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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** **[redacted] – PIN 007530030, [redacted] (Dresden, ON)**		
From	Jason Murchison, P.Geo.		
Date	January 25th, 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 19-October-2017. In this correspondence, Ms. Jacobs provides a summary narrative of a well interference complaint that was received by MOECC on 18-October-2017 (exact time unspecified) from [redacted], the property owner of [redacted] (Dresden, ON).

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

> *The Ministry received a new water well complaint late yesterday from [redacted] at [redacted]. He has given permission to pass on his contact information to the company. He says that in the past week, he has been noticing fine black particulate in his well water, and says that his filters are now completely plugged and he can't get water through. He has requested a water tank. He says he believes the issue was caused by pile driving on the concession behind his house last week and anchor screwing this week.*
>
> *Please consider this an official complaint. The Ministry's expectation is that you will initiate the complaint response process detailed in condition G(5) of your REA forthwith, and that you will keep the Ministry apprised of any and all developments related to this complaint.*

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 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.	Steps undertaken to satisfy the requirements of Condition G5 are summarized, as follows: (1) AECOM was retained by NKW1 to investigate a Well Interference Complaint received from MOECC at 9:23am on 19-October-2017. (2) AECOM arranged directly with the property owner an appointment to visit the property at 12:00pm on 23-October-2017 (appointment based on property owner availability). Based on conditions encountered during the site visit which precluded the collection of a raw water sample for analysis, a second complaint investigation site visit was arranged by AECOM with the property owner for 12:00pm on 7-November-2017. (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); and, ii) digital photographs of pertinent site features (eg. well, water treatment equipment, etc.). A representative sample of raw (untreated) groundwater was not collected during either site visit due to various conditions encountered at the subject property, as described within this TM. (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 Summary Timeline of Complaint Investigation

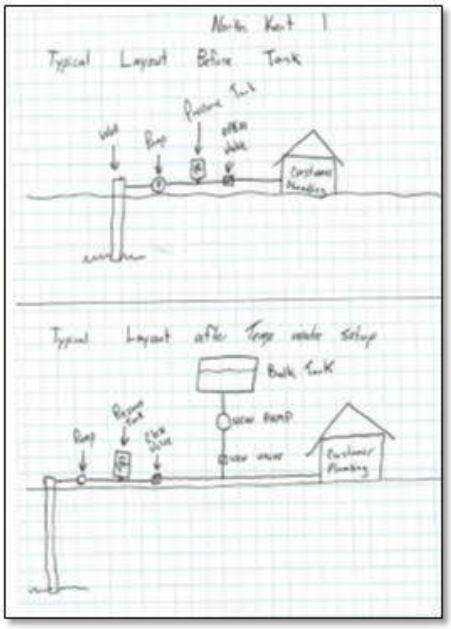
Provided below is a summary of communications and events (in chronological order) pertaining to the current complaint investigation at [redacted]:

- Notification of private well interference complaint received by AECOM from NKW1 by way of an email from MOECC (c/o Ms. Deb Jacobs), dated 19-October-2017.
- AECOM arranged directly with [redacted] a complaint investigation site visit at the subject property on 23-October-2017.
- During AECOM's 23-October-2017 site visit, the presence of a filtration system on the plumbing system precluded testing of the well flow and collection of a raw (untreated) groundwater sample for laboratory analysis. At that time, [redacted] informed AECOM that he was unwilling to drain / remove the filter unit until such time as his consultant (WSC Consulting) had visited the property to collect a sediment sample for analysis.
- Prior to the completion of our 23-October-2017 site visit, the plumbing system at the [redacted] residence had been modified to connect a temporary storage tank provided by NKW1.
- NKW1 provided written notification (email) of the site visit results to MOECC on 24-October-2017. Advice from MOECC regarding how to proceed was requested within the notification.
- MOECC reply, received via email on 25-October-2017 recommended that "*AECOM stay in touch with* [redacted]*. Once he is willing to remove the filter so that they can get a raw*

water sample, AECOM can arrange a follow-up visit at that time to do so. It is duly noted on our end that AECOM made the effort to attend and take a sample promptly".

- AECOM provided written notification to NKW1 on 2-November-2017 that confirmation was received from [redacted] that WSC Consulting had collected sediment samples from the filtration system and that AECOM was permitted to re-attend the property to complete our complaint investigation site visit.
- NKW1 provided a written status update (email) to MOECC on 2-November-2017.
- AECOM arranged directly with [redacted] an appointment to re-visit the subject property on 7-November-2017.
- Following completion of AECOM's site visit, a written (email) update was provided to NKW1 on 8-November-2017. As part of the update, AECOM provided a summary discussion regarding a malfunction in the [redacted] well water pumping system (surging effect within the well) that occurred during the site visit, which (once again) precluded testing of the well flow and the collection of a representative sample of raw (untreated) groundwater for laboratory analysis. At that time, it was recommended to NKW1 that an MOECC-licenced pump contractor be retained by the property owner to assess their water well, pumping system and filtration system so as to determine the cause of the malfunction and that MOECC be notified thereto.
- NKW1 provided written notification (email) of the site visit results to MOECC on 8-November-2017.
- MOECC reply, received via email on 9-November-2017 indicated that "*Our Hydrogeologists have reviewed the video, the well record and information about the system provided by AECOM below as well as by [redacted] to me by telephone (specifically [redacted] advised me that the pump for this well is in the house). Based on the information available to us, the most likely scenario is that there is a break in the line from the jet pump that is injecting air into the water column and causing the water to spray to the surface, especially if this only happens when the pump is running. Odds are that it is related to the modifications that were done. It sounds like the first modification (for plumbing alternative water supply) was done by contractors for North Kent 1. Please advise on whether or not the 2nd modifications were done by contractors North Kent 1, or if that was done independently by [redacted] ? Our normal direction in this situation would be to have the same person / company that made the modifications go back out to check the system. It is just not clear to me whether or not we are dealing with one person / company or two*".
- MOECC reply, received via email on 9-November-2017 indicated that "*Have you been able to determine if the second modification was done by your contractor or someone else? I saw the note from Matthew about the spouting continuing after the pump was reported to be off. Regardless, I would suggest that North Kent 1 have the plumber who completed modification 1 (and modification 2 if it was your contractor) revisit the [redacted] site to re-inspect the work that they did and ensure that all is working as it should, based on the modifications that they made (i.e. if they were indeed plumbers, they should limit the inspection to the work they did / their area of expertise. A plumber who is not a licenced well contractor should NOT try to conduct well inspection). If you have questions on this let me know. If the second modification was done at [redacted] behest, I will communicate with him that he should have that individual back to re-inspect as well. If that doesn't resolve the problem, then the visit from well contractor is indeed in order*".
- NKW1 forwarded an email from JM Controls & Electric Ltd., (JMCE) dated 22-November-2017 which provided a summary of their inspection of the plumbing system within the [redacted] residence. Specifically, it is stated, "*We attended the site and none of the existing plumbing to the well was modified. We simply "t'd" in after the customers pressure tank,*

shut off the valve between the customer well and the house. If the customer was to turn on both valves, I can imagine that our system would pump water back down though the pressure tank, though the pump and into the well head (which may have been what happened). I realize the simple solution for this is to physically isolate (by disconnecting the pipe) between the well and customers house, however, most customers insist we keep it connected so they can continue to sample water from the well. See piping diagram attached on how we are typically connecting the systems. Sorry for its crudeness!".



- AECOM responded to NKW1 (email) with regard to the summary provided by JMCE on 23-November-2017 at 0742h stating: "*the [redacted] pump was physically disconnected from the pressure tank at the time of our site visit, so the scenario of the temporary supply flowing through the system into the wellhead is not possible*". See photograph below.



- AECOM arranged directly with [redacted] to attend a third visit to the subject property on 14-December-2017.
- On 12-December-2017, AECOM received a telephone call from [redacted] regarding the proposed testing of his well to determine the cause of the surging and to obtain an additional raw (untreated) groundwater sample. At that time, [redacted] advised that AECOM was not permitted to re-visit the property to perform any further sampling / testing until AECOM / NKW1 provided them with a report regarding the previous site visit on 7-November-2017 and the sample results for his review. [redacted] indicated that he wanted the report to state what was believed to be the root cause of the surging. In response, we informed [redacted] that AECOM wanted to review his water system configuration once again and to retest the well during the follow-up site visit to aid in us determine the cause of the surging. AECOM was further advised by [redacted] at that time that "*we both know the wind turbine pile driving is what caused this*".
- No further communication between AECOM and the property owner has occurred since 12-December-2017.

2.2 Property Owner Statements Regarding Well Interference Complaint

During each of AECOM's 23-October-2017 and 7-November-2017 site visits to the subject property, a series of seven (7) standard questions were raised with the property owner ([redacted]) for the purposes of obtaining further details regarding their reported well water supply issue(s). The questions raised with the property owner were as detailed on *Form B: Well Complaint Procedure for Site Investigation*, included as part of MOECC's approved *Well Interference Protocol* (AECOM, 2017) for the NKW1 project.

TABLE 2a: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (23-OCTOBER-2017)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Following pile driving on Bush Line during the week of 9-October-2017 to 13-October-2017; on 15-October-2017 chickens wouldn't drink water. • On 15-October-2017, sediment trap had sediments. Backwashed filter at that time and collected sample. • On 18-October-2017, there was no water in the shower in house. • Not enough water and limited use of well since 18-October-2017.
"What do you think is the cause?"	• Construction of wind turbines / pile driving on Bush Line from 9-October-2017 to 13-October-2017.
"When did you first notice the problem (Date/Time)?"	• 15-October-2017.
"Is the problem still occurring?"	• Yes.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No.
"Were you provided a temporary supply of potable water?"	• 19-October-2017: Drinking water provided. • 20-October-2017: Water tank delivered.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes

TABLE 2b: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (7-NOVEMBER-2017)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Water well is plugged, black particles in well. • No water. Haven't used pump or had it on since 18-October-2017.
"What do you think is the cause?"	• Well was installed in 1965; since then there was no issue with the well water; property well water used since the 1800's • Construction of wind turbines / pile driving on Bush Line from 9-October-2017 to 13-October-2017 is the cause for water shortage.
"When did you first notice the problem (Date/Time)?"	• 15-October-2017, noticed when chickens would not drink water.
"Is the problem still occurring?"	• Yes.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No.
"Were you provided a temporary supply of potable water?"	• 19-October-2017: Drinking water provided. • 20-October-2017: Water tank delivered. • Concerned about the water tank freezing / flooding of basement if tank cracks.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes

Upon completion of each questionnaire, both [redacted] and his representative of Water Wells First (Mr. Kevin Jakubec) were provided an opportunity to review the responses detailed in **Table 2a** and **Table 2b** 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 [redacted] reported outset of well impact (15-October-2017), pile driving for foundation construction as part of the NKW1 project was completed at the following nine (9) turbine locations:

- T52 – October 13th & 16th @ 2,150 m West-Northwest
- T5 – October 10th & 12th @ 2,450 m West-Northwest
- T15 – October 2nd @ 3,000 South-Southwest
- T23 – October 2nd @ 4,100 m Southwest
- T19 – October 4th & 5th @ 4,600 m South-Southwest
- T51 – October 2nd & 3rd @ 4,850 m South-Southwest
- T41 – October 2nd & 3rd @ 6,350 m South-Southeast
- T39 – October 12th, 13th & 16th @ 6,500 m South-Southwest
- T42 – October 10th & 12th @ 7,600 m South-Southwest

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

Of the turbines listed above, T52 and T5 represent the closest sites where foundation construction / pile driving work was completed within a two (2) week period prior to the reported outset of well impact, and in the geographic area where [redacted] indicated a specific concern based on the questionnaire responses provided in **Table 2a**.

Monitoring of vibration effects during pile driving at the above-noted turbine locations relating to proximity and timing of well impact reported by the property owner 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 local private water well supplies. Local well supplies monitored by GAL during pile driving at the abovementioned turbine locations (including offset distances from the location of work) is summarized as follows:

- T52 – Well 3 ([redacted] 1,308 m)
- T5 – Well 3 ([redacted]., 911 m)
- T15 – Well 13 ([redacted]., 940 m) & Well 14 [redacted]., 1,218 m)
- T23 – Well 13 ([redacted] 1,954 m) & Well 14 ([redacted]., 2,518 m)
- T19 – Well 13 [redacted] 2,460 m) & Well 14 ([redacted]., 2,787 m)
- T51 – Well 13 ([redacted]., 2,776 m) & Well 14 ([redacted]., 3,056 m)
- T41 – Well 1A ([redacted]., 930 m) & Well 1 ([redacted]., 938 m)
- T39 – Well 1A ([redacted]., 2,295 m) & Well 1 ([redacted]., 1,081 m)
- T42 – Well 1A ([redacted]., 2,748 m) & Well 1 ([redacted]., 999 m)

Vibration monitoring results obtained by GAL are summarized in a site-specific vibration assessment letter pertaining to the subject properties, dated 25-January-2018. A copy of the 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 site-specific assessment letter, which reads:

> *The well at* [redacted] *was typically farther from the pile driving than the wells that were monitored for vibrations, with distances between pile driving and* [redacted] *being between about 2.1 and more than 9.4 km on the dates summarized in Table 1. Based on data available to-date from the test pile and construction monitoring programs, the distances between pile driving and* [redacted]*, the dates on which pile driving occurred and the dates on which the complaints were first noted, 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. Vibrations associated with pile driving would not be discernable from background conditions at this well given the separation distances and, therefore, would be two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s), one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz) and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s). 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.*

4. Well Construction Details

Table 3 provides a summary of available construction details for the water well located at [redacted], based on details provided by [redacted] during AECOM's 23-October-2017 and 7-November-2017 well interference complaint site visits, as well as information provided by the property owner on their completed water well survey (WWS) form and during our baseline site visit on 26-January-2017.

Further to the above, AECOM also completed a review of the MOECC on-line database for the subject property. Based on this review, two (2) water well records were identified for the subject property (#331308 & #331309), as provided in **Attachment C**. The records located included one (1) for a water supply well located in an agricultural field to the rear (northwest) of the [redacted] residence and one (1) for an abandoned 'dry hole' that was located in the agricultural field to the northeast of the [redacted] residence. Based on information provided to AECOM by [redacted] (ie. construction year and depth) and current location of the site well, MOECC Record #331308 is assumed to represent the current water well for the subject property.

The above-grade components of the [redacted] well were assessed visually during both our 23-October-2017 and 7-November-2017 site visits. In general, the condition of the steel well casing (above grade) and cap assembly did not indicate any apparent concerns. Grading around the wellhead was identified as a concern given the presence of ponded water during our 7-November-2017 site visit (see **Photo 1**). It is uncertain whether the application of fertilizers and/or pesticides is completed in the agricultural field where the well is located, which was observed to have been used for corn cultivation during the 2017 growing season. If so, the soil and ponded water may possibly contain chemicals / nutrients that could potentially migrate downward along the wellbore annular space, which likely is not sealed based on typical construction practices at the time the well was originally installed (1960's), and impact the source water supply. Measurement and inspection of internal well details / condition was not completed as part of AECOM's complaint investigation at the subject property.

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	[redacted] (PIN 007530030)
Well Tag #	*Not Applicable*
Well ID	331308
Installation Date	4-July-1966
Well Location	Rear of property within agricultural field
Contractor	RW Simpson
Contractor No.	2217
Construction Method	*Unconfirmed*
Total Depth	14.9 (49')
Target Formation	Clay / Black Shale Interface
Casing Length	14.9 (49')
Casing Diameter	100 mm / 4"
Casing Material	Steel
Casing Stick-Up	0.67 m
Annular Seal	*Unconfirmed*

DETAILS	[redacted] (PIN 007530030)
Sealant Type	*Unconfirmed*
Well Screen Installed?	No (open hole below casing within Black Shale)
Well Screen Details	Not Applicable
Well Screen Interval	Not Applicable
Well Cover Type	Vermin-Proof Well Cap
Pump Intake Depth	9.1 mBGS (30') as on WWR
Pumping Rate	15.2 L/min (4 USgpm) as on WWR
Well Pump Type	Piston Pump (as observed)
Well Pump Size	*Unconfirmed*
Static Level	3.0 mBGS (10') as on WWR
Pumping Level	7.6 mBGS (25') as on WWR

NOTE: mBGS - meters below ground surface; L/min – litres per minute; USgpm – US gallons per minute.

A photograph of the well, as observed during our 7-November-2017 site visit, is provided as **Photo 1**.



PHOTO 1: Site Well (Located within agricultural field to rear of residence)

4.1 Limited Well Flow Rate Testing and Pumping System Assessment

During AECOM's second well interference complaint visit to the [redacted] property on 7-November-2017, a limited flow rate test was attempted to assess the current capacity of the piston pump (Duro® Model: K-255) that is connected to the well. This testing was facilitated through disconnection (by the property owner) of a braided hose on the discharge side of the piston pump (leading to the pressure tank) and the connection of a new segment of braided hose that was directed into a sump pit located in the basement of the residence. The system configuration as observed during our 7-November-2017 site visit is shown in **Photo 2.**



PHOTO 2: Well Pump & Sediment Filter System (as observed on 7-November-2017)

For the test, the well pump was permitted to operate continuously using the braded hose assembly described above, with the discharged water being directed to a local sump pit. Following approximately five (5) minutes of pumping, the well pump ceased to provide water. The pump was then shut down by [redacted] and the well was permitted to recover for a period of approximately seven (7) minutes. Flow testing was then attempted a second time, during which the well was permitted to pump continuously for a period of approximately thirty (30) minutes. During pumping, the discharge rate from the pump was assessed by AECOM on two (2) separate occasions. Flow rate measurement was completed by timing the discharge of 10 L of water into a calibrated pail.

Following approximately 23 minutes of continuous pumping, [redacted] informed AECOM that water was surging from the top of the well. Based on this observation (documented in both photographic and video format), AECOM requested that the property owner turn off the pump. Upon cessation of pumping, surging from the well continued for a period of approximately ten (10) minutes, presumably in response to depressurization within the pump system.

Testing results indicated discharge rates of approximately 8.2 L/min and 12.5 L/min (2.2 and 3.3 USgpm) for the well pump with the downstream plumbing system disconnected and upstream sediment filter in place. A certain amount of discharge rate fluctuation was observed during pumping.

Water discharged from the pump initially was observed by AECOM to be relatively clear and colourless, with the water becoming increasingly dark in colour following the outset of surging at the well. At that same time, sediment became visible both in suspension, as well as settled to the base of the sampling pail.

No detectable odours or evidence of dissolved gases was observed.

The location of a recently-installed sediment filter system represents a concern based on observations made during our 23-October-2017 and 7-November-2017 site visits. As can be observed in **Photo 2**, the filtration system is installed prior to / upstream of both the well (piston) pump / pressure switch and pressure tank. This configuration is not recommended, as the presence of the sediment filter would result in additional head pressure on the inlet side of the pump that will

progressively increase over time as the capacity of the filter becomes used. With the pumping and pressurization system elements being located on the opposing (downstream) side of the filter unit, the water system (via the pressure switch) may be calling for water for prolonged periods of time, resulting in significant additional effort for the pump. This can lead to possible pump damage or failure due to prolonged operation and/or additional effort to overcome suction head pressure. To alleviate these issues, water filtration systems for a well supply typically are installed downstream of the primary pumping and pressure systems (ie. on the distribution side of the water system), inclusive of such components as the well pump, pressure switch and pressure tank(s).

Although not assessed as part of AECOM's investigation, it was noted that an additional filtration system was present on the distribution side of the residence's plumbing system, as shown in **Photo 3**.

Based on the well's reported age (ie. >50 years), location within an actively cultivated agricultural field, grading deficiencies resulting in surface ponding around the casing, (likely) lack of an annular seal, and open bottom configuration; the current condition of the downhole well components (including casing condition, water-tightness and pump foot valve assembly) is considered questionable.

It is recommended that the property owner contact an MOECC-licenced well pump contractor (Class 1 / Class 4) to assess the current condition of the well, pumping system (including downhole components) and filtration system, and to make any necessary replacement, repairs or re-arrangements, as necessary.



PHOTO 3: Water Filtration System on Distribution (as observed on 7-November-2017)

5. Water Quality Data

Table 4 provides a summary of available groundwater quality data for the site well. In review of the table below, it should be noted that the sample collected on 7-November-2017 was significantly affected by a well pumping system malfunction which caused a surging effect within the well. This surging effect would have resulted in the suspension of sediment contained within the wellbore, and in particular the open hole component below the casing terminus (recall that there is no screen reported to have been installed within the well). As a result, the 7-November-2017 sample is not

considered to be representative of the inorganic raw (untreated) groundwater quality at the time of our site visit and has not been considered further here.

Laboratory Certificates of Analysis for both samples are included as **Attachment D** for completeness.

TABLE 4: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	26-January-2017	Raw (Untreated)	Baseline
	AECOM	7-November-2017	Raw (Untreated)	Complaint Investigation

5.1 Discussion

Available sampling data for the [redacted] well indicates the presence of a poor baseline raw (untreated) groundwater quality, with elevated levels of bacteriological constituents (E.coli & Total Coliforms), total dissolved solids, chloride, colour, turbidity, sodium, and iron, along with low hardness, as shown in **Table 5**.

