

Water Well Investigation Results

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North Kent

Having Clean Water is Essential

We understand that water well concerns are of the utmost importance, and we take your concerns very seriously.

Local water well concerns have been investigated by licensed hydrogeologists, vibration scientists, well contractors, and engineers who tracked vibrations at the turbine sites and on steel well casings that penetrate deep into the ground.

Examples of activity in the area that may influence ground vibrations include nearby road or farm traffic, utility or road work, movements of solar panels, and well pump operations.



How the residential water supply wells were monitored:

- Monitoring equipment captured any vibrations that occurred hundreds of times per second
- Over 1,700 continuous hours of vibration monitoring of deep well casings at distances between 570 and 4,366 metres from turbine foundations during construction activity
- More than 2.5 million analyses were completed of well casing vibrations recorded during the monitoring period

Conclusion

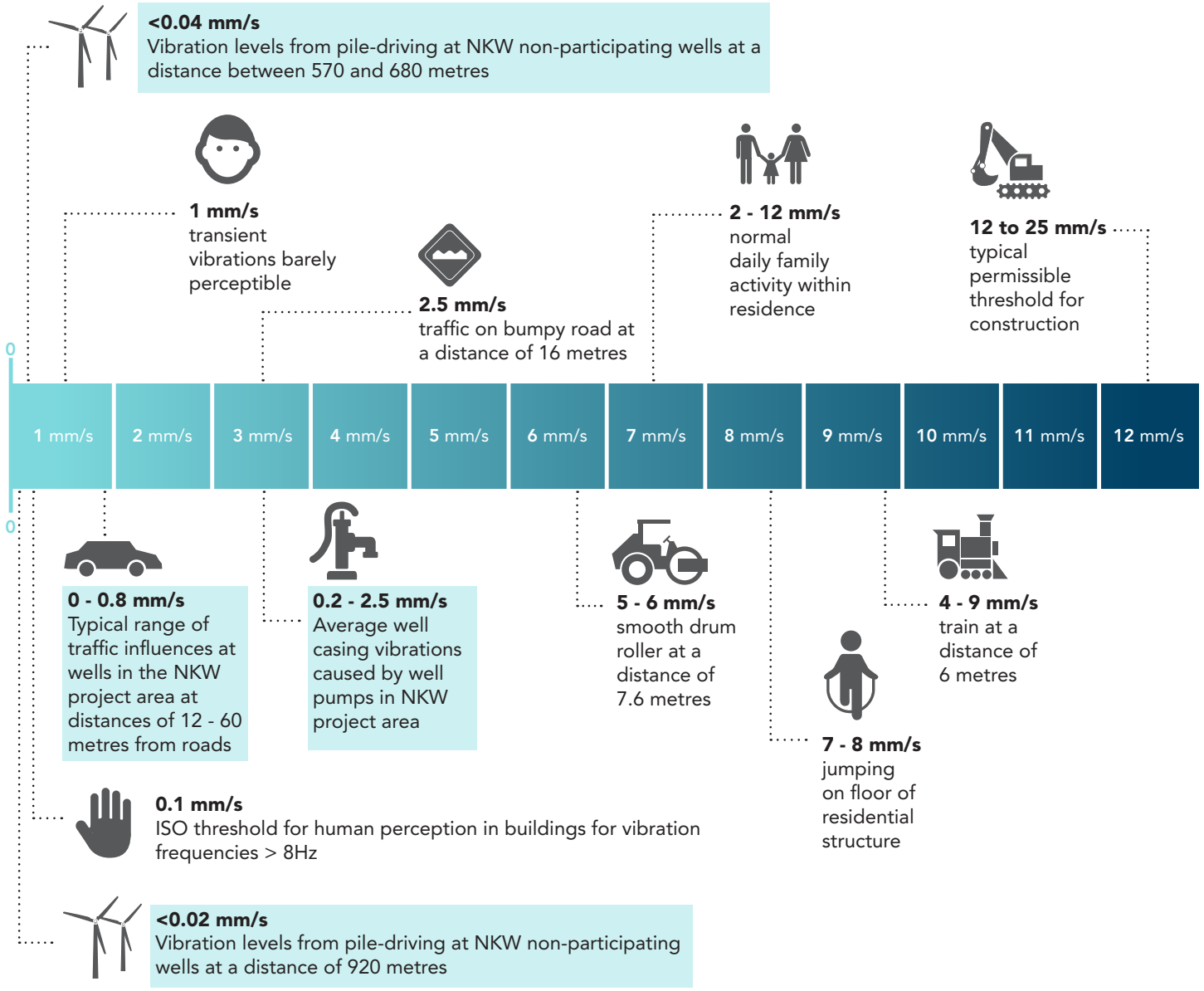
Groundwater quality and quantity issues reported by well owners were not a result of construction activities.

Pile-Driving Monitoring Results

Piling-driving activities occured in 2017 between June and November at distances of more than 500 metres away from water wells located on properties of non-participating residences. Our extensive vibration monitoring program concluded that the level of vibration at those water wells was so low, it was not scientifically plausible that vibrations could cause damage to well infrastructure or re-suspension of sediment existing within wells.

