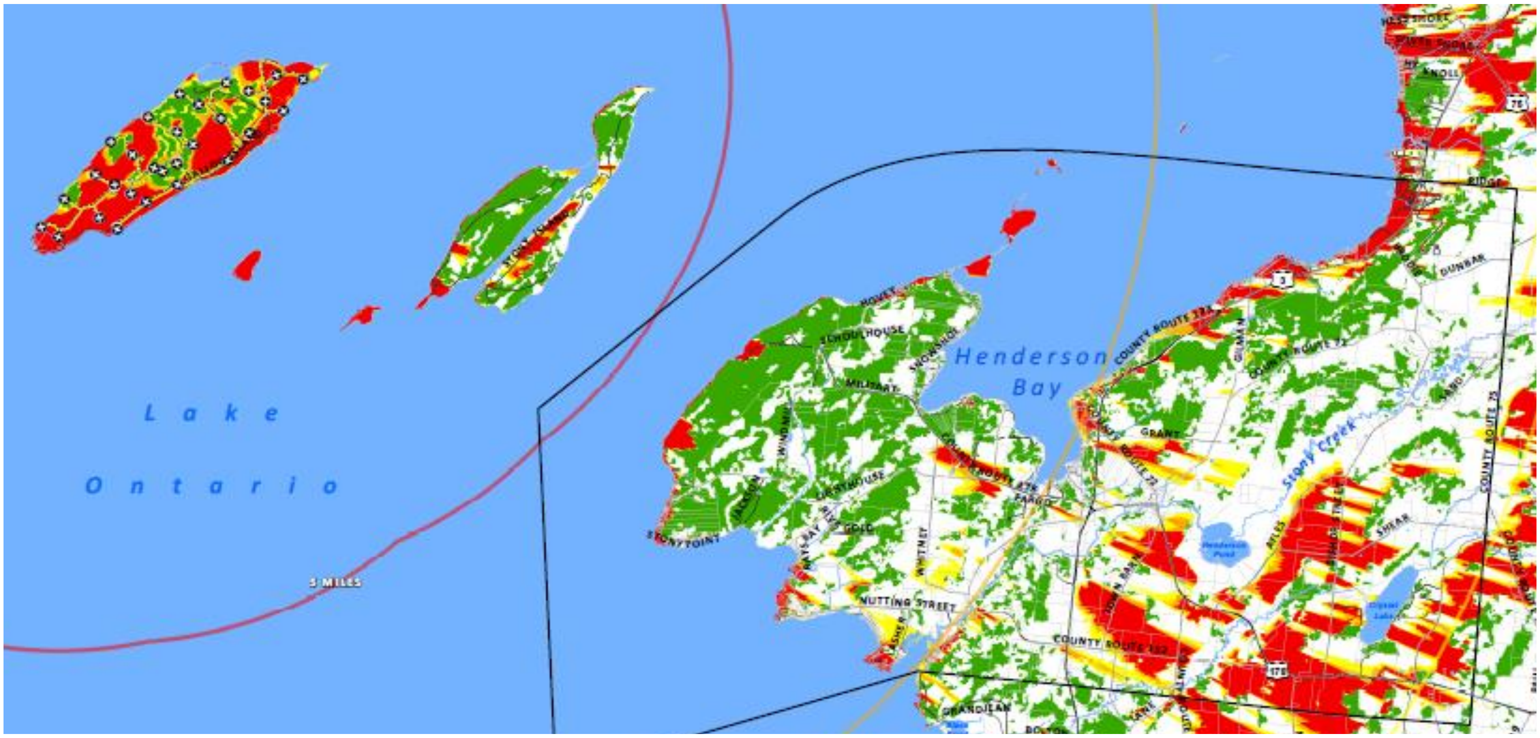

Exploring the impact of the proposed Galloo Island energy project

conducted for the Town of Henderson

submitted by the Nanos Clarkson University Research Collaboration

Project 2016-676, January 2016

Martin Heintzelman
Clarkson University

Stephen Bird
Clarkson University

William Olson
Clarkson University

Nik Nanos
Nanos Research

Daniel Kolundzic
Nanos Research

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January 20, 2016

Attention: John Culkin, Town Supervisor
Town of Henderson
12105 Town Barn Road
Henderson, NY 13650

Dear Mr. Culkin,

Re: Analysis of the proposed Galloo Island wind energy project

We are pleased to submit the following report on the potential impact of a proposed wind energy facility on Galloo Island which was commissioned, funded, and conducted on behalf of the Town of Henderson.

The report is comprised of the following elements:

- a property value analysis;
- a jobs and tourism analysis; and,
- a viewshed analysis.

Together, the analysis conducted by the research team is intended to support the decision-making process on the proposed project. The research was conducted independently by the project team based on our current understanding of the project and its configuration.

Martin Heintzelman	Stephen Bird	Nik Nanos	Dan Kolundzic
Clarkson University	Clarkson University	Nanos Research	Nanos Research

1.0 Executive Summary

The Town of Henderson, New York has been confronted with a challenging development issue. The proposed development of a wind energy facility on Galloo Island has raised concerns by local residents and commercial operators in the Town of Henderson. Uncertainties regarding both social and economic impacts of the proposed development have motivated the Town's leadership to undertake a study of the development proposal's impacts in order to support the local decision-making process

With this in mind, the Town of Henderson has secured the Nanos Clarkson Research Collaboration energy consultant team of experts to assist in determining a series of impacts from the proposed development. The following report provides an overview of property value and economic impacts, as well as a viewshed analysis for the Town of Henderson from the proposed wind energy facility development.

The Galloo Island Wind Energy Facility (henceforth GIWEF) Project was first informally proposed in September 2014 by Albany based Hudson Energy Development LLC under a subsidiary Hudson North Country Wind 1 LLC (henceforth HNCW). Its formal Program Involvement Plan Application occurred in Summer 2015. Its plan comprises 29 turbines located on the privately owned island for an expected 102 MW output. The turbines will be 575 feet high, with blade lengths of 210 feet (Hudson North Country Wind 1, LLC 2015). On Dec. 18, 2015, HNCW sold the project to Apex Clean Energy LLC of Charlottesville, VA.[1]

A key concern of many residents of the Town of Henderson is that the Galloo Island wind facility will negatively impact both property values in the town, as well as economic activity through tourism. These concerns are exacerbated by the fact that the usual benefits which typically accrue to counter potential negative impacts of this type of development, such as payments-in-lieu-of-taxes (PILOTS) or lease payments, are not eligible for residents of the Town of Henderson. As such, the impact of the proposed development on the Town of Henderson is uncertain and requires clarification. This study does not examine environmental benefit / cost impacts for the region as they are beyond the scope of the report as designated by the Town of Henderson.

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[1] See "Hudson North Country Wind 1 LLC letter to PSC Secretary notifying of GIWF sale to APEX" at http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=48345&MNO=15-F-0327.

Key Findings

The Nanos Clarkson Research Collaboration has undertaken a series of analyses, enclosed within the subsequent report, specifically a property value analysis, an economic and jobs analysis, as well as a viewshed analysis. While methodologies (and qualifiers) for the various analyses are highlighted within the report along with report details, the overall general findings can be summarized as follows in terms of the anticipated impacts:

- likely negative land valuations for the Town of Henderson;
- likely positive economic effects to the region, but not commensurate to the Town of Henderson;
- likely minor positive effects on jobs and economic impacts to the Town of Henderson; and,
- likely minor negative effect on tourism

These findings are elaborated in more detail within the subsequent report. It should be noted that this study does not examine environmental benefit/cost impacts for the region as they are beyond the scope of the report as designated by the Town of Henderson. Finally, the report includes a series of view-shed analyses for the Town of Henderson in relation to the proposed Galloo Island development. In addition to the enclosed data and documents, the 3-D viewer can be accessed at: http://arcg.is/20Y5VEc in order to provide a more variable tool for analysis and evaluation.[2]

[2] Disclaimer: The Nanos Clarkson Research Collaboration provides analytic services to stakeholders in the energy and environmental arenas and the views and analysis expressed are the authors'. They do not necessarily represent the policies or views of Clarkson University.

2.0 Town of Henderson Property Value Analysis in regards to Proposed Galloo Island Facility

2.1 Introduction

One concern of many residents of the Town of Henderson is that the Galloo Island wind facility will negatively impact the value of their properties in the town. This section looks at that issue using an analysis of the impacts of the Wolfe Island wind facility in northern Jefferson County. Building on that analysis, the team projected impacts on residential properties in the Town of Henderson.

There are a number of factors related to wind power generation facilities which may result in changes to local property values. For example, both noise and views are often a cause of concern for local homeowners with a potential new project. Wind turbines have become quieter in recent years, but there remain concerns about low frequency noise that dissipates slowly over distance (Bolin, Bluhm, Eriksson, & Nilsson, 2011). In addition, some people raise concerns about health effects, primarily related to noise, although the scientific literature has not found a solid link between the two (Council of Canadian Academies, Expert Panel on Wind Turbine Noise and Human Health, 2015).

Visually, wind turbines are, at the least, large human-made structures that represent a significant change to the landscape. In addition, if wind turbines are improperly sited, there can be more acute visual disamenities such as shadow flicker, when rotating shadows move over a parcel. Flicker is very unlikely to be an impact in Henderson, however, given the relatively large distance of the Town from the turbines. Another visual impact is the array of blinking red lights that sit atop the wind turbine hubs.

Acting counter to these negative impacts are other impacts that may generate a positive effect on property values. These include the benefits from payments-in-lieu-of-taxes (PILOTS) and payments to individual landowners. The first of these would be expected to reduce taxes or increase local public services, or both, while the second would at least have a multiplier effect on the local economy. However, in the case of Henderson, neither of these effects is likely since it is our understanding that Henderson will not be getting PILOT money nor will any Henderson property owners be receiving lease payments. The fact that Henderson landowners may be affected by visual disamenities from the Galloo Island facility, while not receiving any payment as compensation, provides reason to believe that the impact on property values may be negative.

2.2 Existing Literature on Property Value Impacts

There exists a growing scientific literature on the impacts of wind turbines on property values. This literature is not conclusive and a main conclusion from a detailed read of this literature is that the specific context and policy parameters matter tremendously in driving property value impacts. Amongst the first studies of this issue are Sims & Dent (2007) and Sims, Dent, & Oskrochi (2008). Neither of these studies finds any significant impact on property values in a study of facilities in the United Kingdom. Unfortunately, these studies are based, on small samples and in areas with significant confounding factors which make interpretation difficult.

The largest studies of wind turbines and property values have been done by Ben Hoen and his coauthors (Hoen, Wiser, Cappers, Thayer, & Sethi, 2011; Hoen et al., 2015). These studies overcome the small sample size problems of many studies in this literature by using a pooled dataset of property transactions nearby to a large number of wind facilities around the country. They also find no significant impact on property values, but an admitted weakness of their study is exactly its strength – by using multiple sites, their estimates represent an average effect that may be hiding significant impacts in particular sub-samples of their data.

Two other more recent papers also find no significant impact. Vyn & Mccullough (2014) looks at a large wind facility in Ontario while Lang, Opaluch, & Sfinarolakis (2014) look at small facilities in Rhode Island. Both studies are carefully done and have reasonable sample sizes. A weakness of the paper by Lang et al. (2014) for the purposes of applying to the Henderson case is the fact that the facilities they study are mostly sites with individual large turbines or a small number of residential-scale turbines, while the Galloo Island facility is proposed to have a larger number of very large turbines.

There have also been a few recent studies that do find significant impacts on property values. Heintzelman & Tuttle (2012) is the first study to report significant negative impacts on property values using data from the areas around three large wind facilities in Northern New York. Importantly, they only find these negative impacts in two of three study areas which brings to the fore the idea that impacts are likely to vary in different areas, and that using large samples of facilities from a large geographic area may be inappropriate.

Sunak & Madlener (2012) find negative impacts using proximity measures and digital viewshed modelling for a region of Germany with a small wind facility with only 9 turbines. Jensen, Panduro, & Lundhede (2014) use similar methodology and a large dataset in close proximity to wind turbines to find significant negative impacts separately from both proximity and view. Finally, Gibbons (2015) focuses on visibility of turbines and finds significant and large negative impacts on property values in the United Kingdom.

Figure 1: Wolfe Island Study

Our analysis of the likely impacts of the Galloo Island wind farm on property values in Henderson is based upon an analysis of the impacts of the Wolfe Island wind farm on properties in Jefferson County, NY.[3] Wolfe Island is a Canadian island in the St. Lawrence River near its junction with Lake Ontario. The wind turbines are visible from parcels in Jefferson County, NY, on the island itself, and on the Canadian "mainland". Wolfe Island and the surrounding area is a good case study for application to Galloo Island for a number of reasons. First, the impacted area is in the same county as Henderson, with similar socioeconomics and topography. Second, in both cases the turbines are on islands on the water some distance from the affected properties on the shoreline. Third, no affected U.S. municipalities or landowners receive any compensation as a result of the Wolfe Island facility, meaning that, like in the case of Henderson, there are no confounding factors to counteract any negative impacts from disamenities. While Galloo Island is a U.S. island, it is a part of the Town of Hounsfield, meaning that any compensation paid will be paid to Hounsfield, not Henderson. An important qualification however, in using this comparison site is that while the turbines on Galloo Island are

[3] This analysis is based upon, but not the same as, unpublished work by Heintzelman, Vyn, and Guth (2015). That study looks at properties in both countries whereas the analysis described here focuses only on Jefferson County.

expected to be visible in the Town of Henderson, they are considerably further away from Henderson than those on Wolfe Island are to properties in Cape Vincent.

