CHAMPAIGN COUNTY ZONING BOARD OF APPEALS
NOTICE OF REGULAR MEETING

Date: **February 12, 2009**
Time: **6:30 p.m.**
Place: **Lyle Shields Meeting Room**
Brookens Administrative Center
1776 E. Washington Street
Urbana, IL 61802

Note: NO ENTRANCE TO BUILDING FROM WASHINGTON STREET PARKING LOT AFTER 4:30 PM.
Use Northeast parking lot via Lierman Ave.. and enter building through Northeast door.

If you require special accommodations please notify the Department of Planning & Zoning at (217) 384-3708

EVERYONE MUST SIGN THE ATTENDANCE SHEET – ANYONE GIVING TESTIMONY MUST SIGN THE WITNESS FORM

AGENDA

1. Call to Order
2. Roll Call and Declaration of Quorum
3. Correspondence
4. Approval of Minutes
5. Continued Public Hearings
6. New Public Hearings

Case 634-AT-08 Petitioner: **Zoning Administrator**

Request: **Amend the Champaign County Zoning Ordinance as follows:**

A. Authorize the County Board to approve Special Use Permits (SUP) and to change the requirements for development of wind turbine developments (wind farms) to a County Board Special Use Permit (CBSUP) and a rezoning to the new Wind Farm Overlay Zoning District (WFO);

B. Change the requirements for private wind turbines; and

C. Add a requirement for a CBSUP for subdivisions in a Rural Residential Overlay District.

7. Staff Report
8. Other Business
9. Audience Participation with respect to matters other than cases pending before the Board
10. Adjournment

*** Administrative Hearing. Cross Examination allowed.**

CASE NO. 634-AT-08

PRELIMINARY MEMORANDUM

February 6, 2009

Petitioner: **Zoning Administrator**

Champaign County Department of

PLANNING & ZONING

Brookens Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
FAX (217) 328-2426

Prepared by: **John Hall**
Zoning Administrator

J.R. Knight
Associate Planner

Request:

(A) Authorize the County Board to approve Special Use Permits (SUP) and to change the requirements for the development of wind turbine developments (wind farms) to a County Board Special Use Permit (CBSUP) and a rezoning to the new Wind Farm Overlay Zoning District (WFO).

(B) Change the requirements for private wind turbines.

(C) Add a requirement for a County Board Special Use Permit for subdivisions in a Rural Residential Overlay District.

BACKGROUND

Requirements for wind turbine facilities were added to the Champaign County Zoning Ordinance by Ordinance No. 617 (Case 236-AT-00) on October 24, 2000 (see Attachment A). Ordinance No. 617 specifically authorized the following:

- Development of up to three wind turbines by Special Use Permit (approved by the Zoning Board of Appeals (ZBA)) in the AG-1 Agriculture, AG-2 Agriculture, I-1 Light Industry, and I-2 Heavy Industry Zoning Districts.
- Development of more than three wind turbines is authorized only in the I-2 Heavy Industry Zoning District and then only with a Special Use Permit (approved by the ZBA).

A related Ordinance No. 625 (Case 273-AT-00 Part B; see attached) added requirements for reclamation agreements on May 22, 2001. It is anticipated that any wind turbine tower would be considered a "non-adaptable structure" and the ZBA would require a reclamation agreement.

State law was changed in 2007 and it now requires that in a county zoning jurisdiction a wind farm must be authorized by action of the county board but it allows that regulations that were in place before remain valid. See attachment C.

No wind farms have yet been developed in Champaign County but three wind farm developers have contacted landowners about the possible development of three different wind farms in the County. A modern wind farm in a rural setting involves tens of thousands of acres and perhaps hundreds of landowners but only one wind farm developer and so it would be considered a single zoning case. And as amended by Ordinance No. 617 the current *Zoning Ordinance* would require a wind farm to be in the I-2

Heavy Industry District even though most of the acreage of the wind farm would not be suitable for other buildings or uses. The Environment and Land Use Committee (ELUC) of the Champaign County Board discussed the current *Ordinance* requirements for wind farms at their August 2008 meeting and determined that the *Zoning Ordinance* should be amended to allow wind farm development in the rural districts subject to a County Board review. Attachments D, E, and F are ELUC memos that were considered in subsequent meetings and provide background on the discussion at ELUC.

Note that Attachment D discusses two alternatives for County Board approval of wind farms. The alternatives are (1) County Board Special Use Permit and (2) zoning map amendment (overlay rezoning) and County Board Special Use Permit. No other Illinois county requires a map amendment for wind farm development. Staff did not make a recommendation for the type of County Board approval at either the September or October ELUC meetings.

The November 6, 2008, ELUC memo (Attachment F) includes a staff recommendation for the County Board Special Use Permit. However, eight of the nine ELUC members at that meeting voiced support for the alternative that included a zoning map amendment (overlay rezoning). Attachment F also includes a list of the proposed changes to the *Ordinance*.

PROPOSED AMENDMENT

The actual legal advertisement for this case is included as Attachment G and you will note that it is much more extensive than the simple description included above. Attachments H, I, J, and K are not all of the required amendment and the rest of the amendment will be available at the meeting. These attachments do include the most critical part of the amendment and that is the list of standard conditions proposed for a wind farm County Board Special Use Permit (see Attachment K).

The proposed special conditions are based largely on the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* (see Attachment L included separately) which is also the basis for wind farm regulations by other Illinois counties. Note that this *Model Ordinance* has not been promulgated by any state agency and it should not be considered a state model ordinance. A model ordinance published by the New York State Energy Research and Development Authority (see Attachment M included separately) provides more background regarding considerations for a wind farm ordinance.

Comparing the proposed special conditions in Attachment K with the *Model Ordinance* in Attachment L will reveal where staff has supplemented the *Model Ordinance* recommendations. Other sources that have been consulted in the preparation of this amendment include ordinances from other counties; special conditions that other counties have required for wind farm approval; and other nationally recognized organizations. The relevant source for each proposed condition will be reviewed at the meeting but time does not allow a listing to be included in this memorandum.

Other attachments that have also been included separately for additional background information are the following:

- The website of the Danish Wind Industry Association (www.windpower.org) has a very good introduction to wind farms so long as you remember this is an industry website and is therefore inclined to be positive towards wind farm development. Certain sections of the "guided tour" have been included here for background information (see Attachment N).

- Title 35 *Illinois Administrative Code* Subtitle H: Noise Parts 900, 901, 910 (see attachment O) is the Illinois Pollution Control Board (IPCB) regulations for noise that are included in the proposed amendment. Noise impacts are probably the most controversial aspect of wind farm regulation. The IPCB regulations already apply throughout the State and are enforced by the Illinois Environmental Protection Agency (IEPA).

- An alternative approach to noise regulation for wind farm development can be found in the regulations for Trempealeau County, Wisconsin (see attachment P). These regulations were submitted at the November 10, 2008, ELUC meeting by a concerned citizen. This attachment includes a letter that was written to Trempealeau County by George Kampeman and Richard James who appear to be experts. Messer's Kampeman and James were also the authors of *The "How to" Guide To Siting Wind Turbines To Prevent Health Risks From Sound* (see Attachment R). This *Guide* is from the Industrial Wind Action Group website (www.windaction.org) which is also a useful source of information so long as one is aware that this website also has a specific approach towards wind farm regulation.

  Attachments P and R are not included here as an indication of support for this approach but are provided simply as background information.

As the ZBA is aware, the next four meetings (February 12, February 26, March 12, and March 26) have been reserved for only this text amendment. The list of special conditions is quite extensive and ZBA members need to be comfortable with all proposed requirements. It may be useful for the ZBA to begin by reviewing the special conditions proposed in Attachment K because that will help in understanding how a wind farm compares to and impacts the other uses that can be found in the AG-1 District. Understanding wind farm impacts on other uses is essential to making an informed recommendation regarding the need for a map amendment.

No other Illinois county requires a map amendment for wind farm development but no other Illinois county zoning ordinance is like our own. The ZBA should not recommend a map amendment if the evidence presented in the public hearing does not support the need for a map amendment.

A Draft Finding of Fact will also be available at the meeting. As is the practice in all other text amendments, all relevant evidence should be summarized in the Finding of Fact so that the County Board can understand the reasoning of the ZBA in the final recommendation.

ATTACHMENTS

A Ordinance No. 617 (Case 236-AT-00)

B Ordinance No. 647 (Case 273-AT-00 Part B)

C 55 ILCS 5/5-12020

D ELUC Memorandum of September 4, 2008 (without attachments)

E ELUC Memorandum of October 14, 2008 (without attachments)

F ELUC Memorandum of November 6, 2008 (with Attachment A)

G Legal advertisement for Case 634-AT-08

H Draft Proposed Changes To Section 2

I Draft Proposed Changes To Section 3

J Draft Proposed Changes To Section 5

K Draft Proposed New Subsection 6.1.4

L *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois.* Chicago Legal Clinic, Inc. (Included separately)

M *WIND ENERGY Model Ordinance Options.* New York State Energy Research and Development Authority(Included separately)

N Excerpts from the Danish Wind Industry Association website (www.windpower.org) Guided Tour on Wind Energy (Included separately)

O Title 35 Illinois Administrative Code Subtitle H: Noise Parts 900, 901, 910 (Included separately)

P Chapter 21 Wind Generator and Wind Generating Facility Ordinance for Trempealeau County, Wisconsin (includes letter to Mr. David Vind from George Kampeman and Richard James dated October 24, 2007) (Included separately)

R Excerpts from the Industrial Wind Action Group website (www.windaction.org) including *The "How to" Guide To Siting Wind Turbines To Prevent Health Risks From Sound* by George Kamperman and Richard James, October 28, 2008. (Included separately)

ATTACHMENT A

ORDINANCE NO. 617
ORDINANCE AMENDING ZONING ORDINANCE
COMPREHENSIVE ZONING ORDINANCE AMENDMENTS

236-AT-00

WHEREAS, the Champaign County Zoning Board of Appeals held a public hearing, made a formal recommendation, and forwarded to this Board Case Number 236-AT-00;

WHEREAS, the Champaign County Board believes it is for the best interests of the County and for the public good and welfare to amend the Champaign County Zoning Ordinance in a manner hereinafter provided;

NOW, THEREFORE, BE IT ORDAINED, by the Champaign County Board, Champaign County, Illinois as follows:

1. That Resolution No. 971 *The Zoning Ordinance of the County of Champaign, Illinois*, be amended in the following manner:

Part A. Amend Section 5.2 to create a use category for Electric Power Generating Facilities.

Part B. Amend Section 5.2 to permit Coal/Oil Steam Turbines, Natural Gas Steam Turbines, and Wind Turbine Facilities with more than three wind turbines by Special Use Permit in the I-2, Heavy Industry District.

Part C: Amend Section 5.2 to permit Gas Turbine Peaker Plants and Wind Turbine Facilities with three or fewer turbines by Special Use Permit in the AG-1, Agriculture, AG-2, Agriculture, I-1, Light Industry, and I-2, Heavy Industry Districts.

2. That the amendments listed above be incorporated into the text of the Champaign County Zoning Ordinance.

PRESENTED, PASSED, APPROVED AND RECORDED this 24th.day of October , A.D. 2000.

ATTEST:

Mark Shelden

W. Stephen Moser
Chairman,
Champaign County Board
Champaign County, Illinois

W. A. Moser

Mark Shelden,
County Clerk &
Ex Officio Clerk of the County Board

Section 5.2 Table of Authorized Principal USES

Principal USES	CR	AG-1	AG-2	R-1	R-2	R-3	R-4	R-5	B-1	B-2	B-3	B-4	B-5	I-1	I-2
Electric Power Generating Facilities															
Coal/Oil Steam Turbine															S
Natural Gas Steam Turbine															S
Wind Turbine (> 3 wind turbines)															S
Gas Turbine Peaker		S	S											S	S
Wind Turbine (1 - 3 wind turbines)		S	S											S	S

Coal, oil and fired steam turbines being larger plants with greater impacts are restricted to industrial districts. It is anticipated that developing any of these facilities would require rezoning in addition to the special use permit.

Peaker plants and small wind turbine facilities have lesser impacts and can be permitted in a wider array of districts with a special use permit.

REVISED 9/14/2000

ATTACHMENT B

ORDINANCE NO. 647
ORDINANCE AMENDING ZONING ORDINANCE
COMPREHENSIVE ZONING ORDINANCE AMENDMENTS

273-AT-00
Part B

WHEREAS, the Champaign County Zoning Board of Appeals held a public hearing, made a formal recommendation, and forwarded to this Board Case Number 273-AT-00;

WHEREAS, the Champaign County Board believes it is for the best interests of the County and for the public good and welfare to amend the Champaign County Zoning Ordinance in a manner hereinafter provided;

NOW, THEREFORE, BE IT ORDAINED, by the Champaign County Board, Champaign County, Illinois that Resolution No. 971 *The Zoning Ordinance of the County of Champaign, Illinois*, be amended in the following manner:

1. Amend Section 3.0 to add:

    3.0 Definitions

    .

    NON-ADAPTABLE STRUCTURE: Any STRUCTURE or physical alteration to the land which requires a SPECIAL USE permit, and which is likely to become economically unfeasible to remove or put to an alternate USE allowable in the DISTRICT (by right or by SPECIAL USE).

2. Amend Subsection 6.1.1 add new paragraph C to read as follows:

    6.1.1 Standards and Requirements

    .

    C. Site Reclamation

    1. In the course of BOARD review of a SPECIAL USE request, the BOARD may find that a proposed STRUCTURE is a NON-ADAPTABLE

STRUCTURE. In such a case the developer shall enter into a reclamation agreement with the COUNTY for the subject site. The reclamation agreement shall be binding upon all successors of title to the land.

2. Prior to the issuance of a SPECIAL USE permit for such NON-ADAPTABLE STRUCTURES, the landowner shall also record a covenant incorporating the provisions of the reclamation agreement on the deed subject to the lot.

3. Separate cost estimates for items (C)(4)(a) and (C)(4)(b) shall be provided by an Illinois licensed Professional Engineer. Cost estimates provided shall be subject to approval of the BOARD.

4. The reclamation agreement shall provide for:

   a. removal of above-ground portion of any STRUCTURE on the subject site; site grading; and interim soil erosion control;

   b. below-ground restoration, including final grading and surface treatment; and

   c. provision and maintenance of a letter of credit, as set forth in Section 6.1(C)(5).

5. No Zoning Use Permit for such SPECIAL USE will be issued until the developer provides the COUNTY with an irrevocable letter of credit in the amount of one hundred fifty (150) percent of an independent engineer's cost estimate to complete the work described in Section 6.1(C)(4)(a). This letter of credit, or a successor letter of credit pursuant to Section 6.1(C)(6) or (C)(12) shall remain in effect and shall be made available to the COUNTY for an indefinite term.

6. One hundred and twenty (120) days prior to the expiration date of an irrevocable letter of credit submitted pursuant this Section, the Zoning Administrator shall notify the landowner in writing and request information about the landowner's intent to renew the letter of credit, or remove the NON-ADAPTABLE STRUCTURE. The landowner shall have thirty (30) days to respond in writing to this request. If the landowner's intention is to

remove the NON-ADAPTABLE STRUCTURE, the landowner will have a total of ninety (90) days from the date of the County's initial notification to remove it in accordance with Section 6.1(C)(4)(a). At the end of ninety (90) days, the Zoning Administrator shall have a period of thirty (30) days to either:

a. confirm that the bank has renewed the letter of credit; or

b. inspect the subject property for compliance with Section 6.1(C)(4)(a); or

c. draw on the letter of credit and commence the bid process to have a contractor remove the NON-ADAPTABLE STRUCTURE pursuant to Section 6.1(C)(4)(a).

7. The Zoning Administrator may find a NON-ADAPTABLE STRUCTURE abandoned in place. Factors to be considered in making this finding include, but are not limited to:

a. the nature and frequency of use as set forth in the application for SPECIAL USE;

b. the current nature and frequency of use;

c. whether the NON-ADAPTABLE STRUCTURE has become a public nuisance, or otherwise poses a risk of harm to public health or safety;

d. whether the NON-ADAPTABLE STRUCTURE has been maintained in a manner which allows it to be used for its intended purpose, with no greater effects on surrounding properties and the public as a whole than was originally intended.

8. Once the Zoning Administrator has made a finding that a NON-ADAPTABLE STRUCTURE is abandoned in place, the Zoning Administrator shall issue notice to the land owner at the owner's last known address that the COUNTY will draw on the performance guarantee within thirty (30) days unless the owner appeals the Zoning Administrator's finding, pursuant to Section 9.1.8 or enters into a written agreement with the

COUNTY to remove such NON-ADAPTABLE STRUCTURE in accordance with Section 6.1 (C)(4)(a) within ninety (90) days and removes the NON-ADAPTABLE STRUCTURE accordingly.

9. The Zoning Administrator may draw on the funds to have said NON-ADAPTABLE STRUCTURE as per Paragraph (C)(4)(a) of the reclamation agreement when any of the following conditions occur:

   a. no response is received from the land owner within thirty (30) days from initial notification by the Zoning Administrator;

   b. the land owner does not enter, or breaches any term of a written agreement with the COUNTY to remove said NON-ADAPTABLE STRUCTURE as provided in Section 6.1(C)(8);

   c. any breach or performance failure of any provision of the reclamation agreement;

   d. the owner of record has filed a bankruptcy petition, or compromised the County's interest in the letter of credit in any way not specifically allowed by the reclamation agreement;

   e. a court of law has made a finding that a NON-ADAPTABLE STRUCTURE constitutes a public nuisance;

   f. the owner of record has failed to replace an expiring letter of credit within the deadlines set forth in Section 6.1(C)(6); or

   g. any other conditions to which the County and the land owner mutually agree, as set forth in the reclamation agreement.

10. Once the letter of credit has been drawn upon, and the site has been restored to its original condition, as certified by the Zoning Administrator, the covenant entered pursuant to Section 6.1(C)(2) shall expire, and the COUNTY shall act to remove said covenant from the record of the property at the Recorder of Deeds within forty-five (45) days.

11. The proceeds of the letter of credit may only be used by the COUNTY to:

a. Remove the NON-ADAPTABLE STRUCTURE and return the site to its condition prior to the placement of the NON-ADAPTABLE STRUCTURE, in accordance with the most recent reclamation agreement submitted and accepted in relation to the NON-ADAPTABLE STRUCTURE;

b. pay ancillary costs related to this process; and

c. remove any covenants placed on the title in conjunction with Section 6.1(C).

The balance of any proceeds remaining after the site has been reclaimed shall be returned to the issuer of the letter of credit.

12. Upon transfer of any property subject to a letter of credit pursuant to this Section, the new owner of record shall submit a new irrevocable letter of credit of same or greater value to the Zoning Administrator, prior to legal transfer of title, and shall sign a new reclamation agreement, pursuant to Section 6.1(C)(4)(a). Once the new owner of record has done so, the letter of credit posted by the previous owner shall be released, and the previous owner shall be released from any further obligations under the reclamation agreement.

3. Amend Paragraph C of Subsection 9.1.11 to add a new Subparagraph 3 to read as follows:

9.1.11 SPECIAL USES

C. Findings

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3. The BOARD may make a finding that a proposed STRUCTURE or physical change to a site, as a part of a SPECIAL USE request, is a NON-ADAPTABLE STRUCTURE. In such a case the requirements of Section 6.1.1(C) shall be applicable.

4. Incorporate the amendments into the text of the Champaign County Zoning Ordinance.

PRESENTED, PASSED, APPROVED AND RECORDED this 21st day of March, A.D. 2002.

SIGNED:

Patricia Avery
Chair,
Champaign County Board
Champaign County, Illinois

ATTEST:

Mark Shelden,
County Clerk &
Ex Officio Clerk of the County Board

(Source: P.A. 92-347, eff. 8-15-01.)

(55 ILCS 5/5-12018) (from Ch. 34, par. 5-12018)

Sec. 5-12018. Testimony at hearings. All testimony by witnesses in any hearing provided for in this Division shall be given under oath.
(Source: P.A. 86-962.)

(55 ILCS 5/5-12019) (from Ch. 34, par. 5-12019)

Sec. 5-12019. Appearance and presentation of evidence by school district. In any hearing before a zoning commission or board of appeals, any school district within which the property in issue, or any part thereof, is located shall have the right to appear and present evidence.
(Source: P.A. 86-962.)

(55 ILCS 5/5-12020)

Sec. 5-12020. Wind farms. A county may establish standards for wind farms and electric-generating wind devices. The standards may include, without limitation, the height of the devices and the number of devices that may be located within a geographic area. A county may also regulate the siting of wind farms and electric-generating wind devices in unincorporated areas of the county outside of the zoning jurisdiction of a municipality and the 1.5 mile radius surrounding the zoning jurisdiction of a municipality. There shall be at least one public hearing not more than 30 days prior to a siting decision by the county board. Notice of the hearing shall be published in a newspaper of general circulation in the county. Counties may allow test wind towers to be sited without formal approval by the county board. Test wind towers must be dismantled within 3 years of installation. For the purposes of this Section, "test wind towers" are wind towers that are designed solely to collect wind generation data. Any provision of a county zoning ordinance pertaining to wind farms that is in effect before the effective date of this amendatory Act of the 95th General Assembly may continue in effect notwithstanding any requirements of this Section.
(Source: P.A. 95-203, eff. 8-16-07.)

Top

ATTACHMENT D

Champaign County Department of

PLANNING & ZONING

Brookens Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
FAX (217) 328-2426

TO: **Environment and Land Use Committee**
FROM: **September 4, 2008**
DATE: **John Hall, Zoning Administrator**
RE: **Zoning Ordinance requirements for wind farms**

STATUS

This topic was on the agenda and discussed at the August 11, 2008, Committee meeting. The consensus of the Committee was to amend the Zoning Ordinance to require County Board approval for wind farm development in the rural zoning districts. Staff seeks direction regarding such an amendment. Basic considerations relevant to a possible amendment to the Zoning Ordinance are reviewed below.

BACKGROUND

A wind farm developer has begun discussions with landowners regarding a proposed wind farm in northeastern Champaign County in the AG-1 Agriculture Zoning Districts. The proposed wind farm appears to include approximately 14 square miles of land in Champaign County for a gross area of approximately 8,960 acres. The wind farm developer has not yet submitted any applications nor formally contacted the Department of Planning and Zoning.

Current Champaign County Zoning Ordinance requirements for wind turbines were added on October 24, 2000, and allow up to three wind turbines per parcel in the AG-1 and AG-2 Districts by Special Use Permit but more than three turbines require rezoning to the I-2 Heavy Industry District. All Special Use Permits are currently approved by the Zoning Board of Appeals (ZBA) with no County Board review. There are no specific site development requirements for wind turbines in the Zoning Ordinance but any wind turbine will be considered a "non-adaptable structure" and a reclamation agreement with a letter of credit to fund reclamation of the site will be required.

In discussion at the August 11, 2008, meeting the consensus of the Environment and Land Use Committee (ELUC) was that any wind farm development should be approved by the Champaign County Board and not simply the Zoning Board of Appeals. Thus, the Zoning Ordinance will have to be amended to provide for County Board approval of wind farm development in the AG-1 and AG-2 Districts. This memorandum reviews basic considerations relevant to that amendment.

PROPOSED ZONING ORDINANCE AMENDMENT

In addition to adding a requirement for a County Board approval for wind farm development, the amendment to the Zoning Ordinance should also add more specific requirements for wind farms. Both concerns are briefly reviewed below.

Alternatives For County Board Approval

The statutes do not specify the type of County Board approval required for a wind farm. The Model Ordinance (see attached) also makes no recommendation for the type of county board approval that should be required for a wind farm. The obvious alternatives for County Board approval of wind farms are the following:

- **County Board Special Use Permit**. Special use permits are appropriate for land uses that are generally acceptable in a zoning district but that may need site specific review for any specific location. The Zoning Ordinance already authorizes up to three turbines per parcel by special use permit in the AG-1 and AG-2 Districts. However, a wind farm will involve tens of thousands of acres and hundreds of land owners and the Committee should consider if a wind farm is materially different than a few isolated wind turbines. There are no other uses in the Zoning Ordinance that are authorized by special use permit and that involve tens of thousands of acres owned by hundreds of land owners. There are no protest rights for special use permits but special conditions may be imposed when necessary to address the concerns of neighbors and to meet the criteria in the Zoning Ordinance.

  This is the type of approval required for wind farms in McLean County and most other counties. In McLean County each wind farm is a single special use permit involving tens of thousands of acres of land and a few hundred wind turbines and each wind turbine site is reviewed as part of the public hearing and the approval is specific to these sites.

- **Zoning map amendment (overlay rezoning) and County Board Special Use Permit**. If the Committee believes that a wind farm is materially different than a few isolated wind turbines then a map amendment approach involving an overlay rezoning district would be more appropriate in combination with a County Board special use permit. An overlay map amendment is similar to the approach currently used for rural residential development in the Rural Residential Overlay Zoning District. A map amendment will be subject to protest rights by adjacent land owners and any relevant municipality or township with a plan commission. A map amendment could be simultaneous with a County Board special use permit so it should not slow down the approval process.

Specific Standards For Wind Farms

The McLean County Building and Zoning Department reports that the McLean County Zoning Ordinance requirements for wind power generation facilities are based on the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* published on May 5, 2003, by the Chicago Legal Clinic, Inc. See attached. This is a widely accepted model ordinance and the various requirements in the *Model Ordinance* should be added to the Champaign County Zoning Ordinance. Other requirements that could also be added include landscape assessment requirements to illustrate the appearance of the wind farm on the landscape.

ATTACHMENTS
A *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois*
B Items To Be Included In A Proposed Zoning Ordinance Text Amendment

ATTACHMENT E

Champaign County Department of

PLANNING & ZONING

Brookens Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
FAX (217) 328-2426

TO: **Environment and Land Use Committee**
FROM: **October 14, 2008**
DATE: **John Hall, Zoning Administrator**
RE: **Zoning Ordinance requirements for wind farms**

STATUS

This topic was continued from the September meeting. This memo gives a brief overview of the approach of other Illinois counties in regulation of wind farms.

The review of other Illinois counties revealed apparent inconsistencies in application of the recommendations of the *Model Ordinance* in regards to required separations from existing dwellings and required separations for future dwellings.

The review of other counties requirements identified several additional standards for wind farms that have been added to the list of proposed requirements (see attached). However, staff does not yet have a coherent proposed amendment and requests that this item be continued to the next meeting.

REVIEW OF OTHER COUNTIES REQUIREMENTS FOR WIND FARMS

Staff has reviewed the Zoning Ordinance wind farm requirements for the Illinois counties of DeKalb, Ford, Kankakee, LaSalle, Livingston, McLean, Mercer, Ogle, Rock Island, Sangamon, and Woodford. Nine of those 11 counties have wind farm requirements based on the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* published on May 5, 2003, by the Chicago Legal Clinic, Inc. (the *Model Ordinance*). DeKalb County has no specific requirements for wind farms nor is that use specifically authorized in the DeKalb County Zoning Ordinance. Ogle County requirements do not appear to be based on the Model Ordinance. Coles County, which does not have an adopted Zoning Ordinance, has adopted standards for wind farms based on the Model Ordinance

COMPATIBILITY AND SEPARATION FROM RESIDENTIAL USES

Land use compatibility is the most relevant consideration in determining the type of County Board approval that is most reasonable for wind farm development. The primary requirements in the *Model Ordinance* that ensure land use compatibility are (1) the required separation of 1,000 feet between a wind turbine tower and any primary structures (such as dwellings) and (2) the required separation between a wind turbine tower and the perimeter of the development which is required to be a minimum of 1.1 times the height of the tower. The maximum height is 499 feet so this separation is a maximum of 549 feet.

The *Model Ordinance* does not explain the basis of any of the required separations and so a local jurisdiction has no basis on which to evaluate an alternative separation requirement. The Model Ordinance also does not specify whether the 1,000 feet separation is intended to apply only to uses that exist on the date of approval of the wind farm development or if it is intended to apply to future principal uses that may be established. And, in regards to future dwellings that may be constructed on adjacent land, the required separation between wind turbine towers and the perimeter of the development is arguably the most relevant consideration. Of the nine counties surveyed, the following standards were adopted for this basic separation:

- Two of the counties surveyed (LaSalle and Kankakee) require 1,200 feet separation between a wind tower and the nearest existing "non-participating" residence. This is greater than the 1,000 feet required by the Model Ordinance. However, for future principal uses (such as a dwelling), LaSalle County requires a separation of only 1.1 times the height of the tower (a maximum of 549 feet) and Kankakee requires only 600 feet. LaSalle County requires a separation of 1.25 times the height of the tower (approximately 624 feet maximum) from the property line and Kankakee requires a separation of 1.1 times the height of the tower (a maximum of 549 feet).

- Two of the counties surveyed (Woodford and Mercer) require less than 1,000 feet separation (750 feet and 1.1 times the tower height (a maximum of 549 feet), respectively) between a wind tower and the nearest "non-participating" residence. Both counties require a separation of 1.1 times the tower height (a maximum of 549 feet) between a tower and a future principal use (such as a dwelling) or between a tower and a property line.

- The other five counties adopted the 1,000 feet separation between a wind tower and the nearest existing "non-participating" residence. Four of those counties also require a separation of 1.1 times the tower height (a maximum of 549 feet) between a tower and a future principal use (such as a dwelling) or between a tower and a property line. This also would not seem to provide a similar separation for future dwellings on non-participating property.

  Sangamon County was in this group and it requires a 1,200 feet separation between a wind tower and the property line which ensures that any future dwelling on adjacent non-participating properties will be provided with a greater separation than participating dwellings.

It is not clear why a future dwelling on a non-participating property is not provided the same separation as an existing dwelling on a non-participating property. The separation provided between a wind tower and the property line is of greater importance based on the degree of non-agricultural rural development that is authorized within the county. Of the nine counties surveyed only Woodford County allows a greater amount of rural residential development than Champaign County. Many of the counties require non-farm rural dwellings to have a very large minimum lot size (20 acres in Kankakee County, 35 acres in LaSalle, and 40 acres in McLean and Sangamon) and so significant additional separation is probably provided on the lot. Sangamon County is alone in requiring a 1,200 feet separation between a wind tower and the property line which ensures that any future dwelling on adjacent non-participating properties will be provided with a greater separation than participating dwellings.

Note that increasing the separation between a wind tower and the nearest existing "non-participating" residence from 549 feet to 1,200 feet is a little more than doubling of the separation distance but results in much larger increase in the per wind turbine acreage requirement (21.7 acres vs. 103.8 acres). Increasing the separation from 549 feet to 1,000 feet increases the acreage requirement from 21.7 acres to 72 acres. Adding unnecessary acreage to the required separation will make it make it more difficult and expensive for a wind farm developer to assemble the required parcels of land.

In this amendment the County Board needs to be careful to require adequate separation for adjacent non-participating land owners without requiring too much separation so that the development of wind farms are unduly restricted.

Staff does not yet have a coherent proposed amendment and requests that this item be continued to the next meeting.

ADDITIONAL STANDARDS

Based on the review of other counties' requirements several new standard requirements are proposed to be included with the text amendment for Champaign County (see attached).

ATTACHMENTS

A REVISED Items To Be Included In A Proposed Zoning Ordinance Text Amendment

ATTACHMENT F

Champaign
County
Department of
PLANNING &
ZONING

Brookens
Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
FAX (217) 328-2426

TO: **Environment and Land Use Committee**

FROM: **November 6, 2008**

DATE: **John Hall, Zoning Administrator**

RE: **Zoning Ordinance requirements for wind farms**

STATUS

This topic was continued from the October meeting and was also discussed at the September and August meetings. The September Agenda included a copy of the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* but has not been included in this memo.

The list of items to be included in the proposed amendment has been revised and deletions are indicated by strikeout and new items are underlined (see the attachment). A proposal for specific application fees will be available at the meeting.

As indicated in item 44 on the attached list, staff recommends that based on the inherent compatibility of wind farm development with agriculture, it would be appropriate to authorize wind farm development with nothing more than a County Board Special Use Permit. The various recommended separations (items 37 and 38 on the attachment) should result in compatibility with both existing and future rural residences.

ATTACHMENTS

A REVISED Items To Be Included In A Proposed Zoning Ordinance Text Amendment

ATTACHMENT A: Items To Be Included In A Proposed Zoning Ordinance Text Amendment
***REVISED* NOVEMBER 5, 2008**

The following requirements from the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* are recommended to be added to the Champaign County Zoning Ordinance as "standard conditions" for a special use permit for wind farm development (the following is not the actual amendment):

1. A site plan for the installation of the wind turbines showing the planned location each tower, guy lines and anchor bases (if any), property lines, setback lines, public access roads and turnout locations, substations, electrical cabling from the towers to the substations, ancillary equipment, third party transmission lines, and layout of all structures within the geographical boundaries of any applicable setback.

2. Wind farm development shall conform to applicable industry standards, including those of the American National Standards Institute (ANSI) and Underwriters Laboratories (UL), Det Norske Veritas (DNV), Germanisher Lloyd Wind Energie (GL), or an equivalent third party.

3. Certification by an Illinois Professional Engineer that the foundation and tower design are within accepted professional standards based on soil and climate conditions.

4. Redundant braking systems including aerodynamic overspeed controls (including variable pitch, tip, and other similar systems) and mechanical brakes. Mechanical brakes shall be operated in a fail-safe mode. Stall regulation shall not be considered a sufficient braking system for overspeed protection.

5. All electrical components shall comply with ANSI and International Electric Commission (IEC) standards.

6. Towers and blades shall be painted white or gray or another approved non-reflective and unobtrusive color.

7. The proposed development shall comply with all relevant Federal Aviation Administration (FAA) requirements.

8. A reasonable visible warning sign concerning voltage must be placed at the base of all pad-mounted transformers and substations.

9. Visible, reflective, colored objects such as flags, reflectors, or tape shall be placed on the anchor points of guy wires and along the guy wires up to a height of 15 above the ground.

10. All towers shall be unclimable by design or protected by anti-climbing devices such as fences with locking portals at least six-feet high; or anti-climbing devices 12 feet vertically from the base of the tower.

~~11. All towers shall be at least 1,000 feet from any adjacent non-participating residence or other non-participating principal use and a distance at least equal to 1.10 times the tower height (measure to tip of the rotor) of any adjacent residence or other participating~~

~~structure. (Note: Participating residence or structure refers to residences or structures owned by landowners who are participating in the special use permit.)~~ (Note: See item 38 which replaces item 11)

12. All towers shall be at least a distance of 1.10 times the tower height (measure to tip of the rotor) from public streets, third party transmission lines, and communication towers although this may be waived.

13. All towers shall be at least a distance of 1.10 times the tower height (measured to tip of the rotor) from adjacent property lines although this may be waived.

14. An agreement between the developer and any relevant public street jurisdiction regarding any street maintenance and/or street improvements necessitated by the proposed development. Any public streets proposed to be used for the purpose of transporting wind turbines or tower parts and/ or equipment for construction, operation, or maintenance of the wind farm development shall be identified in the proposal and any applicable weight or size permit shall be obtained from the relevant government agency prior to construction and development; and the applicant.

15. Annual operation and maintenance reports.

16. Any physical modification of the wind turbines and wind farm that alters the mechanical load, mechanical load path, or major electrical components shall require re-certification (a new special use permit) but like-kind replacement shall not.

17. The applicant shall provide notice to applicable microwave transmission providers and local emergency service providers of the project summary and site plan and shall take all reasonable measures to minimize and mitigate any interference with microwave transmission.

18. The applicant shall cooperate with the relevant fire protection district emergency response plan.

19. All solid wastes and hazardous wastes shall be disposed of in conformance with all state and federal regulations.

20. Noise generated from the proposed wind farm shall be in conformance with all applicable Illinois Pollution Control Board (IPCB) regulation. The applicant shall demonstrate compliance with the relevant IPCB regulations by submitting documentation thereof by a qualified professional.

21. The applicant shall submit evidence by a qualified wildlife biologist or ornithologist based on an avian habitat study or other relevant studies that the wind farm shall not have a substantial adverse impact on bird or bat populations.

22. The owner/ operator shall maintain a general liability insurance policy covering bodily injury and property damage with limits of at least $1 million per occurrence and $1 million in the aggregate and shall submit annual certification of such.

23. A decommissioning plan to ensure that the wind farm project is property decommissioned. (Note: The existing Champaign County Zoning Ordinance requirement for a reclamation agreement already fulfills this requirement.)

Additional requirements not included in the *Model Ordinance Regulating The Siting Of Wind Energy Conversion Systems In Illinois* that seem reasonable to include as "standard conditions" for a special use permit for wind farm development are the following (items revised since October 14, 2008, are underlined):

24. Landscape visual assessment including at least two photographic images of the subject property before the proposed development and simulated images of the subject property after the proposed development from the same viewing positions.

~~25. Zoning case application fees and Zoning Use Permit fees specific to Wind Energy Developments.~~

25. A description of the applicant's proposed emergency response plan for natural disasters.

26. Authorize a wind farm as an additional principal use on the property.

27. Eliminate minimum yard requirements for wind turbine towers on wind turbine tower lots (*Note: Required separations proposed to be added from the Model Ordinance far exceed the minimum yard requirements.)*

28. Provide that wind turbine towers may exceed the Ordinance basic maximum height limit.

29. Require repairs to underground tiles, drainage ditches, and other drainage infrastructure that are disturbed by the wind farm development (see Ford County).

(Note: The specific requirements for this item are under review.)

30. Provide a sunset clause if construction does not commence within ~~36 months~~ 10 years (see Ford County).

31. Decommissioning triggers including turbine(s) that are non-operational for six months or which are declared by the petitioner to be obsolete, non-functional, or otherwise subject only to nominal taxation (see Livingston County).

32. Public complaint hotline telephone number, complaint logging and tracking procedures with annual report to the County (see Livingston County).

33. Require underground electrical and communication lines to the property line or the relevant substation (see LaSalle County) where practical.

34. Minimum clearance from lowest tip of rotor to ground (15 feet minimum or greater if required by the Board)

35. Prohibit any wind farm from being within ~~a municipal extra-territorial jurisdiction unless specifically indicated in the municipal comprehensive plan.~~one-and-one-half miles of a municipality that has adopted a zoning ordinance unless the wind farm has also been approved by the municipality.

36. The wind turbine tower must be a monopole construction.

37. Specify that the area of a wind farm special use permit shall include all of the following:
    (a) all land that is within 900 feet from the base of each wind turbine tower except that in the case of land that is more than 1,320 feet from an existing public street right of way in which case the area of the wind farm need only include all land that is within a distance equal to 1.10 times the tower height (measured to the tip of the highest rotor) from the base of any tower; and

    (b) all access drives and accessory structures; and

    (c) all electrical distribution lines and substations that are not under the ownership of a utility; and

    (d) require that the area of the wind farm special use permit, excluding any intervening public street rights of way, shall not completely surround any existing parcel of land that is not included in the Special Use Permit application unless a signed statement is received from the owner of the surrounded land asserting no opposition to the proposed Special Use Permit.

(Note: The rumored wind farm development in the northeastern part of the County may surround an area of the B-1 Rural Trade Center Zoning District at Dailey. This provision would allow that are of B-1 to be surrounded by a wind farm development if signed statements are received.)

38. Require the following separations for land use compatibility vis-a-vis dwellings and principal uses (also see related items 11, 12, and 13):
    (a) provide at least 1,000[1] feet separation from the base of any tower to any existing non-participating[2] dwelling or principal use; and

    (b) provide at least 900[1] feet separation from the base of any tower to any existing participating[2] dwelling or principal use; and

    (c) provided that any of the above separations may be reduced to a distance of not less than 1.10 times the tower height (measured to tip of the highest rotor) from the base of any tower upon submission of a signed waiver by the owner(s) of any existing principal use or a signed statement by an applicant for a Zoning Use Permit for a new principal use.

(Notes: 1. The Model Ordinance recommends 1,000 feet separation from all principal uses whether participating or not.
2. Participating dwelling or principal use refers to residences or structures owned by landowners who are participating in the special use permit. Non-participating indicates landowners who are not participating.)

39. Require that within one month of County Board approval of a wind farm special use permit, the applicant must file a miscellaneous document with the Champaign County Recorder of Deeds for every parcel of land on which the special use permit has been approved. This document shall state that a wind farm special use permit has been approved on some or all of the land and shall include the relevant zoning case number and the relevant County Board Approving Resolution number and shall explain that additional information is available at the Champaign County Department of Planning and Zoning.

Additional basic requirements that are recommended to be added to the Zoning Ordinance but which are not standard conditions are the following (items revised since October 14, 2008, are underlined):

40. Zoning case application fees and Zoning Use Permit fees specific to Wind Energy Developments.

(Note: The Committee reviewed possible fees at the September meeting. This item was previously included as item 25 but it should not be a standard condition. A specific proposal for fees will be recommended at the meeting .)

41. Add provision for County Board Special Use Permit approvals.

42. Add defined term "WIND FARM" based on the definition of "wind energy conversion system" included in the Model Ordinance.

43. Delete the existing Ordinance requirement that "Wind Turbine (more than 3 wind turbines)" is a Special Use Permit only in the I-2 Heavy Industry Zoning District.

44. Add requirement that "WIND FARM" requires a County Board Special Use Permit in the AG-1 District.

(Note: The rumored wind farm development in the northeastern part of the County may in fact include a relatively small isolated area of CR Conservation Recreation Zoning that is not along a major stream and is not wooded. If that is the case that land may be suitable for rezoning to the AG-1 District.)

44. Modify the existing Ordinance requirement that "Wind Turbine (1 – 3 wind turbines)" is a Special Use Permit in the AG-1 and AG-2 Agriculture Zoning Districts and the I-1 and I-2 Industrial Zoning Districts and require that such turbines cannot be part of a WIND FARM.

(Note: This particular item must be reviewed for compliance with the Statutes by the State's Attorney.)

45. Add provisions for wind turbines that are no more than 100 feet tall and test towers.

ATTACHMENT G

NOTICE OF PUBLIC HEARING IN REGARD TO AN AMENDMENT TO THE CHAMPAIGN COUNTY ZONING ORDINANCE.

CASE: 634-AT-08

The Champaign County Zoning Administrator, 1776 East Washington Street, Urbana, has filed a petition to change the text of the Champaign County Zoning Ordinance. The petition is on file in the office of the Champaign County Department of Planning and Zoning, 1776 East Washington Street, Urbana, IL.

A public hearing will be held **Thursday, February 12, 2009, at 6:30 p.m.** prevailing time in the Lyle Shields Meeting Room, Brookens Administrative Center, 1776 East Washington Street, Urbana, IL, at which time and place the Champaign County Zoning Board of Appeals will consider a petition to:

Amend the Champaign County Zoning Ordinance as follows:

PART A

1. In Section 2, add a purpose statement regarding promotion of wind energy in a safe manner.
2. In Section 3, add definitions for "WIND FARM" and "WIND FARM TOWER".
3. Add subparagraph 4.2.1 C. 2. to indicate that WIND FARM may be authorized by County Board special use permit as a second principal use on a lot in the AG-1 District and indicate that WIND FARM TOWER may be authorized by County Board special use permit as multiple principal structures per lot in the AG-1 District.
4. Amend subsection 4.3.1 to exempt WIND FARM TOWER from the height regulations except as height regulations are required as a standard condition in Section 6.1.3.
5. Amend paragraph 4.3.4 A. to exempt WIND FARM TOWER lots from the minimum lot requirements of Section 5.3 and paragraph 4.3.4 B. except as minimum lot requirements are required as a standard condition in Section 6.1.3.
6. Amend paragraph 4.3.4 H. to exempt WIND FARM and WIND FARM TOWER from the Pipeline Impact Radius regulations except as Pipeline Impact Radius regulations are required as a standard condition in Section 6.1.3.
7. In Section 5.1, add the WIND FARM Overlay Zoning District with a new purpose and intent statement.
8. In Section 5.2 delete the uses "Wind Turbine (more than 3 wind turbines)" and "Wind Turbine (1- 3 wind turbines)"; add the uses "WIND FARM" and "WIND FARM TOWER" and indicate that both are authorized by County Board Special Use Permit in the AG-1 Zoning District and indicate footnote 17; and add new

footnote 17 indicating WIND FARM County Board special use permit is only authorized in the WIND FARM Overlay Zoning District in areas also zoned AG-1.

9. In Section 5.3 add new footnote 14 that exempts WIND FARM TOWER lots in the WIND FARM Overlay Zoning District from the minimum lot requirements of Section 5.3 except as such regulations are required as a standard condition in Section 6.1.3.

10. Amend Section 5.4 to prohibit the establishment of the Rural Residential Overlay Zoning District on land also zoned WIND FARM Overlay Zoning District.

11. Add new Section 5.5 WIND FARM Overlay Zoning District that limits the overlay district to areas also zoned AG-1; reviews basic considerations in the establishment of the overlay district; requires any WIND FARM TOWER to be authorized in the WIND FARM County Board Special Use Permit; requires minimum separation distances between a new PRINCIPAL USE and a WIND FARM TOWER; establishes an expiration for the overlay district designation; and authorizes the Zoning Board and County Board to recommend specific conditions on the adoption of the overlay district.

12. Amend existing paragraph 6.1.1 C. Site Reclamation to require the irrevocable letter of credit to be drawn upon a federally insured financial institution within 200 miles of Urbana or that reasonable and anticipated travel costs be added to the amount of the letter of credit.

13. In Section 6 relocate existing paragraphs 6.1.1 A. and B. to new subparagraphs 9.1.11 A. 3. and 4.; change the name of Subsection 6.1.1 to indicate standard conditions that may apply to specific special uses; renumber existing paragraph 6.1.1 C. to 6.1.1. A.; change the name of Subsection 6.1.2 to indicate standard conditions that apply to all special use permits; relocate existing text in Subsection 6.1.2 to be under the Section 6.1 heading; relocate and renumber existing paragraph 6.1.1 D. to become new paragraph 6.1.2 A.; and change the name of Subsection 6.1.3 to indicate standard conditions that apply to specific types of special use permits.

14. Add new subsection 6.1.4 with new standard conditions for a WIND FARM, WIND FARM TOWER, and WIND FARM TOWER lot.

15. Amend existing subsection 9.1.11 Special Uses to require the County Board to authorize certain special use permits where identified in Section 5.2; require the County Board to adopt findings; authorize the County Board to waive any standard conditions; authorize the County Board to prescribe any special conditions that it may determine to be appropriate; and clarify all requirements in Section 6 are standard conditions.

16. Amend subsection 9.3.1 to add fees for WIND FARM and WIND FARM TOWER zoning use permits.

17. Amend subsection 9.3.3 to add application fees for WIND FARM County Board special use permit and WIND FARM Overlay Zoning District map amendment.

PART B

1. In Section 3, add a definition for "PRIVATE WIND TURBINE TOWER".

2. Amend subsection 4.3.1 to require that height regulations do not apply to a PRIVATE WIND TURBINE TOWER that is not part of a WIND FARM and require PRIVATE WIND TURBINE TOWER to be located from the nearest property line at least 1.10 times the overall height to the tip of the rotor; and require PRIVATE WIND TURBINE TOWERS that are more than 125 feet in height to be authorized by special use permit.

3. In subsection 6.1.3 add new standard conditions for PRIVATE WIND TURBINE TOWER taller than 125 feet.

4. Add new subsection 7.6.4 PRIVATE WIND TURBINE TOWER and require that there can be no more than one PRIVATE WIND TURBINE TOWER per lot and add other requirements.

PART C

1. Amend Section 5.2 to require a County Board Special Use Permit for any subdivision that requires the Rural Residential Overlay Zoning District.

2. Amend Section 5.4 to require a County Board Special Use Permit for any authorized subdivision in the Rural Residential Overlay Zoning District.

All persons interested are invited to attend said hearing and be heard. The hearing may be continued and reconvened at a later time.

Doug Bluhm, Chair
Champaign County Zoning Board of Appeals

TO BE PUBLISHED: WEDNESDAY, JANUARY 28, 2009 ONLY

Send bill and one copy to: Champaign County Planning and Zoning Dept.
Brookens Administrative Center
1776 E. Washington Street
Urbana, IL 61802
Phone: 384-3708

Attachment H. Draft Proposed Changes To Section 2
FEBRUARY 6, 2009

1. Add new purpose 2.(r):

(r) providing for the safe and efficient development of renewable energy sources in those parts of the COUNTY that are most suited to their development.

Attachment I. Draft Proposed Changes To Section 3
FEBRUARY 6, 2009

1. Add the following to Section 3.0 Definitions

DWELLING OR PRINCIPAL BUILDING, PARTICIPATING:
{NOTE: Staff is still drafting this condit.}

DWELLING OR PRINCIPAL BUILDING, NON- PARTICIPATING:
{NOTE: Staff is still drafting this definition.}

PRIVATE WAIVER:
{NOTE: Staff is still drafting this definition.}

WIND FARM: A unified development of WIND FARM TOWERS and all other necessary components including cabling, transformers, and a common switching station which are intended to produce electricity by conversion of wind energy and to deliver the electricity to the power grid and having a name plate capacity of more than 10 megawatts (MW). A WIND FARM is under a common ownership and operating control even though the individual WIND FARM TOWERS may be located on land that is leased from many different landowners.

WIND FARM TOWER: A wind turbine nacelle and rotor and the supporting tower structure that are part of a WIND FARM development and intended to produce electricity for the power grid.

WIND TOWER, TEST:
{NOTE: Staff is still drafting this definition.}

WIND TURBINE TOWER: A wind turbine nacelle and rotor and the supporting tower structure that is owned by a private landowner for the purpose of producing electrical energy that may be used onsite or sold to a utility. {the regulations will identify relevant height limits, limit on number, etc.)

Attachment J. Draft Proposed Changes To Section 5
FEBRUARY 6, 2009

1. Add new Subsection 5.1.17 as follows:

5.1.17 WIND FARM OVERLAY
The WIND FARM OVERLAY Zoning District is intended to provide areas that are suitable for development of a WIND FARM County Board SPECIAL USE Permit.

2. Add new subsection 5.5 as follows:

5.5 WIND FARM OVERLAY Zoning DISTRICT

5.5.1 Acts Prohibited
No WIND FARM or WIND FARM TOWER or cabling, transformers, common switching station, or other necessary device or STRUCTURE serving a WIND FARM shall be constructed in the AG-1 District on land that is not in conformance with this Section.

5.5.2 Exemptions

A. The following may be authorized without the creation of a WIND FARM OVERLAY Zoning District:

1. The construction of a WIND TURBINE TOWER.

2. The construction of a TEST WIND TOWER.

5.5.3 Establishment of the WIND FARM OVERLAY Zoning District

A. The establishment of the WIND FARM OVERLAY Zoning District is an amendment to the Champaign County Zoning Ordinance and shall be implemented in accord with the provisions of Subsection 9.2 as modified herein.

B. The adoption of the WIND FARM OVERLAY Zoning District shall augment the provisions of the underlying DISTRICT and shall alter the following requirements:

1. The height regulations of Section 4.3.1 and Section 5.3 as applied only to WIND FARM TOWERS except as height regulations are required as a standard condition in Section 6.1.4.

2. The minimum lot requirements of Section 5.3 and paragraph 4.3.4 B. as applied only to WIND FARM TOWERS except as minimum lot requirements are required as a standard condition in Section 6.1.4.

3. The requirements of paragraph 4.3.4 H. regarding Pipeline Impact Radius as applied only to WIND FARM TOWERS and other WIND FARM components except as Pipeline Impact Radius regulations are required as a standard condition in Section 6.1.4.

4. New DWELLINGS and PRINCIPAL BUILDINGS may not be constructed as follows:

(a) less than 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) from the base of a WIND FARM TOWER; or

(b) less than 1,000 feet from the base of a WIND FARM TOWER except upon submission of a PRIVATE WAIVER signed by the owner of said dwelling or building or adjacent property. The PRIVATE WAIVER must specify the agreed minimum separation and specifically acknowledge that the grantor accepts the resulting noise level caused by the WIND FARM.

(c) The Rural Residential Overlay Zoning District shall not be established less than 1,000 feet from the base of a WIND FARM TOWER. *(STAFF NOTE: This same requirement needs to be added to Subsection 5.3 regarding the Rural Residential Overlay Zoning District)*

C. The WIND FARM OVERLAY Zoning District shall include the following areas:

1. All land that is within 1,000 feet from the base of each WIND FARM TOWER except that land that is more than 1,320 feet from any existing public street right of way in which case the area of the wind farm need only include all land that is within a distance equal to 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) from the base of that WIND FARM TOWER.

2. Any tracts of land that are not included in the area of the WIND FARM County Board SPECIAL USE Permit but that are surrounded by the area of the WIND FARM County Board SPECIAL USE Permit except any such tracts of land that are larger than five acres.

3. The area of the WIND FARM OVERLAY Zoning District shall also include such tracts of land or portions of tracts of land so as to make a single contiguous area.

D. BOARD Findings

1. The BOARD shall make the following finding before forwarding a recommendation to the GOVERNING BODY with respect to a map amendment case to create a WIND FARM OVERLAY Zoning District:

   That based on the considerations in the related COUNTY BOARD SPECIAL USE PERMIT (insert actual case number) the proposed site is or is not suitable for the development of the specified maximum number of WIND FARM TOWERS.

2. In making the finding, the BOARD shall consider the following:

   a. The degree of conformance of the related WIND FARM County Board SPECIAL USE permit with the standard conditions for WIND FARM

County Board SPECIAL USE permit established in Section 6.1.4 as recommended by the BOARD including any necessary waiver of standard conditions.

b. The recommended findings of the BOARD in the related WIND FARM County Board SPECIAL USE permit.

3. The BOARD may also make recommendations for specific conditions that should be imposed upon the adoption of any WIND FARM Overlay Zoning District.

E. APPLICANTS Rights and Limitations Upon Approval

1. Approval of a WIND FARM OVERLAY DISTRICT is specific to the tracts of land designated on the application.

2. Approval of a WIND FARM OVERLAY DISTRICT shall not be deemed to be an approval of a WIND FARM County Board SPECIAL USE permit.

3. WIND FARM OVERLAY DISTRICT designation expires in 10 years if no Zoning Use Permit is granted.

5.4.5 Submittals Required Upon Application

A. A written application as required in Subsection 9.2.1 may be submitted by the WIND FARM Applicant provided that it includes the signatures of the OWNERS of more than 50% of the area involved.

B. The application shall include a plan of the proposed WIND FARM OVERLAY DISTRICT indicating the overall dimensions and acreage of the proposed DISTRICT; existing STREETS and STREET numbers; existing tax parcels; township section and range; and location of the proposed WIND FARM County Board SPECIAL USE Permit.

Attachment K. Draft Proposed New Section 6.1.4
FEBRUARY 6, 2009

6.1.4 WIND FARM and WIND FARM TOWER County Board SPECIAL USE Permit

A WIND FARM County Board SPECIAL USE Permit may only be authorized in the WIND FARM Overlay Zoning District subject to the following standard conditions.

A. General Standard Conditions

1. The area of the WIND FARM County Board SPECIAL USE Permit must include the following:

    (a) All land that is a distance equal to 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) from the base of that WIND FARM TOWER.

    (b) All necessary access lanes or driveways and any required new PRIVATE ACCESSWAYS.

    (c) All necessary WIND FARM ACCESSORY STRUCTURES including electrical distribution lines, transformers, common switching stations, and substations not under the ownership of a PUBLICLY REGULATED UTILITY.

2. The WIND FARM County Board SPECIAL USE Permit shall not be located in the following areas:

    (a) Less than one-and-one-half miles of an incorporated municipality that has a zoning ordinance in conformance with {legal citation to municipal zoning enabling statute}.

    (b) Less than one mile from the CR Conservation Recreation Zoning District.

B. Minimum Lot Standard Conditions

1. There are no minimum LOT AREA, AVERAGE LOT WIDTH, SETBACK, YARD, or maximum LOT COVERAGE requirements for a WIND FARM.

C. Minimum Standard Conditions for Separations for WIND FARM TOWERS from adjacent USES and STRUCTURES

The location of each WIND FARM TOWER shall provide the following required separations:

1. At least 1,000 feet separation from the base of a WIND FARM TOWER to any PARTICIPATING DWELLING OR PRINCIPAL BUILDING provided that the noise level caused by the WIND FARM at the particular building complies with the applicable Illinois Pollution Control Board regulations.

2. At least 1,200 feet separation from the base of a WIND FARM TOWER to any NON-PARTICIPATING DWELLING OR PRINCIPAL BUILDING provided that the noise level caused by the WIND FARM at the particular building complies with the applicable Illinois Pollution Control Board regulations.

3. The above separations may be reduced to a distance no less than 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) upon submission of a PRIVATE WAIVER signed by the owner of said dwelling or building or adjacent property. The PRIVATE WAIVER must specify the agreed minimum separation and specifically acknowledge that the grantor accepts the resulting noise level caused by the WIND FARM.

4. A separation distance equal to 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) from the base of a WIND FARM TOWER to the nearest adjacent property line for property that is also part of the WIND FARM County Board SPECIAL USE Permit. This separation may be reduced upon submission of a PRIVATE WAIVER signed by the owner of the adjacent property. The PRIVATE WAIVER must specify the agreed minimum separation.

5. A separation distance equal to 1.10 times the total WIND FARM TOWER height (measured to the tip of the highest rotor blade) from the base of a WIND FARM TOWER to the nearest public STREET RIGHT OF WAY, third party electrical transmission lines, and communication towers. This separation may be reduced upon submission of a PRIVATE WAIVER signed by the owner of said electrical transmission line or communication tower or the relevant public street maintenance jurisdiction. The PRIVATE WAIVER must specify the agreed minimum separation.

6. Any PRIVATE WAIVER establishing an agreement for a lesser minimum separation as authorized above shall be submitted prior to the final determination by the BOARD and must be recorded as part of the chain of title in the deed to any relevant tract of land prior to authorization of any relevant ZONING USE PERMIT. No waiver of a standard condition shall be required in the event of a duly agreed and signed PRIVATE WAIVER.

7. A separation distance from the base of a WIND FARM TOWER to any GAS PIPELINE or HAZARDOUS LIQUID PIPELINE equal or greater than the PIPELINE IMPACT RADIUS required by paragraph 4.3.4 H.

D. Standard Conditions for Design and Installation of WIND FARM TOWERS

1. Design Safety Certification

   (a) WIND FARM TOWERS, turbines, and all related construction shall conform to applicable industry standards, including those of the American National Standards Institute ("ANSI"). Applicants shall submit certificates of design compliance that equipment manufacturers have obtained from Underwriters Laboratories ("UL"), Det Norske Veritas ("DNV"), Germanischer Lloyd Wind Energy ("GL"), or equivalent third party.

   (b) Each Zoning Use Permit Application for a WIND FARM TOWER shall include a certification by an Illinois Professional Engineer or Illinois Licensed Structural Engineer that the foundation and tower design of the WIND FARM TOWER is within accepted professional standards, given local soil and climate conditions.

2. Controls and Brakes

   (a) All WIND FARM TOWER turbines shall be equipped with a redundant braking system. This includes both aerodynamic over speed controls (including variable pitch, tip, and other similar systems) and mechanical brakes.

   (b) Mechanical brakes shall be operated in fail-safe mode.

   (c) Stall regulation shall not be considered a sufficient braking system for over speed protection.

3. Electrical Components. All electrical components of the WIND FARM shall conform to applicable state and national codes including, and relevant national and international standards (e.g. ANSI and International Electrical Commission).

4. The WIND FARM TOWER must be a monopole construction.

5. The total WIND FARM TOWER height (measured to the tip of the highest rotor blade) must be less than 500 feet.

6. WIND FARM TOWERS, turbine nacelles, and blades shall be painted white or gray or another non-reflective, unobtrusive color as specified in the application and authorized by the BOARD.

7. The WIND FARM shall comply with all applicable Federal Aviation Administration (FAA) requirements which shall be explained in the

application. The minimum lighting requirements of the FAA shall not be exceeded and unless otherwise required by the FAA only white strobe lights shall be used at night and only the minimum number of such lights with the minimum intensity and the minimum number of flashes per minute (longest duration between flashes) allowed by FAA.

8. Warnings
   (a) A reasonably visible warning sign concerning voltage must be placed at the base of all pad-mounted transformers and Substations.

   (b) Visible, reflective, colored objects, such as flags, reflectors, or tape shall be placed on the anchor points of guy wires and along the guy wires up to a height of 15 feet from the ground.

9. All WIND FARM TOWERS must be protected from unauthorized climbing by devices such as fences at least six feet high with locking portals or anti-climbing devices 12 feet vertically from the base of the WIND FARM TOWER.

E. Standard Conditions to Protect Agricultural Drainage
{NOTE: Staff is still drafting this condition.}

F. Standard Conditions for Use of Public Streets
1. Any WIND FARM Applicant proposing to use any County Highway or a township or municipal STREET for the purpose of transporting WIND FARM TOWER or Substation parts and/or equipment for construction, operation, or maintenance of the WIND FARM TOWERS or Substations(s), shall:

   a. Identify all such public STREETS that will be used for the purpose of transporting WIND FARM TOWERS or Substation parts and/or equipment for construction, operation, or maintenance of the WIND FARM TOWERS or Substations.

   b. Enter into a Roadway Upgrade and Maintenance agreement approved by the County Engineer and State's Attorney; or Township Highway Commissioner, where relevant, or municipal engineer, where relevant, in which the Applicant shall agree to the following minimum conditions:
      (1) The applicant shall agree to conduct a pre-WIND FARM construction baseline survey to determine existing STREET conditions for assessing potential future damage including the following:

i. A videotape of the affected length of each subject STREET supplemented by photographs if necessary.

ii. Pay for costs of the County to hire a consultant to make a study of any structure on the proposed route that the County Engineer feels may not carry the loads likely during the WIND FARM construction.

iii. Pay for any strengthening of STREET structures that may be necessary to accommodate the proposed traffic loads caused by the WIND FARM construction.

(2) The Applicant shall agree upon an estimate of costs for any other necessary roadway improvements prior to construction.

(3) The Applicant shall obtain any necessary approvals for the STREET improvements from the relevant STREET maintenance authority.

(4) The Applicant shall obtain any necessary Access Permits including any required plans.

(5) The Applicant shall erect permanent markers indicating the presence of underground cables.

(6) The Applicant shall install marker tape in any cable trench.

(7) The Applicant shall become a member of the Illinois state wide One-Call Notice System (otherwise known as the Joint Utility Locating Information for Excavators or "JULIE") and provide JULIE with all of the information necessary to update its record with respect to the WIND FARM.

(8) The Applicant shall use directional boring equipment to make all crossings of County Highways for the cable collection system.

(9) The Applicant shall provide plans for the widening of any corner radius that is necessary to facilitate the turning movements of the transport trucks used by the Applicant.

(10) The Applicant shall pay for the necessary temporary STREET improvements for the widened corner radii and pay for the cost to return the widened radii to their original lines and grades when no longer needed for the WIND FARM construction unless the STREET maintenance authority requests that the widened radii remain as improved.

(11) The Applicant shall notify the STREET maintenance authority in advance of all oversize moves and crane crossings;

(12) The Applicant shall transport the WIND FARM TOWER segments and other oversize loads so as to minimize adverse impact on the local traffic including farm traffic.

(13) The Applicant shall provide as much advance notice as is commercially reasonable to obtain approval of the STREET maintenance authority when it is necessary for a STREET to be closed due to a crane crossing or for any other reason. Notwithstanding the generality of the aforementioned, the Applicant will provide 48 hours notice to the extent reasonably practicable.

(14) The Applicant shall provide signs indicating all highway and STREET closures and work zones in accordance with the Illinois Department of Transportation Manual on Uniform Traffic Control Devices.

(15) The Applicant shall establish a single escrow account and a single Irrevocable Letter of Credit for the cost of all STREET upgrades and repairs pursuant to the WIND FARM construction.

(16) The Applicant shall notify all relevant parties of any temporary STREET closures

(17) The Applicant shall obtain easements and other land rights needed to fulfill the Applicant's obligations under this Agreement.

(18) The Applicant shall agree that the County shall design all STREET upgrades in accordance with the IDOT Bureau of Local Roads and Streets Manual, 2005 edition.

(19) The Applicant shall provide written Notice to Proceed to the relevant STREET maintenance authority by December 31 of each year that identifies the STREETS to be upgraded during the following year.

(20) The Applicant shall provide dust control and grading work to the reasonable satisfaction of the County Engineer on STREETS that become aggregate surface STREETS.

(21) The Applicant shall conduct a post-WIND FARM construction baseline survey similar to the pre- WIND FARM construction baseline survey to identify the extent of repairs necessary to return the STREET to the pre-WIND FARM construction condition.

(22) The Applicant shall Pay for the cost of all repairs to all STREETS that are damaged by the Applicant during the construction of the WIND FARM and restore such STREETS to the condition they were in at the time of the pre-WIND FARM construction inventory.

(23) Other conditions may be required.

2. All relevant Roadway Upgrade and Maintenance agreements shall be included as a condition of approval by the BOARD and the signed and executed Roadway Upgrade and Maintenance agreements must be submitted to the Zoning Administrator prior to any Zoning Use Permit approval.

G. Standard Conditions for Coordination with Local Fire Department

1. The Applicant shall submit to the local fire protection district a copy of the site plan.

2. Upon request by the local fire protection district, the Owner or Operator shall cooperate with the local fire protection district to develop the fire protection district's emergency response plan.

3. Nothing in this section shall alleviate the need to comply with all other applicable fire laws and regulations.

H. Standard Conditions to Mitigate Electromagnetic Interference

1. The Applicant shall provide the applicable microwave transmission providers and local emergency service provider(s) (911 operators) copies of the project summary and site plan.

2. To the extent that any relevant microwave transmission provider and local emergency service provider demonstrates a likelihood of interference with its communications resulting from the WIND FARM, the Applicant shall take reasonable measures to mitigate such anticipated interference.

3. If, after construction of the WIND FARM, the Owner or Operator receives a written complaint related to the above-mentioned interference, the Owner or Operator shall take reasonable steps to respond to the complaint.

4. If, after construction of the WIND FARM, the Owner or Operator receives a written complaint related to interference with local broadcast residential television, the Owner or Operator shall take reasonable steps to respond to the complaint.

I. Standard Conditions for Allowable Noise Level

1. Noise levels from each WIND FARM TOWER or WIND FARM shall be in compliance with the applicable Illinois Pollution Control Board (IPCB) regulations (35 *Illinois Administrative Code* Subtitle H: Noise Parts 900, 901, 910).

2. The Applicant, through the use of a qualified professional, as part of the siting approval application process, shall appropriately demonstrate compliance with the above noise requirements.

3. The Applicant shall submit a map of the relevant noise contours for the proposed WIND FARM and indicate the proposed WIND FARM TOWERS and all existing PRINCIPAL BUILDINGS within at least 1,200 feet of any WIND FARM TOWER or within the coverage of the relevant noise contours.

J. Standard Conditions for Endangered Species Consultation
The Applicant shall apply for consultation with the Endangered Species Program of the Illinois Department of Natural Resources. The Application shall include a copy of the Agency Action Report from the Endangered Species Program of the Illinois Department of Natural Resources.

K. Standard Conditions for Historic and Archaeological Resources Review
The Applicant shall apply for consultation with the State Historic Preservation Officer of the Illinois Department of Natural Resources. The Application shall include a copy of the Agency Action Report from the State Historic Preservation Officer of the Illinois Department of Natural Resources.

L. Standard Conditions for Acceptable Wildlife Impacts

1. The WIND FARM shall be located, designed, constructed, and operated so as to avoid and if necessary mitigate the impacts to wildlife as much as possible including the following:
   (a) Avoid locating WIND FARM TOWERS in known bird migration pathways and daily movement flyways and known hibernacula and flight paths between bat colonies and bat feeding areas.

   (b) As much as possible, orient rows of WIND FARM TOWERS parallel to known movement patterns.

2. A qualified professional, such as an ornithologist or wildlife biologist, shall conduct a pre-construction site assessment study to estimate the impacts of the construction and operation of the proposed WIND FARM on bird and bats. The pre-construction site assessment shall be submitted with the application and shall include the following minimum information:

   (a) A literature review of existing information on species and potential habitats in the vicinity of the proposed WIND FARM area.

   (b) A mapping of the general vegetation and land cover types, wildlife habitat and quality, and physical characteristics of the proposed WIND FARM area.

   (c) A full year of site specific avian use surveys from the beginning of the spring migration for birds or bats, and extending through the end of the fall migration for birds or bats and include both the spring and fall migration for both birds and bats in the proposed WIND FARM area.

   (d) If the above information suggests the probable occurrence of a state or federal threatened or endangered or sensitive-status species in the proposed WIND FARM area, focused surveys must be conducted during the appropriate season to determine the presence or likelihood of the species of interest and the results submitted with the application.

3. A qualified professional, such as an ornithologist or wildlife biologist, shall also conduct a post-construction mortality monitoring study to quantify the mortality impacts of the WIND FARM on birds and bats. The post-construction mortality monitoring study shall consist of the following minimum information at a minimum:
   (a) At least two full years of site specific mortality monitoring from the beginning of the spring migration for birds or bats, and extend through the end of the fall migration for birds or bats and include both the spring and fall migration for both birds and bats in the immediate vicinity of some or all of the WIND FARM TOWERS.

   (b) The application shall include a specific proposal for the degree of precision of the mortality monitoring study including how many days the monitoring is done, at how many towers, for how long each day, and at what radius around the tower, and the extent of monitoring outside of the spring and fall migrations.

   (c) A written report on avian and bat mortality shall be submitted at the end of first two full years of WIND FARM operation. The mortality rate estimates should reflect consideration of carcass removal by scavengers and predators.

   (d) If the Environment and Land Use Committee determines there are legitimate mortality concerns indicated by the monitoring the post-construction mortality monitoring study shall continue in full year increments until the monitoring indicates that the mortality concerns are resolved. When mortality concerns cannot be resolved in any other way, particular WIND FARM TOWERS shall be shut down during periods of peak risk to birds or bats.

4. During both pre-construction assessment and post-construction monitoring, other information required by the United States Fish and Wildlife Service and the Illinois Department of Natural Resources shall also be provided to the County.

M. Standard Conditions for Shadow flicker

1. The Applicant shall submit the results of a study on potential shadow flicker. The shadow flicker study shall identify the locations of shadow flicker that may be caused by the project and the expected durations of the shadow flicker at these locations particularly areas where shadow flicker may interfere more than one hour per year.

2. The Applicant shall ensure the following:
   (a) Existing DWELLINGS shall not be subjected to shadow flicker.

   (b) No public STREET shall be subjected to shadow flicker.

N. Standard Conditions for Visual Impact Assessment

{NOTE: Staff is still drafting this condition.}

O. Standard Condition for Liability Insurance

1. The Owner or Operator of the WIND FARM shall maintain a current general liability policy covering bodily injury and property damage with limits of a least $1 million per occurrence and $1 million in the aggregate. The amount of the limit shall be increased annually to account for the effects of inflation.

2. The general liability policy shall identify landowners in the SPECIAL USE permit as additional insured.

P. Operational Standard Conditions

1. Maintenance

   (a) The Owner or Operator of the WIND FARM must submit, on an annual basis, a summary of the operation and maintenance reports to the Environment and Land Use Committee and any other operation and maintenance reports as the Environment and Land Use Committee reasonably requests.

   (b) Any physical modification to the WIND FARM that alters the mechanical load, mechanical load path, or major electrical components shall require a new County Board SPECIAL USE Permit. Life-kind replacements shall not require re-certification. Prior to making any physical modification (other than a like-kind replacement), the owner of operator shall confer with a relevant third-party certifying entity identified in subparagraph 6.1.4 D. 1. (a) to determine whether the physical modification requires re-certification.

2. Materials Handling, Storage and Disposal

   (a) All solid wastes related to the construction, operation and maintenance of the WIND FARM shall be removed from the site promptly and disposed of in accordance with all federal, state and local laws.

   (b) All hazardous materials related to the construction, operation and maintenance of the WIND FARM shall be handled, stored, transported and disposed of in accordance with all applicable local, state and federal laws.

Q. Standard Condition for Decommissioning Plan and Reclamation Agreement

1. The Applicant shall submit a signed site reclamation agreement conforming to the requirements of paragraph 6.1.1 C. (proposed to be renumbered 6.1.1 A.)

2. In addition to the conditions listed in subparagraph 6.1.1 C. 9. the Zoning Administrator may also draw on the funds for the following reasons:

   (a) In the event that any wind turbine or component thereof ceases to be functional for more than six consecutive months and the Owner is not diligently repairing such wind turbine or component.

   (b) In the event that the Owner declares any wind turbine or other component to be functionally obsolete for tax purposes.

3. The Site Reclamation Agreement shall be included as a condition of approval by the BOARD and the signed and executed Site Reclamation Agreement must be submitted to the Zoning Administrator prior to any Zoning Use Permit approval.

R. Complaint Hotline

1. Prior to the commencement of construction on the WIND FARM and during the entire term of the County Board SPECIAL USE permit and any extension, the Applicant and Owner shall establish a telephone number hotline for the general public to call with any complaints or questions.

2. The telephone number hotline shall be publicized and posted at the operations and maintenance center and the construction marshalling yard.

3. The telephone number hotline shall be manned during usual business hours and shall be an answering recording service during other hours.

4. Each complaint call to the telephone number hotline shall be logged and identify the name and address of the caller and the reason for the call.

5. All calls shall be recorded and the recording shall be saved for transcription for a minimum of two years.

6. A copy of the telephone number hotline shall be provided to the Zoning Administrator on a monthly basis.

7. The Applicant and Owner shall take necessary actions to resolve all legitimate complaints.

S. Standard Condition for Expiration of WIND FARM County Board SPECIAL USE Permit
A WIND FARM County Board SPECIAL USE Permit designation expires in 10 years if no Zoning Use Permit is granted.

T. Application Requirements

1. In addition to all other information required on the SPECIAL USE Permit application and required by Section 9.1.11 A. 2. the application shall contain or be accompanied by the following information:
   (a) A WIND FARM Project Summary, including, to the extent available:
      (1) A general description of the project, including its approximate name plate generating capacity; the potential equipment manufacturer(s), type(s) of wind turbines, number of wind turbines, and name plate generating capacity of each wind turbine ; the maximum height of the WECS Tower(s) and maximum diameter of the WECS(s) rotor(s).

      (2) The specific proposed location of the WIND FARM including all tax parcels on which the WIND FARM will be constructed.

      (3) The specific proposed location of all tax parcels required to be included in the WIND FARM Overlay Zoning District.

      (4) A description of the Applicant; Owner and Operator, including their respective business structures.

   (b) The name(s), address(es), and phone number(s) of the Applicant(s), Owner and Operator, and all property owner(s) for both the WIND FARM County Board SPECIAL USE permit and the WIND FARM Overlay Zoning District.

(c) A site plan for the installation of all WIND FARM TOWERS showing the planned location of each WIND FARM TOWER, PRINCIPAL STRUCTURES, property lines (including identification of adjoining properties), required separations, public access roads and turnout locations, substation(s), electrical cabling from the WIND FARM TOWER to the Substations(s), ancillary equipment, third party transmission lines, and layout of all structures within the geographical boundaries of any applicable setback.

(d) All other required studies, reports, certifications, and approvals demonstrating compliance with the provisions of this Ordinance.

2. The Applicant shall notify the COUNTY of any changes to the information provided above that occurs while the County Board SPECIAL USE permit application is pending.

Power ...Naturally

WIND ENERGY

Model Ordinance Options

New York Energy Smart
Public Service Commission
NYSERDA

NYSERDA
New York State Energy Research and Development Authority

Available at:

October 2005
NYS Energy Research & Development Authority
17 Columbia Circle
Albany, NY 12203-6399

Prepared by:
Katherine Daniels, NY Planning Federation

This document is one of a series of reports and guides that are all part of the NYSERDA Wind Energy Tool Kit. Interested parties can find all the components of the kit at: www.powernaturally.org. All sections are free and downloadable, and we encourage their production in hard copy for distribution to interested parties, for use in public meetings on wind, etc.

Any questions about the tool kit, its use and availability should be directed to:
Vicki Colello; vac@nyserda.org; 518-862-1090, ext. 3273.

In addition, other reports and information about Wind Energy can be found at www.powernaturally.org in the on-line library under "Large Wind."

NOTICE

Wind Energy Model Ordinance Options

Introduction

Effective wind ordinance standards should address several objectives, including: ensuring public safety, identifying and minimizing on- and off-site impacts, promoting good land use practice, expressing local preferences, informing and involving the public and providing legal defensibility. Predictable and clear standards and a reasonable timeframe for review provide fairness for towns, wind developers and the public, and help to streamline the review process. Some flexibility is also needed in ordinance language to enable municipalities to respond to unique situations.

Local Review Options

A town does not have to employ zoning to develop and adopt a wind energy ordinance, although it is preferable as it better assures that the town will get the type of development it wants. There are a variety of ways in which towns can review and allow for wind energy facilities, as follows:

- As an outright permitted use
- With a special use permit
- Subject to site plan review
- As an accessory use
- Based on a use variance

These options are discussed further in the Toolkit section titled *Local Government's Role in the Approval Process.* In most cases, towns will probably want to use a combination of the special use permit and/or site plan review, especially for large, commercial wind energy facilities.

Zoning for Wind

A town that uses zoning and also has an up-to-date comprehensive plan that addresses the wind energy resource (see *Comprehensive Plan* discussion paper) is in an excellent position to proactively identify key wind energy areas that could be developed. The existing zoning for these areas could then be amended to allow wind energy facilities, subject to the town's chosen review process. However, sometimes these areas suitable for wind energy facilities are located within parts of multiple zones rather than primarily in one or two zones. In this case, it might make sense to create a *wind energy overlay zone* for application to these areas. An overlay would apply special wind energy review standards to proposed wind energy uses *in addition* to the standards that apply to the underlying zone. Careful attention to potential visual and avian impacts in defining the overlay area can greatly mitigate or even eliminate these issues when wind energy facilities are proposed. The overlay zone should be shown on the town's zoning map and could be an incentive to attract wind developers to the town.

Setbacks and Other Zoning Considerations

Many concerns associated with safety, noise and aesthetics can be addressed by placing distance between wind turbines and people, property lines, roads and certain environmental areas or scenic or historic landscapes. Although there is no consensus on appropriate distances or types of setbacks, there are several common themes that appear in a number of wind energy regulations that various communities have adopted.

Most local government requirements include setbacks for the distance between the wind turbine and residences/other buildings, property lines and roads. Property lines should always be part of the setback formula in order to provide consistency and not endanger future uses on adjacent parcels. A few communities have also defined setbacks from railroads, above-ground transmission lines and other specific uses. The most common way to define a setback distance is in terms of a multiple of the turbine height. Other options are to specify a fixed distance or a combination of a fixed distance and a multiple of the turbine height. Setbacks should be at least as great as the height of the turbine. When specifying the structure height, it is important to define whether the height is considered the top of the tower or the highest point reached by the rotor blade.

Some communities provide that setbacks may be reduced when doing so would enhance aesthetic, noise or safety considerations. Turbines should be exempt from property line setbacks if the adjacent property contains a wind turbine from the same plant or the adjacent property is a participant in the project through a land lease and/or wind access agreement. This is an important consideration since turbine layouts and plant infrastructure can result in many parcels of land being utilized for one project.

Communities may adopt noise regulations that apply to wind facilities. These can involve the use of setbacks. Noise impacts may be measured at the property line or at the location of the affected uses – residences and certain other public uses. Use of property lines in determining setbacks assures that future uses of unbuilt adjacent parcels will not be exposed to unreasonable noise impacts.

When establishing setbacks, the intended protective effect must be balanced with economic considerations for wind projects. For instance, very large setbacks that could be viewed as providing maximum mitigation of adverse noise, visual and environmental impacts could render a sizable percent of a proposed site unusable for wind turbines reducing the overall number of turbines that could be accommodated, and thereby making the project not feasible.

Height restrictions are a part of most zoning ordinances and can also have an adverse, though unintended, impact on wind turbine installations. Many local height restrictions do make exceptions for church spires, silos, cell towers and similar uses. In areas where wind energy facilities are to be permitted, height exceptions should similarly include wind turbines.

Some communities specify a minimum height for the blade tips above ground level. Minimum limits are driven by safety concerns and typically range from 15 to 30 feet. Because today's commercial wind turbines are typically installed on towers of at least 200 feet, minimum levels above ground are unlikely to be an issue. Although small turbines are installed on lower towers, their rotors are also smaller and so these limits should not be an issue.

For a discussion of appropriate review standards for environmental and cultural impacts, see the *Environmental* section of this Toolkit.

Wind Energy Model Ordinance Options

The following is a mix/match menu of options for creating a local wind energy ordinance. Because no two towns are alike, included are a variety of choices for addressing the many issues involved in a review of a proposed wind energy facility. The standards below are drawn primarily from adopted wind energy ordinances in New York State and around the country. They are grouped under general headings that address different aspects of a wind energy ordinance. Typically, a few issues are addressed under each heading. Where there are multiple ways to address the same essential issue, we have provided "or" language to point out the choices. "And" language is used to identify review standards that are linked and should be used together. In some cases, just one sample standard on a particular issue is offered.

While some standards, particularly most of those that address safety concerns and setbacks, are basic and need to be included in any wind energy ordinance, other standards should be considered optional and considered for inclusion based on the particular circumstances, objectives and desires of each town or municipality.

Purpose

Any new wind ordinance standards should be accompanied by a purpose statement that explains the intent of the new provisions. Examples of possible purpose statements are as follows:

- The purpose of this district is to foster the development of the Town's wind power resources while preserving farmlands and adjoining settlements as compatible adjoining uses.

or

- It is the purpose of these amendments to provide a wind power overlay district and certain regulations regarding setbacks and other requirements relative to wind power facilities.

or

- The purpose of the ordinance is to provide a regulatory scheme for the construction and operation of Wind Energy Facilities in the Town, subject to reasonable restrictions, which will preserve the public health and safety.

Findings

A brief statement of findings provides a rationale for the purpose of the ordinance. The following is a sample findings statement:

- The Town finds that wind energy is an abundant, renewable and nonpolluting energy resource and that its conversion to electricity will reduce our dependence on nonrenewable energy resources and decrease the air and water pollution that results from the use of conventional energy sources. Wind energy systems also enhance the reliability and power quality of the power grid, reduce peak power demands and help diversify the state's energy supply portfolio.

Definitions

Wind energy facilities should be specifically defined in municipal zoning ordinances to ensure that the language of the ordinance legally applies to them. While some existing broad definitions for uses such as 'public or semi-public utilities,' 'industrial uses' or even 'accessory uses' might be argued to include some types of wind energy facilities, they are not likely to apply to the full range of wind energy facilities, including small to large applications. A specific definition of wind energy facilities also provides Towns with a basis for the adoption of approval and siting standards that are specific to this use. The following are examples of definitions for this use.

- Wind Energy Facility: An energy facility that consists of one or more wind turbines or other such devices and their related or supporting facilities that produce electric power from wind and are a) connected to a common switching station or b) constructed, maintained or operated as a contiguous group of devices.

or

- Wind Power Generating Facility: Facilities at which wind is converted to another form of energy and distributed to a customer or customers.

or

- Wind Energy Facility: An electricity-generating facility consisting of one or more wind turbines under common ownership or operating control that includes substations, MET towers, cables/wires and other building accessories to such facility, whose main purpose is to supply electricity to off-site customer(s).

Information to be Submitted

Some of the following information may already be required to be submitted as part of a special use permit or site plan review. However, there may be a need to require the submission of some additional information, depending on the ordinance standards that towns adopt. The following are types of information that towns could request:

- The applicant and landowner's name and contact information.
- The tax map numbers, existing use and acreage of the site parcel.