The reader is reminded that a raw (untreated) groundwater sample was not able to be obtained by AECOM during our 23-October-2017 site visit due to the plumbing configuration at the time (ie. filtration unit installation), and that the sample collected on 7-November-2017 was significantly affected by surging within the well due to a pumping system malfunction that resulted in the sample being considered non-representative of inorganic water quality.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE (22-January-2017)	COMPLAINT INVESTIGATION (7-November-2017)
Escherichia coli	0 CFU/100mL	MAC	**NDOGN**	**NDOGT**
Total Coliforms	0 CFU/100mL	MAC	**NDOGN**	**NDOGT**
Electrical Conductivity	--	--	1,280 µS/cm	*Inorganic Data*
pH	6.5 – 8.5	OG	8.14	*Affected by Surging*
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	**68.3 mg/L**	*Results not Considered*
Total Dissolved Solids	500 mg/L	AO	**650 mg/L**	--
Total Suspended Solids	--	--	17 mg/L	--
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	302 mg/L	--
Fluoride	1.5	MAC	1.08 mg/L	--
Chloride	250	AO	**255 mg/L**	--
Nitrate as N	10	MAC	<0.10 mg/L	--
Nitrite as N	1	MAC	<0.10 mg/L	--
Bromide	--	--	<0.10 mg/L	--
Sulphate	500 mg/L	AO	<0.20 mg/L	--
Ammonia as N	--	--	0.22 mg/L	--
Dissolved Organic Carbon	5 mg/L	AO	2.4 mg/L	--
Colour	5 TCU	AO	**14 TCU**	--
Turbidity	5 NTU	AO	**29.2 NTU**	--

Calcium	--	--	16.6 mg/L	--
Magnesium	--	--	6.51 mg/L	--
Sodium	200 mg/L	AO	**243 mg/L**	--
Potassium	--	--	1.97 mg/L	--
Iron	0.300 mg/L	AO	**0.647 mg/L**	--
Manganese	0.050 mg/L	AO	0.022 mg/L	--

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); OG – Operational Guideline (non health-related); NDOGN – no data, sample overgrown with nontarget (refers to over-crowding microbial growth); NDOGT – no data, sample overgrown with target (refers to over-crowding with microbial growth).

At the time of AECOM's baseline site visit on 26-January-2017, no water treatment devices reportedly were present within the [redacted] residence. During AECOM's 23-October-2017 site visit however, an in-line sediment filter was observed to have been installed on the property's plumbing system at a location upstream of the well pump / pressure switch and pressure tank. According to [redacted], the filter unit was installed in May 2017 at the recommendation of WSC Consulting for the purpose of collecting sediments from the well for analysis.

A sample of raw (untreated) groundwater was obtained by AECOM during our 26-January-2017 baseline sampling program using an exterior faucet installed near the garage. Prior to sampling, the faucet was permitted to flush thoroughly (minimum period of 5 minutes) with the pumped water being directed into a pail. Prior to sample collection, the faucet orifice was disinfected (using chlorine) and flushed. Clean nitrile gloves were worn by AECOM staff during sample collection.

The collected groundwater sample was examined in the field (both visual and olfactory) and then immediately placed in laboratory-supplied sample bottles prepared in advance with the appropriate preservatives. Each sample bottle was sealed, labeled and stored on ice to maintain a temperature of 10°C or lower during transportation under chain of custody documentation to a CALA-accredited environmental analytical laboratory within the specified analyte holding times.

Exceedances of health-related criteria limits of the Ontario Drinking Water Quality Standards (ODWQS) for Escherichia coli and Total Coliforms bacteria was detected in the baseline sample collected from the site well. It is also noted that similar exceedances for both Escherichia coli and Total Coliforms bacteria (bacterial overgrowth) also were identified in the 7-November-2017 complaint investigation water sample analysis results. No other exceedances of health-related parameters, including Fluoride, Nitrate (as N), and/or Nitrite (as N) were detected the baseline raw (untreated) groundwater sample collected from the existing on-site well supply.

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 site well, the turbidity level in the baseline sample was reported to exceed the ODWQS AO limit of 5 NTU, with a measured value of 29.2 NTU.

Total suspended solids (TSS) within the baseline raw groundwater sample was reported at 17 mg/L, indicating a detectable presence of sediment load in the raw (untreated) groundwater pumped from the well at that time. An ODWQS criteria limit has not been established for this parameter.

The potential for groundwater quality impact(s) associated with pile driving is both proximity and time-dependant, and related to the intensity and propagation of ground-borne vibration. In the case of pile driving at T52, T5, T15, T23, T19, T51, T41, T30 and T42, no significant vibrations attributed to pile driving were detected either in close proximity to the work areas, nor at any of the monitored private wells, as reported by GAL and discussed previously in **Section 3**. Based on GAL's monitoring data, timing of the work completed, onset of reported well impact, and separation distance which exists between the turbine sites and the [redacted] well supply at [redacted] 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 T52, T5, T15, T23, T19, T51, T41, T30 and/or T42, 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 turbine locations. 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) and vibration monitoring data collected by GAL.

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 well supply issue reported by the property owner of [redacted] (PIN 007530030) does *not* appear to be as a result of NKW1 turbine foundation construction or pile-driving activities from a vibration monitoring perspective. However, due to an inability to collect a representative raw (untreated) groundwater sample for laboratory analysis during either of our 23-October-2017 or 7-November-2017 site visits, an assessment of current well water quality was not able to be completed by AECOM. As a result, we are not presently able to fulfill the requirements of *Condition G5* of REA No. 5272-A9FHRL with regard to the [redacted] property at [redacted].

The water well issues reported by the property owner appear to be related to local well water system issues versus an area-wide impact to the local groundwater system. As noted within this report, assessment by a qualified professional of the current condition (including completion of any necessary repairs / replacement) of the on-site well supply, pumping equipment and treatment system is recommended. AECOM welcomes an opportunity to re-visit the [redacted] property at [redacted] on a future date, once the current well issues have been rectified, to re-sample the well such that we can provide a more fulsome response in respect of REA *Condition G5*.

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, October 19, 2017 9:23 AM
To: Josh Vaidhyan (j.vaidhyan@samsung.com); Jody Law (jody.law@patternenergy.com); mark.vanderwoerd@aecom.com
Cc: Harman, Bruce (MOECC); Smith, Mark (MOECC); Gilbert, Teri (MOECC); Thuss, Simon (MOECC); Lehouillier, Jason (MOECC); Moroney, Michael (MOECC); Colella, Nick (MOECC); Moroney, Michael (MOECC); Semcesen, Natalie (MOECC)
Subject: New Complaint - [redacted]

Hello Josh and Jody,

The Ministry received an new water well complaint late yesterday from [redacted] at [redacted], [redacted]. He has given permission to pass on his contact information to the company. He says that in the past week, he has been noticing fine black particulate in his well water, and says that his filters are now completely plugged and he can't get water through. He has requested a water tank. He says he believes the issue was caused by pile driving on the concession behind his house last week and anchor screwing this week.

Please consider this an official complaint. The Ministry's expectation is that you will initiate the complaint response process detailed in condition G(5) of your REA forthwith, and that you will keep the Ministry apprised of any and all developments related to this complaint.

Best regards

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

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

January 25, 2018 Project No. 1668031-2000-L24R

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

WATER WELL COMPLAINT 14
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Law:

This letter is provided to summarize vibration monitoring data associated with Well Complaint 14 dated October 19, 2017 related to the well located at 9127 Greenvalley Line in Dresden, Ontario. For the purposes of this letter, vibration data is summarized for the period starting one day prior to prior to the date on which the owner first reported well issues of October 15, 2017, through to one day after. Data for the two weeks preceding the date of the complaint are also summarized in this letter and the data summary pages for each of the referenced turbines are also attached.

Table 1 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.

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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: Well 14 during piles 13 and 14 at T19; Well A during pile 7 at T39, Well A during pile 11 at T41; Well A during pile 12 and Wells 1A and A during pile 15 at T42. The turbine site monitoring data was not available for 4 piles driven on October 12, 2017 at T39. These data were unavailable because of data logger battery issues. 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.

When reviewing Table 1, attached, it should be noted that during well monitoring of multiple wells in the area, well casing vibrations directly attributable to the well pumps were measured and these were as much as 2.4 millimetres per second (mm/s). 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. Peak well casing vibration velocities for Well 4 of nearly 5 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 on the previous day and vehicles travelled and parked on the site in close proximity to the well on September 5 and 6, 2017. Access to Well 4 was unavailable for monitoring after September 10, 2017. 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. Vibrations induced by the Well 13 pump were as much as 0.75 mm/s. Well 14 is located approximately 13 m from the centreline of Union Line which is subjected to local truck traffic. Peak vibration velocities measured at Well 14 of 0.613 mm/s and 0.675 mm/s were associated with a vehicle turning in the driveway and a tractor-trailer transport truck passing the well in the road lane closest to the well, respectively.

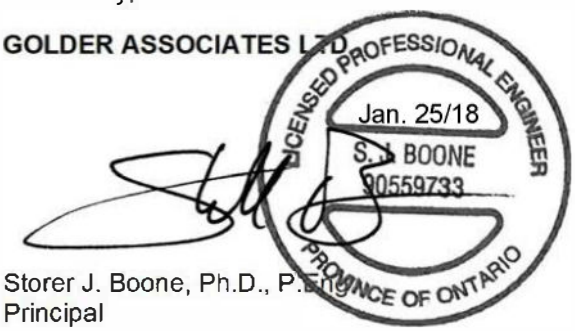
Details of the well or well pump at [redacted] were not available except for information provided by the MOECC water well records that are mapped at this property. Well record 3301308 indicates that the well was drilled in 1966, likely using a cable tool system, 1.2 m into the Kettle Point Formation black shale to a total depth of 16.2 m with a 102 mm steel casing installed to the top of rock and open hole below this depth. Two other wells were drilled in 1966 on this property to similar depths but these were abandoned because of lack of water (MOECC records 3301309 and 3301310).

The well at [redacted] was typically farther from the pile driving than the wells that were monitored for vibrations, with distances between pile driving and [redacted] being between about 2.1 and more than 9.4 km on the dates summarized in Table 1. Based on data available to-date from the test pile and construction monitoring programs, the distances between pile driving and [redacted], the dates on which pile driving occurred and the dates on which the complaints were first noted, 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. Vibrations associated with pile driving would not be discernable from background conditions at this well given the separation distances and, therefore, would be two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s)[1], one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz)[2] and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s)[3]. 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/MAS/cr

CC: J. Vaidyan, Samsung

Attachments: Table 1 - Summary of Vibration Monitoring Data, Well Complaint 14
Data Summary Tables

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[1] Impulse Vibration in Residential Buildings, (NPC-207), Ministry of Environment, Ontario, 1983.

[2] 2007 ASHRAE Handbook—HVAC Applications (SI), American Society of Heating, Refrigerating and Air-Conditioning Engineers, threshold for nighttime acceptable levels.

[3] International Standards Organization. 1989. Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings, ISO 2631, threshold for human response in buildings.

Table 1: Summary of Vibration Monitoring Data, Well Complaint 14[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 14 October 19, 2017						
10/2/2017	T15 (16)	4.16	0.076 (W13, 940 m)	0.341 (W14, 1,218 m)		3,027
10/2/2017	T23 (18)	5.33	0.076 (W13, 1,954 m)	0.341 (W14, 2,518 m)		4,079
10/2/2017	T41 (17)	6.28	0.063 (W1A, 930 m)	0.172 (WA, 938 m)		6,349
10/2/2017	T51 (8)	5.84	0.020 (W13, 2,776 m)	0.258 (W14, 3,056 m)		4,882
10/3/2017	T41(3)	2.13	0.196 (W1A, 930 m)	0.035 (WA, 938 m)		6,349
10/3/2017	T51 (14)	2.54	0.067 (W13, 2,776 m)	0.310 (W14, 3,056 m)		4,882
10/4/2017	T19 (11)	3.94	0.064 (W13, 2,460 m)	0.364 (W14, 2,787 m)		4,598
10/5/2017	T19 (7)	2.03	0.034 (W13, 2,460 m)	0.313 (W14, 2,787 m)		4,598
10/10/2017	T42 (1)	2.23	NA (W1A, 2,748 m)	NA (WA, 999 m)	NA, see text	7,599
10/10/2017	T5 (7)	8.13	0.016 (W3, 911 m)	NA	Well 4 unavailable	2,454
10/12/2017	T5 (9)	4.19	0.019 (W3, 911 m)	NA	Well 4 unavailable	2,454
10/12/2017	T39 (4)	NA	0.041 (W1A, 2,295 m)	0.045 (WA, 1,081 m)	Turbine site data not avail.	6,514
10/12/2017	T42 (17)	3.85	0.128 (W1A, 2,748 m)	0.043 (WA, 999 m)		7,599
10/13/2017	T39 (8)	7.75	0.048 (W1A, 2,295 m)	0.043 (WA, 1,081 m)		6,514
10/13/2017	T52(11)	5.89	0.030 (W3, 1,308 m)	NA	Well 4 unavailable	2,139
10/16/2017	T34 (9)	6.67	0.049 (W3, 2,638 m)	NA	Well 4 unavailable	3,673
10/16/2017	T39 (16)	8.64	0.043 (W1A, 2,295 m)	0.078 (WA, 1,081 m)		6,514
10/16/2017	T52(7)	3.94	0.022 (W3, 1,308 m)	NA	Well 4 unavailable	2,139

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

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T5

Pile No.:	Pile Driving Times and Dates: Start[a]	Rock/Till	End[a]	Geophone Distance (m): BE9679	BE18695	Peak Particle Velocity (mm/s)[b]: BE9679	BE18695	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d]: Well 3	Well 4	No Pump[e]
1	8/28/2017 13:59	8/28/2017 14:21	8/28/2017 14:47	24.9	26.0	2.16	1.70	0.002	0.045	
2	10/10/2017 16:20	10/10/2017 16:29	10/10/2017 16:31	23.2	25.0	2.03	2.03	0.004	NA[e]	
3	10/10/2017 16:40	10/10/2017 16:48	10/10/2017 16:51	21.0	23.3	2.16	2.16	0.016	NA[e]	
4	10/10/2017 17:02	10/10/2017 17:07	10/10/2017 17:11	18.3	21.1	3.56	2.03	0.014	NA[e]	
5	10/10/2017 17:19	10/10/2017 17:25	10/10/2017 17:29	15.4	18.4	2.92	2.14	0.006	NA[e]	
6	10/10/2017 17:37	10/10/2017 17:42	10/10/2017 17:43	12.6	15.5	3.05	2.84	0.006	NA[e]	
7	10/10/2017 17:53	10/10/2017 18:01	10/10/2017 18:06	10.3	12.7	7.24	8.13	0.003	NA[e]	
8	10/10/2017 18:15	10/10/2017 18:21	10/10/2017 18:23	9.4	10.4	4.95	4.45	0.014	NA[e]	
9	10/12/2017 7:53	10/12/2017 8:01	10/12/2017 8:05	10.3	9.5	3.68	4.19	0.003	NA[e]	
10	10/12/2017 8:13	10/12/2017 8:24	10/12/2017 8:26	12.6	10.4	2.67	3.56	0.005	NA[e]	
11	10/12/2017 8:36	10/12/2017 8:43	10/12/2017 8:45	15.4	12.7	2.14	2.54	0.017	NA[e]	
12	10/12/2017 8:58	10/12/2017 9:06	10/12/2017 9:07	18.3	15.5	2.16	2.03	0.008	NA[e]	
13	10/12/2017 10:40	10/12/2017 10:47	10/12/2017 10:48	21.0	18.4	2.16	2.14	0.003	NA[e]	
14	10/12/2017 11:22	10/12/2017 11:28	10/12/2017 11:30	23.2	21.1	1.65	1.40	0.019	NA[e]	
15	10/12/2017 12:00	10/12/2017 12:06	10/12/2017 12:12	24.9	23.3	1.65	1.40	0.003	NA[e]	
16	10/12/2017 11:42	10/12/2017 11:49	10/12/2017 11:52	25.9	25.0	1.90	1.65	0.004	NA[e]	
17	10/12/2017 9:33	10/12/2017 9:42	10/12/2017 9:43	26.3	26.0	1.65	1.78	0.005	NA[e]	
18	8/28/2017 15:56	8/28/2017 16:20	8/28/2017 16:25	25.9	26.4	2.29	1.75	0.006	0.027	

Well Information

Well No.: 3
Municipal Address: [redacted]
Distance from Turbine Centre: 911 m

Well No.: 4
Municipal Address: [redacted]
Distance from Turbine Centre: 1,030 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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.

Monitoring of Well 4 was not permitted after September 10, 2017. For reference in comparison to the vibration velocities noted above, St. Clair Road traffic passing at 78 m from Well 4 on September 5, 2017, 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 throughout the afternoon on September 5, 2017. On September 6, 2017, heavy vehicle traffic on St. Clair Road and near Well 4 was similar to September 5, 2017. Combine harvesting was on-going as close as 25 to 30 m from Well 4, during much of the day on September 6, 2017. On this same day, various individuals were at and in the well shed, connecting, operating and adjusting a well pump. Well 4 pump was cycled on and off on September 6, 2017, operating for periods of 1 to more than 7 minutes. When individuals were working on the pump and well, well casing vibrations were as much as 4.987 mm/s. At other times, Well 4 casing vibrations ranged from about 0.07 to about 0.62 mm/s with an average of about 0.18 mm/s, reflective of the vehicle and foot traffic on site near the well, harvesting equipment and traffic on the nearby St. Clair road. During this same measurement time on September 5 and 6, 2017, the nearest pile driving was more than 2 km distant and vibration measurements did not identify any evidence of pile driving influences. Geophone data shown in columns above on August 28, 2017 were obtained using instruments with serial numbers BE8719 and MP12721 at the respective positions occupied by BE9679 and BE18695 as listed above.

During the October, 2017 period for which data is presented above, Union Gas was constructing a pipeline about 400 m northwest of Well 4 and within about 100 to 180 m of [redacted].

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T15

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	BE18695	MP12721	BE18695	MP12721	Well 13	Well 14	No Pump[e]
1	10/2/2017 15:02	10/2/2017 15:11	10/2/2017 15:12	24.8	24.4		0.95	0.213	0.091	0.017
2	10/2/2017 16:07	10/2/2017 16:21	10/2/2017 16:22	24.4	24.8		0.86	0.036	0.048	
3	10/2/2017 15:42	10/2/2017 15:50	10/2/2017 15:52	23.4	24.4		0.99	0.541	0.282	0.031
4	10/2/2017 15:25	10/2/2017 15:34	10/2/2017 15:35	21.8	23.4		1.43	0.003	0.037	
5	9/29/2017 11:31	9/29/2017 12:52	9/29/2017 13:03	19.6	21.8	3.18	2.06	0.004	0.195	
6	10/2/2017 10:32	10/2/2017 10:45	10/2/2017 10:46	17.0	19.6		1.37	0.010	0.054	
7	10/2/2017 10:10	10/2/2017 10:19	10/2/2017 10:20	14.1	17.0		1.77	0.258	0.079	0.013
8	10/2/2017 9:39	10/2/2017 9:52	10/2/2017 9:53	11.3	14.1		2.33	0.544	0.075	0.005
9	10/2/2017 9:11	10/2/2017 9:25	10/2/2017 9:26	8.9	11.3		2.13	0.014	0.037	
10	10/2/2017 8:44	10/2/2017 8:57	10/2/2017 8:59	7.9	8.9		3.39	0.549	0.182	0.076
11	10/2/2017 8:12	10/2/2017 8:26	10/2/2017 8:27	8.9	7.9		3.37	0.016	0.141	
12	10/2/2017 7:41	10/2/2017 7:54	10/2/2017 7:55	11.3	8.9		4.16	0.009	0.091	
13	9/29/2017 13:43	9/29/2017 14:07	9/29/2017 14:37	14.1	11.3	2.03	2.62	0.033	0.091	
14	10/2/2017 11:08	10/2/2017 11:19	10/2/2017 11:21	17.0	14.1		1.92	0.384	0.039	0.067
15	10/2/2017 11:41	10/2/2017 11:50	10/2/2017 11:55	19.6	17.0		1.60	0.063	0.341	
16	10/2/2017 12:59	10/2/2017 13:21	10/2/2017 13:22	21.8	19.6		1.60	0.035	0.073	
17	10/2/2017 13:34	10/2/2017 13:43	10/2/2017 13:46	23.4	21.8		1.34	0.048	0.315	
18	10/2/2017 14:23	10/2/2017 14:33	10/2/2017 14:34	24.4	23.4		0.89	0.031	0.132	

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 940 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 1,218 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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. Driving of Pile 13 on till/rock included multiple stops and restarts between 14:37 and 15:07 pm with a total of 26 intermittent hammer blows during this period.

Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Well 14 vibration monitoring data was dominated by vibrations induced by local passing traffic including tractor-trailer transport trucks, combines, buses, and tractors passing the site on the road and vehicles entering and leaving driveway. Peak Well 14 casing vibrations of 0.341 mm/s associated with Pile 15 directly related to road traffic passing well outside of times when pile driving on till/rock. Similar traffic influences were identifiable for Well 14 during 10 minute data intervals analysed for Piles 1, 3, 5, 10, 11, 17 and 18. Well 13 pump vibrations were clearly discernable in data and confirmed by audible pump noise. Peak Well 13 casing vibrations induced by the pump were about 0.55 mm/s during 10 minute data analysis intervals associated with Piles 1, 3, 7, 8 and 14. Well 13 pump vibrations dominated data for periods of 1 to 5 minutes. Peak well casing vibrations exclusive of pump influences identified within the same monitoring period at Well 13 are shown in the "no pump" column.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

Golder Associates Ltd.

