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18 July 2018
Douglas Bowen, Chairperson
Chautauqua County Planning Board
201 West Third Street, Suite 115
Jamestown, NY 14701

Subject: Responses to Information Requests at July 11, 2018 Chautauqua County Planning Board (CCPB) Meeting

Dear Chairperson Bowen:

Attached please find responses to questions raised by you and your board on July 11 regarding the scientific basis for the reasonableness of the setbacks of our proposed turbine locations, any changes in expected cumulative impacts associated with our proposed design modifications, and a summary of economic benefits associated with the project.

With regard to the setbacks discussion we enlisted the expertise of Dr. Christopher Ollson, PhD in Environmental Science, Royal Military College of Canada, who has prepared his report with references to primary technical sources. Dr. Ollson has agreed to attend the CCPB meeting July 23 in Mayville to answer any questions you may have.

In the meantime, please let me know if you have any questions for me or RES.

Thank you and we look forward to meeting with you next Monday.

Sincerely,

Mark H. Lyons
Senior Manager, Development

OLLSON
Environmental Health Management

July 19, 2018

Mark Lyons
Senior Manager, Project Development
RES Americas

RE: Recommended Science-Based Setback Distances for V136 3.45MW Wind Turbines for the Ball Hill Wind Project

Mr. Lyons:

Ollson Environmental Health Management (OEHM) was retained by Renewable Energy Systems Americas (RES) to review the proposed wind turbine model change for the Ball Hill Wind Energy Project (Ball Hill or the Project) and provide an opinion on the appropriate setback distances from homes, public roads and non-participating landowner property lines.

Ball Hill is a 100.05 MW project that will be located in Chautauqua County in New York. The Project was issued Special Use Permits (SUP) in December 2016. On June 13, 2018 Ball Hill submitted an application to modify the SUP granted by the Town of Villenova. The primary modification for the Project will be to change wind turbine type from the Vestas V126 3.45MW on 87 meter towers to the newer turbine technology of the V136 3.45MW on 105 meter towers. This would result in a total turbine height increase to about 568 feet, although for flexibility a new maximum height allowance of 599 feet has been requested. The 2016 SUP provides a wind turbine total height restriction of 495 feet and a series of setbacks to ensure the protection of public health, safety and welfare. Dr. Ollson of OEHM has reviewed the original approved SUP, the revised SUP amended application, the updated sound report and provided recommendations for increasing the setback distances.

In addition, Dr. Ollson can attend the Chautauqua Planning Board meeting on July 23, 2018, if required.

In summary, over the past decade there has been considerable research conducted around the world evaluating health concerns of those living in proximity to wind turbines. This independent research by university professors, consultants and government medical agencies has taken place in many different countries on a variety of models of turbines that have been in communities for numerous years. Based on scientific principles, and the collective findings of over 80 scientific articles, OEHM believes that a reasonable increase in setback distances, for the increase in wind turbine height, will still ensure the protection of public health, safety and welfare of Chautauqua County residents. This report provides the scientific justification for the proposed setbacks for the taller wind turbines.

1 Qualifications of Dr. Christopher Ollson of OEHM

Dr. Ollson is owner and a senior environmental health scientist with OEHM. His expertise is in the field of environmental health science. Dr. Ollson is trained, schooled and practiced in the evaluation of potential risks and health effects to people and ecosystems associated with environmental issues. His curriculum vita is provided in Appendix A. In addition to his consulting practice he holds an appointment of Adjunct Professor in the School of the Environment at the University of Toronto.

Over the past decade, approximately one third to half of Dr. Ollson's practice has been devoted to better understanding the relationship between people, animals and wind energy. He has been engaged by a number of private companies to review the potential health effects that may be associated with living in proximity to wind turbines as part of their preparation of planning and permitting documentation. Since 2014, he has provided expert advice on wind turbines, health and proper siting requirements for the Vermont Public Services Department. He has published six peer-reviewed scientific articles in the field and presented at numerous international scientific conferences.

Dr. Ollson has been formally qualified to provide expert opinion evidence on wind turbines and potential health effects at a number of North American hearings, tribunals and legal cases. He has appeared before numerous County Planning & Zoning Boards and County Commissions to provide an overview of potential health concerns during their deliberations on review of WEC ordinances and granting Conditional/Special Use Permits for wind generating facilities.

2 Proposed Changes to the Ball Hill Turbine Technology

The approved Ball Hill Project consists of 29 wind energy conversion systems (WECS), with 23 located in Villenova and six (6) in Hanover. The number of wind turbines being proposed in the amended SUP application has not changed. However, given advances in turbine technology Ball Hill is seeking an amendment to their SUP to change from the Vestas V126 3.45MW to the Vestas V136 3.45MW turbines, which will result in an increase in the overall height of the turbines. Table 1 provides a comparison of heights of the two wind turbine types.

Table 1. Comparison of the Heights of the Wind Turbine Technologies Being Proposed.

	Vestas V126 3.45MW (Approved)	Vestas V136 3.45MW (Amendment)
Hub Height	87m (285 ft)	105 m (344 ft)
Rotor Diameter	126 m (413 ft)	136 m (446 ft)
Total Tip Height	150 m (492 ft)	173 m (568 ft)

Ball Hill has indicated in their amended application that the total tip height of the turbines should be considered 599 feet. Table 2 provides the minimum distances between wind turbine locations and closest residence, public road, non-participating property.

Table 2. Minimum Distance from Wind Turbines to Features.

Turbine Number	Minimum Distance to Residence (feet)	Minimum Distance to Public Road (feet)	Minimum Distance to Non-Participating Property Line (feet)	Turbine Number	Minimum Distance to Residence (feet)	Minimum Distance to Public Road (feet)	Minimum Distance to Non-Participating Property Line (feet)
T2	1750	1615	911	T19	1900	2164	959
T3	1639	1612	962	T20	2285	2164	922
T4	1697	**686**	1361	T21	1801	1692	1463
T5	2427	2166	1791	T23	1668	2095	1280
T6	2071	3003	1379	T27	1732	2095	624
T7	2027	2955	2149	T28	2872	2941	1063
T8	1952	1775	**624**	T30	2048	1879	970
T9	1650	1775	907	T31	2065	1879	1570
T11	1386	1751	1258	T33	3074	3051	1654
T13	1900	1786	1678	T34	3212	1960	669
T14	1955	1786	1157	T35	1636	1960	462[a]
T15	**1207**	1028	1046	T36	1866	3771	970
T16	1721	1707	778	T37	1649	1202	1559
T17	1648	1707	1211	T39	1953	1202	1189
T18	1688	1764	804				

Note: a. Setback Waiver Agreement pending confirmation of Tax Lien satisfaction.

As with any energy facility it is important that proper setbacks and guidelines are in place for wind turbines to ensure the protection of public health and safety. Table 3 provides the setbacks approved in the 2016 SUP and in other Chautauqua County towns that host wind projects (including currently proposed changes by Ball Hill in red), those proposed by OEHM for the taller turbines in the amend SUP application, and the actual measured distances from Ball Hill permitted wind turbine locations and receptors.

Table 3. Local Law and Ball Hill Actual Setback Standards

Town	Residence	Public Road	Off-Site Property Line	Sound Level at Residence	Maximum Turbine Height
Villenova Law	1000 feet	599 feet (1x TH[1])	599 feet (1x TH)	50 dBA	599 feet
Hanover Law	1000 feet	599 feet (1x TH)	599 feet (1x TH)	50 dBA	599 feet
Arkwright Local Law 2 of 2007	1000 feet (2x TH)	500 feet (1x TH)	500 feet (1x TH)	50 dBA	500 feet
Charlotte Zoning Law	1000 feet (2x TH)	500 feet (1x TH)	500 feet (1x TH)	50 dBA	500 feet
Cherry Creek Local Law 2 of 2011	1000 feet (2x TH)	500 feet (1x TH)	500 feet (1x TH)	50 dBA	500 feet
OEHM Proposed setbacks	2x Total Turbine Height (1200 ft)	1.1x Total Turbine Height (659 ft)	1x Total Turbine Height (599 ft)	50 dBA (remains the same)	
Actual Ball Hill minimum/maximum	1207 ft	686 ft	624 ft	47 dBA	599 feet

Note: [1]TH means Total Height

The suitability of these setbacks will be discussed in each of the following sections.

3 Health and Safety Research on Living in Proximity to Wind Turbines to Establish Appropriate Setbacks

Over 80 studies have been published worldwide to examine the relationship between wind turbines and possible human health effects. Based on the findings and scientific merit of these studies they have led health and medical authorities to conclude that when sited properly (i.e., based on distance and/or noise guidelines and setbacks), wind turbines are not causally related to adverse effects.

This letter serves to provide scientific background and justification for the proposed OEHM setbacks listed in Table 3. They were developed to limit the proximity of operating commercial scale wind turbines to sensitive locations to ensure the protection of public health and safety in several areas, including:

- Tower failure
- Blade throw
- Ice throw
- Audible noise
- Low Frequency Noise (LFN) / Infrasound (IS)

3.1 Public Safety Consideration in Siting Wind Turbines

Setback distances to public roads, property lines and homes are required to ensure the protection of public safety from tower failure, blade throw and ice throw.