2.2.1 Methodology

We use a standard hedonic property value analysis to study the impacts of the Wolfe Island facility. Hedonic analysis goes back at least to Rosen (1974), who posits a model where consumers derive utility from the attributes of a good rather than the good itself. This allows researchers to use consumption decisions by a sample of consumers in a market with differentiated goods, which vary along a number of dimensions, to estimate the consumers' marginal willingness-to-pay for changes in the attributes of the good.[4] This turns out to be an excellent model of property markets since parcels and homes vary along a large number of dimensions, many of which are easily observed by the researcher. In addition, most property markets are reasonably competitive in the economic sense since there are usually many properties for sale at any given time and a number of people simultaneously looking to purchase a home.

With Rosen's (1974) model in mind, hedonic analysis uses data on a sample of sales transactions (generally including price, date of sale, and a number of parcel attributes) to estimate the impacts of individual attributes on price. It uses regression analysis to control for all observable factors, thus allowing for an "all else equal" analysis of how each factor affects price.

There are a few problems that often arise in hedonic analysis which can be controlled using a fixed effects approach. First, is omitted variables bias, which occurs whenever an unobserved variable (say, neighborhood quality) is correlated both with parcel prices, and at least one included explanatory variable. When this happens, the estimated effect of the included variables will be biased and inaccurate. Another, related, problem is endogeneity, when prices and an explanatory variable are co-determined as might happen if, all else equal, wind turbines are more likely to be sited in areas with lower value land. In this case, the analysis may mistake the cause of the siting (lower property values) for an effect of the siting. Fixed effects analysis helps to curb the impacts of both of these issues by estimating fixed "area" effects which control for all factors which are homogeneous across a small geographic area. This reduces the number of omitted variables (and particularly those related to geography) and reduces the scope for possible endogeneity.

One tension that arises when using fixed effects analysis is that the smaller the geographic area chosen for the fixed effects, the more control the analyst has for these problems, but also the less power the analyst has to estimate the effects of included variables. Unfortunately, there is no foolproof way to know at which level to control for

[4] See (Freeman, Herriges, & Kling, 2014) and (Taylor, 2003) for comprehensive descriptions of the hedonic method.

these issues. In this analysis we use municipality fixed effects because of the relatively small number of parcels with a view of turbines.

A related problem is spatial autocorrelation which occurs when error terms (variation in prices that is left unexplained by included variables) for transactions nearby to each other are correlated. This can be controlled by allowing for this correlation and calculating standard errors appropriately, which we do by allowing error terms to be clustered within municipalities.

2.2.2 Data

Data for this study comes from several sources, as described in Heintzelman, Vyn, and Guth (2015). We use data on 5,631 single-family residential parcels in Jefferson County, NY. Data on NY transactions come from the New York State Office of Real Property Taxation Services (NYSORPTS). This data includes sale price, sale date, and parcel identifying information. Transaction data is then merged with parcel and home characteristics data from the assessment process, also from NYSORPTS. We then bring in parcel shapefile (GIS) data which we acquired from the Jefferson County Assessor's Office. With this spatial data we calculate a number of distance and spatial variables in ArcGIS. Table 1 presents summary statistics for this sample.

With this data in hand, we conducted a preliminary viewshed analysis to identify parcels within five miles of the turbines that had a potential view of the turbines. A pair of students then visited each of these identified parcels to confirm the view from each parcel. The students recorded the number of visible turbines as well as whether or not these views were full or partial. However, given the small number of parcels (26) with a view in our dataset, we simplify the analysis to only focus on whether or not each parcel had any view of one or more turbines. We use a log-linear functional form in following the bulk of the hedonic literature (Cropper, Deck, & McConnell, 1988). We also include year fixed effects to control for sample-wide price trends. Unfortunately, we are unable to accurately control simultaneously for both distance to turbines and view, which is an important limitation.

2.2.3 Wolfe Island Results

Results for the hedonic study of the Wolfe Island wind farm are shown in Table 2. The primary variable of interest is the variable representing parcel transactions with a view of turbines, after the turbines were constructed. We see that parcels with a view of the turbines sell for a positive premium (approximately 10%) before the turbines are built, but that this premium is more than eroded by a strong negative impact after turbine construction. The estimated coefficient of -0.164 that describes this effect implies a 15% decrease in property values for homes with a view after the turbines are built. We also calculate a 95% confidence interval for this effect, which tells us that, given the observed data, there is a 95% chance that the true effect is a decrease of between 5.1% and 23.9%. So, while we can’t be confident that the effect is exactly negative 15%, we are reasonably confident that there was a negative impact.

Seasonal and waterfront homes both sell at significant premiums while other attributes of the homes have the expected signs. We see a positive premium in the period between announcement and construction for homes with a view, which may have to do with general appreciation for these water view homes. Our spatial controls are not significant but provide important controls for distances to larger communities with shopping and other man-made amenities. Importantly, there is no general post-construction effect across the sample. Instead those affects appear to be limited to those parcels with a view.

Table 1: Summary Statistics for Wolfe Island Sample

	Mean	Std. Dev.	Min	Max
Price ($US)	139,349.30	100,036.80	3,500.00	2,000,000.00
Parcel w/ View of Turbines	0.005	0.068	0	1
Parcel Sold between Approval and Construction	0.216	0.411	0	1
Parcel Sold After Construction	0.398	0.49	0	1
Parcel w/ View of Turbines AND Sold between Approval and Construction	0.001	0.035	0	1
Parcel w/ View of Turbines AND Sold After Construction	0.003	0.052	0	1
Seasonal Home	0.093	0.291	0	1
Waterfront Home	0.113	0.316	0	1
Mobile Home	0.037	0.19	0	1
Lotsize (Acres)	5.145	20.958	0.00573	391.433
Bathrooms	1.421	0.576	0	5.5
Bedrooms	2.992	0.938	0	9
Fireplace	0.174	0.379	0	1
Air Conditioning	0.021	0.143	0	1
Quality=2	0.128	0.334	0	1
Quality=3	0.76	0.427	0	1
Quality=4	0.093	0.291	0	1
Quality=5	0.001	0.03	0	1
Living Area (sq.ft.)	1551.206	596.219	136	6074
Age	69.203	51.83	0	225
Number of Storeys	1.458	0.442	1	3
Distance to University (Miles)	15.644	7.658	0	32.4344
Distance to School (Miles)	2.913	2.91	0	17.9056
Distance to Hospital (Miles)	10.387	6.776	0	34.0026

Table 2: Wolfe Island Results

	Coef.	Std. Err.	t	P>|t|
Parcel w/ View of Turbines	0.106	0.062	1.72	0.097
Parcel Sold between Approval and Construction	-0.032	0.042	-0.77	0.45
Parcel Sold After Construction	-0.034	0.057	-0.61	0.55
Parcel w/ View of Turbines AND Sold between Approval and Construction	0.203	0.058	3.5	0.002
Parcel w/ View of Turbines AND Sold After Construction	-0.164	0.053	-3.07	0.005
Seasonal Home	0.08	0.034	2.32	0.028
Waterfront Home	0.658	0.082	8.05	0
Mobile Home	-0.209	0.051	-4.06	0
Lotsize (Acres)	0.0005	0.0005	1	0.325
Bathrooms	0.11	0.017	6.45	0
Bedrooms	0.003	0.02	0.15	0.879
Fireplace	0.152	0.026	5.9	0
Air Conditioning	0.143	0.046	3.13	0.004
Quality=2	0.394	0.104	3.78	0.001
Quality=3	0.769	0.093	8.24	0
Quality=4	0.94	0.09	10.42	0
Quality=5	0.698	0.108	6.45	0
Living Area (sq.ft.)	0.0003	0.00003	10.8	0
Age	-0.005	0.001	-4.9	0
Age Squared	0.00002	0.00001	3.05	0.005
Number of Storeys	0.07	0.031	2.22	0.034
Distance to University (Miles)	0.005	0.005	1.03	0.311
Distance to School (Miles)	-0.003	0.008	-0.39	0.696
Distance to Hospital (Miles)	-0.011	0.006	-1.69	0.102
Municipality Fixed Effects	Yes			
Year Fixed Effects	Yes			
R-Squared	0.4625			

2.2.4 Application to Town of Henderson

The analysis of the Wolfe Island case study provides important evidence suggesting that the Galloo Island wind farm will likely negatively impact property values for those parcels that are likely to have a view of the turbines, although it is again important to note that the Galloo Island turbines will be considerably further away from the mainland than those on Wolfe Island, despite prominent views. The central estimate of the hedonic analysis suggests a likely 15% reduction in property values for homes with a view, after the turbines are built. We now combine the above analysis with the viewshed analysis conducted in GIS to estimate the aggregate effects on property values in the Town of

Henderson. To do this we use parcel attribute data on 1,453 single-family residential parcels in the Town of Henderson together with an estimate from the viewshed analysis of whether each of these parcels will view the turbines. We plug this parcel attribute data into the estimated hedonic model to project two values for each parcel - with and without the turbines. Because our data ends in 2013, this projection is done in 2013 US dollars, as if the homes were selling in 2013, but with the Galloo Island turbines constructed.[5] These estimates are sensitive to assumptions made in the viewshed analysis and, in particular, the assumed height of the forest canopy. For this reason, we calculate two estimates according to a 13m and 20m assumed canopy heights. These projections, aggregated to the town level, are presented in Table 3.

Table 3: Projected Property Values

	20m Canopy Height		13m Canopy Height	
	Aggregate	Average	Aggregate	Average
Projected Value w/ Turbines	$298,950,891.57	$205,747.34	$294,918,808.00	$202,972.34
Projected Value w/o Turbines	$338,816,107.10	$233,183.83	$338,109,916.64	$232,697.81
Projected Change in Value	-$39,865,215.53	-$27,436.49	-$43,191,108.64	-$29,725.47
Projected % Change in Value	-$11.77		-$12.77	

We see in these projections that the average home is expected to lose between 11.77% and 12.77% of its value if the Galloo Island turbines are built. Importantly, however, this average includes homes both with and without a view. Homes with a view will face the bulk of the value loss. In aggregate, this analysis suggests a total value loss for the Town of Henderson of between $39.8M and $43.2M. These estimates are all calculated using the central estimate of the post-turbine impact for homes with a view from the hedonic analysis of -15%. Because this central estimate is uncertain, our projections are also uncertain. So these estimated aggregate impacts could be considerably larger or smaller in actuality.

While these numbers are large, and suggest a real loss to the people of Henderson, it is important to note that these losses do not affect people's wealth all at once. Instead, for residents who are planning to stay in Henderson for a number of years, they will not actually be significantly affected until such time as they choose to sell. In addition, there is a strong suggestion in the literature (Hoen et al. 2015) that these affects may be short-lived. As people adapt and get used to having the turbines in their landscape, and as

[5] This is a benign assumption. With additional data on appreciation in values since 2013 we could adjust these numbers to 2015, but this would not affect the relative changes projected to be caused by the turbines.

many Americans become more familiar with wind energy, negative property value impacts may dissipate.

Table 4: Projected Effects on Average Parcels w/ Turbine View

	Baseline Price	Low Estimate	Central Estimate	High Estimate
% Effect		-5.10%	-15.00%	-23.90%
Mean	$276,954.50	-$14,156.35	-$41,593.40	-$66,165.92
Median	$221,393.00	-$11,316.36	-$33,249.10	-$52,891.98

To illustrate the statistical uncertainty associated with our projections, Table 4 presents projected impacts for parcels with a Turbine view for low, medium, and high estimates of the post-turbine impacts. We calculate the mean and median projected price for the parcels in our Henderson dataset projected to have a turbine view. Using these projections, we use the low and high ends of the 95% confidence interval as well as the central estimate of the impact and apply these to the mean and median prices for this selection of parcels. This analysis suggests that the mean dollar-value impact on homes with a view could be as low as $14,156.25 and as high as $66,165.92. It is worth noting, however that these two extremes are bounds on likely impacts, and are highly unlikely to occur. Finally, the real uncertainty associated with our estimates is likely to be somewhat larger than that suggested by the analysis of statistical uncertainty presented because of the greater distance from Henderson to Galloo Island than from Cape Vincent to Wolfe Island. On its own, our expectation is that this greater distance should make the realized impacts lower in magnitude than the projections provided above.

3.0 Jobs and Tourism Analysis for Galloo Island Wind Installation

3.2 Background

The Town of Henderson is a small Town situated on the south eastern coast of Lake Ontario in the Thousand Islands area of New York State. Census data shows the town has a total area of 53 square miles of which approximately 12 square miles (22%) is water. The west boundary of the town is Lake Ontario. 2010 Census data shows the town's population at 1360. The town is located in Jefferson County (population: 116,229), southwest of the City of Watertown. It is also located just north of the city of Syracuse and Onondaga County.

