September 21, 2016

Hon. Kathleen H. Burgess
Secretary to the Commission
Three Empire State Plaza
Albany, New York 12223-1350

RE: GALLOO ISLAND WIND, LLC. 15-F-0327

Kevin Casutto
Presiding Examiner
Three Empire State Plaza
Albany, New York 12223-1350

Dear Secretary Burgess and Presiding Examiner Casutto:

After reviewing Galloo Island Wind LLC's Preliminary Scoping Statement (PSS) I applaud the recommendation by the Pubic Service Commission (PSC) that the sponsor include an assessment of low frequency/infrasound noise impacts in their pre-application studies, as outlined in 16 NYCRR §1001.19 -Exhibit 19(e). I am concerned, however, with sponsor's response (#121), "*The evaluation of infrasound will be based on available literature of selected model(s). It is worth noting that infrasound*[1] *data is not required as part of the wind turbine supplier's acoustic standard (IEC 61400-11).*" It is clear from PSC comments that infrasound is a major noise issue at Galloo Island. It is therefore incumbent upon the sponsor to provide a detailed, comprehensive assessment of low frequency sound and infrasound impacts associated with their project rather than a cursory review of available literature or restricting their analytical approach because a turbine manufacturer does not supply the information needed for a proper assessment of noise impacts.

Although the focus of the PSC's infrasound comment was on public health, the rules do not preclude estimating infrasound levels that affect wildlife resources as well: "*The sensitive sound receptors shown shall including residences, outdoor public facilities and areas, hospitals, schools* ***and other noise-sensitive receptors***" (emphasis added). A major oversight in the scoping document provided by Galloo Wind LLC, and the principal reason for this letter, is the failure of the parties to consider the potential negative impacts of infrasound on the colonial water birds that use Little Galloo Island. I would like to provide some suggestions on how to best estimate

1 Note: Infrasound is not audible to humans, but a dynamic pressure wave below 20 Hz that in some instances can be felt and/or affected physically.

low frequency and infrasound levels at sensitive receptors, provide some documentation of bird sensitivity to infrasound, and suggest studies that will help us better understand the effects of infrasound on Little Galloo colonial water birds.

How to model infrasound and low frequency sound

James (2012) notes the usual approach to estimating sound levels at sensitive receptors by the wind industry is to use the Organization for Standardization (ISO) 9613-2 (1996) protocol with commercial software, such as Cadna/A. The common assumption is to configure models to emulate spherical spreading of pressure waves at a decay rate of 6 dB per doubling of distance from the noise source (e.g., 20 log R). However, James (2012) and Thorne (2014) advise that to better estimate low frequency sound and infrasound the models should be configured to emulate cylindrical spreading, which has a decay rate of 3 dB per doubling of distance (e.g., 10 log R). Thorne (2014) in a more involved analysis of infrasound decay properties concluded, "*The propagation of sound for low frequency and infrasonic frequency has been reviewed and the slope for the attenuation of sound below 100Hz is proposed to range from 14.3Log(R) to 12.4Log(R) when a temperature inversion takes place.*" Thorne also provides infrasound levels at varying distances from wind turbine sources and thresholds for adverse impacts on people. Therefore, two recommendations are critical to properly model infrasound impacts:

1. Estimate sound levels for impacts based on center frequency of 1/3 octave bands from 1 Hz to 20 Hz, and
2. use 12.4 log R to model attenuation losses.

In addition, the sponsor should include at least the following sensitive receptors in their analysis of potential impacts:

1) Residences on Galloo including the Galloo lighthouse property (1/4 mile)
2) Little Galloo Island (1.0 mile from Galloo Island)
3) Stony Island lodge and cottages (2.5 miles)
4) Town of Lyme (5.5 miles) and
5) Town of Henderson (6.0 miles).

How does wind turbine infrasound affect people?