The following describes the suitability of the proposed changes to setback distances for projection from ice throw, tower failure and blade failure. Overall, the setback distances in Table 3 are not meant to be protective of the fact that these issues can occur, rather the infrequent events under which they happen and the odds that an individual would be harmed.

3.1.1 Tower Failure

A collapsed wind turbine tower will not fall farther from its base than its total maximum blade tip height. The maximum height being proposed for the amended Ball Hill Project is 599 feet. Therefore, OEHM proposes that the setback distance to non-participating property lines (without a signed waiver) should be the total tip height or 1x total turbine height (599 ft). This will ensure that in the unlikely event that a tower was to collapse, the wind turbine debris would remain on the participating landowner's property.

A setback distance of 1.1x total tip height of the turbine is recommended for public roads. This provides an additional buffer of 10% of the turbine height to the roadway. In the case of the Ball Hill Project this would mean a setback of 648 ft to public roads.

3.1.2 Blade Failure and Blade Fragment Throw

In 2013, MMI Engineering Ltd undertook a study titled "Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines" for the United Kingdom government. They studied wind turbines similar to those being proposed by the amended application of Ball Hill. Through their probabilistic assessment they determined that risk of fatality from wind turbine blade fragment throw is low in comparison to other societal risks. It was roughly equivalent to the risk of fatality from taking two aircraft flights a year or being struck by lightning.

Given the very low probability of risk of injury from blade failure the OEHM recommended setbacks will ensure the protection public health and safety.

3.1.3 Ice Throw

In 2007, Garrad Hassan Canada Inc. was commissioned by the Canadian Wind Energy Association (CanWEA) to undertake a probabilistic risk evaluation of the likelihood of ice fragment throw from wind turbines would strike a member of the public. They examined meteorological conditions in Ontario, Canada, which would be similar to those found in Chautauqua County. Three scenarios were examined – Scenario A House, Scenario B Road and Scenario C Individual. The setback distances they used were consistent with, or less than, those being proposed by OEHM for Ball Hill. Their findings are provided in Table 4.

Table 4. Ice Throw Strike Probabilities (Garrad Hassan, 2007)

Scenario A House	Scenario B Road	Scenario C Individual
• 1000 ft^2 house • 1000 ft from turbine • 1 ice strike per 62,500 years	• north-south road is situated directly west of a turbine at 650 ft • 100 vehicles at 40 mph • 1 vehicle strike per 100,000 years	• ever-present individual between 65 ft to 1000 ft from turbine • 1 strike in 500 years

The common formula for determining maximum distance of ice throw from a turbine is to use 1.5x the turbine hub height + rotor diameter. The hub height + rotor diameter of the Vestas V136 3.4MW turbine is 790 ft and hence maximum ice throw distance would be 1,185 ft. This is less the proposed turbine setback distance to residences of 2x turbine height (1200 ft) by OEHM. The Garrad Hassan results indicate an extremely low probability that a home, an individual or vehicle would ever be struck. Therefore, the setback distances to public roads and property lines of non-participating residences proposed by OEHM are more than sufficient to protect public health and safety from risk of ice throw.

The analysis of ice throw distance contained in the Ball Hill Wind Energy 2018 Application is as follows:

> Ice and Blade Throw Analysis was provided in the 2016 Amended Application and the FEIS. This analysis is hereby updated as follows in accordance with the dimensions of the reference WECS model V136 at a maximum blade tip height of 599 feet:
>
> Based on best practice safety practices and setback requirements, the risk of blade throw, and ice throw is minimal. Ice on turbine blades and towers can pose a safety risk for the general public depending on the site-specific siting of each turbine in relation to publicly accessible areas such as roads, residences, and other developed areas. To date, there have been no serious accidents caused by ice throw; however, that is not to say there is no risk. To mitigate and minimize the risk of ice throw, best practice safety procedures during operation of the wind farm can reduce the risk of ice throw, including but not limited to: visual inspections, de-icing and anti-icing systems, regular and routine maintenance by full-time turbine technicians assigned to wind farm operations, curtailment of turbines in hazardous conditions, educating staff/landowners on specific weather conditions and associated throw risks, standard safety protocols were icing is imminent, and public safety warning signs near public access areas and project boundaries. Recent studies suggest the typical range (90% of events) of ice being thrown from a turbine is less than 623 feet from the turbine base, which falls within our standard turbine setbacks. Almost 50% of these events may occur within the length of the turbine blade (<223 feet). The maximum throw distance based on best practice formulas is approximately 1246 feet, however these events are defined as the “exceptional range” as their impact probably is minimal. Studies also suggest threats to the public from blade fragments are negligible.

Given the extremely low probability that anyone would be struck by ice from a turbine in a field, or that a passing car would be struck, the 1x total turbine height to property line and 1.1x total turbine height to the public roads still ensure public safety.

3.2 Audible Sound Limits

Both the Towns of Hanover and Villenova have sections in their wind laws that dictate a sound limit. The Town of Hanover Article XVI, Section 1606 (Zoning District and Bulk Requirements), Parts 3 through 6 of the Town of Hanover Wind Law provides the following for sound:

> "The statistical sound pressure level generated by a WECS shall not exceed L10 – 50 dBA measured at any off site residence existing at the time of application. If the ambient sound level exceeds 48 dBA, the standard shall be ambient dBA plus 5 dBA. Independent certification shall be provided before and after construction demonstrating compliance with this requirement."

Local Law No. 1 of 2007. A Local Law Governing Wind Energy Facilities in the Town of Villenova. Section 7. Article VI-A, 690.12. Setbacks for Wind Energy Conversion Systems states for sound:

> "The statistical sound pressure level generated by a WECS shall not exceed L10 - 50 dBA measured at the closest exterior wall of any residence existing at the time of completing the SEQRA review of the application. If the ambient sound pressure level exceeds 50 dBA, the standard shall be ambient dBA plus 5 dBA. Independent certification shall be provided before and after construction demonstrating compliance with this requirement."

As part of the 2016 SUP application Ball Hill filed a Sound Level Assessment Report prepared by Epsilon and Associates (August, 2016). They modeled the V126 3.45MW wind turbine, which had under peak sound-producing operating conditions an A-weighted sound power level of 107.3 dBA. They added an uncertainty factor of 2.0 dBA, as provided by the manufacturer.

The SUP amendment filing included an update Memorandum on the new wind turbine model (Vestas V136 3.45 MW) and the final layout. Although the V136 3.45MW wind turbine is approximately 100 ft taller than the original turbine, it was modeled with serrated trailing edge (STE) blades. The result is an A-weighted sound power level of 105.5 dBA, almost 2 dBA lower than the original modeled turbine. Similar to the 2016 report they added an uncertainty factor of 2.0 dBA. The predicted maximum L_{10} sound levels for the Project receptors ranged from 19 to 47 dBA and were compliant with both Town Laws.

Results of modeling the new proposed turbine and the final project layout resulted in sound levels remaining the same or slightly quieter at 750 out of 769 receptor points studied (Table 5). At the remaining 19 points, the sound level would increase imperceptibly by 1-2 dBA. The Project remains fully compliant with Town and NYSDEC noise standards.

Table 5. Summary of Change in Sound Results at Receptors with Changing Wind Turbine Models

Sound Level Change	Number of Receptor Points	Resulting Sound Level (dBA)
No Change	589	
Quieter	161	
+1dBA	17	≤26db (16 points); 36db (1 point)
+2 dBA	2	22 dBA

Even though there is a proposed change in turbine height the emitted sound level is almost 2 dBA lower than the original turbines. The slight movement in turbine location also had little effect on modeled sound levels at receptor points. No change is being requested to the audible sound limit in the amended SUP and the Project will remain fully compliant with local and state standards.

3.3 Low Frequency Noise (LFN) and Infrasound

It is my understanding that public comments on the 2018 Application have focused on levels of low frequencies and infrasound that will be emitted from the proposed turbines.

Infrasound is a term used to describe sounds that are produced at frequencies too low to be heard by the human ear at frequencies of 0 to 20 Hz, at common everyday levels. It is typically measured and reported on the G-weighted scale (dBG). Low frequency noise (LFN), at frequencies between 20 to 200 Hz, can be audible. It is typically measured and reported on the C-weighted scale (dBC) to account for higher-level measurements and peak sound pressure levels. The Project has predicated sound on the A-weighted scale, which covers the audible range 20 Hz to 20 kHz and is similar to the response of the human ear at lower levels.

Although wind turbines are a source of LFN and infrasound during operation, these sound pressure levels are not unique to wind turbines. Common natural sources of LFN and infrasound include ocean waves, thunder, and even the wind itself. Other sources include road traffic, refrigerators, air conditioners, machinery, and airplanes.

Given the growing attention being paid to this issue, an international team of acousticians and health scientists published a peer-reviewed article entitled "*Health-based Audible Noise Guidelines Account for Infrasound and Low Frequency Noise Produced by Wind Turbines*" in the journal Frontiers in Public Health (Berger et al., 2014).

The purpose of this paper was to investigate whether typical audible noise-based guidelines for wind turbines account for the protection of human health given the levels of infrasound and LFN typically produced by wind turbines. New field measurements of indoor infrasound and outdoor LFN at locations between 400 m (1300 feet) and 900 m (2950 feet) from the nearest turbine, which were previously underrepresented in the scientific literature, were reported and put into context with existing published works. The analysis showed that indoor infrasound levels were below auditory threshold levels while LFN levels at generally accepted setback distances were similar to background LFN levels.