NORTH KENT 1
Vibration Monitoring Data Report

T19 Issue Date: 12/5/2017

Turbine Location: T19

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	BE9679	BE8719	BE9679	BE8719	Well 13	Well 14	No Pump[e]
1	10/4/2017 16:23	10/4/2017 16:28	10/4/2017 16:31	24.3	23.8	2.40	1.52	0.023	0.364	
2	10/5/2017 8:20	10/5/2017 8:25	10/5/2017 8:28	24.7	24.8	1.27	1.14	0.522	0.313	0.018
3	10/5/2017 8:38	10/5/2017 8:43	10/5/2017 8:47	24.3	25.2	1.40	1.27	0.006	0.058	
4	10/5/2017 10:40	10/5/2017 10:44	10/5/2017 10:46	23.3	24.8	1.27	1.14	0.005	0.186	
5	10/5/2017 9:41	10/5/2017 9:46	10/5/2017 9:49	21.7	23.8	2.03	1.52	0.424	0.056	0.034
6	10/5/2017 9:21	10/5/2017 9:26	10/5/2017 9:29	19.5	22.2	1.78	1.27	0.010	0.157	
7	10/4/2017 16:01	10/4/2017 16:08	10/4/2017 16:09	16.9	20.0	1.91	1.78	0.010	0.115	
8	10/5/2017 9:02	10/5/2017 9:07	10/5/2017 9:08	14.1	17.4	2.03	1.52	0.026	0.041	
9	10/4/2017 14:21	10/4/2017 14:26	10/4/2017 14:27	11.2	14.5	3.30	2.03	0.064	0.142	
10	10/4/2017 14:05	10/4/2017 14:11	10/4/2017 14:12	8.8	11.6	3.81	3.05	0.007	0.130	
11	10/4/2017 13:46	10/4/2017 13:52	10/4/2017 13:54	7.8	9.3	3.56	3.18	0.015	0.253	
12	10/4/2017 13:24	10/4/2017 13:32	10/4/2017 13:34	8.8	8.3	3.81	3.94	0.039	0.128	
13	10/4/2017 12:56	10/4/2017 13:01	10/4/2017 13:02	11.2	9.3	3.30	3.30	0.026	NA[e]	
14	10/4/2017 12:35	10/4/2017 12:42	10/4/2017 12:46	14.1	11.6	2.67	3.43	0.035	NA[e]	
15	10/4/2017 11:31	10/4/2017 11:37	10/4/2017 11:40	16.9	14.5	2.16	2.54	0.035	0.121	
16	10/4/2017 11:11	10/4/2017 11:18	10/4/2017 11:20	19.5	17.4	2.29	2.41	0.028	0.100	
17	10/4/2017 10:51	10/4/2017 10:58	10/4/2017 11:00	21.7	20.0	1.91	2.29	0.008	0.116	
18	10/5/2017 7:59	10/5/2017 8:04	10/5/2017 8:07	23.3	22.2	1.27	1.27	0.349	0.043	0.014

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 2,460 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 2,787 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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.

Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Well 14 vibration monitoring data was dominated by vibrations induced by local passing traffic including tractor-trailer transport trucks, combines, buses, and tractors passing the site on the road and vehicles entering and leaving driveway. The peak measured Well 14 vibrations of 0.364 mm/s noted above was attributable to vehicles passing on the road. The peak vibrations measured at Well 14 of 0.61 mm/s were associated with a vehicle turning in the driveway (9/27/2017). Data for Piles 13 and 14 for Well 14 not available due to battery failure in monitoring equipment. The battery was subsequently replaced.

Well 13 pump vibrations were clearly discernable in data and confirmed by audible pump noise. Peak well casing vibrations exclusive of pump influences identified within the same monitoring period at Well 13 are shown in the "no pump" column.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

Golder Associates Ltd.

NORTH KENT 1
Vibration Monitoring Data Report

T23 Issue Date: 12/5/2017

Turbine Location: T23

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Maximum Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	BE8719	BE9555	BE8719	BE9555	Well 13	Well 14	No Pump[e]
1	10/2/2017 8:19	10/2/2017 8:27	10/2/2017 8:32	17.3	19.7	2.67	2.79	0.016	0.169	
2	10/2/2017 8:42	10/2/2017 8:50	10/2/2017 8:57	14.4	17.1	5.33	4.83	0.549	0.182	0.076
3	10/2/2017 9:09	10/2/2017 9:13	10/2/2017 9:16	11.5	14.2	3.30	3.02	0.019	0.049	
4	10/2/2017 9:25	10/2/2017 9:31	10/2/2017 9:35	9.2	11.3	2.94	3.68	0.018	0.048	
5	10/2/2017 9:45	10/2/2017 9:51	10/2/2017 9:54	8.2	9.0	4.19	3.81	0.581	0.075	0.004
6	10/2/2017 10:02	10/2/2017 10:09	10/2/2017 10:11	9.2	8.0	4.06	4.19	0.024	0.334	
7	10/2/2017 11:21	10/2/2017 11:29	10/2/2017 11:30	11.5	9.0	2.79	3.18	0.003	0.033	
8	10/2/2017 11:45	10/2/2017 11:50	10/2/2017 11:51	14.4	11.3	1.52	2.29	0.302	0.341	0.008
9	10/2/2017 11:59	10/2/2017 12:05	10/2/2017 12:08	17.3	14.2	1.52	1.91	0.007	0.054	
10	10/2/2017 12:36	10/2/2017 12:42	10/2/2017 12:46	19.9	17.1	1.91	1.78	0.007	0.054	
11	10/2/2017 12:53	10/2/2017 12:59	10/2/2017 13:03	22.1	19.7	2.03	1.78	0.004	0.195	
12	10/2/2017 13:13	10/2/2017 13:18	10/2/2017 13:22	23.7	21.9	2.16	2.03	0.035	0.073	
13	10/2/2017 13:30	10/2/2017 13:36	10/2/2017 13:40	24.7	23.5	1.27	1.68	0.008	0.178	
14	10/2/2017 13:52	10/2/2017 13:59	10/2/2017 14:00	25.1	24.5	1.27	1.40	0.472	0.152	0.019
15	10/2/2017 14:06	10/2/2017 14:18	10/2/2017 14:19	24.7	24.9	1.40	1.27	0.751	0.067	0.012
16	10/2/2017 15:21	10/2/2017 15:25	10/2/2017 15:26	23.7	24.5	1.52	1.14	0.020	0.119	
17	10/2/2017 14:54	10/2/2017 15:03	10/2/2017 15:09	22.1	23.5	1.91	1.40	0.213	0.091	0.017
18	10/2/2017 14:29	10/2/2017 14:36	10/2/2017 14:41	19.9	21.9	2.54	2.16	0.031	0.132	

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 1,954 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 2,518 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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. Driving of Pile 3 on till/rock paused for 2:00 between times noted above.

Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Well 14 vibration monitoring data was dominated by vibrations induced by local passing traffic including tractor-trailer transport trucks, combines, buses, and tractors passing the site on the road and vehicles entering and leaving driveway. The passing of Well 14 by 9 trucks, busses and passenger vehicles was clearly identified in vibration data on 10/2/2017 between 8:31 and 8:41 resulting in a peak vibration velocity of about 0.17 mm/s during this time interval. The peak measured Well 14 vibrations of 0.334 mm/s associated with vehicle entering driveway immediately adjacent to well (10:05 on 10/2/2017).

Well 13 pump vibrations were clearly discernable in data and confirmed by audible pump noise. Peak Well 13 casing vibrations induced by the pump were about 0.75 mm/s during 10 minute data analysis intervals associated with Piles 2, 5, 8, 14, 15 and 17. Peak well casing vibrations exclusive of pump influences identified within the same monitoring period at Well 13 are shown in the "no pump" column.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T34

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site: Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	MP12710	MP12721	MP12710	MP12721	Well 3	Well 4
1	10/16/2017 16:02	10/17/2017 12:01	10/17/2017 12:14	22.6	23.5	2.70	1.70	0.019	NA[e]
2	10/16/2017 15:53	10/18/2017 10:37	10/18/2017 10:48	21.0	22.5	1.91	1.85	0.049	NA[e]
3	10/16/2017 15:44	10/17/2017 13:24	10/17/2017 13:32	18.9	20.9	2.37	2.32	0.008	NA[e]
4	10/16/2017 15:34	10/17/2017 14:48	10/17/2017 14:54	16.3	18.8	2.56	1.78	0.014	NA[e]
5	10/16/2017 15:27	10/17/2017 15:40	10/17/2017 15:49	13.5	16.2	3.00	2.74	0.015	NA[e]
6	10/16/2017 15:17	10/18/2017 12:22	10/18/2017 12:32	10.6	13.4	2.92	3.52	0.005	NA[e]
7	10/16/2017 14:58	10/18/2017 9:27	10/18/2017 9:36	8.1	10.5	3.99	3.59	0.010	NA[e]
8	10/16/2017 15:07	10/17/2017 11:29	10/17/2017 11:41	7.1	8.0	6.67	4.82	0.007	NA[e]
9	10/17/2017 8:35	10/18/2017 14:28	10/18/2017 14:36	8.1	7.0	4.64	5.43	0.020	NA[e]
10	10/17/2017 8:45	10/18/2017 16:06	10/18/2017 16:15	10.6	8.0	3.56	6.01	0.010	NA[e]
11	10/17/2017 9:15	10/19/2017 7:51	10/19/2017 8:16	13.5	10.5	3.56	5.16	0.009	NA[e]
12	10/17/2017 9:29	10/19/2017 8:59	10/19/2017 9:06	16.3	13.4	2.25	4.01	0.009	NA[e]
13	10/17/2017 16:39	10/17/2017 16:45	10/17/2017 16:51	18.9	16.2	2.93	2.67	0.017	NA[e]
14	10/18/2017 15:18	10/19/2017 11:16	10/19/2017 11:24	21.0	18.8	2.08	2.22	0.008	NA[e]
15	10/18/2017 15:08	10/19/2017 12:22	10/19/2017 12:38	22.6	20.9	1.57	2.00	0.005	NA[e]
16	10/18/2017 15:00	10/19/2017 13:14	10/19/2017 13:25	23.6	22.5	1.50	1.80	0.005	NA[e]
17	10/18/2017 14:48	10/18/2017 14:52	10/18/2017 14:53	24.0	23.5	1.45	1.36	0.023	NA[e]
18	10/16/2017 16:12	10/18/2017 14:56	10/18/2017 15:04	23.6	23.9	1.40	1.36	0.020	NA[e]
Restrikes and Continued Pile Driving									
17C	10/19/2017 16:26	10/19/2017 16:26	10/19/2017 16:36	23.6	23.9	2.12	2.31	0.009	NA[e]
13C	10/31/2017 16:26	10/31/2017 16:35	10/31/2017 16:48	18.9	16.2	4.54	4.19	0.018	NA[e]
4C	10/31/2017 10:31	10/31/2017 10:31	10/31/2017 11:17	16.3	18.8	3.68	3.30	0.007	NA[e]
5C	10/31/2017 11:21	10/31/2017 11:21	10/31/2017 11:38	13.5	16.2	3.99	4.45	0.009	NA[e]
6C	10/31/2017 11:41	10/31/2017 11:41	10/31/2017 12:09	10.6	13.4	3.18	4.06	0.006	NA[e]
7C	10/31/2017 14:30	10/31/2017 14:30	10/31/2017 14:48	8.1	10.5	4.35	5.46	0.006	NA[e]
8C	10/31/2017 14:51	10/31/2017 14:51	10/31/2017 15:21	7.1	8.0	6.27	7.49	0.024	NA[e]
18C	11/1/2017 13:44	11/1/2017 13:44	11/1/2017 13:52	23.6	23.9	1.90	2.16	0.010	NA[e]
17C	11/1/2017 13:53	11/1/2017 13:53	11/1/2017 14:02	24.0	23.5	2.39	2.03	0.003	NA[e]
12C	11/1/2017 8:15	11/1/2017 8:15	11/1/2017 8:40	16.3	13.4	3.67	3.56	0.014	NA[e]
10C	11/1/2017 10:48	11/1/2017 10:48	11/1/2017 11:27	10.6	8.0	6.50	4.06	0.007	NA[e]
9C	11/1/2017 12:03	11/1/2017 12:03	11/1/2017 12:38	8.1	7.0	7.20	4.95	0.010	NA[e]
1C	11/1/2017 13:35	11/1/2017 13:35	11/1/2017 13:42	22.6	23.5	2.04	2.67	0.006	NA[e]
3C	11/1/2017 16:20	11/1/2017 16:20	11/1/2017 16:41	18.9	20.9	3.34	4.45	0.010	NA[e]
14C	11/2/2017 10:50	11/2/2017 10:53	11/2/2017 11:24	21.0	18.8	2.27	2.29	0.005	NA[e]
1C	11/2/2017 9:11	11/2/2017 9:11	11/2/2017 9:16	22.6	23.5	1.92	2.54	0.005	NA[e]
2C	11/2/2017 8:30	11/2/2017 8:30	11/2/2017 9:07	21.0	22.5	2.06	2.79	0.001	NA[e]
15C	11/2/2017 12:25	11/2/2017 12:25	11/2/2017 13:32	22.6	20.9	3.18	2.29	0.003	NA[e]
16C	11/2/2017 10:43	11/2/2017 10:43	11/2/2017 13:49	23.6	22.5	2.93	3.30	0.004	NA[e]
17C	11/2/2017 9:41	11/2/2017 9:41	11/2/2017 10:07	24.0	23.5	1.78	1.65	0.003	NA[e]
18C	11/2/2017 9:19	11/2/2017 9:19	11/2/2017 9:39	23.6	23.9	1.37	1.40	0.017	NA[e]
14C	11/8/2017 8:12	11/8/2017 8:12	11/8/2017 8:26	21.0	18.8	1.27	1.91	0.026	NA[e]

Well Information

Well No.: 3
Municipal Address: [redacted]
Distance from Turbine Centre: 2,638 m

Well No.: 4
Municipal Address: [redacted]
Distance from Turbine Centre: 3,258 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

NORTH KENT 1
Vibration Monitoring Data Report

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Piles that were spliced that were then driven deeper are indicated "C" for continuation of pile depth. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. Pile driving was stopped and restarted on multiple days to address splicing and final pile depth requirements. Respective stop/restart times for individual piles were as shown in parentheses following pile number: 1 (10/16 at 16:06; 10/17 at 12:01); 2 (10/16 at 15:58; 10/18 at 10:36:10); 3 (10/16 at 15:48:15; 10/17 at 13:23); 4 (10/16 at 15:39; 10/17 at 14:46:00), 5 (10/16 at 15:30; 10/17 at 15:39), 6 (10/16 at 15:21, 10/18 at 12:21), 7 (10/16 15:01:50 on 10/16, 10/18 at 9:26), 8 (10/16 at 15:11, 10/17 at 11:28), 9 (10/17 at 8:40, 10/18 at 14:27), 10 (10/17 at 8:52, 10/18 at 16:05), 11 (10/17 at 9:19, 10/19 at 7:50), 12 (10/17 at 9:34, 10/19 at 8:59), 16 (10/18 at 15:04, 10/19 at 13:14), 18 (10/16 at 16:21, 10/18 at 14:50), 14C (11/8 at 8:21, 11/8 at 8:26) 15C (11/2 at 12:34, 11/2 at 13:30). Prior to the continued pile driving as shown for the second and third driving times (where applicable for each pile), the depth of the continued advancement was predrilled. Therefore, two intervals of vibration analyses are summarized above where the first instance is consistent with the hardest driving prior to predrilling and the second instance reflects the hard driving at the final depth of the pile once the pile achieved depths that had not been predrilled. Well 4 was unavailable for monitoring after September 10, 2017. Geophone serial numbers BE18695 and BE9555 used on November 8, 2017 in lieu of MP12710 and MP12721, respectively.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T39

Pile No.:	Pile Driving Times and Dates Start[a]	Rock/Till	End[a]	Vibration Measurements at Turbine Site: Geophone Distance (m) BE9555	BE8719	Peak Particle Velocity (mm/s)[b] BE9555	BE8719	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d] Well 1A	Well A	No Pump[e]
1	10/16/2017 7:49	10/16/2017 8:16	10/16/2017 8:28	20.1	18.8	3.30	2.79	0.021	0.014	
2	10/16/2017 8:51	10/16/2017 9:16	10/16/2017 9:20	21.7	20.9	2.16	1.91	0.011	0.029	
3	10/16/2017 9:36	10/16/2017 9:54	10/16/2017 10:13	22.6	22.5	2.29	1.91	0.020	0.027	
4	10/16/2017 11:59	10/16/2017 12:11	10/16/2017 12:19	23.0	23.5	1.40	1.65	0.016	0.025	
5	10/16/2017 11:44	10/16/2017 11:28	10/16/2017 11:40	22.6	23.9	1.14	1.65	0.019	0.018	
6	10/16/2017 10:39	10/16/2017 10:51	10/16/2017 11:05	21.7	23.5	2.03	2.67	0.010	0.020	
7	10/13/2017 13:52	10/13/2017 14:37	10/13/2017 14:41	20.1	22.5	3.43	4.06	0.021	NA[e]	
8	10/13/2017 13:02	10/13/2017 13:17	10/13/2017 13:36	18.0	20.9	2.67	2.92	0.020	0.043	
9	10/13/2017 11:31	10/13/2017 11:46	10/13/2017 11:50	15.5	18.8	5.84	4.45	0.020	0.030	
10	10/12/2017 16:59	10/12/2017 17:13	10/12/2017 17:15	12.6	16.2			0.028	0.019	
11	10/12/2017 16:16	10/12/2017 16:31	10/12/2017 16:43	9.7	13.4			0.020	0.045	
12	10/12/2017 15:40	10/12/2017 15:56	10/12/2017 15:58	7.2	10.5			0.041	0.032	
13	10/12/2017 14:55	10/12/2017 15:17	10/12/2017 15:20	6.1	8.0			0.032	0.029	
14	10/13/2017 7:54	10/13/2017 8:12	10/13/2017 8:19	7.2	7.0	7.75	6.48	0.012	0.013	
15	10/13/2017 8:43	10/13/2017 9:02	10/13/2017 9:07	9.7	8.0	5.08	5.97	0.048	0.032	
16	10/13/2017 9:35	10/13/2017 9:57	10/13/2017 10:01	12.6	10.5	4.45	4.06	0.016	0.027	
17	10/13/2017 10:18	10/13/2017 10:31	10/13/2017 10:37	15.5	13.4	4.06	3.56	0.011	0.013	
18	10/13/2017 15:07	10/13/2017 15:23	10/13/2017 15:35	18.0	16.2	3.56	4.06	0.019	0.010	
Restrikes										
1	10/16/2017 14:12	10/16/2017 14:12	10/16/2017 14:14	20.1	18.8	1.40	1.52	0.010	0.025	
2	10/16/2017 9:25	10/16/2017 9:25	10/16/2017 9:25	21.7	20.9	1.78	1.91	0.027	0.021	
3	10/16/2017 13:25	10/16/2017 13:25	10/16/2017 13:35	22.6	22.5	1.14	1.40	0.033	0.037	
4	10/16/2017 13:40	10/16/2017 13:40	10/16/2017 13:46	23.0	23.5	1.14	1.40	0.013	0.037	
6	10/16/2017 13:52	10/16/2017 13:52	10/16/2017 13:53	21.7	23.5	1.14	1.65	0.043	0.037	
7	10/16/2017 13:57	10/16/2017 13:57	10/16/2017 13:59	20.1	22.5	1.40	1.52	0.043	0.067	
8	10/16/2017 14:05	10/16/2017 14:05	10/16/2017 14:06	18.0	20.9	1.65	1.78	0.017	0.022	
12	10/16/2017 14:39	10/16/2017 14:39	10/16/2017 14:48	7.2	10.5	7.87	8.64	0.026	0.032	
17	10/16/2017 14:19	10/16/2017 14:19	10/16/2017 14:20	15.5	13.4	2.16	2.14	0.010	0.025	
18	10/16/2017 14:33	10/16/2017 14:33	10/16/2017 14:34	18.0	16.2	1.02	1.02	0.010	0.078	

Well Information

Well No.: 1A
Municipal Address: [redacted]
Distance from Turbine Centre: 2,295 m

Well No.: A
Municipal Address: [redacted]
Distance from Turbine Centre: 1,081 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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.

Well 1A located 65 m from Baldoon Road and Well A located 35 m from St. Clair Road. Vibration velocities noted above for both wells reflect maximum values induced by transient sources other than pile driving. Data at both wells was dominated by influence of locally heavy traffic on both roads and on St. Clair Road in particular. Tractor-trailer transport trucks typically passed Well A every 1 to 3 minutes corresponding to peak vibration velocities. Data not available for Well A during driving of Pile 7 due to battery failure. Battery subsequently replaced. Data unavailable for turbine site on October 12, 2017.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T41

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	MP12710	NA[e]	MP12710	NA[e]	Well 1A	Well A	No Pump[e]
1	10/3/2017 7:39	10/3/2017 7:48	10/3/2017 7:51	24.9		2.13		0.027	0.014	
2	10/2/2017 8:06	10/2/2017 8:11	10/2/2017 8:16	25.3		0.75		0.024	0.038	
3	10/3/2017 15:54	10/3/2017 15:58	10/3/2017 16:00	24.9		2.02		0.023	0.029	
4	10/2/2017 9:54	10/2/2017 9:58	10/2/2017 10:05	23.9		6.28		0.019	0.036	
5	10/2/2017 8:26	10/2/2017 8:31	10/2/2017 8:34	22.3		0.29		0.022	0.042	
6	10/2/2017 10:20	10/2/2017 10:30	10/2/2017 10:35	20.1		3.56		0.028	0.010	
7	10/2/2017 10:00	10/2/2017 10:05	10/2/2017 10:10	17.5		3.94		0.031	0.036	
8	10/2/2017 11:13	10/2/2017 11:22	10/2/2017 11:25	14.6		4.26		0.032	0.050	
9	10/2/2017 11:43	10/2/2017 11:49	10/2/2017 11:54	11.7		4.82		0.026	0.039	
10	10/2/2017 12:04	10/2/2017 12:11	10/2/2017 12:20	9.4		5.18		0.029	0.026	
11	10/2/2017 12:33	10/2/2017 12:47	10/2/2017 12:50	8.4		6.28		0.016	NA[e]	
12	10/2/2017 14:18	10/2/2017 14:24	10/2/2017 14:29	9.4		5.80		0.021	0.134	
13	10/2/2017 15:00	10/2/2017 15:06	10/2/2017 15:13	11.7		5.38		0.028	0.031	
14	10/2/2017 15:27	10/2/2017 15:38	10/2/2017 15:38	14.6		2.97		0.010	0.021	
15	10/2/2017 15:49	10/2/2017 15:52	10/2/2017 15:52	17.5		3.92		0.041	0.172	
16	10/2/2017 16:15	10/2/2017 16:20	10/2/2017 16:27	20.1		5.12		0.041	0.016	
17	10/2/2017 16:42	10/2/2017 16:47	10/2/2017 16:53	22.3		3.80		0.063	0.058	
18	10/2/2017 16:59	10/2/2017 17:05	10/2/2017 17:09	23.9		2.23		0.024	0.031	
Restrikes										
8	10/2/2017 11:29	10/2/2017 11:29	10/2/2017 11:29	14.6				0.020	0.050	
8	10/3/2017 10:17	10/3/2017 10:18	10/3/2017 10:19	14.6				0.196	0.035	

Well Information

Well No.: 1A
Municipal Address: [redacted]
Distance from Turbine Centre: 930 m

Well No.: A
Municipal Address: [redacted]
Distance from Turbine Centre: 938 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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. Second geophone unavailable on October 2 and 3, 2017.

