AECOM
55 Cedar Pointe Drive, Suite 620
Barrie, ON, Canada L4N 5R7
www.aecom.com

705 797 3280 tel
705 734 0764 fax

Technical Memorandum

To	North Kent 1 LP	Page	1
CC	Mark Van der Woerd (AECOM), Jody Law (Pattern), Joshua Vaidhyan (Samsung)		
Subject	**North Kent Wind 1 (Chatham-Kent, ON)** **Well Water Impact Complaint Investigation – UPDATED v.2** **[redacted] & [redacted] - PIN 007530115, [redacted]**		
From	Jason Murchison, P.Geo.		
Date	November 22nd, 2017	Project No.	60343599

1. Introduction and Background

AECOM Canada Ltd. (AECOM) has been retained by North Kent Wind 1 LP (NKW1) to provide hydrogeological services pursuant to *Condition G* of Renewable Energy Approval (REA) No. 5272-A9FHRL.

The purpose of this Technical Memorandum (TM) is to present a response to email correspondence received by NKW1 from Ms. Deb Jacobs, Environmental Officer, with the Ministry of the Environment and Climate Change (MOECC), Windsor Area Office, dated 31-August-2017. In this correspondence, Ms. Jacobs provides a summary narrative of a well interference complaint that was received by MOECC on the morning of 31-August-2017 (exact time unspecified) from [redacted] and [redacted], the property owners of [redacted] (Dresden, ON).

In brief, Ms. Jacobs describes the well interference complaint as follows:

> *Caller is complaining of visual differences (cloudy, coloured, grit) and unusual odor from her well water. Caller said they noticed on Tues Aug 29 that the water filters looked different than they have in the past. They indicate that construct activity has been going on in the vicinity of their home lately and believed the two are related.*

A copy of the MOECC correspondence described above is provided herein as **Attachment A**.

2. REA Condition Response

Table 1 provides a summary of action(s) taken pursuant to REA Condition G5 in response to the current well interference complaint.

TABLE 1: REA CONDITIONS AND RESPONSE SUMMARY

REA CONDITIONS	ACTION(S) TAKEN
G5. Should the Company receive a complaint about wells or well water from an owner of an active water well (i) within the Project Study Area; or (ii) outside of the Project Study area and located within 1 km from each individual Equipment and meteorological tower, the microwave tower, and the operations & maintenance building, the	Steps undertaken to satisfy the requirements of Condition G5 are summarized, as follows: (1) AECOM was retained by NKW1 to investigate the Well Interference Complaint received at approximately 2:15pm on 31-August-2017 following MOECC notification earlier that morning.

REA CONDITIONS	ACTION(S) TAKEN
Company shall retain a qualified expert (P.Eng or P.Geo) to immediately undertake the following: (1) collect a water well sample at the complainant's water well, prior to any treatment systems ("raw"), after allowing the distribution system to flow for approximately 5 minutes and submit the water sample to a qualified laboratory for an analysis of the general chemistry suite of water quality parameters identified in Condition G3; (2) compare the results of the analysis of the water sample noted in Condition G5(1) to the pre-construction water sampling analysis results noted in Condition G3 for the subject well (if a pre-construction water sample at the subject well was taken); and (3) provide a detailed written opinion as to whether the water sampling analysis results demonstrate that the construction, operation or decommissioning of the Facility caused or may have caused an adverse effect to the well's water supply.	(2) AECOM arranged directly with the property owners an appointment to visit the property at 1:30pm on 6-September-2017 (timeframe based on property owner availability). (3) Tasks completed by AECOM during the well interference complaint site visit included: i) interview with the property owner regarding their reported well interference issue(s); ii) collection of a raw (untreated) groundwater sample for analytical laboratory testing; and, iii) collection of digital photographs of pertinent site features (eg. water well, water treatment equipment, etc.). (4) Information obtained during the site visit has been compiled and is summarized within this technical memorandum. An opinion regarding potential association of the well interference complaint with local construction activities as part of the NKW1 Project is provided and potential remedial options are presented, as appropriate.

2.1 Property Owner Statements Regarding Well Interference Complaint

During AECOM's 6-September-2017 site visit to the subject property, a series of seven (7) standard questions were raised with the property owners ([redacted]) to obtain further details regarding their reported well water supply issue(s). The questions raised with the property owners were as detailed on *Form B: Well Complaint Procedure for Site Investigation*, included as part of the MOECC approved *Well Interference Protocol* (AECOM, 2017) for the NKW1 project.

TABLE 2: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	· Cloudy water, black sediment at bottom or reservoir tank, filter is blackish-grey. · A single 1µm cartridge filter at well and second filter (1µm) inside house. · First noticed issue a few weeks ago, filter was pulled Tuesday last week, contacted MOECC Thursday last week. · Have not been drinking / cooking with water. · Notice colour when large quantity of water is used (eg. bathing).
"What do you think is the cause?"	· Three (3) active turbine sites within view of well head where pile driving has occurred.
"When did you first notice the problem (Date/Time)?"	· Two weeks ago. · First noticed on 29-August-2017 per MOECC Correspondence.
"Is the problem still occurring?"	· Yes.
"Do you have an alternate source of potable water (i.e. municipal water)?"	· No. · David Herlufsen (Selde Corp., behalf of NKW1) is currently arranging for water to be provided.
"Were you provided a temporary supply of potable water?"	· See response to question above.

"Did you participate in the Detailed Well Assessment program prior to construction?"	· Yes.

Upon completion of the questionnaire, both of the property owners ([redacted]) were permitted an opportunity to review the responses detailed in **Table 2** and were in agreement that the information provided was accurate to the best of their knowledge.

3. Construction Activities and Vibration Monitoring

Within a two (2) week timeframe preceding the property owner's reported outset of well impact (29-August-2017), pile driving for foundation construction as part of the NKW1 project was completed at the following three (3) turbine locations:

- T3 – August 22nd & 23rd @ 2,375 m Northeast
- T4 – August 24th & 25th @ 2,790 m Northeast
- T28 – August 11th & 15th @ 6,500 m East

Approximate directions and distances away from the subject property are provided above for reference purposes.

The following turbines sites represent the nearest three (3) locations to the subject property. Up to and including the reported date of impact by the property owners, pile driving work at these locations had not yet commenced.

- T14 – 725 m Southeast
- T15 – 770 m North-Northwest
- T44 – 990 m South

Pile driving activities for foundation construction at Turbine Location #3 (T3) commenced in the area of Pile #7 at 12:16pm on 22-August-2017. Following the initial pile installation, an additional ten (10) piles at the T3 site were driven on that same day, with work concluding at the location of Pile #8 at approximately 6:54pm. Seven (7) additional piles at the T3 site were installed on the subsequent day, with the final installation at Pile #3 having been completed at 12:41pm. Restrikes (to demonstrate resistance performance) also were completed at nine (9) pile locations this same day. A replacement Pile #7A was completed on 6-September-2017, albeit approximately one (1) week following the reported outset of well interference. As noted above, the pile driving work at T3 was undertaken at a distance of more than 2.35 km (northeast) from the property owner's water well.

Pile driving activities for foundation construction at Turbine Location #4 (T4) commenced in the area of Pile #7 at 9:56am on 24-August-2017. Following the initial pile installation, an additional twelve (12) piles at the T4 site were driven on that same day, with work concluding at the location of Pile #8 at approximately 3:14pm. Five (5) additional piles at the T4 site were installed on the subsequent day, with the final installation at Pile #2 having been completed at 9:16am. As noted above, the pile driving work at T4 was undertaken at a distance of more than 2.75 km (northeast) from the property owner's water well.

Based on its distance of approximately 6.5 km (east) from the subject property, vibration monitoring relating to the installation of a pile foundation at Turbine #28 (T28) has not been considered as part of this assessment.

Monitoring of vibration effects during pile driving at T3 and T4 was completed by Golder Associates Ltd. (GAL) on behalf of NKW1 in accordance with *Condition H* of the REA. The monitoring program

developed and implemented by GAL (and as approved by MOECC) comprised the measurement of particle velocities at locations in close proximity to the piles, as well as at two (2) local private water well supplies. The local groundwater well supplies monitored during pile driving at T3 and T4 included Well 11 ([redacted]) and Well 12 ([redacted]), reportedly being located at radial distances of 1,707 m and 1,264 m from T3 and 1,424 m and 1,072 m from T4, respectively. As previously noted, the location of the water well on the subject property is positioned at a distance of more than 2.35 km from the nearest turbine location (T3). Vibration monitoring results obtained by GAL are summarized in a technical letter, dated 20-September-2017.

In addition to the foregoing, a site-specific vibration assessment pertaining to the subject property was completed by GAL, the results of which are presented in a letter, dated 21-November-2017.

A copy of each GAL letter is included herein as **Attachment B**.

Based on the vibration monitoring completed by GAL, the following interpretation and conclusions are presented within their 20-September-2017 technical letter:

> *In summary, vibration measurements obtained with the geophone system (Instantel Minimate) on all sites reported herein were within expectations as compared to those measured at the T5 and T42 test pile sites and general project expectations. On sites where piles penetrated through the near surface soils under their own weight or a low number of hammer blows (e.g., less than 5) the ground surface vibrations during this phase of pile driving for each pile were nominal. Ground surface vibrations measured when driving the piles on the glacial till or rock were also either comparable to or less than those at the test pile sites and, in all cases, were within expectations. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites and turbine to well distances.*
>
> *Well monitoring to-date has identified several wells for which the vibrations induced by the pumps dominated the instrument readings when the pumps were active or other activities dominated the measured vibrations. Relevant notes regarding various pumps, their operation and other influences on vibration measurements are described below:*
>
> ***Well 3:** Activities at the Well 3 property included crop harvesting, movement of farm vehicles and loading of haul trucks in relatively close proximity to Well 3.*
>
> ***Well 4:** Maximum well casing vibration velocities for Well 4 of about 4.8 mm/s were recorded on September 6, 2017 when a well pump was connected, operated and adjusted and the owner made frequent return visits to the well shed. Crop harvesting was also carried out as close as about 25 m from the well casing.*
>
> ***Well 6:** The pump for Well 6 is mounted in close proximity to the well casing (as illustrated on the attached Photograph 1). Maximum particle velocities of as much as 0.8 mm/s were obtained from monitoring data collected at Well 6 on July 13, 2017 when the well pump was operating during a time period without pile driving. The influences of the pump were readily discernable in the monitoring data. Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor-trailer dump truck drove by on the road near Well 6 and, at the same time, the resident was hammering in a nearby shed. Vibrations associated with the loaded dump truck were also perceptible by our well monitoring staff and registered at about 2.8 mm/s.*
>
> ***Well 9:** A piston pump for Well 9 is located within the barn adjacent to the Well 9 casing location, a total distance (inside and outside) of about 3 to 4 m. During pile driving for turbines T28 and T32, on August 11, 2017, other work was occurring near Well 9. This work included construction along the access road leading to the T32 site and included movement of heavy equipment, excavator operations, dump truck traffic, discharge of stone from delivery vehicles and other activities. This surface construction work was as close as 100 m to Well 9. Additionally, Well 9 is approximately 74*

m from Countryview Line that experiences significant traffic. Traffic included loaded construction equipment, buses, fuel tanker trucks and other vehicles. Golder conducted a separate monitoring event at this well on September 8, 2017 to measure the influence of the pump on well casing vibrations in the absence of pile driving. Maximum measured casing vibrations during this test were about 1.2 mm/s. Measurements at Well 9 on dates other than August 11, 2017 are consistent with expectations based on local traffic volumes and the potential influence of the adjacent piston pump.

***Well 10:** Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. The influence of pump operations were clearly discernable in the vibration monitoring data. The proximity of the pump and well casing are illustrated in the attached Photograph 2.*

***Well 11:** Vibrations of the casing at Well 11 were measured during water quality sampling on August 17, 2017 in the absence of pile driving at any location. When the pump was operating, a maximum vibration magnitude of 0.016 mm/s was measured at this well. The pump is located within the residence and approximately 40 m from the well.*

***Well 12:** During pile driving, Well 12 operated on a number of clearly definable occasions. Maximum vibration measurements of pump-induced well casing vibrations were as much as 2.4 mm/s. The pump for Well 12 is a piston pump mounted directly on top of the well casing as illustrated in the attached Photograph 3.*

***Well 13:** Well 13 is located approximately 87 m from the centreline of Union Line which is subjected to local truck traffic. Review of the data indicates that well pumping and non-pile driving transient sources influenced the results at this location. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.*

***Well 14:** Well 14 is located approximately 13 m from the centreline of Union Line which is subjected to local truck traffic. A limited evaluation of transient traffic vibrations indicated well casing velocities of at least 0.079 mm/s associated with this cause, though inspection of the data indicates higher values occurred outside of pile driving times. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.*

In summary, measured vibrations have been evaluated and reported as associated with driving 329 piles and replacement piles on the glacial till/rock along with restrike events and pile dynamic testing events. These measurements have been obtained at the turbine sites and at wells located at distances ranging from 580 to 4,359 m from the turbine sites. It is our opinion, based on these measurements, that the vibration magnitudes at all wells during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influence of well pumps and inconsequential for the wells.

The interpretation and conclusions above are reconfirmed by GAL within their site-specific assessment letter, dated 21-November-2017, which reads:

The well at [redacted] was farther from the pile driving than the wells that were monitored for vibrations and more than 5 km from pile driving on the day the well issues were noted as well as the previous and following day. Based on data available to-date from the test pile and construction monitoring programs, the distances between pile driving and [redacted] and the dates on which pile driving occurred, it is our opinion that the well would not have experienced pile driving-induced vibrations of any consequence at the time of the complaints and any such vibrations would have been significantly less than those summarized in Table 1. It is our opinion, based on vibration measurements and distances between pile driving and the well, that vibrations associated with pile

driving would be significantly less than may be induced by other common day-to-day sources at the well site and inconsequential for the [redacted] well.

3.1 Discussion

GAL reports that local background PPV values generally fall within the range of <0.01 to 0.07 mm/s, based on data previously collected at T5 and T42. As a basis of comparison, the particle velocity threshold for human perception is stated by GAL to be approximately 0.1 mm/s at between about 8 and 100 Hz (ISO 2631-2).

The interpretation presented by GAL within their technical letter is confirmed through a review of the vibration monitoring data summary appended thereto.

Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 11 during pile driving at T3 ranged between 0.011 and 0.066 mm/s, whereas at Well 12 PPV values ranged between 0.009 and 0.025 mm/s. During restrikes, reported PPV measurements at T3 ranged between 0.007 and 0.025 mm/s at Well 11, whereas at Well 12 the values ranged between 0.004 and 2.405 mm/s. At Well 12, when the vibration effects of well pump operation are excluded by GAL during restrikes, reported PPV values decrease significantly to between 0.006 and 0.022 mm/sec. These PPV values are interpreted to be within local background levels. Considering that the subject property is located at a distance of greater than 650 m farther away than the nearest monitored well (Well 11), it is interpreted that any vibration generated during pile driving at T3 would be fully attenuated prior to reaching the area local to the subject well.

Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 11 during pile driving at T4 ranged between 0.004 and 0.030 mm/s, whereas at Well 12 PPV values ranged between 0.004 and 2.335 mm/s. At Well 12, when the vibration effects of well pump operation are excluded by GAL during pile installation, reported PPV values decrease significantly to between 0.008 and 0.028 mm/sec. These PPV values are interpreted to be within local background levels. Considering that the subject property is located at a distance of greater than 1.35 km farther away than the nearest monitored well (Well 11), it is interpreted that any vibration generated during pile driving at T4 would be fully attenuated prior to reaching the area local to the subject well.

4. Well Construction Details

Table 3 provides a summary of pertinent construction details for a bored water well located at [redacted], based on a review of the MOECC Water Well Record (WWR) and details provided to AECOM by the property owners during our 6-September-2017 well interference complaint site visit, as well as on their completed baseline water well survey (WWS) form.

Measurement of well particulars (eg, total depth, water level, etc.) was not completed by AECOM during our 6-September-2017 site visit due to the presence of a secured Polylok lid on the well.

A photograph of the bored well is provided as **Photo 1**, having been obtained by AECOM during our 6-September-2017 site visit. Also included as **Photo 2** is a perspective image of the bored well from an on-site pumphouse (northerly) with a second drilled well shown in the foreground. According to the property owners, the drilled well was installed in 2013 and presently is not used.

A copy of the MOECC record for each of the bored well and drilled well is included hereto as **Attachment C**. Also included are copies of MOECC well records (abandonment) for two (2) other wells that previously existed on the subject property.

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	[redacted] (PIN 007530115)
MOECC Well Tag #	A186824
MOECC Well ID	7250849
Installation Date	28-September-2015
Well Location	Rear of Residence and Pumphouse
Contractor	Johnson & Baetz Well Boring Co. Ltd.
Contractor No.	7492
Construction Method	Boring
Total Depth	14.48 m / 47.5’
Target Formation	Grey Clay, Stones
Casing Length	14.48 m / 47.5’
Casing Diameter	914 mm / 36”
Casing Material	Concrete
Casing Stick-Up	0.46 m / 1.5’
Annular Seal	9.5 mm (3/8”) Bentonite Chips (0.0 m – 2.6 mBGS) Pea Stone (2.6 m – 14.48 mBGS)
Sealant Type	See Above
Well Screen Installed?	No (Open Bottom)
Well Screen Details	Not Applicable
Well Screen Interval	Not Applicable
Well Cover Type	Plastic Polylok (Screwed Down)
Pump Intake Depth	12.8 m / 42’ (as reported on WWS)
Pumping Rate	~1 L/min (0.25 USgpm) – as on WWS *Well Reported on WWR to be Dry on Completion*
Well Pump Type	Jet (as on WWS)
Well Pump Size	½ hp (as on WWS)
Static Level	4.57 mBGS / 15’ (as reported on WWS) *Well Reported on WWR to be Dry on Completion*
Pumping Level	Unknown *Well Reported on WWR to be Dry on Completion*

PHOTO 1: Site Well (as Observed by AECOM on 6-September-2017)

PHOTO 2: Bored Well with Unused Drilled Well in Foreground (as Observed by AECOM on 6-September-2017)

5. Water Quality Data

Table 4 provides a summary of available groundwater quality data for the site well. Laboratory Certificates of Analysis are included as **Attachment D**.

TABLE 4: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	13-January-2017	Raw (Untreated)	Baseline
	AECOM	6-September-2017	Raw (Untreated)	Complaint Investigation

5.1 Discussion

Available raw (untreated) groundwater sampling data for the bored well indicates the presence of relatively poor baseline groundwater quality, with elevated levels of microbial growth, total dissolved

solids, colour, and turbidity, as shown in **Table 5**. Groundwater quality data reported for the sample collected by AECOM during our 6-September-2017 site visit also is included in the table for comparative purposes.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE (13-January-2017)	COMPLAINT INVESTIGATION (6-September-2017)
Escherichia coli	0 CFU/100mL	MAC	**NDOGT**	Non Detection
Total Coliforms	0 CFU/100mL	MAC	**NDOGT**	**192 CFU/100mL**
Electrical Conductivity	--	--	1,080 µS/cm	1,060 µS/cm
pH	6.5 – 8.5	OG	8.34	8.25
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	84.2 mg/L	**150.0 mg/L**
Total Dissolved Solids	500 mg/L	AO	**574 mg/L**	470 mg/L
Total Suspended Solids	--	--	21 mg/L	<10 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	259 mg/L	295 mg/L
Fluoride	1.5	MAC	0.71 mg/L	0.65 mg/L
Chloride	250	AO	191 mg/L	148 mg/L
Nitrate as N	10	MAC	<0.05 mg/L	<0.05 mg/L
Nitrite as N	1	MAC	<0.05 mg/L	<0.05 mg/L
Bromide	--	--	0.84 mg/L	0.53 mg/L
Sulphate	500 mg/L	AO	10.9 mg/L	12.2 mg/L
Ammonia as N	--	--	0.11 mg/L	0.33 mg/L
Dissolved Organic Carbon	5 mg/L	AO	3.4 mg/L	4.5 mg/L
Colour	5 TCU	AO	**27 TCU**	**46 TCU**
Turbidity	5 NTU	AO	**7.2 NTU**	2.4 NTU
Calcium	--	--	13.1 mg/L	27.9 mg/L
Magnesium	--	--	12.5 mg/L	19.6 mg/L
Sodium	200 mg/L	AO	190 mg/L	155 mg/L
Potassium	--	--	12.1 mg/L	11.2 mg/L
Iron	0.300 mg/L	AO	0.137 mg/L	0.134 mg/L
Manganese	0.050 mg/L	AO	0.004 mg/L	0.005 mg/L

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); Operational Guideline (non health-related); NDOGT – No Data, overgrown with Target (refers to overcrowding of microbial growth)

At the time of AECOM's complaint investigation site visit on 6-September-2017, water treatment at the subject property comprised a T-Style filter housing followed immediately by a standard 508 mm (20") bowl length cartridge filter housing (blue) installed within a pumphouse located to the rear of the residence. At the time of our site visit, the filter element within the T-Style housing had previously been removed by the property owner to facilitate raw (untreated) groundwater sampling and its type / pore size was not confirmed. This said, it is surmised that the element likely was either a "spin-out" type sand separator or steel mesh filter (15 µm minimum pore size according to manufacturer). The filter cartridge within the standard 508 mm (20") long housing was a string wound polypropylene type with a pore diameter of 1 µm (as reported by [redacted]). According to the property owners, a

second 1 µm pore diameter string wound polypropylene type cartridge filter also is installed within the residence, albeit at a shorter 254 mm (10") bowl length.

The location of sampling for AECOM's 6-September-2017 well interference complaint investigation was within the pumphouse. Specifically, the sample was obtained via a drain faucet installed at the base of the T-Style filter housing; the filter element having been previously removed by property owner, as noted above. Prior to sample collection, the faucet orifice was disinfected and permitted to flush a total volume of approximately 95 L (5 x 5 USgal pails). This methodology was consistent with that employed by MOECC staff earlier the same day for their collection of a raw (untreated) groundwater sample from the bored well. The collected groundwater sample was maintained on ice within a cooler and was delivered directly to the selected laboratory (AGAT Laboratories) under chain of custody documentation within five (5) hours of collection.

Laboratory analysis results for the complaint investigation sampling event indicate a hardness level that was elevated (hard) in the raw (untreated) groundwater and above the Ontario Drinking Water Quality Standard (ODWQS) Operational Guideline (OG) range of 80-100 mg/L. This owes to the presence of moderately greater concentrations of calcium and magnesium within the groundwater. Elevated hardness levels within a water, on heating, can result in the formation of scale deposits which can accumulate and restrict water flow in pipes, appliances, and other metallic fixtures and components. As a basis of comparison, water hardness in the baseline sample result was within the ODWQS OG range.

With the notable exception of Escherichia coli and Total Coliforms in the 13-January-2017 baseline sample and Total Coliforms in the 6-September-2017 complaint investigation sample, no other exceedances of health-related parameters analyzed, including Nitrate (as N), Nitrite (as N), and fluoride, were detected in either raw groundwater sample collected from the bored well supply. Although not in exceedance of ODWQS limits, fluoride is noted to be somewhat elevated in both the baseline and complaint investigation sample results.

Turbidity is an Aesthetic Objective (AO) of the ODWQS. In this regard, a value of 5 Nephelometric Turbidity Units (NTU) has been established by MOECC. The MOECC's *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* (June 2003; revised June 2006) makes a clear distinction between turbidity related to organic constituents and inorganic constituents stating: "Raw water supply which is ground water with very low organic content may contain inorganic-based turbidity, which may not seriously hinder disinfection. For such waters, an Operational Guideline for turbidity is not established". Further guidance is provided by MOECC regarding the relationship between turbidity and its organic and inorganic components, the disinfection processes, and as a measure of the water supply filtration and treatment efficiency. The technical explanations also note that while organic turbidity is an important measure as related to health concerns, the AO value is an aesthetic component which is set for all waters at the point of consumption (i.e., not at the source). At the bored well, turbidity levels were 7.2 NTU in the baseline sample and 2.4 NTU in the complaint investigation sample results. Whereas the baseline testing result was above ODWQS limits, the most recent sampling indicated a level of turbidity that was within ODWQS limits.

The potential for groundwater quality impacts associated with pile driving is both time-dependent and related to the intensity and propagation of ground-borne vibration. In the case of piling associated with T3 and T4 within two (2) weeks prior to the reported outset of well impacts (29-August-2017), no significant vibrations attributed to pile driving were detected at either Well 11 or Well 12, as discussed previously in **Section 3**.

According to questionnaire responses provided by the property owners (**Table 2**) during our recent well interference complaint site visit and information provided to MOECC as part of their original

complaint submission, the outset of water quality issues was first detected on 29-August-2017, approximately six (6) days following the completion of pile driving at T3 and four (4) days following the completion of pile driving at T4. During active pile driving at each of T3 and T4 between 22-August-2015 and 25-August-2017, minimal daily PPV values were detected by GAL based on their monitoring in close proximity to the individual pile locations, as well as at Well 11 and Well 12. Based on GAL's monitoring data and considering the separation distance which exists between T3 / T4 and the site well (ie. >2.35 km), the suspension of particles within or in its immediate vicinity is not considered plausible.

As an alternate consideration, to have the potential to impact the subject well vibration impacts in the immediate vicinity of pile driving at T3 and/or T4 would have needed to result in: i) the suspension of settled particles within the groundwater system; ii) the particles remaining in suspension for a prolonged period of time; and, iii) the water well being situated in a position hydraulically downgradient of and/or within the radius of pumping influence relative to the location of T3 / T4. Factors (ii) and (iii) above are not considered plausible in the context of the local hydrogeological setting (ie. potential hydraulic gradient and groundwater travel times), vibration monitoring data collected by GAL, construction type for the subject well (bored), reported aquifer yield (~1 L/min), and reported timeline of outset of impact(s) at the site well.

6. Conclusions

Based on a review and interpretation of information gathered during AECOM's well interference complaint investigation, as presented herein, it is our opinion that the groundwater quality issue reported by the property owners at [redacted] (PIN 007530115) is *not* as a result of NKW1 turbine foundation construction or pile-driving activities. No indication of water quality impact at the site well was apparent based on our recent sampling works relative to baseline data collected prior to the outset of construction.

No pile driving work was being completed as part of the NKW1 construction activities within a radial distance of 2.35 km from the on-site bored well within a period of two (2) weeks prior to the reported outset of water quality concerns that could have represented a potential mechanism of impact. With respect to the pile driving works completed at T3 and T4, monitoring data provided by GAL and presented in this report indicates that full attenuation of residual ground vibration would have occurred prior to reaching the site well.

This interpretation and opinions presented in this technical memorandum are based on information available as of the date the document was prepared. Should additional information become available at a future date, AECOM reserves the right to review and potentially reconsider the findings of our current assessment through the issuance of addenda to this technical memorandum.

-- *End of Memorandum* --

Attachments

Attachment A

Correspondence

From: Jacobs, Deb (MOECC) [mailto:deb.jacobs@ontario.ca]
Sent: Thursday, August 31, 2017 11:07 AM
To: zzJoshua Vaidhyan; Jody Law; mark.vanderwoerd@aecom.com
Cc: Gilbert, Teri (MOECC); Smith, Mark (MOECC); Moroney, Michael (MOECC); Harman, Bruce (MOECC); Keyvani, Mohsen (MOECC); Lehouillier, Jason (MOECC); McDonald, Dan (MOECC); Colella, Nick (MOECC); Moroney, Michael (MOECC); Schofield, Carine (MOECC)
Subject: New water well complaint - [redacted]
Importance: High

Josh / Jody

The Ministry received a complaint today from:

[redacted], RR5 Dresden

Caller is complaining of visual differences (cloudy, coloured, grit) and unusual odor from her well water. Caller said they noticed on Tues Aug 29 that the water filters looked different than they have in the past. They indicate that construct activity has been going on in the vicinity of their home lately and believed the two are related.

