Wind Power GeoPlanner™

Doppler and NEXRAD Weather Radar Study

Hoffman Falls

Prepared on Behalf of
Liberty Renewables Inc.

September 22, 2023

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1. Introduction

The purpose of this document is to describe the research, calculations, and analysis performed to assess the impact of the proposed Hoffman Falls Wind Project (the Project) on the operation of Doppler Weather Radar Systems (owned and operated by television stations and commercial interests) and the NEXRAD radars (jointly operated by the National Weather Service (NWS), the Federal Aviation Administration (FAA), and the U.S. Air Force) within the vicinity of the project. The report also discusses the New York State Mesonet weather station network and addresses any potential for impact from the presence of the wind energy project. This study was performed for Liberty Renewables Inc.

2. Project Area

The Hoffman Falls Wind Project is located within Madison County, New York, as shown below in Figure 1 (the Project Area). The Project Area is defined as the rectangular area with a minimum of a 2-mile buffer from all turbine locations as noted in Figures 1 - 4. The turbines associated with the Project will have a maximum hub height of 127.5 meters and a rotor diameter of 163 meters, giving the structures an overall maximum height of up to 209 meters above ground level. At the time of this study, there are up to 24 turbines proposed for the Hoffman Falls Wind Project. Table 1 lists these turbines and their coordinates within the Project Area. A detailed view of where these turbines are currently sited is provided in Figure 2.

Figure 1: Location of Hoffman Falls Project in the State of New York

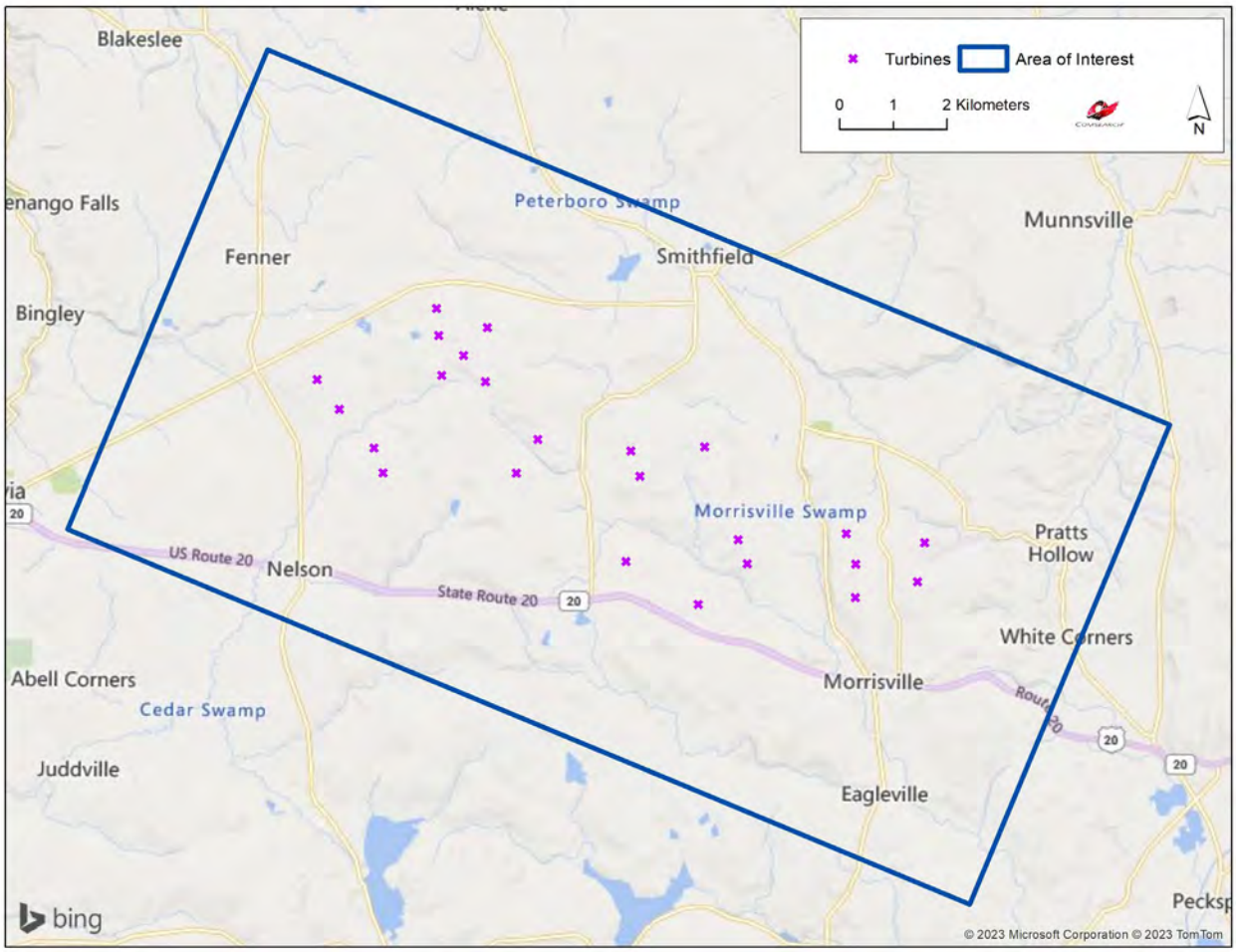

Figure 2: Location of Turbines within Hoffman Falls Wind Project

Turbine ID	Latitude (NAD83)	Longitude (NAD83)	Ground Elevation (m)	Maximum Blade Height Above Mean Sea Level (m)
T-1	42.948944	-75.773562	509.84	718.84
T-2	42.944222	-75.768480	487.25	696.25
T-3	42.937521	-75.760450	524.76	733.76
T-4	42.933364	-75.758277	553.54	762.54
T-5	42.961029	-75.746466	556.26	765.26
T-6	42.956522	-75.745822	563.11	772.11
T-7	42.949788	-75.745046	530.80	739.80
T-8	42.953183	-75.740104	558.83	767.83
T-9	42.957884	-75.734756	545.55	754.55
T-10	42.948816	-75.735056	555.90	764.90
T-11	42.933495	-75.727873	554.05	763.05
T-12	42.939202	-75.723022	509.28	718.28
T-13	42.918923	-75.702677	506.41	715.41
T-14	42.937502	-75.701599	488.86	697.85
T-15	42.933135	-75.699610	493.72	702.72
T-16	42.911790	-75.686049	489.68	698.68
T-17	42.922707	-75.677068	458.90	667.90
T-18	42.918672	-75.674963	447.45	656.45
T-19	42.923920	-75.652358	495.08	704.08
T-20	42.913158	-75.650180	502.45	711.45
T-21	42.918780	-75.650148	509.34	718.34
T-22	42.915871	-75.636078	487.45	696.45
T-23	42.922490	-75.634459	454.57	663.57
T-24	42.938175	-75.684876	454.66	663.66

Table 1: Wind Turbine Coordinates

3. Technical Data

Based on a preliminary analysis of the terrain within the vicinity of the Project and taking into account the maximum height of the proposed wind turbines, a reasonable search radius for radar systems was established at 250 kilometers from the center of the Project Area. Tables 2 and 3 contain the technical parameters of the commercial Doppler radar systems located within 250 kilometers of the Project, including ownership and geographical data[1]. A depiction of the

[1] Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data provided in this report is governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

locations of the Doppler radar systems with respect to the proposed Project are shown below in Figure 3. Table 4 and Figure 4 contains the information on the NEXRAD radar systems found with 250 kilometers.

ID	Call Sign	Frequency (MHz)	Ground Elevation (m)	Antenna Height (m)	Output Power (Watts)	Distance to Nearest Turbine (km)
1	WPPY879	5575.0	483.0	33.0	250000	20.49
2	WPRT837	5460.0	135.7	45.7	200	142.91
3	WPZR862	5550.0-5600.0	292.6	39.0	250000	164.62
4	WNQJ338	5350.0-5460.0	162.0	44.0	175	180.00
5	KKI208	5350.0-5460.0	646.2	12.0	200	192.59

Table 2: Technical Data for Commercial Interest and Television Station Doppler Radar Systems within 250 Kilometers of the Hoffman Falls Wind Project

ID	Call Sign	Owner- Operator	Location	Latitude (NAD83)	Longitude (NAD83)
1	WPPY879	Nexstar Media Inc.	POMPEY, NY	42.944500	-76.024639
2	WPRT837	WRGB Licensee, LLC	NISKAYUNA, NY	42.813194	-73.891250
3	WPZR862	WNYT-TV, LLC	BRUNSWICK, NY	42.785917	-73.628194
4	WNQJ338	WHEC-TV, LLC	BROCKPORT, NY	43.212556	-77.954722
5	KKI208	TEGNA Broadcast Holdings, LLC	HANOVER TOWNSHIP, PA	41.182861	-75.872417

Table 3: Location and Ownership of Commercial Interest and Television Station Doppler Radar Systems within 250 Kilometers of the Hoffman Falls Wind Project

