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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 – UPDATED** **[redacted] - PIN 007500008, [redacted]**		
From	Jason Murchison, P.Geo.		
Date	October 31st, 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 9-August-2017. In this correspondence, Ms. Jacobs provides a summary narrative of a well interference complaint that was received by MOECC at approximately 1:50 pm on 9-August-2017 from [redacted], the property owner of [redacted]

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

- *Water is not flowing out of his well.*
- *Water used for livestock (pigs, cows, horses) and two homes.*
- *Was away and when returned he was told that there had been pile driving going on in the area.*
- *Water is coming out but not at a rate that he needs it; water was flowing a week ago and was fine.*
- *Installed new filter system around July 18, 2017.*
- *Water is not muddy or dirty – just very low flow compared to normal.*
- *Caller had to leave after he installed the filters and assumed everything was running fine.*
- *Caller gave permission to provide his name, address and phone number to Samsung / Pattern and is looking for the matter to be looked into ASAP.*

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

Further to the above, this TM also addresses a subsequent complaint of water quality deterioration that was received by AECOM staff from the property owners on 25-August-2017 and by NKW1 directly on 26-August-2017. Notification of this second well interference complaint was provided by NKW1 to MOECC via email on 26-August-2017 (ie. within 1 business day of receipt).

A copy of NKW1's interference complaint notification email to MOECC is included in **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 complaints (2).

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 the Well Interference Complaint at approximately 5pm on 9-August-2017 immediately following receipt of MOECC notification. (2) AECOM arranged directly with the property owner an appointment to visit the property at 10am on 14-August-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); ii) limited (25-minute) flow testing of the well pump via an existing installed exterior faucet; iii) collection of a raw (untreated) groundwater sample for analytical laboratory testing; and, iv) collection of digital photographs of pertinent site features (eg. well pit, water well, water treatment equipment, etc.). (4) A second complaint regarding the existing well supply was received directly by AECOM from the property owners ([redacted]) on 25-August-2017 during the course of AECOM's work at another local property. Follow-up communication was provided by [redacted]irectly to NKW1 via telephone on 26-August-2017 (MOECC notified via email by NKW1 on same day). An appointment to re-visit the [redacted] property was arranged for and completed by AECOM on 28-August-2017. (5) Tasks completed by AECOM during the second well interference complaint site visit included: i) interview with the property owner regarding their updated well interference issue(s); and, ii) attempt to complete an updated well pump flow test and to collect a sample of raw (untreated) groundwater for laboratory testing (unsuccessful); iii) collection of digital photographs of pertinent site features (eg. well pit & water well, water treatment equipment, etc.). (6) Information obtained during each site visit has been compiled and is summarized within this technical memorandum. An opinion regarding potential association of the well interference complaints with local construction activities as part of the NKW1 Project is provided and potential remedial options are presented, as appropriate.

2.1 Property Owner Statements Regarding Well Interference Complaint

2.1.1 Complaint Investigation #1 (14-August-2017)

During AECOM's 14-August-2017 site visit 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 2: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (14-AUGUST-2017)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Lack of water flow through filters. • Water quantity significantly decreased. • Well supply presently services two (2) residences; including five (5) people full-time, two (2) people part-time, and livestock (3 horses). • Well previously provided adequate supply for livestock; including about 25-30 cattle and 200-250 hogs. • Previously filled 500 gal sprayer tank up to 4 times per day.
"What do you think is the cause?"	• Nearby pile driving as part of NKW1 project.
"When did you first notice the problem (Date/Time)?"	• 2017-08-09: opened lid [of well pit] to view filters and saw they were about ½ full. Running short of water in the house at that time.
"Is the problem still occurring?"	• Yes; concerned with water quantity and quality (fit for use questionable).
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No.
"Were you provided a temporary supply of potable water?"	• No.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes.

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

2.1.2 Complaint Investigation #2 (28-August-2017)

During AECOM's 28-August-2017 site visit to the subject property, a series of seven (7) standard questions were once again raised with the property owners ([redacted]) for the purposes of obtaining further details regarding the subsequent well water supply issue(s). The questions raised with the property owners were as detailed on *Form B: Well Complaint Procedure for Site Investigation*, included as part of MOECC's approved *Well Interference Protocol* (AECOM, 2017) for the NKW1 project.