Well 1A located 65 m from Baldoon Road and Well A located 35 m from St. Clair Road. Vibration velocities noted above for both wells reflect maximum values induced by transient sources other than pile driving. Data at both wells was dominated by influence of locally heavy traffic on both roads and on St. Clair Road in particular. Tractor-trailer transport trucks typically passed Well A every 1 to 3 minutes corresponding to maximum vibration velocities. Data not available for Well A during driving of Pile 11 due to battery failure. Battery subsequently replaced.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

Golder Associates Ltd.

NORTH KENT 1
Vibration Monitoring Data Report

Issue Date: 12/5/2017

Turbine Location: T42

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	MP12721	MP12710	MP12721	MP12710	Well 1A	Well A	No Pump[e]
1	10/12/2017 11:00	10/12/2017 11:06	10/12/2017 11:09	18.1	12.5	1.60	1.46	0.017	0.032	
2	10/12/2017 11:52	10/12/2017 11:59	10/12/2017 12:06	20.7	15.4	1.62	1.63	0.010	0.034	
3	10/12/2017 15:36	10/12/2017 15:41	10/12/2017 15:46	22.9	18.3	1.57	1.47	0.008	0.030	
4	10/12/2017 15:55	10/12/2017 16:01	10/12/2017 16:06	24.6	20.9	1.20	1.08	0.006	0.010	
5	10/12/2017 15:11	10/12/2017 15:20	10/12/2017 15:27	25.6	23.1	1.31	1.16	0.012	0.039	
6	10/12/2017 14:48	10/12/2017 14:56	10/12/2017 15:01	26.0	24.8	1.28	0.95	0.027	0.022	
7	10/12/2017 14:16	10/12/2017 14:23	10/12/2017 14:31	25.6	25.8	1.65	1.84	0.006	0.036	
8	10/12/2017 13:47	10/12/2017 13:52	10/12/2017 13:58	24.6	26.2	1.27	1.23	0.021	0.026	
9	10/12/2017 13:18	10/12/2017 13:23	10/12/2017 13:34	22.9	25.8	2.13	2.14	0.018	0.018	
10	10/12/2017 12:21	10/12/2017 12:29	10/12/2017 12:37	20.7	24.8	2.28	1.49	0.128	0.023	
11	10/12/2017 9:46	10/12/2017 9:53	10/12/2017 9:56	18.1	23.1	2.54	1.86	0.002	0.043	
12	10/12/2017 8:53	10/12/2017 9:01	10/12/2017 9:05	15.2	20.9	1.97	2.14	0.004	NA[e]	
13	10/12/2017 8:29	10/12/2017 8:36	10/12/2017 8:38	12.3	18.3	2.29	3.02	0.029	0.029	
14	10/12/2017 8:10	10/12/2017 8:18	10/12/2017 8:20	10.0	15.4	2.56	4.54	0.016	0.029	
15	10/10/2017 16:34	10/10/2017 16:43	10/10/2017 16:45	9.1	12.5	2.22	2.23	NA[e]	NA[e]	
16	10/12/2017 7:45	10/12/2017 7:54	10/12/2017 7:58	10.0	10.2	2.84	2.68	0.031	0.014	
17	10/12/2017 10:08	10/12/2017 10:15	10/12/2017 10:17	12.3	9.3	3.85	2.52	0.004	0.012	
18	10/12/2017 10:30	10/12/2017 10:36	10/12/2017 10:42	15.2	10.2	2.63	1.88	0.016	NA[e]	

Well Information

Well No.: 1A
Municipal Address: [redacted]
Distance from Turbine Centre: 2748 m

Well No.: A
Municipal Address: [redacted]
Distance from Turbine Centre: 999 m

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

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 1A located 65 m from Baldoon Road and Well A located 35 m from St. Clair Road. Vibration velocities noted above for both wells reflect maximum values induced by transient sources other than pile driving. Data at both wells dominated by influence of locally heavy traffic on both roads and on St. Clair Road in particular. Tractor-trailer transport trucks typically passed Well A every 1 to 3 minutes corresponding to maximum vibration velocities. Data not available for Well A during driving of Pile 12 due to battery failure. Battery was subsequently replaced. Data not available for Wells 1A and A during driving of Pile 15 as a result of insufficient advance notice time to operate the well monitoring equipment for the one pile driven on October 10, 2017.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T51

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	BE18695	BE9769	BE18695	BE9769	Well 13	Well 14	No Pump[e]
1	10/3/2017 10:23	10/3/2017 10:29	10/3/2017 10:33	24.4	24.8	1.40	1.40	0.459	0.040	0.009
2	10/3/2017 12:16	10/3/2017 12:23	10/3/2017 12:24	24.0	25.2	1.02	1.27	0.333	0.166	0.007
3	10/3/2017 12:39	10/3/2017 12:44	10/3/2017 12:45	23.0	24.8	1.91	2.16	0.306	0.083	0.067
4	10/3/2017 12:57	10/3/2017 13:03	10/3/2017 13:06	21.4	23.8	1.27	1.14	0.018	0.165	
5	10/3/2017 11:27	10/3/2017 11:32	10/3/2017 11:33	19.3	22.2	1.40	1.27	0.016	0.079	
6	10/3/2017 8:58	10/3/2017 9:04	10/3/2017 9:05	16.7	20.0	1.65	1.78	0.737	0.185	0.012
7	10/3/2017 8:10	10/3/2017 8:19	10/3/2017 8:24	13.8	17.4	2.16	2.14	0.542	0.084	0.018
8	10/3/2017 7:46	10/3/2017 7:54	10/3/2017 7:56	10.9	14.5	2.54	2.03	0.026	0.124	
9	10/2/2017 12:30	10/2/2017 12:40	10/2/2017 12:42	8.5	11.6	3.43	3.43	0.010	0.048	
10	10/2/2017 13:02	10/2/2017 13:09	10/2/2017 13:12	7.5	9.3	5.84	3.81	0.008	0.195	
11	10/2/2017 13:28	10/2/2017 13:35	10/2/2017 13:35	8.5	8.3	3.81	3.56	0.008	0.178	
12	10/2/2017 14:02	10/2/2017 14:09	10/2/2017 14:11	10.9	9.3	3.68	3.43	0.747	0.054	0.006
13	10/2/2017 14:25	10/2/2017 14:31	10/2/2017 14:33	13.8	11.6	3.05	2.54	0.014	0.132	
14	10/2/2017 14:45	10/2/2017 14:51	10/2/2017 14:55	16.7	14.5	3.05	3.18	0.008	0.258	
15	10/2/2017 15:08	10/2/2017 15:16	10/2/2017 15:27	19.3	17.4	1.78	1.65	0.020	0.037	
16	10/2/2017 16:26	10/2/2017 16:35	10/2/2017 16:37	21.4	20.0	1.65	1.52	0.020	0.038	
17	10/3/2017 9:29	10/3/2017 9:36	10/3/2017 9:37	23.0	22.2	1.40	1.40	0.008	0.070	
18	10/3/2017 9:58	10/3/2017 10:06	10/3/2017 10:08	24.0	23.8	1.27	1.27	0.514	0.062	0.011
Restrikes										
7	10/3/2017 11:39	10/3/2017 11:39	10/3/2017 11:40	13.8	17.4	1.27	1.91	0.320	0.079	0.005
15	10/3/2017 13:14	10/3/2017 13:35	10/3/2017 13:38	19.3	17.4	2.03	2.29	0.067	0.310	
Replacements										
7A	10/3/2017 15:48	10/3/2017 15:55	10/3/2017 15:56	14.8	18.4	2.29	1.91	0.008	0.060	
15A	10/3/2017 15:00	10/3/2017 15:09	10/3/2017 15:11	20.3	18.4	2.16	2.29	0.017	0.065	

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 2776 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 3056 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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". Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. Driving of Pile 15 paused 15:19 to 15:20 and 15:22:10 to 15:27:30.

Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Well 14 vibration monitoring data was dominated by vibrations induced by local passing traffic including tractor-trailer transport trucks, combines, buses, and tractors passing the site on the road and vehicles entering and leaving driveway. The peak measured Well 14 vibrations of 0.258 and 0.310 mm/s noted above were directly attributable to vehicles passing on the road including slow passage of a tractor, and passing of a bus, passenger cars, light trucks and tractor-trailer transport trucks. The peak vibrations measured at Well 14 of 0.61 mm/s were associated with a vehicle turning in the driveway (9/27/2017).

Well 13 pump vibrations were clearly discernable in data and confirmed by audible pump noise. Peak Well 13 casing vibrations induced by the pump were about 0.75 mm/s during monitoring of this well. Peak well casing vibrations exclusive of pump influences identified within the same monitoring period at Well 13 are shown in the "no pump" column.

NORTH KENT 1
Vibration Monitoring Data Report

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Vibration Monitoring Data Report

Turbine Location: T52

	Vibration Measurements at Turbine Site							Vibration Measurements at Wells		
	Pile Driving Times and Dates			Geophone Distance (m)		Peak Particle Velocity (mm/s)[b]		Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	BE9679	BE18695	BE9679	BE18695	Well 3	Well 4	No Pump[e]
1	10/16/2017 10:44	10/16/2017 10:50	10/16/2017 10:52	23.5	23.5	3.05	3.18	0.008	NA[e]	
2	10/16/2017 11:44	10/16/2017 12:00	10/16/2017 12:02	22.5	23.9	1.65	1.52	0.006	NA[e]	
3	10/16/2017 11:23	10/16/2017 11:29	10/16/2017 11:32	20.9	23.5	1.52	2.03	0.022	NA[e]	
4	10/16/2017 11:00	10/16/2017 11:10	10/16/2017 11:13	18.8	22.5	2.16	1.78	0.003	NA[e]	
5	10/13/2017 12:22	10/13/2017 12:32	10/13/2017 12:35	16.2	20.9	3.05	2.29	0.005	NA[e]	
6	10/13/2017 12:00	10/13/2017 12:11	10/13/2017 12:13	13.4	18.8	3.68	3.43	0.003	NA[e]	
7	10/13/2017 11:37	10/13/2017 11:45	10/13/2017 11:45	10.5	16.2	3.68	3.30	0.030	NA[e]	
8	10/13/2017 10:59	10/13/2017 11:13	10/13/2017 11:16	8.0	13.4	4.06	4.70	0.011	NA[e]	
9	10/13/2017 9:53	10/13/2017 11:25	10/13/2017 11:28	7.0	10.5	5.89	4.95	0.006	NA[e]	
10	10/13/2017 9:35	10/13/2017 11:18	10/13/2017 11:21	8.0	7.0	5.08	4.70	0.011	NA[e]	
11	10/13/2017 9:16	10/13/2017 9:21	10/13/2017 9:25	10.5	8.0	5.33	4.70	0.009	NA[e]	
12	10/13/2017 8:53	10/13/2017 9:02	10/13/2017 9:05	13.4	10.5	4.70	3.56	0.015	NA[e]	
13	10/13/2017 14:14	10/13/2017 14:24	10/13/2017 14:26	16.2	13.4	3.56	2.16	0.010	NA[e]	
14	10/16/2017 7:59	10/16/2017 8:08	10/16/2017 8:10	18.8	16.2	2.03	2.03	0.008	NA[e]	
15	10/13/2017 12:48	10/13/2017 12:57	10/13/2017 12:59	20.9	18.8	2.54	2.03	0.005	NA[e]	
16	10/13/2017 13:10	10/13/2017 13:24	10/13/2017 13:24	22.5	20.9	2.14	1.52	0.004	NA[e]	
17	10/16/2017 8:22	10/16/2017 8:32	10/16/2017 8:33	23.5	22.5	3.94	3.68	0.011	NA[e]	
18	10/16/2017 8:43	10/16/2017 8:49	10/16/2017 8:51	23.9	23.5	2.03	1.52	0.004	NA[e]	

Well Information

Well No.: 3
Municipal Address: [redacted]
Distance from Turbine Centre: 1,308 m

Well No.: 4
Municipal Address: [redacted]
Distance from Turbine Centre: 1,254 m

This data report must be read with "Construction Vibration Monitoring Report, North Kent 1," prepared by Golder Associates Ltd., dated December, 2017.

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. Driving of Pile 9 was paused between 10:01 and 11:23 to complete welding on the pile. Driving of Pile 10 was paused between 9:44 and 11:18 to complete welding on the pile.

Monitoring of Well 4 was not permitted after September 10, 2017. For reference in comparison to the vibration velocities noted above, St. Clair Road traffic passing at 78 m from Well 4 on September 5, 2017, 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 throughout the afternoon on September 5, 2017. On September 6, 2017, heavy vehicle traffic on St. Clair Road and near Well 4 was similar to September 5, 2017. Combine harvesting was on-going as close as 25 to 30 m from Well 4, during much of the day on September 6, 2017. On this same day, various individuals were at and in the well shed, connecting, operating and adjusting a well pump. Well 4 pump was cycled on and off on September 6, 2017, operating for periods of 1 to more than 7 minutes. When individuals were working on the pump and well, well casing vibrations were as much as 4.987 mm/s. At other times, Well 4 casing vibrations ranged from about 0.07 to about 0.62 mm/s with an average of about 0.18 mm/s, reflective of the vehicle and foot traffic on site near the well, harvesting equipment and traffic on the nearby St. Clair road. During this same measurement time on September 5 and 6, 2017, the nearest pile driving was more than 2 km distant and vibration measurements did not identify any evidence of pile driving influences.

During the period for which data is presented above, Union Gas was constructing a pipeline about 400 m northwest of Well 4 and within about 100 to 180 m of [redacted].

Footnotes: a) start and end of pile driving are start and stop times for active hammering; b) values shown are peak values regardless of direction; c) well casing vibrations associated with multiple sources, see report text; 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 largest of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

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;

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- 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.

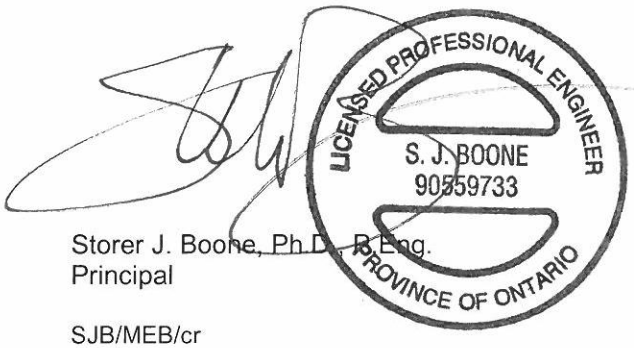
- **Well 9:** A piston pump for Well 9 is located within the barn adjacent to the Well 9 casing location, a total distance (inside and outside) of about 3 to 4 m. During pile driving for turbines T28 and T32, on August 11, 2017, other work was occurring near Well 9. This work included construction along 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

n:\active\2016\3 proj\1668031 pattern_north kent vib monit_chatham-kent\ph 2000-vib monit field work\2-correspondence\3-ltrs\l06\1668031-2000-l06 sep 20 17 summary of vibration monitoring.docx

TABLE 1 – VIBRATION MEASUREMENT LOCATIONS

Turbine Cluster 1		
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.

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Preliminary Vibration Monitoring Report

Turbine Location: T3

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells		
					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.

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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.

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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[c]
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.

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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

Pile No.:	Pile Driving Times and Dates Start[a]	Rock/Till	End[a]	Vibration Measurements at Turbine Site Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s)[b]	Vibration Measurements at Wells Particle Velocity (mm/s)[c, d] 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

	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	8/30/2017 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

Pile No.:	Pile Driving Times and Dates: Start[a]	Rock/Till	End[a]	Vibration Measurements at Turbine Site: Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s)[b]	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d] 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.

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

	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	7/17/2017 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[c]
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 tc 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.

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: T36

Pile No.:	Pile Driving Times and Dates: Start[a]	Rock/Till	End[a]	Vibration Measurements at Turbine Site: Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s)[b]	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d] 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.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T43

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	8/18/2017 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

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells		
					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*	**Well No.:**	12
Municipal Address:	[redacted]	Municipal Address:	[redacted]
Distance from Turbine Centre:	1223 m	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	

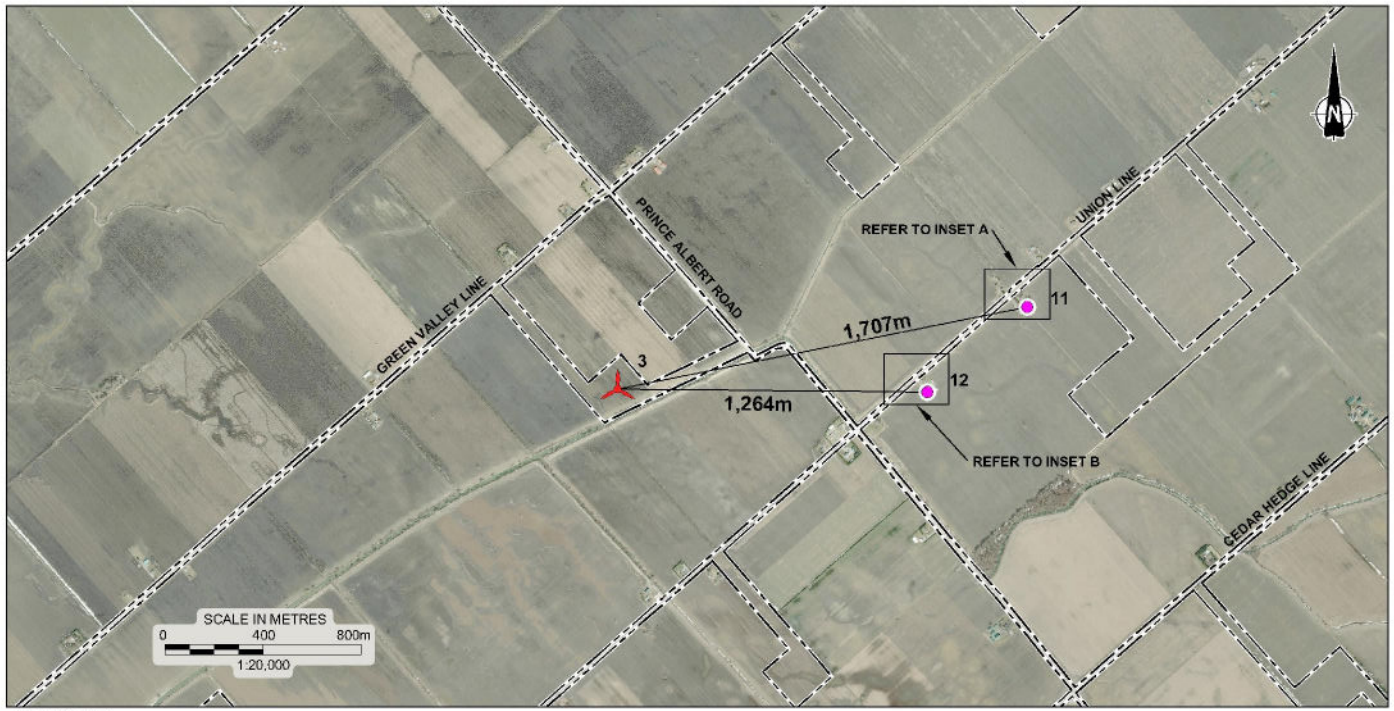
Well Information

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

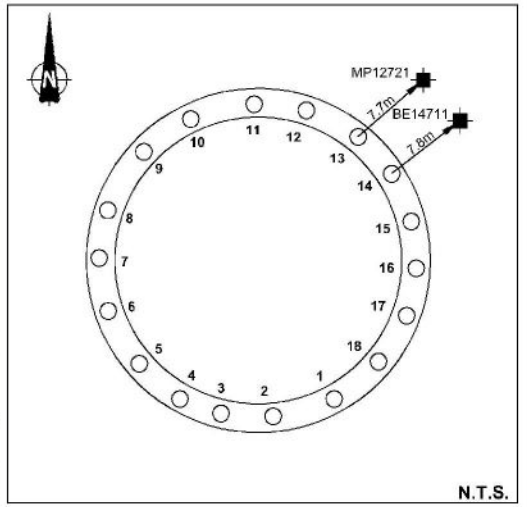
ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

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

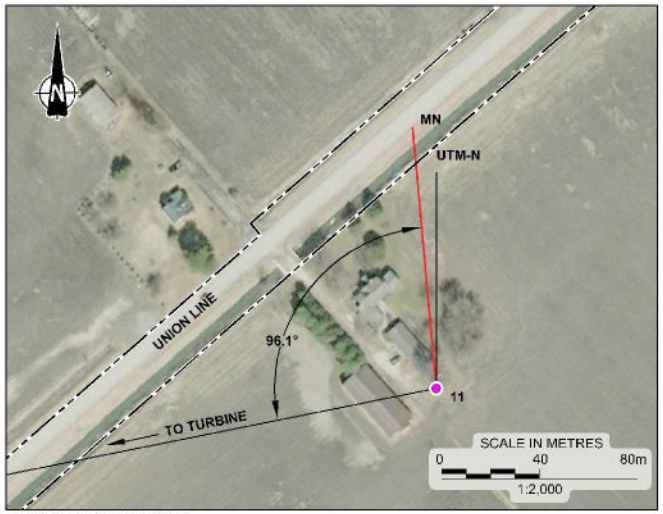
REFERENCE

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.

