# Mad River Wind Farm Impact Assessment Study

# Tug Hill Region of New York State

# (white paper)

**State University of New York**

**College of Environmental Science & Forestry**

# April 2018

**Background to preparation of white paper**

Tug Hill Tomorrow Land Trust first heard of a proposal for a wind energy facility in the Tug Hill towns of Worth and Redfield from media reports in 2017. Created in 1991 to protect lands important to the Tug Hill region's undeveloped character and economy, the Land Trust is not opposed to the development of wind energy, but these media reports gave rise to concerns about this particular project.

Tug Hill Tomorrow Land Trust normally does not take positions on issues at all. It exists to work with forest land owners and farmers who want to see their land remain in these uses. The only time Tug Hill Tomorrow Land Trust has ever taken a stand on an issue was about a decade ago when it expressed concerns about the proposed Roaring Brook wind energy facility. The Roaring Brook project would be in the Tug Hill region's core forest (as mapped by the NYS Tug Hill Commission and member towns of the Cooperative Tug Hill Council).

The proposed Mad River project is also in the Tug Hill core forest, but dwarfs the Roaring Brook proposal. At Mad River, some of the largest wind turbines (far larger than those Tug Hill residents have seen for years at the Maple Ridge wind facility) would cover a forested area of 20,000 acres – almost half the size of an entire, typical New York State town, and about the size of the existing Maple Ridge project.

The scope of the Mad River proposal, in a forested region, not the more typical siting on farm land and woodlots, seemed new to the Land Trust, and fraught with potential major adverse environmental impacts. The Land Trust decided to go to a respected, neutral third party – the State University of New York College of Environmental Science and Forestry – to determine if the Mad River wind proposal is indeed something new. The result is this "white paper."

Earlier drafts of this white paper were used in preparation of Land Trust comments on the Mad River project's preliminary scoping statement (PSS), since the white paper could not be completed in the short time – just a few weeks – allotted to submit comments on the PSS after it was submitted between Christmas and New Year's Day 2017.

The Land Trust hopes this white paper will set the stage for more detailed discussions of the information needed to thoroughly evaluate the Mad River proposal as New York State reviews it through its Public Service Law Article 10 process.

Tug Hill Tomorrow Land Trust

# Mad River Wind Farm Impact Assessment Study in the Tug Hill Region of New York State

**Prepared for: Tug Hill Tomorrow Land Trust**

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## Study Rationale

This assessment study was sought by the Tug Hill Tomorrow Land Trust (THTLT) to identify potential concerns, impacts and legitimate science-based policy issues, regarding the siting of the proposed Mad River Large Scale Wind Farm Energy Project (LSWF) by Avangrid Renewables, LLC, on the WoodWise property on the Tug Hill (Jefferson and Oswego Counties) region of New York State.

## Study Implementation and Support

This study was conducted at the SUNY College of Environmental Science and Forestry (Department of Forest and Natural Resources Management - FNRM) in Syracuse, NY (SUNY ESF). The study was supported by SUNY ESF and a small grant from the Tug Hill Tomorrow Land Trust. The conclusions listed in this report are from the primary author, and not the PI or SUNY ESF.

## Study Authors

While the study was conducted under the guidance of the Principal Investigator, Dr. David H. Newman, the majority of the research and writing of the report was done by Prof. Brian L. Fisher, a current PhD student at SUNY ESF. Dr. Newman, a nationally renowned forest economist, is the past Chair of the FNRM Department at SUNY ESF, with over 30 years of experience in forest project assessment and is the author of numerous peer reviewed publications. Prior to his coming to SUNY ESF, Dr. Newman was the Associate Dean of the Warnell School of Forestry at the University of Georgia, in Athens Georgia.

Prof. Fisher, currently finishing his PhD at SUNY ESF, has been an adjunct college professor in natural resources for over 30 years, and is the former Forestry Program Manager for the Watershed Agricultural Council of the NYC Watersheds. He also has a consulting background in ecological field assessments, NYS and federal permitting requirements, wetland science/delineations, forest management, and past experience with renewable energy development (forest biomass).

# Mad River Wind Farm Impact Assessment Study

# in the Tug Hill Region of New York State (White Paper)

## Prepared for Tug Hill Tomorrow Land Trust

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**Abstract:** Atlantic Wind, LLC, a subsidiary of the renewable energy company Avangrid Renewables of Portland Oregon, is proposing to construct a state-of-the-art large-scale wind turbine energy farm (LSWF) of approximately 88 Gamesa G-132 wind turbines in the heart of the rural Tug Hill region at the intersection of Jefferson, Lewis and Oswego counties in upstate New York. The proposal, entitled the "Mad River Wind Farm," would have a nameplate capacity generate up to 350 MW [megawatts], or million watts of electricity, enough to provide power for 60,000 typical households over the course of the 20-30 year life span of the project (However, the actual power produced may be substantially less). The project is to be sited under a new, unified review and approval process for electrical facilities generating in excess of 25 MW, according to provisions of Art. 10 of the NYS Public Service Law. Traditionally, forested landscapes were considered as "no-go" locations for siting LSWFs, due to their inaccessibility and problems with airflow turbulence in potentially uneven forested canopies. However, as technology has improved and turbines have increased in height (400 to 600+ feet), forests are receiving new attention, as large-scale landscapes to site wind farms. Only a handful of LSWFs have been constructed in forested landscapes in the US. While wind farms are often considered as beneficial, renewable forms of "green energy" and are increasingly favored by the environmental community for their important contributions to sustainable energy development and reductions in greenhouse gas emissions, they may not always have benign impacts to the environment where they are sited. This white paper, prepared for the Tug Hill Tomorrow Land Trust, examines the potential ecological and environmental impacts from the proposed Mad River project, and focuses on direct and indirect impacts from both the construction and operational phases of the project. The bio-physical ecological impacts addressed include: soils; micro-climate and air quality; noise and visual impacts; riparian water quality and palustrine wetlands; timber stand dynamics and the potential for forest fragmentation; invasive species; bat and bird mortality; recreational impacts; transportation, road building, and ancillary energy facilities construction; the potential impact on DOD radar and electronic facilities; safety and security issues; and connectivity issues related to the existing structure and assimilative capacity of the electric grid network of the region, among others (Avangrid Renewables 2016).

**Key words:** adverse impacts**,** Art. 10 Process**,** bat and bird mortality**,** cumulative impact, environmental permits, forested landscapes, fragmentation, landscape footprint, LSWFs, migratory corridors, nacelle fires, NYS Clean Energy Standard, palustrine wetlands, Preliminary Scoping Statement (PSS), Public Information Plan (PIP), riparian corridors, rotor assembly, shadow flicker, safety issues, Tug Hill region, wildlife habitat, wind turbines.

## I. Introduction and Overview

Atlantic Wind, LLC, a subsidiary of the renewable energy company Avangrid Renewables of Portland, Oregon, is proposing to construct a state-of-the-art large-scale wind turbine energy farm (LSWF) of approximately 88 Gamesa G-132 turbines in the heart of the rural Tug Hill at the intersection of Jefferson, Lewis and Oswego counties in upstate New York. The proposal, entitled the "Mad River Wind Farm," would have a nameplate capacity of up to 350 MW [350 million watts] of electricity, enough to power up to 60,000 typical households over the course of the 20-30 year life span of the project (although the actual electrical power produced may be substantially less). The wind project developer (Avangrid) estimates that 350 temporary construction jobs will be created over the 12 to 18 month window of construction and about 20 permanent jobs will be created after construction is complete. Local municipalities and school districts could receive up to $2 million in tax revenues annually, or up to $60 million over the life of the project, if the wind farm is constructed (Avangrid Renewables 2016).

The wind turbines would be constructed throughout a 30 square mile (approximately 20,000 acre) tract of rural, private land in the Town of Redfield [Oswego County], and the Town of Worth [Jefferson County]. The land, which is largely forested, is interlaced with a major river system (i.e., Mad River), part of the larger and more important Salmon River watershed, and several important smaller streams and water bodies. Additionally, the site contains well over one hundred federal and state mapped freshwater palustrine and riverine wetlands. The land site is currently owned in fee simple by one landowner (Salmon River Timberlands, LLC), a subsidiary of WoodWise Land Company, LLC, a private forestry consulting and timberland investment company, headquartered in Scottsville, NY (WoodWise 2016). WoodWise Land Company, LLC, purchased the tract from a holding company associated with Gutchess Lumber Company of Cortland, NY, in 2012.

## II. The Recognized Importance of the Tug Hill Forest

The Tug Hill region of New York State, and the Mad River area in particular, is a landscape of mixed northern hardwood forests with some coniferous pine-spruce-fir forest land interspersed with high quality lotic riparian rivers, streams and pristine palustrine wetlands. Often referred to as a *plateau*, because it is relatively flat and lacks the higher elevation of the Adirondack Mountains, the Tug Hill is geologically considered to be a *cuesta*, or a sedimentary formation that is tipped or elevated up on one side. The Tug Hill rises from about 350 feet (110 m) in elevation in the west closer to Lake Ontario to over 2,000 feet (610 m) in elevation in the east, and covers portions of four counties in New York State: Jefferson, Oswego, Lewis, and Oneida. The Tug Hill region is the third largest and most contiguous forested region in New York State, after the Adirondacks and Catskill forests, and can be considered as one of the most relatively undisturbed and ecologically important areas in New York State. Additionally, the Tug Hill region core forest is still largely un-fragmented and undeveloped and serves as the headwaters for several major watersheds and sub-watersheds in New York State: Oneida Lake, Deer River, Salmon River, Mad River, Mohawk River, East Branch of Fish Creek, Fish Creek, and the eastern Lake Ontario/Sandy Creek watersheds. Situated in the 'North Country' between Lake Ontario to the west and the Black River Valley and Adirondacks to the northeast, *the Tug Hill forested region is an integral component of New York State's important connected system of ecological biodiversity, and is home to seven rare plant species, four rare animal species and some fourteen different bio-physical natural communities* (The Nature Conservancy 2017). The importance of the integrated Tug Hill forest has been recognized in New York by its inclusion in the NYS Open Space plan, and as a Joint NYS DEC Region 6 & 7 Priority Conservation project, among studies and conservation projects.