I have been given permission pass on the complainant's name and number to you.

It is the Ministry's expectation that you will initiate the complaint response procedure as per G5 of your ECA forthwith. The Ministry also expects that you will keep up informed in a timely manner of all developments and findings related to this complaint.

At your earliest convenience, please provide us with a map and schedule of your construction activities, including pile driving, in the vicinity of the complainant's location, as you have with the previous complaints.

Thank you

Deb Jacobs
Environmental Officer / Agente de l'environnement
Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique
Windsor Area Office / Bureau du Secteur de Windsor
4510 Rhodes Drive, Unit(è) 620
Windsor, Ontario
N8W 5K5
Telephone: 519-948-4148
Fax / Télécopieur: 519-948-2396
E-Mail /Courriel: deb.jacobs@ontario.ca

AECOM

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

November 21, 2017 Project No. 1668031-2000-L14R

Mr. Jody Law
c/o North Kent Wind 1 LP
355 Adelaide Street West, Suite 1000
Toronto, ON M5V 1S2

WATER WELL COMPLAINT 6
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Law:

This letter is provided to summarize vibration monitoring data associated with Well Complaint 6 dated August 31 and September 27, 2017 related to the well located at [redacted] in Dresden, Ontario. For the purposes of this letter, vibration data is summarized for the period starting one day prior to the first reported issues, August 29, 2017, through to one day following the date of the reported well condition complaint.

A table is attached summarizing the following data:

1) date of pile driving;

2) turbine site at which pile driving was undertaken and the number of piles driven on the identified date;

3) maximum measured particle velocities at three locations:

    a. at the turbine site; and

    b. at the two wells within the turbine cluster specified for monitoring where the distance from the turbine site to the monitored well is also shown;

    where these tabulated measurements specifically exclude vibrations directly associated with the well pumps (described below) but include vibrations attributable to other general sources such as nearby road and utility construction, nearby road car and truck traffic and movements of farm equipment as examples, and the distances from the pile driving to the well monitoring locations;

4) notes specific to the monitoring data; and

5) the distance from the pile driving to the well for which the complaint was submitted.

Golder Associates Ltd.
309 Exeter Road, Unit #1, London, Ontario, Canada N6L 1C1
Tel: +1 (519) 652 0099 Fax: +1 (519) 652 6299 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Pile driving of the closed-end pipe piles was completed in accordance with the Project foundation design using equipment with a driving hammer with a rated energy no greater than the hammer used during the test pile vibration monitoring. During pile driving, the times during which the pile was being actively struck by the hammer were recorded from the start of hammering to conclusion of hammering. Further, the times during which the pile was driven on glacial till/rock were recorded based on observations of the pile driving conditions. It should be noted that very little energy was required during initial pile penetration since piles penetrated significant depths into the soft clay soil under their own weight or with very few hammer blows. Table 1 summarizes the numbers of individual piles driven at each turbine location on the noted dates, the distances from the turbine locations and monitored wells, and distances of pile driving to the well for which the complaint was reported.

Vibrations at the turbine sites were monitored using portable construction vibration monitoring geophone devices common to construction monitoring and in accordance with the approved monitoring work plan. Vibrations at the well locations were monitored using three accelerometers mounted to the steel well casings and a portable data collection system in accordance with the approved monitoring plan. Monitoring of the well casings and pile driving sites was completed continuously during driving of all piles relevant to this letter, with the exception of monitoring at Well 11 during driving of piles 1 through 3, 5 and 6 for turbine T46 and piles 5 through 8 for turbine T21 during this same time period on August 29, 2017 due to an overheating battery in the data logger. Well 11 data were fully recorded during all other pile driving and pile restrikes at T46 on August 29, 2017. A similar battery problem occurred for Well 12 on August 30, 2017 during driving of piles 6 through 9 for turbine T20. Well 11 and Well 12 data were fully recorded during all other pile driving and restrikes at turbines T20 and T21. All monitoring instruments were calibrated at the manufacturer or manufacturer-approved facility prior to use by Golder. All such calibrations were conducted on a schedule as required according to the manufacturer or instrument supplier. Field verification of accelerometer calibration was completed with a portable controlled vibration source before and after each time the accelerometers were installed on well casings. Accelerometer responses during field verification remained within required tolerances.

Following pile driving, data was downloaded from all devices, stored electronically, vibration magnitudes were assessed, compared to pile driving records and observations at the well sites and summarized. Assessment of vibrations included examination of time histories of data with a specific focus on comparing observation of vibration energy sources such as pile driving, well pumps and nearby farm and roadway vehicle traffic. Analysis of accelerometer data was completed using the methods defined in the test pile vibration monitoring program (June, 2017). Evaluation of data was completed in Golder's London, Ontario office.

The well at the property for which the complaint was reported is located in the rear yard of the residence. The MOECC well record (well identification number 7250849, well tag number A186824) indicates that this is a bored well, constructed in 2015, with a 0.92 m diameter concrete casing installed in a 1.2 m diameter hole to the bottom depth of about 14.48 m. The well was terminated in materials described as grey clay and stones on the well record. The pumping test for this well was completed when the water within the well was exhausted (dry). Water well records 7216292, indicated a well on this property drilled in 2013, approximately 4.7 m into the Kettle Point Formation shale to a total depth of about 18.9 m. This well produced water with a "slight haze" and a pumping rate of about 1 litre per minute was recommended by the driller. The MOECC records 7216293 and 7216295 indicate abandonment of two well at this property in 2013. The reasons for abandonment are unknown.

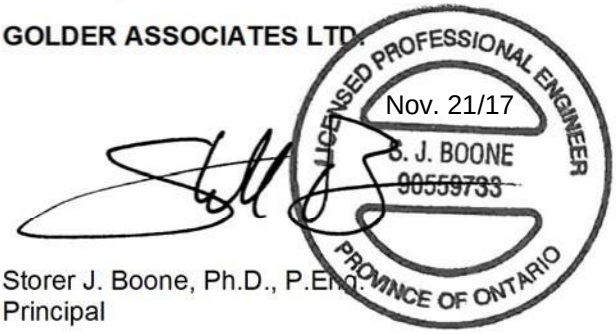
The well at [redacted] was farther from the pile driving than the wells that were monitored for vibrations and more than 5 km from pile driving on the day the well issues were noted as well as the previous and following day. Based on data available to-date from the test pile and construction monitoring programs, the distances between pile driving and [redacted] and the dates on which pile driving occurred, it is our opinion that the well would not have experienced pile driving-induced vibrations of any consequence at the time of the complaints and any

such vibrations would have been significantly less than those summarized in Table 1. It is our opinion, based on vibration measurements and distances between pile driving and the well, that vibrations associated with pile driving would be significantly less than may be induced by other common day-to-day sources at the well site and inconsequential for the [redacted] well.

We trust that this letter is adequate for your present requirements. If any point requires further clarification, please contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.



Storer J. Boone, Ph.D., P.Eng.
Principal

SJB/MEB/cr

CC: J. Vaidyan, Samsung

Attachments: Table 1 - Summary of Vibration Monitoring Data, Well Complaint 6

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Table 1: Summary of Vibration Monitoring Data, Well Complaint 6[1]

Date	Turbine and Piles[4]	Measured Maximum Particle Velocities During Pile Driving, Inclusive of Traffic and Other Activities, Exclusive of Pump-Induced Vibrations (mm/s)[2]				Distance from Well Complaint Residence (m)
		Turbine Site	Monitored Well (Well No., distance)	Monitored Well (Well No., distance)	Other Notes[3]	
Complaint 6 August 29, 2017						
8/28/2017	T21 (8)	3.30	0.015 (W11, 3,960 m)	0.071 (W12, 4,161 m)		6,207
8/28/2017	T46 (11)	7.85	0.021 (W11, 1,697 m)	0.071 (W12, 2,170 m)		5,230
8/29/2017	T21 (10)	2.79	0.009 (W11, 3,960 m)	0.031 (W12, 4,161 m)		6,207
8/29/2017	T46 (7)	5.80	0.005 (W11, 1,697 m)	0.052 (W12, 2,170 m)	Three pile restrikes on this day.	5,230
8/30/2017	T20 (18)	5.33	0.046 (W11, 3,800 m)	0.025 (W12, 3,962 m)		5,891

NOTES:
1) Table shall be read in conjunction with accompanying letter.
2) Other activities included nearby car and truck traffic on adjacent road, vehicle and farm equipment travel on the well property, etc.
3) See letter text for additional discussion of pump and other influences.
4) Number of piles driven on specified date shown in parentheses.

September 20, 2017 Project No. 1668031-2000-L06

Mr. Jody Law
c/o North Kent Wind 1 LP
355 Adelaide Street West, Suite 1000
Toronto, ON M5V 1S2

SUMMARY OF VIBRATION MONITORING
FOUNDATION PILE DRIVING – MULTIPLE TURBINES
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Law:

Please find attached a summary of the vibration monitoring that has been undertaken during driving of foundation piles for turbines being constructed as part of the North Kent Wind 1 project (NK1) at the locations listed in Table 1 (following the text of this letter) through to September 12, 2017, exclusive of data for Turbines T26 and T27 as these are still being processed and analyzed. Vibration monitoring was carried out to meet Section H1 of the Renewable Energy Approval (REA) document issued by the Ontario Ministry of the Environment and Climate Change (MOECC). The work was carried out in accordance with a vibration monitoring program prepared by Golder Associates Ltd. (Golder) dated June 2, 2017 and subsequently approved by MOECC and issued June 9, 2017.

This report addresses vibration monitoring data obtained during pile foundation driving at the turbine sites and domestic water well pairs listed in Table 1, attached, as defined by the times and dates for pile driving within the seven geographic turbine clusters. The locations of the turbines and associated wells are illustrated on the attached figures. The attached pages of summary data and notes include particle velocity measurements made at the referenced sites that were taken in close proximity to the pile driving together with measurements obtained at domestic water well casings associated with the relevant turbine clusters. Previously issued summary pages have been updated to reflect changes, if and as applicable, related to:

- detailed review of Instantel Minimate data histogram files for the turbine sites;
- well and turbine site vibration monitoring data associated with pile dynamic analyser testing, subsequent pile restrikes or replacements;
- monitoring of vibrations during well pump operating periods in the absence of pile driving;

- examination of vibration data associated with background conditions, other transient vibration sources (e.g., road traffic, movement of farm equipment, pump maintenance) and/or time durations during which pile driving was not actively in progress;
- clarifications or additions to pile driving monitoring notes; and
- typographical/clerical corrections, if and as needed.

The vibration measurements as reported on the attached pages are considered finalized for the analysis time periods, stated conditions and the context of this report. Golder reserves the right to update reports for the various turbine sites and wells as additional information becomes available and to address any of the items noted above. In particular, additional evaluation of turbine site geophone data is anticipated whereby actual off-set distances and vibration measurements at specific piles and times of day may be updated rather than the current listing of daily maximum measurements. A finalized report will be issued after the conclusion of all pile driving for this project.

Monitoring Work Plan

Vibration monitoring was carried out in accordance with the June 2, 2017 work plan submitted to and approved by the MOECC and reissued on June 9, 2017. In summary, key elements of the work plan include:

- Pile driving at the turbine sites is visually monitored by a Golder staff member who keeps notes regarding start and stop times of active pile hammering, monitoring data logging and instrument status and other site conditions as relevant to the pile driving. Ground surface vibrations at each turbine site are being monitored with two Instantel Minimate Pro III or Pro IV systems. Two systems are being utilized to allow periodic downloading of data so that vibrations, if any, could then be captured by the other redundant system. The geophone systems captured vibration velocities in three mutually perpendicular directions. One direction was vertical and the longitudinal direction was oriented toward the closest pile with the third (transverse) direction being determined by the other two.
- Three accelerometers are being securely coupled to the monitored well casings for which permissions to enter and carry out monitoring have been obtained. The accelerometers are oriented in three mutually perpendicular directions. One direction is vertical and the longitudinal direction is oriented toward the closest pile driving operation, with the third (transverse) direction being determined by the other two. Golder personnel monitor the instrument status and any other relevant activities around the wells such as local road traffic, movements of farm equipment, traffic in and out of the well properties, other construction activities (if any) and well pump operations or maintenance.

Overview of Pile Driving Conditions and Monitoring Notes

Pile driving at the turbine sites was conducted after constructing an access road, stripping topsoil, excavating to approximately 2.6 m below the ground surface and placing a concrete working pad. The concrete working pads have been fitted with pre-formed openings for the piles or constructed to a smaller diameter with the piles driven just beyond the outer perimeter of the concrete. Pile driving cranes were operated on timber mats placed on the concrete. Typically, piles were driven with the same hammer type as used for the pre-construction test pile and vibration monitoring program. In one case, a different hammer was used with a significantly lower driving energy. Subsequent use of this hammer has been rejected by the constructor.

On the attached monitoring reports, three times are reported for each driven pile. The column heading “Start” refers to the time of day when the pile hammering commenced on the indicated pile. Times of other site activities, such as crane movements, welding, equipment start-up and other work occurring prior to start of active pile hammering were not recorded except in specific instances where the turbine site geophones were inadvertently influenced by other equipment operating too closely. The column heading “Rock/Till” indicates the time at which hard driving started, as evidenced by the rate of pile depth change as compared to the numbers of hammer strikes on the pile. Commonly, the piles penetrated the first few metres of ground under their own weight, with nominal pile driving effort required until the underlying glacial till and/or rock was encountered. In many cases, the pile driving resistance in the upper soil layers was insufficient to engage the firing mechanism in the diesel hammer. Upon reaching the glacial till, the pile hammer fully engaged for the remainder of driving. The column heading “End” indicates the time of day at which active pile hammering ceased for the identified pile. While the total pile driving duration can be determined by the difference between the “Start” and “End” times, the duration of active pile hammering was frequently interrupted by pile splicing, welding, equipment repair, decision-making required for pile termination depths, pile testing and daily labour breaks. Many of these start and stop instances are identified on the attached summary pages.

Summary of Results

In summary, vibration measurements obtained with the geophone system (Instantel Minimate) on all sites reported herein were within expectations as compared to those measured at the T5 and T42 test pile sites and general project expectations. On sites where piles penetrated through the near-surface soils under their own weight or a low number of hammer blows (e.g., less than 5) the ground surface vibrations during this phase of pile driving for each pile were nominal. Ground surface vibrations measured when driving the piles on the glacial till or rock were also either comparable to or less than those at the test pile sites and, in all cases, were within expectations. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites and turbine to well distances.

Well monitoring to-date has identified several wells for which the vibrations induced by the pumps dominated the instrument readings when the pumps were active or other activities dominated the measured vibrations. Relevant notes regarding various pumps, their operation and other influences on vibration measurements are described below:

- **Well 3:** Activities at the Well 3 property included crop harvesting, movement of farm vehicles and loading of haul trucks in relatively close proximity to Well 3.
- **Well 4:** Maximum well casing vibration velocities for Well 4 of about 4.8 mm/s were recorded on September 6, 2017 when a well pump was connected, operated and adjusted and the owner made frequent return visits to the well shed. Crop harvesting was also carried out as close as about 25 m from the well casing.
- **Well 6:** The pump for Well 6 is mounted in close proximity to the well casing (as illustrated on the attached Photograph 1). Maximum particle velocities of as much as 0.8 mm/s were obtained from monitoring data collected at Well 6 on July 13, 2017 when the well pump was operating during a time period without pile driving. The influences of the pump were readily discernable in the monitoring data. Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor-trailer dump truck drove by on the road near Well 6 and, at the same time, the resident was hammering in a nearby shed. Vibrations associated with the loaded dump truck were also perceptible by our well monitoring staff and registered at about 2.8 mm/s.

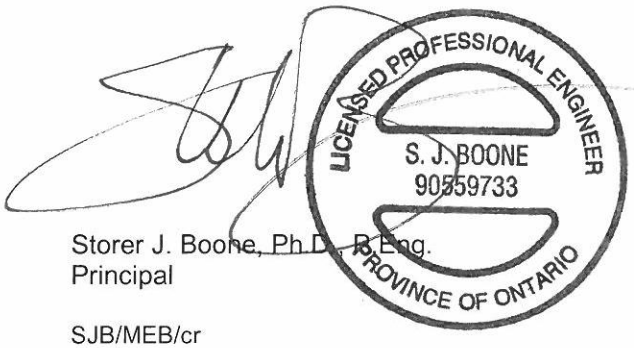
- **Well 9:** A piston pump for Well 9 is located within the barn adjacent to the Well 9 casing location, a total distance (inside and outside) of about 3 to 4 m. During pile driving for turbines T28 and T32, on August 11, 2017, other work was occurring near Well 9. This work included construction along the access road leading to the T32 site and included movement of heavy equipment, excavator operations, dump truck traffic, discharge of stone from delivery vehicles and other activities. This surface construction work was as close as 100 m to Well 9. Additionally, Well 9 is approximately 74 m from Countryview Line that experiences significant traffic. Traffic included loaded construction equipment, buses, fuel tanker trucks and other vehicles. Golder conducted a separate monitoring event at this well on September 8, 2017 to measure the influence of the pump on well casing vibrations in the absence of pile driving. Maximum measured casing vibrations during this test were about 1.2 mm/s. Measurements at Well 9 on dates other than August 11, 2017 are consistent with expectations based on local traffic volumes and the potential influence of the adjacent piston pump.
- **Well 10:** Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. The influence of pump operations were clearly discernable in the vibration monitoring data. The proximity of the pump and well casing are illustrated in the attached Photograph 2.
- **Well 11:** Vibrations of the casing at Well 11 were measured during water quality sampling on August 17, 2017 in the absence of pile driving at any location. When the pump was operating, a maximum vibration magnitude of 0.016 mm/s was measured at this well. The pump is located within the residence and approximately 40 m from the well.
- **Well 12:** During pile driving, Well 12 operated on a number of clearly definable occasions. Maximum vibration measurements of pump-induced well casing vibrations were as much as 2.4 mm/s. The pump for Well 12 is a piston pump mounted directly on top of the well casing as illustrated in the attached Photograph 3.
- **Well 13:** Well 13 is located approximately 87 m from the centreline of Union Line which is subjected to local truck traffic. Review of the data indicates that well pumping and non-pile driving transient sources influenced the results at this location. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.
- **Well 14:** Well 14 is located approximately 13 m from the centreline of Union Line which is subjected to local truck traffic. A limited evaluation of transient traffic vibrations indicated well casing velocities of at least 0.079 mm/s associated with this cause, though inspection of the data indicates higher values occurred outside of pile driving times. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.

In summary, measured vibrations have been evaluated and reported as associated with driving 329 piles and replacement piles on the glacial till/rock along with restrike events and pile dynamic testing events. These measurements have been obtained at the turbine sites and at wells located at distances ranging from 580 to 4,359 m from the turbine sites. It is our opinion, based on these measurements, that the vibration magnitudes at all wells during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influence of well pumps and inconsequential for the wells.

We trust that this letter is adequate for your present requirements. If any point requires further clarification, please contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.



Storer J. Boone, Ph.D., P.Eng.
Principal

SJB/MEB/cr

Attachments: Table 1 - Vibration Measurement Locations
Photographs of Wells 6, 10 and 12 Pump Configurations
Preliminary Vibration Monitoring Summaries and Figures, Turbines T3, T4, T6, T7, T12, T14, T20, T21, T28, T30, T31, T32, T33, T35, T36, T43, T45 and T46

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TABLE 1 – VIBRATION MEASUREMENT LOCATIONS

Turbine	Well	Well
Turbine Cluster 1		
T12	5 [redacted]	6 [redacted]
T35		
T36		
Turbine Cluster 2		
T6	7 [redacted]	8 [redacted]
T7		
T31		
Turbine Cluster 3		
T28	9 ([redacted])	10 ([redacted])
T30		
T32		
Turbine Cluster 4		
T3	11 [redacted])	12 [redacted]
T4		
T20		
T21		
T43		
T45		
T46		
Turbine Cluster 5		
T33	3 ([redacted])	4 ([redacted]
Turbine Cluster 6		
T14	13 ([redacted]	14 ([redacted])
T26		
T27		
Turbine Cluster 7		
No construction pile driving to date of this report	1A ([redacted])	2 ([redacted])

Note: Table to be read in conjunction with accompanying text.

Prepared By: SJB

Checked By: DB

SITE PHOTOGRAPHS

Photograph 1: Well 6 illustrating proximity of pump, hoses and tank to well casing.

Photograph 2: Well 10 illustrating proximity of pump, hoses and tank to well casing.

Photograph 3: Well 12 illustrating pump mounted directly on well casing.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T3

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/23/2017 10:01	8/23/2017 10:10	8/23/2017 10:11	21.6	7.27	NA[e]	0.021	
2	8/23/2017 11:29	8/23/2017 11:35	8/23/2017 12:35	23.2	7.27	0.011	0.003	
3	8/23/2017 11:46	8/23/2017 11:56	8/23/2017 12:41	24.2	7.27	0.024	0.013	
4	8/23/2017 12:12	8/23/2017 12:19	8/23/2017 12:21	24.5	7.27	0.014	0.010	
5	8/23/2017 9:43	8/23/2017 9:49	8/23/2017 9:52	24.2	7.27	NA[e]	0.010	
6	8/23/2017 9:28	8/23/2017 9:35	8/23/2017 9:35	23.2	7.27	NA[e]	0.004	
7	8/22/2017 12:16	8/22/2017 12:22	8/22/2017 12:57	21.6	8.26	0.015	0.016	
8	8/22/2017 18:43	8/22/2017 18:49	8/22/2017 18:54	19.4	8.26	0.013	0.004	
9	8/22/2017 16:52	8/22/2017 16:58	8/22/2017 17:00	16.8	8.26	0.018	0.011	
10	8/22/2017 18:19	8/22/2017 18:27	8/22/2017 18:32	13.9	8.26	0.014	0.008	
11	8/22/2017 16:34	8/22/2017 16:40	8/22/2017 16:45	11.0	8.26	0.022	0.025	
12	8/22/2017 17:48	8/22/2017 17:57	8/22/2017 18:08	8.7	8.26	0.011	0.003	
13	8/22/2017 16:08	8/22/2017 16:16	8/22/2017 16:18	7.7	8.26	0.007	0.029	
14	8/22/2017 17:29	8/22/2017 17:38	8/22/2017 17:39	8.7	8.26	0.012	0.013	
15	8/22/2017 14:27	8/22/2017 14:33	8/22/2017 15:41	11.0	8.26	0.066	0.008	
16	8/22/2017 17:13	8/22/2017 17:20	8/22/2017 17:20	13.9	8.26	0.026	0.005	
17	8/22/2017 13:14	8/22/2017 13:22	8/22/2017 15:48	16.8	8.26	0.046	0.008	
18	8/23/2017 11:05	8/23/2017 11:12	8/23/2017 11:16	19.4	7.27	0.018	0.014	
Restrikes								
7C	8/23/2017 18:27	8/23/2017 18:27	8/23/2017 18:31	21.6	7.27	0.023	1.354	0.022
8C	8/23/2017 8:14	8/23/2017 8:14	8/23/2017 8:14	19.4	7.27	0.010	0.004	
11C	8/23/2017 8:18	8/23/2017 8:18	8/23/2017 8:18	11.0	7.27	0.009	2.405	0.006
12C	8/23/2017 8:22	8/23/2017 8:22	8/23/2017 8:22	8.7	7.27	0.009	2.405	0.006
13C	8/23/2017 8:25	8/23/2017 8:26	8/23/2017 8:26	7.7	7.27	0.009	0.007	
14C	8/23/2017 8:28	8/23/2017 8:28	8/23/2017 8:28	8.7	7.27	0.007	0.007	
16C	8/23/2017 8:31	8/23/2017 8:31	8/23/2017 8:32	13.9	7.27	0.007	0.007	
17C	8/23/2017 8:34	8/23/2017 8:34	8/23/2017 8:34	16.8	7.27	0.007	0.007	
6	8/23/2017 12:14	8/23/2017 12:15	8/23/2017 12:15	23.2	7.27	0.025	0.023	
Replacement Piles								
7A	9/6/2017 12:05	9/6/2017 12:14	9/6/2017 12:19	20.6	1.99	0.033	0.005	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 1707 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1264 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Continued pile driving on subsequent days are marked "C". Replacement piles are marked "A". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and this pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 5 and 6 at Well 11 on August 23, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Driving/restriking of some piles occured in relatively rapid succession and, therefore, in some cases the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 2(6:42), 3(5:13), 7(8:45), 12(7:08), 15(1:20), 17(1:42). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Preliminary Vibration Monitoring Report

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T4

Vibration Measurements at Turbine Site						Vibration Measurements at Wells		
Pile Driving Times and Dates					Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/25/2017 8:00	8/25/2017 8:08	8/25/2017 8:09	23.9	2.54	0.004	0.006	
2	8/25/2017 8:30	8/25/2017 9:15	8/25/2017 9:16	25.6	2.54	0.006	2.335	0.008
3	8/25/2017 9:03	8/25/2017 9:09	8/25/2017 9:10	26.6	2.54	0.007	2.335	0.008
4	8/25/2017 8:47	8/25/2017 8:56	8/25/2017 8:57	27.0	2.54	0.005	0.011	
5	8/25/2017 8:15	8/25/2017 8:22	8/25/2017 8:23	26.6	2.54	0.028	0.018	
6	8/24/2017 13:01	8/24/2017 13:10	8/24/2017 13:11	25.6	4.32	0.011	0.056	
7	8/24/2017 9:56	8/24/2017 10:04	8/24/2017 10:51	23.9	4.32	0.018	1.511	0.024
8	8/24/2017 13:19	8/24/2017 15:13	8/24/2017 15:14	21.6	4.32	0.024	1.777	0.014
9	8/24/2017 10:56	8/24/2017 11:04	8/24/2017 11:04	19.0	4.32	0.006	0.004	
10	8/24/2017 13:35	8/24/2017 13:45	8/24/2017 13:45	16.1	4.32	0.006	0.018	
11	8/24/2017 11:10	8/24/2017 11:18	8/24/2017 11:18	13.2	4.32	0.013	0.026	
12	8/24/2017 13:52	8/24/2017 15:09	8/24/2017 15:10	11.0	4.32	0.024	1.777	0.014
13	8/24/2017 11:23	8/24/2017 11:32	8/24/2017 11:33	10.1	4.32	0.009	0.009	
14	8/24/2017 14:07	8/24/2017 14:17	8/24/2017 14:17	11.0	4.32	0.007	0.006	
15	8/24/2017 11:38	8/24/2017 15:03	8/24/2017 15:04	13.2	4.32	0.009	1.374	0.028
16	8/24/2017 14:24	8/24/2017 14:33	8/24/2017 15:01	16.1	4.32	0.009	1.374	0.028
17	8/24/2017 12:46	8/24/2017 14:55	8/24/2017 14:56	19.0	4.32	0.030	1.374	0.028
18	8/24/2017 14:40	8/24/2017 14:52	8/24/2017 14:52	21.6	4.32	0.030	0.029	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 1424 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1072 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and this pump was mounted on the well casing. During pile driving on August 24, 2017, the maximum vibration measurement of the Well 12 casing was 1.777 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving of some piles was paused while the tip was in the upper soil deposits and subsequently driven to the glacial till/rock later in the day. In these instances, the hard driving conditions for different piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 2(7:33), 7(1:32), 8(0:53), 12(1:10), 15(1:15), 16(1:02), 17(1:31). Total driving durations derived from start and end times noted above include labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T6