ID	WBAN #	Station ID	Station Name	Latitude (NAD83)	Longitude (NAD83)	Elevation (ft)	Tower Height (m)	Distance to Nearest Turbine (km)
1	54763	KRMX	Griffiss AFB, NY	43.467778	-75.457778	1516	30	60.93
2	4725	KBGM	Binghamton, NY	42.199722	-75.984722	1606	20	82.79
3	54766	KENX	Albany, NY	42.586389	-74.063889	1826	20	133.76
4	14733	KBUF	Buffalo, NY	42.948889	-78.736667	693	20	241.82

Table 4: Location and Technical Data for NEXRAD Radar Systems within 250 Kilometers of the Hoffman Falls Wind Project

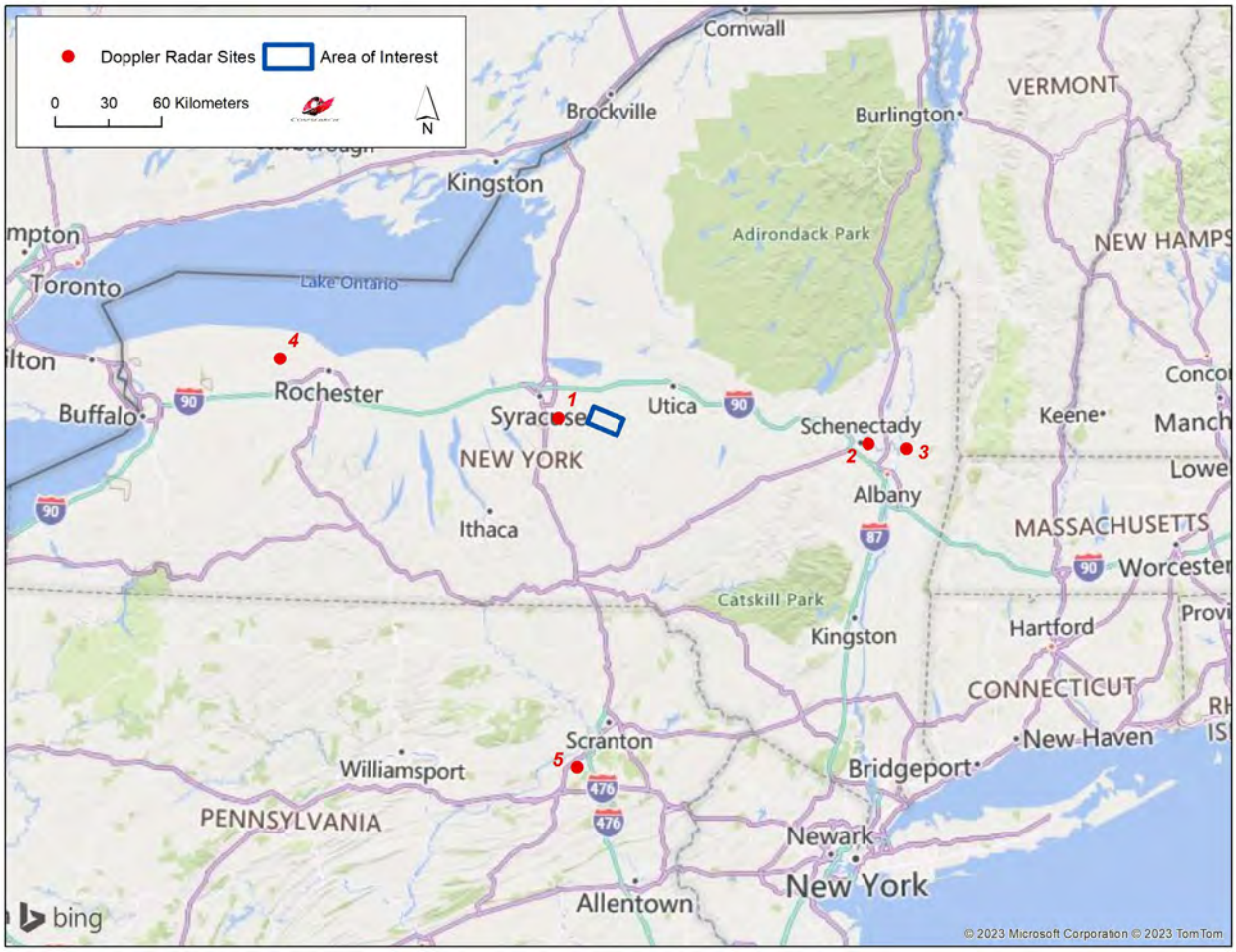

Figure 3: Location of Doppler Radar Systems within 250 Kilometers of the Hoffman Falls Wind Project

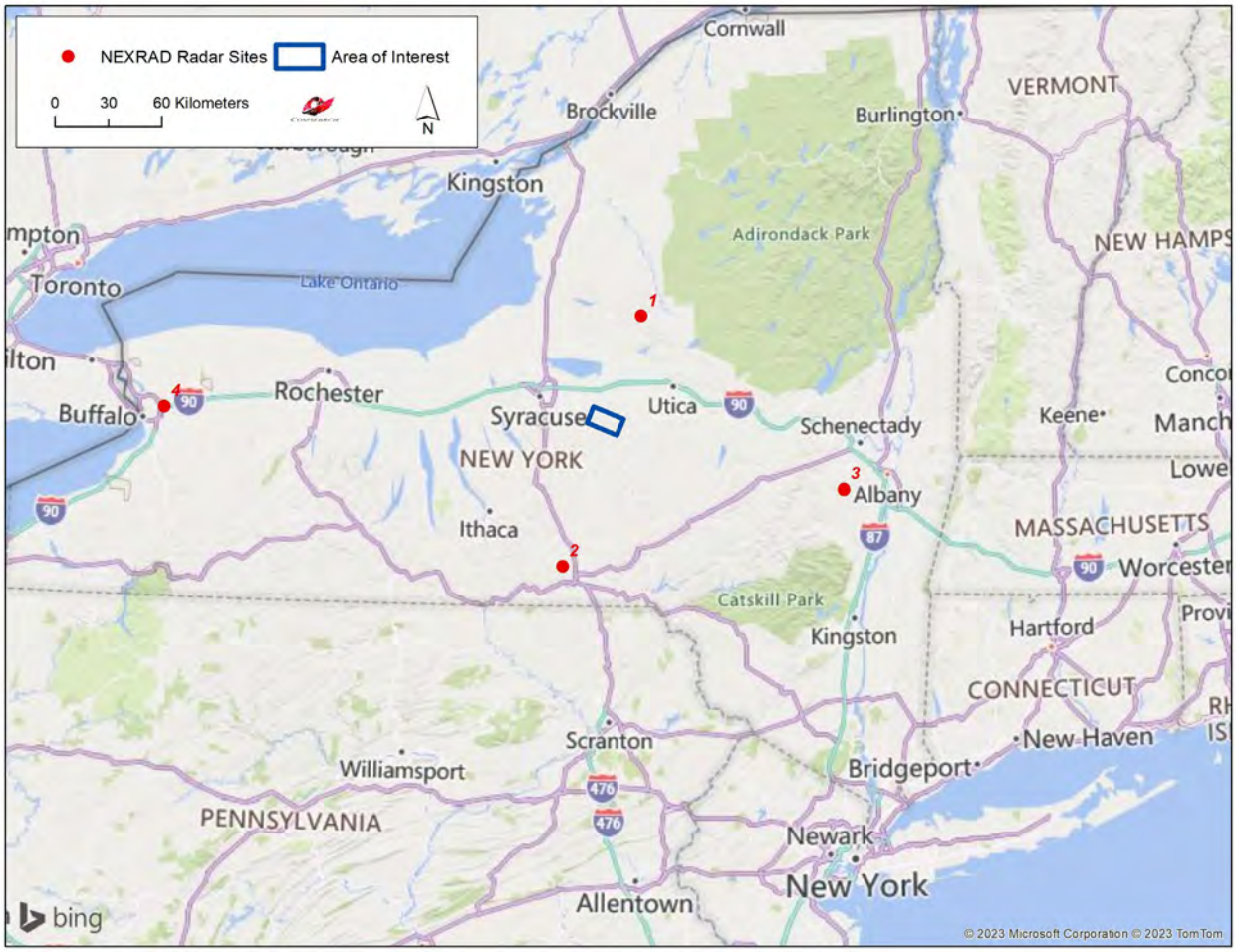

Figure 4: Location of NEXRAD Radar Systems within 250 Kilometers of the Hoffman Falls Wind Project

4. Impact Assessment

The technical approach to determine the potential impact of the turbines on the radar systems in the area is to calculate whether the proposed wind turbines are in line-of-sight (LOS) of the radar systems. The proposed wind turbines of the Hoffman Falls Project have the potential to block radar coverage and produce false targets if the turbines are in line-of-sight of the radar systems' transmitted signals.

To verify the presence or absence of LOS conditions between the Project and the radar systems identified in Section 3, LOS coverage plots were generated for each of the radar systems. These plots identify the geographical regions that have LOS to a given radar by taking into account the height of the radar antenna, the maximum height of the wind turbine blades, the curvature of the earth, and potential refractivity in the atmosphere. The plots may be referenced in the Appendix section of this report.

According to the LOS coverage plots, the effective terrain elevations would block LOS between six radar systems and the entire Project Area. However, one doppler radar antenna, WPPY879, and two NEXRAD radar antennas, KRMX and KBGM, have LOS conditions to the Project wind turbines.