## III. The History of and Growth in Wind Energy and Environmental Benefits

There has been tremendous growth in both offshore and onshore renewable wind energy projects globally over the course of the last 10-20 years with an estimated 341,320 wind turbines operating worldwide and over 53,000 utility-scale wind turbines constructed and operating in the United States, as of the end of 2016. Wind turbines and large-scale wind farms have become more popular in the field of renewable energy, as the costs of development have fallen by some 90% since the early 1980's (Business Insider 2017). The total U.S. installed wind capacity, as of December 2016, was approximately 82,183 MW, up from 61,110 MW in 2013 and just 6,222 MW in 2003 (American Wind Energy Association 2017). In New York State, as of 2014, twenty wind energy projects were operating with a rated capacity of about 1,812 MW. That represents 2.6 percent of all electrical power available from generating facilities in New York and is enough electricity to power 500,000 homes (http://www.dec.ny.gov/energy/40966).

Wind energy is also considered a free, non-polluting, “green” renewable resource that does not contribute to greenhouse gas emissions or air pollution. In fact, according to the United States Department of Energy, in California alone in 1990, LSWFs offset the emission of more than 2.5 billion pounds of carbon dioxide, and some 15 million pounds of other air pollutants that otherwise would have been produced. It would have taken a forest of 90-170 million trees to have sequestered the same amount of CO2 and provided the same level of air quality that resulted from the construction and operation of the LSWFs (BLM Wind Energy Development Programmatic EIS 2017).

Siting wind energy projects properly is a crucial part of wind power development and to successfully site wind turbine farms a developer usually must consider the following variables (American Wind Energy Association 2017):

A. Adequate Wind Velocity and Availability – usually 9 to 56 mph;
B. Land Rights – from either private owners or public agencies, so lease rights can come into play;
C. Permits for Construction and Operation as needed from all levels of government;
D. Transmission – adequate integration and connection with the existing grid network;
E. A Potential Buyer for the electricity produced – either another utility or other entity;
F. Adequate Financing – from either their own pool of capital assets or a group of investors.

## Forested Wind Farms

Until very recently, the vast majority of onshore wind energy turbines and wind farms in operation in the United States have been constructed largely on working agricultural lands, desert landscapes, fallow farmland, transitional old fields and brownfield sites. Earlier, in the history of siting on-shore wind farms, forests were usually considered “no-go” sites, due to their relative inaccessibility, competing and/or higher value forest and natural resource or ecosystem outputs, and problems with airflow turbulence, that often reduced the amount of available electricity generated. However, in the last few years, as wind tower technology has evolved and turbines are now routinely being constructed 400 to 600+ feet in height, both coniferous and deciduous forests are receiving new attention as potential large-scale landscapes to site wind farms, due to the reduction in turbulence that occurs with increased height and the physics of wind flow over a forested canopy (Renewable Energy Focus 2011). Larger and taller turbines generate electricity at a lower cost, because the longer rotor blades capture the kinetic energy from a larger cross-section of the wind (known as the rotor swept area) and because taller turbines provide access to stronger winds. The greater and more consistent the wind resource, the more electricity is produced by a given turbine (National Wind Coordinating Collaborative 2010).

Unfortunately, the transition towards renewable energy resources, including LSWFs sited on forested landscapes, is not without problems. Wind energy projects sited on forests and forested landscapes are becoming highly contested policy issues in various countries of the world, and have the potential to develop into serious policy conflicts. Conflicts over the siting of LSWFs in forested landscapes are usually complex, and involve many different stakeholders, policy actors, local residents, municipalities, non-governmental organizations (NGOs), developers, renewable wind energy companies, recreationists, forest owners and nature conservationists (Schulz, Spiegel OnLine 2013).

Only a handful of wind turbines or wind farms have been sited and constructed in forested landscapes in the United States, as of 2017. The Deerfield Wind Farm, near the towns of Searsburg and Readsboro in Bennington County Vermont is, perhaps, the most relevant. It is currently under construction and nearing completion (if not already in operation) on federal public land on the Green Mountain National Forest in Vermont, on forested land administered by the USDA Forest Service. This facility was scheduled to go into service by the end of 2017. This project consists of 15 Gamesa wind turbines each one between 340 and 370 feet tall with a rotor diameter of approximately 290 feet on two ridgelines within the forest. This wind project is estimated to collectively produce 30 MW of electricity or enough electricity to power 14,000 average homes in the State of Vermont over the coming years, once it is fully operational (National Wind Watch, October 13, 2011).

The Deerfield Wind Farm was ultimately approved in early 2017 despite over a decade of often contentious and bitter public debate and several lawsuits by stakeholders and opponents of the project. Additionally, the project was approved despite the fact that the project site is within approximately two miles of the 4,800 acre George D. Aiken Wilderness area on the Green Mountain Forest and is close to critically important and ecologically sensitive black bear denning habitat (Vermont Biz 2017).

Other states in the U.S. that have recently planned or constructed wind farms or wind turbines sited in coniferous or deciduous forested locations include: California (e.g., Hatchett Ridge Wind Project), Texas, Wisconsin, Pennsylvania and West Virginia (e.g., Mount Storm Wind Project), among others (Personal Research BLF 2017). For many of these facilities, concerns and opposition revolve around several of the same issues that are being raised by potential intervenors for the Mad River site: forest fragmentation, impact on wildlife habitat, bat and bird mortality, safety issues, impact on water resources and/or wetland resources, the integrity of the Mad River corridor, etc. A unique characteristic of the proposed Mad River wind farm is not just that it is a large wind facility being planned for a forested landscape, but that the forested landscape is interspersed with high quality aquatic lotic resources and pristine wetlands, and is an integrated ecological unit within the larger core Tug Hill forest, near an important US DOD military base (Ft. Drum in Jefferson County).

Overseas, wind turbine farms are being constructed in forested landscapes in several countries in Europe especially in Germany, Scotland and parts of Scandinavia. In light of the Fukushima nuclear plant disaster in Japan in 2011, Germany has committed to a national policy of phasing out all of its nuclear power plants by 2022, and is committed to construct some 60,000 wind turbines (many in heavily forested landscapes), as part of its new "energy transformation program" and revised national energy approach or "*Energiewende"* policy. Wind farms are currently in operation on forested sites in Hof (in Bavaria), the Rhineland – Palatinate, and are being planned in the Moselle Valley, the Allgau, near Stuttgart and the foothills of the Alps with wind turbines designed in excess of 590 feet tall (Spiegel Online 2017). Still, we know little of the potential *in situ* ecological impacts of a LSWF in a core, headwaters forest, such as that of the proposed Mad River Project.

In Scotland, the Forestry Commission of Scotland is working with commercial and community partners and stakeholders to increase the renewable energy potential of Scotland's National Forest Estate, primarily through hydro power and wind power generation schemes. There are a handful of wind farms operational and several others are in the planning and consultation stages. The goal is to have an installed capacity of approximately 1.15 GW of wind energy capacity on Scotland's National Forest Estate by the year 2020 (Forestry Commission Scotland, 2016).

## The NYS "Clean Energy" Standard

Wind turbines and wind farms are often considered as beneficial "renewable forms of green energy" and are favored by many in the environmental community and by certain levels of government, including select state governments. For example, in New York State, current Governor Andrew Cuomo has recently issued an aggressive state policy directive under his administration's *Reforming the Energy Vision* (REV) program, by way of a *Clean Energy Standard*. This policy directive stipulates that 50% of the electricity supplied in New York State should come from renewable energy sources by 2030 (NYSERDA 2017). New York State is a fairly windy state, the 15th windiest in the United States, according to the NYS Department of Environmental Conservation, and there are approximately two dozen wind turbine energy projects planned or operating in the Empire State, with many more planned in selected locations throughout the state for future development (www.dec.ny.gov/energy/40966.html). Just on the Tug Hill region alone, at least five LSWFs in recent years have been proposed to be constructed (including Mad River), as follows [N.B. Turbine numbers and Capacity subject to change]:

| Facility | Location | Number of Turbines | Generating Capacity |
|---|---|---|---|
| Roaring Brook | Lewis County | 39 | 78 MW |
| Copenhagen | Town of Denmark | 47 | 79.9 MW |
| Deer River | Towns of Pinckney Montague & Harrisburg | up to 40 | 100 MW |
| Number Three | Town of Harrisburg | 35 to 50 | 105.8 MW |
| Mad River | Towns of Worth & Redfield | 88 | 350 MW |

Currently, the largest wind farm in New York State is also located on the Tug Hill. Maple Ridge Wind Farm, which has been in operation since 2006, is located outside of Lowville, NY about 25 miles from the proposed Mad River project site and has 195 turbines on the site. Each of the Vestas V82 turbines produces approximately 1.65 MWs. The entire LSWF is capable of producing about 321 MW of electricity to power approximately 136,000 homes (Data derived from Maple Ridge Wind Farm 2016 and the Tug Hill Land Trust 2016).