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells	
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 7	Well 8
1	7/31/2017 11:25	7/31/2017 11:28	7/31/2017 11:32	27.0	4.57	0.068	0.049
2	7/31/2017 12:20	7/31/2017 12:26	7/31/2017 12:28	26.6	4.57	0.044	0.032
3	7/31/2017 12:37	7/31/2017 12:41	7/31/2017 12:46	25.6	4.57	0.018	0.028
4	7/31/2017 13:35	7/31/2017 13:40	7/31/2017 13:46	23.9	4.57	0.066	0.011
5	7/31/2017 13:18	7/31/2017 13:23	7/31/2017 13:28	21.6	4.57	0.017	0.010
6	7/31/2017 12:59	7/31/2017 13:05	7/31/2017 13:07	19.0	4.57	0.012	0.033
7	7/31/2017 7:33	7/31/2017 7:37	7/31/2017 7:42	16.1	4.57	0.050	0.050
8	7/31/2017 7:53	7/31/2017 7:56	7/31/2017 8:03	13.2	4.57	0.127	0.070
9	7/31/2017 8:14	7/31/2017 8:18	7/31/2017 8:22	11.0	4.57	0.051	0.015
10	7/31/2017 8:31	7/31/2017 8:37	7/31/2017 8:41	10.1	4.57	0.025	0.058
11	7/31/2017 8:48	7/31/2017 8:51	7/31/2017 8:53	11.0	4.57	0.035	0.012
12	7/31/2017 9:02	7/31/2017 9:07	7/31/2017 9:12	13.2	4.57	0.058	0.023
13	7/31/2017 9:21	7/31/2017 9:25	7/31/2017 9:33	16.1	4.57	0.118	0.005
14	7/31/2017 9:42	7/31/2017 9:47	7/31/2017 9:50	19.0	4.57	0.082	0.007
15	7/31/2017 10:21	7/31/2017 10:24	7/31/2017 10:29	21.6	4.57	0.039	0.032
16	7/31/2017 10:36	7/31/2017 10:40	7/31/2017 10:43	23.9	4.57	0.010	0.014
17	7/31/2017 10:51	7/31/2017 10:54	7/31/2017 10:58	25.6	4.57	0.040	0.057
18	7/31/2017 11:09	7/31/2017 11:13	7/31/2017 11:17	26.6	4.57	0.024	0.071

Well Information

Well No.: 7
Municipal Address: [redacted]
Distance from Turbine Centre: 1049 m

Well No.: 8
Municipal Address: [redacted]
Distance from Turbine Centre: 872 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Well monitoring undertaken during periods of time on these same days when pile driving was not occuring measured maximum particle velocities of as much as 0.37 mm/s (Well 7). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T7

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells	
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 7	Well 8
1	7/27/2017 17:57	7/27/2017 18:03	7/27/2017 18:04	27.0	5.97	0.030	0.011
2	7/27/2017 18:31	7/27/2017 18:36	7/27/2017 18:36	26.6	5.97	0.063	0.013
3	7/28/2017 8:11	7/28/2017 8:16	7/28/2017 8:16	25.6	2.16	0.019	0.022
4	7/28/2017 8:37	7/28/2017 8:43	7/28/2017 8:44	23.9	2.16	0.035	0.045
5	7/27/2017 18:11	7/27/2017 18:17	7/27/2017 18:18	21.6	5.97	0.017	0.012
6	7/27/2017 15:27	7/27/2017 15:32	7/27/2017 15:33	19.0	5.97	0.019	0.028
7	7/27/2017 15:10	7/27/2017 15:15	7/27/2017 15:16	16.1	5.97	0.026	0.028
8	7/27/2017 14:30	7/27/2017 14:36	7/27/2017 14:37	13.2	5.97	0.017	0.027
9	7/27/2017 14:10	7/27/2017 14:16	7/27/2017 14:18	11.0	5.97	0.011	0.031
10	7/27/2017 13:55	7/27/2017 14:00	7/27/2017 14:01	10.1	5.97	0.030	0.012
11	7/27/2017 13:42	7/27/2017 13:46	7/27/2017 13:47	11.0	5.97	0.025	0.042
12	7/27/2017 13:09	7/27/2017 13:13	7/27/2017 13:23	13.2	5.97	0.019	0.035
13	7/27/2017 12:21	7/27/2017 12:34	7/27/2017 12:53	16.1	5.97	0.030	0.049
14	7/27/2017 15:42	7/27/2017 15:51	7/27/2017 15:54	19.0	5.97	0.026	0.039
15	7/27/2017 16:06	7/27/2017 16:12	7/27/2017 16:13	21.6	5.97	0.032	0.021
16	7/27/2017 16:34	7/27/2017 16:44	7/27/2017 16:45	23.9	5.97	0.010	0.066
17	7/27/2017 16:55	7/27/2017 17:01	7/27/2017 17:02	25.6	5.97	0.069	0.030
18	7/27/2017 17:17	7/27/2017 17:25	7/27/2017 17:26	26.6	5.97	0.027	0.060

Well Information

Well No.: 7
Municipal Address: [redacted]
Distance from Turbine Centre: 1354 m

Well No.: 8
Municipal Address: [redacted]
Distance from Turbine Centre: 2883 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Well monitoring undertaken during periods of time on these same days when pile driving was not occuring measured maximum particle velocities of as much as 0.073 mm/s. Total driving duration between till/rock start and end times noted above for Pile 13 is not representative and actual driving duration was 00:1:45 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T12

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	7/5/2017 12:33	7/5/2017 12:46	7/5/2017 12:47	27.5	5.97	0.008	0.044	See Notes
2	7/5/2017 15:47	7/5/2017 16:01	7/5/2017 16:01	27.8	5.97	0.001	0.106	
3	7/6/2017 8:08	7/6/2017 8:19	7/6/2017 8:20	27.5	4.32	0.010	0.775	
4	7/6/2017 7:47	7/6/2017 7:58	7/6/2017 7:59	26.4	4.32	0.002	0.048	
5	7/5/2017 12:57	7/5/2017 13:26	7/5/2017 13:27	24.7	5.97	0.002	0.729	
6	7/5/2017 14:11	7/5/2017 14:22	7/5/2017 14:23	22.5	5.97	0.002	0.298	
7	7/4/2017 14:48	7/4/2017 14:57	7/4/2017 14:58	19.8	5.97	0.002	0.026	
8	7/5/2017 11:38	7/5/2017 11:49	7/5/2017 11:50	16.8	5.97	0.008	0.030	
9	7/4/2017 9:26	7/4/2017 9:58	7/4/2017 10:00	14.0	9.91	0.011	0.246	0.014
10	7/5/2017 11:11	7/5/2017 11:25	7/5/2017 11:26	11.8	5.97	0.002	0.047	0.014
11	6/30/2017 12:03	6/30/2017 13:47	6/30/2017 13:54	11.0	11.20	0.004	0.755	
12	7/4/2017 15:15	7/4/2017 15:25	7/4/2017 15:25	11.8	9.91	0.002	0.179	
13	7/4/2017 11:22	7/4/2017 11:33	7/4/2017 11:34	14.0	9.91	0.002	0.066	
14	7/4/2017 15:47	7/4/2017 15:58	7/4/2017 15:58	16.8	9.91	0.069	0.037	
15	7/4/2017 11:55	7/4/2017 12:06	7/4/2017 12:07	19.8	9.91	0.003	0.023	
16	7/4/2017 16:35	7/4/2017 16:47	7/4/2017 16:47	22.5	9.91	0.004	0.155	
17	7/4/2017 13:01	7/4/2017 13:14	7/4/2017 13:20	24.7	9.91	0.007	0.085	
18	7/4/2017 15:08	7/4/2017 15:27	7/4/2017 15:28	26.4	9.91	0.002	0.729	
Restrikes								
7	7/5/2017 8:42	7/5/2017 8:42	7/5/2017 8:42	19.8	5.97	0.007	0.647	0.027
9	7/5/2017 8:47	7/5/2017 8:47	7/5/2017 8:48	14.0	5.97	0.007	0.634	0.027
11	7/5/2017 8:51	7/5/2017 8:51	7/5/2017 8:52	11.0	5.97	0.007	0.634	0.032
12	7/5/2017 8:57	7/5/2017 8:57	7/5/2017 8:58	11.8	5.97	0.003	0.624	
13	7/5/2017 9:02	7/5/2017 9:02	7/5/2017 9:03	14.0	5.97	0.008	0.662	
14	7/5/2017 9:09	7/5/2017 9:09	7/5/2017 9:10	16.8	5.97	0.008	0.624	
15	7/5/2017 9:13	7/5/2017 9:13	7/5/2017 9:14	19.8	5.97	0.003	0.546	0.057
16	7/5/2017 9:17	7/5/2017 9:17	7/5/2017 9:19	22.5	5.97	0.002	0.546	0.057
17	7/5/2017 9:22	7/5/2017 9:22	7/5/2017 9:23	26.4	5.97	0.002	0.546	0.057

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 3346 m

Well No.: 6
Municipal Address: [redacted]
Distance from Turbine Centre: 3368 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". On July 5, 2017, approximately 1 minute after pile driving stopped for Pile 1, the well monitoring personnel at Well 6 observed a loaded tractor/trailer dump truck drive by the well at 54 m distance and ground vibrations were sensed. At this time, the resident was also hammering on equipment within a nearby (120 m) shed during which it sounded as though a heavy sledge was being used with multiple recoil/hammer falls after each main strike. Vibrations associated with these activities (not separable) registered as 2.8 mm/s, consistent with the perception of vibrations by the well monitoring personnel. Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Driving/restriking of some piles occured in relatively rapid succession and, therefore, in some cases the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. The driving duration for Pile 11 on June 30, 2017 were unusually long since a small driving hammer was used for this pile. The total duration of driving on till/rock was 7 minutes for this pile.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T14

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 13	Well 14	No Pump[e]
1	9/11/2017 16:01	9/11/2017 16:06	9/11/2017 16:09	18.9	4.95	0.020	0.206	
2	9/11/2017 16:24	9/11/2017 16:29	9/11/2017 16:32	21.0	4.95	0.010	0.056	
3	9/11/2017 15:48	9/11/2017 15:54	9/11/2017 15:56	22.6	4.95	0.017	0.132	
4	9/11/2017 15:33	9/11/2017 15:39	9/11/2017 15:43	23.6	4.95	0.012	0.190	
5	9/11/2017 15:19	9/11/2017 15:24	9/11/2017 15:26	24.0	4.95	0.006	0.064	
6	9/11/2017 15:04	9/11/2017 15:10	9/11/2017 15:13	23.6	4.95	0.005	0.221	
7	9/11/2017 12:33	9/11/2017 12:39	9/11/2017 12:44	22.6	4.95	0.007	0.083	
8	9/11/2017 12:17	9/11/2017 12:25	9/11/2017 12:27	21.0	4.95	0.005	0.338	
9	9/11/2017 11:53	9/11/2017 11:59	9/11/2017 12:02	18.9	4.95	0.114	0.675	
10	9/11/2017 11:36	9/11/2017 11:43	9/11/2017 11:45	16.3	4.95	0.013	0.240	
11	9/11/2017 11:20	9/11/2017 11:25	9/11/2017 11:28	13.5	4.95	0.013	0.168	
12	9/11/2017 10:24	9/11/2017 10:30	9/11/2017 10:34	10.6	4.95	0.428	0.077	0.011
13	9/11/2017 10:07	9/11/2017 10:14	9/11/2017 10:16	8.1	4.95	0.543	0.141	0.008
14	9/11/2017 9:50	9/11/2017 9:56	9/11/2017 10:01	7.1	4.95	0.021	0.102	
15	9/11/2017 9:34	9/11/2017 9:39	9/11/2017 9:42	8.1	4.95	0.004	0.014	
16	9/11/2017 9:17	9/11/2017 9:24	9/11/2017 9:28	10.6	4.95	0.318	0.021	0.007
17	9/11/2017 8:57	9/11/2017 9:03	9/11/2017 9:05	13.5	4.95	0.026	0.070	
18	9/11/2017 8:39	9/11/2017 8:47	9/11/2017 8:49	16.3	4.95	0.007	0.018	

Restrikes

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 841 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 580 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. Well 13 pump vibrations dominated data for periods of 1 to 5 minutes. "No pump" data column indicates vibration velocities exclusive of pump operating times for Well 13. Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Vibration velocities noted above for both wells reflect maximum values induced by transient sources other than pile driving. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Data for two 10-minute time periods during which no pile driving occurred were evaluated with start times of 10:47 and 14:27 for Well 13 and and 10:48 and 14:36 for Well 14 indicated a maximum velocity of 0.079 mm/s. Additional evaluation of pump operations and other transient sources for both wells is pending.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T20

Pile No.:	Pile Driving Times and Dates Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	Vibration Measurements at Turbine Site: Daily Maximum Particle Velocity (mm/s)[b]	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d] Well 11	Well 12	No Pump[e]
1	8/30/2017 15:30	8/30/2017 15:33	8/30/2017 15:54	25.0	5.33	0.016	NA[e]	
2	8/30/2017 18:17	8/30/2017 18:21	8/30/2017 18:29	26.0	5.33	0.005	0.008	
3	8/30/2017 18:33	8/30/2017 18:38	8/30/2017 18:45	26.3	5.33	0.003	0.004	
4	8/30/2017 17:55	8/30/2017 17:59	8/30/2017 18:10	26.0	5.33	0.004	0.005	
5	8/30/2017 17:38	8/30/2017 17:37	8/30/2017 17:49	25.0	5.33	0.004	0.855	0.022
6	8/30/2017 17:14	8/30/2017 17:19	8/30/2017 17:31	23.3	5.33	0.004	NA[e]	
7	8/30/2017 16:54	8/30/2017 16:56	8/30/2017 17:09	21.0	5.33	0.003	NA[e]	
8	8/30/2017 16:19	8/30/2017 16:24	8/30/2017 16:53	18.3	5.33	0.046	NA[e]	
9	8/30/2017 16:01	8/30/2017 16:05	8/30/2017 16:12	15.4	5.33	0.005	NA[e]	
10	8/30/2017 11:34	8/30/2017 11:38	8/30/2017 11:50	12.5	5.33	0.005	0.016	
11	8/30/2017 10:26	8/30/2017 10:29	8/30/2017 10:40	9.1	5.33	0.018	0.013	
12	8/30/2017 9:58	8/30/2017 10:02	8/30/2017 10:16	10.1	5.33	0.011	0.014	
13	8/30/2017 9:49	8/30/2017 9:44	8/30/2017 9:50	12.5	5.33	0.010	0.014	
14	8/30/2017 12:02	8/30/2017 12:04	8/30/2017 12:22	15.4	5.33	0.028	0.008	
15	8/30/2017 12:36	8/30/2017 12:39	8/30/2017 12:54	18.3	5.33	0.023	0.006	
16	8/30/2017 13:01	8/30/2017 13:05	8/30/2017 13:20	21.0	5.33	0.004	0.004	
17	8/30/2017 14:26	8/30/2017 14:29	8/30/2017 14:41	23.3	5.33	0.004	0.006	
18	8/30/2017 14:52	8/30/2017 14:56	8/30/2017 15:24	25.0	5.33	0.003	0.025	
Restrikes								
13	8/30/2017 13:23	8/30/2017 13:23	8/30/2017 13:35	12.5	5.33	0.008	0.008	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 3800 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 3962 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and the pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 6, 7, 8 and 9 at Well 12 on August 30, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Total driving duration between till/rock start and end times noted above for Pile 1 is not representative and actual driving duration was 00:7:40 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T21

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/29/2017 12:01	8/29/2017 12:04	8/29/2017 12:14	23.7	2.79	NA[e]	0.008	
2	8/29/2017 1:27	8/29/2017 1:30	8/29/2017 1:39	25.4	2.79	0.003	0.006	
3	8/29/2017 1:44	8/29/2017 1:47	8/29/2017 1:54	26.4	2.79	0.009	0.006	
4	8/29/2017 11:20	8/29/2017 11:23	8/29/2017 11:32	26.8	2.79	0.003	0.013	
5	8/29/2017 11:05	8/29/2017 11:08	8/29/2017 11:13	26.4	2.79	NA[e]	0.013	
6	8/29/2017 8:48	8/29/2017 8:51	8/29/2017 8:59	25.4	2.79	NA[e]	0.026	
7	8/29/2017 8:28	8/29/2017 8:33	8/29/2017 8:40	23.7	2.79	NA[e]	0.005	
8	8/29/2017 8:07	8/29/2017 8:11	8/29/2017 8:19	21.5	2.79	NA[e]	0.003	
9	8/29/2017 7:51	8/29/2017 7:54	8/29/2017 7:59	18.8	2.79	0.004	0.004	
10	8/28/2017 16:40	8/28/2017 16:44	8/28/2017 16:53	15.9	3.30	0.015	0.071	
11	8/28/2017 16:11	8/28/2017 16:14	8/28/2017 16:27	13.0	3.30	0.007	1.551	0.039
12	8/28/2017 15:51	8/28/2017 15:58	8/28/2017 16:05	10.8	3.30	0.005	0.007	
13	8/28/2017 14:27	8/28/2017 14:30	8/28/2017 14:37	9.9	3.30	0.003	0.005	
14	8/28/2017 14:10	8/28/2017 14:13	8/28/2017 14:21	10.8	3.30	0.006	0.005	
15	8/28/2017 13:45	8/28/2017 13:48	8/28/2017 13:58	13.0	3.30	0.008	0.013	
16	8/28/2017 13:21	8/28/2017 13:24	8/28/2017 13:37	15.9	3.30	0.006	0.011	
17	8/28/2017 13:01	8/28/2017 13:05	8/28/2017 13:13	18.8	3.30	0.011	0.010	
18	8/29/2017 11:44	8/29/2017 11:47	8/29/2017 11:54	21.5	2.79	NA[e]	0.031	

Restrikes

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 3960 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 4161 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurement for Well 11 was 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurement for Well 12 was 0.896 mm/s and the pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 5, 6, 7, 8 and 18 at Well 11 on August 29, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T28

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[e]
1	8/15/2017 14:33	8/15/2017 14:41	8/15/2017 14:43	21.6	3.17	0.061	0.020	
2	8/15/2017 14:53	8/15/2017 15:04	8/15/2017 15:06	23.9	3.17	0.019	0.036	
3	8/15/2017 15:31	8/15/2017 15:42	8/15/2017 15:44	25.6	3.17	0.111	0.805	0.019
4	8/15/2017 13:23	8/15/2017 13:37	8/15/2017 13:39	26.6	3.17	0.022	0.804	0.100
5	8/15/2017 12:10	8/15/2017 12:22	8/15/2017 12:24	27.0	3.17	0.108	0.158	
6	8/15/2017 11:46	8/15/2017 11:59	8/15/2017 12:00	26.6	3.17	0.012	0.095	
7	8/15/2017 9:56	8/15/2017 10:08	8/15/2017 10:11	25.6	3.17	0.027	0.052	
8	8/15/2017 9:16	8/15/2017 9:34	8/15/2017 9:36	23.9	3.17	0.040	0.009	
9	8/15/2017 8:51	8/15/2017 9:03	8/15/2017 9:04	21.6	3.17	0.046	0.015	
10	8/15/2017 8:18	8/15/2017 8:33	8/15/2017 8:35	19.0	3.17	NA[e]	0.750	0.026
11	8/15/2017 7:45	8/15/2017 7:58	8/15/2017 8:02	16.1	3.17	NA[e]	0.007	
12	8/11/2017 13:27	8/11/2017 14:45	8/11/2017 14:46	13.2	5.59	0.812	0.014	
13	8/11/2017 12:36	8/11/2017 12:48	8/11/2017 12:50	11.0	5.59	0.054	0.006	
14	8/11/2017 12:13	8/11/2017 12:25	8/11/2017 12:27	10.1	5.59	0.055	0.112	
15	8/11/2017 11:19	8/11/2017 11:28	8/11/2017 11:30	11.0	5.59	0.244	0.015	
16	8/11/2017 11:48	8/11/2017 12:02	8/11/2017 12:03	13.2	5.59	0.183	0.007	
17	8/11/2017 10:22	8/11/2017 11:06	8/11/2017 11:07	16.1	5.59	0.686	0.034	
18	8/15/2017 13:56	8/15/2017 14:09	8/15/2017 14:10	19.0	3.17	0.015	0.705	0.052
Restrikes								
2	8/16/2017 8:19	8/16/2017 8:19	8/16/2017 8:23	23.9	2.65	0.017	0.029	

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 2568 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1769 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz

Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Data for Well 9 was not available for August 15, 2017 during driving of piles 10 and 11 while awaiting site security changes implemented following an incident at the Well 9 property the evening of August 14, 2017. Highlighted values for Well 9 on August 11, 2017 are higher than and inconsistent with other measurements during pile driving at the T28 site. On August 11, 2017, construction activities were underway along the entrance road to T32, located as close as about 100 m from Well 9. These activities included: hammering, movements of large construction equipment (e.g., loaders, dump trucks, excavators, "stone throwers"), and equipment travelled on access road site without construction mats, equipment operating on T32 access resulted in "pounding" sounds. The Well 9 area is also subject to heavy passing traffic on Countryview Line (74 m from well) including: fuel trucks, loaded dump trucks, large transport trucks, a bus, and cranes/boom trucks among other vehicles. Further analysis of Well 9 vibration data was undertaken for 10 minute periods on August 11, 2017 during which pile driving was not occuring between 08:32:00 and 08:42:00, 09:12:00 and 09:22:00, 11:22:00 and 11:32:00, and 13:48:00 and 13:58:00. During these periods the maximum velocities (regardless of direction) of the Well 9 casing ranged from 0.011 to 1.2 mm/s. Data shown for Well 9 during driving of Piles 12, 15, 16 and 17 (highlighted) are considered unrepresentative of pile driving and associated with other vibration sources. The piston pump for Well 9 is within the barn approximately 4 to 5 m from the well location. When the Well 9 pump was deliberately operated on September 8, 2017, in the absence of pile driving, well casing velocities were up to 0.04 mm/s. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Preliminary Vibration Monitoring Report

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T30

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells Particle Velocity (mm/s)[c, d]		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity			
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[e]
1	8/4/2017 14:24	8/4/2017 14:42	8/4/2017 15:01	23.0	4.70	0.054	0.815	0.014
1A	8/9/2017 9:30	8/9/2017 9:51	8/9/2017 9:58	23.5	2.41	0.080	0.935	0.027
2	8/8/2017 8:42	8/8/2017 8:52	8/8/2017 9:03	24.6	3.17	0.061	0.049	
3	8/8/2017 9:17	8/8/2017 9:25	8/8/2017 9:35	25.6	3.17	0.041	0.883	0.009
4	8/8/2017 7:49	8/8/2017 8:02	8/8/2017 8:10	26.0	3.17	0.035	1.251	0.036
5	8/4/2017 16:24	8/4/2017 16:32	8/4/2017 16:40	25.6	4.70	0.061	0.007	
6	8/4/2017 15:57	8/4/2017 16:03	8/4/2017 16:11	24.6	4.70	0.059	0.003	
7	8/4/2017 15:24	8/4/2017 15:34	8/4/2017 15:39	23.0	4.70	0.082	0.028	
8	8/4/2017 10:57	8/4/2017 11:03	8/4/2017 11:06	20.8	4.70	0.032	0.540	0.033
9	8/3/2017 13:33	8/3/2017 13:38	8/3/2017 13:46	18.1	5.33	0.076	0.088	
10	8/3/2017 13:07	8/3/2017 13:16	8/3/2017 13:20	15.2	5.33	0.088	0.014	
11	8/3/2017 11:46	8/3/2017 11:52	8/3/2017 11:56	9.1	5.33	0.029	0.007	
12	8/3/2017 11:25	8/3/2017 11:29	8/3/2017 11:34	10.1	5.33	0.066	0.005	
13	8/3/2017 10:44	8/3/2017 10:53	8/3/2017 10:59	12.4	5.33	0.059	0.876	0.005
14	8/3/2017 14:04	8/3/2017 14:11	8/3/2017 14:19	15.2	5.33	0.061	0.023	
15	8/3/2017 14:34	8/3/2017 14:47	8/3/2017 14:50	18.1	5.33	0.032	0.005	
16	8/4/2017 8:50	8/4/2017 8:55	8/4/2017 9:08	20.8	4.70	0.048	0.032	
17	8/4/2017 9:32	8/4/2017 9:38	8/4/2017 9:43	23.0	4.70	0.051	0.002	
18	8/4/2017 10:17	8/4/2017 10:33	8/4/2017 10:36	24.6	4.70	0.024	0.004	
Restrikes								
15C	8/4/2017 8:15	8/4/2017 8:15	8/4/2017 8:21	18.1	4.70	0.044	0.022	
1	8/8/2017 15:19	8/8/2017 15:19	8/8/2017 15:25	23.0	3.17	0.080	0.006	
5	8/8/2017 8:15	8/8/2017 8:15	8/8/2017 8:20	25.6	3.17	0.056	1.016	0.006
6	8/8/2017 9:40	8/8/2017 9:40	8/8/2017 9:41	24.6	3.17	0.041	1.116	0.146

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 1808 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1385 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Piles noted with "A" represent piles installed to replace similarly-numbered piles. After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes" (where applicable). Piles noted with "C" were those that were started on one day and continued on a separate day; therefore, additional well monitoring data is presented for the time periods during which piling continued on till/rock. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total driving duration between till/rock start and end times noted above for Pile 1 is not representative and actual driving duration was 00:11:50 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T31

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s)[b]	Well 7	Well 8
1	7/17/2017 13:18	7/17/2017 13:24	7/17/2017 13:26	8.1	2.92	0.042	0.028
2	7/17/2017 14:46	7/17/2017 14:52	7/17/2017 14:54	9.1	2.92	0.038	0.034
3	7/18/2017 7:39	7/18/2017 7:47	7/18/2017 7:49	11.4	4.19	0.016	0.075
4	7/18/2017 8:03	7/18/2017 8:10	7/18/2017 8:13	14.3	4.19	0.023	0.005
5	7/17/2017 12:56	7/17/2017 13:01	7/17/2017 13:05	17.2	2.92	0.020	0.071
6	7/17/2017 11:49	7/17/2017 11:53	7/17/2017 11:54	19.8	2.92	0.100	0.099
7	7/17/2017 11:25	7/17/2017 11:30	7/17/2017 11:35	22.0	2.92	0.014	0.028
8	7/17/2017 10:25	7/17/2017 10:31	7/17/2017 10:36	23.6	2.92	0.044	0.028
9	7/17/2017 8:03	7/17/2017 8:09	7/17/2017 8:30	24.6	2.92	0.011	0.041
10	NA	NA	NA	25.0		NA	NA
11	7/14/2017 16:18	7/14/2017 16:25	7/14/2017 16:28	24.6	5.46	0.041	NA
12	7/13/2017 15:38	7/13/2017 15:44	7/13/2017 15:45	23.6	5.08	0.037	0.034
13	7/13/2017 16:12	7/13/2017 16:26	7/13/2017 16:30	24.6	5.08	0.012	0.015
14	7/14/2017 8:22	7/14/2017 8:47	7/14/2017 8:48	25.0	5.46	0.072	0.023
15	7/13/2017 16:56	7/13/2017 17:06	7/13/2017 17:08	24.6	5.08	0.156	0.020
16	7/14/2017 11:18	7/14/2017 11:23	7/14/2017 11:29	23.6	5.46	0.044	0.034
17	7/14/2017 11:40	7/14/2017 11:48	7/14/2017 11:51	22.0	5.46	0.074	0.075
18	7/14/2017 12:10	7/14/2017 12:16	7/14/2017 12:21	19.8	5.46	0.050	0.041