From the abstract of Berger et al., 2015:

> *Over-all, the available data from this and other studies suggest that health-based audible noise wind turbine siting guidelines provide an effective means to evaluate, monitor, and protect potential receptors from audible noise as well as Infrasound and Low Frequency Noise.*

Simply put, the towns 50 dBA sound limit and the 1,200-foot setback to homes, will ensure that the very low levels of LFN and infrasound will not impact health.

In 2016 the Ministry for the Environment, Climate and Energy of the Federal State of Bade Wuerttemberg in Germany reported on their study "*Low-frequency noise including infrasound* *from wind turbines and other sources*" (MECE, 2016). The objective of the research was to collect field measurement of infrasound and low-frequency noise around six different turbines by different manufacturers from 1.8 to 3.2 MW. Measurements were taken at 150 m (492 feet), 300 m (984 feet) and 700 m (2296 feet) from wind turbines. Measurements of other common sources of infrasound and low frequency noise were also collected for comparative purposes.

Figure 1 (from MECE, 2016) provides detail on the range of infrasound and low frequency noise measured at 300 m (984 feet). It can be seen that the levels of infrasound from wind turbines were similar to that of just the wind in an open field, while there was an increase in low frequency sound. The levels were considerably lower than either being in the interior of a car, near road side traffic or in a home with oil heating. All infrasound levels (< 20 Hz) were below the perception threshold and international standards.

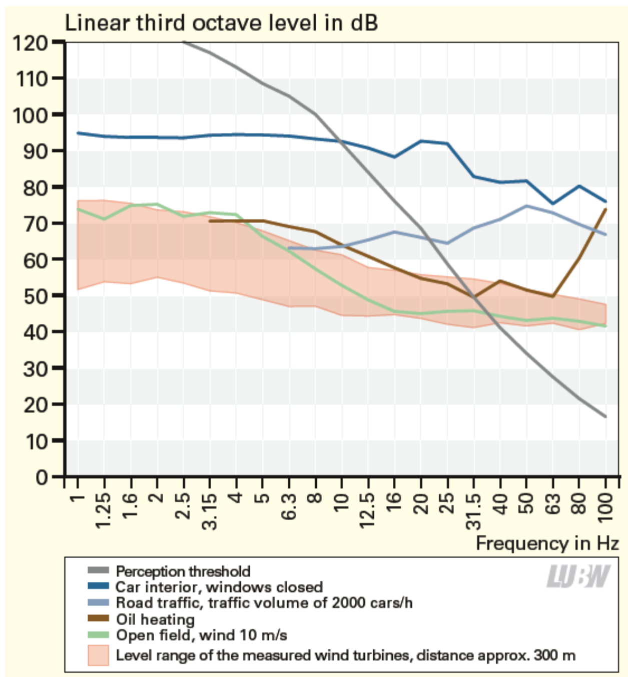

Figure 1. Measurements of infrasound and low frequency noise 300 m from wind turbines compared to other sources. [from MECE, 2016].

Overall, they concluded:

> *"Infrasound and low-frequency noise are an everyday part of our technical and natural environment. Compared with other technical and natural sources, the level of infrasound caused by wind turbines is low. Already at a distance of 150 m, it is well below the human limits of perception. Accordingly, it is even lower at the usual distances from residential areas. Effects on health caused by infrasound below the perception thresholds have not been scientifically proven.* ***Together with the health authorities, we in Baden-Württemberg have come to the conclusion that adverse effects relating to infrasound from wind turbines cannot be expected on the basis of the evidence at hand****.[emphasis added]"*

McCunney et al. (2014), published a study entitled "Wind Turbines and Health: A Critical Review of the Scientific Literature" in the Journal of Environmental and Occupational Medicine. This review conducted a significant review of infrasound and LFN levels from turbines and potential impact on health and concluded:

> *"Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines*

Similar results were found by Epsilon Associates, Inc. (2011) where their research found no audible infrasound either outside or inside homes at 1,000 feet from a wind turbine. The wind turbine sound levels meet the ANSI standard for low frequency noise in bedrooms, classrooms, and hospitals, meet the ANSI standard for thresholds of annoyance from low frequency noise, and there should be no window rattles or perceptible airborne induced vibration of light-weight walls or ceilings within homes. In homes there may be slightly audible low frequency noise beginning at around 50 Hz (depending on other sources of low frequency noise); however, the levels are below criteria and recommendations for low frequency noise within homes (O'Neal et al., 2011).

The 2011 NARUC report states, "the widespread belief that wind turbines produce elevated or even harmful levels of low frequency and infrasonic sound is utterly untrue as proven repeatedly and independently by numerous investigators."

The hypothesis that low frequency noise or infrasound from wind turbines is a causative agent in health effects is not supported by the scientific and medical literature. Although infrasound and low frequency noise are emitted from wind turbines and their contribution above background sources can be measured close to wind turbines, the levels are typically within background at 1,000 feet from turbines and at homes. Even the infrasound and low frequency noise levels right beneath the turbines are much lower that those that cause health impacts and are well below international guidelines on infrasound.

The proposed 2x total turbine height (1,200 feet) to residences will ensure that infrasound and low frequency noise are within background levels and certainly will not impact the health of the residents of the county.

4 Conclusions

Over the past decade there has been considerable research conducted around the world on the potential for wind turbines to adversely impact health. This independent research by university professors, consultants and government medical agencies has taken place in many different countries on a variety of models of turbines that have been in the community for a number of years. Based on scientific principles, and the collective findings of over 80 scientific articles, OEHM has proposed three setback distances for the new wind turbine models that will ensure the protection of public health and safety.

Sincerely,

OLLSON ENVIRONMENTAL HEALTH MANAGEMENT

Christopher Ollson, PhD
Senior Environmental Health Scientist

References

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CHRISTOPHER OLLSON, PH.D., QP_{RA}

Owner and
Senior Environmental Health Scientist

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(416) 456-1388
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Dr. Ollson is Owner and Senior Environmental Health Scientist at Ollson Environmental Health Management (OEHM). He has 20 years of international consulting experience in environmental health sciences and toxicology. Dr. Ollson has worked across the United States and is well versed in Federal and State environmental legislation. His Canadian experience spans from coast-to-coast-to-coast, having worked in all Provinces and Territories. Throughout his career, Chris has led some of North America's most high profile and controversial multi-disciplinary environmental health assessments.

Dr. Ollson is considered an expert in environmental health issues related to the energy sector. He has led risk assessments and provided risk communication support for wind turbine, solar, hydroelectric, energy-from-waste / waste-to-energy facilities, wind turbine projects, natural gas fired stations, oil sands environmental assessments, refineries, pipelines, and coal power plants. Dr. Ollson has conducted extensive research in potential health and environmental issues surrounding wind turbine facilities and has published numerous peer-reviewed articles and government white papers on the topic.

Chris has spent countless hours in community and stakeholder consultation on behalf of clients. Through proper risk communication they became part of the decision-making process on issues surrounding atmospheric, soil and water contaminant issues. Specific to the wind and solar sector Dr. Ollson has spent 1000s of hours in public consultation, stakeholder engagement, meetings with public health staff and local councils.

Dr. Ollson has testified at more than a dozen environmental review tribunals, commissions, hearings and court proceedings with respect to potential health concerns in living in proximity to wind turbines. With six peer-reviewed scientific journal articles, numerous invited conference presentations and invited university lectures he is considered one of the foremost experts in North America on renewable energy health issues. In recognition of these accomplishments he was the co-recipient of the 2015 Canadian Wind Energy Association R.J. Templin Award. The R.J. Templin Award recognizes an individual or organization that has undertaken scientific, technical, engineering or policy research and development work that has produced results that have served to significantly advance the wind energy industry in Canada.

In addition to his consulting practice, Dr. Ollson maintains an active research program through his Adjunct Assistant Professor appointment at the University of Toronto Scarborough. He teaches graduate level courses in Environmental Risk Assessment and has co-supervised a number of graduate students and Post-Doctoral Fellows. Dr. Ollson's primary research interests are in potential health issues related to the renewable energy sector, waste-to-energy sector and the emerging field of Health Impact Assessment of major projects.

