38	08:07 17:02	08:32 17:04
29	08:16 17:44	07:33 18:20	07:33 20:10	06:36 20:52	05:58 21:29	05:54 21:46	06:22 21:25	07:01 20:35	07:42 19:34	08:24 18:36	08:08 17:01	08:32 17:05
30	08:15 17:46	07:31 18:21	07:31 20:11	06:34 20:54	05:58 21:30	05:55 21:46	06:23 21:24	07:03 20:33	07:43 19:32	08:25 18:35	08:10 17:01	08:32 17:06
31	08:14 17:47	07:29 18:12	07:29 20:12		05:57 21:31		06:24 21:23	07:04 20:31	07:27 (22) 07:31 (22)	08:27 18:33	08:10 17:01	08:32 17:07
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266
Total, worst case				65				64	2			
Sun reduction				0.59				0.73	0.69			
Oper. time red.				0.97				0.97	0.97			
Wind dir. red.				0.64				0.64	0.64			
Total reduction				0.37				0.45	0.43			
Total, real				24				29	1			

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: **Minnesota Power - BISON Wind Energy Center**

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534

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

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:32	08:12	07:28	07:27	06:32	06:55 (22)	05:55	06:25	06:57 (22)	07:05	07:45	08:11		
	17:08	17:49	18:30	20:14	20:55	4 06:59 (22)	21:32	21:45	21:21	4 07:01 (22)	20:30	19:30	17:32	17:00
2	08:33	08:11	07:26	07:25	06:31	06:53 (22)	05:56	06:27	06:54 (22)	07:07	07:46	08:12		
	17:09	17:50	18:31	20:15	20:56	6 06:59 (22)	21:33	21:45	21:20	10 07:04 (22)	20:28	19:28	17:30	17:00
3	08:32	08:10	07:24	07:23	06:29	06:51 (22)	05:55	06:28	06:53 (22)	07:08	07:47	08:13		
	17:10	17:52	18:33	20:17	20:58	7 06:58 (22)	21:34	21:45	21:19	12 07:05 (22)	20:26	19:26	17:29	16:59
4	08:32	08:09	07:22	07:21	06:28	06:50 (22)	05:54	06:29	06:54 (22)	07:09	07:49	08:14		
	17:11	17:53	18:34	20:18	20:59	9 06:59 (22)	21:35	21:45	21:17	13 07:07 (22)	20:24	19:24	17:27	16:59
5	08:32	08:07	07:20	07:19	06:26	06:49 (22)	05:54	06:30	06:55 (22)	07:10	07:50	08:15		
	17:12	17:55	18:36	20:19	21:00	10 06:59 (22)	21:36	21:44	21:16	12 07:07 (22)	20:22	19:22	17:26	16:59
6	08:32	08:06	07:18	07:18	06:25	06:47 (22)	05:53	06:32	06:56 (22)	07:12	07:51	08:17		
	17:13	17:56	18:37	20:21	21:02	11 06:58 (22)	21:37	21:44	21:14	11 07:07 (22)	20:20	19:20	17:24	16:58
7	08:32	08:04	07:17	07:16	06:23	06:46 (22)	05:53	06:33	06:57 (22)	07:13	07:53	08:18		
	17:14	17:58	18:39	20:22	21:03	12 06:58 (22)	21:38	21:44	21:13	11 07:08 (22)	20:18	19:18	17:23	16:58
8	08:32	08:03	08:15	07:14	06:22	06:44 (22)	05:53	06:34	06:58 (22)	07:14	07:54	08:19		
	17:15	18:00	18:40	20:23	21:04	12 06:56 (22)	21:38	21:43	21:11	9 07:07 (22)	20:16	19:16	17:22	16:58
9	08:31	08:02	08:13	07:12	06:20	06:43 (22)	05:52	06:35	07:00 (22)	07:16	07:55	08:20		
	17:17	18:00	19:42	20:25	21:06	13 06:58 (22)	21:39	21:43	21:10	8 07:08 (22)	20:14	19:14	17:20	16:58
10	08:31	08:00	08:11	07:10	06:19	06:44 (22)	05:52	06:37	07:01 (22)	07:17	07:57	08:21		
	17:18	18:01	19:43	20:26	21:07	11 06:55 (22)	21:40	21:42	21:08	7 07:08 (22)	20:12	19:12	17:19	16:58
11	08:31	07:59	08:09	07:08	06:18	06:45 (22)	05:52	06:38	07:02 (22)	07:18	07:58	08:22		
	17:19	18:03	19:44	20:28	21:08	7 06:52 (22)	21:40	21:42	21:07	5 07:07 (22)	20:10	19:10	17:18	16:58
12	08:30	07:57	08:07	07:06	06:16	06:52	06:04	06:39	07:03 (22)	07:20	08:00	08:23		
	17:20	18:04	19:46	20:29	21:10	21:41	21:41	21:05	3 07:06 (22)	20:08	19:08	17:17	16:58	
13	08:30	07:55	08:05	07:04	06:15	06:51	06:04	06:41	07:05 (22)	07:21	08:01	08:23		
	17:22	18:06	19:47	20:30	21:11	21:42	21:40	21:04	2 07:06 (22)	20:06	19:06	17:15	16:58	
14	08:29	07:54	08:03	07:02	06:14	06:51	06:05	06:42	07:22	08:02	08:23	08:24		
	17:23	18:07	19:49	20:32	21:12	21:42	21:40	21:02	20:04	19:04	17:14	16:58		
15	08:28	07:52	08:01	07:00	06:12	06:51	06:06	06:43	07:23	08:04	08:24	08:25		
	17:24	18:09	19:50	20:33	21:13	21:43	21:39	21:00	20:02	19:03	17:13	16:58		
16	08:28	07:51	07:59	06:58	06:11	06:51	06:07	06:44	07:25	08:05	08:25	08:26		
	17:25	18:10	19:52	20:34	21:15	21:43	21:38	20:59	20:00	19:01	17:12	16:58		
17	08:27	07:49	07:57	06:57	06:10	06:51	06:08	06:46	07:26	08:07	08:26	08:27		
	17:27	18:12	19:53	20:36	21:16	21:44	21:38	20:57	19:58	18:57	17:11	16:59		
18	08:26	07:47	07:55	06:55	06:09	06:51	06:09	06:47	07:27	08:08	08:27	08:28		
	17:28	18:13	19:54	20:37	21:17	21:44	21:37	20:55	19:56	18:55	17:10	16:59		
19	08:26	07:46	07:53	06:53	06:08	06:51	06:10	06:48	07:29	08:09	08:28	08:29		
	17:30	18:15	19:56	20:39	21:18	21:44	21:36	20:53	19:54	18:53	17:09	16:59		
20	08:25	07:44	07:51	06:51	06:07	06:51	06:11	06:50	07:30	08:11	08:29	08:30		
	17:31	18:16	19:57	20:40	21:19	21:45	21:35	20:52	19:52	18:52	17:08	17:00		
21	08:24	07:42	07:49	06:49	06:05	06:52	06:13	06:51	07:31	08:12	08:29	08:30		
	17:32	18:18	19:59	20:41	21:21	21:45	21:34	20:50	19:50	18:50	17:07	17:00		
22	08:23	07:40	07:47	06:48	06:04	06:52	06:14	06:52	07:33	08:14	08:30	08:31		
	17:34	18:19	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:48	17:06	17:01		
23	08:22	07:39	07:45	06:46	06:03	06:52	06:15	06:54	07:34	08:15	08:30	08:31		
	17:35	18:21	20:01	20:44	21:23	21:45	21:32	20:46	19:46	18:46	17:05	17:01		
24	08:21	07:37	07:43	06:44	06:03	06:52	06:16	06:55	07:35	08:17	08:32	08:33		
	17:37	18:22	20:03	20:45	21:24	21:45	21:31	20:45	19:44	18:45	17:04	17:02		
25	08:20	07:35	07:41	06:42	06:02	06:53	06:17	06:56	07:37	08:18	08:33	08:34		
	17:38	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	18:43	17:04	17:02		
26	08:19	07:33	07:39	06:41	06:01	06:53	06:18	06:57	07:38	08:20	08:34	08:35		
	17:40	18:25	20:06	20:48	21:26	21:46	21:29	20:41	19:40	18:41	17:03	17:03		
27	08:18	07:32	07:37	06:39	06:00	06:53	06:19	06:59	07:39	08:21	08:36	08:37		
	17:41	18:27	20:07	20:49	21:27	21:46	21:28	20:39	19:38	18:40	17:02	17:04		
28	08:17	07:30	07:35	06:37	05:59	06:54	06:21	07:00	07:41	08:22	08:37	08:38		
	17:43	18:28	20:08	20:51	21:28	21:46	21:26	20:37	19:36	18:38	17:02	17:04		
29	08:16	07:33	07:36	06:36	05:58	06:54	06:22	07:01	07:42	08:24	08:39	08:40		
	17:44	18:30	20:10	20:52	21:29	21:46	21:25	20:35	19:34	18:36	17:01	17:05		
30	08:15	07:31	07:34	06:35	05:56 (22)	06:55	06:23	07:03	07:43	08:25	08:40	08:41		
	17:46	18:32	20:12	20:54	2 06:58 (22)	21:30	21:24	20:33	19:32	18:35	17:01	17:06		
31	08:14	07:29	07:32	06:34	05:57	06:54	06:24	07:04	07:44	08:27	08:42	08:43		
	17:47	18:33	20:13	20:55	21:31	21:47	21:25	20:34	19:33	18:36	17:02	17:07		
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266		
Total, worst case				2	102			107						
Sun reduction				0.59	0.68			0.73						
Oper. time red.				0.97	0.97			0.97						
Wind dir. red.				0.60	0.60			0.60						
Total reduction				0.35	0.40			0.43						
Total, real				1	41			46						

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:
Minnesota Power - BISON Wind Energy Center
 Minnesota Power
 Frank Frederickson
 30 West Superior Street
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 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June			
1	08:33	09:47 (212)	08:12	08:43 (211)	07:28	07:27	06:32	05:56	
	17:08	15 10:02 (212)	17:49	22 09:05 (211)	18:30	20:14	20:55	21:32	
2	08:33	09:49 (212)	08:11	08:43 (211)	07:26	07:25	06:31	05:56	
	17:09	13 10:02 (212)	17:50	21 09:04 (211)	18:31	20:15	20:56	21:33	
3	08:32	09:50 (212)	08:10	08:44 (211)	07:24	07:23	06:29	05:55	
	17:10	11 10:01 (212)	17:52	20 09:04 (211)	18:33	20:17	20:58	21:34	
4	08:32	09:52 (212)	08:09	08:46 (211)	07:22	07:21	06:28	05:54	
	17:11	7 09:59 (212)	17:53	18 09:04 (211)	18:34	20:18	20:59	21:35	
5	08:32		08:07	08:47 (211)	07:20	07:19	06:26	05:54	
	17:12		17:55	15 09:02 (211)	18:36	20:19	21:00	21:36	
6	08:32		08:06	08:49 (211)	07:19	07:18	06:25	05:54	
	17:13		17:57	12 09:01 (211)	18:37	20:21	21:02	21:37	
7	08:32		08:04	08:52 (211)	07:17	07:16	06:23	05:53	
	17:14		17:58	5 08:57 (211)	18:39	20:22	21:03	21:38	
8	08:32		08:03		08:15	07:14	06:22	05:53	
	17:15		18:00		18:40	20:23	21:04	21:38	
9	08:31		08:02		08:13	07:12	06:20	05:52	
	17:17		18:00		19:42	20:25	21:06	21:39	
10	08:31		08:00		08:11	07:10	06:19	05:52	
	17:18		18:01		19:43	20:26	21:07	21:40	
11	08:31		07:59		08:09	07:08	06:18	05:52	
	17:19		18:03		19:44	20:28	21:08	21:40	
12	08:30		07:57		08:07	19:20 (216)	07:06	06:16	05:52
	17:20		18:04		19:46	4 19:24 (216)	20:29	21:10	21:41
13	08:30		07:55		08:05	19:19 (216)	07:04	06:15	05:51
	17:22		18:06		19:47	6 19:25 (216)	20:30	21:11	21:42
14	08:29		07:54		08:03	19:18 (216)	07:02	06:14	05:51
	17:23		18:07		19:49	8 19:26 (216)	20:32	21:12	21:42
15	08:28		07:52		08:01	19:17 (216)	07:00	06:12	05:51
	17:24		18:09		19:50	11 19:28 (216)	20:33	21:13	21:43
16	08:28		07:51		07:59	19:17 (216)	06:58	06:11	05:51
	17:25		18:10		19:52	12 19:29 (216)	20:34	21:15	21:43
17	08:27	08:52 (211)	07:49		07:57	19:17 (216)	06:57	06:10	05:51
	17:27	3 08:55 (211)	18:12		19:53	14 19:31 (216)	20:36	21:16	21:44
18	08:26	08:51 (211)	07:47		07:55	19:17 (216)	06:55	06:09	05:51
	17:28	6 08:57 (211)	18:13		19:54	15 19:32 (216)	20:37	21:17	21:44
19	08:26	08:50 (211)	07:46		07:53	19:17 (216)	06:53	06:08	05:51
	17:30	8 08:58 (211)	18:15		19:56	16 19:33 (216)	20:39	21:18	21:44
20	08:25	08:49 (211)	07:44		07:51	19:18 (216)	06:51	06:07	05:51
	17:31	10 08:59 (211)	18:16		19:57	14 19:32 (216)	20:40	21:19	21:45
21	08:24	08:48 (211)	07:42		07:49	19:20 (216)	06:49	06:06	05:52
	17:32	12 09:00 (211)	18:18		19:59	10 19:30 (216)	20:41	21:21	21:45
22	08:23	08:47 (211)	07:40		07:47		06:48	06:04	05:52
	17:34	14 09:01 (211)	18:19		20:00		20:43	21:22	21:45
23	08:22	08:46 (211)	07:39		07:45		06:46	06:03	05:52
	17:35	16 09:02 (211)	18:21		20:01		20:44	21:23	21:45
24	08:21	08:45 (211)	07:37		07:43		06:44	06:03	05:52
	17:37	18 09:03 (211)	18:22		20:03		20:45	21:24	21:45
25	08:20	08:44 (211)	07:35		07:41		06:42	06:02	05:53
	17:38	20 09:04 (211)	18:24		20:04		20:47	21:25	21:46
26	08:19	08:43 (211)	07:33		07:39		06:41	06:01	05:53
	17:40	21 09:04 (211)	18:25		20:06		20:48	21:26	21:46
27	08:18	08:42 (211)	07:32		07:37		06:39	06:00	05:53
	17:41	23 09:05 (211)	18:27		20:07		20:50	21:27	21:46
28	08:17	08:42 (211)	07:30		07:35		06:37	05:59	05:54
	17:43	23 09:05 (211)	18:28		20:08		20:51	21:28	21:46
29	08:16	08:41 (211)			07:33		06:36	05:58	05:54
	17:44	24 09:05 (211)			20:10		20:52	21:29	21:46
30	08:15	08:42 (211)			07:31		06:34	05:58	05:55
	17:46	23 09:05 (211)			20:11		20:54	21:30	21:46
31	08:14	08:42 (211)			07:29			05:57	
	17:47	23 09:05 (211)			20:12			21:31	
Potential sun hours	279	287	368	407	466	474			
Total, worst case	290	113	110						
Sun reduction	0.55	0.50	0.63						
Oper. time red.	0.97	0.97	0.97						
Wind dir. red.	0.74	0.74	0.66						
Total reduction	0.40	0.36	0.41						
Total, real	115	41	45						

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net

Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	July	August	September	October	November	December
1	05:55	06:25	07:05	07:45	18:59 (216)	07:28
	21:45	21:21	20:30	19:30	5 19:04 (216)	17:32
2	05:56	06:27	07:07	07:46	19:00 (216)	07:30
	21:45	21:20	20:28	19:28	2 19:02 (216)	17:30
3	05:57	06:28	07:08	07:47		07:31
	21:45	21:19	20:26	19:26		17:29
4	05:57	06:29	07:09	07:49		07:33
	21:45	21:17	20:24	19:24		17:27
5	05:58	06:30	07:10	07:50		07:34
	21:44	21:16	20:22	19:22		17:26
6	05:59	06:32	07:12	07:51		07:36
	21:44	21:14	20:20	19:20		17:24
7	05:59	06:33	07:13	07:53		07:37
	21:44	21:13	20:18	19:18		17:23
8	06:00	06:34	07:14	07:54		07:39
	21:43	21:11	20:16	19:16		17:22
9	06:01	06:35	07:16	07:55		07:40
	21:43	21:10	20:14	19:14		17:20
10	06:02	06:37	07:17	07:57		07:42
	21:42	21:08	20:12	19:12		17:19
11	06:03	06:38	07:18	07:58		07:43
	21:42	21:07	20:10	19:10		17:18
12	06:04	06:39	07:20	08:00		07:45
	21:41	21:05	20:08	19:08		17:17
13	06:05	06:41	07:21	08:01		07:46
	21:41	21:04	20:06	19:06		17:15
14	06:05	06:42	07:22	08:02		07:48
	21:40	21:02	20:04	19:05		17:14
15	06:06	06:43	07:23	08:04		07:49
	21:39	21:00	20:02	19:03		17:13
16	06:07	06:44	07:25	08:05		07:50
	21:38	20:59	20:00	19:01		17:12
17	06:08	06:46	07:26	08:07		07:52
	21:38	20:57	19:58	18:57		17:11
18	06:09	06:47	07:27	08:08		07:53
	21:37	20:55	19:56	18:55		17:10
19	06:10	06:48	07:29	08:09		07:55
	21:36	20:53	19:54	18:53		17:09
20	06:11	06:50	07:30	08:11		07:56
	21:35	20:52	19:52	18:52		17:08
21	06:13	06:51	07:31	08:12		07:58
	21:34	20:50	19:50	18:50		17:07
22	06:14	06:52	07:33	19:06 (216)	08:14	07:59
	21:33	20:48	19:48	9 19:15 (216)	18:48	17:06
23	06:15	06:54	07:34	19:03 (216)	08:15	08:00
	21:32	20:46	19:46	13 19:16 (216)	18:46	17:05
24	06:16	06:55	07:35	19:01 (216)	08:17	08:02
	21:31	20:45	19:44	16 19:17 (216)	18:45	17:04
25	06:17	06:56	07:37	19:01 (216)	08:18	08:03
	21:30	20:43	19:42	15 19:16 (216)	18:43	17:04
26	06:18	06:57	07:38	18:59 (216)	08:20	08:04
	21:29	20:41	19:40	15 19:14 (216)	18:41	17:03
27	06:19	06:59	07:39	18:58 (216)	08:21	08:06
	21:28	20:39	19:38	13 19:11 (216)	18:40	17:02
28	06:21	07:00	07:41	18:59 (216)	08:22	08:07
	21:26	20:37	19:36	11 19:10 (216)	18:38	17:02
29	06:22	07:01	07:42	18:58 (216)	08:24	08:08
	21:25	20:35	19:34	10 19:08 (216)	18:36	17:01
30	06:23	07:03	07:43	18:58 (216)	08:25	08:10
	21:24	20:33	19:32	7 19:05 (216)	18:35	17:01
31	06:24	07:04			08:27	
	21:23	20:31			18:33	
Potential sun hours	480	441	378	338	282	267
Total, worst case			109	7	360	443
Sun reduction			0.69	0.52	0.43	0.43
Oper. time red.			0.97	0.97	0.97	0.97
Wind dir. red.			0.66	0.66	0.74	0.73
Total reduction			0.44	0.34	0.31	0.31
Total, real			48	2	112	136

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:

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Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
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 17:08	08:12 17:49	07:28 18:30	07:27 20:14	06:33 20:55	05:56 21:32	06:21 (214) 21:45	06:25 (214) 21:21	07:05 20:30	07:45 19:30	07:28 17:32	08:11 17:00
2	08:33 17:09	08:11 17:50	07:26 18:31	07:25 20:15	06:31 20:56	05:56 21:33	06:21 (214) 21:45	06:22 (214) 21:20	07:07 20:28	07:46 19:28	07:30 17:30	08:12 17:00
3	08:32 17:10	08:10 17:52	07:24 18:33	07:23 20:17	06:29 20:58	05:55 21:34	06:20 (214) 21:45	06:23 (214) 21:19	07:08 20:26	07:47 19:26	07:31 17:29	08:13 16:59
4	08:32 17:11	08:09 17:54	07:22 18:34	07:22 20:18	06:28 20:59	05:55 21:35	06:20 (214) 21:45	06:23 (214) 21:17	07:09 20:24	07:49 19:24	07:33 17:27	08:14 16:59
5	08:32 17:12	08:07 17:55	07:20 18:36	07:20 20:19	06:26 21:00	05:54 21:36	06:19 (214) 21:44	06:24 (214) 21:16	07:11 20:22	07:50 19:22	07:34 17:26	08:16 16:59
6	08:32 17:13	08:06 17:57	07:19 18:37	07:18 20:21	06:25 21:02	05:54 21:37	06:19 (214) 21:44	06:25 (214) 21:14	07:12 20:20	07:51 19:20	07:36 17:24	08:17 16:58
7	08:32 17:14	08:04 17:58	07:17 18:39	07:16 20:22	06:23 21:03	05:53 21:38	06:18 (214) 21:44	06:25 (214) 21:13	07:13 20:18	07:53 19:18	07:37 17:23	08:18 16:58
8	08:32 17:16	08:03 18:00	08:15 18:40	07:14 20:24	06:22 21:04	05:53 21:38	06:18 (214) 21:43	06:26 (214) 21:11	07:14 20:16	07:54 19:16	07:39 17:22	08:19 16:58
9	08:31 17:17	08:02 18:00	08:13 18:41	07:12 20:25	06:20 21:06	05:53 21:39	06:18 (214) 21:43	06:27 (214) 21:10	07:16 20:14	07:56 19:14	07:40 17:20	08:20 16:58
10	08:31 17:18	08:00 18:01	08:11 19:43	07:10 20:26	06:19 21:07	05:52 21:40	06:18 (214) 21:42	06:28 (214) 21:08	07:17 20:12	07:57 19:12	07:42 17:19	08:21 16:58
11	08:31 17:19	07:59 18:03	08:09 19:45	07:08 20:28	06:18 21:08	05:52 21:40	06:17 (214) 21:42	06:29 (214) 21:07	07:18 20:10	07:58 19:10	07:43 17:18	08:22 16:58
12	08:30 17:20	07:57 18:04	08:07 19:46	07:06 20:29	06:16 21:10	05:52 21:41	06:17 (214) 21:41	06:29 (214) 21:05	07:20 20:08	08:00 19:08	07:45 17:17	08:23 16:58
13	08:30 17:22	07:56 18:06	08:05 19:47	07:04 20:30	06:15 21:11	05:52 21:42	06:17 (214) 21:41	06:30 (214) 21:04	07:21 20:06	08:01 19:06	07:46 17:15	08:23 16:58
14	08:29 17:23	07:54 18:07	08:03 19:49	07:02 20:32	06:14 21:12	05:51 21:42	06:17 (214) 21:40	06:31 (214) 21:02	07:22 20:04	08:02 19:05	07:48 17:14	08:24 16:58
15	08:28 17:24	07:52 18:09	08:01 19:50	07:00 20:33	06:12 21:13	05:51 21:43	06:17 (214) 21:39	06:32 (214) 21:00	07:24 20:02	08:04 19:03	07:49 17:13	08:25 16:58
16	08:28 17:26	07:51 18:10	07:59 19:52	06:59 20:34	06:11 21:15	05:51 21:43	06:17 (214) 21:38	06:33 (214) 20:59	07:25 20:00	08:05 19:01	07:51 17:12	08:26 16:58
17	08:27 17:27	07:49 18:12	07:57 19:53	06:57 20:36	06:10 21:16	05:51 21:44	06:17 (214) 21:38	06:37 (214) 20:57	07:26 19:58	08:07 18:57	07:52 17:11	08:27 16:59
18	08:26 17:28	07:47 18:13	07:55 19:54	06:55 20:37	06:09 21:17	05:51 21:44	06:17 (214) 21:37	06:47 (214) 20:55	07:27 19:56	08:08 18:55	07:53 17:10	08:27 16:59
19	08:26 17:30	07:46 18:15	07:53 19:56	06:53 20:39	06:08 21:18	05:51 21:44	06:17 (214) 21:36	06:48 (214) 20:53	07:29 19:54	08:09 18:54	07:55 17:09	08:28 16:59
20	08:25 17:31	07:44 18:17	07:51 19:57	06:51 20:40	06:07 21:19	05:52 21:45	06:17 (214) 21:35	06:50 (214) 20:52	07:30 19:52	08:11 18:52	07:56 17:08	08:29 17:00
21	08:24 17:33	07:42 18:18	07:49 19:59	06:49 20:41	06:06 21:21	05:52 21:45	06:18 (214) 21:34	06:51 (214) 20:50	07:31 19:50	08:12 18:50	07:58 17:07	08:29 17:00
22	08:23 17:34	07:41 18:20	07:47 20:00	06:48 20:43	06:05 21:22	05:52 21:45	06:18 (214) 21:33	06:52 (214) 20:48	07:33 19:48	08:14 18:48	07:59 17:06	08:30 17:01
23	08:22 17:35	07:39 18:21	07:45 20:01	06:46 20:44	06:04 21:23	05:52 21:45	06:18 (214) 21:32	06:54 (214) 20:46	07:34 19:46	08:15 18:47	08:00 17:05	08:31 17:01
24	08:21 17:37	07:37 18:23	07:43 20:03	06:44 20:45	06:03 21:24	05:53 21:45	06:18 (214) 21:31	06:55 (214) 20:45	07:35 19:44	08:17 18:45	08:02 17:05	08:31 17:02
25	08:20 17:38	07:35 18:24	07:41 20:04	06:42 20:47	06:02 21:25	05:53 21:46	06:19 (214) 21:30	06:56 (214) 20:43	07:37 19:42	08:18 18:43	08:03 17:04	08:31 17:02
26	08:19 17:40	07:33 18:26	07:39 20:06	06:41 20:48	06:01 21:26	05:53 21:46	06:19 (214) 21:29	06:58 (214) 20:41	07:38 19:40	08:20 18:41	08:04 17:03	08:31 17:03
27	08:18 17:41	07:32 18:27	07:37 20:07	06:39 20:50	06:00 21:27	05:54 21:46	06:20 (214) 21:28	06:59 (214) 20:39	07:39 19:38	08:21 18:40	08:06 17:02	08:32 17:04
28	08:17 17:43	07:30 18:29	07:35 20:08	06:37 20:51	05:59 21:28	05:54 21:46	06:20 (214) 21:26	07:00 (214) 20:37	07:41 19:36	08:23 18:38	08:07 17:02	08:32 17:05
29	08:16 17:44	07:33 18:20	07:33 20:08	06:36 20:51	05:58 21:29	05:55 21:46	06:23 (214) 21:25	07:01 (214) 20:35	07:42 19:34	08:24 18:37	08:08 17:01	08:32 17:05
30	08:15 17:46	07:31 18:23	07:33 20:03	06:34 20:45	05:58 21:24	05:55 21:46	06:22 (214) 21:24	07:03 (214) 20:33	07:43 19:32	08:25 18:35	08:10 17:01	08:32 17:06
31	08:14 17:47	07:29 18:20	07:29 20:12	06:32 20:47	05:57 21:31	05:57 21:47	06:22 (214) 21:23	07:04 (214) 20:32	07:44 18:33	08:27 17:33	08:32 17:07	08:32 17:07
Potential sun hours	279	288	368	407	466	474	480	441	378	338	282	267
Total, worst case					0.38							
Sun reduction					0.68							
Oper. time red.					0.97							
Wind dir. red.					0.56							
Total reduction					0.37							
Total, real					14							

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **Shadow receptor:** SR018 - SR018

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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534

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

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:32 17:08	09:08 (218) 17:49	08:12 41	09:03 (218) 18:30	07:28 20:14	06:33 20:55	05:56 21:32	05:56 21:45	06:26 21:21	07:05 20:30	07:28 17:32	08:40 (218) 17:00	08:11 30	08:45 (218) 09:15 (218)
2	08:32 17:09	09:21 (218) 17:50	08:11 40	09:03 (218) 18:31	07:26 20:15	06:31 20:56	05:56 21:33	05:56 21:45	06:27 21:20	07:07 20:28	07:30 17:30	08:39 (218) 17:00	08:12 28	08:46 (218) 09:14 (218)
3	08:32 17:10	09:21 (218) 17:50	08:10 39	09:04 (218) 18:33	07:24 20:17	06:29 20:58	05:55 21:34	05:57 21:45	06:28 21:19	07:08 20:26	07:31 17:29	08:38 (218) 16:59	08:13 26	08:47 (218) 09:13 (218)
4	08:32 17:11	09:23 (218) 17:54	08:09 38	09:05 (218) 18:34	07:22 20:18	06:28 20:59	05:55 21:35	05:57 21:45	06:29 21:17	07:09 20:24	07:33 17:27	08:37 (218) 16:59	08:14 25	08:48 (218) 09:13 (218)
5	08:32 17:12	09:23 (218) 17:54	08:07 37	09:05 (218) 18:34	07:20 20:19	06:26 20:59	05:54 21:36	05:58 21:44	06:30 21:16	07:11 20:22	07:34 17:26	08:36 (218) 16:59	08:15 23	08:50 (218) 09:13 (218)
6	08:32 17:13	09:25 (218) 17:57	08:06 35	09:07 (218) 18:37	07:19 20:21	06:25 21:02	05:54 21:37	05:59 21:44	06:32 21:14	07:12 20:20	07:36 17:25	08:35 (218) 16:59	08:17 22	08:51 (218) 09:13 (218)
7	08:32 17:14	09:24 (218) 17:56	08:04 34	09:07 (218) 18:37	07:17 20:22	06:23 21:03	05:53 21:37	06:00 21:44	06:33 21:13	07:13 20:18	07:37 17:23	08:35 (218) 16:58	08:18 20	08:52 (218) 09:12 (218)
8	08:32 17:16	09:24 (218) 18:00	08:03 31	09:09 (218) 18:41	07:14 20:24	06:22 21:04	05:53 21:38	06:00 21:43	06:34 21:11	07:14 20:16	07:39 17:22	08:34 (218) 16:58	08:19 18	08:53 (218) 09:11 (218)
9	08:31 17:17	09:24 (218) 18:00	08:02 29	09:09 (218) 18:41	07:12 20:25	06:20 21:06	05:53 21:39	06:01 21:43	06:36 21:10	07:16 20:14	07:40 17:20	08:34 (218) 16:58	08:20 16	08:55 (218) 09:11 (218)
10	08:31 17:18	09:24 (218) 18:01	08:00 25	09:12 (218) 18:41	07:10 20:26	06:19 21:07	05:52 21:40	06:02 21:42	06:37 21:08	07:17 20:12	07:42 17:19	08:34 (218) 16:58	08:21 14	08:56 (218) 09:10 (218)
11	08:31 17:19	09:24 (218) 18:03	07:59 22	09:13 (218) 18:45	07:08 20:28	06:18 21:08	05:52 21:40	06:03 21:42	06:38 21:07	07:18 20:10	07:43 17:18	08:33 (218) 16:58	08:22 12	08:58 (218) 09:10 (218)
12	08:30 17:20	09:22 (218) 18:04	07:57 17	09:15 (218) 18:46	07:06 20:29	06:16 21:10	05:52 21:41	06:04 21:41	06:39 21:05	07:20 20:08	07:45 17:17	08:34 (218) 16:58	08:23 10	08:59 (218) 09:09 (218)
13	08:30 17:22	09:23 (218) 18:06	07:55 8	09:20 (218) 18:46	07:04 20:30	06:15 21:11	05:52 21:42	06:05 21:40	06:41 20:06	07:21 20:06	07:46 17:15	08:33 (218) 16:58	08:23 6	09:02 (218) 09:08 (218)
14	08:29 17:23	09:22 (218) 18:07	07:54 33	09:20 (218) 18:46	07:02 20:30	06:14 21:12	05:52 21:42	06:06 21:40	06:42 21:02	07:22 20:04	07:48 17:14	08:34 (218) 16:58	08:24 42	09:03 (218) 09:15 (218)
15	08:28 17:24	09:21 (218) 18:09	07:52 35	09:21 (218) 18:47	07:00 20:33	06:13 21:13	05:51 21:43	06:07 21:39	06:43 21:00	07:24 20:02	07:49 17:13	08:35 (218) 16:58	08:25 42	09:04 (218) 09:17 (218)
16	08:28 17:26	09:22 (218) 18:10	07:51 35	09:22 (218) 18:47	07:00 20:34	06:13 21:15	05:51 21:43	06:08 21:38	06:45 20:59	07:25 20:00	07:50 17:12	08:36 (218) 16:58	08:26 42	09:05 (218) 09:18 (218)
17	08:27 17:27	09:22 (218) 18:12	07:49 36	09:23 (218) 18:47	06:57 20:36	06:10 21:16	05:51 21:44	06:09 21:38	06:46 20:57	07:26 19:58	07:52 17:11	08:37 (218) 16:59	08:27 42	09:06 (218) 09:19 (218)
18	08:26 17:28	09:21 (218) 18:14	07:47 38	09:23 (218) 18:48	06:55 20:37	06:09 21:17	05:51 21:44	06:10 21:37	06:47 20:55	07:27 19:56	07:53 17:10	08:38 (218) 16:59	08:27 41	09:07 (218) 09:20 (218)
19	08:26 17:30	09:21 (218) 18:15	07:46 38	09:24 (218) 18:48	06:53 20:39	06:08 21:18	05:52 21:44	06:11 21:36	06:48 20:53	07:29 19:54	07:55 17:09	08:39 (218) 16:59	08:28 41	09:08 (218) 09:21 (218)
20	08:25 17:31	09:21 (218) 18:17	07:44 39	09:25 (218) 18:49	06:51 20:40	06:07 21:19	05:52 21:45	06:12 21:35	06:50 20:52	07:30 19:52	07:56 17:08	08:40 (218) 16:59	08:29 40	09:09 (218) 09:22 (218)
21	08:24 17:33	09:21 (218) 18:18	07:42 40	09:26 (218) 18:50	06:49 20:41	06:06 21:21	05:52 21:45	06:13 21:34	06:51 20:50	07:31 19:50	07:58 17:07	08:41 (218) 16:59	08:30 39	09:10 (218) 09:23 (218)
22	08:23 17:34	09:21 (218) 18:20	07:41 40	09:27 (218) 18:52	06:47 20:43	06:05 21:22	05:52 21:45	06:14 21:33	06:52 20:48	07:33 19:48	07:59 17:06	08:42 (218) 16:59	08:30 39	09:11 (218) 09:24 (218)
23	08:22 17:35	09:21 (218) 18:21	07:39 41	09:28 (218) 18:54	06:46 20:44	06:04 21:23	05:52 21:45	06:15 21:32	06:54 20:46	07:34 19:46	07:58 17:05	08:43 (218) 16:59	08:30 38	09:12 (218) 09:25 (218)
24	08:21 17:37	09:21 (218) 18:23	07:37 41	09:29 (218) 18:56	06:44 20:45	06:03 21:24	05:53 21:45	06:16 21:31	06:55 20:45	07:35 19:44	07:58 17:05	08:44 (218) 16:59	08:31 38	09:13 (218) 09:26 (218)
25	08:20 17:38	09:21 (218) 18:24	07:35 42	09:30 (218) 18:58	06:43 20:47	06:02 21:25	05:53 21:46	06:17 21:30	06:56 20:43	07:37 19:42	07:59 17:04	08:45 (218) 16:59	08:31 36	09:14 (218) 09:27 (218)
26	08:19 17:40	09:21 (218) 18:26	07:33 42	09:31 (218) 19:00	06:41 20:48	06:01 21:26	05:53 21:46	06:18 21:29	06:58 20:41	07:38 19:40	07:59 17:03	08:46 (218) 16:59	08:31 36	09:15 (218) 09:28 (218)
27	08:18 17:41	09:22 (218) 18:27	07:32 42	09:32 (218) 19:02	06:39 20:50	06:00 21:27	05:54 21:46	06:19 21:39	06:59 20:39	07:39 19:38	07:59 17:03	08:47 (218) 16:59	08:32 34	09:16 (218) 09:29 (218)
28	08:17 17:43	09:22 (218) 18:29	07:30 42	09:33 (218) 19:04	06:37 20:51	05:59 21:28	05:54 21:46	06:21 21:26	07:00 20:37	07:41 19:36	08:07 17:02	08:48 (218) 16:59	08:32 33	09:17 (218) 09:30 (218)
29	08:16 17:44	09:23 (218) 18:30	07:29 42	09:34 (218) 19:06	06:35 20:52	05:58 21:29	05:55 21:46	06:22 21:35	07:01 20:35	07:42 19:34	08:08 17:01	08:49 (218) 16:59	08:32 32	09:18 (218) 09:31 (218)
30	08:15 17:46	09:24 (218) 18:31	07:28 42	09:35 (218) 19:08	06:33 20:54	05:57 21:30	05:55 21:46	06:23 21:24	07:03 20:33	07:43 19:32	08:09 17:01	08:50 (218) 16:59	08:33 31	09:19 (218) 09:32 (218)
31	08:14 17:47	09:25 (218) 18:32	07:27 41	09:36 (218) 19:10	06:31 20:55	05:56 21:31	05:54 21:47	06:24 21:23	07:04 20:32	07:44 19:33	08:10 17:00	08:51 (218) 16:59	08:34 31	09:20 (218) 09:33 (218)
Potential sun hours	279	288	368	407	466	474	480	441	378	338	282	267	8	09:17 (218)
Total, worst case	1003	396	0.55	0.50	0.97	0.75	0.40	0.39	52	0.52	1124	263	0.43	0.43
Sun reduction	0.55	0.50	0.97	0.75	0.40	0.39	52	0.52	1124	263	0.43	0.43	0.97	0.75
Oper. time red.	0.97	0.97	0.75	0.75	0.40	0.39	52	0.52	1124	263	0.43	0.43	0.97	0.75
Wind dir. red.	0.75	0.75	0.40	0.39	52	0.52	1124	263	0.43	0.43	0.97	0.75	0.97	0.75
Total reduction	0.40	0.36	0.38	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Total, real	399	144	20	350	20	350	20	350	20	350	20	350	20	350

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)
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Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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6/21/2011 8:45 AM / 29

Licensed user:

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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 17:08	08:13 17:49	07:28 18:30	07:28 20:14	19:22 (226) 19:46 (226)	06:33 20:55	05:56 21:32	05:56 21:46	06:26 21:21	07:05 20:30	07:29 17:32	08:11 17:00
2	08:33 17:09	08:11 17:51	07:26 18:32	07:26 20:15	19:22 (226) 19:46 (226)	06:31 20:56	05:56 21:33	05:56 21:45	06:27 21:20	07:07 20:28	07:46 19:28	08:12 17:30
3	08:33 17:10	08:10 17:52	07:24 18:33	07:24 20:17	19:22 (226) 19:45 (226)	06:29 20:58	05:55 21:34	05:57 21:45	06:28 21:19	07:08 20:26	07:47 19:26	08:13 17:29
4	08:33 17:11	08:09 17:54	07:22 18:35	07:22 20:18	19:23 (226) 19:44 (226)	06:28 20:59	05:55 21:35	05:58 21:45	06:29 21:17	07:09 20:24	07:49 19:32 (226)	08:14 17:27
5	08:32 17:12	08:07 17:55	07:21 18:36	07:20 20:19	19:23 (226) 19:43 (226)	06:26 21:00	05:54 21:36	05:58 21:45	06:31 21:16	07:11 20:22	07:50 19:35 (226)	08:16 17:26
6	08:32 17:13	08:06 17:57	07:19 18:37	07:18 20:21	19:24 (226) 19:41 (226)	06:25 21:02	05:54 21:37	05:59 21:44	06:32 21:15	07:12 20:20	07:52 19:37 (226)	08:17 17:25
7	08:32 17:14	08:05 17:58	07:17 18:39	07:16 20:22	19:26 (226) 19:39 (226)	06:23 21:03	05:53 21:38	06:00 21:44	06:33 21:13	07:13 20:18	07:53 19:18 (226)	08:18 17:23
8	08:32 17:16	08:03 18:00	08:15 18:40	07:14 20:24	19:29 (226) 19:35 (226)	06:22 21:04	05:53 21:38	06:00 21:43	06:34 21:12	07:15 20:16	07:54 19:16 (226)	08:19 17:22
9	08:31 17:17	08:02 18:00	08:13 19:42	07:12 20:25	19:32 (226) 20:25	06:21 21:06	05:53 21:39	06:01 21:43	06:36 21:10	07:16 20:14	07:56 19:15 (226)	08:20 17:21
10	08:31 17:18	08:00 18:01	08:11 19:43	07:10 20:26	19:33 (226) 20:26	06:19 21:07	05:52 21:40	06:02 21:42	06:37 21:08	07:17 20:12	07:57 19:15 (226)	08:21 17:19
11	08:31 17:19	07:59 18:03	08:09 19:45	07:08 20:28	19:34 (226) 20:28	06:18 21:08	05:52 21:40	06:03 21:42	06:38 21:07	07:18 20:10	07:58 19:14 (226)	08:22 17:18
12	08:30 17:20	07:57 18:04	08:07 19:46	07:06 20:29	19:35 (226) 20:29	06:16 21:10	05:52 21:41	06:04 21:41	06:39 21:05	07:20 20:08	08:00 19:14 (226)	08:23 17:17
13	08:30 17:22	07:56 18:06	08:05 19:47	07:04 20:30	19:36 (226) 20:30	06:15 21:11	05:52 21:42	06:05 21:41	06:41 21:04	07:21 20:06	08:01 19:13 (226)	08:24 17:16
14	08:29 17:23	07:54 18:08	08:03 19:49	07:02 20:32	19:37 (226) 20:32	06:14 21:12	05:52 21:42	06:06 21:40	06:42 21:02	07:22 20:04	08:03 19:14 (226)	08:24 17:14
15	08:29 17:24	07:52 18:09	08:01 19:50	07:01 20:33	19:38 (226) 20:33	06:13 21:13	05:52 21:43	06:07 21:39	06:43 21:00	07:24 20:02	08:04 19:14 (226)	08:25 17:13
16	08:28 17:26	07:51 18:11	07:59 19:52	06:59 20:35	19:39 (226) 20:35	06:11 21:15	05:51 21:43	06:08 21:38	06:45 20:59	07:25 20:00	08:05 19:14 (226)	08:26 17:12
17	08:27 17:27	07:49 18:12	07:57 19:53	06:57 20:36	19:40 (226) 20:36	06:10 21:16	05:51 21:44	06:09 21:38	06:46 20:57	07:26 19:58	08:07 19:32 (226)	08:27 17:11
18	08:27 17:28	07:47 18:14	07:55 19:55	06:55 20:37	19:41 (226) 20:37	06:09 21:17	05:52 21:44	06:10 21:37	06:47 20:55	07:28 19:56	08:08 19:16 (226)	08:27 17:10
19	08:26 17:30	07:46 18:15	07:53 19:56	06:53 20:39	19:42 (226) 20:39	06:08 21:18	05:52 21:44	06:11 21:36	06:49 20:54	07:29 19:54	08:10 19:18 (226)	08:28 17:09
20	08:25 17:31	07:44 18:17	07:51 19:57	06:51 20:40	19:43 (226) 20:40	06:07 21:20	05:52 21:45	06:12 21:35	06:50 20:52	07:30 19:52	08:11 18:52	08:29 17:08
21	08:24 17:33	07:42 18:18	07:49 19:59	06:50 20:41	19:44 (226) 20:41	06:06 21:21	05:52 21:45	06:13 21:34	06:51 20:50	07:31 19:50	08:12 18:50	08:29 17:07
22	08:23 17:34	07:41 18:20	07:47 20:00	06:48 20:43	19:45 (226) 20:43	06:05 21:22	05:52 21:45	06:14 21:33	06:52 20:48	07:33 19:48	08:14 18:48	08:30 17:06
23	08:22 17:36	07:39 18:21	07:45 20:02	06:46 20:44	19:46 (226) 20:44	06:04 21:23	05:52 21:45	06:15 21:32	06:54 20:46	07:34 19:46	08:15 18:47	08:30 17:06
24	08:21 17:37	07:37 18:23	07:43 20:03	06:44 20:46	19:47 (226) 20:46	06:03 21:24	05:53 21:46	06:16 21:31	06:55 20:45	07:35 19:44	08:17 18:45	08:31 17:05
25	08:20 17:38	07:35 18:24	07:41 20:04	06:43 20:47	19:48 (226) 20:47	06:02 21:25	05:53 21:46	06:17 21:30	06:56 20:43	07:37 19:42	08:18 18:43	08:31 17:04
26	08:19 17:40	07:34 18:26	07:39 20:06	06:41 20:48	19:49 (226) 20:48	06:01 21:26	05:53 21:46	06:18 21:29	06:58 20:41	07:38 19:40	08:20 18:42	08:31 17:03
27	08:18 17:41	07:32 18:27	07:37 20:07	06:39 20:50	19:50 (226) 20:50	06:00 21:27	05:54 21:46	06:20 21:28	06:59 20:39	07:39 19:38	08:21 18:40	08:32 17:03
28	08:17 17:43	07:30 18:29	07:35 20:08	06:38 20:51	19:51 (226) 20:51	05:59 21:28	05:54 21:46	06:21 21:27	07:00 20:37	07:41 19:36	08:23 18:38	08:32 17:02
29	08:16 17:44	07:29 18:29	07:33 20:08	06:36 20:52	19:52 (226) 20:52	05:59 21:30	05:55 21:46	06:22 21:25	07:02 20:35	07:42 19:34	08:24 18:37	08:32 17:01
30	08:15 17:46	07:28 18:31	07:31 20:09	06:34 20:54	19:53 (226) 20:54	05:58 21:31	05:55 21:46	06:23 21:24	07:03 20:34	07:43 19:32	08:26 18:35	08:32 17:01
31	08:14 17:48	07:27 18:34	07:29 20:13	06:34 20:54	19:54 (226) 20:54	05:57 21:31	05:57 21:46	06:24 21:24	07:04 20:34	07:43 19:32	08:27 18:34	08:32 17:07
Potential sun hours	279	288	368	407	466	474	480	441	378	338	282	267
Total, worst case			152	148					304			
Sun reduction			0.63	0.59					0.69			
Oper. time red.			0.97	0.97					0.97			
Wind dir. red.			0.69	0.69					0.69			
Total reduction			0.42	0.40					0.46			
Total, real			64	59					140			

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:
Minnesota Power - BISON Wind Energy Center
 Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
	460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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 17:08	08:13 17:49	07:28 18:30	07:28 20:14	06:33 20:55	06:55 (310) 7 07:02 (310)	05:57 21:33	05:56 21:46	06:26 21:22	07:00 (310) 9 07:09 (310)	07:06 20:30	07:45 19:30	08:11 17:32
2	08:33 17:09	08:12 17:51	07:26 18:32	07:26 20:16	06:31 20:57	06:53 (310) 9 07:02 (310)	05:56 21:34	05:56 21:46	06:27 21:20	06:58 (310) 12 07:10 (310)	07:07 20:28	07:46 19:28	08:12 17:31
3	08:33 17:10	08:10 17:52	07:25 18:33	07:24 20:17	06:30 20:58	06:52 (310) 11 07:03 (310)	05:55 21:34	05:57 21:45	06:28 21:19	06:57 (310) 14 07:11 (310)	07:08 20:26	07:48 19:26	08:14 17:29
4	08:33 17:11	08:09 17:54	07:23 18:35	07:22 20:18	06:28 20:59	06:50 (310) 12 07:02 (310)	05:55 21:35	05:58 21:45	06:30 21:18	06:56 (310) 15 07:11 (310)	07:10 20:24	07:49 19:24	08:15 17:28
5	08:33 17:12	08:08 17:55	07:21 18:36	07:20 20:20	06:27 21:01	06:49 (310) 14 07:03 (310)	05:54 21:36	05:58 21:45	06:31 21:16	06:55 (310) 17 07:12 (310)	07:11 20:22	07:50 19:22	08:16 17:26
6	08:32 17:14	08:06 17:57	07:19 18:38	07:18 20:21	06:25 21:02	06:48 (310) 15 07:03 (310)	05:54 21:37	05:59 21:44	06:32 21:15	06:56 (310) 16 07:12 (310)	07:12 20:20	07:52 19:20	08:17 17:25
7	08:32 17:15	08:05 17:58	07:17 18:39	07:16 20:22	06:24 21:03	06:46 (310) 16 07:02 (310)	05:54 21:38	06:00 21:44	06:33 21:13	06:58 (310) 15 07:13 (310)	07:13 20:18	07:53 19:18	08:18 17:23
8	08:32 17:16	08:03 18:00	08:15 18:41	07:14 20:24	06:22 21:05	06:46 (310) 16 07:02 (310)	05:53 21:39	06:01 21:44	06:35 21:12	06:59 (310) 13 07:12 (310)	07:15 20:16	07:54 19:16	08:19 17:22
9	08:32 17:17	08:02 18:00	08:13 19:42	07:12 20:25	06:21 21:06	06:46 (310) 14 07:00 (310)	05:53 21:39	06:01 21:43	06:36 21:10	07:00 (310) 12 07:12 (310)	07:16 20:14	07:56 19:14	08:20 17:21
10	08:31 17:18	08:00 18:02	08:11 19:43	07:10 20:27	06:19 21:07	06:47 (310) 13 07:00 (310)	05:53 21:40	06:02 21:43	06:37 21:09	07:01 (310) 10 07:11 (310)	07:17 20:12	07:57 19:12	08:21 17:19
11	08:31 17:19	07:59 18:03	08:09 19:45	07:08 20:28	06:18 21:09	06:48 (310) 11 06:59 (310)	05:52 21:41	06:03 21:42	06:38 21:07	07:03 (310) 8 07:11 (310)	07:19 20:10	07:59 19:11	08:22 17:18
12	08:30 17:21	07:57 18:05	08:07 19:46	07:06 20:29	06:17 21:10	06:50 (310) 7 06:57 (310)	05:52 21:41	06:04 21:41	06:40 21:06	07:04 (310) 6 07:10 (310)	07:20 20:08	08:00 19:09	08:23 17:17
13	08:30 17:22	07:56 18:06	08:05 19:48	07:04 20:31	06:15 21:11	06:52 21:42	06:05 21:41	06:05 21:41	06:41 21:04	07:05 (310) 4 07:09 (310)	07:21 20:06	08:01 19:07	08:24 17:16
14	08:29 17:23	07:54 18:08	08:03 19:49	07:03 20:32	06:14 21:12	06:52 21:42	06:06 21:40	06:06 21:40	06:42 21:02	07:23 20:24	08:03 19:05	07:48 17:15	08:25 16:58
15	08:29 17:25	07:53 18:09	08:01 19:51	07:01 20:33	06:13 21:14	06:52 21:43	06:07 21:39	06:07 21:39	06:44 21:01	07:24 20:22	08:04 19:03	07:49 17:13	08:25 16:59
16	08:28 17:26	07:51 18:11	07:59 19:52	06:59 20:35	06:12 21:15	06:52 21:43	06:08 21:39	06:08 21:39	06:45 20:59	07:25 20:00	08:06 19:01	07:51 17:12	08:26 16:59
17	08:27 17:27	07:49 18:12	07:57 19:53	06:57 20:36	06:10 21:16	06:52 21:44	06:09 21:38	06:09 21:38	06:46 20:57	07:26 19:58	08:07 18:57	07:52 17:11	08:27 16:59
18	08:27 17:29	07:48 18:14	07:55 19:55	06:55 20:38	06:09 21:17	06:52 21:44	06:10 21:37	06:10 21:37	06:47 20:56	07:28 19:56	08:08 18:56	07:54 17:10	08:28 16:59
19	08:26 17:30	07:46 18:15	07:54 19:56	06:53 20:39	06:08 21:19	06:52 21:45	06:11 21:36	06:11 21:36	06:49 20:54	07:29 19:54	08:10 18:54	07:55 17:09	08:28 17:00
20	08:25 17:31	07:44 18:17	07:52 19:58	06:52 20:40	06:07 21:20	06:52 21:45	06:12 21:35	06:12 21:35	06:50 20:52	07:30 19:52	08:11 18:52	07:57 17:08	08:29 17:00
21	08:24 17:33	07:43 18:18	07:50 19:59	06:50 20:42	06:06 21:21	06:52 21:45	06:13 21:34	06:13 21:34	06:51 20:50	07:32 19:50	08:13 18:53	07:58 17:07	08:29 17:00
22	08:24 17:34	07:41 18:20	07:48 20:00	06:48 20:43	06:05 21:22	06:52 21:45	06:14 21:33	06:14 21:33	06:53 20:48	07:33 19:48	08:14 18:49	07:59 17:07	08:30 17:01
23	08:23 17:36	07:39 18:21	07:46 20:02	06:46 20:44	06:04 21:23	06:53 21:46	06:15 21:32	06:15 21:32	06:54 20:47	07:34 19:46	08:16 18:47	08:01 17:06	08:30 17:02
24	08:22 17:37	07:37 18:23	07:44 20:03	06:45 20:46	06:03 21:24	06:53 21:46	06:16 21:31	06:16 21:31	06:55 20:43	07:36 19:42	08:17 18:43	08:02 17:04	08:31 17:03
25	08:21 17:39	07:36 18:24	07:42 20:04	06:43 20:47	06:02 21:25	06:53 21:46	06:17 21:30	06:17 21:30	06:57 20:43	07:37 19:42	08:18 18:43	08:03 17:04	08:31 17:03
26	08:20 17:40	07:34 18:26	07:40 20:06	06:41 20:48	06:01 21:27	06:54 21:46	06:19 21:29	06:19 21:29	06:58 20:41	07:38 19:40	08:20 18:42	08:05 17:03	08:32 17:03
27	08:19 17:42	07:32 18:27	07:38 20:07	06:39 20:50	06:00 21:28	06:54 21:46	06:20 21:28	06:20 21:28	06:59 20:39	07:40 19:38	08:21 18:40	08:06 17:03	08:32 17:04
28	08:17 17:43	07:30 18:29	07:36 20:09	06:38 20:51	05:59 21:29	06:54 21:46	06:21 21:27	06:21 21:27	07:00 20:37	07:41 19:36	08:23 18:38	08:07 17:02	08:32 17:05
29	08:16 17:45	07:34 18:20	07:36 20:10	06:36 20:53	05:59 (310) 2 06:59 (310)	06:55 21:46	06:22 21:25	06:22 21:25	07:02 20:36	07:42 19:34	08:24 18:37	08:09 17:02	08:32 17:06
30	08:15 17:46	07:32 18:24	07:33 20:11	06:34 20:54	05:58 (310) 4 07:00 (310)	06:55 21:46	06:23 21:24	06:23 21:24	07:03 20:34	07:44 19:32	08:26 18:35	08:10 17:01	08:33 17:06
31	08:14 17:48	07:30 18:23	07:30 20:13	06:30 20:51	05:57 21:32	06:55 21:46	06:25 21:23	06:25 21:23	07:04 20:32	07:45 19:34	08:27 18:34	08:11 17:01	08:33 17:07
Potential sun hours	279	288	368	407	466	474	480	441		378	338	282	267
Total, worst case				6	145			3	151				
Sun reduction				0.59	0.68			0.76	0.73				
Oper. time red.				0.97	0.97			0.97	0.97				
Wind dir. red.				0.61	0.61			0.61	0.61				
Total reduction				0.35	0.40			0.45	0.43				
Total, real				2	58			1	65				

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)
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Project: **Minnesota Power - BISON Wind Energy Center**

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 wind@eapc.net
 Calculated: 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534

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	09:08 (222)	08:13	07:28	07:28	06:33	05:57	05:56	06:26	07:06	07:45	08:12 (223)	07:29	08:11	
2	17:08	12 09:20 (222)	17:49	18:30	20:14	20:55	21:33	21:46	21:22	20:30	19:30	17 08:29 (223)	17:32	17:01	
3	08:33	09:09 (222)	08:11	07:26	07:26	06:31	05:56	05:56	06:27	07:07	07:46	08:10 (223)	07:30	08:12	
4	17:09	11 09:20 (222)	17:51	18:32	20:16	20:57	21:34	21:46	21:20	20:28	19:28	19 08:29 (223)	17:31	17:00	
5	08:33	09:10 (222)	08:10	07:24	07:24	06:30	05:55	05:57	06:28	07:08	07:48	08:10 (223)	07:32	08:13	
6	17:10	10 09:20 (222)	17:52	18:33	20:17	20:58	21:34	21:45	21:19	20:26	19:26	20 08:30 (223)	17:29	17:00	
7	08:33	09:12 (222)	08:09	07:23	07:23	06:28	05:55	05:58	06:29	07:10	07:49	08:11 (223)	07:33	08:15	
8	17:11	8 09:20 (222)	17:54	18:35	20:18	20:59	21:35	21:45	21:18	20:24	19:24	18 08:29 (223)	17:28	16:59	
9	08:33	09:12 (222)	08:08	07:21	07:21	06:27	05:54	05:58	06:31	07:11	07:50	08:12 (223)	07:35	08:16	
10	17:12	6 09:18 (222)	17:55	18:36	20:20	21:01	21:36	21:45	21:16	20:22	19:22	17 08:29 (223)	17:26	16:59	
11	08:32	08:06	07:19	07:40	07:18	06:25	05:54	05:59	06:32	07:12	07:52	08:14 (223)	07:36	08:17	
12	17:14	17:57	18:38	12 07:52 (223)	20:21	21:02	21:37	21:44	21:15	20:20	19:20	15 08:29 (223)	17:25	16:59	
13	08:32	08:05	07:17	07:38	07:16	06:24	05:54	06:00	06:33	07:13	07:53	08:15 (223)	07:38	08:18	
14	17:15	17:58	18:39	14 07:52 (223)	20:22	21:03	21:38	21:44	21:13	20:18	19:18	13 08:28 (223)	17:23	16:59	5 09:05 (222)
15	08:32	08:03	08:15	08:36	07:14	06:22	05:53	06:01	06:35	07:15	07:54	08:17 (223)	07:39	08:19	08:59 (222)
16	17:16	18:00	18:40	16 08:52 (223)	20:24	21:05	21:39	21:44	21:12	20:16	19:16	10 08:27 (223)	17:22	16:58	8 09:07 (222)
17	08:32	08:02	08:13	08:34	07:12	06:21	05:53	06:01	06:36	07:16	07:56	08:18 (223)	07:41	08:20	08:58 (222)
18	17:17	18:00	19:42	18 08:52 (223)	20:25	21:06	21:39	21:43	21:10	20:14	19:14	8 08:26 (223)	17:21	16:58	10 09:08 (222)
19	08:31	08:00	08:11	08:32	07:10	06:19	05:53	06:02	06:37	07:17	07:57	08:19 (223)	07:42	08:21	08:58 (222)
20	17:18	18:02	19:43	19 08:51 (223)	20:27	21:07	21:40	21:43	21:09	20:12	19:12	4 08:23 (223)	17:19	16:58	11 09:09 (222)
21	08:31	07:59	08:09	08:31	07:08	06:18	05:52	06:03	06:38	07:19	07:59		07:43	08:22	08:58 (222)
22	17:19	18:03	19:45	19 08:50 (223)	20:28	21:09	21:41	21:42	21:07	20:10	19:11		17:18	16:58	12 09:10 (222)
23	08:30	07:57	08:07	08:33	07:06	06:17	05:52	06:04	06:40	07:20	08:00		07:45	08:23	08:58 (222)
24	17:21	18:05	19:46	17 08:50 (223)	20:29	21:10	21:41	21:41	21:05	20:08	19:09		17:17	16:58	13 09:11 (222)
25	08:30	07:56	08:05	08:34	07:04	06:15	05:52	06:05	06:41	07:21	08:01		07:46	08:24	08:58 (222)
26	17:22	18:06	19:48	15 08:49 (223)	20:31	21:11	21:42	21:41	21:04	20:06	19:07		17:16	16:58	14 09:12 (222)
27	08:29	07:54	08:03	08:35	07:03	06:14	05:52	06:06	06:42	07:23	08:03		07:48	08:25	08:59 (222)
28	17:23	18:08	19:49	12 08:47 (223)	20:32	21:12	21:42	21:40	21:02	20:04	19:05		17:15	16:58	14 09:13 (222)
29	08:29	07:53	08:01	08:38	07:01	06:13	05:52	06:07	06:44	07:24	08:04		07:49	08:25	08:59 (222)
30	17:25	18:09	19:50	6 08:44 (223)	20:33	21:14	21:43	21:39	21:01	20:02	19:03		17:13	16:59	15 09:14 (222)
31	08:28	07:51	07:59	06:59	06:12	05:52	06:08	06:45	07:25	08:06	08:06		07:51	08:26	08:59 (222)
32	17:26	18:11	19:52	20:35	21:15	21:43	21:39	20:59	20:00		19:01		17:12	16:59	15 09:14 (222)
33	08:27	07:49	07:57	06:57	06:10	05:52	06:09	06:46	07:26	08:07	08:07		07:52	08:27	08:59 (222)
34	17:27	18:12	19:53	20:36	21:16	21:44	21:38	20:57	20:00	19:58	18:57		17:11	16:59	16 09:15 (222)
35	08:27	07:48	07:55	06:55	06:09	05:52	06:10	06:47	07:28	08:08	08:08		07:54	08:28	09:00 (222)
36	17:29	18:14	19:55	20:38	21:17	21:44	21:37	20:55	20:00	19:56	18:56		17:10	16:59	16 09:16 (222)
37	08:26	07:46	07:53	06:53	06:08	05:52	06:11	06:49	07:29	08:10	08:10		07:55	08:28	09:00 (222)
38	17:30	18:15	19:56	20:39	21:19	21:45	21:36	20:54	20:00	19:54	18:54		17:09	17:00	16 09:16 (222)
39	08:25	07:44	07:51	06:52	06:07	05:52	06:12	06:50	07:30	08:11	08:11		07:56	08:29	09:00 (222)
40	17:31	18:17	19:58	20:40	21:20	21:45	21:35	20:52	20:00	19:52	18:52		17:08	17:00	16 09:16 (222)
41	08:24	07:43	07:50	06:50	06:06	05:52	06:13	06:51	07:32	08:13	08:13		07:58	08:29	09:01 (222)
42	17:33	18:18	19:59	20:42	21:21	21:45	21:34	20:50	20:00	19:50	18:50		17:07	17:00	16 09:17 (222)
43	08:23	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:14	08:14		07:59	08:30	09:01 (222)
44	17:34	18:20	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:48	18:48		17:07	17:01	16 09:17 (222)
45	08:23	07:39	07:46	06:46	06:04	05:53	06:15	06:54	07:34	08:15	08:16		08:01	08:30	09:01 (222)
46	17:36	18:21	20:02	20:44	21:23	21:46	21:32	20:47	19:46	18:47	18:47		17:06	17:01	16 09:17 (222)
47	08:22	07:37	07:44	06:44	06:03	05:53	06:16	06:55	07:36	08:17	08:17		08:02	08:31	09:02 (222)
48	17:37	18:23	20:03	20:46	21:24	21:46	21:31	20:45	19:44	18:45	18:45		17:05	17:02	16 09:18 (222)
49	08:21	07:35	07:42	06:43	06:02	05:53	06:17	06:57	07:37	08:18	08:18		08:03	08:31	09:03 (222)
50	17:39	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	18:43	18:43		17:04	17:03	16 09:19 (222)
51	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:38	08:20	08:20		08:05	08:32	09:03 (222)
52	17:40	18:26	20:06	20:48	21:27	21:46	21:29	20:41	19:40	18:42	18:42		17:03	17:03	16 09:19 (222)
53	08:19	07:32	07:38	06:39	06:00	05:54	06:20	06:59	07:40	08:21	08:21		08:06	08:32	09:04 (222)
54	17:42	18:27	20:07	20:50	21:28	21:46	21:28	20:39	19:38	18:40	18:40		17:03	17:04	16 09:20 (222)
55	08:17	07:30	07:36	06:38	06:59	05:54	06:21	07:00	07:41	08:23	08:23		08:07	08:32	09:05 (222)
56	17:43	18:29	20:09	20:51	21:29	21:46	21:27	20:37	19:36	18:38	18:38		17:02	17:05	15 09:20 (222)
57	08:16		07:34	06:36	06:59	05:55	06:22	07:02	07:42	08:24	08:24		08:09	08:32	09:05 (222)
58	17:45		20:10	20:53	21:30	21:46	21:25	20:36	19:34	11 08:26 (223)	18:37		17:02	17:06	15 09:20 (222)
59	08:15		07:32	06:34	06:58	05:55	06:23	07:03	07:44	08:24	08:24		08:10	08:33	09:06 (222)
60	17:46		20:11	20:54	21:31	21:46	21:24	20:34	19:32	14 08:28 (223)	18:35		17:01	17:06	14 09:20 (222)
61	08:14		07:30	06:32	06:57	05:54	06:25	07:04	07:45	08:27	08:27		08:07	08:33	09:07 (222)
62	17:48		20:13	21:32		21:23	20:32			18:34	18:34		17:07	17:07	13 09:20 (222)
Potential sun hours	279	288	368	407	466	474	480	441	378	338	282	267			
Total, worst case	47		165					25		141		350			
Sun reduction	0.55		0.63					0.69		0.52		0.43			
Oper. time red.	0.97		0.97					0.97		0.97		0.97			
Wind dir. red.	0.75		0.72					0.72		0.72		0.75			
Total reduction	0.40		0.44					0.48		0.36		0.31			
Total, real	19		72					12		51		110			