TABLE 3: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (28-AUGUST-2017)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• May have pump issue; making noise when activated; no flow. • Property owners think the pump was plugged; took sediment samples from filtration system; requested that both jars of sediment be submitted for quality analysis. • Pump turned on again at that time by property owner; pump reportedly still struggled. • 2017-08-09: flow rate from the pump system declined; used to be able to fill four (4) 2000 gal tanks in a day prior to 9-August-2017, each tank would fill within about one (1) hour; toilets were not flushing.
"What do you think is the cause?"	• Pile driving as part of NKW1 project, change to 16" pipe (piles) on-site, concerned about workers breathing dust (on turbine site).
"When did you first notice the problem (Date/Time)?"	• 2017-08-25: noticed additional sediment in system (filters). • 2017-08-27: noticed pump lagging or struggling to pump water.
"Is the problem still occurring?"	• Well owner had not activated the pumping system prior to AECOM's site visit on 28-August-2017. • Pump was activated by property owner during AECOM's site visit. Video taken during pump system operation; pump ran for approximately 1 minute and then started to struggle to maintain flow. Pump shut down by property owner at that time.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No.
"Were you provided a temporary supply of potable water?"	• No.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes.

Upon completion of the questionnaire, both the property owners ([redacted]) and their representative from Water Wells First ([redacted]) were permitted an opportunity to review the responses detailed in the table below and were all in agreement that the information provided was accurate to the best of their knowledge.

3. Construction Activities and Vibration Monitoring

3.1.1 Turbine Location #30 (T30)

Pile driving activities for foundation construction at T30 commenced in the area of Pile #13 at 10:44 am on 3-August-2017. Following the initial pile installation, an additional six (6) piles at the T30 site were driven on that same day, with work concluding at the location of Pile #15 at approximately 2:50 pm. Eight (8) additional piles at the T30 site were installed the following day (including a re-strike at Pile #15C). On 8-August-2017, three (3) additional piles were installed and three (3) restrikes were completed. Driving of the final pile, Pile #1A, was completed at 9:58 am on 9-August-2017.

Monitoring of vibration effects during pile driving at T30 was completed by Golder Associates Ltd. (GAL) on behalf of NKW1 in accordance with *Condition H* of the REA. The monitoring program developed and implemented by GAL (and as approved by MOECC) comprised the measurement of particle velocities at locations in close proximity to the piles, as well as at two (2) local private water well supplies. The local groundwater well supplies monitored during pile driving at T30 included Well 9 ([redacted]) and Well 10 ([redacted]), being located at radial distances of about 1,808 m and 1,385 m from the T30 turbine foundation centre, respectively. Comparatively, the location of the water well on the [redacted] property is positioned at a distance of approximately 875 m from the location of work at T30.

3.1.2 Turbine Location #32 (T32)

Pile driving activities for foundation construction at T32 commenced in the area of Pile #15 at 9:00 am on 11-August-2017. Following the initial pile installation, an additional eight (8) piles at the T32 site were driven on that same day, with work concluding at the location of Pile #1 at approximately 3:01 pm. Nine (9) additional piles at the T32 site were installed approximately three (3) days thereafter (14-August-2017), with the final installation (Pile #3) having been completed at 4:57 pm.

Monitoring of vibration effects during pile driving at T32 was completed by Golder Associates Ltd. (GAL) on behalf of NKW1 in accordance with *Condition H* of the REA. The monitoring program developed and implemented by GAL (and as approved by MOECC) comprised the measurement of particle velocities at locations in close proximity to the piles, as well as at two (2) local private water well supplies. The local groundwater well supplies monitored during pile driving at T32 included Well 9 ([redacted]) and Well 10 ([redacted]), being located at radial distances of about 680 m and 1,122 m from the T32 turbine foundation centre, respectively. Comparatively, the location of the water well on the [redacted] property is positioned at a distance of approximately 1,215 m from the location of work at T32.

3.1.3 Reporting and Interpretation (GAL)

Vibration monitoring results obtained by GAL are summarized in a technical letter, dated 30-August-2017.

In addition to the foregoing, a site-specific vibration assessment pertaining to the subject property was completed by GAL, the results of which are presented in a letter, dated 12-October-2017.