5. New York State Mesonet

The New York State Mesonet is a statewide network of weather stations developed and run by the University at Albany, which currently comprises a total of 126 stations. Mesoscale networks serve to collect data on mesoscale meteorological phenomena, such as dry lines, squall lines, and sea breezes, which is used to supplement data gathered by traditional automated surface observing systems (ASOS) and helps to support decision-making in agriculture, emergency management, energy, ground transportation, and aviation. To ensure the highest quality of data, each station in the New York State Mesonet must be located at least 300 feet from any tall obstacles, such as wind turbines. Table A-1, provided in the Appendix section of this report, lists the New York State Mesonet stations and their respective distances to the proposed turbines in the Hoffman Falls Wind Project. Table A-1 shows that the closest station to the Project, "Morrisville", is more than 3.3 kilometers from the nearest proposed turbine location and well outside range of impact. Finally, it should be noted that the data from each station is transmitted via the Internet to a central ingest system located at the University of Albany and is therefore not subject to telecommunications interference from the Hoffman Falls Wind Project as defined in the scope of this report.

6. Conclusions

Based on the analysis described in this report, one doppler radar system, WPPY879, does not clear the LOS analysis and could be impacted. However, the impact is projected to be insignificant or easily managed by the radar system. Since most doppler radars emit pulses at

various elevation angles ranging from 0.5 – 19.5 degrees [2], wind turbines that fall below the lowest elevation angle based on distance and maximum turbine height would not be "seen" by the radar system. Considering all of the turbines in the project, only T1 exceeds the lowest elevation angle of 0.5 degrees with a calculated angle of 0.567 degrees considering earth curvature. If the single turbine tip is viewed by the radar, it is expected to be a minor consideration correctable by software or other adjustments to recognize the turbine. Based on this result, notification to this Doppler radar licensee may be necessary.

Two NEXRAD radar systems, KRMX and KBGM, also do not clear the LOS analysis for the Project and could be impacted. NOAA's National Weather Service, Radar Operations Center (ROC) is responsible for the NEXRAD WSR-88D system. The ROC has developed a four-zone scheme for evaluating and working with developers to identify and mitigate impacts as defined here: https://www.roc.noaa.gov/wsr88d/WindFarm/Analyses.aspx?wid=dev. Zone 1 is a No Build Zone of 4 km for all wind projects to avoid significantly blocking the radar beam and siting within the radar's near field. Zone 2 is the Mitigation Zone, between 4 km to 36 km, where the turbines penetrate more than one elevation angle. Zone 3 is the Consultation Zone, between 4 km to 36 km, where the turbines penetrate only the 1st elevation, or where the turbines penetrate more than one elevation angle between 36 km to 60 km. Zone 4 is the Notification Zone, between 36 to 60 km with penetration of one elevation angle or any area beyond 60 km with RLOS.

Based on the analysis, both stations look to be in Zone 4. The ROC provides two methods for reviewing and working with wind projects. As defined here: https://www.roc.noaa.gov/WSR88D/WindFarm/WindFarmDeveloper.aspx?wid=dev. Direct notification of the Project information to ROC at Wind.Energy.Matters@noaa.gov or Coordination through the NTIA. We recommend submitting the project information for review and evaluation by ROC either directly or through an NTIA Coordination.

[2] The source of this material is the COMET® Website at http://meted.ucar.edu/ of the University Corporation for Atmospheric Research (UCAR), sponsored in part through cooperative agreement(s) with the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce (DOC) ©1997-2010 University Corporation for Atmospheric Research. All Rights Reserved.

7. Contact

For questions or information regarding the Doppler Radar Study, please contact:

Contact person:	David Meyer
Title:	Senior Manager
Company:	Comsearch
Address:	21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
Telephone:	703-726-5656
Fax:	703-726-5595
Email:	David.Meyer@CommScope.com
Web site:	www.comsearch.com

Appendix

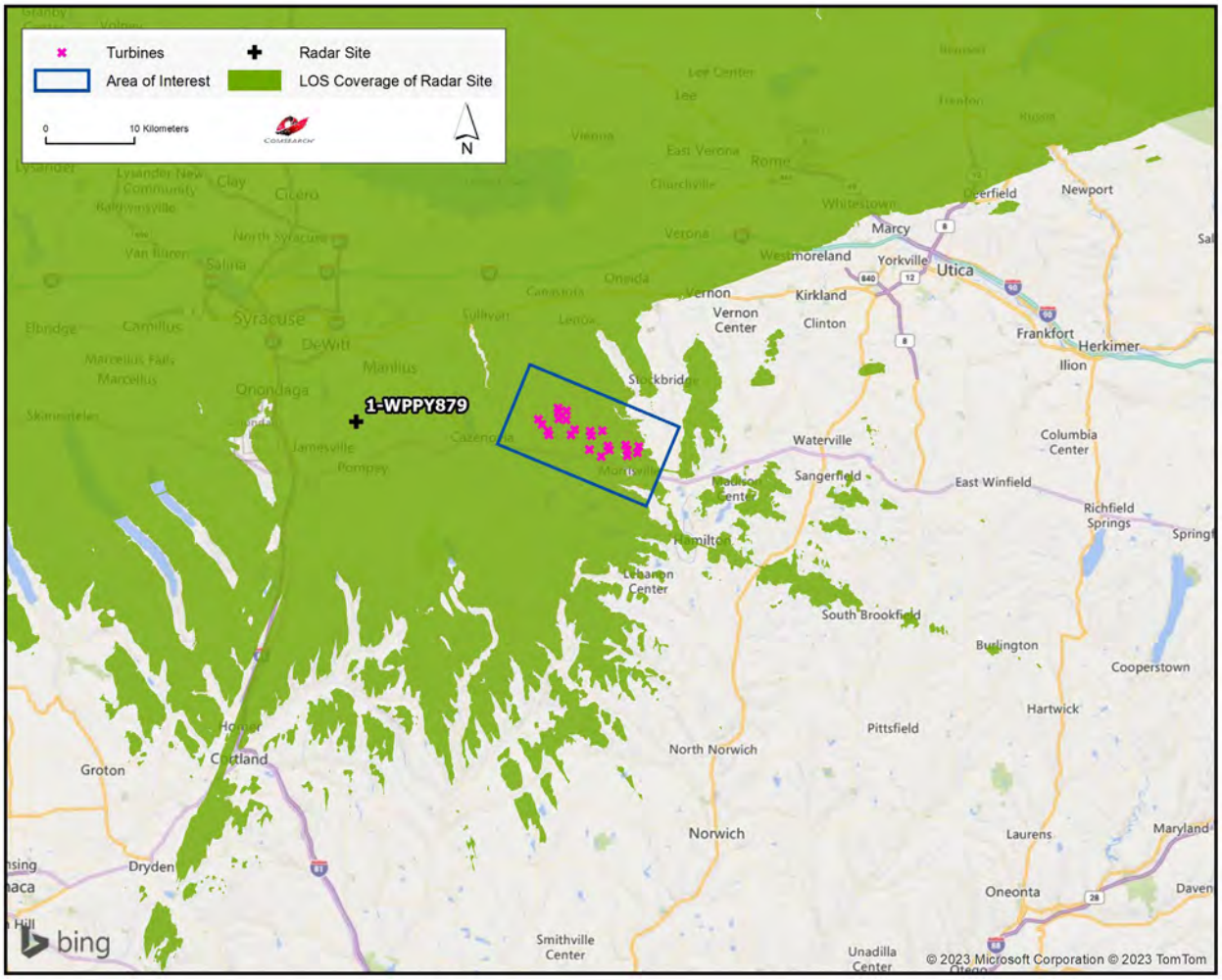

Figure A1-1: Line-of-Sight Coverage of WPPY879 with Respect to Hoffman Falls Project

