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Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Distinguished Council Members,

My name is Walter M. Zima. I live at 12B Greenwoods Turnpike in Colebrook, CT. In 1992 I bought my small ranch home. Just beginning my family, the quite, peaceful, small town community setting Colebrook offered was the major selling point. Over the years I have transformed my home with the help of my father. This has been a labor of love and an experience that afforded me precious time with my dad. I have two sons- Derek, 20 years old and Mark, 13 years old. Last year my fiancee, Brandy and her 10 year old daughter, Kaitlyn, moved into our home. Since their arrival I have made several more improvements with more plans for future expansion, including an outdoor living space. Last Spring we added a deck, with plans for an expanded patio this summer.

In early December it was brought to my attention that BNE Energy, Inc. proposed to build a three turbine wind farm, Petition 984, on Rock Hall Road. This information was shared with me while eating dinner at a local restaurant in Norfolk, CT. This was the first I had heard of this plan. I had attended a meeting the previous year that pertained to the installation of a weather recording station. However, further information regarding the proposed three turbine wind farm located on Flagg Hill Road, Petition 983, had not been forthcoming. It was my understanding that residents on Flagg Hill Road were disputing the ability of the Planning and Zoning Board to allow the meteorological tower to be installed in the first place.

Since the information regarding these proposed projects was, in my case, surprising, limited, and not readily available, I began to do research. I discovered several pieces of information that I found disturbing and potentially dangerous. The first being the lack of regulations. Increased government grants and calls for the decreased reliance on fossil fuels have made wind power seem to be a perfectly safe and reasonable alternative. However, as with all new endeavors, there are many unknowns. Although the GE turbines proposed to go in are considered more efficient, quite, and less intrusive, it does not mean that potential dangers and disturbances to neighbors are decreased. This is a residential area, even though there is a driving range, gun club, and recreational area nearby, these do not pose the same potential threats to the health and safety of my family as 492 foot turbines with enormous blades spinning above my home do. Furthermore, my home will be sandwiched between both wind farms, which means my family will be impacted by SIX turbines, if not more. The proposals would lead one to believe that the gun range causes more distraction to residents than these quite giants, however, there is not gun fire during the night. Intermittent gun fire will not cause the health problems associated with wind turbines. In addition, I do not see the golf range from the windows in my home, and a rogue golf ball does not have the same potential dangers to my home and property values as six, 492 feet wind turbines do. Lastly, the recreation center is used seasonally and one would not know there was a function taking place until driving by.

In an article published in September 2010, a landowner in Wyoming addressed the issue of property values affected negatively (http://www.casperjournal.com/article_113f34f7-c657-53b7-a042-3afafc2d2139.html) by proximity to wind turbines. I contend that selling a home with a turbine in the backyard does not make the property more desirable. Especially, when the once peaceful, serene backyard view is now peppered with turbines.

I would like to draw the Siting Council's attention to the wind energy ordinance 2010 passed in Jackson, ME. Specifically, sections 13.0, 13.1, 13.2, and subcategories pertaining to setbacks from residences and public roads, as well as noise standards. Some note worthy ordinances:

"A setback from the property line of 13x the turbine height for a 400' turbine is 5200 feet, approximately one mile" (see attached document).

"Setbacks for public roads are based on an approximation of a 1680-foot debris field for ice throw. Four times the turbine height for a 400' Wind Turbine is equal to 1600 feet" (see attached document).

In the testimony given by Dr. Apt during the April 23, 2009 Hearing on the American Clean Energy Security Act: Panel on Low Carbon Electricity, Carbon Capture and Storage, Renewables and Grid Modernization, he refers to the importance of decommissioning funding, along with the large task of creating a transmission system. Looking at page 3

(see attached document), Apt states, "...wind and solar can lower the amount of fossil fuels used for a generation, but they don't lessen the need for spending money on always-available generation capacity, nor do we get all the air emissions benefits we once expected. For new generators, the capital cost is the vast majority of new costs and so the savings by having free fuel from the wind or sun are small."

At this early developmental stage and with limited knowledge of the effects turbines have on the surrounding ecosystem and human neighbors this is not something to rush into. If this form of energy is more effective, then funding will remain available until informed decisions can be made, with all aspects considered. These turbine farms will affect the communities in which they are proposed. I ask that the council consider the people affected by having to live around them, the ecosystems that may be damaged and forever changed; more so than the potential profit a corporation stands to make.

Sincerely,

Walter M. Zima

Walter M. Zima

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Testimony of
Dr. Jay Apt

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U.S. House of Representatives
Committee on Energy and Commerce
Subcommittee on Energy and Environment

Hearing on
The American Clean Energy Security Act of 2009

Panel on Low Carbon Electricity, Carbon Capture and Storage, Renewables and Grid Modernization

April 23, 2009

My testimony is based on research described in an article in the Fall 2008 issue of *Issues in Science and Technology*, attached to this testimony, and in a longer working paper, and in several papers published in the research literature. Lester B. Lave and Sompop Pattanariyankool are colleagues in this research.

Chairman Markey, Ranking Member Upton, and members of this subcommittee including my Representative, Mr. Doyle, thank you for giving me the opportunity to testify.

At Carnegie Mellon University, I am a faculty member in the Engineering College and the Tepper School of Business. I am also executive director of the Carnegie Mellon Electricity Industry Center. The opinions here are mine and do not necessarily reflect the views of my coauthors, Carnegie Mellon University, or any other institution.

I commend you for searching for ways to reach the goals of reducing greenhouse gas emissions and pollution, enhancing energy security, maintaining electric supply reliability, and controlling costs. Renewable energy sources are a key part of the nation's future, but I caution that a singular emphasis on renewable energy sources is not the best way to achieve these goals. One goal is paramount as the greatest challenge of the century: reducing air emissions and the atmospheric concentration of carbon dioxide.

I have two recommendations that I hope you will consider:

1. Focus on reducing carbon dioxide rather than singling out renewables as the answer. There are significant savings from letting all technologies compete in satisfying the goals of lowering greenhouse gas emissions, increasing energy security, and improving sustainability, ensuring that energy prices are not so high that they derail the economy.
2. Ensure that efficiency gains, in generating electricity, as well as transmitting and distributing it, and in using it, can count in any low-carbon legislative mandate, such as Sec. 231 of the discussion draft.

If estimates of the amount of recoverable fossil fuels are correct, without carbon dioxide controls we will run out of atmosphere long before we run out of fossil fuels. Burning any appreciable fraction of the estimated coal, oil, and natural gas resources will send atmospheric carbon dioxide concentrations to far greater levels than humans have experienced and lead to major global climate change.

All fossil fuel sectors contribute emissions and need to be addressed, but my testimony focuses only on the electricity sector. The United States is increasing its reliance on electric power and will have to generate 40% more electricity by 2030 if demand keeps growing as it has the past 35 years. We face the additional challenge of quickly reducing carbon dioxide. At the same time, the price of power has risen 25% nationally in four years, and has risen much faster in cities such as Baltimore. We spend about 3% of GDP annually on electricity.

Removing 80% of the CO_2 we emit today from electric power generation with the most cost-effective technologies we know about will cost us about 2/3 of one percent of GDP annually. That's about what we spent on the Clean Air Act. That amount is affordable. But if we try to specify which technologies – like renewables – are the only ones that need apply and don't allow the least expensive clean technologies to compete, these costs can grow to unaffordable levels.

It is important to develop competing low carbon technologies to keep costs low, rather than trying to select technologies based on attributes that have little to do with controlling CO_2.

A national RPS is an expensive way to reduce greenhouse gas emissions because "renewable" and "low greenhouse gas" are not synonyms; there are several other practical and often less expensive ways to generate electricity with low carbon dioxide emissions. In addition, renewable energy is concentrated in only certain states. A national RPS would force other states to transfer wealth to windy or sunny states, instead of using it to develop low carbon technologies that are appropriate to their locales.

Mandating technologies can be much more expensive than mandating performance, by capping emissions at a level that declines over time or by requiring that no more than a given amount of CO_2 be emitted for every kilowatt-hour produced. Renewables portfolio standards unnecessarily increase costs (and often leave out efficiency and demand-side response) in an attempt to eliminate the use of uranium, coal, natural gas, and large hydroelectric power. What is needed instead is a direct performance standard that lowers the limits on emissions of CO_2 in a predictable fashion over the next few decades to very low levels.

For renewables, the maps I have provided of wind and solar resources show vast differences among states. For example, the Southeast has neither good wind nor solar resources. It does have biomass, but that will be needed for producing liquid fuels. Legislation should give each region the greatest flexibility to achieve the goals at least cost, including renewables, efficiency, conservation, fossil fuels with carbon capture and sequestration (CCS), and nuclear.

Many people like wind turbines in the abstract but don't want them as neighbors, for example, the proposed wind farm off Cape Cod. In my state of Pennsylvania, we now have 200 wind turbines. About 10,000 would be required to meet a 25% RPS and the resulting land use issues can't be ignored. A handful of states require wind farm operators to pay into a fund for decommissioning the turbines at their end of life. A quick YouTube search for "wind turbine failure" is all that is required to see why this is very good idea.

Achieving a large national RPS requires building large amounts of transmission from areas with good wind resources to population centers. More people oppose transmission lines than wind turbines. There are likely to be delays of ten years or more in siting transmission.

Even in good areas, the wind doesn't blow all the time. Looking at all the wind power plants in Texas in 2008, we find that in a quarter of the hours during the year Texas wind production was less than 10% of its rated capacity. That means that when a wind farm is built, some other power source of the same size must be built to provide power during those calm hours. Our research shows that natural gas turbines, that are often used to provide this fill-in power, produce more CO_2 and much more nitrous oxide (as they quickly spin up and then slow down to counter the variability of wind than) than they do when they are run steadily.

The point is that wind and solar can lower the amount of fossil fuels used for generation, but they don't lessen the need for spending money on always-available generation capacity, nor do we get all the air emissions benefits we once expected. For new generators, the capital cost is the vast majority of new costs and so the savings by having free fuel from the wind or sun are small.

As you know, wind and solar generation differ from the traditional ways of generating electricity because they are generally not available when we need power. Wind turbines and solar arrays generate electricity when the wind blows and the sun shines. One of the best solar sites in the USA is in the Arizona Desert. A very large solar generator there had a duty cycle, what we call the capacity factor, of 19%, out of the possible 100%, if it had generated full power every hour of the two years we studied it. Wind turbines have higher potential in good wind sites but, for example, the average capacity factor for the wind turbines in Texas was only 29% in 2008.

The solar map shows that the good sites are in the desert Southwest. Sites in the Southeast have lower potential because of cloud cover. The rest of the continental USA has much lower potential for generating solar power, particularly the most heavily populated areas. The capacity factor is important because almost all the costs are in manufacturing and installing the array. Thus, a solar array with a capacity factor of 20% would produce electricity at half the cost of an array with a capacity factor of 10%. Forcing solar installations into Atlanta, Washington, or New York would consume a vast amount of resources per kilowatt-hour.

Nature is more generous in distributing good wind sites around the nation, but they are still distant from population centers. In particular, note that there are no good wind sites in the Southeast. As with solar, the cost of produced power is inversely related to the capacity factor since almost all the costs are building the wind farm. Thus a site with a capacity factor of 40% would have half the cost per kilowatt-hour as a site with a 20% capacity factor.

In general wind and solar power are not available when demand is highest. Wind tends to be strongest at night and lowest in the summer. Solar power is best in the summer, but the Arizona data show that the arrays have all but stopped producing electricity by 5 PM in the summer, just as demand is hitting its peak.

Another problem is that wind and solar generation are variable. Wind speed changes from moment to moment and clouds block the sun, even in the desert. This variable power challenges the grid to provide reliable, high quality power when wind and solar are contributing more than a few percent of total generation.

One solution to both these problems is to store large amounts of electricity when these sources are generating so that it can smooth power output and have that output available when demand is high. Pumped hydroelectric storage is the best way to store electricity, but few new sites are available. Compressed air storage looks promising, but is expensive and less efficient than pumped hydro. The discussion draft does not appear to contain significant incentives for large-scale electricity storage.

Wind farms can affect climate downwind, reducing precipitation. Massive reliance on wind energy would take energy out of the wind, changing the Earth's climate. All power generation options have feet of clay. There is no generation utopia. But just because there is no free lunch doesn't mean we can't eat: we just have to acknowledge the issues honestly so that we are not faced with a public backlash later on.