- A survey map at an appropriate scale showing the proposed location of the wind energy facility (including access roads) as it relates to the boundaries of the parcel, adjacent ownerships and existing residences/schools, churches, hospitals, or libraries to a distance of 2,000 feet (or other measure).
- A survey map at an appropriate scale showing any federal, state, county or local parks, recognized historic or heritage sites, state-identified wetlands or important bird areas as identified in federal, state, county, local or New York Audubon's GIS databases or other generally-available documentation.
- Standard drawings of the wind turbine structure, including the tower, base and footings, drawings of access roads, and including an engineering analysis and certification of the tower, showing compliance with the applicable building code.
- Data pertaining to the tower's safety and stability, including safety results from test facilities.
- Proposal for landscaping and screening.
- A completed Environmental Assessment Form.
- A project visibility map, based on a digital elevation model, showing the impact of topography upon visibility of the project from other locations, to a radius of three miles from the center of the project. The scale used shall depict the three-mile radius as no smaller than 2.7 inches, and the base map used shall be a published topographic map showing man-made features, such as roads and buildings.
- No fewer than four, and no more than the number of proposed individual wind turbines, plus three color photos, no smaller than 3" by 5", taken from locations within a three-mile radius from the site and to be selected by the Planning Board, and computer-enhanced to simulate the appearance of the as-built site facilities as they would appear from these locations.

Approval Standards

The standards chosen must be integrated into whatever local review process is used by the town. The standards that follow may be used in addition to existing special use permit and site plan review standards, if the town feels they are applicable, or the following may be used to create a stand-alone set of review standards that substitute for any existing review standards.

Typical site plan review standards for a wind energy facility would be those that assure proper design and site layout. This would cover most safety, setback and siting and installation issues. Typical special use permit issues for wind energy facilities are those that assure compatibility of the use with and minimal adverse impacts on neighboring properties. This would cover nuisance and most environmental and visual issues. A town that uses both the site plan review process and the special use permit will be in the best position to fully consider all aspects of proposed wind energy facilities.

A town that wishes to allow small wind energy facilities through an outright permitting or accessory use process with minimal review may still use some of the following standards, provided that compliance can be readily determined by the town's code enforcement office.

Safety:

- The minimum distance between the ground and any part of the rotor blade system shall be thirty (30) feet.

- To limit climbing access, a fence six feet high with a locking portal shall be placed around the facility's tower base or the tower climbing apparatus shall be limited to no lower than 12 feet from the ground, or the facility's tower may be mounted on a roof top.

or

- Wind turbine towers shall not be climbable up to 15 feet above ground level.

and

- All access doors to wind turbine towers and electrical equipment shall be lockable.

and

- Appropriate warning signage shall be placed on wind turbine towers, electrical equipment and wind energy facility entrances.

- Towers shall be equipped with air traffic warning lights and shall have prominent markings on the rotor blade tips of an international orange color where the total height of the tower exceeds 175 feet.

or

- Use the minimum lighting necessary for safety and security purposes and use techniques to prevent casting glare from the site, except as otherwise required by the FAA or other applicable authority.

or

- Wind energy facilities shall not be artificially lighted, except to the extent required by the FAA or other applicable authority.

- All wind turbines shall have an automatic braking, governing or feathering system to prevent uncontrolled rotation, overspeeding and excessive pressure on the tower structure, rotor blades and turbine components.

- Prior to issuance of a building permit, the applicant shall provide the town proof of a level of insurance to be determined by the Town Board in consultation with the Town's insurer, to cover damage or injury that might result from the failure of a tower or towers or any other part or parts of the generation and transmission facility.

- Any wind energy system found to be unsafe by the local enforcement officer shall be repaired by the owner to meet federal, state and local safety standards or removed within six months. If any wind energy system is not operated for a continuous period of 12 months, the Town will notify the landowner by registered mail and provide 45 days for a response. In such a response, the landowner shall set forth reasons for the operational difficulty and provide a reasonable timetable for corrective action. If the Town deems the timetable for corrective action as unreasonable, they must notify the landowner and such landowner shall remove the turbine within 120 days of receipt of notice from the Town.

Siting and Installation:

- Use existing roads to provide access to the facility site, or if new roads are needed, minimize the amount of land used for new roads and locate them so as to minimize adverse environmental impacts.

- Combine transmission lines and points of connection to local distribution lines.

- Connect the facility to existing substations, or if new substations are needed, minimize the number of new substations.

- All wiring between wind turbines and the wind energy facility substation shall be underground.

or

- Electrical controls and control wiring and power lines shall be wireless or underground except where wind farm collector wiring is brought together for connection to the transmission or distribution network, adjacent to that network.

- The wind power generation facility, if interconnected to a utility system, shall meet the requirements for interconnection and operation as set forth in the electric utility's then current service regulations applicable to wind power generation facilities.

- Any construction involving agricultural land should be done according to the NYS Department of Agriculture and Market "Guidelines for Agricultural Mitigation for Wind Power Projects" (which can be found at: www.agmkt.state.ny.us, "construction projects affecting farmland.")

Setbacks:

- The minimum setback distance between each wind turbine tower and all surrounding property lines, overhead utility or transmission lines, other wind turbine towers, electrical substations, meteorological towers, public roads and dwellings shall be equal to no less than 1.5 times the sum of proposed structure height plus the rotor radius.

or

- Each wind turbine shall be set back from the nearest residence, school, hospital, church or public library a distance no less than the greater of (a) two (2) times its total height or (b) one thousand (1,000) feet.

or

- All wind power generating facilities shall be located at least 50 feet plus the height of the structure from roads and side and rear lot lines.

or

- Setbacks for wind power generating facilities shall be 100 feet plus the height of the structure from lot lines and 1,500 feet from existing residential structures.

or

- The wind energy system shall be set back a distance equal to one hundred ten (110) percent of the height of the tower plus the blade length from all adjacent property lines and a distance equal to one hundred and fifty (150) percent of the tower height plus blade length from any dwelling inhabited by humans on neighboring property.

or

- Each wind turbine shall be set back from the nearest property line a distance no less than 1.1 times its total height, unless appropriate easements are secured from adjacent property owners.

and

- Each wind turbine shall be set back from the nearest public road a distance no less than 1.1 times its total height, determined at the nearest boundary of the underlying right-of-way for such public road.

and

- Each wind turbine shall be set back from the nearest above-ground public electric power line or telephone line a distance no less than 1.1 times its total height, determined from the existing power line or telephone line.

Nuisance:

- Individual wind turbine towers shall be located so that the level of noise produced by wind turbine operation shall not exceed 55 dBA, measured at the site property line.

or

- Audible noise due to wind energy facility operations shall not exceed fifty (50) dBA for any period of time, when measured at any residence, school, hospital, church or public library existing on the date of approval of the wind energy facility.

- The applicant shall minimize or mitigate any interference with electromagnetic communications, such as radio, telephone or television signals caused by any wind energy facility.

or

- No individual tower facility shall be installed in any location along the major axis of an existing microwave communications link where its operation is likely to produce electromagnetic interference in the link's operation.

and

- No individual tower facility shall be installed in any location where its proximity with fixed broadcast, retransmission or reception antenna for radio, television or wireless phone or other personal communications systems would produce electromagnetic interference with signal transmission or reception.

Environmental and Visual:

- Brand names or advertising associated with any installation shall not be visible from any public access.

or

- Wind turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer or operator of the wind energy facility.

- Colors and surface treatment of the installation shall minimize visual disruption.

or

- Wind turbines shall be painted a non-reflective, non-obtrusive color.

or

- The design of the buildings and related structures shall, to the extent reasonably possible, use materials, colors, textures, screening and landscaping that will blend the facility into the natural setting and existing environment.

- Appropriate landscaping shall be provided to screen accessory structures from roads and adjacent residences.

- Where wind characteristics permit, wind towers shall be set back from the tops of visually prominent ridgelines to minimize the visual contrast from any public access.

and/or

- Towers shall be designed and located to minimize adverse visual impacts from neighboring residential areas, to the greatest extent feasible.

and/or

- The tower shall not significantly impair a scenic vista or scenic corridor as identified in the Town's comprehensive plan or other published source.

or

- No individual tower facility shall be installed at any location that would substantially detract from or block the view of the major portion of a recognized scenic vista, as viewed from any public road right-of-way or publicly-accessible parkland or open space within the Town.

- Avoid, to the extent practicable, the creation of artificial habitat for raptors or raptor prey, such as a) electrical equipment boxes on or near the ground that can provide shelter and warmth, b) horizontal perching opportunities on the towers or related structures or c) soil where weeds can accumulate.

- Wind turbines shall be set back at least 2,500 feet from Important Bird Areas as identified by New York Audubon and at least 1,500 feet from State-identified wetlands. These distances may be adjusted to be greater or lesser at the discretion of the reviewing body, based on topography, land cover, land uses and other factors that influence the flight patterns of resident birds.

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MODEL ORDINANCE REGULATING THE SITING OF WIND ENERGY CONVERSION SYSTEMS IN ILLINOIS

To Whom It May Concern:

We are pleased to provide the attached Model Ordinance Regulating the Siting of Wind Energy Conversion Systems in Illinois. This model ordinance seeks to encourage further wind energy development in Illinois by providing a common set of standards for wind energy developers, local governments and residents. We believe the best way to promote the long-term success of wind energy in Illinois is to establish balanced, uniform ground rules for the siting of wind energy projects.

The process for developing this model ordinance was funded by a grant from the Illinois Clean Energy Community Foundation. The law firm of Baker & McKenzie donated *pro bono* assistance in drafting the ordinance. It was drafted after consultation with a wide group of stakeholders, including wind energy developers, technical consultants, environmental non-profit organizations, government, third party certifying agencies and private environmental attorneys. As a model, this ordinance is intended to be integrated with existing local zoning laws, either as the substance for a special or conditional use permit, a separate chapter within the existing zoning code, or as a stand alone zoning ordinance. Further questions about this ordinance should be directed to Holly Gordon at the phone number above or by email at hgordon@kentlaw.edu.

MODEL ORDINANCE
REGULATING THE SITING OF
WIND ENERGY CONVERSION SYSTEMS
IN ILLINOIS

Drafted by:
The Chicago Environmental Law Clinic and
Baker & McKenzie

Funded by:
The Illinois Clean Energy Community Foundation

ORDINANCE REGULATING THE SITING OF WIND ENERGY CONVERSION SYSTEMS IN ILLINOIS

I. INTRODUCTION

A. *Title*

This Ordinance shall amend the _______ County/Municipality Zoning Ordinance and be known, cited and referred to as the _______ County/Municipality Wind Energy Siting Ordinance.

B. *Purpose*

This Ordinance is adopted for the following purposes:

1. To assure that any development and production of wind-generated electricity in _______ County/Municipality is safe and effective;
2. To facilitate economic opportunities for local residents;
3. To promote the supply of wind energy in support of Illinois' statutory goal of increasing energy production from renewable energy sources.

II. DEFINITIONS

A. "Applicant" means the entity or person who submits to the County/Municipality, pursuant to Section V of this Ordinance, an application for the siting of any WECS or Substation.

B. "Financial Assurance" means reasonable assurance from a credit worthy party, examples of which include a surety bond, trust instrument, cash escrow, or irrevocable letter of credit.

C. "Operator" means the entity responsible for the day-to-day operation and maintenance of the WECS, including any third party subcontractors.

D. "Owner" means the entity or entities with an equity interest in the WECS(s), including their respective successors and assigns. Owner does not mean (i) the property owner from whom land is leased for locating the WECS (unless the property owner has an equity interest in the WECS); or (ii) any person holding a security interest in the WECS(s) solely to secure an extension of credit, or a person foreclosing on such security interest provided that after foreclosure, such person seeks to sell the WECS(s) at the earliest practicable date.

E. "Professional Engineer" means a qualified individual who is licensed as a professional engineer in any state in the United States.

F. "Primary Structure" means, for each property, the structure that one or more persons occupy the majority of time on that property for either business or personal reasons. Primary Structure includes structures such as residences, commercial buildings, hospitals, and day care facilities. Primary Structure excludes structures such as hunting sheds, storage sheds, pool houses, unattached garages and barns.

G. "Substation" means the apparatus that connects the electrical collection system of the WECS(s) and increases the voltage for connection with the utility's transmission lines.

H. "Wind Energy Conversion System" ("WECS") means all necessary devices that together convert wind energy into electricity, including the rotor, nacelle, generator, WECS Tower, electrical components, WECS foundation, transformer, and electrical cabling from the WECS Tower to the Substation(s).

I. "WECS Project" means the collection of WECSs and Substations as specified in the siting approval application pursuant to Section V of this Ordinance.

J. "WECS Tower" means the support structure to which the nacelle and rotor are attached.

K. "WECS Tower Height" means the distance from the rotor blade at its highest point to the top surface of the WECS foundation.

III. APPLICABILITY

This Ordinance governs the siting of WECSs and Substations that generate electricity to be sold to wholesale or retail markets, except that owners of WECSs with an aggregate generating capacity of 3MW or less who locate the WECS(s) on their own property are not subject to this Ordinance.

IV. PROHIBITION

No WECS or Substation governed by Section III of this Ordinance shall be constructed, erected, installed, or located within ______ County/Municipality, unless prior siting approval has been obtained for each individual WECS and Substation pursuant to this Ordinance.

V. SITING APPROVAL APPLICATION

A. To obtain siting approval, the Applicant must first submit a siting approval application to the County/Municipality.

B. The siting approval application shall contain or be accompanied by the following information:

1. A WECS Project summary, including, to the extent available: (1) a general description of the project, including its approximate name plate generating capacity; the potential equipment manufacturer(s), type(s) of WECS(s), number of WECSs, and name plate generating capacity of each WECS; the maximum height of the WECS Tower(s) and maximum diameter of the WECS(s) rotor(s); the general location of the project; and (2) a description of the Applicant, Owner and Operator, including their respective business structures;

2. The name(s), address(es), and phone number(s) of the Applicant(s), Owner and Operator, and all property owner(s), if known;

3. A site plan for the installation of WECSs showing the planned location of each WECS Tower, guy lines and anchor bases (if any), Primary Structure(s), property lines (including identification of adjoining properties), setback lines, public access roads and turnout locations, Substation(s), electrical cabling from the WECS Tower to the Substation(s), ancillary equipment, third party transmission lines, and layout of all structures within the geographical boundaries of any applicable setback;

4. All required studies, reports, certifications, and approvals demonstrating compliance with the provisions of this Ordinance; and

5. Any other information normally required by the County/ Municipality as part of its Zoning Ordinance.

C. The Applicant shall notify ______ County/Municipality of any changes to the information provided in Section V.B. above that occur while the siting approval application is pending.

VI. DESIGN AND INSTALLATION

A. *Design Safety Certification*

1. WECSs shall conform to applicable industry standards, including those of the American National Standards Institute ("ANSI"). Applicants shall submit certificates of design compliance that equipment manufacturers have obtained from Underwriters Laboratories ("UL"), Det Norske Veritas ("DNV"), Germanischer Lloyd Wind Energie ("GL"), or an equivalent third party.

2. Following the granting of siting approval under this Ordinance, a Professional Engineer shall certify, as part of the building permit application, that the foundation and tower design of the WECS is

within accepted professional standards, given local soil and climate conditions.

B. *Controls and Brakes*

1. All WECS shall be equipped with a redundant braking system. This includes both aerodynamic overspeed controls (including variable pitch, tip, and other similar systems) and mechanical brakes. Mechanical brakes shall be operated in a fail-safe mode. Stall regulation shall not be considered a sufficient braking system for overspeed protection.

C. *Electrical Components*

All electrical components of the WECS shall conform to applicable local, state, and national codes, and relevant national and international standards (e.g. ANSI and International Electrical Commission).

D. *Color*

Towers and blades shall be painted white or gray or another non-reflective, unobtrusive color.

E. *Compliance with the Federal Aviation Administration*

The Applicant for the WECS shall comply with all applicable FAA requirements.

F. *Warnings*

1. A reasonably visible warning sign concerning voltage must be placed at the base of all pad-mounted transformers and Substations.

2. Visible, reflective, colored objects, such as flags, reflectors, or tape shall be placed on the anchor points of guy wires and along the guy wires up to a height of 15 feet from the ground.

G. *Climb Prevention*

1. All WECS Towers must be unclimable by design or protected by anti-climbing devices such as:

   a. Fences with locking portals at least six feet high; or

   b. Anti-climbing devices 12 feet vertically from the base of the WECS Tower.

H. *Setbacks*

1. All WECS Towers shall be set back at least 1000 feet from any Primary Structure. The distance for the above setback shall be measured from the point of the Primary Structure foundation closest to the WECS Tower to the center of the WECS Tower foundation. The owner of the Primary Structure may waive this setback requirement; but in no case shall a WECS Tower be located closer to a Primary Structure then 1.10 times the WECS Tower Height.

2. All WECS Towers shall be set back a distance of at least 1.10 times the WECS Tower Height from public roads, third party transmission lines, and communication towers. The County/Municipality may waive this setback requirement.

3. All WECS Towers shall be set back a distance of at least 1.10 times the WECS Tower Height from adjacent property lines. The affected adjacent property owner may waive this setback requirement.

4. The Applicant does not need to obtain a variance from the County/Municipality upon waiver by either the County/Municipality or property owner of any of the above setback requirements. Any waiver of any of the above setback requirements shall run with the land and be recorded as part of the chain of title in the deed of the subject property.

I. *Compliance with Additional Regulations*

Nothing in this Ordinance is intended to preempt other applicable state and federal laws and regulations.

J. *Use of Public Roads*

1. An Applicant, Owner, or Operator proposing to use any [county, municipality, township or village] road(s), for the purpose of transporting WECS or Substation parts and/or equipment for construction, operation, or maintenance of the WECS(s) or Substation(s), shall:

   a. Identify all such public roads; and

   b. Obtain applicable weight and size permits from relevant government agencies prior to construction.

2. To the extent an Applicant, Owner, or Operator must obtain a weight or size permit from the [county, municipality, township or village], the Applicant, Owner, or Operator shall:

   a. Conduct a pre-construction baseline survey to determine existing road conditions for assessing potential future damage; and

   b. Secure Financial Assurance, in a reasonable amount agreed to by the relevant parties, for the purpose of repairing any damage to public roads caused by constructing, operating or maintaining the WECS.

VII. OPERATION

A. *Maintenance*

1. The Owner or Operator of the WECS must submit, on an annual basis, a summary of the operation and maintenance reports to the County/Municipality. In addition to the above annual summary, the Owner or Operator must furnish such operation and maintenance reports as the County/Municipality reasonably requests.

2. Any physical modification to the WECS that alters the mechanical load, mechanical load path, or major electrical components shall require re-certification under Section VI(A)(1) of this Ordinance. Like-kind replacements shall not require re-certification. Prior to making any physical modification (other than a like-kind replacement), the owner or operator shall confer with a relevant third-party certifying entity identified in Section VI(A)(1) of this Ordinance to determine whether the physical modification requires re-certification.

B. *Interference*

1. The Applicant shall provide the applicable microwave transmission providers and local emergency service provider(s) (911 operators) copies of the project summary and site plan, as set forth in Section V.B.1. and V.B.3. of this Ordinance. To the extent that the above provider(s) demonstrate a likelihood of interference with its communications resulting from the WECS(s), the Applicant shall take reasonable measures to mitigate such anticipated interference. If, after construction of the WECS, the Owner or Operator receives a written complaint related to the above-mentioned interference, the Owner or Operator shall take reasonable steps to respond to the complaint.

2. If, after construction of the WECS, the Owner or Operator receives a written complaint related to interference with local broadcast residential television, the Owner or Operator shall take reasonable steps to respond to the complaint.

C. *Coordination with Local Fire Department*

1. The Applicant, Owner or Operator shall submit to the local fire department a copy of the site plan.

2. Upon request by the local fire department, the Owner or Operator shall cooperate with the local fire department to develop the fire department's emergency response plan.

3. Nothing in this section shall alleviate the need to comply with all other applicable fire laws and regulations.

D. *Materials Handling, Storage and Disposal*

1. All solid wastes related to the construction, operation and maintenance of the WECS shall be removed from the site promptly and disposed of in accordance with all federal, state and local laws.

2. All hazardous materials related to the construction, operation and maintenance of the WECS shall be handled, stored, transported and disposed of in accordance with all applicable local, state and federal laws.

VIII. NOISE LEVELS

Noise levels from each WECS or WECS Project shall be in compliance with applicable Illinois Pollution Control Board (IPCB) regulations. The Applicant, through the use of a qualified professional, as part of the siting approval application process, shall appropriately demonstrate compliance with the above noise requirements.

IX. BIRDS

A qualified professional, such as an ornithologist or wildlife biologist, shall conduct an avian habitat study, as part of the siting approval application process, to determine if the installation of WECSs will have a substantial adverse impact on birds.

X. PUBLIC PARTICIPATION

Nothing in the Ordinance is meant to augment or diminish existing opportunities for public participation.

XI. LIABILITY INSURANCE

The Owner or Operator of the WECS(s) shall maintain a current general liability policy covering bodily injury and property damage with limits of at least $1 million per occurrence and $1 million in the aggregate.

XII. DECOMMISSIONING PLAN

Prior to receiving siting approval under this Ordinance, the County/Municipality and the Applicant, Owner, and/or Operator must formulate a Decommissioning Plan to ensure that the WECS Project is properly decommissioned. The Decommissioning Plan shall include:

A. Provisions describing the triggering events for decommissioning the WECS Project;

B. Provisions for the removal of structures, debris and cabling, including those below the soil surface;

C. Provisions for the restoration of the soil and vegetation;

D. An estimate of the decommissioning costs certified by a Professional Engineer;

E. Financial Assurance, secured by the Owner or Operator, for the purpose of adequately performing decommissioning, in an amount equal to the Professional Engineer's certified estimate of the decommissioning costs;

F. Identification of and procedures for County/Municipality access to Financial Assurances;

G. A provision that the terms of the Decommissioning Plan shall be binding upon the Owner or Operator and any of their successors, assigns, or heirs; and

H. A provision that the County/Municipality shall have access to the site, pursuant to reasonable notice, to effect or complete decommissioning.

XIII. REMEDIES

A. The Applicant's, Owner's, or Operator's failure to materially comply with any of the above provisions shall constitute a default under this Ordinance.

B. Prior to implementation of the existing County/Municipal procedures for the resolution of such default(s), the appropriate County/Municipal body shall first provide written notice to the Owner and Operator, setting forth the alleged default(s). Such written notice shall provide the Owner and

Operator a reasonable time period, not to exceed 60 days, for good faith negotiations to resolve the alleged default(s).

C. If the County/Municipality determines in its discretion, that the parties cannot resolve the alleged default(s) within the good faith negotiation period, the existing County/Municipal ordinance provisions addressing the resolution of such default(s) shall govern.

Chapter 21

21.01 Title: Wind Generator and Wind Generating Facility Ordinance for Trempealeau County

21.02 Purpose: This chapter of County ordinances provides a regulatory framework for the construction and operation of Wind Energy Facilities in Trempealeau County, subject to reasonable restrictions, which will preserve the public health and safety.

21.03 Definitions: As used in this Chapter, the following terms have the meanings indicated:

Affected Property: Property impacted by personal or Commercial Wind Turbine.

Applicant: The person or entity filing an application under this Ordinance.

Commercial Wind Turbine: A wind energy conversion system which converts wind energy into electricity through the use of a wind driven turbine generator when the total height exceeds 150 feet or the nameplate capacity exceeds 100 kilowatts. Such wind turbine includes the turbine, blade, tower, base and pad transformer, if any.

Committee: The Zoning and Planning Committee of the County Board or any successor committee established by the Board for the oversight and supervision of Trempealeau County Zoning.

County: Trempealeau County, Wisconsin.

DNR: Department of Natural Resources

DOT: Department of Transportation

FAA: Federal Aviation Administration.

Farmstead: A farmstead is a place of employment and includes all buildings and structures on a farm that are used primarily for agricultural purposes such as housing animals, or storing supplies, production, or machinery.

Hobbyist Wind Turbine: A wind energy conversion system which converts wind energy into electricity through the use of a wind driven turbine generator when the total height is less than 50 feet and a prop diameter of 12 feet or less.

Hub Height: The distance measured from ground level to the center of the turbine hub.

MET Tower: A meteorological tower used for the measurement of wind speed.

Owner/Operator: The person or entity responsible for the day-to-day operation and maintenance of a wind turbine or Wind Energy Facility.

Personal Wind Turbine: A wind energy conversion system which converts wind energy into electricity through the use of a wind driven turbine generator when the Total Height is 150 feet or less.

Total Height: The distance measured from ground level to the blade of a wind turbine extended at its highest point.

Shadow Flicker: The moving shadows or shaded areas which are cast by rotating turbine blades.

Wind Energy Facility: An electricity generating facility consisting of one or more Wind Turbines under common ownership or operating control, and includes substations, MET Towers, cables/wires and other buildings accessory to such facility, whose main purpose is to supply electricity to off-site customer(s).

Wind Energy Facility Siting Permit or Wind Turbine Permit: A construction and operating permit granted in accordance with the provisions of this Ordinance.

21.04 Regulatory Framework

(1) Zoning

(a) Wind Energy Facilities and commercial wind turbines may only be constructed as Conditional Uses in areas that are zoned Exclusive Agriculture, Exclusive Agriculture – 2 and Primary Agriculture.

(b) Personal Wind Turbines may be constructed as a conditional use in areas that are zoned Exclusive Agriculture, Exclusive Agriculture – 2, Primary Agriculture and Rural Residential. They are limited to one wind turbine per contiguous parcels under common ownership.

(c) Hobbyist Wind Turbines may be constructed as a permitted use in areas that are zoned Exclusive Agriculture, Exclusive Agriculture – 2, Primary Agriculture and Rural Residential.

21.05 Applicability

(1) The requirements of this Ordinance shall apply to all wind turbines for which a permit was not issued prior to the effective date of this Ordinance. Wind turbines for which a required permit has been properly issued, or for which a permit was not required, prior to the effective date of this Ordinance shall not be required to meet the requirements of this Ordinance. However, any such pre-existing wind turbine which does not provide energy for a continuous period of twelve (12) months shall meet the requirements of this Ordinance prior to recommencing production of energy. No modification or alteration to an existing wind turbine shall be allowed without full compliance with this Ordinance.

21.06 General Requirements for Wind Energy Facilities

(1) Wind Turbines shall be painted a non-reflective, non-obtrusive color which shall be pre-approved through the conditional use process.

(2) At Wind Energy Facility sites, the design of the buildings and related structures shall, to the extent reasonably possible, use materials, colors, textures, screening and landscaping that will blend the Wind Energy Facility to the natural setting and then existing environment.

(3) Wind Energy Facilities shall not be artificially lighted, except to the extent required by the FAA or other applicable authority.

(4) Wind Turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer or operator of the Wind Energy Facility. Any such identification shall not appear on the blades or other moving parts or exceed six square feet per Wind Turbine.

(5) Electrical controls and control wiring and power-lines shall be wireless or not above ground except where wind farm collector wiring is brought together for connection to the transmission or distribution network, adjacent to that network.

(6) Routes of public travel to be used during the construction phase shall be documented by the Owner/Operator, and reviewed and approved by the Trempealeau County Highway Department, Town Chairman and Trempealeau County Zoning prior to construction. At the Committee's request a qualified independent third party, agreed to by the applicable entity(s), and paid for by the applicant, shall be hired to pre-inspect the roadways to be used during construction and an appropriate bond amount set. The public travel route will be re-inspected 30 days after project completion; any and all repairs will be completed within 90 days of end of construction project paid by the developer. The bond can be used by Trempealeau County for any degradation or damage caused by heavy machinery associated with the construction and demolition phases of a Wind Energy Facility.

(7) An appropriate continuous renewal bond amount will be set for each Wind Turbine for decommissioning should the Owner/Operator fail to comply with the Ordinance requirements or the Wind Turbine does not operate for a period of twelve (12) consecutive months.

(8) A signed statement by the landowner acknowledging that the landowner is financially responsible if the owner/operator fails to reclaim the site as required and that any removal and reclamation costs incurred by the county will become a lien on the property and may be collected from the landowner in the same manner as property taxes.

(9) Proof of continuous liability insurance in the minimum amount of five million dollars ($5,000,000.00) per occurrence shall be submitted to Trempealeau County indicating coverage for potential damages or injury to landowners, occupants, or other third parties.

(10) There shall be a timeline set prior to the construction phase of the project with a starting and ending date when the construction project will be completed.

(11) Evidence of compliance with FAA, DNR, DOT, United States Fish and Wildlife Service requirements and Signal Interference and Microwave Frequency Interference requirements must be submitted by the Applicant to Trempealeau County.

(12) A map shall be provided showing a proposed grid of any future Wind Energy Facilities being developed by the applicant to be located in Trempealeau County and surrounding counties.

(13) A document for each Wind Turbine including an accompanying diagram or maps showing the shadow flicker projection for a calendar year, in relation to affected property, roads and residences shall be submitted with the permit application.

(14) Access to a Facility and construction area shall be constructed and maintained following a detailed Erosion Control Plan in a manner designed to control erosion and provide maneuverability for service and emergency response vehicles.

(15) If a Wind Turbine foundation is proposed in a bedrock area, a baseline of all wells and certified public drinking sources in a ½ mile radius shall be established and permanent remedies shall be the responsibility of the developer if contamination occurs.

(16) If an area where Wind Turbines are planned is identified by the Fish and Wildlife Service to house a significant population of Bald or Golden Eagles a monopole tubular type tower shall be used instead of Lattice type towers.

(17) Setbacks: The following setbacks and separation requirements shall apply to Commercial Wind Turbines.

(a) Public Roads: Each Wind Turbine shall be set back from the nearest public road and its right of way a distance no less than two (2) times its Total Height.

(b) Railroads: Each Wind Turbine shall be set back from all railroads and their right of way a distance of no less than two (2) times its Total Height.

(c) Wind Turbine spacing: Each Wind Turbine shall have a separation distance from other Wind Turbines equal to one and two-tenths (1.2) times the total height of the tallest Wind Turbine.

(d) Communication and electrical lines: Each Wind Turbine shall be set back from the nearest above-ground public electric power line or telephone line a distance no less than two (2) times its Total Height.

(e) Inhabited structures: Each Wind Turbine shall be set back from the nearest structure used as a residence, school, hospital, church, place of employment or public library, a distance no less than one (1) mile, unless mitigation has taken place and agreed by owner/operator and affected property owners involved and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property.

(f) Property lines: Each Wind Turbine shall be set back from the nearest property line a distance no less than one-half (½) mile, unless mitigation has taken place and agreed by owner/operator and affected property owners involved, and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property.

(g) From any wetland, water body, environmental significant or scenic area, each Wind Turbine total height shall have a minimum setback of two (2) times its total height or one thousand (1,000) feet which ever is greater.

(h) From any historical, cultural and archeological resource area, each Wind Turbine shall have a minimum setback of two (2) times its Total Height or one thousand (1,000) feet which ever is greater.

(i) Any new proposed residences, schools, hospitals, churches, public libraries, or place of employment, shall apply for a conditional use permit if they are to be located in the required set back area stated in section 17 (e) Inhabited structures.

(j) Unless owned by the applicant, no parcel of real estate shall be subject to shadow flicker from a Wind Turbine unless mitigation has taken place and agreed by the owner/operator and affected property owners involved and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property that shadow flicker may exist at times on or at the burdened property.

(k) There shall be a two (2) mile Setback from any recognized U.S. Fish and Wildlife Refuge located in Trempealeau County.

(18) Noise: Audible Sound (Audible Noise) emitted during the operation of any Wind Energy Facility or individual Wind Turbine (includes Commercial Wind Turbines, Personal Wind Turbines and Hobbyist Wind Turbines) is limited to the standards set forth in this provision. Testing procedures are provided in Appendix A of this Ordinance.

a) Audible Noise due to Wind Energy Facility or Wind Turbine operations shall not exceed the lesser of five (5) decibels (dBA) increase over the existing background noise level (L_{90}) or exceed forty (40) decibels (dBA) for any period of time, when measured at any structure used as a residence, school, hospital, church, place of employment, or public library existing on the date of approval of any Wind Energy Facility Siting Permit or Wind Turbine permit. All measurements shall be taken using procedures meeting American National Standard Institute Standards including: ANSI S12.18-1994 (R 2004) American National Standard Procedures for Outdoor Measurement of Sound Pressure Level, and (ANSI) S12.9-Parts 1-5:

Part 1: American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound
Part 2: Measurement of Long-Term, Wide-Area Sound
Part 3: Short-Term Measurements with an Observer Present
Part 4: Noise Assessment and Prediction of Long-Term Community Response
Part 5: Sound Level Descriptors for Determination of Compatible Land Use

Measurements must be taken with qualified acoustical testing instruments meeting ANSI Type 1 standards, and Class 1 filters. The windscreen recommended by the instrument's manufacturer must be used and measurements conducted only when wind speeds are ten (10) miles per hour (mph) or less. The microphone must be located at a height of one and two-tenths (1.2) to one and one-half (1.5) meters from the ground.

b) In the event Audible Noise due to Wind Energy Facility or Wind Turbine operations contains a steady Pure Tone, including, but not limited to, a whine, screech, or hum, the standards for audible noise set forth in subparagraph (a) of this subsection shall be reduced by five (5) dBA. A Pure Tone is defined to exist when the one-third (1/3) octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of the sound pressure levels on the two (2) contiguous one-third (1/3) octave bands by five (5) dBA for center frequencies of five hundred (500) Hz and above, and eight (8) dBA for center frequencies between one hundred sixty (160) Hz and four hundred (400) Hz, or by fifteen (15) dBA for center frequencies less than or equal to one hundred twenty-five (125) Hz.

c) In the event the Audible Noise due to Wind Energy Facility or Wind Turbine operations contains Repetitive Impulsive Sounds, the permitted sound pressure level for Audible Noise in 19(a) shall be reduced by five (5) dBA.

d) In the event the Audible Noise due to Wind Energy Facility or Wind Turbine operations contains both a Pure Tone and Repetitive Impulsive Sounds, the permitted sound pressure level for Audible Noise in 19(a) shall be reduced by seven (7) dBA.

e) No low frequency sound or infrasound due to Wind Energy Facilities or Wind Turbine Operations shall be created which causes the sound pressure level at any existing residence, school, hospital, church, place of employment, or public library within a one (1) mile radius from any Wind Turbine to exceed the following limits:

TABLE 19.e.1

Band No.	1/3 Octave Band <u>Center Frequency (HZ)</u>	Limits for 1/3 Octave Bands	Limits for 1/1 Octave Bands
1	1.25 and below	65	
2	1.6	65	
3	2	65	70
4	2.5	65	
5	3.15	65	
6	4	65	70
7	5	65	
8	6.3	65	
9	8	65	70

10	10	65	
11	12.5	61	
12	16	61	65
13	20	61	
14	25	60	
15	31.5	58	63
16	40	58	
17	50	58	
18	63	55	61
19	80	53	
20	100	52	
21	125	50	55

f) A Wind Energy Facility or Wind Turbine operation that emits sound or causes structural or human body vibration with strong low-frequency content where the time-average C-weighted sound level exceeds the A-weighted sound level by at least 20 dB when measured inside a structure and adversely affects the subjective habitability or use of any existing residence, school, hospital, church, place of employment, or public library or other sensitive noise receptor shall be deemed unsafe and shall be shut down immediately. Exceeding any of the limits in Table 19.e.1 shall also be evidence that the Wind Energy Facility or Wind Turbine operation is unsafe and shall be shut down immediately.

g) Prior to approval, developers of a Commercial Wind Turbine operation or Commercial Wind Energy Facility shall submit a Pre-construction Background Noise Survey with measurements for each residence, school, hospital, church, place of employment, or public library within one (1) mile of the proposed development. The Background Noise Survey shall be conducted in accordance with the procedures provided in Appendix A of this Ordinance, showing background sound levels (L_{90}) and 1/1 or 1/3 octave band sound pressure levels (L_{90}) during the quietest periods of the day and night over a reasonable period of time (not less than 10 minutes of sampling). The Pre-construction Background Noise Survey shall be conducted at the Applicant's expense by an independent noise consultant contractor acceptable to the Trempealeau County Zoning Department.

h) Prior to approval, developers of a Commercial Wind Energy Facility or Commercial Wind Turbine operation shall provide additional information regarding the make and model of the turbines, Sound Power Levels (L_W) for each octave band from the Blade Passage Frequency up through 10,000 Hz, and a Sound Impact Study with results reported on a contour map projection showing the predicted sound pressure levels in each of those octave bands for all areas up to one (1) mile from any Commercial Wind Turbine or Commercial Wind Energy Facility for the wind speed and direction that would result in the worst case Wind Energy Facility sound emissions. The Sound Impact Study may be made by a computer modeling, but shall include a description of the assumptions made in the model's construction and algorithms. If the model does not consider the effects of wind direction, geography of the terrain, and the effects of reinforcement from coherent sounds or tones from the turbines, these shall be identified and other means shall be used to adjust the model's output to account for these factors. The Sound Impact Study results shall be displayed as a contour map of the predicted levels, but shall also include a data table showing the predicted levels at any existing residence, school, hospital, church, public library, or place of employment within the model's boundaries. The predicted values shall include dBA values and shall also include the non-weighted octave band levels in the data tables. The Sound Impact Study shall be conducted at the Applicant's expense by an independent noise consultant contractor acceptable to the Trempealeau County Zoning Department.

i) Operators of a Commercial Wind Energy Facility or Commercial Wind Turbine operation shall submit a Post-construction Sound and Vibration Measurement Study conducted for each Commercial Wind Turbine or Commercial Wind Energy Facility according to the procedures provided in Appendix A of this Ordinance within twelve (12) months of the date that the project is fully operational to demonstrate compliance with the noise limitations in Section 19(a). The study shall be conducted at the wind energy facility owner/operator's expense by a noise consultant contractor acceptable to the Trempealeau County Zoning Department.

j) The Committee may impose a noise setback that exceeds the other setbacks set out in this Ordinance or require waivers from affected property owners and persons in legal possession acceptable to the Committee if it deems that greater setbacks are necessary to protect the public health and safety, or if the proposed wind energy facility is anticipated to exceed the levels set forth in Section 19(a) at any existing residence, school, hospital, church, place of employment, or public library.

k) Any noise level falling between two (2) whole decibels shall be deemed the higher of the two.

l) If the noise levels resulting from the Commercial Wind Turbine or Commercial Wind Energy Facility exceed the criteria listed above, a waiver to said levels may be granted by the Committee provided that express written consent from all affected property owners and persons in legal possession has been obtained stating that they are aware of the noise limitations imposed by this Ordinance, and that consent is granted to allow noise levels to exceed the maximum limits otherwise allowed. If the applicant wishes the waiver to apply to succeeding owners of the property, either a permanent noise impact easement or easement for the life of the wind turbine shall be recorded in the Trempealeau County Register of Deeds' office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property that noise levels in excess of those permitted by this Ordinance may exist at the burdened property.

m) A Noise Study may be conducted at the expense of a Commercial Wind Energy Facility or a Wind Turbine (Commercial, Personal or Hobbyist) Owner/Operator by an independent noise consultant contractor acceptable to the Trempealeau County Zoning Department if two (2) or more complaints are received and documented at a particular site. The study shall be conducted according to the procedures provided in Appendix A of this Ordinance for any sites where the complaints were documented. The Operator shall reimburse the County for the Noise Study expense within ten (10) days of billing. Failing to reimburse may be a basis for revoking a permit.

(19) Minimum Ground Clearance: The blade tip of a Commercial Wind Turbine shall, at its lowest point, have ground clearance of no less than seventy-five (75) feet. The blade tip of a personal and hobbyist Wind Turbine shall, at its lowest point, have ground clearance of no less than fifteen (15) feet.

(20) Signal Interference and Microwave Frequency Interference: The owner/operator shall minimize any interference with electromagnetic communications, such as radio, telephone or television signals caused by any Wind Energy Facility or Turbine. (If the applicant is a public utility, s. PSC 113.0707 also applies).

(a) A one thousand (1,000) feet microwave communication corridor between turbines must be maintained if the turbine facility is located between transmission towers.

(b) Communication tower – Wind turbine setback shall be at least one (1) mile to prevent signal interference.

(c) Emergency communication towers will be located on a Geographical Information System (GIS) map so turbine facilities can be properly planned to avoid conflict with Trempealeau County Emergency Services.

21.07 Setbacks: The following setbacks and separation requirements shall apply to Hobbyist and Personal Wind Turbines.

(a) Public Roads: Each Wind Turbine shall be set back from the nearest public road and its right of way a distance no less than two (2) times its Total Height.

(b) Railroads: Each Wind Turbine shall be set back from all railroads and their right of way a distance of no less than two (2) times its Total Height.

(c) Wind Turbine spacing: Each Wind Turbine shall have a separation distance from other Wind Turbines equal to one and two-tenths (1.2) times the total height of the tallest wind turbine.

(d) Communication and electrical lines: Each Wind Turbine shall be set back from the nearest above-ground public electric power line or telephone line a distance no less than two (2) times its Total Height.

(e) Property lines: Each Wind Turbine shall be set back from the nearest property line a distance no less than three (3) times its Total Height, unless mitigation has taken place and agreed by owner/operator and affected property owners involved and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property.

21.08 Miscellaneous Safety Requirements for Commercial and Personal Wind Turbines

(1) All wiring between Wind Turbines and the Wind Energy Facility substation shall be underground.

(a) All neutral grounding connectors from Commercial Wind Turbines shall be insulated from the earth and shall be sized to accommodate at least twice the peak load of the highest phase conductor, to absolutely prevent transient ground currents, in order to comply with the **National Electric Safety Code** and the **IEEE Standard 519-1992, approved by the American National Standards Institute,** as follows:

Grounding of both the electrical transmission lines and the supply lines to the internal electrical systems of the turbines themselves, shall comply with **Rule 92D, Current in Ground Conductors:** "Ground connector shall be so arranged that under normal circumstances, there will be no objectionable flow of current over the grounding conductor."

Rule 215B: [It is not permissible] "to use the earth as a part of a supply circuit."

Under no circumstances shall any Wind Turbine be connected directly to the grid; connection must be made through a substation or transformer properly grounded and filtered to keep harmonic distortion within recommended limits.

Bare, concentric neutrals are specifically prohibited in buried lines between turbines and in underground transmission lines to substations.

(2) Wind Turbine towers shall not be climbable up to fifteen (15) feet above ground level.

(3) All access doors to Wind Turbine towers and electrical equipment shall be lockable and locked when unattended.

(4) Appropriate warning signage shall be placed on Wind Turbine towers, electrical equipment, and Wind Energy Facility entrances.

21.09 Fee Schedule

(1) The permit application is required for a Hobbyist Wind Turbine. No fee or bond amount is required.

(2) The Conditional Use Permit application fee for a Personal Wind Turbine shall be two hundred twenty-five dollars ($225.00). No bond amount is required.

(3) For a Wind Energy Facility the application fee is five hundred dollars ($500.00) per turbine. The amount of the bond required will be based on the number of turbines and the estimated cost to remove the Wind Turbine, including to a point three (3) feet below grade.

21.10 Validity

Should any section, clause or provision of this chapter be declared by the courts to be invalid, the same shall not affect the validity of the chapter as a whole or any part thereof, other than the part so declared.

Chapter 21 - Appendix A

Trempealeau County Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Wind Energy Conversion Systems

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Introduction

The potential sound and vibration impact associated with the operation of wind powered electric generators, including Wind Energy Facilities and Wind Turbine operations, is a primary concern for citizens living near proposed Wind Energy Conversion Systems ("WECS"). This is especially true of projects located near homes, residential neighborhoods, schools, hospitals, churches, places of employment and public libraries. Determining the likely sound and vibration impacts is a highly technical undertaking and requires a serious effort in order to collect reliable and meaningful data for both the public and decision makers.

This protocol is based in part on criteria published in the Standard Guide for Selection of Environmental Noise Measurements and Criteria.[1] and the Public Service Commission of Wisconsin publication Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Electric Power Plants (February 2002).[2] The purpose is to first establish a consistent and scientifically sound procedure for estimating existing ambient (background) sound and vibration levels in a project area, and second to determine the likely impact that operation of a new wind energy conversion system project will have on the existing sound and vibration environment.

The characteristics of the proposed WECS project and the features of the surrounding environment will influence the design of the sound and vibration study. Site layout, types of wind energy conversion units ("WECU") selected and the existence of the significant local sound and vibration sources and sensitive receptors shall be taken into consideration when designing a sound and vibration study. An independent, qualified consultant shall be required to conduct the sound and vibration study.

Note: Trempealeau County Zoning Department Administration shall be consulted prior to conducting any sound and vibration measurements. These guidelines may be modified (with express written approval of the County Zoning Department) to accommodate unique site characteristics. Consult with Zoning Department staff assigned to the project for guidance on study design before beginning any sound and vibration study. During consultation, good quality maps or diagrams of the site are necessary. Maps and diagrams shall show the proposed project area layout and boundaries[5], and identify important landscape features as well as significant local sound and vibration sources and sensitive receptors including, but not limited to, a residence, school, hospital, church, place of employment, or public library.

Measurement of the Existing Sound and Vibration Environment

An assessment of the proposed WECS project area's existing sound and vibration environment is necessary to predict the likely impact resulting from a proposed project. The following guidelines shall be used in developing a reasonable estimate of an area's existing sound and vibration environment. All testing shall be performed by an independent acoustical testing engineer approved by the Trempealeau County Zoning Department. All measurements shall be conducted with industry certified testing equipment.[4] All test results shall be reported to the Trempealeau County Zoning Department.

Sites with No Existing Wind Energy Conversion Units

Sound level measurements shall be taken as follows:

1. At all properties within the proposed WECS project boundaries[5]

2. At all properties within a one mile radius of the proposed WECS project boundaries[5].

3. One test must be performed during each season of the year.
   a. Spring (March 15 – May 15)
   b. Summer (June 1 – September 1)
   c. Fall (September 15- November 15)
   d. Winter (December 1- March 1)

4. All measurement points (MPs) shall be located in consultation with the property owner(s) and such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the site.

5. Duration of measurements shall be a minimum of ten continuous minutes for each criterion (See Item 9 below) at each location.

6. One set of measurements shall be taken during each of the following four periods:
   a. Morning (6 - 8 a.m.)
   b. Midday (12 noon – 2 p.m.)
   c. Evening (6 – 8 p.m.)
   d. Night (10 p.m. – 12 midnight)

7. Sound level measurements must be made on a weekday of a non-holiday week.

8. Measurements must be taken at 6 feet above the ground and at least 15 feet from any reflective surface[3].

9. For each MP and for each measurement period, provide each of the following measurement criteria:
   a. Unweighted octave-band analysis (16[2], 31.5, 63, 125, 250, 500, 1K, 2K, 4K, and 8K Hz)
   b. L_{ave}, L_{10}, L_{50}, and L_{90}, in dBA
   c. L_{ave}, L_{10}, L_{50}, and L_{90}, in dBC
   d. A narrative description of any intermittent sounds registered during each measurement
   e. Wind speed at time of measurement
   f. Wind direction at time of measurement
   g. Description of the weather conditions during the measurement

10. Provide a map and/or diagram clearly showing:
    a. The layout of the project area, including topography, the project boundary lines[5], and property lines
    b. The locations of the MPs
    c. The minimum and maximum distance between any MPs
    d. The location of significant local sound and vibration sources
    e. The distance between all MPs and significant local sound and vibration sources
    f. The location of all sensitive receptors including but not limited to, a residence, school, hospital, church, place of employment, or public library.

Sites with Existing Wind Energy Conversion Units

Two complete sets of sound level measurements must be taken as defined below:

One set of measurements with the wind generator(s) off.

One set of measurements with the wind generator(s) running.

Sound level measurements shall be taken as follows:

1. At all properties within the proposed WECS project boundaries[5]
2. At all properties within a one mile radius of the proposed WECS project boundaries[5].
3. One test must be performed during each season of the year.
    a. Spring (March 15 – May 15)
    b. Summer (June 1 – September 1)
    c. Fall (September 15- November 15)
    d. Winter (December 1- March 1)

4. All measurement points (MPs) shall be located in consultation with the property owner(s) and such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the site.

5. Duration of measurements shall be a minimum of ten continuous minutes for each criterion (See Item 9 below) at each location.

6. One set of measurements shall be taken during each of the following four periods:
    a. Morning (6 - 8 a.m.)
    b. Midday (12 noon – 2 p.m.)
    c. Evening (6 – 8 p.m.)
    d. Night (10 p.m. – 12 midnight)

7. Sound level measurements must be made on a weekday of a non-holiday week.
8. Measurements must be taken at 6 feet above the ground and at least 15 feet from any reflective surface[3].
9. For each MP and for each measurement period, provide each of the following measurement criteria:
    a. Unweighted octave-band analysis (16^2, 31.5, 63, 125, 250, 500, 1K, 2K, 4K, and 8K Hz)
    b. L_{ave}, L_{10}, L_{50}, and L_{90}, in dBA
    c. L_{ave}, L_{10}, L_{50}, and L_{90}, in dBC
    d. A narrative description of any intermittent sounds registered during each measurement

e. Wind speed at time of measurement
f. Wind direction at time of measurement
g. Description of the weather conditions during the measurement

10. Provide a map and/or diagram clearly showing:
   a. The layout of the project area, including topography, the project boundary lines[5], and property lines
   b. The locations of the MPs
   c. The minimum and maximum distance between any MPs
   d. The location of significant local sound and vibration sources
   e. The distance between all MPs and significant local sound and vibration sources
   f. The location of all sensitive receptors including but not limited to, a residence, school, hospital, church, place of employment, or public library.

Sound Level Estimate for Proposed Wind Energy Conversion System

In order to estimate the sound and vibration impact of the proposed WECS project on the existing environment an estimate of the sound and vibration produced by the proposed WECU(s) must be provided.

1. The manufacturer's sound level characteristics for the proposed WECU(s) operating at full load. Include an unweighted octave-band (16[4], 31.5, 63, 125, 250, 500, 1K, 2K, 4K, and 8K Hz) analysis for the WECU(s) at full operation for distances of 500, 1000, 1500, 2000, 2500 feet from the WECU(s).

2. Estimate the sound levels for the proposed WECU(s) in dBA and dBC at distances of 500, 1000, 1500, 2000, 2500 feet from the WECU(s). For projects with multiple WECU's, the combined sound level impact for all WECU's operating at full load must be estimated.

3. Provide a contour map of the expected sound level from the new WECU(s), using 5dBA increments created by the proposed WECU(s) extending out to a distance of at least 5,280 feet (one mile).

4. Determine the impact of the new sound and vibration source on the existing environment. For each MP used in the ambient study (note the sensitive receptor MPs):
   a. Report expected changes to existing sound levels for L_{ave}, L_{10}, L_{50}, and L_{90}, in dBA
   b. Report expected changes to existing sound levels for L_{ave}, L_{10}, L_{50}, and L_{90}, in dBC
   c. Report all assumptions made in arriving at the estimate of impact and any conclusions reached regarding the potential effects on people living near the project area.

5. Include an estimate of the number of hours of operation expected from the proposed WECU(s) and under what conditions the WECU(s) would be expected to run.

Post-Construction Measurements

1. Within twelve months of the date when the project is fully operational, and within two weeks of the anniversary date of the Pre-construction ambient noise measurements, repeat the existing sound and vibration environment measurements taken before the project approval. Post-construction sound level measurements shall be taken both with all WECU running and generating power, and with all WECU off.
2. Report post-construction measurements to the Trempealeau County Zoning Department (available for public review) using the same format as used for the Pre-approval sound and vibration studies.

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[1] Standard Guide for Selection of Environmental Noise Measurements and Criteria (Designation E 1686-96). July 1996. American Society for Testing and Measurements.

[2] Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Electric Power Plants. February 2002. Public Service Commission of Wisconsin.

[3] Environmental Noise Guidelines: Wind Farms. (ISBN 1 876562 43 9). February 2003. Environment Protection Authority, Adelaide SA.

[4] The Trempealeau County Zoning staff acknowledges that few sound level meters are capable of measurement of the 16 Hz center frequency octave band. However, because noise complaints from the public most likely involve low frequency noise associate with proposed WECS, we encourage applicants to pursue the collection of this important background noise data. If obtaining the 16 Hz data presents a problem contact Trempealeau County Zoning staff prior to collection of any field ambient measurement data.

[5] Project Boundary: A continuous line encompassing all WECU's and related equipment associated with the WECS project.

E-Coustic Solutions
Noise Control • Sound Measurement • Consultation
Community • Industrial • Residential • Office • Classroom • HIPPA Oral Privacy
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Principal
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October 24, 2007

RECEIVED

Dave Vind
N26992 Tolokken Rd.
Arcadia, WI 54612

Subject: Review of Draft Noise Ordinance for Trempealeau County, WI

Dear Mr. Vind:

Thank you for the opportunity to review and comment on the current draft noise ordinance. I hope that you have had a chance to review the documents for Chilton that I sent earlier.

Before I begin with the review I would like to provide some background. I am a noise control consultant with over thirty-five years of experience in applied noise control engineering. By 'applied noise control' I mean that I have spent those years working as a consultant to my clients on practical problems related to noise from manufacturing plants both inside and outdoors. I am not an academic or research oriented professional. I was president and senior partner/owner of a consulting firm with over 40 technicians and engineers in three cities of the US. We were the first tier Partners and providers of noise control services to two of the big three auto companies plus many other Fortune 100 firms. I retired from that position about a year ago due to health issues and am now engaged in private practice consulting.

I have had favorable opinions about producing electricity from renewable resources and have promoted those ideas in my practice when the opportunities presented themselves. I am not 'anti-wind power' although one might get that impression since much of what I say is critical of the way the wind farm developers work. I believe that wind energy is an important part of our renewable energy source options and needs to be supported for that reason. But, when I see that the developers are choosing areas for wind farms that are not at least Class 4 or better wind areas or are locating utility grade wind turbines in the quiet areas of rural America without due consideration for the safety and health of the communities that will host the wind farms, I feel compelled to provide my input, as a noise engineering professional to alert the communities to potential problems. Further, if I find that the wind farm developers are not presenting information about sound (e.g. noise) from the wind farm operations in a fair and balanced manner, I feel a need to set that record straight. If the situation was reversed and the communities were the ones at odds with my understanding of the issues I would be just as hard on them as I am on the wind farm developers. I trust that I can be understood as a professional and my observations, comments and opinions as a proper professional response to the current situation. I assure you I am not working as a biased professional.

I have reviewed the documents that were provided and submitted my comments on the attached pages. If you have further questions please let me know. I will be in Wisconsin next week for meets with the people of Chilton and Calumet County. If anyone from your group want to attend or to meet with me during the following days please let me know and I will see what I can do to work with you.

I would strongly suggest that you try to incorporate more of the approach used in the Chilton documents and Appendices. They incorporate elements that address legal issues and meet national standards and commonly accepted practices in community noise regulations that I do not see in the document I reviewed for Trempealeau County.

Sincerely,
E-Coustic Solutions

Richard R. James, INCE

Attachments: Review Comments

Section No: 18.(a)

The limit of 45 dBA addresses only the audible portion of a noise complaint. There is also the situation where low frequency sound may be present and although not audible, it may still be sensed by other organs of the body or create structural vibrations in the building or its contents. The use of a sound test, such as, taking the sound level over a period of 10 minutes or so (Leq) using a sound level meter that meets Type 1 specifications to determine both the dBC and dBA weighted levels and then applying a test for C-A >20 similar to the test in the Chilton License would cover the low frequency situation.

I can say that if this limit is left at 45 dBA there will be complaints from people in quieter areas of the community when the levels are 40 dBA and even less. The complaints will be about noise in the evening and at night when the windows are open, there is little or no wind at ground level, but there is sufficient wind at hub height to power the turbines. The complaints will include those about sleep interference and stress. Some may say these are not health issues, but I expect there are medical experts that will testify that they are health issues.

Section No: 18.(b)

This section is fairly standard in community noise ordinances. It is difficult to apply except for the most straight forward noise emitters such as large industrial blowers and fans. But it is a standard element and may be useful for wind turbine sounds in the lower frequency ranges or if a gear box fails.

Section No: 18.(c)

This section needs to be redone. The ambient level needs to be defined as the L_{90} value sampled during the quiet time of the late evening or night as in the Chilton documents. The definition also needs to use the term 'background' sound level. Ambient really means something different and as used in this section could allow excessively loud turbine sounds in the community. If I am understanding the rule correctly it would base the ambient (e.g. background) sound level on the L_{10} statistical descriptor which allows the louder events during the test to control the final sound level.

Further it is technically impossible to measure sound levels when winds exceed much over 13 miles per hour at the test location, much less 30 mph. Again, refer to the Chilton documents for how to address wind speed. Remember that even at 10 mph on the ground, the wind speed at hub heights will be more like 20+ mph. This should allow accurate measurements during power production conditions, especially if care is taken to screen out data affected by wind gusts. For information on how winds at ground level are lower than at hub height see the web site:
http://www.windpower.org/en/tour/wres/shear.htm

In fact, this is a good web site to review in detail. There are places where you can see how adding turbines changes sound levels ***http://www.windpower.org/en/tour/env/sound***.htm and many other topics.

The only caution I would offer is to remember this is a wind-industry sponsored web site and when they say that 'Noise is not a problem' it is a country where the rule is that no turbine can be closer to a residence than 7 rotor diameters. That would be about 1/3 mile or more for the turbines being installed in Wisconsin. The idea of a setback of only a few rotor diameters would not be acceptable in any European country, even though the wind industry promotes small setbacks here in the US.

Section No: 18.(d)

This is okay.

Section No: 18.(e)

On the surface this appears to be a good idea. But, what if the parties agree to a waiver and then later there is a safety or health issue that results from the operation of the WES? I think that the limits in the above sections are already on the upper bound of safety and health and that allowing the limits to be exceeded may not be a good idea. The Committee should reserve the right to approve or deny any waivers with the burden of proving safety and health on the WES operator.

Joint Statement to Wisconsin Task Force on Wind Siting Reform

By: George Kamperman, INCE Bd. Cert., and Richard James, INCE

To: Wisconsin Task Force on Wind Siting Reform
Subject: Comments on Electric Generation and Supply templates
Re: Wind Siting Reform Policy

Dear Sirs:

Please let me take this opportunity to briefly introduce ourselves. We are noise control consultants with many years of experience in community noise and related land-use planning issues. Mr. Kamperman has over 50 years of experience and was active in the early 1970's assisting the US EPA, states such as Illinois, and many communities in setting their community noise standards and guidelines. Mr. James has over 35 years of experience in the same field and has represented many of the largest corporations in the US on community noise issues and litigation. He has also served on the S12 Working Group for the American National Standards Institute, which has oversight on standards related to acoustics including community noise and works to coordinate ANSI standards with those of ISO and other standards organizations. We are currently involved with assisting some of the communities in Wisconsin with understanding and addressing wind turbine developments proposed for their communities.

We are writing this joint letter to the Task Force because we have mutual concerns about the impact of the work of the Task Force on the communities in Wisconsin that are under consideration for wind farm development. These concerns are a result of our work with those communities and our review of the Task Force's recent draft Policy documents and the Draft Model Wind Ordinance for Wisconsin (Feb. 7, 2007) and its associated reference guide.

Our review finds substantial errors of fact and understanding regarding community noise and the impact of noise on land-use planning and the safety and health of citizens that would be affected by these policies. We do not intend to address all of them but several of the more egregious errors are addressed in this letter.

It appears to us that there has been little or no input into the work of the Task Force from un-biased and experienced professionals from our profession. Nor does it appear that there has been much, if any input from the medical and research professionals. Mr. Kamperman suggests that one way to resolve this lack of expertise on the Task Force panel would be to include someone with his experience on the Task Force panel. Please consider the offer in the Post Script below.

We would like to address two major errors and failures of understanding in the Task Force's documents.

First, the limits and guidelines set forth fail to adequately consider the health and safety of the people who will be living in the communities in which the wind energy systems are to be located. For example, there is no scientific evidence currently available from independent medically qualified authorities to support a statement that the 50 dBA sound pressure level to which residents may be subjected on a 24/7/365 basis is safe and healthful for all people including children and those with special needs.

The World Health Organization has found[1] that sound levels during nighttime and late evening hours should be less than 30 dBA during sleeping periods to protect children's health. They noted that a child's autonomous nervous system is 10 to 15 dB more sensitive to noise than adults. Even for adults, health effects are first noted in some studies when the L_{max} sound levels exceed 32 dBA, 10-20 dBA lower than the levels needed to cause awakening. The WHO researchers found that sound levels of 50 dBA or more strongly disrupted hormone secretion cycles. For sounds that contain a strong low frequency component, which is typical of wind turbines, WHO says that the limits may need to be even lower than 30 dBA to not put people at risk.[2] ANSI standards recommend that no sound pressure levels exceed 65 dB (e.g. No weighting) in the lower frequency ranges to avoid structural vibrations and potential damage. 50 dBA would not protect against this situation, yet studies have shown that wind turbine sounds at residences sometimes exceed 65 dB in the frequency range below 20 Hz.

The recent conference held in Lyons France for the purpose of addressing wind turbine noise and health concerns demonstrated that wind turbine sound emissions of the types routinely experienced by people living close to wind farms may have significant cardio-vascular health effects after long term exposure. Again, we caution the Task Force that there is no scientific or medical basis for equating a 50 dBA limit for Wisconsin communities with health and safety.

Both the policy statement and supporting Model Ordinance are woefully lacking any scientific evidence supporting the sound limits and other recommendations that impact the acoustical environment. There is no un-biased evidence presented that the people living near wind turbine installations will not be forced to accept industrial scale operations that could introduce new risks into a community against the will of its citizens. Further, the statements in these documents that 50 dBA is based on review of other statutes and standards adopted by communities with wind farms shows only that the other communities also did not properly research the issues of community noise and

[1] Report on the second meeting on night noise guidelines, WHO, Dec. 6-7 2004

[2] Community Noise (Berglund et al., 2000)

its effects on health and safety. There is no objective argument for considering these other standards as a reason to adopt a similar set of limits. The documents provided by the promoters of wind energy that support the methods and limits proposed by the Task Force that we have seen would not pass a peer review by professionals in our field. They, also, should not be used as the basis for guidelines in Wisconsin.

Second, to suggest the use of L_{10} as a descriptor of background sound levels is an egregious mistake. On what scientific basis has this recommendation been made? L_{10} is not a descriptor of background sound; L_{90} is the proper descriptor for background sound. L_{10} is a descriptor of noisiness from transient events. The wind turbines will produce steady sound emission for protracted periods of time. They should not be judged against transient events, but against the steady background sounds that occur during the periods of the day when quiet is expected.

Wind turbine siting guidelines for noise in Europe and many other parts of the world have adopted L_{90} to define the sound levels in communities prior to construction of wind farms. In New Zealand, L_{95} is used. The International Energy Agency (IEA) recommends the use of either L_{90} or L_{95} to define background sound levels.[3] L_{90} has been accepted and incorporated into documents developed by wind industry groups. For example, the British Wind Industry Association (BWEA) recommends that turbine sound levels should be kept to within 5 dBA of the average existing evening or nighttime background noise level and defines background noise level as the L_{90} sound level.[4]

It should be noted that even when these stricter guidelines are followed that experiences in Europe, Britain and New Zealand show that residents near the wind farms are often subjected to turbine noise that are considered objectionable.

Finally, if the mission of the task force is to enable the mission of the DNR:

> "To provide a healthy, sustainable environment and a full range of outdoor opportunities.
>
> "To ensure the right of all people to use and enjoy these resources in their work and leisure.
>
> "To work with people to understand each other's views and to carry out the public will."

Then, the views of the communities and citizens of Wisconsin who look to the State for guidance on what amounts to the industrialization of rural Wisconsin

[3] Recommended Practices for Wind Turbine Testing, Chapter 10.

[4] BWEA Wind Turbine Noise Working Group Guidelines.

should be considered as positive and constructive efforts. Their concerns about noise and other new risks being introduced into their communities are valid. They should not be discredited by labeling their concerns as some form of NIMBYism or obstructionism as was implied in earlier drafts of the policy documents. Doing so devalues the input of Wisconsin's citizens to the State's efforts to promote renewable energy.

We appreciate the Task Force taking the time to consider our concerns and hope that they are taken in the most constructive light possible.

Sincerely,

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P.S. from George Kamperman

I feel the wind turbine siting issues are so critical in many areas that I would welcome an opportunity to be a part of the PSC committee responsible for determining wind turbine siting guidelines for the State of Wisconsin. If the State is interested in my involvement in this endeavor I offer my services at no cost.

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE H: NOISE
CHAPTER I: POLLUTION CONTROL BOARD

PART 900
GENERAL PROVISIONS

Section

AUTHORITY: Implementing Section 25 and authorized by Section 27 of the Environmental Protection Act [415 ILCS 5/25 and 27].

SOURCE: Originally filed as Part 1 of Chapter 8: Noise Pollution, effective August 10, 1973; amended at 2 Ill. Reg. 27, p. 223, effective June 26, 1978; amended at 5 Ill. Reg. 6371, effective June 1, 1981; amended at 5 Ill. Reg. 8533, effective August 10, 1981; amended at 6 Ill. Reg. 10960, effective September 1, 1982; codified at 7 Ill. Reg. 13579; amended in R83-7 at 11 Ill. Reg. 3121, effective January 28, 1987; amended in R03-8 at 27 Ill. Reg. 16247, effective October 8, 2003.

Section 900.101 Definitions

Except as stated and unless a different meaning of a term is clear from its context, the definitions of terms used in this Chapter are the same as those used in the Environmental Protection Act. All definitions of acoustical terminology must be in conformance with those contained in American National Standards Institute (ANSI) S1.1 – 1994 (R1999) "American National Standard Acoustical Terminology"and S12.9- 1988 (R1998) "American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 1," incorporated by reference at Section 900.106. As used in 35 Ill. Adm. Code 900 through 910, the following terms mean:

A-Weighted Sound Level: 10 times the logarithm to the base 10 of the square of the ratio of the A-weighted (and time-averaged) sound pressure, to the reference sound pressure of 20 micropascal. The frequency and time weighting must be specified in accordance with ANSI S1.4–1983 (R2001) "American National Standard Specification for Sound Level Meters", incorporated by reference at Section 900.106. The unit of sound level is the decibel (dB) with the letter (A) appended to the decibel unit symbol to indicate the frequency weighting and written as dB(A).

Ambient: the all-encompassing sound associated with a given environment without contributions from the noise source or sources of interest.

Angle of incidence: the orientation of the microphone relative to the sound source.

ANSI: American National Standards Institute or its successor bodies.

Antique vehicle: a motor vehicle that is more than 25 years of age or a bona fide replica thereof and which is driven on the highways only going to and returning from an antique auto show or an exhibition, or for servicing or demonstration, or a fire-fighting vehicle more than 20 years old which is not used as fire-fighting equipment but is used only for the purpose of exhibition or demonstration.

Background ambient sound level: means the ambient sound level, measured in accordance with the procedures specified in 35 Ill. Adm. Code 910.

Bus: every motor vehicle designed for carrying more than 10 passengers and used for the transportation of passengers; and every motor vehicle, other than a taxicab, designed and used for the transportation of persons for compensation.

C-weighted sound level: in decibels, a frequency-weighted sound pressure level, determined by the use of the metering characteristics and C-weighted network specified in ANSI S1.4-1983 (R2001) " American National Standard Specification for Sound Level Meters~~.~~," incorporated by reference at Section 900.106.

Construction: on-site erection, fabrication, installation, alteration, demolition or removal of any structure, facility, or addition thereto, including all related activities including, but not restricted to, clearing of land, earth-moving, blasting and landscaping.

Daytime hours: 7:00 am to 10:00 pm, local time.

dB(A): see "A-weighted sound level in decibles."

Dealer: every person engaged in the business of selling vehicles to persons who purchase such vehicles for purposes other than resale, and who has an established place of business for such activity in this state.

Decibel (dB): a unit of measure, on a logarithmic scale to the base 10, of the ratio of the magnitude of a particular sound pressure to a standard reference pressure, which, for purposes of this Chapter, shall be 20 micronewtons per square meter ($\mu N/m^2$) or 20 micropascals (μPa).

Discrete tone: a sound wave whose instantaneous sound pressure varies essentially as a simple sinusoidal function of time.

Exhaust system: the system comprised of a combination of components which provides for the enclosed flow of exhaust gas from engine parts to the atmosphere.

Existing property-line-noise-source: any property-line-noise-source, the construction or establishment of which commenced prior to August 10, 1973. For the purposes of this sub-section, any property-line-noise-source whose A, B or C land use classification changes, on or after August 10, 1973, is not considered an existing property-line-noise-source.

Farm tractor: every motor vehicle designed and used primarily as a farm implement for drawing wagons, plows, mowing machines and other implements of husbandry, and every implement of husbandry which is self-propelled.

Fast Dynamic Characteristic: the dynamic characteristic specified as fast in ANSI S1.4-1983 (R-2001) "American National Standard Specification for Sound Level Meters," incorporated by reference at Section 900.106.

Fast meter response: as specified in ANSI, S1.4–1983 (R2001) "American National Standard Specification for Sound Level Meters," incorporated by reference at Section 900.106.

Fluctuating sound: a class of nonsteady sound where sound pressure level varies over a range greater than 6 decibels (dB) with the "slow" meter characteristic, and where the meter indication does not equal the ambient level more than once during the period of observation.

Frequency-weighted sound pressure: root mean square of the instantaneous sound pressure which is frequency-weighted (i.e., filtered) with a standard frequency characteristic (e.g., A or C) and exponentially time-weighted in accordance with the standardized characteristics slow (S), fast (F), impulse (I) or peak, with both weightings specified in accordance with ANSI S1.4–1983 (R2001) "American National Standard Specification for Sound Level Meters," incorporated by reference at Section 900.106. The frequency weighting used shall be specified explicitly (e.g., A, C or octave band). The unit frequency-weighted sound pressure is the pascal (Pa).

Gross Vehicle Weight (GVW): the maximum loaded weight for which a motor vehicle is registered or, for vehicles not so registered, the value specified by the manufacturer as the loaded weight of the vehicle.

Highly Impulsive Sound: either a single pressure peak or a single burst (multiple pressure peaks) for a duration usually less than one second. Examples of highly impulsive sound sources are drop forge hammer and explosive blasting.

Highway: the entire width between the boundary lines of every way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel.

IHRA: International Hot Rod Association or its successor body.

Intermittent sound: a class of nonsteady sound where the meter indicates a sound pressure level equal to the ambient level two or more times during the measurement period. The period of time during which the level of the sound remains at a value different from that of the ambient is of the order of one second or more.

LBCS: the Land-Based Classification Standards which designate land, use functions by means of numeric codes.

L_{eq}: equivalent continuous sound pressure level in decibels: 10 times the logarithm to the base 10 of the ratio of a time mean square sound pressure, during the specified time period, to the square of reference sound pressure. The reference sound pressure is 20 micronewtons per square meter or equivalent continuous frequency-weighted sound pressure.

L_{eq} (A): A-weighted time-average (equivalent-continuous) sound pressure level.

L_{eq} (octave band-Hz): time-average (equivalent-continuous) sound pressure level in the octave band specified by its center frequency e.g. L_{eq} (125-Hz).

Measurement Period: the time interval during which acoustical data are obtained. The measurement period is determined by the characteristics of the noise being measured and must be at least ten times as long as the response time of the instrumentation. The greater the variation in indicated sound level, the longer must be the observation time for a given expected precision of the measurement.

Motor driven cycle: every motorcycle, motor scooter, or bicycle with motor attached, with less than 150 cubic centimeter piston displacement.

Motor vehicle: every vehicle which is self-propelled and any combination of vehicles which are propelled or drawn by a vehicle which is self-propelled.

Motorcycle: every motor vehicle having a seat or saddle for the use of the rider and designed to travel on not more than 3 wheels in contact with the ground, but excluding a tractor.

Muffler: a device for abating the sounds of escaping gases of an internal combustion engine.

New snowmobile: a snowmobile, the equitable or legal title to which has never passed to a person who purchases it for purposes other than resale.

Nighttime hours: 10:00 pm to 7:00 am, local time.

Noise floor: the electrical noise (in decibels) of the sound measurement system. When the noise floor is determined by placing a calibrator over the microphone of the sound measurement system, the noise floor may include acoustic noise due to leakage around the calibrator.

Noise pollution: the emission of sound that unreasonably interferes with the enjoyment of life or with any lawful business or activity.

Non-steady sound: a sound whose sound pressure level shifts significantly during the measurement period. Meter variations are greater than +/- 3 dB using the "slow" meter characteristic.

Octave band sound pressure level: the sound pressure level for the sound being measured contained within the specified octave band. The reference pressure is 20 micronewtons per square meter.

Pascal (Pa): a unit of pressure. One pascal is equal to one newton per square meter.

Passenger car: a motor vehicle designed for the carrying of not more than ten persons, including a multi-purpose passenger vehicle, except any motor vehicle of the second division as defined in 625 ILCS 5/1-146, and except any motorcycle or motor driven cycle.

Person: any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof or any legal successor, representative, agent or agency of the foregoing.

Preferred frequencies: those frequencies in Hertz preferred for acoustical measurements which, for the purposes of this Chapter, consist of the following set of values: 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 10,000, 12,500.

Prominent discrete tone: sound, having a one-third octave band sound pressure level which, when measured in a one-third octave band at the preferred frequencies, exceeds the arithmetic average of the sound pressure levels of the two adjacent one-third octave bands on either side of such one-third octave band by:

> 5 dB for such one-third octave band with a center frequency from 500 Hertz to 10,000 Hertz, inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band, or;
>
> 8 dB for such one-third octave band with a center frequency from 160 Hertz to 400 Hertz, inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band, or;
>
> 15 dB for such one-third octave band with a center frequency from 25 Hertz to 125 Hertz, inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band.

Property-line-noise-source: any equipment or facility, or combination thereof, which operates within any land used as specified by 35 Ill. Adm. Code 901.101. Such equipment or facility, or combination thereof, must be capable of emitting sound beyond the property line of the land on which operated.

Quasi-steady sound: a train of two or more acoustical impulses. Examples of quasi-steady sound are that from riveting and pneumatic hammer.

Reflective surface: any building, hillside, or similar object (other than the flat ground surface) that reflects sufficient sound to affect the sound pressure level readings obtained from a noise source. Not included as reflective surfaces are small objects such as trees, posts, chain-linked fences, fire hydrants, vegetation such as bushes and shrubs, or any similar object.

Registered: a vehicle is registered when a current registration certificate or certificates and registration plates have been issued for it under the laws of any state pertaining to the registration of vehicles.

Residential dwelling unit: all land used as specified by the Land-Based Classification Standards (LBCS) Codes 1100 through 1340 and those portions of land used as specified by LBCS Code 6222 used for sleeping.

SAE: Society of Automotive Engineers.

Slow Dynamic Characteristic: the dynamic characteristic specified as "Slow" in ANSI S1.4–1983 (R2001) " American National Standard Specification for Sound Level Meters," incorporated by reference at Section 900.106.

Snowmobile: a self-propelled device designed for travel on snow or ice or natural terrain steered by skis or runners, and supported in part by skis, belts, or cleats.

Sound: a physical disturbance causing an oscillation in pressure in a medium (e.g., air) that is capable of being detected by the human ear or a sound measuring instrument.

Sound exposure (SE): time integral of squared, frequency-weighted instantaneous sound pressure over a given time interval. The time period of integration must be specified: when the sound exposure of the background noise is a significant contributor to the total sound exposure; or when the threshold sound level of the instrument (a level below which the instrument does not accumulate contributions to the integral) used is above the level of the background noise; or when such data is needed to identify a source; or when the time period of integration is otherwise useful. The customary unit for sound exposure is pascal-squared second (Pa^2-s).

Sound exposure level (SEL or L_{eT}): 10 times the logarithm to the base 10 of the ratio of sound exposure to the reference sound exposure (E_o) of 400 micropascal-squared seconds (μPa^2-s). For a given measurement time period of T seconds, the sound exposure level (L_{eT}) is related to the time-average sound level (L_{pT}) as follows: $L_{eT} = L_{pT} + \log (T/t_o)$ where t_o is the reference duration of 1 second. The time period of intergration (T) must be specified. The frequency weighting used must be specified explicitly (e.g., A, C or octave band). The A-weighted SEL and C-weighted SEL are abbreviated ASEL and CSEL respectively. An octave band SEL is expressed in terms of the center frequency (e.g., SEL at 125-Hz). The unit for sound exposure level is decibel (dB).

Sound level (weighted sound pressure level): 20 times the logarithm to the base 10 of the ratio of the frequency-weighted (and time-averaged) sound pressure to the reference pressure of 20 micropascals. The frequency weighting used shall be specified explicitly (e.g., A, C or octave band). The unit for sound level is decibel (dB).

Sound pressure: the root mean square of the instantaneous sound pressures during a specified time interval in a stated frequency band. The unit for sound pressure is pascal (Pa).

Sound pressure level: 20 times the logarithm to the base 10 of the ratio of the particular sound pressure to the reference sound pressure of 20 micropascals.

ANSI S12.9- 1988 (R1998) "American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 1," incorporated by reference at Section 900.106, reserves the term sound pressure level to denote the unweighted sound pressure. The unit for sound pressure level is decibel (dB).

Special mobile equipment: every vehicle not designed or used primarily for the transportation of persons or property and only incidentally operated or moved over a highway, including but not limited to: ditch digging apparatus, well-boring apparatus and road construction and maintenance machinery such as asphalt spreaders, bituminous mixers, bucket loaders, tractors other than truck tractors, leveling graders, finishing machines, motor graders, road rollers, scarifiers, earth-moving carryalls and scrapers, power shovels and drag lines, and self-propelled cranes and other earth-moving equipment.

Steady sound: a sound whose sound pressure level remains essentially constant (that is, meter fluctuations are negligibly small) during the measurement period. Meter variations are less than or equal to +/- 3 dB using the "slow" meter characteristic.

Tactical military vehicle: every vehicle operated by any federal or state military organization and designed for use in field operations, but not including vehicles such as staff cars and personnel carriers designed primarily for normal highway use.

Time-average sound level (or equivalent-continuous sound level or equivalent-continuous frequency-weighted sound pressure level): 20 times the logarithm to the base 10 of the ratio of the time-average (frequency-weighted) sound pressure to the reference pressure of 20 micropascal. The frequency weighting used must be specified explicitly (e.g., A, C or octave band). The unit of time-average sound level is the decibel (dB).

Time-average (frequency-weighted) sound pressure: square root of the quotient of the time integral of frequency-weighted squared instantaneous sound pressures divided by the time period of integration; or the square root of the quotient of the sound exposure, in pascal-squared seconds (Pa^2 –s), in a specified time period, divided by the time period of integration in seconds. The frequency weighting used must be specified explicitly (e.g., A, C or octave band). The unit of time-average sound pressure is the pascal (Pa).

Unregulated safety relief valve: a safety relief valve used and designed to be actuated by high pressure in the pipe or vessel to which it is connected and which is used and designed to prevent explosion or other hazardous reaction from pressure buildup, rather than being used and designed as a process pressure blowdown.

Used motor vehicle: a motor vehicle that is not a new motor vehicle.

Vehicle: every device in, upon, or by which any person or property is or may be transported or drawn upon a highway.

Weekday: any day which occurs during the period of time commencing at 10:00 p.m. Sunday and ending at 10:00 p.m. Friday during any particular week.

Weekend day: any day which occurs during the period of time commencing at 10:00 p.m. Friday and ending at 10:00 p.m. Sunday during any particular week.

Well-maintained muffler: any muffler which is free from defects which affect its sound reduction. Such muffler shall be free of visible defects such as holes and other acoustical leaks.

(Source: Amended at 27 Ill. Reg. 16247, effective October 8, 2003)

Section 900.102 Prohibition of Noise Pollution

No person shall cause or allow the emission of sound beyond the boundaries of his property, as property is defined in Section 25 of the Illinois Environmental Protection Act, so as to cause noise pollution in Illinois, or so as to violate any provision of this Chapter.

Section 900.103 Measurement Procedures

a) Procedures Applicable to all of 35 Ill. Adm. Code: Subtitle H, Chapter I

The Agency may adopt procedures which set forth criteria for the measurement of sound for all Parts except 35 Ill. Adm. Code 900 and 901. Such procedures shall be in substantial conformity with standards and recommended practices established by the American National Standards Institute, Inc. (ANSI) or the Society of Automotive Engineers, Inc. (SAE), incorporated by reference at Section 900.106. Such procedures shall be revised from time to time to reflect current engineering judgment and advances in noise measurement techniques. Such procedures, and revisions~~,~~ thereof, shall not become effective until filed with the Administrative Code Division of the Office of the Secretary of State as required by the Illinois Administrative Procedure Act [5 ILCS 100]. Measurement procedures for 35 Ill. Adm. Code 900 and 901 shall conform to 35 Ill. Adm. Code 910.

b) Procedures Applicable only to 35 Ill. Adm. Code 901

1) All measurement and all measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 901 shall, with the exception of measurements to determine whether emissions of sound comply with 35 Ill. Adm. Code 901.109, be based on L_{eq} averaging, as defined in 35 Ill. Adm. Code 900.101, using a reference time as follows:

   A) Except as specified in subsection (b)(1)(B) for steady sound, a reference time of at least 1 hour shall be used for all sound measurements and measurement procedures.

   B) For measurement of steady sound as defined in Section 101 of this Part, the reference time shall be at least 10 minutes.

2) All measurements and measurement procedures under subsection (b)(1)(B) of this Section must correct~~,~~ or provide for the correction of such emissions for the presence of ambient or background noise in accordance with the procedures in 35 Ill. Adm. Code 910. All measurements must be in conformity with the following ANSI standards, incorporated by reference at Section 900.106:

   A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

   B) ANSI S1.6-1984 (R2001) "American National Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements."

   C) ANSI S1.11-1986 (R1998) "American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters."

   D) ANSI S1.13-1995 (R1999) "American National Standard Measurement of Sound Pressure Level in Air."

   E) ANSI S12.9-1993 (R1998) "American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 3: Short-Term Measurements With an Observer Present."

c) Procedures Applicable only to 35 Ill. Adm. Code 902

1) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 902.120 through 902.123 must be

in conformity with the following ANSI standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) ANSI S1.13-1995 (R1999) "American National Standard Measurement of Sound Pressure Level in Air."

2) The procedures for sound measurement under 35 Ill. Adm. Code 902.123 must conform to the ANSI standards prescribed in subsection (c)(1), above, provided that the procedures are in conformity with those established by the U.S. Department of Transportation under 49 CFR 325 pursuant to Section 17 of the Federal Noise Control Act of 1972, 42 USC §4901 et seq.

3) The Board may provide for measurement at distances other than the 50 feet specified in 35 Ill. Adm. Code 902.120 through 902.123 provided that correction factors are applied so that the sound levels so determined are substantially equivalent to those measured at 50 feet and the measurement distance does not exceed 100 feet. The correction factors used shall be consistent with California Highway Patrol Sound Measurement Procedures HPH 83.1 (October 1, 1973, as amended November 9, 1975), incorporated by reference at Section 900.106.

d) Procedures Applicable only to 35 Ill. Adm. Code 905

1) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 905.102(a) and 905.103(a)(1) must be in conformity with the following standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) SAE Recommended Practice J192 "Exterior Sound Level for Snowmobiles." March 1985.

2) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 905.102(b) and 905.103(a)(2) shall be in substantial conformity with the following standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) SAE/ANSI Recommended Practice J1161 "Operational Sound Level Measurement Procedure for Snow Vehicles", March 1983.

3) The Agency may establish criteria for measuring at distances other than the 50 feet specified in 35 Ill. Adm. Code 905.102 and 905.103, provided that correction factors are applied so that the sound levels so determined are substantially equivalent to those measured at 50 feet. In adopting new or revised criteria, the Agency shall comply with the requirements of the Illinois Administrative Procedure Act, [5 ILCS 100].

