# Section 1.10 Utility Grid Wind Energy Conversion Systems

1. **INTENT AND PURPOSE.**

This Ordinance is intended to protect the health, safety and welfare of the residents of the Township and to encourage the safe, effective, efficient and orderly development and operation of wind energy resources in the Township while preserving and protecting the character and the stability of residential, agricultural, recreational, commercial, industrial and other areas within the Township.

1. **DEFINITIONS.** 
   1. **Adverse Sound Character:** Sound that causes building rattle, is impulsive, tonal, includes amplitude modulation, or has a low-frequency bass rumble.
   2. **Ambient:** Ambient is defined as the sound pressure level exceeded 90% of the time over a 96-hour measurement period with daytime/nighttime division.
   3. **ANSI:** the American National Standards Institute.
   4. **Audible:** The varying degrees of sound perception as reported by affidavit, including, but not limited to, just perceptible, audible, clearly audible, and objectionable.
   5. **dBA:** The A-weighted sound level.
   6. **dBC:** The C-weighted sound level.
   7. **Decibel (dB):** The practical unit of measurement for sound pressure level; the number of decibels of a measured sound is equal to 20 times the logarithm to the base 10 of the ratio of the sound pressure of the measured sound to the sound pressure of a standard sound (20 microPascals); abbreviated "dB."
   8. **Emergency work:** Any work or action necessary to deliver essential services in an emergency situation, including, but not limited to, repairing water, gas, electricity, telephone and sewer facilities and public transportation, removing fallen trees on public rights-of-way, and abating life-threatening conditions.
   9. **Equivalent Sound Level (or Leq):** The sound level measured in decibels with an integrating sound level meter and averaged on an energy basis over a specific duration.
   10. **Excessive noise:** Sound that is determined by ordinance to be too loud or unnecessary or creates a noise disturbance.
   11. **FAA:** The Federal Aviation Administration
   12. **GIS:** Geographic Information System and is comparable to GPS (global positioning system) coordinates.
   13. **IEC:** The International Electrotechnical Commission
   14. **ISO:** The International Organization for Standardization
   15. **LMax (LAMax or LCMax):** The maximum db(A) or db(C) sound level measured using the “fast response” setting of the sound meter (equivalent to 0.125 second exponential averaging time)
   16. **Lease Unit Boundary:** The boundary around a property or properties leased or purchased for purposes of operating a wind energy facility, including leased or purchased adjacent parcels to the parcel on which the wind energy facility tower or equipment is located. For purposes of setback, the Lease Unit Boundary shall not cross road rights of way.
   17. **L10:** Is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic.
   18. **L90:** Is the noise level exceeded for 90% of the time of the measurement duration and is commonly used to determine ambient or background noise level.
   19. **Noise:** A sound that causes disturbance that exceeds 45 db(A) (Lmax) or 55 db(C) (Lmax).
   20. **On Site Wind Energy Conversion System (also called Small Scale):** A wind energy conversion system less than 60 feet in total height with the blade fully extended (tip height) intended to generate electric power from wind solely for the use of the site on which the system is located. Small-scale WECS that are primarily intended to provide on-site power, but contribute surplus energy to the grid, may also be considered On-Site Small-Scale WECS. Small scale wind energy systems that consistently sell power back to the public grid will require a Special Use permit.
   21. **Pasquill Stability Class:** Reference, wikipedia.org “Outline of air pollution dispersion.”
   22. **Pooled Parcel** - A landowner who has leased land to the WECS Applicant, received financial remuneration from the WECS Applicant, recorded with the Branch County Register of Deeds said agreement, and has a contract with the WECS Applicant. A Pooled Parcel may also be called a WECS contract leaseholder. A Pooled Parcel may or may not have turbines or infrastructure located on their property.
   23. **Quiet Rural or Residential property:** Any property where there is an inherent expectation of quiet, including, but not limited to, all residential, business, or agricultural-zoned properties, single family homes, and retirement homes.
   24. **SCADA (supervisory control and data acquisition):** A computer system that (insert community name)s and controls WECS units.
   25. **Sound level meter:**  An instrument for the measurement of sound levels that meets the ANSI requirements of S1.4-1983 (or later revision) for Type 1 or 2 instruments. For frequency analysis, octave and 1/3 octave filters shall conform to ANSI S1.11-1986 (or later revision).
   26. **Sound Pressure:** An average rate at which sound energy is transmitted through a unit area in a specified direction. The pressure of the sound measured at a receiver.
   27. **Sound Pressure Level:** The sound pressure mapped to a logarithmic scale and reported in decibels (dB).
   28. **Strobe Effect:** The effect resulting from the flashing of reflected light, which can be visible from some distance, from the surface finish of turbine blades.
   29. **Survival Wind Speed:** The maximum wind speed, as designated by the WECS manufacturer, at which a WECS in unattended operation (not necessarily producing power) is designed to survive without damage to any structural equipment or loss of the ability to function normally.
   30. **Tip Height:** The height of the turbine with a blade at the highest vertical point.
   31. **Unpooled Parcel** - A landowner who has not signed a contract or any legal document with the WECS Applicant and has not given up rights to their owned land to the WECS Applicant.
   32. **Utility Scale (also known as Commercial and/or Large-Scale) Wind Energy Conversion System:** A wind energy conversion system greater than sixty (60) feet in total height (tip height) intended to generate power from win primarily to supplement the greater electric utility grid. Utility-scale WECS include accessory uses such as, but not limited to, SCADA towers, anemometers, or electric substations.
   33. **WECS Applicant:** The person, firm, corporation, company, limited liability corporation or other entity, as well as the Applicant’s successors, assigns and/or transferees, which applies for Township approval (permit) to construct a WECS and WECS Testing Facility. An Applicant must have the legal authority to represent and bind the Pooled Parcel, or lessee, who will construct, own, and operate the WECS or Testing Facility. The duties and obligations regarding a zoning approval for any approved WECS or Testing Facility shall be with the WECS or Testing Facility owner, and jointly and severally with the owner, operator, and lessee of the WECS or Testing Facility if different than the WECS owner.
   34. **Wind Energy Conversion System (WECS):** Any combination of the following:
       1. A mill or machine operated by wind acting on oblique vanes or sails that radiate from a horizontal shaft;
       2. A surface area such as a blade, rotor, or similar device, either variable or fixed, for utilizing the wind for electrical or mechanical power;
       3. A shaft, gearing, belt, or coupling utilized to convert the rotation of the surface area into a form suitable for driving a generator, alternator, or other electricity-producing device;
       4. The generator, alternator, or another device to convert the mechanical energy of the surface area into electrical energy;
       5. The tower, pylon, or other structure upon which any, all, or some combination of the above are mounted.
       6. Any other components not listed above but associated with the normal construction, operation, and maintenance of a wind energy conversion system.
   35. **Wind Energy Conversion System (WECS) Testing Facility:** A structure and equipment such as a meteorological tower for the collection of wind data and other meteorological data and transmission to a collection source, shall not be deemed to be a communication tower.
   36. **Wind Energy Facility:** Clusters of two or more Utility Grid Wind Energy Conversion Systems, placed upon a lot or parcel with the intent to sell or provide electricity to a site or location other than the premises upon which the Wind Energy Conversion Systems are located. Said Wind Energy Conversion Systems may or may not be owned by the owner of the property upon which they are placed.
2. **ON-SITE WIND ENERGY CONVERSION SYSTEM STANDARDS (ALSO CALLED SMALL SCALE)**

The following standards shall apply to On-Site WECS, including Anemometer Towers, in addition to the general Special Approval/Special Land Use requirements of this Ordinance:

* 1. **Where Permitted.** On Site WECS shall be permitted as special land uses in the *General Agricultural District, Light Agricultural District, and Research Industrial District subject to the limitations provided in this subsection C*. On Site WECS shall be prohibited in all other zoning districts.
  2. **Required Information**
     1. Diagram of wind turbine showing blade length and ground clearance
     2. Approval Letter from the Branch County Memorial Joint Airport Authority Ordinance
     3. Engineering Data concerning construction of the tower base
     4. **Site Plan.** The Applicant shall submit a site plan in full compliance with this Ordinance. The Applicant shall also submit a written explanation of the design characteristics and the ability of the structure(s) and attendant facilities to withstand winds, ice and other naturally occurring hazards, as well as information regarding health, welfare and safety in areas including, but not limited to, noise, vibration, shadow flicker, and blade ice deposits. This information shall also address the potential for the WECS to structurally fail or collapse, and what results should be expected in such an event. The application for a WECS shall be reviewed in accordance with all applicable requirements in site plan review and special use requirements of this Ordinance. In addition to these requirements, site plans and supporting documents for WECS shall include the following additional information, as appropriate:
        1. Documentation that noise emissions, construction code, tower, and safety requirements have been reviewed by the appropriate third-party professional and the submitted site plan is prepared to show compliance with these issues.
        2. Proof of the applicant’s public liability insurance.
        3. A copy of that portion of all the applicant’s Pooled Parcel lease(s) with the land owner(s) granting authority to install the WECS and/or Anemometer Tower; legal description of the property(ies), Lease Unit(s); and the site plan shows the boundaries of the leases as well as the boundaries of the Lease Unit Boundary.
        4. An un-redacted safety manual from the turbine manufacturer and a statement from the applicant verifying that the WECS is or will be operated in compliance with all requirements therein.
        5. The phases, or parts of construction, with a construction schedule.
        6. Engineering data concerning construction of the tower base.
        7. The project area boundaries, including all boundaries within pooled parcels.
        8. The location, height, and dimensions of all existing and proposed structures and fencing.
        9. The location, grades, and dimensions of all temporary and permanent on-site and access roads from the nearest private road, Township road, or State maintained road.
        10. A description of the routes to be used by construction and delivery vehicles and of any road improvements that shall be necessary in the Township to accommodate construction vehicles, equipment or other deliveries, and an agreement or bond which guarantees the repair of damage to public roads and other areas caused by construction of the WECS.
        11. All new infrastructure above and below ground related to the project, including transmission line locations.
        12. A copy of Manufacturers’ Material Safety Data Sheet(s) which shall include the type and quantity of all materials used in the operation of all equipment including, but not limited to, all lubricants and coolants.
        13. Description of operations, including anticipated regular and unscheduled maintenance.
     5. Required Studies
        1. Flicker Study
           1. A shadow flicker study shall be required, and shall be submitted by the applicant with the application. The purpose of the shadow flicker study is to examine the duration and location of shadow flicker on unpooled parcels. The model study area shall include all land extending a minimum of 20 rotor diameters in all directions from a wind turbine generator. The model shall be calculated using the following minimum inputs: turbine locations, shadow flicker receptor locations, existing topography, rotor diameter and hub height, joint wind speed and direction distribution (wind rose table, and hours of sunshine (long term monthly references)). The model shall calculate the locations and durations of shadow flicker caused by the proposed wind energy conversion system within the study area, and the total number of hours anticipated per year of shadow flicker. The application shall include estimates for shadow flicker to the nearest tenth of an hour, on a daily basis for each receptor. Assumptions regarding the percentage of time that shadow flicker is likely to occur shall be clearly explained and subject to approval of the Planning Commission. The shadow flicker study shall include a map that indicates the extent of shadow flicker, pooled and unpooled parcels, public roads and all potential shadow flicker receptors.

**Post-Construction Flicker Mitigation**

Should an unpooled parcel receive shadow flicker that was not indicated in the shadow flicker study, the owner of the wind energy conversion system may be required to cease operations of WECS and perform an additional flicker study and mitigation plan for the affected property and submit it to the Zoning Administrator for review prior to implementing mitigation measures.

* + - 1. **Preconstruction Noise Background Survey**
         1. The applicant shall provide a noise background study at the time of application which indicates Leq, L10, and L90 ten-minute sound levels using A-weighting. For applications submitted after the effective date of this ordinance, the applicant shall submit proposed measurement locations to the Planning Commission in advance of the survey for review and approval. Measurement procedures should generally follow the most recent versions of ANSI S12.18, and ANSI S12.9, Part 3 (with or without an observer present) guidelines. The selected test locations shall be described with GPS coordinates or some other level of detail such that the location can be used by others to repeat or verify sound measurements. Measurements shall be taken using an ANSI or IEC Type 1 Precision Integrating Sound Level Meter. The study must include a minimum of a four day (96-hour) testing period, including one Sunday, and produce data that includes a variety of ground and hub height wind speeds, at low (between 4 and 7 m/s) medium (7-10 m/s) and high (10m/s or more and/or capable of producing maximum power). The noise background study shall report for the period of monitoring topography, temperature, weather patterns, sources of ambient sound, and prevailing wind direction. The study shall include a map showing proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings.
      2. **Sound Modeling Study.** 
         1. A predictive sound study of turbine noise shall accompany an application to verify that ordinance requirements can be met for dBA sound levels. Due to the statistical uncertainty of sound propagation models, environmental factors, and variable wind shear, sound modeling shall demonstrate that the wind energy conversion system will not **exceed 35 dBA (10 min- LAeq) at the property line of any unpooled parcel and 50 45 dBA (10 min- LAeq) at the dwelling of a pooled parcel.**

The applicant shall present the maximum Sound Power Level of the proposed turbine on both the dBA and dBC scales, and will calculate the difference [dBC-dBA] in decibels and compare it to the 20 decibel threshold in IEC 61400-11:2002+A1:2006, as an indicator of whether the turbine is likely to produce low-frequency noise that could create annoyance.

For assessing potential low frequency or vibration problems, refer to Section C.2.(g).

The sound modeling must follow the most recent version of International Standard, ISO 9613-2 “Acoustics-Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

The sound modeling study shall use wind turbine sound power levels determined according to the most recent version of IEC 61400 – Part 11. The model of wind turbine generator proposed for the development shall not be tonal as determined by the most recent version of IEC 61400- Part 11.

The sound study shall include a map with sound contour lines for dBA sound emitted from the proposed wind energy conversion system. The study shall include a map (at 1:200 or better) showing sound contours at 5 dBA intervals, proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings. The predicted values must include cumulative sound levels created by all existing, approved, and proposed turbines. The sound study and accompanying map shall extend out to the 30 dBA sound contour line or 1 mile from a wind turbine generator, whichever is closer to the nearest wind turbine.

* + - * 1. The applicant shall identify each operational component of a wind turbine (other than the spinning blades) that will produce a sound that will be audible at the property line of an unpooled parcel.
        2. For each operational component that is identified, the applicant shall also provide:

The maximum instantaneous volume of the noise, in dBA, that will be received at the property line of an unpooled parcel, along with the modeling results to support that projection.

The characteristics of the noise, in terms of frequency of occurrence, when it will occur, duration, tonal quality, and range of volume. In addition to a written description, the applicant shall provide a recording or video of the various operational sounds or some other form of demonstration.

The measures, if any, the applicant is proposing to implement in order to mitigate the sound.

* + - * 1. The Planning Commission may require the applicant to implement measures to mitigate and/or eliminate an operational sound (other than the spinning blades).
        2. Failure to submit information on all predictable, audible operational sounds of the wind turbines (such as yawing, cooling fans, hydraulics or cooling systems, etc.) may result in a violation of the special land use.
      1. **Post Construction Sound Survey**
         1. Documentation of sound pressure level measurements shall be provided to the Zoning Administrator by a third-party qualified professional selected by the Planning Commission and at the expense of the wind energy conversion system owner within 6 months of the commencement of the operation of the project. The post construction study shall be performed at the same locations as the pre-construction study unless additional or alternative locations are required by the Planning Commission. The study should generally follow the procedures in the most recent versions of ANSI S12.9 Part 3 (with an observer present) and ANSI S12.18. All sound pressure levels shall be measured with instruments that meet ANSI or IEC Type 1 Precision integrating sound level meter performance specifications. In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 1 Hertz. As part of the study, octave band data must be measured as addressed in Section C.2.(g).
         2. **Testing Procedures**

The post construction test shall verify that equivalent sound level limits in dBA are in compliance with the standards of this ordinance. The compliance test procedure will use an alternating series of turbine-on and turbine-off 10-minute LAeq measurements when wind speeds are fairly constant. The testing shall result in a minimum of ten (10) ten-minute LAeq data points per testing location obtained when the wind energy conversion system is operating at maximum sound power. Measured levels (turbine-on and turbine-off) for similar hub height wind speeds (within 1.5 m/s) will be compared to determine the sound level from only the wind turbines. The firm conducting the study shall collect LA90 and LA10 data. The wind energy conversion system owner shall assist the Township and third-party qualified professional by turning off selected wind turbines and providing necessary logistical support for testing on-demand. During a testing period identified by the Township, the wind energy conversion system owner shall park or pause wind turbine operations for an “off” period within two hours of a request made by the third-party professional. During the on-off testing all wind turbine operations will be parked or paused within 8,000 feet of a test location to eliminate the background noise contribution from the wind energy conversion system.

* + - * 1. **Test Locations**

The test locations shall take into consideration noise complaints on file with the Township and may require additional study locations as deemed necessary by the Planning Commission. The firm conducting the post-construction sound survey shall consult with the Planning Commission, or their representative, prior to conducting the study to agree on the compliance testing locations. The study shall delineate pooled and unpooled parcels as well as occupied buildings.

* + - * 1. **Non-Compliance**

Should the sound study indicate a non-compliant measurement, the owner of the wind energy conversion system will be required to obtain compliance through mitigation or other measures.