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)
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Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) Shadow receptor: SR022 - SR022

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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 17:08	08:13 17:49	07:28 18:30	07:28 20:14	06:33 20:55	05:57 21:33	06:29 (222) 07:05 (222)	05:56 21:46	06:32 (222) 07:15 (222)	07:06 20:30	07:45 19:30	07:29 17:32	08:11 17:01
2	08:33 17:09	08:11 17:51	07:26 18:32	07:26 20:15	06:31 20:57	05:56 21:33	06:29 (222) 07:06 (222)	05:56 21:45	06:32 (222) 07:15 (222)	07:07 20:28	07:46 19:28	07:30 17:31	08:12 17:00
3	08:33 17:10	08:10 17:52	07:24 18:33	07:24 20:17	06:30 20:58	05:55 21:34	06:28 (222) 07:06 (222)	05:57 21:45	06:33 (222) 07:15 (222)	07:08 20:26	07:48 19:26	07:32 17:29	08:13 17:00
4	08:33 17:11	08:09 17:54	07:23 18:35	07:22 20:18	06:28 20:59	05:55 21:35	06:28 (222) 07:07 (222)	05:58 21:45	06:33 (222) 07:15 (222)	07:10 20:24	07:49 19:24	07:33 17:28	08:15 16:59
5	08:32 17:12	08:07 17:55	07:21 18:36	07:20 20:20	06:27 21:01	05:54 21:36	06:28 (222) 07:07 (222)	05:58 21:45	06:33 (222) 07:15 (222)	07:11 20:22	07:50 19:22	07:35 17:26	08:16 16:59
6	08:32 17:14	08:06 17:57	07:19 18:38	07:18 20:21	06:25 21:02	05:54 21:37	06:28 (222) 07:08 (222)	05:59 21:44	06:34 (222) 07:15 (222)	07:12 20:20	07:52 19:20	07:36 17:25	08:17 16:59
7	08:32 17:15	08:05 17:58	07:17 18:39	07:16 20:22	06:24 21:03	05:54 21:38	06:28 (222) 07:09 (222)	06:00 21:44	06:35 (222) 07:15 (222)	07:13 20:18	07:53 19:18	07:38 17:23	08:18 16:59
8	08:32 17:16	08:03 18:00	07:15 18:40	07:14 20:24	06:22 21:05	05:53 21:38	06:27 (222) 07:09 (222)	06:01 21:43	06:35 (222) 07:14 (222)	07:15 20:16	07:54 19:16	07:39 17:22	08:19 16:58
9	08:32 17:17	08:02 18:00	07:13 18:42	07:12 20:25	06:21 21:06	05:53 21:39	06:27 (222) 07:10 (222)	06:01 21:43	06:35 (222) 07:14 (222)	07:16 20:14	07:56 19:14	07:40 17:21	08:20 16:58
10	08:31 17:18	08:00 18:02	07:11 18:43	07:10 20:26	06:19 21:07	05:53 21:40	06:27 (222) 07:10 (222)	06:02 21:43	06:36 (222) 07:14 (222)	07:17 20:12	07:57 19:12	07:42 17:19	08:21 16:58
11	08:31 17:19	07:59 18:03	07:09 18:45	07:08 20:28	06:18 21:08	05:52 21:41	06:28 (222) 07:11 (222)	06:03 21:42	06:37 (222) 07:13 (222)	07:19 20:10	07:59 19:11	07:43 17:18	08:22 16:58
12	08:30 17:21	07:57 18:05	07:07 18:46	07:06 20:29	06:17 21:10	05:52 21:41	06:28 (222) 07:12 (222)	06:04 21:41	06:38 (222) 07:13 (222)	07:20 20:08	08:00 19:09	07:45 17:17	08:23 16:58
13	08:30 17:22	07:56 18:06	07:05 18:48	07:04 20:31	06:15 21:11	05:52 21:42	06:27 (222) 07:11 (222)	06:05 21:41	06:39 (222) 07:13 (222)	07:21 20:06	08:01 19:07	07:46 17:16	08:24 16:58
14	08:29 17:23	07:54 18:08	07:03 18:49	07:03 20:32	06:14 21:12	05:52 21:42	06:27 (222) 07:12 (222)	06:06 21:40	06:40 (222) 07:15 (222)	07:23 20:04	08:03 19:05	07:48 17:15	08:25 16:58
15	08:29 17:25	07:53 18:09	07:01 18:50	07:01 20:33	06:13 21:14	05:52 21:43	06:27 (222) 07:12 (222)	06:07 21:39	06:41 (222) 07:10 (222)	07:24 20:02	08:04 19:03	07:49 17:13	08:25 16:59
16	08:28 17:26	07:51 18:11	07:00 18:52	07:00 20:35	06:12 21:15	05:52 21:43	06:27 (222) 07:12 (222)	06:08 21:39	06:42 (222) 07:10 (222)	07:25 20:00	08:05 19:01	07:51 17:12	08:26 16:59
17	08:27 17:27	07:49 18:12	06:59 18:53	06:59 20:36	06:11 21:16	05:52 21:44	06:27 (222) 07:12 (222)	06:09 21:38	06:43 (222) 07:08 (222)	07:26 19:58	08:07 18:57	07:52 17:11	08:27 16:59
18	08:27 17:29	07:48 18:14	06:58 18:55	06:58 20:37	06:10 21:17	05:52 21:44	06:27 (222) 07:13 (222)	06:10 21:37	06:44 (222) 07:07 (222)	07:28 19:56	08:08 18:56	07:54 17:10	08:28 16:59
19	08:26 17:30	07:46 18:15	06:57 18:56	06:57 20:38	06:08 21:18	05:52 21:44	06:28 (222) 07:14 (222)	06:11 21:36	06:45 (222) 07:06 (222)	07:29 19:54	08:10 18:54	07:55 17:09	08:28 17:00
20	08:25 17:31	07:44 18:17	06:56 18:57	06:56 20:40	06:07 21:20	05:52 21:45	06:29 (222) 07:14 (222)	06:12 21:35	06:46 (222) 07:03 (222)	07:30 19:52	08:11 18:52	07:56 17:08	08:29 17:00
21	08:24 17:33	07:43 18:18	06:55 18:59	06:55 20:42	06:06 21:21	05:52 21:45	06:29 (222) 07:14 (222)	06:13 21:34	06:47 (222) 07:00 (222)	07:32 19:50	08:12 18:50	07:58 17:07	08:29 17:00
22	08:23 17:34	07:41 18:20	06:54 19:00	06:54 20:43	06:05 21:22	05:52 21:45	06:29 (222) 07:14 (222)	06:14 21:33	06:48 (222) 07:00 (222)	07:33 19:48	08:14 18:49	07:59 17:07	08:30 17:01
23	08:23 17:36	07:39 18:21	06:53 19:01	06:53 20:44	06:04 21:23	05:53 21:46	06:28 (222) 07:14 (222)	06:15 21:32	06:49 (222) 07:00 (222)	07:34 19:46	08:15 18:47	08:01 17:06	08:30 17:02
24	08:22 17:37	07:37 18:23	06:52 19:02	06:52 20:46	06:03 21:24	05:53 21:46	06:29 (222) 07:15 (222)	06:16 21:31	06:50 (222) 07:00 (222)	07:36 19:44	08:17 18:45	08:02 17:05	08:31 17:02
25	08:21 17:39	07:35 18:24	06:51 19:03	06:51 20:47	06:02 21:25	05:53 21:46	06:29 (222) 07:15 (222)	06:17 21:30	06:51 (222) 07:00 (222)	07:37 19:42	08:18 18:43	08:03 17:04	08:31 17:03
26	08:20 17:40	07:34 18:26	06:50 19:04	06:50 20:48	06:01 21:26	05:54 21:46	06:29 (222) 07:16 (222)	06:19 21:29	06:52 (222) 07:00 (222)	07:38 19:40	08:20 18:42	08:05 17:03	08:32 17:03
27	08:18 17:42	07:32 18:27	06:49 19:05	06:49 20:50	06:00 21:28	05:54 21:46	06:30 (222) 07:15 (222)	06:20 21:28	06:53 (222) 07:00 (222)	07:40 19:38	08:21 18:40	08:06 17:03	08:32 17:04
28	08:17 17:43	07:30 18:29	06:48 19:06	06:48 20:51	05:59 21:29	05:54 21:46	06:30 (222) 07:15 (222)	06:21 21:27	06:54 (222) 07:00 (222)	07:41 19:36	08:23 18:38	08:07 17:02	08:32 17:05
29	08:16 17:45	07:28 18:30	06:47 19:07	06:47 20:52	05:59 21:30	05:55 21:46	06:31 (222) 07:15 (222)	06:22 21:25	06:55 (222) 07:00 (222)	07:42 19:34	08:24 18:37	08:09 17:02	08:32 17:06
30	08:15 17:46	07:26 18:31	06:46 19:08	06:46 20:53	05:58 21:31	05:55 21:46	06:31 (222) 07:15 (222)	06:23 21:24	06:56 (222) 07:00 (222)	07:44 19:32	08:26 18:35	08:10 17:01	08:32 17:06
31	08:14 17:48	07:30 18:32	06:45 19:09	06:45 20:54	05:57 21:32	05:57 21:46	06:30 (222) 07:16 (222)	06:25 21:23	06:57 (222) 07:00 (222)	07:45 19:31	08:27 18:34	08:11 17:01	08:33 17:07
Potential sun hours	279	288	368	407	466	474	480	441	378	338	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)	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)
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Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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Licensed user:

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 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	07:28	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:11
	17:09	17:49	18:30	20:14	20:55	21:32	21:46	21:22	20:30	19:30	17:32	17:01
2	08:33	08:11	07:26	07:26	06:31	05:56	05:57	06:27	07:07	07:46	07:30	08:12
	17:09	17:51	18:32	20:15	20:56	21:33	21:45	21:20	20:28	19:28	17:31	17:00
3	08:33	08:10	07:24	07:24	06:30	05:55	05:57	06:28	07:08	07:48	07:32	08:13
	17:10	17:52	18:33	20:17	20:58	21:34	21:45	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	07:33	08:15
	17:11	17:54	18:35	20:18	20:59	21:35	21:45	21:17	20:24	19:24	17:28	16:59
5	08:32	08:07	07:21	07:20	06:27	05:54	05:58	06:31	07:11	07:50	07:35	08:16
	17:13	17:55	18:36	20:20	21:01	21:36	21:45	21:16	20:22	19:22	17:26	16:59
6	08:32	08:06	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:36	08:17
	17:14	17:57	18:38	20:21	21:02	21:37	21:44	21:15	20:20	19:20	17:25	16:59
7	08:32	08:05	07:17	07:16	06:24	05:54	06:00	06:33	07:13	07:53	07:37	08:18
	17:15	17:58	18:39	20:22	21:03	21:38	21:44	21:13	20:18	19:18	17:23	16:59
8	08:32	08:03	08:15	07:14	06:22	05:53	06:01	06:35	07:15	07:54	07:39	08:19
	17:16	18:00	18:40	20:24	21:04	21:38	21:43	21:12	20:16	19:16	17:22	16:58
9	08:31	08:02	08:13	07:12	06:21	05:53	06:01	06:36	07:16	07:56	07:40	08:20
	17:17	18:00	19:42	20:25	21:06	21:39	21:43	21:10	20:14	19:14	17:21	16:58
10	08:31	08:00	08:11	07:10	06:19	05:53	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:02	19:43	20:26	21:07	21:40	21:42	21:09	20:12	19:12	17:19	16:58
11	08:31	07:59	08:09	07:08	06:18	05:52	06:03	06:38	07:19	07:58	07:43	08:22
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14	08:29	07:54	08:03	07:03	06:14	05:52	06:06	06:42	07:22	08:03	07:48	08:24
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15	08:29	07:53	08:01	07:01	06:13	05:52	06:07	06:44	07:24	08:04	07:49	08:25
	17:25	18:09	19:50	20:33	21:13	21:43	21:39	21:00	20:02	19:03	17:13	16:59
16	08:28	07:51	07:59	06:59	06:12	05:52	06:08	06:45	07:25	08:05	07:51	08:26
	17:26	18:11	19:52	20:35	21:15	21:43	21:38	20:59	20:00	19:01	17:12	16:59
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18	08:27	07:48	07:55	06:55	06:09	05:52	06:10	06:47	07:28	08:08	07:54	08:27
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19	08:26	07:46	07:53	06:53	06:08	05:52	06:11	06:49	07:29	08:10	07:55	08:28
	17:30	18:15	19:56	20:39	21:18	21:44	21:36	20:54	19:54	18:54	17:09	17:00
20	08:25	07:44	07:51	06:52	06:07	05:52	06:12	06:50	07:30	08:11	07:56	08:29
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21	08:24	07:42	07:49	06:50	06:06	05:52	06:13	06:51	07:32	08:13	07:58	08:29
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	17:36	18:21	20:02	20:44	21:23	21:45	21:32	20:47	19:46	18:47	17:06	17:02
24	08:22	07:37	07:44	06:45	06:03	05:53	06:16	06:55	07:36	08:17	08:02	08:31
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	17:40	18:26	20:06	20:48	21:26	21:46	21:29	20:41	19:40	18:42	17:03	17:03
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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

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Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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Licensed user:

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 US-GRAND FORKS, ND 58201
 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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]

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Operational time

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

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1	08:33	08:13	07:28	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:11
	17:09	17:49	18:30	20:14	20:55	21:33	21:46	21:22	20:30	19:30	17:32	17:01
2	08:33	08:11	07:26	07:26	06:31	05:56	05:57	06:27	07:07	07:46	07:30	08:12
	17:10	17:51	18:32	20:16	20:57	21:33	21:45	21:20	20:28	19:28	17:31	17:00
3	08:33	08:10	07:24	07:24	06:30	05:56	05:57	06:28	07:08	07:48	07:32	08:13
	17:11	17:52	18:33	20:17	20:58	21:34	21:45	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	07:33	08:15
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	17:14	17:57	18:38	20:21	21:02	21:37	21:44	21:15	20:20	19:20	17:25	16:59
7	08:32	08:05	07:17	07:16	06:24	05:54	06:00	06:33	07:13	07:53	07:38	08:18
	17:15	17:59	18:39	20:22	21:03	21:38	21:44	21:13	20:18	19:18	17:23	16:59
8	08:32	08:03	08:15	07:14	06:22	05:53	06:01	06:35	07:15	07:54	07:39	08:19
	17:16	18:00	18:41	20:24	21:05	21:38	21:43	21:12	20:16	19:16	17:22	16:58
9	08:32	08:02	08:13	07:12	06:21	05:53	06:02	06:36	07:16	07:56	07:40	08:20
	17:17	18:00	19:42	20:25	21:06	21:39	21:43	21:10	20:14	19:14	17:21	16:58
10	08:31	08:00	08:11	07:10	06:19	05:53	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:02	19:43	20:27	21:07	21:40	21:43	21:09	20:12	19:13	17:20	16:58
11	08:31	07:59	08:09	07:08	06:18	05:52	06:03	06:38	07:19	07:59	07:43	08:22
	17:20	18:03	19:45	20:28	21:08	21:41	21:42	21:07	20:10	19:11	17:18	16:58
12	08:30	07:57	08:07	07:06	06:17	05:52	06:04	06:40	07:20	08:00	07:45	08:23
	17:21	18:05	19:46	20:29	21:10	21:41	21:41	21:05	20:08	19:09	17:17	16:58
13	08:30	07:56	08:05	07:05	06:15	05:52	06:05	06:41	07:21	08:01	07:46	08:24
	17:22	18:06	19:48	20:31	21:11	21:42	21:41	21:04	20:06	19:07	17:16	16:58
14	08:29	07:54	08:03	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	21:12	21:42	21:40	21:02	20:04	19:05	17:15	16:58
15	08:29	07:53	08:01	07:01	06:13	05:52	06:07	06:44	07:24	08:04	07:49	08:25
	17:25	18:09	19:51	20:33	21:14	21:43	21:39	21:01	20:02	19:03	17:14	16:59
16	08:28	07:51	07:59	06:59	06:12	05:52	06:08	06:45	07:25	08:06	07:51	08:26
	17:26	18:11	19:52	20:35	21:15	21:43	21:39	20:59	20:00	19:01	17:12	16:59
17	08:27	07:49	07:57	06:57	06:10	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	21:38	20:57	19:58	18:58	17:11	16:59
18	08:27	07:48	07:55	06:55	06:09	05:52	06:10	06:47	07:28	08:08	07:54	08:28
	17:29	18:14	19:55	20:37	21:17	21:44	21:37	20:55	19:56	18:56	17:10	16:59
19	08:26	07:46	07:53	06:53	06:08	05:52	06:11	06:49	07:29	08:10	07:55	08:28
	17:30	18:15	19:56	20:39	21:18	21:44	21:36	20:54	19:54	18:54	17:09	17:00
20	08:25	07:44	07:52	06:52	06:07	05:52	06:12	06:50	07:30	08:11	07:56	08:29
	17:32	18:17	19:58	20:40	21:20	21:45	21:35	20:52	19:52	18:52	17:08	17:00
21	08:24	07:43	07:50	06:50	06:06	05:52	06:13	06:51	07:32	08:13	07:58	08:29
	17:33	18:18	19:59	20:42	21:21	21:45	21:34	20:50	19:50	18:50	17:07	17:01
22	08:23	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:14	07:59	08:30
	17:34	18:20	20:00	20:43	21:22	21:45	21:33	20:48	19:48	18:49	17:07	17:01
23	08:23	07:39	07:46	06:46	06:04	05:53	06:15	06:54	07:34	08:16	08:01	08:30
	17:36	18:21	20:02	20:44	21:23	21:46	21:32	20:47	19:46	18:47	17:06	17:02
24	08:22	07:37	07:44	06:45	06:03	05:53	06:16	06:55	07:36	08:17	08:02	08:31
	17:37	18:23	20:03	20:46	21:24	21:46	21:31	20:45	19:44	18:45	17:05	17:02
25	08:21	07:35	07:42	06:43	06:02	05:53	06:18	06:57	07:37	08:18	08:03	08:31
	17:39	18:24	20:04	20:47	21:25	21:46	21:30	20:43	19:42	18:43	17:04	17:03
26	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:38	08:20	08:05	08:32
	17:40	18:26	20:06	20:48	21:26	21:46	21:29	20:41	19:40	18:42	17:04	17:03
27	08:19	07:32	07:38	06:39	06:00	05:54	06:20	06:59	07:40	08:21	08:06	08:32
	17:42	18:27	20:07	20:50	21:28	21:46	21:28	20:39	19:38	18:40	17:03	17:04
28	08:17	07:30	07:36	06:38	06:00	05:54	06:21	07:00	07:41	08:23	08:07	08:32
	17:43	18:29	20:09	20:51	21:29	21:46	21:27	20:37	19:36	18:38	17:02	17:05
29	08:16		07:34	06:36	05:59	05:55	06:22	07:02	07:42	08:24	08:09	08:32
	17:45		20:10	20:52	21:30	21:46	21:25	20:36	19:34	18:37	17:02	17:06
30	08:15		07:32	06:34	05:58	05:55	06:23	07:03	07:44	08:26	08:10	08:32
	17:46		20:11	20:54	21:31	21:46	21:24	20:34	19:32	18:35	17:01	17:07
31	08:14		07:30		05:57		06:25	07:04		08:27		08:33
	17:48		20:13		21:32		21:23	20:32		18:34		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:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:
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6/21/2011 8:45 AM / 35
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EAPC Wind Energy
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US-GRAND FORKS, ND 58201
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wind@eapc.net
Calculated:
6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:32	08:12	07:27	07:27	06:32	05:55	05:55	06:25	07:05	07:44	07:28	08:10
	17:07	17:48	18:29	20:13	20:54	21:32	21:45	21:21	20:29	19:29	17:31	16:59
2	08:32	08:11	07:26	07:25	06:30	05:55	05:55	06:26	07:06	07:45	07:29	08:12
	17:08	17:50	18:31	20:15	20:56	21:33	21:45	21:20	20:27	19:27	17:30	16:59
3	08:32	08:09	07:24	07:23	06:29	05:54	05:56	06:27	07:07	07:47	07:31	08:13
	17:09	17:51	18:32	20:16	20:57	21:34	21:45	21:18	20:25	19:25	17:28	16:59
4	08:32	08:08	07:22	07:21	06:27	05:54	05:57	06:28	07:09	07:48	07:32	08:14
	17:10	17:53	18:34	20:17	20:59	21:35	21:44	21:17	20:23	19:23	17:27	16:58
5	08:32	08:07	07:20	07:19	06:26	05:53	05:57	06:30	07:10	07:49	07:34	08:15
	17:11	17:54	18:35	20:19	21:00	21:36	21:44	21:15	20:21	19:21	17:25	16:58
6	08:32	08:05	07:18	07:17	06:24	05:53	05:58	06:31	07:11	07:51	07:35	08:16
	17:12	17:56	18:37	20:20	21:01	21:36	21:44	21:14	20:19	19:19	17:24	16:58
7	08:31	08:04	07:16	07:15	06:23	05:52	05:59	06:32	07:12	07:52	07:37	08:17
	17:14	17:57	18:38	20:22	21:03	21:37	21:43	21:12	20:17	19:17	17:22	16:57
8	08:31	08:03	07:14	07:13	06:21	05:52	06:00	06:33	07:14	07:54	07:38	08:18
	17:15	17:59	18:40	20:23	21:04	21:38	21:43	21:11	20:15	19:15	17:21	16:57
9	08:31	08:01	08:12	07:11	06:20	05:52	06:00	06:35	07:15	07:55	07:40	08:19
	17:16	18:01	19:41	20:24	21:05	21:39	21:42	21:09	20:13	19:13	17:20	16:57
10	08:31	08:00	08:10	07:09	06:18	05:51	06:01	06:36	07:16	07:56	07:41	08:20
	17:17	18:01	19:42	20:26	21:06	21:39	21:42	21:08	20:11	19:12	17:18	16:57
11	08:30	07:58	08:08	07:07	06:17	05:51	06:02	06:37	07:18	07:58	07:43	08:21
	17:18	18:02	19:44	20:27	21:08	21:40	21:41	21:06	20:09	19:10	17:17	16:57
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	17:20	18:04	19:45	20:28	21:09	21:41	21:41	21:05	20:07	19:08	17:16	16:57
13	08:29	07:55	08:04	07:03	06:14	05:51	06:04	06:40	07:20	08:00	07:46	08:23
	17:21	18:05	19:47	20:30	21:10	21:41	21:40	21:03	20:05	19:06	17:15	16:57
14	08:29	07:53	08:02	07:02	06:13	05:51	06:05	06:41	07:22	08:02	07:47	08:24
	17:22	18:07	19:48	20:31	21:12	21:42	21:39	21:01	20:03	19:04	17:14	16:57
15	08:28	07:52	08:01	07:00	06:12	05:51	06:06	06:42	07:23	08:03	07:49	08:25
	17:23	18:08	19:50	20:33	21:13	21:42	21:39	21:00	20:01	19:02	17:12	16:57
16	08:27	07:50	07:59	06:58	06:10	05:51	06:07	06:44	07:24	08:05	07:50	08:25
	17:25	18:10	19:51	20:34	21:14	21:43	21:38	20:58	19:59	19:00	17:11	16:58
17	08:27	07:49	07:57	06:56	06:09	05:51	06:08	06:45	07:26	08:06	07:51	08:26
	17:26	18:11	19:52	20:35	21:15	21:43	21:37	20:56	19:57	18:56	17:10	16:58
18	08:26	07:47	07:55	06:54	06:08	05:51	06:09	06:46	07:27	08:08	07:53	08:27
	17:28	18:13	19:54	20:37	21:17	21:44	21:36	20:55	19:55	18:55	17:09	16:58
19	08:25	07:45	07:53	06:52	06:07	05:51	06:10	06:48	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:44	21:35	20:53	19:53	18:53	17:08	16:59
20	08:24	07:43	07:51	06:51	06:06	05:51	06:11	06:49	07:29	08:10	07:56	08:28
	17:30	18:16	19:57	20:39	21:19	21:44	21:35	20:51	19:51	18:51	17:07	16:59
21	08:24	07:42	07:49	06:49	06:05	05:51	06:12	06:50	07:31	08:12	07:57	08:29
	17:32	18:17	19:58	20:41	21:20	21:44	21:34	20:49	19:49	18:49	17:06	16:59
22	08:23	07:40	07:47	06:47	06:04	05:51	06:13	06:52	07:32	08:13	07:59	08:29
	17:33	18:19	19:59	20:42	21:21	21:45	21:33	20:48	19:47	18:48	17:05	17:00
23	08:22	07:38	07:45	06:45	06:03	05:51	06:14	06:53	07:33	08:15	08:00	08:30
	17:35	18:20	20:01	20:44	21:22	21:45	21:32	20:46	19:45	18:46	17:05	17:00
24	08:21	07:36	07:43	06:43	06:02	05:52	06:15	06:54	07:35	08:16	08:01	08:30
	17:36	18:22	20:02	20:45	21:24	21:45	21:31	20:44	19:43	18:44	17:04	17:01
25	08:20	07:35	07:41	06:42	06:01	05:52	06:16	06:56	07:36	08:18	08:03	08:31
	17:38	18:23	20:04	20:46	21:25	21:45	21:29	20:42	19:41	18:42	17:03	17:02
26	08:19	07:33	07:39	06:40	06:00	05:52	06:18	06:57	07:37	08:19	08:04	08:31
	17:39	18:25	20:05	20:48	21:26	21:45	21:28	20:40	19:39	18:41	17:02	17:02
27	08:18	07:31	07:37	06:38	05:59	05:53	06:19	06:58	07:39	08:21	08:05	08:31
	17:41	18:26	20:06	20:49	21:27	21:45	21:27	20:39	19:37	18:39	17:02	17:03
28	08:17	07:29	07:35	06:37	05:58	05:53	06:20	06:59	07:40	08:22	08:07	08:31
	17:42	18:28	20:08	20:50	21:28	21:45	21:26	20:37	19:35	18:37	17:01	17:04
29	08:16		07:33	06:35	05:58	05:54	06:21	07:01	07:41	08:23	08:08	08:32
	17:44		20:09	20:52	21:29	21:45	21:25	20:35	19:33	18:36	17:00	17:04
30	08:14		07:31	06:33	05:57	05:54	06:22	07:02	07:43	08:25	08:09	08:32
	17:45		20:11	20:53	21:30	21:45	21:23	20:33	19:31	18:34	17:00	17:05
31	08:13		07:29		05:56		06:23	07:03		08:26		08:32
	17:47		20:12		21:31		21:22	20:31		18:33		17:06
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:
Minnesota Power - BISON Wind Energy Center
 Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
 Idle start wind speed: Cut in wind speed from power curve

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

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net

Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) 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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:32	08:12	07:27	07:27	06:32	20:17 (301)	05:56	20:45 (302)	05:55	20:49 (302)	06:25	07:05	07:44	07:28	08:10
2	08:32	08:11	07:26	07:25	06:30	20:17 (301)	05:55	20:46 (302)	05:56	20:50 (302)	06:26	07:06	07:45	07:29	08:12
3	08:32	08:09	07:24	07:23	06:29	20:17 (301)	05:55	20:45 (302)	05:56	20:50 (302)	06:27	07:07	07:47	07:31	08:13
4	08:32	08:08	07:22	07:21	06:27	20:18 (301)	05:54	20:45 (302)	05:57	20:50 (302)	06:29	07:09	07:48	07:32	08:14
5	08:32	08:07	07:20	07:19	06:26	20:18 (301)	05:53	20:45 (302)	05:57	20:50 (302)	06:30	07:10	07:50	07:34	08:15
6	08:32	08:05	07:18	07:17	06:24	20:19 (301)	05:53	20:45 (302)	05:58	20:51 (302)	06:31	07:11	07:51	07:35	08:16
7	08:31	08:04	07:16	07:15	06:23	20:19 (301)	05:53	20:45 (302)	05:59	20:51 (302)	06:32	07:13	07:52	07:37	08:17
8	08:31	08:03	07:14	07:13	06:21	20:21 (301)	05:52	20:45 (302)	06:00	20:52 (302)	06:34	07:14	07:54	07:38	08:18
9	08:31	08:01	07:12	07:11	06:20	20:24 (301)	05:52	20:44 (302)	06:01	20:52 (302)	06:35	07:15	07:55	07:40	08:19
10	08:31	08:00	07:10	07:09	06:18	20:24 (301)	05:52	20:44 (302)	06:01	20:52 (302)	06:35	07:15	07:55	07:40	08:19
11	08:30	07:58	07:08	07:07	06:17	20:24 (301)	05:51	20:45 (302)	06:02	20:53 (302)	06:36	07:16	07:56	07:41	08:20
12	08:30	07:57	07:06	07:05	06:16	20:24 (301)	05:51	20:45 (302)	06:03	20:53 (302)	06:37	07:16	07:56	07:41	08:21
13	08:29	07:55	07:04	07:04	06:14	20:24 (301)	05:51	20:45 (302)	06:04	20:54 (302)	06:39	07:17	07:57	07:42	08:22
14	08:29	07:53	07:02	07:02	06:13	20:24 (301)	05:51	20:45 (302)	06:05	20:54 (302)	06:40	07:18	07:58	07:43	08:23
15	08:28	07:52	07:00	07:00	06:12	20:24 (301)	05:51	20:45 (302)	06:06	20:54 (302)	06:41	07:19	07:59	07:44	08:24
16	08:27	07:50	06:58	06:58	06:11	20:24 (301)	05:51	20:45 (302)	06:07	20:54 (302)	06:42	07:20	08:00	07:45	08:25
17	08:27	07:49	06:56	06:56	06:10	20:24 (301)	05:51	20:45 (302)	06:08	20:54 (302)	06:43	07:21	08:01	07:46	08:26
18	08:26	07:47	06:54	06:54	06:08	20:24 (301)	05:51	20:45 (302)	06:09	20:54 (302)	06:44	07:22	08:02	07:47	08:27
19	08:25	07:45	06:53	06:53	06:07	20:24 (301)	05:51	20:45 (302)	06:10	20:54 (302)	06:45	07:23	08:03	07:48	08:28
20	08:24	07:44	06:51	06:51	06:06	20:24 (301)	05:51	20:45 (302)	06:11	20:54 (302)	06:46	07:24	08:04	07:49	08:29
21	08:24	07:42	06:49	06:49	06:05	20:24 (301)	05:51	20:45 (302)	06:12	20:54 (302)	06:47	07:25	08:05	07:50	08:30
22	08:23	07:40	06:47	06:47	06:04	20:24 (301)	05:51	20:45 (302)	06:13	20:54 (302)	06:48	07:26	08:06	07:51	08:31
23	08:22	07:38	06:45	06:45	06:03	20:24 (301)	05:51	20:45 (302)	06:14	20:54 (302)	06:49	07:27	08:07	07:52	08:32
24	08:21	07:37	06:43	06:44	06:02	20:24 (301)	05:51	20:45 (302)	06:15	20:54 (302)	06:50	07:28	08:08	07:53	08:33
25	08:20	07:35	06:41	06:42	06:01	20:24 (301)	05:51	20:45 (302)	06:16	20:54 (302)	06:51	07:29	08:09	07:54	08:34
26	08:19	07:33	06:39	06:40	06:00	20:24 (301)	05:51	20:45 (302)	06:17	20:54 (302)	06:52	07:30	08:10	07:55	08:35
27	08:18	07:31	06:37	06:39	05:59	20:24 (301)	05:51	20:45 (302)	06:18	20:54 (302)	06:53	07:31	08:11	07:56	08:36
28	08:17	07:29	06:35	06:37	05:59	20:24 (301)	05:51	20:45 (302)	06:19	20:54 (302)	06:54	07:32	08:12	07:57	08:37
29	08:16	07:27	06:33	06:35	05:58	20:24 (301)	05:51	20:45 (302)	06:20	20:54 (302)	06:55	07:33	08:13	07:58	08:38
30	08:14	07:25	06:31	06:33	05:57	20:24 (301)	05:51	20:45 (302)	06:21	20:54 (302)	06:56	07:34	08:14	07:59	08:39
31	08:13	07:23	06:29	06:31	05:56	20:24 (301)	05:51	20:45 (302)	06:22	20:54 (302)	06:57	07:35	08:15	08:00	08:40
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266			
Total, worst case				37	205	798	358	160							
Sun reduction				0.59	0.68	0.71	0.76	0.73							
Oper. time red.				0.97	0.97	0.97	0.97	0.97							
Wind dir. red.				0.73	0.74	0.74	0.74	0.73							
Total reduction				0.42	0.49	0.51	0.55	0.52							
Total, real				16	100	410	196	83							

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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) Shadow receptor: SR028 - SR028

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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534
 Idle start wind speed: Cut in wind speed from power curve

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

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 US-GRAND FORKS, ND 58201
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 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **Shadow receptor:** SR029 - SR029

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	07:28	07:28	06:33	05:56	05:56	06:26	07:06	07:45	07:29	08:12
	17:08	17:49	18:30	20:14	20:56	21:33	21:46	21:22	20:30	19:30	17:32	17:00
2	08:33	08:12	07:27	07:26	06:31	05:56	05:56	06:27	07:07	07:46	07:30	08:13
	17:09	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	05:55	05:57	06:28	07:08	07:48	07:32	08:14
	17:10	17:52	18:33	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	06:29	07:10	07:49	07:33	08:15
	17:11	17:54	18:35	20:19	21:00	21:36	21:45	21:18	20:24	19:24	17:28	16:59
5	08:33	08:08	07:21	07:20	06:27	05:54	05:58	06:31	07:11	07:51	07:35	08:16
	17:12	17:55	18:36	20:20	21:01	21:37	21:45	21:16	20:22	19:22	17:26	16:59
6	08:33	08:06	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:36	08:17
	17:13	17:57	18:38	20:21	21:02	21:37	21:45	21:15	20:20	19:20	17:25	16:59
7	08:33	08:05	07:17	07:16	06:24	05:53	06:00	06:33	07:14	07:53	07:38	08:18
	17:15	17:58	18:39	20:23	21:04	21:38	21:44	21:14	20:18	19:18	17:23	16:58
8	08:32	08:04	08:15	07:14	06:22	05:53	06:01	06:35	07:15	07:55	07:39	08:19
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:16	19:16	17:22	16:58
9	08:32	08:02	08:13	07:12	06:21	05:53	06:01	06:36	07:16	07:56	07:41	08:20
	17:17	18:00	19:42	20:25	21:06	21:40	21:44	21:11	20:14	19:15	17:21	16:58
10	08:32	08:01	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:57	07:42	08:21
	17:18	18:02	19:43	20:27	21:08	21:40	21:43	21:09	20:12	19:13	17:19	16:58
11	08:31	07:59	08:09	07:08	06:18	05:52	06:03	06:38	07:19	07:59	07:44	08:22
	17:19	18:03	19:45	20:28	21:09	21:41	21:42	21:07	20:10	19:11	17:18	16:58
12	08:31	07:58	08:07	07:06	06:17	05:52	06:04	06:40	07:20	08:00	07:45	08:23
	17:21	18:05	19:46	20:30	21:10	21:42	21:42	21:06	20:08	19:09	17:17	16:58
13	08:30	07:56	08:05	07:05	06:15	05:52	06:05	06:41	07:21	08:02	07:47	08:24
	17:22	18:06	19:48	20:31	21:11	21:42	21:41	21:04	20:06	19:07	17:16	16:58
14	08:30	07:54	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	20:04	19:05	17:15	16:58
15	08:29	07:53	08:02	07:01	06:13	05:52	06:07	06:44	07:24	08:04	07:50	08:26
	17:24	18:09	19:51	20:34	21:14	21:43	21:40	21:01	20:02	19:03	17:13	16:58
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
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17	08:28	07:50	07:58	06:57	06:10	05:52	06:09	06:46	07:27	08:07	07:53	08:27
	17:27	18:12	19:53	20:36	21:16	21:44	21:38	20:58	19:58	18:58	17:11	16:59
18	08:27	07:48	07:56	06:55	06:09	05:52	06:10	06:47	07:28	08:09	07:54	08:28
	17:29	18:14	19:55	20:38	21:18	21:45	21:37	20:56	19:56	18:56	17:10	16:59
19	08:26	07:46	07:54	06:53	06:08	05:52	06:11	06:49	07:29	08:10	07:55	08:29
	17:30	18:15	19:56	20:39	21:19	21:45	21:37	20:54	19:54	18:54	17:09	17:00
20	08:26	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:30	08:11	07:57	08:29
	17:31	18:17	19:58	20:41	21:20	21:45	21:36	20:52	19:52	18:52	17:08	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:51	07:32	08:13	07:58	08:30
	17:33	18:18	19:59	20:42	21:21	21:46	21:35	20:51	19:50	18:50	17:07	17:00
22	08:24	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:14	08:00	08:30
	17:34	18:20	20:00	20:43	21:22	21:46	21:34	20:49	19:48	18:49	17:06	17:01
23	08:23	07:39	07:46	06:46	06:04	05:52	06:15	06:54	07:34	08:16	08:01	08:31
	17:36	18:21	20:02	20:45	21:24	21:46	21:33	20:47	19:46	18:47	17:06	17:01
24	08:22	07:38	07:44	06:45	06:03	05:53	06:16	06:55	07:36	08:17	08:02	08:31
	17:37	18:23	20:03	20:46	21:25	21:46	21:32	20:45	19:44	18:45	17:05	17:02
25	08:21	07:36	07:42	06:43	06:02	05:53	06:17	06:57	07:37	08:19	08:04	08:32
	17:39	18:24	20:05	20:47	21:26	21:46	21:31	20:43	19:42	18:43	17:04	17:03
26	08:20	07:34	07:40	06:41	06:01	05:53	06:19	06:58	07:38	08:20	08:05	08:32
	17:40	18:26	20:06	20:49	21:27	21:46	21:29	20:41	19:40	18:42	17:03	17:03
27	08:19	07:32	07:38	06:39	06:00	05:54	06:20	06:59	07:40	08:22	08:06	08:32
	17:42	18:27	20:07	20:50	21:28	21:46	21:28	20:40	19:38	18:40	17:03	17:04
28	08:18	07:30	07:36	06:38	05:59	05:54	06:21	07:00	07:41	08:23	08:08	08:33
	17:43	18:29	20:09	20:51	21:29	21:46	21:27	20:38	19:36	18:38	17:02	17:05
29	08:17	07:34	07:34	06:36	05:59	05:55	06:22	07:02	07:42	08:25	08:09	08:33
	17:45	18:30	20:10	20:53	21:30	21:46	21:26	20:36	19:34	18:37	17:01	17:05
30	08:16	07:32	07:32	06:34	05:58	05:55	06:23	07:03	07:44	08:26	08:10	08:33
	17:46	18:31	20:12	20:54	21:31	21:46	21:25	20:34	19:32	18:35	17:01	17:06
31	08:14	07:30	07:30	06:32	05:57	05:57	06:24	07:04	07:44	08:28	08:10	08:33
	17:48	18:33	20:13	20:54	21:32	21:46	21:23	20:32	19:30	18:34	17:01	17:07
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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 +1 701 775 3000
 wind@eapc.net
 Calculated:
 6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **Shadow receptor:** SR030 - SR030

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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	07:28	07:28	06:33	05:56	05:56	06:26	07:06	07:45	07:29	08:11	
	17:08	17:49	18:30	20:14	20:56	21:33	21:46	21:22	20:30	19:30	17:32	17:00	
2	08:33	08:12	07:27	07:26	06:31	05:56	05:56	06:27	07:07	07:46	07:30	08:13	
	17:09	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	08:10	07:25	07:24	06:30	05:55	05:57	06:28	07:08	07:48	07:32	08:14	
	17:10	17:52	18:33	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	06:29	07:10	07:49	07:33	08:15	
	17:11	17:54	18:35	20:18	21:00	21:36	21:45	21:18	20:24	19:24	17:28	16:59	
5	08:33	08:08	07:21	07:20	06:27	05:54	05:58	06:31	07:11	07:50	07:35	08:16	
	17:12	17:55	18:36	20:20	21:01	21:37	21:45	21:16	20:22	19:22	17:26	16:59	
6	08:33	08:06	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:36	08:17	
	17:13	17:57	18:38	20:21	21:02	21:37	21:45	21:15	20:20	19:20	17:25	16:59	
7	08:33	08:05	07:17	07:16	06:24	05:53	06:00	06:33	07:13	07:53	07:38	08:18	
	17:15	17:58	18:39	20:23	21:04	21:38	21:44	21:14	20:18	19:18	17:23	16:58	
8	08:32	08:04	08:15	07:14	06:22	05:53	06:00	06:34	07:15	07:55	07:39	08:19	
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:16	19:16	17:22	16:58	
9	08:32	08:02	08:13	07:12	06:21	05:53	06:01	06:36	07:16	07:56	07:41	08:20	
	17:17	18:00	19:42	20:25	21:06	21:40	21:43	21:10	20:14	19:14	17:21	16:58	
10	08:32	08:01	08:11	07:10	06:19	05:52	06:02	06:37	07:17	07:57	07:42	08:21	
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11	08:31	07:59	08:09	07:08	06:18	05:52	06:03	06:38	07:19	07:59	07:44	08:22	
	17:19	18:03	19:45	20:28	21:09	21:41	21:42	21:07	20:10	19:11	17:18	16:58	
12	08:31	07:58	08:07	07:06	06:17	05:52	06:04	06:40	07:20	08:00	07:45	08:23	
	17:21	18:05	19:46	20:29	21:10	21:42	21:42	21:06	20:08	19:09	17:17	16:58	
13	08:30	07:56	08:05	07:04	06:15	05:52	06:05	06:41	07:21	08:02	07:47	08:24	
	17:22	18:06	19:48	20:31	21:11	21:42	21:41	21:04	20:06	19:07	17:16	16:58	
14	08:30	07:54	08:03	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	21:40	21:03	20:04	19:05	17:14	16:58	
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	17:24	18:09	19:51	20:34	21:14	21:43	21:40	21:01	20:02	19:03	17:13	16:58	
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21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:51	07:32	08:13	07:58	08:30	
	17:33	18:18	19:59	20:42	21:21	21:46	21:35	20:50	19:50	18:50	17:07	17:00	
22	08:24	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:14	08:00	08:30	
	17:34	18:20	20:00	20:43	21:22	21:46	21:34	20:49	19:48	18:49	17:06	17:01	
23	08:23	07:39	07:46	06:46	06:04	05:52	06:15	06:54	07:34	08:16	08:01	08:31	
	17:36	18:21	20:02	20:45	21:24	21:46	21:33	20:47	19:46	18:47	17:06	17:01	
24	08:22	07:37	07:44	06:44	06:03	05:53	06:16	06:55	07:36	08:17	08:02	08:31	
	17:37	18:23	20:03	20:46	21:25	21:46	21:32	20:45	19:44	18:45	17:05	17:02	
25	08:21	07:36	07:42	06:43	06:02	05:53	06:17	06:56	07:37	08:19	08:04	08:32	
	17:39	18:24	20:05	20:47	21:26	21:46	21:30	20:43	19:42	18:43	17:04	17:03	
26	08:20	07:34	07:40	06:41	06:01	05:53	06:18	06:58	07:38	08:20	08:05	08:32	
	17:40	18:26	20:06	20:49	21:27	21:46	21:29	20:41	19:40	18:42	17:03	17:03	
27	08:19	07:32	07:38	06:39	06:00	05:54	06:20	06:59	07:40	08:22	08:06	08:32	
	17:42	18:27	20:07	20:50	21:28	21:46	21:28	20:40	19:38	18:40	17:03	17:04	
28	08:18	07:30	07:36	06:38	05:59	05:54	06:21	07:00	07:41	08:23	08:08	08:33	
	17:43	18:29	20:09	20:51	21:29	21:46	21:27	20:38	19:36	18:38	17:02	17:05	
29	08:17		07:34	06:36	05:59	05:55	06:22	07:02	07:42	08:25	08:09	08:33	
	17:45		20:10	20:53	21:30	21:46	21:26	20:36	19:34	18:37	17:01	17:05	
30	08:15		07:32	06:34	05:58	05:55	06:23	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	18:35	17:01	17:06	
31	08:14		07:30		05:57		06:24	07:04		08:27		08:33	
	17:48		20:13		21:32		21:23	20:32		18:34		17:07	
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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net

Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) **Shadow receptor:** SR031 - SR031

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
 460 248 266 220 303 505 763 770 523 378 415 371 577 907 1,032 796 8,534

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	07:28	07:28	06:33	05:57	05:56	06:26	07:06	07:45	07:29	08:11
	17:09	17:49	18:30	20:14	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	07:30	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	08:10	07:25	07:24	06:30	05:56	05:57	06:28	07:08	07:48	07:32	08:14
	17:11	17:52	18:33	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	07:33	08:15
	17:12	17:54	18:35	20:19	21:00	21:36	21:45	21:18	20:24	19:24	17:28	16:59
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	21:36	21:45	21:16	20:22	19:22	17:26	16:59
6	08:33	08:06	07:19	07:18	06:25	05:54	05:59	06:32	07:12	07:52	07:36	08:17
	17:14	17:57	18:38	20:21	21:02	21:37	21:45	21:15	20:20	19:20	17:25	16:59
7	08:32	08:05	07:17	07:16	06:24	05:54	06:00	06:33	07:14	07:53	07:38	08:18
	17:15	17:59	18:39	20:23	21:04	21:38	21:44	21:13	20:18	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	07:39	08:19
	17:16	18:00	18:41	20:24	21:05	21:39	21:44	21:12	20:16	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	08:20
	17:17	18:00	19:42	20:25	21:06	21:40	21:43	21:10	20:15	19:15	17:21	16:58
10	08:32	08:01	08:11	07:10	06:20	05:53	06:02	06:37	07:18	07:57	07:42	08:21
	17:18	18:02	19:44	20:27	21:08	21:40	21:43	21:09	20:13	19:13	17:20	16:58
11	08:31	07:59	08:09	07:08	06:18	05:52	06:03	06:39	07:19	07:59	07:44	08:22
	17:20	18:03	19:45	20:28	21:09	21:41	21:42	21:07	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	19:46	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	06:15	05:52	06:05	06:41	07:21	08:02	07:47	08:24
	17:22	18:06	19:48	20:31	21:11	21:42	21:41	21:04	20:07	19:07	17:16	16:58
14	08:30	07:54	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	21:40	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	08:04	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	08:28	07:51	08:00	06:59	06:12	05:52	06:08	06:45	07:25	08:06	07:51	08:26
	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	18:12	19:54	20:36	21:16	21:44	21:38	20:57	19:58	18:58	17:11	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	21:37	20:56	19:56	18:56	17:10	16:59
19	08:26	07:46	07:54	06:54	06:08	05:52	06:11	06:49	07:29	08:10	07:55	08:29
	17:30	18:15	19:56	20:39	21:19	21:45	21:36	20:54	19:54	18:54	17:09	17:00
20	08:25	07:45	07:52	06:52	06:07	05:52	06:12	06:50	07:31	08:11	07:57	08:29
	17:32	18:17	19:58	20:41	21:20	21:45	21:36	20:52	19:52	18:52	17:08	17:00
21	08:25	07:43	07:50	06:50	06:06	05:52	06:13	06:51	07:32	08:13	07:58	08:30
	17:33	18:19	19:59	20:42	21:21	21:45	21:35	20:51	19:50	18:50	17:08	17:01
22	08:24	07:41	07:48	06:48	06:05	05:52	06:14	06:53	07:33	08:14	08:00	08:30
	17:34	18:20	20:01	20:43	21:22	21:46	21:34	20:49	19:48	18:49	17:07	17:01
23	08:23	07:39	07:46	06:46	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	19:46	18:47	17:06	17:02
24	08:22	07:38	07:44	06:45	06:03	05:53	06:16	06:55	07:36	08:17	08:02	08:31
	17:37	18:23	20:03	20:46	21:25	21:46	21:32	20:45	19:44	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	20:47	21:26	21:46	21:30	20:43	19:42	18:44	17:04	17:03
26	08:20	07:34	07:40	06:41	06:01	05:54	06:19	06:58	07:38	08:20	08:05	08:32
	17:40	18:26	20:06	20:49	21:27	21:46	21:29	20:41	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	08:06	08:32
	17:42	18:28	20:07	20:50	21:28	21:46	21:28	20:40	19:38	18:40	17:03	17:04
28	08:18	07:30	07:36	06:38	06:00	05:54	06:21	07:01	07:41	08:23	08:08	08:32
	17:43	18:29	20:09	20:51	21:29	21:46	21:27	20:38	19:36	18:39	17:02	17:05
29	08:17	07:34	07:34	06:36	05:59	05:55	06:22	07:02	07:42	08:25	08:09	08:33
	17:45	18:31	20:10	20:53	21:30	21:46	21:26	20:36	19:34	18:37	17:02	17:06
30	08:15	07:32	07:32	06:35	05:58	05:55	06:23	07:03	07:44	08:26	08:10	08:33
	17:46	18:32	20:11	20:54	21:31	21:46	21:25	20:34	19:32	18:35	17:01	17:07
31	08:14	07:30	07:30	06:34	05:57	05:57	06:25	07:05	07:45	08:27	08:11	08:33
	17:48	18:34	20:12	20:55	21:32	21:46	21:23	20:32	19:30	18:33	17:01	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)	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:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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Calculated:

6/17/2011 12:07 PM/2.7.486

SHADOW - Calendar

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2) Shadow receptor: SR032 - SR032

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
460	248	266	220	303	505	763	770	523	378	415	371	577	907	1,032	796	8,534

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 17:49	07:28 18:30	07:28 20:14	06:33 20:55	05:57 21:33	05:56 21:46	06:26 21:22	07:06 20:30	07:40 (321) 08:13 (321)	07:45 19:30	07:29 17:32	08:11 17:01
2	08:33 17:09	08:12 17:51	07:27 18:32	07:26 20:16	6 07:57 (321) 08:03 (321)	06:31 20:57	05:56 21:34	06:27 21:21	07:07 20:28	33 07:40 (321) 08:13 (321)	07:46 19:28	07:30 17:31	08:13 17:00
3	08:33 17:10	08:10 17:52	07:25 18:33	07:24 20:17	15 08:07 (321) 07:49 (321)	06:30 20:58	05:55 21:35	06:28 21:19	07:08 20:26	31 07:40 (321) 08:11 (321)	07:48 19:26	07:32 17:29	08:14 17:00
4	08:33 17:11	08:09 17:54	07:23 18:35	07:22 20:18	21 08:10 (321) 07:47 (321)	06:28 20:59	05:55 21:36	06:30 21:18	07:10 20:24	30 07:40 (321) 08:10 (321)	07:49 19:24	07:33 17:28	08:15 16:59
5	08:33 17:13	08:08 17:55	07:21 18:36	07:20 20:20	24 08:11 (321) 07:45 (321)	06:27 21:01	05:54 21:36	06:31 21:16	07:11 20:22	29 07:41 (321) 08:10 (321)	07:50 19:22	07:35 17:26	08:16 16:59
6	08:33 17:14	08:06 17:57	07:19 18:38	07:18 20:21	27 08:12 (321) 07:44 (321)	06:25 21:02	05:54 21:37	06:32 21:15	07:12 20:20	27 07:41 (321) 08:08 (321)	07:52 19:20	07:36 17:25	08:17 16:59
7	08:32 17:15	08:05 17:59	07:17 18:39	07:16 20:23	29 08:13 (321) 07:43 (321)	06:24 21:04	05:54 21:38	06:33 21:13	07:14 20:18	24 07:42 (321) 08:06 (321)	07:53 19:18	07:38 17:24	08:18 16:59
8	08:32 17:16	08:04 18:00	08:15 18:41	07:14 20:24	30 08:13 (321) 07:42 (321)	06:22 21:05	05:53 21:39	06:35 21:12	07:15 20:16	21 07:43 (321) 08:04 (321)	07:55 19:16	07:39 17:22	08:19 16:58
9	08:32 17:17	08:02 18:00	08:13 19:42	07:12 20:25	31 08:13 (321) 07:41 (321)	06:21 21:06	05:53 21:40	06:36 21:30	07:16 20:14	16 07:46 (321) 08:02 (321)	07:56 19:15	07:41 17:21	08:20 16:58
10	08:31 17:18	08:01 18:02	08:11 19:44	07:10 20:27	33 08:14 (321) 07:41 (321)	06:19 21:07	05:53 21:40	06:37 21:09	07:17 20:12	7 07:50 (321) 07:57 (321)	07:57 19:13	07:42 17:20	08:21 16:58
11	08:31 17:19	07:59 18:03	08:09 19:45	07:08 20:28	33 08:14 (321) 07:41 (321)	06:18 21:09	05:52 21:41	06:38 21:07	07:19 20:10	07:59 19:11	07:44 17:18	08:22 16:58	08:22 16:58
12	08:31 17:21	07:58 18:05	08:07 19:46	07:06 20:29	43 08:14 (321) 07:29 (320)	06:17 21:10	05:52 21:41	06:40 21:06	07:20 20:08	08:00 19:09	07:45 17:17	08:23 16:58	08:23 16:58
13	08:30 17:22	07:56 18:06	08:05 19:48	07:05 20:31	48 08:14 (321) 07:26 (320)	06:15 21:11	05:52 21:42	06:41 21:04	07:21 20:06	08:02 19:07	07:47 17:16	08:24 16:58	08:24 16:58
14	08:30 17:23	07:54 18:08	08:04 19:49	07:03 20:32	49 08:13 (321) 07:24 (320)	06:14 21:13	05:52 21:43	06:42 21:02	07:23 20:04	08:03 19:05	07:48 17:15	08:25 16:58	08:25 16:58
15	08:29 17:25	07:53 18:09	08:02 19:51	07:01 20:34	50 08:13 (321) 07:23 (320)	06:13 21:14	05:52 21:43	06:44 21:01	07:24 20:02	08:04 19:03	07:50 17:14	08:26 16:59	08:26 16:59
16	08:28 17:26	07:51 18:11	08:00 19:52	06:59 20:35	50 08:12 (321) 07:22 (320)	06:12 21:15	05:52 21:44	06:45 20:59	07:25 20:00	08:06 19:01	07:51 17:12	08:26 16:59	08:26 16:59
17	08:28 17:27	07:50 18:12	07:58 19:53	06:57 20:36	50 08:11 (321) 07:21 (320)	06:10 21:16	05:52 21:44	06:46 20:57	07:27 19:58	4 07:34 (320) 07:38 (320)	07:52 17:11	08:27 16:59	08:27 16:59
18	08:27 17:29	07:48 18:14	07:56 19:55	06:55 20:38	50 08:11 (321) 07:21 (320)	06:09 21:18	05:52 21:44	06:48 20:56	07:28 19:56	20 07:30 (320) 08:04 (321)	07:28 17:10	08:28 16:59	08:28 16:59
19	08:26 17:30	07:46 18:15	07:54 19:56	06:53 20:39	49 08:10 (321) 07:21 (320)	06:08 21:19	05:52 21:45	06:49 20:54	07:29 19:54	29 07:28 (320) 08:07 (321)	07:29 17:09	08:28 17:00	08:28 17:00
20	08:25 17:31	07:44 18:17	07:52 19:58	06:52 20:40	47 08:08 (321) 07:21 (320)	06:07 21:20	05:52 21:45	06:50 20:52	07:30 19:52	35 07:28 (320) 08:09 (321)	07:30 17:08	08:29 17:00	08:29 17:00
21	08:25 17:33	07:43 18:18	07:50 19:59	06:50 20:42	45 08:07 (321) 07:22 (320)	06:06 21:21	05:52 21:45	06:51 20:50	07:32 19:50	42 07:26 (320) 08:11 (321)	07:32 17:07	08:30 17:01	08:30 17:01
22	08:24 17:34	07:41 18:20	07:48 20:00	06:48 20:43	41 08:06 (321) 07:22 (320)	06:05 21:22	05:52 21:46	06:53 20:49	07:33 19:48	46 07:25 (320) 08:12 (321)	07:33 17:06	08:31 17:01	08:31 17:01
23	08:23 17:36	07:39 18:21	07:46 20:02	06:46 20:45	34 08:03 (321) 07:23 (320)	06:04 21:23	05:53 21:46	06:54 20:47	07:34 19:46	48 07:24 (320) 08:12 (321)	07:34 17:06	08:31 17:02	08:31 17:02
24	08:22 17:37	07:37 18:23	07:44 20:03	06:45 20:46	28 08:01 (321) 07:25 (320)	06:03 21:25	05:53 21:46	06:55 20:45	07:36 19:44	49 07:25 (320) 08:14 (321)	07:36 17:05	08:32 17:02	08:32 17:02
25	08:21 17:39	07:36 18:24	07:42 20:05	06:43 20:47	16 07:57 (321) 07:25 (320)	06:02 21:26	05:53 21:46	06:57 20:43	07:37 19:42	50 07:24 (320) 08:14 (321)	07:37 17:04	08:32 17:03	08:32 17:03
26	08:20 17:40	07:34 18:26	07:40 20:06	06:41 20:49	06:01 21:27	06:01 21:27	05:54 21:46	06:58 20:41	07:38 19:40	50 07:24 (320) 08:14 (321)	07:38 17:04	08:32 17:03	08:32 17:03
27	08:19 17:42	07:32 18:27	07:38 20:07	06:39 20:50	06:00 21:28	06:00 21:28	05:54 21:46	06:59 20:40	07:40 19:38	50 07:24 (320) 08:14 (321)	07:40 17:04	08:32 17:04	08:32 17:04
28	08:18 17:43	07:30 18:29	07:36 20:09	06:38 20:51	06:00 21:29	06:00 21:29	05:54 21:46	07:01 20:38	07:41 19:36	50 07:25 (320) 08:15 (321)	07:41 17:04	08:32 17:04	08:32 17:04
29	08:17 17:45	07:34 18:29	07:34 20:09	06:36 20:53	05:59 21:30	05:59 21:30	05:55 21:46	06:22 20:36	07:42 19:34	50 07:25 (320) 08:16 (321)	07:42 17:04	08:33 17:05	08:33 17:05
30	08:15 17:46	07:32 18:29	07:32 20:10	06:35 20:53	05:58 21:30	05:58 21:30	05:55 21:46	07:03 20:36	07:44 19:34	49 07:26 (320) 08:16 (321)	07:44 17:04	08:33 17:05	08:33 17:05
31	08:14 17:48	07:30 18:29	07:30 20:12	06:34 20:54	05:57 21:31	05:57 21:31	05:55 21:46	07:04 20:34	07:44 19:32	47 07:28 (320) 08:17 (321)	07:44 17:04	08:33 17:05	08:33 17:05
Potential sun hours	279	287	368	407	466	474	480	441	378	338	282	266	
Total, worst case					849				611		251		
Sun reduction					0.59				0.73		0.69		
Oper. time red.					0.97				0.97		0.97		
Wind dir. red.					0.66				0.66		0.67		
Total reduction					0.38				0.47		0.45		
Total, real					324				285		113		

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:

Minnesota Power - BISON Wind Energy Center

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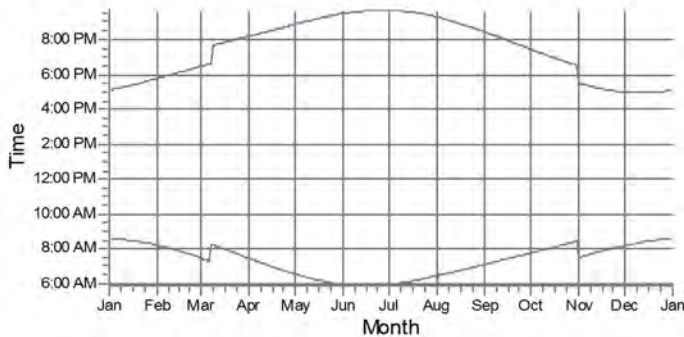
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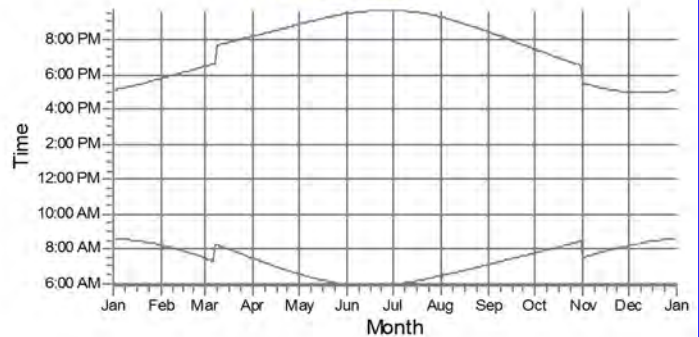
SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

