

Impact of Industrial Wind Turbines on Residential Property Assessment In Ontario

2012 Assessment Base Year Study



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ABSTRACT

The Municipal Property Assessment Corporation (MPAC) commissioned this study of the effects of industrial wind turbines (IWT) on the current value of property in proximity to the turbines. Over the last few years, the subject of IWTs has been the subject of a number of reports and studies – both in Canada and worldwide. Past and current studies undertaken by both academics as well as real estate and health professionals have focused on the potential impacts of IWTs on property value and health. Given MPAC’s legislated mandate, this report focuses on the potential impact of IWTs on property values.

MPAC’s study concludes that 2012 Current Value Assessments (CVA) of properties located within proximity to an IWT are assessed at their current value and are equitably assessed in relation to homes at greater distances. No adjustments are required for 2012 CVAs. This finding is consistent with MPAC’s 2008 CVA report. The 2012 CVA study also found that there is no statistically significant impact on sale prices of residential properties in these market areas resulting from proximity to an IWT. The study underwent a rigorous independent third-party peer review and includes appendices describing the study parameters and documenting the analyses.

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EXECUTIVE SUMMARY

This report provides the results of the Municipal Property Assessment Corporation's (MPAC) study of the *Impact of Industrial Wind Turbines on Residential Property Assessment in Ontario (2012 Assessment Base Year Study)*.

Background

MPAC is responsible for accurately assessing and classifying property in Ontario for the purposes of municipal and education taxation. In Ontario, property assessments are updated on the basis of a four-year assessment cycle. The last province-wide Assessment Update took place in 2012 when MPAC updated the assessments of Ontario's nearly five million properties to reflect the legislated valuation date of January 1, 2012. Assessments updated for the 2012 base year are in effect for the 2013-2016 property tax years. Ontario's assessment phase-in program prescribes that assessment increases are phased in over a four-year period. Any decreases in assessment are applied immediately.

When assessing any property, MPAC relies on the real estate market to indicate what influence a factor, such as Industrial Wind Turbines (IWT), may have on a property's value. MPAC does this through the ongoing study and analysis of the market including the investigation of sales transactions. This market analysis typically reveals whether or not a factor has a negative, positive, or no impact on a property's value.

Over the last few years, the subject of IWTs has been the subject of a number of reports and studies – both in Canada and worldwide. Past and current studies undertaken by both academics as well as real estate and health professionals have focused on the potential impacts of IWTs on property value and health. Given MPAC's legislative mandate, this report focuses on the potential impact of IWTs on property value.

MPAC has completed two reviews of the impact of IWTs: 2008 and 2012 Base Year Studies.

2008 Base Year Study

In 2008, MPAC undertook a study looking at the impact of IWTs on residential assessments using the 2008 base year. The 2008 study concluded that the presence of industrial wind turbines that are either abutting or in proximity to a property did not have a positive or negative impact on the value of assessments.

2012 Base Year Study

In response to the growing presence of IWTs in Ontario as well as requests for information from stakeholders, MPAC undertook a new study using the 2012 assessment base year to provide a thorough examination of the impact of IWTs on residential property assessment.

Specifically, the study examined the following two statements:

1. Determine if residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance. In this report, this is referred to as ***Study 1 – Equity of Residential Assessments in Proximity to Industrial Wind Turbines.***
2. Determine if sale prices of residential properties are affected by the presence of an IWT in close proximity. In this report, this is referred to as ***Study 2 – Effect of Industrial Wind Turbines on Residential Sale Prices.***

Study 2 was added to the original scope of the review to respond to enquiries MPAC received from stakeholders and interested parties.

To conduct these studies, MPAC considered 15 market areas with sufficient sales to allow for analysis and applied industry standard mass appraisal techniques and internationally accepted ratio study standards.

To determine equity of assessments of properties within close proximity to an IWT, MPAC conducted an Assessment-to-Sale Ratio (ASR) study. An individual ASR is calculated by dividing the assessed value of each property by its time adjusted sale price. A ratio study is conducted to first establish the level of appraisal for a group of properties and equity is determined by comparing the level of appraisal with other groups of properties. If a group of properties is assessed at market value, the median ASR will lie between 0.95-1.05. By definition, equity is said to exist if there is 5% or less difference between property categories (or groups of properties) as per International Association of Assessing Officers (IAAO) ratio study standards.

The level of appraisal for properties within 1 km of an IWT is 1.034. The level of appraisal for properties at greater distance (1-2 km, 2-5 km and over 5 km) range from 0.989 to 0.992, a 4.2- 4.5% differential, which is below the 5% noted above.

Conclusions

Following MPAC's review, it was concluded that 2012 CVAs of properties located within proximity of an IWT are assessed at their current value and are equitably assessed in relation to homes at greater distances. No adjustments are required for 2012 CVAs. This finding is consistent with MPAC's 2008 CVA report.

MPAC's findings also concluded that there is no statistically significant impact on sale prices of residential properties in these market areas resulting from proximity to an IWT, when analysing sale prices.

In addition to the results shared in this report, MPAC also commissioned an internationally recognized expert in the field of mass appraisal and ratio studies to review the report and its findings. This expert has confirmed the findings in this report (Appendix A).

As MPAC works towards the next province-wide Assessment Update in 2016, qualified valuation staff will continue to study and analyse the Ontario real estate market including investigation of sales transactions to determine the impact of various factors – including IWTs – have on a property's value.

INTRODUCTION

The topic of wind energy is front and centre in the minds of a large number of Ontarians, particularly those living in rural areas of the province. There has been extensive reporting on the numerous aspects of this new development, be it in the reports of health effects, the approval process for siting IWTs, or the potential for property devaluation due to the perceived stigma attached to these developments.

Several studies, based on both scientific and non-empirical methods, have been completed by academics and real estate professionals to determine whether or not an adverse effect on sales prices exists with the presence of an IWT on a nearby property. In a recent study in the United States¹, released by the Berkeley National Laboratory and prepared for the U.S. Department of Energy, results indicate a minimal impact on property values as a result of being in close proximity to IWTs. One Ontario case study², released in 2013, argues that properties in Ontario are devalued by as much as 30-35%.

Current studies on both the valuation impact and health effects are underway by the University of Guelph³ and Health Canada⁴.

Prior to undertaking this study, MPAC conducted a study using 2008 base year Current Value Assessments (CVA), to determine whether residential properties located near IWTs were equitably assessed when compared to properties at a greater distance. The study was based on very limited sales information as there were a limited number of industrial wind turbines in the province at that time. As a result, it was difficult to draw meaningful conclusions with the 2008 study. Based on the available sale information, no adjustment to value was required for the 2008 CVA.

In conducting this current study, MPAC had additional sales data to review than it did in 2008. In addition to more sales, MPAC also received Requests for Reconsideration from the owners of 83 properties where proximity to IWTs was listed as a concern following the 2012 province-wide Assessment Update.

¹ Ben Hoen et al, "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", Berkeley National Laboratory, August 2013

² Ben Lansink, "Case Studies: Diminution / Change in Price Melancthon and Clear Creek Wind Turbine Analyses, Municipal Property Assessment Corporation (MPAC) Current Value Changes," Lansink Appraisals and Consulting, February 2013

³ R Vyn and R McCullough, "The Effects of Wind Turbines on Property Values in Ontario: Does Perception Match Empirical Evidence?", Canadian Journal of Agricultural Economics, forthcoming

⁴ http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/index-eng.php

PURPOSE OF THIS REPORT

This 2012 base year report has been written to provide a thorough examination of the impact of IWTs on residential property assessment. Specifically, the report examines the following two statements:

1. Determine if residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance. In this report, this is referred to as ***Study 1 – Equity of Residential Assessments in Proximity to Industrial Wind Turbines.***
2. Determine if sale prices of residential properties are impacted by the presence of an IWT in close proximity. In this report, this is referred to as ***Study 2 – Effect of Industrial Wind Turbines on Residential Sale Prices.***

Study 2 was added to the original scope of the review to respond to enquiries MPAC received from stakeholders and interested parties.