EDUCATION

2003	Ph.D., Environmental Science (Specialization in Risk Assessment), Royal Military College of Canada
2000	M.Sc., Environmental Science, Royal Military College of Canada
1995	B.Sc., (Honours), Biology, Queen's University.
QP_{RA}	Qualified Person for Risk Assessment as defined by the Environmental Protection Act of Ontario (Brownfields Legislation)

AREAS OF SCIENTIFIC EXPERTISE

- Health Impact Assessment
- Environmental Health
- Air Quality Assessment
- Human Health Risk Assessment
- Major Infrastructure Health Assessment
- Energy Sector

EMPLOYMENT HISTORY

2015 – Present	**Ollson Environmental Health Management** Senior Environmental Health Scientist
2011-2015	Intrinsik Environmental Sciences Inc. Mississauga, Ontario Vice President, Strategic Development Senior Environmental Health Scientist
2002 – 2011	Stantec Consulting Ltd (formerly Jacques Whitford Limited) Practice Leader, Environmental Health Sciences
1997 - 2002	Royal Military College of Canada, Environmental Sciences Group (ESG) Senior Environmental Scientist / Risk Assessor
1990 – 2002	Naval Reserves, Department of National Defence Maritime Surface (MARS) Officer, Lt(N) Ret'd

PROFESSIONAL AFFILIATIONS

- Full Member of the International Association for Impact Assessment (IAIA)
- Full Member of the Society of Practitioners of Health Impact Assessment (SOPHIA)

ACADEMIC EXPERIENCE

2013 – PRESENT **University of Toronto Scarborough, Department of Physical and Environmental Sciences**
Adjunct Professor

2011 – PRESENT **University of Toronto, School of the Environment**
Graduate Course Lecturer

2013 - 2016 **University of Toronto Scarborough, Member Campus Governing Council, Vice-Chair of the Academic Affairs Committee**

2009-2011 **University of Toronto, Scarborough**
Adjunct Lecturer, Physical & Environmental Sciences,

2004 - PRESENT **Royal Military College of Canada**
Adjunct Assistant Professor

AWARDS

Co-recipient of the 2015 Canadian Wind Energy Association R.J. Templin Award. *First awarded in 1985, the R.J. Templin Award recognizes an individual or organization that has undertaken scientific, technical, engineering or policy research and development work that has produced results that have served to significantly advance the wind energy industry in Canada.*

Wind Turbine Peer Reviewed Scientific Publications

Primary Research

Berger, R.G., Ashtiani, P., **Ollson, C.A.**, Whitfield Aslund, M. McCallum, L.C., Leventhall, G. and Knopper, L.D. 2015 Health-based audible noise guidelines account for infrasound and low-frequency noise produced by wind turbines. Front. Public Health 3:31. Citations: 8

McCallum, L., Whitfield Aslund, M., Knopper, L.D., Ferguson, G.M. and **Ollson, C.A.** 2014. An investigation of wind energy and health: quantifying electromagnetic fields around wind turbines in Canada. *Environmental Health* 2014, **13**:9. Citations: 7

Whitfield Aslund, M.L., **Ollson, C.A.,** Knopper, L.D. 2013. Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada. Energy Policy 62, 44-50. Citations: 4

Systematic Literature Reviews

Knopper, L.D., **Ollson, C.A**., McCallum, L.C., Aslund, M.L., Berger, R.G, Souweine, K., and McDaniel, M. 2014. Wind turbines and Human Health. Front. Public Health, 19 June 2014. Citations: 22

Knopper, L.D. and **Ollson, C.A.** 2011. Health Effects and Wind Turbines: A Review of the Literature. Environmental Health. 10:78. Open Access. Highly Accessed. Citations: 86

Published Critique

Ollson, C.A., Knopper L.D. McCallum, L.C., Aslund-Whitfield, M.L. 2013. Are the findings of ‘Effects of industrial wind turbine noise on sleep and health’ supported? Noise & Health 15:63, 148-150. Citations: 5

Hearings, Tribunals and Court Proceedings on Wind Turbines and Associated Transmission Lines

In the following proceedings I testified and formally qualified as an expert in wind turbines and human health

Ontario Environmental Review Tribunals – Appeal of Company Renewable Energy Approvals

Erickson v. MOE 2011	Suncor
Monture v. MOE [GREP] 2012;	Samsung
Moseley v. MOE 2014;	Capstone
Lambton County v. MOE 2015	Suncor
EOCA v MOE 2015	ProWind

Queen's Bench of Saskatchewan in McKinnon v. Martin (2010 – also referred to as the Red Lily case)

Alberta Utilities Commission (AUC) Proceeding No. 22563, Halkirk 2 Wind Project (November 2017)

Alberta Utilities Commission (AUC) Proceeding No. 3329, Grizzly Bear Creek Wind Project (March 2016)

Alberta Utilities Commission (AUC) Proceeding No. 1955, Bull Creek Wind Project (October 2013)

North Dakota Public Services Commission 2015

Brady Wind Energy Center	NextEra
Brady II Wind Energy Center	NextEra
Oliver III Wind Energy Center	NextEra

Clinton County Planning and Zoning Commission, MO, County Ordinance Changes (2016)

Chowan County and Perquimins County Board of Commissioners hearings for the Timbermill Wind Project (2016)

Court Proceedings Unrelated to Wind Turbine Projects

John Chart vs. Town of Parma. W.D.N.Y Civil Action No. 6:10-CV-06179, Deposed 2013.

Lockridge and Plain v. Ministry of the Environment and Suncor Energy Products Ltd., 528/10, Ontario Superior Court of Justice, Deposed 2012

Appearances before Government Bodies

North Dakota State Senate and Representative Natural Resources Committee. Study on Wind Energy Conversion Facilities. December 2017.

Indiana State Senate Energy Committee Meeting on Wind Turbine Siting. October 2017.

North Dakota State Senate Energy and Natural Resources Committee. Senate Bill 2313. Exclusion Areas for Wind Energy Conversion Facilities. February 2017.

Vermont Public Services Board. Proposed Rule on Sound from Wind Generation Facilities. December 2016.

Example Appearances before US County Planning & Zoning Commissions and County Boards

Redfield Town Board, New York, Mad River Wind Farm, 2017

Parshville Town Board, New York, North Ridge Wind Farm, 2017

Grant and Dickinson County Planning and Zoning Commissions, Iowa, Upland Prairie Wind Farm, 2017

Codington and Grant County Planning Commissions, Dakota Range Wind, South Dakota, 2017

Deuel County Zoning Board, South Dakota, Crown Ridge Wind Project, 2017

Rush County Board of Zoning Appeals, Indiana, West Forks Wind Project, 2016

Hettinger County Planning and Zoning Commission and County Commission, North Dakota, Brady II Wind Energy Center, 2016

Kingman County Planning and Zoning Commission, Kansas, Kingman Wind Energy Center, 2016

Pratt County Planning and Zoning Commission, Kansas, Ninnescah Wind Energy Center, 2016

Stark County Planning and Zoning Commission and County Commission, North Dakota, Dickinson Wind Energy Center, 2015, 2016

Stark County Planning and Zoning Commission and County Commission, North Dakota, Brady Wind Energy Center, 2015, 2016

Colfax Township Board, Dekalb County, Missouri, Osborn Wind Energy Center, 2016

WashingtonTownship Planning Board, Dekalb County, Missouri, Osborn Wind Energy Center, 2016

Niagara County Board of Health, New York, Lightstation Wind Energy Center, 2015

El Paso Planning Commission and County Commission, Colorado, Golden West Energy Center, 2015

Stony Creek Town Commission, New York, Proposed InvEnergy project, working for the Town Commission, 2011

Wind Project Developers- Worked as Project Health Consultant of Record (Alphabetical)

- APEX, Algonquin Power, Avangrid, BluEarth, Boralex, Capital Power, Capstone, EDF, EDPR, InvEnergy, Longyung Power, NextERA, Niagara Region Wind Corporation, Northland Power, Pattern Energy, Prowind, RES, Samsung, South Canoe Wind, Sprott, Suncor, Veresen, Vermont Public Services Department, WPD

Wind Turbine Conference Proceedings

Whitfield Aslund, M.L., Berger, R.G.; Ashtiani, P.; **Ollson, C.A**.; McCallum L.C.; Leventhall, G.; Knopper, L.D. 2015. Health-based audible noise guidelines account for infrasound and low frequency noise produced by wind turbines. *Proceedings of the 6th International Conference on Wind Turbine Noise, April 2015, Glasgow, Scotland*.

Whitfield Aslund, M.L., Ollson, C.A., Knopper, L.D. 2013. 'Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada', submitted for publication in *Proceedings of the 5th International Conference on Wind Turbine Noise, Denver Colorado 28-30 August 2013*

Knopper, L.D., Whitfield Aslund, M.L., McCallum, L.C., Ollson, C.A. 2013. 'Wind turbine noise: What has the Science Told Us?', submitted for publication in *Proceedings of the 5th International Conference on Wind Turbine Noise, Denver Colorado 28-30 August 2013*

Conference Presentations on Wind Turbines and Health

Ollson, C.A., 2015. Effective Communication Strategies for Addressing Health Concerns. CanWEA annual conference.

Ollson, C.A. 2014. Responding to Health Concerns. CanWEA annual conference.

Ollson, C.A. 2014 Wind Turbines – Do They Cause Health Impacts? CPANs Air & Waste Management Association. Edmonton, Alberta

Ollson, C.A., McCallum, L.C., Whitfield Aslund, M.L., Knopper, L.D. 2014. Social Licence to Operate – Lessons From Canadian Wind Industry. International Association of Impact Assessment (IAIA) International Conference 2014. Chile.

Whitfield Aslund, M.L., **Ollson, C.A.,** Knopper, L.D. 2013. 'Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada', Wind Turbine Noise 2013, Denver, August 2013.

Ollson, C.A. ; Knopper, L.D., Whitfield Aslund, M.L., McCallum, L.C., 2013. 'Wind turbine noise: What has the Science Told Us?', Wind Turbine Noise 2013, Denver, August 2013.