There are other renewable sources that are also low-carbon. Hydroelectric dams generate six times as much power today as the other renewables, but there is little prospect for getting significantly more power. Dams are being torn down, not being built. Run of the river hydro could provide small amounts of power. Geothermal provides power in California and more is planned for the Southwest. Where there are good geothermal resources, this resource can be attractive. However, the good areas are limited to the West. Biomass could provide significant amounts of power at competitive costs, but there is a limited amount of land and water, and the biomass may be better used for transportation fuels. Ocean currents and waves can provide power, but corrosion and withstanding storms make the power expensive, in addition to other problems.

Where they can compete for our low-carbon dollar, renewables should be applauded. In good sites, wind power is competitive with new fossil generation with carbon capture and sequestration. At good sites, solar thermal power is almost competitive with new fossil generation. However, even at the best sites, solar photovoltaic generation is several times the cost of other low-carbon power per kilowatt-hour. We should not pick technologies with legislation – rather we should pick the low carbon goal and allow the cost-effective winners to emerge.

Federal support of R&D in this industry is essential to achieving low carbon electricity at affordable cost. While solar photovoltaic power is too expensive for massive deployment, I urge funding solar photovoltaics research, since this technology will ultimately provide most of our energy. I also recommend R&D funding for bulk electricity storage, such as compressed air. America's largest fossil fuel resource is coal; we will rely on coal for much of our energy in the coming decades. In particular, coal will continue to provide most baseload electricity generation.

It is essential that demonstration coal plants with carbon capture be built to improve the technology and that we show that massive underground injection of carbon-dioxide in a range of geological strata can sequester the carbon dioxide without leakage. The Section 114 incentives are at the low end of what is required to demonstrate the commercial viability of sequestration.

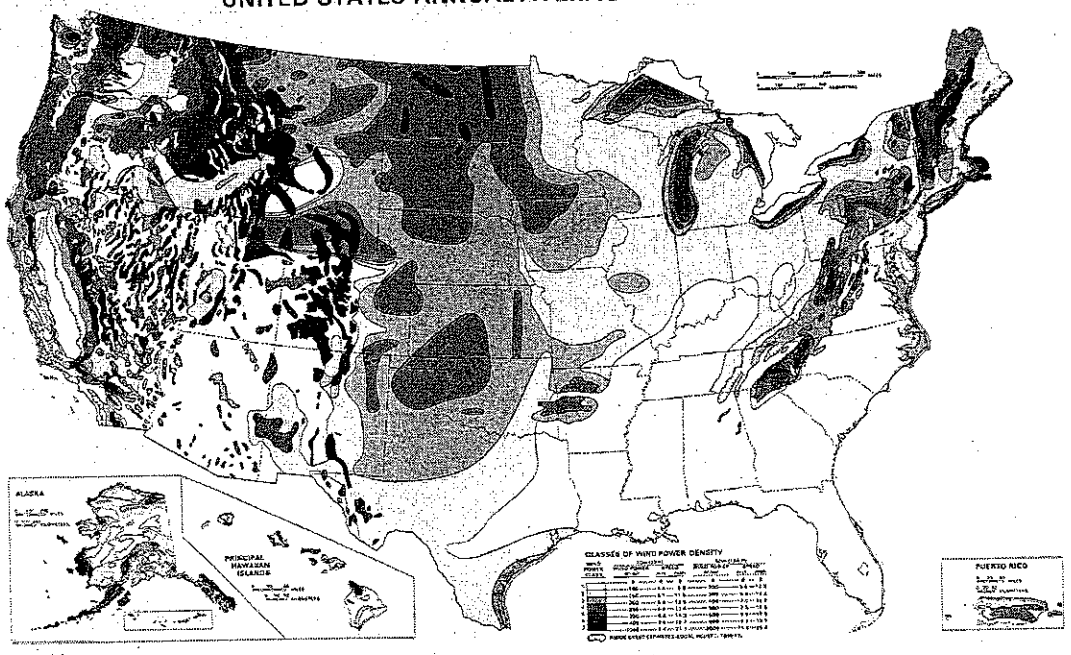
It is also essential that we build half a dozen nuclear plants using new technology to assess their costs and performance.

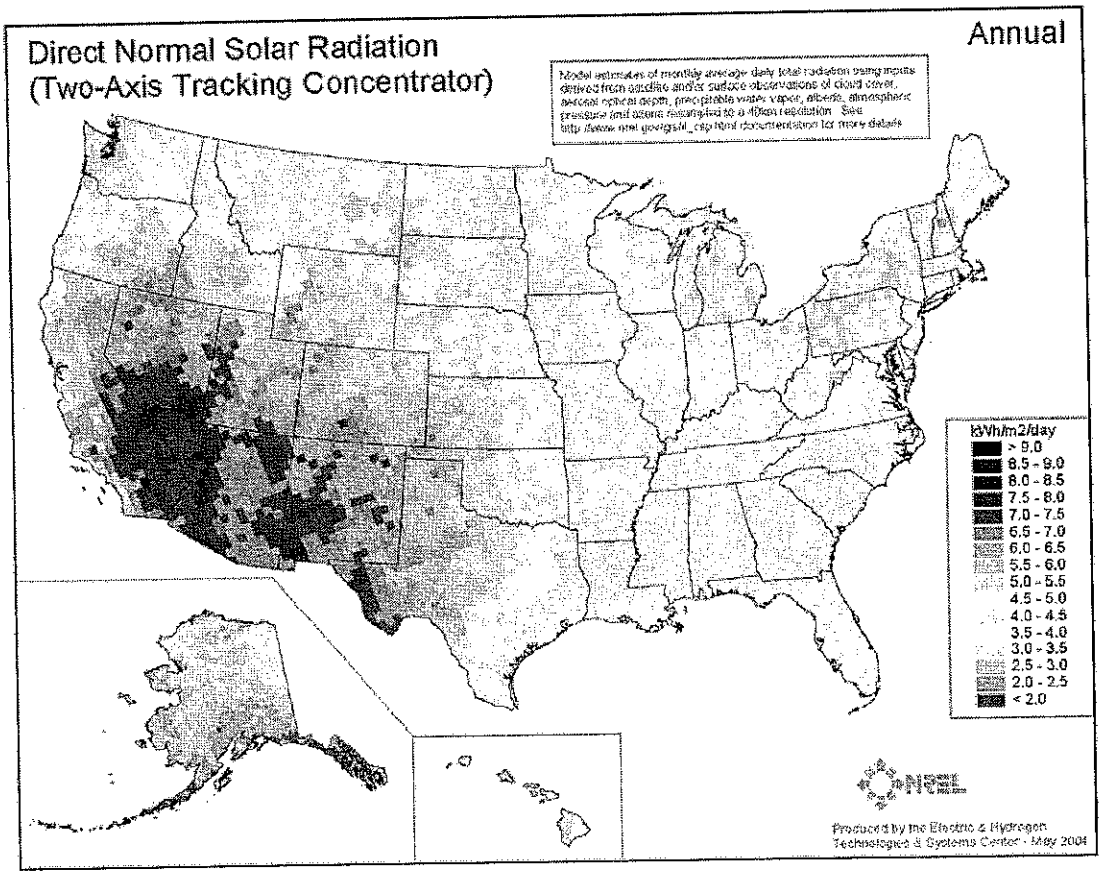
I commend the Committee and Congress for moving this most important topic forward. I hope that you will keep two principles in mind:

1. Focus on reducing carbon dioxide rather than singling out renewables as the answer. There are significant savings from letting all technologies compete in satisfying the goals of lowering greenhouse gas emissions, increasing energy security, and improving sustainability, ensuring that energy prices are not so high that they derail the economy.
2. Ensure that efficiency gains, in generating electricity, as well as transmitting and distributing it, and in using it, can count in any low-carbon legislative mandate, such as Sec. 231 of the discussion draft.

Thank you for the opportunity to testify on this important legislation. I would be happy to answer any questions.

UNITED STATES ANNUAL AVERAGE WIND POWER

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NREL
Produced by the Electric & Hydrogen Technologies & Systems Center - May 2004

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He is Executive Director of the Carnegie Mellon Electricity Industry Center, the largest engineering-business center focused on the electricity industry. The Carnegie Mellon Electricity Industry Center is supported by grants from the Alfred P. Sloan Foundation and the Electric Power Research Institute, with contributions from a large number of government agencies, organizations, and companies.

He is the author of more than fifty peer reviewed scientific publications, and author of several books and book sections. He has received research support from a wide range of federal and state agencies, as well as foundations, nongovernmental organizations, and companies.

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Wind-Turbine NOISE

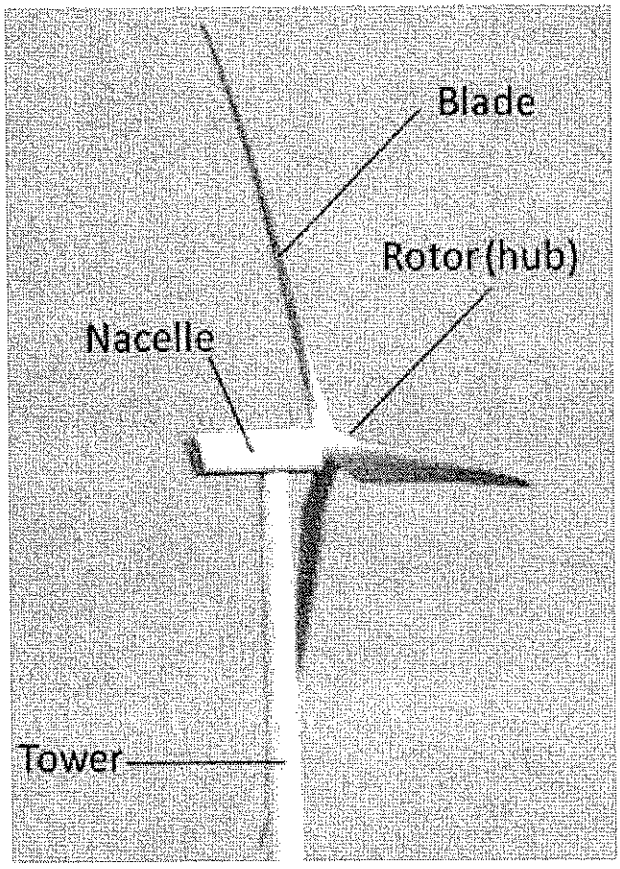
What Audiologists Should Know

BY JERRY PUNCH, RICHARD JAMES, AND DAN PABST

Noise from modern wind turbines is not known to cause hearing loss, but the low-frequency noise and vibration emitted by wind turbines may have adverse health effects on humans and may become an important community noise concern.

Most of us would agree that the modern wind turbine is a desirable alternative for producing electrical energy. One of the most highly touted ways to meet a federal mandate that 20 percent of all energy must come from renewable sources by 2020 is to install large numbers of utility-scale wind turbines. Evidence has been mounting over the past decade, however, that these utility-scale wind turbines produce significant levels of low-frequency noise and vibration that can be highly disturbing to nearby residents.

None of these unwanted emissions, whether audible or inaudible, are believed to cause hearing loss, but they are widely known to cause sleep disturbances. Inaudible components can induce resonant vibration in solids, liquids, and gases—including the ground, houses, and other building structures, spaces within those structures, and bodily tissues and cavities—that is potentially harmful to humans. The most extreme of these low-frequency (infrasonic) emissions, at frequencies under about 16 Hz, can easily penetrate homes. Some residents perceive the energy as sound, others experience it as vibration, and others are not aware of it at all. Research is beginning to show that, in addition to sleep disturbances, these emissions may have other deleterious consequences on health. It is for these reasons that wind turbines are becoming an important community health issue, especially when hosted in quiet rural communities that have no prior experience with industrial noise or urban hum.



Major components of a modern wind turbine.

The people most susceptible to disturbances caused by wind turbines may be a small percentage of the total exposed population, but for them the introduction of wind turbines in their communities is not something to which they can easily become acclimated. Instead, they become annoyed, uncomfortable, distressed, or ill. This problem is increasing as newer utility-scale wind turbines capable of generating 1.5-5 MWatts of electricity or more replace the older turbines used over the past 30 years, which produced less than 1 MWatt of power. These large wind turbines can have hub heights that span the length of a football field and blade lengths that span half that distance. The increased size of these multi-MWatt turbines, especially the blades, has been associated with complaints of adverse health effects (AHEs) that cannot be explained by auditory responses alone.

For this article, we reviewed the English-language, peer-reviewed literature from around the world on the topic of wind-turbine noise and vibration and their effects on humans. In addition, we used popular search engines to locate relevant online trade journals, books, reference sources, government regulations, and acoustic and vibration standards. We also consulted professional engineers and psychoacousticians regarding their unpublished ideas and research.

