

discretion which sometimes includes guidance and recommendations for shadow flicker levels and mitigation. However, a general precedent has been established in the industry both abroad and in the United States that fewer than 30 hours per year of shadow flicker impacts is acceptable to receptors in terms of nuisance and well below health hazard thresholds. In a German court case for example, a judge found 30 hours of actual shadow flicker per year at a certain neighbor's property to be tolerable (WindPower 2003).

## 2.0 WINDPRO SHADOW FLICKER ANALYSIS

An analysis of potential shadow flicker impacts from the Project was conducted using the WindPro software package. The Wilton IV turbine array dated July 28, 2014, which includes 58 turbines and 8 alternate locations, was included in the analysis. The analysis evaluated both the Project only and cumulative (Project plus existing) wind turbine scenarios:

- Scenario A (Wilton IV turbines only) – 66 turbines (58 primary and 8 alternate locations)
- Scenario B (Wilton IV plus existing turbines) – 196 turbines (66 Wilton IV turbine locations and 130 existing turbines from the Wilton I, Wilton II, and Baldwin Wind Energy Centers located adjacent to the east of the Wilton IV Project Area). For the purpose of the shadow flicker analysis, turbines from the existing projects were modeled using the GE 1.6 MW xle model turbine with a conservative rotor speed of 18 rpm.

The WindPro analysis was conducted to determine shadow flicker impacts under realistic impact conditions (actual expected shadow). This analysis calculated the total amount of time (hours and minutes per year) that shadow flicker could occur at receptors out to 1,500 meters (4,921.3 feet). The realistic impact condition scenario is based on the following assumptions:

- The elevation and position geometries of the wind turbines and surrounding receptors (houses). Elevations were determined using USGS digital elevation model (DEM) data. Positions geometries were determined using GIS and referenced to UTM Zone 14 (NAD83).
- The position of the sun and the incident sunlight relative to the wind turbine and receptors on a minute-by-minute basis over the course of a year.
- Historical sunshine hours availability (percent of total available). Historical sunshine rates for the area (as summarized by the National Climatic Data Center (NCDC, 2008) for nearby Bismarck, ND) used in this analysis are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53%	53%	58%	58%	61%	64%	73%	72%	65%	58%	43%	47%

- Estimated wind turbine operations and orientation (based on approximately 7 years of wind data from July 1, 2002 to October 31, 2009 [wind speed / wind direction frequency distribution] measured at meteorological tower approximately 47 miles east of the