(Source: Amended at 27 Ill. Reg. 16247, effective October 8, 2003)

Section 900.104 Burden of Persuasion Regarding Exceptions

In any proceeding pursuant to this Chapter, if an exception stated in this Chapter would limit an obligation, limit a liability, or eliminate either an obligation or a liability, the person who would benefit from the application of the exception shall have the burden of persuasion that the exception applies and that the terms of the exception have been met. The Agency shall cooperate with and assist persons in determining the application of the provisions of this Chapter.

Section 900.105 Severability

If any provision of these rules or regulations is adjudged invalid, or if the application thereof to any person or in any circumstances is adjudged invalid, such invalidity shall not affect the validity of this Chapter as a whole or of any part, sub-part, sentence or clause thereof not adjudged invalid.

Section 900.103 Measurement Procedures

a) Procedures Applicable to all of 35 Ill. Adm. Code: Subtitle H, Chapter I

The Agency may adopt procedures which set forth criteria for the measurement of sound for all Parts except 35 Ill. Adm. Code 900 and 901. Such procedures shall be in substantial conformity with standards and recommended practices established by the American National Standards Institute, Inc. (ANSI) or the Society of Automotive Engineers, Inc. (SAE), incorporated by reference at Section 900.106. Such procedures shall be revised from time to time to reflect current engineering judgment and advances in noise measurement techniques. Such procedures, and revisions~~,~~ thereof, shall not become effective until filed with the Administrative Code Division of the Office of the Secretary of State as required by the Illinois Administrative Procedure Act [5 ILCS 100]. Measurement procedures for 35 Ill. Adm. Code 900 and 901 shall conform to 35 Ill. Adm. Code 910.

b) Procedures Applicable only to 35 Ill. Adm. Code 901

1) All measurement and all measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 901 shall, with the exception of measurements to determine whether emissions of sound comply with 35 Ill. Adm. Code 901.109, be based on L_{eq} averaging, as defined in 35 Ill. Adm. Code 900.101, using a reference time as follows:

A) Except as specified in subsection (b)(1)(B) for steady sound, a reference time of at least 1 hour shall be used for all sound measurements and measurement procedures.

B) For measurement of steady sound as defined in Section 101 of this Part, the reference time shall be at least 10 minutes.

2) All measurements and measurement procedures under subsection (b)(1)(B) of this Section must correct~~,~~ or provide for the correction of such emissions for the presence of ambient or background noise in accordance with the procedures in 35 Ill. Adm. Code 910. All measurements must be in conformity with the following ANSI standards, incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) ANSI S1.6-1984 (R2001) "American National Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements."

C) ANSI S1.11-1986 (R1998) "American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters."

D) ANSI S1.13-1995 (R1999) "American National Standard Measurement of Sound Pressure Level in Air."

E) ANSI S12.9-1993 (R1998) "American National Standard Quantities and Procedures for Description and

Measurement of Environmental Sound - Part 3: Short-Term Measurements With an Observer Present."

c) Procedures Applicable only to 35 Ill. Adm. Code 902

1) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 902.120 through 902.123 must be in conformity with the following ANSI standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) ANSI S1.13-1995 (R1999) "American National Standard Measurement of Sound Pressure Level in Air."

2) The procedures for sound measurement under 35 Ill. Adm. Code 902.123 must conform to the ANSI standards prescribed in subsection (c)(1), above, provided that the procedures are in conformity with those established by the U.S. Department of Transportation under 49 CFR 325 pursuant to Section 17 of the Federal Noise Control Act of 1972, 42 USC §4901 et seq.

3) The Board may provide for measurement at distances other than the 50 feet specified in 35 Ill. Adm. Code 902.120 through 902.123 provided that correction factors are applied so that the sound levels so determined are substantially equivalent to those measured at 50 feet and the measurement distance does not exceed 100 feet. The correction factors used shall be consistent with California Highway Patrol Sound Measurement Procedures HPH 83.1 (October 1, 1973, as amended November 9, 1975), incorporated by reference at Section 900.106.

d) Procedures Applicable only to 35 Ill. Adm. Code 905

1) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 905.102(a) and 905.103(a)(1) must be in conformity with the following standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) SAE Recommended Practice J192 "Exterior Sound Level for Snowmobiles." March 1985.

2) Measurement procedures to determine whether emissions of sound comply with 35 Ill. Adm. Code 905.102(b) and 905.103(a)(2) shall be in substantial conformity with the following standards incorporated by reference at Section 900.106:

A) ANSI S1.4-1983 (R2001) "American National Standard Specification for Sound Level Meters."

B) SAE/ANSI Recommended Practice J1161 "Operational Sound Level Measurement Procedure for Snow Vehicles", March 1983.

3) The Agency may establish criteria for measuring at distances other than the 50 feet specified in 35 Ill. Adm. Code 905.102 and 905.103, provided that correction factors are applied so that the sound levels so determined are substantially equivalent to those measured at 50 feet. In adopting new or revised criteria, the Agency shall comply with the requirements of the Illinois Administrative Procedure Act, [5 ILCS 100].

(Source: Added at 27 Ill. Reg. 16247, effective October 8, 2003)

Section 900.APPENDIX A Old Rule Numbers Referenced

The following table is provided to aid in referencing old Board rule numbers to section numbers pursuant to codification.

Old Part 1 of Chapter 8	35 Ill. Adm. Code Part 900
Rule 101	Section 900.101
Rule 102	Section 900.102
Rule 103	Section 900.103
Rule 104	Section 900.104
Rule 105	Section 900.105

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE H: NOISE
CHAPTER I: POLLUTION CONTROL BOARD

PART 901
SOUND EMISSION STANDARDS AND LIMITATIONS FOR PROPERTY LINE-NOISE-SOURCES

Section

AUTHORITY: Implementing Section 25 and authorized by Section 27 of the Environmental Protection Act [415 ILCS 5/25 and 27].

SOURCE: Originally filed as Part 2 of Chapter 8: Noise Pollution, effective August 10, 1973; amended at 2 Ill. Reg. 27, p. 223, effective June 26, 1978; amended at 5 Ill. Reg. 6371, effective June 1, 1981; amended at 5 Ill. Reg. 8533, effective August 10, 1981; amended at 6 Ill. Reg. 10960, effective September 1, 1982; codified at 7 Ill. Reg. 13646; amended at 7 Ill. Reg. 14519, effective October 17, 1983; amended in R83-35 at 8 Ill. Reg. 18893, effective September 25, 1984; amended in R83-33, 26, 29, 30 and R83-34 at 9 Ill. Reg. 1405, effective January 17, 1985; Section 901.105(f)(1), (2) and (3) recodified to Sections 901.110, 901.111 and 901.112 at 9 Ill. Reg. 7147; amended in R83-25, 31 and 32 at 9 Ill. Reg. 7149, effective May 7, 1985; amended in R83-7 at 11 Ill. Reg. 3136, effective January

28, 1987; amended in R04-11, at 28 Ill. Reg. 11910, effective July 30, 2004; amended in R03-9 at 30 Ill. Reg.5533, effective March 10, 2006; amended in R06-11 at 31 Ill. Reg. 1984, effective January 12, 2007.

Section 901.101 Classification of Land According to Use

a) The land use classification system used for the purposes of applying numeric sound standards for this Part is based on the Land-Based Classification Standards (LBCS) (Jeer, Sanjay. 2001. Land-Based Classification Standards . Online, http://www.planning.org/LBCS. American Planning Association: Chicago, Illinois). The LBCS applicable to this Part is set forth in Appendix B.

b) Class A land includes all land used as specified by LBCS Codes 1000 through 1340, 2410 through 2455, 5200 through 5230, 5500, 6100 through 6145, 6222, 6510 through 6530, 6568 through 6600.

c) Class B land includes all land used as specified by LBCS Codes 2100 through 2336, 2500 through 2720, 3500 through 3600, 4220 through 4243, 5100 through 5160, 5300 through 5390, 5400, 6147, 6210 through 6221, 6300 through 6320, 6400 through 6430, 6560 through 6567, 6700 through 6830, 7100 through 7380.

d) Class C land includes all land used as specified by LBCS Codes 3100 through 3440, 4120 through 4180, 4210 through 4212, 4300 through 4347, 7400 through 7450, 8000 through 8500, and 9100 through 9520.

e) A parcel or tract of land used as specified by LBCS Code 9100, 9400, or 5500 when adjacent to Class B or C land may be classified similarly by action of a municipal government having zoning jurisdiction over such land. Notwithstanding any subsequent changes in actual land use, land so classified retains such B or C classification until the municipal government removes the classification adopted by it.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.102 Sound Emitted to Class A Land

a) Except as elsewhere provided in this Part, no person shall cause or allow the emission of sound during daytime hours from any property-line-noise-source located on any Class A, B or C land to any receiving Class A land which exceeds any allowable octave band sound pressure level specified in the following table, when measured at any point within such receiving Class A land, provided, however, that no measurement of sound pressure levels shall be made less than 25 feet from such property-line-noise-source.

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land

31.5	75	72	72
63	74	71	71
125	69	65	65
250	64	57	57
500	58	51	51
1000	52	45	45
2000	47	39	39
4000	43	34	34
8000	40	32	32

b) Except as provided elsewhere in this Part, no person shall cause or allow the emission of sound during nighttime hours from any property-line-noise-source located on any Class A, B or C land to any receiving Class A land which exceeds any allowable octave band sound pressure level specified in the following table, when measured at any point within such receiving Class A land, provided, however, that no measurement of sound pressure levels shall be made less than 25 feet from such property-line-noise-source.

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land
31.5	69	63	63
63	67	61	61
125	62	55	55
250	54	47	47
500	47	40	40
1000	41	35	35
2000	36	30	30
4000	32	25	25
8000	32	25	25

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.103 Sound Emitted to Class B Land

Except as provided elsewhere in this Part, no person shall cause or allow the emission of sound from any property-line-noise-source located on any Class A, B or C land to any receiving Class B land which exceeds any allowable octave band sound pressure level specified in the following table, when measured at any point within such receiving Class B land, provided, however, that no measurement of sound pressure levels shall be made less than 25 feet from such property-line-noise-source.

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class B Land from		
	Class C Land	Class B Land	Class A Land

31.5	80	79	72
63	79	78	71
125	74	72	65
250	69	64	57
500	63	58	51
1000	57	52	45
2000	52	46	39
4000	48	41	34
8000	45	39	32

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.104 Highly-Impulsive Sound

Except as provided elsewhere in this Part, no person shall cause or allow the emission of highly-impulsive sound from any property-line-noise-source located on any Class A, B, or C land to any receiving Class A or B land which exceeds the allowable A-weighted sound levels, measured with fast dynamic characteristic, specified in the following table when measured in accordance with the procedure of 35 Ill. Adm. Code 900.103 at any point within such receiving Class A or B land, provided, however, that no measurement of sound levels shall be made less than 25 feet from such property-line-noise-source.

Classification of Land on which Property-Line Noise-Source: is Located	Allowable A-weighted Sound Levels in Decibels of Highly-Impulsive Sound Emitted to Receiving Class A or B Land		
	Class B Land	Class A Land	
		Daytime	Nighttime
Class A Land	47	47	37
Class B Land	54	47	37
Class C Land	58	53	43

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.105 Impact Forging Operations

a) For purposes of this Section, only the following are applicable:

1) Daytime hours means any continuous 16-hour period between 6:00 a.m. and 11:00 p.m. local time; and

2) Nighttime hours means those 8 hours between 10:00 p.m. and 7:00 a.m. which are not part of the 16 continuous daytime hours.

3) The reference time for L_{eq}, as defined in 35 Ill. Adm. Code 900.101 is one hour.

4) New Impacting Forging Operation is that property-line-noise-source comprised of impact forging operation on which construction began after September 1, 1982.

5) Existing Impact Forging Operation is that property-line-noise-source comprised of impact forging operations which are in existence on September 1, 1982,

b) Emission Limitations for New Impact Forging Operation.
No impact forging operation shall cause or allow the emission of impulsive sound to any receiving Class A or B land which exceeds the allowable sound levels specified in the following table when measured at any point within such receiving land, provided however, that no measurement of sound levels shall be made less than 25 feet from such new impact forging operation's property-line.

Allowable Highly- Impulsive Sound Levels (L_{eq}) in Decibels Emitted
To Class A or B Land from New
Impact Forging Operation

Class B Land	Class A Land	
	Daytime	Nighttime
59.5	53.5	48.5

c) Limitations for Existing Impact Forging Operation

No existing impact forging operation shall cause or allow the emission of highly-impulsive sound to any receiving Class A or B land which exceeds the allowable sound levels specified in the following table, when measured at any point within such receiving land, provided however, that no measurement of sound levels shall be made less than 25 feet from such existing impact forging operation's property-line, unless such forging operation is granted a permanent site specific allowable operational level pursuant to subsection (d).

Allowable Highly- Impulsive Sound Levels (L_{eq}) in Decibels Emitted
To Class A or B Land from Existing
Impact Forging Operation

Class B Land	Class A Land	
	Daytime	Nighttime
64.5	58.5	53.5

d) Site Specific Allowable Operational Level for Existing Impact Forging Operation

1) An existing impact forging operation which does not comply with subsection (c) may seek a permanent site specific allowable operational level from the Board. A permanent site specific level is that level of operation allowed petitioner after

review and approval by the Board and after implementation of abatement measures, if any, approved by the Board.

2) Any existing impact forging operation seeking a permanent site specific operational level must submit as its petition the following:

A) The location of the petitioner, a description of the surrounding community, and a map locating the petitioner within the community;

B) A description of the petitioner's operations, the number and size of the petitioner's forging hammers, the current hours of hammer operation, the approximate number of forgings manufactured during each of the three prior calendar years and the approximate number of hammer blows used to manufacture the forgings.

C) A description of any existing sound abatement measure.

D) The sound levels in excess of those permitted by subsection (c) emitted by the petitioner into the community, in 5 decibel increments measured in L_{eq}, shown on the map of the community.

E) The number of residences exposed to sound levels in excess of those permitted by subsection (c);

F) A description of other significant sources of noise (mobile and stationary) and their location shown on the map of the community;

G) A description of the proposed operational level and proposed physical abatement measures, if any, a schedule for their implementation and their costs;

H) The predicted improvement in community sound levels as a result of implementation of the proposed abatement measures; and

I) A description of the economic and technical considerations which justify the permanent site specific allowable operational level sought by petitioner.

e) Land Use Classifications Preserved

The land use classifications in effect within a one-mile radius of an existing impact forging operation on September 1, 1982 remains the applicable land use classification for enforcement of these rules against an existing forging operation and any future modification thereof, regardless of actual subsequent changes in land use unless such actual changes would impose less restrictive limitations on the impact forging operations.

f) Site-Specific Operational Levels

Each individual existing forging operation identified in Sections 901.110, 901.111 and 901.112 must comply with the site-specific operational level defined, or is otherwise subject to Section 901.105(c).

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.106 Prominent Discrete Tones

a) No person shall cause or allow the emission of any prominent discrete tone from any property-line-noise-source located on any Class A, B or C land to any receiving Class A, B or C land, provided, however, that no measurement of one-third octave band sound pressure levels shall be made less than 25 feet from such property-line source.

b) This rule shall not apply to prominent discrete tones having a one-third octave band sound pressure level 10 or more dB below the allowable octave band sound pressure level specified in Sections 901.102 through 901.104 for the octave band which contains such one-third octave band. In the application of this sub-section, the applicable numeric standard for sound emitted from any existing property-line-noise-source to receiving Class A land, for both daytime and nighttime operations, is found in Section 901.102(a).

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.107 Exceptions

a) Sections 901.102 through 901.106 inclusive does not apply to sound emitted from land used as specified by LBCS Codes 1100, 6600 and 5500.

b) Sections 901.102 through 901.106 inclusive does not apply to sound emitted from emergency warning devices and unregulated safety relief valves.

c) Sections 901.102 through 901.106 inclusive does not apply to sound emitted from lawn care maintenance equipment and agricultural field machinery used during daytime hours. For the purposes of this sub-section, grain dryers operated off the farm are not considered agricultural field machinery.

d) Sections 901.102 through 901.106 inclusive do not apply to sound emitted from equipment being used for construction.

e) Section 901.102(b) do not apply to sound emitted from existing property-line-noise-sources during nighttime hours, provided, however, that sound emitted from such existing property-line-noise-sources are governed during nighttime hours by the limits specified in Section 901.102.

f) Sections 901.102 through 901.106 inclusive do not apply to the operation of any vehicle registered for highway use while such vehicle is being operated within any land used as specified by Section 901.101 in the course of ingress to or egress from a highway.

g) Sections 901.102 through 901.106 inclusive do not apply to sound emitted from land used as specified by LBCS Codes 5130 and 5140 when used for automobile and motorcycle racing; and, any land used for contests, rallies, time trials, test runs or similar operations of any self-propelled device, and upon or by which any person is or may be transported or drawn, when such self-propelled device is actually being used for sport or recreation and is actually participating in an activity or event organized, regulated, and supervised under the sponsorship and sanction of a club, organization or corporation having national or statewide recognition; provided, however, that the exceptions granted in this subsection do not apply to any automobile and motorcycle race, contest, rally, time trial, test run or similar operation of any self-propelled device if such event is started between the hours of 10:30 p.m. to 7:00 a.m., local time weekdays, or between the hours of 11:00 p.m. and 7:00 a.m., local time, weekend days.

h) Section 901.104 shall not apply to impulsive sound produced by explosive blasting activities conducted on any Class C land other than the land used as specified by LBCS Codes 8300 and 8500, but such operations shall be governed by Section 901.109.

i) Part 901 shall not apply to impulsive sound produced by explosive blasting activities, which are:

   1) Conducted on any Class C land used as specified by LBCS Codes 8300 and 8500; and

   2) Regulated by the Department of Natural Resources in accordance with Section 6.5 of the Surface-Mined Land Conservation and Reclamation Act [225 ILCS 715/6.5] and Section 3.13 of the Surface Coal Mining Land Conservation and Reclamation Act [225 ILCS 720/3.13].

j) Sections 901.102 through 901.106 inclusive do not apply to sound emitted from snowmobiles.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.108 Compliance Dates for Part 901

a) Except as provided in subsections (g), (i), and (j), every owner or operator of a new property-line-noise-source must comply with the standards and limitations of this Part on and after August 10, 1973.

b) Except as otherwise provided in this rule, every owner or operator of an existing property-line-noise-source must comply with the standards and limitations of this Part on and August 10, 1974.

c) Every owner or operator of an existing property-line-noise-source who emits sound which exceeds any allowable octave band sound pressure level of Section 901.102 or 901.103 by 10 dB or more in any octave band with a center frequency of 31.5 Hertz, 63 Hertz or 125 Hertz must comply with the standards and limitations of this Part on and after February 10, 1975.

d) Except as provided in subsections (g) and (h), every owner or operator of an existing property-line-noise-source required to comply with Section 901.104 must comply with the standards and limitations of this Part on and after February 10, 1975.

e) Every owner or operator of an existing property-line-noise-source required to comply with Section 901.106 must comply with the standards and limitations of this Part on and after February 10, 1975.

f) Every owner or operator of Class C land now and hereafter used as specified by LBCS Code 4120 will have until August 10, 1976 to bring the sound from railroad car coupling in compliance with Section 901.104.

g) Existing impact forging operations as defined in Section 901.105 which do not seek permanent site specific allowable operational levels must comply with Section 901.105 by December 1, 1983. Those seeking permanent site specific allowable operational levels pursuant to Section 901.105(d) must comply as of the effective date of the site specific rule granted or denied.

h) Every owner or operator of Class C land now or hereafter used as specified by LBCS Code 3310 must comply with the standards and limitations of this Part on August 10, 1975.

i) Every owner or operator of Class C land now or hereafter used as specified by LBCS Code 5130 and 5140 when used for automobile and motorcycle racing must comply with the standards and limitations of this Part on February 10, 1976.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.109 Highly-Impulsive Sound From Explosive Blasting

a) During the daytime hours that cover the period after sunrise and before sunset, no person shall cause or allow any explosive blasting conducted on any Class C land other than land used as specified by LBCS Codes 8300 and 8500 so as to allow the emission of sound to any receiving Class A or B land which exceeds the allowable outdoor C-weighted sound levels, measured with the slow dynamic characteristic, specified in the following table, when measured at any point, of reasonable interference with the use of such receiving Class A or B land.

Allowable Outdoor C-Weighted
Sound Exposure Levels in Decibels of Explosive
Blasting Sounds Emitted to Receiving

Class A or B Land from Any Class C Land other than Land
Used as Specified by LBCS Code 8300 or 8500

Receiving Class A Land	Receiving Class B Land
107	112

The allowable sound exposure level limits in the above table must be lowered by three decibels (3 dB) for each doubling of the number of blasts during the day or night.

b) Compliance with outdoor peak sound pressure level limits in the following table shall constitute prima facie level limits of this rule when measured on such receiving Class A or B land.

Equivalent Maximum Sound Pressure Level (Peak) Limits in Decibels

Lower Frequency Limit of Measuring System for Flat Response, a Variation from Linear Response of + or - 3dB (Hz)	Receiving Class A Land (dB)	Receiving Class B Land (dB)
< 2.0 but > 0.1	133	133

c) During the period defined by both the beginning of the nighttime hours (10:00 pm) or sunset, whichever occurs earlier, and the ending of the nighttime hours (7:00 am) or sunrise, whichever occurs later, the allowable sound level limits in subsections (a) and (b) must be reduced by 10 decibels except in emergency situations where rain, lightning, other atmospheric conditions, or operator or public safety requires unscheduled nighttime hour explosive blasting.

d) Persons causing or allowing explosive blasting to be conducted on any Class C land other than land used as specified by LBCS Code 8300 or 8500 must notify the local public of such blasting prior to its occurrence, except when emergency situations require unscheduled blasting, by publication of a blasting schedule, identifying the work days or dates and time periods when explosives are expected to be detonated, at least every three months in a newspaper of general circulation in the locality of the blast site.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.110 Amforge Operational Level

Amforge Division of Rockwell International located at 119th Street, Chicago, Illinois must:

a) Operate only ten forging hammers at any one time;

b) Operation of its forging hammers is limited to the hours of 7:00 a.m. through 11:00 p.m., with occasional operations beginning at 6:00 a.m. and ending at midnight, Monday through Saturdays; and

c) Install sound absorptive materials on each of the forging hammer structures as each is routinely overhauled, but no later than January 1, 1987.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.111 Modern Drop Forge Operational Level

Modern Drop Forge Company located at 139th Street and Western Avenue in Blue Island, Illinois must:

a) Operate only twenty-one forging hammers at any one time; and

b) Operate its forging hammers only during the hours of 6:00 a.m. through midnight, Mondays through Fridays, and 6:30 a.m. until 7:30 p.m. on Saturdays.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.112 Wyman-Gordon Operational Level

Wyman-Gordon Company located at 147th Street and Wood Street, Harvey, Illinois shall:

a) Operate only six forging hammer units, each consisting of two hammers, after January 1, 1984.

b) Operate forging units in Buildings 6 and 7, located at the southern perimeter of the Wyman-Gordon Company's Harvey facility, to produce no more than 20% of the total annual hammer production at the Harvey facility;

c) Operate forging units between the hours of 6:00 a.m. and midnight; limit forging operations on Saturdays and Sundays to no more than half a year's total; and limit forging operations during the hours of 6:00 a.m. and 7:00 a.m. and 11:00 p.m. and midnight to less than 2% of the Harvey's facility total annual hammer production; and

d) Consolidate the two existing steel inventory yards at the one located north of Building 75 no later than January 1, 1984.

(Source: Recodified from Section 901.105(f)(3) at 9 Ill. Reg. 7147)

Section 901.113 Wagner Casting Site-Specific Operational Level (Repealed)

(Source: Repealed at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.114 Moline Forge Operational Level

Moline Forge and future owners of the forging facility located at 4101 Fourth Avenue, Moline, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than nine forging hammers at any one time; and

b) Operate its forging hammers only between the hours of 6:00 a.m. until 11:00 p.m. Monday through Friday and from 6:00 a.m. until 3:30 p.m. on Saturdays.

(Source: Added at 9 Ill. Reg. 1405, effective January 17, 1985)

Section 901.115 Cornell Forge Hampshire Division Site-Specific Operational Level

Cornell Forge, Hampshire Division and future owners of the forging facility located at Walker Road, Hampshire, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than seven forging hammers at any one time; and

b) Operate its forging hammers only on Monday through Saturday between the hours of 7:00 a.m. to 3:30 p.m. with an additional shift that may run from either 3:30 p.m. to 12:00 p.m. or from 10:30 p.m. to 7:00 a.m.

(Source: Added at 9 Ill. Reg. 1405, effective January 17, 1985)

Section 901.116 Forgings and Stampings, Inc. Operational Level

Forgings and Stampings, Inc. and future owners of the forging facility located at 1025 23rd Avenue, Rockford, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than six forging hammers at any one time; and

b) Operate its forging hammers only between the hours of 6:00 a.m. and 6:00 p.m. Monday through Friday and 6:00 a.m. and 2:00 p.m. on Saturday.

(Source: Added at 9 Ill. Reg. 1405, effective January 17, 1985)

Section 901.117 Rockford Drop Forge Company Operational Level

Rockford Drop Forge Company and future owners of the forging facility located at 2031 Ninth Street, Rockford, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than twelve forging hammers at any one time; and

b) Operate its forging hammers only between the hours of 6:00 a.m. and 10:00 p.m. Monday through Saturday.

(Source: Added at 9 Ill. Reg. 1405, effective January 17, 1985)

Section 901.118 Scot Forge Company – Franklin Park Division Operational Level

Scot Forge and future owners of the forging facility located at 9394 W. Belmont Avenue, Franklin Park, Illinois, must comply with the following site-specific operational level:

a) Operate no more than seven forging hammers at any one time; and

b) Operate its forging hammers only between the hours of 6:00 a.m. and 6:00 p.m. Monday through Saturday.

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

Section 901.119 Clifford-Jacobs Operational Level

Clifford-Jacobs Forging Company and future owners of the forging facility located at North Market Street, Champaign, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than fourteen hammers at any one time; and

b) Operate its forging hammers only between the hours of 6:00 a.m. and 11:00 p.m. Monday through Saturday.

(Source: Added at 9 Ill. Reg. 7149, effective May 7, 1985)

Section 901.120 C.S. Norcross Operational Level

C.S. Norcross & Sons Company and future owners of the forging facility located at the intersection of Davis and Dean Streets, Bushnell, Illinois, shall comply with the following site-specific operational level:

a) Operate no more than twelve forging hammers at any one time; and

b) Operate its forging hammers only between the hours of 7:00 a.m. and 1:00 a.m. Monday through Saturday.

(Source: Added at 9 Ill. Reg. 7149, effective May 7, 1985)

Section 901.121 Vaughan & Bushnell Operational Level

Vaughan & Bushnell Manufacturing Company and the future owners of the forging facility located at the intersection of Davis and Main Streets, Bushnell, Illinois, must comply with the following site-specific operational level:

a) Operate no more than ten hammers at any one time; and

b) Vaughan & Bushnell may operate 24 hours per day, Monday through Sunday.

(Source: Amended at 31 Ill. Reg. 1984, effective January 12, 2007)

Section 901.122 Ameren Elgin Facility Site-Specific Noise Emission Limitations

The Combustion Turbine Power Generation Facility located at 1559 Gifford Road in Elgin, Illinois shall not cause or allow the emission of sound from any property-line-noise source located on that property which exceeds any allowable octave band sound pressure level specified in the following table, when measured at any point within the receiving Class A or Class B land.

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A or Class B Land from Ameren Elgin Facility	
	Class A Land	Class B Land
31.5	80	80
63	74	79
125	69	74
250	64	69
500	58	63
1000	58	58
2000	58	58
4000	50	50
8000	40	45

(Source: Added at 28 Ill. Reg.11910, effective July 30, 2004)

Section 901.APPENDIX A Old Rule Numbers Referenced

The following table is provided to aid in referencing old Board rule numbers to section numbers pursuant to codification.

Old Part 2 of Chapter 8	35 Ill. Adm. Code Part 901
Rule 201	Section 901.101
Rule 202	Section 901.102(a)
Rule 203	Section 901.102(b)
Rule 204	Section 901.103
Rule 205	Repealed
Rule 205 (was old 206)	Section 901.104
Rule 206 (new rule)	Section 901.105
Rule 207	Section 901.106
Rule 208	Section 901.107
Rule 209	Section 901.108
Rule 210	Section 901.109
Added in Codification	Appendix A
Unnumbered Appendix to Chapter 8, Part 2	Appendix B

Section 901.APPENDIX B Land-Based Classification Standards and Corresponding 35 Ill. Adm. Code 901 Land Classes

LBCS		Description	35 IAC 901 Land Class
Main Category	**Function Code**		
Residence or accommodation functions	**1000**	Residence or accommodation functions	**A**
	1100	Private household	
	1200	Housing services for the elderly	
	1210	Retirement housing services	☐
	1220	Congregate living services	☐
	1230	Assisted-living services	☐
	1240	Life care or continuing care services	☐
	1250	Skilled-nursing services	☐
	1300	Hotels, motels, or other accommodation services	☐
	1310	Bed and breakfast inn	☐
	1320	Rooming and boarding	☐

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	1330	Hotel, motel, or tourist court	
	1340	Casino hotel	A
General sales or services	**2000**	General sales or services	
	2100	Retail sales or service	B
	2110	Automobile sales or service establishment	
	2111	Car dealer	
	2112	Bus, truck, mobile homes, or large vehicles	☐
	2113	Bicycle, motorcycle, ATV, etc.	☐
	2114	Boat or marine craft dealer	☐
	2115	Parts, accessories, or tires	☐
	2116	Gasoline service	☐
	2120	Heavy consumer goods sales or service	☐
	2121	Furniture or home furnishings	☐
	2122	Hardware, home centers, etc.	☐
	2123	Lawn and garden supplies	☐
	2124	Department store, warehouse club or superstore	☐
	2125	Electronics and Appliances	☐
	2126	Lumber yard and building materials	☐
	2127	Heating and plumbing equipment	☐
	2130	Durable consumer goods sales and service	☐
	2131	Computer and software	☐
	2132	Camera and photographic supplies	☐
	2133	Clothing, jewelry, luggage, shoes, etc.	☐
	2134	Sporting goods, toy and hobby, and musical instruments	☐
	2135	Books, magazines, music, stationery	☐
	2140	Consumer goods, other	☐
	2141	Florist	☐
	2142	Art dealers, supplies, sales and service	☐
	2143	Tobacco or tobacconist establishment	☐
	2144	Mail order or direct selling establishment	☐
	2145	Antique shops, flea markets, etc.	☐
	2150	Grocery, food, beverage, dairy, etc.	☐
	2151	Grocery store, supermarket, or bakery	☐
	2152	Convenience store	☐
	2153	Specialty food store	☐
	2154	Fruit and vegetable store	☐

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	2155	Beer, wine, and liquor store	▢
	2160	Health and personal care	▢
	2161	Pharmacy or drug store	▢
	2162	Cosmetic and beauty supplies	▢
	2163	Optical	▢
	2200	Finance and Insurance	▢
	2210	Bank, credit union, or savings institution	▢
	2220	Credit and finance establishment	▢
	2230	Investment banking, securities, and brokerages	▢
	2240	Insurance-related establishment	▢
	2250	Fund, trust, or other financial establishment	▢
	2300	Real estate, and rental and leasing	▢
	2310	Real estate services	▢
	2320	Property management services	▢
	2321	Commercial property-related	▢
	2322	Rental housing-related	▢
	2330	Rental and leasing	▢
	2331	Cars	▢
	2332	Leasing trucks, trailers, RVs, etc.	▢
	2333	Recreational goods rental	▢
	2334	Leasing commercial, industrial machinery, and equipment	▢
	2335	Consumer goods rental	
	2336	Intellectual property rental (video, music, software, etc.)	**B**
	2400	Business, professional, scientific, and technical services	
	2410	Professional services	**A**
	2411	Legal services	
	2412	Accounting, tax, bookkeeping, payroll services	
	2413	Architectural, engineering, and related services	▢
	2414	Graphic, industrial, interior design services	▢
	2415	Consulting services (management, environmental, etc.)	▢
	2416	Research and development services (scientific, etc.)	▢
	2417	Advertising, media, and photography services	▢
	2418	Veterinary services	▢
	2420	Administrative services	▢
	2421	Office and administrative services	▢
	2422	Facilities support services	▢
	2423	Employment agency	▢

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	2424	Business support services	☐
	2425	Collection agency	☐
	2430	Travel arrangement and reservation services	☐
	2440	Investigation and security services	☐
	2450	Services to buildings and dwellings	☐
	2451	Extermination and pest control	☐
	2452	Janitorial	☐
	2453	Landscaping	☐
	2454	Carpet and upholstery cleaning	
	2455	Packing, crating, and convention and trade show services	**A**
	2500	Food services	**B**
	2510	Full-service restaurant	
	2520	Cafeteria or limited service restaurant	
	2530	Snack or nonalcoholic bar	☐
	2540	Bar or drinking place	☐
	2550	Mobile food services	☐
	2560	Caterer	☐
	2570	Food service contractor	☐
	2580	Vending machine operator	☐
	2600	Personal services	☐
	2700	Pet and animal sales or service (except veterinary)	☐
	2710	Pet or pet supply store	
	2720	Animal and pet services	**B**
Manufacturing and wholesale trade	**3000**	Manufacturing and wholesale trade	
	3100	Food, textiles, and related products	**C**
	3110	Food and beverages	
	3120	Tobacco manufacturing establishment	
	3130	Textiles	☐
	3140	Leather and allied products	☐
	3200	Wood, paper, and printing products	☐
	3210	Wood products establishment	☐
	3220	Paper and printing materials	☐
	3230	Furniture and related products	☐
	3300	Chemicals, and metals, machinery, and electronics manufacturing	☐ ☐
	3310	Petroleum and coal products	☐
	3320	Chemicals, plastics, and rubber products	☐

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	3330	Nonmetallic mineral products	☐
	3340	Primary metal manufacturing	☐
	3350	Machinery manufacturing	☐
	3360	Electrical equipment, appliance, and components manufacturing	☐ ☐
	3370	Transportation equipment, automobiles, etc.	☐
	3400	Miscellaneous manufacturing	☐
	3410	Jewelry and silverware	☐
	3420	Dolls, toys, games, and musical instruments	☐
	3430	Office supplies, inks, etc.	
	3440	Signs	**C**
	3500	Wholesale trade establishment	**B**
	3510	Durable goods	
	3520	Nondurable goods	☐
	3600	Warehouse and storage services	**B**
Transportation, communication, information, and utilities	**4000**	Transportation, communication, information, and utilities	
	4100	Transportation services	
	4110	**Air transportation**	**U**
	4111	Air passenger transportation	
	4112	Air freight transportation	
	4113	Airport and support establishment	☐
	4114	Aircraft and accessories	
	4115	Other air transportation (including scenic, balloon, etc.)	**U**
	4120	Rail transportation	**C**
	4121	Rail passenger transportation	
	4122	Rail freight transportation	
	4123	Rail transportation support establishment	☐
	4130	Road, ground passenger, and transit transportation	☐
	4131	Local transit systems-mixed mode	☐
	4132	Local transit systems-commuter rail	☐
	4133	Local transit systems-bus, special needs, and other motor vehicles	☐ ☐
	4134	Interurban, charter bus, and other similar establishments	☐
	4135	School and employee bus transportation	☐
	4136	Special purpose transit transportation (including scenic, sightseeing, etc.)	☐ ☐
	4137	Taxi and limousine service	☐

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	4138	Towing and other road and ground services	☐
	4140	Truck and freight transportation services	☐
	4141	General freight trucking, local	☐
	4142	General freight trucking, long-distance	☐
	4143	Freight trucking, specialized (used household and office goods)	☐ ☐
	4144	Freight trucking, specialized (except used goods)	☐
	4150	Marine and water transportation	☐
	4151	Marine passenger transportation	☐
	4152	Marine freight transportation	☐
	4153	Marine port and harbor operations	☐
	4154	Marine cargo handling and dry dock services	☐
	4155	Marine navigational and other services	☐
	4160	Courier and messenger services	☐
	4170	Postal services	
	4180	Pipeline transportation	C
	4200	Communications and information	
	4210	Publishing	C
	4211	Newspapers, books, periodicals, etc.	C
	4212	Software publisher	C
	4220	Motion pictures and sound recording	B
	4221	Motion picture and video production, publishing, and distribution	
	4222	Motion picture viewing and exhibition services	☐
	4223	Sound recording, production, publishing, and distribution	☐
	4230	Telecommunications and broadcasting	☐
	4231	Radio and television broadcasting	☐
	4232	Cable networks and distribution	☐
	4233	Wireless telecommunications	☐
	4234	Telephone and other wired telecommunications	☐
	4240	Information services and data processing industries	☐
	4241	Online information services	☐
	4242	Libraries and archives	
	4243	News syndicate	B
	4300	Utilities and utility services	C
	4310	Electric power	
	4311	Hydroelectric	
	4312	Fossil	☐

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	4313	Nuclear	□
	4314	Alternative energy sources	□
	4320	Natural gas, petroleum, fuels, etc.	□
	4330	Water, steam, air conditioning supply	□
	4331	Drinking water	□
	4332	Irrigation and industrial water supply	□
	4333	Air conditioning and steam supply	□
	4340	Sewer, solid waste, and related services	□
	4341	Hazardous waste collection	□
	4342	Hazardous waste treatment and disposal	□
	4343	Solid waste collection	□
	4344	Solid waste combustor or incinerator	□
	4345	Solid waste landfill	□
	4346	Waste treatment and disposal	□
	4347	Septic tank and related services	**C**
Arts, entertainment, and recreation	**5000**	Arts, entertainment, and recreation	
	5100	Performing arts or supporting establishment	**B**
	5110	Theater, dance, or music establishment	
	5120	Sports team or club	
	5130	Racetrack establishment	□
	5140	Promoter of performing arts, sports, and similar events	□
	5150	Agent for management services	
	5160	Independent artist, writer, or performer	**B**
	5200	Museums and other special purpose recreational institutions	**A**
	5210	Museum	
	5220	Historical or archeological institution	□
	5230	Zoos, botanical gardens, arboreta, etc.	**A**
	5300	Amusement, sports, or recreation establishment	**B**
	5310	Amusement or theme park establishment	
	5320	Games arcade establishment	
	5330	Casino or gambling establishment	□
	5340	Miniature golf establishment	□
	5350	Skiing	□
	5360	Marina or yachting club facility operators	□
	5370	Fitness, recreational sports, gym, or athletic club,	□
	5380	Bowling, billiards, pool, etc.	□

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	5390	Skating rinks, roller skates, etc.	
	5400	Camps, camping, and related establishments	**B**
	5500	Natural and other recreational parks	**A**
Education, public admin., health care, and other inst.	**6000**	Education, public admin., health care, and other inst.	
	6100	Educational services	
	6110	Nursery and preschool	**A**
	6120	Grade schools	
	6121	Elementary	
	6122	Middle	□
	6123	Senior	□
	6124	Continuance	□
	6125	Alternate education services	□
	6126	Adult education services	□
	6130	Colleges and universities	□
	6140	Technical, trade, and other specialty schools	□
	6141	Beauty schools	□
	6142	Business management	□
	6143	Computer training	□
	6144	Driving education	
	6145	Fine and performing arts education	**A**
	6146	Flight training	**U**
	6147	Sports and recreation education	**B**
	6200	Public administration	
	6210	Legislative and executive functions	**B**
	6220	Judicial functions	**B**
	6221	Courts	**B**
	6222	Correctional institutions	**A**
	6300	Other government functions	**B**
	6310	Military and national security	
	6320	Space research and technology	
	6400	Public Safety	□
	6410	Fire and rescue	□
	6420	Police	
	6430	Emergency response	**B**
	6500	Health and human services	
	6510	Ambulatory or outpatient care services	**A**

LBCS		Description	35 IAC 901 Land Class
Main Category	Function Code		
	6511	Clinics	
	6512	Family planning and outpatient care centers	
	6513	Medical and diagnostic laboratories	□
	6514	Blood and organ banks	□
	6520	Nursing, supervision, and other rehabilitative services	
	6530	Hospital	**A**
	6560	Social assistance, welfare, and charitable services	**B**
	6561	Child and youth services	
	6562	Child day care	
	6563	Community food services	□
	6564	Emergency and relief services	□
	6565	Other family services	□
	6566	Services for elderly and disabled	
	6567	Veterans affairs	**B**
	6568	Vocational rehabilitation	**A**
	6600	Religious institutions	**A**
	6700	Death care services	**B**
	6710	Funeral homes and services	
	6720	Cremation services and cemeteries	
	6800	Associations, nonprofit organizations, etc.	□
	6810	Labor and political organizations	□
	6820	Business associations and professional membership organizations	□
	6830	Civic, social, and fraternal organizations	**B**
Construction-related businesses	**7000**	Construction-related businesses	
	7100	Building, developing, and general contracting	**B**
	7110	Residential construction	
	7120	Land development and subdivision	
	7130	Industrial, commercial and institutional building construction	□
	7200	Machinery related	□
	7210	Building equipment and machinery installation contractors	□
	7220	Excavation contractor	□
	7230	Water well drilling contractor	□
	7240	Wrecking and demolition establishment	□
	7250	Structural steel erection contractor	□
	7300	**Special trade contractor**	□
	7310	Carpentry, floor, and tile contractor	□

LBCS Main Category	LBCS Function Code	Description	35 IAC 901 Land Class
	7320	Concrete contractor	□
	7330	Electrical contractor	□
	7340	Glass and glazing contractor	□
	7350	Masonry and drywall contractors	□
	7360	Painting and wall covering	□
	7370	Plumbing, heating, and air-conditioning	
	7380	Roofing, siding, and sheet metal contractors	**B**
	7400	Heavy construction	**C**
	7410	Highway and street construction;	
	7420	Bridge and tunnel construction	
	7430	Water, sewer, and pipeline construction	□
	7440	Power lines, communication and transmission lines	
	7450	Industrial and other nonbuilding construction	**C**
Mining and extraction establishments	**8000**	Mining and extraction establishments	**C**
	8100	Oil and natural gas	
	8200	Metals (iron, copper, etc.)	
	8300	Coal	□
	8400	Nonmetallic mining	
	8500	Quarrying and stone cutting establishment	**C**
Agriculture, forestry, fishing and hunting	**9000**	Agriculture, forestry, fishing and hunting	
	9100	Crop production	**C**
	9110	Grain and oilseed	
	9111	Wheat	
	9112	Corn	□
	9113	Rice	□
	9114	Soybean and oilseed	□
	9115	Dry pea and bean	□
	9120	Vegetable farming or growing services	□
	9130	Fruits and trees	□
	9140	Greenhouse, nursery, and floriculture	□
	9141	Food crops grown under cover	□
	9142	Nursery and tree production	□
	9143	Floriculture production	□
	9150	All other crops	□
	9151	Tobacco crop	□
	9152	Cotton crop	□

LBCS		Description	35 IAC 901 Land Class
Main Category	Function Code		
	9153	Sugarcane crop	□
	9154	Hay	□
	9155	Peanut crop	□
	9200	Support functions for agriculture	□
	9210	Farm and farm labor management services	□
	9220	Spraying, dusting, and other related services	□
	9230	Crop harvesting and post harvest crop activities (including drying, siloing, etc.)	□ □
	9240	Cotton ginning, grist milling, etc.	□
	9300	Animal production including slaughter	□
	9310	Cattle ranch and crops	□
	9311	Beef cattle ranch establishments	□
	9312	Cattle feedlot establishment	□
	9320	Dairy cattle and milk production	□
	9330	Hog and pig farm	□
	9340	Poultry and egg production and hatcheries	□
	9350	Sheep and goat farming establishments	□
	9360	Fish hatcheries, fisheries, and aquaculture	□
	9370	All other animal production	□
	9371	Apiculture (bees, wax, and related operations)	□
	9372	Horse and equine production	□
	9373	Fur-bearing animal production	□
	9380	Support functions for animal production	□
	9400	Forestry and Logging	□
	9410	Logging	□
	9420	Forest nurseries	□
	9430	Support functions for forestry	□
	9500	Fishing, hunting and trapping, game preserves	□
	9510	Fishing	□
	9520	Hunting and trapping, game retreats, game and fishing preserves	**C**
	9900	Unclassifiable function	**U**
	9910	Not applicable to this dimension	
	9990	To be determined	□
	9999	To be determined	**U**

(Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006)

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE H: NOISE
CHAPTER I: ILLINOIS POLLUTION CONTROL BOARD

PART 910
MEASUREMENT PROCEDURES FOR THE ENFORCEMENT OF 35 ILL. ADM. CODE 900 & 901

Section

AUTHORITY: Implementing and authorized by Sections 25 and 27 of the Environmental Protection Act [415 ILCS 5/25 and 27]

SOURCE: Adopted in R03-9 at 30 Ill. Reg. 5594, effective March 10, 2006.

Section 910.100 General

This Part specifies the instrumentation to be used when conducting acoustical noise measurements and sets forth the specific acoustical measurement techniques to be employed when conducting time-averaged sound level (L_{eq}) measurements. The instrumentation requirements and measurement techniques as more specifically set forth in this Part must be used in determining whether a noise source is in compliance with 35 Ill. Adm. Code 900 and 901.

Section 910.102 Instrumentation

a) Sound Measuring Equipment

1) An integrating sound level meter used alone or used in conjunction with an octave-band or 1/3 octave-band filter set or a real-time sound_analyzer

(octave-band or 1/3 octave-band) must conform with the following standards incorporated by reference at 35 Ill. Adm. Code 900.106:

A) ANSI S1.4 – 1983 (R2001) "American National Standard Specification for Sound Level Meters", and ANSI S1.4 A-1985 "Amendment to ANSI S1.4-1983."

B) ANSI S1.11 - 1986 (R1998) "American National Standard Specifications for Octave-Band and Fractional-Octave-Band Analog and Digital Filters."

C) ANSI S1.6 – 1984 (R2001) "American National Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements."

D) ANSI S1.8 - 1989 "American National Standard Reference Quantities for Acoustical Levels."

E) International Electrotechnical Commission, IEC 804-2000 Integrating/Averaging Sound Level Meters.

2) A magnetic tape recorder, graphic level recorder or other indicating device used must meet the requirements of the Society of Automotive Engineers (SAE) Recommended Practice J184 "Qualifying a Sound Data Acquisition System," November 1998, incorporated by reference at 35 Ill. Adm. Code 900.106

3) The laboratory calibration of instrumentation used for acoustic measurement must be traceable to the National Bureau of Standards, and must be performed no less often than once every 12 months.

4) For outdoor measurement, a windscreen must be attached to the microphone.

b) Weather Measuring Equipment

1) An anemometer and compass or other devices must be used to measure wind speed and direction in accordance with the manufacturer's recommended procedures.

2) A thermometer, designed to measure ambient temperature, must be used in accordance with the manufacturer's recommended procedures.

3) A hygrometer must be used in accordance with the manufacturer's recommended procedures to measure the relative humidity.

4) A barometer must be used in accordance with the manufacturer's recommended procedures to measure the barometric pressure.

Section 910.103 Definitions

The definitions contained in 35 Ill. Adm. Code 900.101 apply to this Part.

Section 910.104 Measurement Techniques for 35 Ill. Adm. Code 900

Sound pressure level measurements are not required to establish a violation of 35 Ill. Adm. Code 900.102 (nuisance noise). However, sound pressure level measurements may be introduced as corroborating evidence when alleging a violation of 35 Ill. Adm. Code 900.102. If sound pressure level measurements are collected, manufacturer's instructions must be followed for the equipment used and 35 Ill. Adm. Code 910.105 may be used as guidance in gathering data.

Section 910.105 Measurement Techniques for 35 Ill. Adm. Code 901

Sound pressure level measurements must be obtained in accordance with the following measurement techniques to determine whether a noise source is in compliance with 35 Ill. Adm. Code 901:

a) Site Selection

1) Measurements may be taken at one or more microphone positions within the appropriate receiving land. Measurement instruments must be set up outdoors within the boundaries of the receiving land for the purpose of determining whether a noise source is in compliance with 35 Ill. Adm. Code 901.

2) Measurement instruments must be set up not less than 25 feet (7.6 meters (m)) from the property-line-noise-source. The 25-foot (7.6 m) setback requirement is from the noise source and not the property line unless the noise source is contiguous to the property line.

3) Other measurement locations may be used for investigatory purposes such as, but not limited to, the following:

A) Determining the extent of noise pollution caused by the source of sound;

B) Determining the ambient; and

C) Analyzing those acoustical parameters that describe the sound source.

4) For measurements of sound sources with no audible discrete tones, microphones should not be set up less than 25 feet (7.6 m) from any reflective surface that may affect data. If measurements must be taken within 25 feet (7.6 m), the effect, if any, of the reflective surface on the measured data must be determined.

5) For measurements of sound sources with audible discrete tones, microphones must not be set up less than 50 feet (15.2 m) from any reflective surface that may affect data. If measurements must be taken within 50 feet (15.2 m), the effect, if any, of the reflective surface on the measured data must be determined.

6) Objects with small dimensions (trees, posts, bushes, etc.) must not be within 5 feet (1.5 m) of the microphone position. If measurements must be taken within 5 feet (1.5 m) of such objects, the effect, if any, on the measured data must be determined.

b) Instrumentation Set Up

1) A tripod must be set at the chosen site. The tripod must be extended to a height between 3 feet 8 inches (1.12 m) and 4 feet 10 inches (1.47 m) above ground.

2) A microphone must be attached to the appropriate end of a 5-foot (1.5 m) or longer cable and must be affixed to the top of the tripod. The other end of the cable must be connected to the measuring instrument.

3) The angle of incidence of the microphone must be adjusted to yield the flattest frequency response in accordance with the manufacturer's specifications.

4) The measuring instrument must be separated from the microphone so as to minimize any influence on the measurements. The cable movement must be minimized during the measurement period.

c) Measurement Site Operation and Instrument Calibration

1) Before taking sound pressure level measurements, measure and record (near the measurement site):

A) Wind speed and direction;

B) Ambient temperature;

C) Relative humidity; and

D) Barometric pressure.

2) Turn the measuring instrument on and allow the instrument to stabilize. Monitor and record the battery condition of the calibrator and all measuring instruments.

3) Turn the calibrator on at its appropriate frequency. Allow the calibrator to stabilize and calibrate the measuring system according to the manufacturer's specifications. After the measuring system has been calibrated, remove the calibrator and attach a windscreen to the microphone.

4) Adjust the microphone to the angle of incidence that will yield the frequency response in accordance with the manufacturer's specifications.

5) Measure the sound pressure level data within the limitations of subsection (d) and according to the manufacturer's recommended procedures. Other sound pressure levels may be used for investigatory purposes such as, but not limited to, the following:

A) Determining the extent of noise pollution caused by the source of sound;

B) Determining the ambient; and

C) Analyzing those acoustical parameters that describe the sound source.

6) While sound measurements are being taken, the operator must be separated from the microphone so as to minimize any influence on the measurements.

7) While measurements are being taken, visual and aural surveillance of extraneous sound sources and varying wind conditions must be made to insure that the conditions of measurement are accurately known. Record any variations in these parameters that may affect data. The number and basis for affected data block must be recorded. When using a tape recorder, voice commentary concerning conditions will be recorded on the cue track.

8) To minimize wind effects on the microphone, sound measurements must not be taken when the wind velocity is greater than 12 miles per hour (5.4 m/second) at the microphone position.

9) For the purposes of data correction, the ambient sound at the measurement site must be determined by means of measurement or analysis.

10) After taking sound pressure level measurements, remove the windscreen and attach the calibrator to the microphone. Turn the calibrator on at its appropriate frequency. After allowing the calibrator to stabilize, monitor and record the measuring system response. When the measuring system response varies by more than $\pm$ 0.5 dB from the most recent field calibration, the sound pressure level measurements obtained since such most recent field calibration cannot be used for enforcement purposes.

11) Before removing the calibrator from the microphone, turn the calibrator off. If the ambient sound has not been determined by means of measurement, determine the noise floor of the measuring system. If the noise floor is within 10 dB of the measured sound pressure level data, such noise floor measurements must be recorded.

12) At the end of the sound survey, monitor and record the battery condition of the calibrator and all measuring instruments. Near the measurement site, measure and record:

A) Windspeed and direction;

B) Ambient temperature;

C) Relative humidity; and

D) Barometric pressure.

13) Record the physical and topographical description of the ground surface within the vicinity of the measurement site, survey site location, a description of the sound source, a diagram of the area, the location of reflective surfaces near the microphone, and the approximate location of the noise source relative to the microphone position.

14) A magnetic tape recorder may be used to preserve the raw data. Calibration signals must be recorded at the beginning and end of each tape as well as at intermediate times such as when relocating to a new measurement site. Voice commentary concerning local conditions and affected data blocks must be recorded on the cue track. The original tape recording must be preserved for subsequent evaluation. Laboratory analyses may be performed on magnetic tape recorded field data. A description of the laboratory instrumentation and procedures must be recorded. Analyses used in the laboratory must be correlated to field measurement techniques.

d) Limiting Procedures for Specific Types of Data Acquisition

1) For measurements of non-impulsive sound with audible discrete tones, 1/3 octave-band sound pressure levels must be obtained in determining whether a noise source is in compliance with 35 Ill. Adm. Code 901.106.

2) For measurements of non-impulsive sound with no audible discrete tones, octave-band sound pressure levels must be obtained in determining whether a noise source is in compliance with 35 Ill. Adm. Code 901.102 and 901.103.

e) Correction Factors

If necessary, correction factors rounded to the nearest 1/2 decibel must be applied to sound pressure level measurements. The correction factors applicable to the measurement system may include, but are not limited to, corrections for windscreen interference and the sound pressure level difference between consecutive field calibrations. Such calibration correction factors must only be used to make negative corrections (subtraction from the field data). In no case must such calibration correction factors be added to the measured sound pressure levels so as to raise the sound pressure level field data. The correction factors applicable to the measurement site may include, but are not limited to, corrections for reflective surfaces and ambient sound.

Section 910.106 Protocols for Determination of Sound Levels

a) The raw data collection procedures for the determination of equivalent continuous sound pressure level (L_{eq}) are described in this Section using as an example the determination of a 1-hour L_{eq} corrected for ambient. The following procedures must be used:

1) Using small blocks:

A) The 1-hour interval is divided into many small blocks of time so that corruption of the data from short-term background transient sound and loss of data can be limited to the corrupted or bad blocks. The block duration in seconds must remain fixed for any measurement hour. The duration must be neither less than 10 seconds nor greater than 100 seconds. For example, if the block duration is chosen to be 60 seconds (1 minute), then the data collection proceeds for 60, 1-minute periods of measurement.

B) The collected data for each block represents a block duration L_{eq} (or sound exposure level (SEL)) in octave-bands (or 1/3 octave-bands if prominent discrete tones may be present).

C) Data for any block corrupted by one or more short-term background transient sounds must be deleted.

D) After deleting corrupted data blocks, there will be a fixed number of "good" data blocks remaining. This number is designated as N_{PLNS}, where PLNS stands for Property-Line-Noise-Source. These remaining "good" blocks must be numbered consecutively. The subscript i is used to denote the numbering of the blocks in time order after corrupted data blocks have been deleted.

E) The data for the N_{PLNS} remaining blocks are time averaged on an energy basis by octave (or 1/3 octave-band) using Equation 1 below. In this equation, two subscripts are used, i to designate time and j to designate the specific frequency, either an octave-band or 1/3 octave-band. The raw, 1-hour L_{eq} in the *j*th frequency band is given by:

$$L_{eqj} = 10\log\left(\frac{1}{N_{PLNS}}\sum_{i=1}^{N_{PLNS}} 10^{\left(\frac{L_{eqij}}{10}\right)}\right) \qquad \text{[Equation 1]}$$

where L_{eq} is the L_{eq} in the *j*th frequency band for the *i*th non-deleted data block.

F) In terms of SEL, the raw SEL in the *j*th frequency band is given by:

$$SEL_j = 10\log\left(\sum_{i=1}^{N_{PLNS}} 10^{\left(\frac{SEL_{ij}}{10}\right)}\right) \qquad \text{[Equation 2]}$$

G) The raw, 1-hour L_{eq} in the *j*th frequency band is given in terms of the corresponding SEL_j by:

$$L_{eqj} = SEL_j + 10\log\left(\frac{3600}{N_{PLNS}\Delta T}\right) \qquad \text{[Equation 3]}$$

Where T is the block duration in seconds, N_{PLNS} is the number of non-discarded data blocks, and 3600 is the number of seconds in an hour.

2) Continuous Data Collection:

A) The measuring instrument must be adjusted to continuously measure sound pressure and accumulate L_{eq} for each block of time. For convenience, the hour may be split into several smaller blocks such as 10, 6-minute blocks or 4, 15-minute blocks, etc.

B) A switch on the measuring instrument must be available to inhibit data collection whenever a short-term background transient sound occurs. This switch shall be used to prevent short-term background ambient sounds from corrupting the data.

C) Data collection must proceed for one hour. The energy average of the several measured L_{eqij} each weighted by the number of seconds actually accumulated during the *i*th block results in the raw, 1-hour L_{eq} in each frequency band given by:

$$L_{eqj} = 10\log\left(\frac{1}{T_{PLNS}}\sum_{i=1}^{N_{PLNS}} T_i 10^{\left(\frac{L_{eqij}}{10}\right)}\right) \qquad \text{[Equation 4]}$$

Where L_{eqij} is the L_{eq} in the jth frequency band for the *i*th large block. T_i is the actual number of seconds of "good" data accumulated in the *i*th block of time (e.g., 6 to 15 minutes); and

$$T_{PLNS} = \sum_{i=1}^{N_{PLNS}} T_i \qquad \text{[Equation 5]}$$

3) Minimum data collection requirements:

A) Initial Measurement Duration. The property-line-noise-source measurements must proceed initially for one hour. Because of correction for short-term background transient sounds, actual reported data collection time T, in seconds, may be less than 3600 seconds (one hour).

i) If small blocks of data are used for data collection, then the total measurement duration in seconds, T_{PLNS}, is given by N_{PLNS} T, where T is the length of each block in seconds and N_{PLNS} is the number of non-discarded blocks. If data inhibition is used for data collection, then T_{PLNS} is the number of non-inhibited seconds during the measurement hour. In either case, T_{PLNS} must be no less than 900 seconds.

ii) If very few blocks were used for data collection, then the duration of each block, T, may be too long and should be reduced.

iii) For either data collection method, sounds considered to be short-term transient may actually be part of the long-term background ambient and should be so redefined.

B) Extended Measurement Duration. If T_{PLNS} is less than 900 seconds during the first hour of measurements, the raw data collection procedures must be appropriately modified and new measurements must proceed for an additional hour. If T_{PLNS} after combining the first and the second hour of measurements is also less than 900 seconds, then the raw data collection must continue using the data inhibition method or method employed during the second hour until T_{PLNS} is greater than or equal to 900 seconds.

4) Correction for Long-Term Background Ambient Sound:

A) The raw 1-hour L_{eq} must be corrected for long-term background ambient sound. Subsection (b) of this Section describes methods to obtain the long-term background ambient sound level in the jth frequency band. The correction is dependent on the difference (in decibels) between the raw, 1-hour, jth band property-line-noise-source: L_{eqj} and corresponding jth band long-term background ambient sound level. The correction to be applied is as follows:

i) If the difference between the raw 1-hour L_{eq} and the long-term background ambient sound is larger than 10 decibels, then the correction must be set to 0.

ii) If the difference between the raw 1-hour L_{eq} and the long-term background ambient sound difference is less than 3 decibels, then the *j*th frequency-band level, L_{eqj}, must be set equal to 0.

iii) If the difference between the raw 1-hour L_{eq} and the long-term background ambient sound is between 3 and 10 decibels, then the correction given in Table 1 below must be subtracted from the raw, 1-hour property-line-noise-source L_{eqj}

Table 1
Corrections in dB for long-term background ambient sound

Difference (dB)	Correction (dB)
3	3
4	2.3
5	1.7
6	1.3
7	1.0

8	0.7
9	0.6
10	0.5

B) The long-term background ambient corrected level must be the property-line-noise-source L_{eqj} reported for the jth frequency band.

b) Obtaining the background ambient sound level:

1) The background ambient must be measured for the purposes of this Section during a 10-minute interval.

2) Long-term background ambient measurement procedures are similar to procedures to measure the property-line-noise-source itself. Eliminating short-term background ambient transient sounds from the measurement of average long-term background ambient sound proceeds in a manner similar to the measurement of the property-line-noise-source emissions themselves. The two methods for measurement are: to divide the 10-minute measurement into short blocks of data, or inhibit data collection when short-term background transient sounds occur. The same method must be used for gathering both the property-line-noise-source data and the corresponding long-term background ambient data. The measurement procedures for each method are given in subsections (b)(3), (b)(4) and (b)(5) of this Section:

3) Using Small Blocks of Data

A) The 10-minute measurement of long-term background ambient must be divided into short measurement blocks. The duration of these blocks must remain constant during the entire measurement, both when measuring the long-term background ambient and when measuring the property-line-noise-source. The duration of this measurement block in seconds, T, must divide exactly (without remainder) into 600 and must be neither greater than 100 seconds nor less than 10 seconds.

B) All data for any measurement block corrupted by one or more short-term ambient transient sounds must be discarded. The number of remaining, non-discarded measurement blocks is designated N_{BA}, where *BA* stands for background ambient.

C) The L_{eq} for each octave-(or 1/3 octave-) band are time-averaged on an energy basis over the N_{BA} remaining measurement blocks to obtain average long-term background ambient L_{eq} per band. Equation 1 (see subsection (a) (1) (E) of this Section) is used for this calculation with N_{BA} replacing N_{PLNS} as the number of elemental blocks to be summed. The total duration of the measurement in seconds, T_{BA}, is given by N_{BA} multiplied by T.

4) Continuous Data Collection

A) The measuring instrument must be adjusted according to manufacturer's instructions to continuously measure sound pressure and accumulate (i.e. record) L_{eq}. A switch must be available to inhibit data collection whenever a short-term background transient sound occurs, (and on some instruments, a button may be available to delete the most recent, previous data).

B) The switches or buttons must be used to prevent short-term background ambient sounds from corrupting the data.

C) Data collection must proceed for 10 minutes. The result is the 10-minute, long-term background ambient L_{eq} in each band.

D) T_{BA} is the number of non-inhibited measurement seconds during the 10-minute measurement period.

5) The minimum duration, for either method, T_{BA} must be no less than 150 seconds. If T_{BA} is less than 150 seconds, then the measurement of the long-term background ambient must continue beyond the original 10 minutes and until T_{BA} for the total long-term background ambient measurement is greater than or equal to 150 seconds.

6) Measurement Alternatives. The long-term background ambient noise should ideally be measured at the potential violation site just before measurement of the property-line-noise-source emissions. However, turning off the property-line-noise-source may not always be possible. The following are a hierarchical order of five procedures for obtaining the long-term background ambient noise. The first four procedures involve direct measurement; the fifth procedure provides for use of tables of values obtained from extensive measurements. These are not equivalent procedures but are ordered from what is considered to be the most accurate to what is considered to be the least accurate procedure.

A) Direct Measurement Procedure –1: With the property-line-noise-source (PLNS) turned off, measure the long-term background ambient noise within the hour before or within the hour after measurement of the PLNS emissions at the location where the PLNS measurements are being taken and with the measurement equipment used for the PLNS measurements.

B) Direct Measurement Procedure-2: With the PLNS turned off, measure the long-term background ambient during a similar time period in terms of background ambient sound level, within one to 24 hours before, or within one to 24 hours after measurement of the PLNS emissions at the location where the PLNS measurements are being taken and with the measurement equipment used for the PLNS.

C) Direct Measurement Procedure- 3: With the PLNS turned off, measure the long-term background ambient during some other acoustically similar period within one to 30 days before, or within one to 30 days after measurement of the PLNS emissions. This alternate long-term background ambient measurement time might be a Saturday night or anytime during a Sunday or holiday. The measurements would be made at the location where the PLNS measurements are being taken and with the measurement equipment (or like equipment) used for the PLNS measurement.

D) Direct Measurement Procedure-4: With the PLNS turned off, measure the long-term background ambient noise during some other acoustically similar period within 30 to 90 days before, or within 30 to 90 days after measurement of the PLNS emissions. These measurements would be made at the location where the PLNS measurements are being taken and with the measurement equipment (or like equipment) used for the property-line-noise-source measurements.

E) Tables of Long-Term Background Ambient Noise. Where none of the alternatives can be used, use the applicable long-term background ambient data taken from Tables A through D in Appendix A of this Part. These tables are organized by predominant land use and time of day (daytime or nighttime). There are separate tables for octave- and 1/3- octave-bands. The background environments presented in the table are based on extensive measurements conducted in the Chicago area and are divided into the five categories given below in accordance with G.L. Bonvallet, "Levels and Spectra of Traffic, Industrial, and Residential Area Noise," Journal of the Acoustical Society of America, 23 (4), pp 435-439, July 1951; and Dwight E. Bishop and Paul D. Schomer, Handbook of Acoustical Measurements and Noise Control, Chapter 50, Community Noise Measurements, 3rd Edition, Cyril M Harris, Editor, McGraw-Hill Book Co., New York (1991).

i) Category 1: Noisy Commercial and Industrial Areas. Very heavy traffic conditions, such as in busy downtown commercial areas, at intersections of mass transportation and other vehicles, including the Chicago Transit Authority trains, heavy motor trucks and other heavy traffic, and street corners where motor buses and heavy trucks accelerate.

ii) Category 2: Moderate Commercial and Industrial Areas, and Noisy Residential Areas. Heavy traffic areas with conditions similar to subsection (b)(6)(E)(i) of this Section but with somewhat less traffic, routes of relatively heavy or fast automobile traffic but where heavy truck traffic is not extremely dense, and motor bus routes.

iii) Category 3: Quiet Commercial and Industrial Areas, and Moderate Residential Areas. Light traffic conditions where no mass transportation vehicles and relatively few automobiles and trucks pass, and where these vehicles generally travel at low speeds. Residential areas and commercial streets and intersections with little traffic comprise this category.

iv) Category 4: Quiet Residential Areas. These areas are similar to Category 3 in subsection (b)(6)(E)(iii) of this Section but, for this group, the background is either distant traffic or is unidentifiable.

v) Category 5: Very Quiet, Sparse Suburban or Rural Areas. These areas are similar to Category 4 subsection (b)(6)(E)(iv) of this Section but are usually in unincorporated areas and, for this group, there are few if any near neighbors.

Section 910.107 Measurement Techniques for Highly-Impulsive Sound Under 35 Ill. Adm. Code 901.104.

a) Measurement of highly-impulsive sound under 35 Ill. Adm. Code 901.104 can be made in two distinct and equally valid ways, namely the general method and the controlled test method.

b) General Method: The general method is to measure the 1-hour, A-weighted L_{eq} (not the octave- or 1/3 octave-band levels) using essentially one of the two procedures described in Sections 910.105 and 910.106.

1) The procedure using small blocks of time to collect data is as follows:

A) The hour must be divided into small blocks and the A-weighted L_{eq} must be measured for each of these small blocks of time. L_{eq} must be measured for the entire hour but data collection must be inhibited whenever a short-term background transient sound occurs.

B) The duration of each block must be held constant during the hour. This duration in seconds must divide exactly into 900 and must be neither greater than 100 seconds nor less than 10 seconds.

C) The data for any block corrupted by one or more short-term background ambient sounds must be discarded.

2) The continuous data collection procedure is as follows:

A) L_{eq} must be measured for the entire hour.

B) Data collection must be inhibited whenever a short-term background transient sound occurs.

3) Correction for the long-term background ambient must be accomplished using all of the other procedures and requirements enumerated in Sections 910.105 and 910.106. These requirements must be complied with to determine an A-weighted, 1-hour, background-ambient-corrected L_{eq} for the highly impulsive property-line-noise-source under study.

c) Controlled Test Method: For this method, the following procedures must be used:

1) General Measurement Description

A) The sound exposure per impulse from each separate individual impulsive source is measured.

B) The total sound exposure per hour from each source is the sound exposure per event multiplied by the number of events per hour.

C) The grand total sound exposure (SE) per hour is the sum of the sound exposures per hour from each of the separate individual sources.

D) The reported SEL is obtained from the grand total sound exposure (SE) per hour using the following:

$$SEL = 10 \log (SE) + 94 \qquad \text{[Equation 7]}$$

E) The equivalent level, L_{eq} corresponding to a SEL measured or predicted for one hour (3600 seconds) is given by:

L_{eq} = SEL - 10 log (3600) [Equation 8]

2) Determination of sound exposure per event must be as follows:

A) The sound exposure per event from each, separate, individual source must be determined by measuring the total A-weighted sound exposure for about 10 repetitions of this source. This set of about 10 measurements may be performed continuously over a short period of time, or this set of measurements may be performed over a discontinuous set of measurement periods. In either case, the total measurement duration must be less than 100 seconds.

B) These separate, individual property-line-noise- source controlled measurements must be free of any short-term ambient sounds. If any short-term background transient sounds occur during these measurements, then the measurement must be repeated until measurement data, free of any corrupting short-term background ambient sounds, are obtained.

C) The total measured A-weighted sound exposure for this group of about 10 repetitions must be corrected for long-term background ambient by subtracting the A-weighted long-term background ambient sound exposure. The sound exposure value subtracted must be the long-term A-weighted background ambient sound exposure per second multiplied by the number of seconds used to measure the several source repetitions.

D) The reported Source: A-weighted sound exposure per event must be the total corrected sound exposure divided by the number of source repetitions measured.

E) The background ambient must be measured for a short time, at least 30 seconds as near in time to the source measurements as possible, but within ½ hour. The total A-weighted long-term background ambient sound exposure per second is the total measured long-term background ambient sound exposure divided by the number of seconds of background ambient measurement.

F) There must be no short-term background ambient sounds present during the measurement of the long-term background ambient. If any short-term background transient sounds occur during these measurements, then the measurements must be repeated until long-term background ambient measurement data free of any corrupting short-term background ambient sound are obtained.

910.APPENDIX A Tables of Long-Term Background Ambient Noise

910.TABLE A. Daytime long-term background ambient L_{eq} levels in decibels by land use categories and 1/3 octave-band level

Octave-Band Center Frequency (Hz)	Background Category 1	2	3	4	5
20	63	56	48	42	36
25	64	57	49	43	37
31	65	58	50	44	38
40	65	58	51	44	38
50	66	59	51	45	39
63	66	59	52	46	40
80	67	60	52	46	40
100	68	60	53	47	41
125	67	59	52	46	40
160	66	59	52	46	40
200	66	58	51	45	39
250	65	58	50	44	38
315	64	57	49	43	37
400	63	55	48	42	36
500	62	54	46	40	34
630	61	53	44	38	32
800	60	51	42	36	30
1000	58	49	40	34	28
1250	56	47	38	32	26
1600	54	45	36	30	24
2000	52	43	33	28	21
2500	50	41	30	25	19
3150	49	39	28	23	17
4000	48	37	25	20	15
5000	46	35	23	18	13
6300	44	33	21	16	10
8000	43	31	19	14	8

10,000	41	29	17	12	6
12,500	39	27	15	10	4

910. APPENDIX A Tables of Long-Term Background Ambient Noise

910.TABLE B. Nighttime long-term background ambient L_{eq} levels in decibels by land use categories and 1/3 octave-band level

Octave-Band Center Frequency (Hz)	Background Category 1	2	3	4	5
20	53	48	43	37	31
25	54	49	44	38	32
31	55	50	45	39	33
40	55	50	46	39	33
50	56	51	46	40	34
63	56	51	47	41	35
80	57	52	47	41	35
100	58	52	48	42	36
125	57	51	47	41	35
160	56	51	47	41	35
200	56	50	46	40	34
250	55	50	45	39	33
315	54	49	44	38	32
400	53	47	43	37	31
500	52	46	41	35	29
630	51	45	39	33	27
800	50	43	37	31	25
1000	48	41	35	29	23
1250	46	39	33	27	21
1600	44	37	31	25	19
2000	42	35	28	23	16
2500	40	33	25	20	14
3150	39	31	23	18	12
4000	38	29	20	15	10
5000	36	27	18	13	8
6300	34	25	16	11	5

8000	33	23	14	9	3
10,000	31	21	12	7	1
12,500	29	19	10	2	

910. APPENDIX A Tables of Long-Term Background Ambient Noise

910.TABLE C. Daytime long-term background ambient L_{eq} levels in decibels by land use categories and octave-band level

Octave-Band Center Frequency (Hz)	Background Category				
	1	2	3	4	5
31	70	63	55	49	43
63	71	64	57	51	45
125	72	64	57	51	45
250	70	63	55	49	43
500	67	59	51	45	39
1000	63	54	45	39	33
2000	57	48	38	33	26
4000	53	42	30	25	20
8000	48	36	24	19	13

910. APPENDIX A Tables of Long-term Background Ambient Noise

910.TABLE D. Nighttime long-term background ambient L_{eq} levels in decibels by land use categories and octave-band level

Octave-Band Center Frequency (Hz)	Background Category				
	1	2	3	4	5
31	60	55	50	44	38
63	61	56	52	46	40
125	62	56	52	46	40
250	60	55	50	44	38
500	57	51	46	40	34
1000	53	46	40	34	28
2000	47	40	33	28	21
4000	43	34	25	20	15
8000	38	28	19	14	8

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About Industrial Wind Action Group

Industrial Wind Action was formed to counteract the misleading information promulgated by the wind energy industry and various environmental groups. Support for this effort comes from a large and diversified group of environmentalists, energy experts, and ordinary citizens.

The rapid growth of industrial wind energy has been fostered by federal and state policies that, while well intentioned, fail to reflect wind energy's limitations as an energy source, its ineffectiveness in reducing emissions, and its impacts on our environment, economy and quality of life.

Industrial Wind Action stands ready to assist communities threatened with industrial wind energy projects by providing residents, as well as government officials, the information to make informed decisions.

Industrial Wind Action (IWA) Group:

- Exposes the impacts of industrial wind energy on our environment, economy and quality of life through fact-based analyses;
- Assists communities threatened with unwanted industrialization;
- Advises officials at the federal, state and local levels regarding wind energy policy to counteract misleading information from the wind energy industry and some environmental groups.

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The lie behind wind energy model ordinances

(Posted December 4, 2008)

In the last ten years, wind industry representatives have successfully laid the groundwork for expedited project review and approval in many States in the US. Reaching out to legislators and State agency directors, the industry argued that existing laws governing siting of electric power plants were unduly onerous when applied to wind facilities. After all, operating wind turbines do not produce air emissions or use/discharge water, the basis for these stricter laws.

To allay concerns over shortened review periods, developers proactively worked with environmentalists and large landowners to help establish guidelines governing the siting of wind plants. The guidelines, or model ordinances, were then presented to State officials with assurances that if developers adhered to them, projects would be safe for residents living near the turbines and less impacting on the natural environment. Although the guidelines did not carry the weight of law, they also helped provide continuity for wind projects subject to local review at the town or county level.

In theory, this proactive teamwork could have worked. But all is not "green" roses.

Wind energy developers count on the fact that few people have "experienced" a wind energy facility and thus cannot imagine the enormity of the towers even from one-mile away. At the same time, these developers know that turbines operate at a noise level that far exceeds the background noise of the rural zones in which they're erected.

We need only look at a few of the 'guidelines' in place to understand how consistent these model ordinances are from state to state and in all cases skewed in favor of wind.

In Michigan, the State Task Force working under the Department of Labor and Economic Growth, recommended in its "Siting Guidelines for Wind Energy Systems" that noise limits be set at 55 dBA or L90 + 5 dBA, whichever is higher. The setback distance from the property is the height of the tower including the blade in the vertical position, which for most turbines today would be about

400-feet.

In Wisconsin, the State Task Force recommended 50 dBA for noise levels and tower setbacks of 1000-feet from the wall of a residence. And in Pennsylvania, the model ordinance, which carried the Gamesa stamp of approval, set noise limits at 55 dBA outside the home and setbacks of 1.1x the height of the turbine as measured at the wall of an occupied building.

In a recent questionnaire submitted to wind developers by Union Township in Wisconsin, the respondents defended these specifications with statements like:

> "Turbines are sited to have maximum sound level of 45dBA, well below levels causing physical harm. Medical books on sound indicate sound levels above 80-90dBA cause physical (health) effects. The possible effects to a person's health due to "annoyance" are impossible to study in a scientific way, as these are often mostly psychosomatic, and are not caused by wind turbines as much as the individuals' obsession with a new item in their environment."

Community noise experts Kamperman and James took issue with this and published a formal response to the questionnaire, highlighting major deficiencies in the wind developers' statements, including:

* The tone and context of the statement implies that 45 dBA is fully compatible with the quiet rural community setting.

* No acknowledgement is made of the dramatic change this will be for the noise environment of nearby families.

* No mention is made of how the wind facility, once in operation, will raise evening and nighttime background sound levels from the existing background levels of 20 to 30 dBA to 45 dBA.

* There is no disclosure of the considerable low frequency content of the wind turbine sound; in fact, there are often claims to the contrary.

* They fail to warn that the home construction techniques used for modern wood frame homes result in walls and roofs that cannot block out a wind turbine's low frequencies.

* They do not disclose that the International Standards Organization (ISO) in ISO 1996-1971 recommends 25 dBA as the maximum night-time limit for rural communities. Sound levels of 40 dBA and above are only appropriate in suburban communities during the day and urban communities during day and night. There are no communities where 45 dBA is considered acceptable at night.

* Making statements outside their area of competence, wind industry advocates, without medical qualifications, label complaints of health effects as "psychosomatic" in a pejorative manner that implies the complaints can be discounted because they are not "really medical" conditions. Such a response cannot be considered to be based in fact.

So how do these model ordinances pass the muster and get approved?

The "stakeholders" involved were largely wind energy proponents, environmentalists, and landowners who might see turbines on their land. A significant group of stakeholders, the residents of targeted communities, likely had no idea such meetings were happening. If these model ordinances were to be reconsidered, it's a certainty that many people would step up and make their thoughts known.

Windaction.org strongly encourages States to revisit their guidelines and model ordinances now that we have experience with the effects of turbines built close to where people live. But in a next go around, the guidelines must be grounded in science and empirical evidence and not on data provided by the very people financially and ideologically vested in the outcome. While everyone is interested in seeing renewable energy get built, no one has the right to harm the health, safety, and welfare of others.

The 'how to' guide to criteria for siting wind turbines to prevent health risks from sound

October 28, 2008

Summary

Community noise experts George W. Kamperman and Richard R. James provide guidelines for siting industrial wind turbines with a focus on preventing health risks due to sound emissions from the turbines. This document offers important background information that should be read by all those involved in the siting and approving of wind energy facilities. The introduction to the paper is included below. The full document can be accessed by clicking on the link at the bottom of the page.

"A subset of society should not be forced to bear the cost of a benefit for the larger society."

Introduction

A new source of community noise is spreading rapidly across the rural U.S. countryside.

Industrial-scale wind turbines (WT), a common sight in many European countries, are now actively promoted by federal and state governments in the U.S. as a way to reduce coal-powered electrical generation and global warming. The presence of industrial wind projects is expected to increase dramatically over the next few years, given the tax incentives and other economic and political support currently available for renewable energy projects in the U.S.

As a part of the widespread enthusiasm for renewable energy, state and local governments are promoting "Model Ordinances" for siting industrial wind farms which establish limits for noise and other potential hazards. These are used to determine where wind projects can be located in communities, which are predominantly rural and often extremely quiet during the evening and night. Yet, complaints about noise from residents near existing industrial wind turbine installations are common. This raises serious questions about whether current state and local government siting guidelines for noise are sufficiently protective for people living close to the wind turbine developments. Research is emerging that suggests significant health effects are associated with living too close to modern industrial wind turbines. Research into the computer modeling and other methods used to determine the layout of wind turbine developments, including the distance from nearby residences, is at the same time showing that the output of the models may not accurately predict sound propagation. The models are used to make decisions about how close a turbine can be to a home or other sensitive property. The errors in the predicted sound levels can easily result in inadequate setback distances thus exposing the property owner to noise pollution and potential health risks. Current information suggests the models should not be used for siting decisions unless known errors and tolerances are applied to the results.

Our formal presentation and paper on this topic (Simple guidelines for siting wind turbines to prevent health risks) is an abbreviated version of this essay. The formal paper was presented to the Institute of Noise Control Engineers (INCE) at its July Noise-Con 2008 conference in Detroit, MI, A copy of the paper is included at the end of this document. The formal paper covered the community noise studies performed in response to complaints, research on health issues related to wind turbine noise, critiques of noise studies performed by consultants working for the wind developer, and research/technical papers on wind turbine sound immissions and related topics. The formal paper also reviewed sound studies conducted by consultants for governments, the wind turbine owner, or the local residents for a number of sites with known health or annoyance problems. The purpose was to determine if a set of simple guidelines using dBA and dBC sound levels can serve as the 'safe' siting guidelines for noise and its effects on communities and people. The papers considered in our review included, but were not limited to, those listed in Tables 1-4 on pages 2 through 4 of the Noise-Con document.

This essay expands upon the Noise–Con paper and includes information to support the findings and recommended criteria. We are proposing very specific, yet reasonably simple to implement and assess criteria for audible and non-audible sound on adjacent properties and also present a sample noise ordinance and the procedures needed for pre-construction sound test, computer model requirements and follow-up tests (including those for assessing compliance).

The purpose of this expanded paper is to outline a rational, evidence-based set of criteria for industrial wind turbine siting in rural communities, using:

1) A review of the European and other wind turbine siting criteria and existing studies of the prevalence of noise problems after construction;

2) Primary review of sound studies done in a variety of locations in response to wind turbine noise complaints (Table 1);

3) Review of publications on health issues for those living in close proximity to wind turbines (Table 2);

4) Review of critiques of pre-construction developer noise impact statements (Table 3); and

5) Review of technical papers on noise propagation and qualities from wind turbines (Table 4).

The Tables are on pages 2-4 of the formal paper. We also cite standard international criteria for community noise levels and allowances for low-frequency noise.

The specific sections are:
1. Introduction (This section)
2. Results of Literature Review and Sound Studies
3. Development of Siting Criteria
4. Proposed Sound Limits
5. How to Include the Recommended Criteria in Local or State Noise Ordinances
6. Elements of a Wind Energy System Licensing Ordinance
7. Measurement Procedures (Appendix to Ordinance)
8. The Noise-Con 2008 paper "Simple guidelines for siting wind turbines to prevent health risks" with revisions not in the paper included in the conference's Proceedings.

The construction of large WT (industrial wind turbines) projects in the U.S. is a relatively recent phenomenon, with most projects built after 2000. Other countries, especially in Europe, have been using wind energy systems (WES) since the early 1990's or earlier. These earlier installations generally used turbines of less than 1 MW capacity with hub heights under 61 m (200 feet). Now, many of these earlier turbines reaching the end of their useful life, are being replaced with the larger 1.5 to 3 MW units. Thus, the concepts and recommendations in this article, developed for the 1.5 MW and larger turbines being build in the U.S, may also be applicable abroad.

Attachment:
08-11-02 Kamperman-James Ver 2.1 (WindAction) Noise Criteria for Siting Wind Turbines .pdf

THE "HOW TO" GUIDE TO SITING WIND TURBINES TO PREVENT HEALTH RISKS FROM SOUND

By:

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"A subset of society should not be forced to bear the cost of a benefit for the larger society."[1]

I. Introduction

A new source of community noise is spreading rapidly across the rural U.S. countryside. Industrial-scale wind turbines (WT), a common sight in many European countries, are now actively promoted by federal and state governments in the U.S. as a way to reduce coal-powered electrical generation and global warming. The presence of industrial wind projects is expected to increase dramatically over the next few years, given the tax incentives and other economic and political support currently available for renewable energy projects in the U.S.