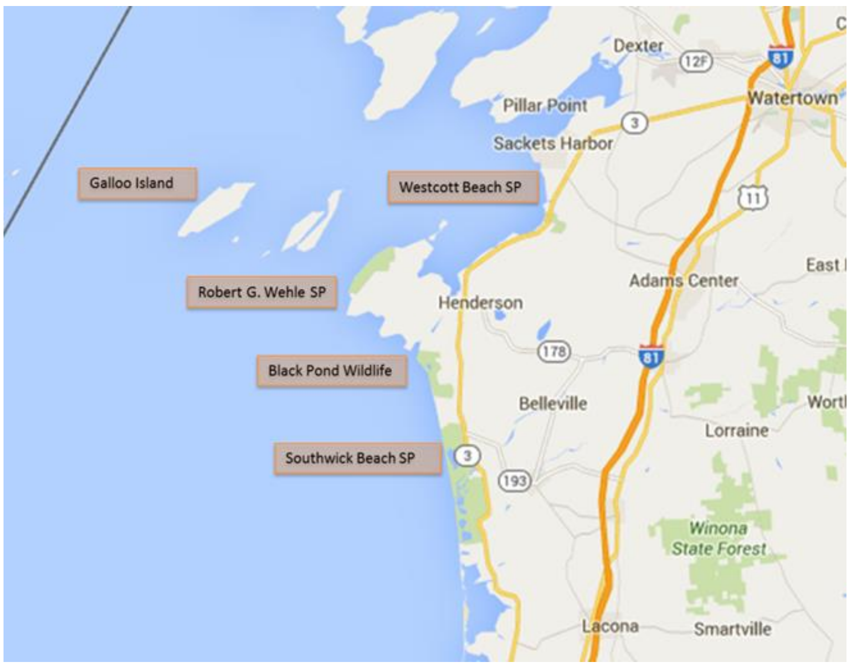

Figure 2. Town of Henderson, with local environmental amenities and Galloo Island shown; source: Google Maps

Henderson's primary industry is tourism. These activities are split between seasonal residents and tourist visitors. Seasonal residents own extensive plots of cottages, residences, and some year-round homes. Other tourist activities focus on day visitors, visitors to the local parks, and extensive activities focused around Henderson Harbor. Water activities include fishing trips, day trips, general boating and sailing, and lakeside activities along the coast. Henderson is exceptionally well-placed for these activities because of the quality of its environmental amenities for these various tourist activities and its close location to the cities of Watertown (19 miles) and Syracuse (65 miles). It has three New York State Parks (Robert G. Wehle, Westcott Beach, and Southwick Beach) and a Wildlife Management area, all of which are water based.

Within Henderson, there is a high proportion of owned land, with few rentals. However, many of the owned properties are owned by seasonal residents (Henderson Comprehensive Land Use Plan Committee 2004). The year round residents of Henderson have generally low income, with a large majority of property taxes paid for by upper and middle income residents with seasonal housing on the coast ("Henderson, Fishers Landing among Poorest Communities in State" 2015).

The Galloo Island Wind Energy Facility (henceforth GIWEF) Project was first informally proposed in September 2014 by Albany based Hudson Energy Development LLC under a subsidiary Hudson North Country Wind 1 LLC (henceforth HNCW) and was sold to Apex Clean Energy in December 2015. Its formal Program Involvement Plan Application occurred in Summer 2015. Its plan comprises 29 (originally planned as 31) turbines located on the privately owned island for an expected 102 MW nameplate capacity. The turbines will be 575 feet high, with blade lengths of 210 feet (Hudson North Country Wind 1, LLC 2015).

The following analysis is divided into three sections. The first provides a specific overview of relevant scholarly literature on jobs and economic development for wind farms. It then proceeds with a Jobs and Economic Development Impact (JEDI) analysis specified to the Galloo Context as much as possible. The third section provides an overview of the research on wind farm impacts on tourism activities.[6]

3.3 Jobs and Economic Development Literature Review

An extensive literature exists that addresses the economic impacts of wind farms, and specifically the question of job development and wind farms. This section is primarily focused on the question of job development with a secondary section on tourism impacts. Our land valuation analysis is a separate part of this report.

As a general rule most energy infrastructure development has significant employment and economic development benefits for communities and jurisdictions. These must always be balanced against potential negative impacts and externalities that can include negative

[6] Note that in addition to the readings discussed in this section, several of which contain extensive reviews of the academic literature, we also consulted several additional readings that support our general conclusions. These include the following: (Westerberg, Jacobsen, and Lifran 2015; Lilley, Firestone, and Kempton 2010; Slattery, Lantz, and Johnson 2011; Brown et al. 2012; Wolsink 2013; Frantál and Kunc 2011; Broekel and Alfken 2015; Stiftung Offshore-Windenergie (German Offshore Wind Energy Foundation) 2013)

environmental impacts, devaluation of land, and loss of environmental benefits. Calculated on a broad basis, wind development has real economic benefits to states and broad regional areas. Loomis and Carter (2011) show that wind development in Illinois has significantly greater number of jobs per MWH compared to coal or natural gas development (Loomis and Carter 2011). A wide range of work (including the development of the JEDI model, used in this analysis) shows broad ranges of economic benefits at the regional or state level.

The two most significant factors affecting economic benefit are the presence of in-state turbine development and manufacturing (either whole or in component parts), and local ownership models (Lantz and Tegen 2008). The sourcing of turbines for Apex is unknown at this time. Apex Ownership for Galloo is based in Virginia and will be out of state.

The key concern for wind implementation is the potential for mismatched benefits and costs. Many authors note a significant dynamic in the siting of most wind developments and community acceptance. This is that communities are more willing to accept the detrimental visual impacts (and potential for land or other associated devaluation) in return for property tax payments, PILOTs (Payments In Lieu of Taxes), and the localized economic benefits of lease payments to individual land owners (Lantz and Tegen 2008; McKeown, Adelaja, and Calnin 2011).

In fact when jurisdictions do not receive these forms of economic benefit, there is a substantial literature showing that affected populations have a high degree of willingness to pay to move turbines farther from shore, or to not be built at all (Snyder and Kaiser 2009). This is particularly the case for offshore wind projects which often have no localized leases and may not have tax benefits.

Willingness to pay, contingent valuation, and choice experiment research are different forms of similar economic assessments that determine the "cost" to the public of a specific activity. It is a well-established and respected way to understand the costs that a community perceives from an activity. It is particularly relevant for thinking through the potential costs of impact for Henderson. Ladenburg and Dubgaard estimated that citizens were willing to pay 46, 96, and 122 Euros per year per household in order to move a theoretical wind farm (relative to an 8 km baseline) to 12, 18, or 50 km away from the coast (2007). A similar analysis from Cape Cod found that 22% of respondents were willing to pay a onetime cost of $286 for windmills not be built at all, with an average net willingness to pay of $75 (Haughton, Giuffre, and Barrett 2003).

Clearly, without specific localized economic benefits many publics understand the implementation of visual disamenities from wind as a net economic cost prior to being built. A full literature review of these types of studies shows that wind developments close to shore, particularly when visible, generate “significant welfare losses” that can be reduced by siting further offshore (Ladenburg and Lutzeyer 2012, 1). In particular, their review shows that residents are most motivated to pay for removal or greater distance in the 8-12 km or less range. Galloo is located 11 km from the coastal area of Henderson near Wehle State Park. Obviously moving the facility in the case of Galloo would require siting the project in water further from shore rather than on the island.

3.4 Jobs and Economic Development Impact Analysis: The JEDI Model

In the early 2000s the U.S. Department of Energy and the National Renewable Energy Laboratory (DOE/NREL) developed a spreadsheet-based wind model called the Jobs and Economic Development Impact Model, or JEDI for short (Goldberg, Sinclair, and Milligan 2004). This tool uses input-output analysis to determine expected economic outcomes from a wind development, including direct jobs outcomes, and associated jobs from supply chain, induced impacts, and other associated activity.[7] The model’s base empirical assumptions are imputed from data on dozens of completed wind projects and have been peer-reviewed (McKeown, Adelaja, and Calnin 2011; Lantz and Tegen 2008; Lantz and Tegen 2009).

That said, the results from any JEDI analysis should be considered as speculative given that every wind farm development has its own specific and unique circumstances. For this reason we develop several different scenarios with the JEDI model as detailed below.

3.4.1 Jurisdictional Impact and Assumptions

A critical concern for assessing job impacts of wind infrastructure (or any form of economic development) is determining the jurisdictional impact. For instance, the JEDI model used in our analysis is generally considered to have State level impacts in its output. Even then, economic benefits may be even more diffuse and extend beyond state borders to other states or other countries. Generally, economic development models assess both direct and secondary impacts (in JEDI these are characterized as “supply chain and induced impacts”). In the jobs category, direct impacts would be any job directly linked to the development or operation of the wind farm. Other related or induced impacts would include administrative positions, or jobs associated with increased economic activity through the local area and the state.

[7] A complete outline of the methodology for the JEDI modelling tool is included in this report as Appendix A. Readers are also directed to the source itself.

In the case of a small local town such as Henderson or more broadly the two local counties (Oswego and Jefferson), affiliated jobs and economic activity could be occurring in Watertown, Albany, or New York City. For that matter, some of the related jobs could be associated with banking services in another country, or the economic impacts from the purchase of turbines in another state or another country. Thus, the challenge is to make reasonable and appropriate assumptions about which impacts will actually be local.

For the purposes of the JEDI analysis, we develop a series of scenarios based on the JEDI output for the state, and we similarly apply the same assumptions to the job claims made by HNCW. We use a 50 mile radius (a reasonable commuting distance) around Galloo Island as the primary area from which we expect local direct jobs (i.e. workers) would be sourced. We expect local area jobs to be located primarily in Jefferson and Oswego Counties. Oswego County is included because the transmission line interconnection will be put in place between Galloo Island and the City of Oswego.

Table 5. Population Base for Job and Jurisdiction Analysis

Henderson	1360
Jefferson County	119,103
Oswego County	120,913
50% of Oswego and Jefferson Counties	120,008
Henderson Proportion of Oswego and Jefferson @ 50% population	1,360 / 120,008 = 0.0113 or 1.13%
Watertown (city)	27,590
Oswego (city and town)	25,908 (17,988 + 7,920)

All 2014 U.S. Census estimates (except Henderson 2010 Census count)

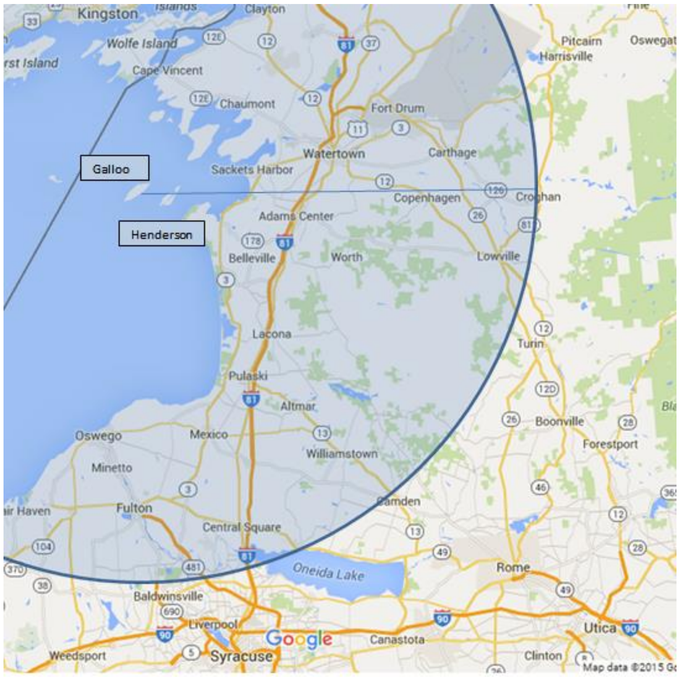

Figure 3. 50 mile radius from Galloo; Source: Google Maps

Figure 4. County Breakdown around Galloo Island

http://www.ezilon.com/maps/images/usa/new-york-county-map.gif

The 50 mile jurisdiction covers slightly more than 50% of both Oswego and Jefferson Counties. To assess Henderson's expected proportion of the jobs from a population basis we use 50% of the population of those counties as the base population for local job benefits. Henderson's proportion of this base population is 1.13% (data shown in Table 6 above). We also include a "best-case" 2.26% scenario (i.e. a doubling or 100% increase of the baseline population proportion) and a "worst-case" 0.57% scenario (50% of the baseline). Since Henderson is so much smaller, and isolated from the city centers that most of the jobs are likely to accrue to, a proportional approach is likely to be slightly optimistic.

Another important aspect of the analysis is that the county/regional option in JEDI is not used because we do not have access to specific county level data needed for the inputs to the county level analysis. Further, benefits from Galloo can be expected to accrue to two counties rather than one. Discussions with other consultants and experts in input/output analysis led us to pursue the 50 mile benefit jurisdiction as a more appropriate and realistic analysis for specific regional and locational benefits. This is also one of the reasons we pursued scenario analysis.