LEGISLATION

Sections of the *Assessment Act* relevant to this study include the following:

Section 1 (1): “current value” means, in relation to land, the amount of money the fee simple, if unencumbered, would realize if sold at arm’s length by a willing seller to a willing buyer; (“valeur actuelle”).

Section 19 (1): The assessment of land shall be based on its current value.

VALUATION OF RESIDENTIAL PROPERTIES

To estimate value of residential properties, MPAC applies the Direct Comparison Approach (DCA) in a mass appraisal environment. DCA estimates the current value of a subject property by adjusting the sale price of comparable properties for differences between the comparable properties and the subject property. Mass appraisal is the valuation of a group of properties as of a given date using standardized processes, employing common data, and allowing for statistical testing.

Multiple Regression Analysis

The DCA approach to value in a mass appraisal setting uses industry standard Computer Assisted Mass Appraisal (CAMA) techniques and, in particular, a statistical tool known as Multiple Regression Analysis (MRA).

Regression analysis is a statistical technique used to analyse data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.). If only one variable is used, such as living area, the procedure is called Simple Regression Analysis. When two or more variables are used in the analysis, the procedure is called Multiple Regression Analysis.

MRA estimates the value of one variable (i.e., the dependent variable) based on the information from the available data (i.e., the independent variables). Assessing authorities, such as MPAC, develop an equation that estimates current value based on the sale prices and property characteristics of sold properties. The equation, or valuation model, provides the best estimate of current value in statistical terms since it reduces the overall error between sale price and predicted value (estimated current value) to the lowest possible amount in dollar terms.

Market Areas

In Ontario, MPAC has defined 130 residential market areas. Market areas are geographic areas subject to the same economic influences. One valuation model is built for each market area. A market area could be a section of a large city, like Toronto, a medium size city like Niagara Falls or a cluster of smaller towns. Also, it could be the rural residential properties with a county or a group of lakes in a recreational waterfront area such as Muskoka or the Kawartha Lakes.

Key Factors Affecting Value

Approximately 85% of the current value of a property can be attributed to the following five property characteristics: location, building area, construction quality, lot size and age of the home adjusted for renovations and additions. Other features that may be adjusted for include; water frontage, building amenities (e.g., basement area, basement finish, bathrooms, fireplaces, heating, air conditioning), secondary structures (e.g., garages, in-ground pools), site features (e.g., abutting green space, abutting a ravine, abutting a commercial property, topography, corner lot, traffic pattern). Not all features will enter every market model; therefore, value influences will differ across the province.

Legislated Valuation Date

All estimates of current value represent market conditions as of January 1, 2012, the legislated valuation date for the 2013-2016 property tax years. As a result, part of MPAC's analysis is to determine the amount of inflation or deflation in each market area and adjust sale prices for time in relation to the legislated valuation date.

Sales Ratio Study

Once each valuation model has been developed, it is tested to ensure equity, accuracy and uniformity using a sales ratio study. A sales ratio study ensures that the overall level of appraisal of the market area is within corporate and industry standards for accuracy and uniformity. The second aspect of the sales ratio study is to ensure that equity has been achieved across all major property characteristics.

Application of Valuation Model

Once the statistical testing has been completed, and the valuation model for each market area has been deemed appropriate, it is applied to all the applicable properties in the market area and individual value review commences by qualified valuation staff. The purpose of this exercise is to reconcile the value estimates to ensure that a fair and equitable assessment has been placed on each property. These efforts tend to focus on areas with few sales and properties with features that cannot be captured within mass appraisal models. This review work continues up until the Assessment Roll is provided to each municipality and will include sales before and after the valuation date.

Sales

For this study, sales in proximity to IWTs were found in 15 market areas.

Table 1 - MPAC Market Area Descriptions

Market Area	MPAC Region	Description
05RR030	05 – Kingston	Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront
20RR010	20 – Brantford	Brant, Haldimand, Norfolk Counties - Rural/Waterfront
22RR010	22 – Kitchener	Dufferin & Wellington Counties - Rural
22UR020	22 – Kitchener	Dufferin County Villages
22UR030	22 – Kitchener	Wellington County Villages
23RR010	23 – London	Elgin, Middlesex & Oxford Counties - Rural
24RR010	24 – Goderich	Huron & Perth Counties - Rural/Waterfront
25RR010	25 – Owen Sound	Grey & Bruce Counties - Rural/Waterfront
25UR010	25 – Owen Sound	Grey & Bruce Counties - Urban
26RR010	26 – Chatham	Chatham-Kent - Rural/Wallaceburg
26RR030	26 – Chatham	Lambton County - Rural/Waterfront
27RR120	27 – Windsor	Essex County
27UR070	27 – Windsor	Lasalle, Tecumseh, Lakeshore Urban & Essex Urban
31RR010	31 – Sault Ste Marie	District of Algoma
31UR010	31 – Sault Ste Marie	Sault Ste. Marie/Prince Township

Adjustments for being in proximity to IWTs were not included when establishing CVAs for the 2008 or 2012 base year in any of these market areas.

INDUSTRIAL WIND TURBINES

2012 BASE YEAR ANALYSIS

Between 2008 and 2012, Ontario has seen a proliferation of wind turbine projects, with the introduction of the *Green Energy Act* in 2009, and the Feed-in-Tariff (FIT) program. This has resulted in a much larger set of available sales data for properties in proximity to these projects.

For the purposes of the 2012 base year study, MPAC has adopted a definition of an IWT to be one with a capacity of at least 1.5 megawatts. This is consistent with the definition currently being used by Health Canada⁵. In instances where the generating capacity of the IWT was not available in MPAC's property assessment database, it was calculated by dividing the IWT legislated rate of \$40,000 per megawatt (MW) into the assessed value of the IWT.

DATA COLLECTION

MPAC assigns a property code of 567 to represent IWTs. As per legislation in the Province of Ontario at the time of this report, IWTs are valued at \$40,000/MW, plus the value of the associated land at the industrial tax class. MPAC analyzed sales within 5 km of any IWT with a generating capacity of 1.5 MW or higher.

To ensure MPAC's inventory of IWTs was as complete as possible, geographic co-ordinates were acquired from NAV Canada. Any IWTs identified by NAV Canada that had not yet been field inspected by MPAC were inspected by local staff and all relevant data keyed into MPAC's database. Any IWTs identified on MPAC's computer database that were not included on NAV Canada's database were inspected by local MPAC staff and the GPS co-ordinates were collected. MPAC staff then process controlled all IWT co-ordinates to ensure accuracy (e.g., co-ordinates not placing the IWTs on the correct property). Of the 1,185 IWTs in MPAC's database after this exercise, only 28 had a capacity below 1.5 MW, leaving 1,157 IWTs for review. The distribution across MPAC's market areas is as follows:

Table 2 - Count of IWTs by Market Area

Market Area	MPAC Region	Description	IWT Count	Property Count
05RR030	05 – Kingston	Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront	86	63
20RR010	20 – Brantford	Brant, Haldimand, Norfolk Counties - Rural/Waterfront	53	42
22RR010	22 – Kitchener	Dufferin & Wellington Counties - Rural	163	107
23RR010	23 – London	Elgin, Middlesex & Oxford Counties - Rural	37	26
24RR010	24 – Goderich	Huron & Perth Counties - Rural/Waterfront	21	18
25RR010	25 – Owen Sound	Grey & Bruce Counties - Rural/Waterfront	167	136
26RR010	26 – Chatham	Chatham-Kent - Rural/Wallaceburg	325	247
26RR030	26 – Chatham	Lambton County - Rural/Waterfront	10	8
27RR120	27 – Windsor	Essex County	170	145
31RR010	31 – Sault Ste. Marie	District of Algoma	69	21
31UR010	31 – Sault Ste. Marie	Sault Ste. Marie/Prince Township	56	21
TOTAL			1,157	834

⁵ http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/comments_part1-commentaires_partie1-eng.php#a16

As some properties had more than one IWT erected on them, the property count does not match the count of IWTs.