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[1] George S. Hawkins, Esq., *"One Page Takings Summary: U.S Constitution and Local Land Use,"* Stony Brook-Millstone Watershed Association; *"...nor shall private property be taken for public use, without just compensation."* Fifth Amendment, US Constitution.

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II. Results of Literature Review and Sound Studies

In the U.K. there are currently about 133 operating WT developments. Many of these have been in operation for over 10 years. The Acoustic Ecology Institute[2] (AEI) reported that a Special Report for the British government titled "Wind Energy Noise Impacts,"[3] found that about 20% of the wind farms in the U.K. generated most of the noise complaints. Another study commissioned by British government, from the consulting firm Hayes, McKensie, reported that only five of 126 wind farms in the U.K. reported problems with the noise phenomenon known as aerodynamic modulation.[4] Thus, experience in the U. K. shows that not all WT projects lead to community complaints. AEI posed an important question: **"What are the factors in *those* wind farms that may be problematic, and how can we avoid replicating these situations elsewhere?"**

As experienced industrial noise consultants ourselves, we would have expected the wind industry, given the U.K. experience, to have attempted to answer this question, conducting extensive research -- using credible independent research institutions -- before embarking on wind power development in the U.S. The wind industry was aware, or should have been aware, that 20% of British wind energy projects provoked complaints about noise and/or vibration, even in a country with more stringent noise limits than in the U.S.

The wind industry complies with stricter noise limits in the U.K. and other countries than it does in the U.S., for example[5]:

- Australia: higher of 35 dBA or L_{90} + 5 dBA
- Denmark: 40 dBA
- France: L_{90} + 3 dBA (night) and L_{90} + 5 dBA (day)
- Germany: 40 dBA
- Holland: 40 dBA
- United Kingdom: 40 dBA (day) and 43 dBA or L_{90} + 5 dBA (night)
- Illinois: Octave frequency band limits of about 50 dBA (day) and about 46 dBA (night)
- Wisconsin: 50 dBA
- Michigan: 55 dBA

Industry representatives on state governmental committees have worked to establish sound limits and setbacks that are lenient and favor the industry. In Michigan, for example, the State Task Force (working under the Department of Labor and Economic Growth) recommended in its "Siting Guidelines for Wind Energy Systems" that the limits be set at 55 dBA or L_{90} + 5 dBA, whichever is higher. In Wisconsin, the State Task Force has recommended 50 dBA.

When Wisconsin's Town of Union wind turbine committee made an open records request to find out the scientific basis for the sound levels and setbacks in the state's draft model ordinance, it found that no scientific or medical data was used at all. Review of the meeting minutes provided

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2 (http://www.acousticecology.org/srwind.html)

3 AEI is a 501(c)3 non-profit organization based in Santa Fe, New Mexico, USA. The article is available at http://www.acousticecology.org/srwind.html

4 Study review available at: http://www.berr.gov.uk/files/file35592.pdf

5 Ramakrishnan, Ph. D., P. Eng., Ramani, "Wind Turbine Facilities Noise Issues" Dec. 2007 Prepared for the Ontario Ministry of Environment.

under the request showed that the limits had been set by Task Force members representing the wind industry.[6] This may explain why state level committees or task forces have drafted ordinances with upper limits of 50 dBA or higher instead of the much lower limits applied to similar projects in other countries. There is no independent, scientific or medical support for claims that locating 400+ foot tall wind turbines as close as 1000 feet (or less) to non-participating properties will not create noise disturbances, economic losses or other risks.[7] But, there is considerable independent research supporting that this will result in public health risks and other negative impacts on people and property.

To illustrate the way a typical WT developer responds to a question raised by a community committee about noise and health the following example is presented and discussed:

> **Q: 19. What sound standards will EcoEnergy ensure that the turbines will be within, based on the setbacks EcoEnergy plans to implement, and what scientific and peer reviewed data do you have to ensure and support there will be no health and safety issues to persons within your setbacks?**
>
> **Answer:** As mentioned, turbines are sited to have maximum sound level of 45dBA. These sound levels are well below levels causing physical harm. Medical books on sound indicate sound levels above 80-90dBA cause physical (health) effects. The possible effects to a person's health due to "annoyance" are impossible to study in a scientific way, as these are often mostly psychosomatic, and are not caused by wind turbines as much as the individuals' obsession with a new item in their environment.
>
> **From EcoEnergy's "Response to the Town of Union Health & Safety Research Questionnaire"**
> By Curt Bjurlin, M.S., Wes Slaymaker, P.E., Rick Gungel, P.E., EcoEnergy, L.L.C., submitted to Town of Union, Wisconsin and Mr. Kendall Schneider, on behalf of the Town of Union

A serious question was asked and it deserves a responsible answer. The committee, charged with fact-finding, sought answers they presumed would be based on independent, peer-reviewed studies. Instead, the industry response was spurious and misleading, and did not address the question. It stated that the turbines will be located so as to produce maximum sound levels of 45 dBA, the tone and context implying that 45 dBA is fully compatible with the quiet rural community setting. No acknowledgement is made of the dramatic change this will be for the noise environment of nearby families. No mention is made of how the WT, once in operation, will raise evening and nighttime background sound levels from the existing background levels of 20 to 30 dBA to 45 dBA. There is no disclosure of the considerable low frequency content of the WT sound; in fact, there are often claims to the contrary. They fail to warn that the home construction techniques used for modern wood frame homes result in walls and roofs that cannot block out WT low frequencies.

There is no mention of the nighttime sound level recommendations set by the World Health Organization (WHO) in its reports, *Guidelines for Community Noise* [8] and "Report on the third

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[6] Lawton, Catharine M., Letter to Wisconsin's "Guidelines and Model Ordinances Ad Hoc Subcommittee of the Wisconsin Wind Power Siting Collaborative" in Response to Paul Helgeson's 9/20/00 "Wisconsin Wind Ordinance Egroups E-Mail Message," Sept. 20, 2000, a Public Record obtained through Open Meetings Act request by the Town of Union, Wisconsin, Large Wind Turbine Citizens Committee.

[7] It is worth noting that the 2007-06-29 version of the Vestas Mechanical Operating and Maintenance Manual for the model V90 – 3.0 MW VCRS 60 Hz turbine includes this warning for technicians and operators:

> **"2. Stay and Traffic by the Turbine**
>
> Do not stay within a radius of 400m (1300ft) from the turbine unless it is necessary. If you have to inspect an operating turbine from the ground, do not stay under the rotor plane but observe the rotor from the front.
> Make sure that children do not stay by or play nearby the turbine. ...."

[8] Available at http://www.who.int/docstore/peh/noise/guidelines2.html.

meeting on night noise guidelines.[9]" In these documents WHO recommends that **sound levels during nighttime and late evening hours should be less than 30 dBA during sleeping periods to protect children's health**. They noted that a child's autonomic nervous system is 10 to 15 dB more sensitive to noise than is an adult. Even for adults, health effects are first noted in some studies when the sound levels exceed 32 dBA L_{max}. These sounds are 10-20 dBA lower than the sound levels needed to cause awakening.

For sounds that contain a strong low frequency component, which is typical of wind turbines, WHO says that the limits may need to be even lower than 30 dBA to avoid health risks. Further, they recommend that the criteria use dBC frequency weighting instead of dBA for sources with low frequency content. When WT sound levels are 45 dBA outside a home, we may find that the interior sound levels will drop to the 30 dBA level recommended for sleeping areas but low frequency noise only decreased 6-7 dBC from outside to inside. That could create a sleep problem because the low frequency content of the noise can penetrate the home's walls and roof with little reduction. An example demonstrating how WT sound is affected by walls and windows is provided later in this document.

The wind turbine developers in the excerpt above do not disclose that the International Standards Organization (ISO) in ISO 1996-1971 recommends 25 dBA as the maximum night-time limit for rural communities. As can be seen in the table below, sound levels of 40 dBA and above are only appropriate in suburban communities during the day and urban communities during day and night. There are no communities where 45 dBA is considered acceptable at night.

ISO 1996-1971 Recommendations for Community Noise Limits (dBA)			
District Type	Daytime Limit	Evening Limit 7-11pm	Night Limit 11pm-7am
Rural	35dB	**30dB**	**25dB**
Suburban	40dB	35dB	**30dB**
Urban residential	45dB	40dB	35dB
Urban mixed	50dB	45db	40dB

Further, the wind industry claims, "*These sound levels are well below levels causing physical harm. Medical books on sound indicate sound levels above 80-90dBA cause physical (health) effects.*" Concern about sound levels in the 80-90 dBA range is for hearing health (your ears) and not the health-related issues of sleep disturbance and other symptoms associated with prolonged exposure to low levels of noise with low frequency and amplitude modulation such as the sound emitted by modern wind turbines. This type of response is a non-answer. It is an overt attempt to mislead while giving the appearance of providing a legitimate response.

Furthermore, the statement, "*The possible effects to a person's health due to 'annoyance' are impossible to study in a scientific way, as these are often mostly psychosomatic, and are not caused by wind turbines as much as the individuals' obsession with a new item in their environment,*" is both inaccurate and misleading. It ignores the work of researchers such as Pedersen, Harry, Phipps, and Pierpont on wind turbine effects specifically, and the numerous medical research studies reviewed by Frey and Hadden. The studies belie the claims of the wind industry. This "failure to locate" published

[9] Available at: http://www.euro.who.int/Noise/activities/20040721_1 References found in Report on third meeting at pages 13 and others

studies that are readily available on the internet as to make some interpret the claim of "no medical research" as a conscious decision to not look for it. Those companies that do acknowledge the existence of medical research take the position that it is not credible for one or another reason and thus can be ignored.

Making statements outside their area of competence, wind industry advocates, without medical qualifications, label complaints of health effects as "psychosomatic" in a pejorative manner that implies the complaints can be discounted because they are not "really medical" conditions. Such a response cannot be considered to be based in fact. It is, at best, an opinion. It ignores the work of many researchers, including the World Health Organizations, on the effect of sounds during nighttime hours that result in sleep disturbance and other disorders with physical, not just psychological, pathologies.[10,11] Many people find it difficult to articulate what has changed. They know something is different from before the wind turbines were operating and they may express it as feeling uncomfortable, uneasy, sleepless, or some other symptom, without being able to explain why it is happening.

Our review of the studies listed in Tables 1-4 of our Noise-Con paper show that some residents living as far as 3 km (1.86 mi) from a wind farm complain of sleep disturbance from the noise. Many residents living 1/10 of this distance (300 m or 984 ft) from wind farms experience major sleep disruption and other serious medical problems from nighttime wind turbine noise. The peculiar acoustic characteristics of wind turbine noise immissions[12] cause the sounds at the receiving properties to be more annoying and troublesome than the more familiar noise from traffic and industrial factories. Limits used for these other community noise sources are not appropriate for siting modern industrial wind turbines. The residents who are annoyed by wind turbine noise complain of the repetitive, approximately once-per-second (1 Hz) "swoosh-boom-swoosh-boom" sound of the turbine blades and of "low frequency" noise. It is not clear to us whether the complaints about "low frequency" noise are about the audible low frequency part of the "swoosh-boom" sound, the once-per-second amplitude modulation (amplitude modulation means that the sound varies in loudness and other characteristics in a rhythmic pattern) of the "swoosh-boom" sound, or some combination of the two.

Figure 1 of our Noise Con paper, reproduced as Figure 1, below, shows the data from one of the complaint sites plotted against the sound immission spectra for a modern 2.5 MWatt wind turbine; A home in the United States at 2km distance, Young's threshold of perception for the 10% most sensitive population (ISO 0266); and a spectrum obtained for a rural community during a three hour, 20 minute test from 11:45 pm until 3:05 am on a windless June evening near Ubly, Michigan. This is a quiet rural community located in central Huron County (also called Michigan's Thumb). It is worth noting that this sound measurement sample demonstrates how quiet a rural community can be when located at a distance from industry, highways, and airport related noise emitters.

The line representing the threshold of perception is the focus of this graph. The remaining graphs show sound pressure levels (dB) at each of the frequency ranges from the lowest inaudible sounds at the left, to sounds that "rumble" (20Hz to about 200 Hz) and then those in the range of communication (200Hz through about 4000Hz) through high pitched sounds (up to 10,000 Hz). At

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10 WHO European Centre for Environment and Health, Bonn Office, "Report on the third meeting on night noise guidelines," April 2005.

11 According to Online Etymology Dictionary, *psychosomatic* means "pertaining to the relation between mind and body, ... applied from 1938 to physical disorders with psychological causes."

12 *Emissions* refer to acoustic energy from the viewpoint of the sound emitter, while *immissions* refer to acoustic energy from the viewpoint of the receiver.

each frequency where the graphs of sound pressures are above (exceed) the graph showing perception the wind turbine sounds would be perceptible or audible. The more the wind turbine sound exceeds the perception curve the more pronounced it will be. When it exceeds the quiet rural background sound level (L_{A90}) it will not be masked or obscured by the rural soundscape.

The over-all sounds from each of the frequency bands are summed and presented on the right hand side of the graph. These are presented with corrections for A-weighting (dBA) and C-weighting (dBC). These show that if only dBA criteria are used to assess and limit wind turbine sound the low frequency content of the wind turbines emissions are not revealed. Note that in many cases the values for dBC are almost 20 dB higher than the dBA values. This is the basis for the WHO warning that when low frequency sound content is present outside a home dBA is not an appropriate method of describing predicted noise impacts, sound limits, or criteria.

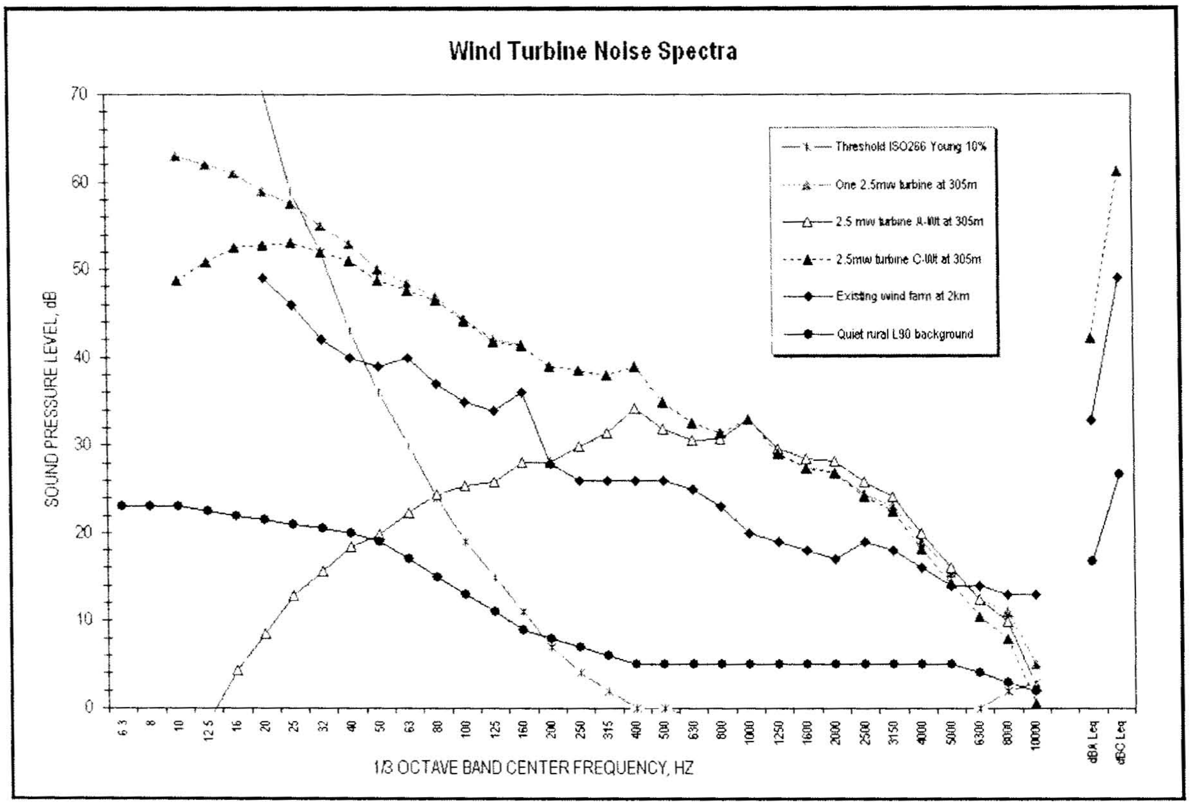

Figure 1-Graph Of Wind Turbine Sounds Vs. Rural Background And Threshold Of Perception

(Note: The lowest L_{Aeq} and L_{Ceq} shown at right are measured background L_{A90} and L_{C90}. The Leq values could be 0-5 dB higher)

Our review of the studies listed in Tables 1-4 in the Noise-Con paper at the end of this document, provided answers to a number of significant questions we had, as acoustical engineers, regarding the development of siting guidelines for industrial-scale wind turbines. They are provided below for easy of reading and continuity:

Do international, national, or local community noise standards for siting wind turbines near dwellings address the low frequency portion of the wind turbines' sound immissions? No. State and local governments are in the process of establishing wind farm noise limits and/or wind turbine setbacks from nearby residents, but the standards incorrectly assume that limits based on dBA levels are sufficient to protect the residents.

Do wind farm developers have noise limit criteria and/or wind turbine setback criteria that apply to nearby dwellings? Yes. But the industry-recommended wind turbine noise levels (typically 50-55 dBA) are too high for the quiet nature of the rural communities and may be unsafe for the nearest residents. An additional concern is that some of the methods for pre-construction computer modeling may predict sound levels that are too low. These two factors combined can lead to post-construction complaints and health risks.

An example of a condition that complies with

Are all residents living near wind farms equally likely to be affected by wind turbine noise? No. Children, people with certain pre-existing medical conditions, and the elderly are likely to be the most susceptible. Some people are unaffected while nearby neighbors develop serious health problems caused by exposure to the same wind turbine noise.

How does wind turbine noise impact nearby residents? Wind turbine-associated symptoms include sleep disturbance, headache, ringing in the ears, dizziness, nausea, irritability, and problems with memory, concentration, and problem solving, as described in the first paper in this volume.

What are the technical options for reducing wind turbine noise immission at residences? There are only two options: 1) increase the distance between the source and receiver, or 2) reduce the source sound power emission. Either solution is incompatible with the objective of the wind farm developer, which is to maximize the wind power electrical generation within the land available.

Is wind turbine noise at a residence much more annoying than traffic noise? Yes. Researchers have found that, "Wind turbine noise was ... found to cause annoyance at sound pressure levels lower than those known to be annoying for other community noise sources, such as road traffic. ...Living in a clearly rural area in comparison with a suburban area increases the risk of annoyance with wind turbine noise.[13]" In other papers by Pedersen wind turbine noise was perceived by about 85% of respondents to the study at sound levels as low as 35.0-37.5 dBA. [14] Currently, this increased sensitivity is believed to be due to the presence of amplitude modulation in the wind turbine's sound emissions which limits the masking effect of other ambient sounds and the low frequency content which is associated with the sounds inside homes and other buildings.

Amplitude modulation is a continuing change in the sound level in synchronization with the turning of the wind turbine's blades. An example of amplitude modulation is shown in the figure 2 below. This figure shows the constantly varying dBA sound level in the graph at the top. The sound level varies from a low of 40 dBA to a high of 45 dBA repeating every 1.3 seconds continuously when the turbine is operating. The turbine is located approximately 1200 feet from the farmhouse. The photo shows the turbine that was dominant during this test.

[13] Pedersen E, Bouma J, Bakker R and Van den Berg F, "Wind Farm perception- A study on acoustic and visual impact of wind turbines on residents in the Netherlands;" 2nd International Meeting on Wind Turbine Noise, Lyon France; Sept. 20-21, 2007 (Pages 2 and 3)

[14] Pedersen E and Persson Waye K. 2004. Perceptions and annoyance due to wind turbine noise -- a dose-response relationship. J Acoust Soc Am 116(6): 3460-3470

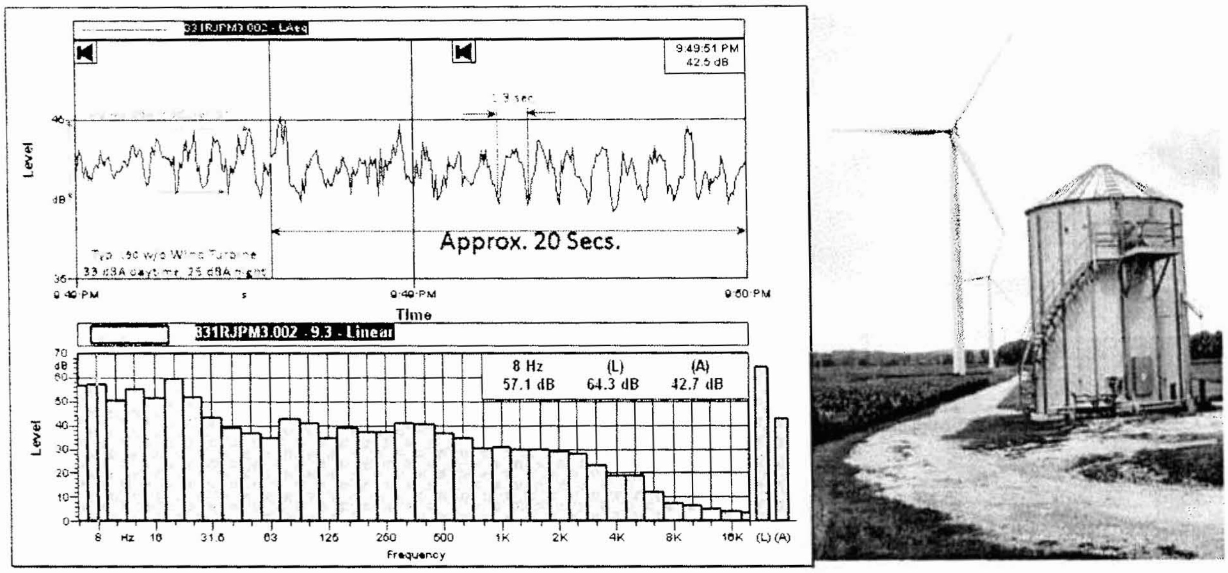

Figure 2 Amplitude Modulation at a farmhouse (Study sponsored by CCCRE, Calumet, Wisconsin)

It is worth noting that this measurement averages about 43 dBA (L_{eq}) which is very close to the sound level predicted for a single turbine at 1000 feet in Figure 1 (solid red line with solid triangle markers). The lower graph shows the frequency spectrum at approximately 9:49 PM at a low point in the amplitude modulation. (The frequency chart's cursor is the vertical line at the upper graph's midpoint.) Note the dominance of sound energy in the lower frequency range. This was also present in the model's predictions in Figure 1.

It is not hard to understand why many people in this community feel that they have been forced to accept noise pollution as a side effect of the wind project. Even though the 40 to 45 dBA sound levels in this example may comply with the 50 dBA limits adopted by the host county from the Wisconsin Model Ordinance the impact on the people near the wind project are subjected to noise pollution. This example demonstrates why criteria set at 50 dBA or higher do not protect the health and economic welfare of people living in the host communities. Adopting criteria such as those recommended later in this essay can prevent these situations from occurring.

Low frequency noise is a problem inside buildings

When low frequency sound is present outside homes and other occupied structures, it is often more an indoor problem than an outdoor one. This is very true for wind turbine sounds.

Why do wind turbine noise immissions of only 35 dBA disturb sleep at night? Affected residents complain of the middle- to high-frequency, repetitive swooshing sounds of the rotating turbine blades at a constant rate of about 1 Hz, plus low frequency noise. The amplitude modulation of the "swooshing" sound changes continuously. Residents also describe a thump or low frequency banging sound that varies in amplitude up to 10 dBA in the short interval between the swooshing sounds. This may be a result of sounds from multiple wind turbines with similar spectral content combining to increase and decrease the sound over and above the effects of modulation. [Note: These effects (e.g. phasing and coherence effects) are not normally considered in predictive models.] It may also be a result of turbulence of the air and wind on wind turbine operations when the blades are not at an optimum angle for noise emissions and/or power generation. It is also a result of sounds penetrating homes and other buildings at night and at other times where quiet is needed. When low frequency sound is present outside homes and other occupied structures, it is often more likely to be an indoor problem than an outdoor one. This is very true for wind turbine sounds.

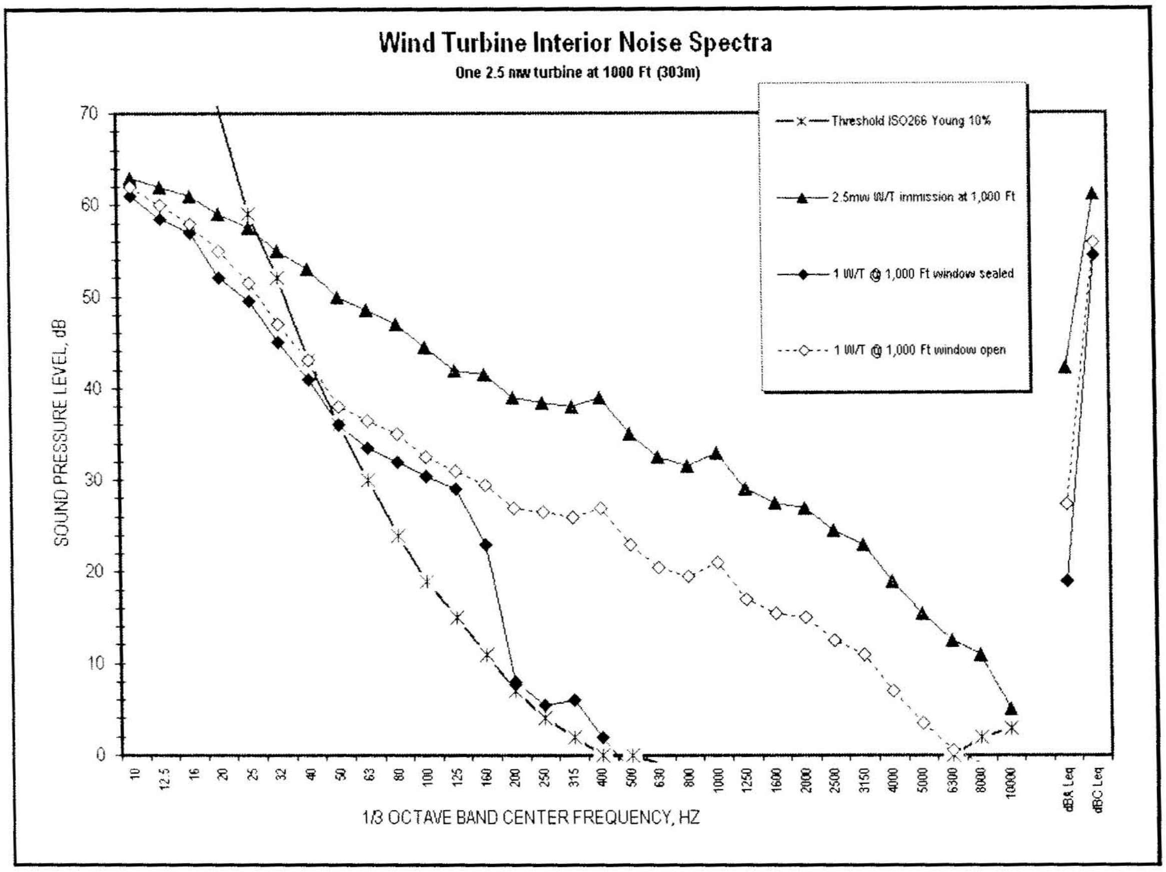

Figure 3-A Single Wind Turbine Sound Inside Home @ 1000 Feet

The usual assumption about wall and window attenuation being 15 dBA or more, which is valid for most sources of community noise, may not be sufficiently protective given the relatively high amplitude of the wind turbines' low frequency immission spectra. Figures 2 and 3 demonstrate the basis for this concern.

To demonstrate the effects of outdoor low frequency content from wind turbines we prepared Figure 1 showing the effect of a single turbine (propagation model based on sound power level test data) at 1000 feet and then in Figure 4 projected the impact of ten (10) similar turbines at one (1) mile. We applied the façade sound isolation data from the Canada Research Council to the wind turbine example used in our Noise-Con 2008 paper and shown in Figure 1 above. The graphs each show the outdoor sound pressure levels predicted for the distance of 1000 feet and one mile as the upper graph line respectively. The curve showing the threshold of human perception for sounds at each 1/3 octave band center is also plotted. When the graphs representing wind turbine sound have data points above this threshold curve the sounds will be perceptible to at least 10% of the population (which includes most children).

In addition to the top graph line representing the sounds outside the home there are two other graph lines for the sounds inside the home[15]. One curve represents the condition of no open windows and the other represents one open window.

With just one turbine at 1,000 feet there is a significant amount of low frequency noise above hearing threshold within rooms having exterior walls without windows or very well sealed windows. Even with the windows closed the sound pressure levels in the 63 Hz to 200 Hz one-octave bands still exceed the perception curve, in many cases by more than 10 dB. Note the perceptible sound between 50 and 200 Hz with a wall resonance frequency at 125 Hz (2 X 4 studs on 16 inch centers) for the "windows closed" condition. This would be perceived as a constant low rumble, which would be present inside homes whenever the turbines are operating.

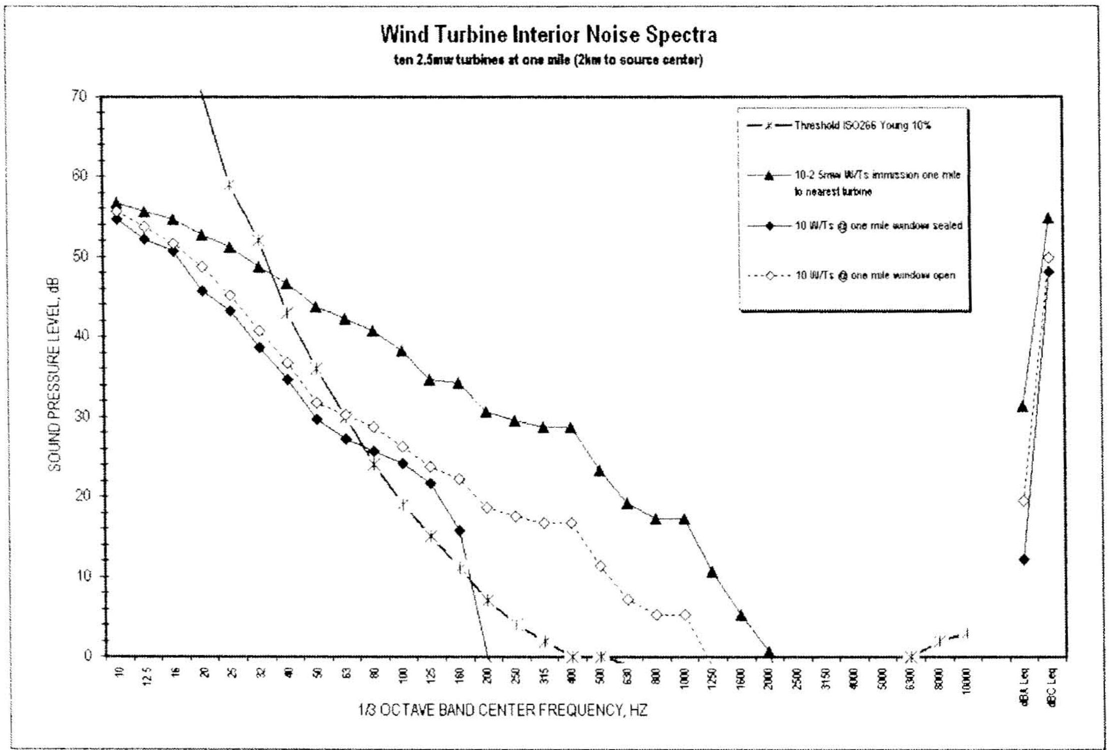

Figure 4-Sound from Ten (10) Wind Turbines inside home at One Mile

When comparing the dBC values the difference between inside sounds and outside is much less. The maximum difference in this example is only 7 dBC and that is for the situation with windows closed. With windows open the sound inside the home would be 56 dBC while it is 61 dBC outside; a difference of only 5 dBC[16,17,18]. If we looked only at dBA it would appear that the home's

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[15] The typical wood stud exterior used in modern home construction is vinyl siding over 1/2 inch OSB or rigid fiberglass board applied to 2 X 4 studs with the stud space filled with thermal and 1/2 inch gypsum board applied on the exposed interior side. This has a mass of about 3-4 lbs/sq ft and low 26 STC.

[16] The basis for these predictions includes reports on aircraft sound insulation for dwellings and façade sound isolation data from the Canada Research Council.

[17] "On the sound insulation of wood stud exterior walls" by J. S. Bradley and J. S. Birta, institute for Research in Construction, National Research Council, Montreal Road, Ottawa K1A 0R6, Canada, published: J.Acoust. Soc. Am. 110 (6), December 2001

walls and roof provide a reduction of 15 dBA or more. But, that that would be misleading because it ignores the effects of low frequency sound.

We next increased the number of 2.5 Mw turbines from one to ten and moved the receiver one mile from the closest turbine. We assumed the acoustic center for the ten turbines to be 2km (1-1/4 miles) from the receiver. These results are presented in Figure 4. We were surprised to find that the one mile low frequency results are only 6.3 dB below the 1,000 foot one turbine example.

There is one other characteristic of wind turbine sound that increases the sleep disturbance potential above that of other long-term noise sources. The amplitude modulation of the sound emissions from the wind turbines create a repetitive rise and fall in sound levels synchronized to the blade rotation speed. Many common weather conditions increase the magnitude of amplitude modulation. Most of these occur at night. The graph in Figure 5 shows this effect in the first floor bedroom of a farm home in the U.K. The home is located 930 meters (3,050 feet) from the nearest turbine. The conditions documented by an independent acoustical consultant show the sound level varying over 9 dBA range from 28 to 37 dBA. The pattern repeats approximately every second often for hours at a time. For many people, especially seniors, children and those with pre-existing medical conditions, this represents a major challenge to restful sleep.

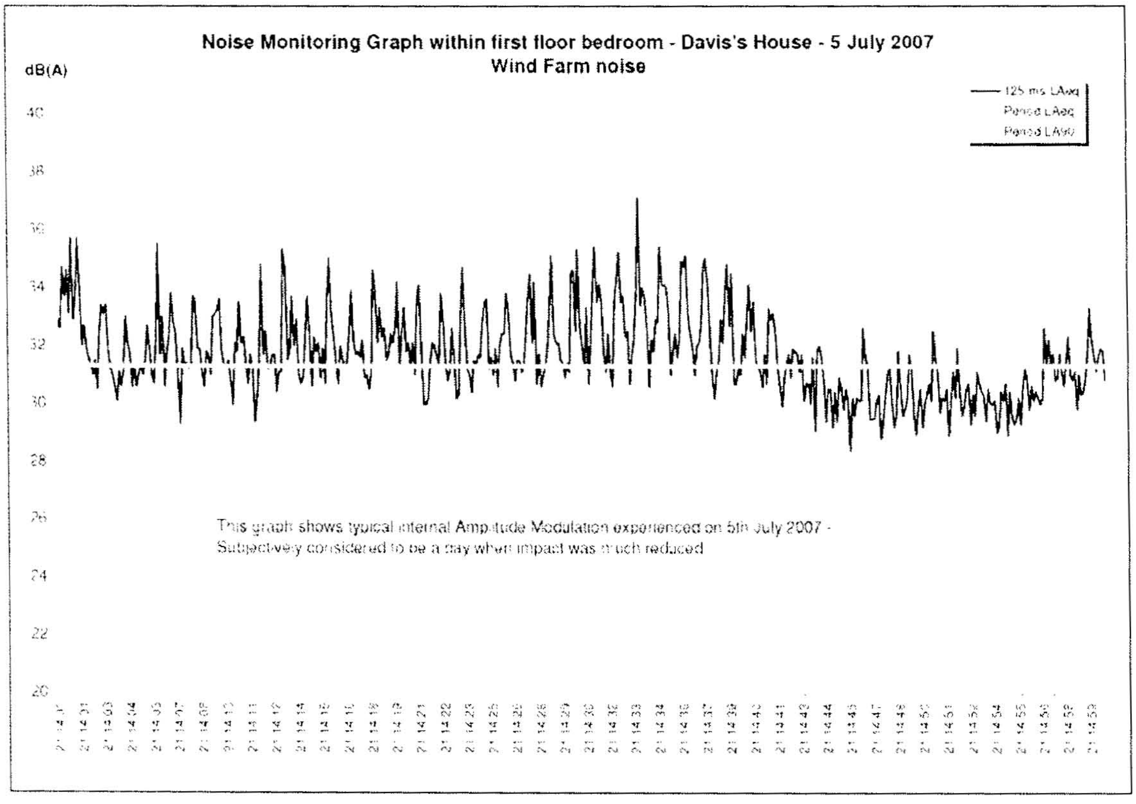

Figure 5- Amplitude modulation in a home 930 meters (3000 feet) from the nearest turbine.[19]

This may explain why some residents as far as two (2) miles from a wind farm find the wind turbines sounds highly annoying. It also demonstrates the primary reason why relying on dBA

[18] Dan Hoffmeyer, Birger Plovsing: "Low Frequency Noise from Large Wind Turbines, Measurements of Sound Insulation of Facades." Journal no. AV 1097/08, Client: Danish Energy Authority, Amaliegade 44, 1256 Copenhagen

[19] This chart used with permission of Mike Stigwood, MIOA, FRSH, MAS Environmental, U.K. and the Davis family.

alone will not work for community noise criteria. It is the low frequency phenomena associated with wind turbine emissions that makes the dBC test criteria an important part of the proposed criteria[20].

III. Development of Siting Criteria

Basis For Using L_{A90} To Determine Pre-Construction Long-Term Background Sound

We began our research into guidelines for proper siting by reviewing guidelines used in other countries to limit WT sound emissions. A recent compendium of these standards was presented in the report "Wind Turbine Facilities Noise Issues."[21] We found common ground in many of them. Some set explicit not-to-exceed sound level limits, for example, in Germany, 40 dBA nighttime in residential areas and 35 dBA nighttime in rural and other noise-sensitive areas. Other countries use the existing background sound levels for each community as the basis for establishing the sound level limits for the WES project. This second method has the advantage of adjusting the allowable limits for various background soundscapes. It makes use of a standard method for assessing background sound levels by measuring over a specified period of observation to determine the sound level exceeded 90% of the time (L_{90}) during the night. The night is important because it is the most likely time for sleep disturbance. Then, using the background sound level as the base, the WES project is allowed to increase it by 5 dBA. It is this second method (L_{90} + 5 dBA) that was adopted for the criteria in this document. It has the advantage of adjusting the criteria for each community without the need for tables of allowable limits for different community types. The focus is only on the nighttime criteria. This is because the WES will operate 24 hours a day and the nighttime limits will be the controlling limits whether or not there are other limits for daytime.

Wind turbine noise is more annoying than other noises and needs lower limits

Since many rural communities are very quiet, it is possible that some will have L_{90} values of 25 dBA or lower. This may seem extreme when compared to limits usually imposed on other sources of community noise. However, wind turbine sounds are not comparable to the more common noise sources of vehicles, aircraft, rail, and industry. Several studies have shown that annoyance to wind turbine sounds begins at levels as low as 30 dBA.[22] This is especially true in quiet rural communities that have not had previous experience with industrial noise sources. This increased sensitivity may be due to the periodic 'swoosh' from the blades in the quiet rural soundscape, or it may be more complex. In either case, it is a legitimate response to wind turbine sound documented in peer-reviewed research.

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[20] Hessler Jr., George F., "Proposed criteria in residential communities for low-frequency noise emissions from industrial sources," 52(4), 179-185, (July-Aug 2004)

[21] Ramani Ramakrishnan, Ph.D., P. Eng., "Wind Turbine Facilities Noise Issues," December 2007. Prepared for the Ontario Ministry of Environment.

[22] Eja Pedersen, "Human response to wind turbine noise: perception, annoyance and moderating factors." Dissertation, Occupational and Environmental Medicine, Department of Public Health and Community Medicine, Goteborg University, Goteborg, Sweden, 2007, and

Van den Berg F, Pedersen E, Bouma J, and Bakker R, Wind Farm Perception, Final Report Project no. 044628, University of Gothenburg and Medical Center Groningen, Netherlands June 3, 2008

Noise criteria need to take into account low frequency noise
In the table to the right are a series of observations and recommendations by the World Health Organization (WHO) supporting the need for stricter limits when there is substantial low frequency content in outdoor sound. Our review of other studies, and our own measurements, has demonstrated that wind turbine sound includes considerable low frequency content. We include a dBC limit in our guidelines to address the WHO recommendation that when low frequency sound may be present, criteria based on measurements using a C-weighting filter on the sound level meter (dBC) are needed in addition to dBA criteria.

> The World Health Organization recognizes the special place of low frequency noise as an environmental problem. Its publication "Community Noise" (Berglund et al., 2000) makes a number of references to low frequency noise, some of which are as follows:
>
> - "It should be noted that low frequency noise... can disturb rest and sleep even at low sound levels.
> - For noise with a large proportion of low frequency sounds a still lower guideline (than 30dBA) is recommended.
> - When prominent low frequency components are present, noise measures based on A-weighting are inappropriate.
> - Since A-weighting underestimates the sound pressure level of noise with low frequency components, a better assessment of health effects would be to use C-weighting.
> - It should be noted that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health."
>
> WHO also states: "The evidence on low frequency noise is sufficiently strong to warrant immediate concern."
>
> Available at http://www.who.int/docstore/peh/noise/guidelines2.html, References found at pages ix, xii through xv and others.

IV. Proposed Sound Limits

The simple fact that so many residents complain of low frequency noise from wind turbines is clear evidence that the single A-weighted (dBA) noise descriptor used in most jurisdictions for siting turbines is not adequate. The only other simple audio frequency weighting that is standardized and available on sound level meters is C-weighting or dBC. A standard sound level meter set to measure dBA is increasingly less sensitive to low frequency below 500 Hz (one octave above middle-C). The same sound level meter set to measure dBC is equally sensitive to all frequencies above 32 Hz (lowest note on grand piano). It is generally accepted that dBC readings are more predictive of perceptual loudness than dBA readings if low frequency sounds are significant.

We are proposing to use the commonly accepted dBA criteria that is based on the pre-existing background sound levels allowing the wind turbine development to increase this by 5 dB (e.g. L_{90A} +5) by the audible sounds from wind turbines. According to the New York State Energy Research & Development Authority:

- "... A change in sound level of 5 dB will typically result in a noticeable community response; and
- "... A 10 dB increase is subjectively heard as an approximate doubling in loudness, and almost always causes an adverse community response." [23]

To address the lower frequencies that are not considered in A-weighted measurements we are proposing to add limits based on dBC that follow the same scheme as used for dBA limits. The Proposed Sound Limits are presented in the text box at the end of this section.

For the current industrial grade wind turbines in the 1.5 to 3 MWatt (or over) range, the addition of the dBC requirement may result in an increased distance between wind turbines and the nearby

[23] (*Wind Energy Development: A Guide for Local Authorities in New York*; page 30; New York State Energy Research & Development Authority, Albany, NY October 2002)

residents. For the conditions shown in Figure 1, the distances would need to be increased significantly. This would result in setbacks in the range of 1 km or greater for the current generation of wind turbines if they are to be located in rural areas with little or no low frequency sound from man-made noise sources and where the L_{A90} background sound levels are 30 dBA or lower. In areas with higher background sound levels, turbines could be located somewhat closer, but still at a distance greater than the 305 m (1000 ft.) or smaller setbacks commonly seen in U.S. based wind turbine standards set by many states and used for wind turbine developments.

Following are some additional Questions and Answers that summarize the major points of this discussion relevant to criteria.

What are the typical wind farm noise immission criteria or standards? Limits are not consistent and may vary even within a particular country. Examples are listed above in the section on Results of Literature and Sound Studies.

What is a reasonable wind farm sound immission limit to protect the health of residences? We are proposing a not-to-exceed immission limit of 35 L_{Aeq} and a site-specific limit of L_{A90} + 5 dBA at the closest property line, whichever is exceeded first. We also propose the use of C-weighted criteria to address complaints of wind turbine low frequency noise. For the C-weighted criteria, we propose a site-specific limit of L_{C90} + 5 dBC. We also require that the site-specific L_{Ceq} (dBC) sound level at a receiving property line not exceed the pre-existing L_{A90} dB background sound level + 5dB by more than 20 dB. In other words, the dBC operating immission limit (as L_{Ceq}) at the receiving property line should not be more than 20 dB above the measured dBA (as L_{A90}) pre-construction long-term background sound level + 5dB.[24] This criterion prevents an Immission Spectra Imbalance that often leads to complaints about rumble or other low frequency problems. We also include a not-to-exceed immission limit of 55 and 60 L_{Ceq} at the receiving property line.[25] Use of the multiple metrics and weightings will address the audible and inaudible low frequency portions of wind turbine sound emissions. Exceedances of any of the limits establish non-compliance.

Why should the dBC immission limit not be permitted to be more than 20 dB above the background measured L_{A90}+5 dB? The World Health Organization and others[26] have determined that if a noise has a measured difference between dBC and dBA more than 20 dB, the noise is highly likely to create an annoyance because of the low frequency component.

Isn't L_{A90} the <u>minimum</u> background noise level? Not exactly. This is the sound level that represents the quietest 10% of the time. It is often considered to be the sound level that represents the sounds one hears late in the evening or at night when there are no near-by or short term sounds present. It is very important to establish this "long term background" noise environment at the property line for a potentially impacted residence (L_{A90}) during the **quietest** sleeping hours of the night, between 10 p.m. and 4 a.m.. Why? Because nighttime sleep disturbance has generated the majority of wind farm noise complaints throughout the world those conditions should guide the design of wind projects. ANSI standards define the "long term background sound" as excluding all short term sounds from the test sample using carefully selected sampling times and conditions using ten (10) minute long samples. This means that nature sounds not present during all seasons and wind noise are not to be included in the measurement. Following the procedures in ANSI S12.9, Part 3 for long term background sound the L_{A90} and L_{C90} can be measured with one or more 10-minute

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[24] Hessler Jr., George F., Proposed criteria in residential communities for low-frequency noise emissions from industrial sources, Noise Control Engineering Journal; 52(4), pg. 180 in "2. Purpose of Proposed Criteria," (July-Aug 2004)

[25] Ibid, pg. 180 in "3. Proposed Criteria."

[26] Ibid

measurements during any night when the atmosphere is classified as stable with a light wind from the area of the proposed wind farm. The basis for the immission limits for the proposed wind farm would then be the Nighttime Immission Limits, which we propose to be the minimum ten (10) minute nighttime L_{A90} and L_{C90} plus 5 dB, a test for Spectra Imbalance, and not-to-exceed limits for the period of 10 p.m. to 7 a.m. Daytime Limits (7 a.m. to 10 p.m.) could be set using daytime measurements, but unless the wind utility only operates during the day, the nighttime limit will always be the limiting sound level. Thus, daytime limits are not normally needed.

A nearby industrial scale wind utility meeting these noise immission criteria would occasionally be audible to the residents during nighttime and daytime. However, it would be unlikely for it to be an indoor problem.

The method used for establishing the background sound level at a proposed wind farm in many of the studies in Table 1, does not meet the requirements set by ANSI S12.9 Part 3 for outdoor measurements and determination of long-term background sound levels. Instead, they use unattended noise monitors to record hundreds of 10-minute or one-hour un-observed measurements that include the short term sounds from varying community and wind conditions over a period of days or weeks. The results for daytime and nighttime are usually combined to determine the average wind noise at the microphone as a function of wind velocity measured at a height of ten (10) meters. This provides an enormous amount of data, but the results have little relationship to wind turbine sound immissions or to potential for turbine noise impacts on nearby residents. They also do not comply with ANSI standards for methodology or quality and as such are not suitable for use in measurements that will be used to assess compliance with other standards and guidelines. This exhaustive exercise often only demonstrates how much 'pseudo-noise' is generated by instruments located in a windy environment that exceeds the capability of the instrument's wind screen to protect the microphone. In many cases, this unqualified data is used to support a claim that the wind noise masks the turbines' sound immissions.

The major complaints of residents living near wind farms is sleep disruption at night when there is little or no wind near ground level and the wind turbines located at a much higher elevation are turning and generating near or at maximum power and maximum noise emission. There is usually more surface wind and turbulence during daytime caused by solar radiation. Thus, the use of averaged data involving one or more 24-hour periods is of little value in predicting conditions that will result in people who cannot sleep in their homes during the night because of loud intrusive wind turbine noise.

The methodology used to predict the sound propagation from the turbines into the community also fails to represent the conditions of maximum turbine noise impact on nearby residents. This should be expected given the limitations of models based on ISO 9613-2[27]. They also do not consider the effects of a frequent nighttime condition when winds at the ground are calm and the winds at the hub are at or above nominal operating speed. This condition is often referred to as a "stable" atmosphere. During this condition, the wind turbines can be producing the maximum or near maximum power while the wind at ground level is calm and the background noise level is low. The Michigan rural night test data in the earlier figure shows how quiet a night can be in the absence of wind at the ground. This common condition is known to directly cause chronic sleep

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[27] The ISO 9613-2 sound propagation model formulas have known errors of 3 dB even when the conditions being modeled are a perfect match to the limiting conditions specified in the standard. Wind turbines operate far outside the limits for wind speed, height of the noise source above the ground, and other factors identified in the standard thus increasing the likelihood for error above the specified 3 dB. In addition, there are known measurement errors in the IEC61400-11 test that add another 2 dB of uncertainty to the model's predictions.

disruption. Further, the studies report average sound levels and do not disclose the effects of amplitude modulation or low frequency sound which makes the turbine's sound more objectionable and likely to cause sleep problems.

Are there additional noise data to be recorded for a pre-wind turbine noise survey near selected dwellings? Yes. The precision measuring sound level meter(s) need to be programmed to include measurement of L_{Aeq}, L_{A10}, L_{A90}, L_{Ceq}, L_{C10}, and L_{C90}, with starting time and date for each 10-minute sample. The L_{10} results will be used to validate the L_{90} data. For example, on a quiet night one might expect L_{10} and L_{90} to show similar results within 5 to 10 dB between L_{10} and L_{90} for each weighting scale. On a windy night or one with nearby short term noise sources the difference between L_{10} and L_{90} may be more than 20 dB. There is also often a need to obtain a time-averaged, one-third octave band analysis over the frequency range from 6.3 Hz to 10 kHz during the same ten minute sample. The frequency analysis is very helpful for identifying and correcting for extraneous sounds such as interfering insect noise. An integrating averaging sound level meter meeting ANSI or IEC Type 1 standards has the capability to perform all of the above acoustic measurements simultaneously and store the results internally. There is also a requirement for measurement of the wind velocity near the sound measurement microphone continuously throughout each 10-minute recorded noise sample. The 10-minute maximum wind speed near the microphone must be less than 2 m/s (4.5 mph) during measurements of background noise (L_{90}), and the maximum wind speed for noise measurements during turbine operation must be less than 4 m/s (9 mph). Measurements should be observed (without contaminating the data) and notes identifying short-term noises should be taken for these tests.

Is there a need to record weather data during the background noise recording survey? One weather monitor is required at the proposed wind farm on the side nearest the residents. The weather station sensors are at the standard 10 meter height above ground. It is critical that the weather be recorded every 10 minutes, synchronized with the clocks in the sound level recorders without ambiguity, at the start and end time of each 10 minute period. The weather station should record wind speed and direction, temperature, humidity and rain.

Why do Canada and some other countries base the permitted wind turbine noise immission limits on the operational wind velocity at the 10m height wind speed instead of a maximum dBA or L_{90} + 5 dBA immission level? First, it appears that the wind turbine industry will take advantage of every opportunity to elevate the maximum permitted noise immission level to reduce the setback distance from the nearby dwellings. Including wind as a masking source in the criteria is one method for elevating the permissible limits. The background noise level does indeed increase with surface wind speed. When this happens, it can be argued that the increased wind noise provides some masking of wind turbine noise. However, this is not true if the surface winds are calm. After sunset, when the ground cools (e.g. in the middle of the night), the lower level atmosphere can separate from the higher-level atmosphere. Then, the winds at the ground will be calm while wind at the turbine hub is very strong. Under this condition, the wind velocity at a 10-meter high wind monitoring station (such as those often used for weather reporting) may be ¼ to ½ the speed of the wind at the hub, yet drop to calm at ground level. The result is that no ground level wind noise is present to mask the sound of the wind turbines, which can be operating at or close to full capacity.

This condition is one of the major causes of wind turbine related noise complaints for residents within 3 km (1.86 miles) of a wind farm. When the turbines are producing high sound levels, it is quiet outside the surrounding homes. The PhD thesis of G.P. van den Berg, *The Sounds of High*

Winds, is very enlightening on this issue (Table 3). See also the letter by John Harrison in Ontario "On Wind Turbine Guidelines.[28]"

What sound monitor measurements would be needed for enforcement of the wind turbine sound ordinance? A similar set of sound tests using the ten (10) minute series of measurements would be repeated, with and without the operation of the wind turbines, at the location where noise was measured before construction, which is closest to the resident registering the wind turbine noise complaint. If the nighttime background (L_{90}) noise level (turbines off) was found to be slightly higher than the measured background prior to the wind farm installation, then the results with the turbines operating must be corrected using standard acoustical engineering methods to determine compliance with the pre-turbine established sound limits.

Who should conduct the sound measurements? An independent acoustics expert should be retained who reports to the County Board or other responsible governing body. This independent acoustics expert should be responsible for all the acoustic measurements including setup and calibration of instruments and interpretation of recorded results. He or she should perform all pre-turbine background noise measurements and interpretation of results to establish the nighttime (and daytime, if applicable) industrial wind turbine sound immission limits, and to monitor compliance.

At present, the acoustical consultants are retained by, and work directly for, the wind farm developers. This presents a serious problem with conflict of interest on the part of the consultants. The wind farm developer would like to show that a significant amount of wind noise is present to mask the sounds of the wind turbine immissions. The community is looking for authentic results showing that the wind turbine noise will be only barely perceptible, and then only occasionally, during the night or daytime.

Is frequency analysis required either during the pre-construction background noise survey or for compliance measurements? Normally one-third octave or narrower band analysis would only be required if there is a complaint of tones immission from the wind farm. Although only standardized dBA and dBC measurements are required to meet the proposed criteria, the addition of one-third octave band analysis is often useful to validate the dBA and dBC results.

The following summarizes the criteria necessary when siting wind turbines to minimize the risk of adverse impacts from noise on the adjacent community[29]. For those not familiar with acoustical annotation the table and its formulas may seem overly complex, but the criteria are defined in this manner to be as unambiguous as possible. They will be clear for those who are familiar with acoustical terminology. Definitions are provided in a later section of this essay.

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[28] Harrison, J., *Wind Turbine Guidelines,* available at http://amherstislandwindinfo.com/

[29] The authors have based these criteria, procedures, and language on their current understanding of wind turbine sound emissions, land-use compatibility, and the effects of sound on health. However, use of the following, in part or total, by any party is strictly voluntary and the user assumes all risks. Please seek professional assistance in applying the recommendations of this document to any specific community or WES development.

NOISE CRITERIA FOR SITING WIND TURBINES TO PREVENT HEALTH RISKS[29]

1. Establishing Long-Term Background Noise Level

a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedures must meet ANSI S12.9, Part 3 except as noted in Section 4. below.

b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles.

c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very little wind near the surface. Sound measurements are only valid when the measured wind speed at the microphone is less than 2 m/s (4.5 mph).

d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes L_{A90}, L_{A10}, L_{Aeq} and dBC data includes L_{C90}, L_{C10}, and L_{Ceq}. Record the maximum wind speed at the microphone during the ten minutes, a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener shall also be recorded. A ten (10) minute measurement contains valid data provided: Both L_{A10} minus L_{A90} and L_{C10} minus L_{C90} are not greater than 10 dB and the maximum wind speed at the microphone is less than 2 m/s during the same ten (10) minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on non-participating property containing a residence in excess of the limits in the following table:

Table of Not-To-Exceed Property Line Sound Immission Limits [1]

Criteria	Condition	dBA	dBC
A	Immission above pre-construction background:	$L_{Aeq} = L_{A90} + 5$	$L_{Ceq} = L_{C90} + 5$
B	Maximum immission:	35 L_{Aeq}	55 L_{Ceq} for quiet[2] rural environment 60 L_{Ceq} for rural-suburban environment
C	Immission spectra imbalance	L_{Ceq} (immission) minus (L_{A90} (background) +5) $\leq$ 20 dB	
D	Prominent tone penalty:	5 dB	5 dB
Notes			
1	Each Test is independent and exceedances of any test establishes non-compliance. Sound "immission" is the wind turbine noise emission as received at a property.		
2	A "Quiet rural environment" is a location >2 miles from a major transportation artery without high traffic volume during otherwise quiet periods of the day or night.		
3	Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose.		

[1] Procedures provided in Section 7. Measurement Procedures (ANSI 12.9 Part 3 with Amendments) of the most recent version of "**The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound**" by Kamperman and James and the apply to this table.

3. Wind Farm Noise Compliance Testing

All of the measurements outlined above in 1. Establishing Nighttime Background Noise Level must be repeated to determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbine background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer to the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction must replicate the conditions that generated the complaint. Procedures of ANSI S12.9- Part 3 apply except as noted in Section 4. The effect of instrumentation limits for wind and other factors must be recognized and followed.

4. ANSI S12.9 Part 3 Selected Options and Requirement Amendments

For measurements taken to assess the preceding criteria specific options provided for in ANSI S12.9-Part 3 (2008) shall be followed along with any additional requirements included below:

5.2 Background Sound: Use definition (1): 'long-term'

5.2 long-term background sound: The L_{90} excludes short term background sounds

5.3 basic measurement period: Ten (10) minutes $L_{90(10\ min)}$

5.6 Sound Measuring Instrument: Type 1 Precision meeting ANSI S1.43 or IEC 61672-1. The sound level meter shall cover the frequency range from 6.3 Hz to 20k Hz and simultaneously measure dBA L_N and dBC L_N. The instrument must also be capable of accurately measuring low-level background sounds down to 20 dBA.

6.5 Windscreen: Required

6.6(a) An anemometer accurate to ± 10% at 2m/s to full-scale accuracy. The anemometer shall be located 1.5 to 2 meters above the ground and orientated to record maximum wind velocity. The maximum wind velocity, wind direction, temperature and humidity shall be recorded for each ten (10) minute sound measurement period observed within 5 m. of the measuring microphone.

7.1 Long-term background sound

7.2 Data collection Methods: Second method with observed samples to avoid contamination by short term sounds (purpose: to avoid loss of statistical data)

8. Source(s) Data Collection: All requirements in ANSI S12.18 Method #2, Precision to the extent possible while still permitting testing of the conditions that lead to complaints. The meteorological requirements in ANSI S12.18 may not be applicable for some complaint tests. For sound measurements in response to a complaint, the compliance sound measurements should be made under conditions that replicate the conditions that caused the complaint without exceeding instrument and windscreen limits and tolerances.

8.1(b) Measuring microphone with windscreen shall be located 1.2m to 1.8m (1.5 preferred) above the ground and greater than 8 m. from large sound reflecting surface.

8.3(a) All meteorological observations required at both (not either) microphone and nearest 10 m. weather reporting station.

8.3(b) For a ten (10) minute background sound measurement to be valid the wind velocity shall be less then 2m/s (4.5 mph) measured less than 5 m. from the microphone. Compliance sound measurements shall be taken when winds are less than 4m/s at the microphone.

8.3(c) In addition to the required acoustic calibration checks, the sound measuring instrument internal noise floor, including microphone, must also be checked at the end of each series of ten minute measurements and no less frequently than once per day. Insert the microphone into the acoustic calibrator with the calibrator signal off. Record the observed dBA and dBC reading on the sound level meter to determine an approximation of the instrument self noise. Perform this test before leaving the background measurement location. The calibrator-covered microphone must demonstrate the results of this test are at least 5 dB below the immediately previous ten (10) minute acoustic test results, for the acoustic background data to be valid. This test is necessary to detect undesired increase in the microphone and sound level meter internal self-noise. As a precaution sound measuring instrumentation should be removed from any air conditioned space at least an hour before use. Nighttime measurements are often performed very near the meteorological dew point. Minor moisture condensation inside a microphone or sound level meter can increase the instrument self noise and void the measured background data.

8.4 The remaining sections, starting at 8.4 in ANSI S12.9 Part 3 Standard do not apply.

V. How to Include the Recommended Criteria in Ordinances and/or Community Noise Limits

The following two sections present the definitions, technical requirements, and complaint resolution processes that support the recommended criteria. Following the formal elements is a section discussing the measurement procedures and requirements for enforcement of these criteria. For the purpose of the following sections the government authority will be referred to as the Local Government Authority (LGA) as a place marker for State, County, Township or other authorized authority. The abbreviation 'WES' is used for industrial scale wind energy system.

The authors have based these criteria, procedures, and language on their current understanding of wind turbine sound emissions, land-use compatibility, and the effects of sound on health. However, use of the following, in part or total, by any party is strictly voluntary and the user assumes all risks. Please seek professional assistance in applying the recommendations of this document to any specific community or WES development.

VI. ELEMENTS OF A WIND ENERGY SYSTEMS LICENSING ORDINANCE FOR SOUND

I. Purpose and Intent.

Based upon the findings stated above, it is the intended purpose of the LGA to regulate Wind Energy Systems to promote the health, safety, and general welfare of the citizens of the Town and to establish reasonable and uniform regulations for the operation thereof so as to control potentially dangerous effects of these Systems on the community.

II. Definitions.

The following terms have the meanings indicated:

"**Aerodynamic Sound**" means a noise that is caused by the flow of air over and past the blades of a WES.

"**Ambient Sound**" Ambient sound encompasses all sound present in a given environment, being usually a composite of sounds from many sources near and far. It includes intermittent noise events, such as, from aircraft flying over, dogs barking, wind gusts, mobile farm or construction machinery, and the occasional vehicle traveling along a nearby road. The ambient also includes insect and other nearby sounds from birds and animals or people. The near-by and transient events are part of the ambient sound environment but are not to be considered part of the long-term background sound.

"American National Standards Institute (ANSI)" Standardized acoustical instrumentation and sound measurement protocol shall meet all the requirements of the following ANSI Standards:

ANSI S1.43 Integrating Averaging Sound Level Meters: Type-1 (or IEC 61672-1)

ANSI S1.11 Specification for Octave and One-third Octave-Band Filters (or IEC 61260)

ANSI S1.40 Verification Procedures for Sound Calibrators

ANSI S12.9 Part 3 Procedures for Measurement of Environmental Sound

ANSI S12.18 Measurement of Outdoor Sound Pressure Level

IEC 61400-11 Wind turbine generator systems -Part 11: Acoustic noise measurements

"**Anemometer**" means a device for measuring the speed and direction of the wind.

"**Applicant**" means the individual or business entity that seeks to secure a license under this section of the Town municipal code.

"**A-Weighted Sound Level (dBA)**" A measure of over-all sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. It is used to describe sound in a manner representative of the human ear's response. It reduces the effects of the low with respect to the frequencies centered around 1000 Hz. The resultant sound level is said to be "A-weighted" and the units are "dBA." Sound level meters have an A-weighting network for measuring A-weighted sound levels (dBA) meeting the characteristics and weighting specified in ANSI Specifications for Integrating Averaging Sound Level Meters, S1.43-1997 for Type 1 instruments and be capable of accurate readings (corrections for internal noise and microphone response permitted) at 20 dBA or lower. In this document dBA means L_{Aeq} unless specified otherwise.

"**Background Sound (L_{90})**" refers to the sound level present at least 90% of the time. Background sounds are those heard during lulls in the ambient sound environment. That is, when transient sounds from flora, fauna, and wind are <u>not</u> present. Background sound levels vary during different times of the day and night. Because WES operates 24/7 the background sound levels of interest are those during the quieter periods which are often the evening and night. Sounds from the WES of interest, near-by birds and animals or people must be excluded from the background sound test data. Nearby electrical noise from streetlights, transformers and cycling AC units and pumps etc must also be excluded from the background sound test data.

Background sound level (dBA and dBC (as L_{90})) is the sound level present 90% of the time during a period of observation that is representative of the quiet time for the soundscape under evaluation and with duration of ten (10) continuous minutes. Several contiguous ten (10) minute tests may be performed in one hour to determine the statistical stability of the sound environment. Measurement periods such as at dusk when bird and insect activity is high or the early morning hours when the 'dawn chorus' is present are not acceptable measurement times. Longer term sound level averaging tests, such as 24 hours or multiple days are not at all appropriate since the purpose is to define the quiet time background sound level. It is defined by the $L_{A\,90}$ and $L_{C\,90}$ descriptors. It may be considered as the quietest one (1) minute during a ten (10) minute test. $L_{A\,90}$ results are valid only when $L_{A\,10}$ results are no more than 10 dB above $L_{A\,90}$ for the same period. $L_{C\,10}$ less $L_{C\,90}$ are not to exceed 10 dB to be valid.

The background noise environment consists of a multitude of distant sources of sound. When a new nearby source is introduced the new background noise level would be increased. The addition of a new source with a noise level 10 below the existing background would increase the new background 0.4 dB. If the new source has the same noise level as the existing background then the new background is increased 3.0 dB. Lastly, if the new source is 3.3 dB above the existing background then the new background would have increased 5 dB. For example, to meet the requirement of L_{90A} + 5 dB = 31 dBA if the existing quiet nighttime background sound level is 26 dBA, the maximum wind turbine noise immission contribution independent of the background cannot exceed 29.3 dBA L_{eq} at a dwelling. When adding decibels, a 26 dBA background combined with 29.3 dBA from the turbines (without background) results in 31 dBA.

Further, background L_{90} sound levels documenting the pre-construction baseline conditions should be determined when the ten (10) minute maximum wind speed is less than 2 m/s (4.5 mph) near ground level/microphone location 1.5 m height.

"**Blade Passage Frequency**" (BPF) means the frequency at which the blades of a turbine pass a particular point during each revolution (e.g. lowest point or highest point in rotation) in terms of events per second. A three bladed turbine rotating at 28 rpm would have a BPF of 1.4 Hz. [E.g. ((3 blades times 28rpm)/60 seconds per minute = 1.4 Hz BPF)]

"**C-Weighted Sound Level (dBC)**" Similar in concept to the A-Weighted sound Level (dBA) but C-weighting does not de-emphasize the frequencies below 1k Hz as A-weighting does. It is used for measurements that must include the contribution of low frequencies in a single number representing the entire frequency spectrum. Sound level meters have a C-weighting network for measuring C-weighted sound levels (dBC)meeting the characteristics and weighting specified in ANSI S1.43-1997 Specifications for Integrating Averaging Sound Level Meters for Type 1 instruments. In this document dBC means L_{Ceq} unless specified otherwise.

"**Decibel (dB)**" A dimensionless unit which denotes the ratio between two quantities that are proportional to power, energy or intensity. One of these quantities is a designated reference by which all other quantities of identical units are divided. The sound pressure level (Lp) in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 MicroPascals.

"**Emission**" Sound energy that is emitted by a noise source (wind farm) is transmitted to a receiver (dwelling) where it is immitted (see "immission).

"**Frequency**" The number of oscillations or cycles per unit of time. Acoustical frequency is usually expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

"**Height**" means the total distance measured from the grade of the property as existed prior to the construction of the wind energy system, facility, tower, turbine, or related facility at the base to its highest point.

"**Hertz (Hz)**" Frequency of sound expressed by cycles per second.

"**Immission**" Noise immitted at a receiver (dwelling) is transmitted from noise source (wind turbine) that emitted sound energy (see "emission").

"**Immission spectra imbalance**" The spectra are not in balance when the C-weighted sound level is more than 20 dB greater than the A-weighted sound level. For the purposes of this requirement, the A-weighted sound level is defined as the long-term background sound level (L_{A90}) +5 dBA. The C-weighted sound level is defined as the L_{Ceq} measured during the operation of the wind turbine operated so as to result in its highest sound output. A Complaint test provided later in this document is based on the immission spectra imbalance criteria.

"**Infra-Sound**" sound with energy in the frequency range of 0-20 Hz is considered to be infra-sound. It is normally considered to not be audible for most people unless in relatively high amplitude. However, there is a wide range between the most sensitive and least sensitive people to perception of sound and perception is not limited to stimulus of the auditory senses. The most significant exterior noise induced dwelling vibration occurs in the frequency range between 5 Hz and 50 Hz. Moreover, levels below the threshold of audibility can still cause measurable resonances inside dwelling interiors. Conditions that support or magnify resonance may also exist in human body cavities and organs under certain conditions. Although no specific test for infrasound is provided in this document, the test for immission spectra imbalance will limit low frequency sound and thus, indirectly limit infrasound. See low-frequency noise (LFN) for more information.

"**Low Frequency Noise (LFN)**" refers to sounds with energy in the lower frequency range of 20 to 200 Hz. LFN is deemed to be excessive when the difference between a C-weighted sound level and an A-weighted sound level is greater than 20 decibels at any measurement point outside a residence or other occupied structure. The criteria for this condition is the "Immission Spectra Imbalance" entry in the **Table of Not-To-Exceed Property Line Sound Immission Limits.**"

"**Measurement Point (MP)**" means location where sound measurements are taken such that no significant obstruction blocks sound from the site. The Measurement Point should be located so as to not be near large objects such as buildings and in the line-of-sight to the nearest turbines. Proximity to large buildings or other structures should be twice the largest dimension of the structure, if possible. Measurement Points should be at quiet locations remote from street lights, transformers, street traffic, flowing water and other local noise sources.

"**Measurement Wind Speed**" For measurements conducted to establish the background noise levels ($L_{A90\ 10\ min}$, $L_{C90\ 10\ min}$, and etc.) the maximum wind speed, sampled within 5m of the microphone and at its height, shall be less than 2 m/s (4.5 mph) for valid background measurements. For valid wind farm noises measurements conducted to establish the post-construction sound level the maximum wind speed, sampled within 5m of the microphone and at its height, shall be less than 4m/s (9 mph). The wind speed at the WES blade height shall be at or above the nominal rated wind speed and operating in its highest sound output mode. For purposes of enforcement, the wind speed and direction at the WES blade height shall be selected to reproduce the conditions leading to the enforcement action while also restricting maximum wind speeds at the microphone to less than 4 m/s (9 mph).

For purposes of models used to predict the sound levels and sound pressure levels of the WES to be submitted with the Application, the wind speed shall be the speed that will result in the worst-case L_{Aeq} and L_{Ceq} sound levels at the nearest non-participating properties to the WES. If there may be more than one set of nearby sensitive receptors, models for each such condition shall be evaluated and the results shall be included in the Application.

"**Mechanical Noise**" means sound produced as a byproduct of the operation of the mechanical components of a WES(s) such as the gearbox, generator and transformers.

"**Noise**" means any unwanted sound. Not all noise needs to be excessively loud to represent an annoyance or interference.

"**Project Boundary**" means the external property boundaries of parcels owned by or leased by the WES developers. It is represented on a plot plan view by a continuous line encompassing all WES(s) and related equipment associated with the WES project.

"**Property Line**" means the recognized and mapped property parcel boundary line.

"**Qualified Independent Acoustical Consultant**" Qualifications for persons conducting baseline and other measurements and reviews related to the application for a WES or for enforcement actions against an operating WES include, at a minimum, demonstration of competence in the specialty of community noise testing. An example is a person with Full Membership in the Institute of Noise Control Engineers (INCE). There are scientists and engineers in other professional fields that have been called upon by their local community for help in the development of a WES Noise Ordinance. Many of these scientists and engineers have recently spent hundreds of hours learning many important aspects of noise related to the introduction of WES into their communities. Then with field measurement experience with background data and wind turbine noise emission, they have become qualified independent acoustical consultants for WES siting. Certifications such as Professional Engineer (P.E.) do not test for competence in acoustical principles and measurement and are thus not, without further qualification, appropriate for work under this document. The Independent Qualified Acoustical Consultant can have no financial or other connection to a WES developer or related company.

"**Sensitive Receptor**" means places or structures intended for human habitation, whether inhabited or not, public parks, state and federal wildlife areas, the manicured areas of recreational establishments designed for public use, including but not limited to golf courses, camp grounds and other nonagricultural state or federal licensed businesses. These areas are more likely to be sensitive to the exposure of the noise, shadow or flicker, etc. generated by a WES or WESF. These areas include, but are not limited to: schools, daycare centers, elder care facilities, hospitals, places of seated assemblage, non-agricultural businesses and residences.

"**Sound**" A fluctuation of air pressure which is propagated as a wave through air

"**Sound Power**" The total sound energy radiated by a source per unit time. The unit of measurement is the watt. Abbreviated as L_W. This information is determined for the WES manufacturer under laboratory conditions specified by IEC 61400-11 and provided to the local developer for use in computer model construction. There is known measurement error in this test procedure that must be disclosed and accounted for in the computer models. Even with the measurement error correction it cannot be assumed that the reported L_w values represent the highest sound output for all operating conditions. They reflect the operating conditions required to meet the IEC 61400-11 requirements. The lowest frequency is 50 Hz for acoustic power (L_w) requirement (at present) in IEC 61400-11. This Ordinance requires wind turbine certified acoustic power (L_w) levels at rated load for the total frequency range from 6.3 Hz to 10k Hz in one-third octave frequency bands tabulated to the nearest 1 dB. The frequency range of 6.3 Hz to 10k Hz shall be used throughout this Ordinance for all sound level modeling, measuring and reporting.

"**Sound Pressure**" The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

"**Sound Pressure Level (SPL)**" 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound pressure level in units of decibels is expressed as SPL (dB) = 20 log p/pr.

"**Spectrum**" The description of a sound wave's resolution into its components of frequency and amplitude. The WES manufacturer is required to supply a one-third octave band frequency spectrum of the wind turbine sound emission at 90% of rated power. The published sound spectrum is often presented as A-weighted values but C-weighted values are preferred. This information is used to construct a model of the wind farm's sound immission levels at locations of interest in and around the WES. The frequency range of interest for wind turbine noise is approximately 6 Hz to 10k Hz.

"**Statistical Noise Levels**" Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{NA}, where L_{NA} is the A-weighted sound level exceeded for N% of a given measurement period. For example, L_{10} is the noise level exceeded for 10% of the time. Of particular relevance, are: L_{A10} and L_{C10} the noise level exceed for 10% of the ten (10) minute interval. This is commonly referred to as the average maximum noise level. L_{A90} and L_{C90} are the A-weighted and C-weighted sound levels exceeded for 90% of the ten (10) minute sample period. The L_{90} noise level is defined by ANSI as the long-term background sound level (i.e. the sounds one hears in the absence of the noise source under consideration and without short term or near-by sounds from other sources), or simply the "background level." L_{eq} is the A or C-weighted equivalent noise level (the "average" noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

"**Tonal sound or tonality**" Tonal audibility. A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch. Tonal sound can be simple or complex.

"**Wind Energy Systems (WES)**" means equipment that converts and then transfers energy from the wind into usable forms of electrical energy.

"**Wind Turbine" or "Turbine" (WT)** means an industrial scale mechanical device which captures the kinetic energy of the wind and converts it into electricity. The primary components of a wind turbine are the blade assembly, electrical generator and tower.

III. APPLICATION PROCEDURE FOR WIND ENERGY SYSTEMS AND TECHNICAL REQUIREMENTS FOR LICENSING

This ordinance is intended to promote the safety and health of the community through criteria limiting sound emissions during operation of Wind Energy Systems. It is recognized that the requirements herein are neither exclusive, nor exhaustive. In instances where a health or safety concern is known to the wind project developer or identified by other means with regard to any application for a Wind Energy System, additional and/or more restrictive conditions may be included in the license to address such concerns. All rights are reserved to impose additional restrictions as circumstances warrant. Such additional or more restrictive conditions may include, without limitation (a) greater setbacks, (b) more restrictive noise limitations, or (c) limits restricting operation during night time periods or for any other conditions deemed reasonable to protect the community.

A. Application

Any Person desiring to secure a Wind Energy Systems license shall file an application form provided by the LGA Clerk, together with two additional copies of the application with the LGA Clerk.

B. Information to be submitted with Application

1. Information regarding the:

- Make and model of all turbines potentially used in this project,
- Sound Power Levels (L_w) for each 1/3 octave band from 6.3 Hz to 10,000 Hz, and
- A sound propagation model predicting the sound levels immitted into the community computed using at minimum 1/1 octave band sound power levels to compute the L_{Ceq} and L_{Aeq} levels to generate L_{Aeq} and L_{Ceq} contours in 5 dB increments overlaying an aerial view and property survey map from the WES property out to a distance to include all residential property within two (2) miles of the WES Property. Appropriate corrections for model algorithm error, IEC61400-11 test measurement accuracy, and directivity patterns of for each model of WT shall be disclosed and accounted for in the model(s). Predictions shall be made at all property lines within and outward for two (2) miles from the project boundary for the wind speed, direction and operating mode that would result in the worst case WT nighttime sound emissions.

The prediction model shall assume that the winds at hub height are sufficient for the highest sound emission operating mode. The projection shall include a description of all assumptions made in the model's construction and algorithms. If the model does not consider the effects of wind direction, geography of the terrain, and/or the effects of reinforcement from coherent sounds or tones from the turbines all these items should be identified and all other means used to adjust the model's output to account for these factors. The results shall be displayed as a contour map of the predicted levels as over-all L_{Aeq} and L_{Ceq} contours out to 2 miles from the WES property, and shall also include a table showing the 1/3 or 1/1 octave band sound pressure as L_{Ceq} levels for the nearest property line(s) for sensitive receptor sites (including residences) within the model's boundaries. The predicted values must include the over-all sound levels and 1/1 or 1/3 octave band sound pressure levels from 6 Hz to 10k Hz in data tables that include the location of each receiving point by GPS location or other repeatable means.

C. Preconstruction Background Noise Survey

1. The Town reserves the right to require the preparation of (a) a preconstruction noise survey for each proposed Wind Turbine location conducted per procedures provided in the section on Measurement Procedures showing long-term background L_{A90} and L_{C90} sound levels. This must be completed and accepted prior to approval of the final layout and issuance of project permits.

   a. If any proposed wind farm project locates a WES within two miles of a sensitive receptor these studies are mandatory. The preconstruction baseline studies shall be conducted by an Independent Qualified Acoustical Consultant selected and hired by the LGA.

   b. The applicant shall be responsible for paying the consultant's fees and costs associated with conducting the study. These fees and cost shall be negotiated with the consultant and determined prior to any work being done on the study. The applicant shall be required to set aside 100% of these fees in an escrow account managed by the LGA, before the study is commenced by the consultant. Payment for this study does not require the WES developer's acceptance of the study's results.

   c. If the review shows that the predicted L_{Aeq} and L_{Ceq} sound levels exceed any of the criteria specified in the **Table of Not-To-Exceed Property Line Sound Immission Limits** then the application cannot be approved.

2. The LGA will refer the application to the LGA engineer (if qualified in acoustics) or an independent qualified acoustical consultant for further review and comparison of the long-term background sound levels against the predicted L_{Aeq} and L_{Ceq} sound levels reported for the model using the criteria in the **Table of Not-To-Exceed Property Line Sound Immission Limits**. The reasonably necessary costs associated with such a review shall be the responsibility of the applicant, in accord with the terms of this ordinance.

D. Post Construction Noise Measurement Requirements

1. **Sound Regulations Compliance**: A WES shall be considered in violation of the conditional use permit unless the applicant demonstrates that the project complies with all sound level limits using the procedures specified in this ordinance. Sound levels in excess of the limits established in this ordinance shall be grounds for the LGA to order immediate shut down of all non-compliant WT units.

2. **Post-Construction Sound Measurements**: Within twelve months of the date when the project is fully operational, and within four weeks of the anniversary date of the pre-construction background noise measurements, repeat the existing sound environment measurements taken before the project approval. Post-construction sound level measurements shall be taken both with all WES's running and with all WES's off. At the discretion of the Town, the Pre-construction background sound levels (L_{A90} and L_{C90}) can be substituted for the "all WES off' tests if a random sampling of 10% of the pre-construction study sites shows that background L_{90A} and L_{90C} conditions have increased less than 3 dB from those measured under the pre-

construction nighttime conditions. The post-construction measurements will be reported to the LGA (available for public review) using the same format as used for the preconstruction sound studies. Post-construction noise studies shall be conducted by a firm chosen and hired by the LGA. Costs of these studies are to be reimbursed by the Licensee in a similar manner to that described above. The wind farm developer's may ask to have its own consultant observe the publicly retained consultant at the convenience of the latter. The WES Licensee shall provide all technical information and wind farm data required by the qualified independent acoustical consultant before, during, and/or after any acoustical studies required by this document and for acoustical measurements.

3. Sound Limits

1. Establishing Long-Term Background Sound Level

a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedures must meet ANSI S12.9, Part 3 and Measurement Procedures Appendix to Ordinance following next Section.

b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles.

c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very little wind near the surface. Sound measurements are only valid when the measured maximum wind speed at the microphone must be less than 2 m/s (4.5 mph).

d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes L_{A90}, L_{A10}, L_{Aeq} and dBC data includes L_{C90}, L_{C10}, and L_{Ceq}. The maximum wind speed at the microphone during the ten minutes, a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener shall also be recorded. A ten (10) minute measurement contains valid data provided: Both L_{A10} minus L_{A90} and L_{C10} minus L_{C90} are not greater than 10 dB and the maximum wind speed at the microphone is less than 2 m/s during the same ten (10) minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on non-participating property containing a residence in excess of the limits in the following table:

Table of Not-To-Exceed Property Line Sound Immission Limits [1]			
Criteria	**Condition**	**dBA**	**dBC**
A	Immission above pre-construction background:	$L_{Aeq} = L_{A90} + 5$	$L_{Ceq} = L_{C90} + 5$
B	Maximum immission:	35 L_{Aeq}	55 L_{Ceq} for quiet[2] rural environment 60 L_{Ceq} for rural-suburban environment
C	Immission spectra imbalance (C - A $\leq$ 20dB)	L_{Ceq} (immission) minus (L_{A90} (background) +5 dB) $\leq$ 20 dB	
D	Prominent tone penalty:	5 dB	5 dB
Notes			
1	Each Test is independent and exceedances of any test establishes non-compliance Sound "immission" is the wind turbine sound emission as received at a property.		
2	A "quiet rural environment" is a location 2 miles from a major transportation artery without high traffic volume during otherwise quiet periods of the day or night.		
3	Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose.		
[1] Required Procedures provided in VIII Reference Standards including ANSI 12.9 Part 3 as Amended			

3. Wind Farm Noise Compliance Testing

All of the measurements outlined above in 1. Establishing Long Term Background Noise Level must be repeated to determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbine background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer to the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction must replicate the conditions that generated the complaint. Procedures of ANSI S12.9- Part 3 apply as amended in the Appendix to Ordinance. The effect of instrumentation limits for wind and other factors must be recognized and followed.

3. Operations

The WES/WT is non-compliant and must be shut down immediately if it exceeds any of the limits in the **Table of Not-To-Exceed Property Line Sound Immission Limits**.