3.4.2 JEDI Analysis

Full results of the JEDI analysis are shown in Appendix B ("Detailed Wind Farm Project Data Costs") and C ("State Level Impacts") of this report. Scenarios are developed as follows. First we develop sets of scenarios for each distinct time period of the wind development's life. The first time period is construction and is defaulted to JEDI's average 2 year period for construction. The second time period is for the twenty year period of wind farm operation.

Next, we develop three sets of scenarios as follows for each time period. Set 1 assumes that Jefferson and Oswego Counties receive 100% of the economic benefits and jobs (direct and indirect) from the wind development. Set 2 assumes an 80% benefit for the counties, with the remaining 20% of benefits accruing to other parts of New York State or possible out of state or country. We believe that the 80% model is most realistic during the construction period because the jobs will be temporary in nature, some proportion will likely be specialized, and that certain accounting and legal activities will likely occur beyond the county regions. HNCW is based in Albany, and we reasonably expect that some economic activity will occur outside of the immediate county region. Finally, we have a least optimal set which assumes 40% of benefits occur beyond the county regions. For the long term job and economic benefits through the operation of the wind farm we prefer to use the 100% benefit option. While fewer jobs and economic activity occur during the O&M period, it is most likely that at least 90-100% of these jobs and activity will occur in the local area. For both sets of analysis we use rose highlighting to denote our expectation for the most likely scenario.

Each of the three sets of analyses uses job numbers derived from JEDI and HNCW (the developer). The jobs analysis is divided into direct jobs and also associated (i.e. derived or indirect) jobs. HNCW has significantly higher numbers for job creation than the JEDI model predicts. We hope that HNCW would be willing to provide its analysis for the job derivation numbers it predicts. We note specifically that HNCW uses the term "*up to* 8 full time" jobs for operations and "*up to* 120 temporary construction jobs." (emphasis added, Hudson North Country Wind 1, LLC 2015, 4) That said it may be reasonable for HNCW to expect slightly higher numbers because the development is on an island and this may have slightly higher needs for human capital.

Finally, we develop scenarios specific to Henderson's expected benefit that are proportional to the county population. Henderson's proportion is 1.13% of the 50% combined populations of Oswego and Jefferson counties that lie within the expected commuting range of the development. Again, we believe the most reasonable expectation for Henderson is a model that is directly proportional to the expected overall population benefit (i.e. the middle case 1.13% model). Arguably, many of the construction jobs will likely go to workers based in Oswego and Watertown. We expect specialized jobs to be sourced beyond the commuting range from Syracuse, Utica, Rochester, and beyond.

Table 6. Construction Jobs and Economic Activity Scenarios: Direct and Indirect Effects

JEDI Direct Construction:	66
JEDI Construction Related:	393
Developer Direct Construction:	120
Developer Inferred Construction Related: (Using JEDI Ratio 5.95:1):	714

Direct Construction and Construction Related Jobs (First 2 year period only)

	Jefferson & Oswego 100%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	66.00	0.38	0.75	1.49
JEDI: Direct Plus Supply Chain and Induced Impacts	393.00	2.24	4.44	8.88
HNCW: Direct Construction	120.00	0.68	1.36	2.71
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	714.00	4.07	8.07	16.14
Earnings (millions)	29.90	0.17	0.34	0.68
Output (millions)	65.00	0.37	0.73	1.47
Value Added (millions)	40.30	0.23	0.46	0.91

	Jefferson & Oswego 80%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	52.80	0.30	0.60	1.19
JEDI: Direct Plus Supply Chain and Induced Impacts	314.40	1.79	3.55	7.11
HNCW: Direct Construction	96.00	0.55	1.08	2.17
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	571.20	3.26	6.45	12.91
Earnings (millions)	23.92	0.14	0.27	0.54
Output (millions)	52.00	0.30	0.59	1.18
Value Added (millions)	32.24	0.18	0.36	0.73

	Jefferson & Oswego 60%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	39.60	0.23	0.45	0.89
JEDI: Direct Plus Supply Chain and Induced Impacts	235.80	1.34	2.66	5.33
HNCW: Direct Construction	72.00	0.41	0.81	1.63
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	428.40	2.44	4.84	9.68
Earnings (millions)	17.94	0.10	0.20	0.41
Output (millions)	39.00	0.22	0.44	0.88
Value Added (millions)	24.18	0.14	0.27	0.55

**Optimal scenarios are shaded in light red in Table 6 of 80% benefit to the county regions during construction.*

Note: Jobs are single job years and monetary values are millions of dollars.

Table 7. Yearly Operations and Maintenance Jobs and Economic Activity Scenarios (20 yrs.)

JEDI Direct O&M:	6
JEDI O&M Related:	17
Developer Direct O&M:	8
Inferred O&M Related (Using JEDI Ratio 2.83:1):	23

	Jefferson & Oswego 100%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	6.00	0.03	0.07	0.14
JEDI: Direct Plus Supply Chain and Induced Impacts	17.00	0.10	0.19	0.38
HNCW: Direct Construction	8.00	0.05	0.09	0.18
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	23.00	0.13	0.26	0.52
Earnings (millions)	1.40	0.01	0.02	0.03
Output (millions)	3.60	0.02	0.04	0.08
Value Added (millions)	2.80	0.02	0.03	0.06

	Jefferson & Oswego 80%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	4.80	0.03	0.05	0.11
JEDI: Direct Plus Supply Chain and Induced Impacts	13.60	0.08	0.15	0.31
HNCW: Direct Construction	6.40	0.04	0.07	0.14
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	18.40	0.10	0.21	0.42
Earnings (millions)	1.12	0.01	0.01	0.03
Output (millions)	2.88	0.02	0.03	0.07
Value Added (millions)	2.24	0.01	0.03	0.05

	Jefferson & Oswego 60%	Henderson 0.57%	Henderson 1.13%	Henderson 2.26%
JEDI: Direct Construction	3.60	0.02	0.04	0.08
JEDI: Direct Plus Supply Chain and Induced Impacts	10.20	0.06	0.12	0.23
HNCW: Direct Construction	4.80	0.03	0.05	0.11
HNCW: Direct Plus Supply Chain and Induced Impacts (inferred via JEDI)	13.80	0.08	0.16	0.31
Earnings (millions)	0.84	0.00	0.01	0.02
Output (millions)	2.16	0.01	0.02	0.05
Value Added (millions)	1.68	0.01	0.02	0.04

**Optimal scenarios are shaded in light red in Table 7 of 100% benefit during the operations period.*

Note: Jobs are single job years and monetary values are millions of dollars.

Analysis and Discussion

Our analysis is based on our optimal scenarios (shaded in light purple in Tables 6 and 7) of 80% benefit to the county regions during construction, and 100% benefit during the operations period. Under these most likely scenarios, the Jedi and HNCW job output data show the potential for 4-8 jobs to the town of Henderson during the two year construction period.[8] During the twenty year operational period Henderson can expect 0-1 job(s). Barring the introduction of analysis from HNCW showing otherwise, we project job creation to occur on the lower end of this scale, closer to the JEDI modelling numbers. Thus our most likely expectation is actually a range of 4-6 temporary construction jobs and likely no long term operational jobs.

Similarly, the JEDI model shows that Henderson can expect to see proportional yearly earnings at approximately $270,000, economic output at $590,000, and added value of $360,000 during the construction period. During the twenty year period of operation Henderson can expect associated benefits of $20,000 in yearly earning, $40,000 in economic output, and $30,000 in added value economic activity on an annual basis.

Several important points accompany the analysis of these most likely scenarios. First, these analyses are predictive and reflect the best range of inputs but they should still be cited or considered with care. Second, they do not reflect potential economic costs associated with loss of land value or tourism activity. Finally, as discussed in the review section, normally communities benefit from local lease payments, property tax payments, and/or PILOTs. Further, the hosting communities benefit from these forms of economic inputs to an extensive degree. They can be the balancing factor that offsets viewshed impacts and the potential costs to a community from those impacts in terms of economic devaluation.

A particular issue for Henderson is that it will not benefit economically from local lease payments, nor property taxes or PILOTs. For this reason we believe the generalized economic outputs of the JEDI model are likely optimistic or overstated in terms of direct benefits to the town. Henderson is in the difficult position of carrying a large majority of negative impacts, while reaping a very small proportion of local economic development.[9]

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[8] Remember that because Galloo is an island this may explain HCNW's higher numbered job analysis compared to the JEDI analysis.

[9] It may be that Hounsfield, the town of jurisdiction, will reap lesser economic benefits than average given that leases are consolidated by a single absentee landowner.

3.5 Tourism Analysis

Wind farms can potentially affect tourism in a variety of ways. They can be perceived as an industrial development in areas of rich beauty that are attractive to tourists for activities such as fishing, boating, beach activities, or hiking.

Riddington et al. summarize the potential problem succinctly:

> …many people find that man-made structures such as pylons and wind turbines reduce the attractiveness of a landscape. It is logical to assume that reduced quality of an important feature will inevitably reduce demand to some degree which in turn may result in either reduced prices for tourism services or reduced numbers of tourists or both. Any loss of expenditure will lead to a reduction in economic activity and result in a loss of income and jobs. (Riddington et al. 2010, 237)

In more rare circumstances, they can also occasionally be perceived as an eco-tourism benefit, although this is almost always in combination with other kinds of eco-tourism. In general, there is mixed evidence on the impact of wind developments in coastal areas. The following discussion outlines some of the evidence.

Distances from a living area to a wind farm are a critical component of assessing impacts. Distances to the center of Galloo in the Henderson coastal areas range from 6.8 miles (Wehle State Park) to 12.2 Miles (Westcott Beach State Park; or approximately 10-19 kilometers). As discussed in the previous section on economic valuation by residents, most negative perceptions occur at the 8-12 km range and under (Lantz and Tegen 2009; Westerberg, Jacobsen, and Lifran 2013).

Finally, a critical concern in interpreting the vast majority of literature on tourism impacts is that most of it is prospective (forward-looking) not retrospective (looking to the past). This means that our understanding is not empirically based. Most of the literature that tests prospective economic impact literature show that the vast majority of the time both positive and negative impacts are less than predicted. Thus the reported impacts (negative and positive) discussed in the following review are likely overstated. In addition, predicted impacts are likely to dissipate over time, as has been discussed in the literature on property values (Hoen et al., 2015).

Westerberg et al. conducted choice experiments in the coastal Mediterranean area of Languedoc Roussillon in France. Their research showed that tourists and beachgoers had negative reactions to all choice variations for wind implementation under a 12 kilometer radius (Westerberg, Jacobsen, and Lifran 2013). Alternately, they also found that wind developments created in partnership with ecotourism opportunities created support for wind development. These recreational activities included diving around the artificial reefs created by offshore wind, and sightseeing tours to the wind farm areas. Importantly, Westerberg et al conclude that

> "…disamenity costs decline as distance from coast increases (Krueger et al., 2011). Our results indicate that the impact of wind farm disamenity costs on tourism revenues tends to zero, somewhere between 8 and 12 km. The study also showed that there is large heterogeneity in the tourists' preferences." (Westerberg, Jacobsen, and Lifran 2013, 182)

Riddington et al review an extensive set of literature based in the UK, Scotland, and Wales (2010). The results they report are mixed. Many of the studies they cite are often biased by the motivations of the funding agency or institution (these studies show both negative, positive, and non-effects) and have minor issues in research design. I review several of the most important here, as cited in Riddington. First they discuss research by Hanley and Nevin (1999) that shows a small but significant willingness to pay of £15 per person on average to have views without turbines. They also review an NFO/System Three (2002) study that shows 29% tourist opposition to wind development. Both these studies have significant research design flaws that may bias these results (Riddington et al. 2010, 239-240).

Riddington also review positive literature by MORI Scotland (2002) that showed 43% positive response to area wind farms and only 8% negative in tourist surveys *during or after their visit.* This is important because it represents one of the few retrospective analyses that exist in the literature. Riddington's characterization of the MORI study continues:

> When asked about the impact on the likelihood of visiting Argyll in future, 91% said it made no difference, 4% said they are more likely to return and 2% said they were less likely to return. As so many studies show, there was strong interest in visiting a wind farm if opened to the public. If a wind farm had a visitor centre, 80% would be interested in going, with 54% 'very interested' and 19% 'not interested'. The majority of tourists who knew about the wind farms came away with a more positive image of the area because of their presence (Riddington et al. 2010, 240).

Lastly, Riddington et al. cite survey work by the Welsh Tourist Board from 2003 that shows 78% with neutral or positive views and 21% negative. 68% stated their interest in wind farm tours or a visitor center (2010, 240).

The Riddington et al. analysis used GIS research and survey work to determine net economic impact on tourist areas in Scotland. They calculate a significant but very small net job loss of less than 0.1% of employment.

Alternately Landry et al assessed the impact of coastal wind turbines on local tourism and recreation for residents in northern coastal counties of North Carolina. They used telephone and web survey data to determine wind development effects on trip behavior and site choice. Most of the respondents stated their support of offshore wind energy development. Their research found "no evidence of aversion to wind farms 4 miles out in the ocean." (2012, 93).