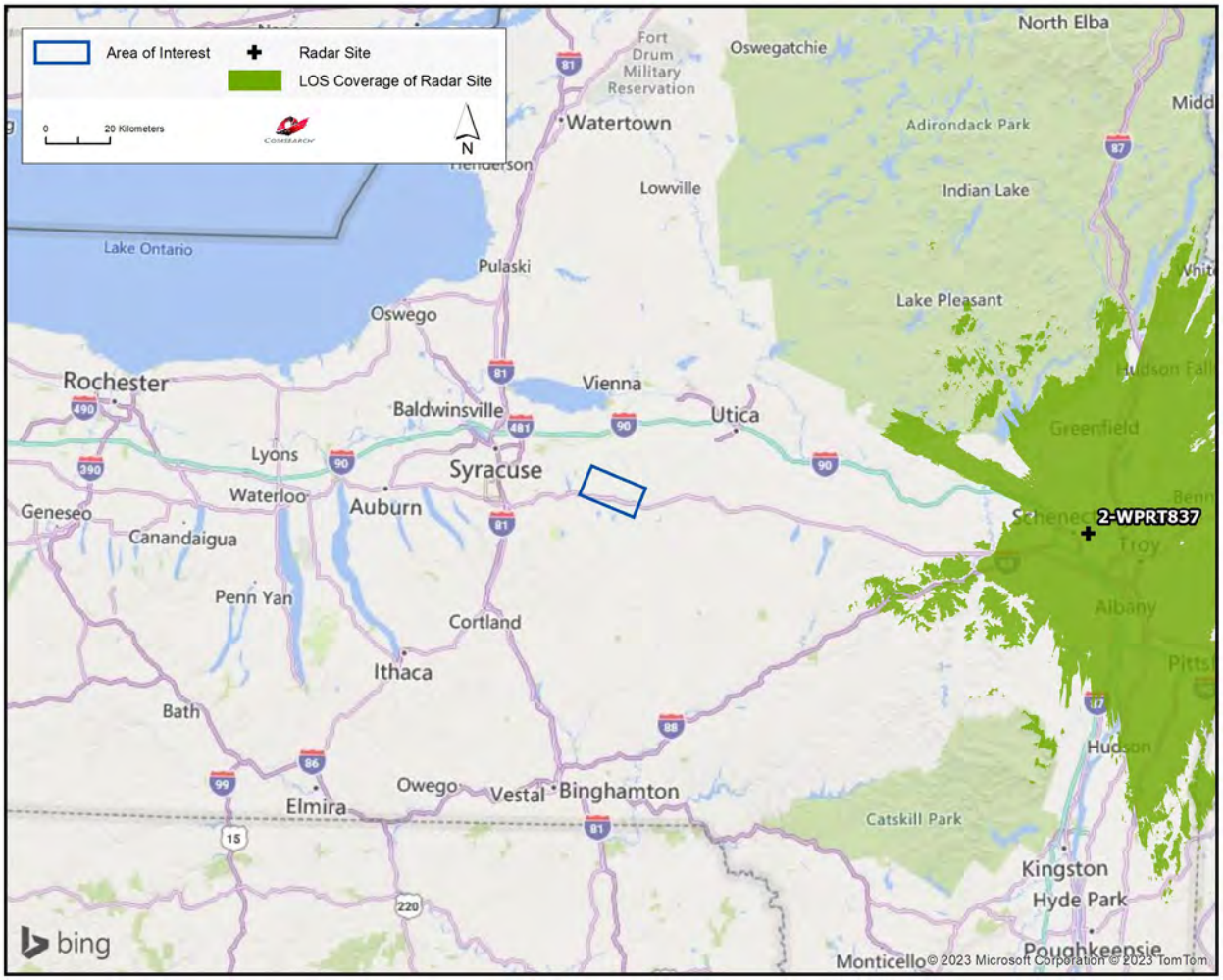

Figure A1-2: Line-of-Sight Coverage of WPRT837 with Respect to Hoffman Falls Project

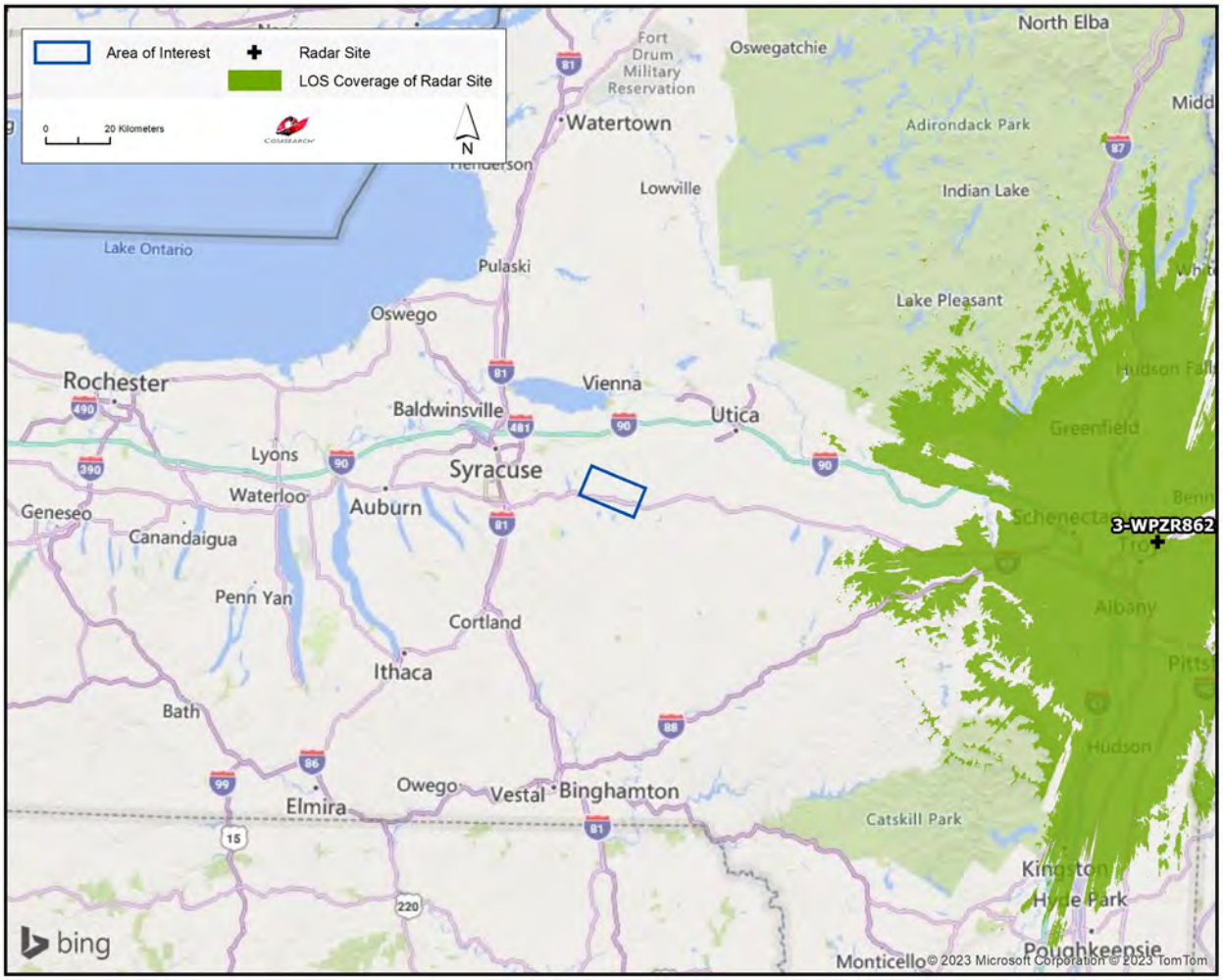

Figure A1-3: Line-of-Sight Coverage of WPZR862 with Respect to Hoffman Falls Project

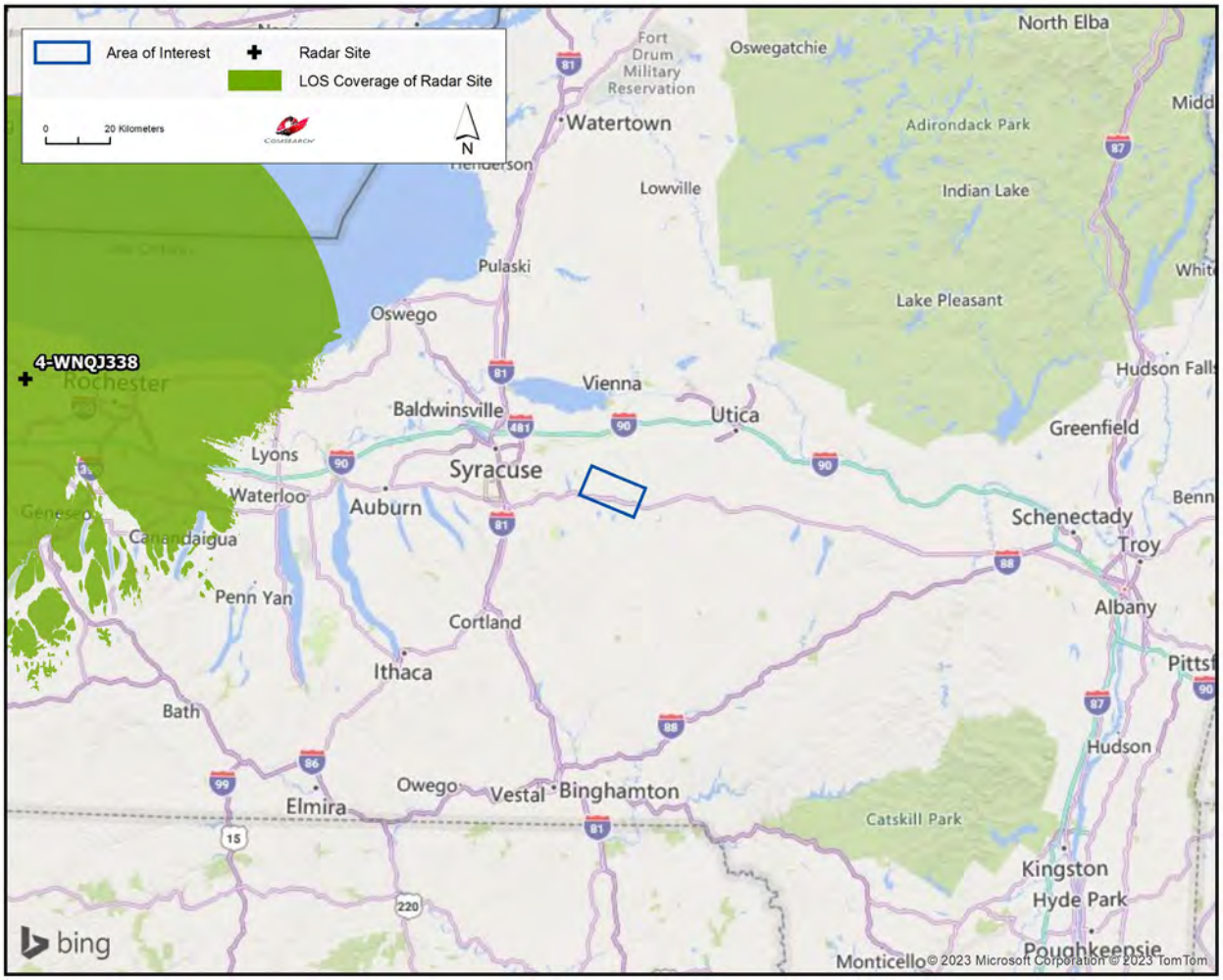

Figure A1-4: Line-of-Sight Coverage of WNQJ338 with Respect to Hoffman Falls Project