4. Complaint Resolution

1. The owner/operator of the WES shall respond within five (5) business days after notified of a noise complaint by any property owner within the project boundary and a one-mile radius beyond the project boundary.
2. The tests shall be performed by a qualified independent acoustical consultant acceptable to the complainant and the local agency charged with enforcement of this ordinance.
3. Testing shall commence within ten (10) working days of the request. If testing cannot be initiated within ten (10) days, the WES(s) in question shall be shut down until the testing can be started.
4. A copy of the test results shall be sent to the property owner, and the LGA's Planning or Zoning department within thirty (30) days of test completion.
5. If a Complaint is made, the presumption shall be that it is reasonable. The LGA shall undertake an investigation of the alleged operational violation by a qualified individual mutually acceptable to the LGA.

a) The reasonable cost and fees incurred by the LGA in retaining said qualified individual shall be reimbursed by the owner of the WESF.

b) Funds for this assessment shall be paid or put into an escrow account prior to the study and payment shall be independent of the study findings.

6. After the investigation, if the LGA reasonably concludes that operational violations are shown to be caused by the WESF, the licensee/operator/owner shall use reasonable efforts to mitigate such problems on a case-by-case basis including such measures as not operating during the nighttime or other noise sensitive period if such operation was the cause of the complaints.

5. Reimbursement of Fees and Costs.

Licensee/operator/owner agrees to reimburse the LGA 's reasonable fees and costs incurred in the preparation, negotiation, administration and enforcement of this Ordinance, including, without limitation, the LGA 's attorneys' fees, engineering and/or consultant fees, LGA meeting and hearing fees and the costs of public notices. If requested by the LGA the funds shall be placed in an escrow account under the management of the LGA. The preceding fees are payable within thirty (30) days of invoice. Unpaid invoices shall bear interest at the rate of 1% per month until paid. The LGA may recover all reasonable costs of collection, including attorneys' fees.

VII. MEASUREMENT PROCEDURES

SUPPLEMENT TO WIND ENERGY SYSTEMS LICENSING ORDINANCE FOR SOUND

I. Introduction

The potential impact of sound and sound induced building vibration associated with the operation of wind powered electric generators is often a primary concern for citizens living near proposed wind energy systems (WES(s)). This is especially true of projects located near homes, residential neighborhoods, businesses, schools, and hospitals in quiet residential and rural communities. Determining the likely sound and vibration impacts is a highly technical undertaking and requires a serious effort in order to collect reliable and meaningful data for both the public and decision makers.

This protocol is based in part on criteria published in American National Standards S12.9 -Part 3 Quantities and Procedures for Description and Measurement of Environmental Sound, and S12.18 and for the measurement of sound pressure level outdoors.

The purpose is to first, establish a consistent and scientifically sound procedure for evaluating existing background levels of audible and low frequency sound in a WES project area, and second to use the information provided by the Applicant in its Application showing the predicted over-all sound levels in terms of L_{Aeq} and L_{Ceq} and 1/3 or 1/1 octave bands as part of the required information submitted with the application.

The over-all values shall be presented as overlays to the applicant's iso-level plot plan graphics and, for 1/1 or 1/3 octave data, in tabular form with location information sufficient to permit comparison of the baseline results to the predicted levels. This comparison will use the level limits of the ordinance to determine the likely impact operation of a new wind energy system project will have on the existing community soundscape. If the comparison demonstrates that the WES project will not exceed any of the level limits the project will be considered to be within allowable limits for safety and health. If the Applicant submits only partial information required for this comparison the application cannot be approved. In all cases the burden to establish the operation as meeting safety and health limits will be on the Applicant.

Next, it covers requirements for the sound propagation model to be supplied with the application.

Finally, if the project is approved, this section covers the study needed to compare the post-build sound levels to the predictions and the baseline study. The level limits in the ordinance apply to the post-build study. In addition, if there have been any complaints about WES sound or low frequency noise emissions or wind turbine noise induced dwelling vibration by any resident of an occupied dwelling that property will be included in the post-build study for evaluation against the rules for sound level limits and compliance.

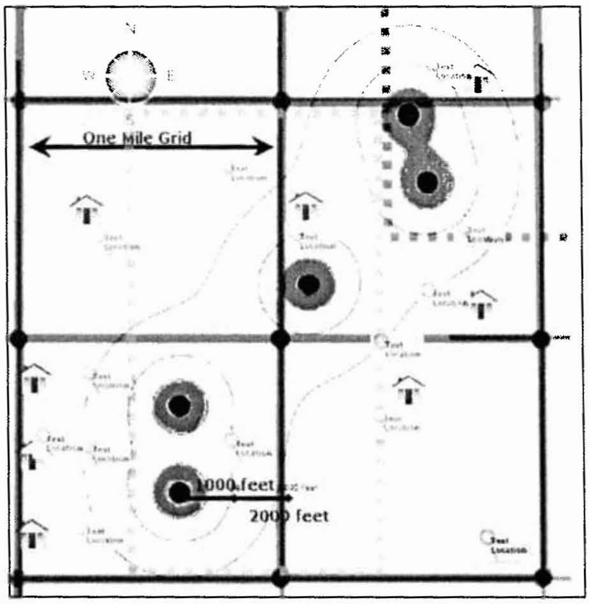
The characteristics of the proposed WES project and the features of the surrounding environment will influence the design of the sound and vibration study. Site layout, types of WES(s) selected and the existence of other significant local audible and low frequency sound sources and sensitive receptors should be taken into consideration when designing a sound study. The work will be performed by a qualified independent acoustical consultant for both the pre-construction background and post-construction sound studies as described in the body of the ordinance.

II. Instrumentation

All instruments and other tools used to measure audible, inaudible and low frequency sound shall meet the requirements for ANSI or IEC Type 1 Integrating Averaging Sound Level Meter Standards The principle standard reference for this document is ANSI 12.9/Part 3 with important additional specific requirements for the measuring instrumentation and measurement protocol.

III. Measurement of Pre-Construction Sound Environment (Base-line)

An assessment of the proposed WES project areas existing sound environment is necessary in order to predict the likely impact resulting from a proposed project. The following guidelines must be used in developing a reasonable estimate of an area's existing background sound environment. All testing is to be performed by an independent qualified acoustical consultant approved by the LGA as provided in the body of the ordinance. The WES applicant may file objections detailing any concerns it may have with the LGA's selection. These concerns will be addressed in the study. Objections must be filed prior to the start of the noise study. All measurements are to be conducted with ANSI or IEC Type 1 certified and calibrated test equipment per reference specification at the end of this section. Test results will be reported to the LGA or its appointed representative.



Sites with No Existing Wind Energy Systems (Base-line Sound Study)

Sound level measurements shall be taken as follows:

The results of the model showing the predicted worst case L_{Aeq} and L_{Ceq} sound emissions of the proposed WES project will be overlaid on a map (or separate L_{Aeq} and L_{Ceq} maps) of the project area. An example (right) shows an approximately two (2) mile square section with iso-level contour lines prepared by the applicant, sensitive receptors (homes) and locations selected for the baseline sound tests whichever are the controlling metric. The test points shall be located at the property line bounding the property of the turbine's host closest to the wind turbine. Additional sites may be added if appropriate. A grid comprised of one (1) mile boundaries (each grid cell is one (1) square mile) should be used to assist in identifying between two (2) to ten (10) measurement points per cell. The grid shall extend to a minimum of two (2) miles beyond the perimeter of the project boundary. This may be extended to more than two (2) miles at the discretion of the LGA. The measurement points shall be selected to represent the noise sensitive receptor sites based on the anticipated sound propagation from the combined WT in the project. Usually, this will be the closest WT. If there is more than one WT near-by then more than one test site may be required.

The intent is to anticipate the locations along the bounding property line that will receive the highest sound immissions. The site that will most likely be negatively affected by the WES project's sound emissions should be given first priority in testing. These sites may include sites adjacent to occupied dwellings or other noise sensitive receptor sites. Sites shall be selected to represent the locations where the background soundscapes reflect the quietest locations of the sensitive receptor sites. Background sound levels (and 1/3 octave band sound pressure levels if required) shall be obtained according to the definitions and procedures provided in the ordinance and recognized acoustical testing practice and standards.

All properties within the proposed WES project boundaries will be considered for this study.

One test shall be conducted during the period defined by the months of April through November with the preferred time being the months of June through August. These months are normally associated with more contact with the outdoors and when homes may have open windows during the evening and night. Unless directed otherwise by the LGA the season chosen for testing will represent the background soundscape for other seasons. At the discretion of the LGA, tests may be scheduled for other seasons.

All measurement points (MPs) shall be located with assistance from the LGA staff and property owner(s) and positioned such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the nearest proposed WES site.

Duration of measurements shall be a minimum of ten (10) continuous minutes for all criteria at each location. The duration must include at least six (6) minutes that are not affected by transient sounds from near-by and non-nature sources. Multiple ten (10) minute samples over longer periods such as 30 minutes or one (1) hour may be used to improve the reliability of the L_{A90} and L_{C90} values. The ten (10) minute sample with the lowest valid L_{90} values will be used to define the background sound.

The tests at each site selected for this study shall be taken during the expected 'quietest period of the day or night' as appropriate for the site. For the purpose of determining background sound characteristics the preferred testing time is from 10pm until 4 am. If circumstances indicated that a different time of the day should be sampled the test may be conducted at the alternate time if approved by the Town.

Sound level measurements shall be made on a weekday of a non-holiday week. Weekend measurements may also be taken at selected sites where there are weekend activities that may be affected by WT sound.

Measurements must be taken with the microphone at 1.2 to 1.5 meters above the ground and at least 15 feet from any reflective surface following ANSI 12.9 Part 3 protocol including selected options and other requirements outlined later in this Section.

Reporting

1. For each Measurement Point and for each qualified measurement period, provide each of the following measurements:

   a. L_{Aeq}, L_{A10}, and L_{A90}, and

   b. L_{Ceq} , L_{C10}, and L_{C90}

2. A narrative description of any intermittent sounds registered during each measurement. This may be augmented with video and audio recordings.

3. A narrative description of the steady sounds that form the background soundscape. This may be augmented with video and audio recordings.

4. Wind speed and direction at the microphone (Measurement Point), humidity and temperature at time of measurement will be included in the documentation. Corresponding information from the nearest 10 meter weather reporting station shall also be obtained.

Measurements taken only when wind speeds are less than 2m/s (4.5 mph) at the microphone location will be considered valid for this study. A windscreen of the type recommended by the monitoring instrument's manufacturer must be used for all data collection.

5. Provide a map and/or diagram clearly showing (Using plot plan provided by LGA or Applicant):

- The layout of the project area, including topography, the project boundary lines, and property lines.
- The locations of the Measurement Points.
- The distance between any Measurement Points and the nearest WT(s).
- The location of significant local non-WES sound and vibration sources.
- The distance between all MPs and significant local sound sources. And,
- The location of all sensitive receptors including but not limited to: schools, day-care centers, hospitals, residences, residential neighborhoods, places of worship, and elderly care facilities.

Sites with Existing Wind Energy Systems

Two complete sets of sound level measurements must be taken as defined below:

1. One set of measurements with the wind generator(s) off unless the LGA elects to substitute the sound data collected for the background sound study. Wind speeds must be suitable for background sound tests as specified elsewhere in this ordinance.

2. One set of measurements with the wind generator(s) running with wind speed at hub height sufficient to meet nominal rated power output or higher and less than 2 m/s below at the microphone location. Conditions should reflect the worst case sound emissions from the WES project. This will normally involve tests taken during the evening or night when winds are calm (less than 2m/sec) at the ground surface yet, at hub height, sufficient to power the turbines.

Sound level measurements and meteorological conditions at the microphone shall be taken and documented as discussed above.

Sound level Estimate for Proposed Wind Energy Systems **(when adding more WT to existing project)**

In order to estimate the sound impact of the proposed WES project on the existing environment an estimate of the sound produced by the proposed WES(s) under worst-case conditions for producing sound emissions must be provided. This study may be conducted by a firm chosen by the WES operator with oversight provided by the LGA.

The qualifications of the firm should be presented along with details of the procedure that will be used, software applications, and any limitations to the software or prediction methods as required elsewhere in this ordinance for models.

Provide the manufacturer's sound power level (L_{Aw}) and (L_{Cw}) characteristics for the proposed WES(s) operating at full load utilizing the methodology in IEC 61400-11 Wind Turbine Noise Standard. Provide one-third octave band sound power level information from 6.3 Hz to 10k Hz. Furnish the data using no frequency weighting. A-weighted data is optional. Provide sound pressure levels predicted for the WES(s) in combination and at full operation and at maximum sound power output for all areas where the predictions indicate L_{Aeq} levels of 30 dBA and above. The same area shall be used for reporting the predicted L_{Ceq} levels. Contour lines shall be in increments of 5 dB.

Present tables with the predicted sound levels for the proposed WES(s) as L_{Aeq} and L_{Ceq} and at all octave band centers (8 Hz to 10k Hz) for distances of 500, 1000, 1500, 2000, 2500 and 5000 feet from the center of the area with the highest density of WES(s). For projects with multiple WES(s), the combined sound level impact for all WES(s) operating at full load must be estimated.

The above tables must include the impact (increased dBA and dBC (L_{eq}) above baseline L_{90} background sound levels) of the WES operations on all residential and other noise sensitive receiving locations within the project boundary. To the extent possible, the tables should include the sites tested (or likely to be tested) in the background study.

Provide a contour map of the expected sound level from the new WES(s), using 5dB L_{Aeq} and L_{Ceq} increments created by the proposed WES(s) extending out to a distance of two (2) miles from the project boundary, or other distance necessary, to show the 25 L_{Aeq} and 50 L_{Ceq} boundaries.

Provide a description of the impact of the proposed sound from the WES project on the existing environment. The results should anticipate the receptor sites that will be most negatively impacted by the WES project and to the extent possible provide data for each MP that are likely to be selected in the background sound study (note the sensitive receptor MPs):

1. Report expected changes to existing sound levels for L_{Aeq} and L_{A90}
2. Report expected changes to existing sound levels for L_{Ceq} and L_{C90}
3. Report the expected changes to existing sound pressure levels for each of the 1/1 or 1/3 octave bands in tabular form from 8 Hz to 10k Hz.
4. Report all assumptions made in arriving at the estimate of impact, any limitations that might cause the sound levels to exceed the values of the estimate, and any conclusions reached regarding the potential effects on people living near the project area. If the effects of coherence, worst case weather, or operating conditions are not reflected in the model a discussion of how these factors could increase the predicted values is required.
5. Include an estimate of the number of hours of operation expected from the proposed WES(s) and under what conditions the WES(s) would be expected to run. Any differences from the information filed with the Application should be addressed.

IV. Post-Construction Measurements

Post Construction Measurements should be conducted by a qualified noise consultant selected by and under the direction of the LGA. The requirements of this Appendix for Sites with Existing Wind Energy Systems shall apply

1. Within twelve months of the date when the project is fully operational, preferably within two weeks of the anniversary date of the pre-construction background sound measurements, repeat the measurements. Post-construction sound level measurements shall be taken both with all WES(s) running and with all WES(s) off except as provided in this ordinance.

2. Report post-construction measurements to the LGA using the same format as used for the background sound study.

VIII. REFERENCE Standards and ANSI S12.9 Part 3 with Required Amendments

ANSI/ASA S12.9-1993/Part 3 (R2008) - American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3: Short-Term Measurements with an Observer Present.

This standard is the second in a series of parts concerning description and measurement of outdoor environmental sound. The standard describes recommended procedures for measurement of short-term, time-average environmental sound outdoors at one or more locations in a community for environmental assessment or planning for compatible land uses and for other purposes such as demonstrating compliance with a regulation. These measurements are distinguished by the requirement to have an observer present. Sound may be produced by one or more separate, distributed sources of sound such as a highway, factory, or airport. Methods are given to correct the measured levels for the influence of background sound.

Wind Turbine Siting Acoustical Measurements
ANSI S12.9 Part 3 Selected Options and Requirement Amendments

For the purposes of this ordinance specific options provided in ANSI S12.9-Part 3 (2008) shall apply with the additional following requirements to Sections in ANSI S12.9/Part 3:

5.2 background sound: Use definition (1) 'long-term'
5.2 long-term background sound: The L_{90} excludes short term background sounds
5.3 basic measurement period: Ten (10) minutes $L_{90(10\ min)}$
5.6 Sound Measuring Instrument: Type 1 Integrating Meter meeting ANSI S1.43 or IEC 61672-1. The sound level meter shall cover the frequency range from 6.3 Hz to 20k Hz and simultaneously measure dBA L_N and dBC L_N. The instrument must also be capable of accurately measuring low-level background sounds down to 20 dBA.
6.5 Windscreen: Required
6.6(a) An anemometer accurate to ± 10% at 2m/s. to full scale accuracy. The anemometer shall be located 1.5 to 2m above the ground and orientated to record maximum wind velocity. The maximum wind velocity, wind direction, temperature and humidity shall be recorded for each ten (10) minute sound measurement period observed within 5 m. of the measuring microphone..
7.1 Long-term background sound
7.2 Data collection Methods: Second method with observed samples to avoid contamination by short term sounds (purpose: to avoid loss of statistical data)
8 Source(s) Data Collection: All requirements in ANSI S12.18 Method #2 precision to the extent possible while still permitting testing of the conditions that lead to complaints. The

meteorological requirements in ANSI S12.18 may not be applicable for some complaints. For sound measurements in response to a complaint, the compliance sound measurements should be made under conditions that replicate the conditions that caused the complaint without exceeding instrument and windscreen limits and tolerances.

8.1(b) Measuring microphone with windscreen shall be located 1.2m to 1.8m (1.5m preferred) above the ground and greater than 8m from large sound reflecting surface.

8.3(a) All meteorological observations required at both (not either) microphone and nearest 10m weather reporting station.

8.3(b) For a 10 minute background sound measurement to be valid the wind velocity shall be less then 2m/s (4.5 mph) measured less than 5m from the microphone. Compliance sound measurements shall be taken when winds shall be less than 4m/s at the microphone.

8.3(c) In addition to the required acoustic calibration checks, the sound measuring instrument internal noise floor, including microphone, must also be checked at the end of each series of ten minute measurements and no less frequently than once per day. Insert the microphone into the acoustic calibrator with the calibrator signal off. Record the observed dBA and dBC reading on the sound level meter to determine an approximation of the instrument self noise. Perform this test before leaving the background measurement location. This calibrator-covered microphone must demonstrate the results of this test are at least 5 dB below the immediately previous ten-minute acoustic test results, for the acoustic background data to be valid. This test is necessary to detect undesired increase in the microphone and sound level meter internal self-noise. As a precaution sound measuring instrumentation should be removed from any air-conditioned space at least an hour before use. Nighttime measurements are often performed very near the meteorological dew point. Minor moisture condensation inside a microphone or sound level meter can increase the instrument self noise and void the measured background data.

8.4 The remaining sections starting at 8.4 in ANSI S12.9 Part 3 Standard do not apply.

ANSI S12.18-1994 (R2004) American National Standard Procedures for Outdoor Measurement of Sound Pressure Level

This American National Standard describes procedures for the measurement of sound pressure levels in the outdoor environment, considering the effects of the ground, the effects of refraction due to wind and temperature gradients, and the effects due to turbulence. This standard is focused on measurement of sound pressure levels produced by specific sources outdoors. The measured sound pressure levels can be used to calculate sound pressure levels at other distances from the source or to extrapolate to other environmental conditions or to assess compliance with regulation. This standard describes two methods to measure sound pressure levels outdoors. METHOD No. 1: general method; outlines conditions for routine measurements. METHOD No. 2: precision method; describes strict conditions for more accurate measurements. This standard assumes the measurement of A-weighted sound pressure level or time-averaged sound pressure level or octave, 1/3-octave or narrow-band sound pressure level, but does not preclude determination of other sound descriptors.

ANSI S1.43-1997(R2007) American National Standard Specifications for Integrating Averaging Sound Level Meters

This Standard describes instruments for the measurement of frequency-weighted and time-average sound pressure levels. Optionally, sound exposure levels may be measured. This standard is consistent with the relevant requirements of ANSI S1.4-1983(R 1997) American National Standard Specification for Sound Level Meters, but specifies additional characteristics that are necessary to measure the time-average sound pressure level of steady, intermittent, fluctuating, and impulsive sounds.

ANSI S1.11-2004 American National Standard 'Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters'

This standard provides performance requirements for analog, sampled-data, and digital implementations of band-pass filters that comprise a filter set or spectrum analyzer for acoustical measurements. It supersedes ANSI S1.11-1986 (R1998) American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters, and is a counterpart to International Standard IEC 61260:1995 Electroacoustics - Octave-Band and Fractional-Octave-Band Filters. Significant changes from ANSI S1.11-1986 have been adopted in order to conform to most of the specifications of IEC 61260:1995. This standard differs from IEC 61260:1995 in three ways: (1) the test methods of IEC 61260 clauses 5 is moved to an informative annex, (2) the term 'band number,' not present in IEC 61260, is used as in ANSI S1.11-1986, (3) references to American National Standards are incorporated, and (4) minor editorial and style differences are incorporated.

ANSI S1.40-2006 American National Standard Specifications and Verification Procedures for Sound Calibrators

IEC 61400-11

Second edition 2002-12, Amendment 1 2006-05

IEC 61400-11

Second edition 2002-12, Amendment 1 2006-0

Wind turbine generator systems –Part 11: Acoustic noise measurement techniques

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the measurement and analysis of acoustical emissions by wind turbine generator systems. The standard has been prepared with the anticipation that it would be applied by:

- the wind turbine manufacturer striving to meet well defined acoustic emission performance requirements and/or a possible declaration system;
- the wind turbine purchaser in specifying such performance requirements;
- the wind turbine operator who may be required to verify that stated, or required, acoustic performance specifications are met for new or refurbished units;
- the wind turbine planner or regulator who must be able to accurately and fairly define acoustical emission characteristics of a wind turbine in response to environmental regulations or permit requirements for new or modified installations.

This standard provides guidance in the measurement, analysis and reporting of complex acoustic emissions from wind turbine generator systems. The standard will benefit those parties involved in the manufacture, installation, planning and permitting, operation, utilization, and regulation of wind turbines. The measurement and analysis techniques recommended in this document should be applied by all parties to insure that continuing development and operation of wind turbines is carried out in an atmosphere of consistent and accurate communication relative to environmental concerns. This standard presents measurement and reporting procedures expected to provide accurate results that can be replicated by others.

End of Measurement Procedure

VIII. Noise-Con 2008 Paper

Dearborn, Michigan

NOISE-CON 2008

2008 July 28-31

Simple guidelines for siting wind turbines to prevent health risks[30]

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Revision: 2.1[31]

Industrial scale wind turbines are a familiar part of the landscape in Europe, U.K. and other parts of the world. In the U.S., however, similar industrial scale wind energy developments are just beginning operation. The presence of industrial wind projects will increase dramatically over the next few years given the push by the Federal and state governments to promote renewable energy sources through tax incentives and other forms of economic and political support. States and local governments in the U.S. are promoting what appear to be lenient rules for how industrial wind farms can be located in communities, which are predominantly rural and often very quiet. Studies already completed and currently in progress describe significant health effects associated with living in the vicinity of industrial grade wind turbines. This paper reviews sound studies conducted by consultants for governments, the wind turbine owner, or the local residents for a number of sites with known health or annoyance problems. The purpose is to determine if a set of simple guidelines using dBA and dBC sound levels can serve as the 'safe' siting guidelines. Findings of the review and recommendations for sound limits will be presented. A discussion of how the proposed limits would have affected the existing sites where people have demonstrated pathologies apparently related to wind turbine sound will also be presented.

Background

A relatively new source of community noise is spreading rapidly across the rural U.S. countryside. Industrial grade wind turbines, a common sight in many European countries, are now being promoted by Federal and state governments as the way to minimize coal powered electrical energy and its effects on global warming. But, the initial developments using the newer 1.5 to 3 MWatt wind turbines here in the U.S. has also led to numerous complaints from

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[31] The criteria table at the end of this paper and portions of the narrative have been revised to reflect our current understanding of how to specify the sound limits with less ambiguity and to use the new format for presenting them.

residents who find themselves no longer in the quiet rural communities they were living in before the wind turbine developments went on-line. Questions have been raised about whether the current siting guidelines being used in the U.S. are sufficiently protective for the people living closest to the developments. Research being conducted into the health issues using data from established wind turbine developments is beginning to appear that supports the possibility there is a basis for the health concerns. Other research into the computer modeling and other methods used for determining the layout of the industrial wind turbine developments and the distances from residents in the adjacent communities are showing that the output of the models should not be considered accurate enough to be used as the sole basis for making the siting decisions.

The authors have reviewed a number of noise studies conducted in response to community complaints for wind energy systems sited in Europe, Canada, and the U.S. to determine if additional criteria are needed for establishing safe limits for industrial wind turbine sound immissions in rural communities. In several cases, the residents who filed the complaints have been included in studies by medical researchers who are investigating the potential health risks associated with living near industrial grade wind turbines 365 days a year. These studies were also reviewed by the authors to help in identifying what factors need to be considered in setting criteria for 'safe' sound limits at receiving properties. Due to concerns about medical privacy, details of these studies are not discussed in this paper. Current standards used in the U.S. and in most other parts of the world rely on not-to-exceed dBA sound levels, such as 50 dBA, or on not-to-exceed limits based on the pre-construction background sound level plus an adder (e.g. L_{90A} + 5 dBA).

Our review covered the community noise studies performed in response to complaints, research on health issues related to wind turbine noise, critiques of noise studies performed by consultants working for the wind developer, and research/technical papers on wind turbine sound immissions and related topics. The papers are listed in Tables 1-4.

Table 1-List of Studies Related to Complaints

Resource Systems Engineering, Sound Level Study - Ambient & Operations Sound Level Monitoring, Maine Department of Environmental Protection Order No. L-21635-26-A-N, June 2007
ESS Group, Inc., Draft Environmental Impact Statement For The Dutch Hill Wind Power Project - Town of Cohocton, NY, November 2006
David M. Hessler, Environmental Sound Survey and Noise Impact Assessment - Noble Wethersfield Wind park - Towns of Wethersfield and Eagle NY For: Noble Environmental Power, LLC January 2007
George Hessler, "Report Number 101006-1, Noise Assessment Jordanville Wind Power Project," October 2006
HGC Engineering, "Environmental Noise Assessment Pubnico Point Wind Farm, Nova Scotia, Natural Resources Canada Contract NRCAN-06-0046," August 23, 2006
John I. Walker, Sound Quality Monitoring, East Point, Prince Edward Island" by Jacques Whitford, Consultants for Prince Edward Island Energy Corporation, May 28, 2007

Table 2- List of Studies related to Health

Nina Pierpont, "Wind Turbine Syndrome - Abstract" from draft article and personal conversations. www.ninapierpont.com
Nina Pierpont, "Letter from Dr. Pierpont to a resident of Ontario, Canada, re: Wind Turbine Syndrome," Autumn 2007
Amanda Harry, "Wind Turbine Noise and Health" (2007)
Barbara J. Frey and Peter J. Hadden, "Noise Radiation from Wind Turbines Installed Near Homes, Effects on Health" (2007)
Eja Pedersen, "Human response to wind turbine noise - Perception, annoyance and moderating factors, Occupational and Environmental Medicine," The Sahlgrenska Academy, Gotenborg 2007
Robin Phipps, "In the Matter of Moturimu Wind Farm Application, Palmerston North, Australia," March 2007
WHO European Centre for Environment and Health, Bonn Office, "Report on the third meeting on night noise guidelines," April 2005

Table 3-List of Studies that review Siting Impact Statements

Richard H. Bolton, "Evaluation of Environmental Noise Analysis for 'Jordanville Wind Power Project,'" December 14, 2006 Rev 3.
Clifford P. Schneider, "Accuracy of Model Predictions and the Effects of Atmospheric Stability on Wind Turbine Noise at the Maple Ridge Wind Power Facility," Lowville, NY - 2007

Table 4-List of Research and Technical papers included in review process

Anthony L. Rogers, James F. Manwell, Sally Wright, "Wind Turbine Acoustic Noise," Renewable Energy Research Laboratory, Dept. of ME and IE, U of Mass, Amherst, amended June 2006
ISO. 1996. Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation. International Organization of Standardization. ISO 9613-2. p. 18.
G.P. van den Berg, "The Sounds of High Winds - the effect of atmospheric stability on wind turbine sound and microphone noise," Ph.D. thesis, 2006
Fritz van den Berg, "Wind Profiles over Complex Terrain," Proceedings of Second International Meeting on Wind Turbine Noise, Lyons, France, Sept. 2007
William K. G. Palmer, "Uncloaking the Nature of Wind Turbines-Using the Science of Meteorology," Proceedings of Second International Meeting on Wind Turbine Noise, Lyons, France, Sept. 2007
Soren Vase Legarth, "Auralization and Assessment of Annoyance from Wind Turbines," Proceedings of Second International Meeting on Wind Turbine Noise, Lyons, France, Sept. 2007
Julian T. and Jane Davis, "Living with aerodynamic modulation, low frequency vibration

and sleep deprivation - how wind turbines inappropriately placed can act collectively and destroy rural quietitude," Proceedings of Second International Meeting on Wind Turbine Noise, Lyons, France, Sept. 2007
James D. Barnes, "A Variety of Wind Turbine Noise Regulations in the United States - 2007," Proceedings of Second International Meeting on Wind Turbine Noise, Lyons, France, Sept. 2007
M. Schwartz and D. Elliott, Wind Shear Characteristics at Central Plains Tall Towers, NREL 2006
IEC 61400 "Wind turbine generator systems, Part 11: Acoustic noise measurement techniques,".rev:2002

Discussion

After reviewing the materials in the tables; we have arrived at our current understanding of wind turbine noise and its impact on the host community and its residents. The review showed that some residents living as far as 3 km (two (2) miles) from a wind farm complain of sleep disturbance from the noise. Many residents living one-tenth this distance (300 m. or 1000 feet) from a wind farm are experiencing major sleep disruption and other serious medical problems from nighttime wind turbine noise. The peculiar acoustic characteristics of wind turbine noise immissions cause the sounds heard at the receiving properties to be more annoying and troublesome than the more familiar noise from traffic and industrial factories. Limits used for these other community noise sources do not appear to be appropriate for siting industrial wind turbines. The residents who are annoyed by wind turbine noise complain of the approximately one (1) second repetitive swoosh-boom-swoosh-boom sound of the turbine blades and "low frequency" noise. It is not apparent to these authors whether the complaints that refer to "low frequency" noise are about the audible low frequency part of the swoosh-boom sound, the one hertz amplitude modulation of the swoosh-boom sound, or some combination of both acoustic phenomena.

To assist in understanding the issues at hand, the authors developed the 'conceptual' graph for industrial wind turbine sound shown in Figure 1. This graph shows the data from one of the complaint sites plotted against the sound immission spectra for a modern 2.5 MWatt wind turbine; Young's threshold of perception for the 10% most sensitive population (ISO 0266); and a spectrum obtained for a rural community during a three hour, 20 minute test from 11:45 pm until 3:05 am on a windless June evening in near Ubly, Michigan a quiet rural community located in central Huron County. (Also called: Michigan's "Thumb.") It is worth noting that this rural community demonstrates how quiet a rural community can be when located at a distance from industry, highways, and airport related noise emitters.

During our review we posed a number of questions to ourselves related to what we were learning. The questions (italics) and our answers are:

Do National or International or local community Noise Standards for siting wind turbines near dwellings address the low frequency portion of the wind turbine's sound immissions?[32] No! State and Local governments are in the process of establishing wind farm noise limits and/or wind turbine

[32] Emissions refer to acoustic energy from the 'viewpoint' of the sound emitter, while immissions refer to acoustic energy from the viewpoint of the receiver.

setbacks from nearby residents, but the standards incorrectly presume that limits based on dBA levels are sufficient to protect the residents.

Do wind farm developers have noise limit criteria and/or wind turbine setback criteria that apply to nearby residents? Yes! But the Wind Industry recommended residential wind turbine noise levels (typically 50-55 dBA) are too high for the quiet nature of the rural communities and may be unsafe for the nearest residents. An additional concern is that some of the methods for implementing pre-construction computer models may predict sound levels that are too low. These two factors combined can lead to post-construction complaints and health risks.

Are all residents living near wind farms equally affected by wind turbine noise? No, children, people with pre-existing medical conditions, especially sleep disorders, and the elderly are generally the most susceptible. Some people are unaffected while some nearby neighbors develop serious health effects caused by exposure to the same wind turbine noise.

How does wind turbine noise impact nearby residents? Initially, the most common problem is chronic sleep deprivation during nighttime. According to the medical research documents, this may develop into far more serious physical and psychological problems

What are the technical options for reducing wind turbine noise immission at residences? There are only two options: 1) increase the distance between source and receiver, and/or 2) reduce the source sound power immission. Either solution is incompatible with the objective of the wind farm developer to maximize the wind power electrical generation within the land available.

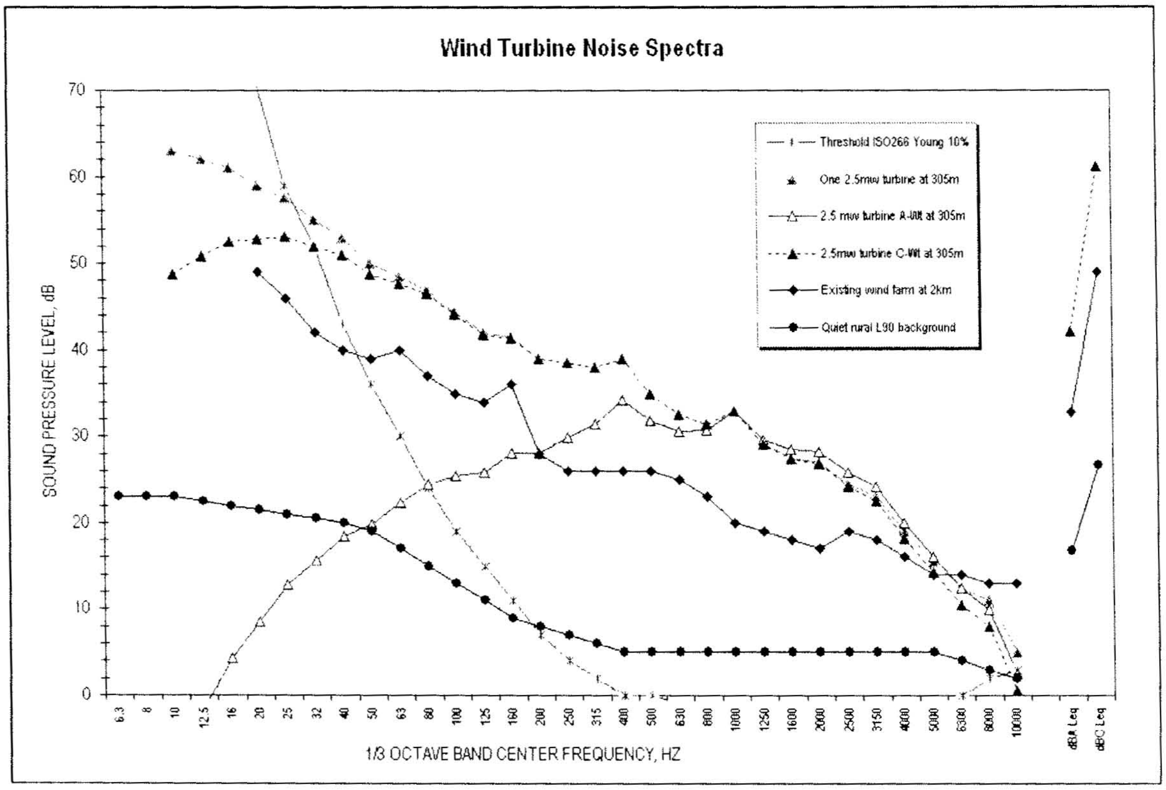

Figure 1-Generalized Sound Spectra vs. perception and rural community L_{90A} background 1/3 octave SPL

Is wind turbine noise at a residence much more annoying than traffic noise? Yes, researchers have found that "Wind turbine noise was perceived by about 85% of the respondents even when the calculated A-weighted SPL were as low as 35.0-37.5 dB. This could be due to the presence of amplitude modulation in the noise, making it easy to detect and difficult to mask by ambient noise." [JASA 116(6), December 2004, pgs 3460-3470, "Perception and annoyance due to wind turbine noise-a dose-relationship" Eja Pedersen and Kerstin Persson Waye, Dept of Environmental Medicine, Goteborg University, Sweden]

Why do wind turbine noise immissions of only 35 dBA disturb sleep at night? This issue is now being studied by the medical profession. The affected residents complain of the middle to high frequency swooshing sounds of the rotating turbine blades at a constant repetitive rate of about 1 hertz plus low frequency noise. The amplitude modulation of the swooshing sound changes continuously. The short time interval between the blade's swooshing sounds described by residents as sometimes having a thump or low frequency banging sound that varies in amplitude up to 10 dBA. This may be a result of phase changes between turbine emissions, turbulence, or an operational mode.. The assumptions about wall and window attenuation being 15 dBA or more may not be sufficiently protective considering the relatively high amplitude of the wind turbine's low frequency immission spectra.

What are the typical wind farm noise immission criteria or standards? Limits are not consistent and may vary even within a particular country. Example criteria include: Australia-the lower of 35 dBA or L_{90} + 5 dBA, Denmark-40 dBA, France L_{90} + 3 (night) and L_{90} + 5 (day), Germany-40 dBA, Holland-40 dBA, United Kingdom-40 dBA (day) and 43 dBA (night) or L_{90} + 5 dBA, Illinois-55 dBA (day) and 51 dBA (night), Wisconsin-50 dBA and Michigan-55 dBA. Note: Illinois statewide limits are expressed only in nine contiguous octave frequency bands and no mention of A-weighting for the hourly l_{eq} limits. Typically, wind turbine noise just meeting the octave band limits would read 5 dB below the energy sum of the nine octave bands after applying A-weighting. So the Illinois limits are approximately 50 dBA (daytime 7 AM to 10 PM) and 46 dBA at night, assuming a wind farm is a Class C Property Line Noise Source.

What is a reasonable wind farm sound immission limit to protect the health of residences? We are proposing an immission limit of 35 dBA or L_{90A} + 5 dBA whichever is lower and also a C-weighted criteria to address the impacted resident's complaints of wind turbine low frequency noise: For the proposed criteria the dBC sound level at a receiving property shall not exceed L_{90A} + 20dB. In other words, the dBC operating immission limit shall not be more than 20 dB above the measured dBA (L_{90A}) pre-construction nighttime background sound level. A maximum not-to-exceed limit of 50 dBC is also proposed.

Why should the dBC immission limit not be permitted to be more than 20 dB above the background measured L_{90A}? The World Health Organization and others have determined a sound emitter's noise that results in a difference between the dBC and dBA value greater than 20 dB will be an annoying low frequency issue.

Is not L_{90A} the minimum dBA background noise level? This is not exactly correct. The L_{90} is the statistical descriptor representing the quietest 10% of the time. It may be understood as the sounds one hears when there are no nearby or short-term sounds from man-made or natural sources. It excludes sounds that are not part of the soundscape during all seasons. It is very important to establish the statistical average background noise environment outside a potentially impacted residence during the quietest (10 pm to 4 am) sleeping hours of the night. This nighttime sleep disturbance has generated the majority of the wind farm noise complaints throughout the world. The basis for a community's wind turbine sound immission limits would be the minimum 10 minute nighttime L_{90A} plus 5 dB for the time period of 10 pm to 7 am. This would become the Nighttime Immission Limits for the proposed wind farm. This can be accomplished with one or several ten (10) minute measurements during any night when the atmosphere is classified stable with a light wind from the area of the proposed wind farm. The Daytime Limits (7 am to 7 pm) could be set 10 dB above the minimum nighttime L_{90A} measured noise, but the nighttime criteria will always be the limiting sound levels.

A nearby wind farm meeting these noise immission criteria will be clearly audible to the residents occasionally during nighttime and daytime. Compliance with this noise standard would be determined by repeating the initial nighttime minimum nighttime L_{90A} tests and adding the dBC (L_{eqC}) noise measurement with the turbines on and off. If the nighttime background noise level (turbines off) was found to be slightly higher than the measured background prior to the wind farm installation, then the results with the turbines on must be corrected to determine compliance with the pre-turbine established sound limits.

The common method used for establishing the background sound level at a proposed wind farm used in many of the studies in Table 1 was to use unattended noise monitors to record hundreds of ten (10) minute measurements to obtain a statistically significant sample over varying wind conditions or a period of weeks. The measured results for daytime and nighttime are combined to determine the statically average wind noise as a function of wind velocity measured at a height of ten (10) meters. This provides an enormous amount of data but the results have little relationship to the wind turbine sound immission or turbine noise impact in nearby residents. The purpose of this exhaustive exercise often only demonstrates how much noise is generated by the wind. In some cases it appears that the data is used to 'prove' that the wind noise masks the turbine's sound immissions.

The most glaring failure of this argument occurs during the frequent nighttime condition of a stable atmosphere. Then, the wind turbines operate at full or near full power and noise output while the wind at ground level is calm and the background noise level is low. This is the condition of maximum turbine noise impact on nearby residents. It is the condition which most directly causes chronic sleep disruption. Furthermore, the measurement methodology is usually faulty, as much of the wind noise measured by unattended sound monitors is the pseudo-wind noise generated by failure of the microphone's windscreen. This results in totally erroneous background sound levels being used for permitting and siting decisions. (See studies in Table 3, esp. Van den Berg)

Are there additional noise data to be recorded for a pre-wind turbine noise survey near selected dwellings? Yes, The measuring sound level meter(s) need document the L_{Aeq}, L_{A10}, L_{A90} and L_{Ceq}, L_{C10}, L_{C90} sound levels plus start time & date for each 10 minute sample. The L_{10} results will be utilized to help validate that conditions were appropriate for measuring the L_{90} long term background sound levels. For example, on a quiet night one would expect L_{A10} to be less than 10 dB higher than the L_{A90} long-term background sound level. On a windy night or day the difference may be more than 20 dB. There is a requirement for measurement of the wind velocity near the sound measurement microphone continuously throughout each ten (10) minute recorded noise sample. The ten (10) minute average of the wind speed near the microphone shall not exceed 2 m/s (4.5 mph) and the maximum wind speed for operational tests shall not exceed 4 m/s (9 mph). It is strongly recommended that observed samples be used for these tests.

Is there a need to record weather data during the background noise recording survey? One weather monitor is required at the proposed wind farm on the side nearest the residents. The weather station sensors are at standard ten (10) meter height above ground. It is critical the weather be recorded every ten (10) minutes synchronized with the clocks in the sound level recorders without ambiguity in the start and end time of each ten (10) minute period. The weather station should record wind speed and direction, temperature, humidity and rain.

Why do Canada and some other countries base the permitted wind turbine noise immission limits on the operational wind velocity at the 10m height wind speed instead of a maximum dBA or L_{A90} + 5 dBA immission level? First, it appears that the wind turbine industry will take advantage of every opportunity to elevate the maximum permitted noise immission level to reduce the setback distance from the nearby dwellings. Including wind as a masking source in the criteria is one method for elevating the permissible limits. Indeed the background noise level does increase with surface wind speed. When it does occur, it can be argued that the increased wind noise provides some masking of the wind farm turbine noise emission. However, in the middle of the night when the atmosphere is defined as stable (no vertical flow from surface heat radiation) the layers of the lower atmosphere can separate and permit wind velocities at the turbine hubs to be 2 to 4 times the wind velocity at the 10m high wind monitor but remain near calm at ground level. The result is the wind turbines can be operating at or close to full capacity while it is very quiet outside the nearby dwellings.

This is the heart of the wind turbine noise "problem" for residents within 3 km (approx. two miles) of a wind farm. When the turbines are producing the sound from operation it is quietest outside the surrounding homes. The PhD thesis of P.G. van den Berg "The Sounds of High Winds" is very enlightening on this issue. See also the letter by John Harrison in Ontario "On Wind Turbine Guidelines."

What sound monitor measurements would be needed for enforcement of the wind turbine sound ordinance? A similar sound and wind 10 minute series of measurements would be repeated at the pre-wind farm location nearest the resident registering the wind turbine noise complaint, with and without the operation of the wind turbines. An independent acoustics expert should be retained who reports to the County Board or other responsible governing body. This independent acoustics expert shall be responsible for all the acoustic measurements including instrumentation setup, calibration and interpretation of recorded results. An independent acoustical consultant shall also perform all pre-turbine background noise measurements and interpretation of results to establish the Nighttime (and Daytime if applicable) industrial wind turbine sound immission limits. At present the acoustical consultants are retained by, and work directly for, the wind farm developer.

This presents a serious problem with conflict of interest on the part of the consultant. The wind farm developer would like to show the significant amount of wind noise that is present to mask the sounds of the wind turbine immissions. The wind farm impacted community would like to know that wind turbine noise will be only barely perceptible and then only occasionally during the night or daytime.

Is frequency analysis required either during pre-wind farm background survey or for compliance measurements? Normally one-third octave or narrower band analysis would only be required if there is a complaint of tones immission from the wind farm.

Proposed Sound Limits

The simple fact that so many residents complain of low frequency noise from wind turbines is clear evidence that the single A-weighted (dBA) noise descriptor used in most jurisdictions for siting turbines is not adequate. The only other simple audio frequency weighting that is standardized and available on all sound level meters is C-weighting or dBC. A standard sound level meter set to measure dBA is increasingly less sensitive to low frequency below 500 Hz (one octave above middle-C). The same sound level meter set to measure dBC is equally sensitive to all frequencies above 32 Hz (lowest note on grand piano). It is well accepted that dBC readings are more predictive of perceptual loudness than dBA readings if low frequency sounds are significant.

We are proposing to use the commonly accepted dBA criteria that is based on the pre-existing background sound levels plus a 5 dB allowance for the wind turbine's immissions (e.g. L_{90A} +5) for the audible sounds from wind turbines. In addition, to address the lower frequencies that are not considered in A-weighted measurements we are proposing to add limits based on dBC. The Proposed Sound Limits are presented in the text box at the end of this paper.

For the current industrial grade wind turbines in the 1.5 to 3 MWatt range, the addition of the dBC requirement will result in an increased distance between wind turbines and the nearby residents. For the generalized graphs shown in Figure 1, the distances would need to be approximately double the current distance. This will result in setbacks in the range of 1 km or greater for the current generation of wind turbines if they are to be located in rural areas where the L_{90A} background sound levels are 30 dBA or lower. When no man-made sounds are audible they can even be under 20 dBA. In areas with higher background sound levels, turbines could be located somewhat closer, but still at a distance greater than the 305 m (1000 ft.) or less setbacks commonly seen in U.S. based wind turbine standards set by many states and used for wind turbine developments.

1. Establishing Long-Term Background Noise Level

a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedures must meet ANSI S12.9, Part 3.

b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles.

c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very little wind near the surface. Sound measurements are only valid when the measured wind speed at the microphone does not exceed 2 m/s (4.5 mph).

d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes L_{A90}, L_{A10}, L_{Aeq} and dBC data includes L_{C90}, L_{C10}, and L_{Ceq}. The maximum wind speed at the microphone during the ten minutes, a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener shall also be recorded. A ten (10) minute measurement contains valid data provided: Both L_{A10} minus L_{A90} and L_{C10} minus L_{C90} are not greater than 10 dB and the maximum wind speed at the microphone did not exceed 2 m/s during the same ten (10) minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on non-participating property containing a residence in excess of the limits in the following table:

Table of Not-To-Exceed Property Line Sound Immission Limits [1]

Criteria	Condition	dBA	dBC
A	Immission above pre-construction background:	$L_{Aeq} = L_{A90} + 5$	$L_{Ceq} = L_{C90} + 5$
B	Maximum immission:	35 L_{Aeq}	55 L_{Ceq} for quiet[2] rural environment 60 L_{Ceq} for rural-suburban environment
C	Immission spectra imbalance	L_{Ceq} (immission) minus (L_{A90} (background)+5) $\leq$ 20 dB	
D	Prominent tone penalty:	5 dB	5 dB

Notes

1	Each Test is independent and exceedances of any test establishes non-compliance Sound "immission" is the wind turbine noise emission as received at a property
2	A "Quiet rural environment" is a location 2 miles from a state road or other major transportation artery without high traffic volume during otherwise quiet periods of the day or night.
3	Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose.

[1] Procedures provided in Section 7. Measurement Procedures (Appendix to Ordinance) of the most recent version of "**The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound**" by Kamperman and James apply to this table.

3. Wind Farm Noise Compliance Testing

All of the measurements outlined above in 1. Establishing the Long-Term Background Noise Level must be repeated to determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbine background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer to the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction must replicate the conditions that generated the complaint. Procedures of ANSI S12.9-Part 3 apply as amended. Instrumentation limits for wind and other factors must be recognized and followed.

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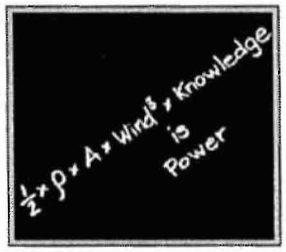
KNOW HOW /

Guided Tour on wind energy

Each one of the chapters of the guided tour is a self-contained unit - a tour in itself. You can take the tours in any order.



We suggest, however, that you start with the first section on Wind, since it makes it much easier to understand the other sections.

The guided tour is available in dansk, deutsch, english, español and francais.

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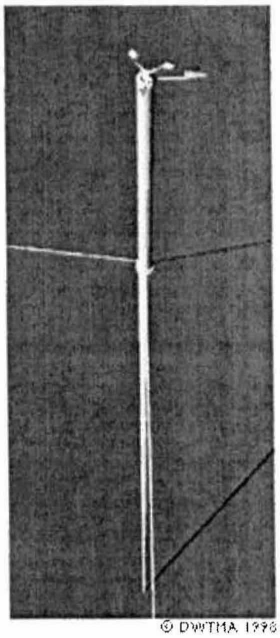
Wind Speed Measurement in Practice



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The best way of measuring wind speeds at a prospective wind turbine site is to fit an anemometer to the top of a mast which has the same height as the expected hub height of the wind turbine to be used. This way one avoids the uncertainty involved in recalculating the wind speeds to a different height.

By fitting the anemometer to the top of the mast one minimises the disturbances of airflows from the mast itself. If anemometers are placed on the side of the mast it is essential to place them in the prevailing wind direction in order to minimise the wind shade from the tower.

Which Tower?

Guyed, thin cylindrical poles are normally preferred over lattice towers for fitting wind measurement devices in order to limit the wind shade from the tower.

The poles come as kits which are easily assembled, and you can install such a mast for wind measurements at (future) turbine hub height without a crane.

Anemometer, pole and data logger (mentioned below) will usually cost somewhere around 5,000 USD.

Data Logging

NRG data logger
Photograph by
Soren Krohn
© 1998 DWIA

The data on both wind speeds and wind directions from the anemometer(s) are collected on electronic chips on a small computer, a data logger, which may be battery operated for a long period.

An example of such a data logger is shown to the left. Once a month or so you may need to go to the logger to collect the chips and replace them with blank chips for the next month's data. (Be warned: The most common mistake by people doing wind measurements is to mix up the chips and bring the blank ones back!)

Arctic Conditions

If there is much freezing rain in the area, or frost from clouds in mountains, you may need a heated anemometer, which requires an electrical grid connection to run the heater.

10 Minute Averages

Wind speeds are usually measured as 10 minute averages, in order to be compatible with most standard software (and literature on the subject). The result for wind speeds are different, if you use different periods for averaging, as we'll see later.

Roughness and Wind Shear

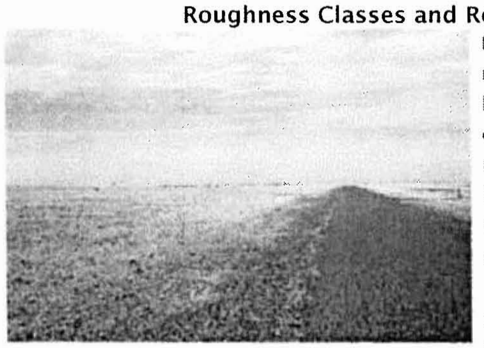
High above ground level, at a height of about 1 kilometre, the wind is hardly influenced by the surface of the earth at all. In the lower layers of the atmosphere, however, wind speeds are affected by the friction against the surface of the earth. In the wind industry one distinguishes between the roughness of the terrain, the influence from obstacles, and the influence from the terrain contours, which is also called the orography of the area. We shall be dealing with orography, when we investigate so called speed up effects, i.e. tunnel effects and hill effects , later.

Roughness

In general, the more pronounced the roughness of the earth's surface, the more the wind will be slowed down.

Forests and large cities obviously slow the wind down considerably, while concrete runways in airports will only slow the wind down a little. Water surfaces are even smoother than concrete runways, and will have even less influence on the wind, while long grass and shrubs and bushes will slow the wind down considerably.

Roughness Classes and Roughness Lengths



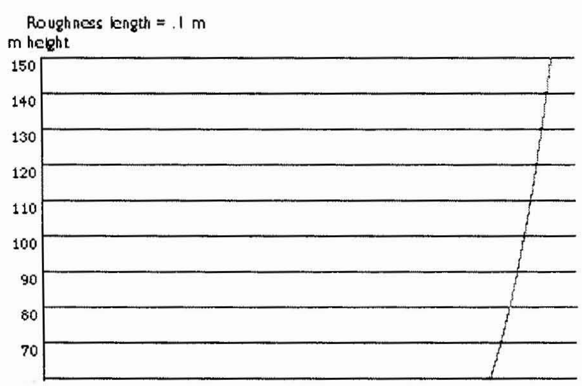
Sheep are a wind turbine's best friend. In this picture from Akaroa Spit, New Zealand, the sheep keep the roughness of the landscape down through their grazing. Photograph Soren Krohn © 1998 DWIA

In the wind industry, people usually refer to roughness classes or roughness lengths, when they evaluate wind conditions in a landscape. A high roughness class of 3 to 4 refers to landscapes with many trees and buildings, while a sea surface is in roughness class 0.

Concrete runways in airports are in roughness class 0.5. The same applies to the flat, open landscape to the left which has been grazed by sheep.

The proper definition of roughness classes and roughness lengths may be found in the Reference Manual. The term roughness length is really the distance above ground level where the wind speed theoretically should be zero.

Wind Shear



The hill effect

Turbine siting

Offshore winds

Wind map Europe

Wind map Denmark

Energy output

How does it work?

Generators

Turbine design

Manufacturing

R & D

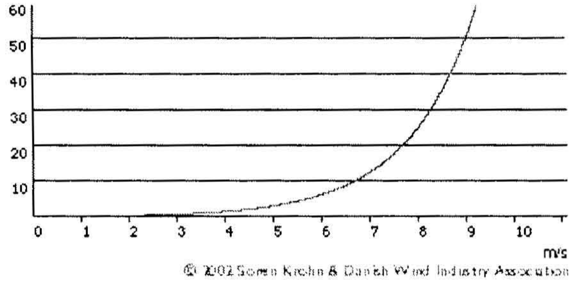
Electrical grid

Environment

Economics

History of wind energy

Wind energy manual



This graph was plotted with the wind speed calculator on the next page. It shows you how wind speeds vary in roughness class 2 (agricultural land with some houses and sheltering hedgerows with some 500 m intervals), if we assume that the wind is blowing at 10 m/s at a height of 100 metres.

The fact that the wind profile is twisted towards a lower speed as we move closer to ground level, is usually called wind shear. Wind shear may also be important when designing wind turbines. If you consider a wind turbine with a hub height of 40 metres and a rotor diameter of 40 metres, you will notice that the wind is blowing at 9.3 m/s when the tip of the blade is in its uppermost position, and only 7.7 m/s when the tip is in the bottom position. This means that the forces acting on the rotor blade when it is in its top position are far larger than when it is in its bottom position.

Wind Shear Formula *)

The wind speed at a certain height above ground level is:

$v = v_{ref} \ln(z/z_0)/\ln(z_{ref}/z_0)$

v = wind speed at height z above ground level.
v_{ref} = reference speed, i.e. a wind speed we already know at height z_{ref}. ln(...) is the natural logarithm function.
z = height above ground level for the desired velocity, v.
z_0 = roughness length in the current wind direction.
Roughness lengths may be found in the Reference Manual.
z_{ref} = reference height, i.e. the height where we know the exact wind speed v_{ref}.

In the above example, assume we know that the wind is blowing at 7.7 m/s at 20 m height. We wish to know the wind speed at 60 m height. If the roughness length is 0.1 m, then
$v_{ref} = 7.7$
$z = 60$
$z_0 = 0.1$
$z_{ref} = 20$ hence,
$v = 7.7 \ln(60/0.1) / \ln(20/0.1) = 9.2966$ m/s

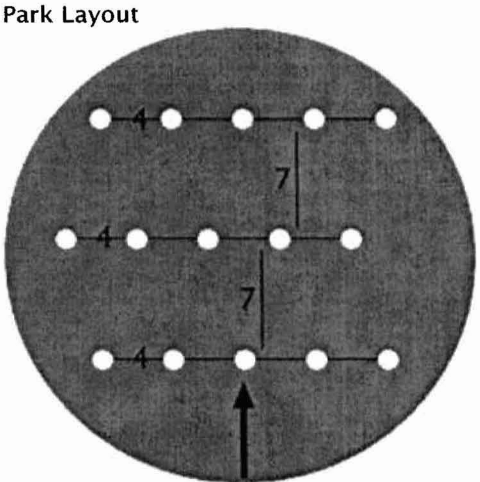
*) = The formula assumes so-called neutral atmospheric stability conditions, i.e. that the ground surface is neither heated nor cooled compared to the air temperature. Further details may be found in the engineering handbook Guidelines for Design of Wind Turbines from Risoe National Laboratory and DNV.

Park Effect

As we saw in the previous section on the wake effect , each wind turbine will slow down the wind behind it as it pulls energy out of the wind and converts it to electricity.

Ideally, we would therefore like to space turbines as far apart as possible in the prevailing wind direction. On the other hand, land use and the cost of connecting wind turbines to the electrical grid would tell us to space them closer together.

Park Layout



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As a rule of thumb, turbines in wind parks are usually spaced somewhere between 5 and 9 rotor diameters apart in the prevailing wind direction, and between 3 and 5 diameters apart in the direction perpendicular to the prevailing winds.

In this picture we have placed three rows of five turbines each in a fairly typical pattern.

The turbines (the white dots) are placed 7 diameters apart in the prevailing wind direction, and 4 diameters apart in the direction perpendicular to the prevailing winds.

Energy Loss from the Park Effect

With knowledge of the wind turbine rotor, the wind rose , the Weibull distribution and the roughness in the different directions manufacturers or developers can calculate the energy loss due to wind turbines shading one another.

Typically, the energy loss will be somewhere around 5 per cent.

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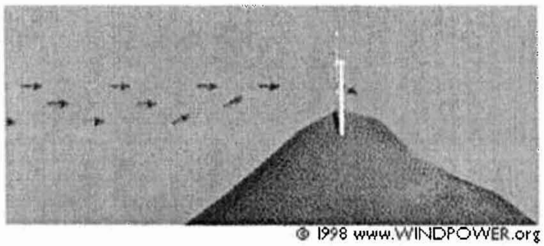
The wind in passing the summits of mountains becomes swift and dense and as it blows beyond the mountains it becomes thin and slow, like water that issues from a narrow channel into the wide sea.
Notebooks of Leonardo da Vinci (1452-1519)

Speed Up Effects: Hill Effect

A common way of siting wind turbines is to place them on hills or ridges overlooking the surrounding landscape. In particular, it is always an advantage to have as wide a view as possible in the prevailing wind direction in the area.

On hills, one may also experience that wind speeds are higher than in the surrounding area. Once again, this is due to the fact that the wind becomes compressed on the windy side of the hill, and once the air reaches the ridge it can expand again as its soars down into the low pressure area on the lee side of the hill.



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You may notice that the wind in the picture starts bending some time before it reaches the hill, because the high pressure area actually extends quite some distance out in front of the hill.

Also, you may notice that the wind becomes very irregular, once it passes through the wind turbine rotor.

As before, if the hill is steep or has an uneven surface, one may get significant amounts of turbulence , which may negate the advantage of higher wind speeds.

Selecting a Wind Turbine Site

Photograph Soren Krohn © 1997 DWIA

Wind Conditions

Looking at nature itself is usually an excellent guide to finding a suitable wind turbine site.

If there are trees and shrubs in the area, you may get a good clue about the prevailing wind direction , as you do in the picture to the left.

If you move along a rugged coastline, you may also notice that centuries of erosion have worked in one particular direction.

Meteorology data, ideally in terms of a wind rose calculated over 30 years is probably your best guide, but these data are rarely collected directly at your site, and here are many reasons to be careful about the use of meteorology data, as we explain in the next section.

If there are already wind turbines in the area, their production results are an excellent guide to local wind conditions. In countries like Denmark and Germany where you often find a large number of turbines scattered around the countryside, manufacturers can offer guaranteed production results on the basis of wind calculations made on the site.

Look for a view

As you have learned from the previous pages, we would like to have as wide and open a view as possible in the prevailing wind direction, and we would like to have as few obstacles and as low a roughness as possible in that same direction. If you can find a rounded hill to place the turbines, you may even get a speed up effect in the bargain.

Grid Connection

Obviously, large wind turbines have to be connected to the electrical grid.

For smaller projects, it is therefore essential to be reasonably close to a 10-30 kilovolt power line if the costs of extending the electrical grid are not to be prohibitively high. (It matters a lot who has to pay for the power line extension, of course).

The generators in large, modern wind turbines generally produce electricity at 690 volts. A transformer located next to the turbine, or inside the turbine tower, converts the electricity to high voltage (usually 10-30 kilovolts).

Grid Reinforcement

The electrical grid near the wind turbine(s) should be able to receive the electricity coming from the turbine. If there are already many turbines connected to the grid, the grid may need reinforcement, i.e. a larger cable, perhaps connected closer to a higher voltage transformer station. Read the section on Electrical Grid Issues for further information.

Soil Conditions

Both the feasibility of building foundations of the turbines, and road construction to reach the site with heavy trucks must be taken into

The hill effect

Turbine siting

Offshore winds

Wind map Europe

Wind map Denmark

Energy output

How does it work?

Generators

Turbine design

Manufacturing

R & D

Electrical grid

Environment

Economics

History of wind energy

Wind energy manual

account with any wind turbine project.

Pitfalls in Using Meteorology Data

Meteorologists already collect wind data for weather forecasts and aviation, and that information is often used to assess the general wind conditions for wind energy in an area.

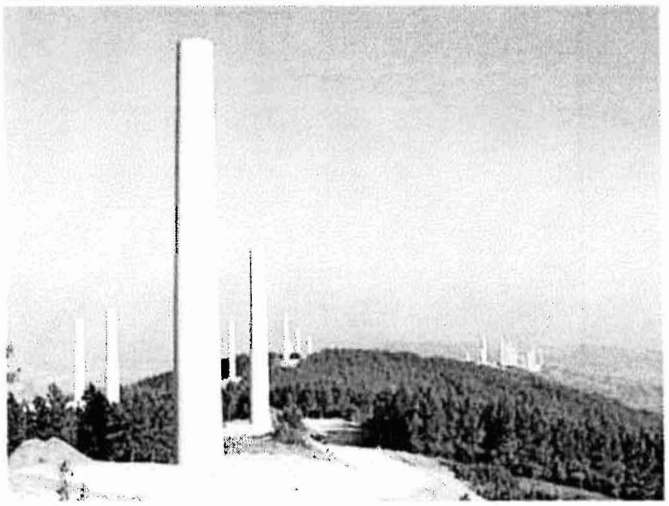
Precision measurement of wind speeds, and thus wind energy is not nearly as important for weather forecasting as it is for wind energy planning, however.

Wind speeds are heavily influenced by the surface roughness of the surrounding area, of nearby obstacles (such as trees, lighthouses or other buildings), and by the contours of the local terrain.

Unless you make calculations which compensate for the local conditions under which the meteorology measurements were made, it is difficult to estimate wind conditions at a nearby site. In most cases using meteorology data directly will underestimate the true wind energy potential in an area.

We'll return to how the professionals do their wind speed calculations on the following pages.

Wind Turbine Towers



Wind turbine towers, Navarra, Spain. Photograph Soren Krohn © 1999 DWIA

The tower of the wind turbine carries the nacelle and the rotor.

Towers for large wind turbines may be either tubular steel towers, lattice towers, or concrete towers. Guyed tubular towers are only used for small wind turbines (battery chargers etc.)

Tubular Steel Towers

Most large wind turbines are delivered with tubular steel towers, which are manufactured in sections of 20-30 metres with flanges at either end, and bolted together on the site. The towers are conical (i.e. with their diameter increasing towards the base) in order to increase their strength and to save materials at the same time.

Photograph © NEG-Micon A/S 1998

Lattice Towers

Lattice towers are manufactured using welded steel profiles. The basic advantage of lattice towers is cost, since a lattice tower requires only half as much material as a freely standing tubular tower with a similar stiffness. The basic disadvantage of lattice towers is their visual appearance (although that issue is clearly debatable). Be that as it may, for aesthetic reasons lattice towers have almost disappeared from use for large, modern wind turbines.

Photograph © Nordex A/S 1998

Guyed Pole Towers

Many small wind turbines are built with narrow pole towers supported by guy wires. The

advantage is weight savings, and thus cost. The disadvantages are difficult access around the towers which make them less suitable in farm areas. Finally, this type of tower is more prone to vandalism, thus compromising overall safety.

Photograph Soren Krohn © 1999 DWIA

Hybrid Tower Solutions

Some towers are made in different combinations of the techniques mentioned above. One example is the three-legged Bonus 95 kW tower which you see in the photograph, which may be said to be a hybrid between a lattice tower and a guyed tower.

Photograph © Bonus Energy A/S 1998

Cost Considerations

The price of a tower for a wind turbine is generally around 20 per cent of the total price of the turbine. For a tower around 50 metres' height, the additional cost of another 10 metres of tower is about 15,000 USD. It is therefore quite important for the final cost of energy to build towers as optimally as possible.

Lattice towers are the cheapest to manufacture, since they typically require about half the amount of steel used for a tubular steel tower.

Aerodynamic Considerations

Generally, it is an advantage to have a tall tower in areas with high terrain roughness, since the wind speeds increases farther away from the ground, as we learned on the page about wind shear.

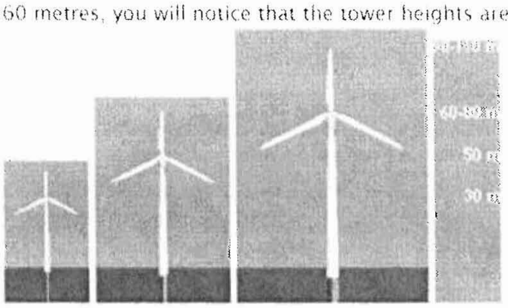
Lattice towers and guyed pole towers have the advantage of giving less wind shade than a massive tower.

Structural Dynamic Considerations

The rotor blades on turbines with relatively short towers will be subject to very different wind speeds (and thus different bending) when a rotor blade is in its top and in its bottom position, which will increase the [illegible] on the turbine.

Choosing Between Low and Tall Towers

Obviously, you get more energy from a larger wind turbine than a small one, but if you take a look at the three wind turbines below, which are 225 kW, 600 kW, and 1,500 kW respectively, and with rotor diameters of 27, 43, and 60 metres, you will notice that the tower heights are different as well.



Clearly, we cannot sensibly fit a 60 metre rotor to a tower of less than 30 metres. But if we consider the cost of a large rotor and a large generator and

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?

Components

Lift

Stall and drag

Sum of wind speeds

Rotor aerodynamics

Rotor blades

Power control

The yaw mechanism

Towers

The size of turbines

Turbine Safety

Labour safety

Generators

Turbine design

Manufacturing

R & D

Electrical grid

Environment

Economics

gearbox, it would surely be a waste to put it on a small tower, because we get much higher wind speeds and thus more energy with a tall tower. (See the section on wind resources). Each metre of tower height costs money, of course, so the optimum height of the tower is a function of

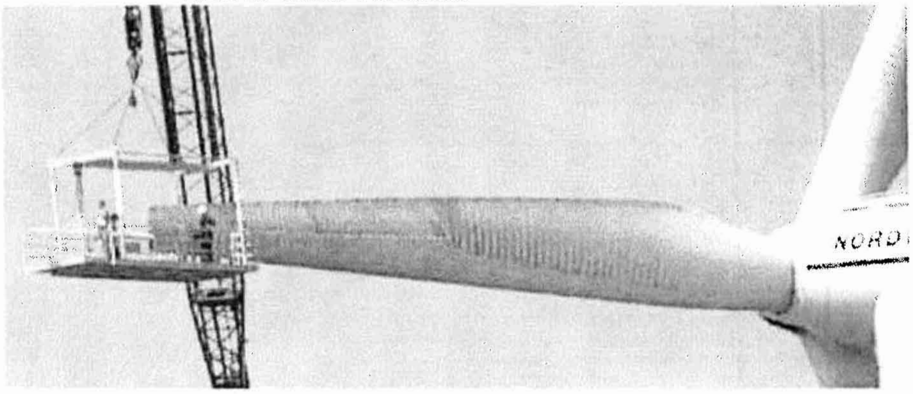
1. tower costs per metre (10 metre extra tower will presently cost you about 15,000 USD)
2. how much the wind locally varies with the height above ground level, i.e. the (large roughness makes it more useful with a taller tower),
3. the price the turbine owner gets for an additional kilowatt hour of electricity.

Manufacturers often deliver machines where the tower height is equal to the rotor diameter. aesthetically, many people find that turbines are more pleasant to look at, if the tower height is roughly equal to the rotor diameter.

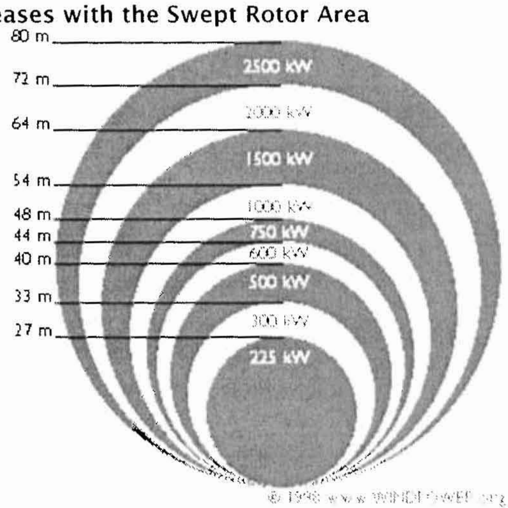
Occupational Safety Considerations

The choice of tower type has consequences for occupational safety. This is discussed in detail on the page on Wind Turbines and Occupational Safety.

Size of Wind Turbines



Power Output Increases with the Swept Rotor Area



When a farmer tells you how much land he is farming, he will usually state an area in terms of hectares or acres. With a wind turbine it is much the same story, though doing wind farming we farm a vertical area instead of a horizontal one.

The area of the disc covered by the rotor, (and wind speeds, of course), determines how much energy we can harvest in a year

The picture gives you an idea of the normal rotor sizes of wind turbines A typical turbine with a 600 kW electrical generator will typically have a rotor diameter of some 44 metres (144 ft.). If you double the rotor diameter, you get an area which is four times larger (two squared) This means that you also get four times as much power output from the rotor

Rotor diameters may vary somewhat from the figures given above, because many to local wind conditions A larger generator, of course, requires more power (i.e. strong winds) to turn at all. So if you install a wind turbine in a low wind area you will actually maximise annual output by using a fairly smallgenerator for a given rotor size (or a larger rotor size for a given generator) For a 600 kW machine rotor diameters may vary from 39 to 48 m (128 to 157 ft.) The reason why you may get more output from a relatively smaller generator in a low wind area is that the turbine will be running more hours during the year.

Reasons for Choosing Large Turbines

1. There are economies of scale in wind turbines, i.e. larger machines are usually able to deliver electricity at a lower cost than smaller machines. The reason is that the cost of foundations, road building, electrical grid connection, plus a number of components in the turbine (the electronic control system etc.), are somewhat independent of the size of the machine.
2. Larger machines are particularly well suited for offshore wind power. The cost of foundations does not rise in proportion to the size of the machine, and maintenance costs are largely independent of the size of the machine.
3. In areas where it is difficult to find sites for more than a single turbine, a large turbine with a tall tower uses the existing wind resource more efficiently.

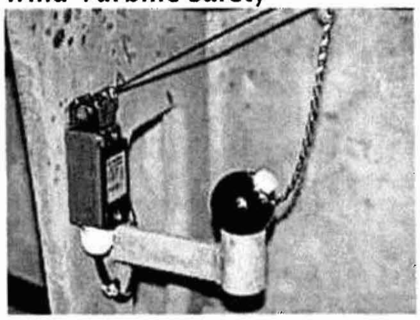
You may take a look at some megawatt-sized wind turbines in the picture gallery.

Reasons for Choosing Smaller Turbines

1. The local electrical grid may be too weak to handle the electricity output from a large machine. This may be the case in remote parts of the electrical grid with low population density and little electricity consumption in the area.
2. There is less fluctuation in the electricity output from a wind park consisting of a number of smaller machines, since wind fluctuations occur randomly, and therefore tend to cancel out. Again, smaller machines may be an advantage in a weak electrical grid.
3. The cost of using large cranes, and building a road strong enough to carry the turbine components may make smaller machines more economic in some areas.
4. Several smaller machines spread the risk in case of temporary machine failure, e.g. due to lightning strikes.
5. aesthetical landscape considerations may sometimes dictate the use of smaller machines. Large machines, however, will usually have a much lower rotational speed, which means that one large machine really does not attract as much attention as many small, fast moving rotors. (See the section on [illegible])

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?
Components
Lift
Stall and drag
Sum of wind speeds
Rotor aerodynamics
Rotor blades
Power control
The yaw mechanism
Towers
The size of turbines
Turbine Safety

Wind Turbine Safety



Photograph Soren Krohn © 1998 DWIA

The components of a wind turbine are designed to last 20 years. This means that they will have to endure more than 120,000 operating hours, often under stormy weather conditions.

If you compare with an ordinary automobile engine, it usually only operates only some 5,000 hours during its lifetime. Large wind turbines are equipped with a number of safety devices to ensure safe operation during their lifetime.

Sensors

One of the classical, and most simple safety devices in a wind turbine is the vibration sensor in the image above, which was first installed in the Gedser wind turbine. It simply consists of a ball resting on a ring. The ball is connected to a switch through a chain. If the turbine starts shaking, the ball will fall off the ring and switch the turbine off.

There are many other sensors in the nacelle, e.g. electronic thermometers which check the oil temperature in the gearbox and the temperature of the generator.

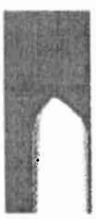
Rotor Blades

Safety regulations for wind turbines vary between countries. Denmark is the only country in which the law requires that all new rotor blades are tested both statically, i.e. applying weights to bend the blade, and dynamically, i.e. testing the blade's ability to withstand fatigue from repeated bending more than five million times. You may read more about this on the page on Testing Wind Turbine Rotor Blades.

Overspeed Protection

It is essential that wind turbines stop automatically in case of malfunction of a critical component. E.g. if the generator overheats or is disconnected from the electrical grid it will stop braking the rotation of the rotor, and the rotor will start accelerating rapidly within a matter of seconds.

In such a case it is essential to have an overspeed protection system. Danish wind turbines are required by law to have two independent fail safe brake mechanisms to stop the turbine.



Aerodynamic Braking System: Tip Brakes

The primary braking system for most modern wind turbines is the aerodynamic braking system, which essentially consists in turning the rotor blades about 90 degrees along their longitudinal axis (in the case of a pitch controlled turbine or an active stall controlled turbine), or in turning the rotor blade tips 90 degrees (in the case

Labour safety

Generators

Turbine design

Manufacturing

R & D

Electrical grid

Environment

Economics

History of wind energy

Wind energy manual

of a stall controlled turbine).

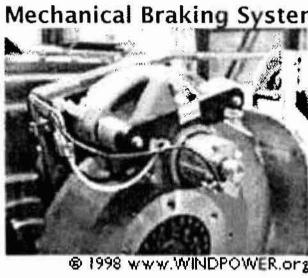
These systems are usually spring operated, in order to work even in case of electrical power failure, and they are automatically activated if the hydraulic system in the turbine loses pressure. The hydraulic system in the turbine is used turn the blades or blade tips back in place once the dangerous situation is over.

Experience has proved that aerodynamic braking systems are extremely safe.

They will stop the turbine in a matter of a couple of rotations, at the most. In addition, they offer a very gentle way of braking the turbine without any major stress, tear and wear on the tower and the machinery.

The normal way of stopping a modern turbine (for any reason) is therefore to use the aerodynamic braking system.

Mechanical Braking System



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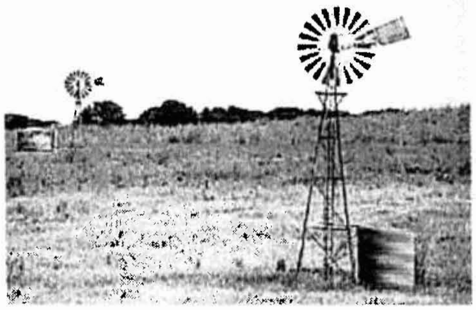
The mechanical brake is used as a backup system for the aerodynamic braking system, and as a parking brake, once the turbine is stopped in the case of a stall controlled turbine.

Pitch controlled turbines rarely need to activate the mechanical brake (except for maintenance work), as the rotor cannot move very much once the rotor blades are pitched 90 degrees.

Optimising Wind Turbines

Optimisation and Economics



Victoria in Southern Australia would never have been populated in the late 19th century, were it not for the water pumping windmills - and these windmills are really optimised for their purpose. Photograph Soren Krohn © 1998 DWIA

The water pumping windmills to the left look very different from modern, large wind turbines. But they are quite sensibly designed for the purpose they serve: The very solid rotor with many blades means that they will be running even at very low wind speeds, and thus pumping a fair amount of water all year round.

Clearly, they will be very inefficient at high wind speeds, and they will have to shut themselves down, and yaw out of the wind in order to avoid damage to the turbine, due to the very solid rotor. But that does not really matter: We do not want them to empty the wells and flood the water tank during a gale.

The ideal wind turbine design is not dictated by technology alone, but by a combination of technology and economics: Wind turbine manufacturers wish to optimise their machines, so that they deliver electricity at the lowest possible cost per kilowatt hour (kWh) of energy.

But manufacturers are not very concerned about how efficiently they use the wind resource: The fuel is free, after all.

It is not necessarily a good idea to maximise annual energy production, if that means that one has to build a very expensive wind turbine. In the next sections we shall look at some of the choices manufacturers have to make.

Relative Generator and Rotor Size

A small generator, (i.e. a generator with low rated power output in kW) requires less force to turn than a large one. If you fit a large wind turbine rotor with a small generator it will be producing electricity during many hours of the year, but it will capture only a small part of the energy content of the wind at high wind speeds.

A large generator, on the other hand, will be very efficient at high wind speeds, but unable to turn at low wind speeds.

Clearly, manufacturers will look at the distribution of wind speeds and the energy content of the wind at different wind speeds to determine the ideal combination of the size of the rotor and the size of the generator at different wind turbine sites.

Fitting a wind turbine with two (or more) generators can sometimes be an advantage, but whether it really pays to do it depends on the electricity price.

Tower Heights

In the section on wind shear, you have learned that taller towers generally increase a wind turbine's energy production.

Once again, whether a taller tower is worth the extra cost depends both on the roughness class, and the cost of electricity.

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?
Generators
Turbine design
Load considerations

Designing for Low Mechanical Noise from Wind Turbines

Sound emissions from wind turbines may have two different origins: Mechanical noise which we deal with on this page, and aerodynamic noise which we deal with on the next page.

Mechanical Sources of Sound Emission

Mechanical noise, i.e. metal components moving or knocking against each other may originate in the gearbox, in the drive train (the shafts), and in the generator of a wind turbine.

Machines from the early 1980s or before do emit some mechanical noise, which may be heard in the immediate surroundings of the turbine, in the worst cases even up to a distance of 200 m (600 ft.)

A survey on research and development priorities of Danish wind turbine manufacturers conducted in 1995, however, showed that no manufacturer considered mechanical noise as a problem any longer, and therefore no further research in the area was considered necessary. The reason was, that within three years noise emissions had dropped to half their previous level due to better engineering practices.

Quieting Wind Turbine Gearboxes

Gearboxes for wind turbines are no longer standard industrial gearboxes, but they have been adapted specifically for quiet operation of wind turbines. One way of doing this is to ensure that the steel wheels of the gearbox have a semi-soft, flexible core, but a hard surface to ensure strength and long time wear.

The way this is done is basically to heat the gear wheels after their teeth have been ground, and then let them cool off slowly while they are packed in a special high carbon-content powder. The carbon will then migrate into the surface of the metal. This ensures a high carbon content and high durability in the surface of the metal, while the steel alloy in the interior remains softer and more flexible.

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?

Structural Dynamics Analysis

When going by car, plane, or train, you may have experienced how resonance of different components, e.g. in the dashboard of a car or a window of a train may amplify noise.

An important consideration, which enters into the turbine design process today, is the fact that the rotor blades may act as membranes that may retransmit noise vibrations from the nacelle and tower.

As explained in the tour section on Research and Development , the turbine manufacturers nowadays make computer models of their machines before building them, to ensure that the vibrations of different components do not interact to amplify noise.

If you look at the chassis frame of the nacelle on some of the large wind turbines on the market today, you may discover some odd holes which were drilled into the chassis frame for no apparent reason. These holes were precisely made to ensure that the frame

Generators

Turbine design

Load considerations

Horizontal/vertical

Upwind/downwind

No. of rotor blades

Optimising turbines

Low mechanical noise

Low aerodynamic noise

Manufacturing

R & D

Electrical grid

Environment

Economics

History of wind energy

Wind energy manual

will not vibrate in step with the other components in the turbine

Sound Insulation

Sound insulation plays a minor role in most wind modern turbines on the market today, although it can be useful to minimise some medium- and high-frequency noise. In general, however, it seems to be more efficient to attack noise problems at the source, in the structure of the machine itself.

Designing for Low Aerodynamic Noise from Wind Turbines

Aerodynamic Sources of Sound Emission

When the wind hits different objects at a certain speed, it will generally start making a sound. If it hits the leaves of trees and bushes or a water surface it will create a random mixture of high frequencies, often called white noise.

The wind may also set surfaces in vibration, as sometimes happens with parts of a building, a car or even an (engineless) glider aeroplane. These surfaces in turn emit their own sound. If the wind hits a sharp edge, it may produce a pure tone, as you can hear it from musical wind instruments.

Rotor Blade Sound Emission and the Fifth Power Law

Rotor blades make a slight swishing sound which you may hear if you are close to a wind turbine at relatively low wind speeds.

Rotor blades must brake the wind to transfer energy to the rotor. In the process they cause some emission of white noise. If the surfaces of the rotor blades are very smooth (which indeed they must be for aerodynamic reasons), the surfaces will emit a minor part of the noise. Most of the noise will originate from the trailing (back) edge of the blades. Careful design of trailing edges and very careful handling of rotor blades while they are mounted, have become routine practice in the industry.

Other things being equal, sound pressure will increase with the fifth power of the speed of the blade relative to the surrounding air. You will therefore notice that modern wind turbines with large rotor diameters have very low rotational speed.

Rotor Blade Tip Design

Since the tip of the blade moves substantially faster than the root of the blade, great care is taken about the design of the rotor tip. If you look closely at different rotor blades you will discover subtle changes in their geometry over time, as more and more research in the area is being done.

The research is also done for performance reasons, since most of the torque (rotational moment) of the rotor comes from the outer part of the blades. In addition, the airflows around the tip of rotor blades is extremely complex, compared to the airflow over the rest of the rotor blade.