Virtually all IWTs are erected on vacant lots or farm properties, with almost 90% located on farms and the remainder on vacant lots.

The year of construction of IWTs in the database ranges from 2002 to 2013, with a market area breakdown as follows:

Table 3 - Typical Physical Characteristics of IWTs Across Ontario

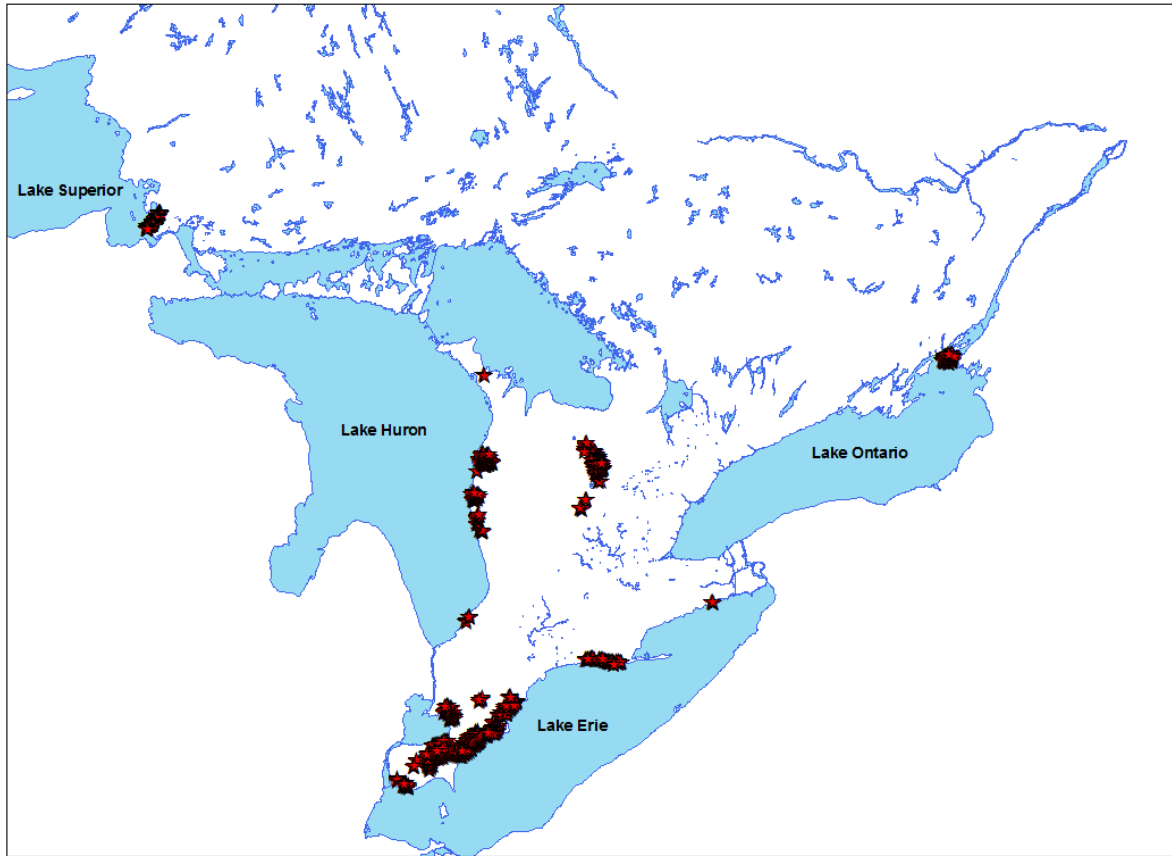
Market Area	MPAC Region	Median Year of Construction	Earliest Year of Construction	Latest Year of Construction	Median Generating Capacity	Minimum Generating Capacity	Maximum Generating Capacity
05RR030	05 - Kingston	2008	2008	2008	2.30	1.65	2.30
20RR010	20 - Brantford	2007	2007	2008	1.50	1.50	1.65
22RR010	22 - Kitchener	2008	2006	2012	1.50	1.50	2.40
23RR010	23 - London	2007	2006	2007	1.50	1.50	1.50
24RR010	24 - Goderich	2006	2006	2006	1.80	1.80	1.80
25RR010	25 - Owen Sound	2008	2002	2012	1.65	1.60	2.30
26RR010	26 - Chatham	2010	2008	2013	2.00	1.50	2.50
26RR030	26 - Chatham	2008	2008	2009	1.65	1.50	1.65
27RR120	27 - Windsor	2010	2010	2010	2.30	1.65	2.30
31RR010	31 - Sault Ste. Marie	2006	2006	2006	1.50	1.50	1.50
31UR010	31 - Sault Ste. Marie	2006	2006	2006	1.50	1.50	1.50
OVERALL		2008	2002	2013	1.80	1.50	2.50

Refer to Table 1 for market area descriptions.

The following map shows the locations of the IWTs used in the analysis. [Appendix B](#) provides the work instructions for local MPAC staff when determining the GPS co-ordinates for each IWT used in the analyses.

Figure 1

Location of IWTs Across Ontario



SALES INVESTIGATIONS

For the purposes of this study, all sales where any portion of a property was within 2 km of one or more IWTs were flagged for inspection by MPAC. The sale was investigated to ensure it was an arm's length transaction and that the property data on file reflected what existed at the time of the sale. Also, GPS co-ordinates were collected from the corner of the residence nearest an IWT. Finally, where possible, pictures were taken from the residence towards the closest surrounding IWT(s). Once this step was completed, distance was once again calculated from the co-ordinates of the IWT to the co-ordinates of the corner of the residences nearest an IWT. This was the actual distance used in the study for sales within 2 km. [Appendix C](#) includes the work instructions for staff conducting the sales review for this project.

A view variable was created using the pictures and descriptions provided for sales within 2 km of an IWT. Three categories were created:

Full View



Partial View



No View



STUDY 1 – EQUITY OF RESIDENTIAL ASSESSMENTS IN PROXIMITY TO INDUSTRIAL WIND TURBINES

For this study, MPAC analyzed open market sales of improved residential properties from January 2009 through December 2012, in the market areas surrounding IWTs. A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together.

Sales Filters

To account for typical minimum sale amounts, any sale below \$10,000 was removed in Southwestern or Eastern Ontario, and any sale below \$5,000 was removed in Northern Ontario. Any sale on a property on which an IWT sits, was removed from analysis to avoid the potential influence that the income stream associated to such properties may offer. Cases where a property sold as a vacant lot and has since been built on, or a sale representing a built on property that is now a vacant lot, have also been removed from the analysis. There were five market areas with five or fewer sales and these were excluded from the analysis. To verify the validity of the remaining sales, any sale within 2 km of an IWT was field inspected and reviewed by staff from the local MPAC offices. Sales determined to be other than open market transactions, or suspect, were removed from analysis. For the sales outside of a 2 km buffer, those with extreme ratios of Current Value Assessment to sale price as defined by the International Association of Assessing Officers (IAAO) Standard on Ratio Studies⁶, were also removed from analysis.