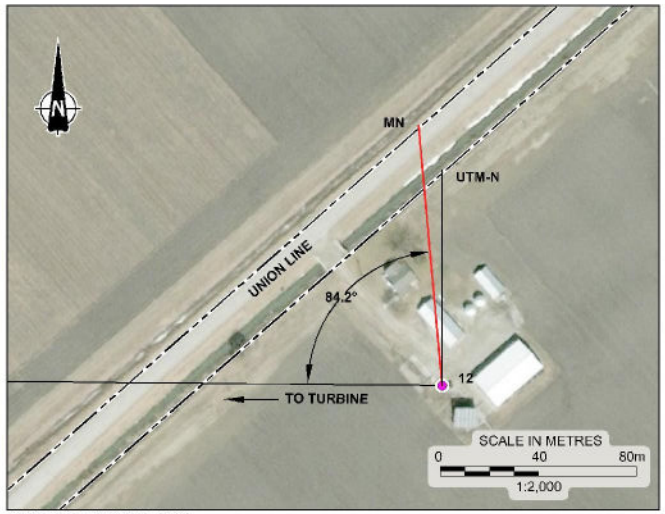
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

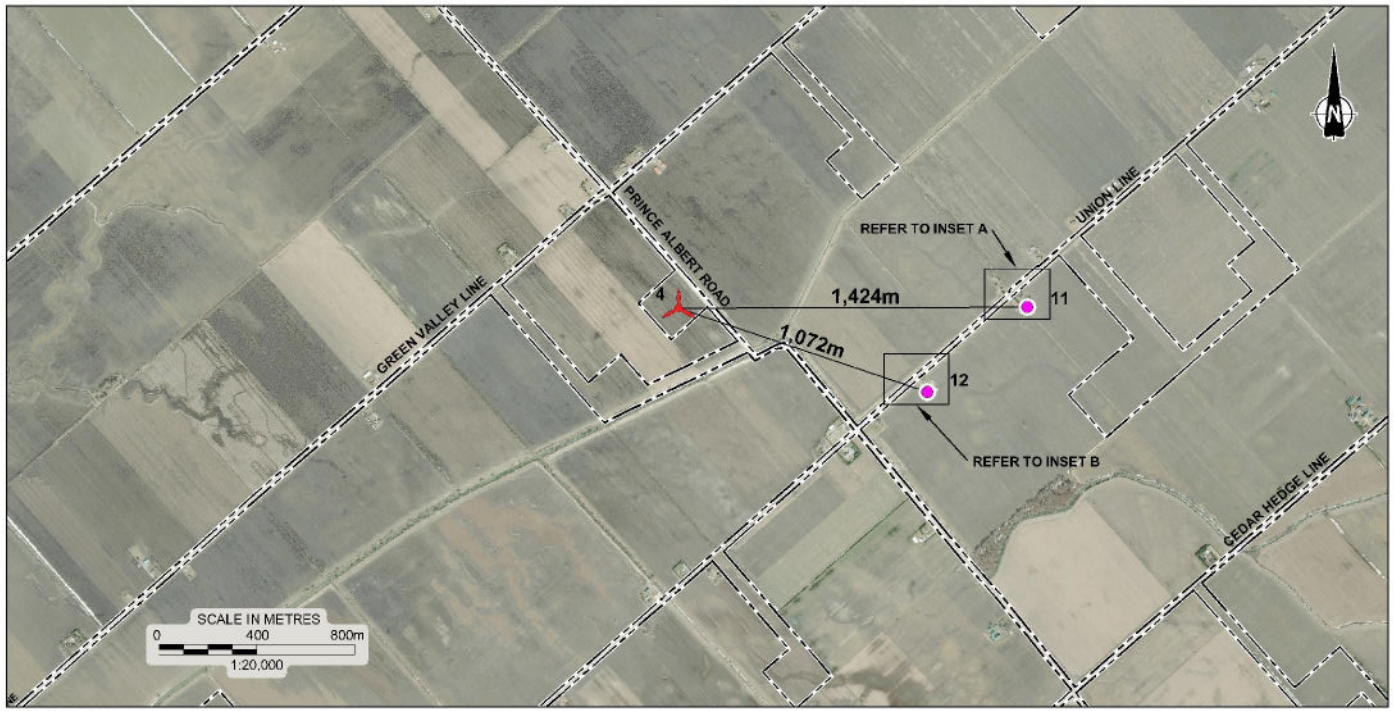
TURBINE PILES AND WATER WELL LOCATION PLAN, T3

Golder Associates

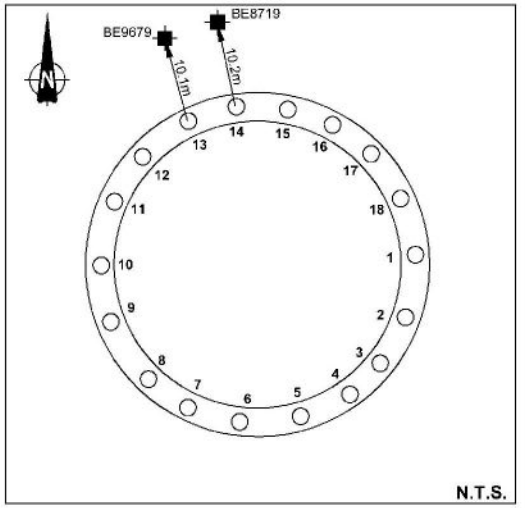
PROJECT No.	1668031	FILE No.	1668031-2000-R020T3
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T3

Drawing file: 1668031-2000-R020T3.dwg Sep 20, 2017 - 2:49pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

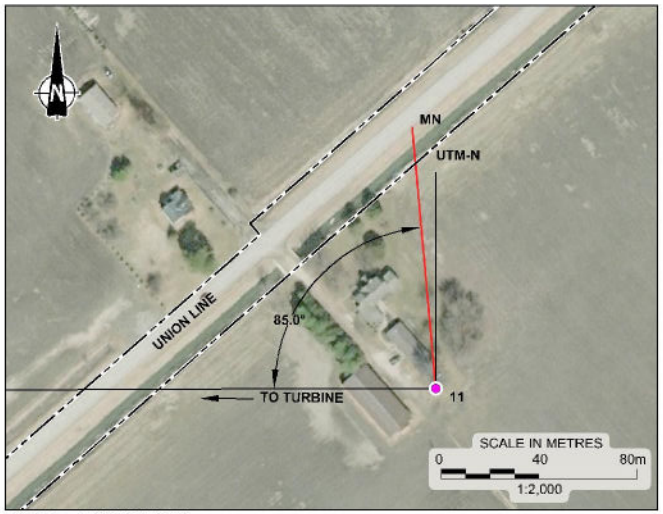
REFERENCE

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.

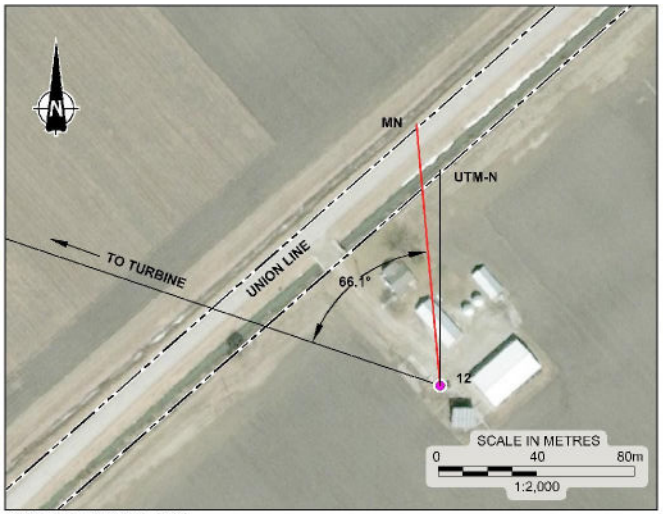
NOTES

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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, T4

Golder Associates

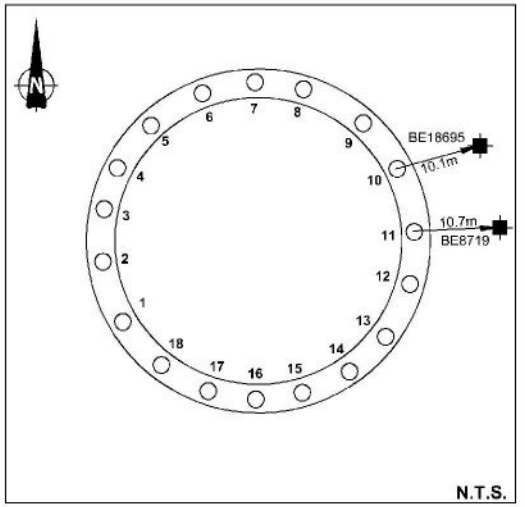
PROJECT No.	1668031	FILE No.	1668031-2000-R020T4
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CADD	DGH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T4

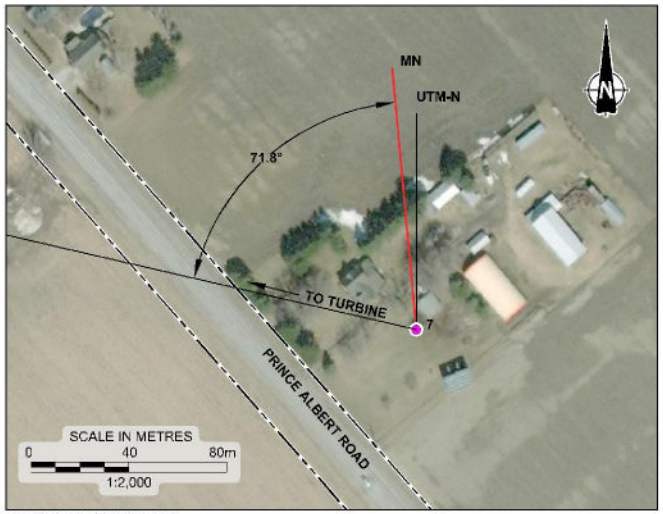
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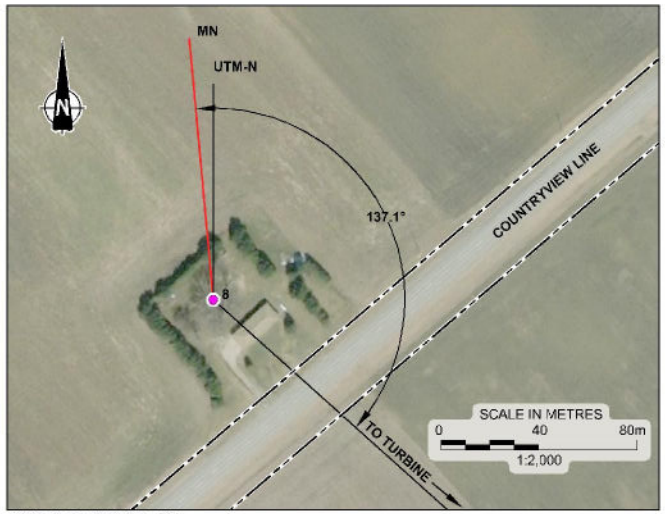
SITE PLAN



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, T6

Golder Associates

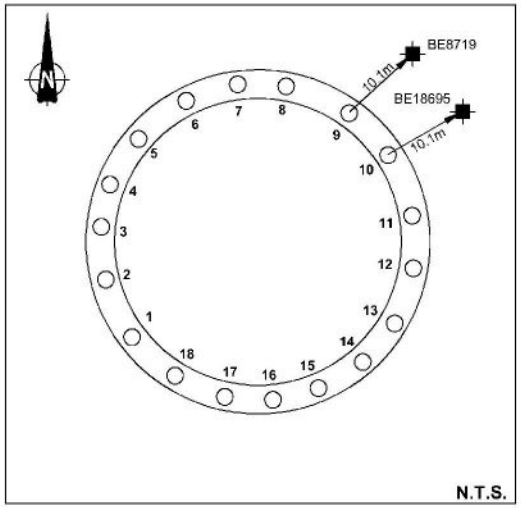
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DESIGN		SCALE	AS SHOWN
CADD	DCH/ZJE Sept. 18/17	REV.	
CHECK			

FIGURE T6

Drawing file: 1658031-2000-R02016.dwg Sep 20, 2017 - 2:52pm



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.

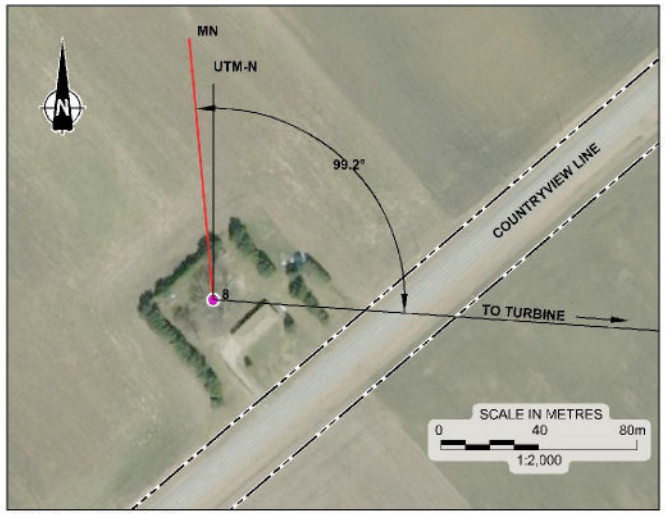
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #7)



INSET B (WELL #8)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T7

Golder Associates

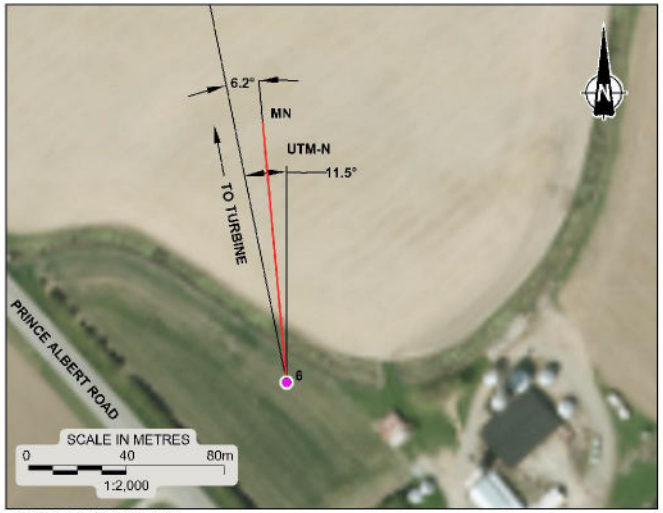
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CADD	DCH/ZJB	Sept. 18/17	REV.
CHECK			

FIGURE T7

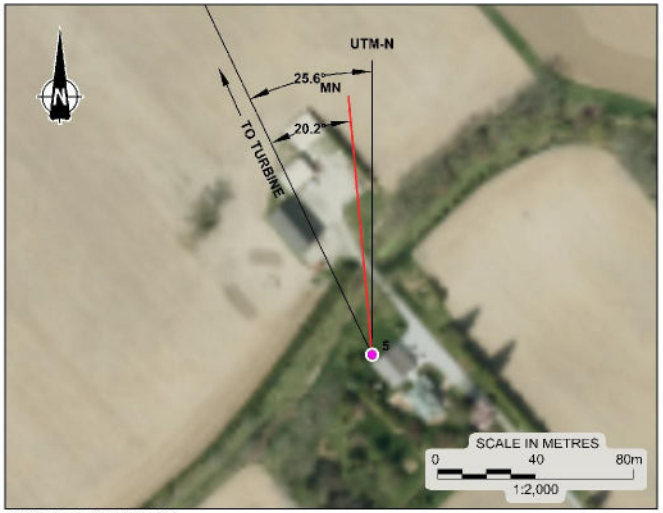
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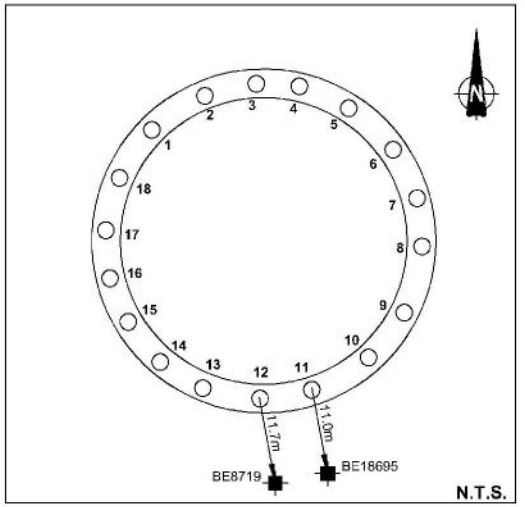
SITE PLAN



INSET A (WELL #6)



INSET B (WELL #5)



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.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T12

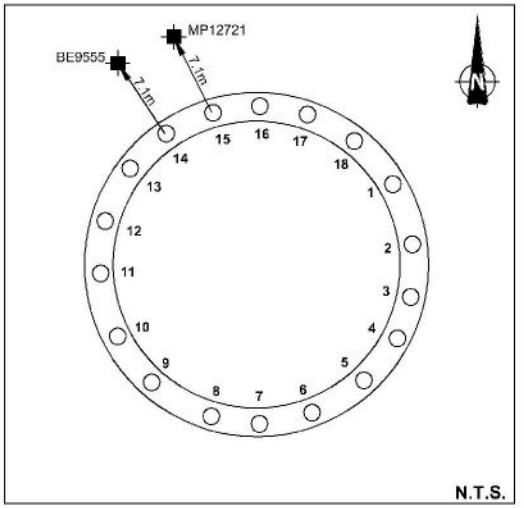
Golder Associates

PROJECT No.			1658031	FILE No. 1658031-2000-R02T12
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		FIGURE T12
CHECK				

Drawing file: 1658031-2000-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

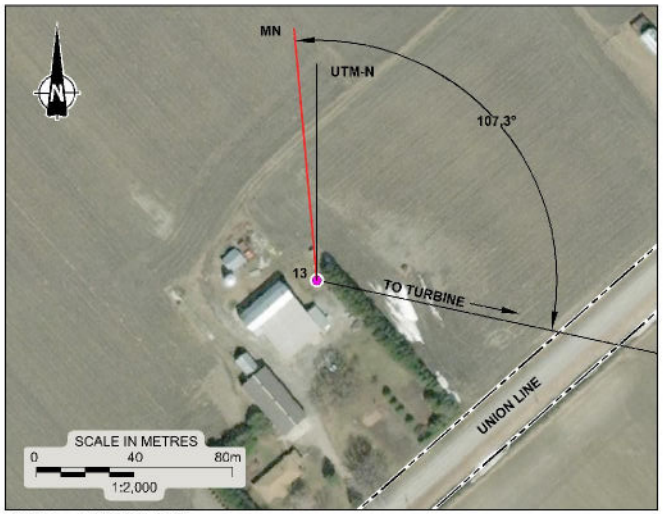
REFERENCE

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.

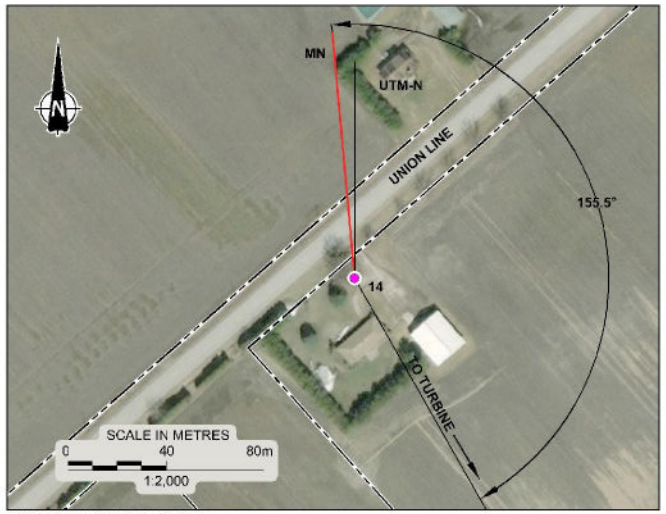
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



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

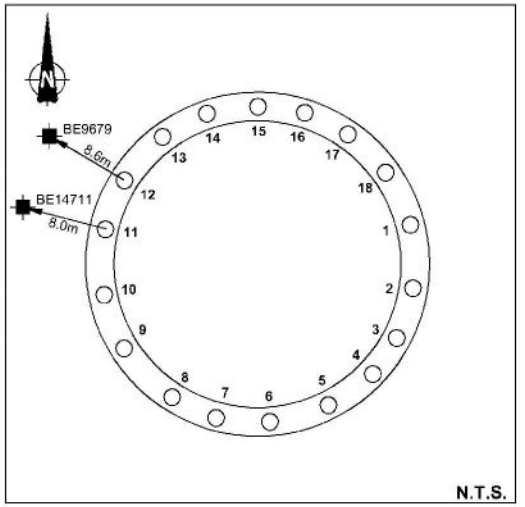
PROJECT No.			1668031	FILE No. 1668031-2000-R02T14
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 18/17		
CHECK				

FIGURE T14

Drawing file: 668031 2000 R02T14.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

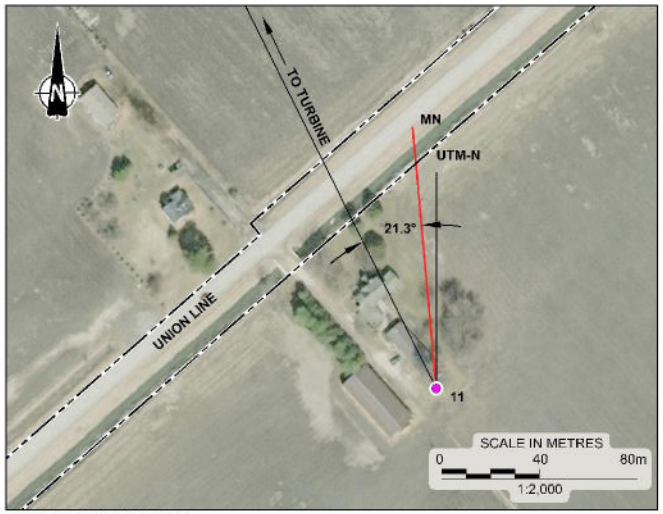
REFERENCE

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.