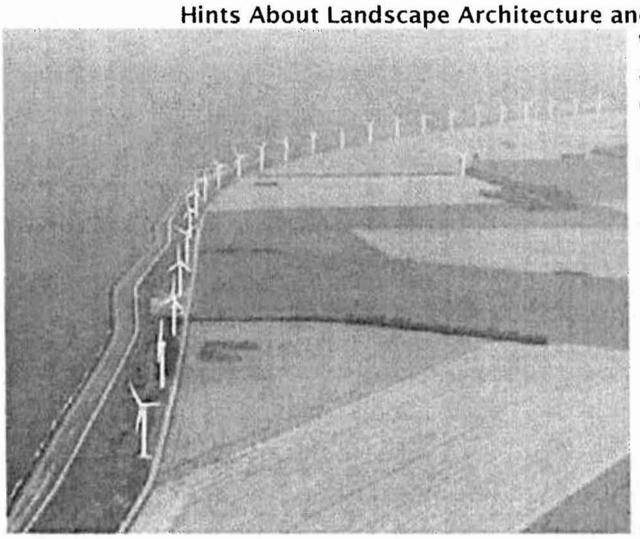
Research on Quieter Blades

Research on quieter rotor blades continues, but as mentioned in the section Noise is a Minor Problem , most of the benefits of that research will be turned into increased rotational speed and increased energy output, since noise is generally not a problem per se, given the distances to neighbouring houses etc.

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?
Generators
Turbine design
Load considerations
Horizontal/vertical

Wind Turbines and the Environment: Landscape

Hints About Landscape Architecture and Wind Turbines



Photograph Soren Krohn © 1999 DWIA

Wind turbines are always highly visible elements in the landscape. Otherwise they are not located properly from a meteorological point of view, cf. the page on wind turbine siting.

The image to the left shows the wind farm at Kappel, Denmark. It is perhaps the most aesthetically pleasing layout of any wind farm known to this author. The shape of the dike along the coastline is repeated in the line of turbines.

There is one disturbing element in the picture above: The single turbine next to the farmhouse, which interrupts the otherwise smooth pattern of turbines. (That turbine was there before the wind farm was built).

Simple Geometrical Patterns

In flat areas it is often a good idea to place turbines in a simple geometrical pattern which is easily perceived by the viewer. Turbines placed equidistantly in a straight line work well, but the example in the picture above may be even more elegant, where landscape contours invite such a solution.

There are limits to the usefulness of being dogmatic about using simple geometrical patterns, however:

In hilly landscapes it is rarely feasible to use a simple pattern, and it usually works better to the the turbines follow the altitude contours of the landscape, or the fencing or other characteristic features of the landscape.

Whenever turbines are placed in several rows, one will rarely be able to perceive the pattern when the park is viewed from normal eye level. Only when one is standing at the end of a row, does it really appear as an ordered layout. In the next panorama picture, you will probably only be able to discern three rows of turbines, while the rest appear to be scattered around the landscape.

Photograph © 1997 Søren Christensen

Light Grey Paint

The picture above shows one of the larger groupings of Danish built wind turbines at Nasudden on the island of Gotland in Sweden. The grey paint on the turbines make them blend well into the landscape.

Size of Wind Turbines

Large wind turbines enable the same amount of energy to be produced with fewer wind turbines. There may be economic advantages to this, such as lower maintenance costs.

From an aesthetic point of view, large wind turbines may be an advantage in the landscape, because they generally have lower rotational speed than smaller turbines. Large turbines therefore do not attract the eye the way fast-moving objects generally do.

People's Perception of Wind Turbines in the Landscape

To a large extent it is a matter of taste how people perceive that wind turbines fit into the landscape.

Numerous studies in Denmark, the UK, Germany, and the Netherlands have revealed that people who live near wind turbines are generally more favourable towards them than city dwellers. You may find more details about these studies in the article Public Attitudes Toward Wind Power on this web site.

A beautiful book of photographic examples of Wind Turbines in the Landscape may be purchased from Birk Nielsens Tegnestue, Aarhus, Denmark. The price is approximately 150 DKK, plus postage.

DANISH WIND INDUSTRY ASSOCIATION

› SEARCH

Home
Guided tour

Wind

Turbine siting

Energy output

How does it work?

Generators

Turbine design

Manufacturing

R & D

Electrical grid

Environment

Landscape and turbines

Aerial markings

Sound from turbines

Sound measurement

Sound map calculator

Sound from Wind Turbines

Noise is a Minor Problem Today

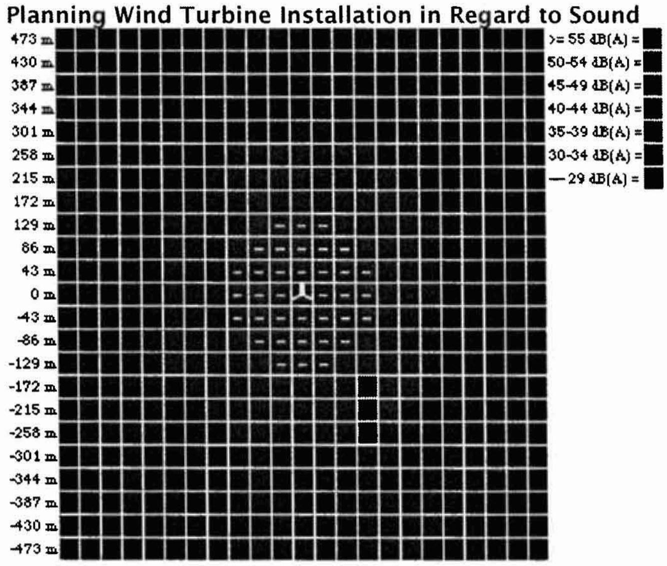
It is interesting to note that the sound emission levels for all new Danish turbine designs tend to cluster around the same values. This seems to indicate that the gains due to new designs of e.g. quieter rotor blade tips are spent in slightly increasing the tip speed (the wind speed measured at the tip of the rotor blade), and thus increasing the energy output from the machines.

In the guided tour section on Wind Turbine Design we have explained how turbines today are engineered to reduce sound emissions.

It thus appears that noise is not a major problem for the industry, given the distance to the closest neighbours (usually a minimum distance of about 7 rotor diameters or 300 m = 1000 ft. is observed).

The concepts of sound perception and measurement are not widely known in the public, but they are fairly easy to understand, once you get to grips with it. You can actually do the calculations yourself in a moment.

Planning Wind Turbine Installation in Regard to Sound



Fortunately, it is usually reasonably easy to predict the sound effect from wind turbines in advance. On one of the following pages you may even try for yourself, using the Sound Map Calculator , which was used to draw the picture.

Each square measures 43 by 43 metres, corresponding to one rotor diameter. The bright red areas are the areas with high sound intensity, above 55 dB(A). The dashed areas indicate areas with sound levels above 45 dB(A), which will normally not be used for housing etc. (We get to the explanation of the sound level and dB (A) in a moment).

Sound calculator

Energy balance

Birds and wind turbines

Birds and offshore wind

Shadow casting

Shadow calculation

Better calculations

Shadow variations

Guide to calculator

Shadow calculator

Economics

·History of wind energy

·Wind energy manual

As you can see, the zone affected by sound extends only a few rotor diameters' distance from the machine.

Background Noise: Masking Noise Drowns out Turbine Noise

No landscape is ever completely quiet. Birds and human activities emit sound, and at winds speeds around 4-7 m/s and up the noise from the wind in leaves, shrubs, trees, masts etc. will gradually mask (drown out) any potential sound from e.g. wind turbines.

This makes it extremely difficult to measure sound from wind turbines accurately. At wind speeds around 8 m/s and above, it generally becomes a quite abstruse issue to discuss sound emissions from modern wind turbines, since background noise will generally mask any turbine noise completely.

The Influence of the Surroundings on Sound Propagation

Sound reflection or absorption from terrain and building surfaces may make the sound picture different in different locations. Generally, very little sound is heard upwind of wind turbines. The wind rose is therefore important to chart the potential dispersion of sound in different directions.

Human Perception of Sound and Noise

Most people find it pleasant listen to the sound of waves at the seashore, and quite a few of us are annoyed with the noise from the neighbour's radio, even though the actual sound level may be far lower.

Apart from the question of your neighbour's taste in music, there is obviously a difference in terms of information content. Sea waves emit random "white" noise, while you neighbour's radio has some systematic content which your brain cannot avoid discerning and analysing. If you generally dislike your neighbour you will no doubt be even more annoyed with the noise. Sound experts for lack of a better definition define "noise" as "unwanted sound".

Since the distinction between noise and sound is a highly psychological phenomenon, it is not easy to make a simple and universally satisfactory modelling of sound phenomena. In fact, a recent study done by the Danish research institute DK Teknik seems to indicate that people's perception of noise from wind turbines is governed more by their attitude to the source of the noise, rather than the actual noise itself.

Measuring and Calculating Sound Levels

The dB(A) Scale

Public authorities around the world use the so-called dB(A), or decibel (A), scale to quantify sound measurement. To give you an idea of the scale, look at the table below.

Sound Level	Threshold of Hearing	Whisper	Talking	City Traffic	Rock Concert	Jet Engine 10 m Away
dB(A)	0	30	60	90	120	150

The dB(A) scale measures the sound intensity over the whole range of different audible frequencies (different pitches), and then it uses a weighing scheme which accounts for the fact that the human ear has a different sensitivity to each different sound frequency. Generally, we hear better at medium (speech range) frequencies than at low or high frequencies. The dB(A) system says, that the sound pressure at the most audible frequencies are to be multiplied by high numbers while the less audible frequencies are multiplied by low numbers, and everything is then added up to get an index number.

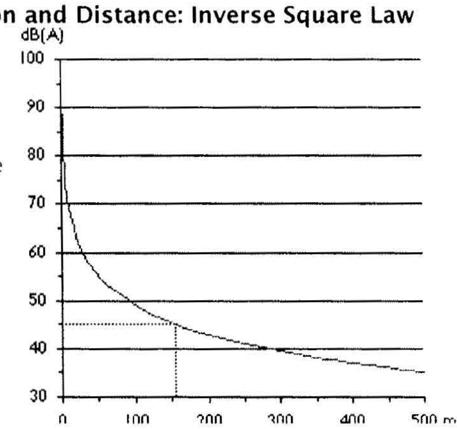
(The (A) weighing scheme is used for weak sounds, such as wind turbines. There exist other weighing schemes for loud sounds called (B) and (C), although they are rarely used).

The dB-scale is a logarithmic, or relative scale. This means, that as you double the sound pressure (or the energy in the sound) the index increases by approximately 3. A sound level of 100 dB(A) thus contains twice the energy of a sound level of 97 dB(A). The reason for measuring sound this way is that our ears (and minds) perceive sound in terms of the logarithm of the sound pressure, rather than the sound pressure itself.

Most people will say, that if you increase the dB(A) by 10, you double the subjective loudness of the sound.

In case you are interested in the exact definitions, take a look at the Reference Manual on Acoustics of this web site.

Sound Propagation and Distance: Inverse Square Law



The energy in sound waves (and thus the sound intensity) will drop with the square of the distance to the sound source. In other words, if you move 200 m away from a wind turbine, the sound level will generally be one quarter of what it is 100 m away. A doubling of your distance will thus make the dB(A) level drop by 6.

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At one rotor diameter distance (43 m) from the base of a wind turbine emitting 100 dB(A) you will generally have a sound level of 55-60 dB(A) corresponding to a (European) clothes dryer. 4 rotor diameters (170 m) away you will have 44 dB(A), corresponding to a quiet living room in a house. 6 rotor diameters (260 m) away you will have some 40 dB(A).

The precise relationship between sound level and distance from the sound source is given in a table on the Reference Manual on Acoustics of this web site.

In practice, sound absorption and reflection (from soft or hard surfaces) may play a role on a particular site, and may modify the results shown here.

Adding Sounds from Several Sources

If we have two wind turbines rather than one, located at the same distance from our ears, naturally the sound energy reaching us will double. As we have just learned, this means that two turbines will increase the sound level by 3 dB(A). Four turbines instead of one (at the same distance) will increase the sound level by 6 dB(A). You will actually need ten turbines placed at the same distance from you, in order to perceive that the subjective loudness has doubled (i.e. the dB level has increased by 10).

If you wish to learn the details about adding sounds together, take a look at the Reference Manual on Acoustics in this web site.

The Pure Tone Penalty

The fact that the human ear (and mind) discerns pure tones more easily than (random) white noise, means the authorities may wish to take that into account when doing sound estimates. They consequently often have rules which specify that you add a certain number to the dB(A) figure in case you have pure tones present in a sound.

Wind Turbine Noise Information in Practice

In accordance with international standards manufacturers generally specify a theoretical dB(A) level for sound emissions which assumes that all sound originates from a central point, although in practice, of course, it will originate from the whole surface of the machine and its rotor.

Sound pressure thus calculated is typically around 96-101 dB(A) for modern wind turbines. The figure itself is rather uninteresting, since there will not be a single point, where you can experience that sound level! Rather, it is useful for predicting the sound level at different distances from the wind turbine.

Pure tones have generally be eradicated completely for modern wind turbines, at least in the case of the modern turbines listed in the catalogue on the Wind Power Calculator page.

Legal Noise Limits

At distances above 300 m the maximum theoretical noise level from high quality wind turbines will generally be significantly below 45 dB(A) outdoors, corresponding to the legislation in Denmark. (For built-up areas with several houses, a noise limit of 40 dB(A) is the legal limit in Denmark).

Noise regulations vary from country to country. In practice the same machine designs can be used everywhere.

Current Practice: Calculations Rather than Measurement

Calculating potential sound emission from wind turbines is

Home
Guided tour
Wind
Turbine siting
Energy output

generally important in order to obtain planning permission (from the public authorities) for installing wind turbines in densely populated areas

Generally speaking, it is far easier to calculate the potential sound emissions than to measure them in practice.

The reason why it is difficult to measure the sound is that the sound level has to be some 10 dB(A) above the background noise in order to measure it properly. The background noise from leaves, birds, and traffic will frequently be above 30 dB(A), however. In most places in the world public authorities therefore rely on calculations rather than measurements, when granting planning permission for wind turbines.

Common Eider (Somateria Mollissima) Photograph Soren Krohn © 1996 DWIA

Birds and Wind Turbines

Birds often collide with high voltage overhead lines, masts, poles, and windows of buildings. They are also killed by cars in the traffic.

Birds are seldom bothered by wind turbines, however. Radar studies from Tjaereborg in the western part of Denmark, where a 2 megawatt wind turbine with 60 metre rotor diameter is installed, show that birds - by day or night - tend to change their flight route some 100-200 metres before the turbine and pass above the turbine at a safe distance.

In Denmark there are several examples of birds (falcons) nesting in cages mounted on wind turbine towers.

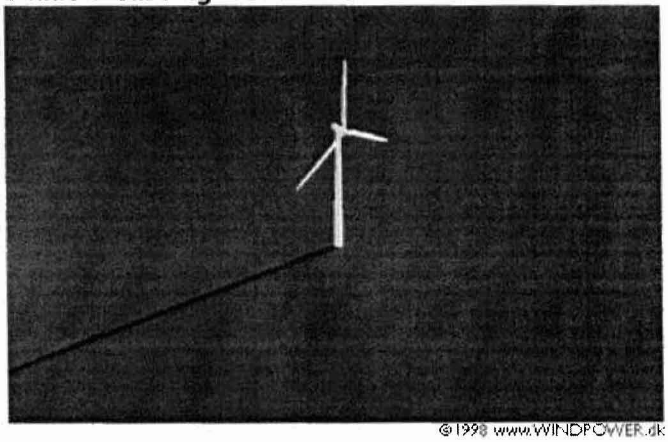
The only known site with bird collision problems is located in the Altamont Pass in California. Even there, collisions are not common, but they are of extra concern because the species involved are protected by law.

A study from the Danish Ministry of the Environment says that power lines, including power lines leading to wind farms, are a much greater danger to birds than the wind turbines themselves.

Some birds get accustomed to wind turbines very quickly, others take a somewhat longer time. The possibilities of erecting wind farms next to bird sanctuaries therefore depend on the species in question. Migratory routes of birds will usually be taken into account when siting wind farms, although bird studies from Yukon, Canada, show that migratory birds do not collide with wind turbines (Canadian Wind Energy Association Conference, 1997).

Updated 10 May 2003
http://www.windpower.org/en/tour/env/birds.htm

Shadow Casting from Wind Turbines



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Wind turbines, like other tall structures will cast a shadow on the neighbouring area when the sun is visible. If you live very close to the wind turbine, it may be annoying if the rotor blades chop the sunlight, causing a flickering (blinking) effect while the rotor is in motion.

A bit of careful planning, and the use of good software to plan your wind turbine site can help you resolve this problem, however. If you know where the potential flicker effect is of a certain size, you may be able to place the turbines to avoid any major inconvenience for the neighbours.

Few Rules

Shadow casting is generally not regulated explicitly by planning authorities. In Germany, however, there has been a court case in which the judge tolerated 30 hours of actual shadow flicker per year at a certain neighbour's property. In the 30 hours, it appears, one should only include flicker which occur during the hours where the property is actually used by people (who are awake).

Predicting Shadow Flicker

Fortunately, we are able to predict quite accurately the probability of when and for how long there may be a flicker effect. We may not know in advance whether there is wind, or what the wind direction is, but using astronomy and trigonometry we can compute either a likely, or a "worst case" scenario, i.e. a situation where there is always sunshine, when the wind is blowing all the time, and when the wind and the turbine rotor keep tracking the sun by yawing the turbine exactly as the sun moves.

Figuring out the exact shape, place, and time of the shadow from a wind turbine requires a lot of computation, but at least one professional wind software programme can do this very accurately, even in hilly terrain, and with house windows of any size, shape, location and inclination facing in any direction. (See the Links page for the address of wind software companies).

Do it Yourself

DANISH WIND INDUSTRY ASSOCIATION

www.windpower.org

Calculating Shadows from Wind Turbines

Daily Shadow Variation - Worst Case

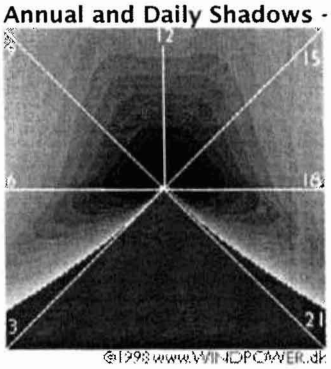
This simulation of shadow casting shows how the rotor shadow moves (worst case) from sunrise to sunset on a particular day at a certain location on the globe. The image is seen directly from above, with the centre of the wind turbine tower placed at the tiny black dot in the centre. The shadow positions are shown for every half hour during the day. Shadows, of course, are long around sunrise and sunset, and short at noon.

This particular set of images was made for 55° Northern latitude for 21 September, assuming a 43 m rotor diameter on a 50 m tower, using the shadow simulation programme on this web site.

Doing a worst case simulation we assume that the rotor yaws so as to track the movement of the sun exactly. This is is equivalent to assuming that the rotor is a solid balloon (or a Darrieus turbine).

Annual and Daily Shadows - Worst Case

Map of maximum (worst case) shadows around a 600 kW wind turbine placed at 55 degrees Northern latitude. The turbine has a 43 m rotor diameter and a 50 m tower. The map is 1200 m wide (East - West) and 750 m in the North - South direction. The map was computed using the Wind Turbine Shadow Calculator on this web site.



This map shows how shadows are typically distributed around a wind turbine throughout a year, assuming a worst case direction of the rotor. You will notice a number of kidney-shaped or bell-shaped areas around the wind turbine in the centre of the map. Each of the grey areas represents a certain maximum number of minutes of shadow from the wind turbine rotor. Since this map was computed for 55 degrees latitude in the Northern hemisphere, there is no shadow South of the turbine.

Timing Shadows

You will notice from the white lines on the map, that we can easily predict the time of day when shadows may occur. The shadow will e.g. obviously be directly North of the turbine at solar noon, when the sun reaches its maximum height in the sky. (Solar noon varies a bit during the year relative to our clocks, but it is fairly close to 12 o' clock, local time). The shadow will be to the bottom left at 4 o'clock in the morning on a summer day, so shadows to the Southwest are a minor problem in the Northern hemisphere. (The shadows occur in summer only, and at 4 in the morning most neighbours will be asleep anyway).

The commercial software we referred to earlier will tell you exactly the dates and times when shadows may occur.

Refining Shadow Calculations for Wind Turbines

Random Rotor Direction (Random Azimuth)

It is very unlikely that the wind and thus the rotor will track the sun in practice. We may therefore get a more realistic result if we modify our calculations by assuming that the rotor can assume any position at any time. In the small picture to the far right you can see a situation where the rotor is directly facing the sun. The tiny white dot near the bottom right is the centre of the wind turbine tower.

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Now, let us assume that we yaw the rotor out of its position by one degree, take a snapshot of the shadow image, then yaw it by another degree, take another snapshot etc., until we have done a full 360 degree turn. Then we overlay all our 360 snapshots, and what we end up with will look similar to the small image to the left: The centre will get the most of the shadow, but as we move towards the outer edge (where the vertical edges of the rotor disc cast their shadows) the overall shadow intensity will decrease.

Shadow casting is on average reduced to 63% of the worst case results, if you assume a random rotor direction. Ideally, we should have a wind rose , (preferably hourly for each day or month) to do an exact calculation.

Fixed Rotor Direction (Fixed Azimuth)

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In practice the wind turbine rotor will follow the wind direction (if the wind speed is above the cut in speed). This image shows the shape of an area (in red) which gives 10 hours or more of shadows per year at 55° Northern latitude with the rotor yaw (azimuth) fixed at an angle of -45 degrees (i.e. with the wind permanently coming from the Southwest or Northeast). As you can see, there will be almost no shadows at an angle of +45 degrees, i.e. in the direction parallel to the rotor plane.

Shadow casting is typically reduced to around 62% of the worst case results, if we assume a fixed rotor direction.

Actual Rotor Direction (Wind Rose)

Usually we will already have a wind rose with a frequency distribution of the wind in the different directions of the compass when we are planning a wind turbine site. Using that information, we may calculate a more exact shadow picture. In the case of our test example, Copenhagen, shadows are reduced to some 64 per cent of the comparable worst case value.

Turbine Operating Hours

The rotor will not be running all the time, so we may multiply the number of minutes of shadow flicker by a factor of typically 0.75, depending on the local wind climate, (and ideally using the correct factor for daytime during each month).

Home
Guided tour
Wind
Turbine siting
Energy output
How does it work?
Generators
Turbine design
Manufacturing
R & D
Electrical grid
Environment
Landscape and turbines
Aerial markings

Actual Sunshine Hours

When studying shadows, we should only count the fraction of the time when the sun is actually shining brightly, ideally using the correct fraction for each hour of the day during the year. In 1853 the first reliable sunshine recording device was invented (and improved in 1879), which means that in many parts of the world the meteorological institutes have very accurate long term statistics on the number of hours of bright sunshine during the year.

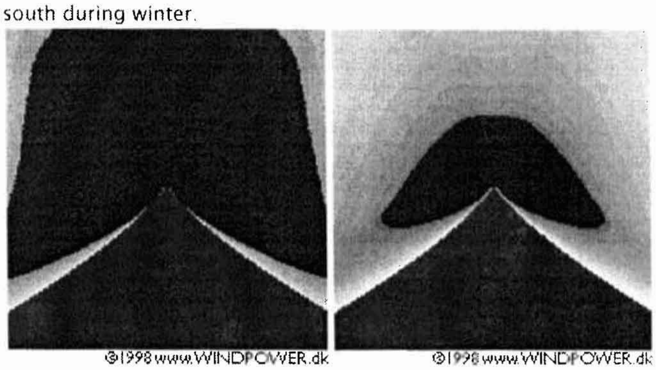
The number of bright sunshine hours varies with the geographical location and the season (summer or winter). We have included data for three Danish sites (Christiansø, Copenhagen, and Viborg) where the number of sunshine hours vary from 44 to 40, and 36 per cent of the time.

Combining Turbine operating hours, Actual Rotor Direction, and Actual Sunshine Hours

If we use both turbine operating hours, the actual rotor direction, and the actual bright sunshine hours we get a result (in the case of Denmark) which is some 18 per cent of the worst case assumption, using 75% operating hours in both cases. (The percentages given above are the results of simulations for Copenhagen on a 720 by 720 metre square with a turbine in the centre with 43 m rotor diameter and 50 m hub height).

The two images below compare a worst case simulation (with 75% operating hours) with an actual simulation for Copenhagen (also 75% operating hours) using both sunshine and wind statistics. The red area is the zone with 30 hours of shadow or more per year. Each map represents 720 by 720 metres.

The important conclusion of this simulation is that actual sunshine hours play a very important role in diminishing the amount of shadows north of the turbine (in the Northern hemisphere). The reason why this is important is that there are very few hours of sunshine when the sun is low in the sky to the south during winter.



Updated 10 May 2003
http://www.windpower.org/en/tour/env/shadow/shadowr.htm

Shadow Variations from Wind Turbines

Monthly Shadow Variation

© 1998 DWTMA

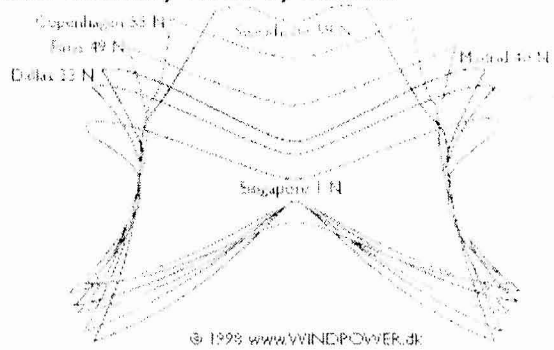
This movie shows the areas affected by shadow casting from a wind turbine. The movie shows how the area varies month by month - in this case in relatively high latitudes (55°) in the Northern hemisphere. The darkest areas represent the areas with most shadows.

In winter the sun stays in the Southern part of the sky, and the shadows are distributed in a V-shaped area to the North of the turbine.

In summer the sun rises very early in the morning to the Northeast and sunset is in the Northwest. This means that the summer shadows will be distributed in an A-shaped area, with the turbine in the tip of the "A".

In locations closer to the equator there will be far less shadow North and South of the turbine.

Shadow Geometry Varies by Latitude



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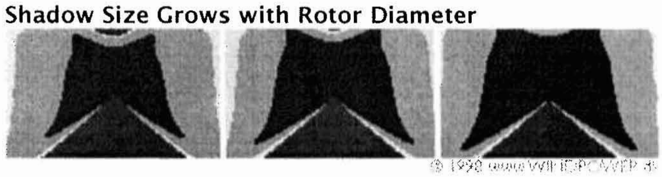
Each latitude on the globe has its own shadow signature in terms of the area affected by a certain period of shadows from an object (30 hours per year). Close to the equator the signature resembles a butterfly. Farther away from the equator it becomes more kidney-shaped, and close to the poles it almost becomes a circle.

All of the graphs above were computed using the shadow calculator on this web site, and assume a "worst case" or a random rotor position.

Shadow Size Grows with Rotor Diameter



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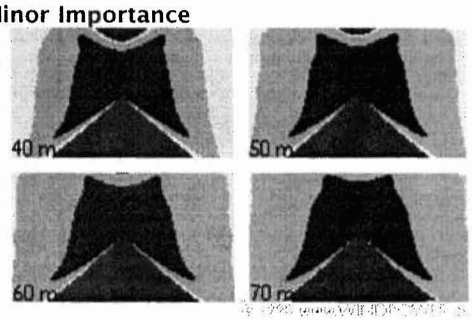
The size of the rotor shadow and the number of shadow minutes per year in the vicinity of the turbine varies in proportion to the rotor area, as shown in the three pictures above. The red areas

Home

rotor area, as shown in the three pictures above. The red areas indicate the annual shadow patterns with more than 30 hours of shadow (worst case) from wind turbine rotors of 43, 53, and 63 m mounted on 50 m towers and computed for 55° latitude.

Hub Height of Minor Importance



The hub height of a wind turbine is of minor importance for the shadow from the rotor. The same shadow will be spread over a larger area, so in the vicinity of the turbine, say, up to 1,000 m, the number of minutes per year with shadows will actually decrease. The four pictures show shadow casting during a year (worst case) from a wind turbine with a 43 m rotor diameter, placed with four different hub heights and computed for 55° latitude. The red areas represent areas with more than 30 hours of shadows.

If you are farther away from a wind turbine rotor than about 500-1000 metres, the rotor of a wind turbine will not appear to be chopping the light, but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances.

Updated 10 May 2003
http://www.windpower.org/en/tour/env/shadow/shadow2.htm

CASE NO. 634-AT-08

SUPPLEMENTAL MEMORANDUM

February 12, 2009

Champaign County Department of

PLANNING & ZONING

Brookens Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
FAX (217) 328-2426

Petitioner: **Zoning Administrator**

Prepared by: **John Hall**
Zoning Administrator

J.R. Knight
Associate Planner

Request:

(A) **Authorize the County Board to approve Special Use Permits (SUP) and to change the requirements for the development of wind turbine developments (wind farms) to a County Board Special Use Permit (CBSUP) and a rezoning to the new Wind Farm Overlay Zoning District (WFO).**

(B) **Change the requirements for private wind turbines.**

(C) **Add a requirement for a County Board Special Use Permit for subdivisions in a Rural Residential Overlay District.**

STATUS

This is the first meeting for this case. Additional documents of record are attached.

SOURCES FOR CONDITIONS

Attachment A briefly reviews the source or justification for all proposed standard conditions.

OTHER ISSUES RELATED TO WIND FARMS

Other issues of concern related to wind farms but for which no standard conditions have been proposed are the following:

- **Effects on adjacent property values.** Attachments B and C relate to the effects on adjacent (non-participating) property values. Both of these reports indicate no negative effects on adjacent property values.

- **Effects on spraying of agricultural land.** Attachments E and F are short articles reporting on the possible effects of agricultural spraying for both participating and non-participating lands. Note that the presence of a wind farm appears to create difficulties in aerial spraying and increased costs of aerial application on adjacent non-participating fields as well as the participating fields.

ADDITIONAL INFORMATION FOR PROPOSED CONDITIONS

Attachments D and G through K provide additional information for conditions that have already been proposed. Note that Attachments D and G relate to the condition to protect agricultural drainage that has not yet been drafted.

ATTACHMENTS

A Source Or Brief Justification Of All Proposed Standard Conditions

B Chapter One Executive Summary of *The Effect Of Wind Development On Local Property Values*. George Sterzinger, Fredric Beck, Damian Lostiuk. Renewable Energy Policy Project. 2003.

C *Impact of Wind Farms on Surrounding Property Values* by Peter Poletti. Presentation at the Illinois Windworking Group Conference. February 4, 2009.

D Section7 of the Champaign County Stormwater Management Policy

E *Sky High Wind towers may limit aerial applications*. Agrinews. Vol. 31-No. 33. October 24, 2008.

F *Non-wind turbine landowners should investigate spraying impact*. Agrinews. Vol. 31-No. 33. October 24, 2008.

G Washington Department of Fish and Wildlife Wind Project Guidelines

H Pipeline Construction Standards And Policies for Agricultural Impact Mitigation Recommended by the Illinois Department of Agriculture (included separately)

I Road Upgrade And Maintenance between McLean County and High Trail Wind Farm and Old Trail Wind Farm (included separately)

J Road Upgrade And Maintenance between McLean County townships and High Trail Wind Farm and Old Trail Wind Farm (included separately)

K *The Possible Effects of Wind Energy on Illinois Birds and Bats*. Report of the Illinois Department of Natural Resources to Governor Rod Blagojevich and the 95th Illinois General Assembly. June 2007. (included separately)

Attachment A. Source Or Brief Justification Of All Proposed Standard Conditions
Case 634-AT-08 February 12, 2009

Standard Condition (Draft)	Purpose of Condition	Source or Justification	Notes
A. !.	Clarify the area of the special use permit	None- good practice	
A.2. (a)	Prohibit wind farms within one-and one- half miles of municipality	Statutes	
A.2(b)	One mile separation from CR District	New York Model Ordinance requires 2,500 feet separation from Important Bird Areas. The CR District is intended to conserve the natural and scenic areas and is the principal rural residential district and is where the Forest Preserve Districts are located	One mile is arbitrary
B. 1.	Eliminate minimum lot requirements for wind farm	Wind farm is a unique development with unique requirements	
C.1.	1,000 feet separation to participating dwelling	*Model Ordinance*	The *Model Ordinance* gives no justification for the 1,000 feet
C.2.	1,200 feet separation for non-participating dwelling	Non-participating dwellings are not benefiting from the wind farm like participating dwellings and may merit greater separation	1,200 feet is arbitrary
C.3.	Allows waiver of above two conditions	*Model Ordinance*	
C.4.	Separation to adjacent participating property line	*Model Ordinance*	
C.5.	Separation to nearest street	*Model Ordinance*	
C.6.	Submittal of private waiver	Supplements the *Model Ordinance*	
C.7.	Separation distance from pipeline impact radius	None- good practice; allows pipeline impact radius to be waived in the special use permit rather than a variance	
D.1.	Design Safety Certification	*Model Ordinance*	State's Attorney must review for compliance with statutes
D.2.	Controls and brakes	*Model Ordinance*	
D.3.	Electrical components	*Model Ordinance*	State's Attorney must review for compliance with statutes
D.4.	Monopole construction	*Model Ordinance*	

Attachment A. Source Or Brief Justification Of All Proposed Standard Conditions
Case 634-AT-08 February 12, 2009

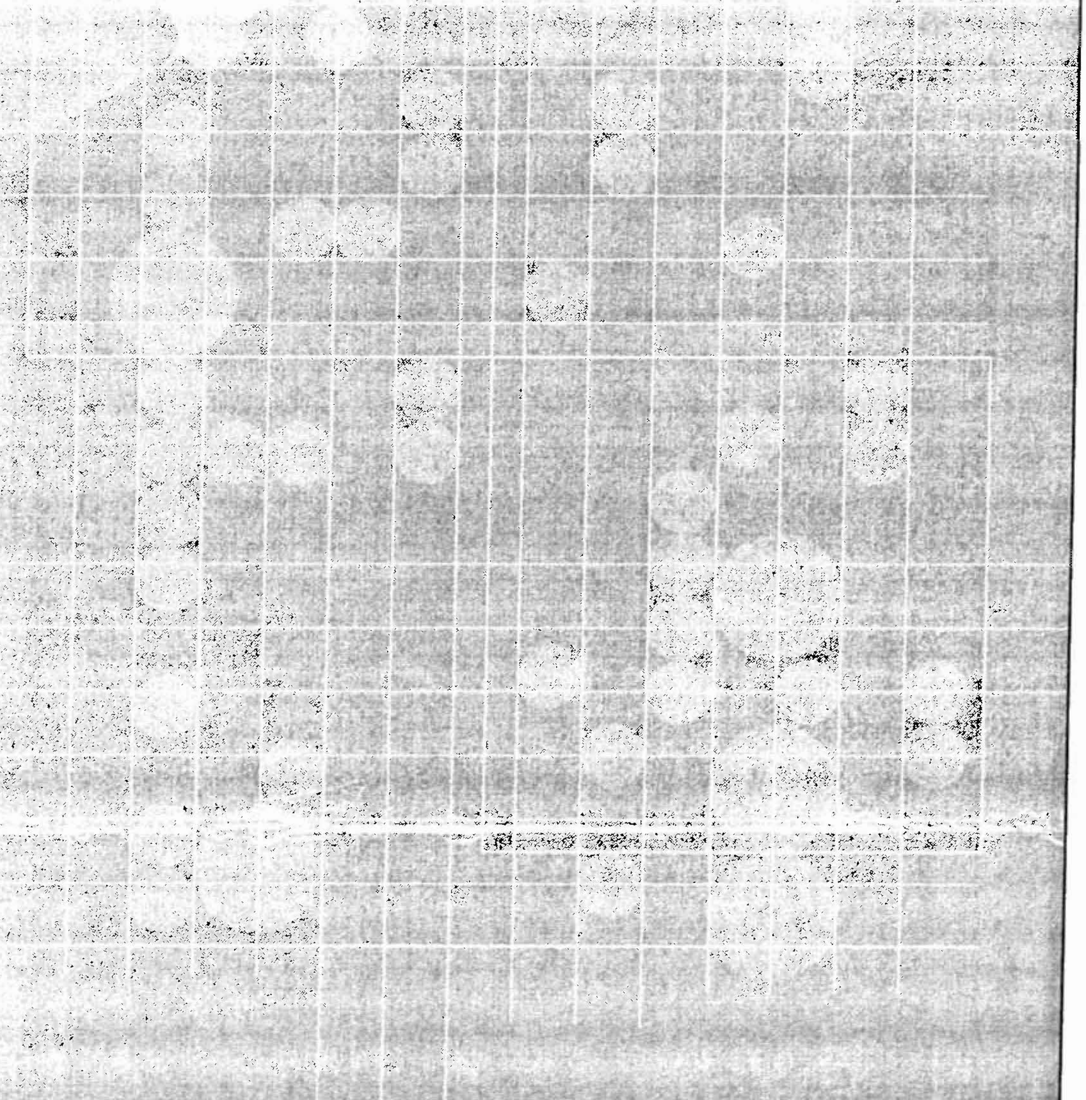
Standard Condition (Draft)	Purpose of Condition	Source or Justification	Notes
D.5.	Maximum height	*Model Ordinance*	Maximum height allowed by Federal Aviation Administration (FAA)
D.6.	Paint color of tower & turbine	*Model Ordinance*	
D.7.	Applicable FAA requirements	*Model Ordinance* (modified)	American Bird Conservancy's Wind Energy Policy recommends minimum lighting so as to minimize avian mortality.
D.8.	Tower warnings	*Model Ordinance*	
D.9.	Prevent unauthorized climbing	*Model Ordinance*	
E.	Protect agricultural drainage *(Not drafted yet)*	*Stormwater Management Policy* and IDAG Recommendations	*Stormwater Management Policy* not sufficient by itself. IDAG Recommendations included with February 12, 2009, Supplemental Memorandum
F.	Use of Public Streets	*Model Ordinance* modified with: ▪ McLean County requirements ▪ Champaign County Engineer review	McLean County requirements included with February 12, 2009, Supplemental Memorandum. Champaign County Engineer comments received but not yet incorporated
G.	Coordination with fire protection district	*Model Ordinance*	Some counties have required payments to FPD to offset specific costs
H.	Mitigate electromagnetic interference	*Model Ordinance*	Could be made more specific to clarify extent of required mitigation
I.	Allowable noise level	*Model Ordinance*	The Illinois Pollution Control Board requirements were included in the Preliminary Memorandum
J.	Endangered Species Consultation	Statutory requirement	
K.	Historic and Archaeological review	Required by other counties	Not a statutory requirement and may never be required since most of these resources are in the CR District

Attachment A. Source Or Brief Justification Of All Proposed Standard Conditions
Case 634-AT-08 February 12, 2009

Standard Condition (Draft)	Purpose of Condition	Source or Justification	Notes
L	Wildlife impacts	*Model Ordinance* modified with: ▪ Washington State Department of Fish and Wildlife guidelines (included with February 12, 2009, Supplemental Memorandum) ▪ Review of other wind farm & wildlife guidelines	No IDNR requirements. Sangamon, Livingston, and Livingston and Macon Counties require post-construction monitoring in their Ordinances and LaSalle has required it as a special condition of approval Review comments have been provided from an environmental consultant and changes will be recommended
M.	Shadow flicker	*Environmental Impacts of Wind-Energy Projects* (Committee on Environmental Impacts of Wind Energy, National Research Council)	Sangamon County Ordinance requires shadow flicker study
N.	Visual Impact Assessment	*Environmental Impacts of Wind-Energy Projects* (Committee on Environmental Impacts of Wind Energy, National Research Council)	
O.	Liability insurance	*Model Ordinance* (modified)	Modification based on a special condition of approval by Livingston County
P.	Operational conditions	*Model Ordinance*	
Q.	Decommissioning plan	*Model Ordinance* modified with: ▪ Existing reclamation agreement standards	Existing reclamation agreement standards established in Case 273-AT-00 Part B (included with Preliminary Memorandum)
R.	Complaint hotline	Based on a special conditions of approval by LaSalle and Livingston Counties Also recommended in *Environmental Impacts of Wind-Energy Projects* (Committee on Environmental Impacts of Wind Energy, National Research Council)	
S.	Expiration of County Board Special Use Permit if no construction within 10 years	Ford County has an expiration clause with a 36 month limit that can be extended	

ATTACHMENT B

[illegible] Effect [illegible] Development [illegible] Property Values



REPP

Renewable Energy Policy Project

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Analytical Report | May 2003

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TABLE OF CONTENTS

Chapter I. Project Overview

The Claim Against Wind Development

Wind energy is the fastest growing domestic energy resource. Between 1998 and 2002 installed capacity grew from 1848 MW to 4685 MW, a compound growth rate of 26 percent. Since wind energy is now broadly competitive with many traditional generation resources, there is wide expectation that the growth rate of the past five years will continue. (Source for statistics: www.awea.org).

As the pace of wind project development has increased, opponents have raised claims in the media and at siting hearings that wind development will lower the value of property within view of the turbines. This is a serious charge that deserves to be seriously examined.

No Existing Empirical Support

As a result of the expansion of capacity from 1998 to 2002, it is reasonable to expect any negative effect would be revealed in an analysis of how already existing projects have affected property values. A search for either European or United States studies on the effect of wind development on property values revealed that no systematic review has as yet been undertaken.

As noted above, the pace of development and siting hearings is likely to continue, which makes it important to do systematic research in order to establish whether there is any basis for the claims about harm to property values. (For recent press accounts of opposition claims see: The Charleston Gazette, WV, March 30, 2003; and Copley News Service. Ottawa, IL, April 11, 2003).

This REPP Analytical Report reviews data on property sales in the vicinity of wind projects and uses statistical analysis to determine whether and the extent to which the presence of a wind power project has had an influence on the prices at which properties have been sold. The hypothesis underlying this analysis is that if wind development can reasonably be claimed to hurt property values, then a careful review of the sales data should show a negative effect on property values within the viewshed of the projects.

A Serious Charge Seriously Examined

The first step in this analysis required assembling a database covering every wind development that came on-line after 1998 with 10 MW installed capacity or greater. (Note: For this Report we cut off projects that came on-line after 2001 because they would have insufficient data at this time to allow a reasonable analysis. These projects can be added in future Reports, however.) For the purposes of this analysis, the wind developments were considered to have a visual impact for the area within five miles of the turbines. The five mile threshold was selected because review of the literature and field experience suggests that although wind turbines may be visible beyond five miles, beyond this distance, they do not tend to be highly noticeable, and they have relatively little influence on the landscape's overall character and quality. For a time period covering roughly six years and straddling the on-line date of the projects, we gathered the records for all property sales for the view shed and for a community comparable to the view shed.

For all projects for which we could find sufficient data, we then conducted a statistical analysis to determine how property values changed over time in the view shed and in the comparable community. This database contained more than 25,000 records of property sales within the view shed and the selected comparable communities.

Three Case Examinations

REPP looked at price changes for each of the ten projects in three ways: Case 1 looked at the changes in the view shed and comparable community for the entire period of the study; Case 2 looked at how property values changed in the view shed before and after the project came on-line; and Case 3 looked at how property values changed in the view shed and comparable community after the project came on-line.

> **Case 1** looked first at how prices changed over the entire period of study for the view shed and comparable region. Where possible, we tried to collect data for three years preceding and three years following the on-line date of the project. For the ten projects analyzed, property values increased faster in the view shed in eight of the ten projects. In the two projects where the view shed values increased slower than for the comparable community, special circumstances make the results questionable. Kern County, California is a site that has had wind development since 1981. Because of the existence of the old wind machines, the site does not provide a look at how the new wind turbines will affect property values. For Fayette County, Pennsylvania the statistical explanation was very poor. For the view shed the statistical analysis could explain only 2 percent of the total change in prices.
>
> **Case 2** compared how prices changed in the view shed before and after the projects came on-line. For the ten projects analyzed, in nine of the ten cases the property values increased faster after the project came on line than they did before. The only project to have slower property value growth after the on-line date was Kewaunee County, Wisconsin. Since Case 2 looks only at the view shed, it is possible that external factors drove up prices faster after the on-line date and that analysis is therefore picking up a factor other than the wind development.
>
> Finally, **Case 3** looked at how prices changed for both the view shed and the comparable region, but only for the period after the projects came on-line. Once again, for nine of the ten projects analyzed, the property values increased faster in the view shed than they did for the comparable community. The only project to see faster property value increases in the comparable community was Kern County, California. The same caution applied to Case 1 is necessary in interpreting these results.

If property values had been harmed by being within the view-shed of major wind developments, then we expected that to be shown in a majority of the projects analyzed. Instead, to the contrary, we found that for the great majority of projects the property values actually rose more quickly in the view shed than they did in the comparable community. Moreover, values increased faster in the view shed after the projects came on-line than they did before. Finally, after projects came on-line, values increased faster in the view shed than they did in the comparable community. In all, we analyzed ten projects in three cases; we looked at thirty individual analyses and found that in twenty-six of those, property values in the affected view shed performed better than the alternative.

This study is an empirical review of the changes in property values over time and does not attempt to present a model to explain all the influences on property values. The analysis we conducted was done solely to determine whether the existing data could be interpreted as supporting the claim that wind development harms property values. It would be desirable in future studies to expand the variables incorporated into the analysis and to refine the view shed in order to look at the relationship between property values and the precise distance from development. However, the limitations imposed by gathering data for a consistent analysis of all major developments done post-1998 made those refinements impossible for this study. The statistical analysis of all property sales in the view shed and the comparable community done for this Report provides no evidence that wind development has harmed property values within the view shed. The results from one of the three Cases analyzed are summarized in Table 1 and Figure 1 below.

Regression Analysis

REPP used standard simple statistical regression analyses to determine how property values changed over time in the view shed and the comparable community. In very general terms, a regression analysis "fits" a linear relationship, a line, to the available database. The calculated line will have a slope, which in our analysis is the monthly change in average price for the area and time period studied. Once we gathered the data and conducted the regression analysis, we compared the slope of the line for the view shed with the slope of the line for the comparable community (or for the view shed before and after the wind project came on-line).

Table 1: Summary of Statistical Model Results for Case 1

Project/On-Line Date	Monthly Average Price Change ($/month)	
	View Shed	Comparable
Riverside County, CA	$1,719.65	$814.17
Madison County, NY (Madison)	$576.22	$245.51
Carson County, TX	$620.47	$296.54
Kewaunee County, WI	$434.48	$118.18
Searsburg, VT	$536.41	$330.81
Madison County, NY (Fenner)	$368.47	$245.51
Somerset County, PA	$190.07	$100.06
Buena Vista County, IA	$401.86	$341.87
Kern County, CA	$492.38	$684.16
Fayette County, PA	$115.96	$479.20

While regression analysis gives the best fit for the data available, it is also important to consider how "good" (in a statistical sense) the fit of the line to the data is. The regression will predict values that can be compared to the actual or observed values. One way to measure how well the regression line fits the data calculates what percentage of the actual variation is explained by the predicted values. A high percentage number, over 70%, is generally a good fit. A low number, below 20%, means that very little of the actual variation is explained by the analysis. Because this initial study had to rely on a database constructed after the fact, lack of data points and high variation in the data that was gathered meant that the statistical fit was poor for several of the projects analyzed. If the calculated linear relationship does not give a good fit, then the results have to be looked at cautiously.

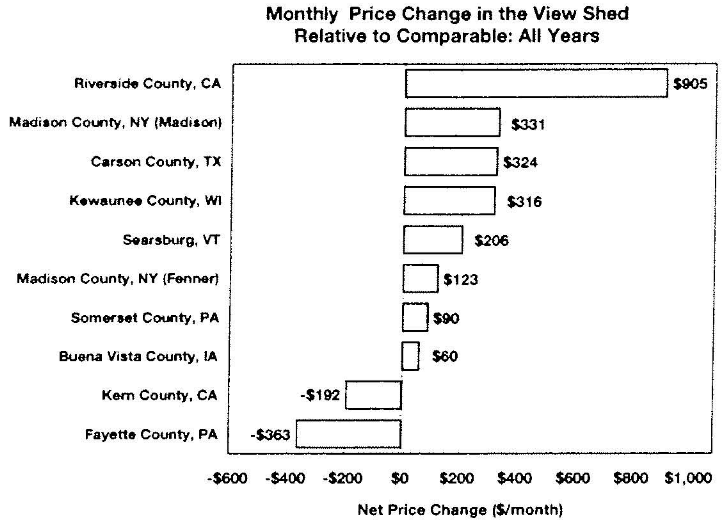


FIGURE 1: MONTHLY PRICE CHANGE IN THE VIEW SHED
RELATIVE TO COMPARABLE: ALL YEARS

CASE RESULT DETAILS

Although there is some variation in the three Cases studied, the results point to the same conclusion: the statistical evidence does not support a contention that property values within the view shed of wind developments suffer or perform poorer than in a comparable region. For the great majority of projects in all three of the Cases studied, the property values in the view shed actually go up faster than values in the comparable region. Analytical results for all three cases are summarized in Table 2 below.

TABLE 2: DETAILED STATISTICAL MODEL RESULTS

Location: Buena Vista County, IA
Project: Storm Lake I & II

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Oct 02 Jan 96 - Oct 02	$401.86 $341.87	0.67 0.72	The rate of change in average view shed sales price is 18% greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Oct 02	$370.52 $631.12	0.51 0.53	The rate of change in average view shed sales price is 70% greater after the on-line date than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	May 99 - Oct 02 May 99 - Oct 02	$631.12 $234.84	0.53 0.23	The rate of change in average view shed sales price after the on-line date is 2.7 times greater than the rate of change of the comparable after the on-line date.

Location: Carson County, TX
Project: Llano Estacado

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 98 - Dec 02 Jan 98 - Dec 02	$620.47 $296.54	0.49 0.33	The rate of change in average view shed sales price is 2.1 times greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 98 - Oct 01 Nov 01 - Dec 02	$553.92 $1,879.76	0.24 0.83	The rate of change in average view shed sales price after the on-line date is 3.4 times greater than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	Nov 01 - Dec 02 Nov 01 - Dec 02	$1,879.76 -$140.14	0.83 0.02	The rate of change in average view shed sales price after the on-line date increased at 13.4 times the rate of decrease in the comparable after the on-line date.

Location: Fayette County, PA
Project: Mill Run

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Dec 97-Dec 02 Dec 97-Dec 02	$115.96 $479.20	0.02 0.24	The rate of change in average view shed sales price is 24% of the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Dec 97 - Nov 01 Oct 01-Dec 02	-$413.68 $1,562.79	0.19 0.32	The rate of change in average view shed sales price after the on-line date increased at 3.8 times the rate of decrease before the on-line date.
Case 3	View shed, after Comparable, after	Oct 01-Dec 02 Oct 01-Dec 02	$1,562.79 $115.86	0.32 0.00	The rate of change in average view shed sales price after the on-line date is 13.5 times greater than the rate of change of the comparable after the on-line date.

Location: Kern County, CA
Project: Pacific Crest, Cameron Ridge, Oak Creek Phase II

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Dec 02 Jan 96 - Dec 02	$492.38 $684.16	0.72 0.74	The rate of change in average view shed sales price is 28% less than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 96-Feb 99 Mar 99 - Dec 02	$568.15 $786.60	0.44 0.75	The rate of change in average view shed sales price is 38% greater after the on-line date than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	Mar 99 - Dec 02 Mar 99 - Dec 02	$786.60 $1,115.10	0.75 0.95	The rate of change in average view shed sales price after the on-line date is 29% less than the rate of change of the comparable after the on-line date.

Location: Kewaunee County, WI
Project: Red River (Rosiere), Lincoln (Rosiere), Lincoln (Gregorville)

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Sep 02 Jan 96 - Sep 02	$434.48 $118.18	0.26 0.05	The rate of change in average view shed sales price is 3.7 times greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 96 - May 99 Jun 99 - Sep 02	-$238.67 $840.03	0.02 0.32	The increase in average view shed sales price after the on-line date is 3.5 times the decrease in view shed sales price before the on-line date.
Case 3	View shed, after Comparable, after	Jun 99 - Sep 02 Jun 99 - Sep 02	$840.03 -$630.10	0.32 0.37	The average view shed sales price after the on-line date increases 33% quicker than the comparable sales price decreases after the on-line date.

Location: Madison County, NY
Project: Madison

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Jan 03 Jan 97 - Jan 03	$576.22 $245.51	0.29 0.34	The rate of change in average view shed sales price is 2.3 times greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 97 - Aug 00 Sep 00 - Jan 03	$129.32 $1,332.24	0.01 0.28	The rate of change in average view shed sales price after the on-line date is 10.3 times greater than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	Sep 00 - Jan 03 Sep 00 - Jan 03	$1,332.24 -$418.71	0.28 0.39	The rate of change in average view shed sales price after the on-line date increased at 3.2 times the rate of decrease in the comparable after the on-line date.

Location: Madison County, NY
Project: Fenner

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Jan 03 Jan 97 - Jan 03	$368.47 $245.51	0.35 0.34	The rate of change in average view shed sales price is 50% greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 97 - Nov 01 Dec 01 - Jan 03	$587.95 -$418.98	0.50 0.04	The rate of decrease in average view shed sales price after the on-line date is 29% lower than the rate of sales price increase before the on-line date.
Case 3	View shed, after Comparable, after	Dec 01 - Jan 03 Dec 01 - Jan 03	-$418.98 -$663.38	0.04 0.63	The rate of decrease in average view shed sales price after the on-line date is 37% less than the rate of decrease of the comparable after the on-line date.

Location: Riverside County, CA
Project: Cabazon, Enron, Energy Unlimited, Mountain View Power Partners I & II, Westwind

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Nov 02 Jan 96 - Nov 02	$1,719.65 $814.17	0.92 0.81	The rate of change in average view shed sales price is 2.1 times greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Nov 02	$1,062.83 $1,978.88	0.68 0.81	The rate of change in average view shed sales price is 86% greater after the on-line date than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	May 99 - Nov 02 May 99 - Nov 02	$1,978.88 $1,212.14	0.81 0.74	The rate of change in average view shed sales price after the on-line date is 63% greater than the rate of change of the comparable after the on-line date.

Location: Bennington and Windham Counties, VT
Project: Searsburg

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 94 - Oct 02 Jan 94 - Oct 02	$536.41 $330.81	0.70 0.45	The rate of change in average view shed sales price is 62% greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 94 - Jan 97 Feb 97 - Oct 02	-$301.52 $771.06	0.88 0.71	The rate of change in average view shed sales price after the on-line date increased at 2.6 times the rate of decrease before the on-line date.
Case 3	View shed, after Comparable, after	Feb 97 - Oct 02 Feb 97 - Oct 02	$771.06 $655.20	0.71 0.78	The rate of change in average view shed sales price after the on-line date is 18% greater than the rate of change of the comparable after the on-line date.

Location: Somerset County, PA
Project: Excelon, Green Mountain

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Oct 02 Jan 97 - Oct 02	$190.07 $100.06	0.30 0.07	The rate of change in average view shed sales price is 90% greater than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 97 - Apr 00 May 00 - Oct 02	$277.99 $969.59	0.37 0.62	The rate of change in average view shed sales price after the on-line date is 3.5 times greater than the rate of change before the on-line date.
Case 3	View shed, after Comparable, after	May 00 - Oct 02 May 00 - Oct 02	$969.59 -$418.73	0.62 0.23	The rate of change in average view shed sales price after the on-line date increased at 2.3 times the rate of decrease in the comparable after the on-line date.

Each of the three Cases takes a different approach to evaluating the price changes in the view shed and comparable community. By finding consistent results in all three Cases, the different approaches help to address concerns that could be raised about individual approaches. The selection of the comparable community is based upon a combination of demographic statistics and the impressions of local assessors and is inherently subjective. It is possible that arguments about the legitimacy of the selection of the comparable could arise and be used to question the legitimacy of the basic conclusion. However, since Case 2 looks only at the view shed and since the results of the Case 2 analysis are completely consistent with the other Cases, the selection of the comparable community will not be crucial to the legitimacy of the overall conclusion. To take another example, Case 1 uses data from the entire time period, both before and after the on-line date. We anticipate possible criticisms of this Case as masking the "pure" effect of the development that would only occur after the project came on-line. However, Cases 2 and 3 look separately at the before and after time periods and produce results basically identical to the Case 1 results. Because all three Cases produce similar results, Cases 2 and 3 answer the concerns about Case 1.

The Database

The results of the analysis depend greatly upon the quality of the database that supports the analysis. The Report is based on a detailed empirical investigation into the effects of wind development on property values. The study first identified the 27 wind projects over 10 MW installed capacity that have come on-line since 1998. REPP chose the 1998 on-line date as a selection criterion for the database because it represented projects that used the new generation of wind machines that are both taller and quieter than earlier generations. (REPP did not consider projects that came on-line in 2002 or after since there would be too little data on property values after the on- line date to support an analysis. These projects can be added to the overall database and used for subsequent updates of this analysis, however.) REPP chose the 10 MW installed capacity as the other criterion because if the presence of wind turbines is having a negative affect it, should be more pronounced in projects with a large rather than small number of installations. In addition, we used the 10 MW cut-off to assure that the sample of projects did not include an over-weighting of projects using a small number of turbines.

Of the 27 projects that came on-line in 1998 or after and that were 10MW or larger installed capacity, for a variety of reasons, 17 had insufficient data to pursue any statistical analysis. For six of the 17 projects we acquired the data, but determined that there were too few sales to support a statistical analysis. For two of the remaining 11, state law prohibited release of property sales information. The remaining nine projects had a combination of factors such as low sales, no electronic data, and paper data available only in the office. (For a project-by-project explanation, see Chapter 2 of the Report.)

For each of the remaining ten projects, we assembled a database covering roughly a six-year period from 1996 to the present. For each of these projects we obtained individual records of all property sales in the "view shed" of the development for this six-year period. We also constructed a similar database for a "comparable community" that is a reasonably close community with similar demographic characteristics. For each of the projects, we selected the comparable community on the basis of the demographics of the community and after discussing the appropriateness of the community with local property assessors. As shown in Table 3 below, the database of view shed and comparable sales included more than 25,000 individual property sales. The initial included database of view shed and comparable sales included over 25,000 individual property sales. After review and culling, the final data set includes over 24,300 individual property sales, as shown in Table 3 below.

Table 3: Number of Property Sales Analyzed, by Project

Project/On-Line Date	Viewshed Sales	Comparable Sales	Total Sales
Searsburg, VT / 1997	2,788	552	3,340
Kern County, CA / 1999	745	2,122	2,867
Riverside County, CA / 1999	5,513	3,592	9,105
Buena Vista County, IA / 1999	1,557	1,656	3,213
Howard County, TX / 1999*	2,192	n/a	2,192
Kewaunee County, WI / 1999	329	295	624
Madison Co./Madison, NY / 2000	219	591	810
Madison Co./Fenner, NY / 2000**	453	591	1,044
Somerset County, PA / 2000	962	422	1,384
Fayette County, PA / 2001	39	50	89
Carson County, TX / 2001	45	224	269
TOTAL	14,842	9,504	24,346

*Howard County, TX comparable data not received at time of publication.

**Both wind projects in Madison County, NY, use the same comparable. Column totals adjusted to eliminate double counting.

Recommendations

The results of this analysis of property sales in the vicinity of the post-1998 projects suggest that there is no support for the claim that wind development will harm property values. The data represents the experience up to a point in time. The database will change as new projects come on-line and as more data becomes available for the sites already analyzed. In order to make the results obtained from this initial analysis as useful as possible to siting authorities and others interested in and involved with wind development, it will be important to maintain and update this database and to add newer projects as they come on-line.

Gathering data on property sales after the fact is difficult at best. We recommend that the database and analysis be maintained, expanded and updated on a regular basis. This would entail regularly updating property sales for the projects already analyzed and adding new projects when they cross a predetermined threshold, for example financial closing. In this way the results and conclusions of this analysis can be regularly and quickly updated.

ATTACHMENT C

ILLINOIS

GROUP

Peter Poletti

Poletti and Associates, Inc.

Impact of Wind Farms on Surrounding Property Values.

- Is the XYZ Wind Farm located so as to minimize any effect on property values?

Land Use

- Land uses in area.
- Topography.
- Vegetative patterns.

Information Sources

- Review of literature
- Personal inspection of study areas and operating wind farms
- Inspection of the XYZ Wind Farm Area.
- Review and analysis of property transactions at the assessor's offices located in areas of an existing wind farm

Methodology

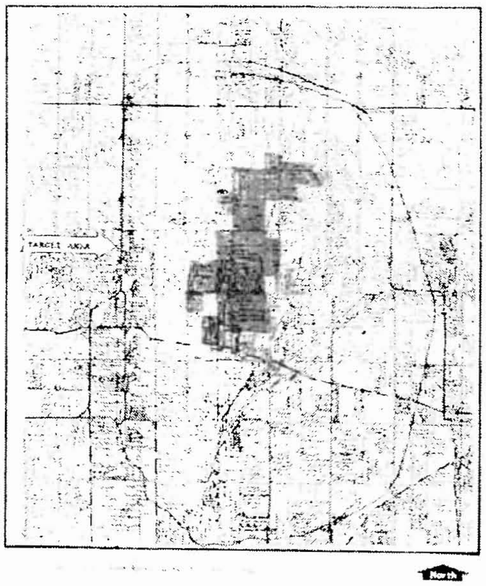
- Comparison of sale prices within Target Area to sale prices of similar properties within a Control Area.
- Target Area: A zone in proximity to a wind farm that is defined by a combination of distance, visibility, and intervening land uses
- Control Area: Region outside of the target area that is considered a zone where property values would not be affected by proximity to an operating wind farm.
- Averages within the Target and Control areas are then subjected to a Student's *t* Test to determine if there is a true difference in the means. If the calculated *t* value is less than the Standard *t* value, there is no statistically significant difference between the two averages.

Data Information

- Sales and information concerning those sales were obtained at local assessor's offices.
- Sales between related parties such as family members, result of judicial action, bank foreclosures, or to an energy company were not used in the analysis.
- These sales are not considered arm's length transactions.
- Collection of anecdotal data

MENDOTA HILLS

Located In Lee County, Illinois near the Community of Paw Paw.



Property Types

- Agricultural Tracts
- Residential Tracts
- Single-Family Residences

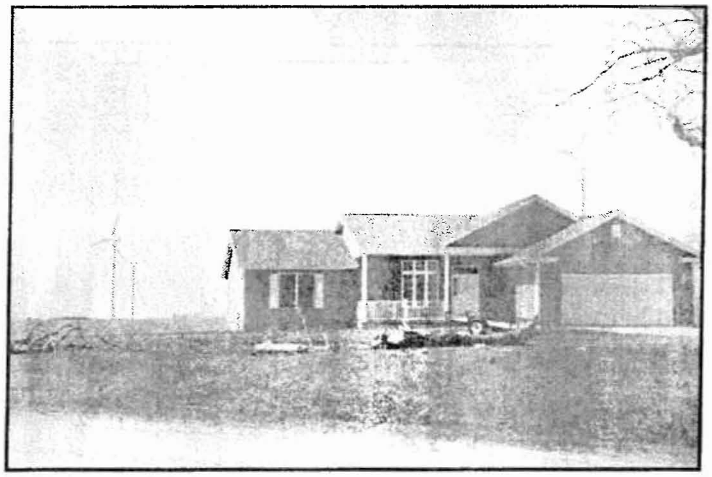
Mendota Results

Type	Target	Control	Target /SF	Control /SF	Stat. Diff.
January 2005 thru March 2008:					
Ag. Land(>20 Ac.):	8	38	$5,798	$5,584	No
Resid. Tracts 5 ac±	12	19	$16,873	$14,515	
Not Inc. Cobb Lane:	11	19	$15,517	$14,515	No
Residences: post 1955	18	40	$96.68	$115.52	No
Post 1955 Resid.:	7	19	$132.56	$134.48	No

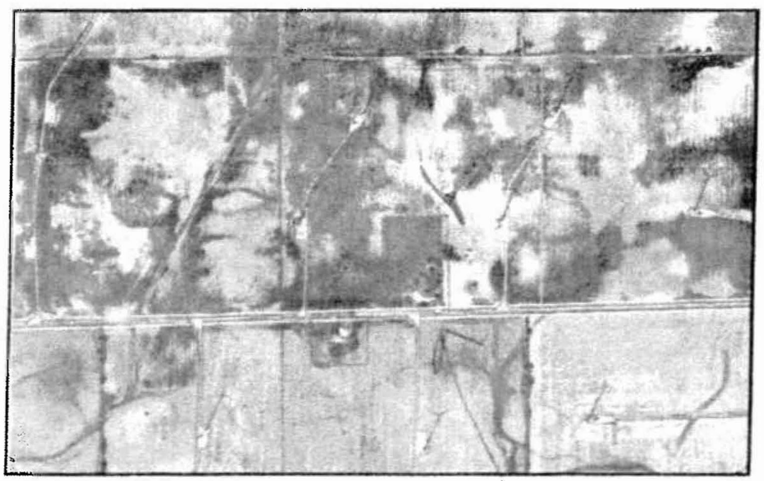
965 Bingham Rd.

- House built in 2005 and placed on Market
- Seven Turbines within 1,500 feet of the house.
- 1,786 square feet; 5 Ac. of land.
- Asking Price was $329,900
- Final Selling Price was $265,000.

965 Bingham Rd.



Aerial Photograph of 965 Bingham.

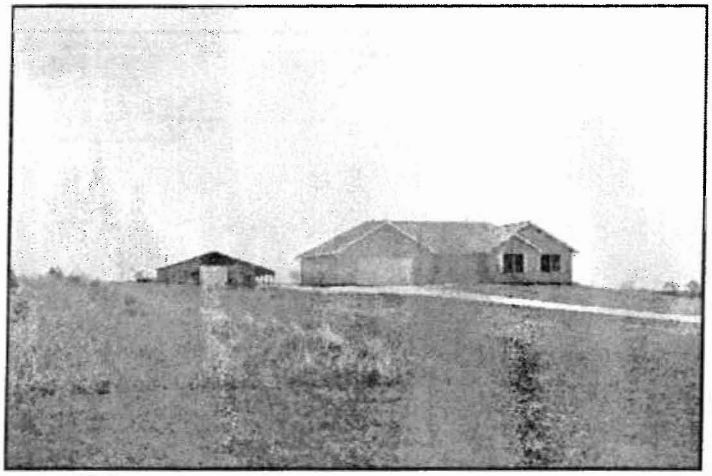


965 Bingham Sales Comparison Chart

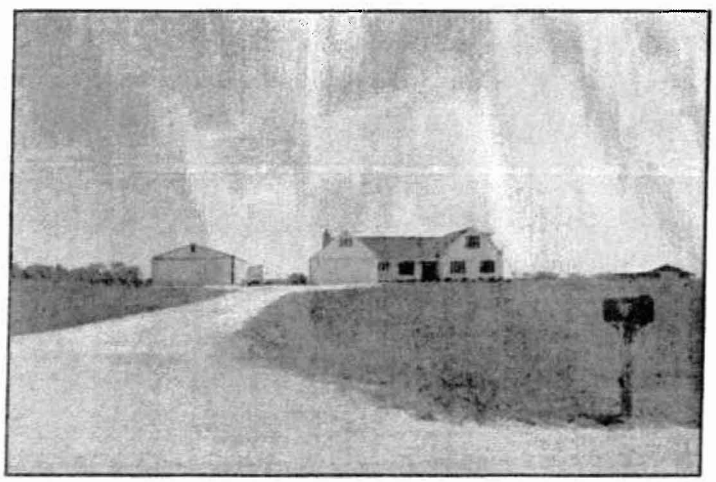
Property	965 Bingham	3569 Paw Paw	656 Ogee	664 Ogee	1995 Cotton Tail	1832 Quail Hollow
Sale Date:	3/27/2008	9/19/2007	5/17/2007	9/17/2007	9/5/2007	6/20/2007
Sale Price:	$265,000	$235,000	$175,000	$400,000	$249,900	$360,000
Size:	1,786	1,660	1,881	2,316	1,916	2,532
Lot:	5	1.39	5	7	1.134	2.44
Basement:	Full	Full	Full	Full	Full	Full
Const.:	Frame	Frame	Frame	Frame	Frame	Brick
Style:	1Sty	1Sty	1Sty	1Sty	1Sty	1Sty
Quality:	Avg.	Sim.	Sim.	Sim.	Sim.	Superior
Cond.:	Good	Good	Good	Good	Good	Good
Adj.Price:		$263,698	$243,125	$348,625	$287,403	$376,200
$/Ft²	$148.38	$158.85	$129.25	$150.53	$150.00	$148.58

3569 Paw Paw

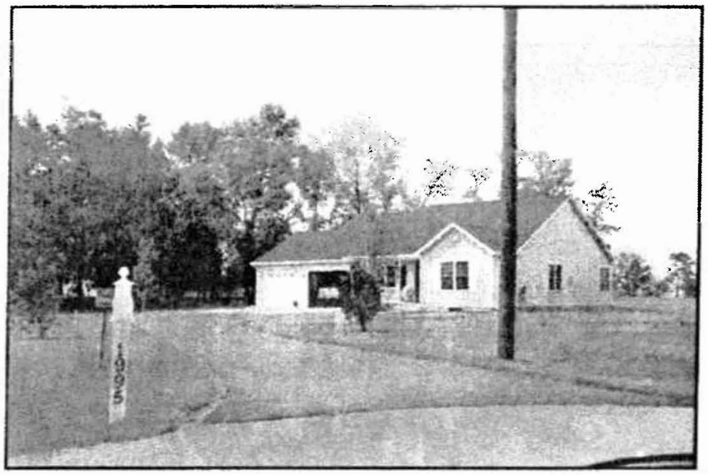
658 Ogee Rd.



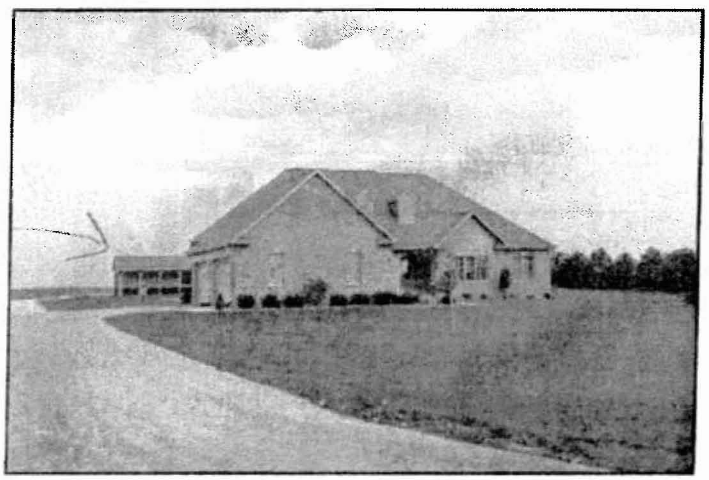
664 Ogee Rd.



1995 Cotton Tail



1832 Quail Hollow



Additional Data

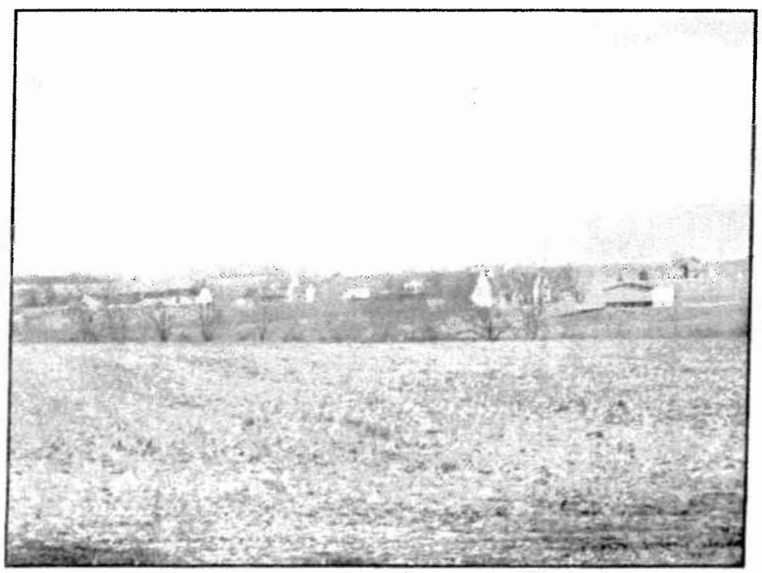
New Construction Near Mendota Hills

Target:	Parcel	Address	Tract Size	Owner	Type	Year	Size	Turbine Dist.
1	21 12 19 200 005	1190 CRESTRIDGE	5.00	OSTERREICHER	1 STY	2003	1,690	6,024
2	21 12 19 200 007	1186 CRESTRIDGE	5.00	BRIGGS	2 STY	2007	2,642	5,608
3	[illegible] 12 19 [illegible] 006	1185 CRESTRIDGE	5.00	DAVISON	1 STY	2003	[illegible]	5,840
4	[illegible]	308 BROOK MEADOW	[illegible]	KOWALSKI	2 STY	2005	[illegible]	4,365
5	[illegible]	[illegible] BROOK MEADOW	[illegible]	[illegible]	2 STY	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible] BROOK MEADOW	2.82	[illegible]	2 STY	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible] BROOK MEADOW	[illegible]	[illegible]	1 STY	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible] BROOK MEADOW	[illegible]	[illegible]	1 STY	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible] BROOK MEADOW	[illegible]	[illegible]	1 STY	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible] BROOK MEADOW	[illegible]	[illegible]	1 STY	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

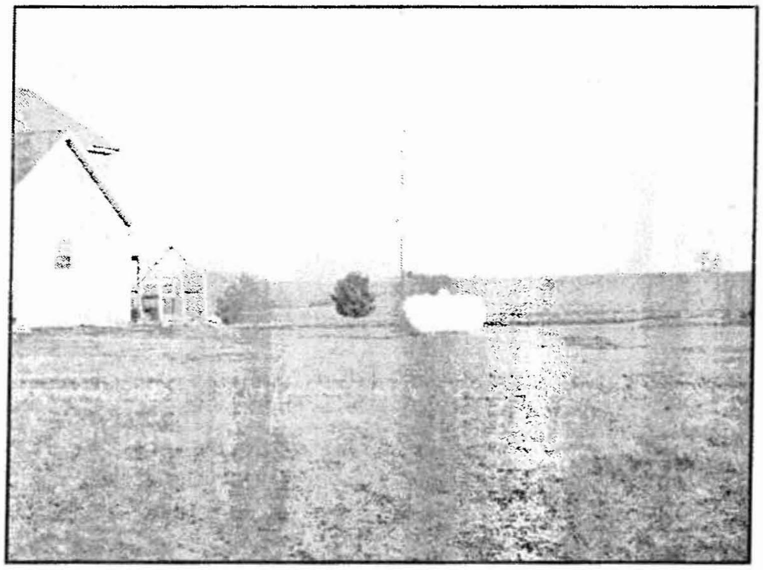
Meadowbrook Subdivision

- Located 0.8 miles from turbines
- Lot prices increased from $35,500 to $47,900
- 9 of 11 lots are sold
- 8 of sales occurred after construction of wind farm
- 7 houses constructed after the wind farm
- New 47 lot addition planned.

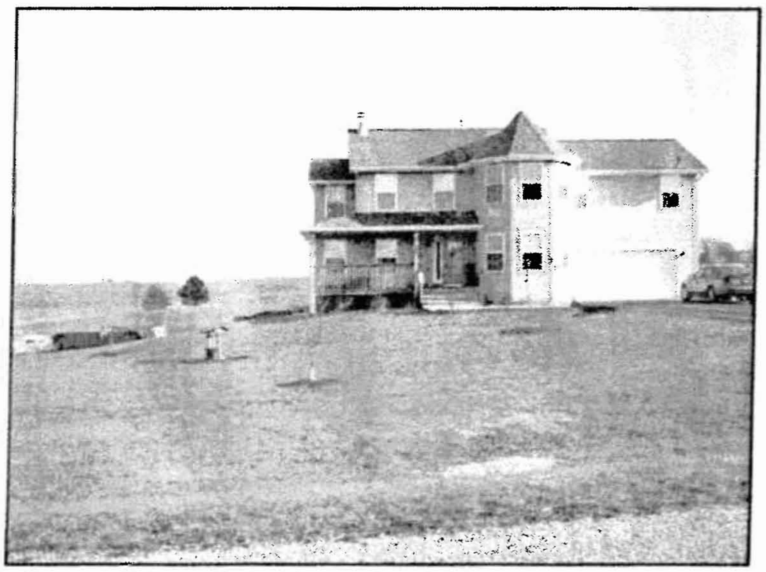
Meadowbrook Sub. And Wind Farm



View of Turbines from Meadowbrook Sub.



House within Meadowbrook Sub



Conclusion

- Based on these studies, there is no statistical difference between sale prices of properties located within proximity to an operating wind farm and those properties located some distance from an operating wind farm.

and including the 50-year storm event. Open waterways such as surface overflow swales shall be designed into the grading plan to receive all excess stormwater runoff. Depressing sidewalks across such overflow swales to meet this requirement shall be acceptable. Street ponding shall be allowed only for the conveyance of stormwater runoff and will be subject to approval by the public body accepting dedication of the street.

C. Rooftop Storm Water Storage

Rooftop storage of excess storm water shall be designed and constructed to provide permanent control inlets and parapet walls to contain excess storm water. Adequate structural roof design must be provided to ensure that roof deflection does not occur which could cause the roofing material to fail and result in leakage. Overflow areas must be provided to ensure that the weight of storm water will never exceed the structural capacity of the roof. Any rooftop storage of excess stormwater shall be approved only upon submission of building plans signed and sealed by a licensed structural engineer or architect attesting to the structural adequacy of the design.

D. Automobile Parking Lot Storage Areas

Automobile parking lots may be designed to provide temporary detention storage on a portion of their surfaces. Automobile parking facilities used to store excess storm water may be constructed having a maximum depth of stored storm water of 0.6 feet; and these areas shall be located in the most remote, least used areas of the parking facility. Design and construction of automobile parking in storm water areas must insure that there is minimal damage to the parking facility due to flooding, including minimal damage to the subbase. Warning signs shall be mounted at appropriate locations to warn of possible flood conditions during storm periods.

E. Underground Storm Water Storage

Underground storm water storage facilities must be designed for easy access in order to remove accumulated sediment and debris. These facilities must be provided with a positive gravity outlet unless otherwise approved by the reviewing authority.

Section 7 Protecting Existing Drainage

7.1 Natural Drainage

A. Existing perennial streams shall not be modified to accommodate onsite flows of stormwater. Streambanks may be modified, however, incident to the installation of excess stormwater runoff outfalls, necessary to ensure safety or bank stabilization, and/or for the improvement of aquatic habitats.

7.1 Natural Drainage - Continued

B. Other natural drainage features such as depressional storage areas and swales shall be incorporated into the drainage system.

7.2 Agricultural Drainage Improvements

A. The outlet for existing agricultural drainage tile will be located and the capacity of the outlet shall be maintained for the watershed upstream of the development area.

B. Existing easements for any agricultural drainage tile located underneath areas that will be developed shall be preserved. If no easement exists an easement shall be granted for access and maintenance as provided in Section 9 below. Such easements shall be of sufficient width and located to provide for continued functioning and necessary maintenance of drainage facilities. No buildings or permanent structures including paved areas but excluding streets, sidewalks, or driveways, which cross the easement by the shortest possible route may be located within the easement without the consent and approval of any public body to which the easement is granted.

C. All agricultural drainage tile located underneath areas that will be developed shall be replaced with non-perforated conduit to prevent root blockage provided however that drainage district tile may remain with the approval of the drainage district.

D. Agricultural drainage tile which, due to development, will be located underneath roadways, drives, or parking areas as allowed by Paragraph C above shall be replaced with ductile iron, or reinforced concrete pipe or equivalent material approved by the reviewing authority as needed to prevent the collapse of the agricultural drainage conduit.

E. Agricultural drainage tile may be relocated within development areas upon approval of the reviewing authority. Such relocation shall maintain sufficient slope and capacity to prevent sedimentation and to prevent an increase in scouring or structural damage to the conduit. Such relocation shall only be with the consent and approval of the drainage district which is responsible for maintaining the tile. If the tile is not under the authority of a drainage district the reviewing authority shall consider the interests of those landowners who are served by the tile.

F. No storm sewer inlet, outlet, or detention basin outlet shall be connected to farm drainage tile unless flow is restricted to an amount equal to or less than the discharge capacity of the tile. Such connection shall only be made with the consent and approval of the drainage district responsible for maintaining the tile. If the tile is not under the authority of a drainage district the reviewing authority shall consider the interests of those landowners who are served by the tile.

G. No fill shall be placed nor grade altered in such a manner that it will cause surface water upstream of the development to pond or direct surface flows in such a way as to

7.2 Agricultural Drainage Improvements - Continued

create a nuisance.

H. All surface runoff water shall exit the development at nonerosive velocities. All subsurface flows shall exit the development at such a velocity so as to prevent an increase in scouring or structural damage to off-site tile drains.

I. Sizing of culvert crossings shall consider entrance and exit losses as well as tailwater conditions on the culvert.

Section 8 Joint Construction

Storm water storage areas may be planned and constructed jointly by two or more landowners so long as compliance with this policy is maintained.

Section 9 Easements

Easements to the County, township, drainage district or other public authority to provide for maintenance of public drainage facilities which serve the site and which are or are to be dedicated to, owned by, or under the control of such public authority shall be granted to further this policy when the need for such facility is in whole or in part specifically and uniquely attributable to the proposed development. All known agricultural drainage tile located underneath areas to be developed shall be granted an easement if no written easement exists prior to development. Such easement shall be approved in writing by the public body to which they are granted and recorded in the Champaign County Recorders Office before the reviewing authority issues any final approval except in the case of subdivisions where such easements are shown on the plat.

Section 10 Rule of Construction

These policy guidelines shall be construed liberally in the interests of the public so as to protect the public health, safety, and welfare.

Section 11 Waivers

Any or all of these policies may be waived or varied by the reviewing authority in accord with the applicable provisions of Article 18 of the Champaign County Subdivision Regulations or Section 9.1.9 of the Champaign County Zoning Ordinance.

ATTACHMENT E

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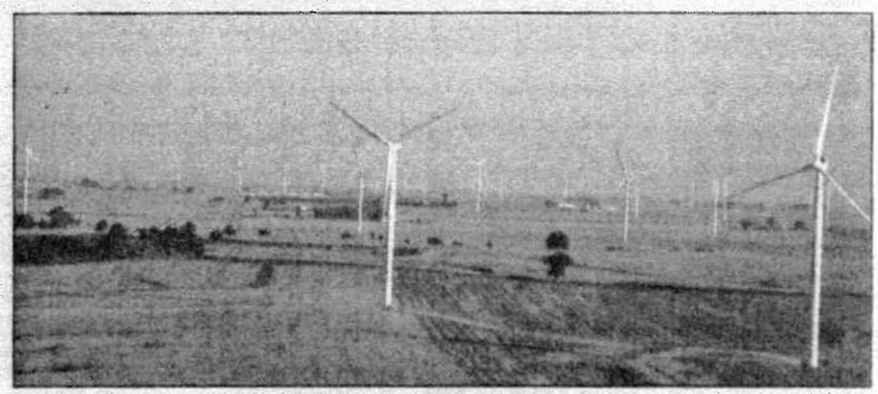
Sky High

Wind towers may limit aerial applications

By TOM C. DORAN
AgriNews Publications



Aerial applicators are required to fly low to the ground to prevent crop treatments from drifting, keep the chemical on target, follow all product label directions and restrictions and keep buffer zones between the target field and sensitive sites such as waterways and wildlife areas.

BLOOMINGTON, Ill. — Wind farms are becoming a major contributor in the quest toward more renewable energy, but growers need to be aware of potential agricultural production limitations these towers could create.