Assessment-to-Sale Ratio Study

To establish the level of appraisal and test for equity, MPAC looks at Assessment-to-Sale Ratio (ASR). The ASR is calculated by dividing the assessed value of each property by its time adjusted sale price.

One would expect to see a median ASR between 0.95-1.05 for a group of properties if they are assessed at market value. The median ASR of different categories of properties can be compared against one another to ensure that they align and therefore, the level of appraisal is equitable between each group. If the median ASR for a group of properties is higher than another group, this would indicate that it is assessed at a higher level of assessment.

Mean and median ASRs and their 95% confidence intervals were calculated for groups of view and distance variables. The median always divides the data into two equal parts and is less affected by extreme ratios than other measures of central tendency. Because of these properties, the median is the generally preferred measure of central tendency. When the mean or median is calculated on the data in a sample, the result is a point estimate, which is accurate for the sample but is only one indicator of the level of appraisal in the population. Confidence intervals around the measures of level provide indicators of the reliability of the sample statistics as predictors of the overall level of appraisal of the population. Note that noncompliance with appraisal level standards cannot be determined without the use of confidence intervals or hypothesis tests⁷. A confidence interval consists of two numbers (upper and lower limits) that bracket a calculated measure of central tendency for the sample; there is a specified degree of confidence that the calculated upper and lower limits bracket the true measure of central tendency for the population.

⁶ International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, pp. 53-54

⁷ *Ibid*, p. 13

MPAC looked at three different data elements in determining if equity exists:

1. Abutting a property with an IWT;
2. Distance to closest IWT; and,
3. View of an IWT.

1. ABUTTING A PROPERTY WITH AN IWT

There were 32 sales of properties that directly abutted a property with an IWT, 31 of which were within 1 km of an IWT as would be expected and one sale within 2 km (two large abutting lots). When looking at the 31 abutting properties within 1 km of an IWT in comparison to sales less than 1 km from an IWT that do not abut an IWT, the median ASR is actually lower for properties abutting an IWT (0.989 abutting vs. 1.040 not abutting). This indicates that there is no inequity between properties that abut an IWT and other properties within 1 km that do not physically abut an IWT.

When looking at all sales that abut a property with an IWT the median ASR is very near 1.00.

Table 4 - Abutting an IWT ASRs

	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Abutting Wind Turbine	32	1.002	0.929	1.121	98%

Based on all sales of properties abutting a property with an IWT there appears to be no difference between these abutting properties and sales that are a similar distance to a IWT but do not abut an IWT. See [Appendix D1 - Abutting a Property with an IWT](#) for statistical output.

2. DISTANCE TO CLOSEST IWT

A breakdown of the 41,424 sales used in the analysis, by distance, follows:

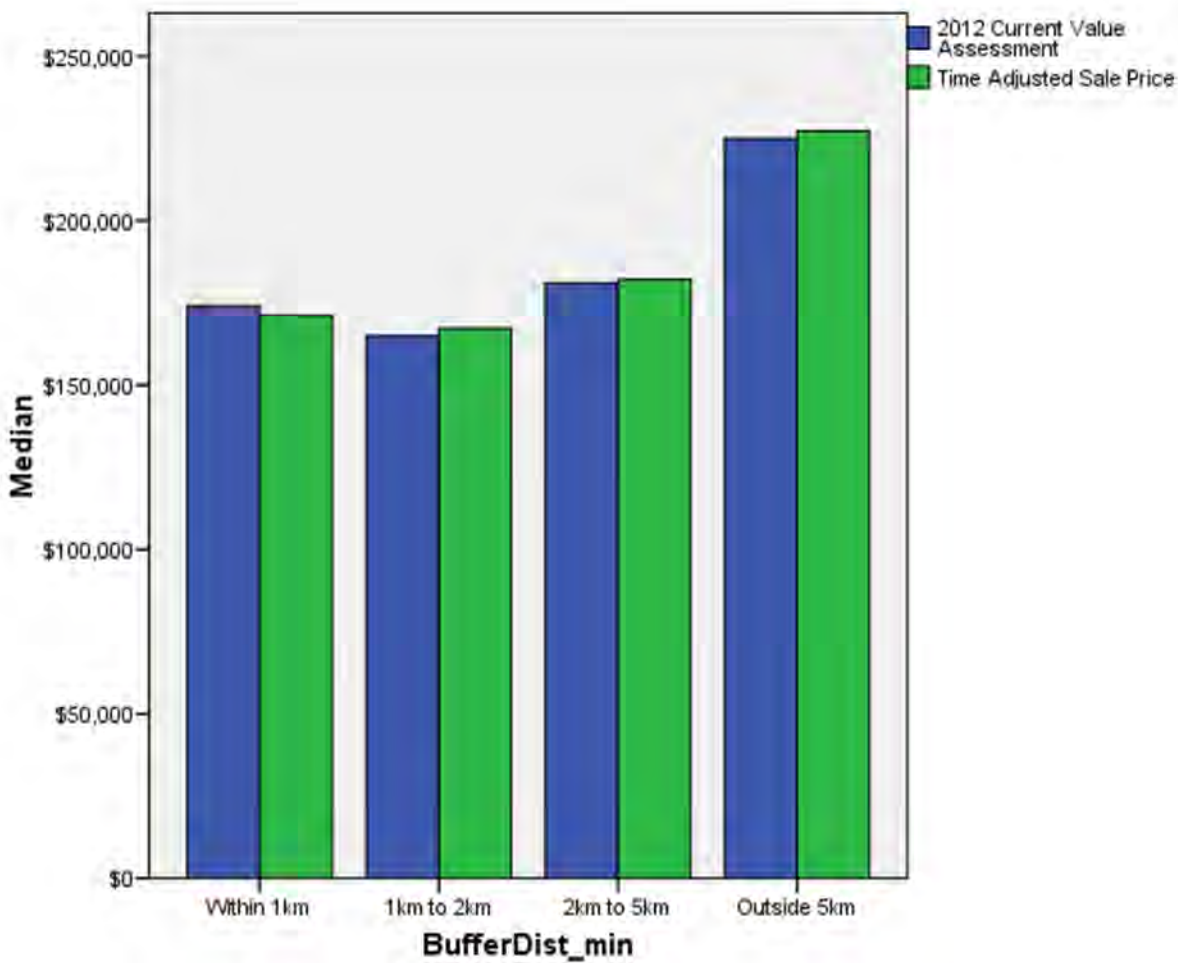
Table 5 - Distance Grouping by Market Area

Market Area	MPAC Region	Pre-Construction			Post Construction Sales			> 5 km
		< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km	
05RR030	05 - Kingston	0	0	0	13	7	8	2,606
20RR010	20 - Brantford	0	0	0	25	9	71	4,868
22RR010	22 - Kitchener	1	3	29	25	22	54	1,597
22UR020	22 - Kitchener	0	0	0	0	0	404	2,017
22UR030	22 - Kitchener	0	18	4	0	74	28	2,300
23RR010	23 - London	0	0	1	4	52	71	4,300
24RR010	24 - Goderich	0	0	0	2	3	98	786
25RR010	25 - Owen Sound	0	1	3	12	18	262	2,692
25UR010	25 - Owen Sound	0	0	0	0	16	161	4,180
26RR010	26 - Chatham	31	86	427	52	214	409	663
26RR030	26 - Chatham	0	0	0	1	23	76	1,942
27RR120	27 - Windsor	20	62	132	92	210	636	2,198
27UR070	27 - Windsor	0	29	32	1	125	147	2,660
31RR010	31 - Sault Ste. Marie	0	0	0	0	5	7	1,483
31UR010	31 - Sault Ste. Marie	0	0	0	0	12	3	2,801
TOTAL		52	199	628	227	790	2,435	37,093

Refer to Table 1 for market area descriptions.