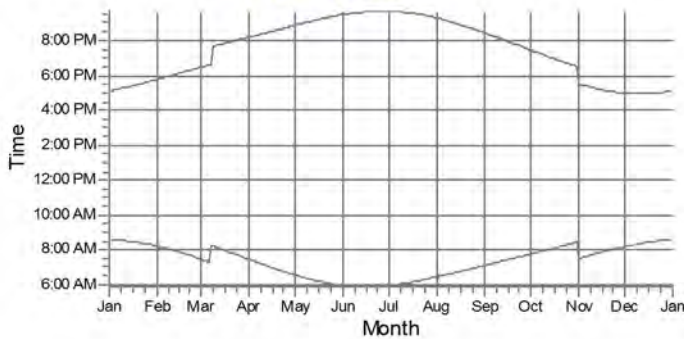
SR001: SR001



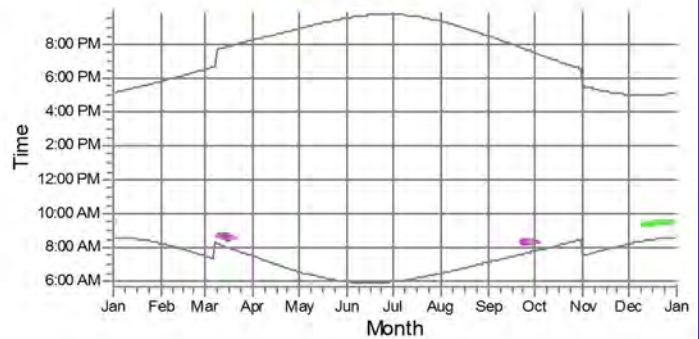
SR002: SR002



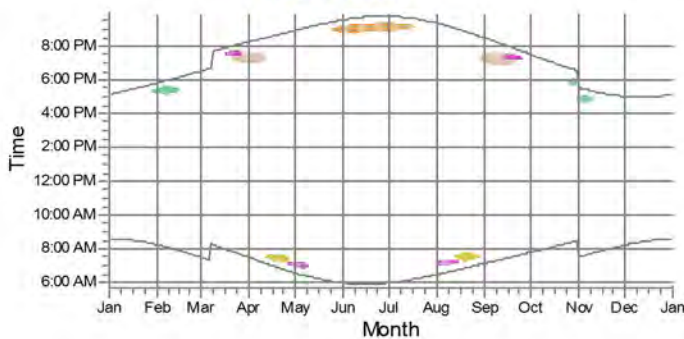
SR003: SR003



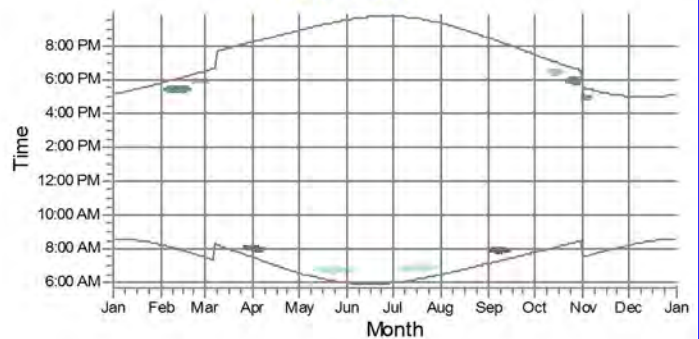
SR004: SR004



SR005: SR005



SR006: SR006



WTGs

- 2: BISON 1B
- 7: BISON 1B
- 20: BISON 1B
- 30: BISON 1B
- 202: BISON 2
- 204: BISON 2
- 6: BISON 1B
- 17: BISON 1B
- 28: BISON 1B
- 201: BISON 2
- 203: BISON 2

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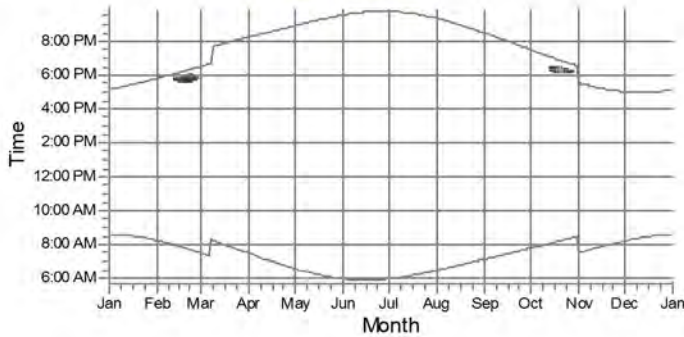
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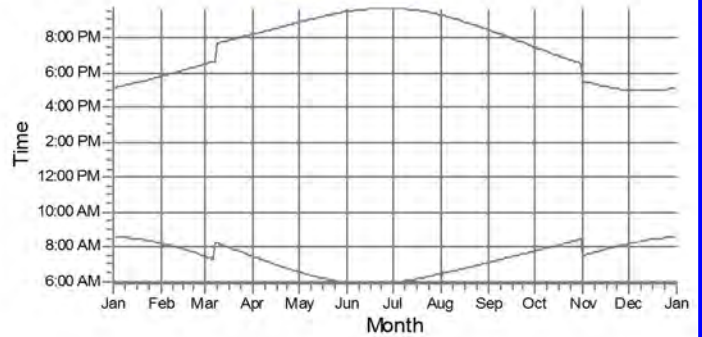
SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

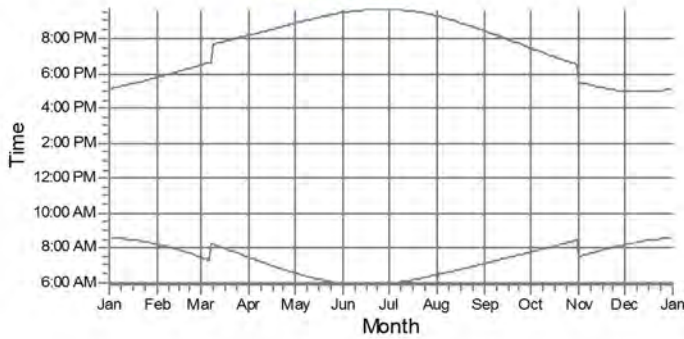
SR007: SR007



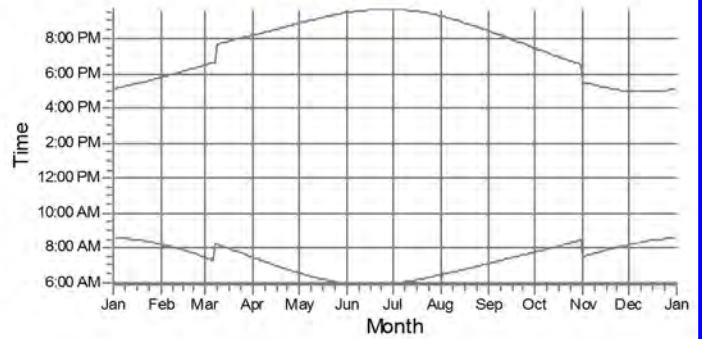
SR008: SR008



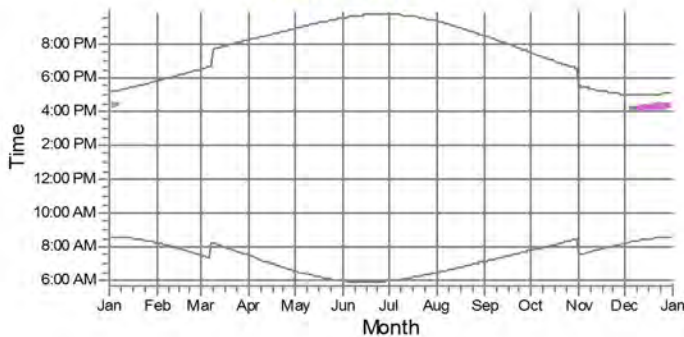
SR009: SR009



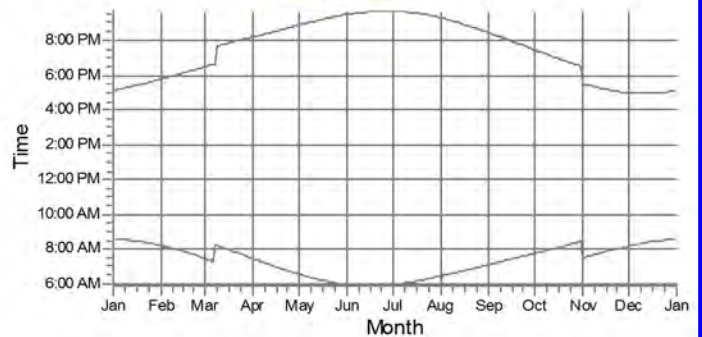
SR010: SR010



SR011: SR011



SR012: SR012



WTGs

206: BISON 2 208: BISON 2

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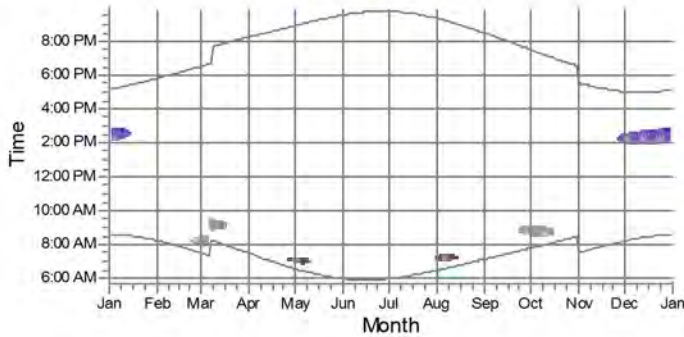
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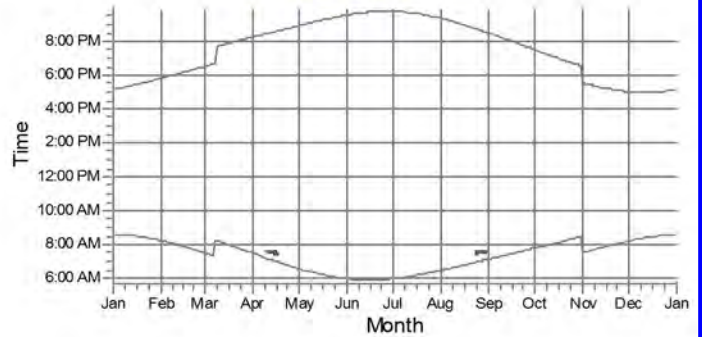
SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

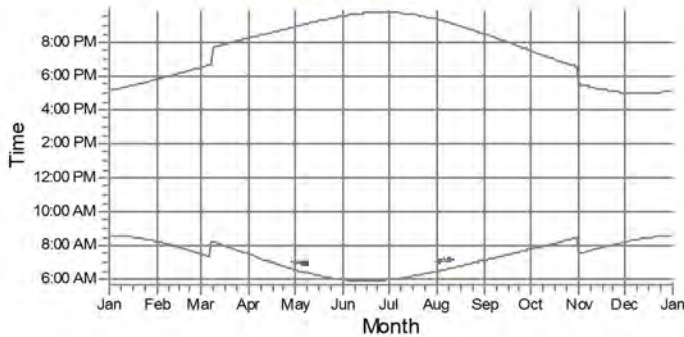
SR013: SR013



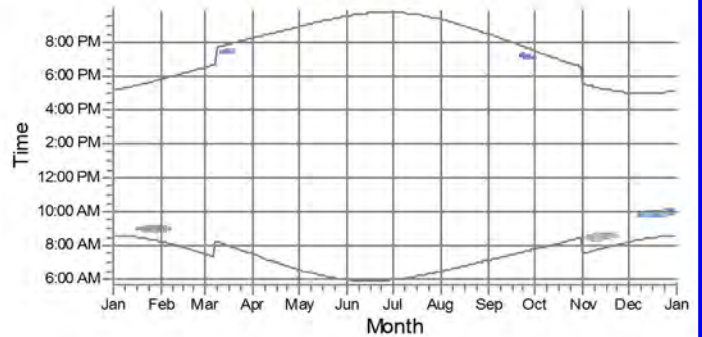
SR014: SR014



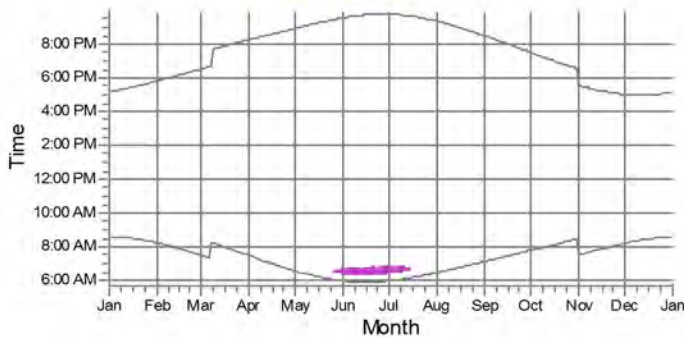
SR015: SR015



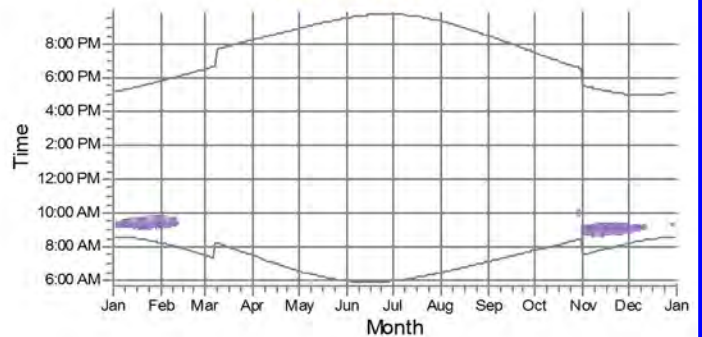
SR016: SR016



SR017: SR017



SR018: SR018



WTGs

- 8: BISON 1A
- 16: BISON 1A
- 22: BISON 1A
- 211: BISON 2
- 212: BISON 2
- 214: BISON 2
- 215: BISON 2
- 216: BISON 2
- 218: BISON 2

Project:

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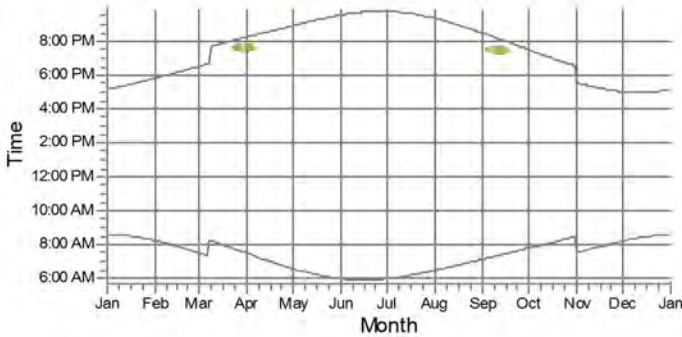
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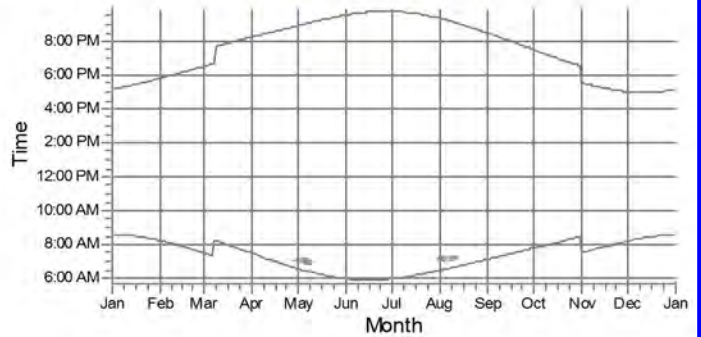
SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

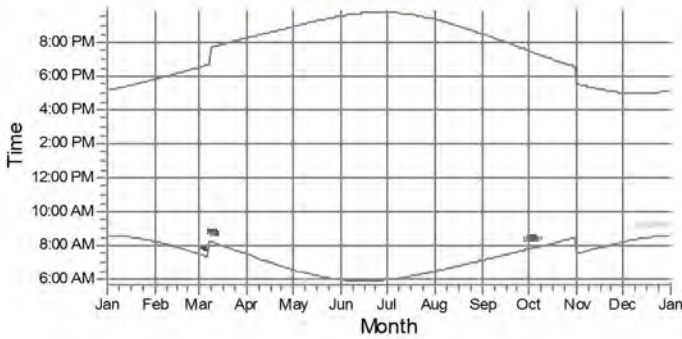
SR019: SR019



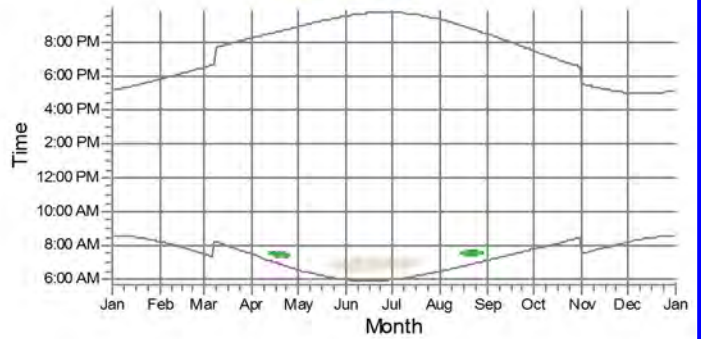
SR020: SR020



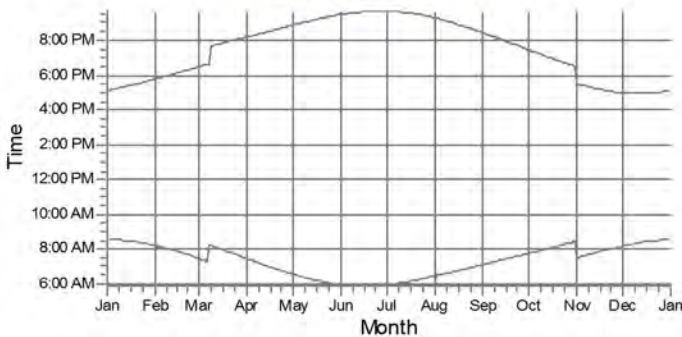
SR021: SR021



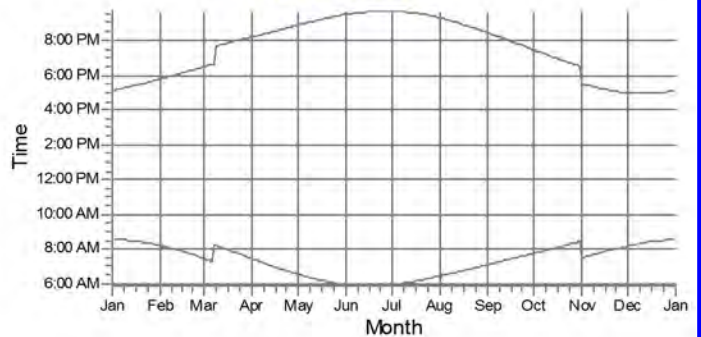
SR022: SR022



SR023: SR023



SR024: SR024



WTGs

- 222: BISON 2
- 223: BISON 2
- 226: BISON 2
- 228: BISON 2
- 310: BISON 3

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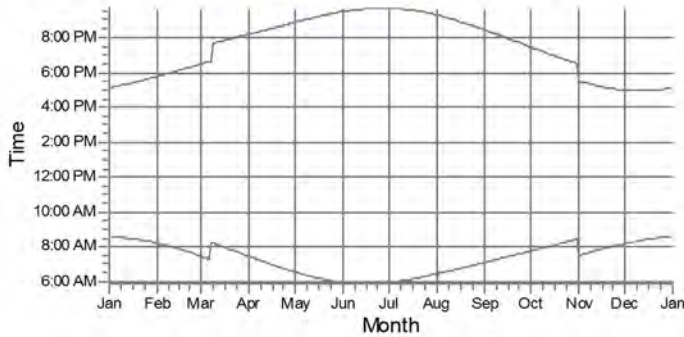
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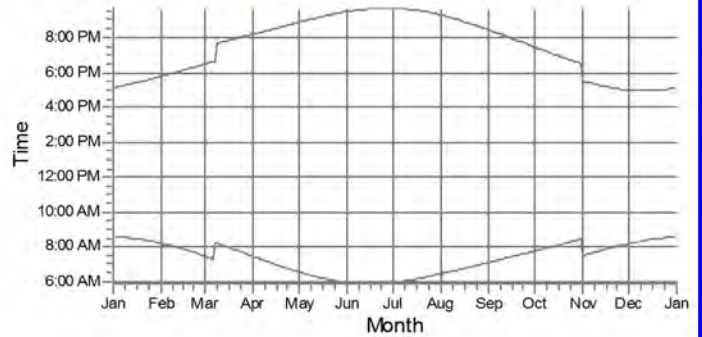
SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)

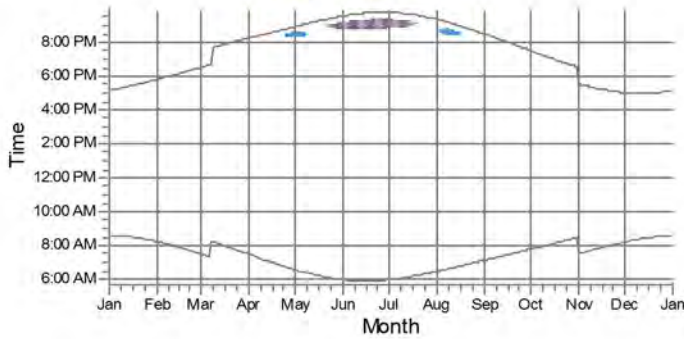
SR025: SR025



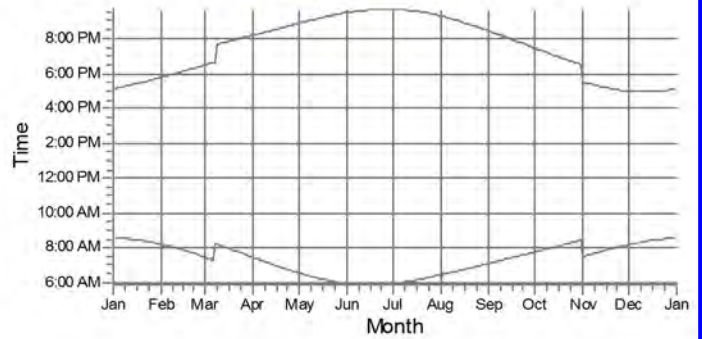
SR026: SR026



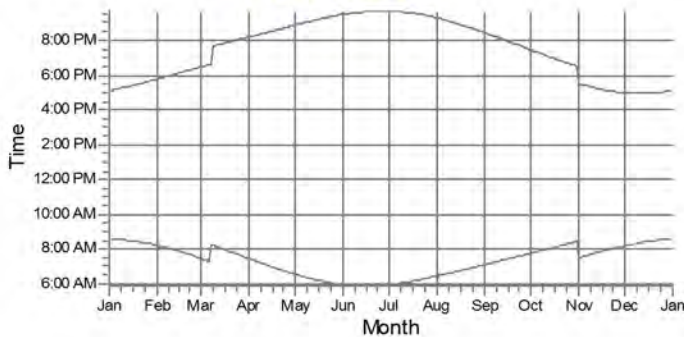
SR027: SR027



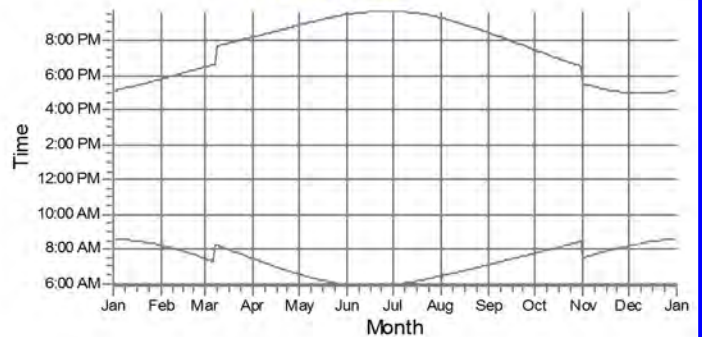
SR028: SR028



SR029: SR029



SR030: SR030



WTGs

301: BISON 3 302: BISON 3

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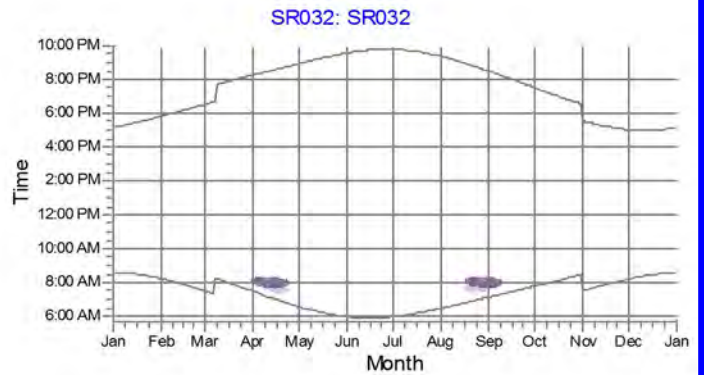
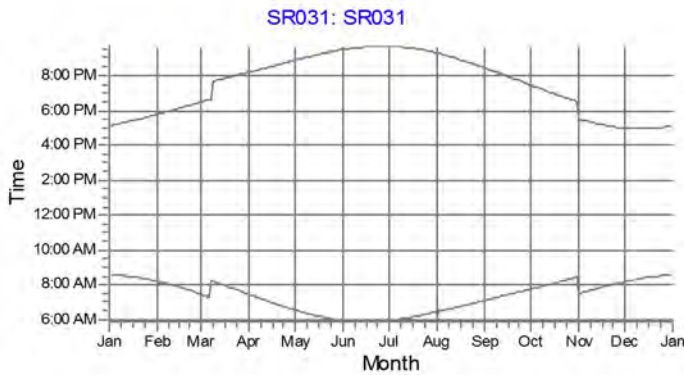
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SHADOW - Calendar, graphical

Calculation: BISON 3 Shadow Flicker (with existing BISON 1, 2)



WTGs

320: BISON 3 321: BISON 3

Appendix I

Project:

Minnesota Power - BISON Wind Energy Center

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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

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:

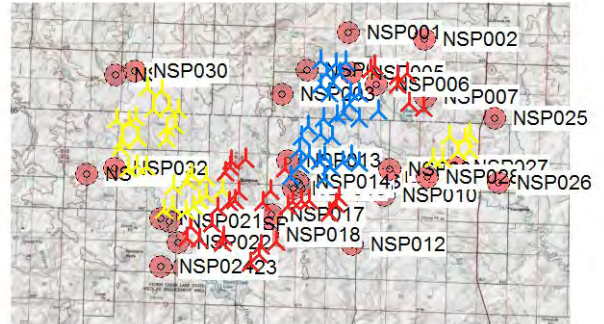
Pure and Impulse tone penalty are added to WTG source noise

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)



WTGs

UTM WGS84 Zone: 14 East				WTG type			Noise data									
UTM WGS84 Zone: 14 East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	Wind speed [m/s]	Hub height [m]	Lwa,ref [dB(A)]	Pure tones	Octave data
1	308,045	5,206,621	710.2 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
2	308,398	5,207,681	712.8 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
3	305,708	5,204,697	697.2 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
4	306,742	5,204,066	684.1 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
5	306,144	5,205,889	687.5 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
6	307,814	5,208,723	699.8 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
7	306,789	5,208,091	697.9 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
8	305,723	5,203,854	694.7 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
9	308,835	5,206,312	686.8 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
10	308,356	5,207,066	704.4 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
11	309,883	5,206,747	665.7 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
12	308,458	5,204,347	662.0 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
13	307,026	5,204,302	678.5 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
14	306,821	5,205,492	674.2 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
15	307,258	5,207,647	696.1 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
16	306,222	5,204,408	682.6 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
17	307,611	5,209,252	691.9 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
18	306,948	5,206,325	663.9 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
19	307,408	5,205,372	666.1 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
20	307,108	5,208,697	698.3 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
22	307,008	5,203,168	670.0 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
23	305,241	5,203,255	705.6 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
25	308,117	5,209,319	675.4 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
26	306,823	5,209,364	689.1 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
27	307,666	5,206,450	684.1 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
28	307,454	5,208,223	699.8 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
29	308,855	5,203,961	659.6 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
30	308,850	5,207,651	682.8 BISON 1B	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
31	308,007	5,204,045	659.6 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
32	305,787	5,205,371	676.0 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
33	307,319	5,203,760	676.0 BISON 1A	Yes	Siemens	SWT-2.3-101-2,300	2,300	101.0	80.0	USER	SWT-2.3-101 Standard	8.0	80.0	107.0	0 dB	Yes
201	309,464	5,208,918	677.3 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
202	309,685	5,209,120	676.7 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
203	310,887	5,208,104	665.3 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
204	310,897	5,208,576	676.0 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
205	311,399	5,208,734	691.6 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
206	311,493	5,207,129	663.0 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
207	312,259	5,206,895	682.4 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
208	307,794	5,202,144	666.4 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
209	307,622	5,201,766	676.7 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
210	307,287	5,201,341	678.5 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
211	306,204	5,201,988	691.0 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
212	305,792	5,201,997	687.0 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
213	305,343	5,201,946	685.8 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
214	305,086	5,201,688	683.4 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
215	304,921	5,203,659	700.3 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes
216	304,151	5,202,483	677.3 BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101 Standard	8.0	80.0	108.0	0 dB	Yes

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

...continued from previous page

UTM WGS84 Zone: 14	UTM WGS84 Zone: 14			Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data		Wind speed [m/s]	Hub height [m]	LwA,ref [dB(A)]	Pure tones	Octave data	
	East	North	Z		Valid	Manufact.	Type-generator				Creator	Name						
UTM WGS84 Zone: 14			[m]															
217	303,760	5,201,883	670.6	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
218	304,453	5,199,790	684.6	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
219	303,654	5,199,579	680.9	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
220	303,574	5,199,109	668.2	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
221	303,104	5,198,656	658.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
222	299,716	5,199,978	657.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
223	299,930	5,200,609	665.1	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
224	301,600	5,199,737	677.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
225	301,676	5,200,064	678.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
226	301,044	5,200,758	684.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
227	301,339	5,201,562	683.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
228	300,385	5,199,954	656.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
229	301,958	5,201,876	689.4	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
230	302,272	5,202,012	695.0	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
231	302,500	5,202,464	685.2	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
232	301,742	5,203,479	692.5	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
233	302,013	5,203,777	696.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
234	302,093	5,204,102	699.8	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
235	302,838	5,204,194	681.1	BISON 2	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
301	312,774	5,204,170	646.1	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
302	313,282	5,204,157	646.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
303	314,088	5,204,579	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
304	314,697	5,204,634	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
305	314,736	5,205,482	658.4	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
306	314,446	5,205,246	670.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
307	313,645	5,205,400	663.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
308	298,480	5,201,477	664.5	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
309	298,972	5,201,680	670.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
310	299,665	5,201,434	671.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
311	300,072	5,201,700	677.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
312	300,370	5,201,989	679.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
313	300,736	5,202,308	705.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
314	301,586	5,202,532	685.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
315	300,740	5,203,215	690.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
316	299,975	5,203,346	696.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
317	299,780	5,202,993	707.7	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
318	298,996	5,202,746	677.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
319	297,558	5,203,763	688.2	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
320	297,064	5,203,816	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
321	296,612	5,203,683	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
322	296,227	5,204,772	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
323	296,321	5,205,129	688.8	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
324	297,120	5,205,284	690.3	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
325	295,979	5,206,293	691.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
326	296,688	5,206,154	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
327	297,008	5,206,367	690.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
328	297,927	5,206,824	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
329	297,639	5,207,972	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
330	298,396	5,207,813	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
331	298,772	5,206,941	701.0	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
332	299,272	5,206,774	694.9	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
333	299,137	5,205,950	701.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
334	298,647	5,205,816	693.1	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101	Standard	8.0	80.0	108.0	0 dB	Yes
335	298,632	5,205,272	684.6	BISON 3	Yes	Siemens	SWT-3.0-101-3,000	3,000	101.0	80.0	USER	SWT-3.0-101						

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

...continued from previous page

Noise sensitive area UTM WGS84 Zone: 14					Demands			Sound Level		Demands fulfilled ?		
No.	Name	East	North	Z	Imission height	Noise	Distance	From WTGs	Noise	Distance	All	
				[m]	[m]	[dB(A)]	[m]	[dB(A)]				
NSP008	NSP008	310,463	5,203,623	650.0	0.0	45.0	427	33.5	Yes	Yes	Yes	
NSP009	NSP009	310,303	5,203,128	643.1	0.0	45.0	427	33.2	Yes	Yes	Yes	
NSP010	NSP010	310,167	5,202,263	676.7	0.0	45.0	427	32.2	Yes	Yes	Yes	
NSP011	NSP011	308,704	5,202,962	655.3	0.0	45.0	427	37.8	Yes	Yes	Yes	
NSP012	NSP012	308,504	5,199,667	674.6	0.0	45.0	427	31.2	Yes	Yes	Yes	
NSP013	NSP013	305,091	5,204,059	680.2	0.0	45.0	427	43.4	Yes	Yes	Yes	
NSP014	NSP014	305,600	5,202,951	680.3	0.0	45.0	427	42.9	Yes	Yes	Yes	
NSP015	NSP015	305,735	5,202,742	681.1	0.0	45.0	427	42.2	Yes	Yes	Yes	
NSP016	NSP016	305,362	5,202,580	681.3	0.0	45.0	427	42.9	Yes	Yes	Yes	
NSP017	NSP017	304,204	5,201,211	671.2	0.0	45.0	427	39.9	Yes	Yes	Yes	
NSP018	NSP018	304,015	5,200,169	672.6	0.0	45.0	427	41.3	Yes	Yes	Yes	
NSP019	NSP019	302,002	5,200,728	663.3	0.0	45.0	427	41.2	Yes	Yes	Yes	
NSP020	NSP020	298,345	5,201,007	658.4	0.0	45.0	427	41.4	Yes	Yes	Yes	
NSP021	NSP021	298,817	5,200,870	660.0	0.0	45.0	427	40.9	Yes	Yes	Yes	
NSP022	NSP022	299,277	5,199,763	649.2	0.0	45.0	427	41.2	Yes	Yes	Yes	
NSP023	NSP023	299,548	5,198,404	658.4	0.0	45.0	427	33.7	Yes	Yes	Yes	
NSP024	NSP024	298,327	5,198,450	669.3	0.0	45.0	427	31.5	Yes	Yes	Yes	
NSP025	NSP025	316,022	5,206,330	640.9	0.0	45.0	427	31.9	Yes	Yes	Yes	
NSP026	NSP026	316,240	5,202,903	634.0	0.0	45.0	427	28.8	Yes	Yes	Yes	
NSP027	NSP027	313,965	5,203,735	643.0	0.0	45.0	427	39.0	Yes	Yes	Yes	
NSP028	NSP028	312,483	5,203,203	631.2	0.0	45.0	427	35.4	Yes	Yes	Yes	
NSP029	NSP029	295,930	5,208,602	690.1	0.0	45.0	427	31.9	Yes	Yes	Yes	
NSP030	NSP030	296,963	5,208,823	695.5	0.0	45.0	427	34.5	Yes	Yes	Yes	
NSP031	NSP031	294,437	5,203,372	677.0	0.0	45.0	427	31.2	Yes	Yes	Yes	
NSP032	NSP032	295,924	5,203,653	667.5	0.0	45.0	427	39.0	Yes	Yes	Yes	

Distances (m)

WTG	NSP001	NSP002	NSP003	NSP004	NSP005	NSP006	NSP007	NSP008	NSP009	NSP010	NSP011	NSP012	NSP013	NSP014	NSP015	NSP016	NSP017	NSP018	NSP019	NSP020	NSP021	NSP022
1	4264	5793	3406	2995	2151	2269	4417	3852	4159	4847	3718	6969	3910	4410	4515	4851	6635	7607	8441	11207	10873	11131
2	3199	4849	3610	2611	1053	1437	3995	4553	4935	5699	4729	8015	4905	5496	5611	5936	7710	8697	9447	12067	11755	12078
3	6695	8818	3064	4197	4882	5295	7219	4875	4855	5080	3462	5755	888	1749	1955	2145	3797	4834	5430	8236	7882	8106
4	6984	8536	4055	4858	4971	5037	6575	3747	3682	3871	2251	4739	1651	1596	1663	2028	3820	4756	5797	8937	8545	8616
5	5427	7727	2198	2990	3664	4246	6432	4877	4992	5416	3889	6655	2111	2988	3173	3400	5064	6103	6718	9201	8881	9202
6	2205	4861	3220	1744	642	2064	4749	5747	6124	6875	5829	9082	5401	6182	6332	6614	8334	9360	9884	12215	11942	12376
7	3161	6050	2055	1061	1786	2988	5635	5785	6081	6736	5475	8597	4375	5276	5452	5693	7350	8394	8782	11022	10756	11215
8	7475	9385	3880	5036	5591	5860	7566	4746	4637	4720	3112	5026	664	911	1112	1324	3048	4062	4860	7908	7523	7635
9	4600	5469	4252	3767	2450	2009	3726	3143	3506	4262	3353	6653	4370	4665	4728	5098	6890	7808	8824	11755	11401	11586
10	3813	5265	3610	2912	1669	1749	4047	4037	4393	5133	4119	7400	4439	4953	5056	5393	7178	8149	8975	11702	11375	11652
11	4431	4496	5168	4362	2445	1343	2597	3177	3643	4493	3964	7213	5494	5723	5766	6148	7931	8815	9917	12887	12530	12699
12	6533	7286	4917	5119	4385	3965	4999	2132	2211	2695	1407	4680	3379	3181	3161	3565	5285	6099	7401	10650	10249	10262
13	6695	8172	4002	4673	4655	4678	6211	3503	3481	3745	2147	4865	1950	1964	2025	2395	4185	5113	6166	9285	8898	8980
14	5580	7458	2942	3467	3629	3933	5896	4094	4209	4650	3154	6063	2246	2819	2957	3257	5018	6017	6776	9589	9243	9473
15	3389	5829	2469	1706	1616	2557	5132	5144	5449	6120	4903	8077	4192	4980	5136	5410	7124	8151	8689	11114	10825	11218
16	6790	8640	3517	4472	4867	5115	6869	4313	4277	4490	2872	5262	1184	1584	1736	2020	3781	4779	5599	8580	8207	8355
17	1759	4887	3260	1579	992	2460	5108	6310	6690	7442	6384	9626	5772	6614	6775	7041	8733	9769	10204	12403	12149	12629
18	4744	6823	2518	2698	2840	3332	5551	4433	4634	5183	3794	6837	2930	3633	3783	4067	5804	6819	7469	10114	9791	10095
19	5575	7122	3451	3750	3520	3603	5390	3520	3663	4157	2736	5809	2663	3022	3117	3461	5252	6212	7127	10059	9699	9878
20	2476	5531	2557	1047	1348	2738	5426	6083	6420	7124	5953	9137	5058	5941	6111	6361	8030	9072	9464	11659	11402	11880
22	7814	9075	4974	5785	5749	5644	6868	3485	3295	3286	1708	3807	2114	1425	1342	1748	3419	4237	5569	8928	8507	8448
23	8207	10150	4388	5685	6351	6627	8280	5235	5064	5025	3475	4850	818	470	712	686	2292	3321	4108	7253	6852	6911
25	1568	4381	3737	2087	678	2068	4665	6160	6566	7348	6384	9660	6068	6847	6995	7280	9003	10027	10545	12829	12565	13018
26	2102	5628	2679	890	1751	3219	5887	6798	7141	7849	6673	9842	5581	6529	6711	6940	8563	9614	9891	11904	11672	12212
27	4471	6190	3106	2902	2415	2671	4823	3977	4241	4877	3639	6835	3514	4063	4181	4504	6280	7265	8051	10794	10461	10728
28	2781	5390	2732	1525	1124	2327	4994	5497	5837	6548	5407	8620	4788	5588	5744	6018	7729	8757	9268	11621	11343	11766
29	6941	7421	5470	5648	4788	4227	4956	1643	1670	2146	1010	4308	3765	3408	3350	3756	5403	6149	7577	10917	10503	10458
30	3277	4510	4061	3032	1151	1024	3542	4339	4751	5547	4691	7991	5199	5714	5814	6155	7941	8908	9738	12430	12110	12404
31	6839	7784	4810	5204	4708	4412	5540	2492	2472	2800	1288	4406	2916	2644	2619	3024	4743	5564	6860	10128	9723	9724
32	6045	8326	2461	3519	4292	4826	6915	4992	5042	5371	3783	6318	1485	2427	2629	2823	4451	5495	5990	8627	8297	8592
33	7183	8414	4615	5267	5100	4976	6262	3147	3050	3217	1598	4261	2248	1900	1883	2285	4025	4880	6121	9387	8980	8981
201	2289	3283	4852	3387	1025	889	3275	5388	5850	6692	6004	9301	6537	7109	7214	7550	9331	10307	11080	13646	13346	13696
202	2250	2993	5121	3616	1289	1038	3181	5552	6024	6874	6236	9526	6835	7399	7502	7840	9623	10596	11378	13943	13645	13996
203	3806	2812	6117	4872	2511	1110	1640	4501	5011	5886	5587	8768	7068	7383	7436	7813	9601	10497	11548	14411	14072	14296
204	3485	2414	6183	4830	2446	1223	1873	4927	5480	6355	6027	9225	7356	7727	7790	8160	9952	10865	11863	14658	14329	14584
205	3784	2013	6703	5324	2943	1747	1628	5196	5712	6587	6370	9518	7852	8190	8245	8621	10410	11308	12345	15170	14837	15081
206	4937	3492	6722	5691	3434	1965	946	3654	4174	5043	5014	8038	7100	7223	7238	7634	9389	10215	11447	14503	14137	14265
207	5629	3624	7505	6492	4224	2753	559	3732	4244	5082	5302	8145	7709	7739	7734	8136	9859	10640	11968	15109	14731	14812

To be continued on next page...

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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

...continued from previous page

Table with columns: WTG, NSP001 to NSP022. Rows 208 to 335. This is a large data table containing noise level calculations for various wind turbine configurations.

Summary table with columns: WTG, NSP023 to NSP032. Rows 1 to 13. This table summarizes noise levels for different turbine types (1-13).

To be continued on next page...

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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

...continued from previous page

WTG	NSP023	NSP024	NSP025	NSP026	NSP027	NSP028	NSP029	NSP030	NSP031	NSP032
14	10156	11033	9239	9768	7357	6107	11326	10406	12564	11051
15	12036	12820	8862	10158	7764	6859	11368	10362	13515	12017
16	8977	9891	9987	10130	7772	6376	11114	10258	11830	10326
17	13516	14243	8904	10713	8415	7767	11699	10657	14427	12959
18	10840	11676	9074	9902	7480	6355	11251	10293	12855	11343
19	10504	11418	8667	9171	6758	5519	11924	11000	13124	11612
20	12771	13495	9223	10815	8464	7686	11178	10146	13744	12269
22	8851	9880	9553	9236	6980	5475	12339	11527	12573	11095
23	7479	8420	11211	11005	8737	7242	10737	9976	10805	9325
25	13877	14628	8451	10351	8086	7514	12208	11165	14917	13445
26	13155	13831	9686	11420	9094	8366	10920	9875	13759	12305
27	11430	12297	8357	9279	6859	5809	11932	10963	13582	12071
28	12606	13372	8775	10271	7908	7106	11530	10508	13892	12403
29	10840	11883	7548	7460	5115	3706	13733	12848	14430	12935
30	13116	13978	7293	8784	6442	5743	12955	11945	15035	13530
31	10167	11181	8334	8312	5966	4555	12908	12033	13587	12089
32	9352	10176	10280	10740	8340	7038	10373	9475	11525	10012
33	9438	10443	9075	8962	6646	5194	12376	11527	12888	11395
201	14452	15284	7050	9061	6865	6463	13538	12501	16018	14528
202	14751	15584	6924	9034	6879	6545	13765	12726	16295	14807
203	14922	15842	5433	7464	5345	5155	14965	13943	17117	15611
204	15241	16142	5595	7793	5731	5602	14967	13937	17263	15762
205	15721	16632	5211	7578	5619	5636	15470	14436	17789	16288
206	14792	15769	4599	6355	4199	4048	15632	14628	17465	15952
207	15286	16292	3805	5638	3591	3699	16418	15417	18167	16654
208	9054	10162	9232	8480	6373	4807	13507	12724	13413	11965
209	8746	9869	9560	8692	6641	5069	13544	12784	13283	11850
210	8278	9415	10059	9088	7094	5519	13480	12750	13010	11596
211	7559	8635	10736	10078	7956	6396	12218	11494	11848	10413
212	7204	8265	11110	10488	8356	6799	11869	11159	11437	10005
213	6791	7838	11544	10939	8806	7250	11528	10840	10999	9572
214	6439	7495	11880	11220	9111	7550	11473	10812	10782	9371
215	7516	8403	11418	11345	9045	7576	10260	9486	10487	8997
216	6151	7085	12478	12096	9893	8363	10248	9585	9755	8310
217	5463	6427	13043	12522	10372	8822	10318	9714	9441	8034
218	5097	6270	13290	12192	10298	8726	12259	11734	10637	9363
219	4271	5446	14090	13017	11117	9544	11878	11411	9967	8738
220	4087	5288	14391	13223	11375	9805	12188	11750	10082	8898
221	3565	4782	15025	13805	11990	10423	12263	11878	9867	8748
222	1582	2065	17500	16781	14736	13168	9419	9264	6276	5281
223	2237	2689	17079	16471	14379	12818	8938	8734	6149	5031
224	2447	3517	15858	14979	12996	11422	10523	10201	8032	6896
225	2699	3718	15655	14838	12826	11254	10292	9947	7959	6780
226	2789	3565	15981	15346	13259	11697	9364	9039	7106	5882
227	3630	4330	15438	14961	12812	11264	8878	8478	7135	5805
228	1762	2549	16887	16127	14096	12526	9728	9506	6860	5795
229	4226	4992	14753	14319	12150	10609	9032	8556	7668	6290
230	4521	5315	14412	13997	11820	10281	9146	8635	7952	6556
231	5020	5790	14064	13747	11536	10011	8991	8432	8114	6682
232	5529	6079	14562	14509	12226	10744	7747	7169	7306	5821
233	5912	6478	14240	14254	11952	10486	7764	7139	7587	6090
234	6240	6791	14106	14198	11878	10429	7631	6972	7691	6185
235	6659	7304	13356	13464	11136	9696	8195	7480	8441	6935
301	14428	15538	3901	3691	1268	1010	17417	16481	18354	16858
302	14890	16007	3497	3213	803	1244	17912	16973	18861	17365
303	15797	16911	2609	2728	853	2114	18598	17643	19688	18187
304	16380	17499	2152	2319	1160	2636	19182	18222	20299	18799

To be continued on next page...

Project:

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DECIBEL - Main Result

Calculation: BISON 3 Noise (with existing BISON 1, 2)

...continued from previous page

WTG	NSP023	NSP024	NSP025	NSP026	NSP027	NSP028	NSP029	NSP030	NSP031	NSP032
305	16756	17852	1541	2986	1910	3205	19063	18084	20408	18900
306	16395	17494	1912	2951	1586	2834	18818	17846	20097	18591
307	15738	16821	2552	3601	1695	2485	18002	17030	19315	17807
308	3253	3031	18201	17817	15649	14109	7568	7501	4465	3357
309	3326	3294	17672	17311	15133	13596	7561	7420	4841	3631
310	3032	3270	17074	16640	14484	12940	8083	7868	5576	4350
311	3337	3689	16608	16212	14041	12501	8050	7773	5878	4585
312	3678	4086	16243	15897	13707	12174	7965	7636	6092	4747
313	4081	4548	15806	15515	13306	11781	7919	7529	6388	4997
314	4603	5223	14927	14659	12437	10918	8297	7807	7198	5772
315	4956	5341	15596	15503	13235	11743	7222	6761	6305	4836
316	4960	5166	16322	16271	13995	12509	6632	6251	5538	4063
317	4595	4769	16582	16461	14205	12705	6803	6475	5356	3912
318	4377	4348	17399	17244	15001	13494	6610	6408	4602	3203
319	5717	5369	18641	18702	16407	14935	5105	5095	3146	1638
320	5955	5513	19124	19198	16902	15432	4918	5008	2664	1151
321	6041	5507	19590	19644	17353	15879	4966	5152	2197	688
322	7182	6661	19856	20100	17768	16331	3842	4117	2273	1159
323	7459	6974	19738	20043	17699	16277	3495	3749	2576	1529
324	7296	6940	18931	19268	16916	15503	3525	3543	3295	2022
325	8658	8187	20043	20542	18167	16790	2310	2715	3303	2640
326	8261	7876	19335	19821	17446	16068	2563	2683	3578	2615
327	8358	8026	19014	19541	17160	15795	2482	2456	3947	2923
328	8575	8384	18102	18728	16333	15000	2674	2219	4909	3751
329	9756	9547	18456	19279	16867	15591	1822	1087	5605	4647
330	9479	9363	17688	18507	16094	14822	2590	1754	5949	4839
331	8572	8503	17261	17929	15528	14212	3292	2610	5615	4350
332	8375	8378	16756	17404	15004	13685	3809	3087	5912	4577
333	7558	7544	16889	17372	14993	13626	4161	3603	5361	3950
334	7466	7373	17383	17833	15459	14081	3891	3446	4868	3477
335	6929	6829	17422	17766	15409	14004	4289	3924	4606	3155

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) **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]
1	4,264	4,265	14.93	108.0	0.00	83.60	-	-	0.00	0.00	-	0.00
2	3,199	3,201	18.41	108.0	0.00	81.11	-	-	0.00	0.00	-	0.00
3	6,695	6,696	7.53	107.0	0.00	87.52	-	-	0.00	0.00	-	0.00
4	6,984	6,984	6.99	107.0	0.00	87.88	-	-	0.00	0.00	-	0.00
5	5,427	5,428	10.20	107.0	0.00	85.69	-	-	0.00	0.00	-	0.00
6	2,205	2,207	22.66	108.0	0.00	77.88	-	-	0.00	0.00	-	0.00
7	3,161	3,163	18.55	108.0	0.00	81.00	-	-	0.00	0.00	-	0.00
8	7,475	7,476	6.11	107.0	0.00	88.47	-	-	0.00	0.00	-	0.00
9	4,600	4,600	13.97	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
10	3,813	3,814	16.31	108.0	0.00	82.63	-	-	0.00	0.00	-	0.00
11	4,431	4,431	14.45	108.0	0.00	83.93	-	-	0.00	0.00	-	0.00
12	6,533	6,534	7.84	107.0	0.00	87.30	-	-	0.00	0.00	-	0.00
13	6,695	6,695	7.53	107.0	0.00	87.52	-	-	0.00	0.00	-	0.00
14	5,580	5,581	9.85	107.0	0.00	85.93	-	-	0.00	0.00	-	0.00
15	3,389	3,390	17.73	108.0	0.00	81.60	-	-	0.00	0.00	-	0.00
16	6,790	6,790	7.35	107.0	0.00	87.64	-	-	0.00	0.00	-	0.00
17	1,759	1,761	25.34	108.0	0.00	75.91	-	-	0.00	0.00	-	0.00
18	4,744	4,745	11.89	107.0	0.00	84.52	-	-	0.00	0.00	-	0.00
19	5,575	5,575	9.86	107.0	0.00	85.93	-	-	0.00	0.00	-	0.00
20	2,476	2,478	21.29	108.0	0.00	78.88	-	-	0.00	0.00	-	0.00
22	7,814	7,815	5.54	107.0	0.00	88.86	-	-	0.00	0.00	-	0.00
23	8,207	8,207	4.90	107.0	0.00	89.28	-	-	0.00	0.00	-	0.00
25	1,568	1,569	26.67	108.0	0.00	74.91	-	-	0.00	0.00	-	0.00
26	2,102	2,104	23.24	108.0	0.00	77.46	-	-	0.00	0.00	-	0.00
27	4,471	4,471	14.33	108.0	0.00	84.01	-	-	0.00	0.00	-	0.00
28	2,781	2,782	20.02	108.0	0.00	79.89	-	-	0.00	0.00	-	0.00
29	6,941	6,941	7.07	107.0	0.00	87.83	-	-	0.00	0.00	-	0.00
30	3,277	3,278	18.13	108.0	0.00	81.31	-	-	0.00	0.00	-	0.00
31	6,839	6,839	7.26	107.0	0.00	87.70	-	-	0.00	0.00	-	0.00
32	6,045	6,046	8.83	107.0	0.00	86.63	-	-	0.00	0.00	-	0.00
33	7,183	7,183	6.63	107.0	0.00	88.13	-	-	0.00	0.00	-	0.00
201	2,289	2,290	22.21	108.0	0.00	78.20	-	-	0.00	0.00	-	0.00
202	2,250	2,251	22.42	108.0	0.00	78.05	-	-	0.00	0.00	-	0.00
203	3,806	3,806	16.34	108.0	0.00	82.61	-	-	0.00	0.00	-	0.00
204	3,485	3,486	17.40	108.0	0.00	81.85	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
205	3,784	3,785	16.41	108.0	0.00	82.56	-	-	0.00	0.00	-	0.00
206	4,937	4,937	13.06	108.0	0.00	84.87	-	-	0.00	0.00	-	0.00
207	5,629	5,630	11.34	108.0	0.00	86.01	-	-	0.00	0.00	-	0.00
208	8,747	8,747	5.24	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
209	9,136	9,136	4.61	108.0	0.00	90.22	-	-	0.00	0.00	-	0.00
210	9,588	9,589	3.91	108.0	0.00	90.64	-	-	0.00	0.00	-	0.00
211	9,129	9,130	4.62	108.0	0.00	90.21	-	-	0.00	0.00	-	0.00
212	9,223	9,223	4.47	108.0	0.00	90.30	-	-	0.00	0.00	-	0.00
213	9,403	9,403	4.19	108.0	0.00	90.47	-	-	0.00	0.00	-	0.00
214	9,729	9,729	3.70	108.0	0.00	90.76	-	-	0.00	0.00	-	0.00
215	7,962	7,963	6.57	108.0	0.00	89.02	-	-	0.00	0.00	-	0.00
216	9,355	9,356	4.27	108.0	0.00	90.42	-	-	0.00	0.00	-	0.00
217	10,067	10,067	3.20	108.0	0.00	91.06	-	-	0.00	0.00	-	0.00
218	11,731	11,731	0.95	108.0	0.00	92.39	-	-	0.00	0.00	-	0.00
219	12,209	12,210	0.36	108.0	0.00	92.73	-	-	0.00	0.00	-	0.00
220	12,676	12,676	-0.20	108.0	0.00	93.06	-	-	0.00	0.00	-	0.00
221	13,273	13,273	-0.88	108.0	0.00	93.46	-	-	0.00	0.00	-	0.00
222	13,863	13,863	-1.53	108.0	0.00	93.84	-	-	0.00	0.00	-	0.00
223	13,236	13,237	-0.84	108.0	0.00	93.44	-	-	0.00	0.00	-	0.00
224	12,991	12,991	-0.56	108.0	0.00	93.27	-	-	0.00	0.00	-	0.00
225	12,672	12,672	-0.19	108.0	0.00	93.06	-	-	0.00	0.00	-	0.00
226	12,441	12,442	0.08	108.0	0.00	92.90	-	-	0.00	0.00	-	0.00
227	11,619	11,619	1.10	108.0	0.00	92.30	-	-	0.00	0.00	-	0.00
228	13,479	13,479	-1.11	108.0	0.00	93.59	-	-	0.00	0.00	-	0.00
229	11,001	11,001	1.90	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
230	10,710	10,711	2.30	108.0	0.00	91.60	-	-	0.00	0.00	-	0.00
231	10,209	10,209	3.00	108.0	0.00	91.18	-	-	0.00	0.00	-	0.00
232	9,874	9,875	3.48	108.0	0.00	90.89	-	-	0.00	0.00	-	0.00
233	9,471	9,472	4.09	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
234	9,177	9,177	4.55	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
235	8,620	8,620	5.45	108.0	0.00	89.71	-	-	0.00	0.00	-	0.00
301	8,073	8,073	6.38	108.0	0.00	89.14	-	-	0.00	0.00	-	0.00
302	8,378	8,378	5.85	108.0	0.00	89.46	-	-	0.00	0.00	-	0.00
303	8,567	8,567	5.53	108.0	0.00	89.66	-	-	0.00	0.00	-	0.00
304	8,953	8,953	4.90	108.0	0.00	90.04	-	-	0.00	0.00	-	0.00
305	8,413	8,413	5.79	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
306	8,350	8,351	5.90	108.0	0.00	89.43	-	-	0.00	0.00	-	0.00
307	7,667	7,667	7.11	108.0	0.00	88.69	-	-	0.00	0.00	-	0.00
308	13,581	13,581	-1.23	108.0	0.00	93.66	-	-	0.00	0.00	-	0.00
309	13,087	13,087	-0.67	108.0	0.00	93.34	-	-	0.00	0.00	-	0.00
310	12,784	12,784	-0.32	108.0	0.00	93.13	-	-	0.00	0.00	-	0.00
311	12,314	12,314	0.23	108.0	0.00	92.81	-	-	0.00	0.00	-	0.00
312	11,900	11,900	0.74	108.0	0.00	92.51	-	-	0.00	0.00	-	0.00
313	11,418	11,418	1.35	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
314	10,700	10,700	2.31	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00
315	10,751	10,752	2.24	108.0	0.00	91.63	-	-	0.00	0.00	-	0.00
316	11,213	11,213	1.62	108.0	0.00	91.99	-	-	0.00	0.00	-	0.00
317	11,595	11,596	1.13	108.0	0.00	92.29	-	-	0.00	0.00	-	0.00
318	12,342	12,342	0.20	108.0	0.00	92.83	-	-	0.00	0.00	-	0.00
319	12,869	12,869	-0.42	108.0	0.00	93.19	-	-	0.00	0.00	-	0.00
320	13,255	13,255	-0.86	108.0	0.00	93.45	-	-	0.00	0.00	-	0.00
321	13,709	13,709	-1.37	108.0	0.00	93.74	-	-	0.00	0.00	-	0.00
322	13,512	13,512	-1.15	108.0	0.00	93.61	-	-	0.00	0.00	-	0.00
323	13,270	13,270	-0.88	108.0	0.00	93.46	-	-	0.00	0.00	-	0.00
324	12,484	12,485	0.03	108.0	0.00	92.93	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power - BISON Wind Energy Center

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
325	13,128	13,129	-0.72	108.0	0.00	93.36	-	-	0.00	0.00	-	0.00
326	12,519	12,519	-0.01	108.0	0.00	92.95	-	-	0.00	0.00	-	0.00
327	12,142	12,142	0.44	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
328	11,119	11,120	1.74	108.0	0.00	91.92	-	-	0.00	0.00	-	0.00
329	11,031	11,032	1.86	108.0	0.00	91.85	-	-	0.00	0.00	-	0.00
330	10,349	10,349	2.80	108.0	0.00	91.30	-	-	0.00	0.00	-	0.00
331	10,292	10,292	2.88	108.0	0.00	91.25	-	-	0.00	0.00	-	0.00
332	9,900	9,900	3.45	108.0	0.00	90.91	-	-	0.00	0.00	-	0.00
333	10,387	10,388	2.74	108.0	0.00	91.33	-	-	0.00	0.00	-	0.00
334	10,883	10,884	2.06	108.0	0.00	91.74	-	-	0.00	0.00	-	0.00
335	11,159	11,159	1.69	108.0	0.00	91.95	-	-	0.00	0.00	-	0.00
Sum	34.15											

- 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]
1	5,793	5,794	10.95	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
2	4,849	4,851	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
3	8,818	8,818	3.97	107.0	0.00	89.91	-	-	0.00	0.00	-	0.00
4	8,536	8,537	4.39	107.0	0.00	89.63	-	-	0.00	0.00	-	0.00
5	7,727	7,728	5.68	107.0	0.00	88.76	-	-	0.00	0.00	-	0.00
6	4,861	4,862	13.26	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
7	6,050	6,051	10.37	108.0	0.00	86.64	-	-	0.00	0.00	-	0.00
8	9,385	9,385	3.15	107.0	0.00	90.45	-	-	0.00	0.00	-	0.00
9	5,469	5,470	11.72	108.0	0.00	85.76	-	-	0.00	0.00	-	0.00
10	5,265	5,266	12.22	108.0	0.00	85.43	-	-	0.00	0.00	-	0.00
11	4,496	4,497	14.26	108.0	0.00	84.06	-	-	0.00	0.00	-	0.00
12	7,286	7,286	6.44	107.0	0.00	88.25	-	-	0.00	0.00	-	0.00
13	8,172	8,173	4.96	107.0	0.00	89.25	-	-	0.00	0.00	-	0.00
14	7,458	7,458	6.14	107.0	0.00	88.45	-	-	0.00	0.00	-	0.00
15	5,829	5,830	10.87	108.0	0.00	86.31	-	-	0.00	0.00	-	0.00
16	8,640	8,641	4.23	107.0	0.00	89.73	-	-	0.00	0.00	-	0.00
17	4,887	4,888	13.19	108.0	0.00	84.78	-	-	0.00	0.00	-	0.00
18	6,823	6,824	7.29	107.0	0.00	87.68	-	-	0.00	0.00	-	0.00
19	7,122	7,122	6.74	107.0	0.00	88.05	-	-	0.00	0.00	-	0.00
20	5,531	5,532	11.57	108.0	0.00	85.86	-	-	0.00	0.00	-	0.00
22	9,075	9,075	3.59	107.0	0.00	90.16	-	-	0.00	0.00	-	0.00
23	10,150	10,151	2.12	107.0	0.00	91.13	-	-	0.00	0.00	-	0.00
25	4,381	4,382	14.59	108.0	0.00	83.83	-	-	0.00	0.00	-	0.00
26	5,628	5,629	11.34	108.0	0.00	86.01	-	-	0.00	0.00	-	0.00
27	6,190	6,190	10.06	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
28	5,390	5,391	11.91	108.0	0.00	85.63	-	-	0.00	0.00	-	0.00
29	7,421	7,422	6.21	107.0	0.00	88.41	-	-	0.00	0.00	-	0.00
30	4,510	4,511	14.22	108.0	0.00	84.08	-	-	0.00	0.00	-	0.00
31	7,784	7,785	5.59	107.0	0.00	88.82	-	-	0.00	0.00	-	0.00
32	8,326	8,326	4.72	107.0	0.00	89.41	-	-	0.00	0.00	-	0.00
33	8,414	8,414	4.58	107.0	0.00	89.50	-	-	0.00	0.00	-	0.00
201	3,283	3,285	18.11	108.0	0.00	81.33	-	-	0.00	0.00	-	0.00
202	2,993	2,994	19.18	108.0	0.00	80.52	-	-	0.00	0.00	-	0.00
203	2,812	2,814	19.89	108.0	0.00	79.99	-	-	0.00	0.00	-	0.00
204	2,414	2,415	21.57	108.0	0.00	78.66	-	-	0.00	0.00	-	0.00
205	2,013	2,016	23.75	108.0	0.00	77.09	-	-	0.00	0.00	-	0.00

To be continued on next page...