Additionally, the federal government, during the Obama Administration formulated a policy within the federal Department of Energy (DOE) to "fast track" the siting of selected wind energy projects that were deemed in the national interest, including the Deerfield Wind Farm site on the Green Mountain National Forest (National Wind Watch 2011). In a document produced by the U.S. Department of Energy entitled, *20% of Wind Energy by 2030*, DOE indicated that it was feasible to consider that wind power in the U.S could supply 20% of the needed electricity, and approximately 500,000 American wind energy jobs by 2030. Further, the document detailed that it was reasonable to assume that rural land owners in the U.S. could expect to receive over $600 million a year in land lease payments from the wind turbines and rural communities could expect to see increases of as much as $1.5 billion annually in direct payments and property tax revenues that could be allocated to fund schools, medical centers, needed infrastructure and several other public services (American Wind Energy Association 2017).

Both the private sector and the public sector of government seek to transition from fossil fuel non-renewable forms of energy, which can contribute to global warming and greenhouse gas emissions such as carbon dioxide ($CO_2$) and methane ($CH_4$), among others, to more renewable and sustainable non-carbon forms of energy. Currently, three-quarters of New York State's electricity is generated from natural gas or from aging coal-fired or nuclear power plants (US Energy Information Administration 2018). A transition away from fossil fuels to renewable sources of energy and electricity is seen as making an important contribution to sustainable energy development for the future (Miller and Spoolman 2015).

## IV. Wind Farm Specifics and Turbine Components

As indicated above, the proposed development action at the Mad River site would consist of the construction of 88 Gamesa wind turbines of approximately 3.3 MW each. Wind turbines, depending on their location, design, manufacturer, and engineered capabilities, usually operate approximately 30 to 40% of the time and are in operation generating electricity optimally when the wind velocity is between 9 mph and approximately 56 mph. Wind speeds below 9-11 mph do not have sufficient force to spin the turbine blades, and the older wind tower nacelles and generators can suffer significant internal damage (with a potential for catastrophic failure and fire) if the wind velocity exceeds 56 mph and the turbines are in operation (UNC TV – Science 2017). Newer turbine designs usually incorporate a governor or braking system that slows or shuts down the turbine if the wind speed exceeds safe levels. Generally speaking, wind turbine farms produce much lower levels of electricity when the wind speeds are below 30 mph (BWEA Fact Sheet 2017). Optimal electricity production typically occurs when the wind speeds are from 30 to 50 mph (Ibid 2017).

Wind turbines are usually given a "Wind Power Class Rating" that is a rating system that is used to rank the quality of the location of a land turbine and the average wind speed of that location. The higher the number, the better the wind resource and the more acceptable the site for development. The Wind Power Class Rating system runs from Class 1 (Poor, wind speeds of 9-11 mph) to Class 7 (Excellent, wind speeds 20+ mph), which is the highest possible rating (Turbine Generator, 2017).

Wind turbines, like aircraft propeller blades, turn moving air and power an electric generator to create an electric current. Although to the casual observer the blades on a wind turbine appear to be moving fairly slowly (11-28 rpm), the displacement of air caused by the rotation of the blades can create wind vortices of 140 to 170 mph directly in front of the blade tips (American Wind Wildlife Institute 2016).

Wind turbines are a variable energy source. Because the wind resource is intermittent and does not blow at a constant velocity all the time, most wind farms over the course of a day or a year operate at below full capacity much of the time. The "capacity factor" of an energy plant measures actual electrical output as a percentage of the total energy potential, if the wind farm ran full-bore for 24 hours a day, 365 days a year. Typical capacity factors for on-shore wind energy facilities in the northeast are about 30% (Ingerson 2011).

Modern wind turbines are usually of two types: (1) the horizontal-axis variety like a traditional farm windmill used to pump water from a well, and (2) the vertical-axis design, much like an egg-beater Darrius model, that was popular a few years ago and is named after its French inventor. Most large turbines that constitute LSWFs are horizontal-axis turbines and have the following components: a blade or rotor assembly that converts the energy in the wind to rotational shaft energy; a drive train consisting of a gearbox and generator housed in a nacelle; a tower that supports the nacelle and rotor; a concrete or cement base pad that the tower is fastened to for support; and various other equipment such as controls, cables, ground support structures and interconnection equipment.

Generally speaking, four of the most common turbine designs that are currently utilized for large wind farms are as follows (Data on turbine designs taken from manufacturer web sites):

**1.** The **GE 1.5 MW** constructed by General Electric in the United States. The GE 1.5 MW has a blade length of 116' and the rotors sit atop a 212' tower for a total height of approximately 312'. The GE 1.5 MW blades sweep a vertical airspace of a little less than an acre. The weight of the GE 1.5 MW assembly (tower, nacelle, rotor assembly and blades) is approximately 164 tons or 328,000 pounds for each turbine.

2. The **Vestas V-90 1.8 MW** constructed by Vestas Engineering from Denmark. Vestas is the world's largest manufacturer of wind turbines. On a Vestas V90 the blades are 148' long and the rotor assembly sits on a 262' tower for a total height of the turbine at 410' tall. The Vestas V90 sweeps a vertical airspace of 1.5 acres. A Vestas V90 weighs 267 tons or approximately 534,000 pounds for each turbine.

3. The **Gamesa G-87 2.0 MW** is constructed by Gamesa Enterprises, a Spanish manufacturer of wind turbines (however, some of their product line is made in the US). The Gamesa G87 model has a blade length of 143' and the large rotor assembly sits on a 256' tall tower for a total height of about 400 feet. Each Gamesa G87 turbine weighs 334 tons or approximately 668,000 pounds. The Gamesa G87 also has a vertical blade sweep of about 1.5 acres.

4. The **Gamesa G-132 3.3 MW** turbine is also constructed by Gamesa Enterprises. The G-132 model is specifically designed to produce maximum generating power at medium wind speeds. The G-132 model has a blade length of approximately 211' and a rotor assembly of 432 feet. The blade tip speed is 75 m/second. Cut in air speed will be 2.0 m/second and cut out air speed will be 25 m/second. The G-132 can be approximately 500+ feet tall with a blade swept area of 13,685 m2.

According to the public information distributed by Avangrid (Atlantic Wind) in September 2017, the wind turbines contemplated for the Mad River site will be the Gamesa G-132 turbines, and collectively they will be capable of producing at least 290 to 350 MW of electricity (Avangrid 2017).

## V. Construction Sequencing & Land Requirements

A survey by the National Renewable Energy Laboratory found that the average wind turbine that produces 2 MW of electricity requires approximately 1.5 acres of land per tower and should be spaced some seven (7) rotor diameters apart from the next turbine (Union of Concerned Scientists 2013). Therefore, given that the Mad River project will involve at least 88 turbines of approximately 3.3 MW, a bare minimum of 188 acres of land may be needed for the towers alone, not counting the amount of land needed for staging areas, access roads, ancillary construction areas, transmission line hook-ups, transmission areas, switching stations, etc. The 188 acre figure may well be very low, compared to what actually may be constructed, and additional significant land area may be needed for the access roads, and other facilities, given the larger rotor diameters and the specific tower configuration engineered for the Mad River site.

Each of the towers is anchored into a concrete pad approximately 30 to 60 feet across and 6 to 30 feet deep, consisting of over a thousand tons of concrete and steel reinforcing rebar. Upland or elevated areas are often blasted to create a level area for each turbine pad of at least 3 acres. The tower structure itself (which may weigh upwards of 220 tons) is then attached to the concrete pad and the nacelle (approximately 72 tons) is affixed to the tower. Finally, the 3-blade rotor assembly is affixed to the nacelles (42 tons). The nacelles contain the gear box and electrical generating equipment along with 80 to 200 gallons of flammable hydraulic oil. As indicated earlier, if the Mad River project uses Gamesa G-132 turbines the total combined weight of all the turbines will be in excess of approximately 41,750 tons or some 83,500,000+ pounds. It is estimated that to erect the completed turbines and construct the access roads (perhaps 20-40+ miles worth of access roads will be needed on the site) a 500 ton crane may be required to lift the turbine assembly parts on the tower structures (Union of Concerned Scientists 2013). Avangrid has indicated that the turbine pads for the Gamesa G-132 turbines at Mad River may be "floating" pads that will not be anchored to bedrock, and that some of the turbine components will be constructed and assembled on site (Avangrid communication to Dr. David H. Newman, SUNY ESF, 2017).

Large-scale wind farms are often promoted by the wind turbine development industry to be energy-wise, publicly beneficial, environmentally benign, and completely compatible with conventional, working agricultural landscapes including: dairy farming, grain farming, livestock pasturing, forestry and timber harvesting operations (Union of Concerned Scientists 2013).

However, many observers have indicated that significant research (depending on the specific ecological characteristics of the site; the number and type of wind turbines sited; the construction history and construction site "footprint" or impact; and their manner of operation over the life of the project) *reveals the likely potential for a high degree of adverse environmental impacts to the environmental and natural resource base in the area where the wind turbine farm is eventually sited* [emphasis added] and operated (National Research Council 2007, U.S. Government Accountability Office 2005, National Academies Press 2007). The most common adverse environmental impacts for a wind project like the Mad River Wind Farm are usually due to either: (a) construction-related activities, or (b) activities related to the long-term operation of the wind farm over its anticipated 20 to 30 year life span. The adverse environmental impacts from a wind farm project are often grouped together and are listed in this report starting on page 17.

## VI. Decision Framework: Decisions, Permits Needed, Public Involvement, Project Issues

The Mad River Wind Farm project is anticipated to involve the construction of 88 wind turbines, each one having an electrical generating capacity of 3.3 MW for a total project generating capacity of 290 to 350 MW (Avangrid 2016).