Comparing the median assessed value to the median time adjusted sale amount by the distance categories the figures are very similar. The results for all sales are provided in the following graph.

Figure 2 - Comparison of CVA and Time Adjusted Sale Price by Distance Groupings



Appendix D2 - CVA and Tas-Amt Bar Charts contains a similar bar chart for each market area.

When broken into the distance categories, sales within 1 km of an IWT show a higher median ASR than the other groups.

Table 3 - Distance Grouping ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	279	1.034	1.011	1.057	95.8%
1 km to 2 km	989	0.989	0.979	1.000	95.1%
2 km to 5 km	3,063	0.992	0.988	0.997	95.3%
Outside 5 km	37,093	0.992	0.991	0.993	95.0%
OVERALL	41,424	0.992	0.991	0.994	95.0%

Sales of properties within 1 km of an IWT have a median ASR of 1.034 while the overall median for all sales outside of 5 km of an IWT is 0.992. This is a difference of 4.2%. Also, the median confidence interval does not overlap the confidence interval for the other groups. This indicates the difference is statistically significant. Sales between 1 km and

5 km away from an IWT appear to be assessed at the same level of appraisal as the sales greater than 5 km from an IWT. See [Appendix D3 - Distance by Market Area and Type](#) for ASR data for each market area.

In Study #2, regressions were run for all rural market areas. Urban models were not recalibrated since there was only one sale within 1 km of an IWT in all urban areas. To ensure that the ASRs were equitable for sales within 5 km of an IWT in urban market areas, the urban and rural markets were looked at separately. The results are displayed below.

Table 4 - Distance Groupings – Urban Market ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	1	1.138			
1 km to 2 km	274	0.975	0.955	0.992	95.4%
2 km to 5 km	779	0.976	0.969	0.984	95.5%
Outside 5 km	13,958	0.988	0.986	0.990	95.1%
OVERALL	15,012	0.987	0.985	0.989	95.1%

Table 5 - Distance Groupings – Rural Market ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	278	1.034	1.011	1.055	95.2%
1 km to 2 km	715	0.996	0.982	1.008	95.7%
2 km to 5 km	2,284	0.999	0.993	1.005	95.3%
Outside 5 km	23,135	0.995	0.993	0.997	95.1%
OVERALL	26,412	0.996	0.994	0.997	95.0%

In the urban markets, there is only one sale within 1 km of an IWT. The median ASRs for sales outside of 1 km are all below 1.00. They are slightly lower than the results for the rural market areas; however, the median ASRs outside 1 km in the rural market areas are still below 1.00. Based on these results, it appears that urban market areas are equitably assessed with regard to the distance to the closest IWT. Also, there is no significant difference between urban market areas and rural market areas regarding the influence of distance to the closest IWT. See [Appendix D3 - Distance by Market Area and Type](#) for ASR data for each market type.

3. VIEW OF AN IWT

When all sales within 2 km of the nearest IWT are analyzed together, the median ASR for full view is higher than the median ASR for properties with no view. However, there is correlation between full view and distance. Almost 75% of sales within 1 km of an IWT have a full view while only 25% of sales from 1 to 2 km to an IWT have a full view. As mentioned above, sales within 1 km of an IWT have a median ASR higher than the other distances. Therefore, the sales were split into two groups to perform the ratio study by view towards the closest IWT.

Table 6 - View Groupings – Sales within 1km ASRs

View	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Full View	190	1.032	1.001	1.060	95.0%
Partial View	33	1.005	0.952	1.057	96.5%
No View	56	1.064	0.998	1.092	95.6%
OVERALL	279	1.034	1.011	1.057	95.8%

Within 1 km, sales with no view have the highest median ASR (1.064 vs. 1.032 for full view) based on 56 sales. Partial view has the lowest median ASR at 1.005. This seems to indicate that view does not affect ASR for sales within 1 km of an IWT.

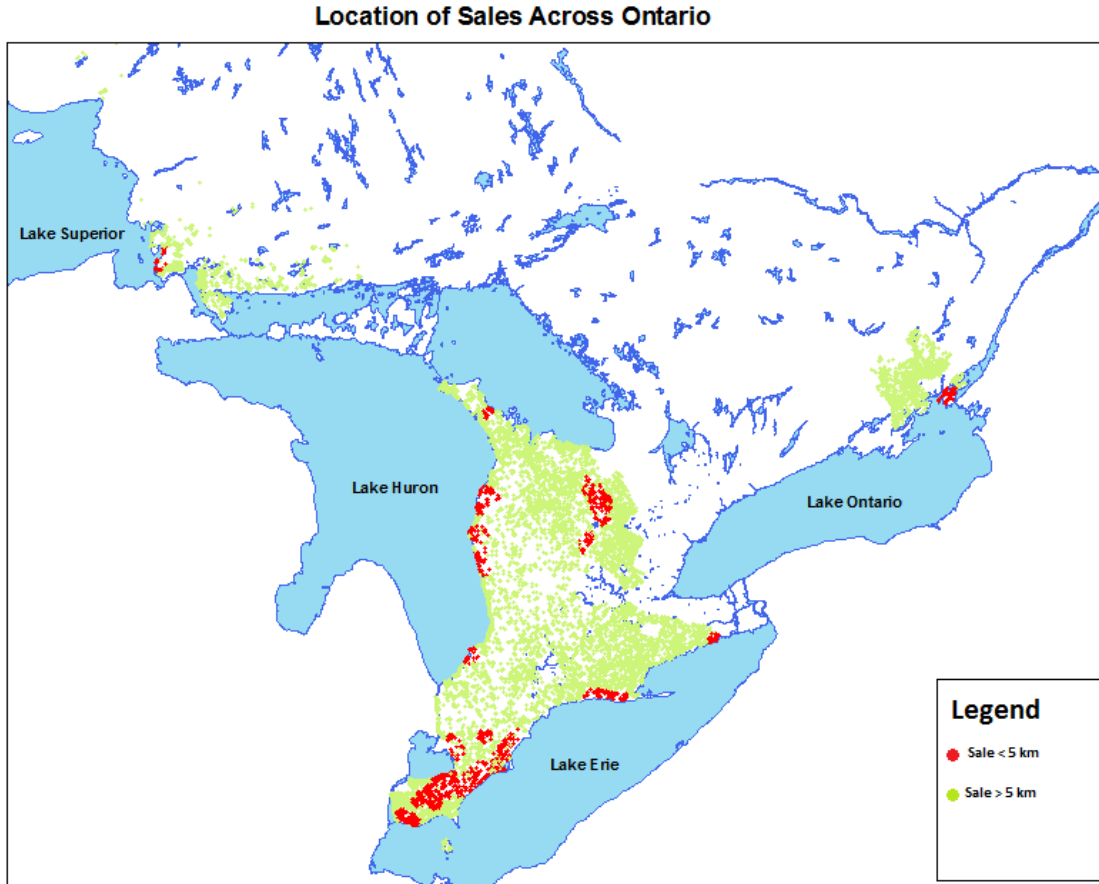
The ASR results for sales from 1 km to 2 km away from an IWT are:

Table 7 - View Groupings – Sales 1km to 2km ASRs

View	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Full View	239	1.001	0.981	1.026	96.2%
Partial View	103	0.980	0.939	1.018	95.2%
No View	647	0.984	0.972	0.997	95.1%
OVERALL	989	0.989	0.979	1.000	95.1%

Properties with a full view of one or more IWTs have a median ASR of 1.001 while properties with a partial view have a median ASR of 0.980. Sales with no view have a median ASR of 0.984. There is a moderate difference between full view and no view of 1.7%. The confidence intervals of the three groups do overlap and all three groups have median ASRs close to 1.00. See [Appendix D4 - View All Sales and by Market Area](#) for ASR data for each market area.