Vibration Measurements

Vibrations are commonly measured by the velocity of movement in millimetres per second (mm/s). Published examples of vibrations caused by common conditions are shown below. Measurements taken in the North Kent Wind (NKW) project area are highlighted.



Responses to Concerns

Specific Concerns by Well Owners and the Corresponding Facts

Concern #1

Water is dirty from particles and sediment disturbed during the construction of wind turbine foundations and travel from the turbine site to residential water supply wells.

FACT: There is no physical way for sediment to travel from the location of turbine construction activity to residential water supply wells hundreds of metres away. Except in the immediate vicinity of a water well, groundwater moves through the aquifer slowly in the project area - only metres per year - due to the nature of the soil and rock conditions.

Concern #2

Vibrations from wind turbine foundation construction activity damaged water wells or caused sediment in wells to break loose.

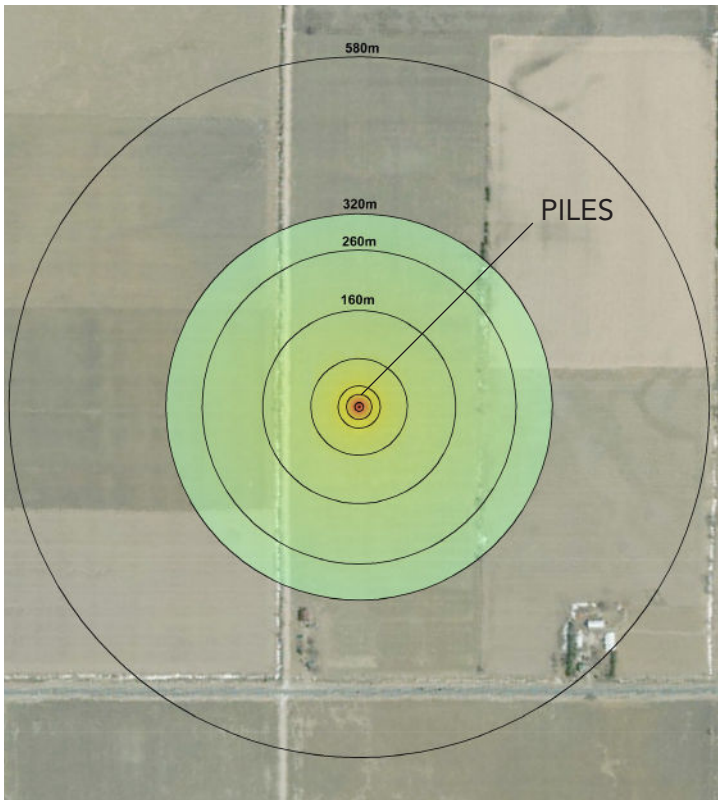
FACT: Construction of wind turbine foundations occurred hundreds of metres away from non-participating properties. It is not scientifically plausible that vibrations from the pile-driving activity could cause damage to well infrastructure or disturb sediment existing within water wells. Vibrations from pile-driving dissipate quickly from the source. The monitoring program found that well casing vibrations from operation of the well pumps and nearby traffic far exceeded any vibrations associated with construction activity.

Vibrations from Pile-Driving Dissipate Quickly

LEGEND

Published and Measured Vibration Magnitudes:

Radius (m)	Peak Particle Velocity (mm/s)	Description
1.6	178	Major damage to residential structure possible (Nichols et al. 1971)
7.0	25	Limit to avoid cracks in structures without plaster walls (AASHTO, 1990)
7.5	21	Water wells, no change in well performance (Robertson et al. 1980, Rose et al. 1991, Straw and Shinko, 1994)
21	5	Limit to avoid cracks in buildings with plastered walls (AASHTO, 1990)
35	2.5	Limit for historic sites (AASHTO, 1990)
80	0.76	Noticeable house rattling (Siskind, 2000)
160	0.3	Ontario Vibration Limit for Frequent Impulses at Nighttime (NPC-207, 1983)
260	0.14	Acceptable nighttime vibration threshold for building equipment (ASHRAE, 2007)
320	0.1	Threshold for human response in buildings, limit for hospital operating rooms (ISO, 1989)
580	**0.037**	**Maximum measured well casing vibrations from NKW pile-driving**



Complaint Investigation Results

We are committed to being transparent with the results of our research and complaint investigations.

Extensive review and application of scientific and engineering research, along with field testing, has demonstrated that the construction and operation of wind turbines has not and will not affect water wells or the quality and quantity of the water in the North Kent Wind project area.

Please take time to review the information that is available.

Out of hundreds of documented water wells in the project area, 16 complaints were received in 2017. Complaints were associated with sediment in the water or flow rate reductions.

We immediately provided clean water to these individuals while their concerns were investigated and those assessments were reviewed by the Ministry of Environment and Climate Change (MOECC).

FINDINGS…

After the completion of complaint investigations, AECOM Canada Ltd. and Golder Associates Ltd. determined the conditions associated with the complaints were not related to pile-driving construction activities at the turbine sites. The MOECC has agreed with the conclusions of the complaint investigations.