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

Based on the vibration monitoring completed by GAL, the following interpretation and conclusions are presented within their 30-August-2017 technical letter:

> *In summary, vibration measurements obtained with the geophone system (Instantel Minimate) on all sites reported herein were within expectations as compared to those measured at the T5 and T42 test pile sites and general project expectations. At some of the sites, piles penetrated through the near-surface soils under their own weight or a low number of hammer blows (e.g., less than 5) and, thus, 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.*
>
> *The pumps at Wells 6, 10 and 12 were noted to influence well casing vibrations. 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. Similar conditions were observed for Wells 10 and 12. At the Well 10 site, maximum well casing particle velocities associated with pump operation during the known pumping time period were significantly greater than any measurements made during pile driving within the turbine cluster associated with Well 10. Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. Vibrations of the casings at Wells 11 and 12 were measured during water quality sampling events on August 17, 2017 in the absence of pile driving at any location. During the well sampling, when the pumps turned on, maximum vibration magnitudes of 0.016 and 0.896 mm/s were measured at these wells, respectively. 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 at Well 12. The pump for Well 12 is a piston pump mounted directly on top of the well casing. Of note, a piston pump for Well 9 is located within the barn immediately adjacent to the Well 9 casing location. Golder has planned to conduct a separate monitoring event at this well to measure the influence of the pump on well casing vibrations in the absence of pile driving. Photographs of Wells 6, 10 and 12 are attached to this letter illustrating the proximity of the well pump to the casing.

Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor trailer 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 perceptible by our well monitoring staff and registered at about 2.8 mm/s. 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 (without wood crane mats), 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. 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.

In summary, through to August 26, 2017, measured vibrations associated with driving a total of 238 piles on the glacial till/rock have been evaluated and reported (including replacement piles, restrike events and pile dynamic monitoring events). These measurements have been obtained at the turbine sites and at wells located at distances of 623 to 3,368 m from the turbine sites. It is our opinion, based on these measurements, that the vibration magnitudes at all wells during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influence of well pumps and inconsequential for the wells.

The interpretation and conclusions above are reconfirmed by GAL within their site-specific assessment letter, dated 12-October-2017, which reads:

Based on the data available to-date from the test pile and construction monitoring programs, pile-induced vibrations at the well, if any, for which the complaint was noted would be expected to be on the order of 0.005 mm/s (5 µm/s) when pile driving was at its closest on August 8 and 9, 2017. Pile-driving-induced vibrations at the well location would be less than 1/100th to 1/1,000th of pump-induced vibrations for similar pump, piping and well casing configurations. The vibrations at the well site should also be less than 1/100th of vibrations associated with nearby tractor-trailer truck traffic and likely less than those that might be induced by movements of vehicles and equipment on the property. For additional context, the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz is 0.1 mm/s, or about 20 times the value that could be associated with pile-driving-induced vibrations at the distance between the nearest turbine site and the [redacted]. As previously noted, it is our opinion, based on these measurements, that the vibration magnitudes 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 influences of typical well pumps in the area and inconsequential for the wells.

3.2 Discussion

3.2.1 Turbine Location #30 (T30)

The interpretation presented by GAL within their technical letter is confirmed through a review of the vibration monitoring data summary appended thereto. Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 9 during pile driving activities at T30 ranged between 0.024 and 0.088 mm/s (average 0.055 mm/s), whereas at Well 10 the values ranged between 0.002 and 1.251 mm/s (average 0.293 mm/s). At Well 10, when the vibration effects of well pump operation are excluded by GAL, reported PPV values decrease to between approximately 0.005 and 0.036 mm/s.

Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 9 during pile restrikes (resistance performance testing) at T30 ranged between 0.041 and 0.080 mm/s (average 0.055 mm/s), whereas at Well 10 the values ranged between 0.006 and 1.116 mm/s (average 0.540 mm/s). At Well 10, when the vibration effects of well pump operation are excluded by GAL, reported PPV values decrease to between approximately 0.006 and 0.146 mm/s.

Vibration monitoring completed by GAL in the immediate vicinity of T30 ranged in offset distance from a minimum of 9.1 m at Pile #11 to a maximum of 26.0 m at Pile #4 (average of 20.2 m). During restrikes, monitoring distances ranged between 18.1 m and 25.6 m (average of 22.8 m). Reported daily PPV values for work completed on 3-August-2017, 4-August-2017, 8-August-2017 and 9-August-2017 were reported as 5.333 mm/s, 4.70 mm/s, 3.17 mm/s, and 2.41 mm/s, respectively. No apparent correlation (increase / decrease) is observed in PPV values reported by GAL for the monitored wells in response to pile driving activities on any given day.

3.2.2 Turbine Location #32 (T32)

The interpretation presented by GAL within their technical letter is confirmed through a review of the vibration monitoring data summary appended thereto. Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 9 during pile driving activities at T32 ranged between 0.028 and 1.346 mm/s (average 0.251 mm/s), whereas at Well 12 the values ranged between 0.009 and 0.880 mm/s (average 0.308 mm/s). At Well 10, when the vibration effects of well pump operation are excluded by GAL, reported PPV values decrease significantly to less than 0.01 mm/sec.

