ISSUE PAPER SERIES

The Montague Doppler Radar: An Overview

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NEW YORK STATE TUG HILL COMMISSION

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The Tug Hill Commission Technical and Issue Paper Series are designed to help local officials and citizens in the Tug Hill region and other rural parts of New York State. The Technical Paper Series provides guidance on procedures based on questions frequently received by the Commission. The Issue Paper Series provides background on key issues facing the region without taking advocacy positions. Other papers in each series are available from the Tug Hill Commission. Please call us or visit our website for more information.

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Introduction

Tug Hill is famous for receiving the most snowfall east of the Rocky Mountains. The Montague Doppler weather radar station is integral to forecasting that snowfall, much of which comes in locally intense lake-effect snowstorms. Over the past several years wind farm development proposals have created numerous questions about the radar. This issue paper gathers the best available information to inform Tug Hill's communities.

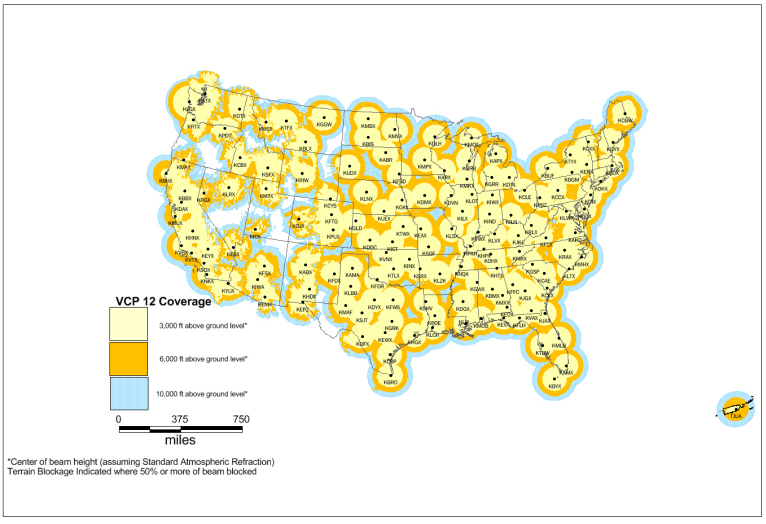
Who owns the Montague radar?

The Department of Defense (DOD) owns and maintains the Montague Doppler weather radar (Montague radar), located on Sears Pond Road in the town of Montague. The Montague radar was originally located in the town of Lewis on State Route 294 and was attached to the Griffiss Air Force Base (AFB). It was moved to its current location in 1996, after Griffiss AFB was closed by the Base Realignment and Closure Commission in 1995. The radar was specifically sited at its current location to serve the mission of Fort Drum.

Who uses the Montague radar?

The National Weather Service (NWS) operates the Montague radar as part of its WSR-88D system, which stands for Weather Surveillance Radar-1988 Doppler. The radar station is one of 159 the National Weather Service, Department of Defense, and Federal Aviation Administration use throughout the country and in select overseas locations. All 159 radars are part of a tri-agency investment, used by all three federal agencies. The Montague radar's "call sign" is KTYX.

NEXRAD Coverage Below 10,000 Feet AGL



The operation of the Montague radar is also done in cooperation with the Air

Force's 18th Combat Weather Squadron, Detachment 1, stationed at Fort Drum. The NWS shares resulting weather data with many entities, including the public, media, academia, and private weather sector. The Montague radar is a critically valuable tool for the NWS' ability to monitor, forecast, and warn the region of hazardous weather, including lake effect snow. Fort Drum uses the data to forecast weather conditions for aircraft using the Wheeler-Sack Army Airfield, located on Fort Drum, and to support their mission and resource protection. The Federal Aviation Administration uses the data for their mission of safety of air navigation for both commercial and general aviation.

How does the radar system work?

Doppler radar systems scan weather by emitting an energy pulse and rotating 360 degrees at different elevation angles, from 0.5 degrees to 19.5 degrees from the horizon. The radar scans up to 14 elevations. Because the Montague radar is located at a local high elevation point, its elevation angles can scan long distances without being interrupted by terrain.

The Montague radar collects two primary types of data: Doppler data that identifies wind velocities, and reflectivity data to identify precipitation. The radar has a 460 km (~286 mile) range for reflectivity detection and up to a 300 km (~186 mile) range for Doppler velocity detection. Additionally, the Montague radar was upgraded in 2013 to become a dual polarization system. This allows the unit to transmit and receive pulses in both a horizontal and vertical orientation, allowing forecasters to better estimate the size, shape, and variety of targets, such as raindrops and frozen precipitation. Prior to the upgrade, pulses were transmitted and received only in a horizontal orientation. Benefits of dual polarization include improved accuracy of precipitation estimates; the ability to discern between heavy rain, hail, snow, and sleet; and improved detection of non-precipitation items like ground clutter, birds, and tornado debris.