The highest vibration levels recorded at the residential water supply well locations were attributed to well pumps and nearby traffic. Vibration levels at the water well locations from construction activities were inconsequential and much less than everyday sources.

Water quality or quantity concerns appeared related to well construction, the condition of existing well pumping and treatment equipment, on-going maintenance, or lack of maintenance in combination with the natural conditions in the region.

In the majority of investigations, filtration systems were found to be improperly connected between the pump and pressure tanks, resulting in added stress on the pumping systems. When these filtration systems were bypassed, the water flow rates were normal.

Pumping of water from the ground will normally bring sediment into wells, particularly if the wells do not have screens. Even the finest screens, however, will not prevent very fine particles from entering the wells.

Accumulations of sediment in water wells, by pumping water from the surrounding water-bearing ground, can be expected to include particles of black shale. This is simply on account of the water wells being drilled into the Kettle Point Formation and the overlying soils that also include black shale fragments.

Natural gas also exists in sufficient quantities and pressures within the Kettle Point Formation and emerges periodically in water wells in the project area. Gas emerging through wells can result in re-suspension of sediments within the wells from time to time. Problems associated with natural gas in water wells in the region have been recognized for decades.



Additional Resources and Information



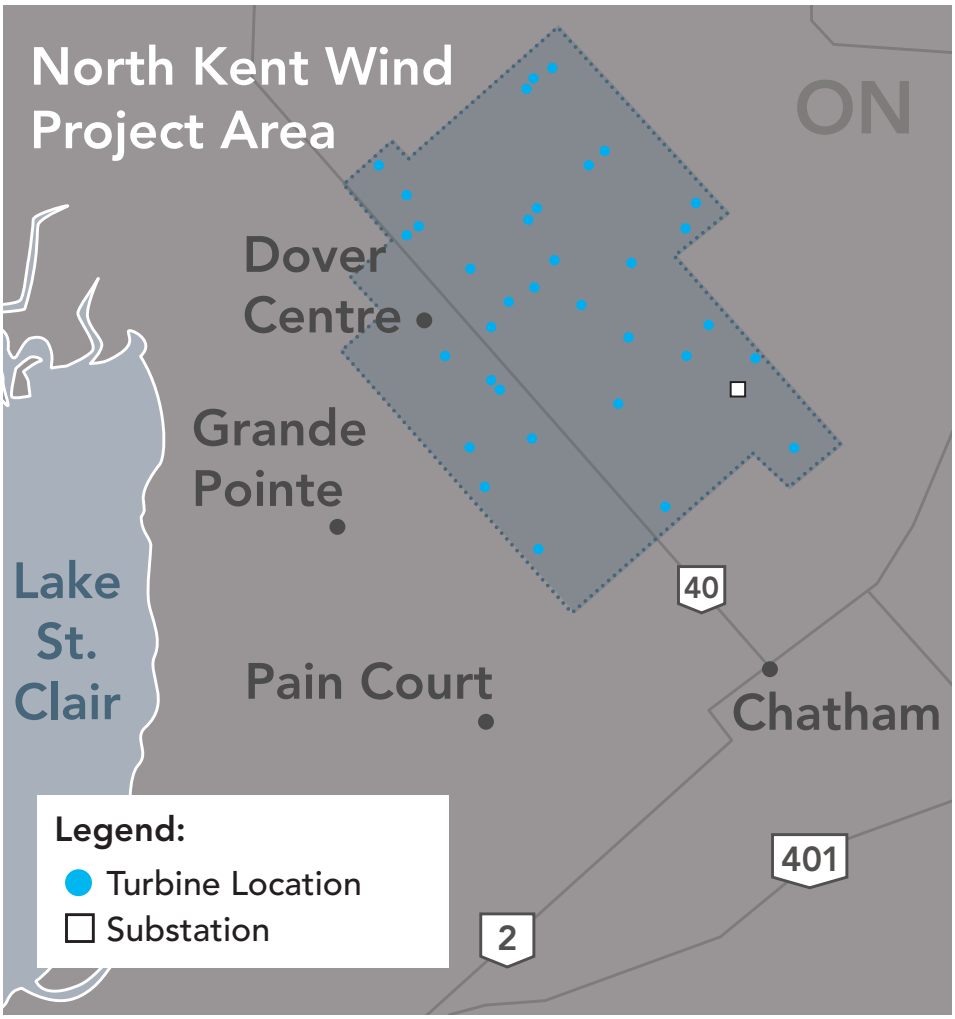
Please visit **northkentwind.com** for:

» Video summarizing the research and findings

» Interviews with the scientists and engineers

» Copies of all studies, reports, and investigation assessments

» Answers to frequently asked questions



We believe in green energy and safe water, and believe the two go hand in hand. We are confident that the scientific research is accurate and that the construction and operation of the North Kent Wind turbines has not and will not harm groundwater quality at water supply wells or in the broader subsurface groundwater environment.

- North Kent Wind Team

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