GAL reports that vibration monitoring data collected at Well 9 on 11-August-2017, during construction works at Pile #11, 12, 13, 16, 17, and 18 are “under on-going review” as the results are reported to be “higher than and inconsistent with other measurements during pile driving at the T32 site”. GAL further reports that other construction activities occurring along the entrance road to T32 at distances as close as 100 m from Well 9 may have affected the monitoring results at that time. The results of GAL’s review were not available as of the date of this technical memorandum.

Vibration monitoring completed by GAL in the immediate vicinity of T32 ranged in offset distance from a minimum of 9.5 m at Pile #8 to a maximum of 26.4 m at Pile #17 (average of 18.9 m). During this monitoring, reported daily PPV values for work completed on 11-August-2017 were consistent at 3.43 mm/s, and on 14-August-2017 at 4.83 mm/s. No apparent correlation (increase / decrease) is observed in PPV values reported by GAL in response to pile driving activities on either day.

3.2.3 Summary

GAL reports that local background PPV values generally fall within the range of <0.01 to 0.07 mm/s, based on data collected previously at T5 and T42. This range is generally consistent with the values presented above for monitoring during pile installation at T30 and T32, in the absence of well pump operation at the monitored well sites. As a basis of comparison, the particle velocity threshold for human perception is stated by GAL to be approximately 0.1 mm/s at between about 8 and 100 Hz (ISO 2631-2).

4. Well Construction Details

Table 4 provides a summary of pertinent details for the existing water well source located at [redacted], based on information provided to AECOM by [redacted] during our 14-August-2017 well interference complaint site visit, as well as on their completed baseline water well survey (WWS) form.

A review of the MOECC on-line database did not reveal a water well record (WWR) for the subject property. This is not unexpected given the well's reported age (70 years). In light of this, other local WWR's in the vicinity of the [redacted] property were obtained and reviewed in the context of assessing the local geology (including depth to bedrock), aquifer yield, and groundwater levels. Based on this review, the following general observations were made:

- Locally, the depth to the shale (black) bedrock is relatively consistent at between approximately 13.7 m to 15.2 m (45' to 50') below ground surface (BGS);
- The overburden profile is comprised dominantly of clay, with intermittent surficial sands;
- A basal layer of gravel (contact aquifer) is evident intermittently throughout the area;
- Groundwater is derived locally from the shale bedrock and/or the overburden-bedrock interface;
- Reported groundwater yield within local wells is not significant, being generally less than about 26 to 30 L/min (7 to 8 USgpm); and,
- Static groundwater levels typically occur at about 3.0 m to 5.2 mBGS (10' to 17').

In-situ measurement of well details (ie. including total depth, water level, etc.) was unable to be completed by AECOM during either of our 14-August-2017 or 28-August-2017 site visits due to: i) installation of a jet pump suction pipe and sealing of the well lid with a glue-like substance causing it to be inaccessible for removal; ii) the well being located within a well pit that was considered to represent a confined space, as per O.Reg. 632/05; and, iii) that [redacted] did not provide access permission to open the well.

A photograph of the well is provided as **Photo 1**, having been obtained by AECOM from ground surface above the well pit.

TABLE 4: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	[redacted]
Well Tag #	*Unknown*
Well ID	*Unknown*
Installation Date	1947 (as on WWS)
Well Location	Adjacent to a Storage Building within a Well Pit and adjacent to a Horse Paddock. Well is situated

DETAILS	[redacted]
	approximately 37 m North of the [redacted]
Contractor	*Unknown*
Contractor No.	*Unknown*
Construction Method	Drilled (as on WWS); possibly cable-tool
Total Depth	21.0 m / 69' (as on WWS)
Target Formation	Black Shale (based on review of local WWR's and reported well depth by property owner)
Casing Length	*Unknown*
Casing Diameter	127 mm / 5" (visual estimate by AECOM)
Casing Material	Steel
Casing Stick-Up	~1.0m below grade (visual estimate by AECOM)
Annular Seal	*Unknown*
Sealant Type	*Unknown*
Well Screen Installed?	*Unknown*
Well Screen Details	*Unknown*
Well Screen Interval	*Unknown*
Well Cover Type	Metal/rubber compression-style well cap; cap sealed with a glue-like substance. Well cap is non-vented
Pump Intake Depth	*Unknown*
Pumping Rate	20 L/min / 5.3 USgpm (as measured by AECOM)
Well Pump Type	Shallow Well Jet Pump Goulds® Model J5SH (as observed by AECOM)
Well Pump Size	½ hp (as observed by AECOM)
Static Level	*Unknown*
Pumping Level	*Unknown*

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

4.1 Limited Well Flow Rate Testing and Pumping System Assessment

During AECOM's well complaint site visit on 14-August-2017, a limited flow rate test was completed to assess the current pumping capacity of the well pump. This testing was completed using a standard hose faucet installed just above the pump discharge within the upper component of the well pit at a location upstream of a recently-installed particle filtration array (see **Photo 2**). A valve located downstream of the faucet was shut to prevent backflow of water through the pressure tank, piping, and particle filtration system.