Malone, NY pediatrician Dr. Nina Pierpont (2009) was the first medical professional to publicize people becoming ill from living close to industrial wind turbines. Symptoms described by Pierpont included sleep disturbance, headache, tinnitus, dizziness, vertigo, nausea, visual blurring, panic attacks and other symptoms associated with the inner ear balance system (e.g., vestibular dysfunction). Dr. Pierpont hypothesized the cause as inaudible infrasound (e.g., frequencies below 20 Hz sensed by the body, not the ear) from wind turbines. Pierpont also described the at-risk population – those with pre-existing migraine disorder, motion sensitivity,

or inner ear damage (e.g., tinnitus, hearing loss, industrial noise exposure). Schomer et al. (2015) reported the collaborative work of four acoustical consultants, some of whom worked extensively for wind developer clients, at a wind farm in Shirley, Wisconsin, where three families abandon their homes because they became ill after turbines were installed near to their homes. The acousticians confirmed what was reported by Pierpont, that affected people reported symptoms similar to motion sickness. They also reported ill effects were linked to infrasound below 1 Hz, with the most serious effects at 0.2 Hz[2]. Schomer et al. (2015) referenced work with Navy pilots who suffered motion sickness in flight simulators where the nauseogenic condition occurred below 1 Hz, similar to what was observed at Shirley, WI. Schomer further reported that the force from the infrasound produced by the wind farm at Shirley was perhaps three times larger than the force generated by the acceleration that was in accordance with U.S. Navy's nauseogenic criteria. Knowing the effects of infrasound on people and the underlying causes are important in order to better understand the potential impacts infrasound may have on avian resources of Little Galloo Island.

Why is Little Galloo included in list of sensitive receptors, since no one lives there?

The National Audubon Society recognizes Little Galloo Island as a prominent Important Bird Area (IBA). On their website[3] they note: "*The island hosts an exceptional breeding concentration of colonial waterbirds, including the largest Ring-billed Gull colony in the U.S. (an estimated 60,000 pairs in 2003), New York's only Caspian Tern colony (1,560 pairs in 2004), and the largest Double-crested Cormorant colony in New York (3,967 pairs in 2004). Smaller numbers of Blackcrowned Night-Herons (three pairs in 2004), Herring Gulls (313 pairs in 2003), and Great Black-backed Gulls (12 pairs in 2003) nest on the island as well.*"

In 2004 NYSDEC recognized the importance of Little Galloo as well[4]. A special Bird Conservation Area was designed for Little Galloo Island, Gull Island and two parcels owned by NYSDEC on Galloo Island. Part of the Department's vision for these islands was "*to protect, maintain and manage the diversity of colonial waterbirds nesting on the Lake Ontario Islands BCA.*" NYSDEC also recommends, *"Identifying any existing or potential use impacts; recommend new management strategies to address those impacts.*" Hopefully, this letter will assist NYSDEC implement their vision for these islands by identifying a use impact ,e.g., infrasound, heretofore unknown and unrecognized in this process.

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2 Note: 0.2 Hz corresponds to the timing of a turbine blade passing the support tower.

3 http://www.audubon.org/important-bird-areas/little-galloo-island

4 http://www.dec.ny.gov/animals/27156.html

New York's Open Space Conservation Plan[5] began twenty-five years ago and was intended to provide public input into the land purchase decisions made by NYSDEC and the State Office of Parks, Recreation and Historic Preservation (OPRHP). Since then "*It has become an important and popular voice for conserving our State's open spaces and the quality of life that they provide us.*" In the 2009 Draft of New York's Open Space Plan it forewarned concerns regarding industrial wind development at Galloo Island, *"An example of current development pressures on these shorelines is the proposed wind farm development on Galloo Island which will encompass the entire island."*

C.P. Schneider - Little Galloo 1998

These references testify to the uniqueness and importance of the islands of Lake Ontario, in particular Little Galloo. Although Galloo Wind LLC is a development project for Galloo Island, its construction, operation and decommissioning will have a potentially adverse effect on Little Galloo in that it lies only one mile to the east. Little Galloo is uninhabited, but nevertheless the colonial waterbird resource is a well-documented, special habitat deserving of our careful

5 http://www.dec.ny.gov/lands/98720.html

consideration and protection. We should be very cautious dismissing potential harmful impacts of Galloo Island wind development.