The construction of wind turbines has not only benefited the national energy picture, but also provided additional income to landowners.

However, 300-foot or taller turbines also are creating some unforeseen challenges and misconceptions among growers who utilize aerial application.

Due to safety concerns, agricultural aerial applicators are not able to fly into some areas with wind turbines, and are forced to add a surcharge in other areas with towers due to the additional costs of liability insurance and fuel.

State and national aerial applicator organizations are urging wind farm developers to work with them toward improving their safety.

"We're not opposed to wind energy towers. We're just concerned about their placement," said Andrew Moon, executive director of the National Agricultural Applicators Association.

"You can't argue against clean energy, but if you can take into account the well being of other people and what kind of criteria they need to do their job, such as in our industry, the placement of these things is important."

Jean Payne, president of the Illinois Fertilizer and Chemical Association, concurred this is not an anti-wind message.

"It's just when farmers go in and negotiate these contracts (with wind companies) they really need to understand that if aerial application is something important to them, then they should use that as a negotiation tool because they're going to be paying more for it if they can get it at all," Payne said.

As the usage of fungicide and insecticide becomes more of a mainstay of crop production and provides a potential for yield increases, giving up a five to 10 bushels an acre boost needs to be factored in when negotiating for a wind tower on one's land, according to Payne.

"Obviously in the last few years there has been a lot of emphasis on the whole fungicide aspect and, yes, it is an important tool. Sometimes insecticides or herbicides are very important tools as well as getting fertilizer on by air," said Scott Schertz of Schertz Aerial Service in Hudson.

"Overall, it is important for farmers to have a platform available to protect their crops when they can't get into the fields practically because the crops are too wet or other situations.

"It is a important tool for agriculture that is well established, that has been a normal part of the existing farm practice in this area.

"They are a real safety hazard, and it is very intimidating to work around them. It is additional fuel and additional planning time to do some of what is around them and even next to them."

Chuck Holzwarth, who operates a flying service at Virden, said "if there's a field we can do, we'll do it."

"But I'm absolutely not going to send me or one of my pilots into a field with a bunch of towers around it and get killed," he stressed. "That's the bottom line."

Landowners with a tower may not only be impacted in terms of aerial spraying, but also their neighbors who may not have a turbine.

"Whether you have a turbine on the ground or you don't but have turbines all around your ground, it may or may not ever be able to be sprayed with an airplane again," Holzwarth said.

"It depends on the location of the neighboring obstructions, and if they impact our operations even if we can do it, they are still going to get a surcharge for it," Schertz said. "Any time that a wind tower is involved, and it is an obstruction of our normal routine, we do enforce the surcharge. On my work order, if it is within a mile and it obstructs our operations, there is a surcharge.

"Obviously, if there is a field where a wind tower is strictly beside and we don't have to go crossways at all, for instance, I don't charge for it.

"But if you have a situation where the field is clear but you've to them all the way around it, that's a huge issue."

Holzwarth said that wind energy companies "tell farmer's they've talked to professionals about aerial application and the professionals tell them this and that. I don't know who they're calling professionals, but it's not anybody who is sitting in an airplane."

"I will admit I am biased. I question if it is in the long term interest of landowners to get involved with those items," Schertz said.

"But strictly from the aerial application side, a little cooperation from the wind power companies would certainly help and I would say I've had very little.

See LIMIT; page A6

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year, expanding the country's wind energy fleet by 45 percent and bringing the total capacity to about 24,300 MW.

Although 20,000 MW is an important milestone, wind power provides just over 1.5 percent of the nation's electricity, far below the potential identified by experts, according to AWEA.

Still, it is one of the fastest-growing electricity sources today, providing 35 percent of the total new capacity added in 2007 — second only to natural gas.

The United States had 1,000 MW of wind power installed by 1985; 2,000 MW installed by 1999; and 5,000 MW by 2003.

Its first 10,000 MW was installed by mid-2006.

conduct a study on the safe height and distance that wind turbines can be installed in relation to aviation sites.

The amendment was included in the version passed by the U.S. House and awaits action by the Senate.

"These vertical obstacle are a major safety concern to aerial applicators and significantly hamper agricultural production," according to the issue brief.

Since 1995, 7.1 percent of all aerial application fatalities are the result of collisions with towers

"Wind energy towers pose the greatest safety and accessibility concerns to agricultural aviators because of their projected rapid growth in the coming years and the manner in which many of these towers are often clustered closely together," the NAAA said in the brief.

"Without wise placement and proper marking of towers in agricultural areas, farmers may be at risk of losing important aerial application services performed on their cropland.

"Towers sited directly in the flight path of aerial applicators' landing strips and/or hampering the accessibility of treatable cropland could literally shutdown aerial applicators' businesses.

"This would detrimentally affect, in some instances, the only method farmers have available to them when the time comes to apply crop protection chemicals, fertilizers and seeds to foster crop growth.

"Aircraft help in treating wet fields when crop foliage is too heavy to allow ground rigs to enter. An aircraft can accom-

account the safety and agricultural production issues of the aerial applicator.

"Erection of these towers should be away from the prime agricultural land."

The NAAA established the following safety guidelines that it requests be met before the construction of towers:

■ Petitions for constructing towers should be provided to the local government zoning authority, landowners and or farmers and aerial applicators within at least a one-half mile radius of a proposed tower, and the state or regional agricultural aviation association, no later than 30 days before tower construction permits are considered for approval.

This information should include the proposed location of each turbine generator, each meteorological tower including the height to be associated with the wind farm, the distribution sub-station and any connecting power lines from the generators, and power lines connecting the sub-station to the existing electrical power grid;

■ Towers should not be erected on prime agricultural land in a manner that may inhibit aerial applicators' access and ability to treat the land;

■ If a proposed tower is to

be put in jeopardy of not being treated;

■ In the event that a proposed tower is constructed on prime agricultural land or in the vicinity of such land, towers should be freestanding without guy wires. Furthermore, towers should be lit and well marked so they are clearly visible to aerial applicators;

■ Towers erected with guide wires, particularly the meteorological testing towers, should be marked with two visible warning spheres on each guy wire, highly visible sleeves on the lower end of the cables that extend at least eight feet above the height of the highest crop that may be grown there, and properly lit;

■ In the event that a number of proposed towers are to be constructed on prime agricultural land or in the vicinity of such land, the towers should be constructed in a linear pattern, not a disordered, clustered pattern that would make an area completely inaccessible by air; and

■ During construction and upon completion, the operator of the wind farm should provide detailed field layout information to the local government zoning authority and make this information available to those working in close proximity to that area.

Limit

From page one

"The placement is a huge issue on how difficult it is to work around them, and obviously they have their own interest and they are not very concerned about other stakeholder interest in safety."

Schertz noted that his business has been impacted by wind farms already constructed in central Illinois.

A small amount of the impact has been felt in areas where Schertz can no longer spray due to turbines in those fields.

"Another part of the impact has been some people have not asked us to spray because of that. I really thing that has probably been a bigger impact," Schertz said.

"I'm not saying that maybe they knew already that it was too much of a mess and there wasn't any point of asking, but I have noticed a decrease in market share in areas where there are a lot of them."

Schertz was asked if the downdraft of the blade rotation causes concern for pilots.

"Yes it is an impact. It isn't necessarily what I would call a downdraft, but it does disrupt the airflow and obviously an airplane is operating in that air.

"So if it is to the point basically that they're able to extract energy out of the air, they're disturbing the air. The more power they pull out, the more it disturbs it, and it is rough around them when you're into that situation.

"Yes, that is another factor. I mean they are not static obstacles. They impact the air and they're variable. It adds a lot of complexity to the operation."

Non-wind turbine landowners should investigate spraying impact

By TOM C. DORAN

AgriNews Publications

BLOOMINGTON, Ill. — Aerial application may not only be limited to farmland with wind turbines, but also nearby, and landowners should take steps to assess the potential impact.

With wind farms sprouting up throughout the Midwest, some aerial sprayers may not be able or want to apply chemicals on land with turbines, depending on the layout and the number of towers in a particular area.

In other cases, the location or number of turbines on one property may either limit an aerial applicator's access to adjacent property without a tower or increase the application cost due to the higher risk.

Jerry Quick, Illinois Farm Bureau senior counsel, who has conducted wind farm informational meetings throughout the state, was asked what advice he would have for a landowner whose aerial application options are limited by his neighbor's wind towers.

"They need to discuss that with their personal legal counsel, and perhaps the also need to discuss that with the wind company and see what they have to offer. They should also talk to the sprayer," Quick said.

He added that at least one wind energy company has said they would "turn off the turbines for a period of time to enhance the spraying process."

From a legal standpoint, the rights of the non-wind tower landowner and the potential for aerial application limitations have not been addressed in any case study.

"To the best of my knowledge, there is nothing out there at the present time. Also I am not aware of anything moving through the court system where there has not been a final decision but it has actually been filed," Quick said.

Any policies regarding where an aerial applicator can spray when wind towers are involved are up to the discretion of the individual fliers.

Quick includes in his presentations on wind farm legal issues comments about aerial sprayer in this scenario.

"I'm not saying, nor do I believe, nor have I learned that it's impossible to have aerial spraying if you have wind turbines," he said.

"But what I am saying is you need to think about how this might impact your ability to get aerial spraying because there may be some aerial sprayers out there who, depending on your configuration and numbers, will not do it or they'll do it but it's going to cost you more.

"You just need to know upfront. Find out how this is going to impact you. Hopefully, it won't, but it might."

ATTACHMENT F

ATTACHMENT G

Washington Department of FISH AND WILDLIFE

August 2003

SECTION 1

BASELINE AND MONITORING STUDIES FOR WIND PROJECTS

PRE-PROJECT ASSESSMENT

The primary purposes of pre-project assessment studies are to 1) collect information suitable for predicting the potential impacts of the project on wildlife and plants and 2) design the project layout (e.g., turbine locations) so that impacts on biological resources are avoided and minimized. To the extent possible, this pre-project assessment may utilize existing information from projects in comparable habitat types in locations close to the proposed project. The site-specific components and the duration of the assessment should depend on the size of the project, the availability and extent of existing and applicable information in the vicinity of the project, the habitats potentially affected, the likelihood and timing of occurrence of Threatened and Endangered and other Sensitive-Status species at the site, and other factors such as issues and concerns identified during public scoping. Each component is discussed below. The results of the information review and baseline studies should be reported to the affected stakeholders (e.g., state and federal wildlife agencies) in a timely fashion.

Information Review

Existing information on species and potential habitats in the vicinity of the project area should be reviewed and if appropriate, mapped. Sources of existing information should include resource agencies, local experts, recognized databases (e.g., Priority Habitats and Species [PHS] database), and data gathered at other nearby wind plants or other types of projects. This information should be used to develop a current state-of-the-art field and analysis protocol that is reviewed and approved by the state wildlife agency.

Habitat Mapping

Key information about general vegetation and land cover types, wildlife habitat, habitat quality, extent of noxious weeds, and physical characteristics within the project area should be collected and compiled using current state-of-the-art protocols.

Raptor Nest Surveys

At a minimum, one raptor nest survey during breeding season within 1-mile of the project site[1] should be conducted to determine the location and species of active nests potentially disturbed by construction activities, and to identify active and potentially active nest sites with the highest likelihood of impacts from the operation of the wind plant. A larger survey area (e.g., a 2-mile buffer) is recommended if there is some likelihood of the

[1] Site – a project "site" for the purposes of addressing potential raptor nest disturbances is defined as the furthest extent of a ground disturbing activity and includes gravel sites used for construction, overhead and underground electrical routes, new and upgraded substations.

occurrence of nesting state and/or federally threatened and endangered raptor species (e.g., ferruginous hawk, bald eagle, golden eagle), or if empirical data on displacement impacts may be monitored after construction (see Research-Orientated Studies Below).

General Avian Use Surveys
A minimum of one full season of avian use surveys is recommended following current state-of-the-art protocols to estimate the use of the project area by avian species/groups of interest during the season of most concern (usually spring/early summer). Additional seasonal data (e.g. fall or winter) is recommended in the following cases: 1) use of the site for the avian groups of concern is estimated to be high relative to other projects, 2) there is very little existing data regarding seasonal use of the project site, and/or 3) the project is especially large. This additional avian use data should be collected to refine impact predictions and make decisions on project layout.

Surveys for Threatened, Endangered and Sensitive Species
If existing information suggests the probable occurrence of state and/or federal threatened or endangered or sensitive-status species on the project site at a level of concern, focused surveys are recommended during the appropriate season to determine the presence or likelihood of presence of the species. For example, if bald eagles are expected to winter in concentrations in the project vicinity, targeted surveys to estimate bald eagle use of the site would be appropriate.

MINIMIZATION OF WILDLIFE IMPACTS
One goal of the pre-project assessment is to help design the project to avoid, reduce and minimize impacts to habitat and wildlife. Below are some considerations for avoiding and minimizing impacts to wildlife.

<u>Avoid Impacts</u>

- Encourage development in agricultural and already disturbed lands, including using existing transmission corridors and roads where possible.

- Use of tubular towers is recommended to reduce the ability of birds to perch on towers and to possibly reduce the risk of collision. Discourage the use of lattice towers, particularly those with horizontal cross-members.

- Discourage tower types that employ guy wires. If guy wired towers are approved, encourage the requirement of bird flight diverters on the guy wires.

- Avoid high bird concentration areas, especially concentration areas of sensitive status species, and breeding sites.

- Discourage the use of rodenticides to control rodent burrowing around towers.

- Encourage the protection of PHS priority habitats.

Minimize Impacts

- Minimize use of overhead power lines.[2]

- When overhead lines are used, use designs that avoid and minimize impacts to raptors and other birds (e.g., adequate conductor spacing, use of perch guards).

- Minimize the use of lights on towers, in accordance with federal, state, and local requirements, wherever possible because they may attract flying wildlife to the vicinity of the turbines in certain conditions.

- Encourage the control of noxious weeds in accordance with federal, state, and local laws. Encourage the control of detrimental weedy species that invade existing habitat as a result of disturbance from construction and operation.

- Encourage the requirement of a complete road siting and management plan, including vehicle-driving speeds that minimize wildlife mortality.

- Encourage the requirement of a fire protection plan.

Reduce or Eliminate Impacts Over Time

- Encourage a decommissioning condition that would require removal of the turbines and infrastructure when it ceases operation, and restoration of the site to approximate pre-project conditions.

OPERATIONAL MONITORING

As is the case with most development, some mortality of bats and birds is expected to result from wind power projects. However, it is anticipated that significant impacts to wildlife can be avoided or lessened at most wind projects if proper pre-project assessment is implemented and good project design and management practices are established. Monitoring studies, such as carcass surveys, using current state-of-the-art protocols are required to determine the actual direct impacts of the wind farm on birds. The duration and scope of the monitoring should depend on the size of the project, and the availability of existing monitoring data at projects in comparable habitat types.

A Technical Advisory Committee (TAC) is recommended to be responsible for reviewing results of monitoring data and making suggestions to the permitting agency regarding the need to adjust mitigation and monitoring requirements based on results of initial monitoring data and available data from other projects. The range of possible adjustments to the monitoring and mitigation requirements should be clearly stated in the project permit (e.g., Conditional Use Permit). Adjustments should be made if unanticipated impacts become apparent from monitoring data. Examples of such changes

[2] However, use of overhead power lines might be warranted if habitat type is of concern.

may include additional monitoring or research focused to understand the identified impacts (e.g., bats) and creation of raptor nesting structures (artificial or natural, on or off-site) if significant impacts to raptor species are identified. Adjustments that are not feasible because they would make the wind project un-financeable include removing turbines or shutting down turbines during certain periods of the year. Adjustments can also reduce monitoring requirements based on monitoring data and site-specific conditions.

Potential members to the TAC include stakeholders such as state and federal wildlife agencies, the developers, environmental groups, landowners, and county representatives. Protocols for conducting the monitoring study and procedures for reporting and handling, and rehabilitating injured wildlife should be reviewed by the TAC. Progress reports summarizing the monitoring results should be reported to the TAC on a quarterly basis. Reporting schedules and scope of reports will be developed in the event of unusual unanticipated avian mortality.

RESEARCH-ORIENTED STUDIES

Standard pre-project assessment studies and standard fatality operational monitoring have been distinguished from more research-orientated studies. At some projects, additional studies that utilize pre-construction data may be conducted to test specific research hypotheses about impacts to a particular species or group of species. Rather than being necessary for pre-permit assessment, such studies are often more research-oriented and often are focused on indirect impacts, such as displacement, that provide information for future projects. Examples include the use of gradient analysis in understanding the level of displacement of grassland nesting birds as a function of distance from turbines or raptor nest monitoring comparing density and nest success before and after operation of the wind plant. If such studies are determined to be important to the overall understanding of wind energy/wildlife interactions, they should be designed to follow appropriate experimental designs and state of the art protocols (Anderson et al. 1999, Morrison et al. 2002). Funding for these more research- oriented studies should be solicited from multiple sources, including the wind industry, environmental groups, state and federal agencies, advocacy groups and other sources.

REFERENCES

Anderson, R.L., M.L. Morrison, K. Sinclair, M.D. Strickland. 1999. Studying wind energy/bird interactions: a guidance document. National Wind Coordinating Committee Avian Subcommittee.

Morrison, M.L., W.M. Block, M.D. Strickland, and W.L. Kendall. 2001. Wildlife study design. Springer-Verlag New York, Inc., New York, NY. 210 pp.

SECTION 2
WIND PROJECT HABITAT MITIGATION

General Principles for Wind Project Siting and Mitigation
These principles are intended for projects proposed for sites east of the Cascades, where almost all wind projects have been proposed to date. These principles would require review and revision for sites west of the Cascades.

- Implementation of the mitigation measures contained in this proposal are presumed to fully mitigate for habitat losses for all species, including species classified as "protected," in the Washington Administrative Code, but excluding species classified as state "endangered" or federally "threatened" or "endangered," for which additional species- and site-specific mitigation may be necessary.
- Wind project developers should be encouraged to site wind power projects on disturbed lands (i.e., developed, cultivated, or otherwise disturbed by road or other corridors).
- Wind project developers should be encouraged to place linear facilities (such as collector cable routes, transmission line routes, or access roads) in or adjacent to existing disturbed corridors in order to minimize habitat fragmentation and degradation.
- Wind project developers should be discouraged from using or degrading high value habitat areas, especially shrub-steppe habitat in "excellent" condition.
- Wind project developers are responsible for acquiring replacement habitat under this proposal and for management of such lands for the life of the project, unless otherwise indicated.
- WDFW mitigation guidance seeks to recognize the full range of environmental benefits and impacts of development in determining appropriate mitigation, including the fact that wind is a renewable energy resource that can replace fossil fuels and other energy sources that have serious environmental consequences to plant and animal species and habitats.

MITIGATION FOR PERMANENT HABITAT IMPACTS

A. No mitigation required for cropland, developed, or disturbed areas

No mitigation will be required for impacts to lands that have little or no habitat value. Examples include lands that are:

- Currently being cultivated;
- Developed (long term); or
- Disturbed by an active road or other corridor that eliminates natural habitat values.

B. Criteria for Mitigation by Acquisition of Replacement Habitat

In each of the mitigation categories listed below, the criteria indicate that the replacement habitat should be:

- Like-kind (e.g., shrub-steppe for shrub-steppe; grassland for grassland) and/or of equal or higher habitat value than the impacted area, noting that an alternative ratio may be negotiated by a wind developer and WDFW for replacement habitat that differs from impacted habitat;
- Given legal protection (through acquisition in fee, a conservation easement, or other means);
- Protected from degradation for the life of the project to improve habitat function and value over time;
- In the same geographical region as the impacted habitat; and
- Jointly agreed upon by the wind developer and WDFW.

If a wind power applicant meets these criteria, then the following ratios apply:

1. **Acquisition of Replacement Habitat Subject to Imminent Development – 1:1**
   One acre of suitable replacement habitat will be accepted as mitigation for one acre of permanently impacted habitat where the replacement habitat is subject to imminent development – that is, there is a credible plan to develop the replacement habitat within five years and WDFW concurs with this assessment.

   Rationale: There is no net loss of habitat function or value where the replacement habitat would be lost but for its acquisition as mitigation. In fact, there should be a net gain in habitat value over time since protection of the replacement habitat (of equal or better value than the impacted area) will usually result in improved habitat value.

2. **Acquisition of Grassland, CRP Replacement Habitat – 1:1**
   One acre of suitable replacement grassland or CRP habitat will be accepted as mitigation for one acre of such habitat that is permanently impacted.

   Rationale: Habitat values are protected under this approach because:

   - Development of degraded grasslands or CRP habitat is preferable to development of shrub-steppe or other high value habitats.
   - The replacement habitat was at some risk of development and is now given permanent protection.
   - The replacement habitat is likely to improve in habitat function and value over time as degrading forces are removed.
   - The value of the replacement habitat is equal to or better than the habitat value of the impacted area.
   - The 1:1 ratio combines a number of factors -- which could require much time, effort, and expense to analyze and process -- in a simple and equitable approach.

3. **Acquisition of Shrub-Steppe, Other High-Value Habitat– 2:1**
   Two acres of suitable shrub-steppe or other high-value replacement habitat will be accepted as mitigation for one acre of permanently impacted shrub-steppe or other high-value habitat. In this context, "other high-value habitat" includes lithosol/shrub matrix (plant communities on lithosol soils intermixed with other plant communities on deeper soils).

   Rationale: A net gain in habitat value is likely under this approach because the replacement habitat:

   - Was at some risk of development and is now given permanent protection.
   - Is likely to improve in habitat function and value over time as degrading forces are reduced on the protected area.
   - Value is equal to or better than the habitat value of the impacted area.
   - The 2:1 ratio combines a number of factors -- which could require much time, effort, and expense to analyze and process -- in a simple and equitable approach.

   Exception for habitat in "excellent" condition: Where a wind project will affect habitat in "excellent" condition (based on federal methodologies for assessing range land, or other method acceptable to WDFW), wind project developers will engage in additional consultation with WDFW regarding suitable mitigation requirements for such habitat.

MITIGATION FOR TEMPORARY IMPACTS TO HABITAT

Temporary impacts to habitat are those that are anticipated to end when construction is complete and land has been restored. Temporary impacts include trenching for placement of underground cables, construction staging areas, lay-down areas, and temporary construction access. Temporary impacts also include the portions of road corridors that are used during construction but that are re-vegetated at the end of construction, but do not include the portions of roads that continue to be used for project operations (which are considered permanently affected). The goal of restoration of temporary impacts should be to restore the disturbed habitat to a condition that is at least as good as its pre-project condition.

A. **No Mitigation Required for Temporary Impacts to Cropland, Developed or Disturbed Areas (same as for permanent impacts)**

B. **Restoration, Mitigation for Temporary Impacts to Grass, CRP Lands -- 0.1:1**
   Temporary impacts to grassland or CRP habitat can be mitigated by:

   - Implementing a WDFW approved restoration plan for the impacted area. A restoration plan should include site preparation, reseeding with appropriate vegetation, noxious weed control, and protection from degradation (irrigation or planting with live plants will not be required).

- Acquiring 0.1 acres of suitable replacement habitat for every acre temporarily impacted by the project.
- A good faith effort should be made to restore the impacted area, however long-term performance targets should not be imposed since temporal losses and the possibility of restoration failure are incorporated into the acquisition and improvement of replacement habitat.
- WDFW and a wind developer may agree on other ratios and terms where doing so is mutually beneficial.

C. Restoration, Mitigation for Temporary Impacts to Shrub-steppe Habitat—0.5:1

Temporary impacts to shrub-steppe habitat can be mitigated by:

- Implementing a WDFW approved restoration plan for the impacted area. A restoration plan should include site preparation, reseeding with appropriate vegetation, noxious weed control, and protection from degradation (irrigation or planting with live plants will not be required).
- Acquiring 0.5 acres of suitable replacement habitat for every acre temporarily impacted by the project.
- A good faith effort should be made to restore the impacted area, however long-term performance targets should not be imposed since temporal losses and the possibility of restoration failure are incorporated into the acquisition and improvement of replacement habitat.
- WDFW and a wind developer may agree on other ratios and terms where doing so is mutually beneficial.

Customized Acquisition and Restoration Packages – This Habitat Mitigation proposal should not be viewed as preventing or discouraging WDFW and wind developers from negotiating "customized" or "alternative" mitigation packages where circumstances make it desirable for both parties to use accepted methodologies (such as NRDA or an alternative mitigation option) to do so.

SECTION 3
WIND POWER ALTERNATIVE MITIGATION PILOT PROGRAM

INTRODUCTION: This pilot program offers an alternative to conventional mitigation for wind projects that can greatly improve the habitat value per mitigation dollar as well as provide a more streamlined and efficient mitigation process for applicants. A significant feature of the pilot program is that it links targeted acquisition by WDFW of the highest value habitat in central and eastern Washington[3] with sustained "stewardship" funding from wind projects to restore, manage, and monitor these critical habitat areas. Fortunately, many of the areas that have the highest habitat values are also low cost, providing an outstanding opportunity to maximize the value of mitigation funds.

Because the Alternative Mitigation Pilot Program is experimental in nature, the fee will be reviewed annually, and adjusted as necessary, by WDFW to ensure that it is equitable, compared to the conventional mitigation option in Section 2, and provides incentives to encourage significant participation by wind developers. In addition, the Alternative Mitigation Pilot Program will be reviewed and evaluated at the end of five years, along with the other sections of the Wind Power Guidelines.

GOAL: The goal of the Wind Power Alternative Mitigation Pilot Program is to provide an optional and streamlined approach to mitigation that results in better habitat value and is more attractive to wind developers than conventional "on-site" mitigation.

PRE-PROJECT ASSESSMENT, OPERATIONAL MONITORING

A wind project applicant may either:

1. Follow the guidance set forth in Section 1 of the Wind Power Guidelines document (Baseline and Monitoring Studies for Wind Projects), or
2. Follow a streamlined process (to be negotiated with WDFW) if the project is to be sited in an area that has been determined by WDFW to present a low probability of significant risk to wildlife (and efforts have been made to avoid and minimize wildlife impacts).

ALTERNATIVE HABITAT MITIGATION

After determination by the wind project applicant, in consultation with WDFW, of the project's impact on habitat (in terms of acres permanently and temporarily impacted, and the type and general quality of habitat impacted), the applicant and WDFW will identify the appropriate annual fee for the life of the project[4], based on an Alternative Mitigation Fee Rate of $55.00/acre/year for each acre of replacement habitat that would be owed

[3] At the time of this writing, a request is being made to the State Legislature for an appropriation in the 2004 Supplemental Operating Budget.

[4] "Life of the project" is defined as beginning at the end of the first year of commercial operation and ending with implementation of the project decommissioning plan.

using the ratios and analysis contained in Section 2.[5]

As noted above, the Alternative Mitigation Fee Rate will be reviewed annually, and adjusted as necessary, by WDFW. Changes to the fee will be applied to future wind development proposals (for which mitigation has not yet been determined); changes in the fee will not be applied retroactively.

General provisions:

- The fee listed above is based on habitat in "average" condition and can be increased or decreased by up to 25% to account for differences in habitat quality.
- The applicant will be required to implement an approved restoration plan for temporarily impacted areas (in accordance with Section 2).
- In cases where the project impacts a mixture of habitat types, the fee schedule will be applied accordingly (to the nearest acre).
- The annual fee will be used primarily to support "stewardship" of high-value habitat in the same ecological region as the project (for management, monitoring, restoration, protection from degradation). It is envisioned that these annual stewardship funds will be applied to strategically important habitat in central and eastern Washington that is newly acquired by WDFW. The annual fees will be deposited into a dedicated WDFW account and may also be used for acquisition.
- If the applicant and WDFW cannot agree on a mutually advantageous "package" under the alternative mitigation program, the conventional mitigation guidance in Section 2 will be applied to the project.

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[5] To determine Alternative Mitigation Fee, use the guidance provided in Section 2 to:

1) Determine acres permanently and temporarily impacted by project for the shrub-steppe and grass categories (i.e., permanently impacted shrub-steppe, permanently impacted grass/CRP, temporarily impacted shrub-steppe, and temporarily impacted grass/CRP);
2) Multiply the acres in each of the four categories by the applicable ratio (e.g., shrub-steppe acres permanently impacted x 2.0);
3) Sum the acreage of the four categories to arrive at the total acres of mitigation owed; and
4) Multiply this total by the Alternative Mitigation Fee Rate to arrive at total annual payment for the project.

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Lori L. Reisinger

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May 20, 2008

All Champaign County Township Trustees
Champaign County Commissioners
Logan-Union-Champaign Planning Commission
Champaign County Community Improvement Corporation
Wayne Township Zoning Commission Members
Union Township Zoning Commission Members

Greetings,

I am pleased to present to you the report of the Champaign County Wind Turbine Study Group ("WTSG").

This report is a culmination of eight months of effort (five months of weekly meetings to study the issues and another three months drafting and rewriting the final product) by representatives of township and county government, industry, agriculture and community activists.

The report contains neither draft model legislation nor a recommendation for or against endorsement of "wind turbines."

Rather, the report contains the results of the research and critical analysis compiled by members of the WTSG regarding fourteen readily identifiable issues associated with wind energy development. The WTSG chose to present its work product in a format that is easy to read and understand. Each issue is specifically defined, with accompanying information assessments and recommendations for action.

The WTSG wants local decision-makers to utilize this report as part of the total consideration process when or if their particular jurisdiction contemplates taking legislative or regulatory action with regard to wind energy development.

I am very proud of the commitment WTSG members showed in our 7 a.m. weekly meetings. I want to also recognize Christopher A. Walker, Esq. for his extraordinary efforts in serving the WTSG as recording secretary for purposes of drafting and rewriting this report.

I urge interested readers to use the WTSG report as starting point when considering their own feelings on wind energy development. While this document will not settle the debate, it will most certainly assist our citizenry in determining what is in the best interests of the Champaign County community where wind energy comes to mind.

Thank you for your consideration.

Very Truly Yours,

Nick A. Selvaggio
Chair, Champaign County Wind Turbine Study Group
Champaign County Prosecuting Attorney

Enclosures
cc: Champaign County Wind Turbine Study Group
file

Champaign County, Ohio
Wind Turbine Study Group

"To inform the decision-makers"

May 2008

Jon Berry, Champaign County Farm Bureau

Jason Dagger, Champaign County Farm Bureau

Hon. Grant Johnson, Wayne Township Trustee

Julie Johnson, Union Neighbors United

Diane McConnell, Union Neighbors United

Mike Pullins, Everpower Renewables Corp.

Hon. Nick A. Selvaggio, Champaign County Prosecuting Attorney

Hon. Fereidoun Shokouhi, Champaign County Engineer

Mike Speerschneider, Everpower Renewables Corp.

Hon. Jim Virts, Union Township Trustee

Christopher A. Walker, Esq., Union Neighbors United

Foreword

BACKGROUND OF THE WTSG

In May 2007, a local citizen's group, Union Neighbors United, called upon its Champaign County, Ohio elected officials to provide a forum from which discussion could be held on issues surrounding proposed wind turbine development in their township. This group of citizens wanted to explore acceptable approaches to wind energy regulation to ensure that wind energy development would have the least amount of impact on the health, safety and welfare of Champaign County residents and its surrounding habitat.

In the months that followed, farmers and owners of undeveloped lands solicited their local governmental leaders for equal opportunity to engage in dialogue that would enable them to voice support for wind turbine placement. These groups of citizens felt strongly that this type of renewable resource would provide the prospects of clean energy, jobs and economic development to Champaign County.

In September 2007, the Champaign County Prosecutor's Office agreed to facilitate a series of weekly community meetings. Participants would be culled from a balanced set of primary stakeholders for the purpose of sharing information, exchanging ideas and exploring areas of mutual agreement regarding the potential placement of wind turbines in Champaign County.

The result was the formation of the Champaign County Wind Turbine Study Group (WTSG). Champaign County Prosecutor Nick A. Selvaggio solicited named representatives from Champaign County Farm Bureau, Champaign County Township Trustees Association, Everpower Renewables Corp., Logan-Union-Champaign Regional Planning Commission, and Union Neighbors United to critically debate the merits and consequences of wind energy development in Champaign County. Although participation in the discussions would be limited to named WTSG members, the WTSG felt that by having its meetings open to the public, it would guarantee transparent access to materials studied and viewpoints debated.

For twenty-four weeks, members of the WTSG were given the opportunity to present research materials from a previously developed list of agreed upon topics. Upon the completion of one presentation, the other stakeholders were given the opportunity to present similar or alternative viewpoints and materials on the same topic. Meeting notes were taken and a compilation of materials presented were retained for bibliographical reference and possible future use.

MISSION OF THE WTSG

The stated mission of the WTSG was "to inform the decision-makers." Specifically, the WTSG wanted to acquire, organize and assess relevant topical information on a variety of wind energy issues. Using the acquired resources, the WTSG would seek to provide input and formulate recommendations to local decision-makers who might be considering a governmental response to potential wind energy development in their region of Champaign County.

WTSG members were mindful that Ohio law places governing responsibility for electrical generation projects over 50 megawatts on the Public Utilities Commission of Ohio (PUCO) and its Power Siting Board. WTSG members considered whether their informational gathering role should result in formulating regulatory guidelines to local leaders. WTSG members decided that they would not draft model ordinances for local governments to consider. Instead, the WTSG chose to develop a report based on informational assessments and recommendations of multiple issues related to wind energy development.

The WTSG was not created by Ohio statutory law. The WTSG has no formal or statutory rule-making authority. The WTSG is comprised of an informal group of concerned community stakeholders that were assembled to study the merits of wind energy development. But for WTSG industry representatives, the members of the WTSG have no specialized knowledge or training in wind energy development. Thus, this document is limited in its ability to be an authoritative guideline on wind energy development due to the educational limitations of its membership.

Yet, WTSG members were vigilant in acquiring information from a variety of sources. They discovered an overwhelming amount of information available from government agencies, private companies, consultants and organizations from proponents and opponents of wind energy. In addition, news articles and anecdotal stories were found available for review. The materials collected by the WTSG are available in total and can be assessed, with the report, at the Champaign County Public Library.

For every document discovered, there were many others not retrieved for review. As such, any cited materials herein should not be considered to be an exhaustive list of available resources. To the extent that readers of this document wish to consider additional information to assess and weigh the credibility of the information and conclusions set forth in this report, readers are cautioned to consider relevant research and data from qualified experts.

In addition to reviewing this document and reading other materials, the WTSG encourages local decision-makers studying wind energy development to visit operating wind farms and consult with other local officials who have previously studied similar issues in their own communities.

FINDINGS AND RECOMMENDATIONS OF THE WTSG

The findings and recommendations of the WTSG are topically organized as follows:

The WTSG studied fourteen (14) different wind energy development topics: Aesthetics, Blade Throw, Decommissioning, Economics, Environmental Impacts, FAA Lighting, Fire/Emergency Response, Ice Shed/Throw, Noise, Road Infrastructure, Shadow Flicker, Telecommunications, Turbine Collapse and Vandalism. The findings and recommendations of the WTSG are topically presented in alphabetical order.

The reader will notice that there are varying page lengths of discussion to some of the topics presented herein. The WTSG cautions the reader not to infer that a higher priority or significance was allocated to a topic simply based on the resulting "page length differential." The WTSG considers each topic equally important to forming a healthy, safe, efficient and economically viable wind energy development plan for our community. Instead, the WTSG trusts that the reader will recognize that a topic's resulting page length was attributable to the WTSG's finding that certain topics merited more vigorous debate based on the nature and content of the material available for review and analysis.

For each topic covered, the WTSG defines the problem or issue involved. A summary assessment of the information presented is then provided. The WTSG concludes a review of the topic by offering recommendations for the decision-maker on how to mitigate any potential adverse impact that the particular problem may have on the local community. Where the WTSG failed to reach unanimity on a particular subject, the alternative viewpoint(s) were provided for the reader's consideration.

A complete bibliography of information as chronologically presented to and considered by the WTSG is included in the appendix.

In summary, consideration should be given to balancing the positive and negative impacts of wind energy on host properties, nonparticipating properties, and the overall community. Decision-makers should take into account cumulative impacts of wind energy projects in the context of other development in the region. Residents, businesses and entities in the vicinity of proposed sites can benefit from a transparent governmental review process in which occasions to voice support, opposition or concern may be made. Opportunities exist to mitigate the negative impacts of wind turbine developments through zoning ordinances and use of scientifically accepted methodology.

The WTSG recognizes there are practical arguments for encouraging the WTSG to continue its study of the issues through the coming months and even years. As technology evolves and more research is published and peer reviewed, calls for further debate will most certainly ensue. However, the WTSG recognizes that perpetuating the discussion only serves to delay the delivery of information to Champaign County's leadership. At some point, the findings must translate into action. It is hoped that this document and its referenced materials will assist our governmental representatives in formulating an action plan that will serve the public good of Champaign County, Ohio.

- Nick A. Selvaggio, WTSG Chair

TABLE OF CONTENTS

1. Aesthetics:

Definition of Issue:

- Aesthetics has been raised as a concern about wind-energy projects. While some people think turbines are pleasing to view, others likely will not agree. Taking care to place the turbines in a manner that takes aesthetics into account will help the project fit more harmoniously with the community.

Information Assessment:

- There are a number of reasons why proposed wind-energy projects evoke aesthetic concerns. Modern wind turbines are relatively new to the United States. Some of the early projects were built in remote areas, but increasingly they are being built in or proposed for areas that are close to residential and recreational uses, and often in areas never before considered for wind power uses. The turbines are often taller than any local zoning ordinance, and they are impossible to screen from view. The movement of the blades makes it more likely that they will draw attention. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 143.

- One commentator suggests that communities with a rural setting and a history of farming might accept harvesting of wind energy as an acceptable use of their land. Ben Hoen, Impacts of Windmill Visibility on Property Values in Madison County, NY (April 2006) (attached as Appendix B to Faulkner, David, Community Improvement Corporation of Champaign County, "Economic Impact Study of Wind Farm Development in Champaign County, Ohio", November 13, 2007).

Recommended Action:

- Local decision-makers should require an aesthetic impact study as part of local jurisdictions' siting and compliance review process. One option for an aesthetic impact study is to require wind developers to provide a visual simulation that depicts how the project would look from different vantage points throughout the project area. The study should specifically address sensitive areas around the project as defined by the local jurisdiction and taking into account, among other things, the policies and designations of the State Historic Preservation Office (SHPO).

- The National Research Council publication, *Environmental Impacts of Wind-Energy Projects* (2007), contains an extensive discussion of how aesthetic impacts can be evaluated in connection with the implementation of projects. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 173-78, 360-75. This publication may be purchased or accessed online at http://www.nap.edu. Follow the "Energy and Energy Conservation" link.

- Aesthetic impacts can be mitigated by ensuring the project has visual order and uniformity, using turbines and towers of consistent height and design, requiring removal of non-operating structures (as appropriately defined), minimizing the visibility of transmission lines and ancillary structures, minimizing erosion during project construction and operation, requiring turbines to be painted white or grey, and prohibiting turbine use for telecommunication antennas, billboards, and signs. Gipe, Paul, *"Design As If People Matter: Aesthetic Guidelines for a Wind Power Future"* (referenced in J. Johnson presentation materials Jan. 29, 2008.)

- Utilizing the above considerations, in combination with setbacks as warranted, can result in a wind project that is compatible with most existing land uses.
  - Some, but not all, of the members of the WTSG agree with Paul Gipe that most existing land uses include rural residential, row crops, grazing, commercial, schools, religious sites, some parks, outdoor recreation, tourism, cycling, walking and jogging. Paul Gipe Ag Workshop Powerpoint, Community Wind.
- Members of the WTSG believe that the following questions could help evaluate the potential for undue cumulative aesthetic impacts associated with new wind turbine projects or expansions of existing wind turbine projects. (All of the following considerations are from National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 150-51.)
  - Are the turbines at a scale appropriate to the landscape?
  - Are turbine types and sizes uniform within the area?
  - How great is the offsite visibility of infrastructure (for example, substations and transmission lines)?
  - Have areas that are inappropriate for wind projects (due to terrain, important scenic, cultural, or recreational values) been identified and evaluated?
  - If the project is built as proposed, would the area retain any undeveloped scenic vistas?
- Members of the WTSG acknowledge that there may be difficulty in the interpretation and implementation of the above considerations.
- Some, but not all, of the WTSG members recommend that consideration be given to the potential aesthetic impact of wind turbine projects on populated areas such as cities or villages.

2. Blade Throw:

Definition of Issue:

- Wind turbine blades can fail resulting in blades or blade fragments coming free and being thrown from the turbine.

Information Assessment:

- According to Garrad Hassan Canada, Inc.:

    - The main causes of blade failure are human interface with control systems, lightning strike or manufacturing defect;

    - Evidence suggests that the most common cause of control system failure is human error. Many manufacturers have reduced that risk by limiting the human adjustment that can be made in the field;

    - Lightning strike does not often lead to detachment of blade fragments. Lightning protection systems have developed significantly over the past decade, leading to a significant reduction in structural damage attributable to lightning strikes;

    - Improved experience and quality control, as well as enhancement of design practices, has resulted in a significant diminution of structural defects in rotor blades; and

    - Garrad Hassan is not aware of any member of the public having been injured by a blade or blade fragment from a wind turbine.

    Garrad Hassan Canada, Inc., *"Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario"*, May 31, 2007 at p. 12-13 (included in Champaign County Farm Bureau report 12/11/07).

- Blade failure can occur in high wind-speed conditions. Ubarana, Vinicius & Giguere, Philippe, General Electric Energy, *"Extreme Wind Speed – Risk and Mitigation"*, October 2007.

- According to GE Energy:

    - The mode of failure of a wind turbine due to an extreme wind event cannot be generalized and depends on the turbine type and configuration, as well as the specifics of the extreme wind event and site conditions. Examples of possible failure scenarios include blade failure or a tower buckling or overturning. When winds are above the cut-out speed, the wind turbine should have its blades idling in a position creating minimal torque on the rotor. This is the only safety mechanism other than the yaw control. If a grid failure were to occur in conjunction with an extreme wind event—which is a likely scenario—the yaw control will become inactive. The loss of yaw control could increase the likelihood of damage/failure in the case of an extreme wind event. Also, the grid components/structures could also be part of the potential windborne debris. At this time, GE has no modeling capability in place that can predict the impact made to a wind plant if an extreme wind event occurs. Ubarana, Vinicius & Giguere, Philippe, General Electric Energy, *"Extreme Wind Speed – Risk and Mitigation"*, October 2007.

- The safety system must have two mutually-independent braking systems capable of bringing the rotor speed under control in the event of grid failure (as required through IEC specifications). Garrad Hassan Canada, Inc., *"Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario"*, May 31, 2007 at p. 12-13 (included in Champaign County Farm Bureau report 12/11/07).

- Professor Terry Matilsky of the Department of Physics and Astronomy, Rutgers University, has calculated that it is physically possible for broken blades to be thrown up to 1,680 feet horizontally. Matilsky, Terry, Rutgers University, *"Part I – Basic Kinematics"* at p. 2.

Recommended Action:

- Members of the Study Group had differing views as to the degree of setback that is warranted to protect against blade throw.

    - Some WTSG members are of the view that the precautions and setbacks employed for protection against ice throw (that is, 1.5 x (hub height + blade diameter) from occupied structures, roads and public use areas) are also adequate to protect against blade failure. This view is based on risk-based calculations done for icing situations which consider the frequency of occurrence and the potential travel distance. Wahl, David & Giguere, Philippe, General Electric Energy, *"Ice Shedding and Ice Throw – Risk and Mitigation"*, April 2006. Using the recommended setback for ice is appropriate because the physics of anything breaking off the blades, including the blades themselves, is similar. Matilsky, Terry, Rutgers University, *"Part I – Basic Kinematics"* at p. 1.

    - Other WTSG members are of the view that a minimum setback of 1,680 feet is warranted based on the potential for broken blades to be thrown that distance. To protect safety and property on adjacent property, these members also believe that this setback should be measured from the adjacent property line.

3. Decommissioning:

Definition of Issue:

- Once the operational life of the turbines has ended, arrangement must be in place that would ensure the removal of the structures.

Information Assessment:

- Lease Agreements between wind developers and landowners normally include provisions for decommissioning, though these provisions are not necessarily uniform from project to project.
- In practice, decommission generally consists of removal of above-ground and subsurface structures to a depth of at least 36 inches, grading and re-seeding of the surface, unless directed otherwise by the landowner.

Recommended Action:

- Local decision-makers should enact zoning to require that the developer or operator decommission (*i.e.*, dismantle and remove) wind turbines and ancillary structures—
  - At the end of the turbine's useful life (as appropriately defined), or
  - if the turbine is determined to be unsafe or detrimental to health, or
  - If the turbine is in significant violation of applicable zoning requirements.

  Local decision-makers may wish to consider different timelines and remedies for decommissioning under the different circumstances set forth above.

  At the landowner's election, roadways and pads may remain in place.
- Local zoning should require the developer and operator to post a surety bond or other financial assurance that is at least 115% of decommissioning costs (less salvage value) as calculated and certified by a registered professional engineer. Calculation of the decommissioning and salvage should be updated every few years and the fund amount adjusted accordingly.
- Local zoning should specify that wind turbines and ancillary structures that are not decommissioned in accordance with zoning requirements are to be deemed a public nuisance.
- Upon decommissioning, all above-ground and subsurface structures should be removed to a depth of at least thirty-six inches (36") and the site returned, as closely as possible, to its previous state (unless otherwise directed by the landowner).
- Some, but not all, WTSG members believe that the leasing landowner should be jointly obligated with the developer and operator to ensure decommissioning since the leasing landowner is a participant in the wind turbine development. These members also believe that decommissioning is consistent with townships' zoning authority for the purpose of preventing nuisance, protecting public safety, and addressing community aesthetics.

- WTSG members requested a legal opinion from the Champaign County Prosecutor regarding township authority to require decommission bonding or funding. That opinion is attached in Appendix B.

- Some WTSG members believe that the Pennsylvania Model Ordinance for Wind Energy Facilities provides a good example of decommissioning language for zoning documents.

4. Economics:

Definition of Issue:

- Wind energy projects have the potential to impact the local economy in the form of capital investment, jobs, patronization of local businesses, lease payments to host landowners, tax revenue, and property values.

Information Assessment:

- David Faulkner of the Champaign County Improvement Corporation conducted a study examining the potential economic benefits to the community. Faulkner, David, Community Improvement Corporation of Champaign County, "Economic Impact Study of Wind Farm Development in Champaign County, Ohio", November 13, 2007. The study utilized an economic model that was developed by the National Renewable Energy Laboratory (NREL) specifically to estimate the economic benefits from a new wind-energy facility. This model, the JEDI-WIND model, calculates the direct, indirect, and induced economic benefits of new wind energy facilities. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 166-67.
  - The JEDI-Wind model employs economic data developed from numerous operating US wind farms and provides for the use of national statistics or the tailoring of the model to local economic circumstances. The case of the Champaign County Economic Study utilized both national statistics and specific local input data to calculate the economic benefits of the project.
  - Based on input from wind developers active in the area, the Champaign County Economic Study estimates a capital investment of $190 Million to $570 Million, based on wind generation of 100-300 megawatts in the county. Faulkner, David, Community Improvement Corporation of Champaign County, "Economic Impact Study of Wind Farm Development in Champaign County, Ohio", November 13, 2007 at p. 3.
  - The Champaign County Economic Study predicts that this investment in the area will result in significant jobs, economic activity, and tax revenue during both construction and operation.
    - Some, but not all, WTSG members question the CIC's findings and conclusions about local economic benefit on the ground that although the report refers "local" economic impacts, the supporting model utilized default data that reflects statewide economic impacts. http://www.eere.energy.gov/windandhydro/windpoweringamerica/docs/jedi_wind_model.xls (FAQ). Although the model provides an option for inputting county or regional data to run a county or region-specific analysis, the utilization of county or regional data in the Economic Study was limited and unsupported. Furthermore, to estimate the secondary effects of a wind-energy project on a region's economy, the region must be geographically defined. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 166. The Champaign County Economic Study does not adequately define the geographic region over which new jobs, spending, and other

economic impacts are being distributed. For these reasons and other reasons, these members believe that the report's projections of "local" job and spending generation are meaningless.

- Some, but not all, WTSG members feel that the CIC findings are representative of Champaign County and the neighboring counties. The results represent general economic impacts based on the JEDI methodology and Faulkner's knowledge of the local economy. See Faulkner, David, Community Improvement Corporation of Champaign County, "Economic Impact Study of Wind Farm Development in Champaign County, Ohio", November 13, 2007 at p. 3.

- On the subject of the impact of wind turbine development on local property values, the Champaign County Economic Study report concludes, "The only safe conclusion one can draw from the body of work done on this is that there is no definitive understanding or conclusion on the impact wind power development has on property values." Faulkner, David, Community Improvement Corporation of Champaign County, "Economic Impact Study of Wind Farm Development in Champaign County, Ohio", November 13, 2007 at 5.

- In addition, a number of other organizations have made general conclusions about the economic impacts of wind energy:

  - According to Environment Ohio:

    - "In 2001 Ohio spent $29 billion on energy, $16 billion of which was exported to other states or nations. A homegrown clean energy strategy would reduce Ohio's exposure to price spikes, supply distribution, and other repercussions of our reliance on fossil fuels." Environment Ohio & Environment Ohio Research and Policy Center, *"Ohio's Wind Energy Future"*, November 2006 at p. 10.

    - "Ohio has the infrastructure to be a leading manufacturer of wind energy technologies. With a national investment in renewable energy and energy efficiency, Ohio could potentially gain more than 22,000 manufacturing jobs. Over 13,000 of these manufacturing jobs would result from an investment in wind power, which is more of a job gain than any other state besides California. The installation and maintenance of wind turbines is a homegrown industry, one that can provide more and better jobs than coal-fired power plants. Over 1,000 companies, located throughout the state, would benefit from increased wind energy production." Environment Ohio & Environment Ohio Research and Policy Center, *"Ohio's Wind Energy Future"*, November 2006 at p. 11.

    - Figure 7 of the Environment Ohio report estimates that Champaign County has the potential to gain 50-99 jobs as a result of a nationwide investment in renewable energy. The same figure estimates that the six surrounding counties have the potential to gain a total of 800-1,744 jobs as a result of a nationwide investment in renewable energy, most of which are predicted for Miami County.

    - "Farmers with good wind resources could increase the economic yield of their land by 30 to 100 percent. This could make the difference between insolvency and survival for many Ohio family farmers." Environment Ohio & Environment Ohio Research and Policy Center, *"Ohio's Wind Energy Future"*, November 2006 at p. 12.

- "If Ohio were to take advantage of only 20 percent of [areas with wind speeds high enough to support commercial-scale wind farms,] wind energy could provide 20 percent of Ohio's electricity needs in 2020 (or about 37,000 GWh per year.) The wind turbines would cover only 0.03 percent of Ohio's total land area, allowing farmers to grow crops right up to the turbine base." Environment Ohio & Environment Ohio Research and Policy Center, *"Energizing Ohio's Economy, Creating Jobs and Reducing Pollution with Wind Power"*, August 2007 at p. 21.

- According to the American Farmland Trust, for every dollar of tax generated by residential property, there is a cost to service those residences of $1.16. By comparison, the cost to service commercial and industrial property is $0.27 for each dollar of tax revenue generated. Faulkner, David, Community Improvement Corporation of Champaign County, *"Economic Impact Study of Wind Farm Development in Champaign County, Ohio"*, November 13, 2007 at p. 11.

- According to the American Wind Energy Association's (hereinafter "AWEA") "Wind Energy and Economic Development: Building Sustainable Jobs and Communities," the European Wind Energy Association has estimated that, in total, every MW of installed wind capability directly and indirectly creates about 60 person-years of employment and 15 to 19 jobs. The rate of job creation will decline as the industry grows and is able to take advantage of economies of scale. AWEA, "Wind Energy and Economic Development: Building Sustainable Jobs and Communities," cited in National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 166.

<u>Recommended Action</u>:

- To fully understand and evaluate the economic impacts of any wind energy project, local decision-makers should require wind developers to provide an economic impact assessment prepared with input from appropriate development agencies such as the Ohio Department of Development and/or the Champaign County Community Improvement Corporation.

5. Environmental Impacts:

Definition of Issue:

- Wind projects, as all human development, can have an impact on local wildlife and wildlife habitat.

Information Assessment:

- There are a number of federal, state, and local agencies that have primary jurisdiction over these issues. The Ohio Department of Natural Resources has jurisdiction over Ohio wildlife species. They are currently developing and adapting measures that will help wind turbine projects avoid or minimize species impacts. U.S. EPA, Ohio EPA, the U.S. Army Corps of Engineers, and other agencies have jurisdiction over wetlands, stormwater and surface water impacts, and other potential environmental impacts from wind turbine developments. Champaign Soil & Water Conservation District oversees drainage and erosion issues.

Recommended Action:

- Local decision-makers should coordinate with the above agencies concerning potential environmental impacts from wind turbine projects.

6. FAA Lighting:

Definition of Issue:

- The FAA requires wind turbines and other tall structures to utilize pulsing lighting for aviation safety.

Information Assessment:

- Wind turbine lighting will be visible in the night sky and will be similar in character to the lighting used for communication towers and other tall structures. This lighting may raise aesthetic concerns. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 143.

Recommended Action:

- Obstruction lighting must follow FAA requirements. Local decision-makers should consider requiring the project to use the minimum lighting required. All lighting should be synchronized within the development and, if possible, with other nearby wind power developments.

7. Fire/Emergency Response:

Definition of Issue:

- As an operating turbine and a workplace, accidents can occur that will result in damage to the facilities and/or worker injury. Accidents involving maintenance and operation staff are unlikely, but possible and would require local response capabilities.

Information Assessment:

- A turbine fire generally represents a risk only to the structure itself. Response units should be able to handle a turbine fire should it occur by alerting neighbors and protecting the area for ground level fires that may result.

Recommended Action:

- Local governments should request the turbine operator and construction crews to work with emergency crews to be prepared to handle a turbine-related incident. In general, if a fire in the structure occurs, the appropriate course of action is to allow the turbine to burn out while the fire brigade prevents ground based fires from developing. Training for tower rescues should also be included in any emergency preparedness plan. The resources and training for emergency and fire response should be facilitated by the owner/operator of the facility.

- Access to the turbine interior should be secured and strictly limited to authorized personnel.

- Each turbine should have a first responder designation to assist emergency personnel in locating the turbine in the event of an emergency.

- Local decision-makers should consult with providers of emergency medical airlift services to determine whether a wind turbine proposal will affect helicopter access to the project site and surrounding area.

8. Ice Shed/Throw:

Definition of Issue:

- Wind turbines can accumulate ice under certain atmospheric conditions. Shedding of this ice from blades and other surfaces presents a safety concern, particularly below the turbine, that should be considered during project development and operation. In the event that icing sensors fail, ice can be thrown from the rotating blades and can travel a distance. Wahl, David & Giguere, Philippe, General Electric Energy, *"Ice Shedding and Ice Throw – Risk and Mitigation"*, April 2006, at p. 2.

Information Assessment:

- Under normal operations, when icing occurs, the turbine will be shut down either automatically or manually. The ice will then shed from the turbine blades before the turbine is re-started. When the turbine is shut down, the risk is confined to an area close to the turbine tower.

Recommended Action:

- Appropriate safety concerns should be addressed by means of a setback. GE Energy, a major manufacturer of wind turbines, suggests a implementing a safe distance equal to 1.5 times the sum of the hub height and the rotor diameter. GE notes also that the actual "safe distance" depends on turbine dimensions, rotational speed, and other factors. Some consulting groups have the capability to provide risk assessment based on site-specific conditions. Wahl, David & Giguere, Philippe, General Electric Energy, *"Ice Shedding and Ice Throw – Risk and Mitigation"*, April 2006, at p. 2.

- Wind turbines should be designed with redundant safety mechanisms and procedures to protect themselves by shutting down, either automatically or manually, when icing conditions occur.

- Safety can be further promoted by utilizing appropriately placed signs and other public education efforts warning the public of the dangers associated with wind turbines in winter weather.

- Maintenance staff should also be trained to recognize icing conditions and should confirm that shut down occurs when conditions dictate.

- Some, but not all, WTSG members recommend that because of the potential for injury or property damage on neighboring properties, the above "safe distance" recommendation should also be applied from the boundary of any adjacent nonparticipating property.

9. Noise:

Definition of Issue:

As with any machine involving moving parts, wind turbines generate noise during operation. Noise from wind turbines arises mainly from two sources: (1) mechanical noise caused by the gearbox and generator, and (2) aerodynamic noise caused by interaction of the turbine blades with the wind. Wind turbine noise can be generally classified as being of one of three types: broadband, tonal, and low frequency. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 157.

Information Assessment:

Characteristics of Wind Turbine Noise:

- Sound from wind turbines is generally classified as mechanical sound or aerodynamic sound. Mechanical sounds are generally "tonal" in character, while aerodynamic sound from turbines is generally "broadband." The tonal sounds are generated by the machinery in the nacelle, including the generator, gearbox, etc. Aerodynamic sounds result from the air flowing over the blades and represent the characteristic "swish" or "whoosh." Aerodynamics sounds generally compose the most dominant type of wind turbine sound. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 158.

- Under certain conditions, aerodynamic noise from wind turbines has been described as having a swishing, clapping, beating, or thumping character with a modulation that is not well-masked by background noise. Van den Berg, G. P., *Do Wind Turbines Produce Significant Low Frequency Sounds?*, 2004 at p. 4, 8; Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review*, 2003 at p. 5, 22. In a stable atmosphere, such as at night, this noise is louder than at daytime and (in the case of one cited wind turbine project) can be heard at distances of at least up to 1 kilometer. In the case of multiple wind turbines, the pulses can synchronize, leading to still higher levels of sound. Van den Berg, G. P., *Do Wind Turbines Produce Significant Low Frequency Sounds?*, 2004 at p. 4, 8.

- In addition to the above areas of agreement, different WTSG members felt that the following information was relevant and informative:

- Some, but not all, WTSG members offered the following:

  - Dr. Geoff Leventhall, sound engineer (hereinafter "Leventhall"), states categorically that there is no significant infrasound from current designs of wind turbines. Memorandum of AWS Truewind, *"Wind Energy and Low Frequency Noise"*, March 6, 2006, at p. 2.

    - Rebuttal--Although Leventhall insists that there is no significant infrasound from wind turbines, he does concede that wind turbine noise includes a low-frequency component and that such low frequency noise can be audible under certain circumstances. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14. Thus, denying the presence of "significant infrasound" in wind turbine noise does not excuse the need to model and monitor for low frequency noise from wind turbines.

  - Research done by Hepburn Explorations has shown that low frequency sound pressure levels are often lower when the turbines are on than when off. This is a result of the turbines converting the energy in the wind to electricity. Memorandum of AWS TrueWind, March 6, 2006, at p. 1.

  - Ambient baseline sound levels will be a function of such things as local traffic, industrial sounds, farm machinery, barking dogs, lawnmowers, children playing and the interaction of the wind with ground cover, buildings, trees, powerlines, etc. It will vary with time of day, wind speed and direction and the level of human activity. As one example, background sound levels measured in the neighborhood of the Hull High School in Hull Massachusetts on March 10, 1992 ranged from 42to 48 dB(A) during conditions in which the wind speed varied from 5 to 9 MPH(2-4m/s). Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006 at p.18.

    - Rebuttal--References to background noise measurements from urban areas are not necessarily representative of rural background noise, which can be at levels in the range of 20-25 dB. James, Richard, E-Coustic Solutions, *"Comments in Response to Everpower Critique of Richard James Presentation"*, March 17, 2008 at p. 2.

  - Recent improvements in mechanical design of large wind turbines have resulted in significantly reduced mechanical sounds from both broadband and pure tones. Today, the sound emission from modern wind turbines is dominated by broadband aerodynamic sounds. Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006 at p. 13.

  - As reported by the NRC, in 2004 there were 17,000 turbines in operation in the United States. NRC, *Environmental Effects of Wind-Energy Projects* 42 (2007).

  - Everpower Renewables Corp. sponsored a trip to Bowling Green, Ohio so farmers and landowners could get first hand knowledge of the scope and sound of the turbines. The Champaign County Farm Bureau sponsored a trip to Leroy, Illinois to visit a large wind turbine project. The public was invited to attend the trip.

- As a result, some, but not all, WTSG members believe we have plenty of local and first hand knowledge on whether the turbines make a sound and if that sound would be an issue.

- Other WTSG members offered the following:

  - A good overview of the nature of sound in general and sound from wind turbines can be found in a report by Anthony Rogers, Ph. D. Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006. This report includes an informative sample noise assessment for a wind turbine project.

  - The misunderstanding on low frequency noise may be associated with the "swish-swish" which is typical for wind turbines. The swish is a modulation of a higher frequency and does not contain low frequencies or infrasound.

  - Dr. Geoff Leventhall has stated, "I can state quite categorically that there is no significant infrasound from current designs of wind turbines. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 8.

  - Numerous studies have shown that low frequency sound output from wind turbines does not significantly exceed background levels, and measures no more than 50-60 dB. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005, at p. 13-14; Hessler, David, Hessler Associates, Inc., Speerschneider, Michael, Everpower Renewables Corp., *"Comments in Response to Richard James Presentation"*, March 3, 2008, at p. 2.

  - From analysis on existing wind turbines it seems that there is no tendency that the larger wind turbines is creating an excessive amount of low frequency noise compared to the overall noise level. Sondergaard, Bo & Hoffmeyer, Dan, *"Low Frequency Noise from Large Wind Turbines"*, Second International Meeting on Wind Turbine Noise, September 20-21, 2007 at p. 21.

  - Frequencies produced by wind turbines below 40 Hz cannot be distinguished from background noise due to wind. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14.

- Yet other WTSG members offered the following:

  - Wind turbine noise includes a low-frequency component that, although inaudible (per NRC) or barely audible (per Leventhall), is still perceptible by humans. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise* *related to Wind Turbines Might Have Developed*", First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14; National Research Council, *"Environmental Impacts of Wind-Energy Projects",* May 2007 at p. 158-59. This low-frequency component is less diminished by building walls or other structures, and individuals sense or perceive low frequency noise in different ways. Leventhall, Geoffrey, *"A Review of Published Research on Low Frequency Noise and its Effects, Report for DEFRA"*, May 2003 at Sections 8.2.4, 13.2. Low frequency noise from wind turbines may be audible under certain circumstances. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed*", First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14. For these reasons, this low-frequency component is important to assess.

- Rebuttal - Leventhall has conducted extensive research on infrasound and low frequency sound in the community and is a leading expert. There are sources of community noise that have generated substantial low frequency sound and infrasound. Concerns about efficient propagation and diminished attenuation are legitimate concerns when taken in the context of significant emitters of low frequency sounds. The DEFRA report does not focus on wind turbine sound, but Leventhall makes it clear in his other work where he does address wind turbine sound that low frequency sound and infrasound from wind turbines is, in general, not an issue. Leventhall, *"How the "mythology" of infrasound and low frequency noise related to wind turbines might have developed",* First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 13-14; British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex*", February 2005 at p. 2.
- Rebuttal - Leventhall's characterization of wind turbine noise indicates that infrasound and low frequency noise components are not problematic. Aside from saying definitively that infrasound is not a problem (Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed*", First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14), he states; "The concerns of the WHO on low frequency noise require us to look carefully at low frequency noise from wind turbines. In general, there is not a problem, although the mythology is that wind turbine noise has a substantial low frequency component." Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed*", First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 13. The data presented by Leventhall to make even these diminutive statements regarding wind turbine sound are based on measurements taken just 65 meters (213 feet) from a turbine. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed*", First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 14.

- Although wind turbines may generate low-frequency noise at levels of 55 dB, rural background noise can be considerably quieter (e.g., in the range of 20-25 dB). James, Richard, E-Coustic Solutions, *"Comments in Response to Everpower Critique of Richard James Presentation"*, March 17, 2008 at p. 2.

  - Rebuttal - There have been a number of studies which have shown that measured low frequency sound from wind turbines are comparable to rural background levels absent of wind turbines. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 13-14; in Hessler, David, Hessler Associates, Inc., Speerschneider, Michael, Everpower Renewables Corp., *"Comments in Response to Richard James Presentation"*, March 3, 2008 at p. 2. According to Sondergaard, "It seems that there is no tendency that the larger wind turbines is [sic] creating an excessive amount of low frequency noise compared to the overall noise level." Sondergaard, Bo & Hoffmeyer, Dan, *"Low Frequency Noise from Large Wind Turbines"*, Second International Meeting on Wind Turbine Noise, September 20-21, 2007 at p. 21. Mr. James' measurements showing background levels of 20-25 dB should be treated with caution as his methodology is not defined and they are not substantiated and do not agree with any published reports on wind turbine measurements or rural background sound measurements.

- The variability of background noise levels in different environments is why a thorough, unbiased pre-construction study of community sound is needed. James, Richard, E-Coustic Solutions, *"Comments in Response to Everpower Critique of Richard James Presentation"*, March 17, 2008 at p. 2.

- Turbine noise is usually most critical within a half-mile of a project. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 153.

  - Rebuttal--While it has been suggested that potential noise on nearby residents may be less important outside of ½ mile, this does not indicate that noise impacts *will be* important within ½ mile.

<u>Effects of Wind Turbine Noise:</u>

- Different WTSG members felt that the following information was relevant and informative:

  - Some, but not all, WTSG members offered the following:

    - Modern wind turbines that utilize upwind blade orientations have dramatically reduced tower interaction effects, and the generation of high levels of low frequency noise by wind turbines. British Wind Energy Association (hereinafter BWEA), *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 1-2.

- There are no direct health effects from noise at the level of noise generated by wind turbines. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005.

- There is no scientific evidence that noise at the levels generated by wind turbines could cause health issues other than annoyance. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 5.

  - Rebuttal: While it may be disputed whether low frequency noise from wind turbines causes public annoyance, it has been documented that wind turbine noise can cause public annoyance. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 22.

  - Rebuttal: Although Pedersen concludes that wind turbine noise does not directly cause any physical health problems, his conclusion continues, "There is not enough data to conclude if wind turbine noise could induce sleep disturbance or stress-related symptoms." Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 22.

- Wind turbines produce low frequency sounds, but it has not been shown this is a major factor contributing to annoyance. Van den Berg, G. P., *Do Wind Turbines Produce Significant Low Frequency Sounds?*, 2004 at p. 1

- Non-sound-related factors also influence individual responses to wind turbines. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 4. This makes it more important that the community is involved in the planning process and is aware of the benefits that will result from the project.

- Research conducted in low frequency noise on modern wind turbines has shown that the levels of low frequency noise have been below thresholds of perception and is therefore not a problem. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 8.

  - Rebuttal: The above report of the British Wind Energy Association cites no specific "accepted" thresholds with which to compare low frequency noise from wind turbines. According to the National Research Council, "More needs to be understood regarding the effects of low-frequency noise on humans." National Research Council, *"Environmental Impacts of Wind-Energy Projects",* May 2007 at p. 158-59.

- The Danish Wind Industry Association and the Danish Environmental Agency confirm that low frequency noise from wind turbines has not been an issue and there have been very few complaints from the general public in the past 20 years. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 6.

  - Rebuttal: The cited information from the report of the Danish Wind Industry Association gives no indication of the number of turbines installed in populated areas of Denmark or the distance of those turbines from residences.

- The German Wind Energy Association has confirmed that no impacts to human health have been proved from low frequency noise from wind turbines in German Studies. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 6.

- Other WTSG members offered the following:

  - Low frequency noise can be annoying or distressing to people who are sensitive to its effects. Leventhall, Geoffrey, *"A Review of Published Research on Low Frequency Noise and its Effects, Report for DEFRA"*, May 2003 at p. 8.2.4; Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003.

    - Rebuttal: The Leventhall report cited above does not focus on wind turbine sound and primarily addresses the impacts of low frequency sound at levels much higher than is generated by wind turbines.

  - Public annoyance from wind turbine noise occurs to a higher degree at low levels than noise annoyance from other sources of community noise such as traffic. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 22.

  - A report for the Swedish Environmental Protection Agency cites statistics that at wind turbine noise ranges of 37.5 to 40 dBA, 20% of 356 respondents were very annoyed with the noise. At above 40 dBA, the percentage of highly annoyed respondents increased to 36%. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 13.

    - Rebuttal: It should be recognized that, in addition to the Swedish study reviewed by Pedersen, his report includes review of other research. The Swedish report is the only one that showed a statistical correlation of annoyance to wind turbine sound pressure levels, and leads him to conclude that wind turbine noise is "to a degree correlated to noise exposure." Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 22.

  - Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans. It has recently been stated (Pierpont, Nina, MD, PhD, *"Wind Turbine Syndrome: Noise, Shadow Flicker and Health", August 1, 2006 / "Health Effects of Wind Turbine Noise"*, March 2, 2006) that "some people feel disturbing amounts of vibration or pulsation from wind turbines, and can count in their bodies, especially their chests, the beats of the blades passing the towers, even when they can't hear or see them." National Research Council, *"Environmental Impacts of Wind-Energy Projects",* May 2007 at p. 158-59.

  - Several studies and reports suggest that certain adverse health effects may be associated with long-term exposure to wind turbine noise, including the infrasound and low-frequency component. *E.g.,* Harry, Amanda Dr., *"Wind Turbines, Noise and Health"*, February 2007; Pierpont, Nina, MD, PhD, *"Vibro-Acoustic Disease"*, June 9, 2007 (summarizing research conducted in Portugal).

  - Noting the need for further scientific data on this subject, in 2006 the French National Academy of Medicine recommended that wind turbines be sited no closer than 1.5 kilometers (0.93 miles) from residences "while waiting for precise studies of the risks connected with these installations." C-H Chouhard, *Le retentissement du fonctionnement des eoliennes sur la sante de l'homme (Repercussions of wind turbine operations on human health)*, Panorama du Medecin (March 20, 2006), *quoted in* Frey and Hayden, *"Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health"*, 2007 at p. 5.

- Yet other WTSG members offered the following:

  - Using available internet search engines, Vibro Acoustic Disease or Wind Turbine Syndrome was not listed as an ailment in any of the following associations or organizations that list known diseases:

    - Medicine Net
    - National Institutes of Health (Office of Rare Diseases)
    - Wikipedia (Internet Encyclopedia)
    - National Organization for Rare Disorders
    - Mayo Clinic

  - In an effort to evaluate the health and safety risks associated with other forms of electrical generation, these presenting members offered the following information regarding the coal industry.

    - In Ohio the burning of coal leads to the premature deaths of 1,700 people per year. Environment Ohio, *"Clean Up Power Plants"*, 2007 at p. 2. In the United States according to the American Lung Association (2004 Study) 24,000 premature deaths are attributed each year due to power plant pollution.
    - The ALA notes that research estimates over 550,000 asthma attacks, 38,000 heart attacks, and 12,000 hospital admissions are caused annually by power plant pollution. In the last century more than 100,000 deaths have been a result of mining coal, with over 200,000 black lung deaths. This is part of the burden of coal. TXU Corporate Presentation included in Champaign County Farm Bureau materials dated 1/15/08.
    - In 1997 the World Health Organization estimated that nearly 700,000 deaths are related to air pollution and that about 8 million avoidable deaths will occur worldwide by 2020. Cifuentes, Luis, et al., *"Climate Change: Hidden Health Benefits of Greenhouse Gas Mitigation"*, Science Magazine, August 17, 2001, vol. 293: 1257-1259 at p. 1.

      - Rebuttal: It is impossible from the above statistics to determine the extent to which the installation of a local wind power facility will offset those impacts, or how those offsets might compare with other potential local impacts (such as nuisance, safety, and health) discussed throughout this report.

- According to Leventhall, infrasound and its companion low frequency noise now occupy a special position in the national psyche of a number of countries where they lie in wait for an activation trigger to re-generate concerns of effects on health. Earlier triggers have been defense establishments and gas pipelines. A current trigger is wind turbines. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005.

<u>Measurement of Wind Turbine Noise</u>

- Different WTSG members felt that the following information was relevant and informative:
  - Some, but not all, WTSG members offered the following:
    - Low-frequency noise is not adequately measured using an "A-weighted" sound measurement (dBA). A-weighted measurements underestimate the levels of low-frequency noise. Leventhal, *Review of Published Research on Low-Frequency Noise and Its Effects* at 8.2.4 (2003) (prepared for British Department for Environment, Food, and Rural Affairs (DEFRA)). Since A-weighting underestimates the sound pressure of noise with low-frequency components, a better assessment of health effects would be to use C-weighting. Frey and Hayden, *"Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health"*, 2007 at p. 36, *quoting* World Health Organization Guidelines for Community Noise S.3.8 (1999). Both A- and C-weighted measurements are necessary to adequately assess noise from wind turbines. James, Richard, E-Coustic Solutions, *"Champaign County Ohio Noise Questions Powerpoint Presentation"*, February 6, 2008.
      - Rebuttal: The Leventhall review cited above is a thorough examination of low frequency noise from a variety of sources. It is recognized that low frequency noise can be an issue in some higher sound level environments, and that using an A-weighted measurements can be inadequate in those environments. This report, however, does not focus on wind turbine noise, and Leventhall has reported repeatedly that low frequency sound at the levels produced by wind turbines is not problematic. Leventhall, *"How the "mythology" of infrasound and low frequency noise related to wind turbines might have developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005 at p. 13-14; British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005 at p. 2.
  - Other WTSG members offered the following:
    - Low frequency sound from wind turbines is comparable to natural ambient levels of low frequency sounds. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005, at p. 13-14. According to Sondergaard, "It seems that there is no tendency that the larger wind turbines is [sic] creating an excessive amount of low frequency noise compared to the overall noise level." Sondergaard, Bo & Hoffmeyer, Dan,

"Low Frequency Noise from Large Wind Turbines", Second International Meeting on Wind Turbine Noise, September 20-21, 2007 at p. 21. Measuring the C-weighted component of wind turbine noise will not help mitigate sound impacts in communities. The C-weighted measurement is generally only useful for environmental sound when the absolute magnitude exceeds about 70-75 dBC. Below this threshold low frequency sound is largely imperceptible and inconsequential. Hessler, David, Hessler Associates, Inc., Speerschneider, Michael, Everpower Renewables Corp., *"Comments in Response to Richard James Presentation"*, March 3, 2008.

- Yet other WTSG members offered the following:
  - At the present time there are no common international noise standards or regulations for sound pressure levels. Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006 at p. 21.
  - Sample Noise Assessment for a Wind Turbine Project, taken from Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006 at p. 22.

    1. An estimation or survey of existing ambient background noise levels.
    2. Prediction of noise levels from the turbines at and near the site.
    3. Identification of a model for sound propagation (sound modeling software will include a propagation model)
    4. Comparing calculated sound pressure levels from wind turbines with background sound pressure levels at the locations of concern.

Mitigation of Wind Turbine Noise:

Different WTSG members felt that the following information was relevant and informative:

- Some, but not all, WTSG members offered the following:
  - Efforts to reduce potential noise impacts on nearby residents may be most important within one-half mile. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 153.
    - Rebuttal: While it has been suggested that potential noise on nearby residents may be less important outside of ½ mile, this does not indicate that noise impacts *will be* important within ½ mile.

Recommended Action:

- The Wind Turbine Study Group recommends a noise standard +5dB above pre-construction background (L_{90}) to mitigate potential noise impacts from wind turbines in Champaign County. Wind turbine noise should not cause the sound levels at any receptor site to exceed 5 decibels above pre-construction background (L_{90}). This standard should be used in siting determinations as well as to assess ongoing operation of wind turbines.

- Some, but not all, WTSG members recommend that a standard include a threshold level of 40-45 dB (based on World Health Organization (WHO) community sound guidelines which recommend sound levels outside a bedroom do not exceed 45 dB to avoid sleep disturbance). If the sound from turbines exceeds this level, the limit should be +5dB above pre-construction background (L_{90}). The sound standards referenced above are designed to minimize possible adverse impact to residents in their homes and are much more stringent than typical outdoor noise standards. It would be appropriate, therefore, to maintain these standards at the residence and not at other parts of the property. The National Research Council study recommends that good practice for dealing with potential impacts of noise includes maintaining a minimum distance between the nearest turbine and a residence. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 176.

    - Some, but not all, WTSG members believe that the proposed noise standard threshold of 40-45 dB is unacceptable because—

        - It would allow wind turbine facilities to significantly increase community noise levels to, or above, the 30 dB threshold for sleep deprivation as recognized by the WHO, *see* Frey and Hayden, "*Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health*", 2007 at p. 34;

        - The WHO has recognized that a lower limit is appropriate where there is a significant low-frequency noise component or where a throbbing or pulsating noise is present (all of which are present in wind turbine noise), Frey and Hayden, "*Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health*", 2007 at p. 35; and James, Richard, E-Coustic Solutions, "*Champaign County Ohio Noise Questions Powerpoint Presentation*", February 6, 2008 at slide 33, and

        - High levels of public annoyance have been documented at wind turbine noise levels above 40 dB. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review,* 2003 at p. 13.

    - Some, but not all, WTSG members state that the WHO guideline for community noise related to sleep disturbance of 30 dB described above applies *inside the bedroom*. The same guideline indicates that sound pressure level of 45 dB at the outside façade, with an open window, is adequate to prevent sleep disturbance. Frey and Hayden, "*Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health*", 2007 at p. 35.

- Some, but not all, WTSG members recommend that compliance with wind turbine noise standards be determined using both A- and C-weightings.

    - Some, but not all, WTSG members believe that measuring the C-weighted component of wind turbine noise will not help mitigate sound impacts in communities. Below the absolute magnitude of 70 or 75 dBC, low frequency sound is largely imperceptible and inconsequential. Hessler, David, Hessler

Associates, Inc., Speerschneider, Michael, Everpower Renewables Corp., *"Comments in Response to Richard James Presentation"*, March 3, 2008, at p. 2.

- The WTSG recommends that wind turbine noise standards be implemented as follows:
  - The L_{90} sound level is a background noise measurement representing that sound level which is exceeded 90 percent (90%) of the time.
  - The background level should be established by a qualified and experienced sound engineer.
    - Some, but not all, WTSG members recommend that background noise samples should be at least 10 minutes in length. Background noise should be measured during late evening or nighttime conditions using pre-construction computer modeling to determine representative receptor sites. James, Richard, E-Coustic Solutions, *"Champaign County Ohio Noise Questions Powerpoint Presentation"*, February 6, 2008 at slides 37, 47.
  - Compliance with the L_{90}+5dB standard should be evaluated through computer modeling as a part of pre-construction project review and approval. This modeling should be based in part on an IEC certified sound power level that represents the sound level originating from the turbine. A qualified sound engineer should then use that sound power level, along with the characteristics of the project area to model the sound propagation through the proposed project area. The modeled sound impact at any particular spot should be evaluated against the noise standard recommended above.
  - Modeling sound from wind turbines and predicting its impact in the community is complicated by the varying noise levels from both the wind turbine and the ambient background noise that will mask the turbine noise. A qualified sound engineer experienced in modeling wind turbine sound should be utilized for this study.
  - Some, but not all, WTSG members recommend that compliance should be determined at the property lines of adjacent non-participating landowners. Determining compliance at existing residences and businesses does not take into account the potential for future development of adjacent parcels.
  - Some, but not all, WTSG members state that the sound standards referenced above are designed to minimize possible adverse impact to residents in their homes and are much more stringent than typical outdoor noise standards. It would be appropriate, therefore, to maintain these standards at the residence and not at other parts of the property. The National Research Council study recommends that good practice for dealing with potential impacts of noise includes maintaining a minimum distance between the nearest turbine and a residence. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 176.
  - If multiple turbines are proposed, their combined noise effects on neighboring properties should be considered as part of the computer modeling. Computer models should reflect conservative assumptions for operating conditions and meteorological conditions. All assumptions should be disclosed in the modeling report.
  - WTSG members had differing views as to the recommended methods to be used to assess compliance with wind turbine noise standards.

- Some, but not all, WTSG members recommend that compliance with the recommended noise standard should be assessed using both dBA and dBC measurements and in accordance with American National Standards Institute (ANSI) Standards S12.9, S12.17, and S12.18.

- These members further state that because low-frequency noise from wind turbines is audible under certain circumstances, it should be measured by use of C-weighted noise measurements.

- Some, but not all, WTSG members recommend using appropriate methods used by the acoustic engineering industry working in the field of community sound impacts of wind energy projects. These members believe that there are a number of acceptable methodologies that are employed to measure compliance, that the ANSI standards listed above are not specific to wind turbine sound measurements, that it is not clear that they would be appropriate for all situations, and that they should not be adopted without further examination of their appropriateness.

- Some, but not all, WTSG members recommend that local decision-makers should assess from the developer a project application fee sufficient to enable the township to engage its own noise consultant for assessing sound modeling and future operational compliance with the sound standard.

10. Road Infrastructure:

Definition of Issue: The road infrastructure must physically support both traffic patterns and loads associated with wind turbine installation projects.

Information Assessment:

- Construction of the project will require heavy traffic and overweight carriers. This traffic will create temporary congestion in some areas and local roads may be damaged. Oversight of road infrastructure is within the purview of the Champaign County Engineer and necessary regulations, permitting and oversight are currently in place to protect local highway infrastructure during construction.
- The Champaign County Engineer requires any activity under special permit for oversized/over-load to submit a transportation plan, engineered road assessments, and completion of adequate roadway improvements before work can begin.
- Some roadway and intersection upgrades will likely be necessary. Again, the Champaign County Engineer would oversee this work to ensure that it is done properly.

Recommended Action:

- Local decision-makers should request a transportation route and work with the developer to make sure the community and school districts are aware of activity on local roads.
- Prior planning with the developer and county engineer or township trustees is imperative. Prior to construction the developer should provide a turbine site plan and transportation route associated with construction of the project.
- The roads after the construction should be as good as or better than they were previously.
- The Natural Resource Conservation Service has "best management practices" that have been written to mitigate negative impacts to the environment, and must be considered.

11. **Shadow Flicker**:

Definition of Issue:

- Shadow flicker describes the effect caused by wind turbine blades passing between the sun and an observer. Rotation of turbine blades in sunny conditions results in moving shadows on the ground, which results in alternating changes in light intensity. Shadow flicker is different from a related strobe-like phenomenon that is caused by intermittent chopping of the sunlight behind the rotating blades. Shadow flicker is a function of several factors, including the location of people relative to the turbine, the wind speed and direction, the diurnal variation of sunlight, the geographic latitude of the location, the local topography, and the presence of any obstructions. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 160. Shadow flicker is also a function of tower height and rotor diameter.

Information Assessment:

- According to the National Research Council, shadow flicker is not important at distant sites (for example, greater than 1,000 feet from a turbine) except during the morning and evening when shadows are long. However, sunlight intensity is also lower during the morning and evening when shadows are long. This tends to reduce the effects of shadows and shadow flicker. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 160.

- Turbines on elevated ridges may cast very long shadows into the adjacent valleys. For example, for a 700' high north-south ridgeline and a 262 foot nacelle, the 300' diameter rotors will cast over a two-mile shadow when the sun is at 5 degrees. Bolton, R.H., *"Evaluation of Environmental Shadow Flicker, Analysis for 'Dutch Hill Wind Power Project"*, January 30, 2007 at p. 9. Although 700' ridgelines are not representative of topography in Champaign County, Ohio, this example illustrates how topography can affect the length of shadows cast by wind turbines. The length of the shadow and potential exposure to shadow flicker should be calculated based on local topography.

    - Some, but not all, WTSG members believe that since elevation changes in Champaign County, Ohio, are roughly 200' with much more gradual slopes than those used in the calculations referenced in the Bolton example above, the above example does not provide an accurate representation of potential impacts in Champaign County, Ohio.

- According to the National Research Council, while shadow flicker can be a nuisance to people living near a wind-energy project, in the United States shadow flicker has not been identified as causing even a mild annoyance. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 160.