How does the radar predict lake-effect snowstorms?

Lake-effect snowstorms occur in the late fall and winter, when cold air flows over a relatively warm lake. Lake Ontario has a long east-west axis that produces heavy snowfall in a narrow zone east of the Lake, with Tug Hill often being the recipient of that snowfall. Lake-effect snowstorms are typically found in the lower elevations of the atmosphere (to a height of approximately 2 km above the water). Capturing radar data in those lower elevations is important to accurately forecasting winter storms.

How do the existing wind farms affect the Montague radar?

The Maple Ridge, Copenhagen, Roaring Brook, and Number Three wind farms spread from northeast to southeast of the Montague radar. The United States Geological Survey (USGS) has a U.S. Wind Turbine Database, showing the location of individual turbines and their parent wind farms. The proximity of the wind turbines to the Montague radar can be easily observed using this resource; the Montague radar is located near the intersection of Parker, Sears Pond, and Rector Roads. The Number Three wind farm is under construction and not yet visible on the map.

The spinning turbines create some clutter that can be seen when viewing the radar online. The radar interference is not limited to areas directly over the wind farms. Due to the proximity of the turbines to the radar, within 18 km (~11.2 miles), the clutter also extends well beyond the wind farm and contaminates data at multiple scanning elevation angles. This can mask true weather signatures by contaminating real weather patterns with false returns from the turbines. As a result, wind turbine clutter (WTC) has caused false positives for weather events. Although operational forecasters can often distinguish WTC from weather signals, the media and the public may misinterpret WTC as weather events. These conflicts could increase with the volume of wind turbines. The National Oceanic and Atmospheric Administration (NOAA) reports that, nationally, WTC impacts to doppler radar data are increasing in scale.

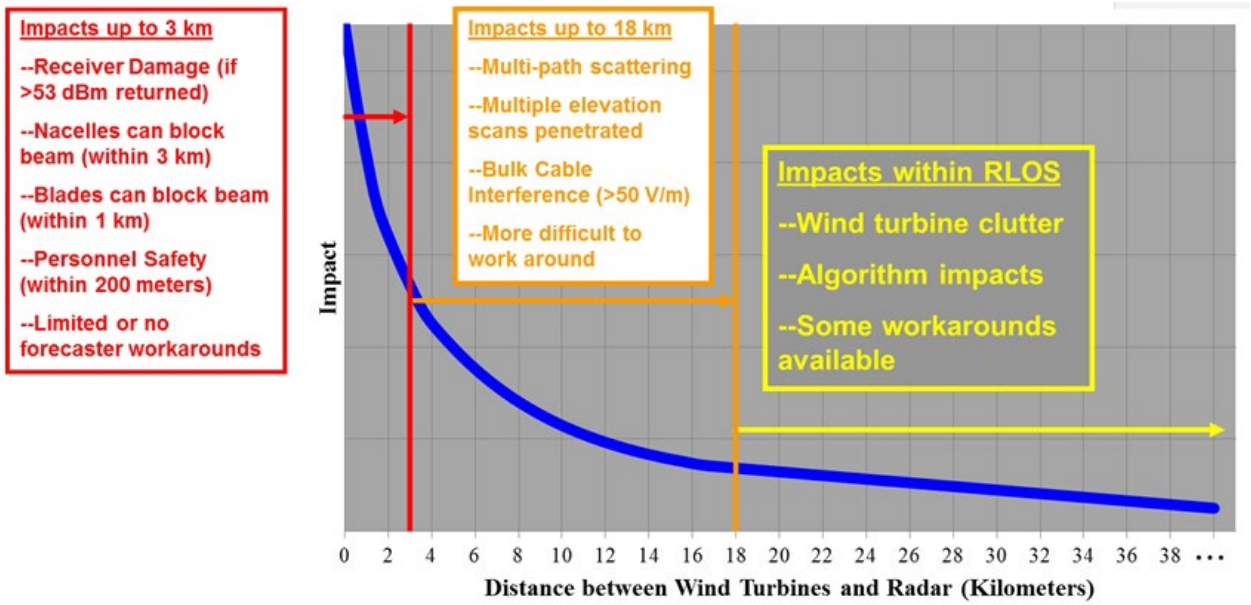
How could future wind farms affect the Montague radar?