Sources of Wind-Turbine Noise and Vibration

Physically, a modern wind turbine consists of a tower; a rotor (or hub); a set of rotating blades—usually three, located upwind to the tower; and a nacelle, which is an enclosure containing a gearbox, a generator, and

computerized controls that monitor and regulate operations (FIGURE 1). Wind speed can be much greater at hub level than at ground level, so taller wind towers are used to take advantage of these higher wind speeds. Calculators are available for predicting wind speed at hub height, based on wind speeds at 10 meter weather towers, which can easily be measured directly.

Mechanical equipment inside the nacelle generates some noise, but at quieter levels than older turbines. This mechanical sound is usually considered of secondary importance in discussions of annoyance from today's turbines. The main cause of annoyance is an aerodynamic source created by interaction of the turning blades with the wind. With optimal wind conditions, this aerodynamic noise is steady and commonly described as an airplane overhead that never leaves.

When wind conditions are not optimal, such as during turbulence caused by a storm, the steady sounds are augmented by fluctuating aerodynamic sounds. Under steady wind conditions, this interaction generates a broadband whooshing sound that repeats itself about once a second and is clearly audible. Many people who live near the wind turbine find this condition to be very disturbing.

The whooshing sound comes from variations of air turbulence from hub to blade tip and the inability of the turbine to keep the blades adjusted at an optimal angle as wind direction varies. The audible portion of the whoosh is around 300 Hz, which can easily penetrate walls of homes and other buildings. In addition, the rotating blades create energy at frequencies as low as 1–2 Hz (the blade-passage frequency), with overtones of up to about 20 Hz. Although some of this low-frequency energy is audible to some people with sensitive hearing, the energy is mostly vibratory to people who react negatively to it.

Adverse Health Effects of Wind-Turbine Noise

Hubbard and Shepherd (1990), in a technical paper written for the National Aeronautics and Space Administration (NASA), were the first to report in depth on the noise and vibration from wind turbines. Most of the relevant research since that time has been conducted by European investigators, as commercial-grade (utility-scale) wind turbines have existed in Europe for many decades. Unfortunately, the research and development done by wind-turbine manufacturers is proprietary and typically has not been shared with the public, but reports of the distressing effects on people living near utility-scale wind turbines in various parts of the world are becoming more common.

Studies carried out in Denmark, The Netherlands, and Germany (Wolsink and Sprengers, 1993; Wolsink et al, 1993), a Danish study (Pedersen and Nielsen, 1994), and two Swedish studies (Pedersen and Persson Waye, 2004, 2007) collectively indicate that wind turbines differ from other sources of community noise in several respects. These investigators confirm the findings of earlier research that amplitude-modulated sound is more easily perceived and more annoying than constant-level sounds (Bradley, 1994; Bengtsson et al, 2004) and that sounds that are unpredictable and uncontrollable are more annoying than other sounds (Geen and McCown, 1984; Hatfield et al, 2002).

Annoyance from wind-turbine noise has been difficult to characterize by the use of such psychoacoustic parameters as sharpness, loudness, roughness, or modulation (Persson Waye and Öhrström, 2002). The extremely low-frequency nature of wind-turbine noise, in combination with the fluctuating blade sounds, also means that the noise is not easily masked by other environmental sounds.

Pedersen et al (2009), in a survey conducted in The Netherlands on 725 respondents, found that noise from

wind turbines is more annoying than transportation or industrial noises at comparable levels, measured in dBA. They noted that annoyance from turbine sounds at 35 dBA corresponds to the annoyance reported for other common community-noise sources at 45 dBA. Higher visibility of the turbines was associated with higher levels of annoyance, and annoyance was greater when attitudes toward the visual impact of the turbines on the landscape were negative. However, the height of wind turbines means that they are also most clearly visible to the people closest to them and those who also receive the highest sound levels. Thus, proximity of the receiver to wind turbines makes it difficult to determine whether annoyance to the noise is independent of annoyance to the visual impact. Pedersen et al (2009) also found that annoyance was substantially lower in people who benefitted economically from having wind turbines located on their property.

Among audiologists and acousticians, it has been understood for many decades that sufficiently intense and prolonged exposure to environmental noise can cause hearing impairment, annoyance, or both. In essence, the view has been *what* you can hear can hurt you. In the case of wind turbines, it seems that *what* you can't hear can also hurt you. Again, there is no evidence that noise generated by wind turbines, even the largest utility-scale turbines, causes hearing loss. But there is increasingly clear evidence that audible and low-frequency acoustic energy from these turbines is sufficiently intense to cause extreme annoyance and inability to sleep, or disturbed sleep, in individuals living near them.

Jung and colleagues (2008), in a Korean study, concluded that low-frequency noise in the frequency range above 30 Hz can lead to psychological complaints and that infrasound in the frequency range of 5–8 Hz can cause complaints due to rattling doors and windows in homes.

The energy generated by large wind turbines can be especially disturbing to the vestibular systems of some people, as well as cause other troubling sensations of the head, chest, or other parts of the body. Dr. Nina Pierpont (2009), in her definitive natural experiment on the subject, refers to these effects as Wind-Turbine Syndrome (WTS). TABLE 1 lists the symptoms that, in various combinations, characterize WTS. Although hearing impairment is not one of the symptoms of WTS, audiologists whose patients report these symptoms should ask them if they live near a wind turbine.

It is well known that sleep deprivation has serious consequences, and we know that noncontinuous sounds and nighttime sounds are less tolerable than continuous and daytime sounds. Somewhat related effects, such as cardiac arrhythmias, stress, hypertension, and headaches have also been attributed to noise or vibration from wind turbines, and some researchers are referring to these effects as Vibroacoustic Disease, or VAD (Castelo Branco, 1999; Castelo Branco and Alves-Pereira, 2004). VAD is described as occurring in persons who are exposed to high-level (>90 dB SPL) infra- and low-frequency noise (ILFN), under 500 Hz, for periods of 10 years or more. It is believed to be a systemic pathology characterized by direct tissue damage to a variety of bodily organs and may involve abnormal proliferation of extracellular matrices.

Alves-Pereira and Castelo Branco (2007) reported on a family who lived near wind turbines and showed signs of VAD. The sound levels in the home were less than 60 dB SPL in each 1/3–octave band below 100 Hz. We have measured unweighted sound levels ranging from 60 to 70 dB Leq (averaged over 1 minute) in these low-frequency bands in Ontario homes of people reporting AHEs from wind turbines. A spectral analysis of sounds emitted at a Michigan site revealed that unweighted peak levels at frequencies under 5 Hz exceeded 90 dB SPL (Wade Bray, pers. comm., 2009).

Table 1. Core Symptoms of Wind-Turbine Syndrome

1	Sleep disturbance
2	Headache
3	Visceral Vibratory Vestibular Disturbance (VVVD)
4	Dizziness, vertigo, unsteadiness
5	Tinnitus
6	Ear pressure or pain
7	External auditory canal sensation
8	Memory and concentration deficits
9	Irritability, anger
10	Fatigue, loss of motivation

Source: Pierpont, 2009

Similar observations have been made in studies of people who live near busy highways and airports, which also expose people to low-frequency sounds, both outdoors and in their homes. Evidence is insufficient to substantiate that typical exposures to wind-turbine noise, even in residents who live nearby, can lead to VAD, but early indications are that there are some more-vulnerable people who may be susceptible. Because ILFN is not yet recognized as a disease agent, it is not covered by legislation, permissible exposure levels have not yet been established, and dose-response relationships are unknown (Alves-Pereira, 2007).

As distinguished from VAD, Pierpont's (2009) use of the term Wind-Turbine Syndrome appears to emphasize a constellation of symptoms due to stimulation, or overstimulation, of the vestibular organs of balance due to ILFN from wind turbines (see TABLE 1). One of the most distinctive symptoms she lists in the constellation of symptoms comprising WTS is Visceral Vibratory Vestibular Disturbance (VVVD), which she defines as "a sensation of internal quivering, vibration, or pulsation accompanied by agitation, anxiety, alarm, irritability, rapid heartbeat, nausea, and sleep disturbance" (p. 270).

Drawing on the recent work of Balaban and colleagues (i.e., Balaban and Yates, 2004), Pierpont describes the close association between the vestibular system and its neural connections to brain nuclei involved with balance processing, autonomic and somatic sensory inflow and outflow, the fear and anxiety associated with vertigo or a sudden feeling of postural instability, and aversive learning. These neurological relationships give credence to Pierpont's linkage of the symptoms of VVVD to the vestibular system.

Todd et al (2008) demonstrated that the resonant frequency of the human vestibular system is 100 Hz, concluding that the mechano-receptive hair cells of the vestibular structures of the inner ear are remarkably sensitive to low-frequency vibration and that this sensitivity to vibration exceeds that of the cochlea. Not only is 100 Hz the frequency of the peak response of the vestibular system to vibration, but it is also a frequency at which a substantial amount of acoustic energy is produced by wind turbines. Symptoms of both VAD and VVVD can presumably occur in the presence of ILFN as a result of disruptions of normal paths or structures that mediate the fine coordination between living tissue deformation and activation of signal transducers; these disruptions can lead to aberrant mechano-electrical coupling that can, in turn, lead to conditions such as heart arrhythmias (Ingber, 2008). Ultimately, further research will be needed to sort out the commonalities and differences among the symptoms variously described in the literature as VAD, VVVD, and WTS.

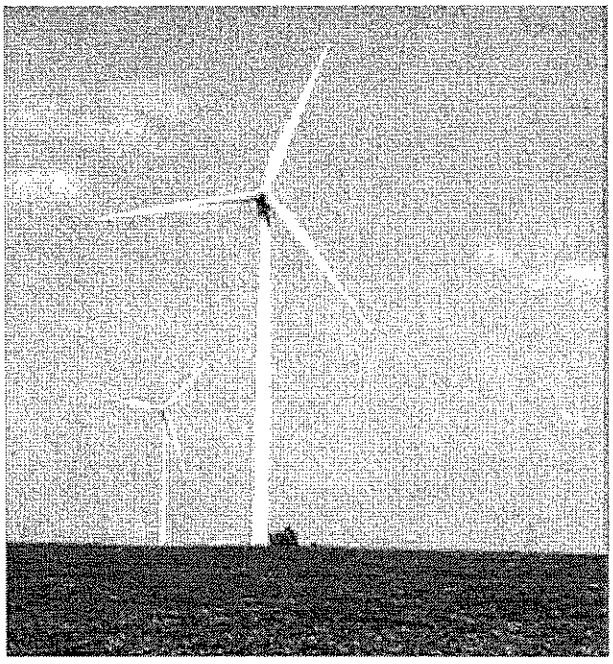
Dr. Geoff Leventhall, a British scientist, and his colleagues (Waye et al, 1997; Leventhall, 2003, 2004) have documented the detrimental effects of low-frequency noise exposure. They consider it to be a special environmental noise, particularly to sensitive people in their homes. Waye et al (1997) found that exposure to dynamically modulated low-frequency ventilation noise (20–200 Hz)—as opposed to midfrequency noise exposure—was more bothersome, less pleasant, impacted work performance more negatively, and led to lower social orientation.

Leventhall (2003), in reviewing the literature on the effects of exposure to low-frequency noise, found no evidence of hearing loss but substantial evidence of vibration of bodily structures (chest vibration), annoyance (especially in homes), perceptions of unpleasantness (pressure on the eardrum, unpleasant perception within the chest area, and a general feeling of vibration), sleep disturbance (reduced wakefulness), stress, reduced performance on demanding

verbal tasks, and negative biological effects that included quantitative measurements of EEG activity, blood pressure, respiration, hormone production, and heart rate.

Regarding work performance, reviewed studies indicated that dynamically modulated low-frequency noise, even when inaudible to most individuals, is more difficult to ignore than mid- or high-frequency noise and that its imperviousness to habituation leads to reduced available information-processing resources. Leventhall hypothesized that low-frequency noise, therefore, may impair work performance. More recently, as a consultant on behalf of the British Wind Energy Association (BWEA), the American Wind Energy Association (AWEA), and the Canadian Wind Energy Association (CANWEA), Leventhall (2006) changed his position, stating that although wind turbines do produce significant levels of low-frequency sound, they do not pose a threat to humans—in effect reverting to the notion that *what* you can't hear can't hurt you.