Finally, an extensive analysis done for the Government of Wales more recently by Regeneris had several findings (Regeneris Consulting 2013). First, the overall effect of wind farms on tourism in Wales was negligible. The exception was for unique markets noted for their tranquility, remoteness, and natural scenery. In these markets, the potential for minor negative impacts existed. Similarly, they noted the possibility of positive visitor impacts, primarily by wind farm association with other activity or via direct tourism.

Analysis and Discussion

As should be obvious at this point, the literature on tourism impacts is heterogeneous and varied in nature.[10] However, the overall summation of the evidence seems to show that tourism impacts on coastal areas in and around Henderson are likely to be non-existent or very minimal in nature. This would include boating, beach activities, and other associated on-shore activities. Overall, this is primarily because the distance from the island to the shore amenities is beyond the distance in which affects seem to occur which negatively affect tourist perceptions. Given the location of the turbines on the island (rather than in water), we can also expect minor effects on boating and fishing according to the literature. Finally, the possibility exists for the development of eco-tourism opportunities which may help reinforce positive perceptions of wind farm activity. Such an option is not a part of the developer's plan, nor is it clear that the development of this type of activity would lead to positive economic or tourist perception outcomes.

[10] Note that in addition to the readings discussed above, several of which contain extensive reviews of the academic literature, we also consulted several additional readings that support our general conclusions. These include the following: (Westerberg, Jacobsen, and Lifran 2015; Lilley, Firestone, and Kempton 2010; Slattery, Lantz, and Johnson 2011; Brown et al. 2012; Wolsink 2013; Frantál and Kunc 2011; Broekel and Alfken 2015; Stiftung Offshore-Windenergie (German Offshore Wind Energy Foundation) 2013)

4.0 Viewshed Analysis & Methodology

4.1 Introduction

Viewshed analysis is a technique used within Geographic Information Systems software (GIS) for predicting areas on a landscape that will be visible or invisible to observers with known locations and elevations. It uses elevation data in a raster, or cell-based, data format to evaluate the visibility potential of objects on the Earth's surface. The function creates individual line-of-sight calculations from multiple points (wind turbines) to every location in the study area and in the case of multiple points, will add up the values to give a cumulative total of objects visible from each cell across the study area. In the case of the proposed Gallo Island Wind Project, the total number of turbines was 29, so the viewshed values range from 0 – 29.

Visibility of distant objects decreases with distance due to many factors, including meteorological conditions, the curvature of the earth, atmospheric refraction, terrain and physical obstructions and the eyesight of individuals viewing the objects. The parameters considered for this viewshed analysis included terrain obstructions, forest vegetation, earth curvature and atmospheric refraction. An atmospheric refraction coefficient of .013 was used for all viewshed calculations. The curvature of the earth begins to affect visibility of objects at around 3 miles, and the proposed turbines would be completely invisible at a distance of 35 miles over open water.

The study area considered for the viewshed focused on the Town of Henderson, but also included the areas around Galloo Island out to a distance of about 30 miles. Visual impacts of distant objects, regardless of height, rapidly decreases beyond about 15 miles. Distance buffers (rings) were created around the proposed turbines at 5, 10 and 15 miles and are shown in Figures 5 and 6. As can be seen on the map, the majority of Henderson Town is within the 5 – 15 mile distance band. For the purpose of providing visibility information for the entire town of Henderson, the viewshed was run out to a distance of approximately 30 miles, even though the visual significance of the turbines would be very small.

The viewshed (or Visibility) analysis was carried out using ArcGIS Desktop 10.3.1 and the 3D Analyst Extension.

4.2 Data Sources and Processing

Proposed wind turbine locations and tower height values were provided by Neil Habig of Hudson Energy Development. Turbine parameters used in the analysis are shown below:

Tower Heights: 110 meters (361 feet)

Rotor Diameter: 130 meters (427 feet)

Blade Tip Height: 175 meters (574 feet)

Total Turbines: 29

Digital Elevation Models (DEMS) were obtained from the United States Geological Survey (USGS) National Elevation Dataset (NED) at a spatial resolution of 10 meters (33 feet). This is the highest resolution data available for the study area. The turbines were plotted on the DEM data to obtain the base elevations of the towers. These values ranged from 76 – 89 meters above sea level (249 – 291 feet). A value of 1.7 meters (5.6 feet) was added to all cells in the study area to represent the approximate height of a person standing on the ground.

Visibility potential depends heavily on vegetation, buildings and local ground conditions. Building footprint data is unfortunately not available for Jefferson County, so the viewshed models do not take existing structures such as houses and commercial buildings into account. The lack of this data will tend to over-estimate the visibility potential of the turbines, especially in urban areas, as buildings will block the view from ground level.

Forest canopy data is available from the National Land Cover Database 2011 (NLCD) at a spatial resolution of 30 meters and was downloaded from the Multi-Resolution Land Characteristics Consortium (MRLC) website. The forested areas were extracted from the NLCD, re-sampled to 10 meter resolution and then added to the heights of the Digital Elevation Model. The forest data does not include the actual heights of the tree canopy, just the presence of continuous forest areas, so assumptions have to be made about the actual heights of the trees. Two forest canopy viewsheds were created, one using estimated canopy heights of 13m and one using forest heights of 20m. The NLCD data does not contain information about individual trees or smaller shrubs, which can also impact the visibility.

Boundary and transportation data for Jefferson County was downloaded from the New York State GIS Clearinghouse.

4.3 GIS Methodology and Results

Once all of the data was downloaded and processed into a common coordinate system, the viewshed parameters were applied and the viewshed function was run using the terrain data only, without vegetation. This is known as a denuded or bare-earth viewshed and predicts visibility across the study area without consideration of forest canopy. This method tends to exaggerate the potential visibility but is useful as a reference point (see Figure 9).

To account for the screening effects of forest canopy, NLCD forest areas were added to the DEM elevations for two simulations, one with 13 meter forest heights and another with 20 meter forest heights. The forest areas are then classified as not being able to see any turbines, assuming that observers in these areas would not have a view of the proposed turbines. This could lead to areas that are classified as zero turbines visible, especially in forested areas that directly face Gallo Island. These visibility maps are shown in Figure 7 and Figure 8.

Additional detail maps are provided at a 1:24,000 scale to show visual impact potential for individual parcels (shown in Figures 10 through 13).

The results of the viewshed analysis were then added to the tax parcel polygons using the Zonal Statistics function. This provided a value that indicates the average number of turbines visible to a given parcel. This step was necessary because parcel size varies greatly across the town and large parcels contain areas that have high and low visibility values. The average turbine visibility values were then used to assess the impacts on property values in section 2 above.

4.4 Interactive Map Viewer on ArcGIS Online

The URL to access an Interactive Map Viewer of some of the GIS analyses is at: http://arcg.is/20Y5VEc. Animations of the view shed analysis can be found at: https://www.youtube.com/watch?v=KHNV6SwQHg0&feature=youtu.be.

Some notes regarding the Interactive Map Viewer:

1. The 3D trees are added randomly to all areas considered "Forest" by the USGS. It would be difficult to fill the areas completely with trees because that would take thousands of individual points and would make the product far too cumbersome. The trees are sized to be 20 meters tall. Turbines are 175m to blade tip.

2. All layers can be turned on and off and zoomed into, however the 3D space doesn't allow two base layers to appear neatly simultaneously. So if a user tries to see the USGS topo together with imagery, it can create some strange effects.

3. The resolution of the terrain surface is such that the draped layers (everything else) may not exactly conform to the surface. You may see a tree floating above or cutting under the surface and roads slightly offset. This cannot be altered, as it is due to the native resolution of the digital elevation model, which also comes from the USGS.

Interactive Map Viewer Functionality:

1. Mouse buttons control the view (left = Pan, middle=Zoom, right=Orbit)

2. Environment settings can be changed in upper right (time of year and day, shadows, etc.)

3. Three views were added at ground level and are shown at bottom middle of screen

4. The viewer requires a WebGL enabled browser, which can be confirmed at: https://en.wikipedia.org/wiki/WebGL.

4.5 List of Figures

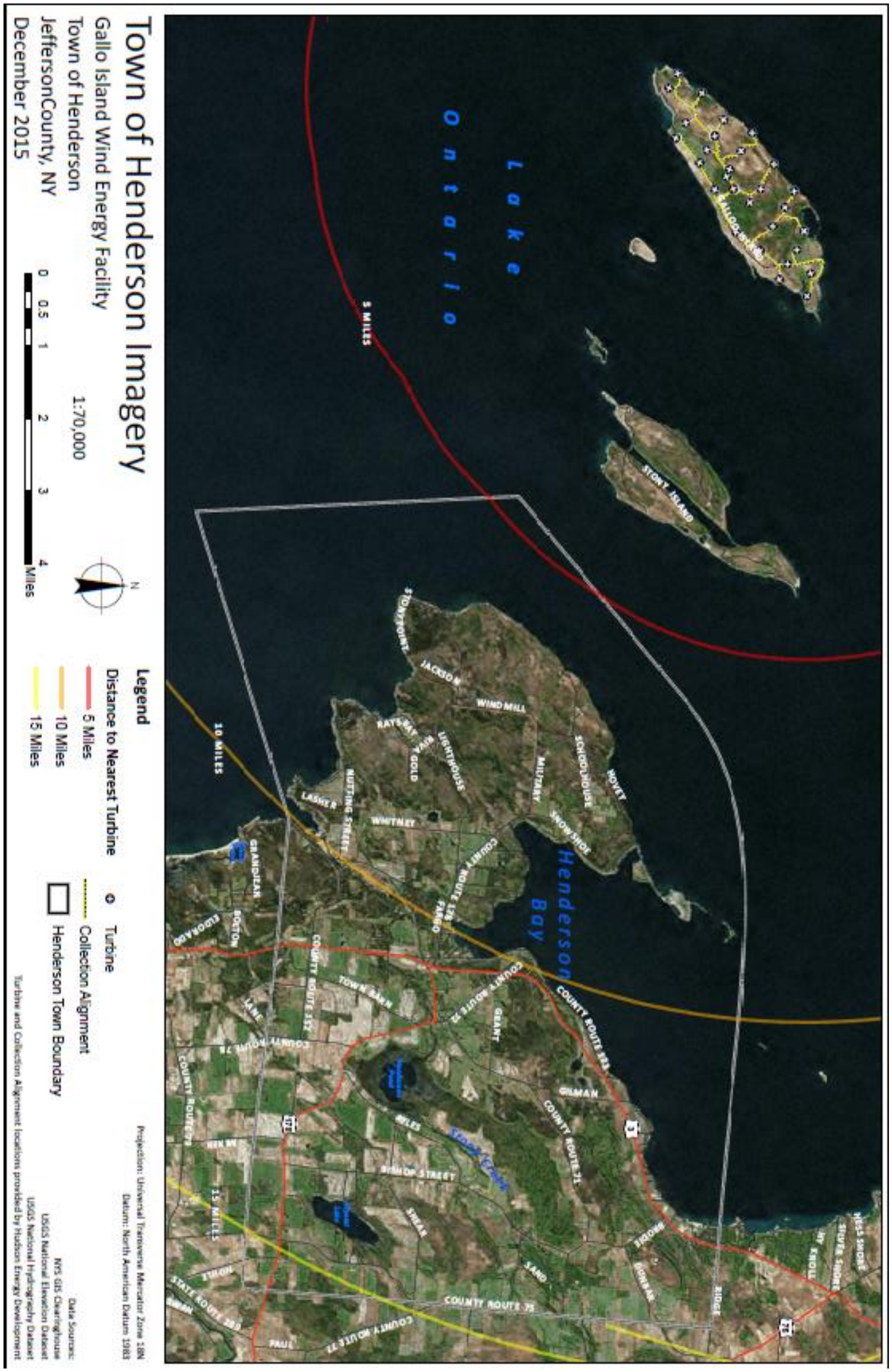

Figure 5. Henderson Overview with Satellite Imagery

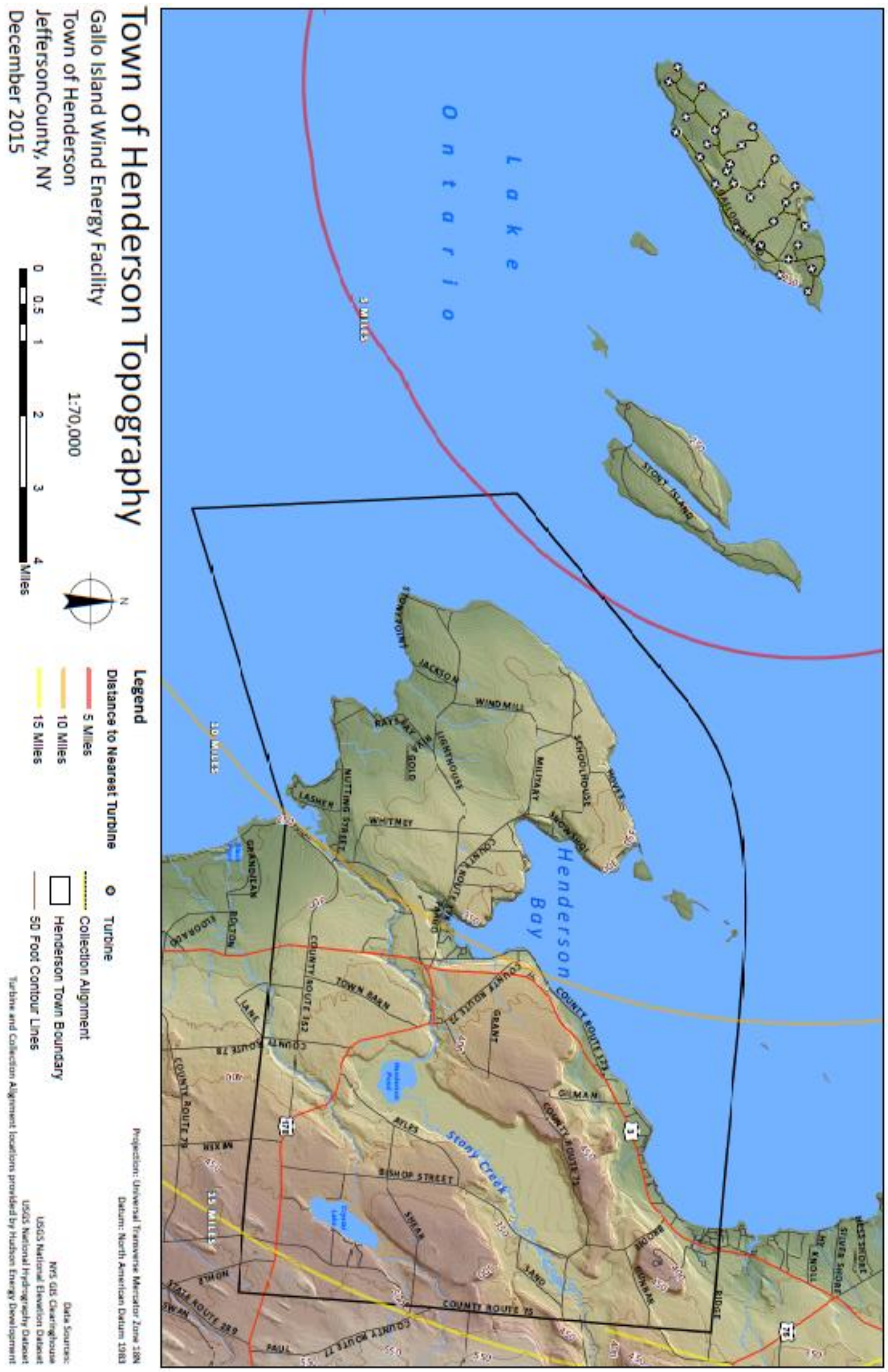

Figure 6. Henderson Overview with Topography

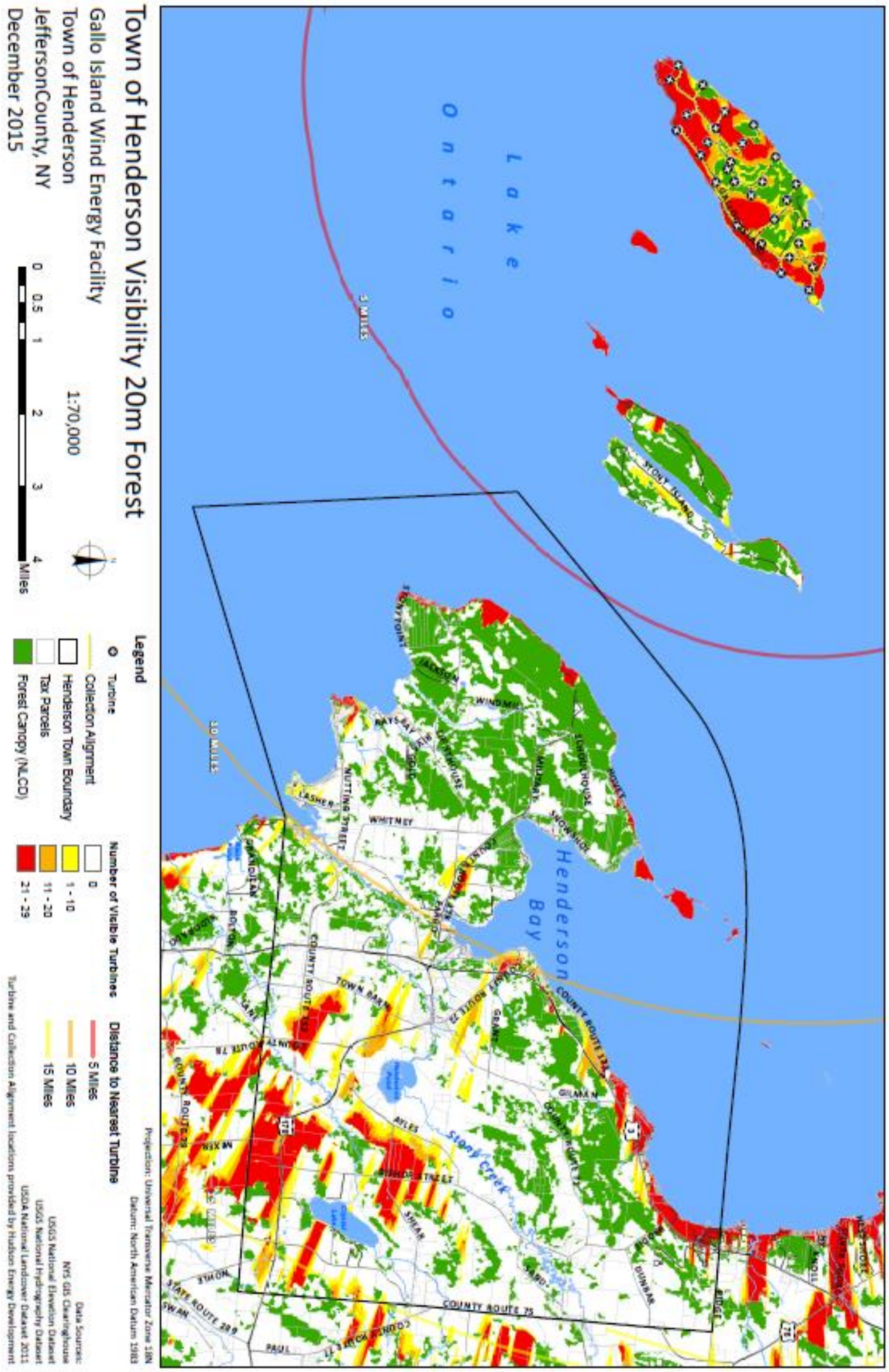

Figure 7. Henderson Town Visibility 20m Forested

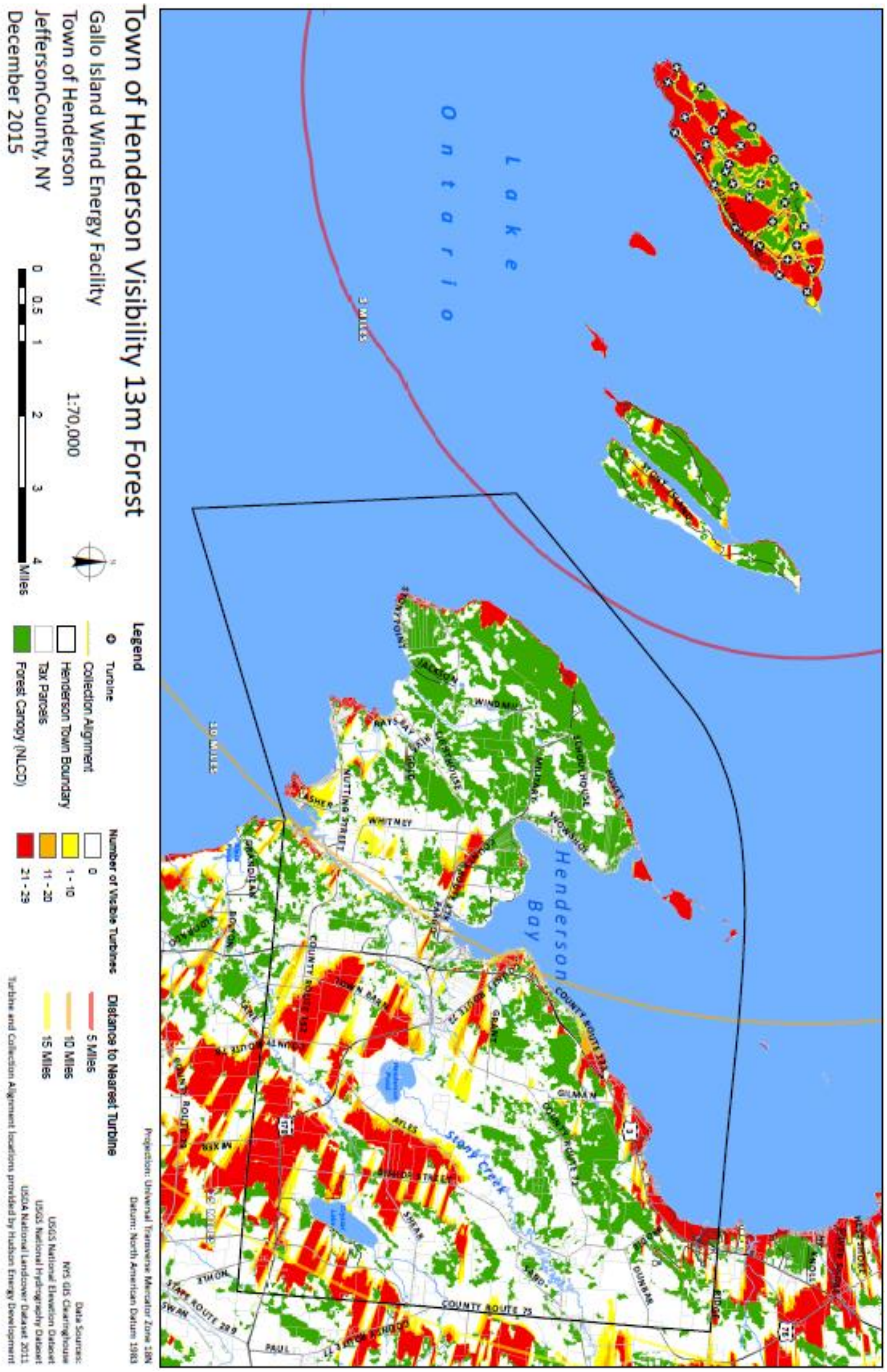

Figure 8. Henderson Town Visibility 13m Forested

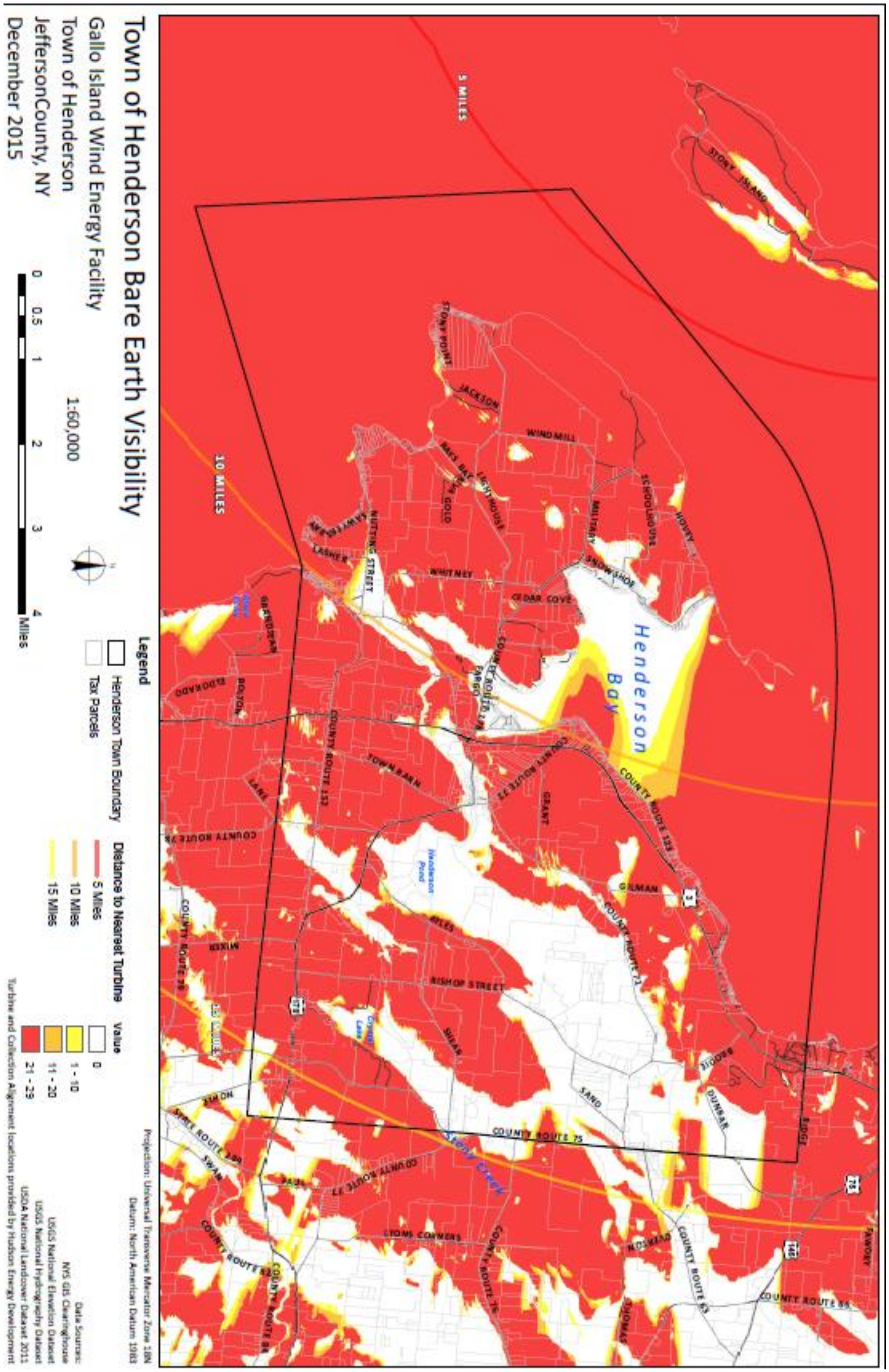

Figure 9. Henderson Town Bare Earth Visibility

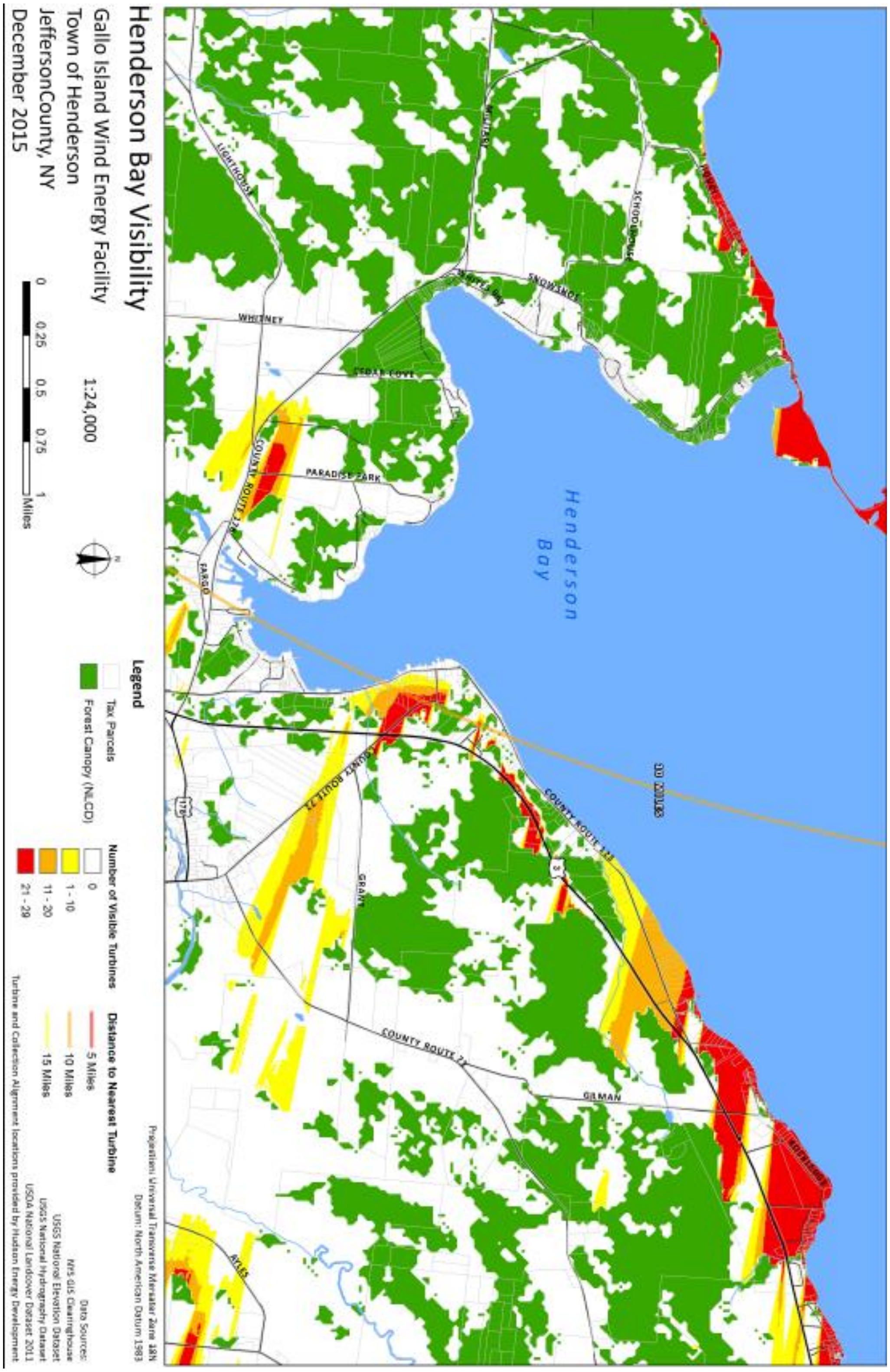

Figure 10. Henderson Bay Detail

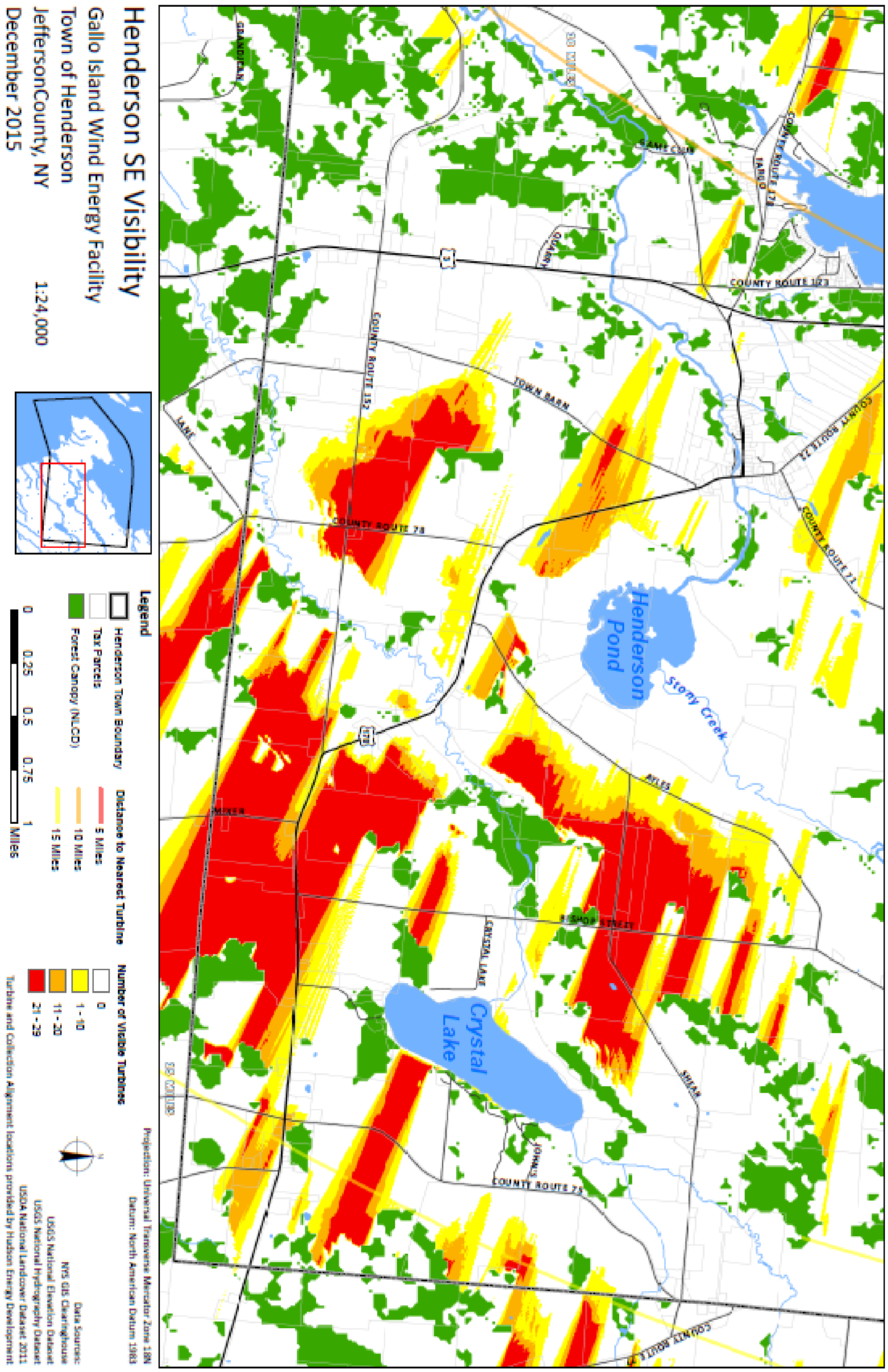

Figure 11. Henderson SE Detail

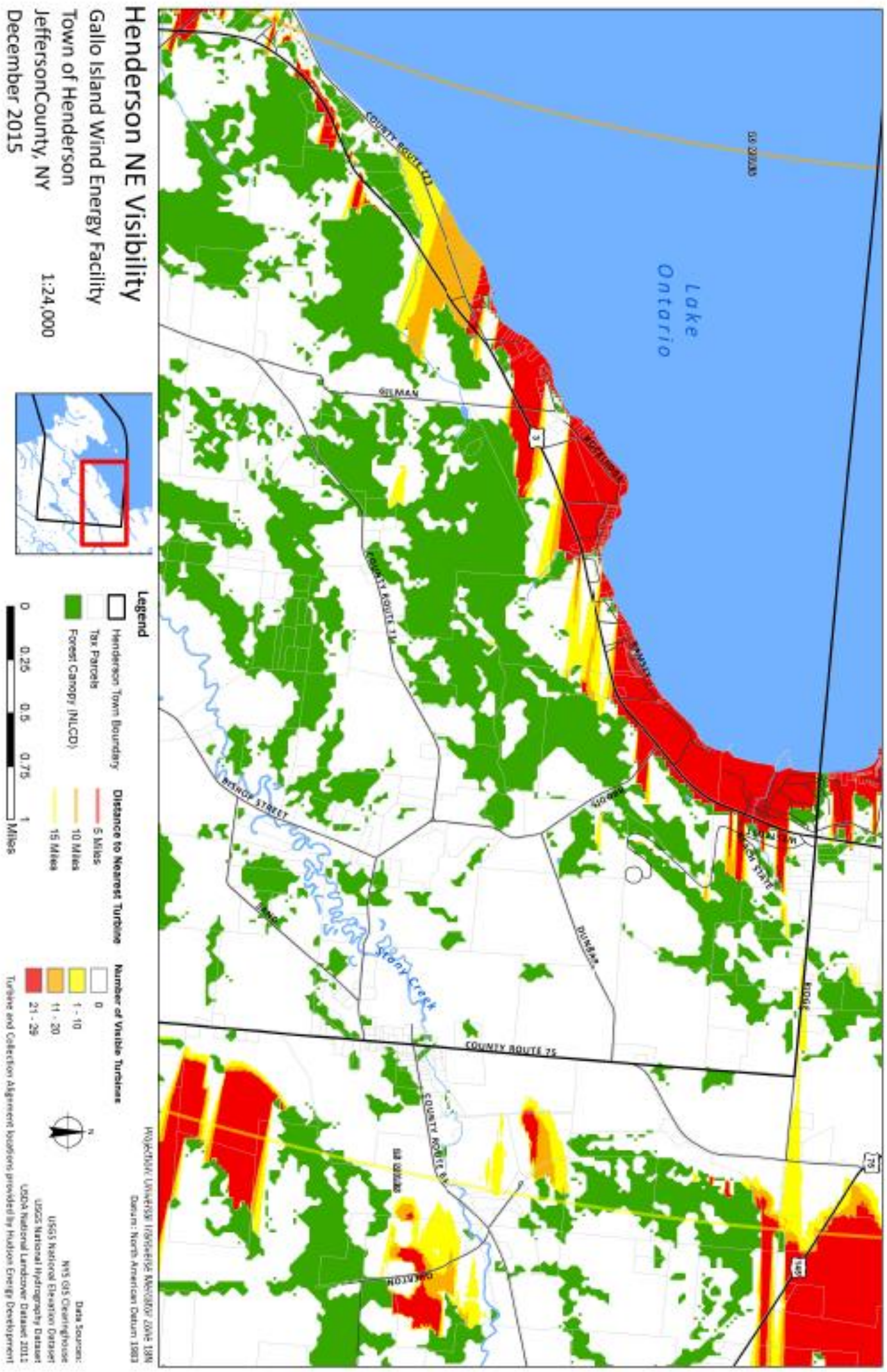

Figure 12. Henderson NE Detail

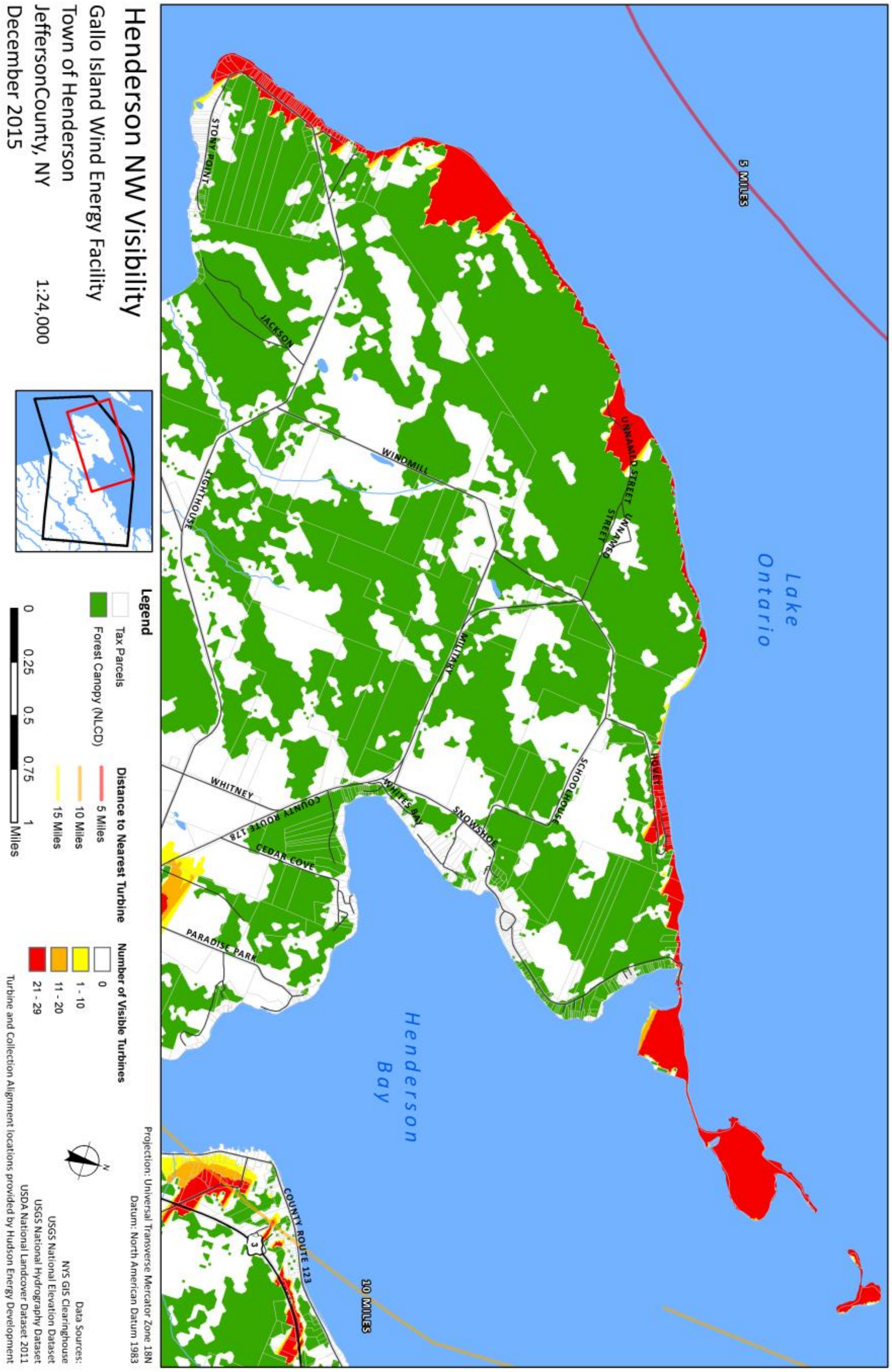

Figure 13. Henderson NW Detail

5.0 Research Note

The Nanos Clarkson Research Collaboration team has made every attempt to ensure the accuracy and reliability of the information provided in this report. However, the information is provided "as is" without warranty of any kind. The Nanos Clarkson Research Collaboration does not accept any legal responsibility or liability for the public use or interpretation of the data. The data prepared is based on the latest available information in the public domain without prejudice.

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6.0 Report Summary & Conclusions

The Nanos Clarkson Research Collaboration team has undertaken the preceding analyses based on the best available public data. While the analytical methodologies (and qualifiers) for the various analyses have been highlighted within the preceding report, the overall general findings can be summarized as follows in terms of the anticipated impacts:

- likely negative land valuations for the Town of Henderson;
- likely positive economic effects to the region, but not commensurate to the Town of Henderson;
- likely minor positive effects on jobs and economic impacts to the Town of Henderson; and,
- likely minor negative effect on tourism.

Finally, the report's series of view-shed analyses for the Town of Henderson in relation to the proposed Galloo Island development are intended as a tool or aid in the planning and decision-making process. Some of the items can be found online in the Interactive Map Viewer identified in the preceding analysis.

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Appendix A
JEDI Wind Model Methodology

Appendix A. JEDI Wind Model Methodology

The following appendix is a verbatim quote taken from Goldberg, Sinclair, and Milligan (2004) paper on the JEDI Wind Model.

Methodology

Basic information about a wind project (at minimum the project's state, county, or region; the year of construction; and the size of the facility), the model calculates the project cost (i.e., specific expenditures) as well as the number of jobs, income (i.e., wages and salary), and economic activity that will accrue to the state, county, or region being analyzed. Although JEDI was originally designed to provide state level analysis, the model also includes a "User Add-in Location" feature. This feature allows users to import specific county or region level multipliers and personal expenditure patterns to localize the analysis to a location other than the state level.