Well Information

Well No.: 7
Municipal Address: [redacted]
Distance from Turbine Centre: 636 m

Well No.: 8
Municipal Address: [redacted]
Distance from Turbine Centre: 2497 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: On July 14, 2017 at about 14:00, Golder was informed that piling operations at T31 were concluded. At 15:45 instruments were therefore turned off at Well 8 in preparation for removal for the day. Piling resumed at approximately 16:15. As a result, data was not captured for Wells 7 or 8 when driving Pile 10 and Well 8 when driving Pile 11. Well monitoring undertaken during periods of time when pile driving was not occuring measured maximum particle velocities of as much as 0.37 mm/s at Well 7. Total driving duration between till/rock start and end times noted above for Pile 9 is not representative and actual driving duration was 00:04:00 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: **T32**

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[e]
1	8/11/2017 14:41	8/11/2017 14:43	8/11/2017 15:01	25.0	3.43	0.069	0.020	
2	8/14/2017 15:43	8/14/2017 15:46	8/14/2017 16:19	23.3	4.83	0.050	0.013	
3	8/14/2017 16:25	8/14/2017 16:28	8/14/2017 16:57	21.1	4.83	0.045	0.045	
4	8/14/2017 14:51	8/14/2017 14:55	8/14/2017 15:21	18.4	4.83	0.046	0.697	
5	8/14/2017 13:52	8/14/2017 13:55	8/14/2017 14:11	15.5	4.83	0.059	0.035	
6	8/14/2017 13:12	8/14/2017 13:15	8/14/2017 13:33	12.7	4.83	0.055	0.009	
7	8/14/2017 11:40	8/14/2017 11:42	8/14/2017 12:18	10.4	4.83	0.062	0.049	
8	8/14/2017 11:20	8/14/2017 11:23	8/14/2017 11:33	9.5	4.83	0.050	0.880	
9	8/14/2017 7:47	8/14/2017 7:50	8/14/2017 7:54	10.4	4.83	0.041	0.733	
10	8/14/2017 10:59	8/14/2017 11:04	8/14/2017 11:12	12.7	4.83	0.028	0.010	
11	8/11/2017 10:53	8/11/2017 10:56	8/11/2017 11:00	15.5	3.43	1.090	0.049	
12	8/11/2017 10:42	8/11/2017 10:44	8/11/2017 10:47	18.4	3.43	0.871	0.014	
13	8/11/2017 10:28	8/11/2017 10:30	8/11/2017 10:34	21.1	3.43	1.346	0.738	0.005
14	8/11/2017 10:14	8/11/2017 10:19	8/11/2017 10:21	23.3	3.43	0.068	0.051	
15	8/11/2017 9:00	8/11/2017 9:03	8/11/2017 9:07	25.0	3.43	0.037	0.764	0.004
16	8/11/2017 11:07	8/11/2017 11:10	8/11/2017 11:14	26.0	3.43	0.229	0.034	
17	8/11/2017 13:12	8/11/2017 13:14	8/11/2017 13:19	26.4	3.43	0.230	0.684	0.009
18	8/11/2017 13:26	8/11/2017 13:28	8/11/2017 13:42	26.0	3.43	0.135	0.713	0.004

Restrikes

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 680 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1122 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Highlighted values for Well 9 on August 11, 2017 are higher than and inconsistent with other measurements during pile driving at the T32 site. On August 11, 2017, construction activities were underway along the entrance road to T32, located as close as about 100 m from the well. These activities included: hammering, movements of large construction equipment (e.g., loaders, dump trucks, excavators, aggregate delivery equipment), and equipment travelled on site access road without construction mats, equipment operating on T32 access road resulted in "pounding" sounds. Well 9 area is subject to heavy passing traffic on Countryview Line (74 m from well) including: fuel trucks, loaded dump trucks, large transport trucks, a bus, and cranes/boom trucks among other vehicles. Further analysis of Well 9 vibration data was undertaken for 10 minute periods on August 11, 2017 during which pile driving was not occuring between 08:32:00 and 08:42:00, 09:12:00 and 09:22:00, 11:22:00 and 11:32:00, and 13:48:00 and 13:58:00. During these periods, the maximum velocities (regardless of direction) of the Well 9 casing ranged from 0.011 to 1.2 mm/s. Data shown for Well 9 during driving of Piles 12, 15, 16 and 17 (highlighted) are considered unrepresentative of pile driving and associated with other vibration sources. The piston pump for Well 9 is within the barn approximately 4 to 5 m from the well location. When the Well 9 pump was deliberately operated on September 8, 2017, in the absence of pile driving, well casing velocities were up to 0.04 mm/s. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T33

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 3	Well 4	No Pump[e]
1	9/5/2017 13:10	9/5/2017 13:16	9/5/2017 13:25	10.9	5.3	0.015	0.118	
2	9/5/2017 13:46	9/5/2017 13:55	9/5/2017 14:03	11.8	5.3	0.011	0.138	
3	9/5/2017 14:11	9/5/2017 14:20	9/5/2017 14:27	14.0	5.3	0.056	0.174	
4	9/5/2017 14:38	9/5/2017 14:46	9/5/2017 14:54	16.8	5.3	0.035	0.082	
5	9/5/2017 15:05	9/5/2017 15:13	9/5/2017 15:18	19.7	5.3	0.049	0.137	
6	9/5/2017 15:34	9/5/2017 15:44	9/5/2017 15:48	22.4	5.3	0.009	0.072	
7	9/5/2017 17:02	9/5/2017 17:10	9/5/2017 17:10	24.6	5.3	0.030	0.298	
8	9/5/2017 17:32	9/5/2017 17:41	9/5/2017 17:49	26.3	5.3	0.036	0.131	
9	9/5/2017 18:14	9/5/2017 18:21	9/5/2017 18:28	27.4	5.3	0.034	0.083	
10	9/6/2017 9:30	9/6/2017 9:47	9/6/2017 9:53	27.8	3.2	0.004	0.243	
11	9/6/2017 10:09	9/6/2017 10:25	9/6/2017 10:35	27.4	3.2	0.004	0.089	
12	9/6/2017 12:03	9/6/2017 12:16	9/6/2017 12:26	26.3	3.2	0.005	0.179	
13	9/6/2017 12:58	9/6/2017 13:08	9/6/2017 13:16	24.6	3.2	0.003	0.162	
14	9/6/2017 13:33	9/6/2017 13:43	9/6/2017 13:58	22.4	3.2	0.004	0.161	
15	9/6/2017 14:37	9/6/2017 14:45	9/6/2017 14:54	19.7	3.2	0.005	4.987	
16	9/6/2017 16:01	9/6/2017 16:08	9/6/2017 16:20	16.8	3.2	0.006	0.277	
17	9/6/2017 15:29	9/6/2017 15:35	9/6/2017 15:45	14.0	3.2	0.003	0.175	
18	9/6/2017 14:13	9/6/2017 14:24	9/6/2017 14:36	11.8	3.2	0.004	0.622	
Restrikes								
6	9/6/2017 18:15	9/6/2017 18:15	9/6/2017 18:23	22.4	3.2	0.009	4.858	
5	9/6/2017 17:02	9/6/2017 17:02	9/6/2017 17:03	19.7	3.2	0.023	0.129	

Well Information

Well No.: 3
Municipal Address: [redacted]
Distance from Turbine Centre: 1778 m

Well No.: 4
Municipal Address: [redacted]
Distance from Turbine Centre: 2080 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz

Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. During vibration monitoring on September 5, 2017, a forklift operated close to the geophone between 16:00:00 and 16:30:00 and triggered a maximum peak particle velocity of 6.2 mm/s. Value shown above excludes the peak measurement triggered by the forklift. On September 5, 2017, tractors, harvest haul trucks and other equipment travelled through Well 3 property frequently from 12:48 to 15:55 and occasionally thereafter until 16:50. On September 5, 2017, St. Clair Road traffic passing at 78 m from Well 4 was observed to include large tractor-trailers, concrete mixers and dump trucks at a rate of about 1 heavy vehicle every 1.5 to 2 minutes. Passenger vehicle movements on the Well 4 property passed and were parked near the well at 12:10, 14:40, 14:47, 15:06, 15:17, 15:42, 16:16, 16:35 and 19:02. On September 6, 2017, heavy vehicle traffic near Well 4 was similar to September 5, 2017. Combine harvesting was on-going as close as 25 to 30 m from Well 4, starting at 8:53 and continuing to after 14:30 on September 6, 2017. Passenger vehicle traffic on September 6, 2017 adjacent to Well 4 on the property was noted at 7:41, 10:40 - 10:45, 10:56 - 11:04, 11:46 - 11:52, 12:57 - 12:59, 13:22, 14:31, 14:36, 16:35, 16:42, 16:49, and 18:34. Various individuals were at and in the well shed at 16:35 to 16:54. Prior to September 6, 2017 obersvations by Golder personnel indicated that a pump was not connected at Well 4. During the afternoon of September 6, 2017 a pump was connected and operational. From 17:02 to 17:18 the newly connected Well 4 pump was cycled on and off, operating for periods of 1 to more than 7 minutes. The owner was physically working on Well 4 after 17:18 and returning to well shed frequently. All data highlighted above is considered to have been significantly influenced by near-well activities, particularly work directly related to the Well 4 pump and shed.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T35

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	6/21/2017 9:16	6/21/2017 9:31	6/21/2017 9:58	25.3	4.32	0.005	0.011	
1A	7/4/2017 14:09	7/4/2017 14:15	7/4/2017 14:20	25.8	4.70	0.011	0.085	
2	6/28/2017 11:40	6/28/2017 11:50	6/28/2017 11:56	27.0	6.86	0.004	0.002	
3	6/29/2017 11:15	6/29/2017 11:26	6/29/2017 11:37	28.1	4.70	0.004	0.080	0.009
4	6/29/2017 11:45	6/29/2017 12:28	6/29/2017 12:35	28.4	4.70	0.002	0.003	
5	6/29/2017 10:36	6/29/2017 10:53	6/29/2017 10:59	28.1	4.70	0.003	0.008	
6	6/29/2017 9:49	6/29/2017 10:09	6/29/2017 10:19	27.0	4.70	0.002	0.017	
7	6/28/2017 16:45	6/28/2017 16:55	6/28/2017 16:59	25.3	6.86	0.002	0.006	
8	6/28/2017 16:19	6/28/2017 16:28	6/28/2017 16:36	23.0	6.86	0.004	0.008	
9	6/29/2017 15:55	6/29/2017 16:03	6/29/2017 16:09	20.3	4.70	0.003	0.011	
10	6/28/2017 15:23	6/28/2017 15:35	6/28/2017 15:43	17.4	6.86	0.002	0.010	
11	6/28/2017 14:34	6/28/2017 14:52	6/28/2017 14:56	14.6	6.86	0.002	0.081	0.011
12	6/28/2017 14:04	6/28/2017 14:19	6/28/2017 14:23	12.4	6.86	0.003	0.016	
13	6/26/2017 16:52	6/26/2017 17:15	6/26/2017 17:22	11.6	4.06	0.004	0.093	0.015
13A	6/30/2017 10:53	6/30/2017 11:24	6/30/2017 11:36	11.6	4.19	0.001	0.093	0.015
14	6/28/2017 8:34	6/28/2017 8:59	6/28/2017 9:16	12.4	6.86	0.005	0.110	0.023
15	6/26/2017 16:03	6/26/2017 16:26	6/26/2017 16:28	14.6	4.06	0.002	0.009	
15A	7/4/2017 12:54	7/4/2017 13:00	7/4/2017 13:21	15.1	4.70	0.008	0.130	
16	6/28/2017 9:32	6/28/2017 9:52	6/28/2017 9:57	17.4	6.86	0.002	0.004	
17	6/26/2017 7:45	6/26/2017 8:19	6/26/2017 8:20	20.3	4.06	0.012	0.002	
17A	7/4/2017 13:39	7/4/2017 13:45	7/4/2017 13:51	20.8	4.70	0.004	0.105	
18	6/28/2017 10:40	6/28/2017 10:55	6/28/2017 11:25	23.0	6.86	0.004	0.015	
Restrikes								
1	6/26/2017 7:39	6/26/2017 7:39	6/26/2017 7:39	25.3	4.06	0.007	0.007	
17	6/28/2017 12:54	6/28/2017 12:54	6/28/2017 13:14	20.3	6.86	0.004	0.014	
10	6/29/2017 13:31	6/29/2017 13:31	6/29/2017 13:32	17.4	4.70	0.006	0.004	
13	6/29/2017 13:37	6/29/2017 13:37	6/29/2017 13:42	11.6	4.70	0.004	0.002	
14	6/29/2017 13:47	6/29/2017 13:47	6/29/2017 13:50	12.4	4.70	0.006	0.003	
16	6/29/2017 13:54	6/29/2017 13:54	6/29/2017 13:56	17.4	4.70	0.005	0.003	
15	6/29/2017 14:20	6/29/2017 14:20	6/29/2017 14:25	14.6	4.70	0.008	0.011	
PDA								
13A	7/6/2017 10:06	7/6/2017 10:06	7/6/2017 10:15	12.1	5.21	0.005	0.138	
13	7/6/2017 11:05	7/6/2017 11:05	7/6/2017 11:23	11.6	5.21	0.006	0.219	
15A	7/6/2017 11:39	7/6/2017 11:39	7/6/2017 11:40	15.1	5.21	0.009	0.130	
17A	7/6/2017 11:55	7/6/2017 11:55	7/6/2017 11:56	20.8	5.21	0.010	0.061	
1A	7/6/2017 12:18	7/6/2017 12:18	7/6/2017 12:18	25.8	5.21	0.011	0.084	

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 623 m

Well No.: 6
Municipal Address: [redacted]
Distance from Turbine Centre: 880 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Tractor was observed operating frequently near Well 6. Water pump was observed cycling on and off during pile driving operations and remaining on for periods of 2 to 4 minutes. When pump was operating, casing at Well 6 exhibited particle velocities in the range of 0.08 to 0.12 mm/s and dominated analysis of data. Pile restrike events were of short duration with the following total number of hammer blows shown in parentheses: Pile 1 (20), Pile 10 (5 to 7), 13 (205), 14 (140), 16 (51), 15 (214). Pile 17 experienced 446 hammer blows over a period of 9 minutes. Piles noted with PDA indicate restrike events during which pile dynamics analyzer monitoring was completed. Piles noted with "A" represent piles installed to replace similarly-numbered piles. After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 13A(10:00), 15A(6:24), 17 restrike (14:00), 13PDA(6:20). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

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Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

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Preliminary Vibration Monitoring Report

Turbine Location: T36

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	7/26/2017 10:33	7/26/2017 10:38	7/26/2017 10:48	23.3	7.87	0.005	0.086	
2	7/26/2017 18:16	7/26/2017 18:21	7/26/2017 18:28	21.1	7.87	0.003	0.016	
3	7/26/2017 19:24	7/26/2017 19:28	7/26/2017 19:42	18.4	7.87	0.002	0.005	
4	7/26/2017 18:37	7/26/2017 19:07	7/26/2017 19:19	15.5	7.87	0.002	0.027	
5	7/26/2017 17:59	7/26/2017 18:04	7/26/2017 18:10	12.7	7.87	0.012	0.016	
6	7/26/2017 17:30	7/26/2017 17:34	7/26/2017 17:44	10.4	7.87	0.004	0.032	
7	7/26/2017 17:10	7/26/2017 17:13	7/26/2017 17:23	9.5	7.87	0.010	0.044	
8	7/26/2017 16:41	7/26/2017 16:45	7/26/2017 16:56	10.4	7.87	0.007	0.038	
9	7/26/2017 16:19	7/26/2017 16:23	7/26/2017 16:33	12.7	7.87	0.004	0.010	
10	7/26/2017 15:48	7/26/2017 15:51	7/26/2017 16:03	15.5	7.87	0.005	0.070	
11	7/26/2017 15:12	7/26/2017 15:15	7/26/2017 15:23	18.4	7.87	0.004	0.045	
12	7/26/2017 14:32	7/26/2017 14:45	7/26/2017 14:57	21.1	7.87	0.005	0.048	
13	7/26/2017 14:15	7/26/2017 14:21	7/26/2017 14:28	23.3	7.87	0.014	0.018	
14	7/26/2017 13:58	7/26/2017 14:03	7/26/2017 14:08	25.0	7.87	0.009	0.031	
15	7/26/2017 13:16	7/26/2017 13:20	7/26/2017 13:32	26.0	7.87	0.005	0.111	0.029
16	7/26/2017 12:48	7/26/2017 12:53	7/26/2017 13:05	26.4	7.87	0.011	0.038	
17	7/26/2017 11:41	7/26/2017 11:47	7/26/2017 11:56	26.0	7.87	0.005	0.021	
18	7/26/2017 11:08	7/26/2017 11:12	7/26/2017 11:22	25.0	7.87	0.006	0.068	
Restrikes								
16	7/27/2017 7:36	7/27/2017 7:36	7/27/2017 7:37	26.4	0.89	0.003	0.437	0.028

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 4201 m

Well No.: 6
Municipal Address: [redacted]
Distance from Turbine Centre: 3380 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: A single restrike event occured on the day following with a total of 24 hammer blows on Pile 16 during a period of approximately 65 seconds. After installation, one pile was struck again with the hammer to demonstrate resistance performance and this event is noted under "restrikes". Water pump was observed cycling on and off during pile driving operations and remaining on for periods of 2 to 4 minutes. When pump was operating during pile driving, casing at Well 6 exhibited particle velocities of up to 0.44 mm/s and this dominated analysis of data. Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

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Preliminary Vibration Monitoring Report

Turbine Location: T43

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/18/2017 12:35	8/18/2017 12:45	8/18/2017 12:52	24.8	5.59	0.006	0.008	
2	8/18/2017 13:01	8/18/2017 13:12	8/18/2017 13:20	23.8	5.59	0.006	0.007	
3	8/21/2017 8:28	8/21/2017 8:38	8/21/2017 8:48	22.2	3.18	0.010	0.007	
4	8/21/2017 12:47	8/21/2017 12:59	8/21/2017 13:10	20.0	3.18	0.007	0.006	
5	8/21/2017 9:03	8/21/2017 9:16	8/21/2017 9:23	17.4	3.18	0.006	1.468	0.009
6	8/21/2017 7:56	8/21/2017 8:08	8/21/2017 8:17	14.5	3.18	0.024	0.024	
7	8/18/2017 14:32	8/18/2017 14:43	8/18/2017 14:50	11.6	3.18	0.006	0.006	
8	8/18/2017 13:37	8/18/2017 13:49	8/18/2017 13:57	9.3	3.18	0.007	0.005	
9	8/15/2017 15:09	8/15/2017 15:18	8/15/2017 15:27	8.3	7.37	0.086	0.005	
10	8/15/2017 13:21	8/15/2017 13:28	8/15/2017 13:37	9.3	7.37	0.004	0.002	
11	8/15/2017 12:22	8/15/2017 12:34	8/15/2017 12:35	11.6	7.37	0.002	0.006	
12	8/15/2017 11:58	8/15/2017 12:10	8/15/2017 12:13	14.5	7.37	0.018	0.018	
13	8/15/2017 9:19	8/15/2017 9:42	8/15/2017 11:40	17.4	7.37	0.003	0.002	
14	8/15/2017 15:46	8/15/2017 15:57	8/15/2017 16:10	20.0	7.37	0.006	0.013	
15	8/18/2017 9:17	8/18/2017 9:23	8/18/2017 9:31	22.2	5.59	0.005	0.009	
16	8/18/2017 9:43	8/18/2017 9:50	8/18/2017 9:59	23.8	5.59	0.012	0.009	
17	8/18/2017 10:10	8/18/2017 10:17	8/18/2017 10:28	24.8	5.59	0.004	0.018	
18	8/18/2017 11:45	8/18/2017 12:02	8/18/2017 12:21	25.2	5.59	0.008	0.004	
Restrikes								
14	8/21/2017 10:43	8/21/2017 10:43	8/21/2017 10:43	20.0	3.18	0.012	0.010	
16(1)	8/21/2017 10:30	8/21/2017 10:30	8/21/2017 10:30	23.8	3.18	0.011	0.010	
16(2)	8/21/2017 11:52	8/21/2017 11:52	8/21/2017 11:54	22.2	3.18	0.005	0.029	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 4092 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 4359 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and the pump was mounted on the well casing. During pile driving for turbine T3, on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving/restriking of some piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Driving of pile 13 was started and stopped on multiple occasions because of problems with fuel pump resulting in a total of approximately 88 minutes of standby between driving intervals for a total driving time on till/rock of 14:45 (minutes:seconds). Pile 18 total driving time on till/rock was 8:46 (minutes:seconds) due to intermittant stops and starts. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T45

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/23/2017 11:47	8/23/2017 11:53	8/23/2017 12:18	14.8	7.75	0.025	0.010	
2	8/23/2017 14:20	8/23/2017 14:27	8/23/2017 14:41	12.0	7.75	0.024	NA[e]	
3	8/23/2017 15:10	8/23/2017 15:17	8/23/2017 15:27	9.6	7.75	0.017	0.005	
4	8/23/2017 16:49	8/23/2017 16:55	8/23/2017 17:05	8.7	7.75	0.008	1.148	
5	8/23/2017 17:22	8/23/2017 17:30	8/23/2017 17:44	9.6	7.75	0.011	0.007	
6	8/23/2017 10:50	8/23/2017 11:00	8/23/2017 11:16	12.0	7.75	0.018	0.016	
7	8/24/2017 8:30	8/24/2017 8:38	8/24/2017 8:47	14.8	3.30	0.014	0.014	
8	8/24/2017 9:05	8/24/2017 9:14	8/24/2017 9:21	17.7	3.30	0.021	0.040	
9	8/24/2017 9:36	8/24/2017 9:44	8/24/2017 10:48	20.4	3.30	0.018	1.511	
10	8/23/2017 12:49	8/23/2017 12:58	8/23/2017 13:15	22.6	7.75	0.009	0.005	
11	8/24/2017 13:32	8/24/2017 13:42	8/24/2017 13:48	24.2	3.30	0.004	0.018	
12	8/24/2017 15:06	8/24/2017 15:15	8/24/2017 15:23	25.2	3.30	0.007	0.008	
13	8/24/2017 15:35	8/24/2017 15:44	8/24/2017 15:53	25.6	3.30	0.026	0.034	
14	8/24/2017 16:05	8/24/2017 16:14	8/24/2017 16:22	25.2	3.30	0.012	0.061	
15	8/24/2017 16:40	8/24/2017 16:46	8/24/2017 16:55	24.2	3.30	0.015	0.007	
16	8/24/2017 17:11	8/24/2017 17:18	8/24/2017 17:24	22.6	3.30	0.012	0.004	
17	8/24/2017 17:33	8/24/2017 17:39	8/24/2017 17:45	20.4	3.30	0.006	0.009	
18	8/24/2017 17:57	8/24/2017 18:08	8/24/2017 18:12	17.7	3.30	0.005	0.006	
Restrikes								
6	8/23/2017 13:28	8/23/2017 13:28	8/23/2017 13:29	12.0	7.75	0.043	0.017	
1	8/23/2017 13:13	8/23/2017 13:13	8/23/2017 13:13	14.8	7.75	0.009	0.005	
15	8/25/2017 7:45	8/25/2017 7:45	8/25/2017 7:47	24.2	5.97	0.015	0.032	
16	8/25/2017 9:11	8/25/2017 9:11	8/25/2017 9:13	22.6	5.97	0.007	2.335	0.008
17	8/25/2017 9:03	8/25/2017 9:03	8/25/2017 9:06	20.4	5.97	0.007	0.019	
18	8/25/2017 8:51	8/25/2017 8:51	8/25/2017 8:55	17.7	5.97	0.011	0.011	
1	8/25/2017 11:44	8/25/2017 11:44	8/25/2017 11:45	14.8	5.97	0.013	0.037	
12	8/25/2017 9:22	8/25/2017 9:22	8/25/2017 9:25	25.2	5.97	0.024	0.010	
18	8/25/2017 9:16	8/25/2017 9:16	8/25/2017 9:18	17.7	5.97	0.011	0.011	
4	8/25/2017 8:43	8/25/2017 8:43	8/25/2017 8:45	8.7	5.97	0.013	0.007	
5	8/25/2017 8:36	8/25/2017 8:36	8/25/2017 8:37	9.6	5.97	0.013	0.013	
7	8/25/2017 8:30	8/25/2017 8:30	8/25/2017 8:32	14.8	5.97	0.006	0.028	
8	8/25/2017 8:25	8/25/2017 8:25	8/25/2017 8:26	17.7	5.97	0.006	0.018	
10	8/25/2017 9:28	8/25/2017 9:28	8/25/2017 10:19	22.6	5.97	0.021	0.011	
13	8/25/2017 7:53	8/25/2017 7:54	8/25/2017 7:59	25.6	5.97	0.013	0.007	
9	8/25/2017 8:09	8/25/2017 8:09	8/25/2017 8:19	20.4	5.97	0.028	0.010	
11	8/25/2017 8:03	8/25/2017 8:03	8/25/2017 8:05	24.2	5.97	0.008	0.024	
Spliced								
13	8/30/2017 11:06	8/30/2017 11:06	8/30/2017 11:07	25.6	6.10	0.006	0.012	
2	8/30/2017 10:06	8/30/2017 10:06	8/30/2017 10:06	12.0	6.10	0.005	0.018	
3	8/30/2017 10:09	8/30/2017 10:09	8/30/2017 10:10	9.6	6.10	0.005	0.018	
4	8/30/2017 10:14	8/30/2017 10:14	8/30/2017 10:16	8.7	6.10	0.011	0.014	
5	8/30/2017 10:19	8/30/2017 10:19	8/30/2017 10:20	9.6	6.10	0.011	0.014	
6	8/30/2017 10:23	8/30/2017 10:23	8/30/2017 10:25	12.0	6.10	0.013	0.016	
7	8/30/2017 10:27	8/30/2017 10:27	8/30/2017 10:29	14.8	6.10	0.013	0.016	
8	8/30/2017 10:32	8/30/2017 10:32	8/30/2017 10:34	17.7	6.10	0.013	0.013	
10	8/30/2017 10:40	8/30/2017 10:40	8/30/2017 11:00	22.6	6.10	0.003	0.018	
Replacement Piles								
6A	9/12/2017 7:51	9/12/2017 7:59	9/12/2017 9:41	13.0	4.70	0.014	0.007	
10A	9/12/2017 8:29	9/12/2017 8:36	9/12/2017 9:37	23.6	4.70	0.015	0.003	
13A	9/12/2017 9:07	9/12/2017 9:13	9/12/2017 9:29	26.6	4.70	0.015	0.011	