According to the World Health Organization guidelines (WHO, 2007), observable effects of nighttime, outdoor wind-turbine noise do not occur at levels of 30 dBA or lower. Many rural communities have ambient, nighttime sound levels that do not exceed 25 dBA. As outdoor sound levels increase, the risk of AHEs also increases, with the most vulnerable being the first to show its effects. Vulnerable populations include elderly persons; children, especially those younger than age six; and people with pre-existing medical conditions, especially if sleep is affected. For outdoor sound levels of 40 dBA or higher, the WHO states that there is sufficient evidence to link prolonged exposure to AHEs. While the WHO identifies long-term, nighttime audible sounds over 40 dBA outside one's home as a cause of AHEs, the wind industry commonly promotes 50 dBA as a safe limit for nearby homes and properties. Recently, a limit of 45 dBA has been proposed for new wind projects in Canada (Keith et al, 2008).



Utility-scale wind turbines located in Huron County, Michigan.

Much of the answer as to why the wind industry denies that noise is a serious problem with its wind turbines is because holding the noise to 30 dBA at night has serious economic consequences. The following quotation by Upton Sinclair seems relevant here: "It is difficult to get a man to understand something when his salary depends upon his not understanding it" (Sinclair, 1935, reprinted 1994, p. 109).

In recent years, the wind industry has denied the validity of any noise complaints by people who live near its utility-scale wind turbines. Residents who are leasing their properties for the siting of turbines are generally so pleased to receive the lease payments that they seldom complain. In fact, they normally are required to sign a leasing agreement, or gag clause, stating they will not speak or write anything unfavorable about the turbines. Consequently, complaints, and sometimes lawsuits, tend to be initiated by individuals who live near property on which wind turbines are sited, and not by those who are leasing their own property. This situation pits neighbor against neighbor, which leads to antagonistic divisions within communities.

Measurement of Wind-Turbine Noise

It is important to point out that the continued use of the A-weighting scale in sound-level meters is the basis for misunderstandings that have led to acrimony between advocates and opponents of locating wind turbines in residential areas. The dBA scale grew out of the desire to incorporate a function into the measurement of sound pressure levels of environmental and industrial noise that is the inverse of the minimum audibility curve (Fletcher and Munson, 1933) at the 40-phon level. It is typically used, though, to specify the levels of noises that are more intense, where the audibility curve becomes considerably flattened, obviating the need for A-weighting. It is mandated in various national and international standards for measurements that are compared to damage-risk criteria for hearing loss and other health effects. The A-weighted scale in sound-level meters drastically reduces

sound-level readings in the lower frequencies, beginning at 1000 Hz, and reduces sounds at 20 Hz by 50 dB.

For wind-turbine noise, the A-weighting scale is especially ill-suited because of its devaluation of the effects of low-frequency noise. This is why it is important to make C-weighted measurements, as well as A-weighted measurements, when considering the impact of sound from wind turbines. Theoretically, linear-scale measurements would seem superior to C-scale measurements in wind-turbine applications, but linear-scale measurements lack standardization due to failure on the part of manufacturers of sound-level meters to agree on such factors as low-frequency cutoff and response tolerance limits. The Z-scale, or zero-frequency weighting, was introduced in 2003 by the International Electro-technical Commission (IEC) in its Standard 61672 to replace the flat, or linear, weighting used by manufacturers in the past.

State of Michigan Siting Guidelines

Michigan's siting guidelines (State of Michigan, 2008) will be used as an example of guidelines that deal only in a limited way with sound. These guidelines refer to earlier, now outdated, WHO and Environmental Protection Agency (EPA) guidelines to support a noise criterion that SPLs cannot exceed 55 dBA at the adjacent property line. This level is allowed to be exceeded during severe weather or power outages, and when the ambient sound level is greater than 55 dBA, the turbine noise can exceed that higher background sound level by 5 dB. These levels are about 30 dB above the nighttime levels of most rural communities. When utility-scale turbines were installed in Huron County, Michigan, in May 2008, the WHO's 2007 guidelines that call for nighttime, outside levels not to exceed 30 dBA were already in place. Based on measurements made by the authors, these turbines produce 40–45 dBA sound levels at the perimeter of a 1,000 ft radius under typical weather conditions, and the additive effects of multiple turbines produce higher levels. Many of the turbines have been located close enough to homes to produce very noticeable noise and vibration.

Kamperman and James (2009) have offered recommendations for change in the State of Michigan guidelines (2008) for wind turbines. Some of the more pertinent details of the Michigan siting guidelines are shown in the left-hand column of TABLE 2. The state of Michigan permits sound levels that do not exceed 55 dBA or L90 + 5 dBA, whichever is greater, measured at the property line closest to the wind-energy system. These guidelines make no provisions to limit low-frequency sounds from wind-turbine operations.

In consideration of the current WHO guidelines (2007), measurements made by the authors in Huron County, Michigan, indicate that the current Michigan guidelines do not appear adequate to protect the public from the nuisances and known health risks of wind-turbine noise. In fact, these guidelines appear to be especially lenient

Table 2. Current and Proposed Wind-Turbine Siting Guidelines

Current Michigan Guidelines*	Alternative Proposed Guidelines**
Sound level cannot exceed 55 dBA or L90 + 5 dBA, whichever is greater.	Operating LAeq is not to exceed the background LA90 +5 dBA, where LA90 is measured during a preconstruction noise study at the quietest time of night. Similar dBC limits should also be applied.
Limits apply to sound levels measured at homes (as stated in Huron County Ordinance).	Limits apply to sound levels measured at property lines, except that turbine sounds cannot exceed 35 dBA at any home.
No provisions are made for limiting low-frequency sounds from wind-turbine operations.	LCeq-LA90 cannot exceed 20 dB at receiving property, e.g., LCeq (from turbines) minus (LA90 [background] + 5) < 20 dB, and is not to exceed 55 LCeq from wind turbines (60 LCeq for properties within one mile of major heavily trafficked roads).

*Source: State of Michigan, 2008

**Source: Kamperman and James, 2009

in terms of tolerable sound levels. Sound levels that approach 20 dBA higher than natural ambient levels are considered unacceptable in most countries; Michigan permits 30 dBA increases.

In considering the health and well-being of people living near wind-turbine projects, the changes recommended by Kamperman and James (2009) would abandon the 55 dBA limit in favor of the commonly accepted criteria of L90 + 5 dBA, for both A- and C-scale readings, where L90 is the preconstruction ambient level. These recommendations also include a prohibition against any wind-turbine-related sound levels exceeding 35 dBA on receiving properties that include homes or other structures in which people sleep. Additional protections against low-frequency sound are given in the right-hand column of TABLE 2. These recommended provisions would protect residents by limiting the difference between C-weighted Leq during turbine operation and the quietest A-weighted pre-operation background sound levels, plus 5 dB, to no more than 20 dB at the property line. This level should not exceed 55 dB Leq on the C scale, or 60 dB Leq for properties within one mile of major heavily trafficked roads, which sets a higher tolerance for communities that tend to experience slightly noisier conditions.

People living near wind turbines may experience sleep disturbance.

Implementation of the recommendations of Kamperman and James would result in siting wind turbines differently than what is currently planned for future wind-turbine projects in Michigan. This change would result in sound levels at nearby properties that are much less noticeable, and much less likely to cause sleep deprivation, annoyance, and related health risks. These sound-level measurements should be made by independent acoustical engineers or knowledgeable audiologists who follow ANSI guidelines (1993, 1994) to ensure fair and accurate readings, and not by representatives of the wind industry.

People living within a mile of one or more wind turbines, and especially those living within a half mile, have frequent sleep disturbance leading to sleep deprivation, and sleep disturbances are common in people who live up to about 1.25 miles away. This is the setback distance at which a group of turbines would need to be in order not to be a nighttime noise disturbance (Kamperman and James, 2009). It is also the setback distance used in several other countries that have substantial experience with wind turbines, and is the distance at which Pierpont (2009) found very few people reporting AHEs.

A study conducted by van den Berg (2003) in The Netherlands demonstrated that daytime levels cannot be used to predict nighttime levels and that residents within 1900 mile (1.18 mile) of a wind-turbine project expressed annoyance from the noise. Pierpont (2009) recommends baseline minimum setbacks of 2 kilometers (1.24 mile) from residences and other buildings such as hospitals, schools, and nursing homes, and longer setbacks in mountainous terrain and when necessary to meet the noise criteria developed by Kamperman and James (2009).

In a panel review report, the American Wind Energy Association (AWEA) and Canadian Wind Energy Association (CANWEA) have objected to setbacks that exceed 1 mile (Colby et al, 2009). A coalition of independent medical and acoustical experts, the Society for Wind Vigilance (2010), has provided a recent rebuttal to that report. The society has described the panel review as a typical product of industry-funded white papers, being neither authoritative nor convincing. The society accepts as a medical fact that sleep disturbance, physiological stress, and psychological distress can result from exposure to wind-turbine noise.

Wind turbines have different effects on different people. Some of these effects are somewhat predictable based on financial compensation, legal restrictions on free speech included in the lease contracts with hosting landowners, and distance of the residence from wind projects, but they are sometimes totally unpredictable. Planning for wind projects needs to be directed not only toward benefitting society at large but also toward protecting the individuals living near them. We believe that the state of Michigan, and other states that have adopted similar siting guidelines for wind turbines, are not acting in the best interest of all their citizens and need to revise their siting guidelines to protect the public from possible health risks and loss of property values, as well as reduce complaints about noise annoyance.

Wind-utility developers proposing new projects to a potential host community are often asked if their projects will cause the same negative community responses that are heard from people living in the footprint of operating projects. They often respond that they will use a different

type of wind turbine or that reports of complaints refer to older-style turbines that they do not use. In our opinion, these statements should usually be viewed as diversionary.

Finally, it is important to note that there is little difference in noise generated across makes and models of modern utility-scale, upwind wind turbines once their power outputs are normalized. Kamperman (pers. comm., 2009), after analyzing data from a project funded by the Danish Energy Authority (Søndergaard and Madsen, 2008), has indicated that when the A-weighted sound levels are converted to unweighted levels, the low-frequency energy from industrial wind turbines increases inversely with frequency at a rate of approximately 3 dB per octave to below 10 Hz (the lowest reported frequency). Kamperman has concluded that the amount of noise generated at low frequencies increases by 3–5 dB for every MW of electrical power generated. Because turbines are getting larger, this means that future noise problems are likely to get worse if siting guidelines are not changed.

Conclusion

Our purpose in this article has been to provide audiologists with a better understanding of the types of noise generated by wind turbines, some basic considerations underlying sound-level measurements of wind-turbine noise, and the adverse health effects on people who live near these turbines. In future years, we expect that audiologists will be called upon to make noise measurements in communities that have acquired wind turbines, or are considering them. Some of us, along with members of the medical profession, will be asked to provide legal testimony regarding our opinions on the effects of such noise on people. Many of us will likely see clinical patients who are experiencing some of the adverse health effects described in this article.

As a professional community, audiologists should become involved not only in making these measurements to corroborate the complaints of residents living near wind-turbine projects but also in developing and shaping siting guidelines that minimize the potentially adverse health effects of the noise and vibration they generate. In these ways, we can promote public health interests without opposing the use of wind turbines as a desirable and viable alternative energy source.

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Acknowledgments. We wish to thank the many families and residents of Huron County, Michigan, with whom we spent many hours discussing a variety of issues related to their concerns about the noise and vibration from nearby wind turbines. Their involvement, and especially their compelling stories, provided information and encouragement that led us to the belief that this work should be shared with members of the audiology profession.

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TOWN OF PHILLIPS, MAINE, WIND ENERGY FACILITY ORDINANCE

1.0 **Title.** This ordinance shall be known as the Town of Phillips, Maine, Wind Energy Facility Ordinance.

2.0 **Purpose**. The purpose of this Ordinance is to protect the health, safety, and general welfare of the residents and property owners of Phillips by establishing reasonable and uniform regulations for Wind Energy Facilities (WEFs).

3.0 **Authority.** This Ordinance is adopted pursuant to the enabling provisions of Article VIII, part 2, Section 1 of the Maine Constitution; the provisions of 30-A M.R.S.A. Section 3001 (Home Rule), and the provisions of the Planning and Land Use Regulation Act 30-A M.R.S.A. Section 4312, *et seq.*

3.1 **Conflicts with Other Ordinances, Laws and Regulations**. If there is a conflict between provisions in this Ordinance or between a provision in this Ordinance and a provision of any other ordinance, regulation, or statute from any jurisdiction, the more restrictive provision shall apply.

3.2 **Validity and Severability**. Should any section or provision of this Ordinance be declared by the courts to be invalid, such a decision shall not invalidate any other section or provision of the Ordinance.

4.0 **Effective Date.**

4.1 This Ordinance shall become effective on the date of its passage.

4.2 If this Ordinance is enacted within 90 days after the expiration of an Ordinance entitled "Wind Facility Moratorium Ordinance, Phillips, Maine" (the Moratorium) adopted February 25, 2010, the effective date of this Ordinance shall be retroactive to the expiration date of the Moratorium.