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
206	3,492	3,492	17.38	108.0	0.00	81.86	-	-	0.00	0.00	-	0.00
207	3,624	3,625	16.93	108.0	0.00	82.19	-	-	0.00	0.00	-	0.00
208	9,524	9,524	4.01	108.0	0.00	90.58	-	-	0.00	0.00	-	0.00
209	9,939	9,939	3.39	108.0	0.00	90.95	-	-	0.00	0.00	-	0.00
210	10,471	10,472	2.63	108.0	0.00	91.40	-	-	0.00	0.00	-	0.00
211	10,503	10,503	2.58	108.0	0.00	91.43	-	-	0.00	0.00	-	0.00
212	10,741	10,741	2.25	108.0	0.00	91.62	-	-	0.00	0.00	-	0.00
213	11,060	11,060	1.82	108.0	0.00	91.88	-	-	0.00	0.00	-	0.00
214	11,421	11,422	1.35	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
215	10,097	10,098	3.16	108.0	0.00	91.08	-	-	0.00	0.00	-	0.00
216	11,466	11,466	1.29	108.0	0.00	92.19	-	-	0.00	0.00	-	0.00
217	12,167	12,167	0.41	108.0	0.00	92.70	-	-	0.00	0.00	-	0.00
218	13,310	13,311	-0.93	108.0	0.00	93.48	-	-	0.00	0.00	-	0.00
219	13,962	13,963	-1.64	108.0	0.00	93.90	-	-	0.00	0.00	-	0.00
220	14,383	14,383	-2.08	108.0	0.00	94.16	-	-	0.00	0.00	-	0.00
221	15,028	15,028	-2.74	108.0	0.00	94.54	-	-	0.00	0.00	-	0.00
222	16,439	16,439	-4.09	108.0	0.00	95.32	-	-	0.00	0.00	-	0.00
223	15,874	15,874	-3.56	108.0	0.00	95.01	-	-	0.00	0.00	-	0.00
224	15,212	15,212	-2.92	108.0	0.00	94.64	-	-	0.00	0.00	-	0.00
225	14,927	14,928	-2.64	108.0	0.00	94.48	-	-	0.00	0.00	-	0.00
226	14,921	14,922	-2.64	108.0	0.00	94.48	-	-	0.00	0.00	-	0.00
227	14,179	14,179	-1.87	108.0	0.00	94.03	-	-	0.00	0.00	-	0.00
228	15,947	15,947	-3.63	108.0	0.00	95.05	-	-	0.00	0.00	-	0.00
229	13,502	13,502	-1.14	108.0	0.00	93.61	-	-	0.00	0.00	-	0.00
230	13,173	13,174	-0.77	108.0	0.00	93.39	-	-	0.00	0.00	-	0.00
231	12,709	12,710	-0.24	108.0	0.00	93.08	-	-	0.00	0.00	-	0.00
232	12,715	12,715	-0.24	108.0	0.00	93.09	-	-	0.00	0.00	-	0.00
233	12,325	12,325	0.22	108.0	0.00	92.82	-	-	0.00	0.00	-	0.00
234	12,083	12,083	0.51	108.0	0.00	92.64	-	-	0.00	0.00	-	0.00
235	11,407	11,407	1.37	108.0	0.00	92.14	-	-	0.00	0.00	-	0.00
301	6,363	6,363	9.69	108.0	0.00	87.07	-	-	0.00	0.00	-	0.00
302	6,432	6,432	9.54	108.0	0.00	87.17	-	-	0.00	0.00	-	0.00
303	6,193	6,193	10.06	108.0	0.00	86.84	-	-	0.00	0.00	-	0.00
304	6,342	6,342	9.73	108.0	0.00	87.04	-	-	0.00	0.00	-	0.00
305	5,580	5,581	11.45	108.0	0.00	85.93	-	-	0.00	0.00	-	0.00
306	5,680	5,681	11.22	108.0	0.00	86.09	-	-	0.00	0.00	-	0.00
307	5,284	5,285	12.17	108.0	0.00	85.46	-	-	0.00	0.00	-	0.00
308	16,541	16,541	-4.18	108.0	0.00	95.37	-	-	0.00	0.00	-	0.00
309	16,018	16,018	-3.70	108.0	0.00	95.09	-	-	0.00	0.00	-	0.00
310	15,587	15,587	-3.29	108.0	0.00	94.86	-	-	0.00	0.00	-	0.00
311	15,101	15,101	-2.81	108.0	0.00	94.58	-	-	0.00	0.00	-	0.00
312	14,691	14,691	-2.40	108.0	0.00	94.34	-	-	0.00	0.00	-	0.00
313	14,207	14,208	-1.90	108.0	0.00	94.05	-	-	0.00	0.00	-	0.00
314	13,388	13,388	-1.01	108.0	0.00	93.53	-	-	0.00	0.00	-	0.00
315	13,700	13,700	-1.36	108.0	0.00	93.73	-	-	0.00	0.00	-	0.00
316	14,287	14,287	-1.98	108.0	0.00	94.10	-	-	0.00	0.00	-	0.00
317	14,634	14,635	-2.34	108.0	0.00	94.31	-	-	0.00	0.00	-	0.00
318	15,434	15,434	-3.14	108.0	0.00	94.77	-	-	0.00	0.00	-	0.00
319	16,244	16,244	-3.91	108.0	0.00	95.21	-	-	0.00	0.00	-	0.00
320	16,673	16,674	-4.30	108.0	0.00	95.44	-	-	0.00	0.00	-	0.00
321	17,141	17,141	-4.72	108.0	0.00	95.68	-	-	0.00	0.00	-	0.00
322	17,098	17,098	-4.68	108.0	0.00	95.66	-	-	0.00	0.00	-	0.00
323	16,893	16,893	-4.50	108.0	0.00	95.55	-	-	0.00	0.00	-	0.00
324	16,086	16,087	-3.76	108.0	0.00	95.13	-	-	0.00	0.00	-	0.00
325	16,889	16,889	-4.49	108.0	0.00	95.55	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
326	16,241	16,241	-3.91	108.0	0.00	95.21	-	-	0.00	0.00	-	0.00
327	15,875	15,875	-3.56	108.0	0.00	95.01	-	-	0.00	0.00	-	0.00
328	14,870	14,871	-2.58	108.0	0.00	94.45	-	-	0.00	0.00	-	0.00
329	14,911	14,911	-2.62	108.0	0.00	94.47	-	-	0.00	0.00	-	0.00
330	14,195	14,195	-1.89	108.0	0.00	94.04	-	-	0.00	0.00	-	0.00
331	14,023	14,023	-1.70	108.0	0.00	93.94	-	-	0.00	0.00	-	0.00
332	13,585	13,586	-1.23	108.0	0.00	93.66	-	-	0.00	0.00	-	0.00
333	13,962	13,963	-1.64	108.0	0.00	93.90	-	-	0.00	0.00	-	0.00
334	14,470	14,470	-2.17	108.0	0.00	94.21	-	-	0.00	0.00	-	0.00
335	14,669	14,669	-2.38	108.0	0.00	94.33	-	-	0.00	0.00	-	0.00
Sum	30.70											

- 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]
1	3,406	3,408	17.67	108.0	0.00	81.65	-	-	0.00	0.00	-	0.00
2	3,610	3,611	16.98	108.0	0.00	82.15	-	-	0.00	0.00	-	0.00
3	3,064	3,066	17.21	107.0	0.00	80.73	-	-	0.00	0.00	-	0.00
4	4,055	4,056	13.83	107.0	0.00	83.16	-	-	0.00	0.00	-	0.00
5	2,198	2,200	21.12	107.0	0.00	77.85	-	-	0.00	0.00	-	0.00
6	3,220	3,221	18.34	108.0	0.00	81.16	-	-	0.00	0.00	-	0.00
7	2,055	2,057	23.51	108.0	0.00	77.26	-	-	0.00	0.00	-	0.00
8	3,880	3,881	14.37	107.0	0.00	82.78	-	-	0.00	0.00	-	0.00
9	4,252	4,253	14.96	108.0	0.00	83.57	-	-	0.00	0.00	-	0.00
10	3,610	3,611	16.98	108.0	0.00	82.15	-	-	0.00	0.00	-	0.00
11	5,168	5,169	12.47	108.0	0.00	85.27	-	-	0.00	0.00	-	0.00
12	4,917	4,917	11.44	107.0	0.00	84.83	-	-	0.00	0.00	-	0.00
13	4,002	4,002	14.00	107.0	0.00	83.05	-	-	0.00	0.00	-	0.00
14	2,942	2,943	17.68	107.0	0.00	80.38	-	-	0.00	0.00	-	0.00
15	2,469	2,471	21.32	108.0	0.00	78.86	-	-	0.00	0.00	-	0.00
16	3,517	3,518	15.57	107.0	0.00	81.93	-	-	0.00	0.00	-	0.00
17	3,260	3,261	18.19	108.0	0.00	81.27	-	-	0.00	0.00	-	0.00
18	2,518	2,518	19.47	107.0	0.00	79.02	-	-	0.00	0.00	-	0.00
19	3,451	3,452	15.79	107.0	0.00	81.76	-	-	0.00	0.00	-	0.00
20	2,557	2,559	20.94	108.0	0.00	79.16	-	-	0.00	0.00	-	0.00
22	4,974	4,975	11.30	107.0	0.00	84.94	-	-	0.00	0.00	-	0.00
23	4,388	4,390	12.86	107.0	0.00	83.85	-	-	0.00	0.00	-	0.00
25	3,737	3,737	16.56	108.0	0.00	82.45	-	-	0.00	0.00	-	0.00
26	2,679	2,681	20.43	108.0	0.00	79.57	-	-	0.00	0.00	-	0.00
27	3,106	3,107	18.76	108.0	0.00	80.85	-	-	0.00	0.00	-	0.00
28	2,732	2,734	20.21	108.0	0.00	79.74	-	-	0.00	0.00	-	0.00
29	5,470	5,470	10.10	107.0	0.00	85.76	-	-	0.00	0.00	-	0.00
30	4,061	4,062	15.54	108.0	0.00	83.17	-	-	0.00	0.00	-	0.00
31	4,810	4,810	11.72	107.0	0.00	84.64	-	-	0.00	0.00	-	0.00
32	2,461	2,462	19.73	107.0	0.00	78.82	-	-	0.00	0.00	-	0.00
33	4,615	4,616	12.23	107.0	0.00	84.29	-	-	0.00	0.00	-	0.00
201	4,852	4,852	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
202	5,121	5,121	12.59	108.0	0.00	85.19	-	-	0.00	0.00	-	0.00
203	6,117	6,118	10.22	108.0	0.00	86.73	-	-	0.00	0.00	-	0.00
204	6,183	6,183	10.08	108.0	0.00	86.82	-	-	0.00	0.00	-	0.00
205	6,703	6,704	8.97	108.0	0.00	87.53	-	-	0.00	0.00	-	0.00
206	6,722	6,722	8.94	108.0	0.00	87.55	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
207	7,505	7,506	7.41	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
208	6,246	6,246	9.94	108.0	0.00	86.91	-	-	0.00	0.00	-	0.00
209	6,504	6,504	9.39	108.0	0.00	87.26	-	-	0.00	0.00	-	0.00
210	6,758	6,758	8.86	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
211	5,807	5,807	10.92	108.0	0.00	86.28	-	-	0.00	0.00	-	0.00
212	5,711	5,712	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
213	5,701	5,702	11.17	108.0	0.00	86.12	-	-	0.00	0.00	-	0.00
214	5,939	5,940	10.62	108.0	0.00	86.48	-	-	0.00	0.00	-	0.00
215	3,963	3,964	15.84	108.0	0.00	82.96	-	-	0.00	0.00	-	0.00
216	5,176	5,177	12.45	108.0	0.00	85.28	-	-	0.00	0.00	-	0.00
217	5,829	5,829	10.87	108.0	0.00	86.31	-	-	0.00	0.00	-	0.00
218	7,838	7,838	6.80	108.0	0.00	88.88	-	-	0.00	0.00	-	0.00
219	8,121	8,121	6.30	108.0	0.00	89.19	-	-	0.00	0.00	-	0.00
220	8,598	8,598	5.48	108.0	0.00	89.69	-	-	0.00	0.00	-	0.00
221	9,121	9,121	4.63	108.0	0.00	90.20	-	-	0.00	0.00	-	0.00
222	9,173	9,173	4.55	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
223	8,531	8,531	5.59	108.0	0.00	89.62	-	-	0.00	0.00	-	0.00
224	8,504	8,504	5.64	108.0	0.00	89.59	-	-	0.00	0.00	-	0.00
225	8,173	8,173	6.21	108.0	0.00	89.25	-	-	0.00	0.00	-	0.00
226	7,817	7,818	6.83	108.0	0.00	88.86	-	-	0.00	0.00	-	0.00
227	6,972	6,973	8.43	108.0	0.00	87.87	-	-	0.00	0.00	-	0.00
228	8,841	8,841	5.08	108.0	0.00	89.93	-	-	0.00	0.00	-	0.00
229	6,404	6,405	9.60	108.0	0.00	87.13	-	-	0.00	0.00	-	0.00
230	6,147	6,148	10.16	108.0	0.00	86.77	-	-	0.00	0.00	-	0.00
231	5,641	5,642	11.31	108.0	0.00	86.03	-	-	0.00	0.00	-	0.00
232	5,141	5,142	12.53	108.0	0.00	85.22	-	-	0.00	0.00	-	0.00
233	4,741	4,742	13.58	108.0	0.00	84.52	-	-	0.00	0.00	-	0.00
234	4,433	4,434	14.44	108.0	0.00	83.94	-	-	0.00	0.00	-	0.00
235	3,943	3,943	15.90	108.0	0.00	82.92	-	-	0.00	0.00	-	0.00
301	8,698	8,698	5.32	108.0	0.00	89.79	-	-	0.00	0.00	-	0.00
302	9,172	9,172	4.55	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
303	9,783	9,783	3.62	108.0	0.00	90.81	-	-	0.00	0.00	-	0.00
304	10,348	10,348	2.80	108.0	0.00	91.30	-	-	0.00	0.00	-	0.00
305	10,174	10,174	3.05	108.0	0.00	91.15	-	-	0.00	0.00	-	0.00
306	9,945	9,945	3.38	108.0	0.00	90.95	-	-	0.00	0.00	-	0.00
307	9,130	9,130	4.62	108.0	0.00	90.21	-	-	0.00	0.00	-	0.00
308	8,806	8,806	5.14	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
309	8,314	8,314	5.96	108.0	0.00	89.40	-	-	0.00	0.00	-	0.00
310	8,033	8,033	6.45	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
311	7,570	7,570	7.29	108.0	0.00	88.58	-	-	0.00	0.00	-	0.00
312	7,158	7,159	8.07	108.0	0.00	88.10	-	-	0.00	0.00	-	0.00
313	6,682	6,682	9.02	108.0	0.00	87.50	-	-	0.00	0.00	-	0.00
314	6,013	6,013	10.46	108.0	0.00	86.58	-	-	0.00	0.00	-	0.00
315	5,983	5,984	10.52	108.0	0.00	86.54	-	-	0.00	0.00	-	0.00
316	6,438	6,438	9.53	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
317	6,819	6,820	8.74	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
318	7,570	7,570	7.29	108.0	0.00	88.58	-	-	0.00	0.00	-	0.00
319	8,195	8,196	6.17	108.0	0.00	89.27	-	-	0.00	0.00	-	0.00
320	8,611	8,611	5.46	108.0	0.00	89.70	-	-	0.00	0.00	-	0.00
321	9,076	9,076	4.71	108.0	0.00	90.16	-	-	0.00	0.00	-	0.00
322	9,023	9,023	4.79	108.0	0.00	90.11	-	-	0.00	0.00	-	0.00
323	8,827	8,827	5.11	108.0	0.00	89.92	-	-	0.00	0.00	-	0.00
324	8,017	8,017	6.48	108.0	0.00	89.08	-	-	0.00	0.00	-	0.00
325	8,909	8,909	4.97	108.0	0.00	90.00	-	-	0.00	0.00	-	0.00
326	8,233	8,233	6.10	108.0	0.00	89.31	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

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Frank Frederickson
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Calculated:
6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
327	7,881	7,882	6.72	108.0	0.00	88.93	-	-	0.00	0.00	-	0.00
328	6,908	6,909	8.56	108.0	0.00	87.79	-	-	0.00	0.00	-	0.00
329	7,158	7,159	8.07	108.0	0.00	88.10	-	-	0.00	0.00	-	0.00
330	6,395	6,396	9.62	108.0	0.00	87.12	-	-	0.00	0.00	-	0.00
331	6,055	6,056	10.36	108.0	0.00	86.64	-	-	0.00	0.00	-	0.00
332	5,582	5,582	11.45	108.0	0.00	85.94	-	-	0.00	0.00	-	0.00
333	5,893	5,894	10.72	108.0	0.00	86.41	-	-	0.00	0.00	-	0.00
334	6,402	6,403	9.60	108.0	0.00	87.13	-	-	0.00	0.00	-	0.00
335	6,589	6,590	9.21	108.0	0.00	87.38	-	-	0.00	0.00	-	0.00
Sum	33.93											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP004 NSP004

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]
1	2,995	2,996	19.18	108.0	0.00	80.53	-	-	0.00	0.00	-	0.00
2	2,611	2,613	20.71	108.0	0.00	79.34	-	-	0.00	0.00	-	0.00
3	4,197	4,198	13.41	107.0	0.00	83.46	-	-	0.00	0.00	-	0.00
4	4,858	4,858	11.59	107.0	0.00	84.73	-	-	0.00	0.00	-	0.00
5	2,990	2,991	17.50	107.0	0.00	80.52	-	-	0.00	0.00	-	0.00
6	1,744	1,746	25.44	108.0	0.00	75.84	-	-	0.00	0.00	-	0.00
7	1,061	1,065	31.00	108.0	0.00	71.55	-	-	0.00	0.00	-	0.00
8	5,036	5,037	11.14	107.0	0.00	85.04	-	-	0.00	0.00	-	0.00
9	3,767	3,768	16.46	108.0	0.00	82.52	-	-	0.00	0.00	-	0.00
10	2,912	2,913	19.50	108.0	0.00	80.29	-	-	0.00	0.00	-	0.00
11	4,362	4,362	14.65	108.0	0.00	83.79	-	-	0.00	0.00	-	0.00
12	5,119	5,119	10.94	107.0	0.00	85.18	-	-	0.00	0.00	-	0.00
13	4,673	4,674	12.08	107.0	0.00	84.39	-	-	0.00	0.00	-	0.00
14	3,467	3,467	15.74	107.0	0.00	81.80	-	-	0.00	0.00	-	0.00
15	1,706	1,708	25.70	108.0	0.00	75.65	-	-	0.00	0.00	-	0.00
16	4,472	4,473	12.63	107.0	0.00	84.01	-	-	0.00	0.00	-	0.00
17	1,579	1,581	26.59	108.0	0.00	74.98	-	-	0.00	0.00	-	0.00
18	2,698	2,698	18.69	107.0	0.00	79.62	-	-	0.00	0.00	-	0.00
19	3,750	3,751	14.79	107.0	0.00	82.48	-	-	0.00	0.00	-	0.00
20	1,047	1,050	31.15	108.0	0.00	71.43	-	-	0.00	0.00	-	0.00
22	5,785	5,786	9.39	107.0	0.00	86.25	-	-	0.00	0.00	-	0.00
23	5,685	5,686	9.61	107.0	0.00	86.10	-	-	0.00	0.00	-	0.00
25	2,087	2,088	23.33	108.0	0.00	77.39	-	-	0.00	0.00	-	0.00
26	890	894	32.89	108.0	0.00	70.02	-	-	0.00	0.00	-	0.00
27	2,902	2,903	19.54	108.0	0.00	80.26	-	-	0.00	0.00	-	0.00
28	1,525	1,527	26.98	108.0	0.00	74.68	-	-	0.00	0.00	-	0.00
29	5,648	5,648	9.70	107.0	0.00	86.04	-	-	0.00	0.00	-	0.00
30	3,032	3,033	19.03	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
31	5,204	5,204	10.73	107.0	0.00	85.33	-	-	0.00	0.00	-	0.00
32	3,519	3,520	15.56	107.0	0.00	81.93	-	-	0.00	0.00	-	0.00
33	5,267	5,267	10.58	107.0	0.00	85.43	-	-	0.00	0.00	-	0.00
201	3,387	3,388	17.74	108.0	0.00	81.60	-	-	0.00	0.00	-	0.00
202	3,616	3,617	16.96	108.0	0.00	82.17	-	-	0.00	0.00	-	0.00
203	4,872	4,872	13.23	108.0	0.00	84.75	-	-	0.00	0.00	-	0.00
204	4,830	4,830	13.35	108.0	0.00	84.68	-	-	0.00	0.00	-	0.00
205	5,324	5,325	12.08	108.0	0.00	85.53	-	-	0.00	0.00	-	0.00
206	5,691	5,692	11.19	108.0	0.00	86.10	-	-	0.00	0.00	-	0.00
207	6,492	6,493	9.41	108.0	0.00	87.25	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
208	6,949	6,949	8.48	108.0	0.00	87.84	-	-	0.00	0.00	-	0.00
209	7,278	7,279	7.84	108.0	0.00	88.24	-	-	0.00	0.00	-	0.00
210	7,633	7,634	7.17	108.0	0.00	88.65	-	-	0.00	0.00	-	0.00
211	6,891	6,891	8.59	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00
212	6,886	6,887	8.60	108.0	0.00	87.76	-	-	0.00	0.00	-	0.00
213	6,971	6,971	8.44	108.0	0.00	87.87	-	-	0.00	0.00	-	0.00
214	7,258	7,258	7.88	108.0	0.00	88.22	-	-	0.00	0.00	-	0.00
215	5,345	5,346	12.02	108.0	0.00	85.56	-	-	0.00	0.00	-	0.00
216	6,678	6,679	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
217	7,369	7,369	7.66	108.0	0.00	88.35	-	-	0.00	0.00	-	0.00
218	9,232	9,233	4.46	108.0	0.00	90.31	-	-	0.00	0.00	-	0.00
219	9,609	9,610	3.88	108.0	0.00	90.65	-	-	0.00	0.00	-	0.00
220	10,085	10,085	3.18	108.0	0.00	91.07	-	-	0.00	0.00	-	0.00
221	10,646	10,646	2.38	108.0	0.00	91.54	-	-	0.00	0.00	-	0.00
222	10,940	10,940	1.98	108.0	0.00	91.78	-	-	0.00	0.00	-	0.00
223	10,304	10,304	2.86	108.0	0.00	91.26	-	-	0.00	0.00	-	0.00
224	10,179	10,179	3.04	108.0	0.00	91.15	-	-	0.00	0.00	-	0.00
225	9,852	9,852	3.52	108.0	0.00	90.87	-	-	0.00	0.00	-	0.00
226	9,553	9,554	3.96	108.0	0.00	90.60	-	-	0.00	0.00	-	0.00
227	8,717	8,717	5.29	108.0	0.00	89.81	-	-	0.00	0.00	-	0.00
228	10,585	10,585	2.47	108.0	0.00	91.49	-	-	0.00	0.00	-	0.00
229	8,124	8,124	6.29	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
230	7,850	7,850	6.78	108.0	0.00	88.90	-	-	0.00	0.00	-	0.00
231	7,344	7,345	7.71	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00
232	6,924	6,924	8.53	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00
233	6,522	6,522	9.35	108.0	0.00	87.29	-	-	0.00	0.00	-	0.00
234	6,220	6,220	10.00	108.0	0.00	86.88	-	-	0.00	0.00	-	0.00
235	5,695	5,695	11.18	108.0	0.00	86.11	-	-	0.00	0.00	-	0.00
301	8,186	8,186	6.18	108.0	0.00	89.26	-	-	0.00	0.00	-	0.00
302	8,614	8,614	5.46	108.0	0.00	89.70	-	-	0.00	0.00	-	0.00
303	9,091	9,091	4.68	108.0	0.00	90.17	-	-	0.00	0.00	-	0.00
304	9,608	9,608	3.88	108.0	0.00	90.65	-	-	0.00	0.00	-	0.00
305	9,301	9,301	4.35	108.0	0.00	90.37	-	-	0.00	0.00	-	0.00
306	9,123	9,124	4.63	108.0	0.00	90.20	-	-	0.00	0.00	-	0.00
307	8,329	8,329	5.94	108.0	0.00	89.41	-	-	0.00	0.00	-	0.00
308	10,606	10,606	2.44	108.0	0.00	91.51	-	-	0.00	0.00	-	0.00
309	10,114	10,114	3.13	108.0	0.00	91.10	-	-	0.00	0.00	-	0.00
310	9,825	9,825	3.56	108.0	0.00	90.85	-	-	0.00	0.00	-	0.00
311	9,359	9,359	4.26	108.0	0.00	90.42	-	-	0.00	0.00	-	0.00
312	8,946	8,947	4.91	108.0	0.00	90.03	-	-	0.00	0.00	-	0.00
313	8,467	8,467	5.70	108.0	0.00	89.56	-	-	0.00	0.00	-	0.00
314	7,775	7,775	6.91	108.0	0.00	88.81	-	-	0.00	0.00	-	0.00
315	7,782	7,782	6.90	108.0	0.00	88.82	-	-	0.00	0.00	-	0.00
316	8,236	8,237	6.09	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
317	8,619	8,620	5.45	108.0	0.00	89.71	-	-	0.00	0.00	-	0.00
318	9,366	9,367	4.25	108.0	0.00	90.43	-	-	0.00	0.00	-	0.00
319	9,936	9,937	3.39	108.0	0.00	90.94	-	-	0.00	0.00	-	0.00
320	10,337	10,338	2.82	108.0	0.00	91.29	-	-	0.00	0.00	-	0.00
321	10,797	10,797	2.18	108.0	0.00	91.67	-	-	0.00	0.00	-	0.00
322	10,671	10,672	2.35	108.0	0.00	91.56	-	-	0.00	0.00	-	0.00
323	10,452	10,452	2.65	108.0	0.00	91.38	-	-	0.00	0.00	-	0.00
324	9,651	9,651	3.82	108.0	0.00	90.69	-	-	0.00	0.00	-	0.00
325	10,423	10,424	2.69	108.0	0.00	91.36	-	-	0.00	0.00	-	0.00
326	9,776	9,777	3.63	108.0	0.00	90.80	-	-	0.00	0.00	-	0.00
327	9,410	9,410	4.18	108.0	0.00	90.47	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
328	8,405	8,405	5.81	108.0	0.00	89.49	-	-	0.00	0.00	-	0.00
329	8,486	8,487	5.67	108.0	0.00	89.57	-	-	0.00	0.00	-	0.00
330	7,754	7,755	6.95	108.0	0.00	88.79	-	-	0.00	0.00	-	0.00
331	7,557	7,558	7.31	108.0	0.00	88.57	-	-	0.00	0.00	-	0.00
332	7,123	7,123	8.14	108.0	0.00	88.05	-	-	0.00	0.00	-	0.00
333	7,532	7,533	7.36	108.0	0.00	88.54	-	-	0.00	0.00	-	0.00
334	8,037	8,037	6.44	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
335	8,272	8,272	6.03	108.0	0.00	89.35	-	-	0.00	0.00	-	0.00
Sum	38.90											

Sum 38.90

- Data undefined due to calculation with octave data

Noise sensitive area: NSP005 NSP005

		Wind speed: 8.0 m/s										
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]
1	2,151	2,154	22.96	108.0	0.00	77.66	-	-	0.00	0.00	-	0.00
2	1,053	1,059	31.06	108.0	0.00	71.50	-	-	0.00	0.00	-	0.00
3	4,882	4,883	11.53	107.0	0.00	84.77	-	-	0.00	0.00	-	0.00
4	4,971	4,972	11.31	107.0	0.00	84.93	-	-	0.00	0.00	-	0.00
5	3,664	3,666	15.07	107.0	0.00	82.28	-	-	0.00	0.00	-	0.00
6	642	650	36.24	108.0	0.00	67.26	-	-	0.00	0.00	-	0.00
7	1,786	1,789	25.16	108.0	0.00	76.05	-	-	0.00	0.00	-	0.00
8	5,591	5,592	9.82	107.0	0.00	85.95	-	-	0.00	0.00	-	0.00
9	2,450	2,451	21.41	108.0	0.00	78.79	-	-	0.00	0.00	-	0.00
10	1,669	1,672	25.94	108.0	0.00	75.47	-	-	0.00	0.00	-	0.00
11	2,445	2,446	21.44	108.0	0.00	78.77	-	-	0.00	0.00	-	0.00
12	4,385	4,386	12.87	107.0	0.00	83.84	-	-	0.00	0.00	-	0.00
13	4,655	4,656	12.13	107.0	0.00	84.36	-	-	0.00	0.00	-	0.00
14	3,629	3,630	15.19	107.0	0.00	82.20	-	-	0.00	0.00	-	0.00
15	1,616	1,619	26.31	108.0	0.00	75.19	-	-	0.00	0.00	-	0.00
16	4,867	4,868	11.57	107.0	0.00	84.75	-	-	0.00	0.00	-	0.00
17	992	997	31.72	108.0	0.00	70.97	-	-	0.00	0.00	-	0.00
18	2,840	2,841	18.09	107.0	0.00	80.07	-	-	0.00	0.00	-	0.00
19	3,520	3,520	15.56	107.0	0.00	81.93	-	-	0.00	0.00	-	0.00
20	1,348	1,352	28.36	108.0	0.00	73.62	-	-	0.00	0.00	-	0.00
22	5,749	5,750	9.47	107.0	0.00	86.19	-	-	0.00	0.00	-	0.00
23	6,351	6,352	8.20	107.0	0.00	87.06	-	-	0.00	0.00	-	0.00
25	678	682	35.73	108.0	0.00	67.68	-	-	0.00	0.00	-	0.00
26	1,751	1,753	25.39	108.0	0.00	75.88	-	-	0.00	0.00	-	0.00
27	2,415	2,416	21.57	108.0	0.00	78.66	-	-	0.00	0.00	-	0.00
28	1,124	1,129	30.36	108.0	0.00	72.05	-	-	0.00	0.00	-	0.00
29	4,788	4,788	11.78	107.0	0.00	84.60	-	-	0.00	0.00	-	0.00
30	1,151	1,154	30.12	108.0	0.00	72.24	-	-	0.00	0.00	-	0.00
31	4,708	4,709	11.99	107.0	0.00	84.46	-	-	0.00	0.00	-	0.00
32	4,292	4,293	13.14	107.0	0.00	83.65	-	-	0.00	0.00	-	0.00
33	5,100	5,101	10.98	107.0	0.00	85.15	-	-	0.00	0.00	-	0.00
201	1,025	1,028	31.38	108.0	0.00	71.24	-	-	0.00	0.00	-	0.00
202	1,289	1,291	28.88	108.0	0.00	73.22	-	-	0.00	0.00	-	0.00
203	2,511	2,512	21.15	108.0	0.00	79.00	-	-	0.00	0.00	-	0.00
204	2,446	2,448	21.43	108.0	0.00	78.77	-	-	0.00	0.00	-	0.00
205	2,943	2,945	19.37	108.0	0.00	80.38	-	-	0.00	0.00	-	0.00
206	3,434	3,435	17.58	108.0	0.00	81.72	-	-	0.00	0.00	-	0.00
207	4,224	4,224	15.05	108.0	0.00	83.52	-	-	0.00	0.00	-	0.00
208	6,621	6,621	9.15	108.0	0.00	87.42	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
209	7,016	7,017	8.35	108.0	0.00	87.92	-	-	0.00	0.00	-	0.00
210	7,482	7,483	7.45	108.0	0.00	88.48	-	-	0.00	0.00	-	0.00
211	7,110	7,111	8.16	108.0	0.00	88.04	-	-	0.00	0.00	-	0.00
212	7,242	7,243	7.90	108.0	0.00	88.20	-	-	0.00	0.00	-	0.00
213	7,466	7,467	7.48	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
214	7,808	7,809	6.85	108.0	0.00	88.85	-	-	0.00	0.00	-	0.00
215	6,183	6,184	10.08	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
216	7,588	7,588	7.25	108.0	0.00	88.60	-	-	0.00	0.00	-	0.00
217	8,304	8,305	5.98	108.0	0.00	89.39	-	-	0.00	0.00	-	0.00
218	9,798	9,798	3.60	108.0	0.00	90.82	-	-	0.00	0.00	-	0.00
219	10,336	10,336	2.82	108.0	0.00	91.29	-	-	0.00	0.00	-	0.00
220	10,791	10,791	2.19	108.0	0.00	91.66	-	-	0.00	0.00	-	0.00
221	11,409	11,409	1.36	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
222	12,370	12,371	0.17	108.0	0.00	92.85	-	-	0.00	0.00	-	0.00
223	11,776	11,777	0.90	108.0	0.00	92.42	-	-	0.00	0.00	-	0.00
224	11,310	11,311	1.49	108.0	0.00	92.07	-	-	0.00	0.00	-	0.00
225	11,005	11,005	1.90	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
226	10,887	10,887	2.06	108.0	0.00	91.74	-	-	0.00	0.00	-	0.00
227	10,103	10,103	3.15	108.0	0.00	91.09	-	-	0.00	0.00	-	0.00
228	11,924	11,925	0.71	108.0	0.00	92.53	-	-	0.00	0.00	-	0.00
229	9,446	9,447	4.13	108.0	0.00	90.51	-	-	0.00	0.00	-	0.00
230	9,132	9,133	4.62	108.0	0.00	90.21	-	-	0.00	0.00	-	0.00
231	8,647	8,647	5.40	108.0	0.00	89.74	-	-	0.00	0.00	-	0.00
232	8,525	8,525	5.60	108.0	0.00	89.61	-	-	0.00	0.00	-	0.00
233	8,128	8,128	6.28	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
234	7,869	7,870	6.74	108.0	0.00	88.92	-	-	0.00	0.00	-	0.00
235	7,222	7,222	7.94	108.0	0.00	88.17	-	-	0.00	0.00	-	0.00
301	6,281	6,281	9.87	108.0	0.00	86.96	-	-	0.00	0.00	-	0.00
302	6,650	6,650	9.09	108.0	0.00	87.46	-	-	0.00	0.00	-	0.00
303	6,997	6,997	8.38	108.0	0.00	87.90	-	-	0.00	0.00	-	0.00
304	7,466	7,466	7.48	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
305	7,071	7,071	8.24	108.0	0.00	87.99	-	-	0.00	0.00	-	0.00
306	6,931	6,931	8.52	108.0	0.00	87.82	-	-	0.00	0.00	-	0.00
307	6,167	6,167	10.11	108.0	0.00	86.80	-	-	0.00	0.00	-	0.00
308	12,335	12,335	0.21	108.0	0.00	92.82	-	-	0.00	0.00	-	0.00
309	11,818	11,819	0.84	108.0	0.00	92.45	-	-	0.00	0.00	-	0.00
310	11,426	11,426	1.34	108.0	0.00	92.16	-	-	0.00	0.00	-	0.00
311	10,943	10,943	1.98	108.0	0.00	91.78	-	-	0.00	0.00	-	0.00
312	10,529	10,529	2.55	108.0	0.00	91.45	-	-	0.00	0.00	-	0.00
313	10,043	10,044	3.24	108.0	0.00	91.04	-	-	0.00	0.00	-	0.00
314	9,254	9,255	4.42	108.0	0.00	90.33	-	-	0.00	0.00	-	0.00
315	9,486	9,486	4.07	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
316	10,047	10,047	3.23	108.0	0.00	91.04	-	-	0.00	0.00	-	0.00
317	10,403	10,403	2.72	108.0	0.00	91.34	-	-	0.00	0.00	-	0.00
318	11,194	11,195	1.65	108.0	0.00	91.98	-	-	0.00	0.00	-	0.00
319	11,977	11,978	0.65	108.0	0.00	92.57	-	-	0.00	0.00	-	0.00
320	12,408	12,408	0.12	108.0	0.00	92.87	-	-	0.00	0.00	-	0.00
321	12,876	12,876	-0.43	108.0	0.00	93.20	-	-	0.00	0.00	-	0.00
322	12,854	12,854	-0.40	108.0	0.00	93.18	-	-	0.00	0.00	-	0.00
323	12,659	12,659	-0.18	108.0	0.00	93.05	-	-	0.00	0.00	-	0.00
324	11,849	11,849	0.80	108.0	0.00	92.47	-	-	0.00	0.00	-	0.00
325	12,713	12,713	-0.24	108.0	0.00	93.09	-	-	0.00	0.00	-	0.00
326	12,047	12,048	0.56	108.0	0.00	92.62	-	-	0.00	0.00	-	0.00
327	11,689	11,690	1.01	108.0	0.00	92.36	-	-	0.00	0.00	-	0.00
328	10,701	10,701	2.31	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
329	10,843	10,844	2.11	108.0	0.00	91.70	-	-	0.00	0.00	-	0.00
330	10,102	10,102	3.15	108.0	0.00	91.09	-	-	0.00	0.00	-	0.00
331	9,848	9,849	3.52	108.0	0.00	90.87	-	-	0.00	0.00	-	0.00
332	9,390	9,391	4.21	108.0	0.00	90.45	-	-	0.00	0.00	-	0.00
333	9,725	9,726	3.71	108.0	0.00	90.76	-	-	0.00	0.00	-	0.00
334	10,234	10,234	2.96	108.0	0.00	91.20	-	-	0.00	0.00	-	0.00
335	10,415	10,415	2.71	108.0	0.00	91.35	-	-	0.00	0.00	-	0.00

Sum 42.73

- 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]
1	2,269	2,272	22.31	108.0	0.00	78.13	-	-	0.00	0.00	-	0.00
2	1,437	1,444	27.63	108.0	0.00	74.19	-	-	0.00	0.00	-	0.00
3	5,295	5,297	10.51	107.0	0.00	85.48	-	-	0.00	0.00	-	0.00
4	5,037	5,038	11.14	107.0	0.00	85.05	-	-	0.00	0.00	-	0.00
5	4,246	4,247	13.27	107.0	0.00	83.56	-	-	0.00	0.00	-	0.00
6	2,064	2,067	23.45	108.0	0.00	77.31	-	-	0.00	0.00	-	0.00
7	2,988	2,990	19.20	108.0	0.00	80.51	-	-	0.00	0.00	-	0.00
8	5,860	5,862	9.23	107.0	0.00	86.36	-	-	0.00	0.00	-	0.00
9	2,009	2,012	23.78	108.0	0.00	77.07	-	-	0.00	0.00	-	0.00
10	1,749	1,754	25.39	108.0	0.00	75.88	-	-	0.00	0.00	-	0.00
11	1,343	1,346	28.41	108.0	0.00	73.58	-	-	0.00	0.00	-	0.00
12	3,965	3,966	14.11	107.0	0.00	82.97	-	-	0.00	0.00	-	0.00
13	4,678	4,679	12.06	107.0	0.00	84.40	-	-	0.00	0.00	-	0.00
14	3,933	3,934	14.21	107.0	0.00	82.90	-	-	0.00	0.00	-	0.00
15	2,557	2,560	20.94	108.0	0.00	79.16	-	-	0.00	0.00	-	0.00
16	5,115	5,116	10.95	107.0	0.00	85.18	-	-	0.00	0.00	-	0.00
17	2,460	2,463	21.36	108.0	0.00	78.83	-	-	0.00	0.00	-	0.00
18	3,332	3,333	16.21	107.0	0.00	81.46	-	-	0.00	0.00	-	0.00
19	3,603	3,604	15.28	107.0	0.00	82.13	-	-	0.00	0.00	-	0.00
20	2,738	2,741	20.18	108.0	0.00	79.76	-	-	0.00	0.00	-	0.00
22	5,644	5,645	9.71	107.0	0.00	86.03	-	-	0.00	0.00	-	0.00
23	6,627	6,628	7.66	107.0	0.00	87.43	-	-	0.00	0.00	-	0.00
25	2,068	2,070	23.43	108.0	0.00	77.32	-	-	0.00	0.00	-	0.00
26	3,219	3,220	18.34	108.0	0.00	81.16	-	-	0.00	0.00	-	0.00
27	2,671	2,673	20.46	108.0	0.00	79.54	-	-	0.00	0.00	-	0.00
28	2,327	2,330	22.00	108.0	0.00	78.35	-	-	0.00	0.00	-	0.00
29	4,227	4,228	13.32	107.0	0.00	83.52	-	-	0.00	0.00	-	0.00
30	1,024	1,029	31.37	108.0	0.00	71.25	-	-	0.00	0.00	-	0.00
31	4,412	4,412	12.79	107.0	0.00	83.89	-	-	0.00	0.00	-	0.00
32	4,826	4,827	11.68	107.0	0.00	84.67	-	-	0.00	0.00	-	0.00
33	4,976	4,977	11.29	107.0	0.00	84.94	-	-	0.00	0.00	-	0.00
201	889	894	32.88	108.0	0.00	70.03	-	-	0.00	0.00	-	0.00
202	1,038	1,043	31.23	108.0	0.00	71.36	-	-	0.00	0.00	-	0.00
203	1,110	1,114	30.51	108.0	0.00	71.94	-	-	0.00	0.00	-	0.00
204	1,223	1,227	29.44	108.0	0.00	72.78	-	-	0.00	0.00	-	0.00
205	1,747	1,750	25.41	108.0	0.00	75.86	-	-	0.00	0.00	-	0.00
206	1,965	1,967	24.04	108.0	0.00	76.87	-	-	0.00	0.00	-	0.00
207	2,753	2,755	20.13	108.0	0.00	79.80	-	-	0.00	0.00	-	0.00
208	6,264	6,265	9.90	108.0	0.00	86.94	-	-	0.00	0.00	-	0.00
209	6,678	6,678	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
210	7,189	7,190	8.01	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
211	7,068	7,069	8.24	108.0	0.00	87.99	-	-	0.00	0.00	-	0.00
212	7,277	7,278	7.84	108.0	0.00	88.24	-	-	0.00	0.00	-	0.00
213	7,574	7,575	7.28	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
214	7,933	7,934	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
215	6,571	6,572	9.25	108.0	0.00	87.35	-	-	0.00	0.00	-	0.00
216	7,940	7,940	6.61	108.0	0.00	89.00	-	-	0.00	0.00	-	0.00
217	8,642	8,642	5.41	108.0	0.00	89.73	-	-	0.00	0.00	-	0.00
218	9,858	9,858	3.51	108.0	0.00	90.88	-	-	0.00	0.00	-	0.00
219	10,481	10,482	2.61	108.0	0.00	91.41	-	-	0.00	0.00	-	0.00
220	10,912	10,913	2.02	108.0	0.00	91.76	-	-	0.00	0.00	-	0.00
221	11,552	11,552	1.18	108.0	0.00	92.25	-	-	0.00	0.00	-	0.00
222	12,922	12,922	-0.48	108.0	0.00	93.23	-	-	0.00	0.00	-	0.00
223	12,364	12,365	0.17	108.0	0.00	92.84	-	-	0.00	0.00	-	0.00
224	11,687	11,687	1.01	108.0	0.00	92.35	-	-	0.00	0.00	-	0.00
225	11,401	11,402	1.37	108.0	0.00	92.14	-	-	0.00	0.00	-	0.00
226	11,400	11,401	1.38	108.0	0.00	92.14	-	-	0.00	0.00	-	0.00
227	10,666	10,667	2.36	108.0	0.00	91.56	-	-	0.00	0.00	-	0.00
228	12,423	12,423	0.10	108.0	0.00	92.88	-	-	0.00	0.00	-	0.00
229	9,985	9,986	3.32	108.0	0.00	90.99	-	-	0.00	0.00	-	0.00
230	9,655	9,656	3.81	108.0	0.00	90.70	-	-	0.00	0.00	-	0.00
231	9,196	9,197	4.52	108.0	0.00	90.27	-	-	0.00	0.00	-	0.00
232	9,262	9,263	4.41	108.0	0.00	90.33	-	-	0.00	0.00	-	0.00
233	8,879	8,880	5.02	108.0	0.00	89.97	-	-	0.00	0.00	-	0.00
234	8,656	8,657	5.39	108.0	0.00	89.75	-	-	0.00	0.00	-	0.00
235	7,956	7,957	6.59	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00
301	4,931	4,931	13.08	108.0	0.00	84.86	-	-	0.00	0.00	-	0.00
302	5,265	5,266	12.22	108.0	0.00	85.43	-	-	0.00	0.00	-	0.00
303	5,557	5,557	11.51	108.0	0.00	85.90	-	-	0.00	0.00	-	0.00
304	6,010	6,011	10.46	108.0	0.00	86.58	-	-	0.00	0.00	-	0.00
305	5,601	5,601	11.41	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
306	5,465	5,466	11.73	108.0	0.00	85.75	-	-	0.00	0.00	-	0.00
307	4,709	4,710	13.67	108.0	0.00	84.46	-	-	0.00	0.00	-	0.00
308	13,088	13,088	-0.67	108.0	0.00	93.34	-	-	0.00	0.00	-	0.00
309	12,561	12,561	-0.06	108.0	0.00	92.98	-	-	0.00	0.00	-	0.00
310	12,104	12,104	0.49	108.0	0.00	92.66	-	-	0.00	0.00	-	0.00
311	11,617	11,618	1.10	108.0	0.00	92.30	-	-	0.00	0.00	-	0.00
312	11,211	11,211	1.62	108.0	0.00	91.99	-	-	0.00	0.00	-	0.00
313	10,729	10,730	2.27	108.0	0.00	91.61	-	-	0.00	0.00	-	0.00
314	9,897	9,897	3.45	108.0	0.00	90.91	-	-	0.00	0.00	-	0.00
315	10,266	10,267	2.92	108.0	0.00	91.23	-	-	0.00	0.00	-	0.00
316	10,888	10,889	2.05	108.0	0.00	91.74	-	-	0.00	0.00	-	0.00
317	11,220	11,221	1.61	108.0	0.00	92.00	-	-	0.00	0.00	-	0.00
318	12,030	12,031	0.58	108.0	0.00	92.61	-	-	0.00	0.00	-	0.00
319	12,961	12,961	-0.53	108.0	0.00	93.25	-	-	0.00	0.00	-	0.00
320	13,411	13,412	-1.04	108.0	0.00	93.55	-	-	0.00	0.00	-	0.00
321	13,882	13,883	-1.55	108.0	0.00	93.85	-	-	0.00	0.00	-	0.00
322	13,949	13,949	-1.63	108.0	0.00	93.89	-	-	0.00	0.00	-	0.00
323	13,777	13,778	-1.44	108.0	0.00	93.78	-	-	0.00	0.00	-	0.00
324	12,963	12,964	-0.53	108.0	0.00	93.25	-	-	0.00	0.00	-	0.00
325	13,914	13,914	-1.59	108.0	0.00	93.87	-	-	0.00	0.00	-	0.00
326	13,231	13,232	-0.84	108.0	0.00	93.43	-	-	0.00	0.00	-	0.00
327	12,884	12,884	-0.44	108.0	0.00	93.20	-	-	0.00	0.00	-	0.00
328	11,917	11,918	0.72	108.0	0.00	92.52	-	-	0.00	0.00	-	0.00
329	12,138	12,139	0.45	108.0	0.00	92.68	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

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 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 wind@eapc.net
 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
330	11,384	11,384	1.40	108.0	0.00	92.13	-	-	0.00	0.00	-	0.00
331	11,064	11,065	1.82	108.0	0.00	91.88	-	-	0.00	0.00	-	0.00
332	10,587	10,587	2.47	108.0	0.00	91.50	-	-	0.00	0.00	-	0.00
333	10,852	10,853	2.10	108.0	0.00	91.71	-	-	0.00	0.00	-	0.00
334	11,360	11,360	1.43	108.0	0.00	92.11	-	-	0.00	0.00	-	0.00
335	11,494	11,495	1.25	108.0	0.00	92.21	-	-	0.00	0.00	-	0.00

Sum 40.47

- 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]
1	4,417	4,419	14.48	108.0	0.00	83.91	-	-	0.00	0.00	-	0.00
2	3,995	3,997	15.74	108.0	0.00	83.03	-	-	0.00	0.00	-	0.00
3	7,219	7,220	6.56	107.0	0.00	88.17	-	-	0.00	0.00	-	0.00
4	6,575	6,576	7.76	107.0	0.00	87.36	-	-	0.00	0.00	-	0.00
5	6,432	6,432	8.04	107.0	0.00	87.17	-	-	0.00	0.00	-	0.00
6	4,749	4,750	13.56	108.0	0.00	84.53	-	-	0.00	0.00	-	0.00
7	5,635	5,636	11.32	108.0	0.00	86.02	-	-	0.00	0.00	-	0.00
8	7,566	7,567	5.96	107.0	0.00	88.58	-	-	0.00	0.00	-	0.00
9	3,726	3,727	16.60	108.0	0.00	82.43	-	-	0.00	0.00	-	0.00
10	4,047	4,049	15.58	108.0	0.00	83.15	-	-	0.00	0.00	-	0.00
11	2,597	2,598	20.78	108.0	0.00	79.29	-	-	0.00	0.00	-	0.00
12	4,999	4,999	11.24	107.0	0.00	84.98	-	-	0.00	0.00	-	0.00
13	6,211	6,211	8.49	107.0	0.00	86.86	-	-	0.00	0.00	-	0.00
14	5,896	5,896	9.15	107.0	0.00	86.41	-	-	0.00	0.00	-	0.00
15	5,132	5,133	12.56	108.0	0.00	85.21	-	-	0.00	0.00	-	0.00
16	6,869	6,869	7.20	107.0	0.00	87.74	-	-	0.00	0.00	-	0.00
17	5,108	5,109	12.62	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
18	5,551	5,551	9.92	107.0	0.00	85.89	-	-	0.00	0.00	-	0.00
19	5,390	5,391	10.29	107.0	0.00	85.63	-	-	0.00	0.00	-	0.00
20	5,426	5,427	11.82	108.0	0.00	85.69	-	-	0.00	0.00	-	0.00
22	6,868	6,868	7.20	107.0	0.00	87.74	-	-	0.00	0.00	-	0.00
23	8,280	8,281	4.79	107.0	0.00	89.36	-	-	0.00	0.00	-	0.00
25	4,665	4,665	13.79	108.0	0.00	84.38	-	-	0.00	0.00	-	0.00
26	5,887	5,887	10.74	108.0	0.00	86.40	-	-	0.00	0.00	-	0.00
27	4,823	4,823	13.36	108.0	0.00	84.67	-	-	0.00	0.00	-	0.00
28	4,994	4,995	12.91	108.0	0.00	84.97	-	-	0.00	0.00	-	0.00
29	4,956	4,957	11.34	107.0	0.00	84.90	-	-	0.00	0.00	-	0.00
30	3,542	3,543	17.21	108.0	0.00	81.99	-	-	0.00	0.00	-	0.00
31	5,540	5,541	9.94	107.0	0.00	85.87	-	-	0.00	0.00	-	0.00
32	6,915	6,916	7.12	107.0	0.00	87.80	-	-	0.00	0.00	-	0.00
33	6,262	6,262	8.39	107.0	0.00	86.93	-	-	0.00	0.00	-	0.00
201	3,275	3,276	18.14	108.0	0.00	81.31	-	-	0.00	0.00	-	0.00
202	3,181	3,182	18.48	108.0	0.00	81.05	-	-	0.00	0.00	-	0.00
203	1,640	1,641	26.16	108.0	0.00	75.30	-	-	0.00	0.00	-	0.00
204	1,873	1,875	24.61	108.0	0.00	76.46	-	-	0.00	0.00	-	0.00
205	1,628	1,631	26.23	108.0	0.00	75.25	-	-	0.00	0.00	-	0.00
206	946	948	32.25	108.0	0.00	70.54	-	-	0.00	0.00	-	0.00
207	559	566	37.67	108.0	0.00	66.05	-	-	0.00	0.00	-	0.00
208	7,009	7,009	8.36	108.0	0.00	87.91	-	-	0.00	0.00	-	0.00
209	7,408	7,409	7.59	108.0	0.00	88.39	-	-	0.00	0.00	-	0.00
210	7,948	7,949	6.60	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
211	8,242	8,243	6.08	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
212	8,550	8,550	5.56	108.0	0.00	89.64	-	-	0.00	0.00	-	0.00
213	8,932	8,933	4.94	108.0	0.00	90.02	-	-	0.00	0.00	-	0.00
214	9,293	9,293	4.36	108.0	0.00	90.36	-	-	0.00	0.00	-	0.00
215	8,368	8,368	5.87	108.0	0.00	89.45	-	-	0.00	0.00	-	0.00
216	9,611	9,611	3.88	108.0	0.00	90.66	-	-	0.00	0.00	-	0.00
217	10,260	10,261	2.92	108.0	0.00	91.22	-	-	0.00	0.00	-	0.00
218	11,021	11,021	1.88	108.0	0.00	91.84	-	-	0.00	0.00	-	0.00
219	11,748	11,749	0.93	108.0	0.00	92.40	-	-	0.00	0.00	-	0.00
220	12,127	12,127	0.46	108.0	0.00	92.67	-	-	0.00	0.00	-	0.00
221	12,779	12,779	-0.32	108.0	0.00	93.13	-	-	0.00	0.00	-	0.00
222	14,704	14,704	-2.41	108.0	0.00	94.35	-	-	0.00	0.00	-	0.00
223	14,206	14,206	-1.90	108.0	0.00	94.05	-	-	0.00	0.00	-	0.00
224	13,254	13,254	-0.86	108.0	0.00	93.45	-	-	0.00	0.00	-	0.00
225	13,004	13,004	-0.58	108.0	0.00	93.28	-	-	0.00	0.00	-	0.00
226	13,163	13,164	-0.76	108.0	0.00	93.39	-	-	0.00	0.00	-	0.00
227	12,513	12,514	-0.01	108.0	0.00	92.95	-	-	0.00	0.00	-	0.00
228	14,144	14,144	-1.83	108.0	0.00	94.01	-	-	0.00	0.00	-	0.00
229	11,819	11,820	0.84	108.0	0.00	92.45	-	-	0.00	0.00	-	0.00
230	11,478	11,479	1.28	108.0	0.00	92.20	-	-	0.00	0.00	-	0.00
231	11,068	11,068	1.81	108.0	0.00	91.88	-	-	0.00	0.00	-	0.00
232	11,357	11,357	1.43	108.0	0.00	92.11	-	-	0.00	0.00	-	0.00
233	11,000	11,001	1.90	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
234	10,821	10,821	2.14	108.0	0.00	91.69	-	-	0.00	0.00	-	0.00
235	10,084	10,085	3.18	108.0	0.00	91.07	-	-	0.00	0.00	-	0.00
301	3,292	3,292	18.08	108.0	0.00	81.35	-	-	0.00	0.00	-	0.00
302	3,402	3,403	17.69	108.0	0.00	81.64	-	-	0.00	0.00	-	0.00
303	3,328	3,328	17.95	108.0	0.00	81.44	-	-	0.00	0.00	-	0.00
304	3,634	3,635	16.90	108.0	0.00	82.21	-	-	0.00	0.00	-	0.00
305	3,058	3,058	18.94	108.0	0.00	80.71	-	-	0.00	0.00	-	0.00
306	3,009	3,010	19.12	108.0	0.00	80.57	-	-	0.00	0.00	-	0.00
307	2,396	2,397	21.65	108.0	0.00	78.59	-	-	0.00	0.00	-	0.00
308	15,130	15,130	-2.84	108.0	0.00	94.60	-	-	0.00	0.00	-	0.00
309	14,598	14,598	-2.31	108.0	0.00	94.29	-	-	0.00	0.00	-	0.00
310	14,067	14,068	-1.75	108.0	0.00	93.96	-	-	0.00	0.00	-	0.00
311	13,585	13,586	-1.23	108.0	0.00	93.66	-	-	0.00	0.00	-	0.00
312	13,195	13,195	-0.80	108.0	0.00	93.41	-	-	0.00	0.00	-	0.00
313	12,730	12,730	-0.26	108.0	0.00	93.10	-	-	0.00	0.00	-	0.00
314	11,863	11,863	0.79	108.0	0.00	92.48	-	-	0.00	0.00	-	0.00
315	12,388	12,389	0.14	108.0	0.00	92.86	-	-	0.00	0.00	-	0.00
316	13,068	13,069	-0.65	108.0	0.00	93.32	-	-	0.00	0.00	-	0.00
317	13,367	13,368	-0.99	108.0	0.00	93.52	-	-	0.00	0.00	-	0.00
318	14,188	14,188	-1.88	108.0	0.00	94.04	-	-	0.00	0.00	-	0.00
319	15,277	15,277	-2.99	108.0	0.00	94.68	-	-	0.00	0.00	-	0.00
320	15,745	15,745	-3.44	108.0	0.00	94.94	-	-	0.00	0.00	-	0.00
321	16,215	16,216	-3.88	108.0	0.00	95.20	-	-	0.00	0.00	-	0.00
322	16,377	16,378	-4.03	108.0	0.00	95.28	-	-	0.00	0.00	-	0.00
323	16,230	16,231	-3.90	108.0	0.00	95.21	-	-	0.00	0.00	-	0.00
324	15,417	15,418	-3.13	108.0	0.00	94.76	-	-	0.00	0.00	-	0.00
325	16,447	16,447	-4.10	108.0	0.00	95.32	-	-	0.00	0.00	-	0.00
326	15,751	15,751	-3.45	108.0	0.00	94.95	-	-	0.00	0.00	-	0.00
327	15,415	15,415	-3.12	108.0	0.00	94.76	-	-	0.00	0.00	-	0.00
328	14,472	14,472	-2.18	108.0	0.00	94.21	-	-	0.00	0.00	-	0.00
329	14,756	14,757	-2.47	108.0	0.00	94.38	-	-	0.00	0.00	-	0.00
330	13,995	13,995	-1.67	108.0	0.00	93.92	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
331	13,623	13,624	-1.27	108.0	0.00	93.69	-	-	0.00	0.00	-	0.00
332	13,131	13,131	-0.72	108.0	0.00	93.37	-	-	0.00	0.00	-	0.00
333	13,332	13,333	-0.95	108.0	0.00	93.50	-	-	0.00	0.00	-	0.00
334	13,835	13,835	-1.50	108.0	0.00	93.82	-	-	0.00	0.00	-	0.00
335	13,923	13,923	-1.60	108.0	0.00	93.87	-	-	0.00	0.00	-	0.00
Sum	40.00											

- 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]
1	3,852	3,854	16.19	108.0	0.00	82.72	-	-	0.00	0.00	-	0.00
2	4,553	4,555	14.10	108.0	0.00	84.17	-	-	0.00	0.00	-	0.00
3	4,875	4,876	11.55	107.0	0.00	84.76	-	-	0.00	0.00	-	0.00
4	3,747	3,749	14.80	107.0	0.00	82.48	-	-	0.00	0.00	-	0.00
5	4,877	4,879	11.54	107.0	0.00	84.77	-	-	0.00	0.00	-	0.00
6	5,747	5,748	11.06	108.0	0.00	86.19	-	-	0.00	0.00	-	0.00
7	5,785	5,786	10.97	108.0	0.00	86.25	-	-	0.00	0.00	-	0.00
8	4,746	4,747	11.88	107.0	0.00	84.53	-	-	0.00	0.00	-	0.00
9	3,143	3,146	18.61	108.0	0.00	80.95	-	-	0.00	0.00	-	0.00
10	4,037	4,039	15.61	108.0	0.00	83.12	-	-	0.00	0.00	-	0.00
11	3,177	3,179	18.49	108.0	0.00	81.05	-	-	0.00	0.00	-	0.00
12	2,132	2,134	21.50	107.0	0.00	77.58	-	-	0.00	0.00	-	0.00
13	3,503	3,505	15.61	107.0	0.00	81.89	-	-	0.00	0.00	-	0.00
14	4,094	4,095	13.72	107.0	0.00	83.24	-	-	0.00	0.00	-	0.00
15	5,144	5,146	12.52	108.0	0.00	85.23	-	-	0.00	0.00	-	0.00
16	4,313	4,315	13.07	107.0	0.00	83.70	-	-	0.00	0.00	-	0.00
17	6,310	6,311	9.80	108.0	0.00	87.00	-	-	0.00	0.00	-	0.00
18	4,433	4,434	12.73	107.0	0.00	83.94	-	-	0.00	0.00	-	0.00
19	3,520	3,522	15.55	107.0	0.00	81.93	-	-	0.00	0.00	-	0.00
20	6,083	6,084	10.30	108.0	0.00	86.68	-	-	0.00	0.00	-	0.00
22	3,485	3,486	15.67	107.0	0.00	81.85	-	-	0.00	0.00	-	0.00
23	5,235	5,237	10.65	107.0	0.00	85.38	-	-	0.00	0.00	-	0.00
25	6,160	6,161	10.13	108.0	0.00	86.79	-	-	0.00	0.00	-	0.00
26	6,798	6,799	8.78	108.0	0.00	87.65	-	-	0.00	0.00	-	0.00
27	3,977	3,978	15.80	108.0	0.00	82.99	-	-	0.00	0.00	-	0.00
28	5,497	5,498	11.65	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
29	1,643	1,646	24.72	107.0	0.00	75.33	-	-	0.00	0.00	-	0.00
30	4,339	4,340	14.71	108.0	0.00	83.75	-	-	0.00	0.00	-	0.00
31	2,492	2,494	19.58	107.0	0.00	78.94	-	-	0.00	0.00	-	0.00
32	4,992	4,993	11.25	107.0	0.00	84.97	-	-	0.00	0.00	-	0.00
33	3,147	3,149	16.89	107.0	0.00	80.96	-	-	0.00	0.00	-	0.00
201	5,388	5,389	11.92	108.0	0.00	85.63	-	-	0.00	0.00	-	0.00
202	5,552	5,553	11.52	108.0	0.00	85.89	-	-	0.00	0.00	-	0.00
203	4,501	4,502	14.25	108.0	0.00	84.07	-	-	0.00	0.00	-	0.00
204	4,972	4,973	12.97	108.0	0.00	84.93	-	-	0.00	0.00	-	0.00
205	5,196	5,197	12.39	108.0	0.00	85.32	-	-	0.00	0.00	-	0.00
206	3,654	3,655	16.83	108.0	0.00	82.26	-	-	0.00	0.00	-	0.00
207	3,732	3,734	16.57	108.0	0.00	82.44	-	-	0.00	0.00	-	0.00
208	3,051	3,053	18.96	108.0	0.00	80.69	-	-	0.00	0.00	-	0.00
209	3,394	3,396	17.71	108.0	0.00	81.62	-	-	0.00	0.00	-	0.00
210	3,910	3,912	16.00	108.0	0.00	82.85	-	-	0.00	0.00	-	0.00
211	4,562	4,564	14.07	108.0	0.00	84.19	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
212	4,946	4,948	13.03	108.0	0.00	84.89	-	-	0.00	0.00	-	0.00
213	5,388	5,389	11.92	108.0	0.00	85.63	-	-	0.00	0.00	-	0.00
214	5,714	5,715	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
215	5,543	5,544	11.54	108.0	0.00	85.88	-	-	0.00	0.00	-	0.00
216	6,414	6,415	9.58	108.0	0.00	87.14	-	-	0.00	0.00	-	0.00
217	6,925	6,926	8.53	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00
218	7,129	7,130	8.12	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
219	7,919	7,920	6.65	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
220	8,237	8,237	6.09	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
221	8,878	8,879	5.02	108.0	0.00	89.97	-	-	0.00	0.00	-	0.00
222	11,348	11,349	1.44	108.0	0.00	92.10	-	-	0.00	0.00	-	0.00
223	10,956	10,956	1.96	108.0	0.00	91.79	-	-	0.00	0.00	-	0.00
224	9,678	9,678	3.78	108.0	0.00	90.72	-	-	0.00	0.00	-	0.00
225	9,480	9,481	4.07	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
226	9,845	9,846	3.53	108.0	0.00	90.86	-	-	0.00	0.00	-	0.00
227	9,354	9,355	4.27	108.0	0.00	90.42	-	-	0.00	0.00	-	0.00
228	10,725	10,725	2.28	108.0	0.00	91.61	-	-	0.00	0.00	-	0.00
229	8,683	8,684	5.34	108.0	0.00	89.77	-	-	0.00	0.00	-	0.00
230	8,348	8,349	5.90	108.0	0.00	89.43	-	-	0.00	0.00	-	0.00
231	8,047	8,048	6.42	108.0	0.00	89.11	-	-	0.00	0.00	-	0.00
232	8,722	8,723	5.28	108.0	0.00	89.81	-	-	0.00	0.00	-	0.00
233	8,451	8,452	5.73	108.0	0.00	89.54	-	-	0.00	0.00	-	0.00
234	8,384	8,385	5.84	108.0	0.00	89.47	-	-	0.00	0.00	-	0.00
235	7,646	7,647	7.14	108.0	0.00	88.67	-	-	0.00	0.00	-	0.00
301	2,375	2,376	21.76	108.0	0.00	78.52	-	-	0.00	0.00	-	0.00
302	2,869	2,870	19.67	108.0	0.00	80.16	-	-	0.00	0.00	-	0.00
303	3,749	3,750	16.52	108.0	0.00	82.48	-	-	0.00	0.00	-	0.00
304	4,353	4,354	14.67	108.0	0.00	83.78	-	-	0.00	0.00	-	0.00
305	4,660	4,660	13.81	108.0	0.00	84.37	-	-	0.00	0.00	-	0.00
306	4,302	4,303	14.82	108.0	0.00	83.67	-	-	0.00	0.00	-	0.00
307	3,645	3,646	16.86	108.0	0.00	82.24	-	-	0.00	0.00	-	0.00
308	12,174	12,174	0.40	108.0	0.00	92.71	-	-	0.00	0.00	-	0.00
309	11,654	11,654	1.05	108.0	0.00	92.33	-	-	0.00	0.00	-	0.00
310	11,018	11,018	1.88	108.0	0.00	91.84	-	-	0.00	0.00	-	0.00
311	10,567	10,568	2.49	108.0	0.00	91.48	-	-	0.00	0.00	-	0.00
312	10,225	10,226	2.97	108.0	0.00	91.19	-	-	0.00	0.00	-	0.00
313	9,815	9,816	3.57	108.0	0.00	90.84	-	-	0.00	0.00	-	0.00
314	8,944	8,945	4.92	108.0	0.00	90.03	-	-	0.00	0.00	-	0.00
315	9,732	9,732	3.70	108.0	0.00	90.76	-	-	0.00	0.00	-	0.00
316	10,492	10,492	2.60	108.0	0.00	91.42	-	-	0.00	0.00	-	0.00
317	10,702	10,703	2.31	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00
318	11,500	11,501	1.25	108.0	0.00	92.21	-	-	0.00	0.00	-	0.00
319	12,906	12,906	-0.47	108.0	0.00	93.22	-	-	0.00	0.00	-	0.00
320	13,401	13,401	-1.03	108.0	0.00	93.54	-	-	0.00	0.00	-	0.00
321	13,852	13,852	-1.52	108.0	0.00	93.83	-	-	0.00	0.00	-	0.00
322	14,282	14,282	-1.98	108.0	0.00	94.10	-	-	0.00	0.00	-	0.00
323	14,222	14,223	-1.92	108.0	0.00	94.06	-	-	0.00	0.00	-	0.00
324	13,446	13,447	-1.08	108.0	0.00	93.57	-	-	0.00	0.00	-	0.00
325	14,728	14,728	-2.44	108.0	0.00	94.36	-	-	0.00	0.00	-	0.00
326	14,006	14,006	-1.69	108.0	0.00	93.93	-	-	0.00	0.00	-	0.00
327	13,732	13,732	-1.39	108.0	0.00	93.75	-	-	0.00	0.00	-	0.00
328	12,938	12,939	-0.50	108.0	0.00	93.24	-	-	0.00	0.00	-	0.00
329	13,541	13,542	-1.18	108.0	0.00	93.63	-	-	0.00	0.00	-	0.00
330	12,773	12,774	-0.31	108.0	0.00	93.13	-	-	0.00	0.00	-	0.00
331	12,153	12,154	0.43	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
332	11,626	11,627	1.09	108.0	0.00	92.31	-	-	0.00	0.00	-	0.00
333	11,563	11,563	1.17	108.0	0.00	92.26	-	-	0.00	0.00	-	0.00
334	12,018	12,019	0.59	108.0	0.00	92.60	-	-	0.00	0.00	-	0.00
335	11,945	11,945	0.68	108.0	0.00	92.54	-	-	0.00	0.00	-	0.00
Sum	33.51											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP009 NSP009