As the Mad River facility will be considerably in excess of 25 MW, the siting and approval of this facility will be governed by the newly revised Article 10 Process for state-level review and permitting of major electrical generating facilities, which is part of the NYS Public Service Law. A "major electric generating facility" under the Public Service Law is defined as having a nameplate capacity of 25 MW [megawatts] or greater per year. Article 10 (Art. 10 of the NYS Public Service Law, Sects. 160-173), also known as the "Power New York Act" was signed into law by Governor Cuomo on August 4, 2011. The law applies to newly constructed electrical generating facilities and existing facilities that are proposing to increase capacity by more than 25 MW. Examples of major electrical generating facilities include, but are not limited to, fossil-fuel power plants, hydroelectric generating projects and wind energy farms. Art. 10 was in effect in New York State until January 2003, and then expired for approximately 9 years. During the period January 2003 – July 2012, local governments in New York had the authority under state law to review proposed wind projects, under the NY State Environmental Quality Review Act (SEQRA), SEQRA implementing regulations, and any local land use laws in place in their respective jurisdictions.

The revisions of 2011-2012 places the siting authority for wind projects greater than 25 MW in the control of a "Board on the Electric Generating Siting and the Environment" (i.e., the Siting Board or Art. 10 Board), which consists of five (5) members from NYS governmental agencies and two (2) ad-hoc members from the specific townships in which a wind farm facility is being proposed. The five (5) members of the Art. 10 Board are:

- NYSERDA (NYS Energy Research and Development Authority) Chairman;
- NYS Department of Environmental Conservation (DEC) Commissioner;
- NYS Economic Development (ED) Commissioner;
- NY Department of Public Service (DPS) Chairman
- NYS Department of Public Health (DPH) Commissioner
- Two local ad-hoc Community Members, one appointed by the Assembly Speaker and one by the President Pro-Tem of the State Senate.

No wind farm project in New York State has ever been sited and completely constructed, as of the Fall of 2017, using the new Art. 10 Process. Mad River would be one of the first wind farms to go through the complete siting process, and would be the largest wind farm sited of all the proposed wind farm projects for the Tug Hill. It would be one of the largest wind farms to be sited in a forested ecosystem (where there are significant lotic freshwater resources, wetland resources, and a major riverine corridor) in the northeastern United States.

## Wind Farm Siting Process Under Art. 10

The formal siting process involves six (6) separate stages:

A. **Stage 1 -- Public Information Stage** -- this where the developer introduces the project and prepares a Public Information Plan (PIP), creates a web site for the project, holds informational meetings, meets with potential stakeholders, and begins the preliminary field work.

B. **Stage 2 -- Scoping Stage** -- this stage involves the issuance of a Preliminary Scoping Statement (PSS) by the developer to identify potential issues and state what information will be collected and addressed for the project. The PSS should contain:
- The Project Description
- Potential Environmental Impacts
- Proposed Studies and Mitigation – pre and post construction
- The Analysis of Alternatives
- Any applicable local laws and how the project intends to comply or not, and why it would be "unreasonable" to require compliance
- Participating Properties
- Federal and State Requirements

The developer must give public notice, as to the availability of the PSS. Additionally, at this stage, the first round of "Intervenor Funds" is to be made available. The initial allocation of intervenor funds is to be allocated at a rate of $350/MW or some $122,500, half of that amount is to be reserved for use by the affected townships (Personal Calculation, BLF). The other half may be used by other intervenor parties. Avangrid had indicated the Mad River Wind Farm PSS would be issued by "late fall 2017 or early winter 2018," depending on how the process goes (Avangrid Personal communication to BLF 2017). The PSS for the Mad River project was actually issued on 29 December 2017, on a Friday – before a major holiday.

C. **Stage 3 -- Comment and Stipulation Stage**

This stage involves a 21-day comment period after the PSS is issued, where intervenors may comment on the substance of the PSS. The developer then has 21 days to respond to those comments. Approximately 60 days after the PSS is issued, the applicant begins the "Stipulation Process" whereby the applicant works with the Art. 10 Board and stakeholders to resolve any PSS disagreements and to document these disagreements in written stipulations. The presiding examiner (appointed in Stage 2) oversees the negotiation of the stipulations.

## D. Stage 4 -- Application Phase

90 days or more after the filing of the PSS and once the Stipulation Phase is completed, the applicant may file the project application with the PSC for their wind farm project. The formal project application is supposed to contain (among other items):

- A detailed project map, civil drawings, SWPP Plan
- Noise, shadow, visual impact studies
- Bird, bat, wildlife, plant studies
- Wetland delineations and permit applications (DEC/ACOE)
- Electric system modeling to demonstrate emission offset benefits
- Interconnection studies (NYISO System Reliability Impact Study)
- SHPO building and archeological studies
- Decommissioning plans
- FAA clearances and other communication information
- Participating properties
- Wind resource assessment
- Capital cost projection

Again, the applicant is supposed to provide public notice of the application and its availability. At this stage the second round of "intervenor funds" [$1,000/MW or up to $350,000] is supposed to be made available to the intervenors to hire consultants, and pay for expert witnesses, etc.

The Art. 10 Board takes up to 60 days to decide if the project application is "complete." If the application is deemed complete, it goes to the next stage of public hearings and Art. 10 Board review.

## E. Stage 5 -- Public Hearing, Art. 10 Board Review, and Project Decision

During this stage the presiding examiner holds a pre-hearing meeting to set the agenda, identify the parties involved, and schedule hearings. Formal administrative hearings are held with rules similar to court proceedings. Witnesses are sworn in; presenters for the applicant are subject to cross examination; the transcript of the proceedings is recorded and posted on the Public Service Commission (PSC) docket.

The Art. 10 Board reviews the testimony presented at the public hearing and any substantive documentation and renders a decision after making explicit findings. **An Art. 10 permit** ["A Certificate of Environmental Compatibility and Statement of Public Need"] **for the project is granted if (**emphasis added**):**

- The Project is a "beneficial addition" to New York's electric generating capacity;
- Operation of the Project will serve the public interest;
- The Project's environmental impacts will be minimized or avoided to the maximum extent practicable;
- If the Project disproportionally impacts one community it is avoiding, minimizing or mitigating these impacts to the maximum extent practicable;
- The Project is designed to comply with applicable laws (except for any local laws where the Art. 10 Board elects to grant an override, if the local law is 'unreasonable');
- Impacts on Environmental Justice communities will be avoided, offset, or minimized "using verifiable measures" identified;
- A permit decision must be made within 12 months of when the application is deemed complete. The Art. 10 Board can extend the time frame for decision making to 18 months in "extraordinary circumstances."

Allowed participants in the administrative hearing include: the staff of the Art. 10 Board, two local representatives from the townships, SHPO, NYS Dept. of State, APA, DEC, APA, if applicable, DOH, certain residents within the townships affected or within 5 miles, and non-profit groups, or non-governmental organizations (NGOs) formed to preserve natural spaces or limit development.

### F. Stage 6 – Project Compliance and Construction

Once a permit decision is made, any party can request a re-hearing within 30 days of the decision. The Board has 120 to 210 days to consider that request. After the hearing process is over the applicant/developer submits engineering plans, drawings, studies or other materials the Art. 10 Board deems necessary to ensure compliance. The Compliance filings are then approved, and the applicant/developer receives permission to begin construction of the project. The construction site and all construction records must be open for inspection by the Art. 10 Board and the PSC.

**Potential Environmental Permits Needed for Mad River Wind Farm Project**

It is likely that the Mad River Wind Farm project will need several types of environmental permits from various local, state, and federal agencies including, perhaps, but not limited to:

- An "**Art. 24 Freshwater Wetlands Permit**" from the NYS DEC for the placement of any "dredge or fill" materials within a state regulated wetland and/or its 100' adjacent buffer area under the NYS Freshwater Wetlands Act;

- A **SWPP Plan and permit** from NYS DEC for controlling storm water runoff from the site;

- A **federal Sect. 404 permit** from the US Army Corps of Engineers for the placement of any "dredge or fill" material in a federally mapped wetland or one that is subject to regulation by the US Army Corps of Engineers under Section 404 the Clean Water Act.

- A **Sect. 401 Water Quality Certification** from the NYS DEC stipulating that the project will not adversely impact the water quality of the State of New York.

- A **NYSDEC "Art. 15 Protection of Waters Permit**" for any potential adverse impacts to protected stream segments on the property from the project and/or stream crossing or disturbance activity from access road construction or turbine placement.

Given that this construction project is fairly extensive and will be massive in size, the environmental permitting required may not be in the form of permits for each individual turbine. Rather both NYS DEC and the U.S. Army Corps of Engineers may decide to issue a type of statewide or nationwide regional or special purpose permits to cover the construction and operational activities at the Mad River site.