* + 1. Wind Rose Chart. The applicant shall submit a Wind Rose Chart at the time of the application. This is a chart or graph that describes 12 months (or more) of wind data collected from the proposed project area. This graph or chart will demonstrate direction, duration, and intensity of the wind. These data will be for each height of wind sensor mounted on the meteorological tower.
    2. Low Frequency Sound and/or Vibration. WECS shall not create vibrations that are detectable by humans on unpooled parcels. The applicant shall provide acoustic modeling at the time of application to assess potential low frequency or vibration problems on both unpooled and pooled parcels. The modeling study of low frequency sound and vibration shall demonstrate meeting: (1) ANSI S12.9/Part 4 Annex D threshold for minimal annoyance and beginning of rattles from outdoor low frequency noise and (2) the ANSI S12.2 sound level limits for moderately perceptible vibration and rattles within homes as modified to equivalent outdoor sound limits in Table 2 of the March-April, 2011 Noise Control Eng. Journal article by O’Neal, et al.. The ANSI S12.2 interior sound level limits for low frequency sound and perceptible vibration within homes, as modified to equivalent outdoor sound limits in Table 2 of the March-April, 2011 Noise Control Eng. Journal article by O’Neal, et al. shall be utilized to determine if outdoor sound levels will create perceptible vibration or low frequency problems indoors. If the post-construction sound survey outdoor octave band sound level measurements reveal that low frequency sound from wind turbines at the exterior of an unpooled, occupied or non-occupied building may create a vibration or low frequency noise problem, then further studies should be conducted to assess the problem. The further studies shall use the above referenced standards (ANSI S12.2 and ANSI S12.9/Part 4 Annex D). If the further study indicates that the low frequency sound/vibration exceeds acceptable levels, mitigation may be required by the Planning Commission. Mitigation may include operational changes to the turbine, modifications to the subject building or buildings, or other measures as determined by the Planning Commission.
    3. Tonality: If a tone is observed from a turbine during the post construction sound survey or at a later date (such as due to a malfunctioning gearbox), a defined assessment of the level of tonality shall be conducted utilizing an accepted international standard, such as ISO 1996-2, by an independent, third party sound consultant selected by the Planning Commission at the expense of the wind energy conversion system owner. A tonal audibility value adjustment (from 0 to 6 dB) will be added to the measured 10-minute LAeq sound level at the testing location of either a pooled or unpooled parcel in accordance with Section D.3.(h).1.d. For tonality arising from a mechanical failure or lack of maintenance, See Section D.8.f.
    4. The Planning Commission retains the authority to require that all noise surveys and reports, both pre-construction and post-construction, be conducted by experts/consulting firm chosen at the Planning Commissions discretion and paid for by the wind developer.
  1. **Regulations**
     1. **Height.** On-Site WECS shall have a maximum height of 60 feet or less; except where state and federal regulations may require a lesser height; or where, as a condition of special use approval, the Planning Commission requires a lesser height. Height is measured from the average grade at the base of the tower to the highest point of WECS when a blade is in its vertical orientation.
     2. **Setbacks.** The distance between an On-Site WECS and the property lines shall be equal to 110% of the height of the tower including the top of the blade in its vertical position. The distance between an accessory structure associated with the WECS and all property lines shall be at least the minimum setback for all accessory structures in the zoning district the WECS is located within. On-site WECS and associated accessory structures shall not count towards the maximum number of accessory structures on a given lot.
     3. **Minimum Lot Area Size.** The minimum lot size for a property to be eligible to have an On-Site WECS shall be three (3) acres if the height is 40 feet or less; five (5) acres if the height is between 40 and 60 feet.
     4. **Minimum Ground Clearance.** The minimum vertical blade tip clearance from grade and any structure, adjoining property, or tree shall be 20 feet for an on-site WECS employing a horizontal axis rotor.
     5. **Branch County Airport**
        1. All WECS shall fully comply with the Branch County Memorial Joint Airport Authority Ordinance
        2. The Branch County Airport must first approve WECS before approval can be granted by the Township
     6. **Noise Emission.** Noise emitting from an on-site WECS shall not exceed 35 dB(A) (Lmax) or 45 dB(C) (Lmax) at the property line closest to the WECS.
     7. **Construction Codes, Towers, & Interconnection Standards.** On-site WECS including towers shall comply with all applicable state construction and electrical codes and local building permit requirements. On-site WECS including towers shall comply with Federal Aviation Administration requirements, the Michigan Airport Zoning Act, the Michigan Tall Structures Act, ~~the Branch County Memorial Joint Airport Authority Ordinance~~, and other applicable local and state regulations. An interconnected On-site WECS shall comply with Michigan Public Service Commission (MPSC) and Federal Energy Regulatory Commission (FERC) standards. Off-grid systems are exempt from MPSC and FERC requirements.
     8. **Safety.** The On-Site WECS shall meet the following safety requirements:
        1. The On-Site WECS shall be designed to prevent unauthorized access to electrical and mechanical components and shall have access doors that are kept securely locked at all times when service personnel are not present.
        2. All energy collection system wiring shall comply with all applicable safety and stray voltage standards.
        3. Each On-Site WECS shall be equipped with both a manual and automatic braking device capable of stopping the WECS operation in high winds within 80% of design limits of the brakingsystem.
        4. A copy of the un-redacted Safety Manual from the turbine manufacturer shall be submitted to the Township and the turbine must comply with all requirements therein.
        5. All towers or poles must be unclimbable by design or protected by anti-climbing devices such as:
           1. Fences with locking portals at least six (6) feet high
           2. Anti-climbing devices twelve (12) feet from base of pole
     9. **Shadow Flicker.** On-site WECS shall produce no off-site shadow flicker. Measures to eliminate all effects of shadow flicker on adjacent properties, such as programming the WECS to stop rotating during times when shadow crosses occupied structures, may be required.
     10. **Fluid Containment.** Each On-Site WECS shall include both an internal and external fluid containment barrier located either within the nacelle, or at the base of the nacelle in the event of a spill or leak.
  2. **Liability Insurance.** The Applicant shall provide proof of insurance for each WECS at all times for at least $2,000,000 for liability, property damage, livestock damage, and future earnings loss. Applicant shall provide yearly proof of insurance to Township that confirms active coverage for the Applicant, Township, Pooled Parcels, and Unpooled Parcels. Aggregate policies are allowed if minimum coverage per WECS is satisfied and coverage is provided for every site where Applicant’s equipment is located. In the event a public service such as police, fire, or rescue is required due to the operation, maintenance, or failure of a wind turbine, any cost incurred as a result of said event shall be the sole responsibility of the applicant and/or owner of the On-Site WECS.