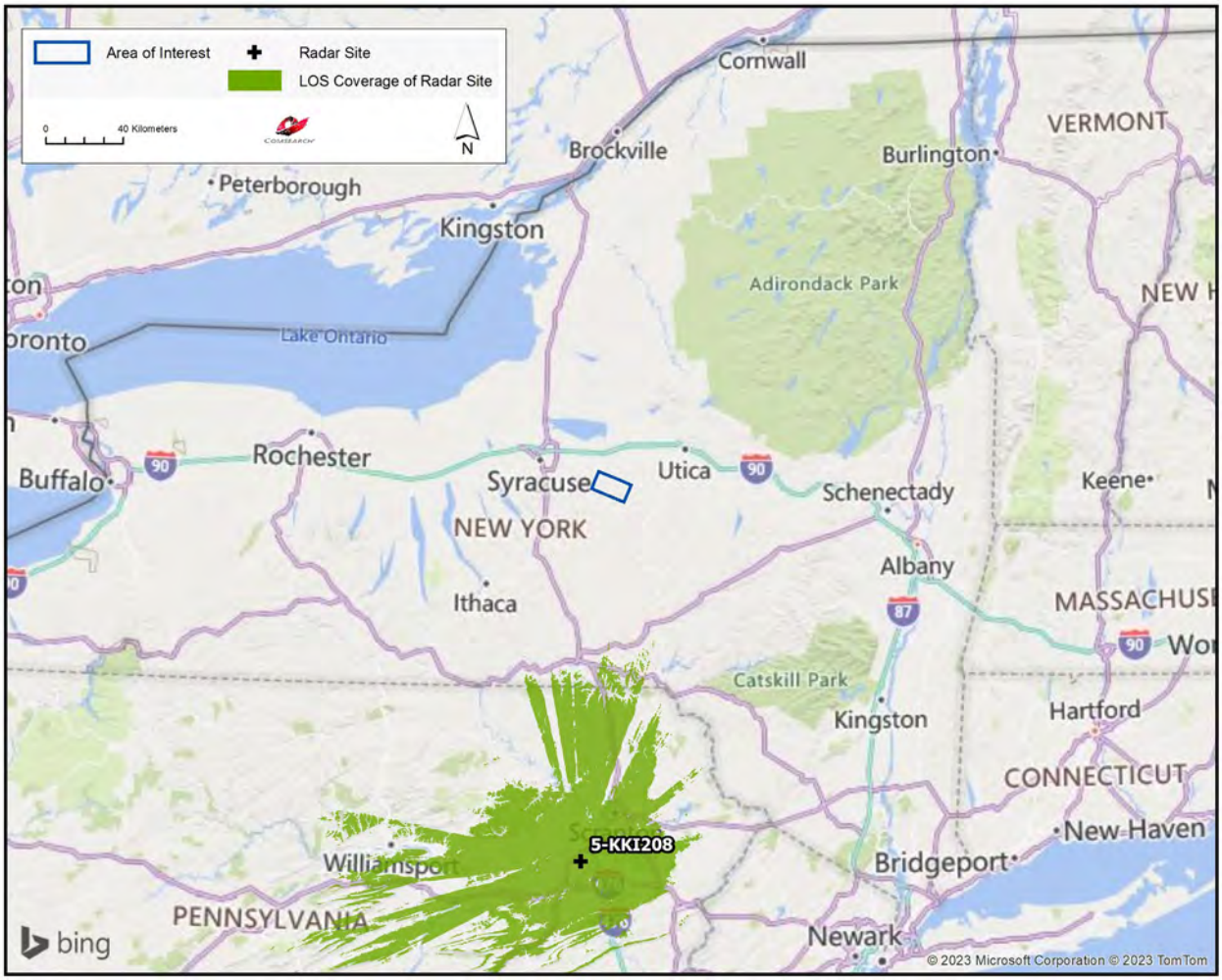

Figure A1-5: Line-of-Sight Coverage of KKI208 with Respect to Hoffman Falls Project

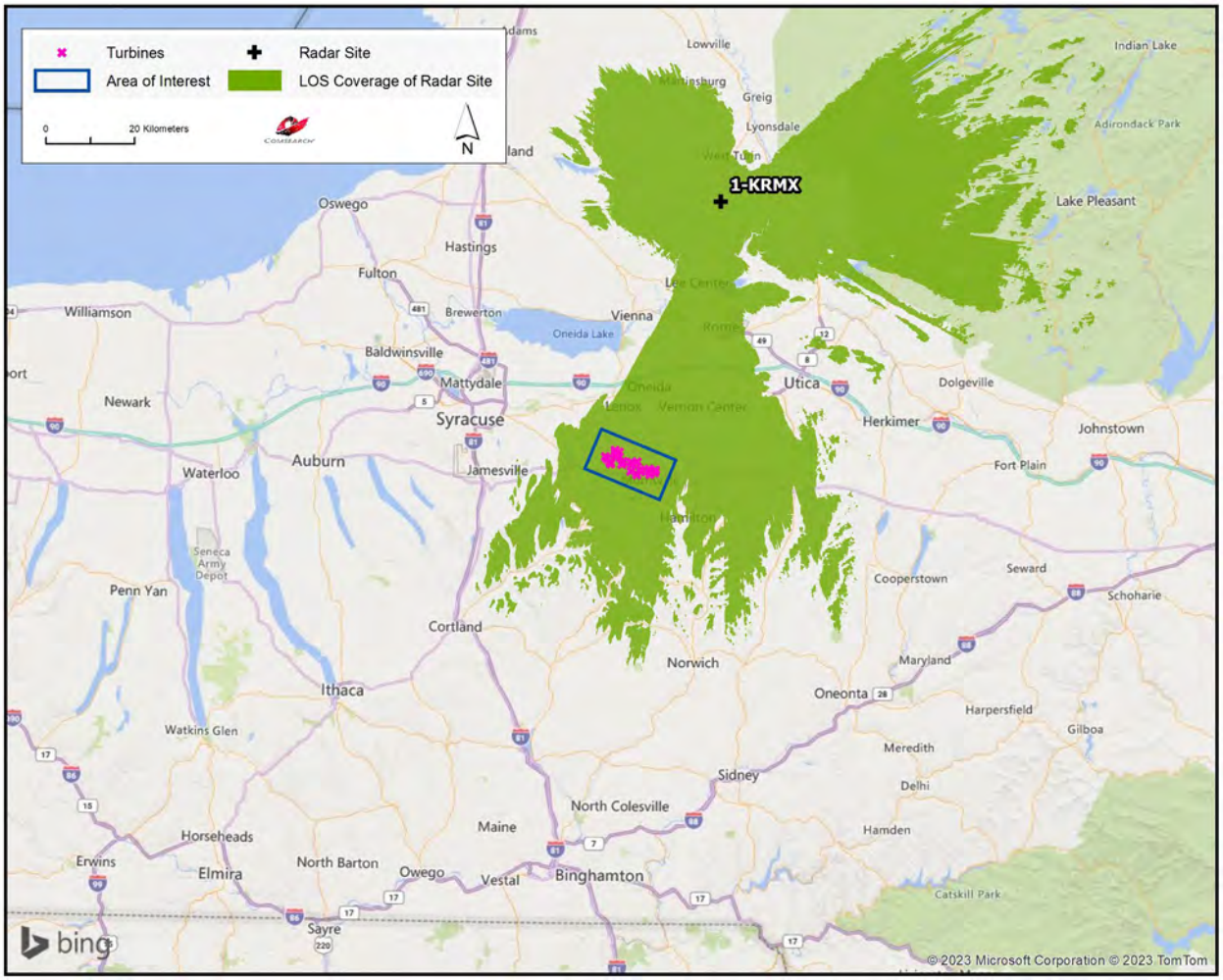

Figure A2-1: Line-of-Sight Coverage of KRMX with Respect to Hoffman Falls Project