**Potential Project Adverse Impacts**

It is anticipated that there will be certain types of adverse impacts from the project to the project site and natural resource base of the site. The adverse impacts may occur in one of two project phases: (a) the physical construction phase of the project, which is anticipated to last approximately 12 to 18 months or (b) the operational phase of the project, anticipated to last approximately 20-30 years. Potential adverse impacts from the project are listed below:

**Potential Adverse Environmental Impacts from the "Mad River" Wind Farm Project**

I. Potential Adverse Impacts to Soils and Sub-Surface Geology

II. Micro-Climate and Air Quality Concerns

III. Potential Noise and Visual Impacts such as "Visual Pollution and Shadow Flicker"

IV. Potential Adverse Impacts to Surface Waters, Riparian Systems, Palustrine and Riverine Wetlands, and Groundwater Supplies

V. Potential Adverse Impacts to Forest Resources and Stand Dynamics – Fragmentation Issues

VI. Potential Adverse Impacts to Wildlife and Habitat Dynamics

- a. Migratory Impacts, Wildlife Corridor Issues, Home Range and Connectivity Disturbances, Sensitivity Issues, Impacts on Floral and Faunal Biodiversity, Invasive Species, Impacts to Endangered, Threatened Species or Species of Special Concern
- b. Bat Impacts – Mortality and Habitat Interference and Loss
- c. Bird Impacts – Mortality and Habitat Interference and Loss
- d. Fisheries Impacts – due to Sedimentation and Siltation from construction

VIII. Construction, Road, and Transportation Adverse Impacts

- I. Safety and Security Issues and Adverse Impacts
  - a. Ice Throws and Ice Shedding
  - b. Tower Collapse and Blade Failure
  - c. Lightning Strikes and/or Stray Voltage Impacts
  - d. Nacelle Fires – both from Equipment Failure, Improper Operation and/or Maintenance, and Lightning Strikes
  - e. Lack of Appropriate Fire Fighting Equipment at the Township Level
- II. Potential Adverse Impacts to Surrounding NYS Public Lands
- III. Potential Impacts to Recreation and Eco-Tourism Industries
- IV. Potential Impacts to the Defense and Telecommunications Industries (Ft. Drum)

Many governmental agencies such as the USDA Forest Service, the USDI Bureau of Land Management, and the USDI Fish and Wildlife Service (along with many state conservation departments) have begun to formulate and implement guidelines and protocols for siting, constructing and operating wind energy farms on public lands (BLM Wind Programmatic EIS 2017 and USDA Forest Service Strategic Energy Network 2011).

## Problematic Areas of Concern When Siting the Mad River Project – Direct and Indirect Likely Impacts of the Project

Despite the progress that has been made in addressing environmental and ecological issues that result from siting wind farms in forested landscapes, many areas of potential concern remain. Regarding siting the proposed Mad River Wind Farm for the Tug Hill region of New York State, there are several environmental and ecological areas of concern in a heavily forested landscape (especially one with high quality surface riparian resources and numerous palustrine wetlands, and steam and river corridors) that may be very problematic. Unfortunately, because the author did not have access to the site, we are not able to conduct *in situ* ecological field studies that would allow for a better understanding of the site conditions at the WoodWise property. Therefore, the thrust of the research in this white paper is restricted to information, data, and published research results contained in the relevant literature, and the "Best Professional Judgment" (BPJ) of the authors. This white paper examines these problematic areas of concern and addresses potential adverse impacts from the proposed LSWF at the Mad River site, as follows:

**1. Adverse impacts to soils and sub-surface geology**.

It is anticipated that the total weight of the 88 turbines on the landscape will be in excess of 41,750 tons or 83,5000,000 pounds (exclusive of the other facilities constructed at the site and the constructed access roads), distributed throughout the site (BLF personal calculation). The wind turbines will be built in a remote geographic area that is characterized by differential microtopography, consisting of upland and upslope areas interlaced with bottomland wetlands and saturated soils that will likely require a high amount of "fill' material to be trucked in to support the weight of the turbine assembles on the concrete pads. Significant soil compaction and disturbance activity may occur to the naturally occurring soils and sub-surface geology on the site, due to the construction of the concrete turbine pads, ancillary facilities, above and below ground transmission lines and the network of access roads needed to support the wind farm complex. There exists the possibility of some degree of soil erosion, sediment transport, and degradation of adjacent or proximate surface lotic and lentic systems and palustrine wetlands, depending on the placement of the turbines and the proper application of BMPs (Best Management Practices) to protect water quality.

The soils on the WoodWise property are a combination of upland and lowland hydric or near-hydric soils soil types. Due to changes in topography and site elevation, the soil drainage classes range from moderately well drained to very poorly drained soils with high water tables and saturation at or near the surface. The soil series in the area of the Mad River project include: the Bice-Haights Complex (BmB, BlB), Carbondale Mucks (Cc), Ensley silt loams (Em), Gulf silt loam (Gw), Fluvaquents (Fu), Pinckney-Ensley silt loams (PkB), Rifle Mucks (RM), Westbury-Dannemora series (WDB), and the Worth and Empeyville series (WSC), among several others (NRCS Web Soil Survey 2017).

**2. Micro-Climate and Air Quality.**

It is expected that some minor reduction in local air quality may occur during the construction phase of the project, due to the amount of soil disturbance and resulting particulate matter dispersed to the atmosphere from the pad construction and the physical alteration of the landscape for the construction of the access roads and ancillary facilities.

However, while converting wind's kinetic energy into electricity, there is some evidence that wind turbines can modify surface-atmosphere exchanges and the transfer of energy, mass and moisture within the lower atmosphere and modify temperature and moisture levels at the land surface - atmosphere interface (Zhou et al. 2012). In a recent study in Texas, satellite data showed a significant warming trend of up to 0.72 degrees C, especially at night-time, over wind farms relative to non-farm regions nearby (Ibid 2012). Additionally, recent research in Scotland indicates that wind farm turbines can affect several measures of ground-level microclimate. In this study, operational wind turbines located in a peatland ecosystem raised air temperature by 0.18 degrees C and absolute humidity (AH) by 0.03 g m-3 during the night, and increased the variability in air, surface and soil temperature during the diurnal cycle. These effects on ground-level microclimate (including soil temperature and soil moisture) have uncertain implications for surface herbaceous vegetation, invertebrate soil and surface organisms that may be subject to changes in ambient temperature and soil moisture conditions, biogeochemical processes and ecosystem carbon cycling (Armstrong et al. 2016).

**3. Potential Noise and Visual Impacts.**

One of the most readily identified objections to large scale wind farms from the public is the "visual pollution" they create on the landscape. Each of the planned 88 Gamesa - 132 turbines anticipated for the Mad River wind farm site will tower upwards of 500+ feet in the air, way above the canopy from any mixed, northern hardwood climax forest that will ever grow at the site. The tallest tree in New York State is an Eastern White Pine (*Pinus strobus*) over 160.4 feet tall, and some 300 years old that can be found associated with other white pine in the "Elder's Grove" a stand of white pine dating from about 1675 located outside Paul Smith's, New York on the Saranac Lake Wild Forest. A climax forested canopy at the Mad River site is unlikely to "hide" these towers in the project viewshed. These wind turbine towers will likely be visible many miles away from the site, even if the construction site is on remote, secluded, private land.

This is especially true at night when all of the potential aviation safety lights (usually red in color) that will be installed on the towers are activated and they start blinking throughout the night. The red aviation lights are installed on the turbine towers to prevent collisions with low-flying aircraft and are a standard safety measure.

In addition to the potential for visual pollution as "eyesores on the landscape," some research indicates that the wind towers can be quite noisy, the closer you get to them. At the actual tower location itself, the sound pressure level can reach 90 to 105 dB(A), or as noisy as a lawnmower or blender in the average kitchen. At 100 meters away from the tower, sound levels drop off to about 50 dB(A), or as loud as an air conditioner. It should be noted that some research papers have found higher sound pressure levels than are here indicated (GE Reports 2014).

"Shadow Flicker" is a phenomenon associated with wind turbines and occurs when the large blades of a turbine pass in front of the sun to create a recurring shadow on an object. Shadow flicker has been reported to be a problem where wind turbines have been built in close proximity to residential housing. However, given that the Mad River project would be built on private land that is secluded and away from private homes or residences, it is unlikely that shadow flicker should be a significant problem. Mitigation measures for noise and adverse visual impacts, including shadow flicker, should be considered by the developer for this project and include the installation of vegetative buffers and setback requirements (Wind Energy Foundation 2009).

**5. Potential Impacts to Water and Wetland Resources.**

The Mad River site contains many high quality lotic surface waters, including the Mad River, (which is a major tributary of the Salmon River), and the Salmon River, a world class, multi-million dollar fishery resource. The Salmon River flows in a westerly direction into Lake Ontario. These two rivers within the mapped project site study area have been listed as "study rivers" to be examined by the USDI National Park Service (NPS) and/or the NYS Department of Environmental Conservation (DEC) for possible inclusion into the state or federal Wild and Scenic River system. Both the Mad River and Salmon River systems were listed as study rivers, due to their "wild" characteristics, the importance of their watershed locations, and the fact that they represent undeveloped and remote riverine corridors on the Tug Hill.

Further, the Mad River (or its immediate project study area) site contains all or portions of several different riparian streams and stream corridors, many of which are classified by the NYSDEC at a minimum as either C or C(t), in terms of their water quality classification. Included in or near to the Mad River site are: Mad River, Big Brook, Cold Brook, Roaring Creek, Castor Brook, Gillman Creek and possibly Grindstone Brook, Slide Creek, Pigeon Creek, and Abijah Creek, among others. Additionally, according to data contained in both the NYS DEC Environmental Mapper Data Base and the US Fish and Wildlife Wetland Map Data Base, the entire Mad River acreage is interspersed with over one to two hundred pristine mapped DEC and ACOE regulated wetland resources. These wetland resources may be negatively impacted depending on where the towers are specifically sited on the landscape, or on where the access roads and ancillary equipment areas are placed. Much "fill" material will likely be needed to be placed on the project site, for the construction activities planned (NYS DEC Environmental Mapper 2017 and US Fish and Wildlife Service Wetlands Mapper 2017). Any construction activity within the proposed site will have to be especially sensitive to the full and complete implementation of BMPs to protect water quality and avoid sedimentation and sediment transport issues which might adversely affect the riparian corridors and palustrine wetland areas, especially the Mad River or other tributaries to the Salmon River fishery.