1. **UTILITY SCALE ENERGY CONVERSION SYSTEM STANDARDS (ALSO CALLED LARGE SCALE)**
   1. **Where Permitted.** Utility Scale WECS shall be considered special uses in the *General Agricultural District, Light Agricultural District, and Research Industrial District subject to the limitations provided in this subsection D*. They shall be prohibited in all other zoning districts.
      1. If applicable, WECS shall adhere to setback requirements established by adjacent municipalities in addition to the setback requirements established in Section D.3.(b).
   2. **Required Information**
      1. Diagram of wind turbine showing blade length and ground clearance
      2. Approval letter from the Branch County Memorial Joint Airport Authority Ordinance
      3. Engineering data concerning construction of the tower base;
         1. Construction materials
         2. Depth of the base
         3. Analysis of impact on water table, nearby wells, and ground water
         4. The Applicant shall provide certification with documentation (structural analysis) including calculations that the WECS and foundation and attachments, rooftop support structure, water tank structure, and any other supporting structure as proposed to be utilized are designed and will be constructed to meet all local, City, State and Federal structural requirements for loads, including wind and ice loads.
         5. A copy of a geotechnical sub-surface soils investigation, evaluation report and foundation recommendation for the proposed WECS site.
      4. Site Plan. The Applicant shall submit a site plan in full compliance with this Ordinance. The Applicant shall also submit a written explanation of the design characteristics and the ability of the structure(s) and attendant facilities to withstand winds, ice and other naturally occurring hazards, as well as information regarding health, welfare and safety in areas including, but not limited to, noise, vibration, shadow flicker, and blade ice deposits. This information shall also address the potential for the WECS to structurally fail or collapse, and what results should be expected in such an event. The application for a WECS shall be reviewed in accordance with all applicable requirements in site plan review and special use requirements of this Ordinance. In addition to these requirements, site plans and supporting documents for WECS shall include the following additional information, as appropriate:
         1. Documentation that noise emissions, construction code, tower, and safety requirements have been reviewed by the appropriate third-party professional and the submitted site plan is prepared to show compliance with these issues.
         2. Proof of the applicant’s public liability insurance.
         3. A copy of that portion of all the applicant’s Pooled Parcel lease(s) with the land owner(s) granting authority to install the WECS and/or Anemometer Tower; legal description of the property(ies), Lease Unit(s); and the site plan shows the boundaries of the leases as well as the boundaries of the Lease Unit Boundary.
         4. An un-redacted safety manual from the turbine manufacturer and a statement from the applicant verifying that the WECS is or will be operated in compliance with all requirements therein.
         5. The phases, or parts of construction, with a construction schedule.
         6. The project area boundaries, including all boundaries within pooled parcels.
         7. The location, height, and dimensions of all existing and proposed structures and fencing.
         8. Engineering data concerning construction of the tower base
         9. The location, grades, and dimensions of all temporary and permanent on-site and access roads from the nearest Township or State maintained road.
         10. A description of the routes to be used by construction and delivery vehicles and of any road improvements that shall be necessary in the Township to accommodate construction vehicles, equipment or other deliveries, and an agreement or bond which guarantees the repair of damage to public roads and other areas caused by construction of the WECS.
         11. All new infrastructure above and below ground related to the project, including transmission line locations.
         12. A copy of Manufacturers’ Material Safety Data Sheet(s) which shall include the type and quantity of all materials used in the operation of all equipment including, but not limited to, all lubricants and coolants.
         13. Description of operations, including anticipated regular and unscheduled maintenance.
      5. **Required Studies**
         1. **Economic Impact Study Required.** The Applicant shall fund and provide an economic impact study for the area affected by the WECS project. Such a study shall include probable financial impact regarding jobs, tax revenue, lease payments and property values at a minimum and average set-backs distances. Business and residential growth potential shall be considered.
         2. **Flicker Study.** A shadow flicker study shall be required, and shall be submitted by the applicant with the application. The purpose of the shadow flicker study is to examine the duration and location of shadow flicker on unpooled parcels. The model study area shall include all land extending a minimum of 20 rotor diameters in all directions from a wind turbine generator. The model shall be calculated using the following minimum inputs: turbine locations, shadow flicker receptor locations, existing topography, rotor diameter and hub height, joint wind speed and direction distribution (wind rose table, and hours of sunshine (long term monthly references)). The model shall calculate the locations and durations of shadow flicker caused by the proposed wind energy conversion system within the study area, and the total number of hours anticipated per year of shadow flicker. The application shall include estimates for shadow flicker to the nearest tenth of an hour, on a daily basis for each receptor. Assumptions regarding the percentage of time that shadow flicker is likely to occur shall be clearly explained and subject to approval of the Planning Commission. The shadow flicker study shall include a map that indicates the extent of shadow flicker, pooled and unpooled parcels, public roads and all potential shadow flicker receptors.
            1. **Post-Construction Flicker Mitigation.** Should an unpooled parcel receive shadow flicker that was not indicated in the shadow flicker study, the owner of the wind energy conversion system may be required to cease operations of WECS and perform an additional flicker study and mitigation plan for the affected property and submit it to the Zoning Administrator for review prior to implementing mitigation measures.
         3. **Avian Study Required.** 
            1. At the time of application, the Applicant shall submit a wildlife study, completed by a qualified professional, to assess the potential impacts of the proposed wind energy conversion system upon bird and bat species. The wildlife study shall include the results of an environmental review request from the Michigan Department of Natural Resources, a literature review for threatened and endangered species and for birds and bats, the results of supplemental environmental surveys conducted by the applicant to provide information related to critical flyways, migratory routes, feeding areas, and/or nesting sites for protected species. It is the intent of this ordinance to reasonably consider and protect avian and bat species, not just those that are endangered or threatened. The applicant must identify any plans for post-construction monitoring and studies. The analysis shall also include an explanation of potential impacts and proposed mitigation plans, if necessary.
            2. A qualified, third party chosen at the discretion of the Planning Commission may be required to review of the applicant's wildlife studies and/or environmental surveys may be required by the Planning Commission.
            3. The Planning Commission may require a post-construction bird and bat mortality study completed by a third-party professional selected by the Planning Commission. The timing of such a study shall be specified as a condition of the special land use.
            4. A wind development application shall adhere to and comply with all guidelines and best practice recommendations made by the United States Fish and Wildlife Service (USFWS) regarding the siting, design, and operation of a wind energy conversion system to protect the natural resources of watersheds, wetlands and wildlife. The application shall include documentation of all studies, consultations, and recommendations made by or with the USFWS regarding the placement of wind turbine generators and operation of the wind energy conversion system.
            5. The Applicant shall be required to follow minimum setbacks from natural features in order to protect wetlands less than 5 acres that are not regulated by the MDEQ. Wetland shall mean land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp or marsh.
            6. The compatibility of the tower structure with the rotors and other components of the conversion systems shall be certified by a certified, registered engineer and by the authorized factory representative. In addition, the lowest point of the blade shall be a minimum of one hundred (100) feet above the ground.
         4. **Preconstruction Noise Background Survey.** The applicant shall provide a noise background study at the time of application which indicates Leq, L10, and L90 ten-minute sound levels using A-weighting. For applications submitted after the effective date of this ordinance, the applicant shall submit proposed measurement locations to the Planning Commission in advance of the survey for review and approval. Measurement procedures should generally follow the most recent versions of ANSI S12.18, and ANSI S12.9, Part 3 (with or without an observer present) guidelines. The selected test locations shall be described with GPS coordinates or some other level of detail such that the location can be used by others to repeat or verify sound measurements. Measurements shall be taken using an ANSI or IEC Type 1 Precision Integrating Sound Level Meter. The study must include a minimum of a four day (96-hour) testing period, including one Sunday, and produce data that includes a variety of ground and hub height wind speeds, at low (between 4 and 7 m/s) medium (7-10 m/s) and high (10m/s or more and/or capable of producing maximum power). The noise background study shall report for the period of monitoring topography, temperature, weather patterns, sources of ambient sound, and prevailing wind direction. The study shall include a map showing proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings.
         5. **Sound Modeling Study.** A predictive sound study of turbine noise shall accompany an application to verify that ordinance requirements can be met for dBA sound levels. Due to the statistical uncertainty of sound propagation models, environmental factors, and variable wind shear, sound modeling shall demonstrate that the wind energy conversion system will not exceed 35 dBA (10 min- LAeq) at the property line of any unpooled parcel and 50 45 dBA (10 min- LAeq) at the dwelling of a pooled parcel.
            1. The applicant shall present the maximum Sound Power Level of the proposed turbine on both the dBA and dBC scales, and will calculate the difference [dBC-dBA] in decibels and compare it to the 20 decibel threshold in IEC 61400-11:2002+A1:2006, as an indicator of whether the turbine is likely to produce low-frequency noise that could create annoyance.
            2. For assessing potential low frequency or vibration problems, refer to Section D.3.(h).1.d.
            3. The sound modeling must follow the most recent version of International Standard, ISO 9613-2 “Acoustics-Attenuation of sound during propagation outdoors – Part 2: General method of calculation.
            4. The sound modeling study shall use wind turbine sound power levels determined according to the most recent version of IEC 61400 – Part 11. The model of wind turbine generator proposed for the development shall not be tonal as determined by the most recent version of IEC 61400- Part 11.
            5. The sound study shall include a map with sound contour lines for dBA sound emitted from the proposed wind energy conversion system. The study shall include a map (at 1:200 or better) showing sound contours at 5 dBA intervals, proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings. The predicted values must include cumulative sound levels created by all existing, approved, and proposed turbines. The sound study and accompanying map shall extend out to the 30 dBA sound contour line or 1 mile from a wind turbine generator, whichever is closer to the nearest wind turbine.
            6. The applicant shall identify each operational component of a wind turbine (other than the spinning blades) that will produce a sound that will be audible at the property line of an unpooled parcel.

For each operational component that is identified, the applicant shall also provide:

The maximum instantaneous volume of the noise, in dBA, that will be received at the property line of an unpooled parcel, along with the modeling results to support that projection.

The characteristics of the noise, in terms of frequency of occurrence, when it will occur, duration, tonal quality, and range of volume. In addition to a written description, the applicant shall provide a recording or video of the various operational sounds or some other form of demonstration.

The measures, if any, the applicant is proposing to implement in order to mitigate the sound.

The Planning Commission may require the applicant to implement measures to mitigate and/or eliminate an operational sound (other than the spinning blades).

Failure to submit information on all predictable, audible operational sounds of the wind turbines (such as yawing, cooling fans, hydraulics or cooling systems, etc.) may result in a violation of the special land use.