5.0 **Applicability.** This ordinance applies to all Wind Energy Facilities and Meteorological Towers in the Town of Phillips proposed to be constructed or operated after the effective date of this Ordinance.

6.0 **Definitions**.

Acoustic Hazard. Annoyance and hazard (health, property values) owing to the sound produced by a WEF.

Applicant. Person, or persons or entity applying for a Meteorologicl Tower permit or Wind Energy Facility permit to the Town of Phillips Planning Board.

CEO means Town of Phillips Code Enforcement Officer

Covenants. A legal agreement, convention or promise by two or more parties by deed in writing, signed, and delivered, by which one of the parties pledges himself to the other that something is done, or shall be done, or shall not be done, or stipulates the truth of certain facts. For this Ordinance this legal agreement shall contain stipulations required and put forth herein and shall be a covenant running with land.

D = Distance measured in feet.

Debris Hazard. Hazard owing to the possibility that the parts of a WEF, or material (ice or other debris) accumulated on its rotating elements, could be dislodged and fall or be thrown some distance onto surrounding property.

Decibel (dB) means 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."

dB(A) or dBA means the abbreviation designating both the unit of measure sound level, the decibel, and the mode of measurement that uses the A-weighting of a sound level meter.

dB(C) or dBC means the abbreviation designating both the unit of measure sound level, the decibel, and the mode of measurement that uses the C-weighting of a sound level meter.

Engineering drawing. Rendering of an object or land area using drafting instruments or CAD showing all critical features and appropriate dimensions to describe the subject.

Falling Hazard. Hazard owing to the possibility that the elements of a WEF could fall onto the surrounding property.

Flicker Hazard. Annoyance and hazard (health, property values) owing to the shadows produced by the rotating elements of a WEF.

Geological Instability. Can include possible fault lines, areas of potential landslides, heavily fractured or unstable bedrock that would cause the tower and/or structure to fall or collapse.

Ho. Height overall. Height of a Meteorological Tower or WEF Turbine from the base of the tower pad to the highest point on the structure or the highest point of any rotating element, whichever is higher.

Inhabitant means one who resides actually and permanently in a given place, and has his domicile there.

LAeq means the energy-equivalent sound pressure level measured in decibels with a sound level meter set for A-weighting, "Fast" response over a measurement period; expressed as LAeq or Leq in dBA.

Lc = Criterion sound level, dBA, set to 30 dBA, consistent with the World Health Organization's Night Noise Guideline 2009, to prevent biological effects, to protect public health in risk groups including children, elderly and those with disease or pre-existing health conditions and, to minimize sleep disturbance at night; a criterion level of 30 decibels (LAeq) for continuous intrusive noise as the level above which biological effects, medical impacts on sensitive populations, and sleep disturbance were found with sufficient evidence under comprehensive medical and scientific peer review by World Health Organization.

LCeq means the energy-equivalent sound pressure level measured in decibels with a sound level meter set for C-weighting, "Fast" response over a measurement period; expressed as LCeq or Leq in dBC.

Lp = Sound Pressure Level measured in dBA in accordance with American National Standards S12.9 – Part 3, "Quantities and Procedures for Description and Measurement of Environmental Sound" or ANSI S12.18.

Ls = Safety Factor, shall be 2 dBA unless otherwise authorized by the Town Planning Board, to account for variations in meter total instrument response.

Lu = Uncertainty factor, shall be 5 dBA unless otherwise authorized by the Town Planning Board, based on measured maximum hourly sound levels at wind turbine facilities in Maine compared to predicted sound levels and the resulted required corrections of 5 dB.

Lw = Manufacturer's Guaranteed Maximum Sound Power Level, in dBA re 1pW, under any operating conditions, including high winds, yawing, furling, and power outages, whether electrically loaded or unloaded.

Maximum sound level (also Lmax) means the maximum sound pressure level measured in decibels with a sound level meter set for A-weighting, "Fast" meter response over a measurement period; expressed as Lmax in dBA.

Meteorological Tower (MT). Tower constructed to mount instruments at one or more heights above grade for the purpose of collecting wind or other meteorological data.

n = Number (quantity) of wind turbines, where the expression 4log(n) represents the change in sound level due to the increase in the number of turbines based on independent analysis of measured noise levels around wind turbine facilities in Maine, and -0.5 dB is required when converting from sound power level to sound pressure level assuming spherical spreading, for dimensions in feet.

Owner/Operator. The person or entity that is the legal owner of the WEF, including successors and assigns, and that has the authority and responsibility to operate the WEF on a day-to-day basis. An Owner/Operator must have the legal authority to represent and bind.

Property line. The imaginary line along the ground surface and the vertical extension of that line which constitutes a legally enforceable boundary which separates real property owned or controlled by owner(s) from contiguous real property owned or controlled by another person.

$S_{f/d}$. Falling and Debris Hazard setback requirement (ft)

S_c. Flicker Hazard setback requirement (ft)

S_s. Acoustic Hazard setback requirement (ft)

Sound level meter means an instrument for the measurement of sound levels conforming to ANSI type I or type II standards.

Sound pressure level means the level of a sound measured in dB units with a sound level meter which has a uniform (flat) response over the band of frequencies measured. Sound pressure levels are referenced to 20 micropascals; expressed as [sound level] dB re 20uPA.

Sound power level is calculated from a sound pressure level at a given distance by the formula Lw=Lp+20logD+0.5, dB re 10^{-12} W where Lp is measured in accordance with American National Standards S12.9 – Part 3, "Quantities and Procedures for Description and Measurement of Environmental Sound" or ANSI S12.18, or Lw=Lp-6+10log(4pi(D^2)), dB re 10^{-12} W where Lp is measured in accordance with AWEA/IEC 61400-11 using a 1-meter flat ground board. D is the distance from the source (typically the hub height plus ½ the rotor diameter).

Setback Area. The entire land base that falls within the Setback for a particular MT or WEF.

Setback. A distance measured horizontally in feet from the center axis of any WEF turbine or Meteorological Tower radially for 360 degrees.

Type 0: Micro Wind Energy Facility. One or more wind turbines, each with a nameplate capacity of less than 1 kW and a turbine height (measured to the top of an upright blade) of 35 feet or less.

Type 1: Small Wind Energy Facility. A single wind turbine with a nameplate capacity of 10 kW or less and a turbine height (measured to the top of an upright blade) of 80 feet or less.

Type 2: Intermediate Wind Energy Facility. A single wind turbine with a nameplate capacity of less than 100 kW and or a turbine height (measured to the top of an upright blade) of 150 feet or less.

Type 3: Large/Commercial Wind Energy Facility. A single wind turbine with a nameplate capacity of 100 kW or a turbine height (measured to the top of an upright blade) of more than 150 feet. Or a WEF composed of two or more turbines each with a nameplate capacity of 1 kW or more. Or a WEF (of any size or number of turbines) 25% or more of whose power is intended for sale or use by entities or persons other than the generator.

W means power in Watts.

Waiver. A legal decision that may be made by the Planning Board that grants the Covenantees and the Covenantors of a Covenant presented to the Board a right of waiving or relinquishing protection for them in this Ordinance as regards acoustic and flicker effects.

Wind Energy Facility (WEF). All equipment, structures, roads, and power lines that together form a system for the production of electrical power using ambient wind as a source of motive power.

Wind Energy Facility Turbine (WEFT). Any machine constructed to convert ambient wind energy to electromotive energy.

7.0 **Documents.**

7.1 **Documents cited in this Ordinance**

- Bureau of Land and Water Quality, Site Location Development Law, 38 M.R.S.A. §§481-490, with regulations 06-096 CMR 371-377
- Maine Erosion and Sediment Controls Best Management Practices, Bureau of Land and Water Quality, Maine Department of Environmental Protection, March 2003, DEP LW0588
- Night Noise Guidelines for Europe, World Health Organization, October 2009, ISBN 9789289041737
- Town of Phillips Comprehensive Plan dated March 25, 2005 and amended December 4, 2008
- Zoning Ordinance of the Municipality of Phillips, Maine adopted June 1974, amended February 2010

7.2 **Guidance Documents as aids to Applicant**

- 12 M.R.S., Sections 685-B,2-C, 4, and 4-B of the Commission's statutes; 35-A M.R.S., Ch. 34-A, Sections 3451, 3452, 3454, and 3455, and other applicable provisions of the Legislature statute, 12 M.R.S., Sections 681 through 689
- Maine Association of Wetland Scientists (MAWS): Vernal Pool Technical Committee (VPTC) 2010 Interim Vernal Pool Survey Protocol, April 2010
- Maine Endangered Species Act, State of Maine, Inland Fisheries and Wildlife Laws, 12 MRSA Part 13, Chapter 925, Subchapter 3, Endangered Species
- Management Guidelines, for Land Use In or Adjacent To Spring Salamander and Roaring Brook Mayfly Habitat Maine Department of Inland Fisheries and Wildlife, dated March 4, 2010
- Natural Resource Protection Act, 38 M.R.S.A. §§ 480-A through 480-BB, statute and application
- Public Law, 123rd Legislature, Second Regular Session, Chapter 533, H.P. 1390- L.D. 1952, An Act to Streamline the Administration of Significant Vernal Pool Habitat Protection

8.0 **Design, Manufacture, and Construction Standards**

8.1 The design and manufacture of all meteorological towers, all wind turbines, and all other components of a WEF shall conform to applicable national, state, and local standards for the wind industry, such as those established by the American National Standards Institute (ANSI), Underwriters Laboratories, and similar certifying organizations. All MTs and all components of a WEF shall conform to local, state, and national building codes.

8.2 **Meteorological towers (MT).** Meteorological towers must be under 200 feet in height, and must be designed so as not to require lighting. Guy wires are allowed but must be designed so as to limit Environmental Hazard to wildlife, especially birds and bats. For MTs connected with the potential development of commercial WEFs, a Decommissioning Bond will be required to ensure timely removal of the equipment.

8.3 No WEF Turbines or WEF components that are home-made or whose design has been altered except by the manufacturer shall be permitted except when necessary to facilitate mounting.

8.4 Underground power and transmission lines shall be buried at a depth consistent with state public utility engineering standards to prevent transient ground currents and stray voltage.

8.5 An application for a permit for a Type 3 WEF that will be connected to the Public Utility Grid shall include a Public Utility Grid Impact Statement documenting all anticipated changes to the public utility grid within

the Town of Phillips due to the WEF. The Statement shall be signed and approved by the Maine Public Utilities Commission and shall include proof of leases or rights of way for transmission lines, and an analysis of the residual capacity in the grid that will be available to other local generating projects after the construction of the WEF.

8.6 A WEFT with a nameplate capacity less than 1 kW shall be equipped with a braking system designed to limit rotor speed and prevent blade flutter.

8.7 A WEFT with a nameplate capacity equal to or greater than 1 kW but less than or equal to 10 kW shall be equipped with a redundant braking system that includes stall regulation.

8.8 A WEFT with a nameplate capacity of more than 10 kW shall be equipped with a redundant braking system that includes both aerodynamic over-speed controls (including variable pitch, tip, and other similar systems) and mechanical brakes. Mechanical brakes shall operate in fail-safe mode. Stall regulation shall not be considered a sufficient braking system for over-speed protection on WEFTs with a nameplate capacity of more than 10 kW.

8.9 WEFs shall be designed and sited to prevent the disruption or loss of emergency or private radio, telephone, television, or similar signals. Interference with such communications shall be grounds for ordering the immediate shut down of the WEF until the interference has been remedied.

8.10 The minimum distance between the ground and the blades of a WEF shall be 25 feet as measured at the lowest point in the arc of the blades.

8.11 WEFTs shall be mounted on monopole towers with no guy wires except that WEFTs with a nameplate capacity of under 1 kW may be mounted on structure roof tops.

8.12 The color of WEFTs and MTs shall be off-white or grey or some other unobtrusive color approved by the Town of Phillips Planning Board.

8.13 WEFs shall not be used to display signs or advertising except for signs at ground level identifying the turbine manufacturer, the WEF Owner/Operator, emergency contact information, and appropriate warnings as required by national, state, and local laws.

8.14 All construction activities must conform to the approved site plan, including any conditions of approval and changes approved by the Code Enforcement Officer and/or the Planning Board.