Figure 3



SUMMARY OF FINDINGS

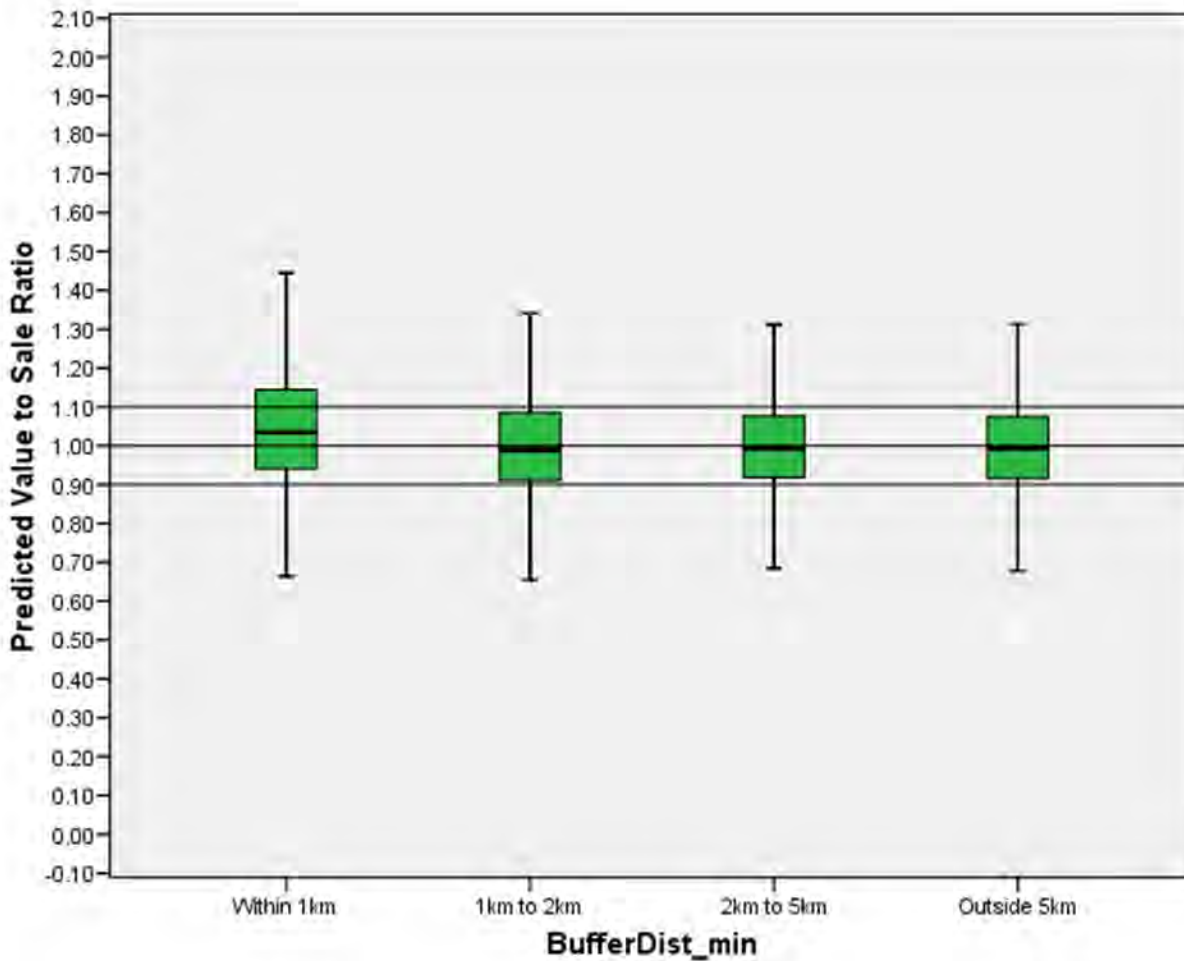
Section 9.2.1 of the IAAO Standard on Ratio Studies states:

“The level of appraisal of each stratum (class, neighborhood, age group, market areas, and the like) should be within 5 percent of the overall level of appraisal of the jurisdiction. For example, if the overall level of appraisal of the jurisdiction is 1.00, but the appraisal level for residential property is 0.93 and the appraisal level for commercial property is 1.06, the jurisdiction is not in compliance with this requirement. This test should be applied only to strata subject to compliance testing. It can be concluded that this standard has been met if 95 percent (two-tailed) confidence intervals about the chosen measures of central tendency for each of the strata fall within 5 percent of the overall level of appraisal calculated for the jurisdiction. Using the above example, if the upper confidence limit for the level of residential property is 0.97 and the lower confidence limit for commercial property is 1.01, the two strata are within the acceptable range.”

Sales within 1 km of an IWT showed a level of appraisal that was higher than the median ASR of sales further away (median ASR of 1.034). The lower confidence level of sales within 1 km of an IWT is 1.011. This is well within 5% of the

overall level of appraisal ($1.011 - 0.992 = 1.9\%$). So, although sales within 1 km of an IWT do have a median ASR above the overall level, the difference is not great enough to require value adjustment according to IAAO guidelines. These findings are illustrated in the following box plot.