* + - 1. **Post Construction Sound Survey.** Documentation of sound pressure level measurements shall be provided to the Zoning Administrator by a third-party qualified professional selected by the Planning Commission and at the expense of the wind energy conversion system owner within 6 months of the commencement of the operation of the project. The post construction study shall be performed at the same locations as the pre-construction study unless additional or alternative locations are required by the Planning Commission. The study should generally follow the procedures in the most recent versions of ANSI S12.9 Part 3 (with an observer present) and ANSI S12.18. All sound pressure levels shall be measured with instruments that meet ANSI or IEC Type 1 Precision integrating sound level meter performance specifications. In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 1 Hertz. As part of the study, octave band data must be measured as addressed in Section D.3.(h).1.d.
         1. **Testing Procedures.** The post construction test shall verify that equivalent sound level limits in dBA are in compliance with the standards of this ordinance. The compliance test procedure will use an alternating series of turbine-on and turbine-off 10-minute LAeq measurements when wind speeds are fairly constant. The testing shall result in a minimum of ten (10) ten-minute LAeq data points per testing location obtained when the wind energy conversion system is operating at maximum sound power. Measured levels (turbine-on and turbine-off) for similar hub height wind speeds (within 1.5 m/s) will be compared to determine the sound level from only the wind turbines. The firm conducting the study shall collect LA90 and LA10 data. The wind energy conversion system owner shall assist the Township and third-party qualified professional by turning off selected wind turbines and providing necessary logistical support for testing on-demand. During a testing period identified by the Township, the wind energy conversion system owner shall park or pause wind turbine operations for an “off” period within two hours of a request made by the third-party professional. During the on-off testing all wind turbine operations will be parked or paused within 8,000 feet of a test location to eliminate the background noise contribution from the wind energy conversion system.
         2. **Test Locations.** The test locations shall take into consideration noise complaints on file with the Township and may require additional study locations as deemed necessary by the Planning Commission. The firm conducting the post-construction sound survey shall consult with the Planning Commission, or their representative, prior to conducting the study to agree on the compliance testing locations. The study shall delineate pooled and unpooled parcels as well as occupied buildings.
         3. **Non-Compliance.** Should the sound study indicate a non-compliant measurement, the owner of the wind energy conversion system will be required to obtain compliance through mitigation or other measures.
         4. **Wind Rose Chart.** The applicant shall submit a Wind Rose Chart at the time of the application. This is a chart or graph that describes 12 months (or more) of wind data collected from the proposed project area. This graph or chart will demonstrate direction, duration, and intensity of the wind. These data will be for each height of wind sensor mounted on the meteorological tower.
         5. **Low Frequency Sound and/or Vibration.** WECS shall not create vibrations that are detectable by humans on unpooled parcels. The applicant shall provide acoustic modeling at the time of application to assess potential low frequency or vibration problems on both unpooled and pooled parcels. The modeling study of low frequency sound and vibration shall demonstrate meeting: (1) ANSI S12.9/Part 4 Annex D threshold for minimal annoyance and beginning of rattles from outdoor low frequency noise and (2) the ANSI S12.2 sound level limits for moderately perceptible vibration and rattles within homes as modified to equivalent outdoor sound limits in Table 2 of the March-April, 2011 Noise Control Eng. Journal article by O’Neal, et al.. The ANSI S12.2 interior sound level limits for low frequency sound and perceptible vibration within homes, as modified to equivalent outdoor sound limits in Table 2 of the March-April, 2011 Noise Control Eng. Journal article by O’Neal, et al. shall be utilized to determine if outdoor sound levels will create perceptible vibration or low frequency problems indoors. If the post-construction sound survey outdoor octave band sound level measurements reveal that low frequency sound from wind turbines at the exterior of an unpooled, occupied or non-occupied building may create a vibration or low frequency noise problem, then further studies should be conducted to assess the problem. The further studies shall use the above referenced standards (ANSI S12.2 and ANSI S12.9/Part 4 Annex D). If the further study indicates that the low frequency sound/vibration exceeds acceptable levels, mitigation may be required by the Planning Commission. Mitigation may include operational changes to the turbine, modifications to the subject building or buildings, or other measures as determined by the Planning Commission.
         6. **Tonality.** If a tone is observed from a turbine during the post construction sound survey or at a later date (such as due to a malfunctioning gearbox), a defined assessment of the level of tonality shall be conducted utilizing an accepted international standard, such as ISO 1996-2, by an independent, third party sound consultant selected by the Planning Commission at the expense of the wind energy conversion system owner. A tonal audibility value adjustment (from 0 to 6 dB) will be added to the measured 10-minute LAeq sound level at the testing location of either a pooled or unpooled parcel in accordance with Section D.3.(h).1.d. For tonality arising from a mechanical failure or lack of maintenance, see Section D.8.f.
         7. The Planning Commission retains the authority to require that all noise surveys and reports, both pre-construction and post-construction, be conducted by experts/consulting firm chosen at the Planning Commissions discretion and paid for by the wind developer.
  1. Regulations
     1. **Height.** Utility-scale WECS shall have a maximum height of 328 feet or less; except where state and federal regulations may require a lesser height; or where, as a condition of special use approval, the Planning Commission requires a lesser height. Height is measured from the average grade at the base of the tower to the highest point of WECS when a blade is in its vertical orientation.
     2. **Setbacks:** The following setbacks, measured from the outside edge (the point furthest from the pylon as it rotates horizontally) of the blades, not from the tower itself, shall be observed.
        1. **Pooled Parcels**
           1. In the case of a “pooling of parcels,” no wind turbine generator shall be located such that the distance between the outside edge of the blades and any outside boundary line of the area comprising the special land use in which the pooled parcels are located is less than four times the height of the wind turbine generator.
           2. No wind turbine generator shall be located such that the distance between the nearest point of the blade (while in rotation) and the nearest boundary line of any individual land parcel comprising the pooled parcel is less than 4 times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade; provided, however, that the Planning Commission may approve a lesser setback distance if written consents for such lesser distance are obtained from the owners of all lands located, in whole or in part, within one rotor-diameter of the wind turbine generator measured from the center of the base of the wind turbine generator. In determining whether such lesser setback may be approved, the Planning Commission shall consider the technical needs of the applicant, the feasibility of alternate locations, the nature and proximity of nearby buildings, structures, and public roads, for the potential for adverse impacts that noise, shadow flicker, and other features may have on adjacent land uses.
        2. **Unpooled Parcels**
           1. In the case of a single (unpooled) parcel, no wind turbine generator shall be located such that the distance between the center of the base of the tower and any property line is less than 1.25 mile setback or four times the height of the wind turbine generator, whichever is greater, as measured from the ground at the center of the base of the tower to the highest reach of the blade.
        3. No wind turbine generator shall be located such that the distance between the center of the base of the tower and the nearest point of any existing building designed or used for human occupancy or assembly (including but not limited to a dwelling, school, foster care facility, church and the like) is less than four times the height of the wind turbine as measured from the ground at the center of the base of the tower to the highest reach of the blade.
        4. No wind turbine generator shall be located such that the distance between the center of the base of the tower to the nearest point of any road is less than four times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade.
        5. No wind turbine generator shall be located such that the distance between the center of the base of the tower to the nearest point of any existing gas transmission, distribution, or gathering line is less than four times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade.
        6. Between WECS: Separation between Utility Scale WECS shall not be less than 200% of the height of the taller of the two WECS to allow for proper safety setback. Measurement shall be from center of hub to center of hub.
     3. **Lot Size.** The size of the lot(s) to be used for a utility-scale WECS shall be sufficient to comply with all setback requirements in Section D.3.(b).
     4. **Minimum Ground Clearance.** The minimum vertical blade tip clearance shall be a minimum of fifty (50) feet of clearance over and above any structure and a minimum of 100 feet of clearance above the ground.
     5. **Branch County Airport**
        1. All WECS shall fully comply with the Branch County Memorial Joint Airport Authority Ordinance
        2. The Branch County Airport must first approve WECS before approval can be granted by the Township
     6. **Noise Emission:**
        1. No WECS shall generate or permit to be generated audible noise from commercial or industrial permitted facilities that exceeds 45 dBA (Lmax) or 55 dBC (Lmax) (dBC to dBA ratio of 10 dB per ANSI standard S12.9 Part 4 Annex D) for any duration, at a property line or any point within any property.
        2. No WECS shall generate or permit to be generated from commercial or industrial permitted facilities any acoustic, vibratory, or barometric oscillations in the frequency range of 0.1 to 1 Hz that is detectable at any time and for any duration by confirmed human sensation or exceeds a sound pressure level from 0.1 to 20 Hz of 50 dB(unweighted) re 20uPA or exceeds an RMS acceleration level of 50 dB(unweighted) re 1 micro-g by instrumentation at a landowner’s property line or at any point within a landowner’s property.