What was the level of concern for Little Galloo in the Galloo Wind LLC PSS and PSS comments from NYSDEC?

The project sponsor in its PSS showed minimal concern for Little Galloo and other islands, "*The Findings Statement*[6] *for the Hounsfield Wind Farm Project stated that no impacts to these habitats would result from construction or operation of the Hounsfield Wind Farm.*" NYSDEC in their comments on the sponsor's PSS recommended "...*an evaluation of potential impacts the project would have on construction, operation, maintenance and decommissioning on nearby Little Galloo and Stony Islands*". In response the sponsor was again dismissive, "*As part of the SEQRA review of the Hounsfield project, it was previously found by the NYSDEC that the habitats associated with Little Galloo Island and Stony Island "will not be impacted by the construction or operation of the wind generation project on Galloo Island"*. One of the problems in the SEQRA review cited by the sponsor was a sound study limited to distant, mainland noise receptors and one which provided no detailed assessment of noise impacts for Little Galloo.

What possible impacts could infrasound have on Little Galloo colonial waterbirds?

Colonial waterbirds have a regrettable history of large-scale nest failures and desertions in response to various negative environmental impacts (e.g. DDT egg shell thinning) as well as, man's penchant for wanton killing for sport and to supply plumes for the fashion industry (Kushlan 2012). Much of this early history is what led to the enactment of the Migratory Bird Treaty Act of 1918. One of the problems in trying to understand potential impacts of wind turbine infrasound on a massive concentration of nesting waterbirds only one mile distant is the lack of an adequate scientific study base. Until recently little was known about the effects of infrasound on the human population, let alone its effects on a colony of waterbirds nesting on a remote island in Lake Ontario. It is easy for the sponsor and the wind industry to suggest there are no negative impacts because none were identified. That argument would be justified if there was a body of scientific inquiry that addressed infrasound impacts on birds. The fact there is so little study is by no means reason to suggest there are no negative effects from infrasound. More study is needed before we understand the impacts. There is some limited evidence, however, that suggests infrasound will adversely affect Little Galloo Island waterbirds.

Is their any evidence that Little Galloo waterbirds might react the same way to wind turbine infrasound?

Schomer et al. (2015) went to great length to discuss the anatomy and function of the vestibular system (e.g. balance) in humans. Very briefly they conclude, "*the acoustic pressure* (e.g., wind

6 This case Filing Number 50.

turbine infrasound) *that reaches the otolith through the eardrum and middle ear pathway described earlier should cause the utricular macula to signal the brain in virtually identical fashion to signals generated by inertial forces, i.e., forces generated by acceleration of the head."* The anatomy of the vestibular system of birds is similar to mammals, i.e., they have otoliths, sensory hairs, saccule and utricle. Hence, birds should be affected in the same way as humans to the incongruent cues from the vestibular and visual centers of the brain that cause motion sickness. If so, then birds that inhabit and nest on Little Galloo may also experience dizziness, vertigo, nausea, visual blurring and other symptoms described by Pierpont. If we assume waterbirds experience similar symptoms then mating, nesting and feeding behaviors could all be altered in a negative way. Not all humans are sensitive to motion sickness and this may be the case with birds, too. However, the Navy study cited by Schomer showed that given enough time and exposure, most pilots will get sick. Possbily most birds on Little Galloo will get sick, as well.

In Japan, Tamura et al. (2012) investigated whether chronic exposure to low frequency sound (LFN) at a moderate level of 70 dB SPL affects the vestibule, which is one of the organs responsible for balance in mice. Wild-type, ICR mice were exposed for 1 month to 100 Hz and 16 kHz noise at 70 dB sound pressure level (SPL). In a series of behavioral tests the mice exposed to LFN had impaired balance, but not those that were not exposed to noise or those exposed to 16 kHz. Researchers also reported: "*Immunohistochemical analysis showed a decreased number of vestibular hair cells and increased levels of oxidative stress in LFN-exposed mice compared to those in non-exposed mice*." What was surprising and important is a relatively short exposure, e.g. one month, to moderate LFN led to inner ear damage that affected balance.