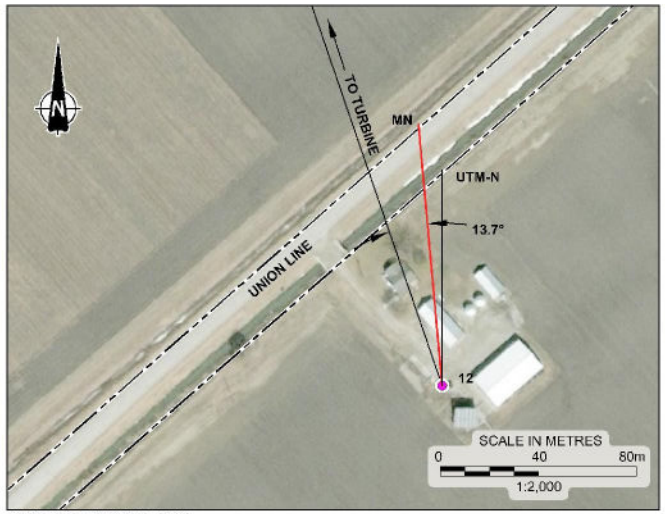
NOTES

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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

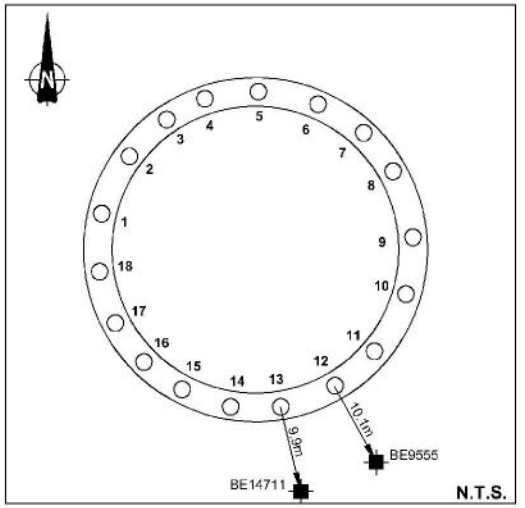
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CADD	DCH/ZJB	Sept. 18/17		
CHECK				

FIGURE T20

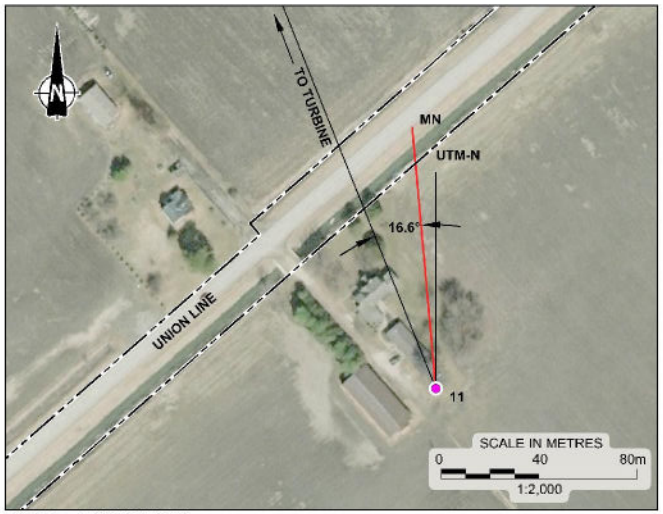
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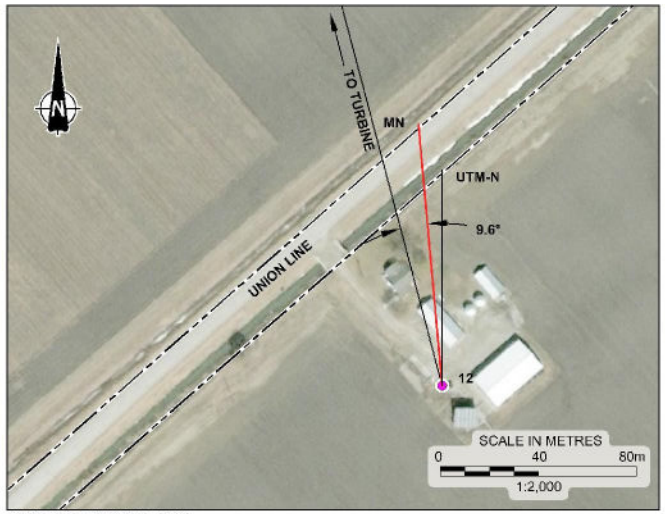
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #11)



INSET B (WELL #12)

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.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T21

Golder Associates

PROJECT No.			1668031
CADD	DCH/ZJB	Sept. 18/17	
CHECK			

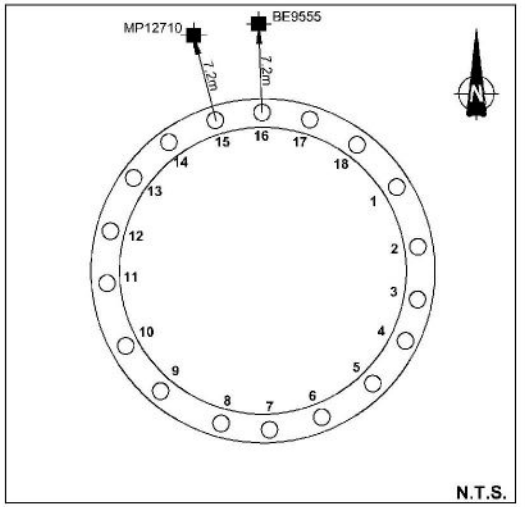
FILE No. 1668031-2000-RG2T21
SCALE AS SHOWN REV.

FIGURE T21

Drawing file: 668031 2000 RG2T21.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

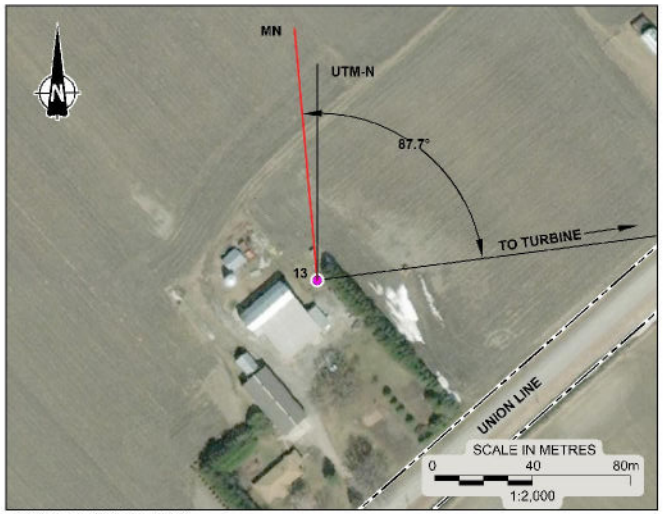
REFERENCE

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.

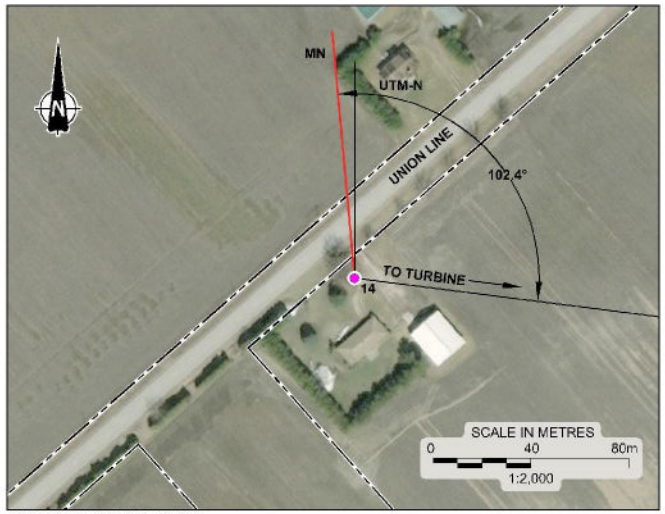
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T26

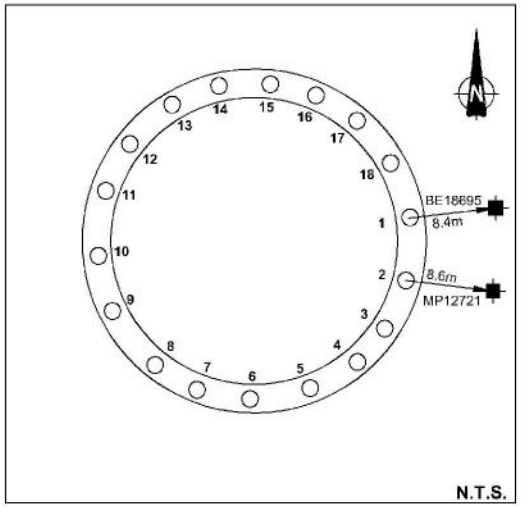
Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T26
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		FIGURE T26
CHECK				

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



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

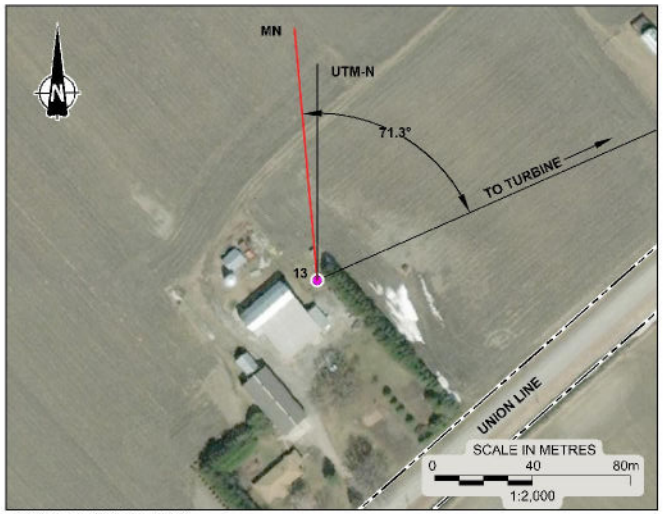
REFERENCE

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.

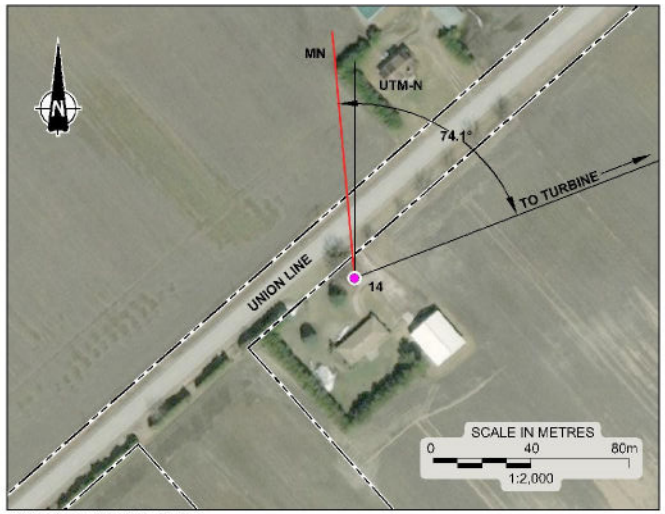
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

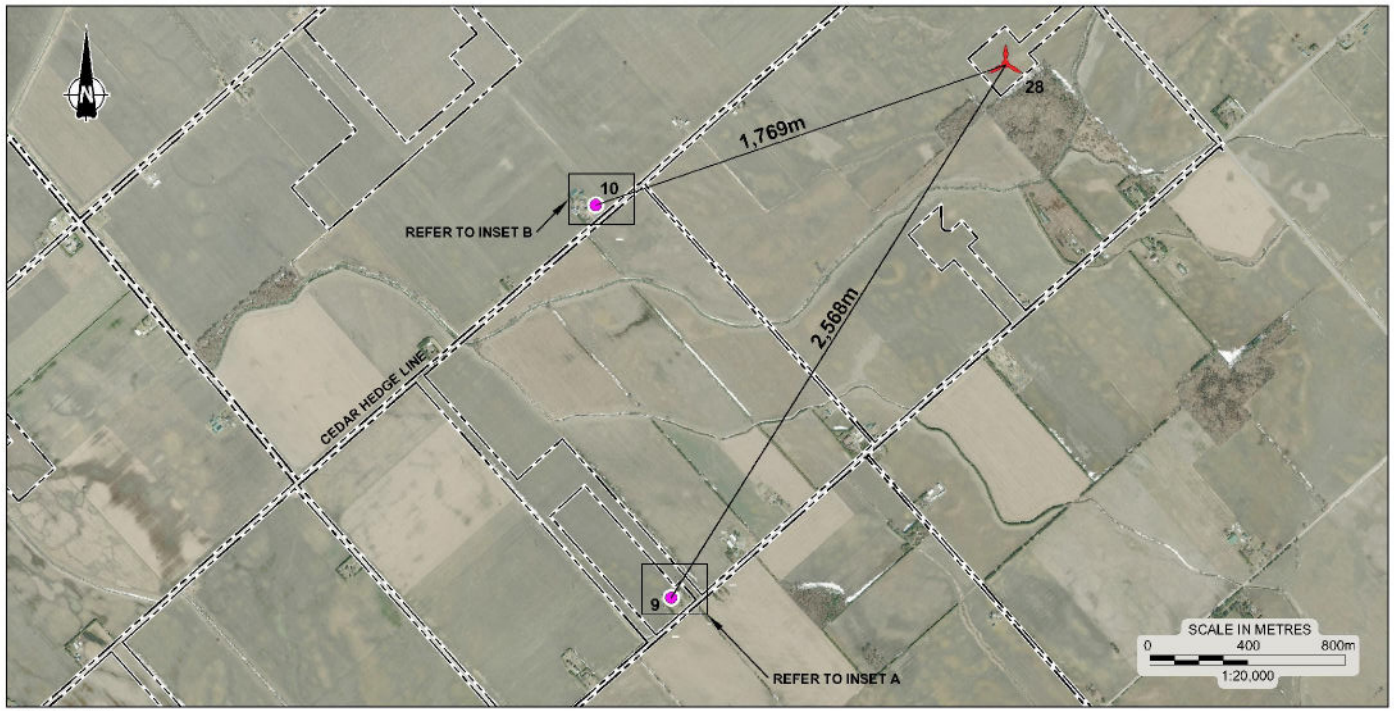
TURBINE PILES AND WATER WELL LOCATION PLAN, T27

Golder Associates

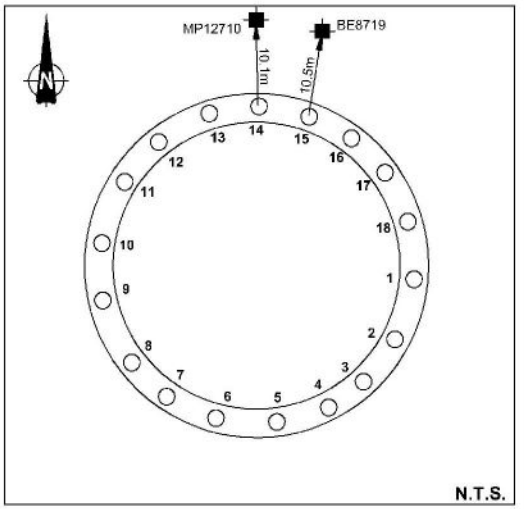
PROJECT No.		1668031	FILE No. 1668031-2000-R02727	
			SCALE AS SHOWN	REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				

FIGURE T27

Drawing file: 1668031-2000-R02727.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

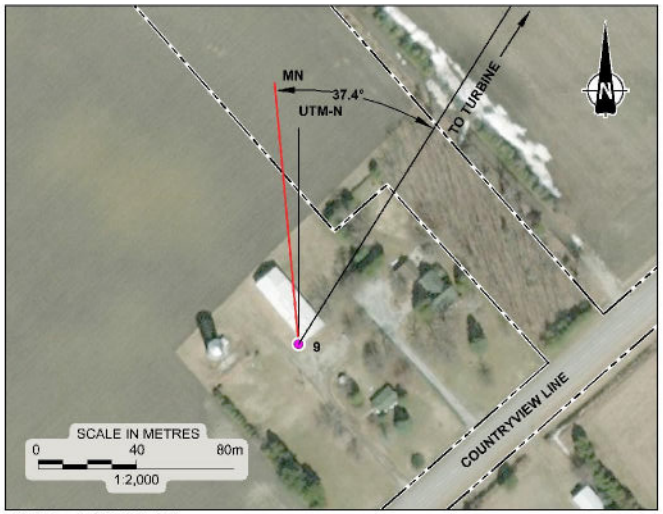
REFERENCE

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.

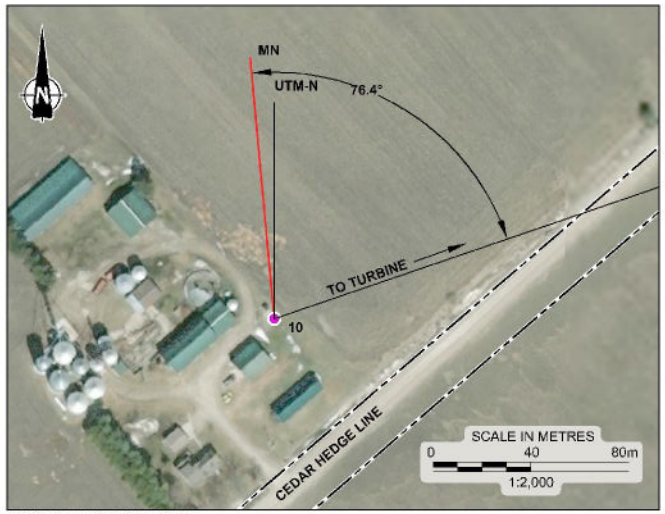
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T28

Golder Associates

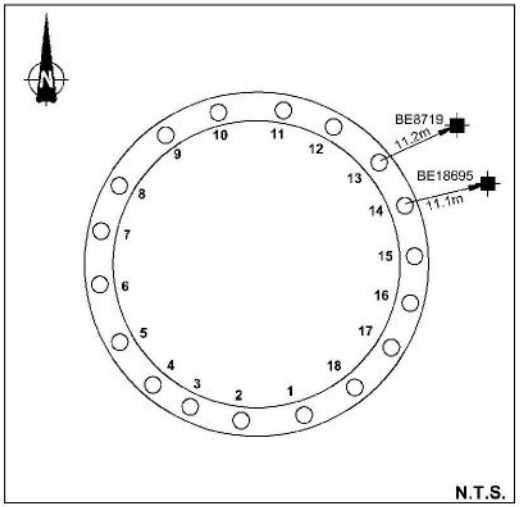
PROJECT No.			1668031	FILE No. 1668031-2000-R02T28
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				

FIGURE T28

Drawing file: 668031 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

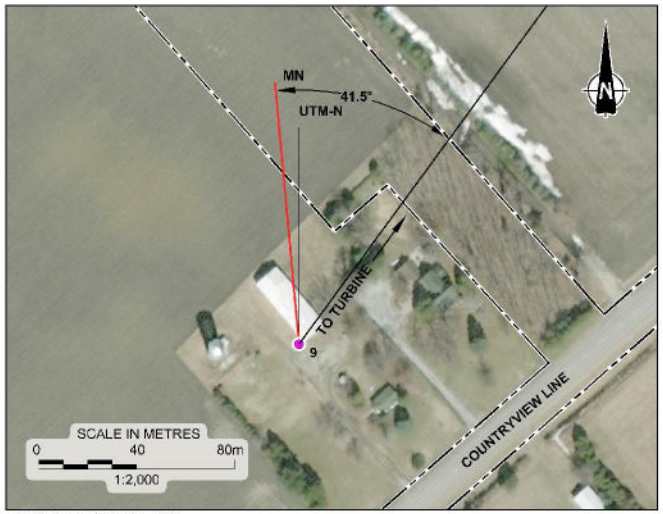
REFERENCE

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.