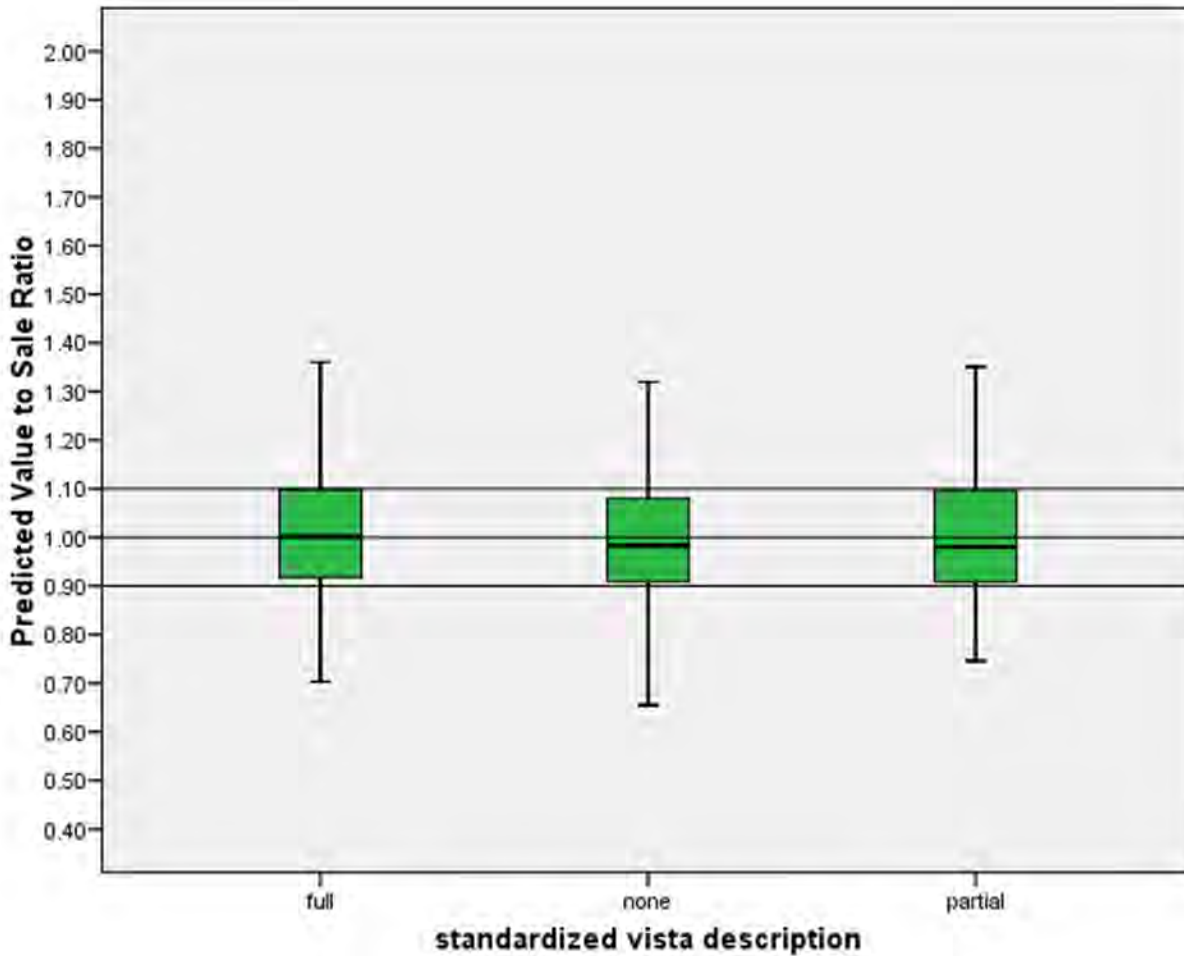
Figure 4 - ASR by Distance Grouping



The dark line within each box represents the median ASR. The lower and upper ends of the box represent the 25th and 75th percentiles, respectively. This box plot illustrates that the median ASR for sales within 1 km of an IWT is slightly higher than the other groups, but the boxes for all the groups overlap. See [Appendix D5 - Distance Boxplots](#) for additional graphs.

Also, between 1 km and 2 km some testing appeared to indicate a difference in the level of appraisal based on the view towards the closest IWT. The median ASR for properties with a full view is 1.001 while the median ASR for properties with No View is 0.984. This is a difference of 1.7%. This difference is well below 5% without reference to the confidence intervals. Again, based on IAAO standards, the difference between median ASRs does not approach the threshold to require an adjustment. This is also illustrated using the following box plots.

Figure 5 - ASR by View Grouping Sales 1km to 2km to an IWT



The median ASR for full view is slightly higher than the other two view categories but again there is a large amount of overlap among the three boxes. See [Appendix D6 - View Boxplots](#) for additional graphs.

In the IAAO Standard on Ratio Studies, 2013⁸, an equity decision making matrix is provided to allow a jurisdiction to determine if equity exists between groups of properties. This matrix has been populated for the two scenarios described above. The performance standard range is 0.95 to 1.05. Note that if the point estimate is outside of the performance standard range but the confidence interval does overlap the range, action is not required.

Table 8 - Decision Making Matrix

Scenario	Point Estimate	Confidence Interval (CI) Width	CI Overlaps Performance Standard Range	Point Estimate in Performance Standard Range	Action Required
<1 km to IWT	1.034	1.011 to 1.057	Yes	Yes	No
Full View 1 to 2 km to an IWT	1.001	0.981 to 1.026	Yes	Yes	No

⁸ International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, p. 35

Therefore, based on the results of this analysis, there is no inequity with regards to distance to the closest IWT and view towards an IWT.

This finding is consistent with MPAC's 2008 study. *MPAC's 2008 study is included as Appendix E* of this report.

Our findings are also consistent with a third party review of this study conduct by Robert J. Gloudemans. Mr. Gloudemans is an independent internationally recognized mass appraisal consultant. MPAC provided Mr. Gloudemans with a dataset of all sales less than 5 km from the nearest IWT to conduct his analysis. *Mr. Gloudemans' report is included as Appendix A.*

STUDY 2 – EFFECT OF PROXIMITY TO INDUSTRIAL WIND TURBINES ON RESIDENTIAL SALE PRICES

To determine if sale prices of residential properties are impacted by being in proximity to IWTs, three binary variables (0 – No, 1 – Yes) were created based on the following distance groupings:

- IWT_1km - The home is within 1 km of the nearest IWT.
- IWT_2km - The home is within 1-2 km of the nearest IWT.
- IWT_5km - The centre of the lot is within 2-5 km of the nearest IWT.

The requirement for exact location of the house was assumed to be less important as distance to the nearest IWT increases and the centroid of the lot was deemed acceptable for the purposes of this study for properties further than 2 km away from the nearest IWT.

The regression models used to produce the January 1, 2012 Current Value Assessments were recalibrated with these variables included to determine whether they would enter the equation at a statistically significant level. The typical significance level for Multiple Regression Analysis is either 5% or 10%.

If one or more of the distance variables enters a regression analysis significantly, that is an indication that distance to an IWT affects sale prices in that market area and a value adjustment to the assessed value may be required.

SALES UTILIZED

Table 9 provides a breakdown of the distance grouping variables for each market area.

Table 9 - Distance Grouping by Market Area

Market Area	MPAC Region	Pre-Construction			Post-Construction		
		< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km
05RR030	05 - Kingston	0	0	0	7	6	10
20RR010	20 - Brantford	0	0	0	19	7	54
22RR010	22 - Kitchener	1	3	32	20	18	37
22UR020	22 - Kitchener	0	0	0	0	0	281
22UR030	22 - Kitchener	0	17	4	0	47	24
23RR010	23 - London	0	0	1	3	41	53
24RR010	24 - Goderich	0	0	0	2	2	74
25RR010	25 – Owen Sound	0	2	2	8	10	201
25UR010	25 – Owen Sound	0	0	0	0	14	109
26RR010	26 - Chatham	33	81	415	15	96	173
26RR030	26 - Chatham	0	0	0	0	23	60
27RR120	27 - Windsor	22	66	185	64	128	397
27UR070	27 - Windsor	0	30	33	1	78	84
31RR010	31 – Sault Ste. Marie	0	0	0	0	12	19
31UR010	31 – Sault Ste. Marie	0	0	0	0	8	4
TOTAL		56	199	672	142	490	1584

This table also indicates the number of sales occurring pre-construction and post construction periods. Pre-construction sales include sales one year prior to completion of the IWT.

Two market areas have sufficient sales to test distance groupings and state of IWT construction, namely *MPAC Region 26-Chatham* representing Lambton County – Rural/Waterfront (market area 26RR010) and *MPAC Region 27-Windsor* representing Essex County (market area 27RR120). Most market areas have sufficient sales within 1 km to test the value impact within that distance.

The sales period to develop valuation models ranges from December 2008 to December 2011 in these market areas. Table 10 provides a summary.

Table 10 - Market Area Sales Summary

Market Area	MPAC Region	Median House Square Footage (sq ft)	Median Age (years)	Median Lot Size (Acres)	Sale Date Range (year/month)	Median Time Adjusted Sale Price
05RR030	05 - Kingston	1,314	38	0.53	08/12 – 11/11	\$219,918
20RR010	20 - Brantford	1,324	44	0.25	09/01 – 11/12	\$218,254
22RR010	22 - Kitchener	1,729	33	1.32	09/01 – 11/12	\$401,056
23RR010	23 - London	1,441	40	0.32	09/01 – 11/12	\$230,697
24RR010	24 - Goderich	1,428	46	0.82	08/12 – 11/11	\$246,041
25RR010	25 – Owen Sound	1,340	37	0.61	08/12 – 11/11	\$219,375
26RR010	26 - Chatham	1,245	52	0.23	09/01 – 11/12	\$129,842
26RR030	26 - Chatham	1,346	39	0.26	09/01 – 11/12	\$176,225
27RR120	27 - Windsor	1,305	37	0.20	09/01 – 11/12	\$170,238
31RR010	31 – Sault Ste. Marie	1,086	43	0.26	08/01 – 11/12	\$85,065
OVERALL		1,332	39.5	0.29	09/01 – 11/12	\$218,814

Refer to Table 1 for market area descriptions.