A recent study in Great Britain reported excessive stress in wild badgers (Meles meles) that were living in close proximity to industrial wind farms. Agnew et al. (2016) measured cortisol (e.g., stress hormone) levels in badger hair samples they collected from 25 locations: 9 from sites <0.62 miles from a wind farm and 16 sites >6 miles away from wind turbines. The results showed, "*that the hair of badgers living within 1 km of a wind farm have a 264% higher cortisol level than control badgers. This demonstrates that affected badgers suffer from enhanced hypothalamo-pituitary-adrenal activity and thus are physiologically stressed."* Agnew et al. (2016)concluded by suggesting the higher cortisol levels in the badgers was caused by wind turbine noise, specifically the infrasound component. They were also concerned that the high cortisol levels may affect immune systems, thereby increasing risk of infection and disease.

Researchers in Poland found a similar stress response in domestic geese, as well as decreased weight gain for individuals raised in close proximity to 2 MW wind turbines. Mikołajczak et al.

(2013) separated 40, 5-week-old domestic geese (Anser anser f. domestica) and divided them into two groups of 20 individuals each. The first gaggle (group I) was raised within 50 m (150 ft) from a turbine and the second one (group II) within 500 m (1,500 ft). The study lasted for 12 weeks. To analyze the concentration of cortisol, blood was collected on three separate occasions from 20 randomly selected animals (10 individuals from each group, 5 males and 5 females). At the close of the study, on the 17th week, blood cortisol levels were 2.7 times higher and body weights 10% lower in group I compared to group II. In addition to the physiological impairments researchers also noted behavioral changes as well: *"Birds of group I, for the most part, remained in a compact group and showed less physical activity, while individuals from gaggle II moved freely*." Finally, Mikołajczak et al. (2013) concluded, "*This information suggests that infrasound noise may be a very serious source of stress. In addition, it was noted that the cortisol concentration in the animals from group II was higher than the control concentration, which may* ***therefore suggest that the distance of 500 m from the turbine is still not a safe distance****.*" (emphasis added)

Lastly, in a study reference in the Article 11 permit issued to the sponsor of the Hounsfield Wind Farm in 2010, Leddy et al. (1999) found "*Conservation Reserve Program grasslands without turbines and areas located 180 m from turbines supported mean densities of grassland birds that were four times higher than those grasslands nearer to turbines.*" The authors provided a number of possible causes for the diminished density, including possible noise impacts from operational wind turbines.

These collective studies did not speculate as to the behavorial and physiological responses by the badgers, geese and grassland birds to wind turbine noise. Referring back to Pierpont and Schomer's description of human responses we can surmise the effect on these animals may include imbalance, sleep disruption, motion sensitivity and inner ear damage, all of which could negatively affect mating, nesting and feeding behavior as well as survival. In both studies that examined stress parameters researchers also noted that increased stress can depress immune function and increase the risk of infection and disease. None of these conditions, if they occurred, would augur well for colonial waterbirds nesting on Little Galloo Island.

Special environmental conditions can exacerbate transmitted sound

These negative impacts could be exacerbated with a perfect storm of environmental conditions that will increase levels of infrasound on Little Galloo: 1) temperature inversions will concentrate turbine infrasound toward the ground, 2) prevailing westerly winds will direct Galloo turbine infrasound to the east towards Little Galloo, 3) one mile of open water between Galloo and Little Galloo provides no obstruction or attenuation of sound, and 4) synchrony in blade pass frequency in two or more turbines will increase turbine infrasound levels. Adding to

these conditions that will increase levels of infrasound, is their frequency - they occur regularly! Unfortunately for Little Galloo, these conditions are all too common to the Galloos.