Ollson, C.A., 2013 Health Effects and Renewable Energy: An Overview of the Issues. Association of Power Producers of Ontario Toronto, 2013

Ollson, C.A. and Knopper, L.D. Health Effects and Wind Turbines: A Review of the Issues. CANWEA Communications Summit , Vancouver, October, 2011

Additional Peer-Reviewed Scientific Publications

McCallum, LC, **Ollson, CA**, Stefanovic, IL. 2017. An adaptable Health Impact Assessment (HIA) framework for assessing health within Environmental Assessment (EA): Canadian Context, International Application. Impact Assessment and Project Appraisal. In Press.

McCallum, LC, **Ollson, CA**, Stefanovic, IL. 2016. Prioritizing Health: A Systematic Approach to Scoping Determinants in Health Impact Assessment. Frontiers in Public Health. Aug 22;4:170

McCallum, LC, **Ollson, CA**, Stefanovic, IL. 2016. Development of a Health Impact Assessment Screening Tool: A Value Versus Investment Approach. Journal of Environmental Assessment Policy and Management Vol. 18, No. 2

McAuley, C., Dersch, A., Kates, L. N., Sowan, D. R. and **Ollson, C. A.** 2016. Improving Risk Assessment Calculations for Traditional Foods Through Collaborative Research with First Nations Communities. Risk Analysis. Dec; 36(12):2195-2207

McAuley, C., Dersch, A., Kates, L. N., Sowan, D. R., Koppe, R and **Ollson, C. A.** 2016. Assessment of Exposure to Chlorinated Organics through the Ingestion of Moose Meat for a Canadian First Nation Community. Frontiers in Environmental Science. November 2016: Vol 4: Article 78

McCallum LC, Souweine K, McDaniel M, Koppe B, McFarland C, Butler K**, Ollson CA**. Health Impact Assessment of an oil drilling project in California. Int J Occup Med Environ Health. 2016;29(2):229-53.

McCallum, L.C., **Ollson, C.A.** and Stefanovic I.L. 2015. Advancing the practice of health impact assessment in Canada: obstacles and opportunities. Environmental Impact Assessment Review. Volume 55, November 2015, Pages 98–109

Ollson, C.A., Knopper, L.D., Whitfield Aslund, M., Jayasinghe, R. 2014. Site specific risk assessment of an energy-from-waste thermal treatment facility in Durham Region, Ontario, Canada. Part A: Human health risk assessment. Science of the Total Environment 466-467: 345-356.

Ollson, C.A., Knopper, L.D., Whitfield Aslund, M., Dan, T. 2014. Site specific risk assessment of an energy-from-waste/ thermal treatment facility in Durham Region, Ontario, Canada. Part B: Ecological risk assessment. Science of the Total Environment 466-467: 242-252.

Johnson KE, Knopper LD, Schneider DC, **Ollson CA**, Reimer KJ. 2009. Effects of local point source polychlorinated biphenyl (PCB) contamination on bone mineral density in deer mice (Peromyscus maniculatus). Sci Total Environ. 2009 Sep 1; 407(18):5050-5. Epub 2009 Jul 5

Ollson, C.A., Koch, I., Smith, P.; Knopper, L.D., Hough, C., Reimer, K, J. 2009. Addressing arsenic bioaccessibility in ecological risk assessment: A novel approach to avoid overestimating risk. Environmental Toxicology and Chemistry 28(3): 668-675.

Knopper, L.D., Smith, G.K., **Ollson, C.A.**, Stephenson, M. 2009. Use of Body Mass Scaling of Dose in Ecological Risk Assessments In Ecotoxicological Research Developments. Nova Publishers, pp. 23-29.

Gregor, D., Stow, J., Kennedy, D., Reimer, K., **Ollson, C**. 2003. Local Sources of Contaminants in the

Canadian Arctic. Canadian Arctic Contaminants Assessment Report /I(CACAR /I) Physical Environment 157-183

Reimer, K.J., **Ollson, C.A**., Koch, I. 2002. An Approach for Characterizing Arsenic Sources and Risks at Contaminated Sites: The Consequences of 60 Years of Gold Mining in Yellowknife, NWT, Canada. 2003. Metals in the Environment. American Chemical Society.

Koch, I., Hough, C., Mousseau, S., Mir, K., Rutter, A., **Ollson, C.,** Lee, E., Andrewes, P., Granhchino, S,, Cullen, B., Reimer, K. 2002. Canadian Journal of Analytical Sciences And Spectroscopy 47(4):109-118.

Koch, I., **Ollson, C.A**., Potten, J., and Reimer, K.J. 2002. Arsenic in Vegetables: An Evaluation of Risk from the Consumption of Produce from Residential and Mine Gardens in Yellowknife, Northwest Territories, Canada. I. in Annual Reviews in Food and Nutrition: Toxic and Pathological Aspects, Taylor & Francis, London.

Koch, I., Wang, L., **Ollson, C.A.,** Cullen, W.R., Reimer, K. J. 2000. The Predominance of Inorganic Arsenic Species in Plants from Yellowknife, Northwest Territories, Canada. Environmental Science and Technology 34:22 26.

Ollson, C. A. 2003. Arsenic Risk Assessments: The Importance of Bioavailability. PhD Thesis, Royal Military College of Canada.

Ollson, C. A. 1999. Arsenic Contamination of the Terrestrial and Freshwater Environment Impacted by Gold Mining Operations, Yellowknife, NWT. M,Sc, Thesis, Royal Military College of Canada.

ATTACHMENT 2

Cumulative Impacts

Please note that under New York law, when examining the cumulative impacts of a change to an already approved project, the deciding body is limited to reviewing the impacts in comparison to those of the previously approved version of the project, and not for the overall project. Nevertheless, we are happy to provide this broader assessment at the request of the Chautauqua County Planning Board.

In support of its 2016 application for Special Use Permits from the Towns of Villenova and Hanover, Ball Hill Wind Energy investigated potential cumulative impacts associated with the coincidence of the Ball Hill project ("Project"), Arkwright energy project, and then-proposed Cassadaga Wind Energy project. Such potential impacts were assessed in the following areas:

- Visual impacts
- Sound
- Avian species and bats
- Wildlife
- Traffic
- Cultural resources
- Land Use
- Socioeconomics

In support of its 2018 Application, proposing a maximum total height increase of 104 feet and elimination of a collection substation and approximately 5.8-mile overhead 115kv generator intertie and associated 80-foot poles, in favor of undergrounding the generator intertie. All marginal impacts associated with these proposed modifications have been studies and documented in the 2018 Applications and Full Environmental Assessment Form (FEAF). Of the areas in which potential cumulative impacts were assessed in 2016, there is only one where increased Project impacts are expected, and that is in the Visual area. Thus, it is only in the area of visual impacts where the 2016 Cumulative Impacts assessment has been explicitly revised. The following summarizes the impacts assessments conducted in the foregoing areas for the 2018 Application.

Visual

The following is the conclusion of Saratoga Associates with regard to cumulative visual impacts associated with Project facility visibility.

As a result of the proposed revisions in the 2017 Layout, a slight increase is expected in the total acreage that may have visibility by those wind projects reviewed. With the introduction of the proposed Ball Hill Wind Project (2016 Layout), as well as the

Arkwright Summit Wind Farm and Cassadaga Wind Project, one (1) or more structures will be theoretically visible from approximately 40.2 percent of the Projects five-mile radius study area. The total cumulative visibility of the proposed wind projects is approximately 40,645 acres.

Based on the 2017 Layout one (1) or more structures will be theoretically visible from approximately 40.8 percent of the Projects five-mile radius study area (see Appendix B). The total cumulative visibility of the proposed wind projects is approximately 41,199 acres. This represents an increase of 554 acres when compared to the 2016 Layout.

The introduction of additional turbines within the same viewshed will increase the number of structures visible from many affected vantage points – thus creating a potential higher density of visible structures. However, visibility of the projects is dependent on viewer location/orientation, distance, and other factors. It is possible that with the additional turbines, the cumulative impact may be minimal.

It is also possible that all three (3) projects may not be visible in a single field of view. For example, views of the Ball Hill Wind Project are to the east and north, views of the Arkwright Summit and Cassadaga projects are to the west and south. If a viewer is at a location north of the adjacent projects and is viewing eastward, it is possible that the adjacent projects will not be visible.

Sound

Insofar as the sound level from the 2018 turbines is equal, less than, or in the case of 19 recptors, imperceptibly higher (1-2 dBA), no change is expected in the cumulative sound impacts of the three reference projects.

Wildlife

Insofar as ground disturbance, including tree clearing and wetlands impacts are reduced from the 2016 design to the 2018 design, no change is expected in the cumulative wildlife impacts of the three reference projects.

Avian and Bat Species

<u>Summary Change in Cumulative Impacts since Ball Hill FEIS</u>

Since the Ball Hill Wind FEIS was accepted in December 2016, the Cumulative Approximate Maximum Bird Fatalities per Turbine for Ball Hill, Arkwright and Cassadaga has decreased from 1,142 to 1,049 as a result of a decrease in number of turbines proposed at Cassadaga. Cumulative Approximate Maximum Bat Fatalities per Turbine for Ball Hill, Arkwright and Cassadaga has decreased from 4,920 to 4,520.