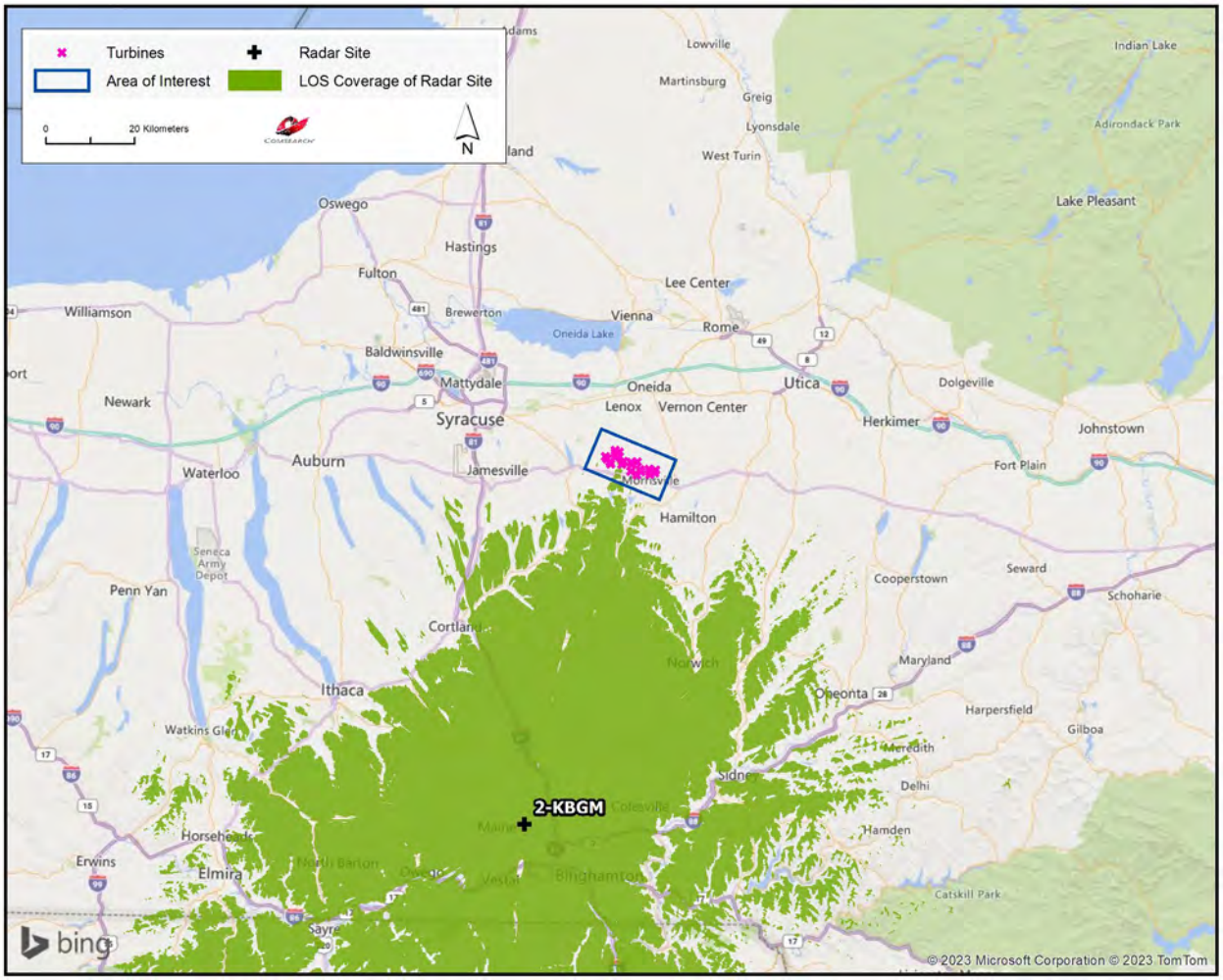

Figure A2-2: Line-of-Sight Coverage of KBGM with Respect to Hoffman Falls Project

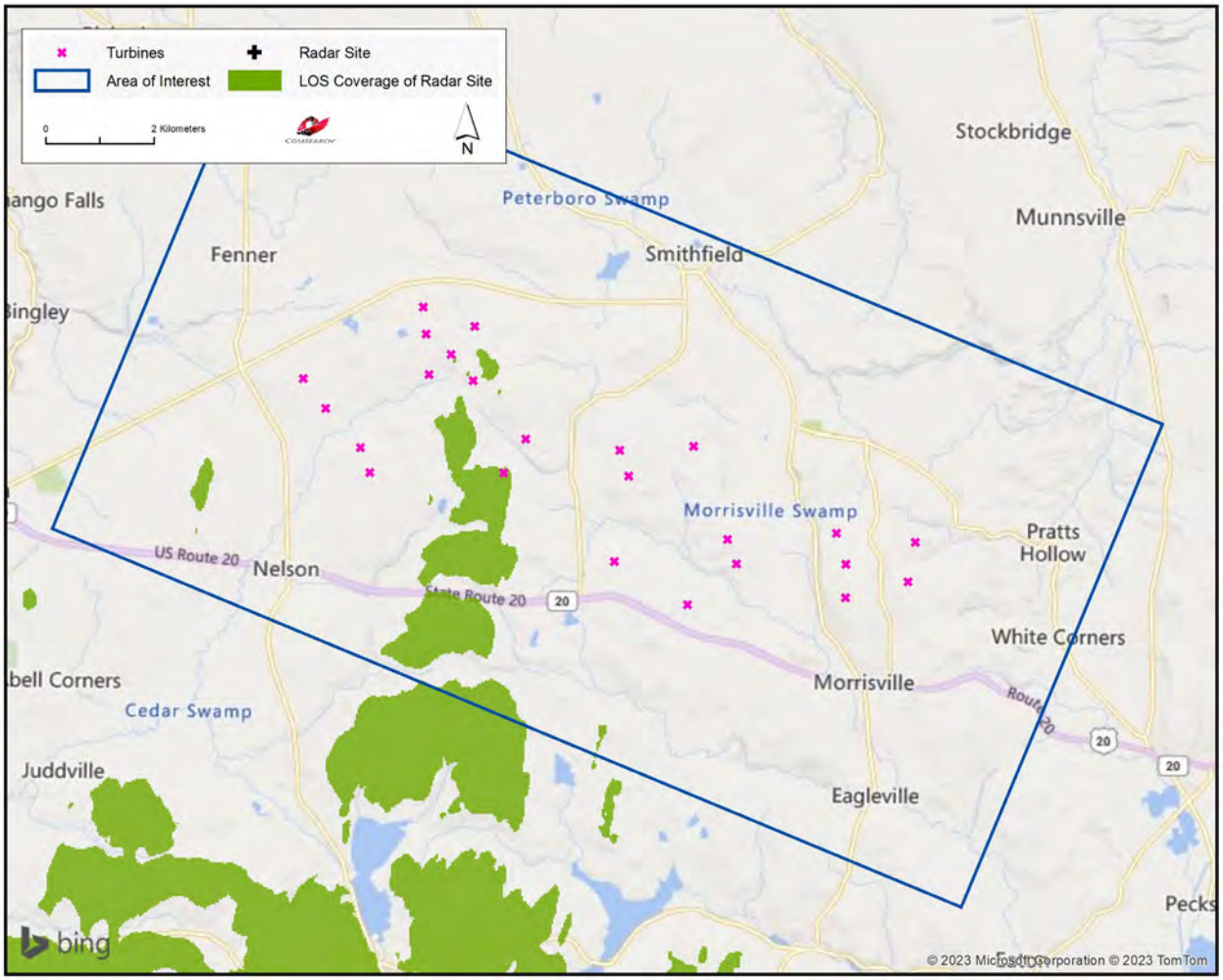

Figure A2-2-1: Line-of-Sight Coverage of KBGM with Respect to Hoffman Falls Project (Turbine Area)