        3. No WECS shall generate or permit to be generated from commercial or industrial permitted facilities any vibration in the low-frequency range of 0.1 to 20 Hz, including the 1, 2, 4, 8, and 16 Hertz octave bands that is perceivable by human sensation or exceeds an rms acceleration level of 50 dB(unweighted) re 1 micro-g at any time and for any duration either due to impulsive or periodic excitation of structure or any other mechanism at a landowner’s property line or at any point within landowner’s property.
        4. A noise level measurement made in accordance with methods in Section D.3.g. that is higher than 45dBA (Lmax) or 55 dBC (Lmax) adjusted for the penalty assessed for a tonal noise condition, shall constitute prima facie evidence of a nuisance.
        5. An acoustic, vibratory or barometric measurement documenting oscillations associated to commercial or industrial permitted facilities with levels exceeding the noise limits shall constitute prima facie evidence of a nuisance.
        6. All commercial and industrial activity shall comply with limits and restrictions anywhere at any time on another property.
        7. Leq 1-sec shall be used for all measurements and modeling.
     7. **Noise Measurement and Compliance**
        1. Post construction validation and compliance testing shall include a variety of ground and hub height wind speeds, at low (between 6-9mph) medium (between 9-22mph) and high (greater than 22mph). SCADA data shall be provided in the format determined by Township, Township licensed engineers, or Township professional acousticians. Compliance noise measurements are the financial responsibility of the WECS owner of the facility and shall be independently performed by a qualified professional acoustician approved by the *(insert community name)* Board or their designated agent. Compliance noise measurements shall not exceed the stipulated noise limits and shall assess for and apply tonal noise penalties when warranted.
        2. **Quality:** Measurements shall be attended. All noise measurements shall (must) exclude contributions from wind on microphone, tree/leaf rustle, flowing water, and natural sounds such as tree frogs and insects. The latter two can be excluded by calculating the dBA noise level by excluding octave band measurements above the 1000 Hz band as in ANSI S12.100 3.11. The ANS-weighted sound level is obtained by eliminating values for octave bands above 1000 Hz, or one-third octave bands above 1250 Hz, and A-weighting and summing the remaining lower frequency bands. The wind velocity at the sound measurement microphone shall not exceed 3 m/s (7 mph, maximum) during measurements. A 7-inch or larger diameter windscreen shall be used. Instrumentation shall have an overall internal noise floor that is at least 5 dB lower than what is being measured. During testing of elevated sources including, but not limited to, wind turbines, the atmospheric profile shall be Pasquill Stability Class E or F preferred, Class D as alternate.
     8. **Noise Level:** Noise measurements shall be conducted consistent with ANSI S12.18 Procedures for Outdoor Measurement of Sound Pressure Level and ANSI S12.9 Part3 (Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-term Measurements with an Observer Present), using Type 1 meter, A-weighting, Fast Response.
        1. Sound Level Limits.
           1. Between the hours of 7 a.m. to 10 p.m., any single 10-minute LAeq A-weighted equivalent sound level measured at the property line of an unpooled (single) parcel (as defined in Section B hereof) upon which there is an occupied building or dwelling shall not exceed 35 dBA or 5 dBA over ambient noise limit, whichever is lower. Between the hours of 10 p.m. to 7 a.m., any single 10-minute LAeq A-weighted equivalent sound level measured at the property line of an unpooled (single) parcel (as defined in Section B hereof) upon which there is an occupied building or dwelling shall not exceed 30 dBA or 5 dBA over ambient noise limit, whichever is lower.
           2. On a pooled parcel, the ten-minute LAeq sound level measured at the wall of an occupied building nearest to the wind turbine or turbines shall not exceed 45 dBA.
           3. These sound level limits are to be evaluated using the A-weighted equivalent sound level (LAeq) descriptor. The LAeq is measured using a ten-minute time interval.
           4. In the event audible noise due to wind energy conversion system operations contains a tone, such as from a gearbox or generator, the standards for audible noise set forth in Section D.3.(h).1.a and D.3.(h).1.b of this subsection shall be reduced from 0 to 6 dBA depending on the severity of the tone as determined by ISO 1996-2, see Sections D.3.a.iv. and D.6.f.
     9. **Tonal Noise:** Tonal noise shall be assessed using unweighted (linear) 1/3 octave band noise measurements with time-series, level-versus-time data acquisition. A measurement shall constitute prima facie evidence of a tonal noise condition if at any time (single sample or time interval) the noise spectrum of the noise source under investigation shows a 1/3 octave band exceeding the average of the two adjacent bands for by 15 dB in low one-third octave bands (10–125 Hz), 8 dB in middle-frequency bands (160–400 Hz), or 5 dB in high frequency bands (500–10,000 Hz).
        1. **Sample Metric and Rate:** Noise level measurements for essentially continuous non-time varying noise sources shall be acquired using the Leq(Fast) metric at a sample rate of 1-persecond. For fluctuating or modulating noise sources including, but not limited to, wind turbines, a 10-per-second sample rate or faster shall be used. These sample rates shall apply to dBA, dBC and unweighted 1/3 octave band measurements.
        2. **Reporting:** Measurements of time-varying dBA and dBC noise levels and 1/3 octave band levels shall be reported with time-series level-versus-time graphs and tables. Graphs shall show the sound levels graphed as level-vs-time over a period of time sufficient to characterize the noise signature of the noise source being measured. For 1-per-second sampling, a 5-minute-or-longer graph shall be produced. For 10-per-second sampling, a 30-second-or-longer graph shall be produced. Reporting shall identify, and graphs shall be clearly notated, identifying what was heard and when the noise source is dominating the measurement. Reporting shall furnish all noise data and information on weather conditions and, Pasquill Class occurring during testing.
     10. **Construction Codes, Towers, & Interconnection Standards.** Utility-scale WECS including towers shall comply with all applicable state construction and electrical codes and local building permit requirements. Utility-scale WECS including towers shall comply with Federal Aviation Administration requirements, the Michigan Airport Zoning Act, the Michigan Tall Structures Act, the Branch County Memorial Joint Airport Authority Ordinance, and other applicable local and state regulations. An interconnected utility-scale WECS shall comply with Michigan Public Service Commission (MPSC) and Federal Energy Regulatory Commission (FERC) standards. Off-grid systems are exempt from MPSC and FERC requirements. Utility-scale WECS shall comply with the following construction requirements:
         1. Tubular towers are required for WECS.
         2. The base of the wind turbine must be constructed in such a manner that upon removal of said tower, the soil will be restored to its original condition to a depth of 4 feet.
         3. “Up wind turbines” are required.
         4. Constant velocity turbines are preferred. Variable speed turbines must submit additional data concerning noise when their revolutions per minute exceed 25 rpms.
         5. Visual appearance shall be limited by the use of paint color and finishes that minimize visibility and reflectivity and create a consistent appearance among turbines and turbine components.
         6. Color shall be RAL 9001, or similar muted soft white or gray.
         7. At the time of application, a paint sample shall be provided for all visible turbine components to demonstrate consistent appearance in paint finish and color.
         8. Coatings shall be defined according to ISO 2813:2014 (or most recent version utilized at the time of turbine production) at a viewing angle of 60 degrees with a gloss rating of less than or equal to 30 gloss units.
         9. All turbine components shall meet a gloss rating specification of equal to or less than 30 gloss units throughout special land use or shall be recoated at the owner’s expense within 180 days of a determination of non-compliance.
         10. The Planning Commission, or designated staff, shall ensure verification of paint finishes and gloss rating prior to the erection of the turbine components, at the expense of the Wind Energy Conversion System (WES) owner, through a third-party qualified tester using ISO 2813:2014 (or most recent version utilized at the time of turbine production) to demonstrate compliance.
         11. If the Planning Commission determines that additional testing of the paint finish is needed at any point during the duration of the special land use to confirm compliance with the 30-gloss unit maximum, testing shall be completed, at the expense of the WECS owner, by a third party qualified tester selected by the Planning Commission. Testing shall follow ISO 2813:2014 (or most recent version) to demonstrate compliance.
         12. No advertising of any kind shall be allowed on the wind turbine.
         13. The electrical wires used to connect the turbine tower to its step-up transformer shall be installed at a depth of 48 inches or more below ground.
         14. The certified registered engineer and authorized factory representative shall certify that the construction and installation of the conversion system meets or exceeds the manufacturer's construction and installation standards.
     11. **Safety.** The utility-scale WECS shall meet the following safety requirements:
         1. The utility-scale WECS shall be designed to prevent unauthorized access to electrical and mechanical components and shall have access doors that are kept securely locked at all times when service personnel are not present.
         2. All energy collection system wiring shall comply with all applicable safety and stray voltage standards.
         3. Each utility-scale WEC shall be equipped with both a manual and automatic braking device capable of stopping the WECS operation in high winds within 80% of design limits of the brakingsystem.
         4. A copy of the un-redacted Safety Manual from the turbine manufacturer shall be submitted to the Township and the turbine must comply with all requirements therein.
         5. All towers or poles must be unclimbable by design or protected by anti-climbing devices such as:
            1. Fences with locking portals at least six (6) feet high
            2. Anti-climbing devices twelve (12) feet from base of pole
     12. **Shadow Flicker.** Utility-scale WECS shall produce no off-site shadow flicker. Measures to eliminate all effects of shadow flicker on adjacent properties, such as programming the WECS to stop rotating during times when shadow crosses occupied structures, may be required.