When reviewing sale counts for properties within 5 km of an IWT, it was determined that some sales occurred in the urban market areas; however, there were no sales of properties in these market areas within 1 km of an IWT. For the purposes of this study, only rural market areas that had sales within 1 km were studied.

Variables for each distance were added to the model for each market area. If the distance grouping variables entered the equation with 5% significance level (95% confidence level), it would indicate very strong statistical evidence that distance to the nearest IWT is impacting on sale prices.

Tables 11 and 12 provide the dollar adjustment and an indication if the variables entered the model with a 10%, 5% or 1% significance level. Typically, MPAC sets a 5% significance level for any property characteristic to be included in a valuation model in accordance with statistical practice.

Table 11 - Dollar Adjustments in Market Areas with Insufficient Pre-Construction Sales

Market Area	MPAC Region	< 1 km	1-2 km	2-5 km
05RR030	05 - Kingston	+\$36,435**	DNE	+\$31,832**
20RR010	20 - Brantford	DNE	DNE	DNE
22RR010	22 - Kitchener	DNE	DNE	DNE
23RR010	23 - London	DNE	DNE	-\$21,021**
24RR010	24 - Goderich	DNE	DNE	DNE
25RR010	25 – Owen Sound	DNE	DNE	DNE
26RR030	26 - Chatham	DNE	DNE	+\$12,261**
31RR010	31 – Sault Ste. Marie	DNE	DNE	DNE

, **, * indicate that the dollar adjustment is statistically significant at the 10%, 5% or 1% significance level, respectively (DNE = Did Not Enter)*

Table 12 - Dollar Adjustments in Market Areas with Sufficient Pre-Construction Sales

Market Area	MPAC Region	Pre-Construction Sales			Post Construction Sales		
		< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km
26RR010	26 - Chatham	-\$6,451*	-\$3,686*	DNE	DNE	DNE	DNE
27RR120	27 - Windsor	DNE	DNE	DNE	DNE	DNE	DNE

, **, * indicate that the dollar adjustment is statistically significant at the 10%, 5% or 1% significance level, respectively*

(DNE = Did Not Enter)

Appendix F includes the regression outputs referred to Tables 11 and 12.

Summary of Findings

Rural valuation models used for the 2012 base year were re-calibrated incorporating the three distance variables. With the exception of *MPAC Region 26-Chatham* representing Chatham-Kent – Rural/Wallaceburg (market area 26RR010) and *MPAC Region 27– Windsor* representing Essex County (market area 27RR120), there were insufficient sales to study any potential difference in impact pre-construction and post-construction. In the case of market area 05RR030 (*MPAC Region 5-Kingston* representing Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront), being within 1 km of an IWT entered the model as a positive value of \$36,435. In this market area and the 26RR030 market area, the variable representing properties between 2 and 5 km from an IWT also entered positively.

Upon review of the sales database, it was determined that the IWT variables created for this study were highly correlated with the neighbourhood locational identifier. This strong correlation resulted in coefficients that did not make appraisal sense, and thus have been negated for the purposes of this study.

For market areas 26RR010 and 27RR120, sufficient sales data was evident to study the activity on both pre-construction and post-construction home sales. In neither instance did any of the variables enter the regression for 27RR120. For 26RR010, the variable identifying sales within 1 km of an IWT entered in the pre-construction period, and then only at the 10% significance level. The indicated coefficient was -\$6,451. The variable representing sales between 1 and 2 km away from an IWT also entered at a coefficient of -\$3,686, also only at the 10% significance level. In the post-construction period, no variable entered the regression for these areas. Thus, it can be assumed that any impact, no matter how marginal, was isolated in these areas to the post-announcement, pre-construction period.

In market area 23RR010 (*MPAC Region 23 – London* representing Elgin, Middlesex & Oxford Counties – Rural), the variable used to identify properties 2-5km away from an IWT entered the regression with a negative coefficient. After review of the sales database, it was determined that this variable was highly correlated with the neighbourhood locational identifier. This is borne out by the fact that neither of the other, closer, distance variables entered the regression.

With the exceptions noted above, no distance variables entered any regression equations for any of the other market areas.

To further confirm its findings, MPAC also conducted an additional analysis using approximately 2,000 sales and re-sales following similar logic to the Lansink study. The main differences between the February 2013 Lansink Study and MPAC's re-sale analysis is the sample size and the determination of the increase in the market between re-sales. Using 2,051 properties and generally accepted time adjustment techniques, MPAC cannot conclude any loss in price due to the proximity of an IWT. *Appendix G includes the re-sales analysis.*

LIST OF REPORT APPENDICES

Appendix -A – Independent Review of Report – Summary of Wind Turbines, Analysis by R.J. Gloudemans

Appendix B -- Industrial Wind Project – Work Instructions for IWT Locations

Appendix- C – Industrial Wind Project – Work Instructions for Sales Review

Appendix –D1- Abutting a Property with an Industrial Wind Turbine

Appendix –D2 – CVA & TAS AMT Bar Charts

Appendix –D3 – Distance by Market Area and Type

Appendix –D4– View All Sales and Market Area

Appendix – D5 - Distance Boxplots

Appendix –D6- View Box Plots

Appendix –E – MPAC 2008 Report on the Impact of Wind Turbines on Residential Properties

Appendix –F- Regression Output for Study 2

Appendix –G- Re-sale Analysis – Lansink & MPAC Industrial Wind Project –Sales Review

GLOSSARY OF TERMS

Assessment Roll – An annual listing provided to each taxing authority in the Province of Ontario containing, among other things, the current value and tax classification of each property within the jurisdiction.

Assessment-to-Sale Ratio (ASR) – The ratio obtained by dividing the assessed value of a property by the time adjusted sale price of a property.

Base Year – The year that an estimate of a property’s value is based on.

CVA – Current value assessment. The estimated value of a property based on a specific date.

Direct Comparison Approach to Value (aka Sales Comparison Approach to Value) – An approach to valuing a property which estimates the current value of a subject property by adjusting the sale price of comparable properties for differences between the comparable properties and the subject property.

Industrial Wind Turbine (IWT) – A wind turbine used to generate at least 1.5 MW of electricity.

GPS Co-ordinates – A set of two numbers that reference the latitude and longitude of a point on the Earth.

Market Area – A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together.

Market Model – Geographic areas subject to the same economic influences.

Mass Appraisal – The valuation of a group of properties as of a given date using standardized processes, employing common data, and allowing for statistical testing.

Median - The median of a group of numbers is the middle number after they have been sorted from lowest to highest. If you have an odd number of cases, the median is the middle value. If you have an even number of cases, the median is the value midway between the two middle values. The median, in comparison to the mean, is less sensitive to extreme values.

Megawatt (MW) – A unit of measure in energy generation or consumption.

MPAC – The Municipal Property Assessment Corporation. A body responsible for determining the correct market value and tax classification for all properties in the Province of Ontario, based on current value assessment.

Regression Analysis – A statistical technique used to analyse data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.).

For more information about MPAC and how MPAC assesses properties, visit www.mpac.ca.