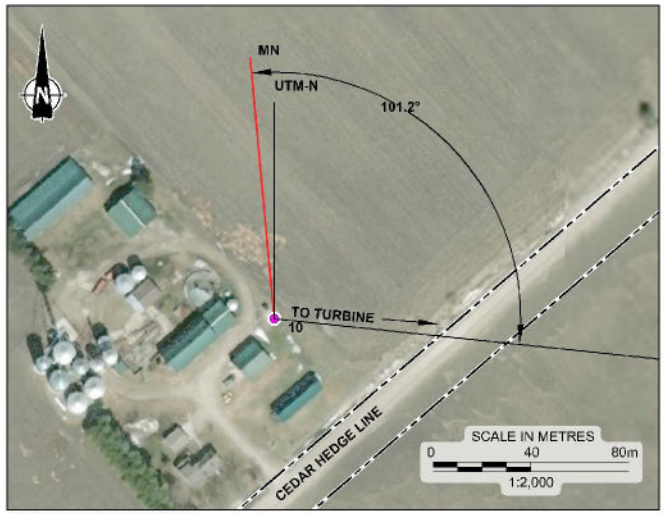
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T30

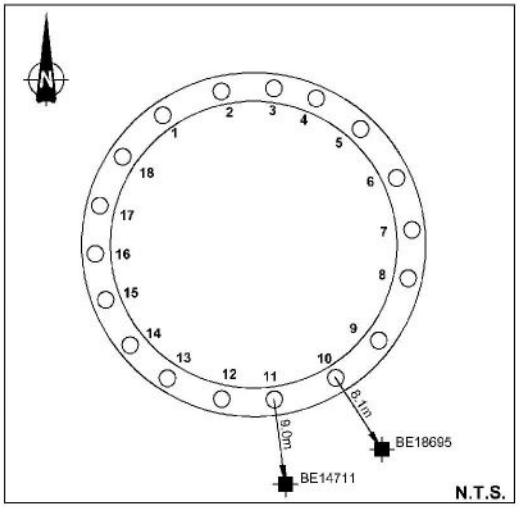
Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T30
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				FIGURE T30

Drawing file: 1668031-2000-R02T30.dwg Sep 20, 2017 - 2:41pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

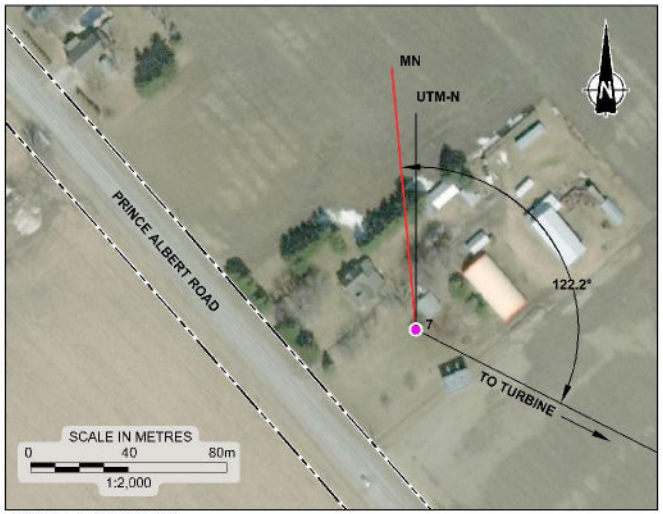
REFERENCE

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.

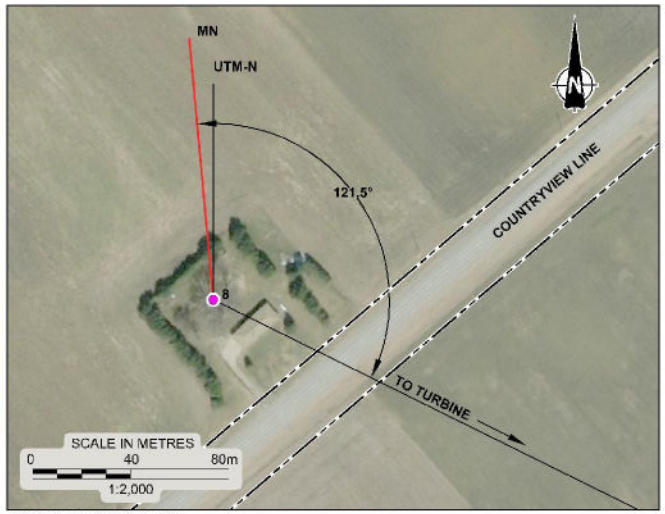
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #7)



INSET B (WELL #8)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T31

Golder Associates

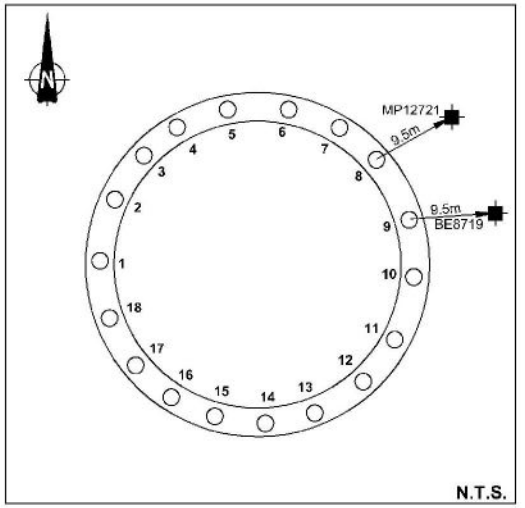
PROJECT No.	1668031		FILE No.	1668031-2000-RG2T31
			SCALE	AS SHOWN
CADD	DDI/ZJB	Sept. 18/17	REV.	
CHECK				

FIGURE T31

Drawing file: 668031 2000 RG2T31.dwg Sep 20, 2017 12:42pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

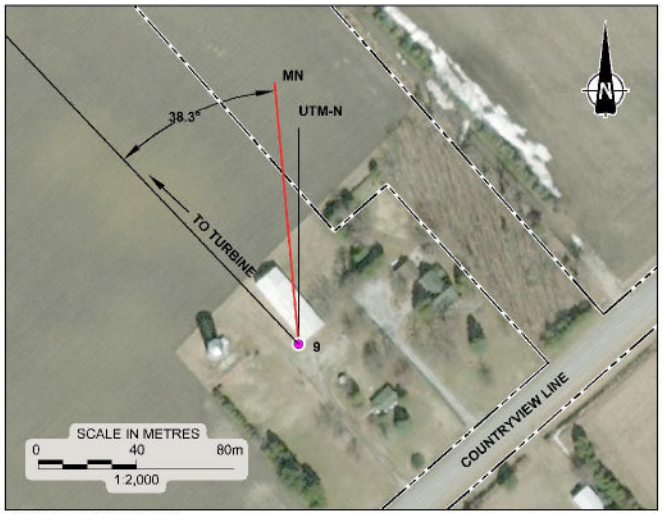
REFERENCE

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.

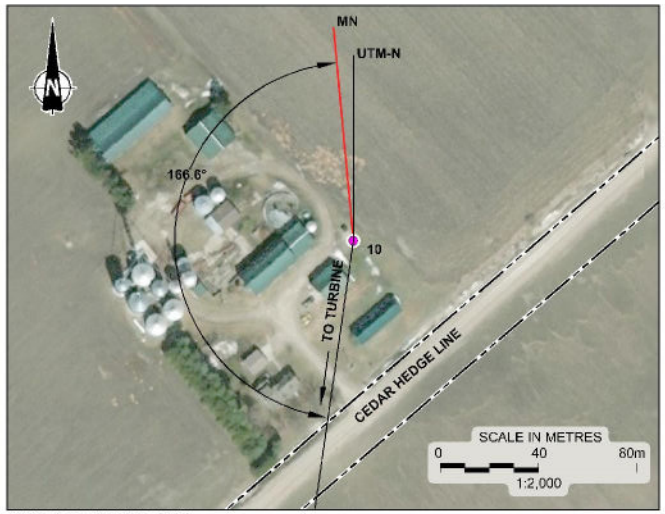
NOTES

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

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T32

Golder Associates

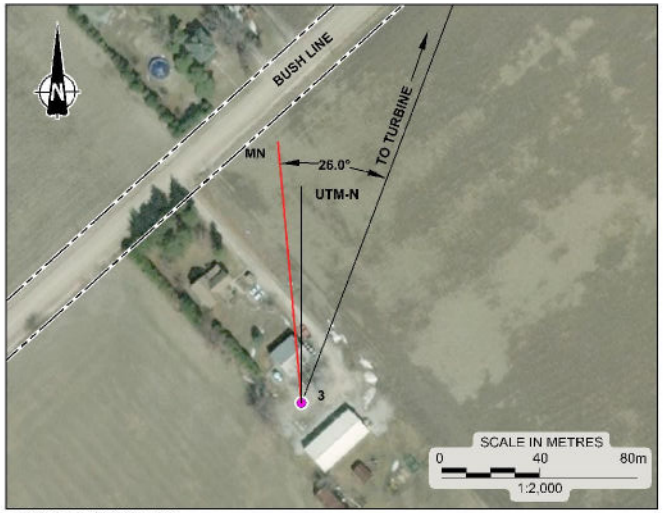
PROJECT No.	1668031	FILE No.	1668031-2000-R02T32
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T32

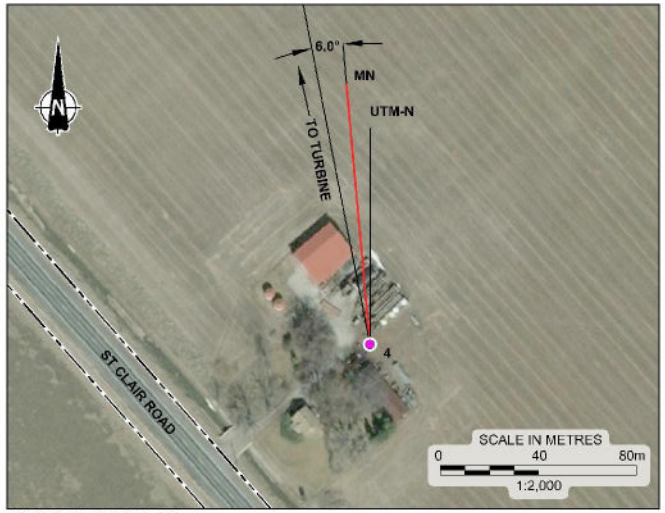
Drawing file: 668031 2000 R02T32.dwg Sep 20, 2017 12:55pm



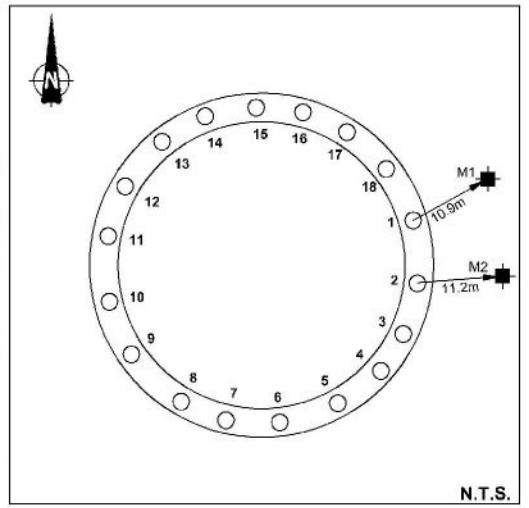
SITE PLAN



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

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, T33

Golder Associates

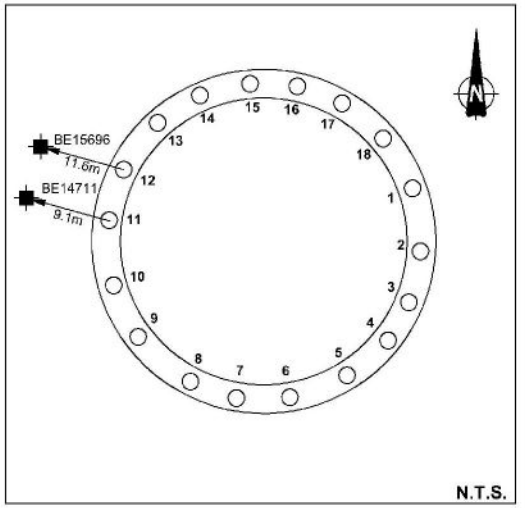
PROJECT No.	1668031	FILE No.	1668031-2000-R02T33
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T33

Drawing file: 1668031-2000-R02T33.dwg Sep 20, 2017 - 2:46pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

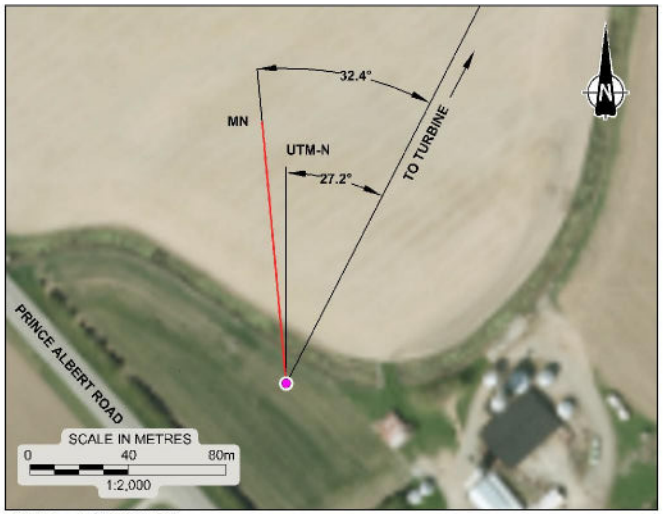
REFERENCE

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.

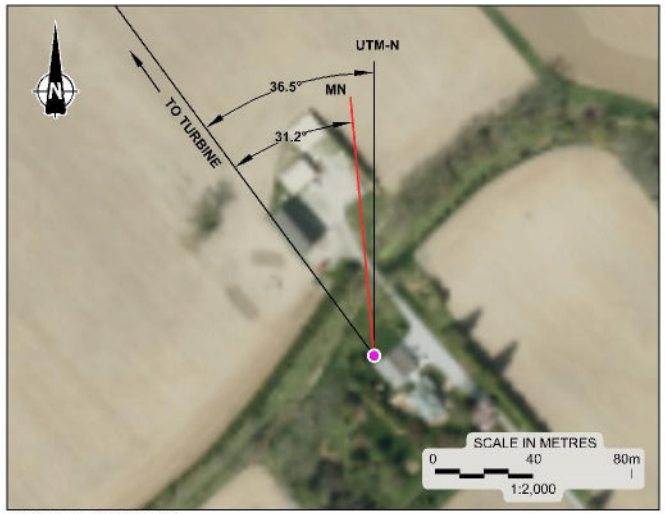
NOTES

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

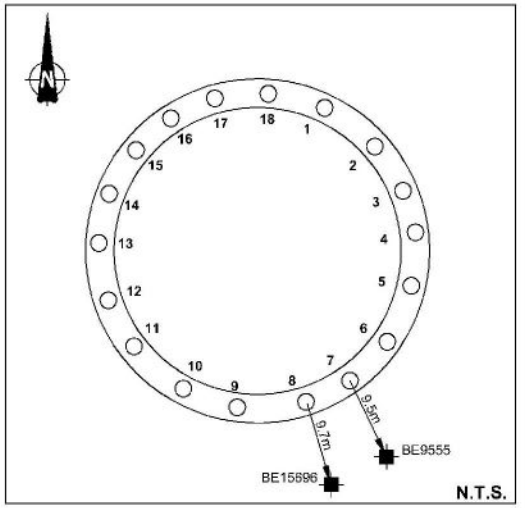
PROJECT No.	1668031	FILE No. 1668031-2000-R02T35
		SCALE AS SHOWN REV.
CADD	DDH/ZJB Sept. 18/17	
CHECK		

FIGURE T35

Drawing file: 1668031 2000 R02T35.dwg Sep 20, 2017 12:47pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

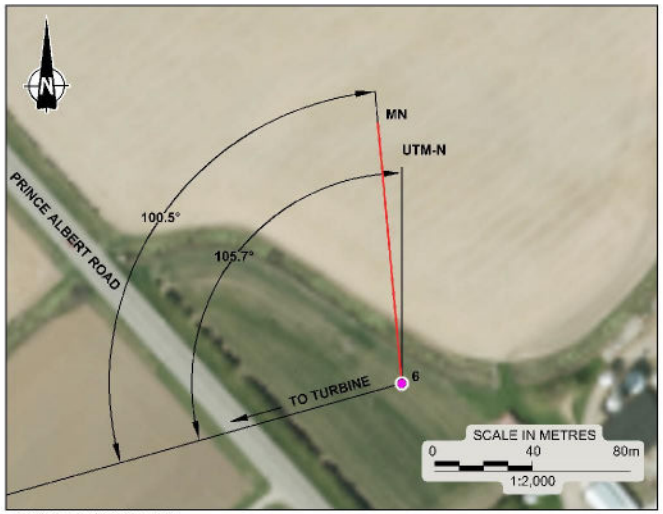
REFERENCE

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.

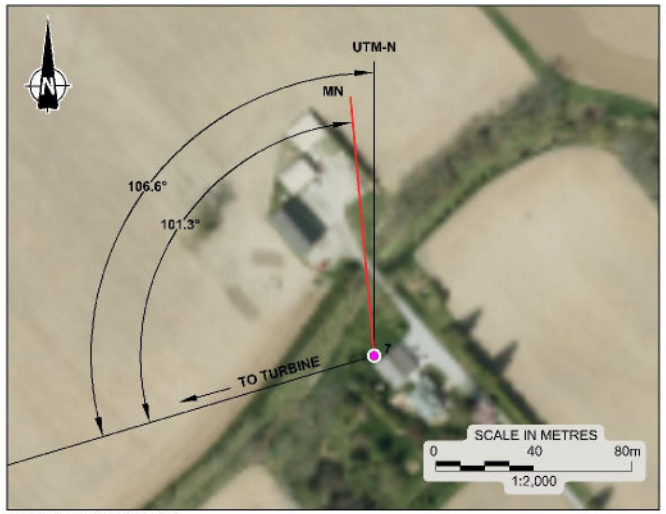
NOTES

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, T36

Golder Associates

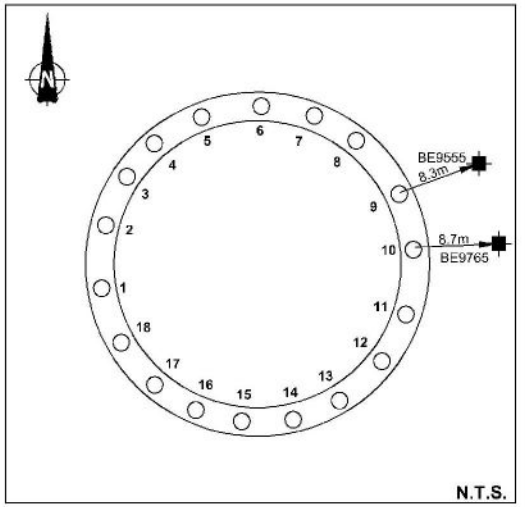
PROJECT No.	1668031		FILE No.	1668031-2000-R02T36
CADD	DCH/ZJB	Sept. 20/17	SCALE	AS SHOWN
CHECK			REV.	

FIGURE T36

Drawing file: 1668031-2000-R02T36.dwg Sep 20, 2017 - 2:49pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

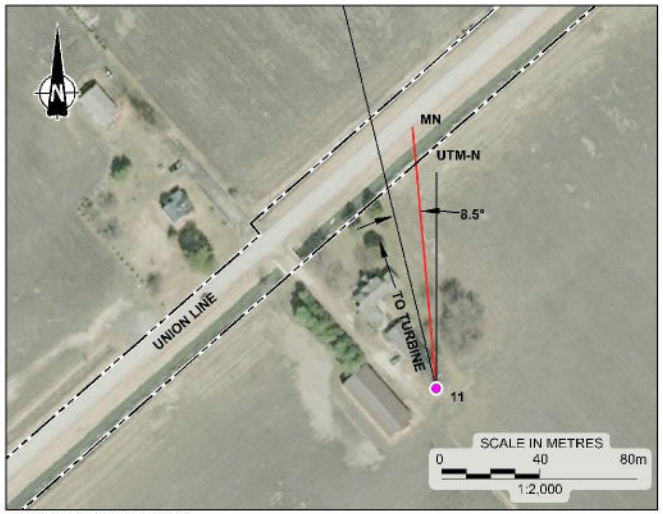
REFERENCE

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.

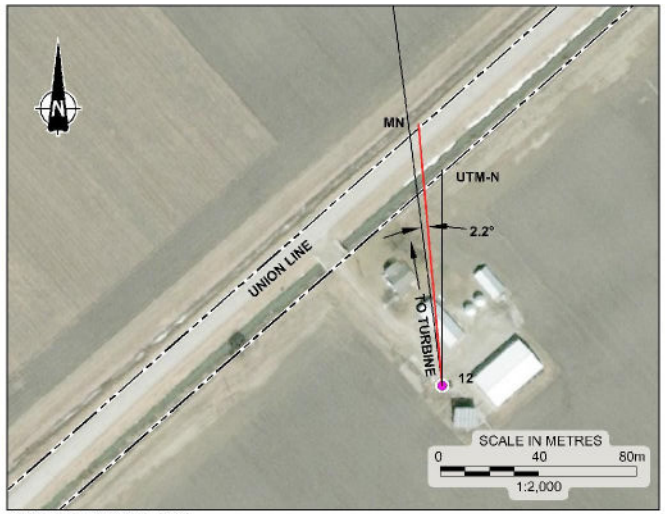
NOTES

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, T43

Golder Associates

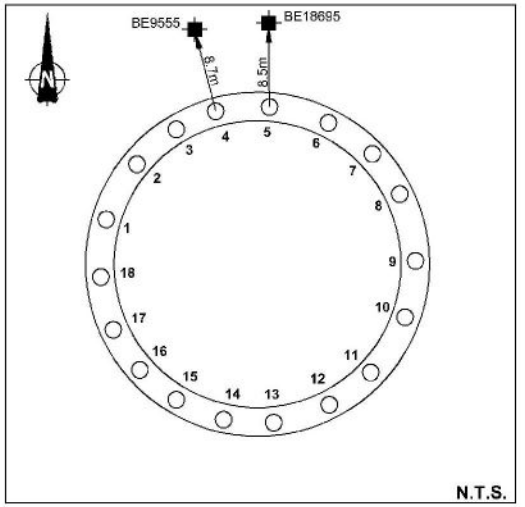
PROJECT No.	1668031	FILE No.	1668031-2000-R02T43
		SCALE	AS SHOWN
CADD	DCH/ZJR Sept. 20/17	REV.	
CHECK			

FIGURE T43

Drawing file: 1668031-2000-R02T43.dwg Sep 20, 2017 - 2:08pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

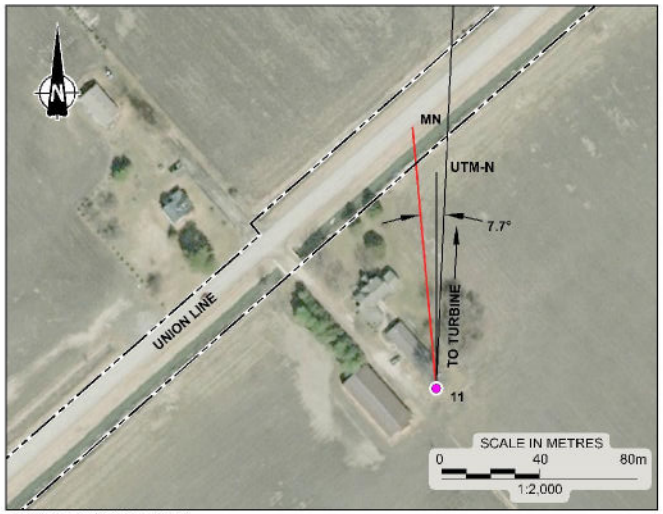
REFERENCE

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.