Additional wind farm construction could create additional radar interference, depending on the proximity and location of the proposed projects. According to NOAA, wind turbines built within 18 km of a doppler radar are especially likely to affect data accuracy (see graphic below). Turbines can create clutter that appears to the radar to be real weather patterns. The wind farm signatures can mask real, weak weather features that are precursors to lake effect snow development. They can also obscure tornadoes and high wind signatures during severe weather. The clutter also erroneously increases the precipitation estimates, making it harder for forecasters to gain an accurate picture of snow or rain totals for forecasts and warnings. Turbines located closer to the radar cause interference at more elevation angles of the radar,

meaning more real weather data is masked through a deeper portion of the atmosphere, further hindering forecasters' ability to detect hazardous weather. The radar processor uses many algorithms to detect and forecast weather patterns. The algorithms can exclude interference by inanimate objects but moving turbines can corrupt these algorithms.

How can wind farms affect Fort Drum?

In addition, future industrial wind turbine development, if not properly mitigated, could have an adverse and increasing impact on military readiness at Fort Drum. This includes flight operations, testing and evaluation, and training according to the 2018 Fort Drum Joint Land Use Study Report. The Digital Airport Surveillance Radar at Wheeler-Sack Army Airfield is also susceptible to interference from wind turbines. Additional wind energy development, if not properly sited, is likely to impair or degrade the ability of units to perform their warfighting missions. The Fort Drum Land Use Study Report outlines several strategies that would limit the impact of future wind energy development, including establishing a No Build Zone within 4 kilometers of the Montague radar, identifying alternative energy development areas, and adopting renewable energy ordinances.

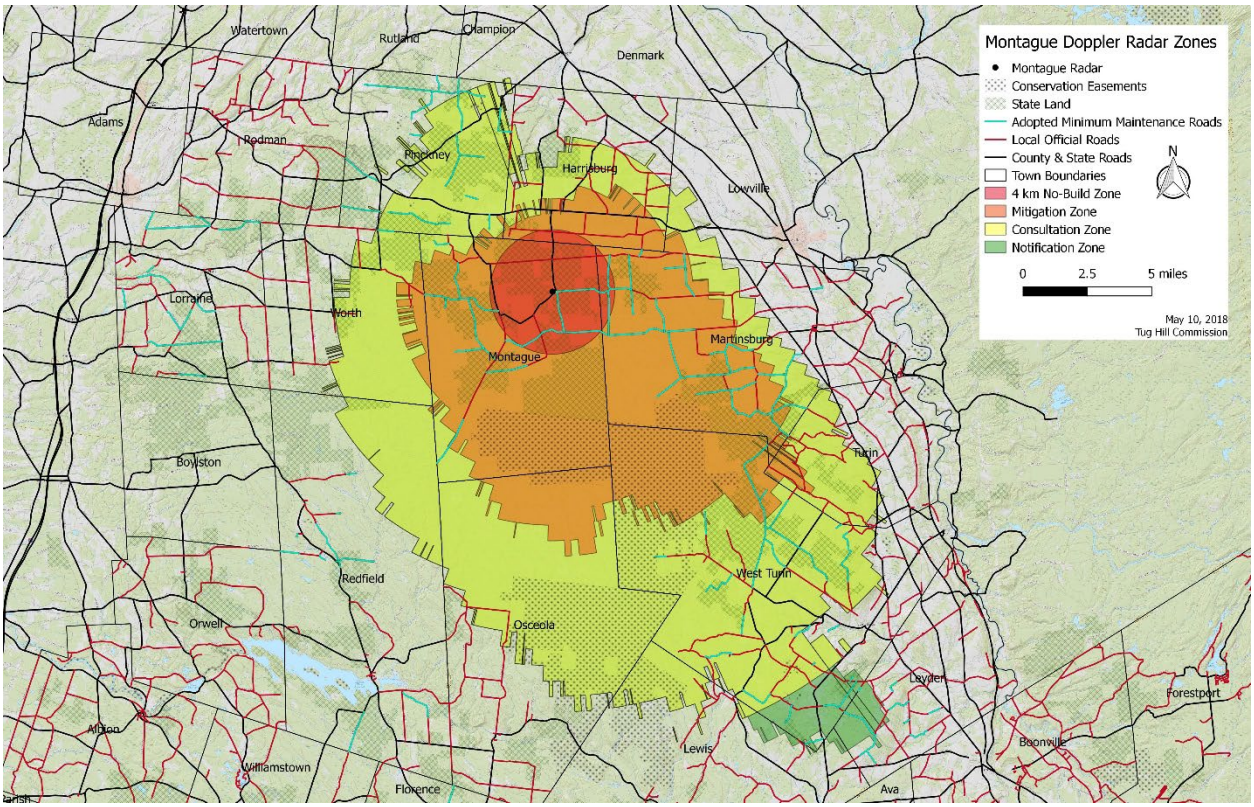


The relative impact of wind turbines (or wind farms) on NEXRAD radars and forecasters as a function of distance (on level terrain) if wind turbines are in the RLOS (Radar Line of Sight) (NOAA 2022).