8.15 **Modification During Construction** If at any time it appears necessary or desirable to modify the approved plans before or during construction of the WEF, the Code Enforcement Officer, with assistance at the Applicant's expense from such staff, consultants or experts as the CEO deems appropriate, is authorized to approve minor modifications due to unforeseen circumstances such as encountering hidden outcrops of bedrock, natural springs, etc. The Code Enforcement Officer shall issue any approval under this section in writing and shall transmit a copy of the approval to the Selectmen and Planning Board. Revised plans shall be filed with the Planning Board for the record. For major modifications such as relocation of rights-of-way, relation of WEFTs, changes in grade by more than 1%, etc., the Applicant shall submit to the Planning board an amended plan for review and approval.

9.0 Public Health and Safety Standards

9.1 **Setback Standards.** All MTs and WEFs must be sited so as to satisfy the Setback Standards calculated in Table 1 for the following hazards:

- Falling and Debris Hazard
- Flicker Hazard
- Acoustic Hazard (See Table 2 for calculations of typical setback distances)

TABLE 1

SETBACK DISTANCE STANDARDS
ALL MEASUREMENTS AND DISTANCES IN FEET

SETBACK (FT)	METEOROLOGICAL TOWER	TYPE 0 & TYPE 1	TYPE 2	TYPE 3
FALLING & DEBRIS HAZARD	$S_{f/d}=H_o X1.5$ Where: $S_{f/d}$ Setback Distance H_o Height Overall	$S_{f/d}=H_o X1.5$ Where: $S_{f/d}$- Setback Distance H_o- Height Overall	$S_{f/d}=H_o X1.5$ Where: $S_{f/d}$- Setback Distance H_o- Height Overall	$S_{f/d}=H_o X1.5$ Where: $S_{f/d}$- Setback Distance H_o- Height Overall
FLICKER HAZARD	Not Applicable	$S_c=(H_o/.176)x1.5$ Where: S_c- Setback Distance H_o- Height Overall Not including 120° to 240° True	$S_c=(H_o/.176)x1.5$ Where: S_c- Setback Distance H_o- Height Overall Not including 120° to 240° True	Flicker Analysis Report
ACOUSTIC HAZARD	Not Applicable	$S_s=10^{((L_w+L_u+L_s+4log(n)-.5-30)/20)}$ Where:S_s- Setback Distance L_w- Manufacturer's Guaranteed Maximum Sound Power Level, in dBA re 1pW L_u- Uncertainty Factor = 5 L_s- Safety Factor = 2 n- No. of Turbines for one turbine 4log(n)=0	$Ss=10^{((L_w+L_u+L_s+4log(n)-.5-30)/20)}$ Where:S_s- Setback Distance L_w- Manufacturer's Guaranteed Maximum Sound Power Level, in dBA re 1pW L_u- Uncertainty Factor = 5 L_s- Safety Factor = 2 n- No. of Turbines for one turbine 4log(n)=0	$Ss=10^{((L_w+L_u+L_s+4log(n)-.5-30)/20)}$ Where:S_s- Setback Distance L_w- Manufacturer's Guaranteed Maximum Sound Power Level, in dBA re 1pW L_u- Uncertainty Factor = 5 L_s- Safety Factor = 2 n- No. of Turbines

TABLE 2

Acoustic Setback Distance in Feet

Property Line Criteria, dBA:	30
Uncertainty Factor, dBA:	5
Safety Factor, dBA:	2

Manufacturer's Guaranteed Maximum Sound Power Level, dBA re 1pW	Number of Wind Turbines									
	1	2	3	4	5	6	7	8	9	10
70	211	243	263	279	292	302	312	320	328	335
71	237	272	295	313	327	339	350	359	368	376
72	266	306	331	351	367	381	393	403	413	422
73	299	343	372	394	412	427	441	452	463	473
74	335	385	417	442	462	479	494	508	520	531
75	376	432	468	496	519	538	555	570	583	596
76	422	484	525	556	582	603	622	639	654	668
77	473	544	589	624	653	677	698	717	734	750
78	531	610	661	701	732	760	783	805	824	841
79	596	684	742	786	822	852	879	903	924	944
80	668	768	833	882	922	956	986	1,013	1,037	1,059
81	750	861	934	989	1,035	1,073	1,107	1,137	1,164	1,189
82	841	967	1,048	1,110	1,161	1,204	1,242	1,275	1,306	1,334
83	944	1,084	1,176	1,246	1,303	1,351	1,393	1,431	1,465	1,496
84	1,059	1,217	1,320	1,398	1,461	1,516	1,563	1,606	1,644	1,679
85	1,189	1,365	1,481	1,568	1,640	1,701	1,754	1,801	1,844	1,884
86	1,334	1,532	1,661	1,760	1,840	1,908	1,968	2,021	2,069	2,113
87	1,496	1,719	1,864	1,974	2,064	2,141	2,208	2,268	2,322	2,371
88	1,679	1,928	2,091	2,215	2,316	2,402	2,478	2,545	2,605	2,661
89	1,884	2,164	2,347	2,485	2,599	2,695	2,780	2,855	2,923	2,985
90	2,113	2,428	2,633	2,789	2,916	3,024	3,119	3,203	3,280	3,350
91	2,371	2,724	2,954	3,129	3,272	3,393	3,500	3,594	3,680	3,758
92	2,661	3,056	3,315	3,511	3,671	3,807	3,927	4,033	4,129	4,217
93	2,985	3,429	3,719	3,939	4,119	4,272	4,406	4,525	4,633	4,732
94	3,350	3,848	4,173	4,420	4,622	4,793	4,943	5,077	5,198	5,309
95	3,758	4,317	4,682	4,959	5,186	5,378	5,547	5,697	5,832	5,957
96	4,217	4,844	5,253	5,564	5,818	6,034	6,223	6,392	6,544	6,683
97	4,732	5,435	5,894	6,243	6,528	6,771	6,983	7,172	7,343	7,499
98	5,309	6,098	6,613	7,005	7,325	7,597	7,835	8,047	8,239	8,414
99	5,957	6,842	7,420	7,860	8,219	8,524	8,791	9,029	9,244	9,441
100	6,683	7,677	8,326	8,819	9,221	9,564	9,863	10,130	10,372	10,593
101	7,499	8,614	9,342	9,895	10,347	10,731	11,067	11,366	11,637	11,885
102	8,414	9,665	10,482	11,102	11,609	12,040	12,417	12,753	13,057	13,335
103	9,441	10,844	11,760	12,457	13,025	13,509	13,932	14,309	14,650	14,962
104	10,593	12,168	13,195	13,977	14,615	15,158	15,632	16,055	16,438	16,788
105	11,885	13,652	14,806	15,682	16,398	17,007	17,540	18,014	18,444	18,836
106	13,335	15,316	16,612	17,596	18,399	19,082	19,680	20,212	20,694	21,135
107	14,962	17,187	18,639	19,743	20,644	21,411	22,081	22,679	23,219	23,714
108	16,788	19,284	20,913	22,152	23,163	24,023	24,775	25,446	26,052	26,607
109	18,836	21,637	23,465	24,856	25,989	26,954	27,798	28,551	29,231	29,854
110	21,135	24,278	26,328	27,888	29,160	30,243	31,190	32,035	32,798	33,497
111	23,714	27,240	29,541	31,290	32,719	33,934	34,996	35,943	36,800	37,584
112	26,607	30,564	33,145	35,108	36,711	38,074	39,266	40,329	41,290	42,170
113	29,854	34,293	37,190	39,392	41,190	42,720	44,057	45,250	46,329	47,315
114	33,497	38,477	41,728	44,199	46,216	47,933	49,433	50,771	51,981	53,088
115	37,584	43,172	46,819	49,592	51,855	53,781	55,465	56,966	58,324	59,566

9.2 The applicant shall compute or look up, as appropriate, and graph the required setback for each hazard as a circle for a single unit or as a series of connected arcs for multiple units centered on each turbine and submitted with the required setback graphically superimposed to scale on town maps identifying lot owners and lot property lines.

9.3 **Acoustic Standards.** Sound levels due to the operation of the WEF shall not exceed 30 dBA or 50 dBC at property lines or structures in the Town of Phillips. Owner/Operators may request a waiver of these standards by means of written Covenants as specified in section 14.2.3 of this Ordinance.

9.3.1 Sound measurements shall be carried out at appropriate property lines or structures as soon as possible after the Town of Phillips Planning Board determines that a violation of the noise standards may have occurred.

9.3.2 All sound measurements shall be made by a professional acoustical engineer who is a Full Member of the Institute of Noise Control Engineering (INCE) or who possesses some comparable qualification. The engineer shall chosen by the Owner/Operator from a list provided by the Planning Board and paid by the Owner/Operator.

9.3.3 Except as specifically noted otherwise, sound measurements shall be conducted in compliance with the American National Standards Institute (ANSI) Standard S12.18-1994 "Outdoor Measurements of Sound Pressure."

9.3.4 Sound level meters and calibration equipment shall comply with the latest version of ANSI Standard S1.4 "Specifications for General Purpose Sound Level Meters," and shall have been calibrated at a recognized laboratory within one year before the sound measurements are carried out.

9.4 An Application for a permit to construct a Type 3 WEF with one or more turbines having a nameplate capacity of 100 kW or more shall include a Fire Prevention and Fire Fighting Plan that has been approved by the Town of Phillips Fire Department. The plan shall identify a response plan to address all potential WEF fire scenarios and include a list of hazardous materials that may be encountered.

9.5 The Owner/Operator of a Type 3 WEF with one or more turbines having a nameplate capacity of 100 kW or more shall ensure that the WEF complies with the following fire control and prevention measures and assumes responsibility for all associated incremental costs.

- Use of fireproof or fire resistant building materials and buffers as required by state law or the Phillips Fire Department.
- Incorporation of a self-contained fire protection system in the WEF turbine nacelle.
- Maintenance of firebreak areas, cleared of vegetation, as required by state law or the Phillips Fire Department.
- Provision for any additional fire fighting or rescue personnel, services, training, materials, and vehicles as may be required to deal with any emergency related to the WEF that is beyond the current capabilities of the Phillips Fire Department.

9.6 The Owner/Operator of all WEFs shall be responsible for compliance with all ordinances, regulations, and laws applicable to the generation, storage, cleanup, and disposal of hazardous materials connected with the WEF.

9.7 **Road and Property Risk Assessment**

9.7.1 An application for a permit to construct a Type 2 or Type 3 WEF shall include a Road and Property Risk Assessment that has been approved by the Town of Phillips Road Commissioner.

9.7.2 The Town of Phillips Planning Board shall require changes to the Road and Property Risk Assessment plan that it deems appropriate to protect public safety, to protect public and private property, and to address anticipated costs to the town.

9.7.3 A qualified third party engineer, chosen by the Applicant from a list provided by the Planning Board and paid by the Applicant, shall document road conditions prior to the construction of the WEF, and again within thirty days after construction is complete. Any road damage determined by the engineer to have been caused by the applicant or his contractors shall be promptly repaired at the applicant's expense.

9.7.4 The Town of Phillips may bond the roads in compliance with state regulations, and the bond is to be paid by the applicant prior to the transport of WEF components.

9.8 The Owner/Operator of the any WEF shall notify the Town of Phillips Planning Board of any "extraordinary event" within 24 hours after that event. Extraordinary events shall include but not be limited to tower collapse, catastrophic turbine failure, fires, leakage of hazardous materials, unauthorized entry into a tower base, thrown blade or hub, injury caused by the WEF, and any other event that affects the public health and safety of the town or its residents.

10.0 Environmental Standards

10.1 The siting and construction of all WEFs shall meet all the applicable standards of the Zoning Ordinance of the Municipality of Phillips, Maine and be consistent with the Town of Phillips Comprehensive Plan.

10.2 If required by the laws of the State of Maine, a Department of Environmental Protection Site Location of Development permit shall be obtained and submitted with an application for a WEF permit. If submitted, this permit shall be considered adequate evidence that sections 11.3 and 11.3.1 of this Ordinance have been satisfied.

10.3 **Environmentally Sensitive Areas**. The design, construction, and maintenance of a WEF shall protect all environmentally sensitive areas that may be affected by its siting. Such areas shall include but not limited to wetlands, vernal pools, seeps or springs, steep slopes (equal to or greater than 15%), watersheds, flood plains, significant habitat for wildlife, fish, and plants. An application for a Type 3 WEF permit shall demonstrate appropriate measures for protecting all such areas during both construction and operation of the WEF.

10.4 **Wildlife Protection.**

10.4.1 The application for a Type 3 WEF shall include a Wildlife Protection Plan based on pre-construction field studies designed and carried out by a qualified wildlife biologist chosen by the Applicant from a list provided by the Planning Board and paid by the applicant. Such studies shall describe the possible adverse effects of the WEF on birds, bats, animals and their habitats, and shall propose remedies for these effects.