Based on actual post-construction studies conducted in New York State, where there are averages of 4.0 birds/turbine/year (2.2 birds/MW/year) and 11.2 bats/turbine/year (6.1 bats/MW/year), cumulative totals for the three projects is a more reasonable estimate of 452 to 671 birds per year and 1,266 to 1,861 bats per year. This is without regard to operational curtailment at the three wind projects in accordance with NYSDEC policy; as *such, the number of annual bat fatalities are expected to be much lower than these estimates.*

There is a potential for bird and bat impacts from other wind projects in the region to be cumulative if multiple projects are located within the same migratory corridor or within a common local movement area. As such, cumulative impacts associated with the proposed Arkwright Summit and Cassadaga projects were evaluated as they relate to birds and bats in both the SDEIS and FEIS. The analysis is updated here based on the proposal for taller turbines at Ball Hill and reflects other updates from the three projects.

Construction-related activities at each project (e.g., clearing for road construction, infrastructure construction, equipment noise, and increased vehicle traffic) can potentially impact birds and bats by causing temporary displacement from habitat. Because these impacts are generally temporary and would be limited at any one location, potential cumulative construction impacts on bird and bat populations are not expected to be significant. Construction of these projects are also proceeding on different timelines.

The potential cumulative impacts of the operation of the proposed Arkwright Summit project and the Cassadaga project were assessed using approximate fatality rates from post-construction studies conducted at New York State wind energy facilities (see Tables 1 and 2 which are an update of Tables 4.2-2 and 4.2-3 from the FEIS). There is an order of magnitude difference between the lowest and highest fatality rates used here, which makes for a wide range in approximate fatalities. These minimum and maximum fatality rates used in the analysis are unchanged from the FEIS analysis. The number of proposed turbines changed in the Cassadaga project since the time of the FEIS analysis.

The following approximate ranges of cumulative annual bird fatalities for the Ball Hill, Arkwright, and Cassadaga projects were identified (see Table 1).

Between 75 and 1,049 birds (based on number of turbines); and

Between 134 and 1,717 birds (based on the number of megawatts).

Likewise, the following approximate numbers of bat fatalities for the three projects were identified (see Table 2):

Between 79 and 4,520 bats (based on number of turbines); and

Between 140 and 4,972 bats (based on the number of megawatts).

Tables 1 and 2 present the extreme range of estimates of fatalities based on surveys conducted at operating wind energy facilities in New York. Another way to estimate the bird and bat fatalities from these projects is to apply the mean fatality rates from post-construction studies conducted in New York State, where there are averages of 4.0 birds/turbine/year (2.2 birds/MW/year) and 11.2 bats/turbine/year (6.1 bats/MW/year). Applying these rates to the three projects comes up with **more reasonable estimates of 452 to 671 birds per year and 1,266 to 1,861 bats per year**.

The available data from New York and elsewhere indicate that there can be considerable variation in fatality rates, especially for bats, from turbine to turbine and project to project. In particular, the fatality rates used for bats, come from sites that did not include the operational minimization measures that Ball Hill would implement to greatly reduce bat mortality. Through its public documents it appears that Cassadaga will have a similar operational minimization plan as Ball Hill. Thus, the bat fatality rates at these projects should be much lower than the estimates.

Table 1 Approximate Regional Number of Bird Fatalities based on Minimum and Maximum Fatality Rates in New York

Project	Number of Turbines	Number of Megawatts (MW)	Approximate Minimum Bird Fatalities/ Turbine/[1]	Approximate Minimum Bird Fatalities/ MW[2]	Approximate Maximum Bird Fatalities/ Turbine[3]	Approximate Maximum Bird Fatalities/ MW[4]
Ball Hill Wind	29	100	19	44	269	563
Arkwright Summit	36	79	24	35	334	445
Cassadaga Wind	48	126	32	55	446	709
Total	**113**	**305**	**75**	**134**	**1,049**	**1,717**

Notes:

[1] 0.66 birds/turbine/survey period (Jain et al. 2009e). Survey Period Based on 2008 Noble Bliss three-day Survey Rate.

[2.] 0.44 birds/MW/survey period (Jain et al. 2009e). Survey Period Based on 2008 Noble Bliss three-day Survey Rate.

[3] 9.29 birds/turbine/survey period (Jain et al. 2007). Survey Period Based on 2006 Maple Ridge Daily Survey Rate.

[4] 5.63 birds/MW/survey period (Jain et al. 2007). Survey Period based on 2006 Maple Ridge Daily Survey Rate.

One other thing that is different since the cumulative impacts analysis in the FEIS is that there are taller turbines proposed for these three projects. There are taller turbines than the sites previously studied in New York for post-construction bird and bat fatalities. Taller turbines and more overall rotor sweep in these Projects could result in some slightly higher fatality rates than projects with shorter turbines. Most nocturnal songbird migration occurs between 400 feet agl and 2,000 feet agl. With taller turbines, more nocturnal migrants than previously may encounter the risk of turbine collision, while there could be slightly fewer bird collisions with the turbines in the daytime (see previously provided analysis on taller proposed turbines for the Ball Hill project for more details). Potential changes are less clear for bats, but the current consensus is that taller turbines serve as a greater attractant to bats, perhaps being viewed as "taller trees" and from greater distances, and thus pose increased risk of collision. Similar to diurnal bird flight, the more open-air space from the ground could benefit some bat species that tend to fly closer to the ground when foraging. Even with taller turbines and more rotor sweep area, it is not anticipated that fatalities to birds and bats would fall outside of the minimum and maximum rates identified from other studies in New York, especially since the maximum rates are extreme.

Table 2 Approximate Regional Number of Bat Fatalities based on Minimum and Maximum Fatality Rates in New York

Project	Number of Turbines	Number of Megawatts	Approximate Minimum Bat Fatalities/ Turbine/[1]	Approximate Minimum Bat Fatalities/ MW/[2]	Approximate Maximum Bat Fatalities/ Turbine/[3]	Approximate Maximum Bat Fatalities/ MW/[4]
Ball Hill Wind	29	100	20	46	1,160	1,630
Arkwright Summit	36	79	25	36	1,440	1,288
Cassadaga Wind	48	126	34	58	1,920	2,054
Total	**113**	**305**	**79**	**140**	**4,520**	**4,972**

Notes:

[1] 0.7 bats/turbine/survey period (Stantec Consulting 2009). Survey Period Based on 2008 Munnsville Weekly Survey Rate.

[2] 0.46 bats/MW/survey period (Stantec Consulting 2009). Survey Period Based on 2008 Munnsville Weekly Survey Rate.

[3] 40 bats/turbine/survey period (Stantec Consulting 2011). Survey Period Based on 2009 Cohocton and Dutch Hill Daily Survey Rate. Note that this Project did not implement operational minimizations to reduce bat mortality that Ball Hill would employ.

[4] 16.3 bats/MW/survey period (Jain et al. 2011a). Survey Period based on 2010 Noble Wethersfield Weekly Survey Rate. Note that this Project did not implement operational minimizations to reduce bat mortality that Ball Hill would employ.

The cumulative loss of approximately 75 to 1,717 birds per year is not considered to be biologically significant, considering the size of the populations and losses due to other sources of bird mortality: the USFWS estimates that a minimum of 10 billion birds breed in North America (USFWS 2002). There are many widespread sources of bird mortality. However, it is challenging to compare predicted mortality from a proposed wind site to other sources of mortality because local mortality rates from other sources are rarely quantified to allow comparison. On a national scale, the annual bird mortality associated with wind energy facilities is low compared with other sources of mortality but would likely increase with an increase in the number of wind power facilities (AWWI 2015). Other sources that cause much higher numbers of bird mortality than those associated with wind energy facilities include the following:

Vehicles (60 million or more deaths per year);

Building windows (97 million to 976 million deaths per year);

Power and transmission lines (conservatively, tens of thousands of deaths per year, possibly closer to 174 million deaths per year);

Communication towers (conservatively, 4 to 5 million deaths per year, possibly closer to 40 to 50 million deaths per year);

Electrocution (estimated tens of thousands per year);

Pesticides (at least 72 million deaths annually, likely far more);

Oil spills (hundreds of thousands of deaths per year);

Oil and wastewater pits (up to two million deaths per year);

Cats (hundreds of millions of deaths per year);

Agricultural practices (i.e., hay mowing, pesticides) (at least 72 million); and

Hunting (up to 120 million deaths per year) (Gill 1995; Erickson et al. 2001; USFWS 2002).

These sources of mortality are also present or can possibly occur within Chautauqua County.

The species composition of bird fatalities resulting from turbine collision is primarily passerine species (approximately 60% of bird fatalities in the United States, with high percentages in the eastern United States) that occur at the highest rates during spring and fall migration (AWWI 2015). For most bird species, there is often only one individual killed at a site, suggesting that wind power projects do not have impacts at local or range-wide population levels for those species. Most of the fatalities resulting from a project would be of single individuals of one species, but the most common species would have fatalities of multiple individuals. Fatality rates at currently estimated values of avian mortality do not appear likely to lead to population declines in most bird species (AWWI 2015), which is even more applicable for a cumulative evaluation of three proposed projects in Chautauqua County, New York.

Providing a context for the impact of the estimated regional bat mortality from local wind energy facilities in upstate New York (within the extremes of approximately 79 to 4,972 bats/year, but likely much less than previous statewide average of 1,266 to 1,861) on bat populations overall is still challenging because the overall status of bat species populations is poorly known and the ecological impact of bat fatality levels is not known (AWWI 2015). Therefore, it is not possible to quantitatively evaluate population impacts on even a regional scale.