In addition to potential degradation of surface waters and wetlands, the project will likely cause the outright destruction of some wetland and aquatic resources, especially those that cannot be "avoided or minimized." It is likely that the developer-applicant will offer some type of compensatory mitigation to offset losses to wetland and aquatic resources (either in the form of newly created or restored ecotype or financial compensation as directed by the federal and state regulatory agencies). One of the important ecological features of the WoodWise site on the Tug Hill is not just that it constitutes a significantly large component of the original "core forest" for the Tug Hill, but from an ecological biodiversity standpoint, the Tug Hill WoodWise property represents a unique interspersion of upland forest and lowland wetland ecotype with key distinctive and critically important riparian components. Many of the NYS mapped freshwater wetlands identified in the PSS are classified as Class 2 or above, and are of significant importance to the area. Some type of functional assessment of the wetlands (both ACOE jurisdictional and NYS mapped wetlands) that might be adversely impacted by construction activities should be conducted to determine the potential wetland functions and values that might be forever lost due to construction activities.

**6. Potential Impacts to Timber Stand Dynamics, Forest Resources and Fragmentation.**

Without access to the WoodWise property, the only way to visually gauge the on-the-ground natural resource base (including the forest cover) has been to visually assess the site during a low altitude flyover (January 2018). Therefore, it has been extremely difficult to assess the condition and structure of the forest resource on the property. The Mad River forest can be considered part of the historical "core forest" that existed on the Tug Hill, prior to settlement. Specific forest parameters such as: (1) condition of the growing stock; (2) age and diameter classes extant; (3) stumpage values; (4) net annual increment; (5) species composition; (6) site class; (7) stand volumes and potential yield; (8) allowable harvest; (9) and silvicultural recommendations for the future …. none of these parameters are currently known with a high degree of certainty. The property formerly belonged to a holding company associated with Gutchess Lumber Company of Cortland, NY. The land was sold to WoodWise (Salmon River Timberlands, LLC) in 2012, from Gutchess Lumber. It is known that a timber harvest was done on the site, prior to the transfer of ownership from Gutchess Lumber to WoodWise. Therefore, it is likely that a reduced amount of the larger diameter, higher quality growing stock (veneer or sawlogs) remains from the previous cutting cycle (Personal Communication, 2017, Dr. Rene Germain and Dr. David H. Newman).

Based on known data, the forest on site is a mesic, mixed northern hardwood forest consisting of American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*) and yellow birch (*Betula alleghaniensis*) with a likely understory of Eastern hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), ironwood (*Ostrya virginiana*), and musclewood or Blue-beech (*Carpinus caroliniana*) on the wetter or riparian sites. Additionally, it is likely that the site contains some spruce-fir cover type (*Picea rubens*, *Picea glauca*, and *Abies balsamea*), as the forest is located in a transition zone to the semi-boreal Adirondack forests that occur to the north and northeast.

Because significant land clearing will need to be done around each pad, a cleared area in the forest will have to be harvested around each of the turbines (~1-3 acres) ---- creating a pattern of little pockets of open land surrounded by more dense forest cover. Additionally, the extensive network of access roads necessary to service the turbines will contribute to a significant fragmentation of the forest cover. Thus, the forest cover will no longer be completely intact at the Mad River site, but will be a fragmented patchwork. It is unclear at this time, the degree to which the forest can remain a "working landscape," based on the anticipated level of development.

## 7. Potential Impacts to Wildlife, Wildlife Habitat, and Invasive Species.

The total amount of animal habitat permanently altered by wind farms is often thought to be smaller than other forms of land use (BLM 2017). However, surrounding habitat near a wind turbine is usually degraded in the near and long term by turbine construction, road construction, noise, human presence, habitat fragmentation, and migratory and travel corridor disruption. With an estimated 88 turbines that will be constructed at the Mad River site, significant openings will be created in the forest structure around each turbine of potentially 1-3 acres. Those animal species that rely on un-fragmented, congruent habitat or intact travel/migratory corridors will likely suffer some degree of habitat disruption and avoidance, and are especially vulnerable to wind farm development (American Wind Wildlife Institute 2016). The loss of natural communities to tower pads, roads, transmission lines and other structures affects all species in the impacted area, including plants and non-flying animals not subject to collisions. The construction of access roads in wind farms (even small ones) have been shown to negatively impact bird species, facilitate the spread of invasive species, and dramatically increase habitat fragmentation (Ingelfinger and Anderson 2004). Unfortunately, because no information or data has been released from the *in situ* field studies associated with the construction of this project (as of January 2018) no definitive assessment or conclusions can be made about the *site specific adverse impacts* on wildlife species such as migratory waterfowl, terrestrial megafauna, upland birds, invertebrates, fish populations in the riparian habitats, bat populations, and other forms of wildlife. This white paper addresses the issue of unwelcome invasive species, due to land clearing, road and facilities construction, and other adverse activities that potentially damage native herbaceous species and allow invasive plant species into the seed bed at construction sites, further on (page 27).

## 8. Potential Impacts to Bats.

The increased use of wind energy in the future to generate electricity without producing significant carbon emissions is largely expected to lower or reduce the risk of potentially catastrophic effects to selected wildlife populations from unmitigated climate change. Unfortunately, the siting and operation of LSWFs and wind energy operations does present a potential problem for wildlife populations, including bat populations.

Relatively small numbers of bat fatalities were recorded at wind turbine farms prior to 2001 (Johnson 2005), primarily due to the fact that most of the early monitoring studies on wildlife mortality focused on bird fatalities (Anderson et al. 1999). Thus, it is more than a little likely that bat fatalities have historically been underestimated in the research literature up until very recently (Kunz et al. 2007). Recent wildlife monitoring studies have indicated that some utility-scale LSWFs have killed large numbers of bats (Johnson 2005; Arnett 2005; Kerns et al. 2005). Bats may be killed or injured by: (1) direct impact with turbine blades, wind tower structures, or transmissions lines, and by (2) a phenomenon called "barotrauma," where the bat is injured or killed due to lung damage caused by suddenly passing through a low pressure region surrounding the turbine blade tips, as the rotor is spinning (American Wind Energy Association 2009). There is some disagreement in the literature about the severity of the "barotrauma" issue.

Of the approximately 45 species of bats found in North America, 21 have been positively identified in ground searches at LSWFs when conducting bat mortality studies around the United States. Of these 21 species, nearly 41% of the total mortality (2,329 specimens) in one study was made up of the Hoary bat (*Lasiurus cinereus*); 23.3% of the mortality was the foliage-roosting Eastern red bat (*Lasiurus borealis*); 10.5% of the dead bats sampled were the Eastern pipistrelle (*Pipistrellus subflavus*); 8.4% were the tree cavity-dwelling Silver-haired bat (*Lasionycteris noctivagans*); 5.8% of the sampled bats were the Little brown Myotis (*Myuotis lucifugus*); 5.7% were the Brazilian free-tailed bat (*Tadarida brasiliensis*);and 2.4% the Big brown bat (*Eptesicus fuscus*). Other bat species found in the mortality studies included: the Western red bat ((*Lasiurus blossivilli)*, the long-eared myotis (*Myotis evotis*), and the northern long-eared myotis (*Myotis septentrionalis*) (Kunz et al. 2007).

Based on recent research several important trends relative to bat mortality have emerged in recent years, as follows:

- Migratory tree-roosting species of bats common to forested ecosystems seem to be especially vulnerable to collisions with wind turbines, during the periods March through May and again from August to November;
- Fatalities of bats have been recorded at all wind energy facilities for which results and records are publicly available;
- Bat fatalities peak at wind facilities during spring migration and again during the late summer and early fall migration;
- Fatalities of migrating and feeding bats are highest during periods of low wind velocity and at dawn and dusk;
- Bat fatalities reported in the US have been highest at wind energy facilities along forested ridgetops in the East;
- Some bat species may be attracted to wind turbines because of several factors, including: the audible or ultrasonic sounds produced by turbines; a concentration of insects near the nacelle that are attracted by heat or the altered forested landscape when openings in the forest are created; the turbines may be perceived as potential roosts; the bats cannot detect moving turbine blades through echolocation or they miscalculate rotor velocity; nocturnal insects are visually attracted to turbines; wind turbines constructed in forested landscapes create clearings with linear landscapes and openings that are attractive to bats; wind turbines produce complex electromagnetic fields, causing the bats to become disoriented (American Wind Wildlife Institute 2016; Kunz et al. 2007).

In April 2009 the Bats and Wind Energy Cooperative released initial study results that indicated a 73% reduction in bat fatalities when wind farm operations were stopped during low wind conditions, and at dawn and dusk when bats are most active (American Wind Energy Association 2009). Additionally, bats avoid radar transmitters, and placing microwave transmitters on wind turbine towers may reduce the number of bat fatalities (Nicholls et al. 2007). Bats are usually long-lived and some species have relatively low biotic potential and reproductive rates (BP), making populations susceptible to localized population reductions and extinctions (Barclay and Harder 2003).

Here, in central New York, two bat species of great interest and concern are the endangered Indiana bat (*Myotis sodalis*) and the threatened Northern long-eared bat (*Myotis septentrionalis*). Both of these species occur in Central New York, and can probably be found on the Tug Hill, as there is a winter hibernaculum located both in Jefferson and Onondaga Counties (Indiana Bat 2017 NYSDEC). Both of these species will summer roost in trees with exfoliating bark (e.g., the hickories, *Carya spp.),* and both are susceptible to “white-nose syndrome,” a fungal disease that has decimated populations of the Indiana bat in recent years. The Copenhagen Wind Farm project in Lewis County (62 turbines) has recently been involved in surveying for bat activity and preparing a bat conservation plan at that wind farm site (NCPR 2015).