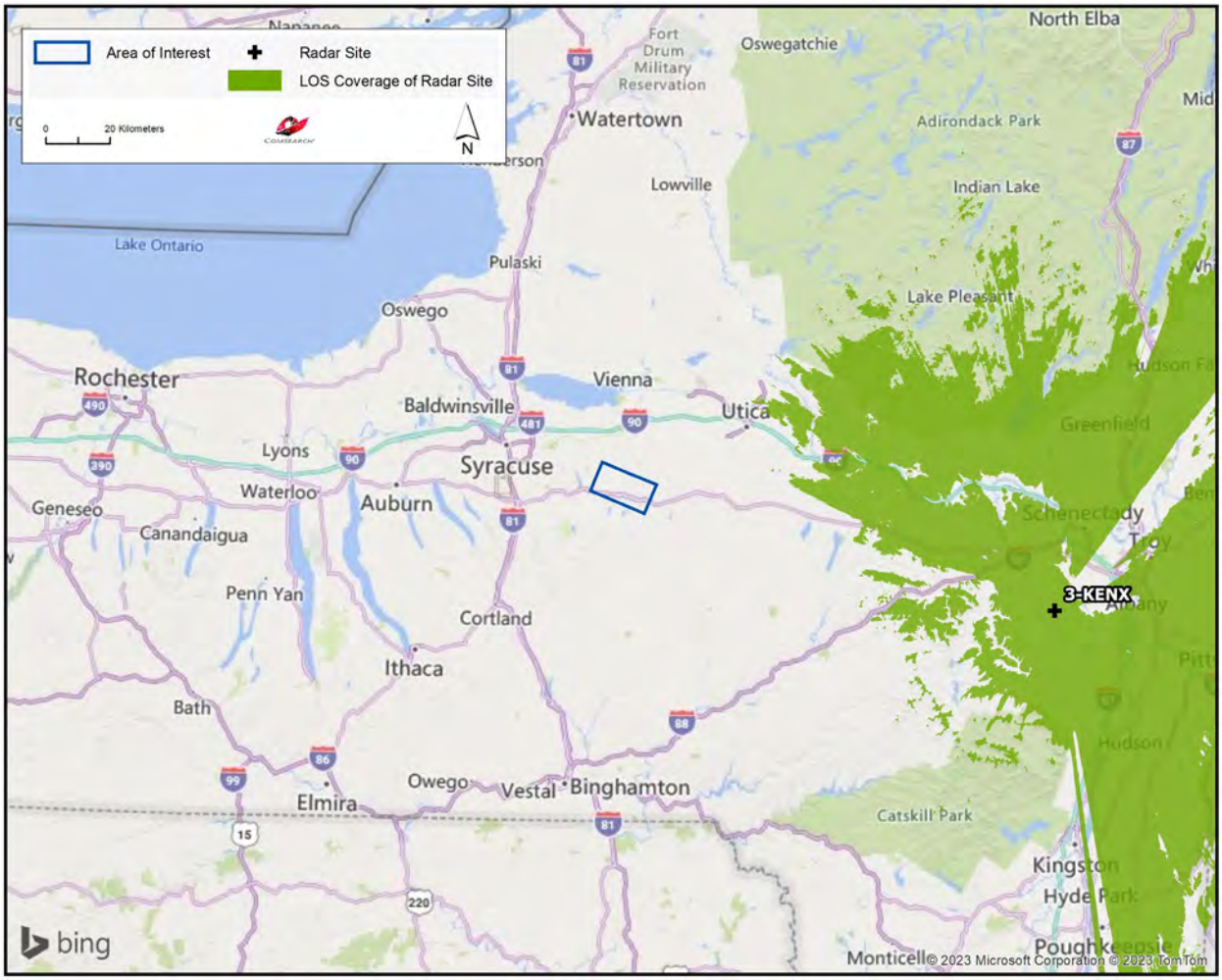

Figure A2-3: Line-of-Sight Coverage of KENX with Respect to Hoffman Falls Project

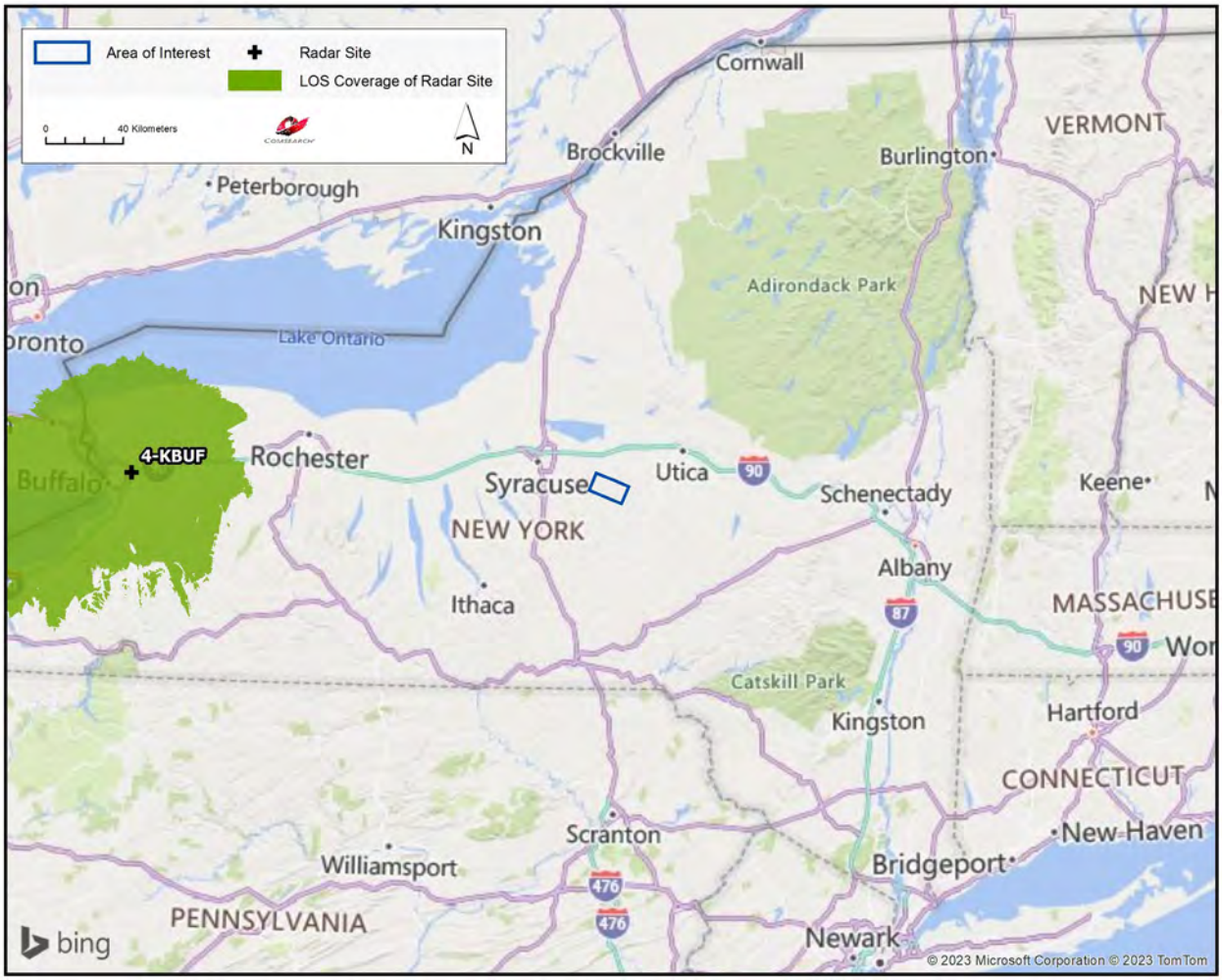

Figure A2-4: Line-of-Sight Coverage of KBUF with Respect to Hoffman Falls Project

Station ID	Station Name	Date Commissioned	County	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
MORR	Morrisville	6/27/2016	Madison	42.883917	-75.642447	3.31
FAYE	Fayetteville	7/14/2016	Onondaga	43.054226	-75.990041	21.17
WEST	Westmoreland	11/18/2015	Oneida	43.106470	-75.461460	24.82
BROO	Brookfield	8/5/2016	Madison	42.795910	-75.299290	30.57
TULL	Tully	3/30/2016	Onondaga	42.794630	-76.115550	32.77
SHER	Sherburne	2/23/2016	Chenango	42.640260	-75.483700	33.05
CAMD	Camden	6/29/2016	Oneida	43.339850	-75.742990	42.07
CINC	Cincinnatus	4/21/2016	Cortland	42.522424	-75.975622	48.98
CSQR	Central Square	11/5/2015	Oswego	43.326130	-76.104450	49.79
HERK	Herkimer	8/10/2016	Herkimer	43.036620	-75.009570	52.50
JORD	Jordan	11/17/2015	Onondaga	43.069800	-76.470060	58.33
LAUR	Laurens	1/15/2016	Otsego	42.525260	-75.136900	59.60
OSCE	Osceola	6/22/2016	Lewis	43.499150	-75.711750	59.83
SPRI	Springfield	8/15/2016	Otsego	42.843150	-74.889610	61.46
COLD	Cold Brook	11/11/2015	Herkimer	43.261268	-74.978778	65.29
SCIP	Scipio Center	9/22/2016	Cayuga	42.756216	-76.534035	65.72
GROT	Groton	12/21/2016	Tompkins	42.548550	-76.375340	66.16
REDF	Redfield	6/21/2016	Oswego	43.622180	-75.877690	74.20
BELD	Belden	11/30/2015	Broome	42.223220	-75.668520	76.48
BERK	Berkshire	11/19/2015	Tioga	42.320300	-76.203190	77.24
WGAT	Woodgate	8/29/2016	Oneida	43.532408	-75.158597	77.98
OPPE	Oppenheim	7/29/2016	Fulton	43.062600	-74.665437	80.51
OSWE	Oswego	7/7/2016	Oswego	43.443183	-76.553233	83.83
WALT	Walton	4/18/2016	Delaware	42.239500	-75.178790	83.96
WATE	Waterloo	11/4/2015	Seneca	42.879660	-76.812550	85.16
GFLD	Glenfield	8/29/2016	Lewis	43.716800	-75.409250	88.27
HARP	Harpersfield	8/4/2016	Delaware	42.472800	-74.698490	91.21
SPRA	Sprakers	11/9/2015	Montgomery	42.874270	-74.508590	92.07
WOLC	Wolcott	3/9/2016	Wayne	43.228680	-76.842610	92.40