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]
1	4,159	4,162	15.24	108.0	0.00	83.39	-	-	0.00	0.00	-	0.00
2	4,935	4,938	13.06	108.0	0.00	84.87	-	-	0.00	0.00	-	0.00
3	4,855	4,857	11.60	107.0	0.00	84.73	-	-	0.00	0.00	-	0.00
4	3,682	3,684	15.01	107.0	0.00	82.33	-	-	0.00	0.00	-	0.00
5	4,992	4,994	11.25	107.0	0.00	84.97	-	-	0.00	0.00	-	0.00
6	6,124	6,125	10.21	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
7	6,081	6,083	10.30	108.0	0.00	86.68	-	-	0.00	0.00	-	0.00
8	4,637	4,639	12.17	107.0	0.00	84.33	-	-	0.00	0.00	-	0.00
9	3,506	3,508	17.33	108.0	0.00	81.90	-	-	0.00	0.00	-	0.00
10	4,393	4,395	14.55	108.0	0.00	83.86	-	-	0.00	0.00	-	0.00
11	3,643	3,645	16.87	108.0	0.00	82.23	-	-	0.00	0.00	-	0.00
12	2,211	2,214	21.04	107.0	0.00	77.90	-	-	0.00	0.00	-	0.00
13	3,481	3,483	15.69	107.0	0.00	81.84	-	-	0.00	0.00	-	0.00
14	4,209	4,210	13.37	107.0	0.00	83.49	-	-	0.00	0.00	-	0.00
15	5,449	5,451	11.77	108.0	0.00	85.73	-	-	0.00	0.00	-	0.00
16	4,277	4,279	13.17	107.0	0.00	83.63	-	-	0.00	0.00	-	0.00
17	6,690	6,691	9.00	108.0	0.00	87.51	-	-	0.00	0.00	-	0.00
18	4,634	4,635	12.18	107.0	0.00	84.32	-	-	0.00	0.00	-	0.00
19	3,663	3,664	15.07	107.0	0.00	82.28	-	-	0.00	0.00	-	0.00
20	6,420	6,422	9.56	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
22	3,295	3,297	16.34	107.0	0.00	81.36	-	-	0.00	0.00	-	0.00
23	5,064	5,066	11.07	107.0	0.00	85.09	-	-	0.00	0.00	-	0.00
25	6,566	6,567	9.26	108.0	0.00	87.35	-	-	0.00	0.00	-	0.00
26	7,141	7,142	8.10	108.0	0.00	88.08	-	-	0.00	0.00	-	0.00
27	4,241	4,243	14.99	108.0	0.00	83.55	-	-	0.00	0.00	-	0.00
28	5,837	5,839	10.85	108.0	0.00	86.33	-	-	0.00	0.00	-	0.00
29	1,670	1,673	24.51	107.0	0.00	75.47	-	-	0.00	0.00	-	0.00
30	4,751	4,752	13.56	108.0	0.00	84.54	-	-	0.00	0.00	-	0.00
31	2,472	2,474	19.67	107.0	0.00	78.87	-	-	0.00	0.00	-	0.00
32	5,042	5,044	11.13	107.0	0.00	85.05	-	-	0.00	0.00	-	0.00
33	3,050	3,052	17.26	107.0	0.00	80.69	-	-	0.00	0.00	-	0.00
201	5,850	5,852	10.82	108.0	0.00	86.35	-	-	0.00	0.00	-	0.00
202	6,024	6,025	10.43	108.0	0.00	86.60	-	-	0.00	0.00	-	0.00
203	5,011	5,012	12.87	108.0	0.00	85.00	-	-	0.00	0.00	-	0.00
204	5,480	5,482	11.69	108.0	0.00	85.78	-	-	0.00	0.00	-	0.00
205	5,712	5,713	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
206	4,174	4,175	15.20	108.0	0.00	83.41	-	-	0.00	0.00	-	0.00
207	4,244	4,246	14.98	108.0	0.00	83.56	-	-	0.00	0.00	-	0.00
208	2,695	2,697	20.36	108.0	0.00	79.62	-	-	0.00	0.00	-	0.00
209	3,007	3,009	19.13	108.0	0.00	80.57	-	-	0.00	0.00	-	0.00
210	3,505	3,507	17.33	108.0	0.00	81.90	-	-	0.00	0.00	-	0.00
211	4,255	4,257	14.95	108.0	0.00	83.58	-	-	0.00	0.00	-	0.00
212	4,651	4,653	13.83	108.0	0.00	84.35	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power - BISON Wind Energy Center

Minnesota Power
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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
213	5,099	5,101	12.64	108.0	0.00	85.15	-	-	0.00	0.00	-	0.00
214	5,412	5,413	11.86	108.0	0.00	85.67	-	-	0.00	0.00	-	0.00
215	5,409	5,410	11.86	108.0	0.00	85.66	-	-	0.00	0.00	-	0.00
216	6,185	6,186	10.07	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
217	6,660	6,661	9.06	108.0	0.00	87.47	-	-	0.00	0.00	-	0.00
218	6,736	6,737	8.91	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
219	7,537	7,537	7.35	108.0	0.00	88.54	-	-	0.00	0.00	-	0.00
220	7,838	7,839	6.80	108.0	0.00	88.89	-	-	0.00	0.00	-	0.00
221	8,475	8,475	5.69	108.0	0.00	89.56	-	-	0.00	0.00	-	0.00
222	11,046	11,046	1.84	108.0	0.00	91.86	-	-	0.00	0.00	-	0.00
223	10,675	10,675	2.34	108.0	0.00	91.57	-	-	0.00	0.00	-	0.00
224	9,341	9,341	4.29	108.0	0.00	90.41	-	-	0.00	0.00	-	0.00
225	9,155	9,156	4.58	108.0	0.00	90.23	-	-	0.00	0.00	-	0.00
226	9,557	9,558	3.96	108.0	0.00	90.61	-	-	0.00	0.00	-	0.00
227	9,100	9,101	4.67	108.0	0.00	90.18	-	-	0.00	0.00	-	0.00
228	10,413	10,414	2.71	108.0	0.00	91.35	-	-	0.00	0.00	-	0.00
229	8,439	8,440	5.75	108.0	0.00	89.53	-	-	0.00	0.00	-	0.00
230	8,108	8,110	6.32	108.0	0.00	89.18	-	-	0.00	0.00	-	0.00
231	7,831	7,832	6.81	108.0	0.00	88.88	-	-	0.00	0.00	-	0.00
232	8,568	8,569	5.53	108.0	0.00	89.66	-	-	0.00	0.00	-	0.00
233	8,315	8,316	5.96	108.0	0.00	89.40	-	-	0.00	0.00	-	0.00
234	8,268	8,269	6.04	108.0	0.00	89.35	-	-	0.00	0.00	-	0.00
235	7,541	7,542	7.34	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00
301	2,682	2,683	20.42	108.0	0.00	79.57	-	-	0.00	0.00	-	0.00
302	3,152	3,153	18.59	108.0	0.00	80.97	-	-	0.00	0.00	-	0.00
303	4,054	4,055	15.56	108.0	0.00	83.16	-	-	0.00	0.00	-	0.00
304	4,645	4,646	13.84	108.0	0.00	84.34	-	-	0.00	0.00	-	0.00
305	5,019	5,020	12.85	108.0	0.00	85.01	-	-	0.00	0.00	-	0.00
306	4,654	4,655	13.82	108.0	0.00	84.36	-	-	0.00	0.00	-	0.00
307	4,041	4,042	15.60	108.0	0.00	83.13	-	-	0.00	0.00	-	0.00
308	11,938	11,938	0.69	108.0	0.00	92.54	-	-	0.00	0.00	-	0.00
309	11,423	11,423	1.35	108.0	0.00	92.16	-	-	0.00	0.00	-	0.00
310	10,772	10,773	2.21	108.0	0.00	91.65	-	-	0.00	0.00	-	0.00
311	10,330	10,330	2.83	108.0	0.00	91.28	-	-	0.00	0.00	-	0.00
312	9,999	9,999	3.30	108.0	0.00	91.00	-	-	0.00	0.00	-	0.00
313	9,602	9,603	3.89	108.0	0.00	90.65	-	-	0.00	0.00	-	0.00
314	8,737	8,738	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
315	9,563	9,564	3.95	108.0	0.00	90.61	-	-	0.00	0.00	-	0.00
316	10,330	10,331	2.82	108.0	0.00	91.28	-	-	0.00	0.00	-	0.00
317	10,524	10,525	2.55	108.0	0.00	91.44	-	-	0.00	0.00	-	0.00
318	11,313	11,314	1.49	108.0	0.00	92.07	-	-	0.00	0.00	-	0.00
319	12,761	12,761	-0.30	108.0	0.00	93.12	-	-	0.00	0.00	-	0.00
320	13,257	13,258	-0.87	108.0	0.00	93.45	-	-	0.00	0.00	-	0.00
321	13,703	13,703	-1.36	108.0	0.00	93.74	-	-	0.00	0.00	-	0.00
322	14,171	14,172	-1.86	108.0	0.00	94.03	-	-	0.00	0.00	-	0.00
323	14,125	14,125	-1.81	108.0	0.00	94.00	-	-	0.00	0.00	-	0.00
324	13,358	13,359	-0.98	108.0	0.00	93.52	-	-	0.00	0.00	-	0.00
325	14,669	14,670	-2.38	108.0	0.00	94.33	-	-	0.00	0.00	-	0.00
326	13,947	13,948	-1.62	108.0	0.00	93.89	-	-	0.00	0.00	-	0.00
327	13,684	13,684	-1.34	108.0	0.00	93.72	-	-	0.00	0.00	-	0.00
328	12,916	12,917	-0.48	108.0	0.00	93.22	-	-	0.00	0.00	-	0.00
329	13,559	13,559	-1.20	108.0	0.00	93.64	-	-	0.00	0.00	-	0.00
330	12,795	12,796	-0.34	108.0	0.00	93.14	-	-	0.00	0.00	-	0.00
331	12,145	12,146	0.44	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
332	11,618	11,619	1.10	108.0	0.00	92.30	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

Description:
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6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
333	11,517	11,518	1.22	108.0	0.00	92.23	-	-	0.00	0.00	-	0.00
334	11,962	11,963	0.66	108.0	0.00	92.56	-	-	0.00	0.00	-	0.00
335	11,866	11,866	0.78	108.0	0.00	92.49	-	-	0.00	0.00	-	0.00
Sum	33.17											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP010 NSP010

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]
1	4,847	4,848	13.30	108.0	0.00	84.71	-	-	0.00	0.00	-	0.00
2	5,699	5,701	11.17	108.0	0.00	86.12	-	-	0.00	0.00	-	0.00
3	5,080	5,081	11.03	107.0	0.00	85.12	-	-	0.00	0.00	-	0.00
4	3,871	3,872	14.40	107.0	0.00	82.76	-	-	0.00	0.00	-	0.00
5	5,416	5,417	10.23	107.0	0.00	85.67	-	-	0.00	0.00	-	0.00
6	6,875	6,876	8.63	108.0	0.00	87.75	-	-	0.00	0.00	-	0.00
7	6,736	6,737	8.91	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
8	4,720	4,721	11.95	107.0	0.00	84.48	-	-	0.00	0.00	-	0.00
9	4,262	4,263	14.93	108.0	0.00	83.60	-	-	0.00	0.00	-	0.00
10	5,133	5,134	12.55	108.0	0.00	85.21	-	-	0.00	0.00	-	0.00
11	4,493	4,493	14.27	108.0	0.00	84.05	-	-	0.00	0.00	-	0.00
12	2,695	2,696	18.70	107.0	0.00	79.61	-	-	0.00	0.00	-	0.00
13	3,745	3,746	14.81	107.0	0.00	82.47	-	-	0.00	0.00	-	0.00
14	4,650	4,651	12.14	107.0	0.00	84.35	-	-	0.00	0.00	-	0.00
15	6,120	6,120	10.22	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
16	4,490	4,491	12.57	107.0	0.00	84.05	-	-	0.00	0.00	-	0.00
17	7,442	7,442	7.53	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
18	5,183	5,183	10.78	107.0	0.00	85.29	-	-	0.00	0.00	-	0.00
19	4,157	4,157	13.53	107.0	0.00	83.38	-	-	0.00	0.00	-	0.00
20	7,124	7,125	8.13	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
22	3,286	3,287	16.38	107.0	0.00	81.34	-	-	0.00	0.00	-	0.00
23	5,025	5,026	11.17	107.0	0.00	85.02	-	-	0.00	0.00	-	0.00
25	7,348	7,348	7.70	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00
26	7,849	7,849	6.78	108.0	0.00	88.90	-	-	0.00	0.00	-	0.00
27	4,877	4,878	13.22	108.0	0.00	84.76	-	-	0.00	0.00	-	0.00
28	6,548	6,549	9.30	108.0	0.00	87.32	-	-	0.00	0.00	-	0.00
29	2,146	2,147	21.43	107.0	0.00	77.64	-	-	0.00	0.00	-	0.00
30	5,547	5,547	11.53	108.0	0.00	85.88	-	-	0.00	0.00	-	0.00
31	2,800	2,801	18.26	107.0	0.00	79.95	-	-	0.00	0.00	-	0.00
32	5,371	5,371	10.33	107.0	0.00	85.60	-	-	0.00	0.00	-	0.00
33	3,217	3,218	16.63	107.0	0.00	81.15	-	-	0.00	0.00	-	0.00
201	6,692	6,693	9.00	108.0	0.00	87.51	-	-	0.00	0.00	-	0.00
202	6,874	6,874	8.63	108.0	0.00	87.74	-	-	0.00	0.00	-	0.00
203	5,886	5,886	10.74	108.0	0.00	86.40	-	-	0.00	0.00	-	0.00
204	6,355	6,356	9.70	108.0	0.00	87.06	-	-	0.00	0.00	-	0.00
205	6,587	6,588	9.21	108.0	0.00	87.37	-	-	0.00	0.00	-	0.00
206	5,043	5,043	12.79	108.0	0.00	85.05	-	-	0.00	0.00	-	0.00
207	5,082	5,083	12.68	108.0	0.00	85.12	-	-	0.00	0.00	-	0.00
208	2,376	2,377	21.76	108.0	0.00	78.52	-	-	0.00	0.00	-	0.00
209	2,593	2,594	20.79	108.0	0.00	79.28	-	-	0.00	0.00	-	0.00
210	3,023	3,025	19.07	108.0	0.00	80.61	-	-	0.00	0.00	-	0.00
211	3,973	3,974	15.81	108.0	0.00	82.98	-	-	0.00	0.00	-	0.00
212	4,383	4,384	14.58	108.0	0.00	83.84	-	-	0.00	0.00	-	0.00
213	4,835	4,836	13.33	108.0	0.00	84.69	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
214	5,113	5,114	12.61	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
215	5,429	5,430	11.82	108.0	0.00	85.70	-	-	0.00	0.00	-	0.00
216	6,020	6,020	10.44	108.0	0.00	86.59	-	-	0.00	0.00	-	0.00
217	6,418	6,419	9.57	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
218	6,227	6,227	9.98	108.0	0.00	86.89	-	-	0.00	0.00	-	0.00
219	7,044	7,045	8.29	108.0	0.00	87.96	-	-	0.00	0.00	-	0.00
220	7,309	7,310	7.78	108.0	0.00	88.28	-	-	0.00	0.00	-	0.00
221	7,931	7,931	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
222	10,698	10,698	2.31	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00
223	10,370	10,370	2.77	108.0	0.00	91.32	-	-	0.00	0.00	-	0.00
224	8,932	8,932	4.94	108.0	0.00	90.02	-	-	0.00	0.00	-	0.00
225	8,771	8,771	5.20	108.0	0.00	89.86	-	-	0.00	0.00	-	0.00
226	9,246	9,246	4.44	108.0	0.00	90.32	-	-	0.00	0.00	-	0.00
227	8,856	8,856	5.06	108.0	0.00	89.95	-	-	0.00	0.00	-	0.00
228	10,051	10,051	3.23	108.0	0.00	91.04	-	-	0.00	0.00	-	0.00
229	8,219	8,219	6.13	108.0	0.00	89.30	-	-	0.00	0.00	-	0.00
230	7,899	7,900	6.69	108.0	0.00	88.95	-	-	0.00	0.00	-	0.00
231	7,670	7,670	7.10	108.0	0.00	88.70	-	-	0.00	0.00	-	0.00
232	8,512	8,513	5.63	108.0	0.00	89.60	-	-	0.00	0.00	-	0.00
233	8,293	8,294	6.00	108.0	0.00	89.38	-	-	0.00	0.00	-	0.00
234	8,281	8,282	6.02	108.0	0.00	89.36	-	-	0.00	0.00	-	0.00
235	7,579	7,580	7.27	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
301	3,230	3,230	18.30	108.0	0.00	81.18	-	-	0.00	0.00	-	0.00
302	3,646	3,646	16.86	108.0	0.00	82.24	-	-	0.00	0.00	-	0.00
303	4,554	4,554	14.10	108.0	0.00	84.17	-	-	0.00	0.00	-	0.00
304	5,113	5,114	12.61	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
305	5,589	5,589	11.43	108.0	0.00	85.95	-	-	0.00	0.00	-	0.00
306	5,217	5,217	12.34	108.0	0.00	85.35	-	-	0.00	0.00	-	0.00
307	4,684	4,684	13.74	108.0	0.00	84.41	-	-	0.00	0.00	-	0.00
308	11,713	11,714	0.98	108.0	0.00	92.37	-	-	0.00	0.00	-	0.00
309	11,210	11,210	1.62	108.0	0.00	91.99	-	-	0.00	0.00	-	0.00
310	10,535	10,535	2.54	108.0	0.00	91.45	-	-	0.00	0.00	-	0.00
311	10,110	10,111	3.14	108.0	0.00	91.10	-	-	0.00	0.00	-	0.00
312	9,801	9,802	3.59	108.0	0.00	90.83	-	-	0.00	0.00	-	0.00
313	9,431	9,431	4.15	108.0	0.00	90.49	-	-	0.00	0.00	-	0.00
314	8,585	8,586	5.50	108.0	0.00	89.68	-	-	0.00	0.00	-	0.00
315	9,475	9,475	4.08	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
316	10,249	10,250	2.94	108.0	0.00	91.21	-	-	0.00	0.00	-	0.00
317	10,413	10,414	2.71	108.0	0.00	91.35	-	-	0.00	0.00	-	0.00
318	11,181	11,181	1.66	108.0	0.00	91.97	-	-	0.00	0.00	-	0.00
319	12,698	12,698	-0.22	108.0	0.00	93.07	-	-	0.00	0.00	-	0.00
320	13,195	13,196	-0.80	108.0	0.00	93.41	-	-	0.00	0.00	-	0.00
321	13,630	13,630	-1.28	108.0	0.00	93.69	-	-	0.00	0.00	-	0.00
322	14,164	14,164	-1.85	108.0	0.00	94.02	-	-	0.00	0.00	-	0.00
323	14,140	14,140	-1.83	108.0	0.00	94.01	-	-	0.00	0.00	-	0.00
324	13,392	13,393	-1.02	108.0	0.00	93.54	-	-	0.00	0.00	-	0.00
325	14,749	14,749	-2.46	108.0	0.00	94.38	-	-	0.00	0.00	-	0.00
326	14,030	14,030	-1.71	108.0	0.00	93.94	-	-	0.00	0.00	-	0.00
327	13,784	13,784	-1.45	108.0	0.00	93.79	-	-	0.00	0.00	-	0.00
328	13,062	13,063	-0.64	108.0	0.00	93.32	-	-	0.00	0.00	-	0.00
329	13,767	13,768	-1.43	108.0	0.00	93.78	-	-	0.00	0.00	-	0.00
330	13,013	13,014	-0.59	108.0	0.00	93.29	-	-	0.00	0.00	-	0.00
331	12,318	12,318	0.23	108.0	0.00	92.81	-	-	0.00	0.00	-	0.00
332	11,792	11,792	0.88	108.0	0.00	92.43	-	-	0.00	0.00	-	0.00
333	11,630	11,630	1.08	108.0	0.00	92.31	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
334	12,056	12,056	0.55	108.0	0.00	92.62	-	-	0.00	0.00	-	0.00
335	11,921	11,921	0.72	108.0	0.00	92.53	-	-	0.00	0.00	-	0.00
Sum	32.21											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP011 NSP011

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]
1	3,718	3,720	16.62	108.0	0.00	82.41	-	-	0.00	0.00	-	0.00
2	4,729	4,731	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
3	3,462	3,464	15.75	107.0	0.00	81.79	-	-	0.00	0.00	-	0.00
4	2,251	2,254	20.81	107.0	0.00	78.06	-	-	0.00	0.00	-	0.00
5	3,889	3,890	14.35	107.0	0.00	82.80	-	-	0.00	0.00	-	0.00
6	5,829	5,831	10.87	108.0	0.00	86.31	-	-	0.00	0.00	-	0.00
7	5,475	5,476	11.70	108.0	0.00	85.77	-	-	0.00	0.00	-	0.00
8	3,112	3,114	17.02	107.0	0.00	80.87	-	-	0.00	0.00	-	0.00
9	3,353	3,354	17.86	108.0	0.00	81.51	-	-	0.00	0.00	-	0.00
10	4,119	4,121	15.36	108.0	0.00	83.30	-	-	0.00	0.00	-	0.00
11	3,964	3,965	15.84	108.0	0.00	82.97	-	-	0.00	0.00	-	0.00
12	1,407	1,409	26.59	107.0	0.00	73.98	-	-	0.00	0.00	-	0.00
13	2,147	2,150	21.41	107.0	0.00	77.65	-	-	0.00	0.00	-	0.00
14	3,154	3,155	16.87	107.0	0.00	80.98	-	-	0.00	0.00	-	0.00
15	4,903	4,905	13.15	108.0	0.00	84.81	-	-	0.00	0.00	-	0.00
16	2,872	2,874	17.96	107.0	0.00	80.17	-	-	0.00	0.00	-	0.00
17	6,384	6,385	9.64	108.0	0.00	87.10	-	-	0.00	0.00	-	0.00
18	3,794	3,795	14.65	107.0	0.00	82.58	-	-	0.00	0.00	-	0.00
19	2,736	2,738	18.52	107.0	0.00	79.75	-	-	0.00	0.00	-	0.00
20	5,953	5,954	10.59	108.0	0.00	86.50	-	-	0.00	0.00	-	0.00
22	1,708	1,711	24.24	107.0	0.00	75.67	-	-	0.00	0.00	-	0.00
23	3,475	3,478	15.70	107.0	0.00	81.83	-	-	0.00	0.00	-	0.00
25	6,384	6,385	9.64	108.0	0.00	87.10	-	-	0.00	0.00	-	0.00
26	6,673	6,674	9.04	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
27	3,639	3,641	16.88	108.0	0.00	82.22	-	-	0.00	0.00	-	0.00
28	5,407	5,409	11.87	108.0	0.00	85.66	-	-	0.00	0.00	-	0.00
29	1,010	1,014	30.46	107.0	0.00	71.12	-	-	0.00	0.00	-	0.00
30	4,691	4,692	13.72	108.0	0.00	84.43	-	-	0.00	0.00	-	0.00
31	1,288	1,291	27.63	107.0	0.00	73.22	-	-	0.00	0.00	-	0.00
32	3,783	3,784	14.68	107.0	0.00	82.56	-	-	0.00	0.00	-	0.00
33	1,598	1,602	25.05	107.0	0.00	75.09	-	-	0.00	0.00	-	0.00
201	6,004	6,005	10.47	108.0	0.00	86.57	-	-	0.00	0.00	-	0.00
202	6,236	6,236	9.96	108.0	0.00	86.90	-	-	0.00	0.00	-	0.00
203	5,587	5,587	11.44	108.0	0.00	85.94	-	-	0.00	0.00	-	0.00
204	6,027	6,028	10.42	108.0	0.00	86.60	-	-	0.00	0.00	-	0.00
205	6,370	6,371	9.67	108.0	0.00	87.08	-	-	0.00	0.00	-	0.00
206	5,014	5,014	12.86	108.0	0.00	85.00	-	-	0.00	0.00	-	0.00
207	5,302	5,303	12.13	108.0	0.00	85.49	-	-	0.00	0.00	-	0.00
208	1,224	1,227	29.44	108.0	0.00	72.78	-	-	0.00	0.00	-	0.00
209	1,613	1,616	26.34	108.0	0.00	75.17	-	-	0.00	0.00	-	0.00
210	2,152	2,155	22.95	108.0	0.00	77.67	-	-	0.00	0.00	-	0.00
211	2,683	2,686	20.41	108.0	0.00	79.58	-	-	0.00	0.00	-	0.00
212	3,068	3,070	18.89	108.0	0.00	80.74	-	-	0.00	0.00	-	0.00
213	3,512	3,513	17.31	108.0	0.00	81.91	-	-	0.00	0.00	-	0.00
214	3,835	3,837	16.24	108.0	0.00	82.68	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
215	3,847	3,849	16.20	108.0	0.00	82.71	-	-	0.00	0.00	-	0.00
216	4,578	4,579	14.03	108.0	0.00	84.22	-	-	0.00	0.00	-	0.00
217	5,060	5,061	12.74	108.0	0.00	85.09	-	-	0.00	0.00	-	0.00
218	5,305	5,306	12.12	108.0	0.00	85.49	-	-	0.00	0.00	-	0.00
219	6,078	6,079	10.31	108.0	0.00	86.68	-	-	0.00	0.00	-	0.00
220	6,416	6,417	9.57	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
221	7,064	7,065	8.25	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00
222	9,470	9,471	4.09	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
223	9,084	9,085	4.69	108.0	0.00	90.17	-	-	0.00	0.00	-	0.00
224	7,802	7,803	6.86	108.0	0.00	88.85	-	-	0.00	0.00	-	0.00
225	7,602	7,603	7.23	108.0	0.00	88.62	-	-	0.00	0.00	-	0.00
226	7,971	7,971	6.56	108.0	0.00	89.03	-	-	0.00	0.00	-	0.00
227	7,497	7,498	7.42	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
228	8,846	8,846	5.07	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
229	6,833	6,834	8.71	108.0	0.00	87.69	-	-	0.00	0.00	-	0.00
230	6,502	6,503	9.39	108.0	0.00	87.26	-	-	0.00	0.00	-	0.00
231	6,224	6,225	9.99	108.0	0.00	86.88	-	-	0.00	0.00	-	0.00
232	6,981	6,982	8.41	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
233	6,740	6,741	8.90	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
234	6,709	6,710	8.96	108.0	0.00	87.53	-	-	0.00	0.00	-	0.00
235	5,994	5,995	10.50	108.0	0.00	86.56	-	-	0.00	0.00	-	0.00
301	4,245	4,246	14.99	108.0	0.00	83.56	-	-	0.00	0.00	-	0.00
302	4,731	4,732	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
303	5,621	5,622	11.36	108.0	0.00	86.00	-	-	0.00	0.00	-	0.00
304	6,222	6,223	9.99	108.0	0.00	86.88	-	-	0.00	0.00	-	0.00
305	6,537	6,538	9.32	108.0	0.00	87.31	-	-	0.00	0.00	-	0.00
306	6,180	6,181	10.08	108.0	0.00	86.82	-	-	0.00	0.00	-	0.00
307	5,510	5,510	11.62	108.0	0.00	85.82	-	-	0.00	0.00	-	0.00
308	10,331	10,332	2.82	108.0	0.00	91.28	-	-	0.00	0.00	-	0.00
309	9,816	9,816	3.57	108.0	0.00	90.84	-	-	0.00	0.00	-	0.00
310	9,167	9,168	4.56	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
311	8,723	8,724	5.27	108.0	0.00	89.81	-	-	0.00	0.00	-	0.00
312	8,391	8,392	5.83	108.0	0.00	89.48	-	-	0.00	0.00	-	0.00
313	7,995	7,996	6.52	108.0	0.00	89.06	-	-	0.00	0.00	-	0.00
314	7,131	7,132	8.12	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
315	7,968	7,969	6.56	108.0	0.00	89.03	-	-	0.00	0.00	-	0.00
316	8,737	8,738	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
317	8,924	8,925	4.95	108.0	0.00	90.01	-	-	0.00	0.00	-	0.00
318	9,710	9,710	3.73	108.0	0.00	90.74	-	-	0.00	0.00	-	0.00
319	11,175	11,175	1.67	108.0	0.00	91.97	-	-	0.00	0.00	-	0.00
320	11,672	11,672	1.03	108.0	0.00	92.34	-	-	0.00	0.00	-	0.00
321	12,114	12,114	0.48	108.0	0.00	92.67	-	-	0.00	0.00	-	0.00
322	12,607	12,608	-0.12	108.0	0.00	93.01	-	-	0.00	0.00	-	0.00
323	12,571	12,572	-0.07	108.0	0.00	92.99	-	-	0.00	0.00	-	0.00
324	11,814	11,815	0.85	108.0	0.00	92.45	-	-	0.00	0.00	-	0.00
325	13,153	13,154	-0.75	108.0	0.00	93.38	-	-	0.00	0.00	-	0.00
326	12,433	12,434	0.09	108.0	0.00	92.89	-	-	0.00	0.00	-	0.00
327	12,181	12,182	0.39	108.0	0.00	92.71	-	-	0.00	0.00	-	0.00
328	11,448	11,449	1.31	108.0	0.00	92.18	-	-	0.00	0.00	-	0.00
329	12,146	12,147	0.44	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
330	11,392	11,393	1.39	108.0	0.00	92.13	-	-	0.00	0.00	-	0.00
331	10,700	10,700	2.31	108.0	0.00	91.59	-	-	0.00	0.00	-	0.00
332	10,173	10,174	3.05	108.0	0.00	91.15	-	-	0.00	0.00	-	0.00
333	10,023	10,024	3.27	108.0	0.00	91.02	-	-	0.00	0.00	-	0.00
334	10,455	10,455	2.65	108.0	0.00	91.39	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]	
335	10,333	10,334	2.82	108.0	0.00	91.29	-	-	0.00	0.00	-	0.00	
Sum			37.80										

- 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]
1	6,969	6,970	8.44	108.0	0.00	87.86	-	-	0.00	0.00	-	0.00
2	8,015	8,016	6.48	108.0	0.00	89.08	-	-	0.00	0.00	-	0.00
3	5,755	5,756	9.46	107.0	0.00	86.20	-	-	0.00	0.00	-	0.00
4	4,739	4,740	11.90	107.0	0.00	84.51	-	-	0.00	0.00	-	0.00
5	6,655	6,655	7.61	107.0	0.00	87.46	-	-	0.00	0.00	-	0.00
6	9,082	9,083	4.70	108.0	0.00	90.16	-	-	0.00	0.00	-	0.00
7	8,597	8,597	5.48	108.0	0.00	89.69	-	-	0.00	0.00	-	0.00
8	5,026	5,027	11.17	107.0	0.00	85.03	-	-	0.00	0.00	-	0.00
9	6,653	6,654	9.08	108.0	0.00	87.46	-	-	0.00	0.00	-	0.00
10	7,400	7,401	7.60	108.0	0.00	88.39	-	-	0.00	0.00	-	0.00
11	7,213	7,213	7.96	108.0	0.00	88.16	-	-	0.00	0.00	-	0.00
12	4,680	4,681	12.06	107.0	0.00	84.41	-	-	0.00	0.00	-	0.00
13	4,865	4,866	11.58	107.0	0.00	84.74	-	-	0.00	0.00	-	0.00
14	6,063	6,064	8.80	107.0	0.00	86.65	-	-	0.00	0.00	-	0.00
15	8,077	8,077	6.37	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
16	5,262	5,262	10.59	107.0	0.00	85.42	-	-	0.00	0.00	-	0.00
17	9,626	9,627	3.85	108.0	0.00	90.67	-	-	0.00	0.00	-	0.00
18	6,837	6,838	7.26	107.0	0.00	87.70	-	-	0.00	0.00	-	0.00
19	5,809	5,810	9.34	107.0	0.00	86.28	-	-	0.00	0.00	-	0.00
20	9,137	9,138	4.61	108.0	0.00	90.22	-	-	0.00	0.00	-	0.00
22	3,807	3,808	14.61	107.0	0.00	82.61	-	-	0.00	0.00	-	0.00
23	4,850	4,851	11.61	107.0	0.00	84.72	-	-	0.00	0.00	-	0.00
25	9,660	9,660	3.80	108.0	0.00	90.70	-	-	0.00	0.00	-	0.00
26	9,842	9,842	3.53	108.0	0.00	90.86	-	-	0.00	0.00	-	0.00
27	6,835	6,835	8.71	108.0	0.00	87.69	-	-	0.00	0.00	-	0.00
28	8,620	8,621	5.44	108.0	0.00	89.71	-	-	0.00	0.00	-	0.00
29	4,308	4,309	13.09	107.0	0.00	83.69	-	-	0.00	0.00	-	0.00
30	7,991	7,992	6.52	108.0	0.00	89.05	-	-	0.00	0.00	-	0.00
31	4,406	4,407	12.81	107.0	0.00	83.88	-	-	0.00	0.00	-	0.00
32	6,318	6,319	8.27	107.0	0.00	87.01	-	-	0.00	0.00	-	0.00
33	4,261	4,262	13.22	107.0	0.00	83.59	-	-	0.00	0.00	-	0.00
201	9,301	9,301	4.35	108.0	0.00	90.37	-	-	0.00	0.00	-	0.00
202	9,526	9,527	4.01	108.0	0.00	90.58	-	-	0.00	0.00	-	0.00
203	8,768	8,768	5.20	108.0	0.00	89.86	-	-	0.00	0.00	-	0.00
204	9,225	9,225	4.47	108.0	0.00	90.30	-	-	0.00	0.00	-	0.00
205	9,518	9,518	4.02	108.0	0.00	90.57	-	-	0.00	0.00	-	0.00
206	8,038	8,038	6.44	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
207	8,145	8,146	6.25	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
208	2,577	2,578	20.86	108.0	0.00	79.23	-	-	0.00	0.00	-	0.00
209	2,276	2,278	22.28	108.0	0.00	78.15	-	-	0.00	0.00	-	0.00
210	2,070	2,071	23.43	108.0	0.00	77.32	-	-	0.00	0.00	-	0.00
211	3,268	3,269	18.16	108.0	0.00	81.29	-	-	0.00	0.00	-	0.00
212	3,576	3,577	17.09	108.0	0.00	82.07	-	-	0.00	0.00	-	0.00
213	3,897	3,898	16.05	108.0	0.00	82.82	-	-	0.00	0.00	-	0.00
214	3,971	3,972	15.82	108.0	0.00	82.98	-	-	0.00	0.00	-	0.00
215	5,365	5,366	11.97	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00

To be continued on next page...

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
216	5,184	5,185	12.42	108.0	0.00	85.30	-	-	0.00	0.00	-	0.00
217	5,236	5,236	12.29	108.0	0.00	85.38	-	-	0.00	0.00	-	0.00
218	4,053	4,054	15.56	108.0	0.00	83.16	-	-	0.00	0.00	-	0.00
219	4,851	4,851	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
220	4,962	4,963	13.00	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
221	5,494	5,494	11.66	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
222	8,793	8,794	5.16	108.0	0.00	89.88	-	-	0.00	0.00	-	0.00
223	8,626	8,626	5.44	108.0	0.00	89.72	-	-	0.00	0.00	-	0.00
224	6,905	6,905	8.57	108.0	0.00	87.78	-	-	0.00	0.00	-	0.00
225	6,839	6,840	8.70	108.0	0.00	87.70	-	-	0.00	0.00	-	0.00
226	7,539	7,540	7.34	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00
227	7,411	7,412	7.58	108.0	0.00	88.40	-	-	0.00	0.00	-	0.00
228	8,124	8,124	6.29	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
229	6,909	6,910	8.56	108.0	0.00	87.79	-	-	0.00	0.00	-	0.00
230	6,659	6,660	9.07	108.0	0.00	87.47	-	-	0.00	0.00	-	0.00
231	6,624	6,624	9.14	108.0	0.00	87.42	-	-	0.00	0.00	-	0.00
232	7,762	7,763	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
233	7,683	7,683	7.08	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
234	7,796	7,796	6.87	108.0	0.00	88.84	-	-	0.00	0.00	-	0.00
235	7,252	7,253	7.89	108.0	0.00	88.21	-	-	0.00	0.00	-	0.00
301	6,206	6,206	10.03	108.0	0.00	86.86	-	-	0.00	0.00	-	0.00
302	6,557	6,557	9.28	108.0	0.00	87.33	-	-	0.00	0.00	-	0.00
303	7,437	7,437	7.53	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
304	7,939	7,939	6.62	108.0	0.00	89.00	-	-	0.00	0.00	-	0.00
305	8,524	8,524	5.61	108.0	0.00	89.61	-	-	0.00	0.00	-	0.00
306	8,151	8,152	6.24	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
307	7,700	7,701	7.05	108.0	0.00	88.73	-	-	0.00	0.00	-	0.00
308	10,186	10,186	3.03	108.0	0.00	91.16	-	-	0.00	0.00	-	0.00
309	9,742	9,742	3.68	108.0	0.00	90.77	-	-	0.00	0.00	-	0.00
310	9,014	9,014	4.80	108.0	0.00	90.10	-	-	0.00	0.00	-	0.00
311	8,673	8,673	5.36	108.0	0.00	89.76	-	-	0.00	0.00	-	0.00
312	8,459	8,460	5.71	108.0	0.00	89.55	-	-	0.00	0.00	-	0.00
313	8,204	8,205	6.15	108.0	0.00	89.28	-	-	0.00	0.00	-	0.00
314	7,488	7,488	7.44	108.0	0.00	88.49	-	-	0.00	0.00	-	0.00
315	8,536	8,537	5.58	108.0	0.00	89.63	-	-	0.00	0.00	-	0.00
316	9,289	9,289	4.37	108.0	0.00	90.36	-	-	0.00	0.00	-	0.00
317	9,337	9,338	4.30	108.0	0.00	90.40	-	-	0.00	0.00	-	0.00
318	9,994	9,994	3.31	108.0	0.00	90.99	-	-	0.00	0.00	-	0.00
319	11,687	11,688	1.01	108.0	0.00	92.35	-	-	0.00	0.00	-	0.00
320	12,170	12,170	0.41	108.0	0.00	92.71	-	-	0.00	0.00	-	0.00
321	12,552	12,553	-0.05	108.0	0.00	92.97	-	-	0.00	0.00	-	0.00
322	13,296	13,296	-0.91	108.0	0.00	93.47	-	-	0.00	0.00	-	0.00
323	13,352	13,352	-0.97	108.0	0.00	93.51	-	-	0.00	0.00	-	0.00
324	12,694	12,695	-0.22	108.0	0.00	93.07	-	-	0.00	0.00	-	0.00
325	14,169	14,170	-1.86	108.0	0.00	94.03	-	-	0.00	0.00	-	0.00
326	13,480	13,480	-1.11	108.0	0.00	93.59	-	-	0.00	0.00	-	0.00
327	13,306	13,306	-0.92	108.0	0.00	93.48	-	-	0.00	0.00	-	0.00
328	12,771	12,771	-0.31	108.0	0.00	93.12	-	-	0.00	0.00	-	0.00
329	13,675	13,676	-1.33	108.0	0.00	93.72	-	-	0.00	0.00	-	0.00
330	12,981	12,982	-0.55	108.0	0.00	93.27	-	-	0.00	0.00	-	0.00
331	12,150	12,151	0.43	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
332	11,651	11,651	1.05	108.0	0.00	92.33	-	-	0.00	0.00	-	0.00
333	11,279	11,280	1.53	108.0	0.00	92.05	-	-	0.00	0.00	-	0.00
334	11,618	11,618	1.10	108.0	0.00	92.30	-	-	0.00	0.00	-	0.00
335	11,352	11,352	1.44	108.0	0.00	92.10	-	-	0.00	0.00	-	0.00

Sum 31.24

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
1	3,910	3,912	16.00	108.0	0.00	82.85	-	-	0.00	0.00	-	0.00
2	4,905	4,906	13.14	108.0	0.00	84.81	-	-	0.00	0.00	-	0.00
3	888	893	31.92	107.0	0.00	70.02	-	-	0.00	0.00	-	0.00
4	1,651	1,653	24.66	107.0	0.00	75.37	-	-	0.00	0.00	-	0.00
5	2,111	2,113	21.62	107.0	0.00	77.50	-	-	0.00	0.00	-	0.00
6	5,401	5,402	11.89	108.0	0.00	85.65	-	-	0.00	0.00	-	0.00
7	4,375	4,376	14.61	108.0	0.00	83.82	-	-	0.00	0.00	-	0.00
8	664	671	35.13	107.0	0.00	67.53	-	-	0.00	0.00	-	0.00
9	4,370	4,370	14.62	108.0	0.00	83.81	-	-	0.00	0.00	-	0.00
10	4,439	4,440	14.42	108.0	0.00	83.95	-	-	0.00	0.00	-	0.00
11	5,494	5,495	11.66	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
12	3,379	3,380	16.05	107.0	0.00	81.58	-	-	0.00	0.00	-	0.00
13	1,950	1,952	22.62	107.0	0.00	76.81	-	-	0.00	0.00	-	0.00
14	2,246	2,248	20.85	107.0	0.00	78.03	-	-	0.00	0.00	-	0.00
15	4,192	4,193	15.14	108.0	0.00	83.45	-	-	0.00	0.00	-	0.00
16	1,184	1,186	28.63	107.0	0.00	72.49	-	-	0.00	0.00	-	0.00
17	5,772	5,773	11.00	108.0	0.00	86.23	-	-	0.00	0.00	-	0.00
18	2,930	2,930	17.73	107.0	0.00	80.34	-	-	0.00	0.00	-	0.00
19	2,663	2,664	18.84	107.0	0.00	79.51	-	-	0.00	0.00	-	0.00
20	5,058	5,059	12.75	108.0	0.00	85.08	-	-	0.00	0.00	-	0.00
22	2,114	2,115	21.61	107.0	0.00	77.51	-	-	0.00	0.00	-	0.00
23	818	825	32.82	107.0	0.00	69.33	-	-	0.00	0.00	-	0.00
25	6,068	6,069	10.33	108.0	0.00	86.66	-	-	0.00	0.00	-	0.00
26	5,581	5,581	11.45	108.0	0.00	85.93	-	-	0.00	0.00	-	0.00
27	3,514	3,515	17.30	108.0	0.00	81.92	-	-	0.00	0.00	-	0.00
28	4,788	4,789	13.46	108.0	0.00	84.60	-	-	0.00	0.00	-	0.00
29	3,765	3,766	14.74	107.0	0.00	82.52	-	-	0.00	0.00	-	0.00
30	5,199	5,200	12.39	108.0	0.00	85.32	-	-	0.00	0.00	-	0.00
31	2,916	2,917	17.79	107.0	0.00	80.30	-	-	0.00	0.00	-	0.00
32	1,485	1,487	25.94	107.0	0.00	74.45	-	-	0.00	0.00	-	0.00
33	2,248	2,249	20.84	107.0	0.00	78.04	-	-	0.00	0.00	-	0.00
201	6,537	6,537	9.32	108.0	0.00	87.31	-	-	0.00	0.00	-	0.00
202	6,835	6,836	8.71	108.0	0.00	87.70	-	-	0.00	0.00	-	0.00
203	7,068	7,069	8.24	108.0	0.00	87.99	-	-	0.00	0.00	-	0.00
204	7,356	7,357	7.69	108.0	0.00	88.33	-	-	0.00	0.00	-	0.00
205	7,852	7,852	6.77	108.0	0.00	88.90	-	-	0.00	0.00	-	0.00
206	7,100	7,100	8.18	108.0	0.00	88.03	-	-	0.00	0.00	-	0.00
207	7,709	7,709	7.03	108.0	0.00	88.74	-	-	0.00	0.00	-	0.00
208	3,312	3,313	18.01	108.0	0.00	81.40	-	-	0.00	0.00	-	0.00
209	3,416	3,417	17.64	108.0	0.00	81.67	-	-	0.00	0.00	-	0.00
210	3,494	3,495	17.37	108.0	0.00	81.87	-	-	0.00	0.00	-	0.00
211	2,351	2,353	21.88	108.0	0.00	78.43	-	-	0.00	0.00	-	0.00
212	2,177	2,179	22.82	108.0	0.00	77.77	-	-	0.00	0.00	-	0.00
213	2,128	2,130	23.09	108.0	0.00	77.57	-	-	0.00	0.00	-	0.00
214	2,371	2,372	21.78	108.0	0.00	78.50	-	-	0.00	0.00	-	0.00
215	434	446	40.07	108.0	0.00	63.98	-	-	0.00	0.00	-	0.00
216	1,835	1,836	24.85	108.0	0.00	76.28	-	-	0.00	0.00	-	0.00
217	2,551	2,552	20.98	108.0	0.00	79.14	-	-	0.00	0.00	-	0.00
218	4,317	4,318	14.78	108.0	0.00	83.70	-	-	0.00	0.00	-	0.00
219	4,705	4,705	13.68	108.0	0.00	84.45	-	-	0.00	0.00	-	0.00
220	5,178	5,178	12.44	108.0	0.00	85.28	-	-	0.00	0.00	-	0.00
221	5,757	5,757	11.04	108.0	0.00	86.20	-	-	0.00	0.00	-	0.00
222	6,749	6,749	8.88	108.0	0.00	87.59	-	-	0.00	0.00	-	0.00
223	6,208	6,209	10.02	108.0	0.00	86.86	-	-	0.00	0.00	-	0.00
224	5,556	5,557	11.51	108.0	0.00	85.90	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
225	5,256	5,257	12.24	108.0	0.00	85.41	-	-	0.00	0.00	-	0.00
226	5,222	5,223	12.33	108.0	0.00	85.36	-	-	0.00	0.00	-	0.00
227	4,507	4,508	14.23	108.0	0.00	84.08	-	-	0.00	0.00	-	0.00
228	6,245	6,245	9.94	108.0	0.00	86.91	-	-	0.00	0.00	-	0.00
229	3,819	3,820	16.30	108.0	0.00	82.64	-	-	0.00	0.00	-	0.00
230	3,484	3,485	17.40	108.0	0.00	81.84	-	-	0.00	0.00	-	0.00
231	3,043	3,044	18.99	108.0	0.00	80.67	-	-	0.00	0.00	-	0.00
232	3,399	3,400	17.70	108.0	0.00	81.63	-	-	0.00	0.00	-	0.00
233	3,091	3,092	18.81	108.0	0.00	80.81	-	-	0.00	0.00	-	0.00
234	2,998	3,000	19.16	108.0	0.00	80.54	-	-	0.00	0.00	-	0.00
235	2,257	2,258	22.38	108.0	0.00	78.08	-	-	0.00	0.00	-	0.00
301	7,683	7,684	7.08	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
302	8,192	8,192	6.17	108.0	0.00	89.27	-	-	0.00	0.00	-	0.00
303	9,012	9,012	4.81	108.0	0.00	90.10	-	-	0.00	0.00	-	0.00
304	9,623	9,624	3.86	108.0	0.00	90.67	-	-	0.00	0.00	-	0.00
305	9,749	9,749	3.67	108.0	0.00	90.78	-	-	0.00	0.00	-	0.00
306	9,431	9,431	4.15	108.0	0.00	90.49	-	-	0.00	0.00	-	0.00
307	8,658	8,659	5.38	108.0	0.00	89.75	-	-	0.00	0.00	-	0.00
308	7,097	7,098	8.19	108.0	0.00	88.02	-	-	0.00	0.00	-	0.00
309	6,565	6,565	9.26	108.0	0.00	87.35	-	-	0.00	0.00	-	0.00
310	6,028	6,028	10.42	108.0	0.00	86.60	-	-	0.00	0.00	-	0.00
311	5,546	5,546	11.54	108.0	0.00	85.88	-	-	0.00	0.00	-	0.00
312	5,155	5,156	12.50	108.0	0.00	85.25	-	-	0.00	0.00	-	0.00
313	4,694	4,695	13.71	108.0	0.00	84.43	-	-	0.00	0.00	-	0.00
314	3,823	3,824	16.28	108.0	0.00	82.65	-	-	0.00	0.00	-	0.00
315	4,432	4,433	14.44	108.0	0.00	83.93	-	-	0.00	0.00	-	0.00
316	5,165	5,166	12.47	108.0	0.00	85.26	-	-	0.00	0.00	-	0.00
317	5,417	5,418	11.85	108.0	0.00	85.68	-	-	0.00	0.00	-	0.00
318	6,234	6,235	9.97	108.0	0.00	86.90	-	-	0.00	0.00	-	0.00
319	7,539	7,539	7.34	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00
320	8,031	8,032	6.45	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
321	8,488	8,488	5.67	108.0	0.00	89.58	-	-	0.00	0.00	-	0.00
322	8,892	8,893	5.00	108.0	0.00	89.98	-	-	0.00	0.00	-	0.00
323	8,835	8,836	5.09	108.0	0.00	89.92	-	-	0.00	0.00	-	0.00
324	8,065	8,065	6.39	108.0	0.00	89.13	-	-	0.00	0.00	-	0.00
325	9,381	9,382	4.23	108.0	0.00	90.45	-	-	0.00	0.00	-	0.00
326	8,660	8,661	5.38	108.0	0.00	89.75	-	-	0.00	0.00	-	0.00
327	8,406	8,406	5.80	108.0	0.00	89.49	-	-	0.00	0.00	-	0.00
328	7,679	7,680	7.08	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
329	8,417	8,417	5.79	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
330	7,675	7,676	7.09	108.0	0.00	88.70	-	-	0.00	0.00	-	0.00
331	6,945	6,946	8.49	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
332	6,421	6,422	9.56	108.0	0.00	87.15	-	-	0.00	0.00	-	0.00
333	6,247	6,248	9.94	108.0	0.00	86.91	-	-	0.00	0.00	-	0.00
334	6,680	6,680	9.02	108.0	0.00	87.50	-	-	0.00	0.00	-	0.00
335	6,571	6,572	9.25	108.0	0.00	87.35	-	-	0.00	0.00	-	0.00

Sum 43.44

- Data undefined due to calculation with octave data

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]
1	4,410	4,411	14.50	108.0	0.00	83.89	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
2	5,496	5,497	11.66	108.0	0.00	85.80	-	-	0.00	0.00	-	0.00
3	1,749	1,752	23.95	107.0	0.00	75.87	-	-	0.00	0.00	-	0.00
4	1,596	1,598	25.07	107.0	0.00	75.07	-	-	0.00	0.00	-	0.00
5	2,988	2,989	17.50	107.0	0.00	80.51	-	-	0.00	0.00	-	0.00
6	6,182	6,183	10.08	108.0	0.00	86.82	-	-	0.00	0.00	-	0.00
7	5,276	5,277	12.19	108.0	0.00	85.45	-	-	0.00	0.00	-	0.00
8	911	916	31.62	107.0	0.00	70.24	-	-	0.00	0.00	-	0.00
9	4,665	4,666	13.79	108.0	0.00	84.38	-	-	0.00	0.00	-	0.00
10	4,953	4,954	13.02	108.0	0.00	84.90	-	-	0.00	0.00	-	0.00
11	5,723	5,723	11.12	108.0	0.00	86.15	-	-	0.00	0.00	-	0.00
12	3,181	3,181	16.77	107.0	0.00	81.05	-	-	0.00	0.00	-	0.00
13	1,964	1,966	22.53	107.0	0.00	76.87	-	-	0.00	0.00	-	0.00
14	2,819	2,820	18.18	107.0	0.00	80.01	-	-	0.00	0.00	-	0.00
15	4,980	4,981	12.95	108.0	0.00	84.95	-	-	0.00	0.00	-	0.00
16	1,584	1,586	25.16	107.0	0.00	75.01	-	-	0.00	0.00	-	0.00
17	6,614	6,615	9.16	108.0	0.00	87.41	-	-	0.00	0.00	-	0.00
18	3,633	3,634	15.17	107.0	0.00	82.21	-	-	0.00	0.00	-	0.00
19	3,022	3,022	17.37	107.0	0.00	80.61	-	-	0.00	0.00	-	0.00
20	5,941	5,941	10.62	108.0	0.00	86.48	-	-	0.00	0.00	-	0.00
22	1,425	1,426	26.44	107.0	0.00	74.08	-	-	0.00	0.00	-	0.00
23	470	482	38.72	107.0	0.00	64.66	-	-	0.00	0.00	-	0.00
25	6,847	6,848	8.68	108.0	0.00	87.71	-	-	0.00	0.00	-	0.00
26	6,529	6,529	9.34	108.0	0.00	87.30	-	-	0.00	0.00	-	0.00
27	4,063	4,064	15.53	108.0	0.00	83.18	-	-	0.00	0.00	-	0.00
28	5,588	5,589	11.43	108.0	0.00	85.95	-	-	0.00	0.00	-	0.00
29	3,408	3,409	15.95	107.0	0.00	81.65	-	-	0.00	0.00	-	0.00
30	5,714	5,715	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
31	2,644	2,645	18.92	107.0	0.00	79.45	-	-	0.00	0.00	-	0.00
32	2,427	2,428	19.88	107.0	0.00	78.71	-	-	0.00	0.00	-	0.00
33	1,900	1,901	22.94	107.0	0.00	76.58	-	-	0.00	0.00	-	0.00
201	7,109	7,109	8.16	108.0	0.00	88.04	-	-	0.00	0.00	-	0.00
202	7,399	7,399	7.61	108.0	0.00	88.38	-	-	0.00	0.00	-	0.00
203	7,383	7,383	7.64	108.0	0.00	88.37	-	-	0.00	0.00	-	0.00
204	7,727	7,727	7.00	108.0	0.00	88.76	-	-	0.00	0.00	-	0.00
205	8,190	8,190	6.18	108.0	0.00	89.27	-	-	0.00	0.00	-	0.00
206	7,223	7,224	7.94	108.0	0.00	88.18	-	-	0.00	0.00	-	0.00
207	7,739	7,740	6.98	108.0	0.00	88.77	-	-	0.00	0.00	-	0.00
208	2,337	2,338	21.96	108.0	0.00	78.38	-	-	0.00	0.00	-	0.00
209	2,344	2,345	21.92	108.0	0.00	78.40	-	-	0.00	0.00	-	0.00
210	2,332	2,333	21.98	108.0	0.00	78.36	-	-	0.00	0.00	-	0.00
211	1,136	1,140	30.25	108.0	0.00	72.14	-	-	0.00	0.00	-	0.00
212	973	976	31.94	108.0	0.00	70.79	-	-	0.00	0.00	-	0.00
213	1,038	1,041	31.24	108.0	0.00	71.35	-	-	0.00	0.00	-	0.00
214	1,363	1,366	28.25	108.0	0.00	73.71	-	-	0.00	0.00	-	0.00
215	982	987	31.82	108.0	0.00	70.88	-	-	0.00	0.00	-	0.00
216	1,522	1,524	27.01	108.0	0.00	74.66	-	-	0.00	0.00	-	0.00
217	2,127	2,129	23.10	108.0	0.00	77.56	-	-	0.00	0.00	-	0.00
218	3,363	3,364	17.82	108.0	0.00	81.54	-	-	0.00	0.00	-	0.00
219	3,893	3,894	16.06	108.0	0.00	82.81	-	-	0.00	0.00	-	0.00
220	4,344	4,345	14.70	108.0	0.00	83.76	-	-	0.00	0.00	-	0.00
221	4,968	4,968	12.98	108.0	0.00	84.92	-	-	0.00	0.00	-	0.00
222	6,593	6,593	9.20	108.0	0.00	87.38	-	-	0.00	0.00	-	0.00
223	6,135	6,135	10.18	108.0	0.00	86.76	-	-	0.00	0.00	-	0.00
224	5,132	5,132	12.56	108.0	0.00	85.21	-	-	0.00	0.00	-	0.00
225	4,872	4,872	13.23	108.0	0.00	84.75	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
	226	5,056	5,057	12.75	108.0	0.00	85.08	-	-	0.00	0.00	-	0.00
	227	4,482	4,483	14.30	108.0	0.00	84.03	-	-	0.00	0.00	-	0.00
	228	6,015	6,015	10.45	108.0	0.00	86.58	-	-	0.00	0.00	-	0.00
	229	3,798	3,799	16.36	108.0	0.00	82.59	-	-	0.00	0.00	-	0.00
	230	3,458	3,459	17.49	108.0	0.00	81.78	-	-	0.00	0.00	-	0.00
	231	3,138	3,139	18.64	108.0	0.00	80.94	-	-	0.00	0.00	-	0.00
	232	3,894	3,895	16.06	108.0	0.00	82.81	-	-	0.00	0.00	-	0.00
	233	3,681	3,682	16.74	108.0	0.00	82.32	-	-	0.00	0.00	-	0.00
	234	3,691	3,692	16.71	108.0	0.00	82.35	-	-	0.00	0.00	-	0.00
	235	3,029	3,030	19.05	108.0	0.00	80.63	-	-	0.00	0.00	-	0.00
	301	7,277	7,277	7.84	108.0	0.00	88.24	-	-	0.00	0.00	-	0.00
	302	7,776	7,776	6.91	108.0	0.00	88.82	-	-	0.00	0.00	-	0.00
	303	8,643	8,643	5.41	108.0	0.00	89.73	-	-	0.00	0.00	-	0.00
	304	9,252	9,252	4.43	108.0	0.00	90.32	-	-	0.00	0.00	-	0.00
	305	9,480	9,480	4.08	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
	306	9,139	9,140	4.61	108.0	0.00	90.22	-	-	0.00	0.00	-	0.00
	307	8,409	8,410	5.80	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
	308	7,271	7,271	7.85	108.0	0.00	88.23	-	-	0.00	0.00	-	0.00
	309	6,748	6,749	8.88	108.0	0.00	87.58	-	-	0.00	0.00	-	0.00
	310	6,126	6,126	10.20	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
	311	5,667	5,668	11.25	108.0	0.00	86.07	-	-	0.00	0.00	-	0.00
	312	5,318	5,319	12.09	108.0	0.00	85.52	-	-	0.00	0.00	-	0.00
	313	4,906	4,907	13.14	108.0	0.00	84.82	-	-	0.00	0.00	-	0.00
	314	4,036	4,037	15.62	108.0	0.00	83.12	-	-	0.00	0.00	-	0.00
	315	4,867	4,868	13.24	108.0	0.00	84.75	-	-	0.00	0.00	-	0.00
	316	5,639	5,640	11.31	108.0	0.00	86.02	-	-	0.00	0.00	-	0.00
	317	5,821	5,822	10.89	108.0	0.00	86.30	-	-	0.00	0.00	-	0.00
	318	6,607	6,607	9.17	108.0	0.00	87.40	-	-	0.00	0.00	-	0.00
	319	8,083	8,083	6.36	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
	320	8,580	8,581	5.51	108.0	0.00	89.67	-	-	0.00	0.00	-	0.00
	321	9,018	9,019	4.80	108.0	0.00	90.10	-	-	0.00	0.00	-	0.00
	322	9,548	9,548	3.97	108.0	0.00	90.60	-	-	0.00	0.00	-	0.00
	323	9,531	9,532	4.00	108.0	0.00	90.58	-	-	0.00	0.00	-	0.00
	324	8,795	8,796	5.16	108.0	0.00	89.89	-	-	0.00	0.00	-	0.00
	325	10,184	10,185	3.03	108.0	0.00	91.16	-	-	0.00	0.00	-	0.00
	326	9,470	9,471	4.09	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
	327	9,246	9,246	4.44	108.0	0.00	90.32	-	-	0.00	0.00	-	0.00
	328	8,595	8,596	5.49	108.0	0.00	89.69	-	-	0.00	0.00	-	0.00
	329	9,412	9,412	4.18	108.0	0.00	90.47	-	-	0.00	0.00	-	0.00
	330	8,691	8,691	5.33	108.0	0.00	89.78	-	-	0.00	0.00	-	0.00
	331	7,909	7,909	6.67	108.0	0.00	88.96	-	-	0.00	0.00	-	0.00
	332	7,393	7,394	7.62	108.0	0.00	88.38	-	-	0.00	0.00	-	0.00
	333	7,125	7,126	8.13	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
	334	7,521	7,521	7.38	108.0	0.00	88.53	-	-	0.00	0.00	-	0.00
	335	7,344	7,344	7.71	108.0	0.00	88.32	-	-	0.00	0.00	-	0.00