NORTH KENT 1
Preliminary Vibration Monitoring Report

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 1223 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1635 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. The maximum vibration measurement for Well 11 was 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. The maximum vibration measurement for Well 12 was 0.896 mm/s and the pump was mounted on the well casing. The maximum vibration measurement of the Well 12 casing during all monitoring completed to the date of report issue was about 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving/restriking of some piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Data for Well 12 during driving of Pile 2 on August 23, 2017 was not captured when data logger battery failed and then changed. Total driving time on till/rock for Pile 9 was interrupted by repairs to the pile driving hammer and the actual driving duration on till/rock was 8:00 (minutes:seconds) for this pile. Total driving time on till/rock for restrike of Pile 10 was interrupted by damage to the pile top, splicing and welding and total driving duration on till/rock was 5:48 (minutes:seconds). Driving time on till/rock for driving of Pile 6A was interrupted from 8:07:35 to 8:10:35 and from 8:12:45 to 9:40:28. Driving time on till/rock for driving of Pile 10A was interrupted from 8:49:30 to 9:37:05. Driving time on till/rock for driving of Pile 13A was interrupted from 9:18:45 to 9:26:30. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T46

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/29/2017 8:38	8/29/2017 8:44	8/29/2017 9:10	26.5	5.80	NA[e]	0.002	
2	8/29/2017 9:24	8/29/2017 9:33	8/29/2017 9:49	25.5	5.80	NA[e]	0.003	
3	8/29/2017 10:14	8/29/2017 10:19	8/29/2017 10:30	23.8	5.80	NA[e]	0.037	
4	8/29/2017 12:41	8/29/2017 12:52	8/29/2017 13:01	21.5	5.80	0.004	0.010	
5	8/29/2017 12:00	8/29/2017 12:09	8/29/2017 12:28	18.9	5.80	NA[e]	0.003	
6	8/29/2017 11:02	8/29/2017 11:11	8/29/2017 11:25	16.0	5.80	NA[e]	0.006	
7	8/28/2017 16:35	8/28/2017 16:47	8/28/2017 16:53	13.1	7.85	0.015	0.071	
8	8/28/2017 16:02	8/28/2017 16:12	8/28/2017 16:20	10.9	7.85	0.007	1.551	0.039
9	8/28/2017 13:25	8/28/2017 13:34	8/28/2017 13:36	10.0	7.85	0.006	0.011	
10	8/28/2017 12:44	8/28/2017 12:56	8/28/2017 12:59	10.9	7.85	0.006	0.008	
11	8/28/2017 11:25	8/28/2017 11:34	8/28/2017 11:41	13.1	7.85	NA[e]	0.011	
12	8/28/2017 10:07	8/28/2017 10:17	8/28/2017 10:20	16.0	7.85	0.003	0.009	
13	8/28/2017 9:33	8/28/2017 9:43	8/28/2017 9:49	18.9	7.85	0.021	0.015	
14	8/28/2017 9:00	8/28/2017 9:12	8/28/2017 9:16	21.5	7.85	0.003	0.003	
15	8/28/2017 8:30	8/28/2017 8:44	8/28/2017 8:47	23.8	7.85	0.004	0.004	
16	8/28/2017 13:53	8/28/2017 14:03	8/28/2017 14:07	25.5	7.85	0.002	0.006	
17	8/28/2017 14:27	8/28/2017 14:38	8/28/2017 14:48	26.5	7.85	0.017	0.004	
18	8/29/2017 7:53	8/29/2017 8:01	8/29/2017 8:05	26.9	5.80	NA[e]	0.002	
Restrikes								
9	8/29/2017 13:14	8/29/2017 13:14	8/29/2017 13:16	10.0	5.80	0.005	0.006	
8	8/29/2017 13:25	8/29/2017 13:25	8/29/2017 13:26	10.9	5.80	0.003	0.052	
16	8/29/2017 13:36	8/29/2017 13:36	8/29/2017 13:38	25.5	5.80	0.003	0.006	

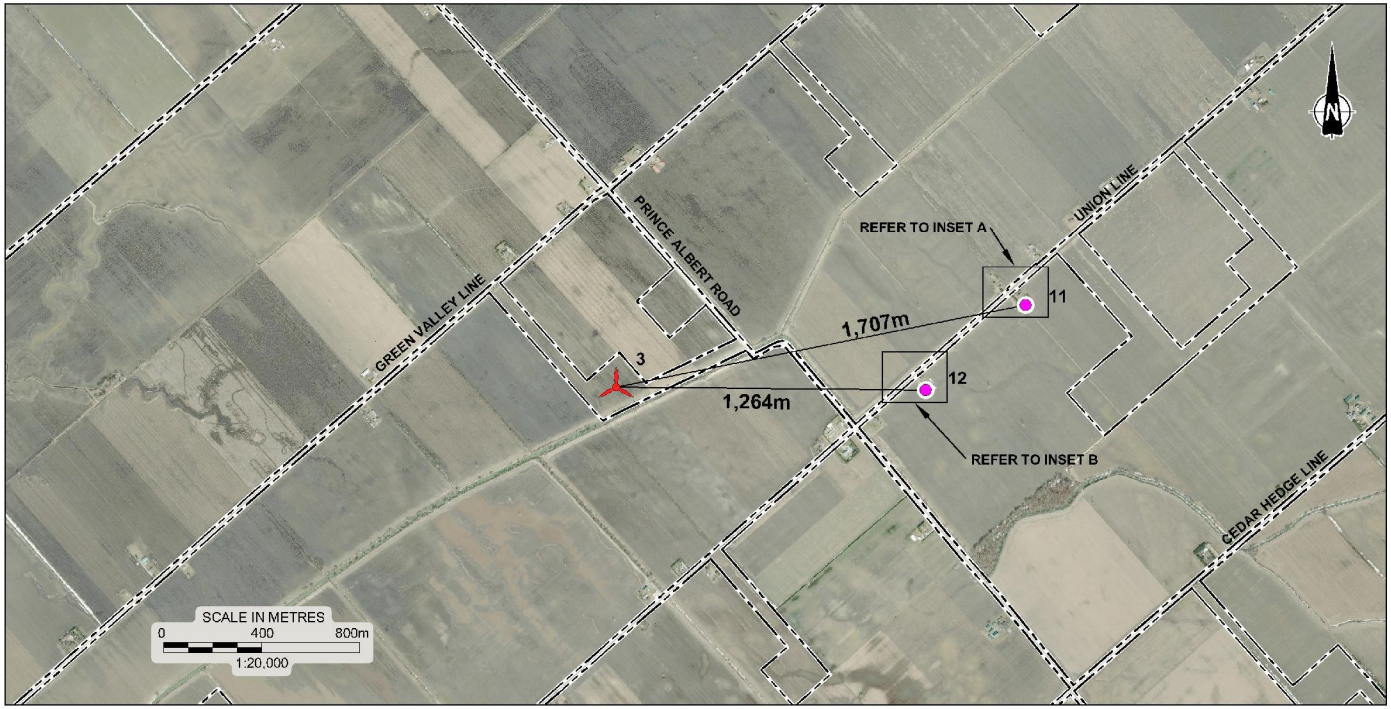
Well Information

Well No.:	11	**Well No.:**	12
Municipal Address:		Municipal Address:	
Distance from Turbine Centre:	1697 m	Distance from Turbine Centre:	2170 m

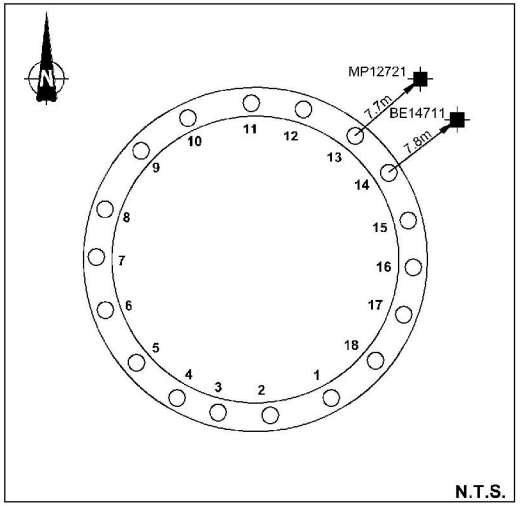
ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Data obtained during pile dynamic analyses is pending. Piles noted with "A" represent piles installed to replace similarly-numbered piles. After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Total duration for pile driving on rock/till based on times noted above is not representative for Piles 1 and where the actual duration for driving on till/rock was (minutes:seconds): 1(11:30) and 5(18:32) . Maximum vibrations for Well 12 were 1.55 mm/s for August 29, 2017. The pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 2, 3, 5, 6, 11 and 18 at Well 11 on August 28 and 29, 2017 due to several separate battery failures in monitoring equipment. Batteries were subsequently replaced upon discovery.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN MAGNETIC NORTH
- UTM-N UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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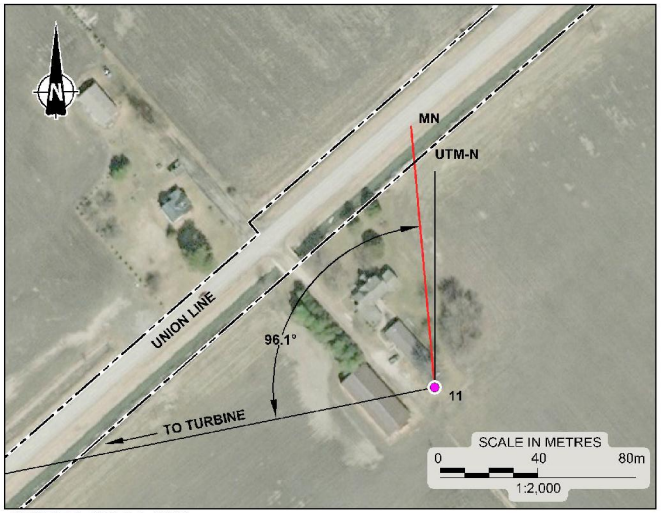
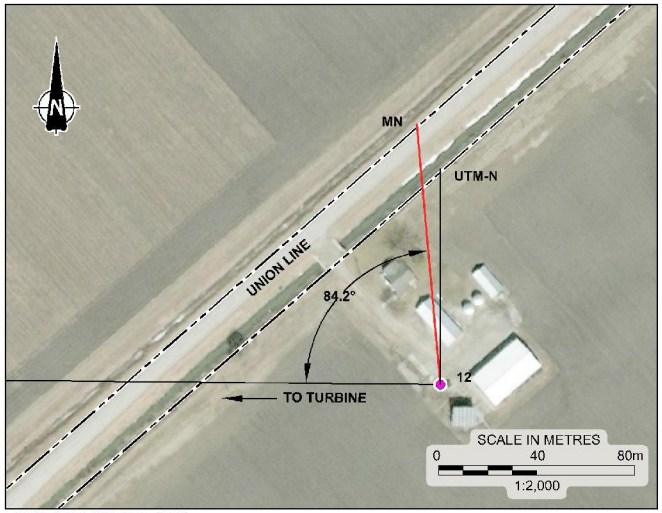
ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

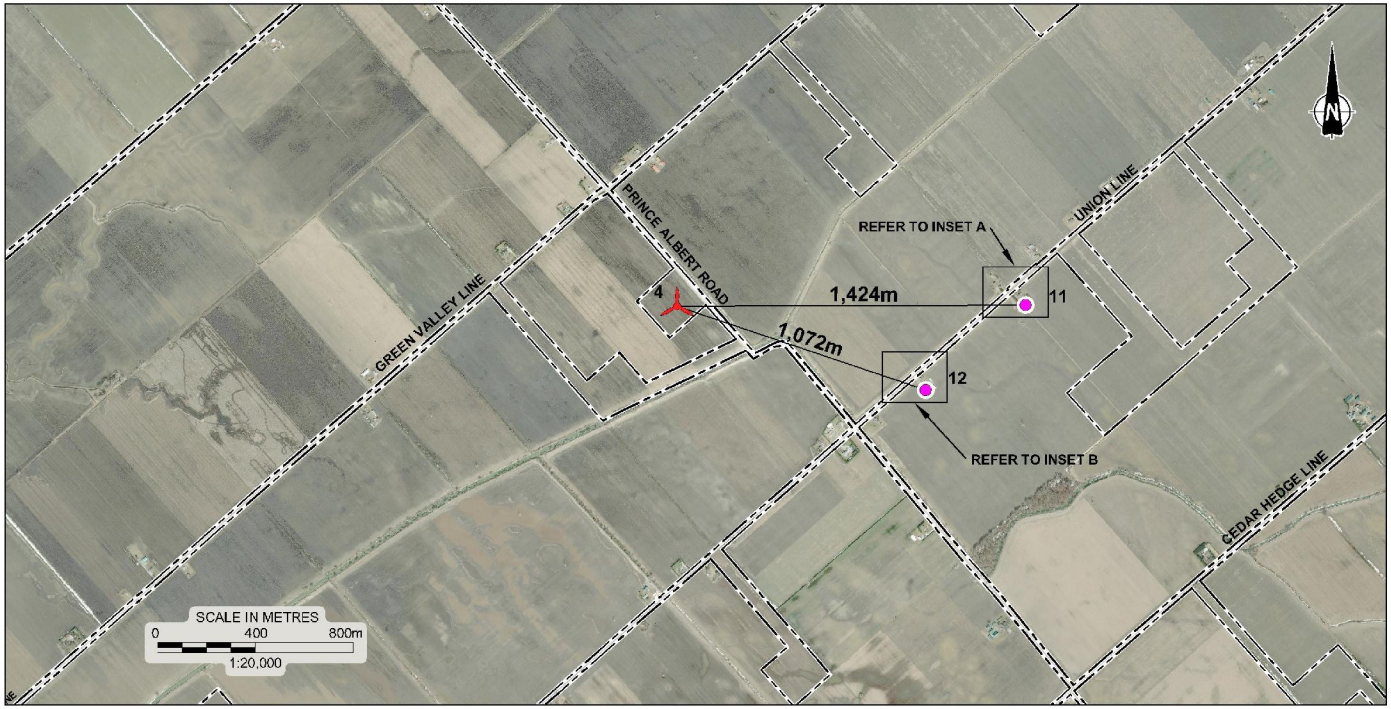
TURBINE PILES AND WATER WELL LOCATION PLAN, T3

Golder Associates

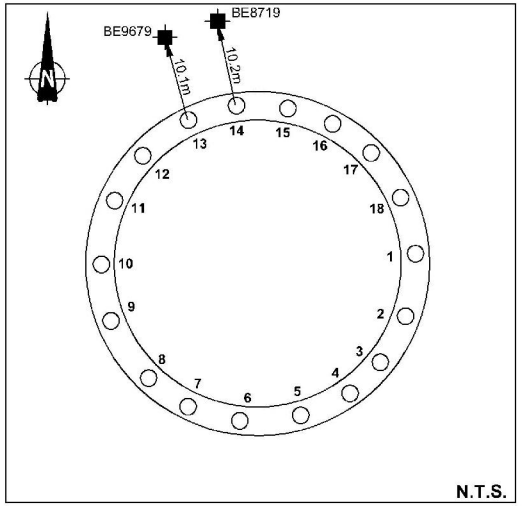
PROJECT No.	1668031	FILE No.	1668031-2000-R020T3
DESIGN		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T3

Drawing file: 1668031-2000-R020T3.dwg Sep 20, 2017 - 12:49pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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NOTES

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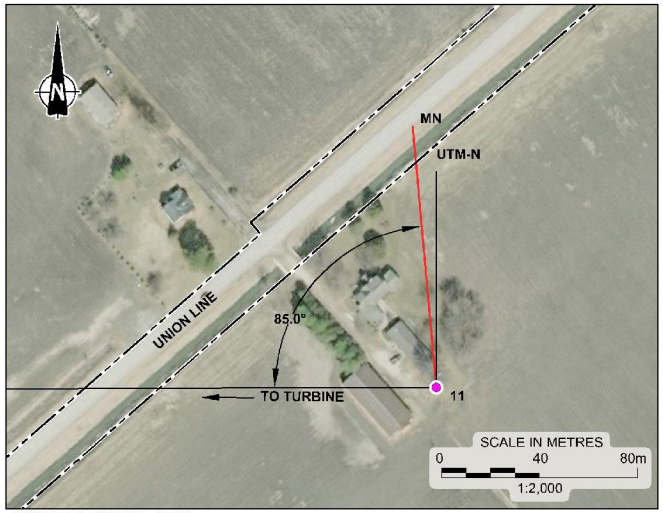
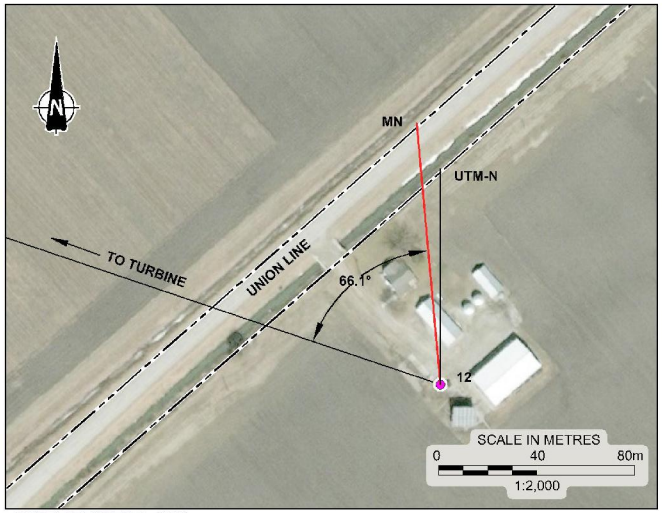


INSET A (WELL #11)



INSET B (WELL #12)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

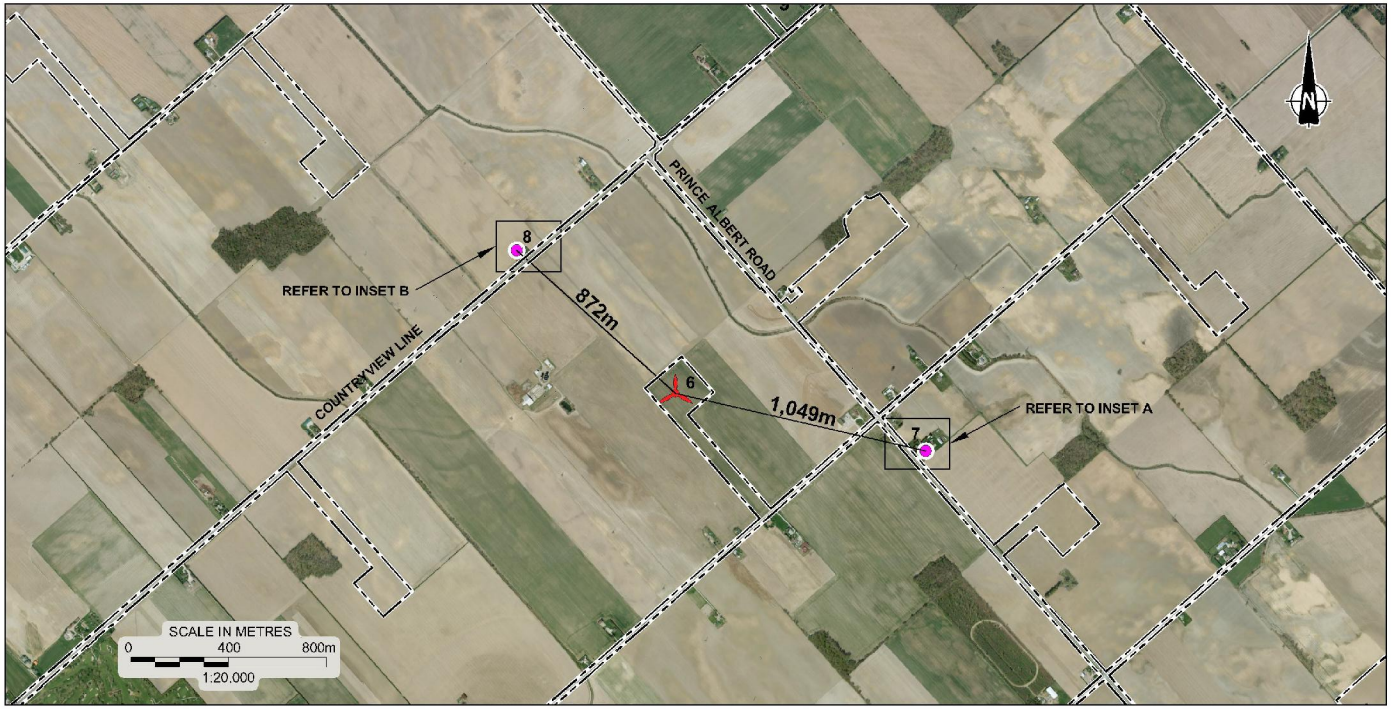
TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T4

Golder Associates

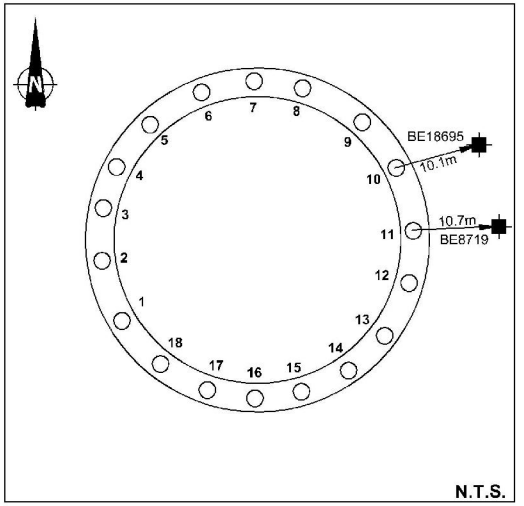
PROJECT No.	1668031	FILE No.	1668031-2000-R020T4
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept 18/17		
CHECK			

FIGURE T4

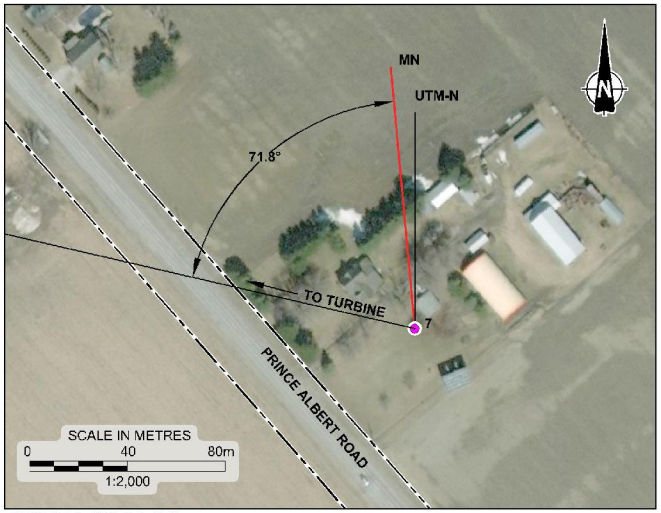
Drawing file: 668031 2000 R020T4.dwg Sep 20, 2017 12:51pm



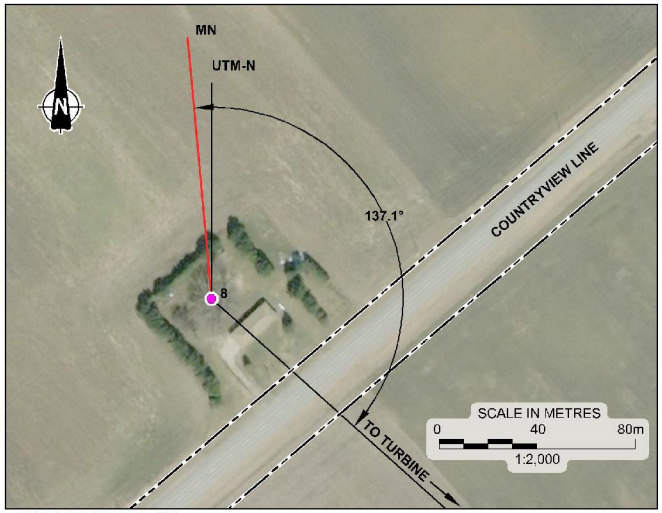
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #7)



INSET B (WELL #8)

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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NOTES

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PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T6

Golder Associates

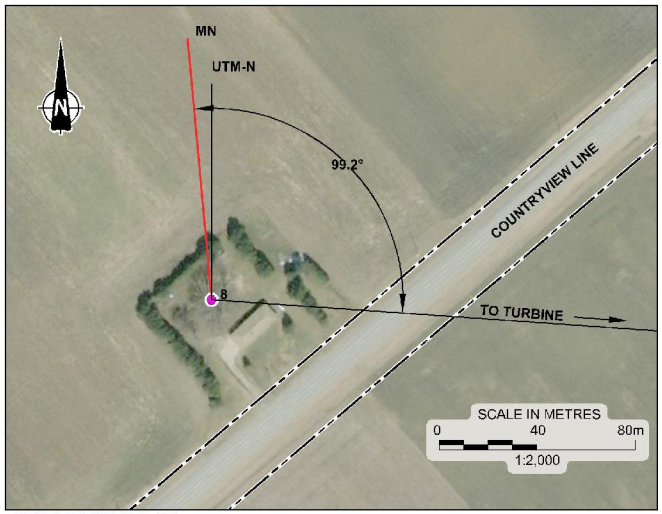
PROJECT No.	1668031	FILE No.	1668031-2000-R02016
CADD	DCH/ZJB Sept. 18/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T6

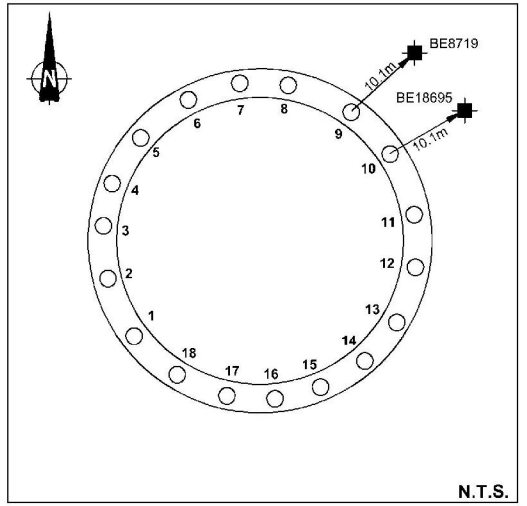
Drawing file: 1668031-2000-R02016.dwg Sep 20, 2017 - 12:52pm

SITE PLAN

INSET A (WELL #7)



INSET B (WELL #8)



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T7

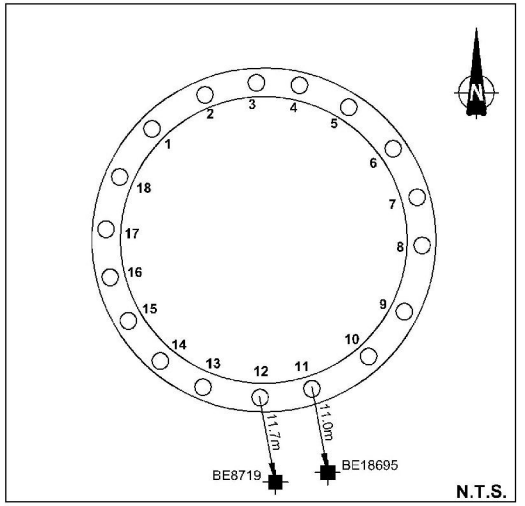
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02017
		SCALE	AS SHOWN
CADD	DCH/ZJB	Sept. 18/17	
CHECK			