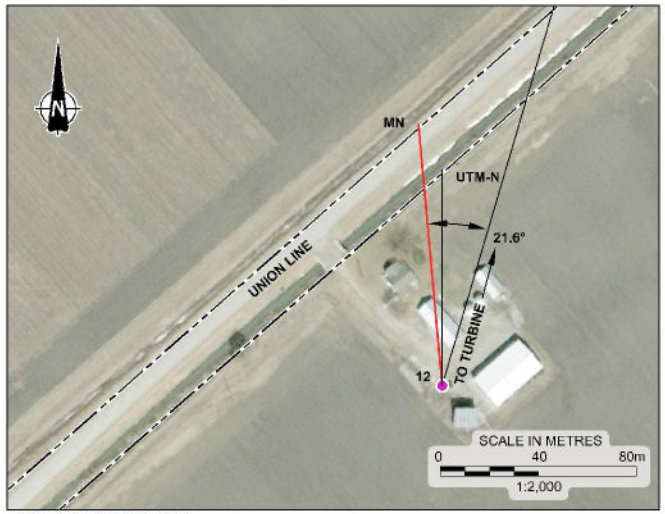
NOTES

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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

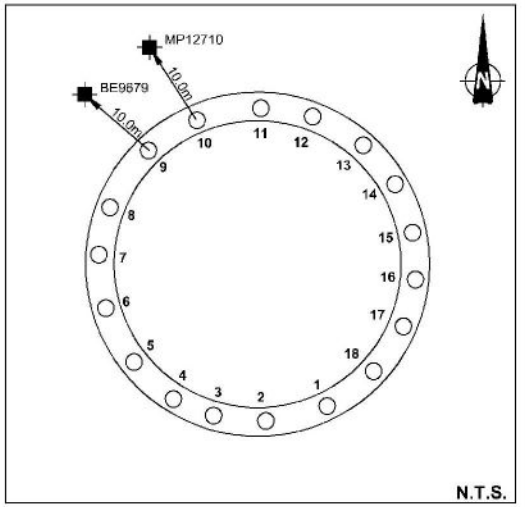
PROJECT No.	1668031	FILE No.	1668031-2000-R02T45
CADD	DCH/ZJB Sept. 18/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T45

Drawing file: 1668031-2000-R02T45.dwg Sep 18, 2017 - 2:07pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

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

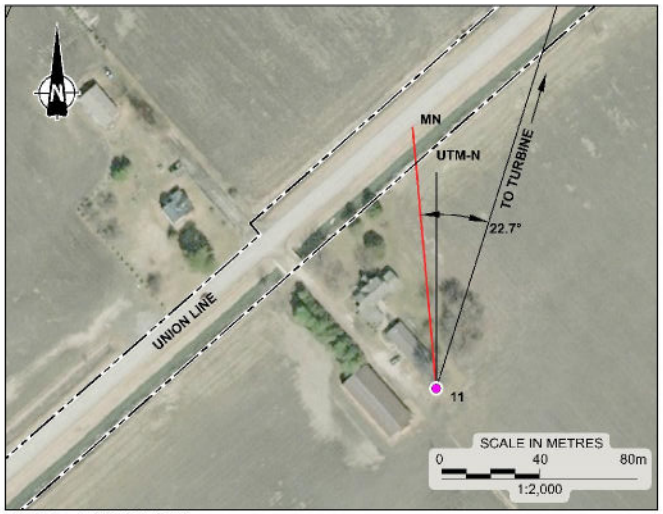
REFERENCE

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.

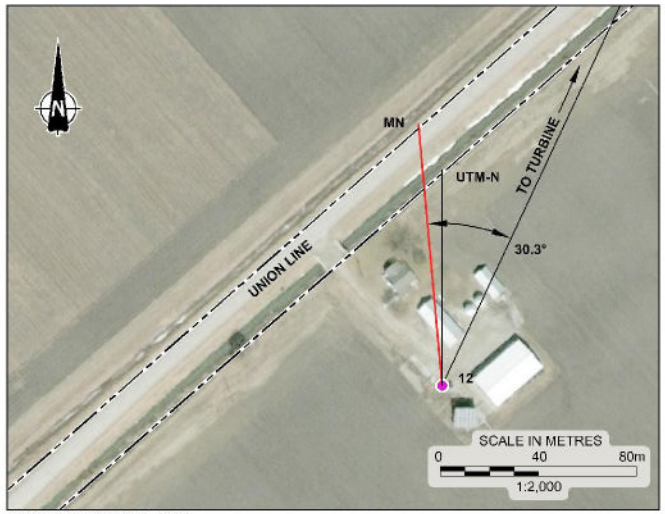
NOTES

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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, T46

Golder Associates

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

FIGURE T46

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

Attachment C

MOECC Water Well Records

F

33 No. 1308

UTM 17 | 319 | 3718 | 10 E
5 | 4710 | 8750 | N
Elev. 4 | 0580 | 10

The Ontario Water Resources Commission Act

WATER WELL RECORD

Basin 23 | | KENT County or District ... Township, Village, Town or City CHATHAM

Con. 12 Lot 5 ... Date completed 4 (day) July (month) 66 (year)

[redacted] ... ess DRESDEN RR#5

Casing and Screen Record

Inside diameter of casing 4"
Total length of casing 49'
Type of screen —
Length of screen —
Depth to top of screen —
Diameter of finished hole 4"

Pumping Test

Static level 10'
Test-pumping rate 4 G.P.M.
Pumping level 25'
Duration of test pumping 5 hrs
Water clear or cloudy at end of test clear
Recommended pumping rate 4 G.P.M.
with pump setting of 30' feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Top soil	0	2	49'	fresh
Blue clay	2	49		
Black shale	49	53		

For what purpose(s) is the water to be used? D.

Is well on upland, in valley, or on hillside?

Drilling or Boring Firm

Address

Licence Number 2217

Name of Driller or Borer R W Simpson

Address RR#5 Dresden

Date Jan 18/67

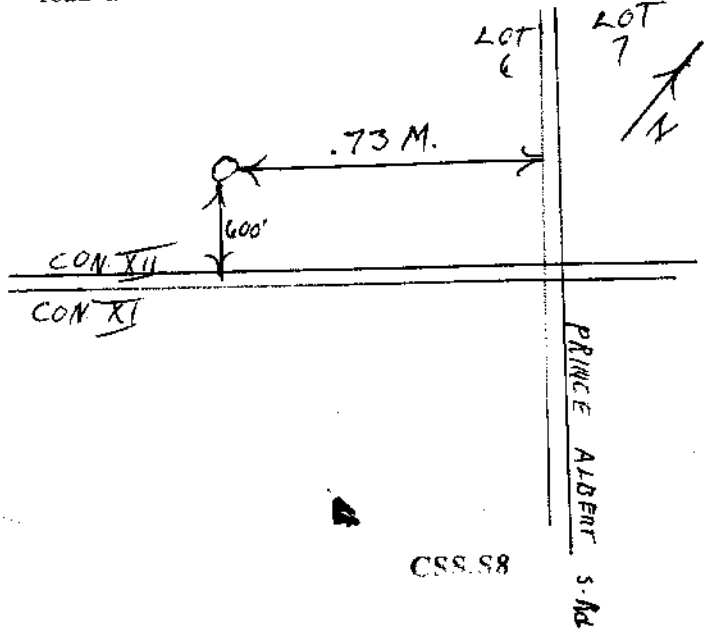
R W Simpson
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.S8

F

UTM 17 Z 319318515 E
Can 15 E 4710818761 9 N
Lot 5
Elev. 4 R 016010

33 No. 1309

The Ontario Water Resources Commission Act

WATER WELL RECORD

Basin 23 KENT
County or District

Township, Village, Town or City CHATHAM

Con. 12 Lot 5

Date completed 3 (day) Jul (month) 66 (year)

[redacted] ess DRESDEN RR#5

Casing and Screen Record

Inside diameter of casing 4"
Total length of casing pulled
Type of screen
Length of screen
Depth to top of screen
Diameter of finished hole

Pumping Test

Static level
Test-pumping rate G.P.M.
Pumping level Dry Hole
Duration of test pumping
Water clear or cloudy at end of test
Recommended pumping rate G.P.M.
with pump setting of feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Top soil	0	2		
Blue clay	2	49		
Black Shale	49	53		

For what purpose(s) is the water to be used? Dry

Is well on upland, in valley, or on hillside?

Drilling or Boring Firm

Address

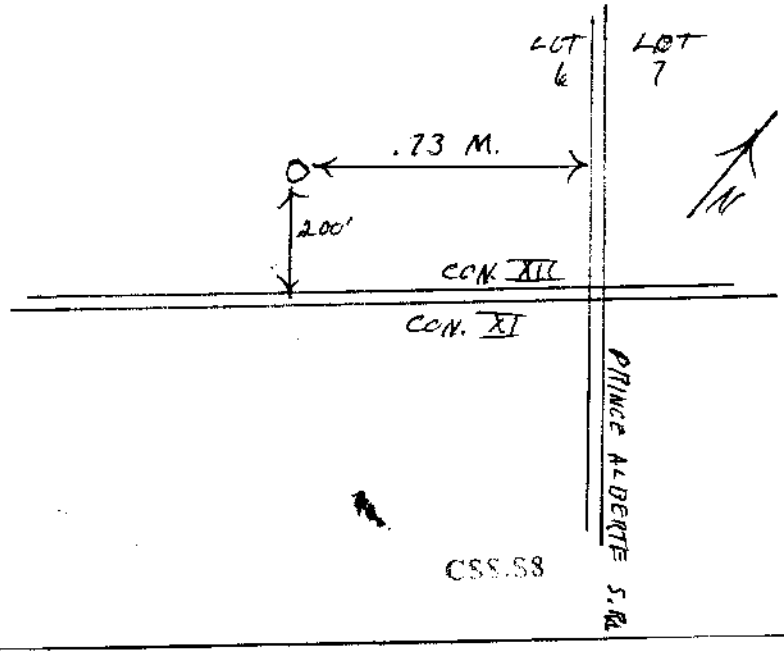
Licence Number 2217
Name of Driller or Borer R.W. Simpson
Address RR#2 Dresden
Date Jan 18/67
R.W. Simpson
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.58

Attachment D

Water Quality Data

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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: **17T181834**

MICROBIOLOGY ANALYSIS REVIEWED BY: **Inesa Alizarchyk, Inorganic Lab Supervisor**

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

DATE REPORTED: **Feb 07, 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
VERSION 1:Partial report sent January 30, 2017.

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

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17T181834

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-27

DATE REPORTED: 2017-02-07

				007530030[redacted]
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-26
Parameter	Unit	G / S	RDL	8152998
Escherichia coli	CFU/100mL	0	1	NDOGN
Total Coliforms	CFU/100mL	0	1	NDOGN

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

8152998 NDOGN – No Data; Overgrown with nontarget, refers to over-crowding microbial growth;

Certified By:



Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17T181834

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:D. D.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-27

DATE REPORTED: 2017-02-07

				SAMPLE DESCRIPTION:	007530030 [redacted]
				SAMPLE TYPE:	Water
				DATE SAMPLED:	2017-01-26
Parameter	Unit	G / S	RDL	8152998	
Electrical Conductivity	uS/cm		2	1280	
pH	pH Units	(6.5-8.5)	NA	8.14	
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	68.3	
Total Dissolved Solids	mg/L	500	20	**650**	
Total Suspended Solids	mg/L		10	17	
Alkalinity (as CaCO3)	mg/L	(30-500)	5	302	
Fluoride	mg/L	1.5	0.10	1.08	
Chloride	mg/L	250	0.50	**255**	
Nitrate as N	mg/L	10.0	0.10	<0.10	
Nitrite as N	mg/L	1.0	0.10	<0.10	
Bromide	mg/L		0.10	<0.10	
Sulphate	mg/L	500	0.20	<0.20	
Ammonia as N	mg/L		0.02	0.22	
Dissolved Organic Carbon	mg/L	5	0.5	2.4	
Colour	TCU	5	5	**14**	
Turbidity	NTU	5	0.5	**29.2**	
Calcium	mg/L		0.10	16.6	
Magnesium	mg/L		0.10	6.51	
Sodium	mg/L	20 (200)	0.10	**243**	
Potassium	mg/L		0.10	1.97	
Iron	mg/L	0.3	0.010	**0.647**	
Manganese	mg/L	0.05	0.002	0.022	

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

8152998 Elevated RDLs for Anions & Cations indicate the degree of dilution prior to analysis in order to keep analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Guideline Violation

AGAT WORK ORDER: 17T181834

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Chloride	mg/L	250	255
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	TCU	5	14
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Iron	mg/L	0.3	0.647
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	243
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	650
8152998	007530030[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Turbidity	NTU	5	29.2

Results relate only to the items tested and to all the items tested

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

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T181834

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D.

Microbiology Analysis

RPT Date: Feb 07, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8152989	8152989	ND	ND	NA	< 1									
Total Coliforms	8152989	8152989	ND	ND	NA	< 1									

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

Microbiological Analysis (water)															
Escherichia coli	8153062	8153062	ND	ND	NA	< 1									
Total Coliforms	8153062	8153062	5	4	NA	< 1									

Comments: ND – Not detected; NA - % RPD Not Applicable
NA - % RPD Not Reportable based on the number of colonies count acceptable for RPD calculation

Certified By:

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CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T181834

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D.

Water Analysis

RPT Date: Feb 07, 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	8153041	8153041	758	762	0.5%	< 2	103%	80%	120%	NA			NA		
pH	8153041	8153041	8.33	8.20	1.6%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8153041	8153041	428	422	1.4%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8149764		<10	<10	NA	< 10	100%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8153041	8153041	329	328	0.3%	< 5	97%	80%	120%	NA			NA		
Fluoride	8161424		0.49	0.45	8.5%	< 0.05	95%	90%	110%	98%	90%	110%	104%	80%	120%
Chloride	8161424		33.6	33.6	0.0%	< 0.10	98%	90%	110%	102%	90%	110%	89%	80%	120%
Nitrate as N	8161424		0.45	0.45	0.0%	< 0.05	100%	90%	110%	104%	90%	110%	111%	80%	120%
Nitrite as N	8161424		<0.05	<0.05	NA	< 0.05	NA	90%	110%	102%	90%	110%	90%	80%	120%
Bromide	8161424		<0.05	<0.05	NA	< 0.05	110%	90%	110%	92%	90%	110%	94%	80%	120%
Sulphate	8161424		28.2	28.2	0.0%	< 0.10	96%	90%	110%	95%	90%	110%	96%	80%	120%
Ammonia as N	8152989	8152989	0.18	0.18	0.0%	< 0.02	107%	90%	110%	97%	90%	110%	100%	80%	120%
Dissolved Organic Carbon	8152989	8152989	1.9	1.7	NA	< 0.5	100%	90%	110%	106%	90%	110%	94%	80%	120%
Colour	8161451		56	56	0.0%	< 5	102%	90%	110%	NA			NA		
Turbidity	8152989	8152989	5.0	5.0	0.0%	< 0.5	109%	90%	110%	NA			NA		
Calcium	8153005	8153005	11.9	11.7	1.7%	< 0.05	101%	90%	110%	101%	90%	110%	100%	70%	130%
Magnesium	8153005	8153005	4.75	4.80	1.0%	< 0.05	96%	90%	110%	97%	90%	110%	95%	70%	130%
Sodium	8153005	8153005	176	174	1.1%	< 0.05	102%	90%	110%	101%	90%	110%	98%	70%	130%
Potassium	8153005	8153005	1.47	1.51	2.7%	< 0.05	99%	90%	110%	99%	90%	110%	98%	70%	130%
Iron	8152989	8152989	0.422	0.431	2.1%	< 0.010	98%	90%	110%	94%	90%	110%	89%	70%	130%
Manganese	8152989	8152989	0.023	0.023	0.0%	< 0.002	103%	90%	110%	107%	90%	110%	80%	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:

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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: 17T181834

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D.

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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AGAT Laboratories

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

CLIENT NAME: AECOM CANADA LTD
105 Commerce Valley Drive West 7th Floor
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: Jason Murchison

PROJECT: 60343599

AGAT WORK ORDER: 17T281499

MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

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

DATE REPORTED: Nov 13, 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.

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

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Certificate of Analysis

AGAT WORK ORDER: 17T281499

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Microbiological Analysis (water)

DATE RECEIVED: 2017-11-07

DATE REPORTED: 2017-11-13

				11/07 PM; [redacted]
			SAMPLE DESCRIPTION:	
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-11-07
Parameter	Unit	G / S	RDL	8887945
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
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.

8887945 NDOGT - No Data; Overgrown with Target, refers to over-crowding microbial growth;

Certified By: Divine Basily

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Certificate of Analysis

AGAT WORK ORDER: 17T281499

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-11-07

DATE REPORTED: 2017-11-13

				11/07 PM; [redacted]
SAMPLE DESCRIPTION:				
SAMPLE TYPE:				Water
DATE SAMPLED:				2017-11-07
Parameter	Unit	G / S	RDL	8887945
Electrical Conductivity	uS/cm		2	1290
pH	pH Units		NA	8.09
Total Hardness (as CaCO3)	mg/L		0.5	70.0
Total Dissolved Solids	mg/L		20	690
Total Suspended Solids	mg/L		10	1340
Alkalinity (as CaCO3)	mg/L		5	316
Fluoride	mg/L	1.5	0.05	0.78
Chloride	mg/L		0.50	248
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	0.37
Sulphate	mg/L		0.10	<0.10
Ammonia as N	mg/L		0.02	0.34
Dissolved Organic Carbon	mg/L		0.5	2.5
Colour	Apparent CU		50	4080
Turbidity	NTU	5	0.5	963
Calcium	mg/L		0.10	16.8
Magnesium	mg/L		0.10	6.81
Sodium	mg/L	20	0.10	253
Potassium	mg/L		0.10	2.08
Iron	mg/L		0.010	5.16
Manganese	mg/L		0.002	0.328

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.

8887945 Elevated RDLs for Chloride & Cations indicate the degree of dilution prior to analysis in order to keep analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

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AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T281499

PROJECT: 60343599

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CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8887945	11/07 PM; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20	253
8887945	11/07 PM; [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Turbidity	NTU	5	963

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T281499

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Nov 13, 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 - Microbiological Analysis (water)															
Escherichia coli	8887937	8887937	NDOGT	NDOGT	NA	< 1									
Total Coliforms	8887937	8887937	NDOGT	NDOGT	NA	< 1									

Comments: NDOGT - No Data; Overgrown with Target, refers to over-crowding microbial growth; NA - % RPD Not Applicable

Certified By: Nivine Basily

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T281499

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Nov 13, 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	8888591		755	753	0.3%	< 2	100%	80%	120%	NA			NA		
pH	8888591		7.43	7.40	0.4%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8877156		92	96	NA	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8887937	8887937	<10	<10	NA	< 10	102%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8888591		131	295	130.0%	< 5	99%	80%	120%	NA			NA		
Fluoride	8888446		<0.05	<0.05	NA	< 0.05	106%	90%	110%	99%	90%	110%	101%	80%	120%
Chloride	8888446		23.5	23.5	0.0%	< 0.10	94%	90%	110%	107%	90%	110%	108%	80%	120%
Nitrate as N	8888446		0.30	0.30	0.0%	< 0.05	103%	90%	110%	101%	90%	110%	100%	80%	120%
Nitrite as N	8888446		<0.05	<0.05	NA	< 0.05	NA	90%	110%	99%	90%	110%	97%	80%	120%
Bromide	8888446		<0.05	<0.05	NA	< 0.05	100%	90%	110%	107%	90%	110%	94%	80%	120%
Sulphate	8888446		3.18	3.08	3.2%	< 0.10	103%	90%	110%	100%	90%	110%	101%	80%	120%
Ammonia as N	8887937	8887937	0.23	0.24	4.3%	< 0.02	98%	90%	110%	94%	90%	110%	87%	80%	120%
Dissolved Organic Carbon	8887937	8887937	2.5	2.5	0.0%	< 0.5	96%	90%	110%	93%	90%	110%	98%	80%	120%
Colour	8878797		104	104	0.0%	< 5	106%	90%	110%	NA			NA		
Turbidity	8887944	8887944	2.6	2.6	0.0%	< 0.5	98%	90%	110%	NA			NA		
Calcium	8876962		57.7	57.3	0.7%	< 0.05	97%	90%	110%	97%	90%	110%	98%	70%	130%
Magnesium	8876962		4.75	4.68	1.5%	< 0.05	98%	90%	110%	98%	90%	110%	98%	70%	130%
Sodium	8876962		11.5	11.4	0.9%	< 0.05	100%	90%	110%	100%	90%	110%	101%	70%	130%
Potassium	8876962		1.01	1.00	1.0%	< 0.05	99%	90%	110%	100%	90%	110%	102%	70%	130%
Iron	8887937	8887937	0.247	0.236	4.4%	< 0.010	106%	90%	110%	105%	90%	110%	100%	70%	130%
Manganese	8887937	8887937	0.011	0.010	2.1%	< 0.002	106%	90%	110%	104%	90%	110%	103%	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.

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T281499

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-93-6002	AMM-002-A & SM 4500 NH3-G	DISCRETE ANALYZER
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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