10.4.2 **Post Construction Wildlife Protection Field Studies**. Within three years after completion of construction of a Type 3 WEF, studies to ascertain its actual effect on wildlife shall be designed and carried out by a qualified wildlife biologist chosen by the Owner/Operator from a list provided by the Planning Board and paid by the Owner/Operator. If these studies demonstrate undue adverse effects on wildlife caused by the WEF, the Owner/Operator in consultation with the Maine Department of Inland Fisheries and Wildlife (MDIFW) shall design and implement an appropriate mitigation plan. The plan shall be submitted to the Town of Phillips Planning Board for approval. The Owner/Operator shall be responsible for the full cost of carrying out the plan under the supervision of the MDIFW.

10.5 **Erosion Control.** Type 3 WEFs shall be designed , constructed, and maintained in accordance with accepted erosion and sediment control methods as set out in the Maine Erosion Control Handbook for Construction; The Best Management Practices, dated March (2003).

10.6 **Water Quality Protection**.

10.6.1 Type 3 WEFs shall be designed, constructed, and maintained so as to avoid undue adverse impacts to groundwater, including sand and gravel aquifers. The Planning Board may require as condition of issuing a permit for a Type 3 WEF that a pre-construction baseline study of all wells, springs, and public water sources within the watershed of the WEF site be conducted. The study shall be designed and carried out by a water quality professional chosen by the Applicant from a list provided by the Planning Board and paid by the Applicant.

10.6.2 **Post Construction Groundwater Quality Study**. Within two years after completion of construction of a Type 3 WEF for which the Planning Board has required a pre-construction baseline Water Quality Study as described in section 10.6.1of this Ordinance, a Post Construction Water Quality study of all wells, springs, and public water sources within the watershed of the WEF site shall be designed and carried out by a water quality professional chosen by the Applicant from a list provided by the Planning Board and paid by the Owner/Operator. If degradation or contamination is found to have occurred, fines and/or permanent remedies as required by the Town of Phillips or the State of Maine shall be the responsibility of the Owner/Operator.

10.7 **Hazardous Wastes**. The Owner/ Operator shall be responsible for compliance with all state and federal regulations applicable to the use and disposal of hazardous wastes involved in or generated by the WEF's construction and operation. This responsibility shall extend to safe and lawful disposal of the by-products of any Acid Rock Testing and Mitigation Plan.

10.8 **Blasting.** Owner/Operator of a WEF shall not undertake any blasting without notifying the Town of Phillips and submitting a blasting plan in accordance with the latest DEP Standards. The blasting plan shall be reviewed and approved by the Phillips Planning Board before any blasting takes place. Forty-eight hour notice shall be given to all residents within a two mile radius of the blasting area (measured horizontally) before blasting can begin.

10.9 **Light Pollution**. All WEFs shall be designed and sited to minimize nighttime light pollution and shall not exceed the minimal requirements by the Federal Aviation Authority. Red lights shall be used instead of white if possible and shall be shielded to the greatest extent possible from viewers on the ground. An applicant for a WEF shall provide a plan showing all lighting on and around the WEF.

10.10 **Scenic Resource Standards**. If a Type 2 or Type 3 WEF is proposed for a site that is visible from a Scenic or Special Resource as defined by the State of Maine or by the Phillips Comprehensive Plan, the Applicant shall provide the Planning Board with a Visual Impact Assessment that addresses the evaluation criteria set forth in the Department of Conservation Standards, Chapter 3, 04-056, adopted April 4, 2010.

11. 0 Financial Standards

11.1 An applicant for a Type 3 WEF shall provide evidence satisfactory to the Town of Phillips Planning Board that the project is financially viable. Evidence of financial viability shall include the following:

- A budget for the construction of the WEF
- Proof of adequate financing for all aspects of the construction
- Proof of long-term power purchase contracts if 25% or more of the WEF output is intended for sale.
- Proof of adequate funds for Decommissioning as specified in section 11.3 of this Ordinance.

11.2 The Owner/Operator of a Type 3 WEF shall maintain a current general liability policy for the WEF covering bodily injury and property damage commensurate with the scope and scale of the project. Proof of current insurance must be presented to the Planning Board with the application for a permit and every year thereafter on the date of the insurance's annual renewal.

11.3 The Owner/Operator of a Type 3 WEF shall, at his/her expense, be responsible for complete Decommissioning of the WEF within twelve months after it ceases to generate electricity, or after its operational license has been revoked.

11.3.1 Decommissioning shall include removal and disposal off-site of all parts of the WEF (including foundations) in accordance with local, state and federal laws and regulations. Areas of disturbed earth shall be graded, seeded, or otherwise re-vegetated.

11.3.2 A Professional Engineer shall be chosen by the Applicant from a list provided by the Planning Board and paid by the Applicant to estimate the total cost of Decommissioning without consideration of the salvage value of the equipment. The amount of this estimate shall be the amount of the Decommissioning Funds required to be posted at the time of the initial Application.

11.3.3 No permit for a Type 3 WEF shall be issued until Decommissioning Funds have been posted by the Applicant with a bonding company or a Federal or State-chartered lending institution (the Escrow Agent) authorized to conduct such business in the State of Maine and approved by the Town of Phillips.

11.3.4 Estimates as described in section 11.3.2 shall be redone annually on the anniversary of the granting of a WEF Permit, and the Owner/Operator of the WEF shall be required to maintain Decommissioning Funds that are at least equal to the most recent estimate.

11.3.5 Decommissioning funds may be in the form of a performance bond, surety bond, letter of credit or other form of financial assurance acceptable to the Town of Phillips.

11.3.6 If the Owner/Operator of the WEF does not complete Decommissioning within the time prescribed in section 11.3 of this Ordinance, the Town of Phillips may take such action as necessary (including court action) to secure the posted Decommissioning Funds and to ensure completion of the Decommissioning.

11.3.7 The Escrow Agent shall not release the Decommissioning Funds except upon written approval of the Town of Phillips.

11.4 **Tax Valuation Agreement and Tax Impact Statement** An Applicant for a WEF that will have a taxable property value of more than $10 million or that will be qualified as a "designated business" for the purposes of state tax incremental financing as defined in Title 30-A M.R.S,A. Section 5241 shall enter into a written Tax Valuation Agreement with the Town of Phillips and shall also present to the Town a Tax Impact Statement.

11.4.1 The Tax Valuation Agreement shall describe the methodology that will be used for tax valuation of the WEF throughout the period of its useful life. The Tax Valuation Agreement shall be reviewed by a qualified tax attorney chosen from a list provided by the Town of Phillips Planning Board and paid by the Applicant. No Permit shall be issued until the Tax Valuation Agreement has been approved by the Town of Phillips Planning Board.

11.4.2 The Tax Impact Statement shall estimate the annual tax burden on the citizens of Phillips over a 10 year period beginning with the first full year of the WEF's operation. The Tax Impact Statement's estimates shall be based on the following data and assumptions: 1) the estimated tax contribution from the WEF that will result from the Tax Valuation Agreement; 2) estimated reduction in tax revenue due to any reductions in the value of properties covered by waivers (assuming that other property values remain constant); 3) estimated adjustments to the amount received from the State for aid to education (assuming a constant school budget); 4) estimated adjustments to the amount received as part of the State municipal revenue sharing program; 5) a constant mill rate. The Tax Impact Statement shall be prepared by an Accountant chosen from a list provided by the Town of Phillips Planning Board and paid by the Applicant.

11.5 Promises of benefits made to the Town of Phillips by the applicant shall be documented and submitted with the Final Application. These benefits shall become a legally enforceable provision of the permit.

12.0 Ethical Standards

12.1 All deliberations concerning the permitting and regulation of WEFs shall be conducted at public meetings for which notice has been duly given.

12.2 Conflicts of Interest. No elected or appointed official or employee of the Town of Phillips who has a financial interest in the WEF under consideration shall be directly or indirectly involved in the permitting or other regulation of that WEF. Financial interest includes but is not limited to the following:

- Having right, title or interest in land on which any part of the WEF will be constructed
- Having signed for the Applicant's benefit a Covenant with financial remuneration
- Having a financial arrangement such as employment or the promise of employment–including employment as an outside contractor–with the Applicant

- Serving as a paid representative of an individual or company that derives income from the development of wind power

13.0 Permitting and Licensing Authority

13.1 The Town of Phillips Planning Board is authorized to review all applications for permits to erect Meteorological Towers and to construct Wind Energy Facilities and all applications for operational licenses to operate such Facilities in the Town of Phillips. The Planning Board may approve, reject, or conditionally approve applications in accordance with the standards of this Ordinance.

13.2 The Town of Phillips Planning Board and/or its designated agents or representatives shall have the right to access and inspect WEF sites.

13.3 The Town of Phillips Planning Board reserves the right to limit the number of applications for WEF permits that are under review at any given time. Only one application for a Type 3 WEF permit will be accepted or processing at any given time.

13.4 The Maine Department of Environmental Protection (DEP) may be required to review WEF applications within the Town of Phillips. When making its own determination about such applications, the Planning Board shall consider, to the extent applicable, findings in the DEP review.

14.0 Permit and Operational License Requirements

14.1 **Meteorological Tower (MT).** In addition to what is required in Section 22.J of the Zoning Ordinance, the application for a permit for an MT shall be submitted in at least ten hard copies and five CDs to the Town of Phillips Planning Board and shall include the following information:

- Applicant and property owner name, address and contact information
- Proposed location of the MT including lot designation
- Engineering drawing of proposed tower structure, instrument package, and guy system, if any
- Engineering drawing of proposed tower base
- Engineering drawing of tower location showing property lines and setback requirements (as specified in Table 1 of this Ordinance)
- Any building, use or construction permits required by other authorities because of the size or construction of the tower
- Intended period of data collection and date MT will be removed
- Plans for mitigation of Environmental Hazard to wildlife for towers requiring guy systems
- Description of intention
- Decommissioning Bond for MT
- A legally enforceable agreement that the applicant shall pay (in advance if required by the Town of Phillips Planning Board) for the services of all consultants that the Planning Board deems necessary to evaluate the application.
- Fee: As established by the Selectmen

14.1.1 Within 30 days of the Planning Board's receiving a Meteorological Tower (MT) application the Planning Board shall, with assistance from such staff, consultants, committees or commissions as it deems appropriate, notify the applicant in writing that the application is complete or, if the application is incomplete, shall inform the applicant of the specific additional material needed to complete the application.

14.1.2 Within 60 days of determining the MT application is complete, the Planning Board shall approve the MT Application, approve the MT Application with conditions, or disapprove the MT Application. The time limit for review may be extended by mutual agreement between the Planning Board and the Applicant.

14.2 **Wind Energy Facility (WEF).** A Preliminary Application for a Permit to Construct a Type 0, Type 1, Type 2, or a Type 3 WEF shall include at least ten hard copies. Type 3 WEF applications shall also include five CDs of the complete application. Upon approval of the Preliminary WEF Application, a Final WEF Application shall be prepared and submitted in at least ten hard copies for Type 0, Type 1, Type 2, and Type 3 WEFs. Type 3 WEF applications shall also include five CDs of the complete application. Approval of the Final WEF Application shall constitute a Permit to Construct the WEF.

14.2.1 **The Preliminary Application shall include the following items in addition to what is required in section 22.J of the Zoning Ordinance of the Municipality of Phillips, Maine:**

- Applicant and property owner's name, address and contact information
- Nameplate data for the type of WEF turbine(s) to be used including manufacturer, model, rated power output and maximum sound power level
- Engineering drawing of the type of WEF turbine to be used
- Certification of the non-reflecting properties of the WEF turbine's external surfaces
- Engineering drawing of the tower base for the type of WEF turbine to be used
- Engineering drawing of the WEF turbine location(s)
- Engineering or architectural drawings of all planned structures, including structures for support and maintenance of the WEF
- Description of intended use, including energy storage and grid connections, and the percentage (if any) of generation intended for sale or use by entities or persons other than the applicant
- Engineering drawings and/or electrical schematics of any energy storage equipment or facilities
- Calculations and supporting data for all setback requirements (as specified in Table 1 of this Ordinance). For Type 3 WEFs, setback requirements must be calculated for each WEF turbine.
- Overlay of Town of Phillips property maps showing the setback area and all property lines and rights of way affected by the setback requirements
- List of property owners whose property, wholly or in part, lies within the setback areas
- Shadow-Flicker Modeling Report as specified in Table 1 of this Ordinance
- A legally enforceable agreement that the applicant shall pay (in advance if required by the Town of Phillips Planning Board) for the services of all consultants that the Planning Board deems necessary to evaluate the application
- Fees: As established by the Board of Selectmen

14.2.1.1 Within 30 days for Type 0 or 1 or within 60 days for Type 2 or 3 of the Planning Board's receiving a Preliminary WEF Application, the Planning Board shall, with assistance from such staff, consultants, committees or commissions as it deems appropriate, notify the applicant in writing that the application is complete or, if the application is incomplete, shall inform the applicant of the specific additional material needed to complete the application.