Sum 42.92

- Data undefined due to calculation with octave data

Noise sensitive area: NSP015 NSP015

		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]
	1	4,515	4,516	14.21	108.0	0.00	84.10	-	-	0.00	0.00	-	0.00
	2	5,611	5,612	11.38	108.0	0.00	85.98	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
3	1,955	1,958	22.58	107.0	0.00	76.83	-	-	0.00	0.00	-	0.00
4	1,663	1,665	24.57	107.0	0.00	75.43	-	-	0.00	0.00	-	0.00
5	3,173	3,175	16.79	107.0	0.00	81.03	-	-	0.00	0.00	-	0.00
6	6,332	6,333	9.75	108.0	0.00	87.03	-	-	0.00	0.00	-	0.00
7	5,452	5,453	11.76	108.0	0.00	85.73	-	-	0.00	0.00	-	0.00
8	1,112	1,116	29.34	107.0	0.00	71.95	-	-	0.00	0.00	-	0.00
9	4,728	4,729	13.62	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
10	5,056	5,057	12.75	108.0	0.00	85.08	-	-	0.00	0.00	-	0.00
11	5,766	5,766	11.02	108.0	0.00	86.22	-	-	0.00	0.00	-	0.00
12	3,161	3,161	16.84	107.0	0.00	81.00	-	-	0.00	0.00	-	0.00
13	2,025	2,026	22.15	107.0	0.00	77.13	-	-	0.00	0.00	-	0.00
14	2,957	2,958	17.63	107.0	0.00	80.42	-	-	0.00	0.00	-	0.00
15	5,136	5,137	12.55	108.0	0.00	85.21	-	-	0.00	0.00	-	0.00
16	1,736	1,738	24.05	107.0	0.00	75.80	-	-	0.00	0.00	-	0.00
17	6,775	6,775	8.83	108.0	0.00	87.62	-	-	0.00	0.00	-	0.00
18	3,783	3,783	14.69	107.0	0.00	82.56	-	-	0.00	0.00	-	0.00
19	3,117	3,118	17.01	107.0	0.00	80.88	-	-	0.00	0.00	-	0.00
20	6,111	6,112	10.24	108.0	0.00	86.72	-	-	0.00	0.00	-	0.00
22	1,342	1,344	27.15	107.0	0.00	73.57	-	-	0.00	0.00	-	0.00
23	712	720	34.35	107.0	0.00	68.15	-	-	0.00	0.00	-	0.00
25	6,995	6,995	8.39	108.0	0.00	87.90	-	-	0.00	0.00	-	0.00
26	6,711	6,711	8.96	108.0	0.00	87.54	-	-	0.00	0.00	-	0.00
27	4,181	4,181	15.18	108.0	0.00	83.43	-	-	0.00	0.00	-	0.00
28	5,744	5,745	11.07	108.0	0.00	86.19	-	-	0.00	0.00	-	0.00
29	3,350	3,350	16.15	107.0	0.00	81.50	-	-	0.00	0.00	-	0.00
30	5,814	5,814	10.91	108.0	0.00	86.29	-	-	0.00	0.00	-	0.00
31	2,619	2,620	19.03	107.0	0.00	79.37	-	-	0.00	0.00	-	0.00
32	2,629	2,631	18.98	107.0	0.00	79.40	-	-	0.00	0.00	-	0.00
33	1,883	1,884	23.05	107.0	0.00	76.50	-	-	0.00	0.00	-	0.00
201	7,214	7,215	7.96	108.0	0.00	88.16	-	-	0.00	0.00	-	0.00
202	7,502	7,502	7.41	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
203	7,436	7,437	7.54	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
204	7,790	7,790	6.88	108.0	0.00	88.83	-	-	0.00	0.00	-	0.00
205	8,245	8,246	6.08	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
206	7,238	7,239	7.91	108.0	0.00	88.19	-	-	0.00	0.00	-	0.00
207	7,734	7,734	6.99	108.0	0.00	88.77	-	-	0.00	0.00	-	0.00
208	2,144	2,145	23.01	108.0	0.00	77.63	-	-	0.00	0.00	-	0.00
209	2,125	2,126	23.11	108.0	0.00	77.55	-	-	0.00	0.00	-	0.00
210	2,091	2,092	23.30	108.0	0.00	77.41	-	-	0.00	0.00	-	0.00
211	888	892	32.91	108.0	0.00	70.01	-	-	0.00	0.00	-	0.00
212	747	752	34.72	108.0	0.00	68.52	-	-	0.00	0.00	-	0.00
213	888	892	32.91	108.0	0.00	70.00	-	-	0.00	0.00	-	0.00
214	1,237	1,240	29.33	108.0	0.00	72.87	-	-	0.00	0.00	-	0.00
215	1,227	1,231	29.41	108.0	0.00	72.80	-	-	0.00	0.00	-	0.00
216	1,605	1,606	26.41	108.0	0.00	75.12	-	-	0.00	0.00	-	0.00
217	2,154	2,155	22.95	108.0	0.00	77.67	-	-	0.00	0.00	-	0.00
218	3,219	3,220	18.34	108.0	0.00	81.16	-	-	0.00	0.00	-	0.00
219	3,786	3,787	16.40	108.0	0.00	82.57	-	-	0.00	0.00	-	0.00
220	4,228	4,228	15.04	108.0	0.00	83.52	-	-	0.00	0.00	-	0.00
221	4,860	4,860	13.27	108.0	0.00	84.73	-	-	0.00	0.00	-	0.00
222	6,623	6,624	9.14	108.0	0.00	87.42	-	-	0.00	0.00	-	0.00
223	6,185	6,185	10.07	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
224	5,112	5,113	12.61	108.0	0.00	85.17	-	-	0.00	0.00	-	0.00
225	4,863	4,864	13.26	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
226	5,093	5,094	12.66	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power - BISON Wind Energy Center

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 Frank Frederickson
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
227	4,552	4,553	14.10	108.0	0.00	84.17	-	-	0.00	0.00	-	0.00
228	6,033	6,033	10.41	108.0	0.00	86.61	-	-	0.00	0.00	-	0.00
229	3,875	3,876	16.12	108.0	0.00	82.77	-	-	0.00	0.00	-	0.00
230	3,539	3,541	17.22	108.0	0.00	81.98	-	-	0.00	0.00	-	0.00
231	3,247	3,248	18.24	108.0	0.00	81.23	-	-	0.00	0.00	-	0.00
232	4,060	4,061	15.54	108.0	0.00	83.17	-	-	0.00	0.00	-	0.00
233	3,863	3,864	16.15	108.0	0.00	82.74	-	-	0.00	0.00	-	0.00
234	3,888	3,889	16.08	108.0	0.00	82.80	-	-	0.00	0.00	-	0.00
235	3,240	3,241	18.26	108.0	0.00	81.21	-	-	0.00	0.00	-	0.00
301	7,182	7,182	8.02	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
302	7,679	7,679	7.09	108.0	0.00	88.71	-	-	0.00	0.00	-	0.00
303	8,552	8,553	5.56	108.0	0.00	89.64	-	-	0.00	0.00	-	0.00
304	9,160	9,160	4.57	108.0	0.00	90.24	-	-	0.00	0.00	-	0.00
305	9,409	9,409	4.19	108.0	0.00	90.47	-	-	0.00	0.00	-	0.00
306	9,064	9,065	4.72	108.0	0.00	90.15	-	-	0.00	0.00	-	0.00
307	8,345	8,345	5.91	108.0	0.00	89.43	-	-	0.00	0.00	-	0.00
308	7,364	7,365	7.67	108.0	0.00	88.34	-	-	0.00	0.00	-	0.00
309	6,846	6,846	8.69	108.0	0.00	87.71	-	-	0.00	0.00	-	0.00
310	6,209	6,210	10.02	108.0	0.00	86.86	-	-	0.00	0.00	-	0.00
311	5,758	5,758	11.04	108.0	0.00	86.21	-	-	0.00	0.00	-	0.00
312	5,418	5,419	11.84	108.0	0.00	85.68	-	-	0.00	0.00	-	0.00
313	5,018	5,019	12.85	108.0	0.00	85.01	-	-	0.00	0.00	-	0.00
314	4,154	4,155	15.26	108.0	0.00	83.37	-	-	0.00	0.00	-	0.00
315	5,017	5,018	12.85	108.0	0.00	85.01	-	-	0.00	0.00	-	0.00
316	5,791	5,792	10.96	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
317	5,961	5,962	10.57	108.0	0.00	86.51	-	-	0.00	0.00	-	0.00
318	6,739	6,739	8.90	108.0	0.00	87.57	-	-	0.00	0.00	-	0.00
319	8,240	8,241	6.09	108.0	0.00	89.32	-	-	0.00	0.00	-	0.00
320	8,738	8,738	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
321	9,172	9,172	4.55	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
322	9,722	9,722	3.71	108.0	0.00	90.76	-	-	0.00	0.00	-	0.00
323	9,712	9,713	3.72	108.0	0.00	90.75	-	-	0.00	0.00	-	0.00
324	8,982	8,983	4.85	108.0	0.00	90.07	-	-	0.00	0.00	-	0.00
325	10,382	10,382	2.75	108.0	0.00	91.33	-	-	0.00	0.00	-	0.00
326	9,669	9,670	3.79	108.0	0.00	90.71	-	-	0.00	0.00	-	0.00
327	9,450	9,450	4.12	108.0	0.00	90.51	-	-	0.00	0.00	-	0.00
328	8,811	8,811	5.13	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
329	9,638	9,639	3.84	108.0	0.00	90.68	-	-	0.00	0.00	-	0.00
330	8,920	8,920	4.95	108.0	0.00	90.01	-	-	0.00	0.00	-	0.00
331	8,131	8,132	6.28	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
332	7,618	7,618	7.20	108.0	0.00	88.64	-	-	0.00	0.00	-	0.00
333	7,337	7,337	7.72	108.0	0.00	88.31	-	-	0.00	0.00	-	0.00
334	7,726	7,727	7.00	108.0	0.00	88.76	-	-	0.00	0.00	-	0.00
335	7,540	7,540	7.34	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00

Sum 42.20

- Data undefined due to calculation with octave data

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]
1	4,851	4,852	13.29	108.0	0.00	84.72	-	-	0.00	0.00	-	0.00
2	5,936	5,937	10.63	108.0	0.00	86.47	-	-	0.00	0.00	-	0.00
3	2,145	2,147	21.42	107.0	0.00	77.64	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
4	2,028	2,030	22.13	107.0	0.00	77.15	-	-	0.00	0.00	-	0.00
5	3,400	3,401	15.97	107.0	0.00	81.63	-	-	0.00	0.00	-	0.00
6	6,614	6,615	9.16	108.0	0.00	87.41	-	-	0.00	0.00	-	0.00
7	5,693	5,694	11.19	108.0	0.00	86.11	-	-	0.00	0.00	-	0.00
8	1,324	1,327	27.30	107.0	0.00	73.46	-	-	0.00	0.00	-	0.00
9	5,098	5,099	12.64	108.0	0.00	85.15	-	-	0.00	0.00	-	0.00
10	5,393	5,394	11.90	108.0	0.00	85.64	-	-	0.00	0.00	-	0.00
11	6,148	6,149	10.15	108.0	0.00	86.78	-	-	0.00	0.00	-	0.00
12	3,565	3,565	15.41	107.0	0.00	82.04	-	-	0.00	0.00	-	0.00
13	2,395	2,396	20.04	107.0	0.00	78.59	-	-	0.00	0.00	-	0.00
14	3,257	3,258	16.49	107.0	0.00	81.26	-	-	0.00	0.00	-	0.00
15	5,410	5,411	11.86	108.0	0.00	85.67	-	-	0.00	0.00	-	0.00
16	2,020	2,022	22.18	107.0	0.00	77.11	-	-	0.00	0.00	-	0.00
17	7,041	7,041	8.30	108.0	0.00	87.95	-	-	0.00	0.00	-	0.00
18	4,067	4,067	13.80	107.0	0.00	83.19	-	-	0.00	0.00	-	0.00
19	3,461	3,462	15.76	107.0	0.00	81.79	-	-	0.00	0.00	-	0.00
20	6,361	6,362	9.69	108.0	0.00	87.07	-	-	0.00	0.00	-	0.00
22	1,748	1,749	23.97	107.0	0.00	75.86	-	-	0.00	0.00	-	0.00
23	686	694	34.76	107.0	0.00	67.82	-	-	0.00	0.00	-	0.00
25	7,280	7,281	7.83	108.0	0.00	88.24	-	-	0.00	0.00	-	0.00
26	6,940	6,940	8.50	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
27	4,504	4,505	14.24	108.0	0.00	84.07	-	-	0.00	0.00	-	0.00
28	6,018	6,019	10.44	108.0	0.00	86.59	-	-	0.00	0.00	-	0.00
29	3,756	3,757	14.77	107.0	0.00	82.50	-	-	0.00	0.00	-	0.00
30	6,155	6,155	10.14	108.0	0.00	86.78	-	-	0.00	0.00	-	0.00
31	3,024	3,024	17.37	107.0	0.00	80.61	-	-	0.00	0.00	-	0.00
32	2,823	2,824	18.16	107.0	0.00	80.02	-	-	0.00	0.00	-	0.00
33	2,285	2,286	20.63	107.0	0.00	78.18	-	-	0.00	0.00	-	0.00
201	7,550	7,550	7.32	108.0	0.00	88.56	-	-	0.00	0.00	-	0.00
202	7,840	7,840	6.79	108.0	0.00	88.89	-	-	0.00	0.00	-	0.00
203	7,813	7,813	6.84	108.0	0.00	88.86	-	-	0.00	0.00	-	0.00
204	8,160	8,161	6.23	108.0	0.00	89.23	-	-	0.00	0.00	-	0.00
205	8,621	8,621	5.44	108.0	0.00	89.71	-	-	0.00	0.00	-	0.00
206	7,634	7,634	7.17	108.0	0.00	88.66	-	-	0.00	0.00	-	0.00
207	8,136	8,136	6.27	108.0	0.00	89.21	-	-	0.00	0.00	-	0.00
208	2,470	2,471	21.32	108.0	0.00	78.86	-	-	0.00	0.00	-	0.00
209	2,402	2,404	21.62	108.0	0.00	78.62	-	-	0.00	0.00	-	0.00
210	2,289	2,291	22.21	108.0	0.00	78.20	-	-	0.00	0.00	-	0.00
211	1,029	1,033	31.33	108.0	0.00	71.28	-	-	0.00	0.00	-	0.00
212	724	729	35.05	108.0	0.00	68.25	-	-	0.00	0.00	-	0.00
213	634	640	36.40	108.0	0.00	67.12	-	-	0.00	0.00	-	0.00
214	933	937	32.38	108.0	0.00	70.43	-	-	0.00	0.00	-	0.00
215	1,166	1,170	29.96	108.0	0.00	72.37	-	-	0.00	0.00	-	0.00
216	1,215	1,217	29.53	108.0	0.00	72.71	-	-	0.00	0.00	-	0.00
217	1,747	1,748	25.43	108.0	0.00	75.85	-	-	0.00	0.00	-	0.00
218	2,935	2,936	19.41	108.0	0.00	80.36	-	-	0.00	0.00	-	0.00
219	3,453	3,454	17.51	108.0	0.00	81.77	-	-	0.00	0.00	-	0.00
220	3,905	3,906	16.02	108.0	0.00	82.83	-	-	0.00	0.00	-	0.00
221	4,527	4,528	14.17	108.0	0.00	84.12	-	-	0.00	0.00	-	0.00
222	6,217	6,217	10.00	108.0	0.00	86.87	-	-	0.00	0.00	-	0.00
223	5,779	5,779	10.99	108.0	0.00	86.24	-	-	0.00	0.00	-	0.00
224	4,716	4,716	13.65	108.0	0.00	84.47	-	-	0.00	0.00	-	0.00
225	4,463	4,464	14.36	108.0	0.00	83.99	-	-	0.00	0.00	-	0.00
226	4,686	4,687	13.73	108.0	0.00	84.42	-	-	0.00	0.00	-	0.00
227	4,150	4,151	15.27	108.0	0.00	83.36	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
228	5,627	5,627	11.34	108.0	0.00	86.01	-	-	0.00	0.00	-	0.00
229	3,476	3,478	17.43	108.0	0.00	81.83	-	-	0.00	0.00	-	0.00
230	3,142	3,143	18.62	108.0	0.00	80.95	-	-	0.00	0.00	-	0.00
231	2,865	2,866	19.68	108.0	0.00	80.15	-	-	0.00	0.00	-	0.00
232	3,730	3,731	16.58	108.0	0.00	82.44	-	-	0.00	0.00	-	0.00
233	3,556	3,558	17.16	108.0	0.00	82.02	-	-	0.00	0.00	-	0.00
234	3,606	3,607	16.99	108.0	0.00	82.14	-	-	0.00	0.00	-	0.00
235	2,996	2,997	19.17	108.0	0.00	80.53	-	-	0.00	0.00	-	0.00
301	7,580	7,580	7.27	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
302	8,076	8,076	6.38	108.0	0.00	89.14	-	-	0.00	0.00	-	0.00
303	8,952	8,952	4.90	108.0	0.00	90.04	-	-	0.00	0.00	-	0.00
304	9,559	9,559	3.96	108.0	0.00	90.61	-	-	0.00	0.00	-	0.00
305	9,813	9,813	3.58	108.0	0.00	90.84	-	-	0.00	0.00	-	0.00
306	9,468	9,468	4.10	108.0	0.00	90.53	-	-	0.00	0.00	-	0.00
307	8,750	8,750	5.23	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
308	6,970	6,970	8.44	108.0	0.00	87.86	-	-	0.00	0.00	-	0.00
309	6,453	6,453	9.50	108.0	0.00	87.20	-	-	0.00	0.00	-	0.00
310	5,811	5,812	10.91	108.0	0.00	86.29	-	-	0.00	0.00	-	0.00
311	5,362	5,363	11.98	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00
312	5,027	5,028	12.83	108.0	0.00	85.03	-	-	0.00	0.00	-	0.00
313	4,634	4,635	13.88	108.0	0.00	84.32	-	-	0.00	0.00	-	0.00
314	3,776	3,777	16.43	108.0	0.00	82.54	-	-	0.00	0.00	-	0.00
315	4,665	4,666	13.79	108.0	0.00	84.38	-	-	0.00	0.00	-	0.00
316	5,441	5,442	11.79	108.0	0.00	85.72	-	-	0.00	0.00	-	0.00
317	5,598	5,599	11.41	108.0	0.00	85.96	-	-	0.00	0.00	-	0.00
318	6,368	6,368	9.68	108.0	0.00	87.08	-	-	0.00	0.00	-	0.00
319	7,893	7,894	6.70	108.0	0.00	88.95	-	-	0.00	0.00	-	0.00
320	8,390	8,391	5.83	108.0	0.00	89.48	-	-	0.00	0.00	-	0.00
321	8,820	8,820	5.12	108.0	0.00	89.91	-	-	0.00	0.00	-	0.00
322	9,394	9,394	4.21	108.0	0.00	90.46	-	-	0.00	0.00	-	0.00
323	9,394	9,394	4.21	108.0	0.00	90.46	-	-	0.00	0.00	-	0.00
324	8,674	8,675	5.36	108.0	0.00	89.77	-	-	0.00	0.00	-	0.00
325	10,090	10,091	3.17	108.0	0.00	91.08	-	-	0.00	0.00	-	0.00
326	9,382	9,382	4.23	108.0	0.00	90.45	-	-	0.00	0.00	-	0.00
327	9,172	9,172	4.55	108.0	0.00	90.25	-	-	0.00	0.00	-	0.00
328	8,561	8,562	5.54	108.0	0.00	89.65	-	-	0.00	0.00	-	0.00
329	9,419	9,419	4.17	108.0	0.00	90.48	-	-	0.00	0.00	-	0.00
330	8,712	8,713	5.29	108.0	0.00	89.80	-	-	0.00	0.00	-	0.00
331	7,903	7,903	6.68	108.0	0.00	88.96	-	-	0.00	0.00	-	0.00
332	7,395	7,395	7.61	108.0	0.00	88.38	-	-	0.00	0.00	-	0.00
333	7,079	7,080	8.22	108.0	0.00	88.00	-	-	0.00	0.00	-	0.00
334	7,454	7,455	7.50	108.0	0.00	88.45	-	-	0.00	0.00	-	0.00
335	7,248	7,248	7.89	108.0	0.00	88.20	-	-	0.00	0.00	-	0.00
Sum	42.89											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP017 NSP017

		Wind speed: 8.0 m/s										
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]
1	6,635	6,636	9.11	108.0	0.00	87.44	-	-	0.00	0.00	-	0.00
2	7,710	7,711	7.03	108.0	0.00	88.74	-	-	0.00	0.00	-	0.00
3	3,797	3,798	14.64	107.0	0.00	82.59	-	-	0.00	0.00	-	0.00
4	3,820	3,821	14.56	107.0	0.00	82.64	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power - BISON Wind Energy Center

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
5	5,064	5,065	11.07	107.0	0.00	85.09	-	-	0.00	0.00	-	0.00
6	8,334	8,335	5.93	108.0	0.00	89.42	-	-	0.00	0.00	-	0.00
7	7,350	7,350	7.70	108.0	0.00	88.33	-	-	0.00	0.00	-	0.00
8	3,048	3,050	17.27	107.0	0.00	80.69	-	-	0.00	0.00	-	0.00
9	6,890	6,890	8.60	108.0	0.00	87.76	-	-	0.00	0.00	-	0.00
10	7,178	7,179	8.03	108.0	0.00	88.12	-	-	0.00	0.00	-	0.00
11	7,931	7,931	6.63	108.0	0.00	88.99	-	-	0.00	0.00	-	0.00
12	5,285	5,285	10.54	107.0	0.00	85.46	-	-	0.00	0.00	-	0.00
13	4,185	4,186	13.44	107.0	0.00	83.44	-	-	0.00	0.00	-	0.00
14	5,018	5,018	11.19	107.0	0.00	85.01	-	-	0.00	0.00	-	0.00
15	7,124	7,125	8.13	108.0	0.00	88.06	-	-	0.00	0.00	-	0.00
16	3,781	3,782	14.69	107.0	0.00	82.55	-	-	0.00	0.00	-	0.00
17	8,733	8,734	5.26	108.0	0.00	89.82	-	-	0.00	0.00	-	0.00
18	5,804	5,804	9.35	107.0	0.00	86.27	-	-	0.00	0.00	-	0.00
19	5,252	5,252	10.62	107.0	0.00	85.41	-	-	0.00	0.00	-	0.00
20	8,030	8,030	6.46	108.0	0.00	89.09	-	-	0.00	0.00	-	0.00
22	3,419	3,420	15.90	107.0	0.00	81.68	-	-	0.00	0.00	-	0.00
23	2,292	2,295	20.58	107.0	0.00	78.22	-	-	0.00	0.00	-	0.00
25	9,003	9,003	4.82	108.0	0.00	90.09	-	-	0.00	0.00	-	0.00
26	8,563	8,564	5.54	108.0	0.00	89.65	-	-	0.00	0.00	-	0.00
27	6,280	6,280	9.87	108.0	0.00	86.96	-	-	0.00	0.00	-	0.00
28	7,729	7,729	6.99	108.0	0.00	88.76	-	-	0.00	0.00	-	0.00
29	5,403	5,404	10.26	107.0	0.00	85.65	-	-	0.00	0.00	-	0.00
30	7,941	7,941	6.61	108.0	0.00	89.00	-	-	0.00	0.00	-	0.00
31	4,743	4,743	11.89	107.0	0.00	84.52	-	-	0.00	0.00	-	0.00
32	4,451	4,452	12.68	107.0	0.00	83.97	-	-	0.00	0.00	-	0.00
33	4,025	4,026	13.93	107.0	0.00	83.10	-	-	0.00	0.00	-	0.00
201	9,331	9,331	4.31	108.0	0.00	90.40	-	-	0.00	0.00	-	0.00
202	9,623	9,623	3.86	108.0	0.00	90.67	-	-	0.00	0.00	-	0.00
203	9,601	9,602	3.89	108.0	0.00	90.65	-	-	0.00	0.00	-	0.00
204	9,952	9,953	3.37	108.0	0.00	90.96	-	-	0.00	0.00	-	0.00
205	10,410	10,410	2.71	108.0	0.00	91.35	-	-	0.00	0.00	-	0.00
206	9,388	9,389	4.22	108.0	0.00	90.45	-	-	0.00	0.00	-	0.00
207	9,859	9,859	3.51	108.0	0.00	90.88	-	-	0.00	0.00	-	0.00
208	3,709	3,710	16.65	108.0	0.00	82.39	-	-	0.00	0.00	-	0.00
209	3,463	3,464	17.48	108.0	0.00	81.79	-	-	0.00	0.00	-	0.00
210	3,086	3,087	18.83	108.0	0.00	80.79	-	-	0.00	0.00	-	0.00
211	2,145	2,148	22.99	108.0	0.00	77.64	-	-	0.00	0.00	-	0.00
212	1,772	1,774	25.26	108.0	0.00	75.98	-	-	0.00	0.00	-	0.00
213	1,355	1,359	28.31	108.0	0.00	73.66	-	-	0.00	0.00	-	0.00
214	1,003	1,008	31.60	108.0	0.00	71.07	-	-	0.00	0.00	-	0.00
215	2,551	2,553	20.97	108.0	0.00	79.14	-	-	0.00	0.00	-	0.00
216	1,273	1,276	29.01	108.0	0.00	73.12	-	-	0.00	0.00	-	0.00
217	805	809	33.94	108.0	0.00	69.16	-	-	0.00	0.00	-	0.00
218	1,443	1,446	27.61	108.0	0.00	74.20	-	-	0.00	0.00	-	0.00
219	1,722	1,724	25.59	108.0	0.00	75.73	-	-	0.00	0.00	-	0.00
220	2,195	2,196	22.72	108.0	0.00	77.83	-	-	0.00	0.00	-	0.00
221	2,782	2,783	20.02	108.0	0.00	79.89	-	-	0.00	0.00	-	0.00
222	4,654	4,655	13.82	108.0	0.00	84.36	-	-	0.00	0.00	-	0.00
223	4,316	4,317	14.78	108.0	0.00	83.70	-	-	0.00	0.00	-	0.00
224	2,993	2,994	19.18	108.0	0.00	80.52	-	-	0.00	0.00	-	0.00
225	2,776	2,777	20.04	108.0	0.00	79.87	-	-	0.00	0.00	-	0.00
226	3,192	3,193	18.44	108.0	0.00	81.09	-	-	0.00	0.00	-	0.00
227	2,887	2,888	19.59	108.0	0.00	80.21	-	-	0.00	0.00	-	0.00
228	4,020	4,021	15.66	108.0	0.00	83.09	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
229	2,343	2,345	21.92	108.0	0.00	78.40	-	-	0.00	0.00	-	0.00
230	2,092	2,094	23.29	108.0	0.00	77.42	-	-	0.00	0.00	-	0.00
231	2,115	2,117	23.16	108.0	0.00	77.52	-	-	0.00	0.00	-	0.00
232	3,348	3,349	17.88	108.0	0.00	81.50	-	-	0.00	0.00	-	0.00
233	3,374	3,376	17.78	108.0	0.00	81.57	-	-	0.00	0.00	-	0.00
234	3,580	3,581	17.08	108.0	0.00	82.08	-	-	0.00	0.00	-	0.00
235	3,281	3,282	18.12	108.0	0.00	81.32	-	-	0.00	0.00	-	0.00
301	9,066	9,066	4.72	108.0	0.00	90.15	-	-	0.00	0.00	-	0.00
302	9,544	9,544	3.98	108.0	0.00	90.59	-	-	0.00	0.00	-	0.00
303	10,442	10,442	2.67	108.0	0.00	91.38	-	-	0.00	0.00	-	0.00
304	11,037	11,038	1.85	108.0	0.00	91.86	-	-	0.00	0.00	-	0.00
305	11,365	11,365	1.42	108.0	0.00	92.11	-	-	0.00	0.00	-	0.00
306	11,009	11,009	1.89	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
307	10,329	10,329	2.83	108.0	0.00	91.28	-	-	0.00	0.00	-	0.00
308	5,730	5,731	11.10	108.0	0.00	86.16	-	-	0.00	0.00	-	0.00
309	5,253	5,253	12.25	108.0	0.00	85.41	-	-	0.00	0.00	-	0.00
310	4,545	4,545	14.12	108.0	0.00	84.15	-	-	0.00	0.00	-	0.00
311	4,160	4,161	15.24	108.0	0.00	83.38	-	-	0.00	0.00	-	0.00
312	3,913	3,914	16.00	108.0	0.00	82.85	-	-	0.00	0.00	-	0.00
313	3,637	3,639	16.89	108.0	0.00	82.22	-	-	0.00	0.00	-	0.00
314	2,932	2,934	19.42	108.0	0.00	80.35	-	-	0.00	0.00	-	0.00
315	4,002	4,003	15.72	108.0	0.00	83.05	-	-	0.00	0.00	-	0.00
316	4,737	4,738	13.59	108.0	0.00	84.51	-	-	0.00	0.00	-	0.00
317	4,770	4,771	13.50	108.0	0.00	84.57	-	-	0.00	0.00	-	0.00
318	5,429	5,430	11.82	108.0	0.00	85.70	-	-	0.00	0.00	-	0.00
319	7,119	7,120	8.14	108.0	0.00	88.05	-	-	0.00	0.00	-	0.00
320	7,601	7,602	7.23	108.0	0.00	88.62	-	-	0.00	0.00	-	0.00
321	7,985	7,985	6.53	108.0	0.00	89.05	-	-	0.00	0.00	-	0.00
322	8,735	8,736	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
323	8,803	8,804	5.14	108.0	0.00	89.89	-	-	0.00	0.00	-	0.00
324	8,171	8,172	6.21	108.0	0.00	89.25	-	-	0.00	0.00	-	0.00
325	9,668	9,668	3.79	108.0	0.00	90.71	-	-	0.00	0.00	-	0.00
326	8,996	8,997	4.83	108.0	0.00	90.08	-	-	0.00	0.00	-	0.00
327	8,852	8,853	5.06	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
328	8,421	8,421	5.78	108.0	0.00	89.51	-	-	0.00	0.00	-	0.00
329	9,424	9,424	4.16	108.0	0.00	90.48	-	-	0.00	0.00	-	0.00
330	8,793	8,793	5.16	108.0	0.00	89.88	-	-	0.00	0.00	-	0.00
331	7,896	7,897	6.69	108.0	0.00	88.95	-	-	0.00	0.00	-	0.00
332	7,435	7,435	7.54	108.0	0.00	88.43	-	-	0.00	0.00	-	0.00
333	6,938	6,939	8.50	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
334	7,217	7,218	7.95	108.0	0.00	88.17	-	-	0.00	0.00	-	0.00
335	6,894	6,895	8.59	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00

Sum 39.87

- Data undefined due to calculation with octave data

Noise sensitive area: NSP018 NSP018

		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]
1	7,607	7,608	7.22	108.0	0.00	88.63	-	-	0.00	0.00	-	0.00
2	8,697	8,698	5.32	108.0	0.00	89.79	-	-	0.00	0.00	-	0.00
3	4,834	4,835	11.65	107.0	0.00	84.69	-	-	0.00	0.00	-	0.00
4	4,756	4,757	11.86	107.0	0.00	84.55	-	-	0.00	0.00	-	0.00
5	6,103	6,104	8.71	107.0	0.00	86.71	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net
 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
6	9,360	9,360	4.26	108.0	0.00	90.43	-	-	0.00	0.00	-	0.00
7	8,394	8,394	5.83	108.0	0.00	89.48	-	-	0.00	0.00	-	0.00
8	4,062	4,063	13.81	107.0	0.00	83.18	-	-	0.00	0.00	-	0.00
9	7,808	7,809	6.85	108.0	0.00	88.85	-	-	0.00	0.00	-	0.00
10	8,149	8,150	6.24	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
11	8,815	8,815	5.13	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
12	6,099	6,099	8.72	107.0	0.00	86.71	-	-	0.00	0.00	-	0.00
13	5,113	5,114	10.95	107.0	0.00	85.18	-	-	0.00	0.00	-	0.00
14	6,017	6,018	8.89	107.0	0.00	86.59	-	-	0.00	0.00	-	0.00
15	8,151	8,152	6.24	108.0	0.00	89.22	-	-	0.00	0.00	-	0.00
16	4,779	4,780	11.80	107.0	0.00	84.59	-	-	0.00	0.00	-	0.00
17	9,769	9,769	3.64	108.0	0.00	90.80	-	-	0.00	0.00	-	0.00
18	6,819	6,819	7.30	107.0	0.00	87.67	-	-	0.00	0.00	-	0.00
19	6,212	6,212	8.49	107.0	0.00	86.86	-	-	0.00	0.00	-	0.00
20	9,072	9,072	4.71	108.0	0.00	90.15	-	-	0.00	0.00	-	0.00
22	4,237	4,238	13.29	107.0	0.00	83.54	-	-	0.00	0.00	-	0.00
23	3,321	3,323	16.25	107.0	0.00	81.43	-	-	0.00	0.00	-	0.00
25	10,027	10,028	3.26	108.0	0.00	91.02	-	-	0.00	0.00	-	0.00
26	9,614	9,615	3.87	108.0	0.00	90.66	-	-	0.00	0.00	-	0.00
27	7,265	7,266	7.86	108.0	0.00	88.23	-	-	0.00	0.00	-	0.00
28	8,757	8,758	5.22	108.0	0.00	89.85	-	-	0.00	0.00	-	0.00
29	6,149	6,149	8.62	107.0	0.00	86.78	-	-	0.00	0.00	-	0.00
30	8,908	8,909	4.97	108.0	0.00	90.00	-	-	0.00	0.00	-	0.00
31	5,564	5,565	9.89	107.0	0.00	85.91	-	-	0.00	0.00	-	0.00
32	5,495	5,496	10.04	107.0	0.00	85.80	-	-	0.00	0.00	-	0.00
33	4,880	4,880	11.54	107.0	0.00	84.77	-	-	0.00	0.00	-	0.00
201	10,307	10,307	2.86	108.0	0.00	91.26	-	-	0.00	0.00	-	0.00
202	10,596	10,596	2.45	108.0	0.00	91.50	-	-	0.00	0.00	-	0.00
203	10,497	10,498	2.59	108.0	0.00	91.42	-	-	0.00	0.00	-	0.00
204	10,865	10,865	2.08	108.0	0.00	91.72	-	-	0.00	0.00	-	0.00
205	11,308	11,309	1.50	108.0	0.00	92.07	-	-	0.00	0.00	-	0.00
206	10,215	10,216	2.99	108.0	0.00	91.19	-	-	0.00	0.00	-	0.00
207	10,640	10,640	2.39	108.0	0.00	91.54	-	-	0.00	0.00	-	0.00
208	4,264	4,265	14.93	108.0	0.00	83.60	-	-	0.00	0.00	-	0.00
209	3,945	3,946	15.90	108.0	0.00	82.92	-	-	0.00	0.00	-	0.00
210	3,476	3,477	17.43	108.0	0.00	81.82	-	-	0.00	0.00	-	0.00
211	2,846	2,848	19.75	108.0	0.00	80.09	-	-	0.00	0.00	-	0.00
212	2,549	2,551	20.98	108.0	0.00	79.13	-	-	0.00	0.00	-	0.00
213	2,218	2,220	22.59	108.0	0.00	77.93	-	-	0.00	0.00	-	0.00
214	1,859	1,861	24.69	108.0	0.00	76.40	-	-	0.00	0.00	-	0.00
215	3,606	3,608	16.99	108.0	0.00	82.14	-	-	0.00	0.00	-	0.00
216	2,318	2,320	22.05	108.0	0.00	78.31	-	-	0.00	0.00	-	0.00
217	1,733	1,735	25.52	108.0	0.00	75.78	-	-	0.00	0.00	-	0.00
218	579	586	37.30	108.0	0.00	66.36	-	-	0.00	0.00	-	0.00
219	691	697	35.51	108.0	0.00	67.86	-	-	0.00	0.00	-	0.00
220	1,149	1,151	30.14	108.0	0.00	72.22	-	-	0.00	0.00	-	0.00
221	1,766	1,767	25.30	108.0	0.00	75.95	-	-	0.00	0.00	-	0.00
222	4,303	4,304	14.82	108.0	0.00	83.68	-	-	0.00	0.00	-	0.00
223	4,109	4,109	15.39	108.0	0.00	83.28	-	-	0.00	0.00	-	0.00
224	2,454	2,455	21.39	108.0	0.00	78.80	-	-	0.00	0.00	-	0.00
225	2,341	2,343	21.94	108.0	0.00	78.39	-	-	0.00	0.00	-	0.00
226	3,029	3,030	19.05	108.0	0.00	80.63	-	-	0.00	0.00	-	0.00
227	3,017	3,018	19.09	108.0	0.00	80.59	-	-	0.00	0.00	-	0.00
228	3,636	3,637	16.89	108.0	0.00	82.21	-	-	0.00	0.00	-	0.00
229	2,673	2,675	20.45	108.0	0.00	79.55	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
230	2,537	2,539	21.03	108.0	0.00	79.09	-	-	0.00	0.00	-	0.00
231	2,750	2,752	20.14	108.0	0.00	79.79	-	-	0.00	0.00	-	0.00
232	4,015	4,017	15.68	108.0	0.00	83.08	-	-	0.00	0.00	-	0.00
233	4,126	4,127	15.34	108.0	0.00	83.31	-	-	0.00	0.00	-	0.00
234	4,377	4,379	14.60	108.0	0.00	83.83	-	-	0.00	0.00	-	0.00
235	4,194	4,194	15.14	108.0	0.00	83.45	-	-	0.00	0.00	-	0.00
301	9,629	9,630	3.85	108.0	0.00	90.67	-	-	0.00	0.00	-	0.00
302	10,089	10,089	3.17	108.0	0.00	91.08	-	-	0.00	0.00	-	0.00
303	10,996	10,996	1.91	108.0	0.00	91.82	-	-	0.00	0.00	-	0.00
304	11,578	11,578	1.15	108.0	0.00	92.27	-	-	0.00	0.00	-	0.00
305	11,965	11,965	0.66	108.0	0.00	92.56	-	-	0.00	0.00	-	0.00
306	11,602	11,602	1.12	108.0	0.00	92.29	-	-	0.00	0.00	-	0.00
307	10,959	10,959	1.96	108.0	0.00	91.80	-	-	0.00	0.00	-	0.00
308	5,687	5,688	11.20	108.0	0.00	86.10	-	-	0.00	0.00	-	0.00
309	5,264	5,265	12.22	108.0	0.00	85.43	-	-	0.00	0.00	-	0.00
310	4,530	4,531	14.17	108.0	0.00	84.12	-	-	0.00	0.00	-	0.00
311	4,229	4,230	15.03	108.0	0.00	83.53	-	-	0.00	0.00	-	0.00
312	4,074	4,075	15.50	108.0	0.00	83.20	-	-	0.00	0.00	-	0.00
313	3,915	3,916	15.99	108.0	0.00	82.86	-	-	0.00	0.00	-	0.00
314	3,389	3,390	17.73	108.0	0.00	81.60	-	-	0.00	0.00	-	0.00
315	4,473	4,474	14.33	108.0	0.00	84.01	-	-	0.00	0.00	-	0.00
316	5,139	5,140	12.54	108.0	0.00	85.22	-	-	0.00	0.00	-	0.00
317	5,090	5,092	12.66	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
318	5,642	5,642	11.31	108.0	0.00	86.03	-	-	0.00	0.00	-	0.00
319	7,390	7,390	7.62	108.0	0.00	88.37	-	-	0.00	0.00	-	0.00
320	7,850	7,851	6.77	108.0	0.00	88.90	-	-	0.00	0.00	-	0.00
321	8,195	8,196	6.17	108.0	0.00	89.27	-	-	0.00	0.00	-	0.00
322	9,046	9,047	4.75	108.0	0.00	90.13	-	-	0.00	0.00	-	0.00
323	9,155	9,155	4.58	108.0	0.00	90.23	-	-	0.00	0.00	-	0.00
324	8,585	8,586	5.50	108.0	0.00	89.68	-	-	0.00	0.00	-	0.00
325	10,103	10,104	3.15	108.0	0.00	91.09	-	-	0.00	0.00	-	0.00
326	9,461	9,461	4.10	108.0	0.00	90.52	-	-	0.00	0.00	-	0.00
327	9,355	9,355	4.27	108.0	0.00	90.42	-	-	0.00	0.00	-	0.00
328	9,020	9,020	4.79	108.0	0.00	90.10	-	-	0.00	0.00	-	0.00
329	10,076	10,077	3.19	108.0	0.00	91.07	-	-	0.00	0.00	-	0.00
330	9,487	9,487	4.07	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
331	8,565	8,565	5.54	108.0	0.00	89.65	-	-	0.00	0.00	-	0.00
332	8,132	8,132	6.28	108.0	0.00	89.20	-	-	0.00	0.00	-	0.00
333	7,564	7,565	7.30	108.0	0.00	88.58	-	-	0.00	0.00	-	0.00
334	7,792	7,792	6.88	108.0	0.00	88.83	-	-	0.00	0.00	-	0.00
335	7,417	7,418	7.57	108.0	0.00	88.41	-	-	0.00	0.00	-	0.00
Sum	41.27											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP019 NSP019

		Wind speed: 8.0 m/s										
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]
1	8,441	8,442	5.74	108.0	0.00	89.53	-	-	0.00	0.00	-	0.00
2	9,447	9,448	4.13	108.0	0.00	90.51	-	-	0.00	0.00	-	0.00
3	5,430	5,431	10.19	107.0	0.00	85.70	-	-	0.00	0.00	-	0.00
4	5,797	5,798	9.37	107.0	0.00	86.27	-	-	0.00	0.00	-	0.00
5	6,618	6,618	7.68	107.0	0.00	87.41	-	-	0.00	0.00	-	0.00
6	9,884	9,885	3.47	108.0	0.00	90.90	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
7	8,782	8,783	5.18	108.0	0.00	89.87	-	-	0.00	0.00	-	0.00
8	4,860	4,861	11.59	107.0	0.00	84.73	-	-	0.00	0.00	-	0.00
9	8,824	8,825	5.11	108.0	0.00	89.91	-	-	0.00	0.00	-	0.00
10	8,975	8,975	4.87	108.0	0.00	90.06	-	-	0.00	0.00	-	0.00
11	9,917	9,917	3.42	108.0	0.00	90.93	-	-	0.00	0.00	-	0.00
12	7,401	7,402	6.24	107.0	0.00	88.39	-	-	0.00	0.00	-	0.00
13	6,166	6,166	8.58	107.0	0.00	86.80	-	-	0.00	0.00	-	0.00
14	6,776	6,777	7.38	107.0	0.00	87.62	-	-	0.00	0.00	-	0.00
15	8,689	8,690	5.33	108.0	0.00	89.78	-	-	0.00	0.00	-	0.00
16	5,599	5,600	9.81	107.0	0.00	85.96	-	-	0.00	0.00	-	0.00
17	10,204	10,204	3.00	108.0	0.00	91.18	-	-	0.00	0.00	-	0.00
18	7,469	7,470	6.12	107.0	0.00	88.47	-	-	0.00	0.00	-	0.00
19	7,127	7,127	6.73	107.0	0.00	88.06	-	-	0.00	0.00	-	0.00
20	9,464	9,465	4.10	108.0	0.00	90.52	-	-	0.00	0.00	-	0.00
22	5,569	5,570	9.88	107.0	0.00	85.92	-	-	0.00	0.00	-	0.00
23	4,108	4,110	13.67	107.0	0.00	83.28	-	-	0.00	0.00	-	0.00
25	10,545	10,545	2.52	108.0	0.00	91.46	-	-	0.00	0.00	-	0.00
26	9,891	9,891	3.46	108.0	0.00	90.90	-	-	0.00	0.00	-	0.00
27	8,051	8,052	6.42	108.0	0.00	89.12	-	-	0.00	0.00	-	0.00
28	9,268	9,269	4.40	108.0	0.00	90.34	-	-	0.00	0.00	-	0.00
29	7,577	7,578	5.94	107.0	0.00	88.59	-	-	0.00	0.00	-	0.00
30	9,738	9,738	3.69	108.0	0.00	90.77	-	-	0.00	0.00	-	0.00
31	6,860	6,861	7.22	107.0	0.00	87.73	-	-	0.00	0.00	-	0.00
32	5,990	5,991	8.95	107.0	0.00	86.55	-	-	0.00	0.00	-	0.00
33	6,121	6,121	8.68	107.0	0.00	86.74	-	-	0.00	0.00	-	0.00
201	11,080	11,080	1.80	108.0	0.00	91.89	-	-	0.00	0.00	-	0.00
202	11,378	11,378	1.40	108.0	0.00	92.12	-	-	0.00	0.00	-	0.00
203	11,548	11,548	1.19	108.0	0.00	92.25	-	-	0.00	0.00	-	0.00
204	11,863	11,863	0.79	108.0	0.00	92.48	-	-	0.00	0.00	-	0.00
205	12,345	12,345	0.20	108.0	0.00	92.83	-	-	0.00	0.00	-	0.00
206	11,447	11,448	1.32	108.0	0.00	92.17	-	-	0.00	0.00	-	0.00
207	11,968	11,969	0.66	108.0	0.00	92.56	-	-	0.00	0.00	-	0.00
208	5,962	5,963	10.57	108.0	0.00	86.51	-	-	0.00	0.00	-	0.00
209	5,715	5,716	11.14	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
210	5,321	5,322	12.08	108.0	0.00	85.52	-	-	0.00	0.00	-	0.00
211	4,386	4,388	14.57	108.0	0.00	83.84	-	-	0.00	0.00	-	0.00
212	3,997	3,998	15.74	108.0	0.00	83.04	-	-	0.00	0.00	-	0.00
213	3,556	3,557	17.16	108.0	0.00	82.02	-	-	0.00	0.00	-	0.00
214	3,230	3,232	18.30	108.0	0.00	81.19	-	-	0.00	0.00	-	0.00
215	4,137	4,138	15.31	108.0	0.00	83.34	-	-	0.00	0.00	-	0.00
216	2,775	2,777	20.04	108.0	0.00	79.87	-	-	0.00	0.00	-	0.00
217	2,104	2,105	23.23	108.0	0.00	77.47	-	-	0.00	0.00	-	0.00
218	2,624	2,626	20.66	108.0	0.00	79.39	-	-	0.00	0.00	-	0.00
219	2,012	2,015	23.76	108.0	0.00	77.08	-	-	0.00	0.00	-	0.00
220	2,257	2,258	22.38	108.0	0.00	78.08	-	-	0.00	0.00	-	0.00
221	2,347	2,348	21.91	108.0	0.00	78.41	-	-	0.00	0.00	-	0.00
222	2,406	2,407	21.61	108.0	0.00	78.63	-	-	0.00	0.00	-	0.00
223	2,076	2,077	23.39	108.0	0.00	77.35	-	-	0.00	0.00	-	0.00
224	1,070	1,074	30.91	108.0	0.00	71.62	-	-	0.00	0.00	-	0.00
225	740	746	34.80	108.0	0.00	68.46	-	-	0.00	0.00	-	0.00
226	958	963	32.08	108.0	0.00	70.68	-	-	0.00	0.00	-	0.00
227	1,065	1,070	30.95	108.0	0.00	71.59	-	-	0.00	0.00	-	0.00
228	1,793	1,794	25.13	108.0	0.00	76.08	-	-	0.00	0.00	-	0.00
229	1,149	1,154	30.12	108.0	0.00	72.24	-	-	0.00	0.00	-	0.00
230	1,312	1,317	28.66	108.0	0.00	73.39	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

WTG												
Wind speed: 8.0 m/s												
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]
231	1,806	1,809	25.03	108.0	0.00	76.15	-	-	0.00	0.00	-	0.00
232	2,764	2,766	20.08	108.0	0.00	79.84	-	-	0.00	0.00	-	0.00
233	3,049	3,051	18.97	108.0	0.00	80.69	-	-	0.00	0.00	-	0.00
234	3,375	3,377	17.78	108.0	0.00	81.57	-	-	0.00	0.00	-	0.00
235	3,565	3,567	17.13	108.0	0.00	82.05	-	-	0.00	0.00	-	0.00
301	11,308	11,308	1.50	108.0	0.00	92.07	-	-	0.00	0.00	-	0.00
302	11,790	11,790	0.88	108.0	0.00	92.43	-	-	0.00	0.00	-	0.00
303	12,685	12,685	-0.21	108.0	0.00	93.07	-	-	0.00	0.00	-	0.00
304	13,283	13,283	-0.89	108.0	0.00	93.47	-	-	0.00	0.00	-	0.00
305	13,592	13,592	-1.24	108.0	0.00	93.67	-	-	0.00	0.00	-	0.00
306	13,239	13,240	-0.85	108.0	0.00	93.44	-	-	0.00	0.00	-	0.00
307	12,545	12,546	-0.04	108.0	0.00	92.97	-	-	0.00	0.00	-	0.00
308	3,601	3,602	17.01	108.0	0.00	82.13	-	-	0.00	0.00	-	0.00
309	3,176	3,177	18.50	108.0	0.00	81.04	-	-	0.00	0.00	-	0.00
310	2,441	2,443	21.45	108.0	0.00	78.76	-	-	0.00	0.00	-	0.00
311	2,160	2,162	22.91	108.0	0.00	77.70	-	-	0.00	0.00	-	0.00
312	2,063	2,065	23.46	108.0	0.00	77.30	-	-	0.00	0.00	-	0.00
313	2,024	2,028	23.68	108.0	0.00	77.14	-	-	0.00	0.00	-	0.00
314	1,851	1,854	24.74	108.0	0.00	76.36	-	-	0.00	0.00	-	0.00
315	2,789	2,791	19.98	108.0	0.00	79.91	-	-	0.00	0.00	-	0.00
316	3,311	3,313	18.01	108.0	0.00	81.40	-	-	0.00	0.00	-	0.00
317	3,173	3,176	18.50	108.0	0.00	81.04	-	-	0.00	0.00	-	0.00
318	3,620	3,622	16.94	108.0	0.00	82.18	-	-	0.00	0.00	-	0.00
319	5,382	5,383	11.93	108.0	0.00	85.62	-	-	0.00	0.00	-	0.00
320	5,825	5,826	10.88	108.0	0.00	86.31	-	-	0.00	0.00	-	0.00
321	6,147	6,148	10.16	108.0	0.00	86.77	-	-	0.00	0.00	-	0.00
322	7,050	7,050	8.28	108.0	0.00	87.96	-	-	0.00	0.00	-	0.00
323	7,187	7,187	8.01	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
324	6,678	6,678	9.03	108.0	0.00	87.49	-	-	0.00	0.00	-	0.00
325	8,200	8,201	6.16	108.0	0.00	89.28	-	-	0.00	0.00	-	0.00
326	7,595	7,596	7.24	108.0	0.00	88.61	-	-	0.00	0.00	-	0.00
327	7,532	7,533	7.36	108.0	0.00	88.54	-	-	0.00	0.00	-	0.00
328	7,333	7,333	7.73	108.0	0.00	88.31	-	-	0.00	0.00	-	0.00
329	8,456	8,457	5.72	108.0	0.00	89.54	-	-	0.00	0.00	-	0.00
330	7,949	7,950	6.60	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00
331	7,003	7,004	8.37	108.0	0.00	87.91	-	-	0.00	0.00	-	0.00
332	6,634	6,635	9.12	108.0	0.00	87.44	-	-	0.00	0.00	-	0.00
333	5,957	5,958	10.58	108.0	0.00	86.50	-	-	0.00	0.00	-	0.00
334	6,095	6,096	10.27	108.0	0.00	86.70	-	-	0.00	0.00	-	0.00
335	5,657	5,658	11.27	108.0	0.00	86.05	-	-	0.00	0.00	-	0.00
Sum	41.22											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP020 NSP020

WTG												
Wind speed: 8.0 m/s												
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]
1	11,207	11,208	1.63	108.0	0.00	91.99	-	-	0.00	0.00	-	0.00
2	12,067	12,067	0.53	108.0	0.00	92.63	-	-	0.00	0.00	-	0.00
3	8,236	8,237	4.86	107.0	0.00	89.32	-	-	0.00	0.00	-	0.00
4	8,937	8,937	3.79	107.0	0.00	90.02	-	-	0.00	0.00	-	0.00
5	9,201	9,202	3.41	107.0	0.00	90.28	-	-	0.00	0.00	-	0.00
6	12,215	12,215	0.35	108.0	0.00	92.74	-	-	0.00	0.00	-	0.00
7	11,022	11,023	1.87	108.0	0.00	91.85	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
8	7,908	7,909	5.38	107.0	0.00	88.96	-	-	0.00	0.00	-	0.00
9	11,755	11,756	0.92	108.0	0.00	92.40	-	-	0.00	0.00	-	0.00
10	11,702	11,702	0.99	108.0	0.00	92.37	-	-	0.00	0.00	-	0.00
11	12,887	12,887	-0.44	108.0	0.00	93.20	-	-	0.00	0.00	-	0.00
12	10,650	10,651	1.48	107.0	0.00	91.55	-	-	0.00	0.00	-	0.00
13	9,285	9,286	3.29	107.0	0.00	90.36	-	-	0.00	0.00	-	0.00
14	9,589	9,590	2.87	107.0	0.00	90.64	-	-	0.00	0.00	-	0.00
15	11,114	11,115	1.75	108.0	0.00	91.92	-	-	0.00	0.00	-	0.00
16	8,580	8,580	4.32	107.0	0.00	89.67	-	-	0.00	0.00	-	0.00
17	12,403	12,404	0.13	108.0	0.00	92.87	-	-	0.00	0.00	-	0.00
18	10,114	10,114	2.17	107.0	0.00	91.10	-	-	0.00	0.00	-	0.00
19	10,059	10,060	2.24	107.0	0.00	91.05	-	-	0.00	0.00	-	0.00
20	11,659	11,659	1.04	108.0	0.00	92.33	-	-	0.00	0.00	-	0.00
22	8,928	8,929	3.80	107.0	0.00	90.02	-	-	0.00	0.00	-	0.00
23	7,253	7,254	6.50	107.0	0.00	88.21	-	-	0.00	0.00	-	0.00
25	12,829	12,829	-0.38	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
26	11,904	11,905	0.74	108.0	0.00	92.51	-	-	0.00	0.00	-	0.00
27	10,794	10,794	2.18	108.0	0.00	91.66	-	-	0.00	0.00	-	0.00
28	11,621	11,621	1.09	108.0	0.00	92.31	-	-	0.00	0.00	-	0.00
29	10,917	10,918	1.15	107.0	0.00	91.76	-	-	0.00	0.00	-	0.00
30	12,430	12,430	0.09	108.0	0.00	92.89	-	-	0.00	0.00	-	0.00
31	10,128	10,129	2.15	107.0	0.00	91.11	-	-	0.00	0.00	-	0.00
32	8,627	8,628	4.25	107.0	0.00	89.72	-	-	0.00	0.00	-	0.00
33	9,387	9,387	3.15	107.0	0.00	90.45	-	-	0.00	0.00	-	0.00
201	13,646	13,646	-1.30	108.0	0.00	93.70	-	-	0.00	0.00	-	0.00
202	13,943	13,944	-1.62	108.0	0.00	93.89	-	-	0.00	0.00	-	0.00
203	14,411	14,411	-2.11	108.0	0.00	94.17	-	-	0.00	0.00	-	0.00
204	14,658	14,658	-2.37	108.0	0.00	94.32	-	-	0.00	0.00	-	0.00
205	15,170	15,170	-2.88	108.0	0.00	94.62	-	-	0.00	0.00	-	0.00
206	14,503	14,503	-2.21	108.0	0.00	94.23	-	-	0.00	0.00	-	0.00
207	15,109	15,109	-2.82	108.0	0.00	94.58	-	-	0.00	0.00	-	0.00
208	9,517	9,517	4.02	108.0	0.00	90.57	-	-	0.00	0.00	-	0.00
209	9,308	9,309	4.34	108.0	0.00	90.38	-	-	0.00	0.00	-	0.00
210	8,949	8,949	4.91	108.0	0.00	90.04	-	-	0.00	0.00	-	0.00
211	7,920	7,920	6.65	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
212	7,512	7,513	7.39	108.0	0.00	88.52	-	-	0.00	0.00	-	0.00
213	7,060	7,061	8.26	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00
214	6,776	6,777	8.83	108.0	0.00	87.62	-	-	0.00	0.00	-	0.00
215	7,090	7,091	8.20	108.0	0.00	88.01	-	-	0.00	0.00	-	0.00
216	5,991	5,992	10.50	108.0	0.00	86.55	-	-	0.00	0.00	-	0.00
217	5,485	5,486	11.68	108.0	0.00	85.79	-	-	0.00	0.00	-	0.00
218	6,228	6,229	9.98	108.0	0.00	86.89	-	-	0.00	0.00	-	0.00
219	5,498	5,499	11.65	108.0	0.00	85.81	-	-	0.00	0.00	-	0.00
220	5,563	5,563	11.50	108.0	0.00	85.91	-	-	0.00	0.00	-	0.00
221	5,308	5,309	12.11	108.0	0.00	85.50	-	-	0.00	0.00	-	0.00
222	1,715	1,716	25.64	108.0	0.00	75.69	-	-	0.00	0.00	-	0.00
223	1,634	1,636	26.19	108.0	0.00	75.28	-	-	0.00	0.00	-	0.00
224	3,494	3,495	17.37	108.0	0.00	81.87	-	-	0.00	0.00	-	0.00
225	3,462	3,464	17.48	108.0	0.00	81.79	-	-	0.00	0.00	-	0.00
226	2,711	2,713	20.30	108.0	0.00	79.67	-	-	0.00	0.00	-	0.00
227	3,045	3,047	18.98	108.0	0.00	80.68	-	-	0.00	0.00	-	0.00
228	2,296	2,297	22.17	108.0	0.00	78.22	-	-	0.00	0.00	-	0.00
229	3,716	3,717	16.63	108.0	0.00	82.40	-	-	0.00	0.00	-	0.00
230	4,053	4,055	15.56	108.0	0.00	83.16	-	-	0.00	0.00	-	0.00
231	4,403	4,404	14.53	108.0	0.00	83.88	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 wind@eapc.net
 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

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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]
232	4,201	4,203	15.11	108.0	0.00	83.47	-	-	0.00	0.00	-	0.00
233	4,597	4,598	13.98	108.0	0.00	84.25	-	-	0.00	0.00	-	0.00
234	4,860	4,862	13.26	108.0	0.00	84.74	-	-	0.00	0.00	-	0.00
235	5,509	5,510	11.62	108.0	0.00	85.82	-	-	0.00	0.00	-	0.00
301	14,771	14,771	-2.48	108.0	0.00	94.39	-	-	0.00	0.00	-	0.00
302	15,266	15,266	-2.98	108.0	0.00	94.67	-	-	0.00	0.00	-	0.00
303	16,143	16,143	-3.82	108.0	0.00	95.16	-	-	0.00	0.00	-	0.00
304	16,750	16,750	-4.37	108.0	0.00	95.48	-	-	0.00	0.00	-	0.00
305	16,991	16,991	-4.58	108.0	0.00	95.60	-	-	0.00	0.00	-	0.00
306	16,650	16,650	-4.28	108.0	0.00	95.43	-	-	0.00	0.00	-	0.00
307	15,918	15,918	-3.61	108.0	0.00	95.04	-	-	0.00	0.00	-	0.00
308	489	497	38.99	108.0	0.00	64.92	-	-	0.00	0.00	-	0.00
309	920	925	32.52	108.0	0.00	70.32	-	-	0.00	0.00	-	0.00
310	1,387	1,390	28.05	108.0	0.00	73.86	-	-	0.00	0.00	-	0.00
311	1,861	1,864	24.68	108.0	0.00	76.41	-	-	0.00	0.00	-	0.00
312	2,250	2,252	22.41	108.0	0.00	78.05	-	-	0.00	0.00	-	0.00
313	2,722	2,725	20.25	108.0	0.00	79.71	-	-	0.00	0.00	-	0.00
314	3,582	3,583	17.07	108.0	0.00	82.09	-	-	0.00	0.00	-	0.00
315	3,257	3,259	18.20	108.0	0.00	81.26	-	-	0.00	0.00	-	0.00
316	2,851	2,853	19.73	108.0	0.00	80.11	-	-	0.00	0.00	-	0.00
317	2,450	2,453	21.40	108.0	0.00	78.79	-	-	0.00	0.00	-	0.00
318	1,857	1,860	24.70	108.0	0.00	76.39	-	-	0.00	0.00	-	0.00
319	2,866	2,869	19.67	108.0	0.00	80.15	-	-	0.00	0.00	-	0.00
320	3,088	3,090	18.82	108.0	0.00	80.80	-	-	0.00	0.00	-	0.00
321	3,188	3,190	18.45	108.0	0.00	81.08	-	-	0.00	0.00	-	0.00
322	4,319	4,321	14.77	108.0	0.00	83.71	-	-	0.00	0.00	-	0.00
323	4,592	4,594	13.99	108.0	0.00	84.24	-	-	0.00	0.00	-	0.00
324	4,449	4,450	14.39	108.0	0.00	83.97	-	-	0.00	0.00	-	0.00
325	5,791	5,792	10.96	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
326	5,407	5,408	11.87	108.0	0.00	85.66	-	-	0.00	0.00	-	0.00
327	5,524	5,525	11.59	108.0	0.00	85.85	-	-	0.00	0.00	-	0.00
328	5,832	5,833	10.86	108.0	0.00	86.32	-	-	0.00	0.00	-	0.00
329	7,001	7,002	8.38	108.0	0.00	87.90	-	-	0.00	0.00	-	0.00
330	6,806	6,807	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
331	5,950	5,951	10.60	108.0	0.00	86.49	-	-	0.00	0.00	-	0.00
332	5,841	5,842	10.84	108.0	0.00	86.33	-	-	0.00	0.00	-	0.00
333	5,006	5,008	12.88	108.0	0.00	84.99	-	-	0.00	0.00	-	0.00
334	4,818	4,820	13.37	108.0	0.00	84.66	-	-	0.00	0.00	-	0.00
335	4,275	4,276	14.90	108.0	0.00	83.62	-	-	0.00	0.00	-	0.00
Sum	41.36											