To evaluate these impacts, input-output or multiplier analysis is used. Input-output models were originally developed to trace supply linkages in the economy. For example, they show how purchases of wind turbines not only benefit turbine manufacturers, but also the fabricated metal industries and others businesses supplying inputs to those manufacturers. The benefits that are ultimately generated by expenditures for wind plants depend on the extent to which those expenditures are spent locally and the structure of the local economy. Consistent with the spending pattern and location-specific economic structure (state, county, or region), different expenditures support a different level of employment, income, and output. Input-output analysis is a method of evaluating and summing the impacts of a series of effects generated by an expenditure (i.e., input). To determine the total effect of developing a wind power plant, three impacts are examined for each expenditure. These include direct effect, indirect effect, and induced effect.

Direct effect: Direct effects are the on-site or immediate effects created by an expenditure. In constructing a wind plant, it refers to the on-site jobs of the contractors and crews hired to construct the plant. It also includes the jobs at the turbine manufacturing plants and the jobs at the tower and blade factories.

Indirect effect: Indirect effects refer to the increase in economic activity that occurs when a contractor, vendor or manufacturer receives payment for goods or services and in turn is able to pay others who support their business. For instance, this impact includes the banker who finances the contractor; the accountant who keeps the contractor's books;

and the steel mills and electrical manufacturers and other suppliers that provide the necessary materials.

Induced effect: Induced effects refer to the change in wealth and income that is induced by the spending of those persons directly and indirectly employed by the project. This would include spending on food, clothing, or day care by those directly or indirectly employed by the project, retail services, public transit, utilities, cars, oil, property & income taxes, medical services, and insurance, for example.

The sum of these three effects yields a total effect that results from a single expenditure. To accomplish this analysis at the state level, state-specific multipliers and personal expenditure patterns are used to derive the results. These state-by-state multipliers for employment, wage and salary income and output (economic activity), and personal expenditure patterns were adapted from the IMPLAN Professional model using year 2000 data, the most current data available last year.

The changes in expenditures from investments in developing wind power plants are matched with their appropriate multipliers for each sector affected by the change in expenditure. Consistent with an analysis of this type and scope, the assumptions play an important role in influencing the results. Thus, to accommodate the greatest level of flexibility in user skill level and availability of specific detailed project information, the model is designed to incorporate model default values or new values entered by the user. The default values represent a reasonable expenditure pattern for constructing and operating a wind power plant in the United States and the share of expenditures spent locally. The default expenditure pattern is based on a review of numerous wind resource studies.

Currently, not every project will follow this exact "default" pattern for expenditures. Project size, location, financing arrangements, and numerous site-specific factors influence the construction and operating costs. Similarly, the availability of local resources (including skilled labor and materials) and the availability of locally manufactured power plant components will have a significant effect on the costs and the economic benefits that accrue to the state or local region. To the extent the user has and can incorporate project-specific data and the share of spending that is expected to occur locally, the more localized the impact analysis will be."