Traffic

No change in cumulative traffic impacts described in the 2016 FEIS is expected as a result of the proposed Project modifications.

Cultural Resources

Insofar as ground disturbance associated with the 2018 proposed modifications is ~10.4 acres less than the 2016, the NYS State Historic Preservation Office (SHPO) has concluded that there will be no increase in archaeological impacts, so that no change is expected in the cumulative sound impacts of the three reference projects (see Attachment 1). The subject matter expert that prepared the historical architectural resources impacts study for the 2016 Application reviewed the viewsheds in the revised Visual Impacts Assessment and concluded that there is no increase in impacts on such resources as a result of the proposed modification, thus no change is expected in the cumulative impacts of the three reference projects (see Attachment 2).

Land Use

Given the reduction in ground disturbances and otherwise lack of change in the location of proposed Project facilities, no increase is anticipated in Land Use impacts of the 2018 design, so that no change is expected in the cumulative impacts of the three reference projects.

Socioeconomics

The subject matter expert that prepared the Property Values Impacts Assessment associated with the 2016 Application has concluded that there will be no additional impacts as a result of the proposed modifications, and no change is expected in the cumulative socioeconomic impacts of the three reference projects (see Attachment 3).

Attachment 1

NEW YORK
STATE OF
OPPORTUNITY.

Parks, Recreation, and Historic Preservation

ANDREW M. CUOMO
Governor

ROSE HARVEY
Commissioner

May 29, 2018

Mr. Mark Lyons Development
Manager
Renewable Energy Systems Americas Inc. 455
Boston Post Road
Suite 206
Old Saybrook, CT 06475

Re: USACE
Noble Ball Hill Wind Farm/94.5 MW/63 Turbines Chautauqua
County
08PR01814

Thank you for requesting the comments of the New York State Historic Preservation Office (SHPO). We have reviewed the information regarding changes to the project that include placement of the transmission line underground and reducing the project area required for the transmission line placement from 55.3 acres to 44.9 acres in accordance with Section 106 of the National Historic Preservation Act of 1966. These comments are those of the SHPO and relate only to Historic/Cultural resources. They do not include other environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the National Environmental Policy Act and/or the State Environmental Quality Review Act (New York Conservation Law Article 8).

The SHPO concurs that since there is a reduction in acreage, no additional impacts to archaeological resources will occur and no additional archaeological investigations are required.

If you have any questions, I can be reached at (518) 268-2179. Sincerely,

Nancy Herter
Archaeology Unit Program Coordinator

Nancy Herter

Division for Historic Preservation

P.O. Box 189, Waterford, New York 12188-0189 • (518) 237-8643 • www.nysparks.com

BUFFALO ● TUSCALOOSA ● MEMPHIS

Panamerican Consultants, Inc. ● 2390 Clinton St. ● Buffalo, NY 14227 ● (716) 821-1650

June 5, 2018

Mark Lyons
RES Group
455 Boston Post Road, Suite 206
Old Saybrook, CT 06475

Subject: Reduction of Visual Impacts to Historic Structures from the Ball Hill Wind Energy Project, Towns of Villanova (23 turbines/Lead Agency) and Hanover (6 turbines), Chautauqua County, New York. NYSHPO Number 08PR01814.

Dear Mr. Lyons:

On May 16, 2018, I discussed the proposed modifications to the project design for Ball Hill Wind Energy Project ("Project") with Mr. John Bonafide, Historic Preservation Services Coordinator, Historic Preservation Field Services Bureau, New York State Historic Preservation Office (SHPO). These modifications include increase in turbine height, minimal turbine location changes, and placement of the transmission line underground.

To present these changes for comparative review with previous Project design submittals, Panamerican prepared an updated viewshed map which depicts the positive viewshed (Zone of Visual Influence) and negative viewsheds (i.e., no structures can be seen) for the current proposed Project design. The current viewshed utilizes a maximum 599-foot tall turbine. Specifically, 27 turbines will be at maximum height of 599 feet, one turbine at 586 feet and one turbine at 567 feet. This positive viewshed was overlaid with the previous positive viewshed (submitted to SHPO in 2016) to highlight the areas of the current viewshed that have not been surveyed for presence of historic structures.

The attached viewshed map compares the viewshed for the current APE and highlights the parts of the current viewshed where turbines would not have been visible in the 2016 project viewshed. The total area within a 5-mile radius of turbines and 3-miles of the transmission line is 170.1 sq. miles, of which turbines will be visible from 135 sq. miles. The 2018 increase to the turbine height makes turbines visible from 5.3 sq. miles more than in 2016 (the 2016 viewshed was 129.7 sq. miles with turbine heights of 492 feet tall). Both the 2016 and 2018 project configurations have 29 turbines. The additional area of positive viewshed does not appear to be significant impact as it is spread over 135 square mile area (see attachment viewshed map).

No structures or buildings will be demolished or physically altered in connection with the Project. No NRHP listed or eligible buildings will be directly affected by Project construction, as documented throughout the Project history (Longiaru et al. 2008; and Addenda 1, 2, 3). While there is some potential for visual and noise impacts to structures

potentially eligible for inclusion in the NRHP, due to construction activities, it is unlikely that these impacts will be significant due to their temporary nature.

In addition, Saratoga Associates submitted photo simulations from various historic sources throughout the proposed Project area in November of 2008. These simulations were updated in May 2016, and have been further updated to reflect design changes and present the impacts associated with the 2018 submittal. The report: Ball Hill Wind Project, Visual Resource Assessment – Technical Memorandum (Saratoga Associates), is included for your review with this letter as a supplement to our report.

Project Description Comparison prepared by Saratoga Associates

The 2016 Layout included twenty-nine (29) turbines in the Towns of Villanova (23 turbines) and Hanover (6 turbines). The turbines then proposed were Vestas V126-3.45 MW, which had a hub height of 285 feet (87 meters), a rotor diameter of 413 feet (126 meters), and a maximum blade tip height of approximately 492 feet. A 5.7-mile overhead
115 kV transmission line was proposed to originate at a new 115/34.5kv collection substation and connect the turbines with an existing National Grid 230 kV transmission line in the Town of Hanover. The line included 60 tangent and angled structure, an 8.6-acre± switchyard, and an approximately 5-acre collection substation.

The 2018 Layout will consist of twenty-nine (29), taller, turbines. The proposed turbines would have a maximum hub height of approximately 360 feet (110 meters), a maximum rotor diameter of approximately 449 feet (137 meters), and a maximum allowable blade tip height of 599 feet. This new proposed turbine configuration represents a maximum increase of 75 feet (23 meters) in hub height and 36 feet (11 meters) to the rotor diameter. The turbine model proposed for the 2018 Layout will result in an increase in maximum blade tip height of 107 feet (33 meters) as compared to the 2016 Layout. (Saratoga Associated, Ball Hill Wind Project Technical Memorandum – February 2018 #2017-026.10 Page 2).

The proposed turbine locations are substantially similar in both layouts, with only three (3) turbines being marginally shifted in the 2018 Layout. It is not anticipated that the adjustments (turbine model and layout) will significantly change the appearance of the previously approved Project layout. The 2018 Layout also removes the above-ground 115 kV transmission line, undergrounds the electric intertie from wind turbine generators to the grid (“gen-tie”), and eliminates the collection substation. An approximate 80-foot-wide clearing will be required through vegetation, which is less than the previously proposed Project.

The placement of the gen-tie predominantly underground will reduce visual impacts from the project. While the underground placement required minor deviations from the previously proposed overhead alignment, the resulting deviations decreased the overall ground disturbance by approximately 10 acres. As no additional acreage has been added to the project, no additional archaeological investigation will be required, as confirmed by Dr. Herter of SHPO in a letter dated May 29, 2018.

The revised viewshed map documenting minimal increase in the positive viewshed and the Saratoga report concludes that it is not anticipated that the adjustments (turbine model and layout) will significantly change the appearance of the previously approved Project layout, or its impacts on historic structures. This recommendation will be submitted to the New York SHPO for their confirmation and concurrence.

If you have any questions, or require any additional information, please do not hesitate to contact me at your convenience.

Sinc
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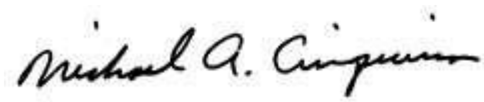

Michael A. Cinquino, Ph.D.,
RPA Senior Vice President
Director, Buffalo Branch
Office

Panamerican Consultants, Inc.

IREM SOLUTIONS

Providing real estate appraisals and compliant solutions

July 18, 2018

Mark Lyons, Senior Manager
RES America Developments, Inc.
11101 West 120th Avenue, Suite 400
Broomfield, Colorado 80021

Re: ***Ball Hill Wind Energy Project***
Towns of Hanover and Villenova, Chautauqua County, New York

Dear Mr. Lyons:

Pursuant to your request, I have reviewed the Ball Hill Wind Project Visual Resource Assessment – Technical Memorandum prepared by Saratoga Associates dated February 2018 specific to changes on the above captioned project.

Project Description:

The Ball Hill Wind Energy Project is an approximately 100 megawatt wind energy project proposed for an area located within two towns in the northeastern portion of Chautauqua County, New York. The proposed project will consist of a total of 29 turbines located on approximately 5,569 acres (includes all easements and setbacks necessary for project construction). The turbines are proposed to be located in the Town of Hanover and the Town of Villenova.