FIGURE T7

Drawing file: 668031 2000 R02017.dwg Sep 20, 2017 12:54pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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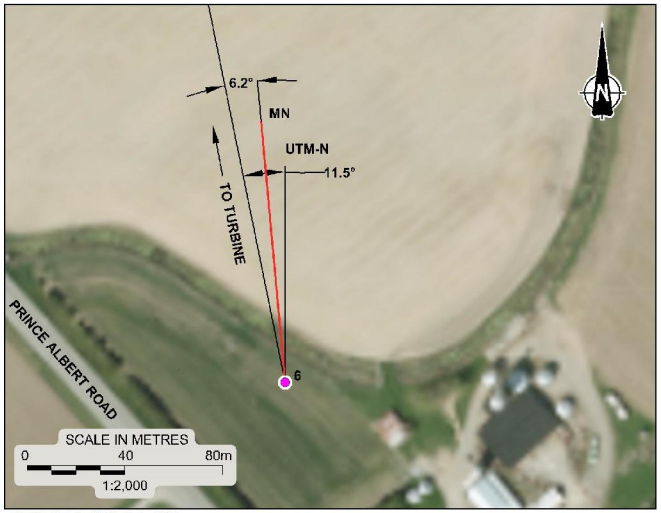
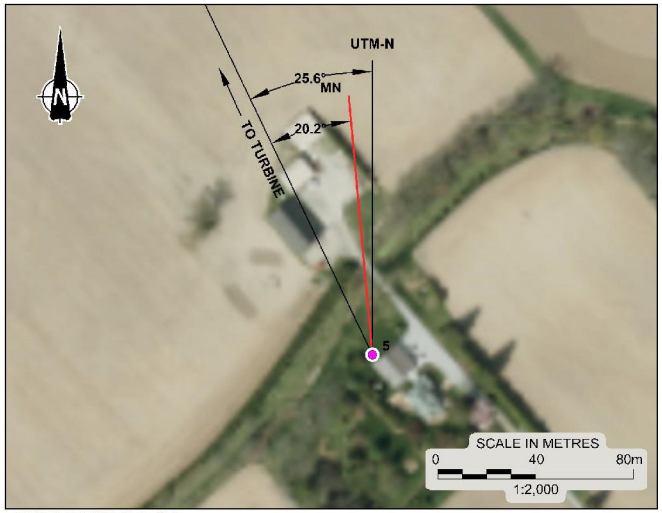


INSET A (WELL #6)



INSET B (WELL #5)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T12

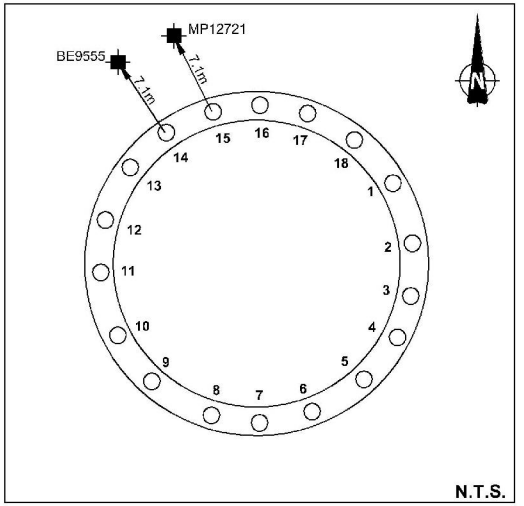
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02T12
DSGN	DCH/ZJB Sept. 20/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T12

Drawing file: 1668031-2000-R02T12.dwg Sep 20, 2017 - 12:39pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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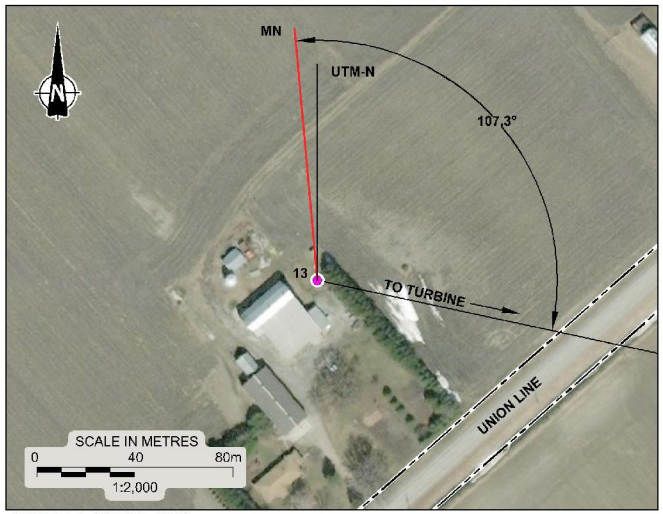
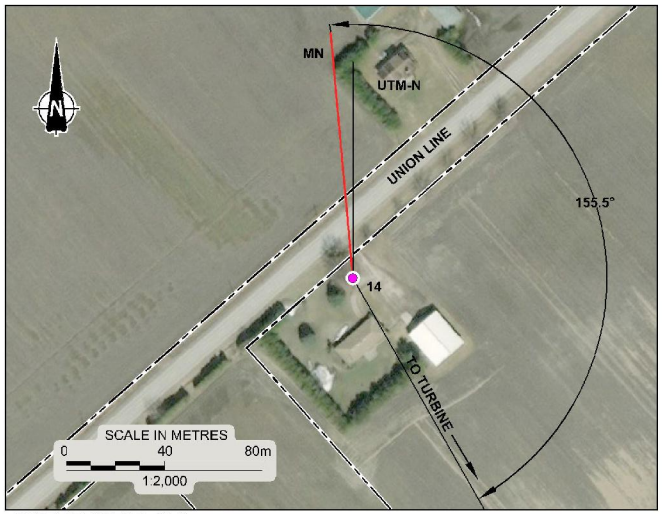


INSET A (WELL #13)



INSET B (WELL #14)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

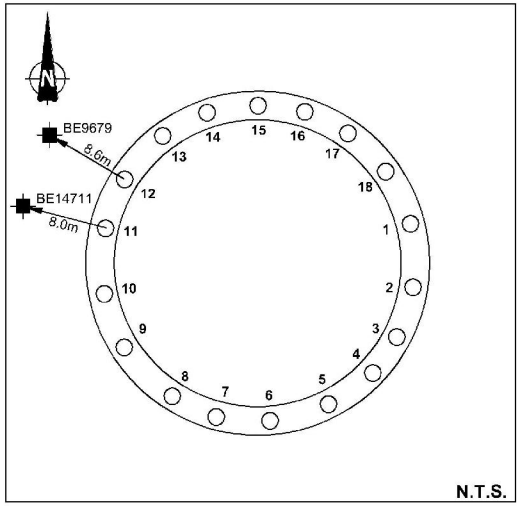
TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T14

Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T14
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 18/17		FIGURE T14
CHECK				

Drawing file: 668031 2000 R02T-4.dwg Sep 18, 2017 4:46pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN MAGNETIC NORTH
- UTM-N UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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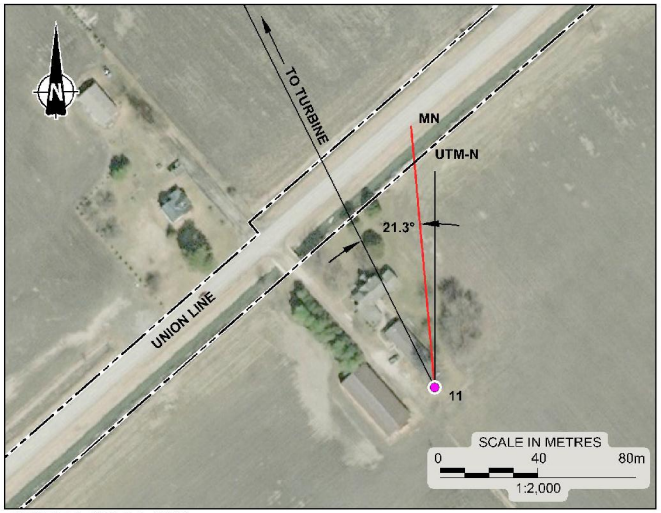
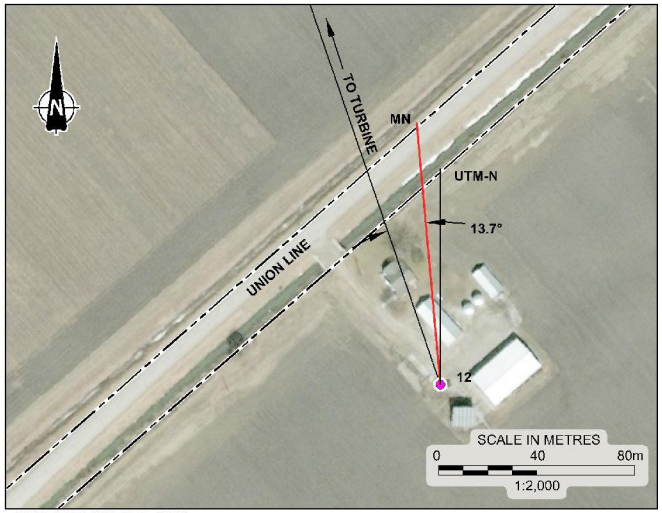
ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

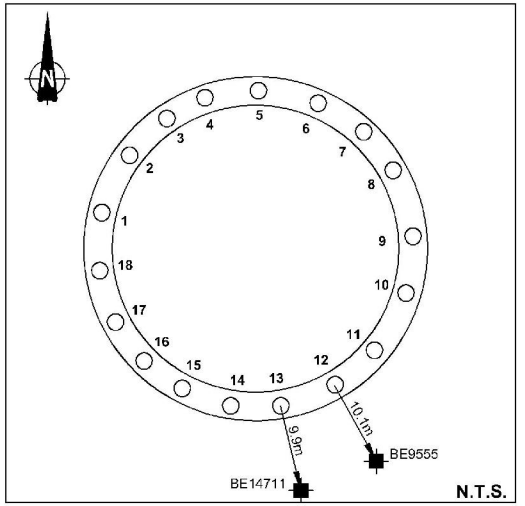
TURBINE PILES AND WATER WELL LOCATION PLAN, T20

Golder Associates

			PROJECT No. 1668031	FILE No. 1668031-2000-R02T20
				SCALE AS SHOWN REV.
			CADD DCH/ZJB Sept. 18/17	
			CHECK	FIGURE T20

Drawing file: 1668031-2000-R02T20.dwg Sep 18, 2017 - 2:21pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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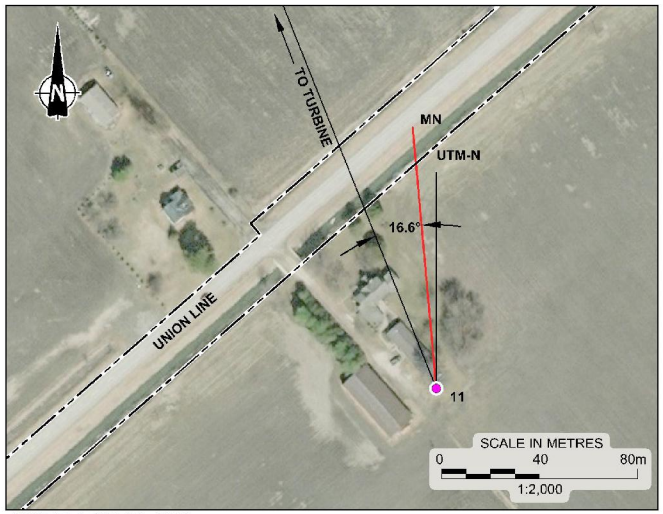
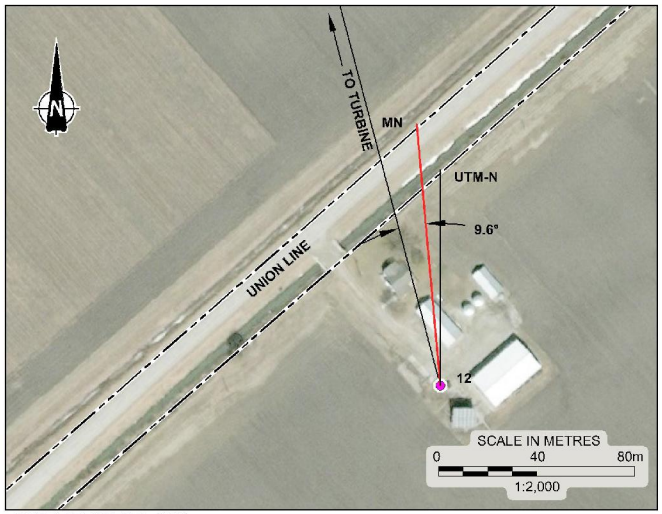


INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T21

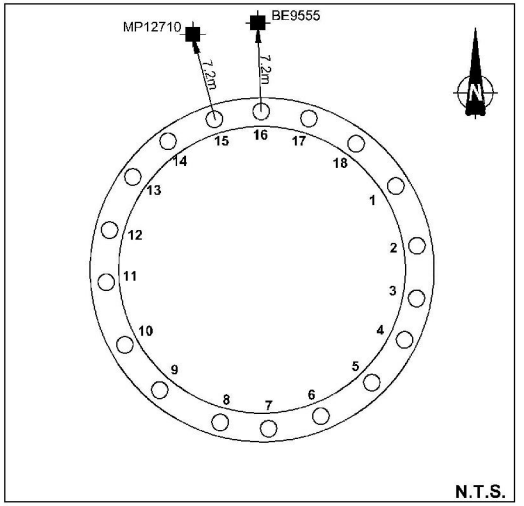
Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T21
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 18/17		
CHECK				

FIGURE T21

Drawing file: 668031 2000 R02T21.dwg Sep 18, 2017 2:24pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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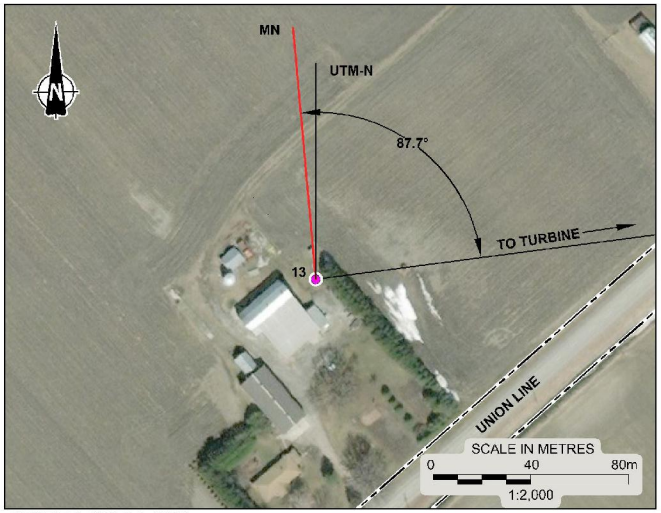
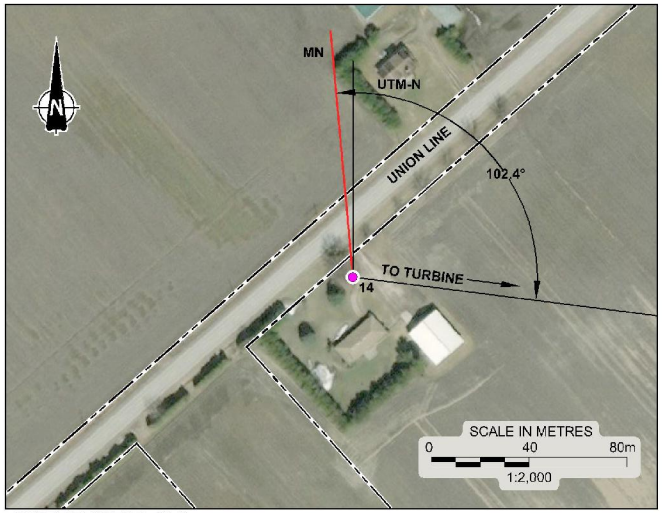


INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T26

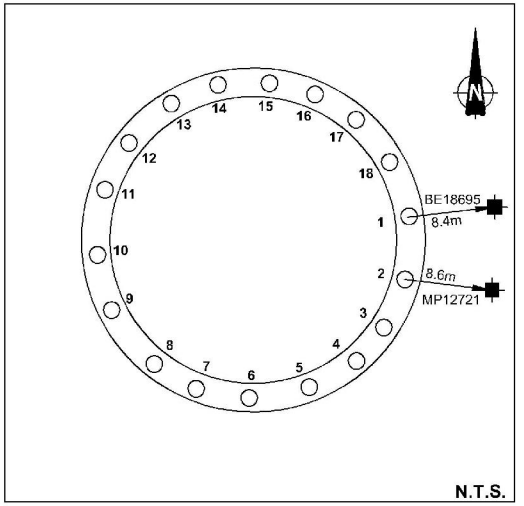
Golder Associates

PROJECT No.	1668031			FILE No.	1668031-2000-R02T26
				SCALE	AS SHOWN
CADD	DCH/ZJB	Sept 20/17		REV.	
CHECK					

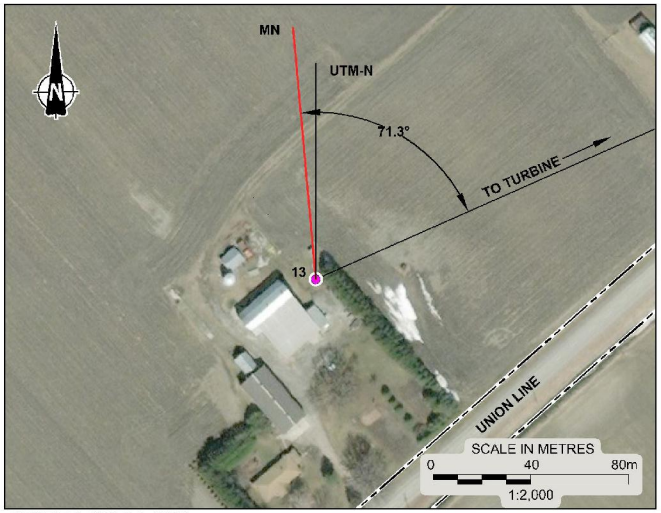
FIGURE T26

Drawing file: 1668031-2000-R02T26.dwg Sep 20, 2017 - 11:15am

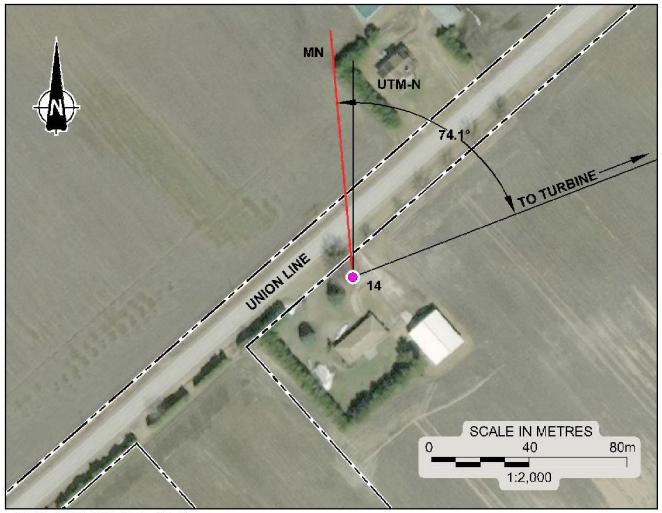
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #13)



INSET B (WELL #14)

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

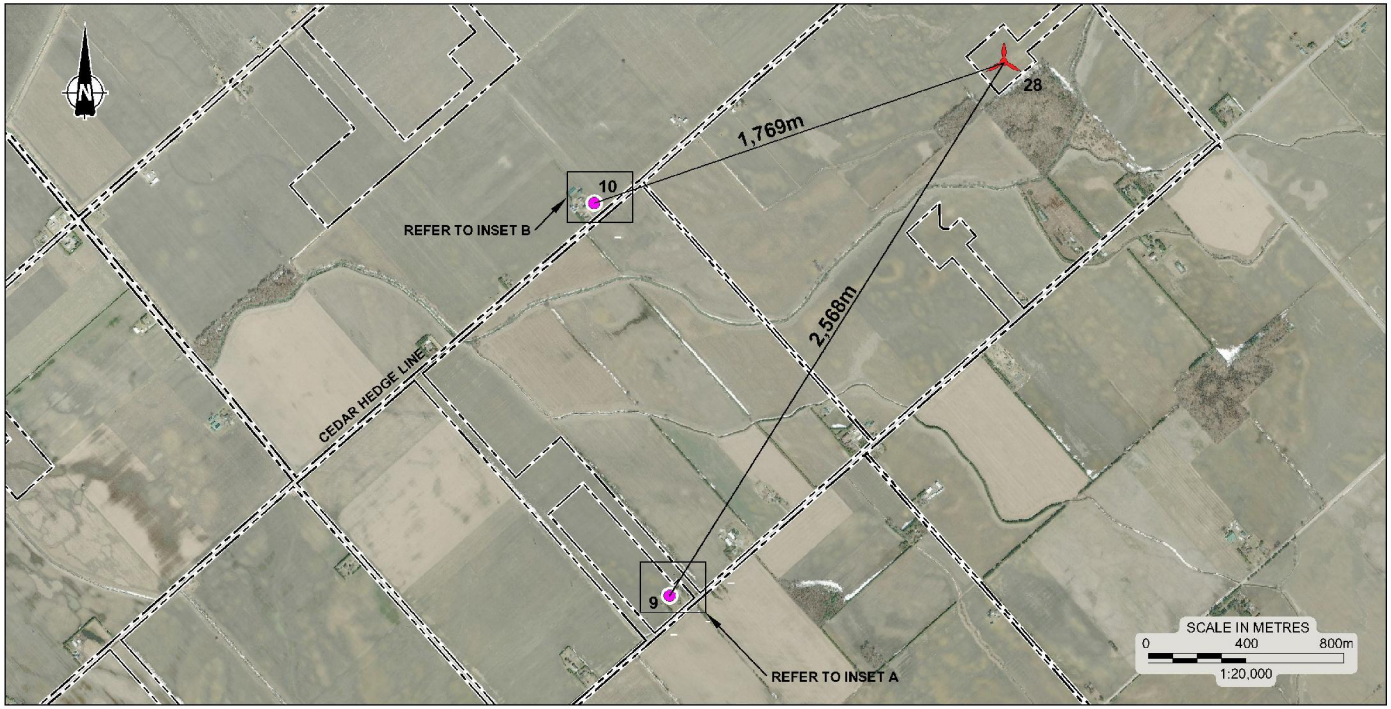
TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T27

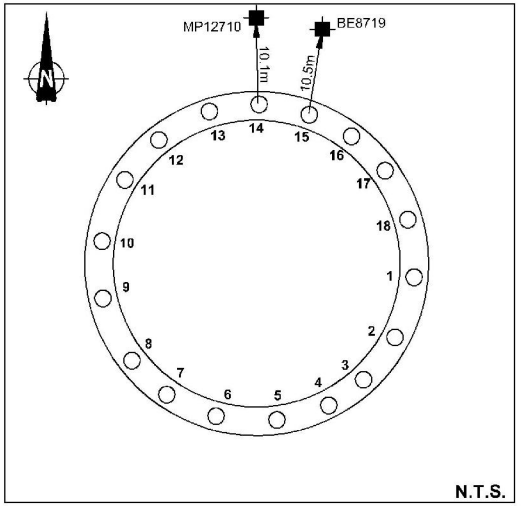
Golder Associates

			PROJECT No. 1668031	FILE No. 1668031-2000-R02127
			SCALE AS SHOWN	REV.
			DSGN DCH/ZJB Sept 20/17	FIGURE T27
			CHECK	

Drawing file: 1668031-2000-R02127.dwg Sep 20, 2017 - 11:10am



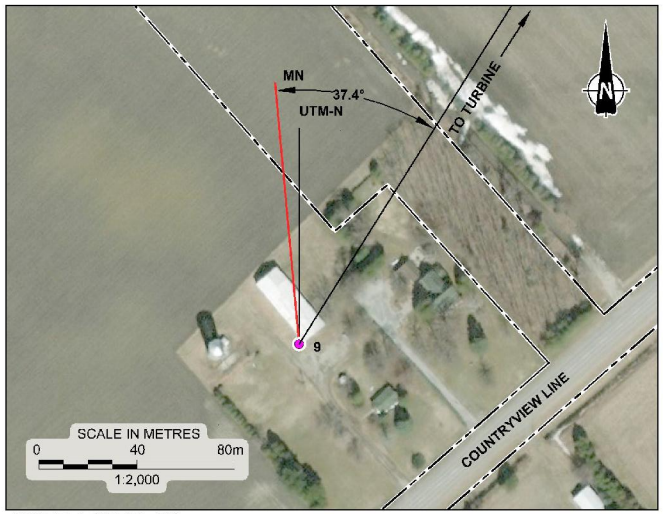
SITE PLAN



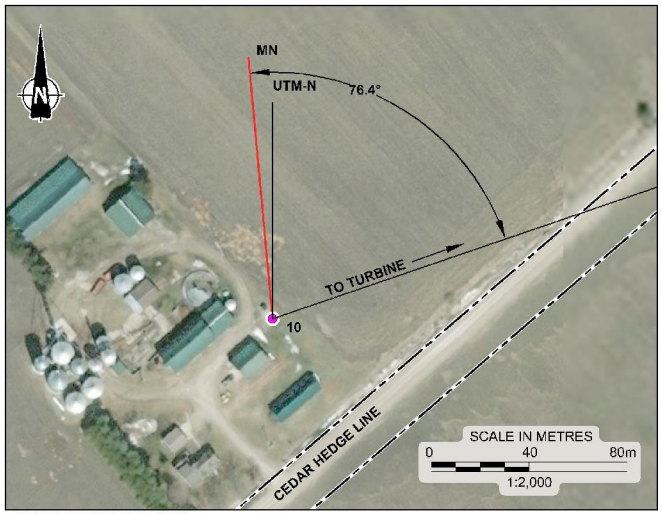
TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH



INSET A (WELL #9)



INSET B (WELL #10)

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

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PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T28

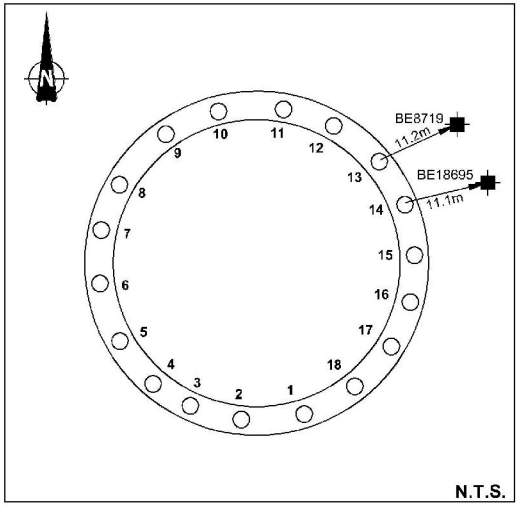
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02T28
		SCALE	AS SHOWN
CADD	DCH/ZJB	Sept. 20/17	
CHECK			

FIGURE T28

Drawing file: 1668031 2000 R02T28.dwg Sep 20, 2017 12:39pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