Appendix B

JEDI Model – Detailed Wind Farm Project Data Costs

Appendix B. JEDI Model – Detailed Wind Farm Project Data Costs

Detailed Wind Farm Project Data Costs		NEW YORK		
Construction Costs		**Cost**	**Local Share**	
Equipment				
Turbines		$79,223,991	0%	$0
Blades		$18,547,423	0%	$0
Towers		$20,534,646	0%	$0
Transportation		$14,175,530	0%	$0
Equipment Total		$132,481,590		$0
Balance of Plant				$0
Materials				$0
Construction (concrete rebar, equip, roads and site prep)		$19,143,590	90%	$17,229,231
Transformer		$2,165,537	0%	$0
Electrical (drop cable, wire,)		$2,282,622	100%	$2,282,622
HV line extension		$4,169,589	70%	$2,918,712
Materials Subtotal		$27,761,338		$0
Labor				$0
Foundation		$1,542,541	95%	$1,465,414
Erection		$1,747,146	75%	$1,310,360
Electrical		$2,546,118	70%	$1,782,283
Management/supervision		$1,321,186	0%	$0
Misc.		$6,802,950	50%	$3,401,475
Labor Subtotal		$13,959,941		$0
Development/Other Costs				$0
HV Sub/Interconnection				$0
Materials		$1,315,666	90%	$1,184,099
Labor		$403,014	10%	$40,301
Engineering		$1,790,292	0%	$0
Legal Services		$975,709	100%	$975,709
Land Easements		$0	100%	$0
Site Certificate		$456,524	100%	$456,524
Development/Other Subtotal		$4,941,205		$0
Balance of Plant Total		$46,662,485		$0
Sales Tax (Materials & Equipment Purchases)		$12,269,661	100%	$12,269,661
Total Project Costs		**$191,413,737**		**$45,316,391**
Wind Plant Annual Operating and Maintenance Costs				
		Cost	**Local**	

			Share	
Labor Costs				
Personnel				
Field Salaries		$351,051	100%	$351,051
Administrative		$55,130	100%	$55,130
Management		$137,826	100%	$137,826
Labor/Personnel Subtotal		$544,007		$0
Materials and Services				$0
Vehicles		$42,908	100%	$42,908
Misc. Services		$16,734	80%	$13,387
Fees, Permits, Licenses		$8,367	100%	$8,367
Misc. Materials		$33,468	100%	$33,468
Insurance		$321,810	0%	$0
Fuel (motor vehicle gasoline)		$16,734	100%	$16,734
Tools and Misc. Supplies		$108,772	100%	$108,772
Spare Parts Inventory		$953,200	2%	$19,064
Materials and Services Subtotal		$1,501,993		$0
Sales Tax (Materials & Equipment Purchases)		$92,810	100%	$92,810
Other Taxes/Payments		$0	100%	$0
Total (with Sales Tax and Other Taxes/Payments)		$2,138,810		$0
Debt Payment (average annual)		$21,102,314	0%	$0
Equity Payment - Individuals		$0	100%	$0
Equity Payment - Corporate		$6,775,440	0%	$0
Property Taxes		$774,923	100%	$774,923
Land Lease		$306,900	100%	$306,900
Total Annual Operating and Maintenance Costs		**$31,098,387**		**$1,961,340**

Appendix C

State Level Impacts – JEDI Analysis

Appendix C. State Level Impacts – JEDI Analysis[11]

	Jobs	Earnings	Output	Value Added
During construction period				
Total Impacts	**393**	**$29.9**	**$65.0**	**$40.3**
During operating years (annual)				
Total Impacts	**17**	**$1.4**	**$3.6**	**$2.8**

	Jobs	Earnings	Output	Value Added
During construction period				
Project Development and Onsite Labor Impacts				
Construction and Interconnection Labor	61	$4.7		
Construction Related Services	5	$0.6		
Total	66	$5.3	$5.7	$5.4
Turbine and Supply Chain Impacts	213	$16.2	$39.4	$21.1
Induced Impacts	115	$8.4	$19.9	$13.7
Total Impacts	**393**	**$29.9**	**$65.0**	**$40.3**
During operating years (annual)				
Onsite Labor Impacts	6	$0.5	$0.5	$0.5
Local Revenue and Supply Chain Impacts	6	$0.5	$2.1	$1.6
Induced Impacts	5	$0.4	$1.0	$0.7
Total Impacts	**17**	**$1.4**	**$3.6**	**$2.8**

[11] Primary expected impacts would likely accrue primarily to Jefferson, Oswego, and Onondaga Counties, though many benefits would extend far afield. For instance to the rest of New York State, out of state, and for some benefits, out of country.