    - In Northern Europe because of the higher latitude and the lower angle of the sun, especially in winter, shadow flicker can be a problem. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 160.

- Some, but not all, WTSG members believe that the experience with shadow flicker in the United States may be different from that in Europe because large wind-energy facilities in populated areas are relatively new in the United States.

- According to one publication, people and animals (for example, dairy cattle) directly under the shadow flicker cast by a bright sun will both be highly affected by shadow flicker from wind turbines by the rapid dimming and brightening. This has not been experienced by most people or livestock ever before and will be a completely new phenomenon. Bolton, R.H., *"Evaluation of Environmental Shadow Flicker, Analysis for 'Dutch Hill Wind Power Project"*, January 30, 2007 at p. 10.

  - Some, but not all, WTSG members feel that the Bolton statement above is opinion and not based on science, expertise, or experience. These members are not aware of any evidence of negative impact to livestock associated with shadow flicker from wind turbines around the world. Other than the report referenced above, according to Mr. Bolton's statement of experience, his experience in wind industry is limited to one analysis of wind turbine noise of unknown content or influence. The report referenced above is an evaluation of shadow flicker assessment made by another firm.

  - Some, but not all, WTSG members note that the author of the Bolton report has at 23 years of professional experience as a project engineer (Eastman Kodak) and physics faculty member (Rochester Institute of Technology). Mr. Bolton has prepared evaluations concerning at least two wind power facilities. Furthermore, these members assert that the determination whether shadow flicker may constitute a nuisance is determined by what a reasonable person would consider an unacceptable impact, and is not solely a scientific matter.

- To the WTSG's knowledge, there are no U.S. or global uniform standards for mitigation of shadow flicker. In Denmark, it is generally recommended that there be no more than 10 hours per year when shadow flicker is experienced. One wind-energy project in Germany is subject to a restriction of 30 hours per year of shadow flicker on a neighbor's property; that restriction pertains to hours when the neighboring residents are present and awake. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 161. The NRC publication does not specify the underlying assumptions and methodologies used in the Denmark and Germany examples cited above.

- It is sometimes difficult to work in a dwelling if there is shadow flicker on a window. Even in the worst situations, shadow flicker only lasts for a short time each day, rarely more than a half hour. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 161.

  - Some, but not all, WTSG members also believe that shadow flicker can be a nuisance outside of a residence, for example, in outdoor recreation contexts.

- If a turbine is close to a highway, the movement of the large rotor blades and possible resulting shadow flicker can also distract motorists. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 161. A recent compilation of wind industry related accidents reports that three fatalities have been attributed to driver distraction on a circular road in Germany where turbines become visible to drivers. Craig, David, *Wind Turbine Accident Compilation* (enclosed in 12/11/07 materials compiled by Champaign County Farm Bureau). Because of the potential for driver distraction, Irish guidelines recommend that turbines be set back from roadways at least 300 meters. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 161.

- Some, but not all, WTSG members feel that motorists are subject to a number of distractions when driving. There is no evidence that distance of the turbine from the road can increase or decrease the potential for distraction.

<u>Recommended Action</u>:

- Shadow flicker impacts should be mitigated through proper turbine siting. The wind turbine developer should provide an analysis of the potential shadow flicker impacts for the entire project. The analysis should be performed by a qualified professional and should include the use of an accepted software tool specifically designed for shadow flicker calculations. In general, shadow flicker models have the ability to consider local weather conditions, tree cover, and other factors that can determine potential exposure to shadow flicker. These models can also calculate maximum possible exposure given full sunlight without clouds.

- Local decision-makers should establish reasonable exposure limits for shadow flicker. These exposure limits should be clearly defined, and compliance should be determined during the siting process by use of the software tools referenced above.

  - Some, but not all, WTSG members believe that there is minimal potential for shadow flicker impact and it is limited to residences. Therefore, any limits for shadow flicker should be calculated based on real exposure to residences. Any calculation of exposure time should take into account scientific data and base calculations on our specific area and latitude of Champaign County, Ohio.

- Some, but not all, WTSG members recommend that to mitigate potential nuisance to people and animals and adverse property value impacts on adjacent property, any restriction on shadow flicker impacts should be measured from boundaries of adjacent properties. These members recommend that shadow flicker modeling should be based on maximum possible exposure given full sunlight without clouds. These members also recommend that a 10 hour/year exposure standard, similar to the Danish guideline referenced above, is reasonable and appropriate under any scenario.

12. Telecommunications:

Definition of Issue:

- Wind turbines have the potential to interfere with television, radio, microwave/radio fixed links, cellular phones, and radar transmissions. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 160.

Information Assessment:

- The main form of interference to TV transmission caused by wind-energy projects is the scattering and reflection of signals by the turbines, mainly the blades. In relation to the components that make up a wind turbine, the tower and nacelle have very little effect on reception (that is, only a small amount of blocking, reflection, and diffraction occurs.) National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 170.

- Available literature indicates that the effects of wind projects on both AM and FM radio transmission signals are considered to be negligible and only apply at very small distances from the turbines (that is, within tens of meters). National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 171.

- A wind turbine may degrade the performance of fixed link radio receivers (like satellite dishes), not only if the turbine is within the line of site of the link but also if it is within a certain lateral distance of the link, known as the "Fresnel zone." National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 171.

- The potential for interference of wind turbines with radar is only partially understood. If there is such interference, it would primarily affect military and civilian air-traffic control and National Weather Service weather radar. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 171-72. As of late 2006, the interference of wind turbines with radars is a problem as yet unsolved. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007 at p. 173.

Recommended Action:

- Local decision-makers should require sufficient information about the potential for telecommunications and radar interference during siting and compliance review of proposed wind-power developments, and should require prompt mitigation of any such interference post-installation.

13. Turbine Collapse:

Definition of Issue:

- As a built structure, a wind turbine may collapse under extreme conditions, operator error or manufacturing defect.

Information Assessment:

- Published literature suggests that turbine tower failure is rare, but these accidents do occur. Craig, David, *Wind Turbine Accident Compilation*.

Recommended Action:

- In connection with pre-construction review and approval of wind power developments, local decision-makers should address this issue with the use of property line, utility line, and roadway setbacks of at least the height of the hub plus the rotor radius. This would ensure that if the turbine structure does fail, it would not damage occupied structures, roadway rights-of-way, or adjacent nonparticipating properties. Also, it would be appropriate to limit access in the immediate area of the wind turbine during testing and inspection procedures. The design and construction of the wind energy project should conform to all applicable industry standards and developer/operator should provide certification of design compliance.

14. Vandalism:

Definition of Issue:

- There may be a community concern that vandals would seek to damage the turbine, which could result in a safety concern.

Information Assessment:

- The industry standard for wind turbines is a monopole design with operating components located inside the rolled-steel tower and secured behind a locked metal door.

Recommended Action:

- According to the particular landowner's desire, gates can be installed at the access roads to help prevent unauthorized persons from entering a property.

Appendix A

Bibliography of WTSG source material

1. Harsh, Stephen B., "*Wind Energy Renewable Energy for the Future*", Michigan State University Powerpoint Presentation, October 17, 2007
2. American Wind Energy Association, "*Wind Power Myths vs. Facts*"
3. U.S. Department of Energy, Energy Efficiency and Renewable Energy, "*Wind Energy Myths*", May 2005
4. Twin Groves Wind Farm Information Sheet
5. General Electric Handout, "*1.5 MW Series Wind Turbine*", 2005
6. General Electric Handout, "*Wind Power Plant Performance*"
7. Siemens Power Generation Handout, "*Characteristics of Siemens Wind Turbines*", 2007
8. Press Release, "*Governor Ted Strickland Energy Plan*"
9. Invenergy Press Release, "*Support of Ohio-Generated Renewable Energy*", October 25, 2007
10. Ohio Farm Bureau, "*Issue Briefing on Strickland Energy Plan*", October 22, 2007
11. National Research Council, Committee on Environmental Impacts of Wind Energy Projects, "*Environmental Impacts of Wind-Energy Projects*", 2007
12. National Research Council, Committee on Environmental Impacts of Wind Energy Projects, "*Environmental Impacts of Wind-Energy Projects*", *Executive Summary*, 2007
13. Environment Ohio & Environment Ohio Research and Policy Center, "*Ohio's Wind Energy Future*", November 2006
14. Environment Ohio & Environment Ohio Research and Policy Center, "*Energizing Ohio's Economy, Creating Jobs and Reducing Pollution with Wind Power*", August 2007
15. Ohio Department of Development, Office of Strategic Research, "*Ohio County Profiles, Champaign County*"
16. Faulkner, David, Community Improvement Corporation of Champaign County, "*Economic Impact Study of Wind Farm Development in Champaign County, Ohio*", November 13, 2007
17. Miller, Michael J., EPIC Consulting, "*A Statistical Critique of Two Studies Regarding the Impact of Wind Farms on Local Property Values*", January 2007
18. PJM, "*Ohio Regional Transmission Expansion Plan Overview*", 2006
19. PJM Interconnection 2007, "*R52 – Mechanicsburg – Darby 69kV Generation Interconnection*"
20. PJM Interconnection 2007, "*S45 – Mechanicsburg North Generation Interconnection*"
21. PJM Interconnection 2007, "*S46 - Mechanicsburg South – Darby 69 kV Generation Interconnection*"
22. The Tribune-Democrat, "*Adhesive Defect Caused Wind Turbine Blade Problem, Company Says*", May 12, 2007
23. Hill, Gail Kinsey, The Oregonian, "*Siemens looks at Excessive Blade Speed in Tower Fall*", August 29, 2007
24. Eger, Justin, Mainline Newspapers, "*Wind Turbine Blade Safety, Questioned after Damage*", March 22, 2007
25. Pierpont, Nina, M.D., PhD., Archives & Collections Society, "*Health, Hazard and Quality of Life near Wind Power Installations – How Close is too Close?*" March 1, 2005
26. Matilsky, Terry, Rutgers University, "*Part I – Basic Kinematics*"
27. Lawton, Catherine M., "*Risk of Wind Turbine Ice Throw & Required Safety Setbacks, Wind Turbine Ice Sensor Reliability, Wind Turbine Icing Safety Issues and Adequacy & Safety of Current Wind Turbine Designs*", December 21, 2003

28. Wahl, David & Giguere, Philippe, General Electric Energy, *"Ice Shedding and Ice Throw – Risk and Mitigation"*, April 2006
29. The Guardian, *"Giant Wind Turbines Face a Storm of Protest"*, October 25, 2007
30. Champaign County Farm Bureau documents presented in binder format:
    a. Windwatch.com, *"Wind Turbine Accident Report"*, 2006
    b. Craig, David, *"Wind Turbine Accident Compilation"*
    c. Craig, David, Caithness Windfarm Information Forum, *"Summary of Wind Turbine Accident Data to November 1, 2006"*
    d. Horizon Wind Energy, *"Wind Farm Safety"*, 2005
    e. LM Glasfiber, *"Effective Lightning Protection"*
    f. Lewke, B, Kirchhof, J. & Hernandez, Y., et. al, *"EMC Analysis of a Wind Turbine Blade's Lightning Protection System"*
    g. Yoh, Yasuda, *"A New Lightning Protection System for Wind Turbines Using Two Ring-Shaped Electrodes"*, June 22, 2006
    h. Garrad Hassan Canada, Inc., *"Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario"*, May 31, 2007
    i. Seifert, Henry, et.al., *"Risk Analysis of Ice Throw from Wind Turbines"*, April 9-11, 2003
    j. Sagrillo, Mick, Sagrillo Power & Light, American Wind Association, *"Home-Sized Wind Turbines and Flying Ice"*, June 2003
    k. Global Energy Concepts, New York State Energy Research and Development Authority (NYSERDA) Wind Energy Tool Kit, *"Public Health and Safety"*, October 2005
31. Kithil, Richard, National Lightning Safety Institute, *"Lightning Hazard Reduction at Wind Farms"*, December 3, 2007
32. McNiff, Brian, McNiff Light Industry, National Renewable Energy Laboratory, *"Wind Turbine Lightning Protection Project 1999-2001"*, May 2002
33. National Wind Watch, *"Dangers of Wind Power"*, August 24, 2007
34. Bolton, R.H., *"Evaluation of Environmental Shadow Flicker, Analysis for 'Dutch Hill Wind Power Project"*, January 30, 2007
35. Danish Wind Industry Web Site, www.windpower.org, Guided Tour on Wind Energy, *"Refining Shadow Calculations for Wind Turbines"*, September 26, 2000
36. Danish Wind Industry Web Site, www.windpower.org, Guided Tour on Wind Energy, *"Shadow Variations from Wind Turbines"*, September 26, 2000
37. Department for Business Enterprise & Regulatory Reform, *"Onshore Wind: Shadow Flicker"* 2007
38. WIND Engineers, Inc., *"Wind Farm Measurements and Modeling, Shadow Flicker Briefing"*, November 2003
39. PJM, *"PJM on Wind"*, December 5, 2007
40. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines, Technical Annex"*, February 2005
41. FAA, *"FAA Advisory Circular: Obstruction Marking and Lighting"*, February 12, 2007
42. Speerschneider, Michael, *"Report to Logan County Wind Power Committee"*
43. James, Richard, E-Coustic Solutions, *"Champaign County Ohio Noise Questions Powerpoint Presentation"*, February 6, 2008
44. Leventhall, Geoffrey, *"A Review of Published Research on Low Frequency Noise and its Effects, Report for DEFRA"*, May 2003
45. Kamperman, George & James, Richard, *"Wind Siting Reform Policy: Comments on Electric Generation and Supply Templates Regarding Turbine Noise"*, December 13, 2007
46. James, Richard, E-Coustic Solutions, *"2006 Baseline Noise Study for Residents For Sound Economics and Planning"*, January 22, 2007

47. Leventhall, Geoffrey, *"Notes on Low Frequency Noise from Wind Turbines with Special Reference to the Genesis Power Ltd. Proposal, near Waiuku, NZ"*, June 4, 2004
48. Leventhall, Geoffrey, *"How the 'Mythology' of Infrasound and Low Frequency Noise related to Wind Turbines Might Have Developed"*, First International Meeting on Wind Turbine Noise: Perspectives for Control, October 17-18, 2005
49. Pierpont, Nina, MD, PhD, *"Wind Turbine Syndrome: Noise, Shadow Flicker and Health", August 1, 2006 / "Health Effects of Wind Turbine Noise"*, March 2, 2006
50. Pierpont, Nina, MD, PhD, *"Letter from Dr. Pierpont to a Resident of Ontario, Canada re. Wind Turbine Syndrome"*, Autumn 2007
51. Alves-Pereira, Mariana & Branco, Nuno Castelo, *"Infrasound & Low Frequency Noise Dose Responses: Contributions"*, August 28-31, 2007
52. Pierpont, Nina, MD, PhD, *"Vibro-Acoustic Disease"*, June 9, 2007
53. Soysal, Hilkat & Soysal, Oguz, *"Wind Farm Noise and Regulations in the Eastern United States"*, Second International Meeting on Wind Turbine Noise, September 20-21, 2007
54. Harry, Amanda Dr., *"Wind Turbines, Noise and Health"*, February 2007
55. Stewart, John, *"Location, Location, Location"*, July 2006
56. Archives & Collections Society, *"Some Health Aspects of Wind Driven Industrial Turbines"*, May 19, 2004
57. Sondergaard, Bo & Hoffmeyer, Dan, *"Low Frequency Noise from Large Wind Turbines"*, Second International Meeting on Wind Turbine Noise, September 20-21, 2007
58. Ritter, Jim, Chicago Sun-Times, *"Can Sleep Trouble Cause Diabetes?"*, January 1, 2008
59. Hessler, David, Hessler Associates, Inc., Speerschneider, Michael, Everpower Renewables Corp., *"Comments in Response to Richard James Presentation"*, March 3, 2008
60. James, Richard, E-Coustic Solutions, *"Comments in Response to Everpower Critique of Richard James Presentation"*, March 17, 2008
61. Champaign County Farm Bureau documents presented in binder format:
    a. *"Coal vs. Wind"* Charts
    b. Cifuentes, Luis, et al., *"Climate Change: Hidden Health Benefits of Greenhouse Gas Mitigation"*, Science Magazine, August 17, 2001, vol. 293: 1257-1259
    c. Hypography, *"Study Cites Air Pollution Deaths"*, August 18, 2001
    d. Gulland, Anne, *"Air Pollution Responsible for 600,000 Premature Deaths Worldwide"*, Global Health Council, December 14, 2002
    e. CBS News, *"Report: Pollution Killing Thousands"*, August 16, 2001
    f. Environment Ohio, *"Clean Up Power Plants"*, 2007
    g. Lashof, David et al., *"Coal in a Changing Climate"*, Natural Resources Defense Council, February 2007
    h. Union of Concerned Scientists, *"Environmental Impacts of Coal Power: Wastes Generated"*
    i. Union of Concerned Scientists, *"Environmental Impacts of Coal Power: Fuel Supply"*
    j. Union of Concerned Scientists, *"Environmental Impacts of Coal Power: Air Pollution"*
    k. Union of Concerned Scientists, *"Environmental Impacts of Coal Power: Water Use"*
    l. *"Ohio Sport Fish Consumption Advisory – Champaign County"*, Ohio EPA, Division of Surface Water, January 7, 2008
    m. *"Percentage of State Electricity from Coal"*, U.S. Department of Energy, National Renewable Energy Laboratory, May 17. 2007
    n. Bradbury, Dieter, *"Coal-fired Power Plants Spew Mercury but Avoid Crackdown"*, The Mercury Menace, Blethen Maine Newspapers, 1997

o. National Renewable Energy Laboratory, *"Renewables Portfolio Standards"* Map, September 2007
p. Rogers, Anthony, PhD, et al., *"Wind Turbine Acoustic Noise"*, Renewable Energy Research Laboratory, June 2002, Amended January 2006
q. AWS Truewind, *"Wind Energy and Low Frequency Noise"*, March 6, 2006
r. British Wind Energy Association, *"Low Frequency Noise and Wind Turbines"*, February 2005
s. All Tech Insulation, *"Common Noise Levels"*, 1999-2008
t. Bellhouse, George, *"Low Frequency Noise and Infrasound from Wind Turbine Generators: A Literature Review"*, Bel Acoustic Consulting, June 30, 2004
u. MedicineNet.com, *"Listing of Diseases starting with letter 'V'"*, January 9, 2008
v. National Institute of Health, Office of Rare Diseases, *"Listing of Diseases starting with letter 'V'"*, January 9, 2008
w. RxWiki.com, *"Listing of Diseases starting with letter 'V'"*, January 9, 2008
x. National Organization for Rare Disorders (NORD), *"Listing of Diseases starting with letter 'V'"*, January 9, 2008
y. Mayo Clinic, *"Listing of Diseases & Conditions starting with letter 'V'"*, January 9, 2008
z. Pirie, Hon. Robert B. Jr., Under Secretary of the Navy, Remarks of Speech entitled *"National Image Salute to Hispanic-Americans in the Military Banquet"*, May 21, 2001
aa. Becker, Robert, *"Scientists Debunk Vibroacoustic Disease Theory"*, Puerto Rico Herald, October 26, 2001

62. Alisankus, Tom, Large Wind Turbine Citizens Committee, Crescent Ridge Wind Farm, Illinois, Town of Union, *"Setback Recommendations Report"*, January 6, 2008
63. National Research Council, *"Environmental Impacts of Wind-Energy Projects"*, May 2007
64. The Wildlife Society, *"Impacts of Wind Energy Facilities on Wildlife and Wildlife Habitat"*, Technical Review 07-2, September 2007
65. Press Release, United States Secretary of the Interior Dirk Kempthorne, *"Interior Secretary Kempthorne Names Members for Committee to Address Wildlife Impacts of Wind Turbines"*, October 26, 2007
66. Gipe, Paul, *"Design As If People Matter: Aesthetic Guidelines for a Wind Power Future"*
67. Fouts, Jordan, Bowling-Green Sentinel-Tribune, *"Wind Farm Planners Try to Clear Air"*, September 20, 2007
68. Orr, Ryan, McClatchy-Tribune Regional News, *"Energy Project Slated for Apple Valley: Twenty-seven wind turbines will be viewable from town"*, January 27, 2008
69. Ubarana, Vinicius & Giguere, Philippe, General Electric Energy, *"Extreme Wind Speed – Risk and Mitigation"*, October 2007
70. Department of Agriculture, *"Farmland Preservation & Conservation Ag Easement Plan regarding Wind Energy"*
71. White Construction, *"Typical Service Road Cross Section"*, Big Sky Wind Farm Service Road Cross Section, January 2008
72. Arrowsmith Wind Farm, McLean County, *"Decommissioning Plan"*, May 4, 2005
73. Pennsylvania Model Ordinance, *"Decommissioning Plan"*
74. Murray County Zoning Ordinance, *"Decommissioning Plan"*, August 22, 2005
75. Adams Township, *"Decommissioning Plan"*, June 8, 2006
76. Walker, Christopher, *"Property Rights and Wind Turbine Development"*, February 19, 2008
77. On Compact Diskette: Frey and Hayden, *"Noise Radiation from Wind Turbines Installed Near Homes: Effect on Health"*, 2007
78. Pedersen, Eja, *Noise Annoyance from Wind Turbines—A Review*, 2003

79. Van den Berg, G. P., *Do Wind Turbines Produce Significant Low Frequency Sounds?*, 2004

END

Appendix B

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Re: Township Authority to Require Decommissioning Bonding or Funding for Wind Turbine Projects; C.C.Op. 08-006

QUESTION PRESENTED

The wind turbine study group has asked whether townships have the statutory authority to require "decommissioning bonding or funding." Decommissioning is the act of dismantling and removing a wind turbine at the end of its useful life or when it is deemed unsafe.

SHORT ANSWER

Since multiple agencies have jurisdiction over the generation and transmission of electrical power, the answer to this question is largely dependent upon who owns or operates the wind turbine or wind farm and its generating capacity.

DETAILED ANSWER

A township is a creature of statute, possessing only the powers it is granted by statute, either expressly or by necessary implication.[1] Thus, a board of township trustees may only exercise the powers expressly conferred by statute and the powers that must necessarily be implied from those express powers to enable the trustees to perform the duties imposed upon them. With that principle in mind, this opinion will briefly discuss several possible scenarios involving the decommissioning of wind turbines and wind farms.

[1] E.g., *Hopple v. Trustees of Brown Township*, 13 Ohio St. 311, 324 (1862).

a. Public Utilities

Revised Code Chapter 519, the statute authorizing townships to enact zoning resolutions, exempts public utilities from its scope. In that regard, R.C. 519.211(A) states:

> Except as otherwise provided in division (B) or (C) of this section, sections 519.02 to 519.25 of the Revised Code confer no power on any board of township trustees or board of zoning appeals in respect to the location, erection, construction, reconstruction, change, alteration, maintenance, removal, use, or enlargement of any buildings or structures of any public utility or railroad, whether publicly or privately owned, or the use of land by any public utility or railroad, for the operation of its business.[2]

As this language makes clear, if a wind turbine or wind farm is erected by a public utility, regardless of its generating capacity, it is exempt from township zoning.[3]

However, to the extent that a wind turbine or wind farm qualifies as a "major utility facility,"[4] the Power Siting Board has jurisdiction over its siting. The hearing procedures used by the Power Siting Board allow for public comment, a forum where the decommissioning issue might be raised. With regard to electrical generating facilities that do not qualify as a "major utility facility," the Public Utilities Commission has jurisdiction and its rules might also allow for public comment. Otherwise, it appears that a township can only address the "decommissioning" of wind turbines and wind farms owned or operated by public utilities via R.C. 505.86, the general nuisance statute governing unsafe buildings and structures.[5]

b. Major Utility Facilities

If a wind turbine or wind farm is erected by an entity that does not qualify as a public utility, it might still be exempt from township zoning. Revised Code Chapter 4906 sets forth a comprehensive scheme governing the process for applying for and granting

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[2] Division (B) allows townships to regulate telecommunication towers in areas zoned for residential use. Division (C) allows limited regulation over public utilities engaged in the business of transporting personas or property over any public street, road, or highway. Neither division has any application to electric generating and distribution facilities.

[3] *A & B Refuse Disposers, Inc. v. Ravenna Twp. Bd. of Trustees* (1992), 64 Ohio St.3d 385, defines "public utility" for purposes of township zoning. A discussion of the characteristics of a "public utility" is beyond the scope of this opinion.

[4] An electric generating facility with a capacity of 50 megawatts or more qualifies as a "major utility facility." See R.C. 4906.01(B)(1).

[5] R.C. 505.86 allows boards of township trustees to provide for the removal, repair, or securance of buildings or other structures that have been declared insecure, unsafe, or structurally defective by any fire department, county building department, or board of health.

certificates to construct major utility facilities, including electric generating plants designed for, or capable of, operation at a capacity of 50 megawatts or more.[6]

More specifically, R.C. 4906.13 provides:

> No public agency or political subdivision of this state may require any approval, consent, permit, certificate, or other condition for the construction or initial operation of a major utility facility authorized by a certificate issued pursuant to [this chapter]. . . . Nothing herein shall prevent the application of state laws for the protection of employees engaged in the construction of such facility nor of municipal regulations that do not pertain to the location or design of, or pollution control and abatement standards for, a major utility facility for which a certificate has been granted under this chapter.

The first sentence of R.C. 4906.13 wholly exempts the siting of major utility facilities from local regulation.[7] The second sentence allows for limited regulation by villages and cities. This sentence makes no provision for townships, however. Therefore, a township has no authority to impose any condition, including the posting of a decommissioning bond or plan, on the construction or initial operation of a major utility facility.

It should also be noted that the jurisdiction of the Power Siting Board is not dependent upon whether the "major utility facility" is owned or operated by a public utility. In that regard, R.C. 4906.04 provides in part:

> No person shall commence to construct a major utility facility in this state without first having obtained a certificate for the facility [from the Power Siting Board]. . . .

R.C. 4906.01(A), in turn, defines a "person" as "an individual, corporation, business trust, association, estate, trust, or partnership or any officer, board, commission, department, division, or bureau of the state or a political subdivision of the state, or any other entity." This definition of "person" includes anyone wishing to construct a major utility facility, without regard to whether they are a public utility.

Furthermore, if multiple wind turbines are connected together and enter the grid at a single point, this office believes that their generating capacities should be aggregated, for purposes of determining whether the project qualifies as a "major utility facility." If the aggregate capacity is 50 megawatts or more, a township would have no authority to condition the operation of a wind turbine or wind farm on the posting of a decommissioning bond or plan.

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6 E.g., *State ex rel. State Edison Co. v. Parrott* (1995), 73 Ohio St.3d 705, 707.

7 *Parrott*, 73 Ohio St.3d at 707, 709; *Chester Township v. Power Siting Comm.* (1977), 49 Ohio St.2d 231, 234

Rather, the siting procedure set forth in Revised Code Chapter 4906 and the accompanying administrative rules make provision for public comment. This forum may allow township officials or residents to address the decommissioning issue. Otherwise, it appears that a township's only authority regarding the decommissioning of wind turbines or wind farms with a generating capacity of 50 megawatts or more is R.C. 505.86.

c. Agricultural Use

Wind turbines used primarily to generate electrical power for agricultural activities might also be exempt from township zoning. In that regard, R.C. 519.21(A) provides in part:

> Except as otherwise provided in division (B) of this section, sections 519.02 to 519.25 of the Revised Code confer no power on any township zoning commission, board of township trustees, or board of zoning appeals to prohibit the use of any land for agricultural purposes or **the construction or use of buildings or structures incident to the use for agricultural purposes of the land on which such buildings or structures are located**[.] . . .

(emphasis added).

For purposes of R.C. 519.21(A), a structure is "incident to the use for agricultural purposes of the land" where the structure is directly and immediately related to an agricultural use, or is usually or naturally and inseparably dependent upon an agricultural use.[8] In light of this test, wind turbines that generate electricity that is used for agricultural purposes would appear to be directly and immediately related to an agricultural use, and therefore, exempt from township zoning. If so, a township would have no authority to require the posting of a decommissioning bond or plan as a condition for the wind turbine's erection. Of course, if the wind turbine is abandoned, and therefore no longer used for agricultural purposes, the township would be able to address its removal via the process set forth in R.C. 505.86.

d. Non-Major Utility Facilities Owned or Operated by Non-Public Utilities

Notwithstanding the broad exemptions provided by Revised Code Chapters 519 and 4906 of the Revised Code, some wind turbines and wind farms might still be subject to township zoning. For example, wind turbines and wind farms owned or operated by non-public utilities with a generating capacity under 50 megawatts cannot avail themselves of either the public utility exemption or the major utility facility exemption. Such facilities may be subject to township zoning resolutions. Similarly, small-scale wind turbines intended for personal use might be subject to township zoning.

In such cases, a township, as part of the authority granted by Revised Code Chapter 519, may require the posting of a decommissioning bond or plan. A number of

[8] E.g., *State v. Huffman* (1969), 20 Ohio App.2d 263, 269-70.

townships in Champaign County pursuant to their authority to regulate telecommunication towers in areas zoned for residential use have required bonds or decommissioning plans to be posted as part of the permitting process.

Sincerely yours,

NICK A. SELVAGGIO, CHAMPAIGN
COUNTY PROSECUTING ATTORNEY

Scott D. Schockling
Assistant Prosecuting Attorney

cc: file

ROAD UPGRADE AND MAINTENANCE

This ROAD UPGRADE AND MAINTENANCE AGREEMENT (this "Agreement") is made and entered into this 20th day of September, 2005 by and among McLean County, an Illinois County (the "County"), and High Trail Wind Farm, LLC ("High Trail") and Old Trail Wind Farm, LLC ("Old Trail", and together with High Trail, collectively, "Developers"). Each of the Developers and the County are sometimes referred to herein individually as a "Party" and collectively as the "Parties". The term "Developers' Representative(s)" shall include the Developers' contractors, sub-contractors, agents, employees, suppliers and designees.

RECITALS

WHEREAS, Developers are in the process of developing a wind-powered electric energy generating facility (the "Project") in McLean County, Illinois and have submitted an application for a Special Use Permit for the Project with the Department of Building and Zoning in accordance with the Zoning Ordinance of McLean County, and

WHEREAS, Developers propose to construct the Project in two or more phases. Each phase will be constructed and owned either by High Trail or Old Trail, and

WHEREAS, in connection with the construction, operation and maintenance of the Project, the Parties desire to address certain issues relating to the roads owned, operated and maintained by the County (collectively, the "County Roads") over which it will be necessary for the Developers and the Developers' Representative(s) to, among other things, (i) transport heavy equipment and materials over certain County Roads, which may in certain cases be in excess of the design limits of the County Roads; (ii) transport certain locally sourced materials, such as concrete and gravel, on such County Roads; (iii) widen certain County Roads and make certain modifications and improvements (both temporary and permanent) to such County Roads (including to certain culverts, bridges, road shoulders and other related fixtures) to permit such equipment and materials to pass; and (iv) place certain electrical and communications cables (collectively "Cables") for the Project adjacent to, under or across certain County Roads, and

WHEREAS, 605 ILCS 5/9-113 grants to the County, authority to impose reasonable rules, regulations and specifications for the use of County roads by public and private utilities, and

WHEREAS, 605 ILCS 5/9 113.01 imposes a liability on public or private utilities for any damage to County highways, and

WHEREAS, under 605 ILCS 5/5 et seq the County has broad power regarding the opening, construction, maintenance, relocation, access to or repair of highways in the County Highway system, and

WHEREAS, it is in the best interest of the public health, safety and welfare that Developers and the County reach an agreement to address the majority of issues that will arise in a project of this size, and

WHEREAS, Developers have provided to the County Engineer of McLean County a site layout plan for the Project that shows the tower sites, the access road entrances, the underground collection system and the power transformer site, a copy of which is attached as Exhibit A (the "Plan"), and

WHEREAS, Developers and the County of McLean wish to set forth their understanding and agreement as to the road issues relating to the construction and operation of the Project, and

WHEREAS, this Agreement shall apply to those County Roads listed on the Principal Road Upgrade Schedule attached as Exhibit B and, subject to Section 3D herein, any other County Highway used by Developers, Developers' Representative(s) in direct support of the construction and operation of the Project.

AGREEMENT

NOW, THEREFORE, in consideration of the mutual promise and covenants herein set forth, the parties, intending to be legally bound, agree as follows:

Section 1. Each of High Trail, in respect of the phases of the project owned, developed and constructed by it, and Old Trail, in respect of the phases of the project owned, developed and constructed by it, agree to undertake the following activities in accordance with the terms of this Agreement:

A. Within five business days following the award of any contract by the County for the improvements to the County Highways in accordance with Section 5 and Exhibit B for which a Notice to Proceed has been given pursuant to Section 1. T. and not withdrawn, Developers shall pay McLean County Highway Department for the costs of the improvements contained in the bid accepted by the County ("Bid Cost"). For purposes of this Agreement, "commencement of construction" shall mean construction by Developers or Developers' Representative(s) of access roads and wind turbines on the Project site has begun and does not include testing or surveying (including geotechnical drilling and meteorological testing) to determine the adequacy of the site for construction.

The Parties acknowledge the costs set forth in Exhibit B are estimates. Upon final payment by the County to its contractor for each improvement for which a contract was awarded, the County shall compare the actual cost with the Bid Cost. The County shall provide the Developers with a statement of the final actual costs. In the event the actual costs for the improvements were greater than the Bid Cost payment made by the Developers, the Developers shall reimburse the County for those additional costs. In the event the actual costs for the improvements were less than the Bid Cost payment made by the Developers, the County shall reimburse the Developers for those overpaid costs.

B. If Developer obtains all required governmental approvals, finds an acceptable market for the power from the respective phases of the project and enters into a power purchase agreement, and elects to proceed with any phase of the Project, Developer shall build the Project substantially as depicted on the Plan and obtain County Highway Department approval of any material alteration of the Plan insofar as it involves the use of County Highways;

C. Present Access Permit applications and required plans for all access points to the County Highway system;

D. Erect permanent markers indicating the presence of the Cables;

E. Install marker tape in any trench in which Developers or Developers' Representative(s) have placed Cables located on County right-of-way;

F. Become a member of the Illinois State-Wide One-Call Notice System (otherwise known as the Joint Utility Locating Information for Excavators or "J.U.L.I.E.") and provide J.U.L.I.E. with all of the information necessary to update its records;

G. Use directional boring equipment to make all crossings of County Highways for the cable collection system;

H. Provide plans for the widening of any corner radius necessary to facilitate the turning movements of the transport trucks used by the Developers or Developers' Representative(s);

I. Make the necessary improvements for these widened radii and once these widened radii are no longer needed to return the corners substantially to their original lines and grades unless the County Engineer requests that the widened radii remain as improved;

J. Notify the County Engineer in advance of all oversize moves and crane crossings;

K. Transport the tower segments and other oversize loads so as to minimize adverse impact on the local traffic;

L. Provide as much advance notice as is commercially reasonable to obtain approval of the McLean County Highway Department when it is necessary for a road to be closed due to a crane crossing or for any other reason. Notwithstanding the generality of the aforementioned, Developers will provide 48 hours notice to the extent reasonably practicable;

M. Sign all highway closures and work zones in accordance with the Illinois Department of Transportation Manual On Uniform Traffic Control Devices;

N. Pay for the cost of all repairs to all County Highways that are damaged by Developers or the Developers' Representative(s) during the construction of the Project and restore such roads to the condition they were in at the time of the pre-construction inventory;

O. Establish a single escrow account and a single Letter of Credit in accordance with Section 6 for all phases of the Project;

P. Notify all relevant parties identified under Section 4 of any temporary road closures.

Q. At the commencement of construction of each phase of the Project and on the first, second, third and fourth anniversaries thereafter, pay to the McLean County Highway Department, the amount of $50,000.00. Thereafter, the annual fee shall be 100% of what the prior year's fees would have been based on the County standard charges for agreements of this type. The fee shall not be cumulative, so if two or more phases are under way in any one year, only one $50,000 payment per year shall be made.

R. Obtain easements and other land rights needed to fulfill Developers' obligations under this Agreement.

S. Agree that the County shall design all road upgrades in accordance with the IDOT Bureau of Local Roads and Streets Manual – 2005 edition.

T. Provide written Notice to Proceed to the County by December 31 of each year, which notice shall identify the roads to be upgraded during the following year. The Notice to Proceed may be withdrawn at any time by Developers prior to the County's advertisement of the notice of bids. In the event Developers elect to withdraw the Notice to Proceed, Developers agree to pay the County for its actual reasonable costs incurred related to the subject improvements following the receipt of the Notice to Proceed through receipt of the notice of withdrawal.

U. Acknowledge that the estimates provided in Exhibit B are good faith estimates, but actual costs may vary.

V. Provide dust control and grading work to the reasonable satisfaction of the County Engineer on County roads covered by this Agreement that become aggregate surface roads.

W. Anywhere this Agreement obligates Developers to make a payment, said payment shall be made directly to the McLean County Highway Department. Except as called for in section 1A payments shall be made within 21 days of receipt of an invoice, containing such detail as Developers may reasonably request, from McLean County Highway Department. Such payments shall be made, at the Developers' discretion, by check or wire transfer of immediately available funds.

Section 2. The County, in accordance with the terms of this Agreement, agrees to:

A. Review for approval all access points to the County Highway system by giving consideration to sight distances, drainage and proximity to other entrances, in a reasonable manner and in accordance with accepted engineering practices;

B. Review for approval plans for all utility encroachments on County rights-of-way; in a reasonable manner in accordance with accepted engineering practices;

C. Review for approval all crane crossings across the County Highway system by giving consideration of road damage and traffic safety in a reasonable manner based on accepted engineering practices;

D. Issue master overweight and oversize permits in a timely manner for the roads scheduled on Exhibit B upon the filing of such applications on behalf of Developers and waive overweight permit fees for loads with axle weights of 18,000 pounds or less. Issue permits during the spring posting period, between January 15th and April 15th when conditions warrant;

E. Coordinate with Developers and Developers' Representative(s) so as to minimize the impact of their use of the County Highway system;

F. Waive all individual work permit fees.

G. Perform all routine maintenance on the County Highways used for the construction of the towers in accordance with Section 5 of this Agreement.

H. Consent to the use of the County Highway's rights-of-way for utility encroachments, including Cables for the Project. Consent granted herein shall be effective only to the extent of the property interest of the County of McLean. Such consent shall not be binding on any owner of a fee over or under which the highway is located and shall not relieve Developers from obtaining by purchase, condemnation or otherwise the necessary approval of any owner of the fee over or under which the highway is located if such approval is legally required.

I. Design all road upgrades in accordance with IDOT Bureau of Local Roads and Streets Manual – 2005 edition.

J. Implement road upgrades as agreed to in Exhibit B upon receipt of the Notice to Proceed.

K. Authorize County Engineer to agree on behalf of County to revisions to Exhibits A and B and to determine appropriate improvements.

L. One week prior to advertisement of bids, notify Developers of its intent to advertise notice of bids.

Section 3 Planning Inventory

A. Road Inventory

1. Pre-Construction Inventory

The Parties, prior to the commencement of construction of any phase, shall jointly perform a survey to record the condition of the pavement surface of the County Highways listed in Exhibit 'B'. For County Highways 15, 17 & 21 this survey shall be performed no later than ten (10) days prior to the start of any pre-construction upgrade. For County Highways 28 and 36, the survey shall be done no later than 10 days prior to the start of use by the Developers and Developers' Representative(s). During this survey the entire length of the road as listed in Exhibit B shall be video taped and if necessary photographs may be taken. In addition the County will provide the Developer or his agent copies of any plans, cross-sections and specifications relevant to the existing road structure.

For any structures on the proposed routes that the County feels may not carry the loads proposed by the Developer, the County shall have the right to hire a consultant to make a study of the structure to determine the load carrying capacity. The Developer shall furnish the consultant with drawings depicting the axle numbers, spacing and loading for the trucks moving the oversized loads. If it is determined that a structure will not carry the loads that are proposed the Developer may propose a plan to strengthen the structure. The County will then furnish the Developer with all available plans. Should the Developer present a plan to strengthen a structure the County will then have their consultant review these plans to determine if the improvements will carry the proposed loads. All costs incurred by the County for these services shall be paid by the Developers or from the escrow account.

Copies of all pre-construction documentation shall be provided to each of the Parties.

2. Post-Construction Inventory

Upon completion of construction of each phase of the Project, representatives of the County and Developer will perform a post-construction inventory, the methods of which shall be similar to those of the pre-construction survey. The two sets of data will be compared and if there is any wheel lane rutting, cracking or other damage in excess of the original survey McLean County will determine the extent of the repairs or improvements needed to return the roads to a pre-construction condition. The design of these repairs or improvements shall conform to standards provided in the IDOT Bureau of Local Roads and Streets Manual – 2005 edition the cost of these repairs or improvements to be paid by the Developers or from the escrow account.

B. Routing and Access Approval

As soon as practical and as necessary throughout the construction of any phase of the Project, Developers and County shall meet and by mutual agreement revise the Plan (Exhibit A) in so far as it affects the County Highways and make it more definitive. By mutual agreement, County Highways may be added to or deleted from the Principal Road Upgrade Schedule attached as Exhibit B, specific timing for upgrades shall be established, access points to public roads may be approved, preferred traffic routes shall be established and utility encroachments, including Cable, finalized. The Principal Road Upgrade Schedule (Exhibit B) has two parts. The first part is an estimate of the cost of improvements that are to be made before construction commences to give the road sufficient structural strength to handle the traffic anticipated during the construction of the Project. The second part is an estimate of the improvement that may need to be completed at the completion of the construction of the Project to return the roads identified in Exhibit B as amended from time to time to the same or better condition than those roads were in during the pre-construction inspection.

C. Revisions

As the Principal Road Upgrade Schedule (Exhibit B) is revised and roads are added or removed, pre-construction and post-construction improvement details shall be prepared and added to the Exhibit B using the same methodology as was used to establish the improvement descriptions and cost estimates included in Exhibit B.

D. Incidental Use

The Parties recognize that the Project traffic may, either through mistake or with the consent of the County, use roads other than those listed on the Principal Road Upgrade Schedule (Exhibit B). Repairs for damage caused by Developers or the Developers' Representative(s) during such mistaken or permitted use shall be paid by Developers directly to McLean County Highway Department, or as provided in Section 6 C of this Agreement.

Section 4. Construction Cooperation:

A. With Others:

Prior to the commencement of construction of any phase, Developers shall hold a meeting and shall invite all public or semi-public entities that may be affected by the Project including, but not limited to, schools and fire protection districts. At said meeting, Developers will discuss their plans for the construction of the Project and compile a list of contact persons that will need to be notified of any temporary road closures that may have an effect on the daily routine or routing of those agencies. Should all of the parties contacted not be represented, Developers shall attempt to make contact with these entities in an effort to obtain the contact information. A copy of this list shall be furnished to the Highway Department.

B. With the County:

During construction of any phase, the County and Developers shall meet regularly to disclose and discuss Project activities, including anticipated material and equipment deliveries and traffic movement – which may be reflected as changes in the Plan (Exhibit A) and/or the Principal Road Upgrade Schedule (Exhibit B).

Section 5. Upgrades and Maintenance of the County Highways

A. In order to minimize the adverse effect of the construction traffic on the County Highways, certain upgrades will be required on certain roads as described below the cost of which shall be paid by Developers.

See the Principal Road Upgrade Schedule attached as Exhibit B, as amended from time to time.

B. The daily routine maintenance of the County Highways affected by the Project including snow removal, striping, and routine signage and regularly scheduled maintenance or repair shall be the responsibility of the McLean County Highway Department. If repairs or maintenance, other than daily routine maintenance, are deemed necessary because of activity of Developers or Developers' Representative(s), the County will invoice the Developers for such cost and Developers shall make payment to the County therefore.

Section 6. Escrow Account and Letter of Credit

A. Once the Developers have elected to proceed with the Project in accordance with Section 1 B, then not more than two days following receipt of the notice of intent by the County to advertise the first bid for road upgrades identified on Exhibit B that are subject to this Agreement, the Developers shall establish an escrow account in the amount of $500,000.00 (the "Escrow Account"). The Escrow Account shall be used to pay for expenses incurred for the upgrade and/or repair of the County Highways in accordance with the terms of this Agreement in the event Developers do not otherwise pay the costs thereof. The Escrow Account shall be established at a bank doing business within McLean County selected by Developers. Within forty-five days of the execution of this Agreement by the Parties, or such later date as the Parties may agree, the Parties shall execute a mutually agreeable form of escrow agreement (the "Escrow Agreement"), which agreement shall, among other things, appoint the escrow agent and set forth the disbursement provisions in detail. Developers shall be responsible for making additional deposits in the Escrow Account in order to maintain the original minimum balance provided however, that the aggregate amount (including the initial balance) Developers shall be required to deposit shall not in any event exceed $11,000,000. At the same time the Escrow Account is established, Developers shall also provide to McLean County an "Irrevocable Letter of Credit" in the face amount of $500,000.00 (the "Letter of Credit") which the County may draw against in the event and only to the extent that sufficient funds are not available in the Escrow Account to pay for Developers' failure to pay for the upgrade and repair expense of the County Highways in accordance with the terms of this Agreement. The Letter of Credit shall be issued by a bank and in such form as is reasonably acceptable to the County.

B. The Escrow Account and Letter of Credit shall remain in place from the date the initial deposit is made until a date two years after the commencement of commercial operations of the final phase of the Project. For avoidance of doubt the commencement of commercial operation date shall be the date that the entire Project is placed into service. The County agrees to deliver any certification required for any permitted withdrawal from the Escrow Account or surrender of the Letter of Credit, including any final withdrawal and/or surrender when Developers are no longer required to fund the Escrow Account or provide the Letter of Credit pursuant to the terms hereof, or the terms of the Escrow Agreement or Letter of Credit. For so long as Developers are required to maintain the Letter of Credit pursuant to the terms hereof, in the event that, pursuant to the terms of such Letter of Credit, the County shall be entitled to draw down the full outstanding amount of such Letter of Credit as a result of a failure to extend, amend or replace such Letter of Credit prior to its expiration, the County agrees that it shall immediately deposit any amounts so drawn into the Escrow Account. Developers shall be entitled to withdraw from the Escrow Account any and all amounts in the Escrow Account (including any interest accrued thereon) two years after the commencement of commercial operations of the last phase of the Project.

C. The Escrow Agreement shall set forth, among other things, the disbursement procedures for the Escrow Account and shall include:

1. For the pre and post construction improvements listed on the Principal Road Improvement Schedule attached as Exhibit B, as such Exhibit may be amended by the Parties from time to time:

    a. The County shall notify Developers in writing of the work to be done.
    b. The contract shall be let by the County. Payment shall be made by the Developers or from the Escrow Account for pre and post construction road improvements.

2. For Damage during Construction to the roads listed on the Principal Road Upgrade Summary, as amended from time to time:

a. The County shall notify Developers of the work to be done.

b. The work shall be performed or contract shall be let by the County. Payment for such work shall be made by the Developers or from the Escrow Account.

3. For damages on roads other than those listed on the Principal Road Upgrade Summary attached as Exhibit B, as amended from time to time:

   a. The County notifies Developer of the location and nature of the repair or maintenance required and a suggested time framework for completion.

   b. If Developers agrees, the County or County's contractor shall perform the repair in the time framework specified and recover its costs from the Developers or the Escrow Account.

   c. If Developers disagree, the County and Developers will in good faith attempt to resolve the dispute and shall involve Lewis, Yockey and Brown as a neutral intermediary to help resolve the dispute within a 5-day period. The costs of the intermediary will be paid equally by the Parties if a mutually agreeable solution is proposed, or if not, by the Party rejecting the intermediary proposed solution. Either Party may reject the intermediary solution by written notice to the other party within 2 days from the date it is rendered.

   d. If the Parties cannot agree and the County rejects the intermediary's proposed solution, the County may take unilateral action to prevent harm or protect public safety, the cost of which shall be paid from the Escrow Account. If the appropriateness of the County action is ultimately determined not to be justified either by agreement or adjudication, County shall promptly refund applicable cost of repairs to the Developer.

   e. If the Parties agree and/or don't reject the intermediary's proposed solution, then the County or County's contractor may make the repair and shall recover its costs from Developer or the Escrow Account.

f. The County charges shall be based on County maintained time and material cost records, which shall be made available to Developers for review. County billing rates shall be those established by the County and shall be uniformly applied to all consumers.

D. Emergency Repairs.

Notwithstanding the foregoing, in the event Developers or the Developers' Representative(s) are reasonably believed by the County to have caused damage to County roads of a magnitude sufficiently great to create a hazard to the motoring public, which in the County's opinion warrants an immediate repair or road closing, the County may unilaterally make or authorize repair, with the reasonable, documented costs thereof paid by the Developer or from the Escrow Account. The County shall photograph, videotape and otherwise document the conditions and make all such documentation available to Developers. Any such emergency repair shall be subject to post-repair negotiations by the Parties, involvement of the intermediary and, if necessary, adjudication. If such post-repair proceedings favor Developers, the County will reimburse the Escrow Account for amounts withdrawn to fund the repair if any.

Section 7. Mutual Indemnification/Hold Harmless and Liability Insurance Provisions.

A. Indemnification by Developers. The Developers hereby release and agree to indemnify and hold harmless the County and their respective officers, employees, elected or appointed officials, and agents, and their respective heirs, executors, administrators, successors and assigns (hereinafter collectively "County Releasees") from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands against the County Releasees arising out of or relating to the performance by Developers of their obligations under this Agreement. More particularly, but without in any way limiting the foregoing, the Developers hereby release the County Releasees and agree to indemnify and hold harmless the County Releasees from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands arising directly or indirectly from any personal injury, death or property damage arising out of the use, construction, modifications, repair or improvement of any road subject to this Agreement by the

Developers, its employees, agents, representatives, suppliers or contractors, or their respective employees, agents or representatives.

B. Indemnification by the County. The County hereby releases and agrees to indemnify and hold harmless the Developers and their members, officers, directors, contractors, subcontractors, employees and agents, and their respective employees, heirs, executors, administrators, successors and assigns (hereinafter collectively "Developers Releasees") from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands against the Developers Releasees arising out of or relating to the performance by the County of its obligations under this Agreement. More particularly, but without in any way limiting the foregoing, the County hereby releases the Developers Releasees and agrees to indemnify and hold harmless the Developers Releasees from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands arising directly or indirectly from any personal injury, death or property damage arising out of the use, construction, modifications, repair or improvement of any road subject to this Agreement by the County, their respective employees, agents, representatives, suppliers or contractors, or their respective employees, agents or representatives.

C. Limitations of Liability. In no event shall the Developers or any of their members, officers, directors or employees or the County or any of its Board, officers or employees be liable (in contract or in tort, involving negligence, strict liability, or otherwise) to any other party or their contractors, suppliers, employees, members and shareholders for indirect, incidental, consequential or punitive damages resulting from the performance, non-performance or delay in performance under this Agreement.

D. Required Insurance. The Developers shall at all times throughout the term of this Agreement maintain in full force and effect commercial general liability insurance, naming McLean County, its Board, officers and employees as an additional insured, in the aggregate amount equal to Ten Million Dollars ($10,000,000). The Developers may utilize any combination of primary and/or excess insurance to satisfy this requirement.

Section 8. Miscellaneous

A. Remedies and Enforcement. Each of the parties hereto covenant and agree that in the event of default of any of the terms, provisions or conditions of this Agreement by any party (the "Defaulting Party"), which default is not caused by the party seeking to enforce said provisions (the "Non-Defaulting Party") and after notice and reasonable opportunity to cure has been provided to the Defaulting Party, then in such an event, the Non-Defaulting Party shall have the right of specific performance. The remedy of specific performance and injunctive relief shall not be exclusive of any other remedy available at law or in equity.

B. Due Authorization. Each of High Trail and Old Trail hereby represents and warrants that this Agreement has been duly authorized, executed and delivered on behalf of High Trail and Old Trail. The County hereby represents and warrants that this Agreement has been duly authorized, executed and delivered on behalf of the County.

C. Severability. If any provision of this Agreement is held invalid under any applicable law, such invalidity shall not affect any other provision of this Agreement that can be given effect without the invalid provision and, to this end, the provisions hereof are severable.

D. Amendments. No amendment or modification to this Agreement or waiver of a Party's rights hereunder shall be binding unless it shall be in writing and signed by the Party against whom enforcement is sought.

E. Notices. All notices shall be in writing and sent (including via facsimile transmission) to the parties hereto at their respective addresses or fax numbers (or to such other address or fax number as any such party shall designate in writing to the other parties from time to time).

Developers:

High Trail Wind Farm, LLC and Old Trail Wind Farm, LLC
1001 McKinney Street
Suite 1740
Houston, TX 77002
Phone: 713/571-6640;
Fax: 713/571-6659

with a copy to:

High Trail Wind Farm, LLC and Old Trail Wind Farm, LLC
Project Manager
716 E. Empire, Suite C
Bloomington, IL 61701
Phone: 309/829-8211;
Fax: 309/829-8611

McLean County

McLean County Engineer
102 S. Towanda-Barnes Road
Bloomington, IL 61704
Phone: (309) 663-9445
Fax: (309) 662-8038

F. This Agreement may not be assigned without the written consent of the other Party.

G. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, with the same effect as if the signatures thereto and hereto were upon the instrument. Delivery of an executed counterpart of a signature page to this Agreement by telecopy shall be as effective as delivery of a manually signed counterpart to this Agreement.

H. Governing Law. This Agreement shall be governed by and interpreted in accordance with the laws of the state of Illinois, irrespective of any conflict of laws provisions.

I. Successors and Assigns. This Agreement shall inure to the benefit of and shall be binding upon the Parties hereto, their respective successors, assignees and legal representatives.

J. Termination. The Developers shall have the right to terminate this Agreement at any time for convenience by providing fifteen (15) days prior written notice to the County of its intent to terminate this Agreement. In the event such termination occurs, the Escrow Account and Letter of Credit shall remain in place as follows, rather than the date specified in Section 6. B. of this Agreement.

In the event such termination occurs prior to the date that the Developers have issued the first Notice to Proceed pursuant to Section 1.T. of this Agreement, then notwithstanding anything herein to the contrary the Letter of Credit and the escrowed funds held in the Escrow Account (together with accrued interest, if any) shall be returned to the Developers and the Developers shall have no further liability to the County under this Agreement.

In the event such termination occurs prior to the commencement of construction of the first phase of the Project but after the Developers have issued the first Notice to Proceed and prior to the County awarding any bids for road work hereunder, Developers agree to pay the County for its actual reasonable costs incurred related to the subject improvements following the receipt of the Notice to Proceed through the date of termination. Upon payment by Developers to the County for such costs, the Letter of Credit and the escrowed funds held in the Escrow Account (together with accrued interest, if any) shall be returned to the Developers and the Developers shall have no further liability to the County under this Agreement.

In the event such termination occurs prior to the commencement of construction of the first phase of the Project, but after the County has commenced road work hereunder pursuant to a bid accepted by the County (the Bid Costs of which were paid by Developers), then the County shall complete such road work. Upon final payment for such road work by the County to its contractor, if the Bid Costs paid by Developer (i) are less then the actual final costs paid by the County then the Developer shall reimburse the County for such difference (the "Final Developer Payment") or (ii) are greater than the actual costs to be paid by the County for such work, then the County shall reimburse the Developers for such difference. Upon payment by Developers of the Final Payment to the County, the Letter of Credit and the escrowed funds held in the Escrow Account (together with accrued interest, if any) shall be returned to the Developers and the Developers shall have no further liability to the County under this Agreement.

In the event such termination occurs prior to "commencement of commercial operations of the final phase of the Project", the Escrow Account and Letter of Credit shall remain in place until a date two years after the date on which the Developers' construction activities have ceased.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first written above.

HIGH TRAIL WIND FARM, LLC

By________________________

Its Authorized Representative

OLD TRAIL WIND FARM, LLC

By________________________

Its Authorized Representative

THE COUNTY OF McLEAN

By: Michael F. Sweeney
Chairman, McLean County Board

ATTEST:

Peggy Ann Milton, McLean County Clerk

FROM : FAX NO. :13098885111 Nov. 04 2005 11:31AM P19/19

Principal Road Upgrade Schedule
Exhibit 'B' to High Trail and Old Trail Road Agreement

Highway Number	Highway Name	From	To	Milage	Pre-Construction Improvements	Post-Construction Improvements
C.H. 15	Arrowsmith-Sabina Rd.	1100N	CH 36	1.00	3/4" Level Binder 1.5" Surface	Level Binder & Surface as Needed
C.H. 15	Arrowsmith-Sabina Rd.	875N			Install Crossing	Remove Crossing
C.H. 17	Ellsworth Rd.	RT 9	Ellsworth	2.25	1.5" Surface	Level Binder & Surface as Needed
C.H. 17	Ellsworth Rd.	In Ellsworth		0.50	None	Mill 2" 2" Surface Course
C.H. 17	Ellsworth Rd.	Ellsworth	CH 36	1.50	2.5" Binder	Level Binder & Surface Required
1/4 Mi ? 9 South C.H. 21	Leroy-Lexington Rd.	RT 9	CH 36	5.25	1.5" Surface	Level Binder & Surface as Needed
C.H. 28	Ellsworth-Arrowsmith Rd.	2850E	3200E	3.50	None	4" Aggregate A-3 Surface
C.H. 36	Dawson Lake Rd.	2800E	3100E	3.00	None	4" Aggregate A-3 Surface
C.H. 36	Dawson Lake Rd.	3150E	3200E	0.50	None	4" Aggregate A-3 Surface

ROAD UPGRADE AND MAINTENANCE AGREEMENT

This ROAD UPGRADE AND MAINTENANCE AGREEMENT (this "Agreement") is made and entered into this 1st day of September, 2005 by and among Tim Bane, Highway Commissioner of Dawson Township, Tim Morefield, Highway Commissioner of Arrowsmith Township, Paul Bottles, Highway Commissioner of Cheneys Grove Township, ("the Commissioners"), High Trail Wind Farm, LLC ("High Trail") and Old Trail Wind Farm, LLC ("Old Trail", and together with High Trail, collectively, the "Developers"). Each of the Developers and the Commissioners are sometimes referred to herein individually as a "Party" and collectively as the "Parties".

RECITALS

A. Developers are in the process of developing a wind-powered electric generating facility (the "Project") in McLean County, Illinois and have submitted an application for a Special Use Permit for the Project with the Department of Building and Zoning in accordance with the Zoning Ordinance of McLean County.

B. Developers propose to construct the Project in two or more phases. Each phase will be constructed and owned either by High Trail or Old Trail.

C. In connection with the construction, operation and maintenance of the Project, the Parties desire to address certain issues relating to the roads owned, operated and maintained by the Township Road Districts (collectively, the "Township Roads") over which it will be necessary for the Developers and their respective agents, contractors, suppliers, vendors, employees, subcontractors and designees (collectively the "Developers' Parties") to, among other things, (i) transport heavy equipment and materials over certain Townships Roads, which may in certain cases be in excess of the design limits of the Township Roads; (ii) transport certain locally sourced materials, such as concrete and gravel, on such Township Roads; (iii) widen certain Township Roads and make certain modifications and improvements (both temporary and permanent) to such Township Roads (including to certain culverts, bridges, road shoulders and other related fixtures) to permit such equipment and materials to pass; and (iv) place certain electrical and communications cables (collectively "Cables") for the Project adjacent to, under or across certain Township Roads.

D. The Commissioners have broad statutory authority to regulate the use of Township Roads (605 ILCS 5/6-101, et seq.).

E. It is in the best interest of the public health, safety and welfare that Developers and the Commissioners reach an agreement to address the majority of issues that will arise in a project of this size.

F. Developers have provided to the Commissioners a site layout plan for the Project that shows the proposed tower sites, the access road entrances, the underground collection system and the power transformer site, a copy of which is attached as Exhibit A (the "Plan").

G. This Agreement shall apply to those Township Roads listed on the Principal Road Upgrade Schedule attached as Exhibit B and, subject to Section 3C herein, any other Township Roads used by Developers and Developers' Parties in direct support of the construction and operation of the Project.

AGREEMENT

NOW, THEREFORE, in consideration of the mutual promise and covenants herein set forth, the Parties, intending to be legally bound, agrees as follows:

Section 1. Each of High Trail, in respect of the phases of the project owned, developed and constructed by it, and Old Trail, in respect of the phases of the Project owned, developed and constructed by it, agree to undertake the following activities in accordance with the terms of this Agreement:

A. Ten (10) days prior to the expected commencement of construction of any phase of the Project, make the payment provided for in item P. of this Section and commence the improvements to the Township Roads in accordance with Section 5 and Exhibit B for such phase. For purposes of this Agreement, "commencement of construction" shall mean that unlimited and continuous construction of access roads and wind turbines on the Project site has begun and does not include testing or surveying (including geotechnical drilling and meteorological testing) to determine the adequacy of the site for construction.

B. If the Project is built, build the Project substantially as depicted on the Plan and obtain the Commissioners' approval of any material alteration of the Plan insofar as it involves the use of Township Roads;

C. Present Access Permits to permit Developers and Developers' Parties to use the Township Roads and required plans to the Commissioners for all access points to the Township Roads;

D. Erect permanent markers indicating the presence of the Cables;

E. Install marker tape in any trench located on or adjacent to Township Roads in which Developers or Developers' Parties have placed Cables;

F. Become a member of the Illinois State-Wide One-Call Notice System (otherwise known as the Joint Utility Locating Information for Excavators or "J.U.L.I.E.") and provide, from time to time, J.U.L.I.E. with all information necessary to permit J.U.L.I.E. to have current information for its records;

G. Provide plans for the widening of any corner radius necessary to facilitate the turning movements of the transport trucks used by the Developers or the Developers' Parties;

H. Make the necessary improvements for the widened corner radii described in paragraph G above and once these widened corner radii are no longer needed, to return the corners to their original lines and grades as near as is reasonably practicable unless the Commissioners request that the widened radii remain;

I. Notify the Commissioners in advance of all oversize moves and crane crossings on the Township Roads;

J. Transport the tower segments and other oversize loads so as to minimize the adverse impact on the local traffic resulting from such transport and in the exercise of commercial reasonableness;

K. Provide as much advance notice as is commercially reasonable to obtain approval of the Commissioners when it is necessary for a Township Road to be closed due to a crane crossing or for any other reason. Notwithstanding the generality of the aforementioned, Developers will provide 48 hours notice to the extent reasonably practicable;

L. Sign all closures and work zones on the Township Roads used by the Developers and Developers' Parties in accordance with the Illinois Department of Transportation Manual On Uniform Traffic Control Devices;

M. Pay for the cost of all repairs to all Township Roads that are damaged as a result of the use by Developers and the Developer Parties during the construction of any phase of the Project and restore such roads to the condition they were in prior to the use causing the damage (as near as is reasonably practicable);

N. Establish a single escrow account in accordance with Section 6 for all phases of the Project that will be used for the repair and improvements of the Township Roads;

O. Notify all relevant parties identified under Section 4 of any temporary road closures;

P. At the start of construction of each phase of the Project and on the first, second, third and fourth anniversaries of such date thereafter, pay Twenty Five Thousand Dollars ($25,000) to each of Dawson Road District and Cheneys Grove Road District, and Fifty Thousand Dollars ($50,000) to Arrowsmith Road District. The payments shall not be cumulative, so if two or more phases are underway in any one year, only one payment per year shall be made to each of the Township Road Districts. Thereafter, the annual fee shall be $7,500 for each Township Road District through the thirtieth anniversary of the commencement of commercial operations of the last phase of the project constructed subject to this Agreement. Such $7,500 per year payment shall be adjusted annually by the U.S. Department of Labor St. Louis Consumer Price Index (CPI) with a Base of January 1, 2006. For purposes of clarification, the following example illustrates how the annual payments will work for Arrowsmith Road District, assuming that the first phase of the Project is constructed in 2006 and the second phase of the Project is constructed in 2007:

Year	Project Phase I Annual Fee	Project Phase II Annual Fee	Total Annual Fee Payment
2006	$50,000	$0	$50,000
2007	$50,000	$50,000	$50,000
2008	$50,000	$50,000	$50,000
2009	$50,000	$50,000	$50,000
2010	$50,000	$50,000	$50,000
2011	$7,500*	$50,000	$50,000
2012 through 2036	$7,500*	$7,500*	$7,500*
2037	$0	$7,500*	$7,500*

*Note $7,500 payment would be adjusted annually by the CPI.

Q. Use commercially reasonable efforts to obtain easements and other land rights needed to fulfill Developers' obligations under this Agreement;

R. Agree that all Township Road upgrades hereunder shall be in accordance with IDOT Bureau of Local Roads and Streets Manual 2005 edition;

S. Provide dust control and grading work on Township Roads that become aggregate surface roads and which are listed on the Principal Road Upgrade Schedule attached as Exhibit B and, subject to Section 3C herein, any other Township Roads used by Developers and Developers' Parties in direct support of the construction and operation of any phase of the Project.

T. For clarity, when the phrase "Township Roads" is used in this Agreement, such phrase shall mean those Township Road District Roads listed on the Principal Road Upgrade Schedule attached as Exhibit B and, subject to Section

3C herein, any other Township Roads used by Developers and Developers' Parties in direct support of the construction and operation of the Project.

Section 2. The Commissioners, for and on behalf of the Township Road Districts, in accordance with the terms of this Agreement, agree to:

A. Review for approval all access points to the Township Roads by giving consideration to sight distances, drainage and proximity to other entrances, in a reasonable manner and in accordance with accepted engineering practices;

B. Review for approval plans for all utility encroachments on Township Roads, in a reasonable manner in accordance with accepted engineering practices;

C. Review for approval all crane crossings across the Township Roads by giving consideration of road damage and traffic safety in a reasonable manner based on accepted engineering practices;

D. Issue master overweight and oversize permits in a timely manner for the roads scheduled on Exhibit B upon the filing of such applications on behalf of Developers and waive overweight permit fees for loads with axle weights of 18,000 pounds or less and issue permits during the spring posting period, between January 15th and April 15th when conditions warrant;

E. Coordinate with Developers and Developers' Parties so as to minimize the impact of their use of the Township Roads;

F. Waive all individual work permit fees;

G. Perform routine maintenance on the Township Roads used for the construction of the towers in accordance with Section 5B of this Agreement;

H. Consent to the use of the Township Roads' rights-of-way for utility encroachments, including Cables for the Project. The consent granted herein shall be effective only to the extent of the property interest of the Commissioners and the Township Road Districts in the Township Roads. Such consent shall not be binding on any owner of a fee over or under which a Township Road is located and shall not relieve Developers from obtaining by purchase, condemnation or otherwise the necessary approval of any owner of the fee over or under which the Township Road is located if such approval is required by applicable law.

I. Design all Township Road upgrades in accordance with IDOT Local Road Administrative Policy Manual;

J. When the Commissioners are not readily available, they agree to delegate the day to day authority to implement the Agreement on behalf of the Commissioners and to so advise the Developers each Commissioner's designee.

Section 3. Planning Cooperation:

A. Roadway Condition Survey

The Parties, prior to the commencement of construction of any phase of the Project, shall jointly perform a survey to record the condition of the Township Roads to be used during the construction of such phase as set forth on Exhibit B. This survey shall be conducted no later than ten (10) days prior to the commencement of construction for such phase. Documentation shall include video taping, photography, information on original construction specifications and structural strength, boring records and reports of consultants retained by Developers and/or the Commissioners to ascertain the carrying capacities of relevant roads and structures, with consultant fees to be paid by the Developer or from the Escrow Account. In the event the Commissioners desire to retain a consultant, they shall first obtain the consent of the Developers (such consent not to be unreasonably withheld). Copies of all pre-construction documentation shall be provided to each of the Parties.

B. Routing and Access Approval

As soon as practical and as necessary throughout the construction of any phase of the Project, Developers and the Commissioners shall meet and by mutual agreement revise the Plan (Exhibit A) in so far as it affects the Township Roads and make it more definitive. By mutual agreement and prior to the commencement of construction of each phase of the Project, Township Roads may be added to or deleted from the Principal Road Upgrade Schedule attached as Exhibit B, specific timing for upgrades may be established, access points to Township Roads may be approved, preferred traffic routes may be negotiated and utility encroachments, including Cable installation, finalized. The Principal Road Upgrade Schedule contains a list of the principal Township Roads that are currently anticipated to be used during construction of the Project and contains two specifications, the first describing the minimum specifications which the Township Roads must have prior to and during the construction of any phase of the Project;

the second part describes the repairs or improvements that may be necessary following completion of material use. Such restoration to be within six (6) months following completion of material use by the Developers, or such longer period as mutually agreed by the appropriate Commissioner and the Developers.

As the Principal Road Upgrade Schedule (Exhibit B) is revised and roads are added or removed, pre-construction and post-construction improvement details shall be prepared and added to Exhibit B using the same methodology as was used to establish the improvement descriptions and cost estimates included in Exhibit B on the date of signing this Agreement.

C. Incidental Use

The Parties recognize that the Project traffic may, either through mistake or with the consent of the Commissioners, use Township Roads other than those listed on the Principal Road Upgrade Schedule. Repairs for damage caused by the Developers or any of the Developer Parties during such mistaken or permitted use may be paid as provided in Section 6 C of this Agreement.

Section 4. Construction Cooperation:

A. With Others:

Prior to the commencement of construction of any phase, Developers shall hold a meeting and shall invite all public or semi-public entities that may be affected by the Project including, but not limited to, schools and fire protection districts. At said meeting, Developers will discuss their plans for the construction of the Project and compile a list of contact persons that will need to be notified of any temporary road closures that may have an effect on the daily routine or routing of those agencies. Should all of the parties contacted not be represented, Developers shall attempt to make contact with these entities in an effort to obtain the contact information. A copy of this list shall be furnished to the Commissioners.

B. With the Commissioners:

During construction of any phase, the Commissioners and Developers shall meet regularly to disclose and discuss Project activities, including anticipated material and equipment deliveries and traffic movement which may be reflected as changes in the Plan (Exhibit A) and/or the Principal Road Upgrade Schedule (Exhibit B).

Section 5. Upgrades and Maintenance of the Township Roads

A. In order to minimize the adverse effect of the construction traffic on the Township Roads, certain upgrades will be required to be completed by Developers on certain roads as determined by and paid for by Developers in accordance with Exhibit B. All material incorporated into Township Roads and all related tools, fuel, lumber for forms and other end use or consumption items, whether or not incorporated into Township Roads, which are sold directly or indirectly to Developers and are used in connection with the road work described in Exhibit B, shall be exempt from Illinois Retailer Occupation Tax and Use Tax (Title 86 Part 130, § 130, 2075 (d) Ill. Dept. of Revenue Regulation). To the extent any such work is done or materials incorporated into roadways not currently under the jurisdiction of the Commissioners, such roadway shall be transferred to the Commissioners and shall, therefore, be exempt from Retailer Occupation and Use Tax (Title 86 Part 130, 2075 (e)(2) Ill. Department of Revenue Regulations).

B. The daily routine maintenance of the Township Roads affected by the Project, including snow removal, striping, and routine signage and regularly scheduled maintenance or repair shall be the responsibility of the Commissioners.

C. If repairs or maintenance (other than daily routine maintenance which shall be the responsibility of the Commissioners), including dust control and grading, is not performed by the applicable Developer following notice from the Commissioners and an opportunity to cure such failure of no less than 10 days, and such repairs and maintenance are deemed necessary because of activity of Developers and the Developer Parties, the Commissioners may perform (or cause to be performed) such work, with payment pursuant to the Escrow Disbursement Procedure set forth in Section 6-C.

Section 6. Escrow Account and Letter of Credit

A. Thirty days prior to the start of the initial upgrades of the Township Roads in accordance with this Agreement, the Developers shall establish an escrow account in the amount of Five Hundred Thousand Dollars ($500,000) (the "Escrow Account"). The Escrow Account shall be used to pay for expenses incurred for the upgrade and/or repair of the Township Roads in accordance with the terms of this Agreement in the event Developers do not otherwise pay the costs thereof. The Escrow Account shall be established at a bank doing business within McLean County selected by Developers. Within forty-five days of the execution of this Agreement, the Parties shall execute a mutually agreeable form of escrow agreement (the "Escrow Agreement"), which agreement shall, among other things, appoint the escrow agent and set forth the disbursement provisions in detail. Developers shall be responsible for making additional deposits in this escrow account in order to maintain the original minimum balance; provided however, that the aggregate amount (including the initial balance) Developers shall be required to deposit shall not in any event exceed $7,000,000. Developers shall also provide, thirty days prior to the start of the initial upgrades of the Township Roads in accordance with this Agreement, to the Commissioners an Irrevocable Letter of Credit in the face amount of Five Hundred Thousand Dollars ($500,000) (the "Letter of Credit") which the Commissioners may draw against in the event and only to the extent that sufficient funds are not available in the Escrow Account to pay for Developers' failure to upgrade and/or repair of the Township Roads in accordance with the terms of this Agreement. The Letter of Credit shall be issued by a bank and in such form as is reasonably acceptable to the Commissioners.

B. The Escrow Account and Letter of Credit shall remain in place from the date the initial deposit is made until a date two years after the completion of the road upgrades in Exhibit B. Claims by the Commissioners for damage caused by Developers or the Developers' Parties after the expiration of the Letter of Credit shall be resolved as provided in Section 6 C 2 a-f, recognizing that the Escrow Account may be depleted by this point in time. The Commissioners agree to deliver any certification required for any permitted withdrawal from the Escrow Account or surrender of the Letter of Credit, including any final withdrawal and/or surrender when Developers are no longer required to fund the Escrow Account or provide the Letter of Credit pursuant to the terms hereof, the Escrow Agreement or Letter of Credit. For so long as Developers are required to maintain the Letter of Credit pursuant to the terms hereof, in the event that, pursuant to the terms of such Letter of Credit, the Commissioners shall be entitled to draw down the full outstanding amount of such Letter of Credit as a result of a failure to extend, amend or replace such Letter of Credit prior to its expiration, the Commissioners agree that they shall immediately deposit any amounts so drawn into the Escrow Account. Developers shall be entitled to withdraw from the Escrow Account any and all amounts in the Escrow Account (including any interest accrued thereon) two years after completion of the road upgrades in Exhibit B.

C. The Escrow Agreement shall set forth, among other things, the disbursement procedures for the Escrow Account and shall include:

1. On the roads listed on the Principal Road Upgrade Summary attached as Exhibit B, as such Exhibit may be amended by the Parties from time to time:

a. The Commissioners shall notify Developers in writing of damage shown to be caused by Developers or the Developers' Parties and request that Developers repair the damage to such roads and return such roads to the condition they were in prior to such damage (as near as is reasonably practicable).

b. Prior to commencement of such repair, the Parties shall meet to review the damage in relation to the most recent survey. Developers shall repair (or cause to be repaired) such damage in accordance with subsection c, unless the Developers demonstrate to the reasonable satisfaction of the Commissioners that the damage was not caused by Developers or the Developer Parties. Any repair and restoration shall be promptly performed at such times as the Parties determine, having due regard for safety, the presence of emergency conditions and the costs of such repairs.

c. The work shall be performed by Developers in accordance with the applicable Illinois Department of Transportation Local Roads and Streets Manual, 2005 edition. Payment for such work shall be made by Developers or from the Escrow Account.

2. For damages on roads other than those listed on the Principal Road Summary attached as Exhibit B, as amended from time to time:

a. The Commissioners notify Developer of the location and nature of the repair or maintenance required and a suggested time framework for completion.

b. If Developers agree, the Developers (or its contractor) or Commissioners (or Commissioner's contractor) shall perform the repair in the time frame agreed by the Parties and recover its reasonable, documented costs from the Escrow Account.

c. If Developers disagree, the Commissioners and Developers will in good faith attempt to resolve the dispute and shall involve Lewis, Yockey and Brown as a neutral intermediary to help resolve the dispute within a 5-day period. The costs of the intermediary will be paid equally by the Parties if a mutually agreeable solution is proposed, or if not, by the Party rejecting the intermediary proposed solution. Either Party may reject the intermediary solution by written notice to the other Party within 2 days from the date it is rendered.

d. If the Parties cannot agree and the Commissioners reject the intermediary's proposed solution, the Commissioners may take unilateral action to prevent harm or protect public safety, the cost of which shall be paid from the Escrow Account. If the appropriateness of the Commissioners' action is ultimately determined not to be justified either by agreement or adjudication, Commissioners shall promptly refund applicable cost of repairs to the Developer.

e. If the Parties agree and/or don't reject the intermediary's proposed solution, then the Commissioners (or Commissioners' contractor) may make the repair and shall recover its reasonable documented costs from the Escrow Account.

f. The Commissioners' charges shall be based on County maintained time and material cost records, which shall be made available to Developers for review. County billing rates shall be those established by the County and shall be uniformly applied to all consumers.

3. Emergency Repairs.

Notwithstanding the foregoing, in the event Developers or the Developers' Parties are reasonably believed by the Commissioners to have caused damage to Township Roads of a magnitude sufficiently great to create a hazard to the motoring public, which in the Commissioners' opinion warrants an immediate repair or road closing, the Commissioners may unilaterally make or authorize repair, with the reasonable, documented costs thereof paid from the Escrow Account. The Commissioners shall photograph, videotape and otherwise document the conditions and make all such documentation available to Developers. Any such emergency repair shall be subject to post-repair negotiations by the Parties, involvement of the intermediary and, if necessary, adjudication. If such post-repair proceedings favor Developers, the Commissioners will reimburse the Escrow Account for amounts withdrawn to fund the repair.

Section 7. Mutual Indemnification/Hold Harmless and Liability Insurance Provisions.

A. Indemnification by Developers. The Developers hereby release and agree to indemnify and hold harmless the Commissioners and their respective officers, employees, elected or appointed officials, and agents, and their respective heirs, executors, administrators, successors and assigns (hereinafter collectively "Commissioners Releasees") from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands against the Commissioners Releasees arising out of or relating to the performance by Developers of their obligations under this Agreement. More particularly, but without in any way limiting the foregoing, the Developers hereby release the Commissioner Releasees and agree to indemnify and hold harmless the Commissioner Releasees from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands arising directly or indirectly from any personal injury, death or property damage arising out of the use, construction, modifications, repair or improvement of any Principal Road identified in Exhibit B by the Developers, its employees, agents, representatives, suppliers or contractors, or their respective employees, agents or representatives.

B. <u>Indemnification by the Commissioners</u>. The Commissioners hereby releases and agrees to indemnify and hold harmless the Developers and their respective members, officers, directors, contractors, subcontractors, employees and agents, and their respective employees, heirs, executors, administrators, successors and assigns (hereinafter collectively "Developers Releasees") from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands against the Developers Releasees arising out of or relating to the performance by the Commissioners of their obligations under this Agreement. More particularly, but without in any way limiting the foregoing, the

Commissioners hereby release the Developers Releasees and agrees to indemnify and hold harmless the Developers Releasees from any and all actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands arising directly or indirectly from any personal injury, death or property damage arising out of the use, construction, modifications, repair or improvement of any Principal Road identified in Exhibit B by the Commissioners, their respective employees, agents, representatives, suppliers or contractors, or their respective employees, agents or representatives.

C. Limitations of Liability. In no event shall any Party be liable (in contract or in tort, involving negligence, strict liability, or otherwise) to any other Party or its contractors, suppliers, employees, members and shareholders for indirect, incidental, consequential or punitive damages resulting from a Party's performance, non-performance or delay in performance under this Agreement.

D. Required Insurance. The Developers shall at all times throughout the term of this Agreement maintain in full force and effect workers' compensation insurance as required by the State of Illinois and commercial general liability insurance, naming each of the Commissioners and Township Road Districts as an additional insured, in an aggregate amount equal to Ten Million Dollars ($10,000,000). The Developers may utilize any combination of primary and/or excess insurance to satisfy this requirement. Developers shall provide proof of insurance upon written request by a Commissioner.

Section 8. Miscellaneous

A. Remedies and Enforcement. Each of the Parties hereto covenant and agree that in the event of default of any of the terms, provisions or conditions of this Agreement by any party (the "Defaulting Party"), which default is not caused by the party seeking to enforce said provisions (the "Non-Defaulting Party") and after notice and reasonable opportunity to cure has been provided to the Defaulting Party, then in such an event, the Non-Defaulting Party shall have the right of specific performance. The remedy of specific performance and injunctive relief shall not be exclusive of any other remedy available at law or in equity.

B. Due Authorization. Each of High Trail and Old ~~t~~Trail hereby represents and warrants that this Agreement has been duly authorized, executed and delivered on behalf of High Trail and Old Trail. The Commissioners hereby represent and warrant that this Agreement has been duly authorized, executed and delivered on behalf of the Township Road Districts.

C. Severability. If any provision of this Agreement is held invalid under any applicable law, such invalidity shall not affect any other provision of this Agreement that can be given effect without the invalid provision and, to this end, the provisions hereof are severable.

D. Amendments. No amendment or modification to this Agreement or waiver of a Party's rights hereunder shall be binding unless it shall be in writing and signed by the Party against whom enforcement is sought.

E. Notices. All notices shall be in writing and sent (including via facsimile transmission) to the Parties hereto at their respective addresses or fax numbers (or to such other address or fax number as any such Party shall designate in writing to the other Parties from time to time).

High Trail Wind Farm, LLC and Old Trail Wind Farm, LLC
1001 McKinney Street
Suite 1740
Houston, TX 77002
Office: 713/571-6640; fax: 713/571-6659

With a copy to:

High Trail Wind Farm, LLC and Old Trail Wind Farm, LLC
Project Manager
716 E. Empire, Suite F
Bloomington, IL 61701
Office: 309/829-8211; fax: 309/829-8611

The Commissioners

Tim Bane
Dawson Township Road Commissioner
28986 E 800 North Rd.
Ellsworth, IL 61737
Phone: 309/724-8071

Tim Morefield
Arrowsmith Township Road Commissioner
10569 North 3300 East Road
Arrowsmith, IL 61722
Phone: 309/275-6146

Paul Bottles
Cheneys Grove Township Road Commissioner
40096 E 950 North Rd.
Saybrook, IL 61770
Phone: 309/475-8461

With a copy to:

McLean County Engineer
102 S. Towanda-Barnes Road
Bloomington, IL 61704
Ph. (309) 663-9445
Fax (309) 662-8038

F. Assignment. This Agreement may not be assigned without the written consent of the other Party.

G. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, with the same effect as if the signatures thereto and hereto were upon the instrument. Delivery of an executed counterpart of a signature page to this Agreement by telecopy shall be as effective as delivery of a manually signed counterpart to this Agreement.

H. Governing Law. This Agreement shall be governed by and interpreted in accordance with the laws of the state of Illinois, irrespective of any conflict of laws provisions.

I. Successors and Assigns. This Agreement shall inure to the benefit of and shall be binding upon the Parties hereto, their respective successors, assignees and legal representatives.

J. Fees and Costs. Developer agrees to reimburse Commissioners their reasonable attorney and other professional fees incurred in negotiating this Agreement and the Escrow Agreement, not to exceed $ 10,000.00 .

K. Prior to the commencement of construction as defined in Section 1 A, Developer has the unilateral right to terminate this Agreement without further liability to the Commissioners other than to reimburse attorney fees under

Section 8 J. If thereafter, Developer elects to discontinue the Project, Developer shall notify Commissioners in writing of that decision. Such notification shall constitute "completion of the project". Since such termination notification may precede "completion of the road upgrades in Exhibit B", then, if such notification is given, the Escrow Account and Letter of Credit shall remain in place until a date two years after the date on which the Developers' construction activities have ceased and the road upgrades are completed on those Township Roads whereupon the road upgrades had commenced prior to such termination notification but had not yet been completed, rather than the date specified in Paragraph 6 B of this Agreement.

[SIGNATURES FOLLOW ON NEXT PAGE]