Discussion, conclusion and recommendations:

I hope I have provided the Siting Board with a better understanding of the potentially harmful impacts of the Galloo Wind LLC proposal on Little Galloo Island: one of the most important natural resources in New York and the U.S., one of Audubon's Important Bird Areas, and one of NYSDEC's Bird Conservation Areas. These designations and documented importance are in contrast to how the impacts on Little Galloo were characterized by NYSDEC in the Hounsfield Findings Statement and repeated by Galloo Wind LLC in their PSS. Those reports and comments focused entirely on collision mortality without any mention of potential wind turbine noise impacts. Considering the special, unique natural resource features of Little Galloo Island and the inherent risks associated with development and operation of a wind farm a mile away, it is difficult to understand how NYSDEC could issue an Article 11 permit to Galloo Wind LLC and risk potential adverse impacts that could result in wholesale abandonment of the colony. Today, too little is known about these outcomes to say with any confidence that Galloo Wind LLC will not have a significant adverse impact on Little Galloo. Galloo Island may have a great wind resource, it may be distant from significant human habitation and therefore have less negative impact on human health and safety, but for the largest nesting colony of Ring-billed Gulls in North America it is a disastrous site for a wind farm. If the Siting Board is serious about assessing risks and rewards then much more has to be done to understand and minimize those risks.

To improve understanding and hopefully minimize risks, here is a start to what needs to be done by the sponsor and NYSDEC:

1. Estimates of infrasound levels on Little Galloo need to account for worst case conditions and attenuation modelled in compliance with recommendations from Thorne (2012) and James (2013). Results should be review, vetted and approved by PSC's acoustical engineer.
2. A study should be undertaken during the springs of 2017-2018 to examine infrasound effects on egg hatching success. NYSDEC can provide eggs collected from Ring-billed Gull and Caspian Tern nests on Little Galloo for a laboratory study subjecting eggs to infrasound (e.g., 1, 5 and 10 Hz) sound pressure levels projected for Little Galloo. Hatch rates could then be compared with a control group to establish if there is any reproductive loss associated with infrasound exposure.
3. NYSDEC should continue to monitor waterbird reproductive success on Little Galloo. It is important to establish a baseline of hatching success and reproduction to evaluate any future development impacts.

4. The sponsor and NYSDEC should initiate a baseline study to measure of stress parameters in the Little Galloo waterbird population. Since bird feathers have been shown to be a reliable measure of cortisol levels (Lattin et al. 201), NYSDEC should collect feathers in spring 2017-2018 for sponsor supported cortisol assessment. These levels could then be used to monitor any potential stressor response to future wind turbine operation or other development proposed in the area of Little Galloo.

These proposals are by no means complete and comprehensive, but they represent the kind of study and effort that is commensurate with the value of the Little Galloo resource and the uncertainty and risk associated with the potential infrasound impacts from the Galloo Wind LLC proposal.

Finally, potential infrasound impacts have heretofore been unidentified in the previous Hounsfield Wind Farm SEQRA review or Galloo Wind's Preliminary Scoping Statement. I believe my background provides a useful perspective. Just prior to my retirement in 1999 as NYSDEC's Lake Ontario Unit Leader I lead inter-governmental studies to evaluate the impacts of Little Galloo's Double-crested Cormorants on eastern basin fisheries of Lake Ontario (Schneider 1999)[7]. Also, in 2009 I presented an invited paper at the International Conference of Noise Control Engineers describing a method to estimate background sound levels during nights with stable atmospheric conditions (Schneider 2009). These disparate, but connected experiences helped me better appreciate the potential impacts of wind turbine noise on wildlife that may have alluded both biologists and/or acoustic professionals. I hope this perspective may be of value to the Siting Board.

Sincerely yours,

Clifford P. Schneider
Pro Se

7 http://www.dec.ny.gov/docs/wildlife_pdf/sect1.pdf

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