Station ID	Station Name	Date Commissioned	County	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
HARR	Harrisburg	6/21/2016	Lewis	43.803520	-75.688530	93.68
COBL	Cobleskill	1/25/2016	Schoharie	42.676267	-74.507967	96.01
DEPO	Deposit	8/23/2016	Delaware	42.068551	-75.392193	96.15
BELL	Belleville	4/28/2016	Jefferson	43.789620	-76.113730	96.72
BING	Binghamton	10/4/2016	Broome	42.058430	-75.951040	97.23
BURD	Burdett	5/23/2016	Schuyler	42.410420	-76.771760	101.33
PENN	Penn Yan	5/24/2016	Yates	42.655780	-76.987460	104.48
OLDF	Old Forge	9/2/2016	Herkimer	43.741570	-74.977860	105.39
ANDE	Andes	8/4/2016	Delaware	42.182270	-74.801390	106.45
COPE	Copenhagen	2/5/2016	Lewis	43.920564	-75.607866	107.16
OWEG	Owego	7/20/2016	Tioga	42.025710	-76.255430	108.76
JOHN	Johnstown	3/22/2016	Montgomery	42.984283	-74.301767	108.92
PISE	Piseco	3/25/2017	Hamilton	43.464740	-74.504320	109.81
CLIF	Clifton Springs	7/13/2016	Ontario	43.014790	-77.185180	115.35
ROXB	Roxbury	8/24/2016	Delaware	42.329640	-74.467460	115.85
DUAN	Duanesburg	7/22/2016	Schenectady	42.803190	-74.173610	120.07
CROG	Croghan	11/2/2016	Lewis	43.974960	-75.201000	120.93
TYRO	Tyrone	5/23/2016	Schuyler	42.406110	-77.053900	121.01
ELMI	Elmira	6/30/2016	Chemung	42.113320	-76.836640	127.05
EDIN	Edinburg	7/15/2016	Saratoga	43.228190	-74.112930	128.43
RAQU	Raquette Lake	11/10/2016	Hamilton	43.822752	-74.625091	129.16
MEDU	Medusa	8/24/2016	Albany	42.468690	-74.165410	130.30
SBRI	South Bristol	2/19/2016	Ontario	42.752170	-77.359310	131.42
NBRA	North Branch	7/21/2016	Sullivan	41.827920	-74.996890	131.77
ONTA	Ontario	11/1/2016	Wayne	43.259410	-77.373310	134.69
CAPE	Cape Vincent	4/27/2016	Jefferson	44.104520	-76.326860	135.39
PHIL	Philadelphia	7/8/2016	Jefferson	44.193540	-75.715910	136.91
CLAR	Claryville	10/20/2016	Ulster	41.979200	-74.517100	138.87
VOOR	Voorheesville	8/16/2016	Albany	42.652420	-73.975620	138.93
BSPA	Ballston Spa	8/18/2016	Saratoga	43.022800	-73.874980	143.91

Station ID	Station Name	Date Commissioned	County	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
COHO	Cohocton	5/17/2016	Steuben	42.511780	-77.437620	144.65
ILAK	Indian Lake	7/26/2016	Hamilton	43.790670	-74.239330	148.58
TANN	Tannersville	2/1/2017	Greene	42.170710	-74.113430	149.92
WELL	Wellesley Island	4/27/2016	Jefferson	44.307820	-76.008580	151.07
RUSH	Rush	7/12/2016	Monroe	43.000990	-77.637390	152.13
WBOU	Woodbourne	9/1/2016	Sullivan	41.745050	-74.588330	156.05
EDWA	Edwards	8/16/2016	St. Lawrence	44.321770	-75.244130	156.46
ADDI	Addison	8/10/2016	Steuben	42.040360	-77.237260	156.89
NEWC	Newcomb	10/18/2016	Essex	43.973290	-74.222730	163.30
SCHA	Schaghticoke	6/20/2016	Rensselaer	42.896970	-73.614050	164.95
ELDR	Eldred	8/25/2016	Sullivan	41.539610	-74.879920	165.06
SCHO	Schodack	1/11/2017	Rensselaer	42.506310	-73.685840	166.05
KIND	Kinderhook	8/30/2016	Columbia	42.410010	-73.715570	167.11
SCHU	Schuylerville	8/9/2015	Saratoga	43.116996	-73.578284	168.93
YORK	York	8/9/2016	Livingston	42.855040	-77.847760	169.70
CHES	Chestertown	12/6/2015	Warren	43.653900	-73.777360	171.16
GFAL	Glens Falls	3/10/2017	Warren	43.340870	-73.602020	171.71
HAMM	Hammond	8/16/2016	St. Lawrence	44.513020	-75.617290	172.69
TUPP	Tupper Lake	7/13/2016	Franklin	44.221280	-74.438260	173.59
HFAL	High Falls	11/17/2016	Ulster	41.798800	-74.123120	175.81
REDH	Red Hook	8/2/2016	Dutchess	42.001680	-73.883910	176.23
HART	Hartsville	8/9/2016	Steuben	42.211221	-77.689733	177.34
BROC	Brockport	6/16/2016	Monroe	43.208350	-77.965920	180.83
OTIS	Otisville	12/10/2015	Orange	41.482490	-74.503680	184.58
GROV	Grove	7/20/2016	Allegany	42.489510	-77.949460	185.37
WALL	Wallkill	6/23/2016	Ulster	41.634090	-74.153700	187.61
WHIT	Whitehall	8/26/2015	Washington	43.485073	-73.423071	190.21
STEP	Stephentown	12/8/2015	Rensselaer	42.526200	-73.359060	191.39
BATA	Batavia	2/18/2016	Genesee	43.019940	-78.135660	192.80
COPA	Copake	8/3/2016	Columbia	42.136590	-73.519880	194.16

Station ID	Station Name	Date Commissioned	County	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
NHUD	North Hudson	9/13/2016	Essex	44.013100	-73.705160	197.54
POTS	Potsdam	7/8/2016	St. Lawrence	44.656867	-74.974433	198.32
WARS	Warsaw	5/16/2016	Wyoming	42.779930	-78.208890	199.88
BELM	Belmont	5/16/2016	Allegany	42.242490	-78.039580	201.84
GABR	Gabriels	1/20/2016	Franklin	44.417420	-74.178670	203.32
BEAC	Beacon	8/22/2016	Dutchess	41.528750	-73.945270	207.82
TICO	Ticonderoga	1/28/2016	Essex	43.874690	-73.418790	208.27
MEDI	Medina	7/19/2016	Orleans	43.226680	-78.309270	208.75
DOVE	Dover Plains	12/9/2016	Dutchess	41.773670	-73.575420	211.88
WARW	Warwick	4/14/2016	Orange	41.240360	-74.390560	212.65
WFMB	Whiteface Mountain Base	1/29/2016	Essex	44.393236	-73.858829	217.20
LOUI	Louisville	3/26/2016	St. Lawrence	44.871690	-75.056080	219.33
DELE	Delevan	3/8/2016	Cattaraugus	42.418464	-78.423200	225.00
EAUR	East Aurora	8/8/2016	Erie	42.713490	-78.631730	235.16
SOME	Somers	2/28/2017	Westchester	41.310370	-73.767110	235.90
SUFF	Suffern	8/17/2016	Rockland	41.130380	-74.089870	235.97
BREW	Brewster	3/30/2017	Putnam	41.439930	-73.576420	236.19
OLEA	Olean	6/2/2016	Cattaraugus	42.091410	-78.407430	236.46
MALO	Malone	8/15/2016	Franklin	44.852869	-74.328874	238.67
ESSX	Essex	12/5/2015	Essex	44.313604	-73.371896	239.15
BUFF	Buffalo	3/9/2017	Erie	43.000170	-78.767170	244.28
BURT	Burt	6/15/2016	Niagara	43.316990	-78.749030	245.53
SARA	Saranac	7/12/2016	Clinton	44.707585	-73.671150	253.44
ELLE	Ellenburg	8/30/2016	Clinton	44.895500	-73.845020	262.03
BRAN	Brant	4/23/2016	Erie	42.594940	-79.021540	268.74
BRON	Bronx	9/12/2017	Bronx	40.872481	-73.893522	269.00
RAND	Randolph	6/2/2016	Cattaraugus	42.149280	-78.900960	271.81
MANH	Manhattan	7/18/2017	New York	40.767544	-73.964482	275.95
CHAZ	Chazy	7/8/2016	Clinton	44.895650	-73.464610	279.96
STAT	Staten Island	5/3/2017	Richmond	40.604014	-74.148499	284.90

Station ID	Station Name	Date Commissioned	County	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
QUEE	Queens	4/18/2017	Queens	40.734335	-73.815856	285.50
BKLN	Brooklyn	6/19/2017	Kings	40.631762	-73.953678	289.58
FRED	Fredonia	4/23/2016	Chautauqua	42.418170	-79.366600	300.37
STON	Stony Brook	2/21/2018	Suffolk	40.919120	-73.131680	303.77
WANT	Wantagh	11/10/2016	Nassau	40.655100	-73.506160	307.12
CLYM	Clymer	6/1/2016	Chautauqua	42.024470	-79.624080	332.88
SOUT	Southold	11/10/2016	Suffolk	41.040081	-72.465864	335.20

Table A-1: New York State Mesonet Weather Stations and Distance to the Baron Winds II Project