         1. **Mitigation and Mitigation Plan.** A shadow flicker detection/abatement system is required on each wind turbine generator. An equivalent type of system may be used, but only with prior approval by the Planning Commission. Shadow detection systems must be kept in good working order for the entire duration of the special land use. Shadow flicker mitigation measures for each receptor modeled to receive flicker shall be described in a mitigation plan and submitted with the application. Flicker mitigation measures may include but are not limited to, turbine siting changes and flicker detection/abatement system operation. If landscaping is used as a mitigation procedure, the planting of mature trees shall be required. The Planning Commission may require a performance guarantee or other mitigation measures, to assure the long term viability and effectiveness of the mitigation.
     13. **Fluid Containment.**  Each utility-scale WECS shall include both an internal and external fluid containment barrier located either within the nacelle, or at the base of the nacelle in the event of a spill or leak.
     14. **Vibrations.** Wind turbines shall not create vibrations that are detectable by humans on unpooled properties.
     15. **Substations and Accessory Buildings.** Structures related to a WECS shall be subject to the dimensional and locational standards of accessory structures in the zoning district. However, WECS and structures associated with a WECS shall not count towards the maximum number of accessory structures on a given lot.
     16. **Inspection.** The Township shall have the right upon issuing any WECS or wind energy facility special use permit to inspect the premises on which each WECS is located at any reasonable time. The Township may hire a consultant to assist with any such inspections at a reasonable cost to be charged to the operator of the WECS.
     17. **Signage:** Each WECS and Testing Facility shall have one sign per turbine, or tower, located at the roadside and one sign attached to base of each WECS, easily visible throughout four seasons. Signs shall be two square feet in area and be placed at the road right of way. Signs shall be the same and shall uniquely identify each WECS. Additional signage on and around the tower is recommended. The sign shall contain at least the following:
         1. Warning high voltage.
         2. The sign shall have at a minimum six (6) inch letters with 3/4-inch stroke.
         3. This sign shall include a 24-hour emergency phone number.
         4. Pooled Parcel Land owner’s name, WECS owner’s name, and operator’s name.
         5. Emergency telephone numbers and web address. (list more than one number).
         6. If WECS uses fencing, place signs on the perimeter fence at fence entrance door.
         7. Unique identification such as address of WECS. If more than one WECS on access drive, units shall have further identification such that first responders can positively identify.
     18. **Coating and Color:** A WECS shall be painted a non-obtrusive (light environmental color such as beige, gray or off-white) color that is non-reflective. The wind turbine base and blades shall be of a color consistent with all other turbines in the area. No striping of color or advertisement shall be visible on the blades or tower.
     19. **Communication Interference:** Each WECS shall be designed, constructed and operated so as not to cause radio and television or other communication interference. In the event that verified interference is experienced and confirmed by a licensed engineer, the Applicant must produce confirmation that said interference had been resolved to residents’ satisfaction within ninety (90) days of receipt of the complaint. Any such complaints shall follow the process stated in Section D.9.
     20. **Braking:** Each WECS shall be equipped with a braking, or equivalent device, capable of stopping the WECS operation in high winds with or without SCADA control. Braking system shall be effective during complete GRID power failure where WECS are unable to communicate with SCADA control or receive power.
     21. **Applicant Compliance:** The WECS and related equipment shall comply with any and all State, Federal, County and Township requirements, and obtain all necessary permits from the FAA, Michigan Department of Transportation, and/or any other Federal, State, Township, or other government authority prior to construction of any WECS.
  2. Liability Insurance
     1. Liability Insurance: The current WECS owner and operator shall insure for liability for the WECS in an amount of $2,000,000, without interruption until removed and to protect the current WECS owner and operator. In the event a public service such as police, fire, or rescue is required due to the operation, maintenance, or failure of a wind turbine, any cost incurred as a result of said event shall be the sole responsibility of the applicant and/or owner of the utility-scale WECS.
  3. Decommissioning:
     1. To ensure proper removal of each WECS structure when it is abandoned or non-operational, application for a special land use permit shall include a proof of the financial security in effect before permit is approved. The security shall be in the form of a cash deposit. Additionally, security is based on each WECS and is to be backed by owner assets, operator assets, parent company assets, and leaseholder, or Pooled Parcel, assets (liquid or fixed such as cash equivalents, land, equipment, buildings, etc.) approved by the Planning Commission. a) The amount of each WECS security guarantee, shall be the average of at least two independent (applicant) demolition (removal) quotes obtained by the Planning Commission and approved by the Township Board. If the quantity of quotes obtained is two (2), the formula should be (quote 1 + quote 2) divided by two (2). The security guarantee shall be a cash deposit of no less than 150% of the cost for the first turbine, 120% of the cost for the second turbine and 100% of the cost for each additional WECS thereafter. The security guarantee shall be no less than one-million-dollar cash deposit with (150% for the first turbine, 120% for the second turbine, 100% for each additional turbine) per WECS. Quotes shall be based on individual WECS removal and shall not group multiple WECS simultaneous removals together. Quotes shall be ordered and obtained by the Township from established demolitions companies. Quotes shall not include salvage values. The cash deposit shall be updated every two (2) years at the rate of 1.5 times CPI (consumer price index) for each year. b) Such financial guarantee shall be deposited with the Township Treasurer after a special use has been approved but before construction operations begin on the WECS project. Failure to keep such financial security in full force and effect at all times while the structure exists shall constitute a material and significant violation of a special use approval and this ordinance, and shall subject the Applicant to all available remedies to the Township, including enforcement action, fines, revocation of the special use approval and WECS removal. The Applicant shall be responsible for the payment of all attorney fees and other costs incurred by the Township in the event that the structure is not voluntarily removed and the Township has to enforce removal. d) The Applicant/Owner and Operator shall execute any and all document (as provided or approved by the Township), sufficient to provide the Township with a perfected security interest in monies deposited with the Township for the purpose of decommissioning any wind energy conversion system.
  4. Transfer or Sale. In the event of a transfer or sale of the WECS, the Township shall be notified and the special land use permit may be amended administratively by the Township board.
     1. In the event of an ownership change the current owner shall present at a meeting of the Township Board a report and information regarding the following:
        1. The current condition of the WECS Tower
        2. Description and introduction of the new owner
        3. Any changes to ongoing maintenance of the WECS
     2. Any proposed changes to the operating procedure or approved site plan shall be amended and resubmitted for Township review according to the procedures for all WECS as outlined herein, including a public hearing.
     3. Upon transfer or sale, the cash bond shall be maintained at all times, the estimated costs of decommissioning shall be resubmitted, and the security bond adjusted to account for the new estimate.
  5. Safety Manual: The Applicant must provide an unredacted copy of the manufacturer’s safety manual for each model of turbine without distribution restraints to be kept at the Township Hall and other locations deemed necessary by Planning Commission or local first responders. The Manual should include standard details for an industrial site such as materials, chemicals, fire, access, safe distances during WECS failure, processes in emergencies, etc.
  6. Operational, Maintenance, and Issue Resolution: Each WECS and Testing Facility must be kept and maintained in good repair and condition at all times. If a WECS is not maintained in operational and reasonable condition or poses a potential safety hazard, the Applicant shall take expeditious action to correct the situation, including WECS removal. The Applicant shall keep a maintenance log on each WECS and must provide complete log to the Township within thirty (30) days of request. To assure compliance with this requirement, an annual audit of maintenance records, conducted by a qualified third-party maintenance expert acceptable to the Township, shall be completed at the expense of the owner/operator of the turbine, and a copy of this report provided as specified by the Township.
     1. WECS must be maintained and kept in operational working order or shall be removed by the owner of the wind energy conversion system. Any wind energy conversion system, or part of a wind energy conversion system such as a wind turbine generator, that has not produced electrical energy for 6 consecutive months shall be deemed to be abandoned; provided, however, that the owner or operator of the wind turbine may apply to the Planning Commission, not less than 60 days prior to the expiration of said 6-month period, for one additional extension of up to six months upon establishing, to the satisfaction of the Planning Commission, that the lack of production was caused by reasons beyond the control of the owner or operator. In determining whether such abandonment has occurred, the Planning Commission or Township Zoning Administrator may request, and the operator, system owner, or property owner shall provide written documentation accurately indicating the amount of electrical energy produced by the wind energy conversion system during said 6-month period. It shall be the obligation of the wind energy conversion system owner to remove the abandoned wind energy conversion system.
     2. An escrow account shall be set up when the applicant applies for a Special Use Permit for a WECS and WECS Testing Facilities to cover permitting costs. The monetary amount filed by the Applicant with the Township shall be in an amount estimated by the Township Board to cover all reasonable costs and expenses associated with the special use zoning review and approval process, which costs can include, but are not limited to, fees of the Township Attorney, Township Planner, and Township Engineer, as well as any reports or studies which the Township anticipates it may have done related to the zoning review process for the particular application. Such escrow amount shall include regularly established fees. At any point during the zoning review process, the Township may require that the Applicant place additional monies into the Township escrow should the existing escrow amount filed by the Applicant prove insufficient. If the escrow account needs replenishing and the Applicant refuses to do so within fourteen (14) days after receiving notice, the zoning review and approval process shall cease until and unless the Applicant makes the required escrow deposit. Any escrow amounts which are in excess of actual costs shall be returned to the Applicant within ninety (90) days of permitting process completion. An itemized billing of all expenses shall be provided to the Applicant. The Township shall hire qualified professionals for each and any of the technical fields associated with the Special Use Permit, such as, but not limited to, electrical, acoustics, environment, economics, wildlife, health, and land-use.