## 9. Potential Impacts to Birds (Avian Impacts).

Although renewable "green" wind energy has gained prominence in recent years as a means of generating electricity without emitting air pollutants or greenhouse gases, a significant problem remains concerning adverse impacts to avian populations and bird mortality – usually resulting from collisions with moving rotor blades. Two general types of local adverse impacts to bird populations have been observed at existing wind facilities: (1) direct mortality or "bird strikes" and (2) indirect impacts from area avoidance, habitat disruption, reduced on-site nesting/breeding density, habitat abandonment, altered habitat unsuitability, loss of refugia, and behavioral effects. These "bird strikes" have grown in frequency and occurrence over the last decade as turbine towers have become more numerous on the landscape. Over 200 species of birds have been documented as being killed by collisions with wind turbine blades. These include resident and migratory passerines (songbirds), and raptors (hawks, eagles and falcons) that hunt by day, and some wetland species. Raptors are especially vulnerable to mortality by rotor strikes due to their flight behaviors. The given risk of a bird collision with a wind turbine is influenced based on turbine location and orientation (placement); turbine height, size and design; wind flow and direction; and bird behavior (including how birds move) across the landscape (Audubon 2016).

At a landscape scale, mortality may increase near migratory routes, in areas with high concentrations such as roosting or feeding areas, along riparian corridors and ridgelines, near wetland ecosystems and along coastlines. How birds use the landscape also influences their exposure to turbine collision risk, such as:

- Birds in soaring flight are often unable to maneuver well, and get swept up in the rotor sweep zone;
- Diurnal birds usually fly at lower heights and may be more likely to get caught up in the rotor sweep than birds that are nocturnal.
- Birds that are migratory or that have lower flight heights often congregate near summits or steep slopes or are attracted to open habitats (wetlands, riverine corridors, grassy openings in the canopy) where turbines are often sited, looking for food and increasing their risk of collision.

Current best estimates are that turbines kill somewhere between 140,000 to 328,000 birds each year in North America, although that number may be low (Audubon 2016). There are several strategies to try and prevent bird strikes including the use of cameras, radar, and GPS units to detect incoming flocks of birds and to turn off the rotors in time for the birds to fly through the area without sustaining damage. Other strategies being considered include: bright blades, bright lights, turbines that look like trees, and smart blades (Ibid. 2016). Given the combination and interspersion of forested, riparian, and wetland ecosystems, the Mad River site may be especially vulnerable to bird mortality from blade strikes and collisions with the turbine structures. The developer should give special attention to the potential problem of avian mortality, both during and after the construction of the LSWF at the Mad River site.

## 10. Potential Impacts to Fishery Resource

The WoodWise property where the Mad River LSWF is scheduled to be sited is located within the Mad River watershed, which is nested within the much larger Salmon River watershed (approximately 285 square miles). The Mad River flows west from Lewis County onto the WoodWise property and then turns south for several miles before becoming a tributary of the Salmon River/Reservoir system. The Salmon River then flows west, eventually making its way to Lake Ontario. The entire integrated Mad River/Salmon River/Lake Ontario system is home to a world class fishery resource that includes brook trout (both native and stocked) in the upper reaches of the Mad River down to the Salmon River and Lake Ontario (Trout and Chinook, Atlantic, Coho Salmon and Steelhead). Every year the NYS DEC stocks approximately 400 brook trout in the Lewis County portion of the Mad River to complement the existing wild brook trout population in the rest of the Mad River and several of its tributaries (Slide Creek, Roaring Brook, and Beaver Creek, among others). The Mad River, which is largely tree-lined along its watercourse, and is partially located in Lewis, Jefferson, and Oswego counties contains approximately 6.6 miles of Public Fishing Rights (PFRs) access areas to allow the public access to the valuable brook trout fishery resource (www.dec.ny.gov/outdoors/44869.html.). The Mad River also affords opportunities for rafting and kayaking south of the WoodWise property from the area near Caster Hill south to North Branch (or east of Greensboro to north of Redfield north of the Salmon River Reservoir).

Additionally, the NYSDEC, through its fish hatchery at Altmar, NY stocks over 3.5 million trout and salmon fingerlings (Atlantic salmon, Chinook, Coho, and Steelhead) in the Salmon River corridor system that eventually contribute to the outstanding fishery resource of the Salmon River and Lake Ontario regions. The entire region has become a "world class" fishery resource for the Tug Hill region. Recent NYS DEC Angler Surveys estimate that approximately 2.6 million angler days are spent in recreational fishing on Lake Ontario and its tributaries (including the Salmon River and Mad River corridors) each year and that the combined fishery resource contributes some 112 million dollars annually to the local economies of the region on the Tug Hill (www.visitoswegocounty.com). The importance of the integrated fishery resource from the Mad River south to the Salmon River west to Lake Ontario to this region cannot be overestimated. Clearly, any land disturbance activities on a large scale from a LSWF through the construction of the wind towers and pads, ancillary buildings, access roads, staging areas, etc. may have adverse water quality impacts regarding siltation and sedimentation transport to the Mad River/Salmon River integrated system (unless there is scrupulous and painstaking attention to the full implementation of BMPs to protect water quality during construction). Further, construction of wind towers along the Mad River corridor may be problematic for both visual and wildlife habitat concerns, as indicated elsewhere in this report.

## 11. Recreational Impacts

The Tug Hill region of New York State supports a variety of recreational pursuits that are of great importance to the local regional economy. Hiking, canoeing and kayaking, whitewater rafting, camping, world class fishing on the Salmon River, motorcycling, bicycling, ATVs, golfing, birding, rock climbing, boating, hunting, snowmobiling, downhill and cross country skiing, snowboarding, horseback riding, fall foliage tours, and shopping for antiques are a few of the many recreational opportunities available in the Tug Hill region. With numerous state forests and the Little John State Wildlife Management area in close proximity, the Mad River region is an important attraction for both big game and small game hunters. Additionally, there are several museums and other tourist attractions in the Tug Hill region that draw people in to the area: Snow Ridge Ski Resort, Maple Ridge Snow Park, Tug Hill Vineyards, the American Maple Museum, the Mennonite Heritage Farm, and the North American Fiddlers Hall of Fame and Museum Institute.

Perhaps the greatest attraction for recreation revolves around the fact that the Tug Hill receives in excess of 200 inches of snowfall during the average winter, due to lake-effect snowfall generated off Lake Ontario. This means that the Tug Hill is a "mecca" for the many snowmobilers in the area that take advantage of a vast network of approximately 450 miles of trails that connect to other Adirondack snowmobile trails and a similar trail network in southern Ontario and Quebec.

The literature on the impact of wind turbines to an area's tourist and recreational base is somewhat mixed. The question "does wind power development harm tourism" in a given area is not easily answered, but the majority of the studies that have been done on this topic usually do not show a serious negative long-term impact to regional tourism from wind development (Aitchison 2012 and Prinsloo 2013). However, it is unclear at this time as to the impact on site recreational opportunities (such as the impact on the Mad River Hunt Club leases) or the regional recreational opportunities (Salmon River fishery or local snowmobile operations). More research should be done on both the economic impacts and recreational impacts of the Mad River LSWF prior to construction.

## 12. Transportation, Roads, and Construction

At the present time, it is anticipated that some additional road construction will be necessary to facilitate the placement of the turbines on the property. Currently, some 20+ miles of roads exist at the site (personal correspondence, 2017, Robert Quinn), but more ancillary roads will need to be constructed up to the placement of each of the turbine pads. Given the fact that the 88 turbines will be sited throughout the entire bulk of the property, some degree of wildlife habitat fragmentation and/or corridor fragmentation in the various compartments on the property is inevitable. This may result in fairly substantial habitat disruption and abandonment, reduced nesting and or breeding, and behavioral changes in animal populations. Again, at this time it cannot be known with certainty, as no field studies or data have been released by the applicant-developer. However, it is likely that some degree of habitat disruption will result from the 12 to 18 month construction window for the project. Finally, the construction of new roads and expansion of the existing road network at the site, coupled with additional truck traffic into the construction site, may place a heavy burden on the existing road infrastructure of the two towns involved in the construction of the project (Towns of Worth and Redfield).

**13. Invasive Species**

Given the likelihood of substantial land clearing and disturbance activities with the construction of the towers and turbines, staging areas, and the access road network, there is a significant potential for the introduction and spread of non-native, invasive species (NNIS), primarily invasive plant species including: Phragmites, Purple Loosestrife, Giant Hogweed, and Japanese Knotweed, among many others. There are several vectors and modes of NNIS infestation and transport including: mowing, shoulder scrapping, construction activities, and heavy equipment transport during both the construction and operational phases of the project for the turbine towers, roads, layout areas, landings, building sites, and other impacted areas. Careful consideration needs to be given to any pre and post construction NNIS surveys, an Invasive Species Control plan (ISCP), post construction monitoring, and a functional removal protocol.

**14. Impact of DOD and Telecommunications Infrastructure**

Concern has been raised by the US Army at Ft. Drum, regarding the adverse impact of the wind turbines being contemplated, not just at the Mad River project construction site, but for all of the proposed wind farms on the Tug Hill. There is evidence that wind turbines do interfere with radar operations, by creating a type of "black hole" in the radar signal at lower elevations below 3000', thus interfering with air traffic control for low-flying airplanes, helicopters and military drones. Additionally, based on discussions with the Army at Ft. Drum the Army has concerns about the impact that the Mad River facility might have on their weather predicting capability, especially concerning aircraft operations, and weather systems (Personal Correspondence, BLF, 2017).