Residential uses are either clustered at various crossroad hamlets or are very sparsely located on individual parcels. Residences are often located roadside, however many are located on isolated lots not viewable from local roads. These rural homes range in quality and condition from well-maintained single-family frame construction to older homes exhibiting significant signs of deferred maintenance. There are also a number of seasonal homes, camps and cabins interspersed throughout the market area. New residential development is limited in the market area.

Project Changes:

The primary changes to the project consists of changes to the turbine height which resulted in an increase of 60 feet in hub height, 32 feet to the rotor diameter and 76 feet in maximum blade tip height. Based on the technical memorandum, the Zone of Visual Influence (five-mile radius) for the 2016 layout versus the proposed 2017 layout is minimal.

Other changes include the elimination of a 5.8 mile above ground transmission line and 60 tangent and angled structures that will significantly reduce visibility of the project. It is noted in the memorandum the proposed revisions will slightly increase the total acreage that may have visibility of the project.

Conclusion:

Based on a review of the cited technical memorandum prepared by Saratoga Associates, there is no conclusive evidence which would indicate any additional impact or potential impact on residential real estate values in the market area analyzed due to the proposed project changes from my 2106 report.

This conclusion is in concert with much of the quantitative research available today on wind farm development effects on property value. While it is impossible to definitively say that there will be no effect on every affected properties value, it is apparent from studying similar areas where wind farms have been developed that no broad based value effects have occurred in those markets.

Respectfully submitted,

IREM Solutions, Inc.

Darrel R. Lloyd Jr.

Darrel R. Lloyd Jr.
New York State Certified General
Real Estate Appraiser
Certificate #46-5539

Addenda

Qualifications of Darrel R. Lloyd, Jr.

QUALIFICATIONS OF DARREL R. LLOYD, JR.

IREM Solutions, Inc.

Education:

- Valencia College, Orlando, Florida
- State University of New York at Buffalo

Technical Training:

- Society of Real Estate Appraisers-Course 101, "Introduction to Appraising Real Property", Buffalo, New York, 1989
- Society of Real Estate Appraisers-Course 102, "Applied Residential Property Valuation", Buffalo, New York, 1987
- Society of Real Estate Appraisers-Course 201, "Principles of Income Property Appraising", Buffalo, New York, 1988
- Society of Real Estate Appraisers-Course 202, "Applied Income Property Valuation", Tarpon Springs, Florida, 1989
- Society of Real Estate Appraisers, "Professional Practice Seminar", Kingston, NY, 1989
- Marshall & Swift Cost Valuation Seminar, "Calculator Cost Method", Buffalo, NY, 1988
- Appraisal Institute, "Standards of Professional Practice", Buffalo, New York, 1991
- Appraisal Institute - Course 520, "Highest & Best Use and Market Analysis", West Palm Beach, Florida, 1994
- American Society Appraisers, "Machinery and Technical Specialties", Chicago, IL, 1994
- American Society Appraisers, "Business Valuation", Toronto, Canada, 1994
- National Golf Foundation, "Golf Course Development and Revaluation", San Francisco, California, 1995
- Appraisal Institute, "Appraisal of Nursing Facilities", Syracuse, New York, 1997
- Appraisal Institute, "Standards of Professional Practice", Buffalo, New York, 1996
- Appraisal Institute, "Standards of Professional Practice", Boca Rotan, Florida, 12/2002
- Appraisal Institute, "Evaluating Commercial Construction", Tampa, Florida, 11/2003
- Appraisal Institute, "National USPAP Course", Amherst, New York, 05/2006
- Appraisal Institute, "Analyzing Operating Expenses", 11/2007
- Seminar: “Law of Easements”, Buffalo, New York, 06/2008
- Appraisal Institute, "Valuation Case Studies", Ellicottville, New York, 01/2009
- Appraisal Institute, "Valuation Case Studies", Tampa, Florida,
- Appraisal Institute, "Office Building Valuation", Tampa, Florida, 10/2010
- Appraisal Institute, "Business Practice & Ethics", 10/2010
- Appraisal Institute, "Analyzing Tenant Credit Risk/Commercial Lease Analysis", Lakewood Ranch, FL, 09/2011
- Appraisal Institute, "National USPAP Course", 07/2011
- Appraisal Institute, "Valuation Perspectives Course", Ellicottville, New York 02/2012
- Appraisal Institute, "Fundamentals of Separating Real Property, Personal Property and Intangible Business Assets Course", Lakewood Ranch, FL,03/2012
- Pennsylvania Law for Appraisers, 5/2013
- 2014-2015 “National USPAP Course”, 11/2013
- Appraisal of fast food facilities, 4/2015
- Expert witness for commercial appraisers, 6/2015
- Appraisal of self-storage facilities, 11/2015

Technical Training (Contd):

- 2016-2017 – "National USPAP Course", 5/22/2017
- Appraisal of Single Tenant Distribution Centers, 5/22/17
- Residential Appraisal Review and USPAP Compliance, 5/26/2017
- The Dirty Dozen, 9/11/2017
- Managing Appraiser Liability, 9/18/2017
- PA State Mandated Law For Appraisers, 5/15/2017

Appraisal Assignments:

- Apartment Complexes
- Automobile Dealerships
- Bulk Petroleum Storage Terminals
- Certiorari Actions
- Community Shopping Plazas
- Condemnation Properties
- Feasibility Studies
- Funeral Homes
- Gas and Service Stations
- Golf Courses
- High Rise Condominiums & Office Bldgs.
- Hotels
- Industrial Complexes
- Land Fills
- Banks,
- Steel Plants,
- Medical Offices
- Nursing Homes
- ROW Projects
- Rehabilitation
- Restaurants
- Retail Department Stores
- Residential
- Steel Plants
- Special Purpose Properties
- Pipelines, Tank Farms
- Petroleum Bulk Storage Facilities
- Temporary and Permanent Easements
- Urban Renewal
- Vacant Land and Subdivision Analysis
- Waterfront Properties
- Nascar Raceway

Prepared & Participated in Appraisals For:

- AT&T Financial Services
- Affiliated Capital Corporation
- Bank of New York
- Benchmark Financial, Inc.
- Buffalo Urban Renewal Agency
- Central Trust Company
- Citibank (NYS) N.A.
- Citizen Associates, Ltd.
- Diversified Capital
- Empire of America, FSA
- Erie Cnty. Industrial Development Agency
- Fleet Bank, N.A
- Future Funding Mortgage Co., of NY, Inc.
- ITT Small Business Finance Corporation
- Key Bank of New York
- Liberty Mutual
- First Niagara Bank
- Manufacturers & Traders Trust Company
- HSBC Bank
- Midas Realty Corporation
- Niagara Frontier Transportation Authority
- NYS Housing Finance Agency
- NYS DOT
- Sibley Mortgage Corporation
- Statewide Capital Corp.
- The Chase Manhattan Bank
- Various Municipalities
- UAW Legal Services

- KPMG Peat Marwick
- Various attorneys & private clients
- Sprague Energy

Licensure/Certifications:

- New York State Certified General Real Estate Appraiser #46-5539
- Pennsylvania State Certified General Real Estate Appraiser #GA003387
- Florida State Certified General Real Estate Appraiser #RZ3955
- New York State Appraisal Continuing Education Instructor
- Maine State Temporary License Certificate #TL3798

Prepared Appraisals in:

California, Colorado, Connecticut, Delaware, Florida, Kansas, Indiana, Georgia, Maine, Massachusetts, Missouri, New Hampshire, New York (including New York City), Ohio, Oklahoma, Pennsylvania, Rhode Island, Texas, Vermont.

Qualified As Expert Witness:

- The appraiser has appeared as an expert witness regarding real estate valuation in New York State Supreme and Federal Courts.
- The appraiser has also appeared before municipal assessment review boards.

Employment History:

- IREM Solutions, Inc., Amherst, NY, CEO, 2012-Present
- Klauk, Lloyd & Wilhelm Inc., Buffalo, NY, Vice President/Partner, 1995-2012
- Upstate Appraisal, Inc. - Commercial, Buffalo, NY, Vice President/Manager, 1993-1995
- International Appraisal Associates (Commercial, Industrial, and Residential), Tonawanda, NY, President, 1990-1993
- Northeastern Appraisal Associates - Commercial Division, Amherst, NY, Associate Appraiser, 1986-1989
- Century 21 M.J. Peterson, Sales Associate, 1982-1986

ATTACHMENT 3

Ball Hill Wind Project Summary of Economic Benefits

Based on the PILOT, Host Community and landowner agreements in place, the Project will contribute approximately $1.16 million to the regional economy annually, including:

- $307,854 in PILOT payments to all property tax entities (Towns, School Districts and County), escalating beginning in Year 6.
- $446,686 total PILOT and Host Community Payments to Towns of Villenova and Hanover annually, escalating beginning in Year 6.
- Over $600,000 annually, escalating.

As summarized in the Revenue Bond and Tax Lease Application the Project submitted to Chautauqua Cunty Industrial Development Agency, during Construction the Project is estimated to create 70-90 full time equivalent jobs, with an estimated $5.3 million in payroll, including benefits.

During Operations over the life of the Project, an estimated 5-7 full time high-skill jobs will be created, with an estimated annual payroll of $649,000 – 909,000, including benefits.