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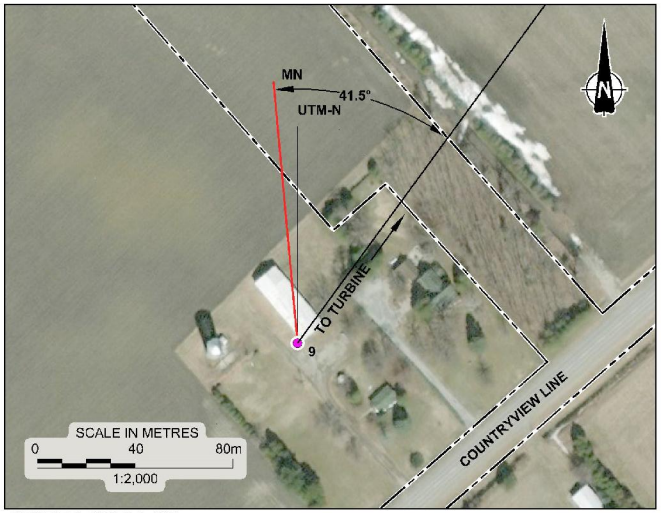
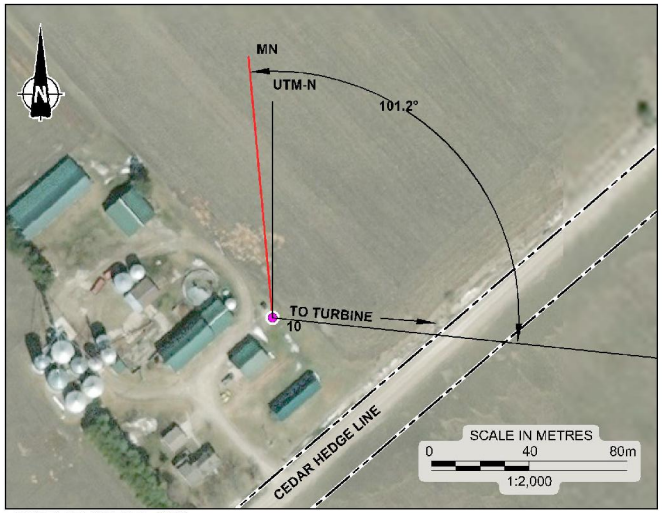


INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T30

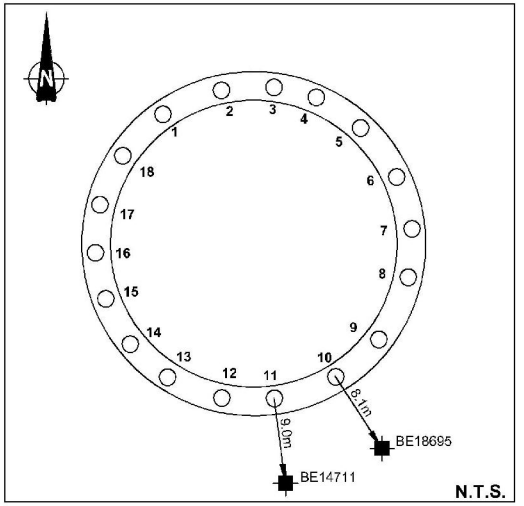
Golder Associates

PROJECT No.	1668031		FILE No.	1668031-2000-R02T30
			SCALE	AS SHOWN
CADD	DCH/ZJB	Sept. 20/17	REV.	
CHECK				

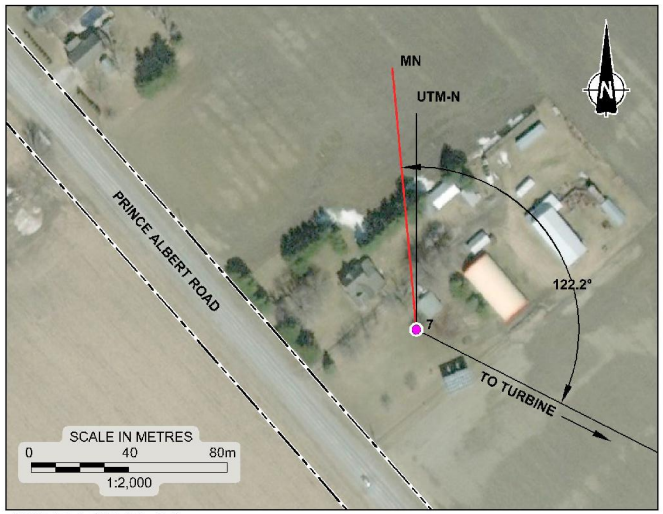
FIGURE T30

Drawing file: 1668031-2000-R02T30.dwg Sep 20, 2017 - 12:41pm

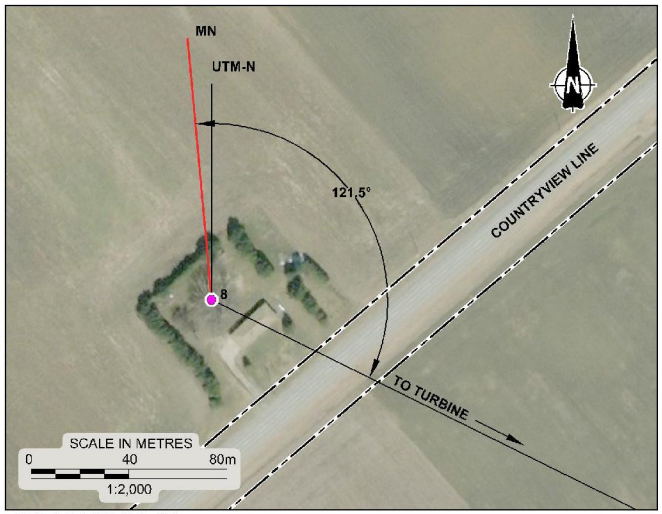
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #7)



INSET B (WELL #8)

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T31

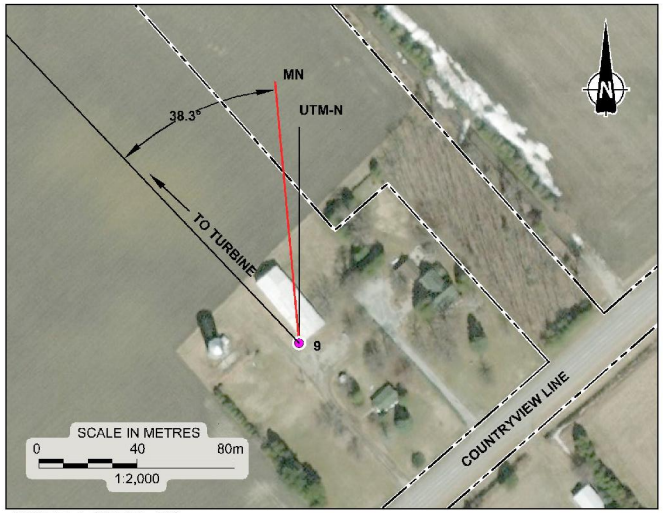
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-RC2T31
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

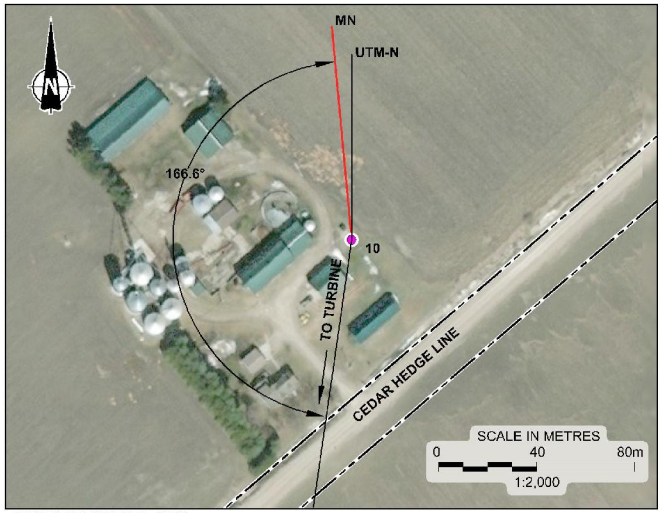
FIGURE T31

Drawing file: 668031 2000 RC2T31.dwg Sep 20, 2017 12:42pm

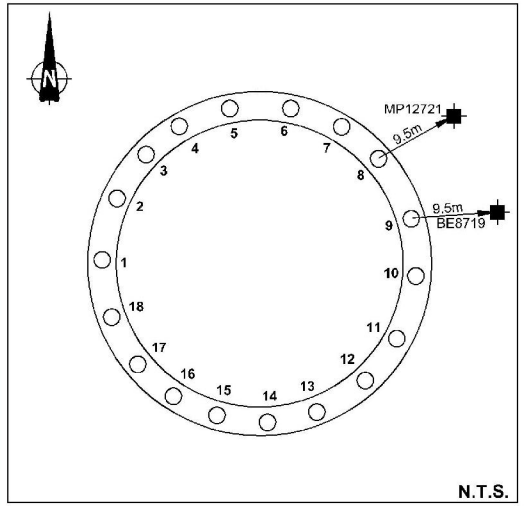
SITE PLAN



INSET A (WELL #9)



INSET B (WELL #10)



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

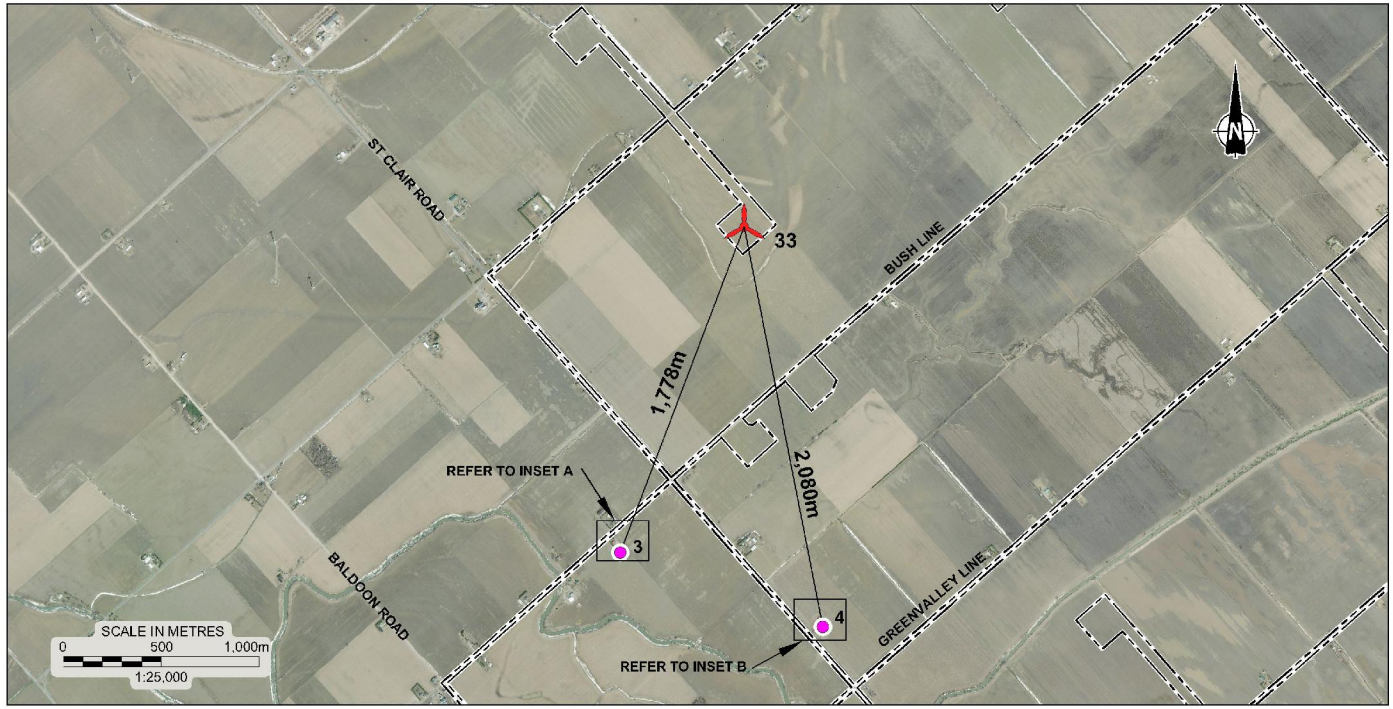
TURBINE PILES AND WATER WELL LOCATION PLAN, T32

Golder Associates

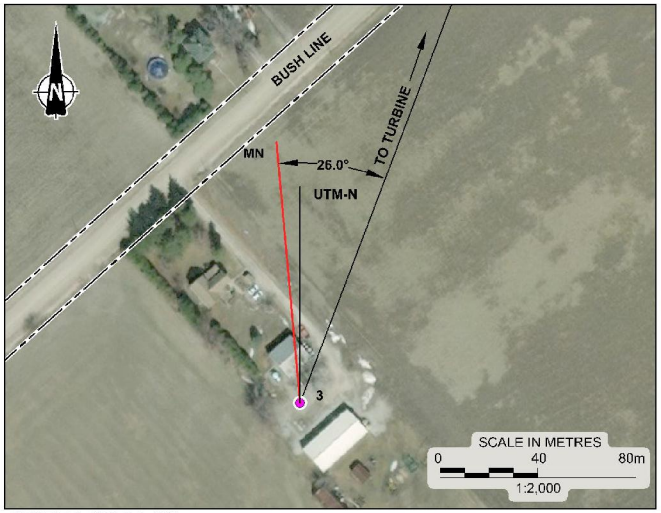
PROJECT No.	1668031	FILE No.	1668031-2000-R02T32
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T32

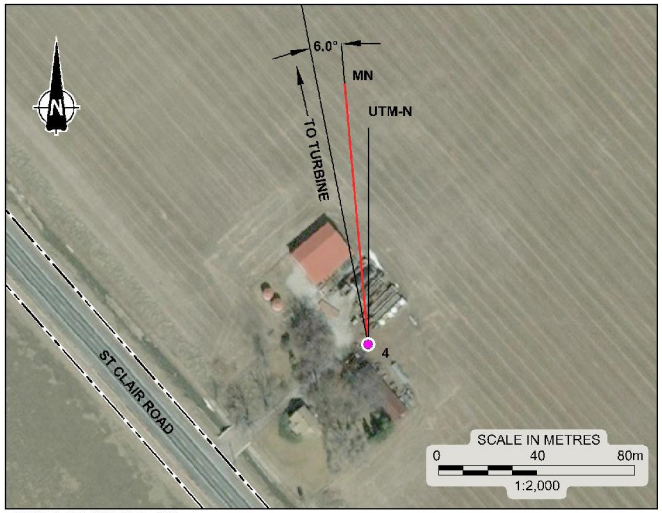
Drawing file: 668031 2000 R02T32.dwg Sep 20, 2017 12:59pm



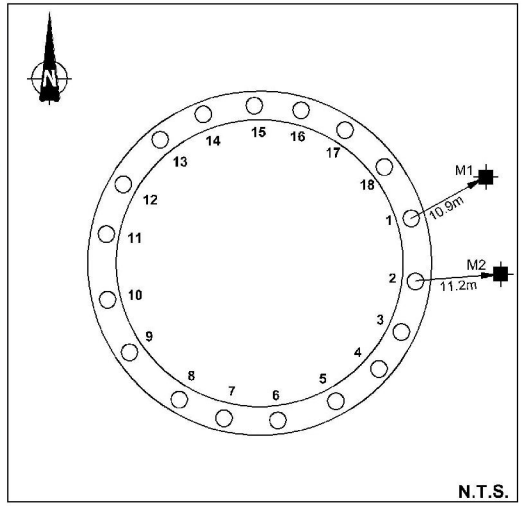
SITE PLAN



INSET A (WELL #3)



INSET B (WELL #4)



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

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PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T33

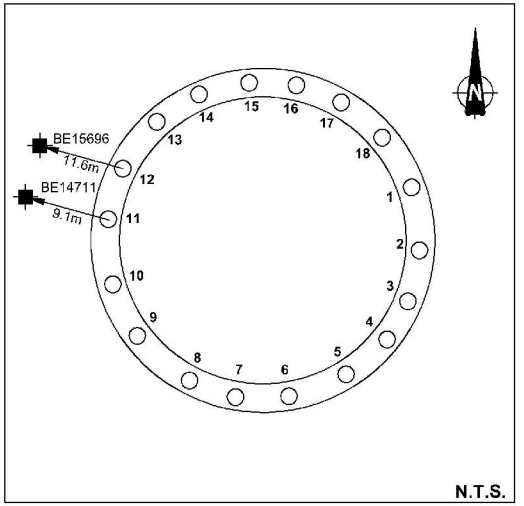
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02T33
CADD	DCH/ZJB Sept. 18/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T33

Drawing file: 1668031-2000-R02T33.dwg Sep 20, 2017 - 12:46pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

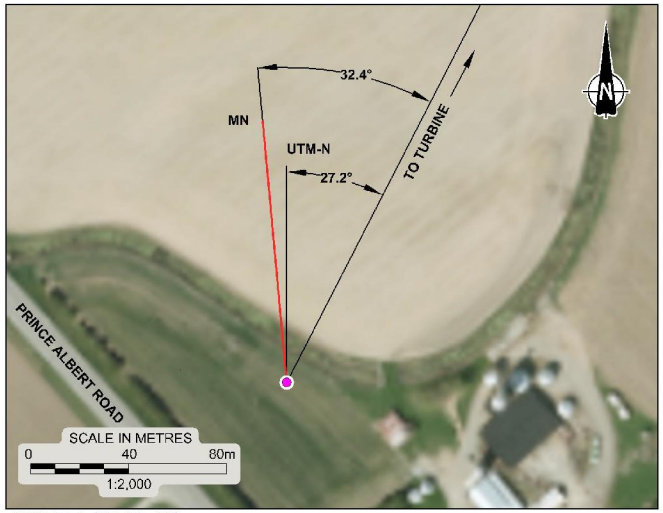
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

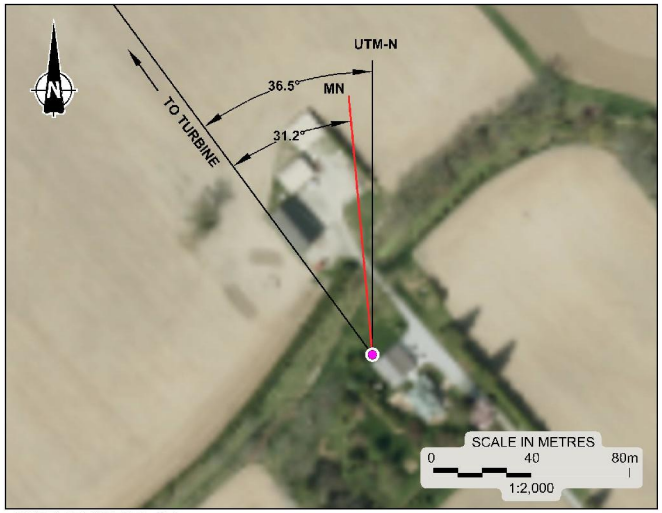
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #6)



INSET B (WELL #5)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

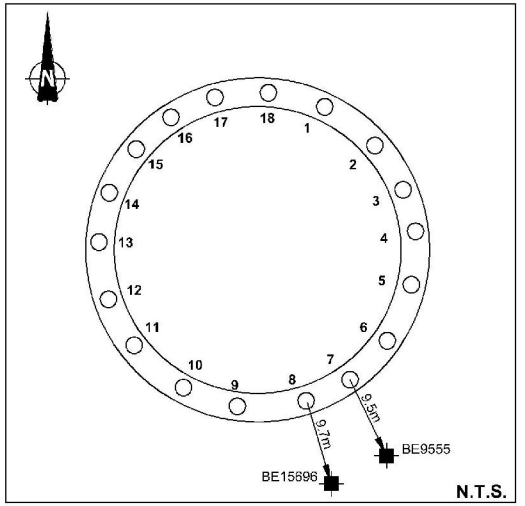
TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T35

Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02T35
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T35

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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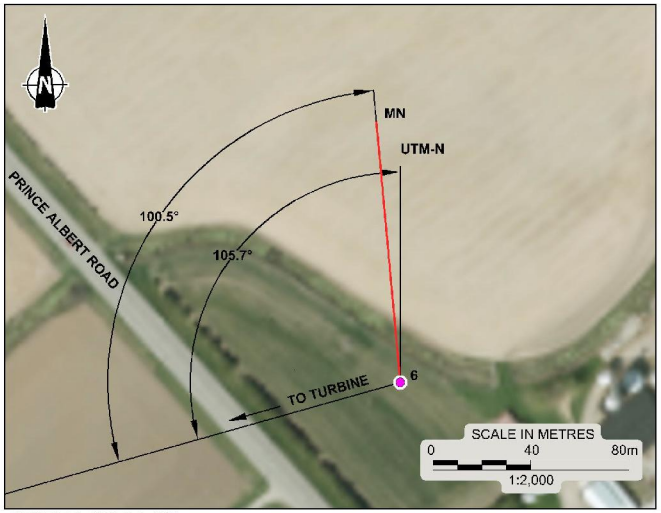
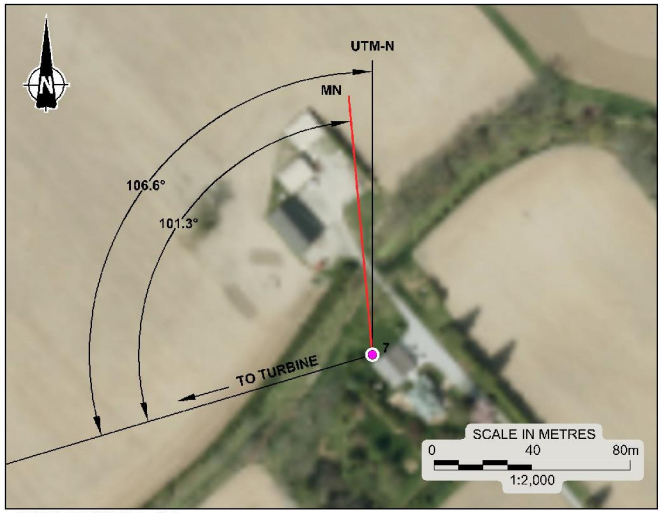
ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #6)



INSET B (WELL #5)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

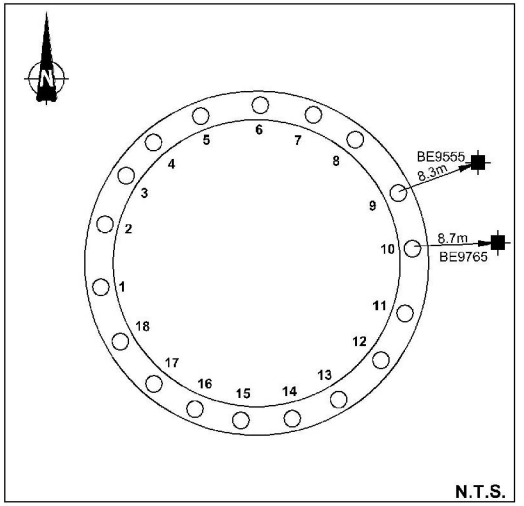
TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T36

Golder Associates

				PROJECT No. 1668031	FILE No. 1668031-2000-R02T36
					SCALE AS SHOWN REV.
				CADD DCH/ZJB Sept. 20/17	FIGURE T36
				CHECK	

Drawing file: 1668031-2000-R02T36.dwg Sep 20, 2017 - 12:48pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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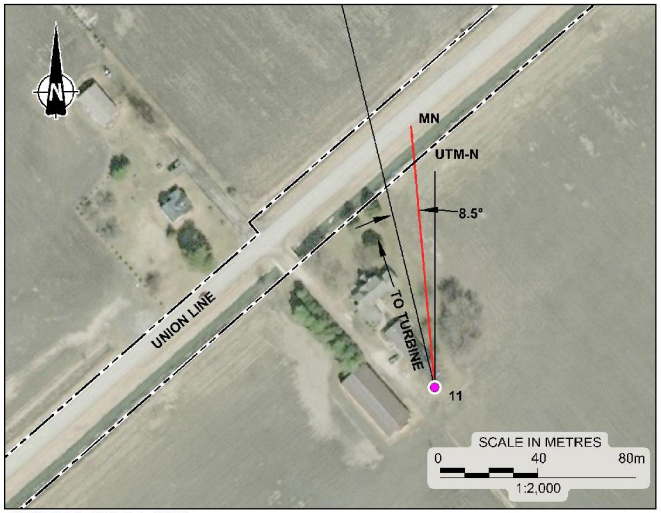
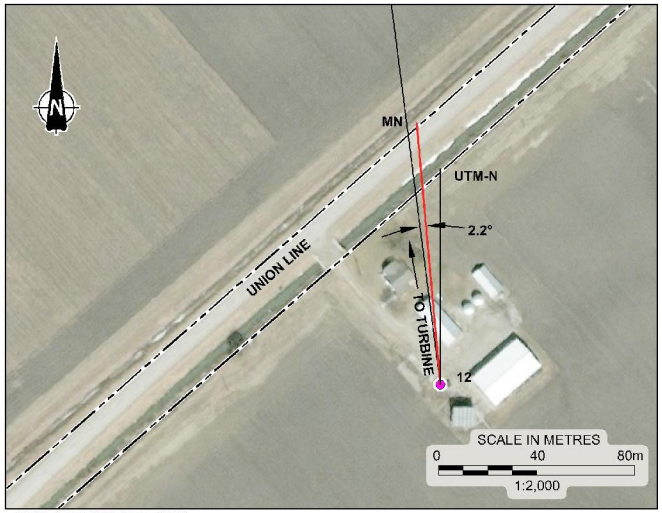
ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T43

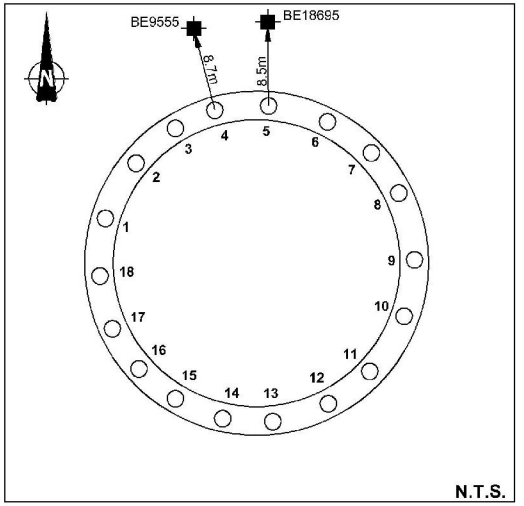
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R02T43
		SCALE	AS SHOWN
DSGN	DCH/ZJB Sept. 20/17	REV.	
CHECK			

FIGURE T43

Drawing file: 1668031-2000-R02T43.dwg Sep 20, 2017 - 12:06pm

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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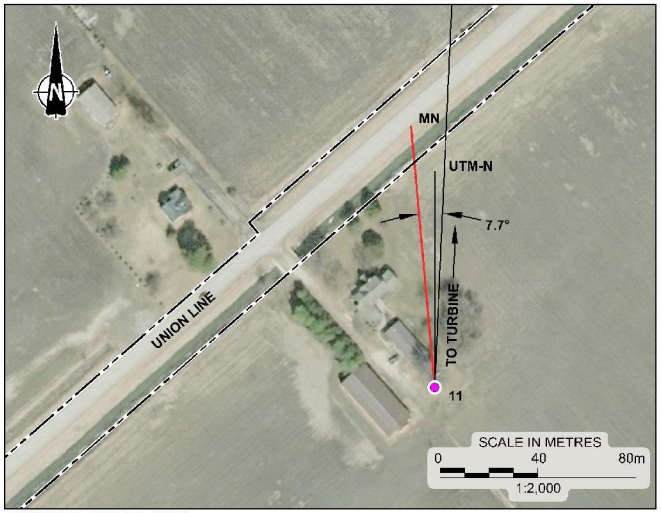
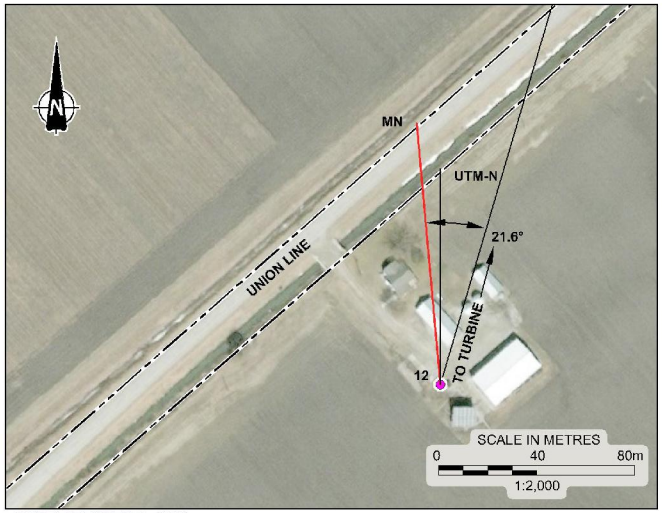
ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