- Data undefined due to calculation with octave data

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]
1	10,873	10,874	2.07	108.0	0.00	91.73	-	-	0.00	0.00	-	0.00
2	11,755	11,756	0.92	108.0	0.00	92.41	-	-	0.00	0.00	-	0.00
3	7,882	7,883	5.43	107.0	0.00	88.93	-	-	0.00	0.00	-	0.00
4	8,545	8,546	4.38	107.0	0.00	89.64	-	-	0.00	0.00	-	0.00
5	8,881	8,882	3.87	107.0	0.00	89.97	-	-	0.00	0.00	-	0.00
6	11,942	11,943	0.69	108.0	0.00	92.54	-	-	0.00	0.00	-	0.00
7	10,756	10,757	2.23	108.0	0.00	91.63	-	-	0.00	0.00	-	0.00
8	7,523	7,524	6.03	107.0	0.00	88.53	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
9	11,401	11,401	1.38	108.0	0.00	92.14	-	-	0.00	0.00	-	0.00
10	11,375	11,375	1.41	108.0	0.00	92.12	-	-	0.00	0.00	-	0.00
11	12,530	12,530	-0.02	108.0	0.00	92.96	-	-	0.00	0.00	-	0.00
12	10,249	10,249	1.99	107.0	0.00	91.21	-	-	0.00	0.00	-	0.00
13	8,898	8,898	3.85	107.0	0.00	89.99	-	-	0.00	0.00	-	0.00
14	9,243	9,243	3.35	107.0	0.00	90.32	-	-	0.00	0.00	-	0.00
15	10,825	10,825	2.14	108.0	0.00	91.69	-	-	0.00	0.00	-	0.00
16	8,207	8,207	4.90	107.0	0.00	89.28	-	-	0.00	0.00	-	0.00
17	12,149	12,149	0.43	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
18	9,791	9,792	2.59	107.0	0.00	90.82	-	-	0.00	0.00	-	0.00
19	9,699	9,700	2.72	107.0	0.00	90.73	-	-	0.00	0.00	-	0.00
20	11,402	11,402	1.37	108.0	0.00	92.14	-	-	0.00	0.00	-	0.00
22	8,507	8,508	4.43	107.0	0.00	89.60	-	-	0.00	0.00	-	0.00
23	6,852	6,854	7.23	107.0	0.00	87.72	-	-	0.00	0.00	-	0.00
25	12,565	12,565	-0.07	108.0	0.00	92.98	-	-	0.00	0.00	-	0.00
26	11,672	11,673	1.03	108.0	0.00	92.34	-	-	0.00	0.00	-	0.00
27	10,461	10,462	2.64	108.0	0.00	91.39	-	-	0.00	0.00	-	0.00
28	11,343	11,344	1.45	108.0	0.00	92.10	-	-	0.00	0.00	-	0.00
29	10,503	10,503	1.67	107.0	0.00	91.43	-	-	0.00	0.00	-	0.00
30	12,110	12,110	0.48	108.0	0.00	92.66	-	-	0.00	0.00	-	0.00
31	9,723	9,723	2.68	107.0	0.00	90.76	-	-	0.00	0.00	-	0.00
32	8,297	8,298	4.76	107.0	0.00	89.38	-	-	0.00	0.00	-	0.00
33	8,980	8,980	3.73	107.0	0.00	90.07	-	-	0.00	0.00	-	0.00
201	13,346	13,347	-0.97	108.0	0.00	93.51	-	-	0.00	0.00	-	0.00
202	13,645	13,645	-1.30	108.0	0.00	93.70	-	-	0.00	0.00	-	0.00
203	14,072	14,072	-1.76	108.0	0.00	93.97	-	-	0.00	0.00	-	0.00
204	14,329	14,329	-2.03	108.0	0.00	94.12	-	-	0.00	0.00	-	0.00
205	14,837	14,838	-2.55	108.0	0.00	94.43	-	-	0.00	0.00	-	0.00
206	14,137	14,137	-1.83	108.0	0.00	94.01	-	-	0.00	0.00	-	0.00
207	14,731	14,731	-2.44	108.0	0.00	94.36	-	-	0.00	0.00	-	0.00
208	9,067	9,067	4.72	108.0	0.00	90.15	-	-	0.00	0.00	-	0.00
209	8,851	8,851	5.07	108.0	0.00	89.94	-	-	0.00	0.00	-	0.00
210	8,484	8,484	5.67	108.0	0.00	89.57	-	-	0.00	0.00	-	0.00
211	7,471	7,472	7.47	108.0	0.00	88.47	-	-	0.00	0.00	-	0.00
212	7,065	7,066	8.25	108.0	0.00	87.98	-	-	0.00	0.00	-	0.00
213	6,614	6,615	9.16	108.0	0.00	87.41	-	-	0.00	0.00	-	0.00
214	6,323	6,323	9.77	108.0	0.00	87.02	-	-	0.00	0.00	-	0.00
215	6,711	6,712	8.96	108.0	0.00	87.54	-	-	0.00	0.00	-	0.00
216	5,573	5,574	11.47	108.0	0.00	85.92	-	-	0.00	0.00	-	0.00
217	5,046	5,047	12.78	108.0	0.00	85.06	-	-	0.00	0.00	-	0.00
218	5,738	5,739	11.08	108.0	0.00	86.18	-	-	0.00	0.00	-	0.00
219	5,007	5,008	12.88	108.0	0.00	84.99	-	-	0.00	0.00	-	0.00
220	5,072	5,073	12.71	108.0	0.00	85.11	-	-	0.00	0.00	-	0.00
221	4,825	4,826	13.36	108.0	0.00	84.67	-	-	0.00	0.00	-	0.00
222	1,267	1,269	29.07	108.0	0.00	73.07	-	-	0.00	0.00	-	0.00
223	1,143	1,146	30.19	108.0	0.00	72.19	-	-	0.00	0.00	-	0.00
224	3,004	3,006	19.14	108.0	0.00	80.56	-	-	0.00	0.00	-	0.00
225	2,971	2,972	19.27	108.0	0.00	80.46	-	-	0.00	0.00	-	0.00
226	2,230	2,233	22.52	108.0	0.00	77.98	-	-	0.00	0.00	-	0.00
227	2,615	2,617	20.70	108.0	0.00	79.36	-	-	0.00	0.00	-	0.00
228	1,816	1,818	24.97	108.0	0.00	76.19	-	-	0.00	0.00	-	0.00
229	3,298	3,300	18.05	108.0	0.00	81.37	-	-	0.00	0.00	-	0.00
230	3,639	3,640	16.88	108.0	0.00	82.22	-	-	0.00	0.00	-	0.00
231	4,013	4,014	15.68	108.0	0.00	83.07	-	-	0.00	0.00	-	0.00
232	3,920	3,921	15.97	108.0	0.00	82.87	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 wind@eapc.net
 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
233	4,320	4,322	14.76	108.0	0.00	83.71	-	-	0.00	0.00	-	0.00
234	4,602	4,603	13.96	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
235	5,217	5,218	12.34	108.0	0.00	85.35	-	-	0.00	0.00	-	0.00
301	14,342	14,342	-2.04	108.0	0.00	94.13	-	-	0.00	0.00	-	0.00
302	14,834	14,834	-2.55	108.0	0.00	94.43	-	-	0.00	0.00	-	0.00
303	15,715	15,715	-3.41	108.0	0.00	94.93	-	-	0.00	0.00	-	0.00
304	16,320	16,320	-3.98	108.0	0.00	95.25	-	-	0.00	0.00	-	0.00
305	16,573	16,574	-4.21	108.0	0.00	95.39	-	-	0.00	0.00	-	0.00
306	16,231	16,231	-3.90	108.0	0.00	95.21	-	-	0.00	0.00	-	0.00
307	15,505	15,505	-3.21	108.0	0.00	94.81	-	-	0.00	0.00	-	0.00
308	694	699	35.48	108.0	0.00	67.89	-	-	0.00	0.00	-	0.00
309	825	830	33.68	108.0	0.00	69.38	-	-	0.00	0.00	-	0.00
310	1,018	1,022	31.44	108.0	0.00	71.19	-	-	0.00	0.00	-	0.00
311	1,505	1,508	27.13	108.0	0.00	74.57	-	-	0.00	0.00	-	0.00
312	1,914	1,916	24.35	108.0	0.00	76.65	-	-	0.00	0.00	-	0.00
313	2,398	2,401	21.63	108.0	0.00	78.61	-	-	0.00	0.00	-	0.00
314	3,229	3,231	18.30	108.0	0.00	81.19	-	-	0.00	0.00	-	0.00
315	3,033	3,035	19.03	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
316	2,733	2,736	20.20	108.0	0.00	79.74	-	-	0.00	0.00	-	0.00
317	2,331	2,334	21.98	108.0	0.00	78.36	-	-	0.00	0.00	-	0.00
318	1,885	1,887	24.53	108.0	0.00	76.52	-	-	0.00	0.00	-	0.00
319	3,155	3,157	18.57	108.0	0.00	80.99	-	-	0.00	0.00	-	0.00
320	3,429	3,431	17.59	108.0	0.00	81.71	-	-	0.00	0.00	-	0.00
321	3,575	3,576	17.09	108.0	0.00	82.07	-	-	0.00	0.00	-	0.00
322	4,683	4,684	13.74	108.0	0.00	84.41	-	-	0.00	0.00	-	0.00
323	4,937	4,938	13.06	108.0	0.00	84.87	-	-	0.00	0.00	-	0.00
324	4,729	4,730	13.61	108.0	0.00	84.50	-	-	0.00	0.00	-	0.00
325	6,120	6,121	10.21	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
326	5,697	5,698	11.18	108.0	0.00	86.11	-	-	0.00	0.00	-	0.00
327	5,787	5,788	10.97	108.0	0.00	86.25	-	-	0.00	0.00	-	0.00
328	6,020	6,021	10.44	108.0	0.00	86.59	-	-	0.00	0.00	-	0.00
329	7,199	7,200	7.99	108.0	0.00	88.15	-	-	0.00	0.00	-	0.00
330	6,955	6,956	8.47	108.0	0.00	87.85	-	-	0.00	0.00	-	0.00
331	6,071	6,073	10.32	108.0	0.00	86.67	-	-	0.00	0.00	-	0.00
332	5,922	5,923	10.66	108.0	0.00	86.45	-	-	0.00	0.00	-	0.00
333	5,090	5,092	12.66	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
334	4,949	4,950	13.03	108.0	0.00	84.89	-	-	0.00	0.00	-	0.00
335	4,406	4,407	14.52	108.0	0.00	83.88	-	-	0.00	0.00	-	0.00

Sum 40.93

- Data undefined due to calculation with octave data

Noise sensitive area: NSP022 NSP022

		Wind speed: 8.0 m/s										
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]
1	11,131	11,132	1.73	108.0	0.00	91.93	-	-	0.00	0.00	-	0.00
2	12,078	12,079	0.52	108.0	0.00	92.64	-	-	0.00	0.00	-	0.00
3	8,106	8,107	5.06	107.0	0.00	89.18	-	-	0.00	0.00	-	0.00
4	8,616	8,617	4.27	107.0	0.00	89.71	-	-	0.00	0.00	-	0.00
5	9,202	9,203	3.41	107.0	0.00	90.28	-	-	0.00	0.00	-	0.00
6	12,376	12,377	0.16	108.0	0.00	92.85	-	-	0.00	0.00	-	0.00
7	11,215	11,216	1.62	108.0	0.00	92.00	-	-	0.00	0.00	-	0.00
8	7,635	7,636	5.84	107.0	0.00	88.66	-	-	0.00	0.00	-	0.00
9	11,586	11,587	1.14	108.0	0.00	92.28	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 wind@eapc.net
 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
10	11,652	11,652	1.05	108.0	0.00	92.33	-	-	0.00	0.00	-	0.00
11	12,699	12,699	-0.22	108.0	0.00	93.08	-	-	0.00	0.00	-	0.00
12	10,262	10,262	1.97	107.0	0.00	91.22	-	-	0.00	0.00	-	0.00
13	8,980	8,981	3.73	107.0	0.00	90.07	-	-	0.00	0.00	-	0.00
14	9,473	9,473	3.03	107.0	0.00	90.53	-	-	0.00	0.00	-	0.00
15	11,218	11,219	1.61	108.0	0.00	92.00	-	-	0.00	0.00	-	0.00
16	8,355	8,356	4.67	107.0	0.00	89.44	-	-	0.00	0.00	-	0.00
17	12,629	12,630	-0.14	108.0	0.00	93.03	-	-	0.00	0.00	-	0.00
18	10,095	10,095	2.19	107.0	0.00	91.08	-	-	0.00	0.00	-	0.00
19	9,878	9,878	2.48	107.0	0.00	90.89	-	-	0.00	0.00	-	0.00
20	11,880	11,881	0.77	108.0	0.00	92.50	-	-	0.00	0.00	-	0.00
22	8,448	8,448	4.53	107.0	0.00	89.54	-	-	0.00	0.00	-	0.00
23	6,911	6,912	7.12	107.0	0.00	87.79	-	-	0.00	0.00	-	0.00
25	13,018	13,018	-0.59	108.0	0.00	93.29	-	-	0.00	0.00	-	0.00
26	12,212	12,212	0.36	108.0	0.00	92.74	-	-	0.00	0.00	-	0.00
27	10,728	10,729	2.27	108.0	0.00	91.61	-	-	0.00	0.00	-	0.00
28	11,766	11,767	0.91	108.0	0.00	92.41	-	-	0.00	0.00	-	0.00
29	10,458	10,458	1.72	107.0	0.00	91.39	-	-	0.00	0.00	-	0.00
30	12,404	12,405	0.12	108.0	0.00	92.87	-	-	0.00	0.00	-	0.00
31	9,724	9,724	2.68	107.0	0.00	90.76	-	-	0.00	0.00	-	0.00
32	8,592	8,593	4.30	107.0	0.00	89.68	-	-	0.00	0.00	-	0.00
33	8,981	8,981	3.73	107.0	0.00	90.07	-	-	0.00	0.00	-	0.00
201	13,696	13,697	-1.35	108.0	0.00	93.73	-	-	0.00	0.00	-	0.00
202	13,996	13,996	-1.68	108.0	0.00	93.92	-	-	0.00	0.00	-	0.00
203	14,296	14,296	-1.99	108.0	0.00	94.10	-	-	0.00	0.00	-	0.00
204	14,584	14,585	-2.29	108.0	0.00	94.28	-	-	0.00	0.00	-	0.00
205	15,081	15,081	-2.79	108.0	0.00	94.57	-	-	0.00	0.00	-	0.00
206	14,265	14,265	-1.96	108.0	0.00	94.09	-	-	0.00	0.00	-	0.00
207	14,812	14,813	-2.52	108.0	0.00	94.41	-	-	0.00	0.00	-	0.00
208	8,843	8,844	5.08	108.0	0.00	89.93	-	-	0.00	0.00	-	0.00
209	8,582	8,583	5.51	108.0	0.00	89.67	-	-	0.00	0.00	-	0.00
210	8,165	8,165	6.22	108.0	0.00	89.24	-	-	0.00	0.00	-	0.00
211	7,275	7,276	7.84	108.0	0.00	88.24	-	-	0.00	0.00	-	0.00
212	6,887	6,888	8.60	108.0	0.00	87.76	-	-	0.00	0.00	-	0.00
213	6,447	6,448	9.51	108.0	0.00	87.19	-	-	0.00	0.00	-	0.00
214	6,120	6,121	10.21	108.0	0.00	86.74	-	-	0.00	0.00	-	0.00
215	6,858	6,859	8.66	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00
216	5,582	5,583	11.45	108.0	0.00	85.94	-	-	0.00	0.00	-	0.00
217	4,959	4,960	13.00	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
218	5,176	5,177	12.44	108.0	0.00	85.28	-	-	0.00	0.00	-	0.00
219	4,381	4,383	14.59	108.0	0.00	83.83	-	-	0.00	0.00	-	0.00
220	4,346	4,347	14.69	108.0	0.00	83.76	-	-	0.00	0.00	-	0.00
221	3,984	3,985	15.78	108.0	0.00	83.01	-	-	0.00	0.00	-	0.00
222	489	497	38.99	108.0	0.00	64.92	-	-	0.00	0.00	-	0.00
223	1,068	1,073	30.92	108.0	0.00	71.61	-	-	0.00	0.00	-	0.00
224	2,323	2,325	22.03	108.0	0.00	78.33	-	-	0.00	0.00	-	0.00
225	2,418	2,420	21.55	108.0	0.00	78.68	-	-	0.00	0.00	-	0.00
226	2,028	2,031	23.66	108.0	0.00	77.16	-	-	0.00	0.00	-	0.00
227	2,736	2,738	20.19	108.0	0.00	79.75	-	-	0.00	0.00	-	0.00
228	1,125	1,128	30.37	108.0	0.00	72.05	-	-	0.00	0.00	-	0.00
229	3,413	3,415	17.65	108.0	0.00	81.67	-	-	0.00	0.00	-	0.00
230	3,745	3,747	16.53	108.0	0.00	82.47	-	-	0.00	0.00	-	0.00
231	4,205	4,206	15.10	108.0	0.00	83.48	-	-	0.00	0.00	-	0.00
232	4,460	4,461	14.36	108.0	0.00	83.99	-	-	0.00	0.00	-	0.00
233	4,858	4,860	13.27	108.0	0.00	84.73	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power - BISON Wind Energy Center

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
234	5,172	5,174	12.45	108.0	0.00	85.28	-	-	0.00	0.00	-	0.00
235	5,685	5,686	11.21	108.0	0.00	86.10	-	-	0.00	0.00	-	0.00
301	14,198	14,198	-1.89	108.0	0.00	94.04	-	-	0.00	0.00	-	0.00
302	14,678	14,678	-2.39	108.0	0.00	94.33	-	-	0.00	0.00	-	0.00
303	15,574	15,574	-3.28	108.0	0.00	94.85	-	-	0.00	0.00	-	0.00
304	16,171	16,172	-3.84	108.0	0.00	95.18	-	-	0.00	0.00	-	0.00
305	16,483	16,483	-4.13	108.0	0.00	95.34	-	-	0.00	0.00	-	0.00
306	16,130	16,130	-3.80	108.0	0.00	95.15	-	-	0.00	0.00	-	0.00
307	15,434	15,434	-3.14	108.0	0.00	94.77	-	-	0.00	0.00	-	0.00
308	1,890	1,893	24.50	108.0	0.00	76.54	-	-	0.00	0.00	-	0.00
309	1,941	1,943	24.18	108.0	0.00	76.77	-	-	0.00	0.00	-	0.00
310	1,715	1,718	25.63	108.0	0.00	75.70	-	-	0.00	0.00	-	0.00
311	2,094	2,096	23.28	108.0	0.00	77.43	-	-	0.00	0.00	-	0.00
312	2,479	2,482	21.28	108.0	0.00	78.90	-	-	0.00	0.00	-	0.00
313	2,934	2,937	19.40	108.0	0.00	80.36	-	-	0.00	0.00	-	0.00
314	3,605	3,607	16.99	108.0	0.00	82.14	-	-	0.00	0.00	-	0.00
315	3,749	3,751	16.52	108.0	0.00	82.48	-	-	0.00	0.00	-	0.00
316	3,650	3,652	16.84	108.0	0.00	82.25	-	-	0.00	0.00	-	0.00
317	3,269	3,272	18.15	108.0	0.00	81.30	-	-	0.00	0.00	-	0.00
318	2,996	2,998	19.17	108.0	0.00	80.54	-	-	0.00	0.00	-	0.00
319	4,354	4,356	14.66	108.0	0.00	83.78	-	-	0.00	0.00	-	0.00
320	4,618	4,620	13.92	108.0	0.00	84.29	-	-	0.00	0.00	-	0.00
321	4,740	4,742	13.58	108.0	0.00	84.52	-	-	0.00	0.00	-	0.00
322	5,864	5,865	10.79	108.0	0.00	86.37	-	-	0.00	0.00	-	0.00
323	6,127	6,128	10.20	108.0	0.00	86.75	-	-	0.00	0.00	-	0.00
324	5,927	5,929	10.65	108.0	0.00	86.46	-	-	0.00	0.00	-	0.00
325	7,315	7,316	7.76	108.0	0.00	88.29	-	-	0.00	0.00	-	0.00
326	6,895	6,897	8.58	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00
327	6,983	6,984	8.41	108.0	0.00	87.88	-	-	0.00	0.00	-	0.00
328	7,189	7,190	8.01	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
329	8,371	8,372	5.86	108.0	0.00	89.46	-	-	0.00	0.00	-	0.00
330	8,098	8,099	6.33	108.0	0.00	89.17	-	-	0.00	0.00	-	0.00
331	7,196	7,197	7.99	108.0	0.00	88.14	-	-	0.00	0.00	-	0.00
332	7,011	7,012	8.35	108.0	0.00	87.92	-	-	0.00	0.00	-	0.00
333	6,189	6,190	10.06	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
334	6,086	6,087	10.29	108.0	0.00	86.69	-	-	0.00	0.00	-	0.00
335	5,547	5,548	11.53	108.0	0.00	85.88	-	-	0.00	0.00	-	0.00
Sum	41.20											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP023 NSP023

		Wind speed: 8.0 m/s										
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]
1	11,820	11,821	0.84	108.0	0.00	92.45	-	-	0.00	0.00	-	0.00
2	12,821	12,822	-0.37	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
3	8,806	8,807	3.98	107.0	0.00	89.90	-	-	0.00	0.00	-	0.00
4	9,155	9,155	3.48	107.0	0.00	90.23	-	-	0.00	0.00	-	0.00
5	9,977	9,977	2.35	107.0	0.00	90.98	-	-	0.00	0.00	-	0.00
6	13,221	13,222	-0.83	108.0	0.00	93.43	-	-	0.00	0.00	-	0.00
7	12,094	12,095	0.50	108.0	0.00	92.65	-	-	0.00	0.00	-	0.00
8	8,236	8,237	4.86	107.0	0.00	89.32	-	-	0.00	0.00	-	0.00
9	12,198	12,198	0.37	108.0	0.00	92.73	-	-	0.00	0.00	-	0.00
10	12,354	12,354	0.19	108.0	0.00	92.84	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
11	13,282	13,283	-0.89	108.0	0.00	93.47	-	-	0.00	0.00	-	0.00
12	10,710	10,710	1.41	107.0	0.00	91.60	-	-	0.00	0.00	-	0.00
13	9,524	9,525	2.96	107.0	0.00	90.58	-	-	0.00	0.00	-	0.00
14	10,156	10,156	2.11	107.0	0.00	91.13	-	-	0.00	0.00	-	0.00
15	12,036	12,037	0.57	108.0	0.00	92.61	-	-	0.00	0.00	-	0.00
16	8,977	8,978	3.73	107.0	0.00	90.06	-	-	0.00	0.00	-	0.00
17	13,516	13,517	-1.15	108.0	0.00	93.62	-	-	0.00	0.00	-	0.00
18	10,840	10,840	1.25	107.0	0.00	91.70	-	-	0.00	0.00	-	0.00
19	10,504	10,504	1.66	107.0	0.00	91.43	-	-	0.00	0.00	-	0.00
20	12,771	12,772	-0.31	108.0	0.00	93.12	-	-	0.00	0.00	-	0.00
22	8,851	8,852	3.92	107.0	0.00	89.94	-	-	0.00	0.00	-	0.00
23	7,479	7,481	6.10	107.0	0.00	88.48	-	-	0.00	0.00	-	0.00
25	13,877	13,877	-1.55	108.0	0.00	93.85	-	-	0.00	0.00	-	0.00
26	13,155	13,155	-0.75	108.0	0.00	93.38	-	-	0.00	0.00	-	0.00
27	11,430	11,430	1.34	108.0	0.00	92.16	-	-	0.00	0.00	-	0.00
28	12,606	12,607	-0.12	108.0	0.00	93.01	-	-	0.00	0.00	-	0.00
29	10,840	10,840	1.25	107.0	0.00	91.70	-	-	0.00	0.00	-	0.00
30	13,116	13,117	-0.71	108.0	0.00	93.36	-	-	0.00	0.00	-	0.00
31	10,167	10,168	2.10	107.0	0.00	91.14	-	-	0.00	0.00	-	0.00
32	9,352	9,353	3.20	107.0	0.00	90.42	-	-	0.00	0.00	-	0.00
33	9,438	9,438	3.08	107.0	0.00	90.50	-	-	0.00	0.00	-	0.00
201	14,452	14,453	-2.16	108.0	0.00	94.20	-	-	0.00	0.00	-	0.00
202	14,751	14,751	-2.46	108.0	0.00	94.38	-	-	0.00	0.00	-	0.00
203	14,922	14,923	-2.64	108.0	0.00	94.48	-	-	0.00	0.00	-	0.00
204	15,241	15,241	-2.95	108.0	0.00	94.66	-	-	0.00	0.00	-	0.00
205	15,721	15,722	-3.42	108.0	0.00	94.93	-	-	0.00	0.00	-	0.00
206	14,792	14,792	-2.50	108.0	0.00	94.40	-	-	0.00	0.00	-	0.00
207	15,286	15,287	-3.00	108.0	0.00	94.69	-	-	0.00	0.00	-	0.00
208	9,054	9,055	4.74	108.0	0.00	90.14	-	-	0.00	0.00	-	0.00
209	8,746	8,747	5.24	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
210	8,278	8,279	6.02	108.0	0.00	89.36	-	-	0.00	0.00	-	0.00
211	7,559	7,560	7.31	108.0	0.00	88.57	-	-	0.00	0.00	-	0.00
212	7,204	7,205	7.98	108.0	0.00	88.15	-	-	0.00	0.00	-	0.00
213	6,791	6,792	8.79	108.0	0.00	87.64	-	-	0.00	0.00	-	0.00
214	6,439	6,440	9.53	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
215	7,516	7,517	7.39	108.0	0.00	88.52	-	-	0.00	0.00	-	0.00
216	6,151	6,152	10.15	108.0	0.00	86.78	-	-	0.00	0.00	-	0.00
217	5,463	5,464	11.73	108.0	0.00	85.75	-	-	0.00	0.00	-	0.00
218	5,097	5,098	12.65	108.0	0.00	85.15	-	-	0.00	0.00	-	0.00
219	4,271	4,272	14.91	108.0	0.00	83.61	-	-	0.00	0.00	-	0.00
220	4,087	4,088	15.46	108.0	0.00	83.23	-	-	0.00	0.00	-	0.00
221	3,565	3,566	17.13	108.0	0.00	82.04	-	-	0.00	0.00	-	0.00
222	1,582	1,584	26.56	108.0	0.00	75.00	-	-	0.00	0.00	-	0.00
223	2,237	2,239	22.49	108.0	0.00	78.00	-	-	0.00	0.00	-	0.00
224	2,447	2,449	21.42	108.0	0.00	78.78	-	-	0.00	0.00	-	0.00
225	2,699	2,701	20.35	108.0	0.00	79.63	-	-	0.00	0.00	-	0.00
226	2,789	2,791	19.98	108.0	0.00	79.92	-	-	0.00	0.00	-	0.00
227	3,630	3,632	16.91	108.0	0.00	82.20	-	-	0.00	0.00	-	0.00
228	1,762	1,763	25.33	108.0	0.00	75.93	-	-	0.00	0.00	-	0.00
229	4,226	4,228	15.04	108.0	0.00	83.52	-	-	0.00	0.00	-	0.00
230	4,521	4,522	14.19	108.0	0.00	84.11	-	-	0.00	0.00	-	0.00
231	5,020	5,021	12.84	108.0	0.00	85.02	-	-	0.00	0.00	-	0.00
232	5,529	5,530	11.57	108.0	0.00	85.86	-	-	0.00	0.00	-	0.00
233	5,912	5,913	10.68	108.0	0.00	86.44	-	-	0.00	0.00	-	0.00
234	6,240	6,241	9.95	108.0	0.00	86.91	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

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 Frank Frederickson
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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
235	6,659	6,660	9.06	108.0	0.00	87.47	-	-	0.00	0.00	-	0.00
301	14,428	14,428	-2.13	108.0	0.00	94.18	-	-	0.00	0.00	-	0.00
302	14,890	14,890	-2.60	108.0	0.00	94.46	-	-	0.00	0.00	-	0.00
303	15,797	15,797	-3.49	108.0	0.00	94.97	-	-	0.00	0.00	-	0.00
304	16,380	16,380	-4.03	108.0	0.00	95.29	-	-	0.00	0.00	-	0.00
305	16,756	16,756	-4.38	108.0	0.00	95.48	-	-	0.00	0.00	-	0.00
306	16,395	16,395	-4.05	108.0	0.00	95.29	-	-	0.00	0.00	-	0.00
307	15,738	15,738	-3.43	108.0	0.00	94.94	-	-	0.00	0.00	-	0.00
308	3,253	3,254	18.22	108.0	0.00	81.25	-	-	0.00	0.00	-	0.00
309	3,326	3,327	17.96	108.0	0.00	81.44	-	-	0.00	0.00	-	0.00
310	3,032	3,033	19.03	108.0	0.00	80.64	-	-	0.00	0.00	-	0.00
311	3,337	3,338	17.92	108.0	0.00	81.47	-	-	0.00	0.00	-	0.00
312	3,678	3,679	16.75	108.0	0.00	82.31	-	-	0.00	0.00	-	0.00
313	4,081	4,083	15.47	108.0	0.00	83.22	-	-	0.00	0.00	-	0.00
314	4,603	4,605	13.96	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
315	4,956	4,958	13.01	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
316	4,960	4,962	13.00	108.0	0.00	84.91	-	-	0.00	0.00	-	0.00
317	4,595	4,597	13.98	108.0	0.00	84.25	-	-	0.00	0.00	-	0.00
318	4,377	4,378	14.60	108.0	0.00	83.83	-	-	0.00	0.00	-	0.00
319	5,717	5,718	11.13	108.0	0.00	86.14	-	-	0.00	0.00	-	0.00
320	5,955	5,957	10.58	108.0	0.00	86.50	-	-	0.00	0.00	-	0.00
321	6,041	6,042	10.39	108.0	0.00	86.62	-	-	0.00	0.00	-	0.00
322	7,182	7,182	8.02	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
323	7,459	7,460	7.49	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
324	7,296	7,297	7.80	108.0	0.00	88.26	-	-	0.00	0.00	-	0.00
325	8,658	8,659	5.38	108.0	0.00	89.75	-	-	0.00	0.00	-	0.00
326	8,261	8,262	6.05	108.0	0.00	89.34	-	-	0.00	0.00	-	0.00
327	8,358	8,359	5.89	108.0	0.00	89.44	-	-	0.00	0.00	-	0.00
328	8,575	8,575	5.52	108.0	0.00	89.67	-	-	0.00	0.00	-	0.00
329	9,756	9,757	3.66	108.0	0.00	90.79	-	-	0.00	0.00	-	0.00
330	9,479	9,480	4.08	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
331	8,572	8,573	5.52	108.0	0.00	89.66	-	-	0.00	0.00	-	0.00
332	8,375	8,375	5.86	108.0	0.00	89.46	-	-	0.00	0.00	-	0.00
333	7,558	7,559	7.31	108.0	0.00	88.57	-	-	0.00	0.00	-	0.00
334	7,466	7,467	7.48	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
335	6,929	6,930	8.52	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00

Sum 33.65

- Data undefined due to calculation with octave data

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]
1	12,697	12,697	-0.22	108.0	0.00	93.07	-	-	0.00	0.00	-	0.00
2	13,661	13,662	-1.31	108.0	0.00	93.71	-	-	0.00	0.00	-	0.00
3	9,670	9,670	2.76	107.0	0.00	90.71	-	-	0.00	0.00	-	0.00
4	10,117	10,117	2.16	107.0	0.00	91.10	-	-	0.00	0.00	-	0.00
5	10,791	10,791	1.31	107.0	0.00	91.66	-	-	0.00	0.00	-	0.00
6	13,983	13,984	-1.66	108.0	0.00	93.91	-	-	0.00	0.00	-	0.00
7	12,828	12,828	-0.37	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
8	9,160	9,160	3.47	107.0	0.00	90.24	-	-	0.00	0.00	-	0.00
9	13,124	13,124	-0.71	108.0	0.00	93.36	-	-	0.00	0.00	-	0.00
10	13,222	13,222	-0.83	108.0	0.00	93.43	-	-	0.00	0.00	-	0.00
11	14,226	14,226	-1.92	108.0	0.00	94.06	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
12	11,722	11,722	0.21	107.0	0.00	92.38	-	-	0.00	0.00	-	0.00
13	10,484	10,485	1.69	107.0	0.00	91.41	-	-	0.00	0.00	-	0.00
14	11,033	11,034	1.01	107.0	0.00	91.85	-	-	0.00	0.00	-	0.00
15	12,820	12,820	-0.37	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
16	9,891	9,891	2.46	107.0	0.00	90.91	-	-	0.00	0.00	-	0.00
17	14,243	14,244	-1.94	108.0	0.00	94.07	-	-	0.00	0.00	-	0.00
18	11,676	11,677	0.26	107.0	0.00	92.35	-	-	0.00	0.00	-	0.00
19	11,418	11,419	0.56	107.0	0.00	92.15	-	-	0.00	0.00	-	0.00
20	13,495	13,495	-1.13	108.0	0.00	93.60	-	-	0.00	0.00	-	0.00
22	9,880	9,881	2.47	107.0	0.00	90.90	-	-	0.00	0.00	-	0.00
23	8,420	8,420	4.57	107.0	0.00	89.51	-	-	0.00	0.00	-	0.00
25	14,628	14,628	-2.34	108.0	0.00	94.30	-	-	0.00	0.00	-	0.00
26	13,831	13,831	-1.50	108.0	0.00	93.82	-	-	0.00	0.00	-	0.00
27	12,297	12,297	0.25	108.0	0.00	92.80	-	-	0.00	0.00	-	0.00
28	13,372	13,373	-0.99	108.0	0.00	93.52	-	-	0.00	0.00	-	0.00
29	11,883	11,883	0.02	107.0	0.00	92.50	-	-	0.00	0.00	-	0.00
30	13,978	13,979	-1.66	108.0	0.00	93.91	-	-	0.00	0.00	-	0.00
31	11,181	11,181	0.84	107.0	0.00	91.97	-	-	0.00	0.00	-	0.00
32	10,176	10,176	2.08	107.0	0.00	91.15	-	-	0.00	0.00	-	0.00
33	10,443	10,443	1.74	107.0	0.00	91.38	-	-	0.00	0.00	-	0.00
201	15,284	15,285	-3.00	108.0	0.00	94.69	-	-	0.00	0.00	-	0.00
202	15,584	15,584	-3.29	108.0	0.00	94.85	-	-	0.00	0.00	-	0.00
203	15,842	15,842	-3.53	108.0	0.00	95.00	-	-	0.00	0.00	-	0.00
204	16,142	16,142	-3.81	108.0	0.00	95.16	-	-	0.00	0.00	-	0.00
205	16,632	16,633	-4.26	108.0	0.00	95.42	-	-	0.00	0.00	-	0.00
206	15,769	15,769	-3.46	108.0	0.00	94.96	-	-	0.00	0.00	-	0.00
207	16,292	16,292	-3.95	108.0	0.00	95.24	-	-	0.00	0.00	-	0.00
208	10,162	10,162	3.07	108.0	0.00	91.14	-	-	0.00	0.00	-	0.00
209	9,869	9,869	3.49	108.0	0.00	90.89	-	-	0.00	0.00	-	0.00
210	9,415	9,416	4.17	108.0	0.00	90.48	-	-	0.00	0.00	-	0.00
211	8,635	8,635	5.42	108.0	0.00	89.73	-	-	0.00	0.00	-	0.00
212	8,265	8,265	6.05	108.0	0.00	89.35	-	-	0.00	0.00	-	0.00
213	7,838	7,839	6.80	108.0	0.00	88.89	-	-	0.00	0.00	-	0.00
214	7,495	7,496	7.43	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
215	8,403	8,404	5.81	108.0	0.00	89.49	-	-	0.00	0.00	-	0.00
216	7,085	7,085	8.21	108.0	0.00	88.01	-	-	0.00	0.00	-	0.00
217	6,427	6,427	9.55	108.0	0.00	87.16	-	-	0.00	0.00	-	0.00
218	6,270	6,271	9.89	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
219	5,446	5,446	11.78	108.0	0.00	85.72	-	-	0.00	0.00	-	0.00
220	5,288	5,288	12.17	108.0	0.00	85.47	-	-	0.00	0.00	-	0.00
221	4,782	4,782	13.47	108.0	0.00	84.59	-	-	0.00	0.00	-	0.00
222	2,065	2,066	23.46	108.0	0.00	77.30	-	-	0.00	0.00	-	0.00
223	2,689	2,690	20.39	108.0	0.00	79.59	-	-	0.00	0.00	-	0.00
224	3,517	3,518	17.29	108.0	0.00	81.92	-	-	0.00	0.00	-	0.00
225	3,718	3,719	16.62	108.0	0.00	82.41	-	-	0.00	0.00	-	0.00
226	3,565	3,566	17.13	108.0	0.00	82.04	-	-	0.00	0.00	-	0.00
227	4,330	4,331	14.74	108.0	0.00	83.73	-	-	0.00	0.00	-	0.00
228	2,549	2,550	20.98	108.0	0.00	79.13	-	-	0.00	0.00	-	0.00
229	4,992	4,993	12.92	108.0	0.00	84.97	-	-	0.00	0.00	-	0.00
230	5,315	5,316	12.10	108.0	0.00	85.51	-	-	0.00	0.00	-	0.00
231	5,790	5,791	10.96	108.0	0.00	86.25	-	-	0.00	0.00	-	0.00
232	6,079	6,080	10.31	108.0	0.00	86.68	-	-	0.00	0.00	-	0.00
233	6,478	6,479	9.44	108.0	0.00	87.23	-	-	0.00	0.00	-	0.00
234	6,791	6,792	8.79	108.0	0.00	87.64	-	-	0.00	0.00	-	0.00
235	7,304	7,304	7.79	108.0	0.00	88.27	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
301	15,538	15,538	-3.24	108.0	0.00	94.83	-	-	0.00	0.00	-	0.00
302	16,007	16,007	-3.69	108.0	0.00	95.09	-	-	0.00	0.00	-	0.00
303	16,911	16,911	-4.51	108.0	0.00	95.56	-	-	0.00	0.00	-	0.00
304	17,499	17,499	-5.03	108.0	0.00	95.86	-	-	0.00	0.00	-	0.00
305	17,852	17,852	-5.33	108.0	0.00	96.03	-	-	0.00	0.00	-	0.00
306	17,494	17,494	-5.02	108.0	0.00	95.86	-	-	0.00	0.00	-	0.00
307	16,821	16,821	-4.43	108.0	0.00	95.52	-	-	0.00	0.00	-	0.00
308	3,031	3,032	19.04	108.0	0.00	80.63	-	-	0.00	0.00	-	0.00
309	3,294	3,295	18.07	108.0	0.00	81.36	-	-	0.00	0.00	-	0.00
310	3,270	3,271	18.16	108.0	0.00	81.29	-	-	0.00	0.00	-	0.00
311	3,689	3,690	16.72	108.0	0.00	82.34	-	-	0.00	0.00	-	0.00
312	4,086	4,087	15.46	108.0	0.00	83.23	-	-	0.00	0.00	-	0.00
313	4,548	4,550	14.11	108.0	0.00	84.16	-	-	0.00	0.00	-	0.00
314	5,223	5,224	12.33	108.0	0.00	85.36	-	-	0.00	0.00	-	0.00
315	5,341	5,342	12.03	108.0	0.00	85.55	-	-	0.00	0.00	-	0.00
316	5,166	5,167	12.47	108.0	0.00	85.26	-	-	0.00	0.00	-	0.00
317	4,769	4,771	13.50	108.0	0.00	84.57	-	-	0.00	0.00	-	0.00
318	4,348	4,349	14.68	108.0	0.00	83.77	-	-	0.00	0.00	-	0.00
319	5,369	5,370	11.96	108.0	0.00	85.60	-	-	0.00	0.00	-	0.00
320	5,513	5,514	11.61	108.0	0.00	85.83	-	-	0.00	0.00	-	0.00
321	5,507	5,508	11.63	108.0	0.00	85.82	-	-	0.00	0.00	-	0.00
322	6,661	6,662	9.06	108.0	0.00	87.47	-	-	0.00	0.00	-	0.00
323	6,974	6,975	8.43	108.0	0.00	87.87	-	-	0.00	0.00	-	0.00
324	6,940	6,940	8.50	108.0	0.00	87.83	-	-	0.00	0.00	-	0.00
325	8,187	8,187	6.18	108.0	0.00	89.26	-	-	0.00	0.00	-	0.00
326	7,876	7,877	6.73	108.0	0.00	88.93	-	-	0.00	0.00	-	0.00
327	8,026	8,027	6.46	108.0	0.00	89.09	-	-	0.00	0.00	-	0.00
328	8,384	8,384	5.84	108.0	0.00	89.47	-	-	0.00	0.00	-	0.00
329	9,547	9,547	3.97	108.0	0.00	90.60	-	-	0.00	0.00	-	0.00
330	9,363	9,364	4.26	108.0	0.00	90.43	-	-	0.00	0.00	-	0.00
331	8,503	8,504	5.64	108.0	0.00	89.59	-	-	0.00	0.00	-	0.00
332	8,378	8,378	5.85	108.0	0.00	89.46	-	-	0.00	0.00	-	0.00
333	7,544	7,545	7.33	108.0	0.00	88.55	-	-	0.00	0.00	-	0.00
334	7,373	7,374	7.66	108.0	0.00	88.35	-	-	0.00	0.00	-	0.00
335	6,829	6,829	8.72	108.0	0.00	87.69	-	-	0.00	0.00	-	0.00
Sum	31.47											

- Data undefined due to calculation with octave data

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]
1	7,982	7,984	6.54	108.0	0.00	89.04	-	-	0.00	0.00	-	0.00
2	7,743	7,744	6.97	108.0	0.00	88.78	-	-	0.00	0.00	-	0.00
3	10,442	10,443	1.74	107.0	0.00	91.38	-	-	0.00	0.00	-	0.00
4	9,552	9,553	2.92	107.0	0.00	90.60	-	-	0.00	0.00	-	0.00
5	9,888	9,889	2.46	107.0	0.00	90.90	-	-	0.00	0.00	-	0.00
6	8,550	8,551	5.56	108.0	0.00	89.64	-	-	0.00	0.00	-	0.00
7	9,399	9,400	4.20	108.0	0.00	90.46	-	-	0.00	0.00	-	0.00
8	10,592	10,593	1.55	107.0	0.00	91.50	-	-	0.00	0.00	-	0.00
9	7,187	7,188	8.01	108.0	0.00	88.13	-	-	0.00	0.00	-	0.00
10	7,701	7,703	7.04	108.0	0.00	88.73	-	-	0.00	0.00	-	0.00
11	6,153	6,154	10.14	108.0	0.00	86.78	-	-	0.00	0.00	-	0.00
12	7,820	7,820	5.53	107.0	0.00	88.86	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 Calculated:
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DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
13	9,222	9,223	3.38	107.0	0.00	90.30	-	-	0.00	0.00	-	0.00
14	9,239	9,240	3.36	107.0	0.00	90.31	-	-	0.00	0.00	-	0.00
15	8,862	8,863	5.05	108.0	0.00	89.95	-	-	0.00	0.00	-	0.00
16	9,987	9,987	2.33	107.0	0.00	90.99	-	-	0.00	0.00	-	0.00
17	8,904	8,905	4.98	108.0	0.00	89.99	-	-	0.00	0.00	-	0.00
18	9,074	9,075	3.59	107.0	0.00	90.16	-	-	0.00	0.00	-	0.00
19	8,667	8,668	4.19	107.0	0.00	89.76	-	-	0.00	0.00	-	0.00
20	9,223	9,224	4.47	108.0	0.00	90.30	-	-	0.00	0.00	-	0.00
22	9,553	9,553	2.92	107.0	0.00	90.60	-	-	0.00	0.00	-	0.00
23	11,211	11,212	0.80	107.0	0.00	91.99	-	-	0.00	0.00	-	0.00
25	8,451	8,452	5.73	108.0	0.00	89.54	-	-	0.00	0.00	-	0.00
26	9,686	9,687	3.76	108.0	0.00	90.72	-	-	0.00	0.00	-	0.00
27	8,357	8,358	5.89	108.0	0.00	89.44	-	-	0.00	0.00	-	0.00
28	8,775	8,776	5.19	108.0	0.00	89.87	-	-	0.00	0.00	-	0.00
29	7,548	7,549	5.99	107.0	0.00	88.56	-	-	0.00	0.00	-	0.00
30	7,293	7,294	7.81	108.0	0.00	88.26	-	-	0.00	0.00	-	0.00
31	8,334	8,335	4.70	107.0	0.00	89.42	-	-	0.00	0.00	-	0.00
32	10,280	10,280	1.95	107.0	0.00	91.24	-	-	0.00	0.00	-	0.00
33	9,075	9,075	3.59	107.0	0.00	90.16	-	-	0.00	0.00	-	0.00
201	7,050	7,051	8.28	108.0	0.00	87.97	-	-	0.00	0.00	-	0.00
202	6,924	6,925	8.53	108.0	0.00	87.81	-	-	0.00	0.00	-	0.00
203	5,433	5,434	11.81	108.0	0.00	85.70	-	-	0.00	0.00	-	0.00
204	5,595	5,596	11.42	108.0	0.00	85.96	-	-	0.00	0.00	-	0.00
205	5,211	5,212	12.36	108.0	0.00	85.34	-	-	0.00	0.00	-	0.00
206	4,599	4,600	13.97	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
207	3,805	3,807	16.34	108.0	0.00	82.61	-	-	0.00	0.00	-	0.00
208	9,232	9,232	4.46	108.0	0.00	90.31	-	-	0.00	0.00	-	0.00
209	9,560	9,560	3.95	108.0	0.00	90.61	-	-	0.00	0.00	-	0.00
210	10,059	10,059	3.21	108.0	0.00	91.05	-	-	0.00	0.00	-	0.00
211	10,736	10,736	2.26	108.0	0.00	91.62	-	-	0.00	0.00	-	0.00
212	11,110	11,111	1.76	108.0	0.00	91.91	-	-	0.00	0.00	-	0.00
213	11,544	11,545	1.19	108.0	0.00	92.25	-	-	0.00	0.00	-	0.00
214	11,880	11,880	0.77	108.0	0.00	92.50	-	-	0.00	0.00	-	0.00
215	11,418	11,419	1.35	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
216	12,478	12,479	0.04	108.0	0.00	92.92	-	-	0.00	0.00	-	0.00
217	13,043	13,044	-0.62	108.0	0.00	93.31	-	-	0.00	0.00	-	0.00
218	13,290	13,291	-0.90	108.0	0.00	93.47	-	-	0.00	0.00	-	0.00
219	14,090	14,091	-1.78	108.0	0.00	93.98	-	-	0.00	0.00	-	0.00
220	14,391	14,392	-2.09	108.0	0.00	94.16	-	-	0.00	0.00	-	0.00
221	15,025	15,026	-2.74	108.0	0.00	94.54	-	-	0.00	0.00	-	0.00
222	17,500	17,500	-5.03	108.0	0.00	95.86	-	-	0.00	0.00	-	0.00
223	17,079	17,079	-4.66	108.0	0.00	95.65	-	-	0.00	0.00	-	0.00
224	15,858	15,858	-3.55	108.0	0.00	95.01	-	-	0.00	0.00	-	0.00
225	15,655	15,655	-3.35	108.0	0.00	94.89	-	-	0.00	0.00	-	0.00
226	15,981	15,981	-3.66	108.0	0.00	95.07	-	-	0.00	0.00	-	0.00
227	15,438	15,439	-3.15	108.0	0.00	94.77	-	-	0.00	0.00	-	0.00
228	16,887	16,887	-4.49	108.0	0.00	95.55	-	-	0.00	0.00	-	0.00
229	14,753	14,753	-2.46	108.0	0.00	94.38	-	-	0.00	0.00	-	0.00
230	14,412	14,413	-2.12	108.0	0.00	94.18	-	-	0.00	0.00	-	0.00
231	14,064	14,065	-1.75	108.0	0.00	93.96	-	-	0.00	0.00	-	0.00
232	14,562	14,562	-2.27	108.0	0.00	94.26	-	-	0.00	0.00	-	0.00
233	14,240	14,240	-1.93	108.0	0.00	94.07	-	-	0.00	0.00	-	0.00
234	14,106	14,107	-1.79	108.0	0.00	93.99	-	-	0.00	0.00	-	0.00
235	13,356	13,356	-0.98	108.0	0.00	93.51	-	-	0.00	0.00	-	0.00
301	3,901	3,902	16.04	108.0	0.00	82.83	-	-	0.00	0.00	-	0.00

To be continued on next page...

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Minnesota Power
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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
302	3,497	3,498	17.36	108.0	0.00	81.88	-	-	0.00	0.00	-	0.00
303	2,609	2,611	20.72	108.0	0.00	79.33	-	-	0.00	0.00	-	0.00
304	2,152	2,154	22.95	108.0	0.00	77.67	-	-	0.00	0.00	-	0.00
305	1,541	1,544	26.86	108.0	0.00	74.77	-	-	0.00	0.00	-	0.00
306	1,912	1,915	24.36	108.0	0.00	76.65	-	-	0.00	0.00	-	0.00
307	2,552	2,555	20.96	108.0	0.00	79.15	-	-	0.00	0.00	-	0.00
308	18,201	18,201	-5.62	108.0	0.00	96.20	-	-	0.00	0.00	-	0.00
309	17,672	17,673	-5.18	108.0	0.00	95.95	-	-	0.00	0.00	-	0.00
310	17,074	17,075	-4.66	108.0	0.00	95.65	-	-	0.00	0.00	-	0.00
311	16,608	16,609	-4.24	108.0	0.00	95.41	-	-	0.00	0.00	-	0.00
312	16,243	16,244	-3.91	108.0	0.00	95.21	-	-	0.00	0.00	-	0.00
313	15,806	15,807	-3.50	108.0	0.00	94.98	-	-	0.00	0.00	-	0.00
314	14,927	14,928	-2.64	108.0	0.00	94.48	-	-	0.00	0.00	-	0.00
315	15,596	15,597	-3.30	108.0	0.00	94.86	-	-	0.00	0.00	-	0.00
316	16,322	16,323	-3.98	108.0	0.00	95.26	-	-	0.00	0.00	-	0.00
317	16,582	16,582	-4.22	108.0	0.00	95.39	-	-	0.00	0.00	-	0.00
318	17,399	17,399	-4.94	108.0	0.00	95.81	-	-	0.00	0.00	-	0.00
319	18,641	18,642	-5.98	108.0	0.00	96.41	-	-	0.00	0.00	-	0.00
320	19,124	19,125	-6.36	108.0	0.00	96.63	-	-	0.00	0.00	-	0.00
321	19,590	19,590	-6.72	108.0	0.00	96.84	-	-	0.00	0.00	-	0.00
322	19,856	19,856	-6.92	108.0	0.00	96.96	-	-	0.00	0.00	-	0.00
323	19,738	19,738	-6.84	108.0	0.00	96.91	-	-	0.00	0.00	-	0.00
324	18,931	18,931	-6.21	108.0	0.00	96.54	-	-	0.00	0.00	-	0.00
325	20,043	20,043	-7.07	108.0	0.00	97.04	-	-	0.00	0.00	-	0.00
326	19,335	19,336	-6.53	108.0	0.00	96.73	-	-	0.00	0.00	-	0.00
327	19,014	19,014	-6.27	108.0	0.00	96.58	-	-	0.00	0.00	-	0.00
328	18,102	18,102	-5.54	108.0	0.00	96.15	-	-	0.00	0.00	-	0.00
329	18,456	18,457	-5.83	108.0	0.00	96.32	-	-	0.00	0.00	-	0.00
330	17,688	17,688	-5.19	108.0	0.00	95.95	-	-	0.00	0.00	-	0.00
331	17,261	17,261	-4.82	108.0	0.00	95.74	-	-	0.00	0.00	-	0.00
332	16,756	16,757	-4.38	108.0	0.00	95.48	-	-	0.00	0.00	-	0.00
333	16,889	16,890	-4.49	108.0	0.00	95.55	-	-	0.00	0.00	-	0.00
334	17,383	17,384	-4.93	108.0	0.00	95.80	-	-	0.00	0.00	-	0.00
335	17,422	17,422	-4.96	108.0	0.00	95.82	-	-	0.00	0.00	-	0.00
Sum			31.92									

- Data undefined due to calculation with octave data

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]
1	8,999	9,000	4.83	108.0	0.00	90.09	-	-	0.00	0.00	-	0.00
2	9,183	9,184	4.53	108.0	0.00	90.26	-	-	0.00	0.00	-	0.00
3	10,684	10,685	1.44	107.0	0.00	91.58	-	-	0.00	0.00	-	0.00
4	9,569	9,570	2.89	107.0	0.00	90.62	-	-	0.00	0.00	-	0.00
5	10,528	10,529	1.63	107.0	0.00	91.45	-	-	0.00	0.00	-	0.00
6	10,241	10,242	2.95	108.0	0.00	91.21	-	-	0.00	0.00	-	0.00
7	10,781	10,782	2.20	108.0	0.00	91.65	-	-	0.00	0.00	-	0.00
8	10,560	10,561	1.59	107.0	0.00	91.47	-	-	0.00	0.00	-	0.00
9	8,152	8,153	6.24	108.0	0.00	89.23	-	-	0.00	0.00	-	0.00
10	8,916	8,917	4.96	108.0	0.00	90.00	-	-	0.00	0.00	-	0.00
11	7,429	7,430	7.55	108.0	0.00	88.42	-	-	0.00	0.00	-	0.00
12	7,915	7,916	5.37	107.0	0.00	88.97	-	-	0.00	0.00	-	0.00
13	9,320	9,320	3.24	107.0	0.00	90.39	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
	14	9,768	9,769	2.62	107.0	0.00	90.80	-	-	0.00	0.00	-	0.00
	15	10,158	10,159	3.07	108.0	0.00	91.14	-	-	0.00	0.00	-	0.00
	16	10,130	10,131	2.14	107.0	0.00	91.11	-	-	0.00	0.00	-	0.00
	17	10,713	10,714	2.29	108.0	0.00	91.60	-	-	0.00	0.00	-	0.00
	18	9,902	9,903	2.44	107.0	0.00	90.92	-	-	0.00	0.00	-	0.00
	19	9,171	9,171	3.45	107.0	0.00	90.25	-	-	0.00	0.00	-	0.00
	20	10,815	10,816	2.15	108.0	0.00	91.68	-	-	0.00	0.00	-	0.00
	22	9,236	9,237	3.36	107.0	0.00	90.31	-	-	0.00	0.00	-	0.00
	23	11,005	11,006	1.05	107.0	0.00	91.83	-	-	0.00	0.00	-	0.00
	25	10,351	10,352	2.79	108.0	0.00	91.30	-	-	0.00	0.00	-	0.00
	26	11,420	11,421	1.35	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
	27	9,279	9,280	4.39	108.0	0.00	90.35	-	-	0.00	0.00	-	0.00
	28	10,271	10,272	2.91	108.0	0.00	91.23	-	-	0.00	0.00	-	0.00
	29	7,460	7,461	6.14	107.0	0.00	88.46	-	-	0.00	0.00	-	0.00
	30	8,784	8,785	5.17	108.0	0.00	89.87	-	-	0.00	0.00	-	0.00
	31	8,312	8,312	4.74	107.0	0.00	89.39	-	-	0.00	0.00	-	0.00
	32	10,740	10,741	1.37	107.0	0.00	91.62	-	-	0.00	0.00	-	0.00
	33	8,962	8,963	3.75	107.0	0.00	90.05	-	-	0.00	0.00	-	0.00
	201	9,061	9,061	4.73	108.0	0.00	90.14	-	-	0.00	0.00	-	0.00
	202	9,034	9,035	4.77	108.0	0.00	90.12	-	-	0.00	0.00	-	0.00
	203	7,464	7,465	7.48	108.0	0.00	88.46	-	-	0.00	0.00	-	0.00
	204	7,793	7,794	6.88	108.0	0.00	88.83	-	-	0.00	0.00	-	0.00
	205	7,578	7,580	7.27	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
	206	6,355	6,356	9.70	108.0	0.00	87.06	-	-	0.00	0.00	-	0.00
	207	5,638	5,639	11.32	108.0	0.00	86.02	-	-	0.00	0.00	-	0.00
	208	8,480	8,481	5.68	108.0	0.00	89.57	-	-	0.00	0.00	-	0.00
	209	8,692	8,693	5.32	108.0	0.00	89.78	-	-	0.00	0.00	-	0.00
	210	9,088	9,089	4.69	108.0	0.00	90.17	-	-	0.00	0.00	-	0.00
	211	10,078	10,079	3.19	108.0	0.00	91.07	-	-	0.00	0.00	-	0.00
	212	10,488	10,488	2.60	108.0	0.00	91.41	-	-	0.00	0.00	-	0.00
	213	10,939	10,940	1.98	108.0	0.00	91.78	-	-	0.00	0.00	-	0.00
	214	11,220	11,220	1.61	108.0	0.00	92.00	-	-	0.00	0.00	-	0.00
	215	11,345	11,346	1.45	108.0	0.00	92.10	-	-	0.00	0.00	-	0.00
	216	12,096	12,097	0.50	108.0	0.00	92.65	-	-	0.00	0.00	-	0.00
	217	12,522	12,522	-0.02	108.0	0.00	92.95	-	-	0.00	0.00	-	0.00
	218	12,192	12,192	0.38	108.0	0.00	92.72	-	-	0.00	0.00	-	0.00
	219	13,017	13,018	-0.59	108.0	0.00	93.29	-	-	0.00	0.00	-	0.00
	220	13,223	13,223	-0.83	108.0	0.00	93.43	-	-	0.00	0.00	-	0.00
	221	13,805	13,806	-1.47	108.0	0.00	93.80	-	-	0.00	0.00	-	0.00
	222	16,781	16,781	-4.40	108.0	0.00	95.50	-	-	0.00	0.00	-	0.00
	223	16,471	16,471	-4.12	108.0	0.00	95.33	-	-	0.00	0.00	-	0.00
	224	14,979	14,979	-2.69	108.0	0.00	94.51	-	-	0.00	0.00	-	0.00
	225	14,838	14,839	-2.55	108.0	0.00	94.43	-	-	0.00	0.00	-	0.00
	226	15,346	15,347	-3.06	108.0	0.00	94.72	-	-	0.00	0.00	-	0.00
	227	14,961	14,962	-2.68	108.0	0.00	94.50	-	-	0.00	0.00	-	0.00
	228	16,127	16,127	-3.80	108.0	0.00	95.15	-	-	0.00	0.00	-	0.00
	229	14,319	14,320	-2.02	108.0	0.00	94.12	-	-	0.00	0.00	-	0.00
	230	13,997	13,997	-1.68	108.0	0.00	93.92	-	-	0.00	0.00	-	0.00
	231	13,747	13,748	-1.41	108.0	0.00	93.76	-	-	0.00	0.00	-	0.00
	232	14,509	14,510	-2.22	108.0	0.00	94.23	-	-	0.00	0.00	-	0.00
	233	14,254	14,254	-1.95	108.0	0.00	94.08	-	-	0.00	0.00	-	0.00
	234	14,198	14,199	-1.89	108.0	0.00	94.04	-	-	0.00	0.00	-	0.00
	235	13,464	13,465	-1.10	108.0	0.00	93.58	-	-	0.00	0.00	-	0.00
	301	3,691	3,692	16.71	108.0	0.00	82.35	-	-	0.00	0.00	-	0.00
	302	3,213	3,214	18.36	108.0	0.00	81.14	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

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 Frank Frederickson
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
303	2,728	2,730	20.23	108.0	0.00	79.72	-	-	0.00	0.00	-	0.00
304	2,319	2,321	22.05	108.0	0.00	78.31	-	-	0.00	0.00	-	0.00
305	2,986	2,988	19.21	108.0	0.00	80.51	-	-	0.00	0.00	-	0.00
306	2,951	2,953	19.34	108.0	0.00	80.41	-	-	0.00	0.00	-	0.00
307	3,601	3,603	17.01	108.0	0.00	82.13	-	-	0.00	0.00	-	0.00
308	17,817	17,817	-5.30	108.0	0.00	96.02	-	-	0.00	0.00	-	0.00
309	17,311	17,311	-4.86	108.0	0.00	95.77	-	-	0.00	0.00	-	0.00
310	16,640	16,641	-4.27	108.0	0.00	95.42	-	-	0.00	0.00	-	0.00
311	16,212	16,213	-3.88	108.0	0.00	95.20	-	-	0.00	0.00	-	0.00
312	15,897	15,897	-3.59	108.0	0.00	95.03	-	-	0.00	0.00	-	0.00
313	15,515	15,516	-3.22	108.0	0.00	94.82	-	-	0.00	0.00	-	0.00
314	14,659	14,659	-2.37	108.0	0.00	94.32	-	-	0.00	0.00	-	0.00
315	15,503	15,504	-3.21	108.0	0.00	94.81	-	-	0.00	0.00	-	0.00
316	16,271	16,272	-3.93	108.0	0.00	95.23	-	-	0.00	0.00	-	0.00
317	16,461	16,461	-4.11	108.0	0.00	95.33	-	-	0.00	0.00	-	0.00
318	17,244	17,245	-4.81	108.0	0.00	95.73	-	-	0.00	0.00	-	0.00
319	18,702	18,702	-6.03	108.0	0.00	96.44	-	-	0.00	0.00	-	0.00
320	19,198	19,199	-6.42	108.0	0.00	96.67	-	-	0.00	0.00	-	0.00
321	19,644	19,644	-6.76	108.0	0.00	96.86	-	-	0.00	0.00	-	0.00
322	20,100	20,100	-7.11	108.0	0.00	97.06	-	-	0.00	0.00	-	0.00
323	20,043	20,044	-7.07	108.0	0.00	97.04	-	-	0.00	0.00	-	0.00
324	19,268	19,268	-6.47	108.0	0.00	96.70	-	-	0.00	0.00	-	0.00
325	20,542	20,543	-7.43	108.0	0.00	97.25	-	-	0.00	0.00	-	0.00
326	19,821	19,821	-6.90	108.0	0.00	96.94	-	-	0.00	0.00	-	0.00
327	19,541	19,542	-6.69	108.0	0.00	96.82	-	-	0.00	0.00	-	0.00
328	18,728	18,729	-6.05	108.0	0.00	96.45	-	-	0.00	0.00	-	0.00
329	19,279	19,280	-6.48	108.0	0.00	96.70	-	-	0.00	0.00	-	0.00
330	18,507	18,507	-5.87	108.0	0.00	96.35	-	-	0.00	0.00	-	0.00
331	17,929	17,929	-5.39	108.0	0.00	96.07	-	-	0.00	0.00	-	0.00
332	17,404	17,405	-4.95	108.0	0.00	95.81	-	-	0.00	0.00	-	0.00
333	17,372	17,373	-4.92	108.0	0.00	95.80	-	-	0.00	0.00	-	0.00
334	17,833	17,834	-5.31	108.0	0.00	96.02	-	-	0.00	0.00	-	0.00
335	17,766	17,767	-5.25	108.0	0.00	95.99	-	-	0.00	0.00	-	0.00

Sum 28.80

- Data undefined due to calculation with octave data

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]
1	6,586	6,588	9.21	108.0	0.00	87.37	-	-	0.00	0.00	-	0.00
2	6,824	6,825	8.73	108.0	0.00	87.68	-	-	0.00	0.00	-	0.00
3	8,313	8,314	4.73	107.0	0.00	89.40	-	-	0.00	0.00	-	0.00
4	7,231	7,232	6.54	107.0	0.00	88.18	-	-	0.00	0.00	-	0.00
5	8,112	8,113	5.05	107.0	0.00	89.18	-	-	0.00	0.00	-	0.00
6	7,919	7,920	6.65	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
7	8,395	8,396	5.82	108.0	0.00	89.48	-	-	0.00	0.00	-	0.00
8	8,243	8,244	4.84	107.0	0.00	89.32	-	-	0.00	0.00	-	0.00
9	5,741	5,742	11.07	108.0	0.00	86.18	-	-	0.00	0.00	-	0.00
10	6,524	6,525	9.35	108.0	0.00	87.29	-	-	0.00	0.00	-	0.00
11	5,073	5,074	12.71	108.0	0.00	85.11	-	-	0.00	0.00	-	0.00
12	5,541	5,542	9.94	107.0	0.00	85.87	-	-	0.00	0.00	-	0.00
13	6,962	6,963	7.03	107.0	0.00	87.86	-	-	0.00	0.00	-	0.00
14	7,357	7,358	6.32	107.0	0.00	88.33	-	-	0.00	0.00	-	0.00

To be continued on next page...