What is the National Weather Service's role regarding wind farms?

The National Weather Service's Radar Operations Center (ROC, www.roc.noaa.gov/WSR88D/) has developed ways to analyze wind turbine siting proposals on a case-by-case basis. The analysis of the Montague radar and impacts from proposed wind farms is ongoing. Data used in

the analysis includes site topography, proposed turbine heights, distance from radar to turbines, and elevation of the radar's antenna. Ultimately, a map is generated that shows the location of the radar site, and four zones around the radar. Below is the map showing the Montague radar site and the four zones generated by the ROC's analysis.



What do the zones around the radar site mean?

1. **No-build zone:** The no-build zone (4 km/~2.5 miles) is the red circle around the Montague radar. The NWS requests that developers not build turbines in this area due to the potential for serious impacts, including turbine nacelles blocking the radar beam and potential receiver damage if sited in the radar's near field.
2. **Mitigation zone:** The orange mitigation zone, is defined as the area between 4 km (~2.5 miles) and 36 km (~22 miles) where a 160-meter (~525 feet) turbine would penetrate more than one elevation angle. Wind farms sited within the mitigation zone have the potential for moderate to high impacts. The NWS would work with the developer to get detailed project information, do a thorough impact analysis, and discuss potential mitigation solutions.
3. **Consultation zone:** The yellow consultation zone is the area between 4 km (~2.5 miles) and 36 km (~22 miles) where a 160-meter (~525 feet) turbine only penetrates the 1st elevation angle or when a 160-meter tall turbine will penetrate more than one elevation angle between 36 km and 60 km. Due to the increased potential for impacts to operations or

medium impact, the NWS requests consultation with the developer to track the project and acquire additional information for a thorough impact analysis.

4. **Notification zone:** The Notification Zone, green areas on the map, is the area between 36 km (~22 miles) and 60 km (~37 miles) where a 160-meter (~525 feet) tall turbine will only penetrate one elevation angle, or any area beyond 60 km that a 160-meter-tall turbine is in the radar's line of site. Since impacts are typically minimal or low impact beyond 60 km and workarounds are available for penetration of only one elevation angle, NWS consultation is optional, but notification is encouraged.

What are potential mitigation options for wind farms in zones 1-3?

There are several possible mitigation measures that can be taken to eliminate or minimize wind farm impacts to Doppler radar systems. Under a Memorandum of Understanding signed in 2014, federal agencies established the Wind Turbine Radar Interference Mitigation (WTRIM) Working Group to address these impacts. Most mitigation measures are site dependent and come with various costs attached.

- Eliminate or move turbines away to minimize blades entering the radar elevation angles.
- Reduce the height of wind turbines or use terrain masking to minimize blades entering the radar elevation angles.
- Turn turbines off during specified conditions, to allow radar to gather needed data (referred to as curtailment).
- Interference reducing turbine blade treatments.

What do the zones mean for obstructions other than wind turbines?

While the four zones described above are meant for wind energy projects, in general the ROC recommends that nothing be built within a 1200' radius of the radar site. However, the 1200' radius does not cover all circumstances, and the range could be expanded based on height and width of proposed obstructions. It is recommended to contact the Radar Operations Center (www.roc.noaa.gov/WSR88D/Comments.aspx) for any new obstruction proposed near the radar (water towers, communication towers, etc.).

For More Information

Wind Turbine Radar Interference Mitigation (WTRIM) Working Group

windexchange.energy.gov/projects/radar-interference

NOAA - WIND FARM INTERACTION WITH NEXRAD RADAR

www.roc.noaa.gov/WSR88D/WindFarm/WindFarm.aspx

National Weather Service - Using and Understanding Doppler Radar

www.weather.gov/mkx/using-radar

NOAA's Wind Turbine Impact Evaluation Process and Mitigation Efforts

www.roc.noaa.gov/wsr88d/PublicDocs/AWEA2011.pdf

Fort Drum Joint Land Use Study Report

evogov.s3.amazonaws.com/media/159/media/116417.pdf

U.S. Wind Turbine Database

https://eerscmap.usgs.gov/uswtdb/viewer/#10.37/43.7899/-75.8342