     3. Transfer or sale. In the event of a transfer or sale of the WECS, the Township shall be notified and the special land use permit, may be amended administratively by the Township board.
        1. Change in ownership alone shall be considered a minor amendment to the special land use and may be approved administratively without a public hearing.
        2. Any proposed changes to the operating procedure or approved site plan shall be amended and resubmitted for Township review according to the procedures for all WECS as outlined herein, including a public hearing.
        3. Upon transfer or sale, the cash bond shall be maintained at all times, the estimated costs of decommissioning shall be resubmitted, and the security bond adjusted to account for the new a performance bond or letter of credit, in an amount determined by the Planning Commission to be sufficient to cover the entire cost of removal, shall be submitted by the applicant prior to the issuance of the special land use. To assist the Planning Commission in determining the amount of the performance bond or letter of credit, the applicant may submit information regarding the estimated cost to remove a wind energy conversion system.
     4. The WECS owner or operator shall provide the Zoning Administrator with a copy of the monthly maintenance inspections for WECS located on absentee landowner parcels.
     5. Applicant must provide Township with current copy of the un-redacted manufacturer’s user manuals including safety manuals with permit application. Manufacturer’s safety manuals will be made available for review upon request by any resident living within 2 miles of any Industrial Wind Turbine.
     6. If there is a mechanical failure resulting in, but not limited to, an abnormal sound emission, release of a pollutant, or a public safety hazard including blade throw, ice throw, fire or injury to any person or property, the Zoning Administrator shall be notified of the event the next day of business following the event. The applicant shall provide the Township at the time of application an operational procedure for this event, a mitigation strategy, and appropriate emergency contact information. A written report describing the failure and the owner’s response to the failure shall be submitted to the Zoning Administrator within 10 business days of the event. Sound emitted from a wind turbine generator that is the result of a mechanical failure or lack of maintenance may not be subject to the complaint resolution procedure outlined in D.9. Emergency contact information and a turbine reference number shall be placed in an appropriate location near the site of the turbine, such as at the gate for the access road, so it can be viewed without trespassing on private property.
  7. Complaint Resolution. The purpose of this section is to provide the public with a mechanism to file a complaint with the wind energy conversion system owner and the Zoning Administrator and receive a timely response from the wind energy conversion system owner regarding alleged wind energy conversion system ordinance violations. The applicant shall submit procedures which it intends to implement for receiving, acting upon, and resolving complaints or allegations that the wind energy conversion system is not in compliance with this ordinance.
     1. Complaint resolution procedures must be presented at the time of application and must meet the approval of the Planning Commission prior to approval of a special land use. Those procedures, at a minimum, shall:
        1. Require the system owner to accept complaints regarding non-compliance with the ordinance from all property owners within the project boundary and up to one a two-mile radius of a wind turbine generator.
        2. Provide a telephone number and mailing address at which the operator can be contacted for purposes of submitting complaints or allegations of non-compliance.
        3. Require that all such complaints or allegations be submitted in writing.
        4. As a condition of the system owner acting on the complaint, require that a complainant allow the wind energy conversion system owner or designated staff, or other authorized personnel such as an engineer or acoustic professional, on the property of the complainant for further investigation and testing.
        5. Set forth information that must be included in the complaint or allegation.
        6. Require that a complaint is acknowledged in writing by the wind turbine owner to both the complainant and the Zoning Administrator within five (5) business days of receipt of said complaint.
        7. Set forth the number of days, not to exceed thirty (30), in which the operator shall investigate and resolve any and all complaints or allegations, either by way of correction or formal denial of non-compliance.
        8. Require the operator to advise the Zoning Administrator in writing of the resolution of any complaint or allegation of non-compliance within thirty (30) days of its receipt of the same.
     2. Any complaint not resolved within thirty (30) days shall result in a performance review by the Planning Commission as described in Section D.12. Resolution or mitigation of a complaint that involves construction, landscaping, testing or other significant alteration/operational condition that is dependent on seasonal or other conditions may exceed thirty (30) days if approved by the Planning Commission.
     3. For complaints not resolved within (30) days, the Planning Commission may request punitive damages for the complainant(s) and a civil penalty for the Commission to vindicate the public interest.
     4. It shall be a violation of this ordinance to modify the approved complaint resolution procedures without the prior approval of the Planning Commission.
  8. Non-Compliance with Standards: The Township Board reserves the right to require WECS Applicant to shut down any WECS unit that does not meet ordinance requirements until such WECS unit meets ordinance requirements or is removed.
  9. Signal Interference. Through the appropriate placement of wind turbine generators, the applicant shall design to eliminate any interference such as, but not limited to, internet (Wi-Fi or satellite), AM or FM radio, cell telephones (including cellular and landline), 911, satellite television, microwave, navigational, emergency systems, and digital television. Post-construction signal interference caused by the wind energy conversion system shall be mitigated by the wind energy conversion system owner at their expense.
     1. An application shall include a Licensed Microwave Search and Worst Case Fresnel Zone (WCFZ) analysis.
     2. The application shall include an interference mitigation plan. The plan shall describe mitigation measures and procedures to eliminate interference from the wind energy conversion system. The plan shall address various forms of interference and corresponding mitigation measures employed before and after construction of the wind energy conversion system. The plan must include relevant maps and modeling showing all known television, internet, emergency services, radio broadcast, or other signal paths along with proposed wind turbine locations.
  10. Performance Review. The Planning Commission shall require a performance review of the special land use on a three-year basis or as it may be required. The three-year time period commences after the first turbine of the wind energy conversion system becomes operational. The Planning Commission shall provide the performance review and the Township shall perform, where reasonably practicable, investigation regarding a complaint or other matter requiring a performance review. In its sole discretion, the Township may require the assistance of an independent third party due to the specialized nature of the complaint, conflicting evidence, or other condition. The reasonable cost of an independent third-party consultant shall be at the expense of the WECS owner. Failure to maintain compliance with this ordinance shall result in enforcement action which may include the termination of the special land use, or portions of the special land use. The Township will retain jurisdiction to modify, suspend or revoke all IWT licenses, should any violations occur.
      1. To administer the provisions relating to the WECS, the Township may hire consultants and experts as are reasonably necessary in the sole discretion of the Township. The applicant shall pay the Township in advance for the costs of such consultants and experts. The Township may charge an annual fee to be determined by the Matteson Township Board and assess additional fees in order to execute its responsibilities related to a project. Any fees charged must be reasonable in light of efforts required.
      2. The purpose of the performance review is to evaluate the status of:
         1. Compliance with Special Land Use. Compliance with the conditions set forth by the special land use, such as specific mitigation measures or operation procedures.
         2. Ownership Change. Changes in ownership or operation of the wind energy system. (Already addressed)
         3. Avian or Bat Mortality. A significant avian or bat mortality event that exceeds projected impacts described in the Wildlife Study as required in Section D.2.(e).3 of this ordinance.
         4. Other. Other matters as determined by the Planning Commission.
         5. Unresolved and/or repeated complaints. A complaint taking longer than thirty (30) days to resolve may require a performance review unless otherwise specified in the ordinance. If after the performance review and further investigation, the Planning Commission verifies that alleged ordinance violations are the result of the operation or condition of the wind energy conversion system, the owner/operator shall eliminate the non-compliance by mitigation or other measures which may include temporary operational changes. The Planning Commission shall establish the effective date of the mitigation measure based on the nature of the mitigation.
         6. As a condition of the Planning Commission conducting a performance review, the complainant shall be required to allow Township staff, the wind energy conversion system owner or designated staff, or other authorized personnel such as an engineer or acoustic professional, on the property of the complainant for further investigation and testing.
         7. Actions taken by the Planning Commission to terminate or modify the Special Land Use, portions of the Special Land Use, or the conditions of the Special Land Use shall require a public hearing and notification to the wind energy conversion system owner pursuant to the conditions of the original permit.