14.2.1.2 After the Planning Board determines that a Preliminary WEF Application is complete, the Planning Board shall determine whether Preliminary WEF Application meets all requirements of this Ordinance and Section 22.J of the Zoning Ordinance of the Municipality of

Phillips, Maine. In determining whether the Application meets the requirements of this Ordinance, the Planning Board may obtain assistance from such staff and consultants as it deems appropriate.

14.2.1.3 Within 30 days for a Type 0 or 1 or within 60 days for a Type 2 or 3 WEF of determining the Preliminary WEF Application is complete, the Planning Board shall approve the Preliminary WEF Application, approve the Preliminary Application with conditions, or disapprove the Preliminary WEF Application. The time limit for review may be extended by mutual agreement between the Planning Board and the Applicant.

14.2.1.4 The Planning Board shall make findings of fact and conclusions relative to the standards contained in this Ordinance and the Zoning Ordinance of the Municipality of Phillips, Maine. If the Planning Board finds that all standards have been met, they shall approve the Preliminary WEF Application. If the Planning Board finds that any of the standards of this Ordinance or the Zoning Ordinance of the Municipality of Phillips, Maine, have not been met, the Planning Board shall either deny the Preliminary WEF Application or approve the Preliminary WEF Application with conditions to ensure all of the standards will be met. The reasons for any conditions shall be stated in the findings of facts and conclusions.

14.2.2 **The Final Application shall include the following items**:

- Updates to information provided in the preliminary permit, including additions, corrections, and any other changes
- Results of any meteorological testing
- Any building use or construction permits required by other authorities due to the scope of the intended project
- Public Utility Grid Impact Statement as specified in section 8.5 of this Ordinance
- Financial analysis for Type 3 WEFs, including evidence of financial capacity to carry out the project, as specified in section 11.1 of this Ordinance
- Proof of general liability insurance as specified in section 11.2 of this Ordinance
- Decommissioning bond for Type 3 WEFs as specified in section 11.3 of this Ordinance
- Tax Valuation Agreement as specified in section 11.4.1 of this Ordinance
- Tax Impact Statement as specified in section 11.4.2 of this Ordinance
- Statement of Benefits promised to the Town of Phillips, if any
- Fire Prevention and Fire Fighting Plan as specified in sections 9.4-9.5 of this Ordinance
- Road and Property Risk Assessment as specified in section 9.7 of this Ordinance
- Plan to protect Environmentally Sensitive Areas, as specified in section 10.3 of this Ordinance
- Wildlife Protection Plan as specified in section 10.2.4 of this Ordinance
- Baseline Water Quality Study (if required) as specified in section 10.6 of this Ordinance
- Plan for the handling and disposal of Hazardous Wastes as specified in section 10.7 of this Ordinance
- Plan to minimize Light Pollution as specified in section 10.9 of this Ordinance
- Visual Impact Assessment (if required) as specified in section 10.10 of this Ordinance
- Blasting Plan as specified in Section 10.8 of this Ordinance

- A legally enforceable agreement that the applicant shall pay (in advance if required by the Town of Phillips Planning Board) for the services of all consultants that the Planning Board deems necessary to evaluate the application.

- Fees : As established by the Board of Selectmen

14.2.2.1 Within 30 days for Type 0 or 1 or 60 days for Type 2 or 3 of the Planning Board's receiving a Final WEF Application, the Planning Board shall, with assistance from such staff, consultants, committees or commissions as it deems appropriate, notify the applicant in writing that the application is complete or, if the application is incomplete, shall inform the applicant of the specific additional material needed to complete the application.

14.2.2.2 The Planning Board shall hold a public hearing within 30 days of the date of determination of a complete Final WEF Application for a Type 3 WEF. The Planning Board shall publish the time, date, and place of the hearing at least two times, the date of the first publication to be at least seven days prior to the hearing in a newspaper of area wide circulation. The abutting landowners shall be notified by the Planning Board of the hearing. Public hearings by the Planning Board shall be conducted according to the procedures outlined in title 30-A M.R.S.A. Section 2691, Subsection 3 (A), (B), (C), (D), and (E).

14.2.2.3 After the Planning Board determines that a Final WEF Application is complete, the Planning Board shall determine whether the Application meets all requirements of this Ordinance and Section 22.J of the Zoning Ordinance of the Municipality of Phillips, Maine. In determining whether the Final WEF Application meets the requirements of this Ordinance, the Planning Board may obtain assistance from such staff and consultants as it deems appropriate.

14.2.2.4 Within 30 days for a Type 0 or 1 or within 90 days for a Type 2 or 3 of determining the Final WEF Application is complete, the Planning Board shall approve the Final WEF Application, approve the Final WEF Application with conditions, or disapprove the Final WEF Application. The time limit for review may be extended by mutual agreement between the Planning Board and the Applicant.

14.2.2.5 The Planning Board shall make findings of fact and conclusions relative to the standards contained in this Ordinance and the Zoning Ordinance of the Municipality of Phillips, Maine. If the Planning Board finds that all standards have been met, they shall approve the Final WEF Application. If the Planning Board finds that any of the standards of this Ordinance or the Zoning Ordinance of the Municipality of Phillips, Maine, have not been met, the Planning Board shall either deny the Final WEF Application or approve the Final WEF Application with conditions to ensure all of the standards will be met. The reasons for any conditions shall be slated in the findings of facts and conclusions.

14.2.3 An Applicant for a WEF permit may also apply for a Waiver of the Flicker Hazard and Acoustic Hazard Setback Standards and the Acoustic Standards specified in section 10.3. The Application (in at least ten hard copies) shall be submitted with the Final Application for the WEF and shall include the following items:

- A legal Covenant signed by the Applicant and each Inhabitant or Property Owner or other party of legal status in the Town of Phillips whose residence and/or property falls within the Flicker Hazard and Acoustic Hazard setback areas for the WEF declaring that the Inhabitant is willing to waive with respect to his/her residence and/or property the Flicker Hazard and/or Acoustic Hazard Setback Standards of this Ordinance and also the Acoustic Standards specified in section 9.3, including the protections they afford for the value of his/her property and for his/her personal health, safety, and welfare.

- A declaration signed by parties to the Covenant that it has been recorded at the Registry of Deeds office appropriate to the affected property, and that the Covenant contains such legal language as may be necessary to make the agreement binding on current and future Inhabitants and/or Property Owners.

- A declaration signed by parties to the Covenant of the amount and terms of any consideration(s) provided to the Inhabitant and/or Property Owner for entering into the Covenant.

- A declaration signed by parties to the Covenant that they recognize that the burden of proof as to the legality of the Covenant and any Waiver of Standards of this Ordinance that may be granted by the Planning Board rests on the Applicant.

14.2.4 Waivers shall be permitted for Acoustic Hazard and Flicker Hazard Standards and for the Acoustic Standards specified in section 9.3. No Waivers of other Requirements and Standards in this Ordinance shall be permitted.

14.3 An Operational License is required for the operation of any type 3 WEF built in the Town of Phillips after the effective date of this Ordinance. An application for an Operational License shall be submitted in ten hard copies to the Town of Phillips Planning Board after the WEF has been fully built.

14.3.1 **The application for an original Operational License shall include the following items:**

- An Inspection Report certifying the structural and operational integrity of the WEF. This Report shall be signed by a Maine licensed professional engineer chosen by the Town of Phillips Planning Board and paid by the Owner/Operator of the WEF.

- A signed statement that the Applicant has read this Ordinance, understands all its provisions, and agrees to abide by them.

- Fee: As established by the Selectmen.

14.3.2 An Operational License shall be valid for two years and can be renewed by submission of a new Inspection Report and Fee as specified in section 14.3.1 of this Ordinance at least thirty days before expiration of the License.

14.3.3 An Operational License shall be revoked and the WEF required to cease operations if the Town of Phillips Planning Board determines that the WEF is violating any of the standards and requirements of this Ordinance. The Operational License shall not be reinstated until the Planning Board is satisfied that all violations have ceased and all problems have been corrected.

14.3.4 **An Operational License shall automatically terminate upon transfer of ownership of the WEF.** The new Owner/Operator shall apply for a new Operational License and shall not operate the Type 3 WEF until the new License has been issued.

14.3.4.1 The Application for an Operational License by a new Owner/Operator shall contain the following items:

- Copies of the original Permit Applications, updated as necessary, and signed by the new Applicant

- A copy of the original Operational License Application, updated as necessary, and signed by the new Applicant

- A statement, signed by the new Applicant, that he/she has read this Ordinance, understands it, and will abide by all of its provisions.

- Fee: As established by the Selectman.

14.3.4.2 A new Applicant for a Type 3 WEF shall provide evidence satisfactory to the Town of Phillips Planning Board that the project remains financially viable. Evidence of financial viability shall include the following:

- Proof of long-term power purchase contracts

- Proof of adequate funds for Decommissioning as specified in Section 11.3 of this Ordinance.

14.3.4.3 Within 60 days of the Planning Board receiving an Application for a Type 3 WEF Operational License, the Planning Board shall, with assistance from such staff, consultants, committees or commissions as it deems appropriate, notify the applicant in writing that the application is complete or, if the application is incomplete, shall inform the applicant of the specific additional material needed to complete the application.

14.3.4.4 Within 60 days of the determining that the Operational License Application is complete, the Planning Board shall determine whether the Type 3 WEF Application meets the requirements for an Operational License. In determining whether the Type 3 WEF Application meets the requirements of this Ordinance, the Planning Board may obtain assistance from such staff and consultants as it deems appropriate.

14.3.4.5 The Planning Board shall make findings of fact and conclusions relative to the standards contained in this Ordinance. If the Planning Board finds that all standards have been met, they shall approve the Type 3 WEF application. If the Planning Board finds that any of the standards of this Ordinance have not been met, the Planning Board shall either deny the Type 3 WEF Application or approve the Type 3 WEF Application with conditions to ensure all of the standards will be met. The reasons for any conditions shall be stated in the findings of facts and conclusions.

15.0 Violations and Enforcement

15.1 It shall be the duty of the Code Enforcement Officer to enforce the provisions of this Ordinance. If the Code Enforcement Officer shall find that any provision of this Ordinance is being violated, he/she shall notify in writing the persona responsible for such violation, indicating the nature of the violation and ordering the action necessary to correct it. He/she shall order discontinuance of illegal use of land, buildings or structures, removal of illegal buildings, structures, additions, or work being done, or shall take any other action authorized by this Ordinance to ensure compliance with or to prevent violation of its provisions.

15.2 The Code Enforcement Officer shall keep a complete record of all essential transactions of the office, including applications submitted, permits granted or denied, variances granted or denied, revocation actions, revocation of permits, appeals, court actions, violations investigated, violations found, and fees collected.

15.3 Legal Action and Violations: When any violation of any provision of this Ordinance shall be found to exist, the Municipal Attorney, as designated by the Municipal Officers, either on his own initiative, or upon notice from the Code Enforcement Officer, is hereby authorized and directed to institute any and all actions and proceedings, either legal or equitable, that may be appropriate or necessary to enforce the provisions of this Ordinance in the name of the Municipality.

15.4 Fines: Any person, including, but not limited to, a landowner, a landowner's agent or a contractor, who orders or conducts any activity in violation of this Ordinance, shall be penalized in accordance with Title 30-A, Maine Revised Statutes, Annotated, Subsection 4452. The Selectmen are authorized to enter into a Consent Agreement and in such cases court action is not necessary.

16.0 Appeals

16.1 The Town of Phillips Board of Appeals shall have the authority to hear and decide administrative appeals by a party who alleges that an error in applying this Ordinance has been committed by the Town of Phillips Planning Board or the Code Enforcement Officer (CEO). In conducting an administrative appeal the Board of Appeals shall follow the procedures as set forth in Section 22.1 of the Zoning Ordinance of the Municipality of Phillips, Maine.

16.2 The Board of Appeals may reverse a decision of the Planning Board or the CEO only upon finding that the decision was contrary to specific provisions of the Ordinance or contrary to the facts presented to the Planning Board or the CEO. If the Board of Appeals determines that the record of the Planning Board is inadequate, the Board of Appeals may remand the matter to the Planning Board for additional fact finding.