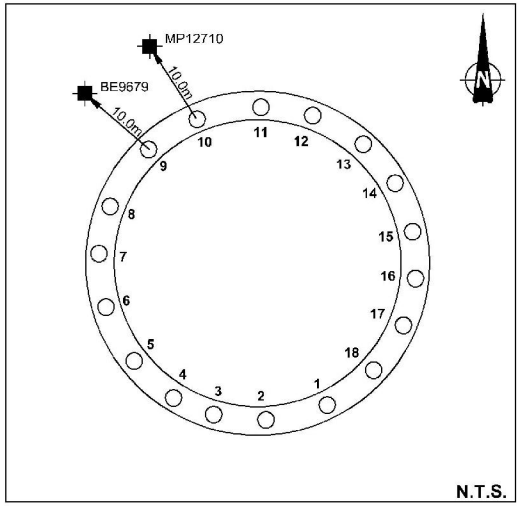
TURBINE PILES AND WATER WELL LOCATION PLAN, T45

Golder Associates

			PROJECT No. 1668031	FILE No. 1668031-2000-R02T45
				SCALE AS SHOWN REV.
			CADD DCH/ZJB Sept. 18/17	
			CHECK	

FIGURE T45

SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

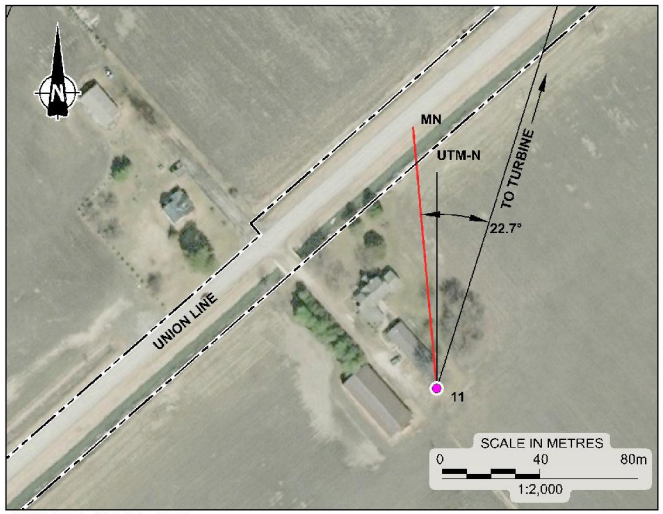
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

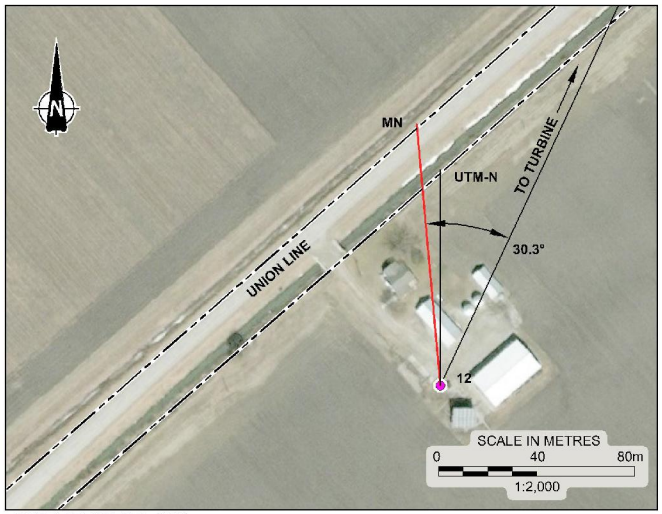
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T46

Golder Associates

PROJECT No.	1658031	FILE No.	1658031-2000-R02T46
DESIGN	DCH/ZJB Sept. 18/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T46

Drawing file: 1658031 2000 R02T46.dwg Sep 18, 2017 2:07pm

Attachment C

MOECC Water Well Records

Well ID

Well ID Number: 7250849
Well Audit Number: *Z213558*
Well Tag Number: *A186824*

This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	[redacted]
Township	CHATHAM TOWNSHIP
Lot	002
Concession	CON 11
County/District/Municipality	KENT
City/Town/Village	DRESDEN
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 393640 Northing: 4706783
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	LOAM			0 ft	1 ft
BRWN	CLAY	SAND	LYRD	1 ft	6 ft
GREY	CLAY	SILT	LYRD	6 ft	17 ft
GREY	CLAY			17 ft	44 ft
GREY	CLAY	STNS		44 ft	47.5 ft

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	8.5 ft	3/8 BENTONITE CHIPS	
8.5 ft	47.5 ft	PEA STONE	

Method of Construction & Well Use

Method of Construction	Well Use
Boring	
	Domestic

Status of Well

Water Supply

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To
36 inch	CONCRETE	1.5 ft	47.5 ft

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 7492

Results of Well Yield Testing

After test of well yield, water was	
If pumping discontinued, give reason	NO WATER ON COMPLETION
Pump intake set at	
Pumping Rate	
Duration of Pumping	
Final water level	
If flowing give rate	
Recommended pump depth	
Recommended pump rate	
Well Production	
Disinfected?	N

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
45		45	
50		50	
60		60	

Water Details

Water Found at Depth	Kind
47.5 ft	Untested

Hole Diameter

Depth From	Depth To	Diameter
0 ft	47.5 ft	48 inch

Audit Number: Z213558

Date Well Completed: September 28, 2015

Date Well Record Received by MOE: October 26, 2015

Updated: March 20, 2017
RateRate
Sharefacebook twitter Print
Tags

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A139346

Well Record

Regulation 903 Ontario Water Resources Act

Page of

[redacted]

Address of Well Location (Street Number/Name)	Township	Lot	Concession
8911 Union rd.	Dover	2	11

County/District/Municipality	City/Town/Village	Province	Postal Code
Chatham-Kent	Dresden	Ontario	N0P 1M0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	393643	4706778		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	Topsoil			0	1
Brown	Clay			1	46
Black	Sand	silt		46	46'4"
Black	Shale		Hard.	46'4"	62

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	Bentenite Grout	

Method of Construction

☒ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify*

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
5"	Steel	.188	+2	46'4"
5	Open hole		46'4"	62

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Status of Well

☒ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☒ Other, *specify* slight haze

If pumping discontinued, give reason:

Pump intake set at (m/ft): 42 ft

Pumping rate (l/min / GPM): .25 gpm us

Duration of pumping: 2 hrs + 0 min

Final water level end of pumping (m/ft): 14 ft

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft): 42 ft

Recommended pump rate (l/min / GPM): .25 gpm us

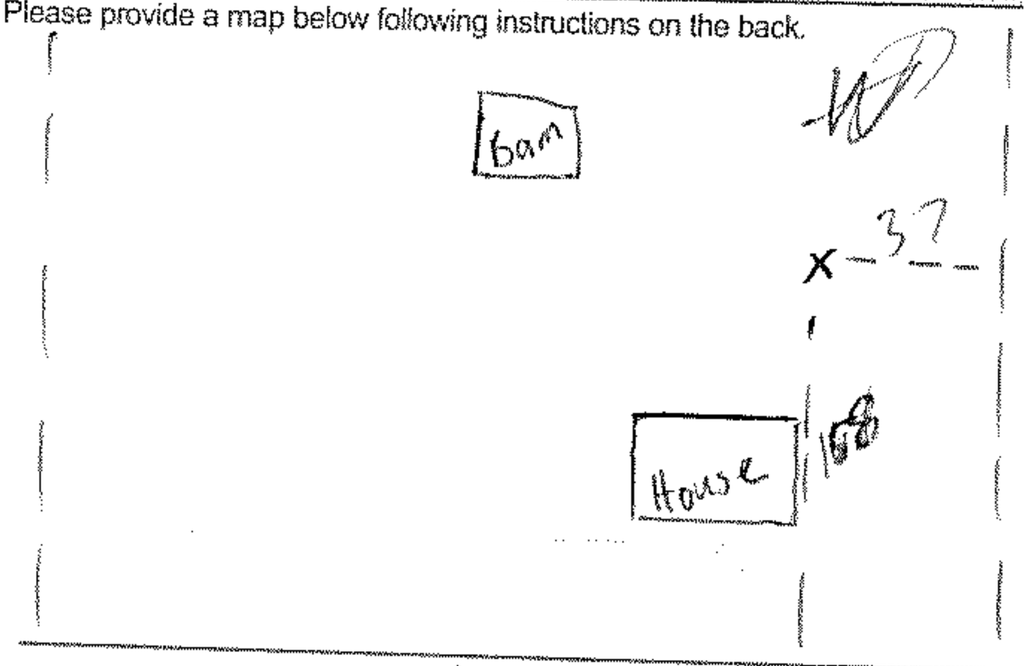
Well production (l/min / GPM):

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	9		
1	9'3"	1	13'9"
2	9'6"	2	13'6"
3	9'9"	3	13'3"
4	10	4	13
5	10'3"	5	12'9"
10	10'9"	10	13'7
15	11'2"	15	12'9"
20	11'7"	20	12'1"
25	11'10"	25	11'5"
30	12	30	10'10"
40	12'9"	40	10'8"
50	13'6"	50	9'7"
60	14'	60	9'2"

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth From	Depth To	Diameter (cm/in)
46-47 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, *specify*	0	20	8"
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*	20	62	5
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*			

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Rumble Water Wells	4692

Business Address (Street Number/Name)	Municipality
12C S Bentheim	Chatham-Kent

Province	Postal Code	Business E-mail Address
ON	N0P 1M0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5196768203	Garnet Rumble

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
5544		

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2013/12/12	2013/12/12

Ministry Use Only

Audit No. Z170080

Received FEB 14 2014

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Ministry's Copy

Ontario

Ministry of the Environment

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* [illegible]

Well Record

Regulation 903 Ontario Water Resources Act

Page of

[redacted]

Address of Well Location (Street Number/Name)	Township	Lot	Concession
8811 Union rd.	Dover	2	11

County/District/Municipality	City/Town/Village	Province	Postal Code
Chatham Kent.	Dresden	Ontario	N0P 1M0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	393643	4706778		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Peastone			46	42
	Bentonite Grout			42	-6'6"
	Bentonite pad.			6'6"	6'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify*

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
2"	Steel	?	-6.6"	?

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☒ Abandoned, other, *specify* Not used
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water	Hole Diameter Depth From (m/ft)	Depth To (m/ft)	Diameter (cm/in)
☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*			
☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*			
☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*			

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

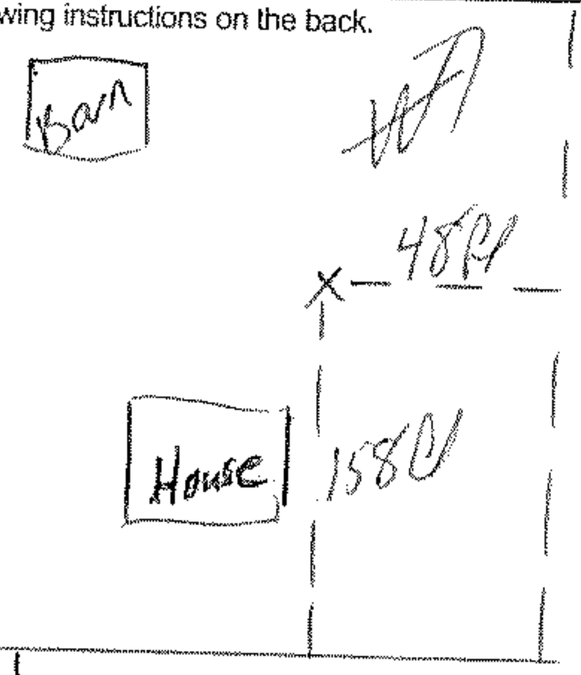
Well production (l/min / GPM)

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Lumble Water Wells	4642

Business Address (Street Number/Name)	Municipality
445 Stephens	Chatham

Province	Postal Code	Business E-mail Address
ON	N7M 1M2	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
519-676-8203	Comet Lumble

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3549		

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☒ No		2013 11 22

Ministry Use Only

Audit No. Z170082

FEB 14 2014

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Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* [illegible]

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

[redacted]

Address of Well Location (Street Number/Name): 8811 Union rd. | Township: Dover | Lot: 2 | Concession: 11

County/District/Municipality: Chatham Kent | City/Town/Village: Bresden | Province: Ontario | Postal Code: N0P 1M0

UTM Coordinates — NAD 83 | Zone: 17 | Easting: 393643 | Northing: 4706778 | Municipal Plan and Sublot Number: | Other:

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Peastone.			44	56
	Bentonite grout			0	44

Pump house still in use

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify* ____

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify* ____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
3"	Steel	.7	0	.7

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☒ Abandoned, other, *specify* not used.
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water	
	☐ Fresh ☐ Untested	☐ Gas ☐ Other, *specify*
	☐ Fresh ☐ Untested	☐ Gas ☐ Other, *specify*
	☐ Fresh ☐ Untested	☐ Gas ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

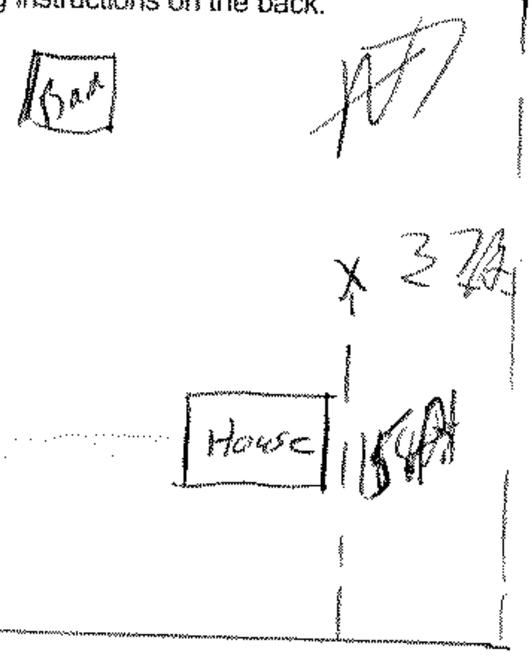
Well production (l/min / GPM)

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Rumble Water Wells | Well Contractor's Licence No.: 4642

Business Address (Street Number/Name): RR 5 Blenheim | Municipality: Chatham Kent

Province: ON | Postal Code: N0P 1M0 | Business E-mail Address:

Bus. Telephone No. (inc. area code): 5197628203 | Name of Well Technician (Last Name, First Name): Rumble, Garnet

Well Technician's Licence No.: 3544 | Signature of Technician and/or Contractor | Date Submitted

Well owner's information package delivered: ☐ Yes ☒ No

Date Package Delivered:

Date Work Completed: 2013/11/22

Ministry Use Only

Audit No.: Z170081

FEB 14 2014

0506E (2007/12)

Ministry's Copy

Attachment D

Water Quality Data

AGAT Laboratories

5835 COOPERS AVENUE
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TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **AECOM CANADA LTD**
105 COMMERCE VALLEY DR.W 7TH FLOOR
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: **Erin Wilson**

PROJECT: **60343599**

AGAT WORK ORDER: **17T178047**

MICROBIOLOGY ANALYSIS REVIEWED BY: **Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor**

WATER ANALYSIS REVIEWED BY: **Mike Muneswar, BSc (Chem), Senior Inorganic Analyst**

DATE REPORTED: **Jan 24, 2017**

PAGES (INCLUDING COVER): **9**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-16

DATE REPORTED: 2017-01-24

				007530115;
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-13
Parameter	Unit	G / S	RDL	8127800
Escherichia coli	CFU/100mL	0	1	NDOGT
Total Coliforms	CFU/100mL	0	1	NDOGT

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology

8127800 ND - Not Detected.
NDOGT - No Data, overgrown with Target; refers to over-crowding microbial growth.

Certified By: Elizabeth Rolakowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-16

DATE REPORTED: 2017-01-24

Parameter	Unit	G / S	RDL	007530115; [redacted]
SAMPLE DESCRIPTION:				[redacted]
SAMPLE TYPE:				Water
DATE SAMPLED:				2017-01-13
Electrical Conductivity	uS/cm		2	1080
pH	pH Units	(6.5-8.5)	NA	8.34
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	84.2
Total Dissolved Solids	mg/L	500	20	**574**
Total Suspended Solids	mg/L		10	21
Alkalinity (as CaCO3)	mg/L	(30-500)	5	259
Fluoride	mg/L	1.5	0.05	0.71
Chloride	mg/L	250	0.50	191
Nitrate as N	mg/L	10.0	0.05	<0.05
Nitrite as N	mg/L	1.0	0.05	<0.05
Bromide	mg/L		0.05	0.84
Sulphate	mg/L	500	0.10	10.9
Ammonia as N	mg/L		0.02	0.11
Dissolved Organic Carbon	mg/L	5	0.5	3.4
Colour	TCU	5	5	**27**
Turbidity	NTU	5	0.5	**7.2**
Calcium	mg/L		0.10	13.1
Magnesium	mg/L		0.10	12.5
Sodium	mg/L	20 (200)	0.10	**190**
Potassium	mg/L		0.10	12.1
Iron	mg/L	0.3	0.010	0.137
Manganese	mg/L	0.05	0.002	0.004

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)

8127800 Elevated RDLs for Chloride indicate the degree of dilution prior to analysis in order to keep analyte within the calibration range of the instrumentsand to reduce matrix interferences.

Certified By:

AGAT Laboratories

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Guideline Violation

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8127800	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	TCU	5	27
8127800	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	190
8127800	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	574
8127800	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Turbidity	NTU	5	7.2

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Jan 24, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8127771	8127771	ND	ND	NA	< 1									
Total Coliforms	8127771	8127771	ND	ND	NA	< 1									

Comments: ND – Not detected; NA - % RPD Not Applicable

Certified By: Elizabeth Pololowska

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jan 24, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
North Kent - Groundwater Samples															
Electrical Conductivity	8127773	8127773	750	747	0.4%	< 2	101%	80%	120%	NA			NA		
pH	8127773	8127773	8.42	8.31	1.3%	NA	99%	90%	110%	NA			NA		
Total Dissolved Solids	8125035		742	738	0.5%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8127771	8127771	< 10	<10	NA	< 10	100%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8127773	8127773	336	333	0.9%	< 5	99%	80%	120%	NA			NA		
Fluoride	8127771	8127771	1.01	1.01	0.0%	< 0.05	98%	90%	110%	97%	90%	110%	90%	80%	120%
Chloride	8127771	8127771	37.0	37.3	0.8%	< 0.10	93%	90%	110%	102%	90%	110%	88%	80%	120%
Nitrate as N	8127771	8127771	< 0.05	<0.05	NA	< 0.05	97%	90%	110%	104%	90%	110%	108%	80%	120%
Nitrite as N	8127771	8127771	< 0.05	<0.05	NA	< 0.05	NA	90%	110%	99%	90%	110%	96%	80%	120%
Bromide	8127771	8127771	0.19	0.20	NA	< 0.05	107%	90%	110%	99%	90%	110%	97%	80%	120%
Sulphate	8127771	8127771	< 0.10	<0.10	NA	< 0.10	91%	90%	110%	102%	90%	110%	98%	80%	120%
Ammonia as N	8127771	8127771	0.12	0.12	0.0%	< 0.02	93%	90%	110%	96%	90%	110%	108%	80%	120%
Dissolved Organic Carbon	8127771	8127771	3.0	3.0	0.0%	< 0.5	92%	90%	110%	101%	90%	110%	96%	80%	120%
Colour	8128881		<5	<5	NA	< 5	102%	90%	110%	NA			NA		
Turbidity	8127815	8127815	13.5	13.6	0.7%	< 0.5	102%	90%	110%	NA			NA		
Calcium	8131887		55.0	55.7	1.3%	< 0.05	100%	90%	110%	101%	90%	110%	102%	70%	130%
Magnesium	8131887		17.1	17.3	1.2%	< 0.05	97%	90%	110%	98%	90%	110%	99%	70%	130%
Sodium	8131887		66.8	65.0	2.7%	< 0.05	100%	90%	110%	100%	90%	110%	96%	70%	130%
Potassium	8131887		1.28	1.28	0.0%	< 0.05	98%	90%	110%	98%	90%	110%	102%	70%	130%
Iron	8127771	8127771	0.278	0.286	2.8%	< 0.010	96%	90%	110%	94%	90%	110%	74%	70%	130%
Manganese	8127771	8127771	0.006	0.006	NA	< 0.002	98%	90%	110%	103%	90%	110%	93%	70%	130%
North Kent - Groundwater Samples															
Electrical Conductivity	8127773	8127773	750	747	0.4%	< 2	102%	80%	120%	NA			NA		
pH	8127773	8127773	8.42	8.31	1.3%		100%	90%	110%	NA			NA		
Total Dissolved Solids	8127821	8127821	660	678	2.7%	< 20	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8127773	8127773	336	333	0.9%	< 5	112%	80%	120%	NA			NA		
Calcium	8128828		74.8	72.5	3%	< 0.05	101%	90%	110%	102%	90%	110%	98%	70%	130%
Magnesium	8128828		14.0	13.8	1.5%	< 0.05	99%	90%	110%	99%	90%	110%	96%	70%	130%
Sodium	8128828		13.0	13.1	0.7%	< 0.05	101%	90%	110%	99%	90%	110%	96%	70%	130%
Potassium	8128828		2.18	2.12	2.7%	< 0.05	98%	90%	110%	97%	90%	110%	101%	70%	130%

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T178047

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO3)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH3-F	LACHAT FIA
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: AECOM CANADA LTD
55 Cedar Pointe Drive, Suite 620
BARRIE, ON L4N5R7
(705) 721-9222

ATTENTION TO: Jason Murchison

PROJECT: 60343599

AGAT WORK ORDER: 17T257228

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Sep 11, 2017

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiological Analysis (water)

DATE RECEIVED: 2017-09-07

DATE REPORTED: 2017-09-11

				007530115;
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-09-06
Parameter	Unit	G / S	RDL	8696378
Escherichia coli	CFU/100mL	0	1	ND
Total Coliforms	CFU/100mL	0	1	192

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8696378

ND - Not Detected.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-09-07

DATE REPORTED: 2017-09-11

				007530115;
		SAMPLE DESCRIPTION:		[redacted]
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-09-06
Parameter	Unit	G / S	RDL	8696378
Electrical Conductivity	uS/cm		2	1060
pH	pH Units	(6.5-8.5)	NA	8.25
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	150
Total Dissolved Solids	mg/L	500	20	470
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	295
Fluoride	mg/L	1.5	0.05	0.65
Chloride	mg/L	250	0.50	148
Nitrate as N	mg/L	10.0	0.05	<0.05
Nitrite as N	mg/L	1.0	0.05	<0.05
Bromide	mg/L		0.05	0.53
Sulphate	mg/L	500	0.10	12.2
Ammonia as N	mg/L		0.02	0.33
Dissolved Organic Carbon	mg/L	5	0.5	4.5
Colour	Apparent CU	5	5	46
Turbidity	NTU	5	0.5	2.4
Calcium	mg/L		0.10	27.9
Magnesium	mg/L		0.10	19.6
Sodium	mg/L	20 (200)	0.10	155
Potassium	mg/L		0.10	11.2
Iron	mg/L	0.3	0.010	0.134
Manganese	mg/L	0.05	0.002	0.005

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8696378 Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

Certified By: Amanjot Bhela

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

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http://www.agatlabs.com

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8696378	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	Apparent CU	5	46
8696378	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	155
8696378	007530115; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Hardness (as CaCO3)	mg/L	(80-100)	150
8696378	007530115; [redacted]	SDWA - Microbiology	Microbiological Analysis (water)	Total Coliforms	CFU/100mL	0	192

AGAT Laboratories

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Sep 11, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8696294		ND	ND	NA	< 1									
Total Coliforms	8696294		ND	ND	NA	< 1									

Comments:
ND – Not detected; NA - % RPD Not Applicable

Certified By:

AGAT Laboratories

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CANADA L4Z 1Y2
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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Sep 11, 2017

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	DUPLICATE Dup #2	DUPLICATE RPD	Method Blank	REFERENCE MATERIAL Measured Value	REFERENCE MATERIAL Acceptable Limits Lower	REFERENCE MATERIAL Acceptable Limits Upper	METHOD BLANK SPIKE Recovery	METHOD BLANK SPIKE Acceptable Limits Lower	METHOD BLANK SPIKE Acceptable Limits Upper	MATRIX SPIKE Recovery	MATRIX SPIKE Acceptable Limits Lower	MATRIX SPIKE Acceptable Limits Upper
North Kent - Groundwater Samples															
Electrical Conductivity	8696407		434	434	0.0%	< 2	99%	80%	120%	NA			NA		
pH	8696407		7.95	8.06	1.4%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8696378	8696378	470	474	0.8%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8687726		<10	<10	NA	< 10	94%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8696407		191	192	0.5%	< 5	94%	80%	120%	NA			NA		
Fluoride	8696751		<0.5	<0.5	NA	< 0.05	110%	90%	110%	108%	90%	110%	105%	80%	120%
Chloride	8696751		385	395	2.6%	< 0.10	93%	90%	110%	105%	90%	110%	103%	80%	120%
Nitrate as N	8696751		12.7	13.0	2.3%	< 0.05	100%	90%	110%	106%	90%	110%	106%	80%	120%
Nitrite as N	8696751		<0.5	<0.5	NA	< 0.05	NA	90%	110%	107%	90%	110%	109%	80%	120%
Bromide	8696751		<0.5	<0.5	NA	< 0.05	104%	90%	110%	101%	90%	110%	100%	80%	120%
Sulphate	8696751		43.4	44.3	2.1%	< 0.10	94%	90%	110%	102%	90%	110%	102%	80%	120%
Ammonia as N	8697217		<0.02	<0.02	NA	< 0.02	101%	90%	110%	95%	90%	110%	80%	80%	120%
Dissolved Organic Carbon	8696378	8696378	4.5	4.5	0.0%	< 0.5	98%	90%	110%	100%	90%	110%	103%	80%	120%
Colour	8694749		11	12	NA	< 5	106%	90%	110%	NA			NA		
Turbidity	8696378	8696378	2.4	2.5	NA	< 0.5	108%	90%	110%	NA			NA		
Calcium	8696435		96.0	95.8	0.2%	< 0.05	97%	90%	110%	96%	90%	110%	97%	70%	130%
Magnesium	8696435		6.71	6.57	2.1%	< 0.05	101%	90%	110%	100%	90%	110%	98%	70%	130%
Sodium	8696435		10.5	10.5	0.0%	< 0.05	97%	90%	110%	98%	90%	110%	96%	70%	130%
Potassium	8696435		0.97	0.92	5.3%	< 0.05	99%	90%	110%	98%	90%	110%	96%	70%	130%
Iron	8696378	8696378	0.134	0.142	5.8%	< 0.010	107%	90%	110%	95%	90%	110%	83%	70%	130%
Manganese	8696378	8696378	0.005	0.005	NA	< 0.002	102%	90%	110%	100%	90%	110%	92%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T257228

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO3)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH3-F	LACHAT FIA
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 C	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

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