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
15	7,764	7,766	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
16	7,772	7,773	5.61	107.0	0.00	88.81	-	-	0.00	0.00	-	0.00
17	8,415	8,416	5.79	108.0	0.00	89.50	-	-	0.00	0.00	-	0.00
18	7,480	7,480	6.10	107.0	0.00	88.48	-	-	0.00	0.00	-	0.00
19	6,758	6,759	7.41	107.0	0.00	87.60	-	-	0.00	0.00	-	0.00
20	8,464	8,465	5.71	108.0	0.00	89.55	-	-	0.00	0.00	-	0.00
22	6,980	6,981	6.99	107.0	0.00	87.88	-	-	0.00	0.00	-	0.00
23	8,737	8,738	4.09	107.0	0.00	89.83	-	-	0.00	0.00	-	0.00
25	8,086	8,087	6.36	108.0	0.00	89.16	-	-	0.00	0.00	-	0.00
26	9,094	9,094	4.68	108.0	0.00	90.18	-	-	0.00	0.00	-	0.00
27	6,859	6,860	8.66	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00
28	7,908	7,909	6.67	108.0	0.00	88.96	-	-	0.00	0.00	-	0.00
29	5,115	5,116	10.95	107.0	0.00	85.18	-	-	0.00	0.00	-	0.00
30	6,442	6,443	9.52	108.0	0.00	87.18	-	-	0.00	0.00	-	0.00
31	5,966	5,967	9.00	107.0	0.00	86.51	-	-	0.00	0.00	-	0.00
32	8,340	8,341	4.69	107.0	0.00	89.42	-	-	0.00	0.00	-	0.00
33	6,646	6,647	7.62	107.0	0.00	87.45	-	-	0.00	0.00	-	0.00
201	6,865	6,866	8.65	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00
202	6,879	6,880	8.62	108.0	0.00	87.75	-	-	0.00	0.00	-	0.00
203	5,345	5,346	12.02	108.0	0.00	85.56	-	-	0.00	0.00	-	0.00
204	5,731	5,732	11.10	108.0	0.00	86.17	-	-	0.00	0.00	-	0.00
205	5,619	5,620	11.36	108.0	0.00	86.00	-	-	0.00	0.00	-	0.00
206	4,199	4,200	15.12	108.0	0.00	83.46	-	-	0.00	0.00	-	0.00
207	3,591	3,593	17.04	108.0	0.00	82.11	-	-	0.00	0.00	-	0.00
208	6,373	6,374	9.67	108.0	0.00	87.09	-	-	0.00	0.00	-	0.00
209	6,641	6,642	9.10	108.0	0.00	87.45	-	-	0.00	0.00	-	0.00
210	7,094	7,094	8.19	108.0	0.00	88.02	-	-	0.00	0.00	-	0.00
211	7,956	7,957	6.59	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00
212	8,356	8,357	5.89	108.0	0.00	89.44	-	-	0.00	0.00	-	0.00
213	8,806	8,807	5.14	108.0	0.00	89.90	-	-	0.00	0.00	-	0.00
214	9,111	9,112	4.65	108.0	0.00	90.19	-	-	0.00	0.00	-	0.00
215	9,045	9,046	4.75	108.0	0.00	90.13	-	-	0.00	0.00	-	0.00
216	9,893	9,894	3.46	108.0	0.00	90.91	-	-	0.00	0.00	-	0.00
217	10,372	10,372	2.77	108.0	0.00	91.32	-	-	0.00	0.00	-	0.00
218	10,298	10,299	2.87	108.0	0.00	91.26	-	-	0.00	0.00	-	0.00
219	11,117	11,117	1.75	108.0	0.00	91.92	-	-	0.00	0.00	-	0.00
220	11,375	11,375	1.41	108.0	0.00	92.12	-	-	0.00	0.00	-	0.00
221	11,990	11,990	0.63	108.0	0.00	92.58	-	-	0.00	0.00	-	0.00
222	14,736	14,736	-2.45	108.0	0.00	94.37	-	-	0.00	0.00	-	0.00
223	14,379	14,379	-2.08	108.0	0.00	94.15	-	-	0.00	0.00	-	0.00
224	12,996	12,996	-0.57	108.0	0.00	93.28	-	-	0.00	0.00	-	0.00
225	12,826	12,826	-0.37	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
226	13,259	13,260	-0.87	108.0	0.00	93.45	-	-	0.00	0.00	-	0.00
227	12,812	12,812	-0.36	108.0	0.00	93.15	-	-	0.00	0.00	-	0.00
228	14,096	14,097	-1.78	108.0	0.00	93.98	-	-	0.00	0.00	-	0.00
229	12,150	12,151	0.43	108.0	0.00	92.69	-	-	0.00	0.00	-	0.00
230	11,820	11,820	0.84	108.0	0.00	92.45	-	-	0.00	0.00	-	0.00
231	11,536	11,536	1.20	108.0	0.00	92.24	-	-	0.00	0.00	-	0.00
232	12,226	12,226	0.34	108.0	0.00	92.75	-	-	0.00	0.00	-	0.00
233	11,952	11,953	0.68	108.0	0.00	92.55	-	-	0.00	0.00	-	0.00
234	11,878	11,879	0.77	108.0	0.00	92.50	-	-	0.00	0.00	-	0.00
235	11,136	11,137	1.72	108.0	0.00	91.94	-	-	0.00	0.00	-	0.00
301	1,268	1,271	29.05	108.0	0.00	73.08	-	-	0.00	0.00	-	0.00
302	803	807	33.97	108.0	0.00	69.14	-	-	0.00	0.00	-	0.00
303	853	859	33.31	108.0	0.00	69.68	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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 Calculated:
 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
304	1,160	1,164	30.03	108.0	0.00	72.32	-	-	0.00	0.00	-	0.00
305	1,910	1,912	24.38	108.0	0.00	76.63	-	-	0.00	0.00	-	0.00
306	1,586	1,590	26.53	108.0	0.00	75.03	-	-	0.00	0.00	-	0.00
307	1,695	1,698	25.76	108.0	0.00	75.60	-	-	0.00	0.00	-	0.00
308	15,649	15,649	-3.35	108.0	0.00	94.89	-	-	0.00	0.00	-	0.00
309	15,133	15,133	-2.85	108.0	0.00	94.60	-	-	0.00	0.00	-	0.00
310	14,484	14,484	-2.19	108.0	0.00	94.22	-	-	0.00	0.00	-	0.00
311	14,041	14,041	-1.72	108.0	0.00	93.95	-	-	0.00	0.00	-	0.00
312	13,707	13,708	-1.36	108.0	0.00	93.74	-	-	0.00	0.00	-	0.00
313	13,306	13,306	-0.92	108.0	0.00	93.48	-	-	0.00	0.00	-	0.00
314	12,437	12,438	0.08	108.0	0.00	92.90	-	-	0.00	0.00	-	0.00
315	13,235	13,236	-0.84	108.0	0.00	93.44	-	-	0.00	0.00	-	0.00
316	13,995	13,996	-1.68	108.0	0.00	93.92	-	-	0.00	0.00	-	0.00
317	14,205	14,206	-1.90	108.0	0.00	94.05	-	-	0.00	0.00	-	0.00
318	15,001	15,002	-2.71	108.0	0.00	94.52	-	-	0.00	0.00	-	0.00
319	16,407	16,407	-4.06	108.0	0.00	95.30	-	-	0.00	0.00	-	0.00
320	16,902	16,902	-4.51	108.0	0.00	95.56	-	-	0.00	0.00	-	0.00
321	17,353	17,354	-4.90	108.0	0.00	95.79	-	-	0.00	0.00	-	0.00
322	17,768	17,768	-5.26	108.0	0.00	95.99	-	-	0.00	0.00	-	0.00
323	17,699	17,700	-5.20	108.0	0.00	95.96	-	-	0.00	0.00	-	0.00
324	16,916	16,917	-4.52	108.0	0.00	95.57	-	-	0.00	0.00	-	0.00
325	18,167	18,167	-5.59	108.0	0.00	96.19	-	-	0.00	0.00	-	0.00
326	17,446	17,446	-4.98	108.0	0.00	95.83	-	-	0.00	0.00	-	0.00
327	17,160	17,160	-4.73	108.0	0.00	95.69	-	-	0.00	0.00	-	0.00
328	16,333	16,333	-3.99	108.0	0.00	95.26	-	-	0.00	0.00	-	0.00
329	16,867	16,867	-4.47	108.0	0.00	95.54	-	-	0.00	0.00	-	0.00
330	16,094	16,094	-3.77	108.0	0.00	95.13	-	-	0.00	0.00	-	0.00
331	15,528	15,528	-3.23	108.0	0.00	94.82	-	-	0.00	0.00	-	0.00
332	15,004	15,005	-2.72	108.0	0.00	94.52	-	-	0.00	0.00	-	0.00
333	14,993	14,993	-2.71	108.0	0.00	94.52	-	-	0.00	0.00	-	0.00
334	15,459	15,460	-3.17	108.0	0.00	94.78	-	-	0.00	0.00	-	0.00
335	15,409	15,410	-3.12	108.0	0.00	94.76	-	-	0.00	0.00	-	0.00
Sum	39.01											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP028 NSP028

		Wind speed: 8.0 m/s										
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]
1	5,602	5,604	11.40	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
2	6,061	6,063	10.34	108.0	0.00	86.65	-	-	0.00	0.00	-	0.00
3	6,938	6,939	7.07	107.0	0.00	87.83	-	-	0.00	0.00	-	0.00
4	5,806	5,807	9.35	107.0	0.00	86.28	-	-	0.00	0.00	-	0.00
5	6,885	6,886	7.17	107.0	0.00	87.76	-	-	0.00	0.00	-	0.00
6	7,230	7,231	7.93	108.0	0.00	88.18	-	-	0.00	0.00	-	0.00
7	7,504	7,506	7.41	108.0	0.00	88.51	-	-	0.00	0.00	-	0.00
8	6,791	6,793	7.35	107.0	0.00	87.64	-	-	0.00	0.00	-	0.00
9	4,793	4,795	13.44	108.0	0.00	84.62	-	-	0.00	0.00	-	0.00
10	5,653	5,655	11.28	108.0	0.00	86.05	-	-	0.00	0.00	-	0.00
11	4,395	4,397	14.55	108.0	0.00	83.86	-	-	0.00	0.00	-	0.00
12	4,184	4,186	13.45	107.0	0.00	83.44	-	-	0.00	0.00	-	0.00
13	5,567	5,568	9.88	107.0	0.00	85.91	-	-	0.00	0.00	-	0.00
14	6,107	6,108	8.70	107.0	0.00	86.72	-	-	0.00	0.00	-	0.00
15	6,859	6,861	8.66	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
16	6,376	6,377	8.15	107.0	0.00	87.09	-	-	0.00	0.00	-	0.00
17	7,767	7,768	6.92	108.0	0.00	88.81	-	-	0.00	0.00	-	0.00
18	6,355	6,356	8.20	107.0	0.00	87.06	-	-	0.00	0.00	-	0.00
19	5,519	5,520	9.99	107.0	0.00	85.84	-	-	0.00	0.00	-	0.00
20	7,686	7,687	7.07	108.0	0.00	88.72	-	-	0.00	0.00	-	0.00
22	5,475	5,476	10.09	107.0	0.00	85.77	-	-	0.00	0.00	-	0.00
23	7,242	7,244	6.52	107.0	0.00	88.20	-	-	0.00	0.00	-	0.00
25	7,514	7,515	7.39	108.0	0.00	88.52	-	-	0.00	0.00	-	0.00
26	8,366	8,367	5.87	108.0	0.00	89.45	-	-	0.00	0.00	-	0.00
27	5,809	5,811	10.92	108.0	0.00	86.28	-	-	0.00	0.00	-	0.00
28	7,106	7,107	8.17	108.0	0.00	88.03	-	-	0.00	0.00	-	0.00
29	3,706	3,708	14.93	107.0	0.00	82.38	-	-	0.00	0.00	-	0.00
30	5,743	5,745	11.07	108.0	0.00	86.19	-	-	0.00	0.00	-	0.00
31	4,555	4,556	12.40	107.0	0.00	84.17	-	-	0.00	0.00	-	0.00
32	7,038	7,039	6.89	107.0	0.00	87.95	-	-	0.00	0.00	-	0.00
33	5,194	5,195	10.75	107.0	0.00	85.31	-	-	0.00	0.00	-	0.00
201	6,463	6,465	9.47	108.0	0.00	87.21	-	-	0.00	0.00	-	0.00
202	6,545	6,546	9.30	108.0	0.00	87.32	-	-	0.00	0.00	-	0.00
203	5,155	5,156	12.50	108.0	0.00	85.25	-	-	0.00	0.00	-	0.00
204	5,602	5,604	11.40	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
205	5,636	5,638	11.32	108.0	0.00	86.02	-	-	0.00	0.00	-	0.00
206	4,048	4,050	15.57	108.0	0.00	83.15	-	-	0.00	0.00	-	0.00
207	3,699	3,701	16.68	108.0	0.00	82.37	-	-	0.00	0.00	-	0.00
208	4,807	4,809	13.40	108.0	0.00	84.64	-	-	0.00	0.00	-	0.00
209	5,069	5,070	12.72	108.0	0.00	85.10	-	-	0.00	0.00	-	0.00
210	5,519	5,520	11.60	108.0	0.00	85.84	-	-	0.00	0.00	-	0.00
211	6,396	6,397	9.62	108.0	0.00	87.12	-	-	0.00	0.00	-	0.00
212	6,799	6,801	8.78	108.0	0.00	87.65	-	-	0.00	0.00	-	0.00
213	7,250	7,251	7.89	108.0	0.00	88.21	-	-	0.00	0.00	-	0.00
214	7,550	7,551	7.32	108.0	0.00	88.56	-	-	0.00	0.00	-	0.00
215	7,576	7,578	7.27	108.0	0.00	88.59	-	-	0.00	0.00	-	0.00
216	8,363	8,364	5.88	108.0	0.00	89.45	-	-	0.00	0.00	-	0.00
217	8,822	8,823	5.11	108.0	0.00	89.91	-	-	0.00	0.00	-	0.00
218	8,726	8,727	5.27	108.0	0.00	89.82	-	-	0.00	0.00	-	0.00
219	9,544	9,544	3.98	108.0	0.00	90.59	-	-	0.00	0.00	-	0.00
220	9,805	9,806	3.59	108.0	0.00	90.83	-	-	0.00	0.00	-	0.00
221	10,423	10,424	2.69	108.0	0.00	91.36	-	-	0.00	0.00	-	0.00
222	13,168	13,169	-0.77	108.0	0.00	93.39	-	-	0.00	0.00	-	0.00
223	12,818	12,819	-0.36	108.0	0.00	93.16	-	-	0.00	0.00	-	0.00
224	11,422	11,423	1.35	108.0	0.00	92.16	-	-	0.00	0.00	-	0.00
225	11,254	11,254	1.57	108.0	0.00	92.03	-	-	0.00	0.00	-	0.00
226	11,697	11,698	1.00	108.0	0.00	92.36	-	-	0.00	0.00	-	0.00
227	11,264	11,265	1.55	108.0	0.00	92.03	-	-	0.00	0.00	-	0.00
228	12,526	12,527	-0.02	108.0	0.00	92.96	-	-	0.00	0.00	-	0.00
229	10,609	10,610	2.43	108.0	0.00	91.51	-	-	0.00	0.00	-	0.00
230	10,281	10,282	2.89	108.0	0.00	91.24	-	-	0.00	0.00	-	0.00
231	10,011	10,012	3.28	108.0	0.00	91.01	-	-	0.00	0.00	-	0.00
232	10,744	10,745	2.25	108.0	0.00	91.62	-	-	0.00	0.00	-	0.00
233	10,486	10,487	2.61	108.0	0.00	91.41	-	-	0.00	0.00	-	0.00
234	10,429	10,430	2.68	108.0	0.00	91.37	-	-	0.00	0.00	-	0.00
235	9,696	9,697	3.75	108.0	0.00	90.73	-	-	0.00	0.00	-	0.00
301	1,010	1,014	31.52	108.0	0.00	71.12	-	-	0.00	0.00	-	0.00
302	1,244	1,248	29.26	108.0	0.00	72.92	-	-	0.00	0.00	-	0.00
303	2,114	2,117	23.16	108.0	0.00	77.51	-	-	0.00	0.00	-	0.00
304	2,636	2,639	20.61	108.0	0.00	79.43	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
305	3,205	3,206	18.39	108.0	0.00	81.12	-	-	0.00	0.00	-	0.00
306	2,834	2,836	19.80	108.0	0.00	80.06	-	-	0.00	0.00	-	0.00
307	2,485	2,488	21.25	108.0	0.00	78.92	-	-	0.00	0.00	-	0.00
308	14,109	14,109	-1.80	108.0	0.00	93.99	-	-	0.00	0.00	-	0.00
309	13,596	13,597	-1.24	108.0	0.00	93.67	-	-	0.00	0.00	-	0.00
310	12,940	12,940	-0.50	108.0	0.00	93.24	-	-	0.00	0.00	-	0.00
311	12,501	12,502	0.01	108.0	0.00	92.94	-	-	0.00	0.00	-	0.00
312	12,174	12,175	0.40	108.0	0.00	92.71	-	-	0.00	0.00	-	0.00
313	11,781	11,782	0.89	108.0	0.00	92.42	-	-	0.00	0.00	-	0.00
314	10,918	10,919	2.01	108.0	0.00	91.76	-	-	0.00	0.00	-	0.00
315	11,743	11,744	0.94	108.0	0.00	92.40	-	-	0.00	0.00	-	0.00
316	12,509	12,510	0.00	108.0	0.00	92.94	-	-	0.00	0.00	-	0.00
317	12,705	12,706	-0.23	108.0	0.00	93.08	-	-	0.00	0.00	-	0.00
318	13,494	13,495	-1.13	108.0	0.00	93.60	-	-	0.00	0.00	-	0.00
319	14,935	14,936	-2.65	108.0	0.00	94.48	-	-	0.00	0.00	-	0.00
320	15,432	15,432	-3.14	108.0	0.00	94.77	-	-	0.00	0.00	-	0.00
321	15,879	15,879	-3.57	108.0	0.00	95.02	-	-	0.00	0.00	-	0.00
322	16,331	16,332	-3.99	108.0	0.00	95.26	-	-	0.00	0.00	-	0.00
323	16,277	16,277	-3.94	108.0	0.00	95.23	-	-	0.00	0.00	-	0.00
324	15,503	15,504	-3.21	108.0	0.00	94.81	-	-	0.00	0.00	-	0.00
325	16,790	16,791	-4.41	108.0	0.00	95.50	-	-	0.00	0.00	-	0.00
326	16,068	16,069	-3.75	108.0	0.00	95.12	-	-	0.00	0.00	-	0.00
327	15,795	15,795	-3.49	108.0	0.00	94.97	-	-	0.00	0.00	-	0.00
328	15,000	15,000	-2.71	108.0	0.00	94.52	-	-	0.00	0.00	-	0.00
329	15,591	15,592	-3.29	108.0	0.00	94.86	-	-	0.00	0.00	-	0.00
330	14,822	14,822	-2.53	108.0	0.00	94.42	-	-	0.00	0.00	-	0.00
331	14,212	14,212	-1.91	108.0	0.00	94.05	-	-	0.00	0.00	-	0.00
332	13,685	13,686	-1.34	108.0	0.00	93.73	-	-	0.00	0.00	-	0.00
333	13,626	13,627	-1.28	108.0	0.00	93.69	-	-	0.00	0.00	-	0.00
334	14,081	14,082	-1.77	108.0	0.00	93.97	-	-	0.00	0.00	-	0.00
335	14,004	14,005	-1.69	108.0	0.00	93.93	-	-	0.00	0.00	-	0.00
Sum	35.44											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP029 NSP029

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]
1	12,276	12,276	0.28	108.0	0.00	92.78	-	-	0.00	0.00	-	0.00
2	12,502	12,502	0.01	108.0	0.00	92.94	-	-	0.00	0.00	-	0.00
3	10,529	10,529	1.63	107.0	0.00	91.45	-	-	0.00	0.00	-	0.00
4	11,725	11,725	0.20	107.0	0.00	92.38	-	-	0.00	0.00	-	0.00
5	10,568	10,568	1.58	107.0	0.00	91.48	-	-	0.00	0.00	-	0.00
6	11,885	11,885	0.76	108.0	0.00	92.50	-	-	0.00	0.00	-	0.00
7	10,871	10,871	2.08	108.0	0.00	91.73	-	-	0.00	0.00	-	0.00
8	10,883	10,884	1.19	107.0	0.00	91.74	-	-	0.00	0.00	-	0.00
9	13,107	13,107	-0.70	108.0	0.00	93.35	-	-	0.00	0.00	-	0.00
10	12,521	12,521	-0.01	108.0	0.00	92.95	-	-	0.00	0.00	-	0.00
11	14,076	14,076	-1.76	108.0	0.00	93.97	-	-	0.00	0.00	-	0.00
12	13,231	13,231	-1.42	107.0	0.00	93.43	-	-	0.00	0.00	-	0.00
13	11,900	11,900	0.01	107.0	0.00	92.51	-	-	0.00	0.00	-	0.00
14	11,326	11,327	0.66	107.0	0.00	92.08	-	-	0.00	0.00	-	0.00
15	11,368	11,369	1.42	108.0	0.00	92.11	-	-	0.00	0.00	-	0.00
16	11,114	11,114	0.92	107.0	0.00	91.92	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
17	11,699	11,699	0.99	108.0	0.00	92.36	-	-	0.00	0.00	-	0.00
18	11,251	11,251	0.75	107.0	0.00	92.02	-	-	0.00	0.00	-	0.00
19	11,924	11,924	-0.02	107.0	0.00	92.53	-	-	0.00	0.00	-	0.00
20	11,178	11,179	1.67	108.0	0.00	91.97	-	-	0.00	0.00	-	0.00
22	12,339	12,339	-0.48	107.0	0.00	92.83	-	-	0.00	0.00	-	0.00
23	10,737	10,738	1.37	107.0	0.00	91.62	-	-	0.00	0.00	-	0.00
25	12,208	12,208	0.36	108.0	0.00	92.73	-	-	0.00	0.00	-	0.00
26	10,920	10,920	2.01	108.0	0.00	91.76	-	-	0.00	0.00	-	0.00
27	11,932	11,932	0.70	108.0	0.00	92.53	-	-	0.00	0.00	-	0.00
28	11,530	11,531	1.21	108.0	0.00	92.24	-	-	0.00	0.00	-	0.00
29	13,733	13,733	-1.92	107.0	0.00	93.76	-	-	0.00	0.00	-	0.00
30	12,955	12,955	-0.52	108.0	0.00	93.25	-	-	0.00	0.00	-	0.00
31	12,908	12,908	-1.08	107.0	0.00	93.22	-	-	0.00	0.00	-	0.00
32	10,373	10,373	1.83	107.0	0.00	91.32	-	-	0.00	0.00	-	0.00
33	12,376	12,376	-0.52	107.0	0.00	92.85	-	-	0.00	0.00	-	0.00
201	13,538	13,538	-1.18	108.0	0.00	93.63	-	-	0.00	0.00	-	0.00
202	13,765	13,765	-1.43	108.0	0.00	93.78	-	-	0.00	0.00	-	0.00
203	14,965	14,966	-2.68	108.0	0.00	94.50	-	-	0.00	0.00	-	0.00
204	14,967	14,968	-2.68	108.0	0.00	94.50	-	-	0.00	0.00	-	0.00
205	15,470	15,470	-3.18	108.0	0.00	94.79	-	-	0.00	0.00	-	0.00
206	15,632	15,633	-3.33	108.0	0.00	94.88	-	-	0.00	0.00	-	0.00
207	16,418	16,418	-4.07	108.0	0.00	95.31	-	-	0.00	0.00	-	0.00
208	13,507	13,508	-1.14	108.0	0.00	93.61	-	-	0.00	0.00	-	0.00
209	13,544	13,544	-1.19	108.0	0.00	93.64	-	-	0.00	0.00	-	0.00
210	13,480	13,480	-1.11	108.0	0.00	93.59	-	-	0.00	0.00	-	0.00
211	12,218	12,219	0.35	108.0	0.00	92.74	-	-	0.00	0.00	-	0.00
212	11,869	11,869	0.78	108.0	0.00	92.49	-	-	0.00	0.00	-	0.00
213	11,528	11,529	1.21	108.0	0.00	92.24	-	-	0.00	0.00	-	0.00
214	11,473	11,474	1.28	108.0	0.00	92.19	-	-	0.00	0.00	-	0.00
215	10,260	10,260	2.93	108.0	0.00	91.22	-	-	0.00	0.00	-	0.00
216	10,248	10,249	2.94	108.0	0.00	91.21	-	-	0.00	0.00	-	0.00
217	10,318	10,318	2.84	108.0	0.00	91.27	-	-	0.00	0.00	-	0.00
218	12,259	12,260	0.30	108.0	0.00	92.77	-	-	0.00	0.00	-	0.00
219	11,878	11,878	0.77	108.0	0.00	92.49	-	-	0.00	0.00	-	0.00
220	12,188	12,188	0.39	108.0	0.00	92.72	-	-	0.00	0.00	-	0.00
221	12,263	12,264	0.29	108.0	0.00	92.77	-	-	0.00	0.00	-	0.00
222	9,419	9,419	4.17	108.0	0.00	90.48	-	-	0.00	0.00	-	0.00
223	8,938	8,939	4.93	108.0	0.00	90.03	-	-	0.00	0.00	-	0.00
224	10,523	10,523	2.55	108.0	0.00	91.44	-	-	0.00	0.00	-	0.00
225	10,292	10,292	2.88	108.0	0.00	91.25	-	-	0.00	0.00	-	0.00
226	9,364	9,364	4.25	108.0	0.00	90.43	-	-	0.00	0.00	-	0.00
227	8,878	8,879	5.02	108.0	0.00	89.97	-	-	0.00	0.00	-	0.00
228	9,728	9,728	3.70	108.0	0.00	90.76	-	-	0.00	0.00	-	0.00
229	9,032	9,032	4.78	108.0	0.00	90.12	-	-	0.00	0.00	-	0.00
230	9,146	9,146	4.60	108.0	0.00	90.22	-	-	0.00	0.00	-	0.00
231	8,991	8,991	4.84	108.0	0.00	90.08	-	-	0.00	0.00	-	0.00
232	7,747	7,748	6.96	108.0	0.00	88.78	-	-	0.00	0.00	-	0.00
233	7,764	7,765	6.93	108.0	0.00	88.80	-	-	0.00	0.00	-	0.00
234	7,631	7,632	7.17	108.0	0.00	88.65	-	-	0.00	0.00	-	0.00
235	8,195	8,195	6.17	108.0	0.00	89.27	-	-	0.00	0.00	-	0.00
301	17,417	17,417	-4.96	108.0	0.00	95.82	-	-	0.00	0.00	-	0.00
302	17,912	17,912	-5.38	108.0	0.00	96.06	-	-	0.00	0.00	-	0.00
303	18,598	18,598	-5.94	108.0	0.00	96.39	-	-	0.00	0.00	-	0.00
304	19,182	19,182	-6.41	108.0	0.00	96.66	-	-	0.00	0.00	-	0.00
305	19,063	19,063	-6.31	108.0	0.00	96.60	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
306	18,818	18,818	-6.12	108.0	0.00	96.49	-	-	0.00	0.00	-	0.00
307	18,002	18,002	-5.45	108.0	0.00	96.11	-	-	0.00	0.00	-	0.00
308	7,568	7,568	7.29	108.0	0.00	88.58	-	-	0.00	0.00	-	0.00
309	7,561	7,562	7.30	108.0	0.00	88.57	-	-	0.00	0.00	-	0.00
310	8,083	8,083	6.36	108.0	0.00	89.15	-	-	0.00	0.00	-	0.00
311	8,050	8,050	6.42	108.0	0.00	89.12	-	-	0.00	0.00	-	0.00
312	7,965	7,965	6.57	108.0	0.00	89.02	-	-	0.00	0.00	-	0.00
313	7,919	7,920	6.65	108.0	0.00	88.97	-	-	0.00	0.00	-	0.00
314	8,297	8,297	5.99	108.0	0.00	89.38	-	-	0.00	0.00	-	0.00
315	7,222	7,222	7.94	108.0	0.00	88.17	-	-	0.00	0.00	-	0.00
316	6,632	6,633	9.12	108.0	0.00	87.43	-	-	0.00	0.00	-	0.00
317	6,803	6,804	8.77	108.0	0.00	87.66	-	-	0.00	0.00	-	0.00
318	6,610	6,610	9.17	108.0	0.00	87.40	-	-	0.00	0.00	-	0.00
319	5,105	5,106	12.63	108.0	0.00	85.16	-	-	0.00	0.00	-	0.00
320	4,918	4,919	13.11	108.0	0.00	84.84	-	-	0.00	0.00	-	0.00
321	4,966	4,966	12.99	108.0	0.00	84.92	-	-	0.00	0.00	-	0.00
322	3,842	3,843	16.22	108.0	0.00	82.69	-	-	0.00	0.00	-	0.00
323	3,495	3,496	17.37	108.0	0.00	81.87	-	-	0.00	0.00	-	0.00
324	3,525	3,526	17.27	108.0	0.00	81.95	-	-	0.00	0.00	-	0.00
325	2,310	2,311	22.10	108.0	0.00	78.28	-	-	0.00	0.00	-	0.00
326	2,563	2,564	20.92	108.0	0.00	79.18	-	-	0.00	0.00	-	0.00
327	2,482	2,483	21.27	108.0	0.00	78.90	-	-	0.00	0.00	-	0.00
328	2,674	2,675	20.45	108.0	0.00	79.55	-	-	0.00	0.00	-	0.00
329	1,822	1,824	24.93	108.0	0.00	76.22	-	-	0.00	0.00	-	0.00
330	2,590	2,591	20.81	108.0	0.00	79.27	-	-	0.00	0.00	-	0.00
331	3,292	3,293	18.08	108.0	0.00	81.35	-	-	0.00	0.00	-	0.00
332	3,809	3,810	16.33	108.0	0.00	82.62	-	-	0.00	0.00	-	0.00
333	4,161	4,162	15.23	108.0	0.00	83.39	-	-	0.00	0.00	-	0.00
334	3,891	3,892	16.07	108.0	0.00	82.80	-	-	0.00	0.00	-	0.00
335	4,289	4,289	14.86	108.0	0.00	83.65	-	-	0.00	0.00	-	0.00
Sum	31,90											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP030 NSP030

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]
1	11,299	11,299	1.51	108.0	0.00	92.06	-	-	0.00	0.00	-	0.00
2	11,492	11,492	1.26	108.0	0.00	92.21	-	-	0.00	0.00	-	0.00
3	9,669	9,670	2.76	107.0	0.00	90.71	-	-	0.00	0.00	-	0.00
4	10,875	10,875	1.21	107.0	0.00	91.73	-	-	0.00	0.00	-	0.00
5	9,638	9,639	2.80	107.0	0.00	90.68	-	-	0.00	0.00	-	0.00
6	10,851	10,852	2.10	108.0	0.00	91.71	-	-	0.00	0.00	-	0.00
7	9,853	9,854	3.52	108.0	0.00	90.87	-	-	0.00	0.00	-	0.00
8	10,071	10,071	2.22	107.0	0.00	91.06	-	-	0.00	0.00	-	0.00
9	12,135	12,135	0.45	108.0	0.00	92.68	-	-	0.00	0.00	-	0.00
10	11,528	11,528	1.21	108.0	0.00	92.24	-	-	0.00	0.00	-	0.00
11	13,086	13,086	-0.67	108.0	0.00	93.34	-	-	0.00	0.00	-	0.00
12	12,336	12,336	-0.48	107.0	0.00	92.82	-	-	0.00	0.00	-	0.00
13	11,032	11,032	1.01	107.0	0.00	91.85	-	-	0.00	0.00	-	0.00
14	10,406	10,406	1.79	107.0	0.00	91.35	-	-	0.00	0.00	-	0.00
15	10,362	10,362	2.78	108.0	0.00	91.31	-	-	0.00	0.00	-	0.00
16	10,258	10,258	1.98	107.0	0.00	91.22	-	-	0.00	0.00	-	0.00
17	10,657	10,657	2.37	108.0	0.00	91.55	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
18	10,293	10,293	1.93	107.0	0.00	91.25	-	-	0.00	0.00	-	0.00
19	11,000	11,000	1.05	107.0	0.00	91.83	-	-	0.00	0.00	-	0.00
20	10,146	10,146	3.09	108.0	0.00	91.13	-	-	0.00	0.00	-	0.00
22	11,527	11,528	0.43	107.0	0.00	92.23	-	-	0.00	0.00	-	0.00
23	9,976	9,977	2.35	107.0	0.00	90.98	-	-	0.00	0.00	-	0.00
25	11,165	11,165	1.68	108.0	0.00	91.96	-	-	0.00	0.00	-	0.00
26	9,875	9,875	3.48	108.0	0.00	90.89	-	-	0.00	0.00	-	0.00
27	10,963	10,963	1.95	108.0	0.00	91.80	-	-	0.00	0.00	-	0.00
28	10,508	10,508	2.58	108.0	0.00	91.43	-	-	0.00	0.00	-	0.00
29	12,848	12,848	-1.02	107.0	0.00	93.18	-	-	0.00	0.00	-	0.00
30	11,945	11,945	0.69	108.0	0.00	92.54	-	-	0.00	0.00	-	0.00
31	12,033	12,033	-0.14	107.0	0.00	92.61	-	-	0.00	0.00	-	0.00
32	9,475	9,475	3.02	107.0	0.00	90.53	-	-	0.00	0.00	-	0.00
33	11,527	11,528	0.43	107.0	0.00	92.23	-	-	0.00	0.00	-	0.00
201	12,501	12,501	0.01	108.0	0.00	92.94	-	-	0.00	0.00	-	0.00
202	12,726	12,726	-0.26	108.0	0.00	93.09	-	-	0.00	0.00	-	0.00
203	13,943	13,943	-1.62	108.0	0.00	93.89	-	-	0.00	0.00	-	0.00
204	13,937	13,937	-1.61	108.0	0.00	93.88	-	-	0.00	0.00	-	0.00
205	14,436	14,437	-2.14	108.0	0.00	94.19	-	-	0.00	0.00	-	0.00
206	14,628	14,628	-2.34	108.0	0.00	94.30	-	-	0.00	0.00	-	0.00
207	15,417	15,417	-3.12	108.0	0.00	94.76	-	-	0.00	0.00	-	0.00
208	12,724	12,724	-0.25	108.0	0.00	93.09	-	-	0.00	0.00	-	0.00
209	12,784	12,784	-0.32	108.0	0.00	93.13	-	-	0.00	0.00	-	0.00
210	12,750	12,750	-0.28	108.0	0.00	93.11	-	-	0.00	0.00	-	0.00
211	11,494	11,494	1.26	108.0	0.00	92.21	-	-	0.00	0.00	-	0.00
212	11,159	11,160	1.69	108.0	0.00	91.95	-	-	0.00	0.00	-	0.00
213	10,840	10,841	2.12	108.0	0.00	91.70	-	-	0.00	0.00	-	0.00
214	10,812	10,812	2.16	108.0	0.00	91.68	-	-	0.00	0.00	-	0.00
215	9,486	9,486	4.07	108.0	0.00	90.54	-	-	0.00	0.00	-	0.00
216	9,585	9,585	3.92	108.0	0.00	90.63	-	-	0.00	0.00	-	0.00
217	9,714	9,714	3.72	108.0	0.00	90.75	-	-	0.00	0.00	-	0.00
218	11,734	11,735	0.95	108.0	0.00	92.39	-	-	0.00	0.00	-	0.00
219	11,411	11,412	1.36	108.0	0.00	92.15	-	-	0.00	0.00	-	0.00
220	11,750	11,750	0.93	108.0	0.00	92.40	-	-	0.00	0.00	-	0.00
221	11,878	11,878	0.77	108.0	0.00	92.49	-	-	0.00	0.00	-	0.00
222	9,264	9,264	4.41	108.0	0.00	90.34	-	-	0.00	0.00	-	0.00
223	8,734	8,734	5.26	108.0	0.00	89.82	-	-	0.00	0.00	-	0.00
224	10,201	10,201	3.01	108.0	0.00	91.17	-	-	0.00	0.00	-	0.00
225	9,947	9,947	3.38	108.0	0.00	90.95	-	-	0.00	0.00	-	0.00
226	9,039	9,039	4.76	108.0	0.00	90.12	-	-	0.00	0.00	-	0.00
227	8,478	8,478	5.68	108.0	0.00	89.57	-	-	0.00	0.00	-	0.00
228	9,506	9,506	4.04	108.0	0.00	90.56	-	-	0.00	0.00	-	0.00
229	8,556	8,556	5.55	108.0	0.00	89.65	-	-	0.00	0.00	-	0.00
230	8,635	8,636	5.42	108.0	0.00	89.73	-	-	0.00	0.00	-	0.00
231	8,432	8,432	5.76	108.0	0.00	89.52	-	-	0.00	0.00	-	0.00
232	7,169	7,169	8.05	108.0	0.00	88.11	-	-	0.00	0.00	-	0.00
233	7,139	7,140	8.10	108.0	0.00	88.07	-	-	0.00	0.00	-	0.00
234	6,972	6,972	8.43	108.0	0.00	87.87	-	-	0.00	0.00	-	0.00
235	7,480	7,480	7.46	108.0	0.00	88.48	-	-	0.00	0.00	-	0.00
301	16,481	16,481	-4.13	108.0	0.00	95.34	-	-	0.00	0.00	-	0.00
302	16,973	16,973	-4.57	108.0	0.00	95.60	-	-	0.00	0.00	-	0.00
303	17,643	17,643	-5.15	108.0	0.00	95.93	-	-	0.00	0.00	-	0.00
304	18,222	18,222	-5.64	108.0	0.00	96.21	-	-	0.00	0.00	-	0.00
305	18,084	18,084	-5.52	108.0	0.00	96.15	-	-	0.00	0.00	-	0.00
306	17,846	17,846	-5.32	108.0	0.00	96.03	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:

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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
307	17,030	17,030	-4.62	108.0	0.00	95.62	-	-	0.00	0.00	-	0.00
308	7,501	7,501	7.42	108.0	0.00	88.50	-	-	0.00	0.00	-	0.00
309	7,420	7,421	7.57	108.0	0.00	88.41	-	-	0.00	0.00	-	0.00
310	7,868	7,868	6.74	108.0	0.00	88.92	-	-	0.00	0.00	-	0.00
311	7,773	7,773	6.92	108.0	0.00	88.81	-	-	0.00	0.00	-	0.00
312	7,636	7,636	7.16	108.0	0.00	88.66	-	-	0.00	0.00	-	0.00
313	7,529	7,529	7.36	108.0	0.00	88.54	-	-	0.00	0.00	-	0.00
314	7,807	7,807	6.85	108.0	0.00	88.85	-	-	0.00	0.00	-	0.00
315	6,761	6,762	8.86	108.0	0.00	87.60	-	-	0.00	0.00	-	0.00
316	6,251	6,251	9.93	108.0	0.00	86.92	-	-	0.00	0.00	-	0.00
317	6,475	6,476	9.45	108.0	0.00	87.23	-	-	0.00	0.00	-	0.00
318	6,408	6,408	9.59	108.0	0.00	87.13	-	-	0.00	0.00	-	0.00
319	5,095	5,095	12.65	108.0	0.00	85.14	-	-	0.00	0.00	-	0.00
320	5,008	5,008	12.88	108.0	0.00	84.99	-	-	0.00	0.00	-	0.00
321	5,152	5,152	12.51	108.0	0.00	85.24	-	-	0.00	0.00	-	0.00
322	4,117	4,118	15.37	108.0	0.00	83.29	-	-	0.00	0.00	-	0.00
323	3,749	3,750	16.52	108.0	0.00	82.48	-	-	0.00	0.00	-	0.00
324	3,543	3,543	17.21	108.0	0.00	81.99	-	-	0.00	0.00	-	0.00
325	2,715	2,716	20.29	108.0	0.00	79.68	-	-	0.00	0.00	-	0.00
326	2,683	2,685	20.42	108.0	0.00	79.58	-	-	0.00	0.00	-	0.00
327	2,456	2,458	21.38	108.0	0.00	78.81	-	-	0.00	0.00	-	0.00
328	2,219	2,221	22.59	108.0	0.00	77.93	-	-	0.00	0.00	-	0.00
329	1,087	1,090	30.74	108.0	0.00	71.75	-	-	0.00	0.00	-	0.00
330	1,754	1,756	25.38	108.0	0.00	75.89	-	-	0.00	0.00	-	0.00
331	2,610	2,612	20.72	108.0	0.00	79.34	-	-	0.00	0.00	-	0.00
332	3,087	3,088	18.83	108.0	0.00	80.79	-	-	0.00	0.00	-	0.00
333	3,603	3,604	17.00	108.0	0.00	82.13	-	-	0.00	0.00	-	0.00
334	3,446	3,447	17.54	108.0	0.00	81.75	-	-	0.00	0.00	-	0.00
335	3,924	3,925	15.96	108.0	0.00	82.88	-	-	0.00	0.00	-	0.00
Sum	34.47											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP031 NSP031

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]
1	13,990	13,991	-1.67	108.0	0.00	93.92	-	-	0.00	0.00	-	0.00
2	14,611	14,611	-2.32	108.0	0.00	94.29	-	-	0.00	0.00	-	0.00
3	11,349	11,349	0.64	107.0	0.00	92.10	-	-	0.00	0.00	-	0.00
4	12,325	12,325	-0.46	107.0	0.00	92.82	-	-	0.00	0.00	-	0.00
5	11,975	11,975	-0.08	107.0	0.00	92.57	-	-	0.00	0.00	-	0.00
6	14,408	14,408	-2.11	108.0	0.00	94.17	-	-	0.00	0.00	-	0.00
7	13,223	13,223	-0.83	108.0	0.00	93.43	-	-	0.00	0.00	-	0.00
8	11,296	11,297	0.70	107.0	0.00	92.06	-	-	0.00	0.00	-	0.00
9	14,695	14,695	-2.41	108.0	0.00	94.34	-	-	0.00	0.00	-	0.00
10	14,401	14,401	-2.10	108.0	0.00	94.17	-	-	0.00	0.00	-	0.00
11	15,810	15,811	-3.50	108.0	0.00	94.98	-	-	0.00	0.00	-	0.00
12	14,055	14,055	-2.23	107.0	0.00	93.96	-	-	0.00	0.00	-	0.00
13	12,623	12,624	-0.79	107.0	0.00	93.02	-	-	0.00	0.00	-	0.00
14	12,564	12,564	-0.72	107.0	0.00	92.98	-	-	0.00	0.00	-	0.00
15	13,515	13,515	-1.15	108.0	0.00	93.62	-	-	0.00	0.00	-	0.00
16	11,830	11,831	0.08	107.0	0.00	92.46	-	-	0.00	0.00	-	0.00
17	14,427	14,427	-2.13	108.0	0.00	94.18	-	-	0.00	0.00	-	0.00
18	12,855	12,855	-1.03	107.0	0.00	93.18	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
 30 West Superior Street
 Duluth, MN 55802-2093

Description:
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 6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		Wind speed: 8.0 m/s										
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]
19	13,124	13,124	-1.31	107.0	0.00	93.36	-	-	0.00	0.00	-	0.00
20	13,744	13,745	-1.40	108.0	0.00	93.76	-	-	0.00	0.00	-	0.00
22	12,573	12,573	-0.73	107.0	0.00	92.99	-	-	0.00	0.00	-	0.00
23	10,805	10,805	1.29	107.0	0.00	91.67	-	-	0.00	0.00	-	0.00
25	14,917	14,917	-2.63	108.0	0.00	94.47	-	-	0.00	0.00	-	0.00
26	13,759	13,760	-1.42	108.0	0.00	93.77	-	-	0.00	0.00	-	0.00
27	13,582	13,583	-1.23	108.0	0.00	93.66	-	-	0.00	0.00	-	0.00
28	13,892	13,892	-1.56	108.0	0.00	93.86	-	-	0.00	0.00	-	0.00
29	14,430	14,430	-2.59	107.0	0.00	94.19	-	-	0.00	0.00	-	0.00
30	15,035	15,035	-2.75	108.0	0.00	94.54	-	-	0.00	0.00	-	0.00
31	13,587	13,587	-1.77	107.0	0.00	93.66	-	-	0.00	0.00	-	0.00
32	11,525	11,525	0.43	107.0	0.00	92.23	-	-	0.00	0.00	-	0.00
33	12,888	12,888	-1.06	107.0	0.00	93.20	-	-	0.00	0.00	-	0.00
201	16,018	16,018	-3.70	108.0	0.00	95.09	-	-	0.00	0.00	-	0.00
202	16,295	16,296	-3.96	108.0	0.00	95.24	-	-	0.00	0.00	-	0.00
203	17,117	17,117	-4.70	108.0	0.00	95.67	-	-	0.00	0.00	-	0.00
204	17,263	17,264	-4.82	108.0	0.00	95.74	-	-	0.00	0.00	-	0.00
205	17,789	17,790	-5.27	108.0	0.00	96.00	-	-	0.00	0.00	-	0.00
206	17,465	17,465	-5.00	108.0	0.00	95.84	-	-	0.00	0.00	-	0.00
207	18,167	18,167	-5.59	108.0	0.00	96.19	-	-	0.00	0.00	-	0.00
208	13,413	13,413	-1.04	108.0	0.00	93.55	-	-	0.00	0.00	-	0.00
209	13,283	13,283	-0.89	108.0	0.00	93.47	-	-	0.00	0.00	-	0.00
210	13,010	13,010	-0.58	108.0	0.00	93.29	-	-	0.00	0.00	-	0.00
211	11,848	11,848	0.81	108.0	0.00	92.47	-	-	0.00	0.00	-	0.00
212	11,437	11,438	1.33	108.0	0.00	92.17	-	-	0.00	0.00	-	0.00
213	10,999	10,999	1.90	108.0	0.00	91.83	-	-	0.00	0.00	-	0.00
214	10,782	10,782	2.20	108.0	0.00	91.65	-	-	0.00	0.00	-	0.00
215	10,487	10,488	2.60	108.0	0.00	91.41	-	-	0.00	0.00	-	0.00
216	9,755	9,755	3.66	108.0	0.00	90.78	-	-	0.00	0.00	-	0.00
217	9,441	9,442	4.14	108.0	0.00	90.50	-	-	0.00	0.00	-	0.00
218	10,637	10,637	2.40	108.0	0.00	91.54	-	-	0.00	0.00	-	0.00
219	9,967	9,968	3.35	108.0	0.00	90.97	-	-	0.00	0.00	-	0.00
220	10,082	10,083	3.18	108.0	0.00	91.07	-	-	0.00	0.00	-	0.00
221	9,867	9,867	3.49	108.0	0.00	90.88	-	-	0.00	0.00	-	0.00
222	6,276	6,277	9.88	108.0	0.00	86.95	-	-	0.00	0.00	-	0.00
223	6,149	6,149	10.15	108.0	0.00	86.78	-	-	0.00	0.00	-	0.00
224	8,032	8,033	6.45	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
225	7,959	7,960	6.58	108.0	0.00	89.02	-	-	0.00	0.00	-	0.00
226	7,106	7,106	8.17	108.0	0.00	88.03	-	-	0.00	0.00	-	0.00
227	7,135	7,136	8.11	108.0	0.00	88.07	-	-	0.00	0.00	-	0.00
228	6,860	6,861	8.66	108.0	0.00	87.73	-	-	0.00	0.00	-	0.00
229	7,668	7,668	7.11	108.0	0.00	88.69	-	-	0.00	0.00	-	0.00
230	7,952	7,952	6.59	108.0	0.00	89.01	-	-	0.00	0.00	-	0.00
231	8,114	8,114	6.31	108.0	0.00	89.18	-	-	0.00	0.00	-	0.00
232	7,306	7,307	7.78	108.0	0.00	88.27	-	-	0.00	0.00	-	0.00
233	7,587	7,588	7.25	108.0	0.00	88.60	-	-	0.00	0.00	-	0.00
234	7,691	7,691	7.06	108.0	0.00	88.72	-	-	0.00	0.00	-	0.00
235	8,441	8,442	5.74	108.0	0.00	89.53	-	-	0.00	0.00	-	0.00
301	18,354	18,354	-5.74	108.0	0.00	96.27	-	-	0.00	0.00	-	0.00
302	18,861	18,861	-6.15	108.0	0.00	96.51	-	-	0.00	0.00	-	0.00
303	19,688	19,688	-6.80	108.0	0.00	96.88	-	-	0.00	0.00	-	0.00
304	20,299	20,300	-7.26	108.0	0.00	97.15	-	-	0.00	0.00	-	0.00
305	20,408	20,408	-7.34	108.0	0.00	97.20	-	-	0.00	0.00	-	0.00
306	20,097	20,097	-7.11	108.0	0.00	97.06	-	-	0.00	0.00	-	0.00
307	19,315	19,315	-6.51	108.0	0.00	96.72	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
30 West Superior Street
Duluth, MN 55802-2093

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6/23/2011 1:33 PM/2.7.486

DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s**

...continued from previous page

		Wind speed: 8.0 m/s										
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]
308	4,465	4,466	14.35	108.0	0.00	84.00	-	-	0.00	0.00	-	0.00
309	4,841	4,841	13.32	108.0	0.00	84.70	-	-	0.00	0.00	-	0.00
310	5,576	5,576	11.47	108.0	0.00	85.93	-	-	0.00	0.00	-	0.00
311	5,878	5,879	10.76	108.0	0.00	86.39	-	-	0.00	0.00	-	0.00
312	6,092	6,092	10.28	108.0	0.00	86.70	-	-	0.00	0.00	-	0.00
313	6,388	6,389	9.63	108.0	0.00	87.11	-	-	0.00	0.00	-	0.00
314	7,198	7,199	7.99	108.0	0.00	88.15	-	-	0.00	0.00	-	0.00
315	6,305	6,306	9.81	108.0	0.00	86.99	-	-	0.00	0.00	-	0.00
316	5,538	5,539	11.55	108.0	0.00	85.87	-	-	0.00	0.00	-	0.00
317	5,356	5,357	12.00	108.0	0.00	85.58	-	-	0.00	0.00	-	0.00
318	4,602	4,603	13.96	108.0	0.00	84.26	-	-	0.00	0.00	-	0.00
319	3,146	3,147	18.61	108.0	0.00	80.96	-	-	0.00	0.00	-	0.00
320	2,664	2,666	20.49	108.0	0.00	79.52	-	-	0.00	0.00	-	0.00
321	2,197	2,199	22.71	108.0	0.00	77.84	-	-	0.00	0.00	-	0.00
322	2,273	2,275	22.30	108.0	0.00	78.14	-	-	0.00	0.00	-	0.00
323	2,576	2,578	20.86	108.0	0.00	79.22	-	-	0.00	0.00	-	0.00
324	3,295	3,296	18.07	108.0	0.00	81.36	-	-	0.00	0.00	-	0.00
325	3,303	3,304	18.04	108.0	0.00	81.38	-	-	0.00	0.00	-	0.00
326	3,578	3,580	17.08	108.0	0.00	82.08	-	-	0.00	0.00	-	0.00
327	3,947	3,948	15.89	108.0	0.00	82.93	-	-	0.00	0.00	-	0.00
328	4,909	4,910	13.13	108.0	0.00	84.82	-	-	0.00	0.00	-	0.00
329	5,605	5,606	11.39	108.0	0.00	85.97	-	-	0.00	0.00	-	0.00
330	5,949	5,950	10.60	108.0	0.00	86.49	-	-	0.00	0.00	-	0.00
331	5,615	5,616	11.37	108.0	0.00	85.99	-	-	0.00	0.00	-	0.00
332	5,912	5,913	10.68	108.0	0.00	86.44	-	-	0.00	0.00	-	0.00
333	5,361	5,362	11.98	108.0	0.00	85.59	-	-	0.00	0.00	-	0.00
334	4,868	4,868	13.24	108.0	0.00	84.75	-	-	0.00	0.00	-	0.00
335	4,606	4,606	13.95	108.0	0.00	84.27	-	-	0.00	0.00	-	0.00
Sum	31.18											

- Data undefined due to calculation with octave data

Noise sensitive area: NSP032 NSP032

		Wind speed: 8.0 m/s										
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]
1	12,479	12,480	0.04	108.0	0.00	92.92	-	-	0.00	0.00	-	0.00
2	13,108	13,109	-0.70	108.0	0.00	93.35	-	-	0.00	0.00	-	0.00
3	9,840	9,840	2.53	107.0	0.00	90.86	-	-	0.00	0.00	-	0.00
4	10,826	10,826	1.26	107.0	0.00	91.69	-	-	0.00	0.00	-	0.00
5	10,462	10,462	1.72	107.0	0.00	91.39	-	-	0.00	0.00	-	0.00
6	12,926	12,926	-0.49	108.0	0.00	93.23	-	-	0.00	0.00	-	0.00
7	11,736	11,737	0.95	108.0	0.00	92.39	-	-	0.00	0.00	-	0.00
8	9,801	9,802	2.58	107.0	0.00	90.83	-	-	0.00	0.00	-	0.00
9	13,182	13,182	-0.78	108.0	0.00	93.40	-	-	0.00	0.00	-	0.00
10	12,892	12,892	-0.45	108.0	0.00	93.21	-	-	0.00	0.00	-	0.00
11	14,298	14,298	-2.00	108.0	0.00	94.11	-	-	0.00	0.00	-	0.00
12	12,553	12,553	-0.71	107.0	0.00	92.98	-	-	0.00	0.00	-	0.00
13	11,121	11,121	0.91	107.0	0.00	91.92	-	-	0.00	0.00	-	0.00
14	11,051	11,051	0.99	107.0	0.00	91.87	-	-	0.00	0.00	-	0.00
15	12,017	12,018	0.60	108.0	0.00	92.60	-	-	0.00	0.00	-	0.00
16	10,326	10,326	1.89	107.0	0.00	91.28	-	-	0.00	0.00	-	0.00
17	12,959	12,959	-0.53	108.0	0.00	93.25	-	-	0.00	0.00	-	0.00
18	11,343	11,343	0.64	107.0	0.00	92.09	-	-	0.00	0.00	-	0.00
19	11,612	11,612	0.33	107.0	0.00	92.30	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:
Minnesota Power - BISON Wind Energy Center

Minnesota Power
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DECIBEL - Detailed results

Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise calculation model: ISO 9613-2 General 8.0 m/s

...continued from previous page

		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]
20	12,269	12,269	0.29	108.0	0.00	92.78	-	-	0.00	0.00	-	0.00
22	11,095	11,095	0.94	107.0	0.00	91.90	-	-	0.00	0.00	-	0.00
23	9,325	9,326	3.23	107.0	0.00	90.39	-	-	0.00	0.00	-	0.00
25	13,445	13,445	-1.08	108.0	0.00	93.57	-	-	0.00	0.00	-	0.00
26	12,305	12,305	0.24	108.0	0.00	92.80	-	-	0.00	0.00	-	0.00
27	12,071	12,071	0.53	108.0	0.00	92.63	-	-	0.00	0.00	-	0.00
28	12,403	12,403	0.13	108.0	0.00	92.87	-	-	0.00	0.00	-	0.00
29	12,935	12,935	-1.11	107.0	0.00	93.24	-	-	0.00	0.00	-	0.00
30	13,530	13,530	-1.17	108.0	0.00	93.63	-	-	0.00	0.00	-	0.00
31	12,089	12,090	-0.21	107.0	0.00	92.65	-	-	0.00	0.00	-	0.00
32	10,012	10,012	2.30	107.0	0.00	91.01	-	-	0.00	0.00	-	0.00
33	11,395	11,396	0.58	107.0	0.00	92.13	-	-	0.00	0.00	-	0.00
201	14,528	14,528	-2.23	108.0	0.00	94.24	-	-	0.00	0.00	-	0.00
202	14,807	14,808	-2.52	108.0	0.00	94.41	-	-	0.00	0.00	-	0.00
203	15,611	15,611	-3.31	108.0	0.00	94.87	-	-	0.00	0.00	-	0.00
204	15,762	15,762	-3.46	108.0	0.00	94.95	-	-	0.00	0.00	-	0.00
205	16,288	16,288	-3.95	108.0	0.00	95.24	-	-	0.00	0.00	-	0.00
206	15,952	15,952	-3.64	108.0	0.00	95.06	-	-	0.00	0.00	-	0.00
207	16,654	16,654	-4.28	108.0	0.00	95.43	-	-	0.00	0.00	-	0.00
208	11,965	11,965	0.66	108.0	0.00	92.56	-	-	0.00	0.00	-	0.00
209	11,850	11,850	0.80	108.0	0.00	92.47	-	-	0.00	0.00	-	0.00
210	11,596	11,597	1.12	108.0	0.00	92.29	-	-	0.00	0.00	-	0.00
211	10,413	10,414	2.71	108.0	0.00	91.35	-	-	0.00	0.00	-	0.00
212	10,005	10,006	3.29	108.0	0.00	91.01	-	-	0.00	0.00	-	0.00
213	9,572	9,573	3.94	108.0	0.00	90.62	-	-	0.00	0.00	-	0.00
214	9,371	9,371	4.24	108.0	0.00	90.44	-	-	0.00	0.00	-	0.00
215	8,997	8,997	4.83	108.0	0.00	90.08	-	-	0.00	0.00	-	0.00
216	8,310	8,311	5.97	108.0	0.00	89.39	-	-	0.00	0.00	-	0.00
217	8,034	8,034	6.45	108.0	0.00	89.10	-	-	0.00	0.00	-	0.00
218	9,363	9,363	4.26	108.0	0.00	90.43	-	-	0.00	0.00	-	0.00
219	8,738	8,739	5.25	108.0	0.00	89.83	-	-	0.00	0.00	-	0.00
220	8,898	8,898	4.99	108.0	0.00	89.99	-	-	0.00	0.00	-	0.00
221	8,748	8,748	5.23	108.0	0.00	89.84	-	-	0.00	0.00	-	0.00
222	5,281	5,281	12.18	108.0	0.00	85.46	-	-	0.00	0.00	-	0.00
223	5,031	5,032	12.82	108.0	0.00	85.03	-	-	0.00	0.00	-	0.00
224	6,896	6,896	8.59	108.0	0.00	87.77	-	-	0.00	0.00	-	0.00
225	6,780	6,781	8.82	108.0	0.00	87.63	-	-	0.00	0.00	-	0.00
226	5,882	5,883	10.75	108.0	0.00	86.39	-	-	0.00	0.00	-	0.00
227	5,805	5,805	10.93	108.0	0.00	86.28	-	-	0.00	0.00	-	0.00
228	5,795	5,796	10.95	108.0	0.00	86.26	-	-	0.00	0.00	-	0.00
229	6,290	6,291	9.84	108.0	0.00	86.97	-	-	0.00	0.00	-	0.00
230	6,556	6,557	9.28	108.0	0.00	87.33	-	-	0.00	0.00	-	0.00
231	6,682	6,683	9.02	108.0	0.00	87.50	-	-	0.00	0.00	-	0.00
232	5,821	5,822	10.89	108.0	0.00	86.30	-	-	0.00	0.00	-	0.00
233	6,090	6,091	10.28	108.0	0.00	86.69	-	-	0.00	0.00	-	0.00
234	6,185	6,186	10.07	108.0	0.00	86.83	-	-	0.00	0.00	-	0.00
235	6,935	6,936	8.51	108.0	0.00	87.82	-	-	0.00	0.00	-	0.00
301	16,858	16,858	-4.47	108.0	0.00	95.54	-	-	0.00	0.00	-	0.00
302	17,365	17,365	-4.91	108.0	0.00	95.79	-	-	0.00	0.00	-	0.00
303	18,187	18,187	-5.61	108.0	0.00	96.20	-	-	0.00	0.00	-	0.00
304	18,799	18,799	-6.10	108.0	0.00	96.48	-	-	0.00	0.00	-	0.00
305	18,900	18,900	-6.18	108.0	0.00	96.53	-	-	0.00	0.00	-	0.00
306	18,591	18,591	-5.94	108.0	0.00	96.39	-	-	0.00	0.00	-	0.00
307	17,807	17,807	-5.29	108.0	0.00	96.01	-	-	0.00	0.00	-	0.00
308	3,357	3,358	17.85	108.0	0.00	81.52	-	-	0.00	0.00	-	0.00

To be continued on next page...

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
 Frank Frederickson
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 Duluth, MN 55802-2093

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DECIBEL - Detailed results**Calculation: BISON 3 Noise (with existing BISON 1, 2) Noise 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]
309	3,631	3,632	16.91	108.0	0.00	82.20	-	-	0.00	0.00	-	0.00
310	4,350	4,350	14.68	108.0	0.00	83.77	-	-	0.00	0.00	-	0.00
311	4,585	4,586	14.01	108.0	0.00	84.23	-	-	0.00	0.00	-	0.00
312	4,747	4,748	13.57	108.0	0.00	84.53	-	-	0.00	0.00	-	0.00
313	4,997	4,998	12.90	108.0	0.00	84.98	-	-	0.00	0.00	-	0.00
314	5,772	5,773	11.00	108.0	0.00	86.23	-	-	0.00	0.00	-	0.00
315	4,836	4,837	13.33	108.0	0.00	84.69	-	-	0.00	0.00	-	0.00
316	4,063	4,064	15.53	108.0	0.00	83.18	-	-	0.00	0.00	-	0.00
317	3,912	3,914	16.00	108.0	0.00	82.85	-	-	0.00	0.00	-	0.00
318	3,203	3,205	18.40	108.0	0.00	81.12	-	-	0.00	0.00	-	0.00
319	1,638	1,641	26.16	108.0	0.00	75.30	-	-	0.00	0.00	-	0.00
320	1,151	1,157	30.09	108.0	0.00	72.27	-	-	0.00	0.00	-	0.00
321	688	696	35.53	108.0	0.00	67.85	-	-	0.00	0.00	-	0.00
322	1,159	1,164	30.03	108.0	0.00	72.32	-	-	0.00	0.00	-	0.00
323	1,529	1,532	26.95	108.0	0.00	74.70	-	-	0.00	0.00	-	0.00
324	2,022	2,025	23.69	108.0	0.00	77.13	-	-	0.00	0.00	-	0.00
325	2,640	2,642	20.59	108.0	0.00	79.44	-	-	0.00	0.00	-	0.00
326	2,615	2,617	20.70	108.0	0.00	79.36	-	-	0.00	0.00	-	0.00
327	2,923	2,924	19.45	108.0	0.00	80.32	-	-	0.00	0.00	-	0.00
328	3,751	3,752	16.51	108.0	0.00	82.49	-	-	0.00	0.00	-	0.00
329	4,647	4,648	13.84	108.0	0.00	84.35	-	-	0.00	0.00	-	0.00
330	4,839	4,840	13.32	108.0	0.00	84.70	-	-	0.00	0.00	-	0.00
331	4,350	4,352	14.68	108.0	0.00	83.77	-	-	0.00	0.00	-	0.00
332	4,577	4,578	14.03	108.0	0.00	84.21	-	-	0.00	0.00	-	0.00
333	3,950	3,951	15.88	108.0	0.00	82.94	-	-	0.00	0.00	-	0.00
334	3,477	3,479	17.43	108.0	0.00	81.83	-	-	0.00	0.00	-	0.00
335	3,155	3,157	18.57	108.0	0.00	80.99	-	-	0.00	0.00	-	0.00

Sum 39.03

- Data undefined due to calculation with octave data

Project:
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DECIBEL - Assumptions for noise calculation

Calculation: BISON 3 Noise (with existing BISON 1, 2) **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-2.3-101 60Hz 2300 101.0 !O!

Noise: SWT-2.3-101 Standard

Source	Source/Date	Creator	Edited
Siemens via MN Power	3/31/2009	USER	4/4/2011 3:12 PM

Octave data

Status	Hub height	Wind speed	LwA,ref	Pure tones	63	125	250	500	1000	2000	4000	8000
	[m]	[m/s]	[dB(A)]		[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
From Windcat	80.0	8.0	107.0	No	83.5	94.4	98.1	102.1	102.1	98.4	91.2	87.2

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

Noise: SWT-3.0-101 Standard

Source	Source/Date	Creator	Edited
Siemens via MN Power	5/17/2010	USER	4/4/2011 3:17 PM

Octave data

Status	Hub height	Wind speed	LwA,ref	Pure tones	63	125	250	500	1000	2000	4000	8000
	[m]	[m/s]	[dB(A)]		[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[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

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DECIBEL - Assumptions for noise calculation**Calculation:** BISON 3 Noise (with existing BISON 1, 2) **Noise calculation model:** ISO 9613-2 General 8.0 m/s**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**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

Project:

Minnesota Power - BISON Wind Energy Center

Minnesota Power
Frank Frederickson
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Duluth, MN 55802-2093

Description:

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DECIBEL - Assumptions for noise calculation

Calculation: BISON 3 Noise (with existing BISON 1, 2) **Noise calculation model:** ISO 9613-2 General 8.0 m/s

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

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

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DECIBEL - Assumptions for noise calculation**Calculation:** BISON 3 Noise (with existing BISON 1, 2) **Noise calculation model:** ISO 9613-2 General 8.0 m/s**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**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

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DECIBEL - Assumptions for noise calculation

Calculation: BISON 3 Noise (with existing BISON 1, 2) **Noise calculation model:** ISO 9613-2 General 8.0 m/s

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

NSA: NSP028-NSP028

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: NSP029-NSP029

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: NSP030-NSP030

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: NSP031-NSP031

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: NSP032-NSP032

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