**15. Safety and Security Issues**

There are several important safety and security issues associated with wind turbines. Among members of the public, wind turbine related accidents and nacelle fires are thought to be rare and uncommon. However, they actually occur more often than is generally realized or often reported in the press (Guillermo Rein et al. 2014). Safety issues with regard to wind turbines usually revolve around:

a. **Ice throws or ice shedding**. Ice and snow can be thrown or shed from the rotor blades during the winter in colder climates and geographic locations that receive significant winter snowfall. This may be a problem at the Mad River location, as the Tug Hill region of New York State generally receives upwards of 200-300 inches of snowfall per year. Freezing and thawing cycles, when the turbine blades are at rest, can result in a considerable build-up of snow and ice, which is then "thrown" considerable distances once the turbine resumes operation.

b. **Lightning strikes**. Wind turbines are susceptible to being hit by lightning during lightning storms and precipitation events, depending on their geographic location and size. Lightning strikes are far more common in the United States than in Europe, due to topographical differences in terrain (Smith 2004). Additionally, the taller the turbine, the more likely their vulnerability to being hit by lightning. The use of conductive carbon fibers in the construction of rotor blades can reduce, but not eliminate, the risk of fire from lightning strikes (Ibid 2004).

c. **Internal technical failure and blade failure/breakage**. There are several ways that wind turbines can suffer electrical or mechanical failure within the gearboxes, drive train, bearings, mechanical brakes, and other components and surfaces contained within the nacelle of the average turbine. Stress fractures, equipment failure, overheating, poor design, manufacturing defects and age can all contribute to technical failure of a wind turbine. Additionally, blade failure/breakage is a leading cause of accidents in turbines.

d. **Blades can suffer hairline cracks** along the axis with the rotor assembly and the enormous stresses from repeated rotational movements over time can result in the blades falling off the rotor assembly with serious damage to the rotor and tower structures.

e. **Fires in the Nacelle**. Wind turbines often catch fire and burn much more frequently than is reported, according to recent research conducted by the Imperial College London, Edinburgh University and the SP Technical Research Institute of Sweden (Rein et al. 2014). The fire problem in wind turbines arises due to the fact that large amounts of very flammable materials (e.g., composite materials, insulation, polymers) within the nacelle are packed in close proximity to potential ignition sources such as overheated mechanical components, and failed electrical connections. Each nacelle contains from 80 to 200 gallons of highly flammable hydraulic fluid and lubricants. The nacelles are usually made from fiberglass reinforced plastic (FRP) which is flammable, but internal insulation within the nacelle, which is often contaminated by oil deposits, adds to the fuel loading. Further, the transformers at the base of the turbine contain another 400+ gallons of transformer oil. Braking systems within the nacelle pose an especially high risk of fire.

Overheating can cause hot fragments of the disc brake material to fracture and fall off, rupturing hydraulic hoses and resulting in combustible hydraulic fluid being expelled under pressure and coming into contact with extremely hot disc brake fragments. Also, hydraulic pumps and connections have been known to fail within the nacelle structure, allowing super-heated hydraulic fluid to burst into flames upon contact with a heated surface and the release of toxic fumes (Wind Systems Magazine 2017).

Historically, the wind turbine industry has suffered from incomplete reported data and poor statistical records of wind turbine fires. Regional news reports can be found that occasionally report about a turbine fire, but the true extent of the fire problem on an international scale is exceedingly difficult to assess. Most sources of information about turbine fires are incomplete, biased, or non-disclosed due to proprietary information within the industry. In certain political jurisdictions turbine fires are not reported due to their remote locations or lack of reporting requirements. While the official data indicated an average of 11.7 turbine fires worldwide for a recent reporting year, researchers at the Imperial College London believe the actual figure is ten times what is reported or about 117 turbine fires per year around the globe (Caithness Wind Farm Information Forum 2017).

Most turbine fires are allowed to burn themselves out, usually with the complete loss of the nacelle, rotor assembly, turbine blades and turbine tower (often a financial loss in excess of $ 3,000,000 per turbine). Many of the new, next generation wind turbines are 400 to 600 feet in height, and local towns and rural municipalities usually do not have the fire-fighting equipment to control or fight a turbine fire that high up in the air, or if the turbine is located in a remote, inaccessible area, such as a forested landscape. Therefore, it is often the case that firefighters, once called to the scene of a turbine fire, simply stand around helplessly while the fire burns itself out. Also, it is often dangerous to approach a turbine that is on fire due to the dangers associated with the high voltage electric current at the turbine (You Tube video, 2015).

Given the fact that the Mad River site is heavily forested with a significant amount of potential fuel loading, a crown fire that got started in the forest due to either a lightning strike or nacelle mechanical failure could have catastrophic consequences for the Mad River location. Crown fires often have internal temperatures of 2100 degrees F and they usually do not put themselves out. They can move rapidly across a forested landscape, destroying most of the trees and herbaceous vegetation in their path and resulting in the serious destruction of the slow moving faunal species that cannot get out of the way of the advancing flames.

There are newer fire suppression systems and extinguishers that can be installed in the nacelles of certain types of wind turbines (along with smoke and fire detectors), however they raise the price of the turbine. Given the remote location of the Mad River LSWF site, and the probable lack of fire-fighting capabilities of the Towns of Worth and Redfield, additional investigation into the potential need for fire suppression systems on the turbines installed at the Mad River site is warranted.

**16. Connectivity Site Grid Hook-Up**

The Mad River LSWF is scheduled to connect to the existing 345 KV Marcy-Volney transmission line at some point south of the proposed LSWF construction site between: (1) the Town of Amboy in Oswego County and (2) the Town of Camden in Oneida County. However, Avangrid LLC has not conclusively determined the exact connectivity site. There remain significant questions concerning the impact on the forested corridor from the connectivity grid work that should be explored in greater detail, especially if the connectivity lines involve going through New York State DEC managed forests or re-forestation areas, where the public has a significant interest in those public forested resources.

## 17. Conclusions

Increasingly it is the case that forested landscapes throughout the United States are being seriously examined for their potential in siting LSWFs. The Mad River site, while secluded and probably possessing the necessary wind resources, is a somewhat problematic location to site a wind turbine farm for many of the reasons listed above in this narrative. The Mad River site is not just a "forested landscape" but is a demonstrated important component in the greater integrated ecological core unit of the Tug Hill forest. It is also a forested area interspersed with very high quality aquatic lotic riparian and pristine palustrine wetland resources and a major river corridor that supports a world class fishery resource. As has been noted elsewhere in this white paper, the USDI Fish and Wildlife Service in their interim guidance on avoiding and minimizing wildlife impacts from wind turbines, recommended *against:* (1) locating turbines in known bird migration pathways or in areas where birds are highly concentrated., e.g., wetlands, roosts, riparian areas along streams or riverine corridors (2) locating turbines such that large, continuous tracts of wildlife habitat would be fragmented, (3) locating turbines near known bat hibernation, breeding, nursery colonies, migration corridors or in flight paths between colonies and feeding areas, and (4) spreading out widely the siting of turbines. *Rather, turbines should be grouped together and parallel to known bird movement areas to avoid strikes* (USFWS Interim Guidance 2003). While the Mad River project does represent a commitment to renewable energy for New York State, siting the project at the Mad River site has a series of potential drawbacks from an ecological and land use perspective.

There are a wide variety of adverse environmental and bio-physical impacts that may accrue, should the Mad River Wind Farm proposal be sited at the WoodWise location. Unfortunately, until the actual Mad River Project Application is released by Avangrid, there is no access to any of the conducted field studies or *in situ* data that may have been completed by the developer. There are legitimate environmental, ecological and policy issues that have been raised by the project and the PSS (Preliminary Scoping Statement) that should be further addressed in the Stipulation Process and as the Project Application is released and as this construction project moves forward to an eventual public hearing.

Foremost among the problematic issues is the fact that within the PSS, Avangrid provided no Project Alternative external to the site, nor did the PSS consider any internal Project Alternatives, with regard to the location of the turbines that might have reduced or mitigated potential project adverse impacts. There seems to be no rational basis for why only one particular pattern of turbine location that was chosen and discussed in the PSS (over the entire site) was considered. The northern portion of the property contains a considerable amount of freshwater wetlands and open water areas, including a portion of a sole source groundwater aquifer and other important, sensitive ecological resources. Additionally, the PSS indicates that several turbines will be constructed along a portion of the Mad River riparian corridor, which is less than completely desirable from an ecological standpoint. Little, if any, consideration seems to have been given to an investigation by the applicant - developer of alternative patterns of wind turbine placement and construction on the WoodWise site itself (e.g., clustering turbine locations away from more sensitive wetland or aquatic areas and stream or river corridors), perhaps to the southern portion of the property on drier, elevated sites. Additionally, little consideration seems to have been given to protecting or even thinking about protecting "core forest" compartments within the WoodWise property that might be ecologically sensitive, or dealing with potential forest fragmentation issues.

Finally, little consideration in the PSS seems to have been given toward the utilization of conservation easements by the developer and property landowner to ensure the valuable site will be protected for the long term, while ensuring the landowner's contention that the property will continue to be a "working forested landscape."

Clearly, there are significant, legitimate, scientific-based natural resource and policy issues that need further clarification and should be addressed in more detail by the applicant/developer in both the Stipulation Phase of this LSWF project at the Mad River site – and as the full Project Application (along with the *in situ* field studies and field data sets) is released.

It is anticipated that SUNY ESF researchers will continue to examine the important ecological and policy issues associated with the siting of the Mad River LSWF project, including an analysis and structural – functional assessment of the feasibility, institutional capability, capacity, and adequacy of the Art. 10 Board’s decision-making process for siting LSWFs in forested ecosystems in New York State.

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