For the test, the well pump was permitted to operate continuously for a period of twenty five (25) minutes using a sanitized hose assembly (provided by AECOM) attached to the faucet orifice. Discharge from the hose was directed away from the well (north) and onto a grassed area near a horse paddock at a distance of approximately 10 m. During pumping, the discharge rate from the hose was assessed by AECOM at the 2, 7, 15, and 25 minute interval. Flow rate measurement was

completed by timing the discharge of 10 L of water into a calibrated pail. Based on this monitoring, a constant flow rate of approximately 20 L/min (5.3 USgpm) was determined. No variation in flow rate (including increasing or decreasing trends) was observed during the test. An appreciable amount of entrained air / gas was observed in the discharge stream which appeared to increase progressively (ie. bubbles became larger) until about the mid-point of the test and then remained relatively stable through to testing completion.

PHOTO 1: Site Well (as Observed by AECOM on 14-August-2017)

A copy of the technical brochure for the well pump was obtained from the manufacturer (Goulds) to provide a basis of comparison against the testing results (**Attachment C**). According to the property owner ([redacted]), the water system operates in a set cut in/out pressure range of 30/50 PSI (206.8 to 344.7 kPa). Based on this information, a median pressure value of 40 PSI (275.8 kPa) was considered in our review of projected flow rate specifications for the well pump. According to manufacturer specifications, a discharge range of between 19.7 L/min and 41.7 L/min (5.2 to 11.0 USgpm) has been determined for the pump, depending on the required level of suction lift (and being in as-new condition).

Assuming a static groundwater level of between approximately 3 m and 5 mBGS (based on a review of local WWR's) and considering friction losses within the plumbing system upstream of the pump (ie. riser pipe [steel and polyethylene], insert adaptors [x3], 90° elbows [x3], and check valve), a total suction lift in excess of 6.1 m (20') has been estimated. Thus, it is projected that the capacity of the pump (not withstanding age and/or other system condition limitations) would likely be in the range of about 19.7 L/min to 24.6 L/min (5.2 to 6.5 USgpm). When compared to the results of AECOM's flow rate test on 14-August-2017, the results fall within the estimated range of flows based on manufacturer specifications, and age / condition of the pump (manufactured in 2006 based on motor-end model number) and downhole suction piping / foot valve assembly (appears older than pump based on material type and visible condition).

The location of recently-installed filtration system represents a potential concern based on observations made during our 14-August-2017 site visit. As can be observed in **Photo 2**, the filtration system is installed intermediate to the pump / pressure switch and pressure tank. This configuration

is not recommended, as the presence of the filter array would result in additional backpressure on the discharge side of the pump that will progressively increase over time as the capacity of the filters becomes used. With the pressure tank being located on the opposing side of the filtration array, the water system (via the pressure tank) 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 repetitive cycling. Water filtration systems for a well supply typically are installed downstream of the primary pumping and pressure systems, inclusive of such components as the well pump, pressure switch and pressure tank.

The observation of entrained air / gas within the discharge water stream during testing on 14-August-2017 should also be considered. The air / gas observed may be attributable to a natural source (methane is relatively common within shale rock formations), and/or be an indicator of leakage within the downhole components of the well pump system. Condition inspection of the pump suction pipe and foot valve assembly (if present) is recommended.

The lack of water observed during AECOM's subsequent site visit on 28-August-2017 is interpreted to likely be a result of one or both of the potential mechanisms below.

- Age / condition of the well pump and/or downhole components (including possible loss of prime);
- Presence of the filtration system (as noted above) resulting in damage to the pump system.

In either case above, it is recommended that the property owner contact an MOECC-licenced well pump contractor (Class 4) to assess the system components and to make any necessary replacement, repairs or re-arrangements, as necessary. The information detailed herein appears to be related to the property's pumping / filtration systems and not associated with changes in groundwater flow / quality within the shale bedrock associated with construction of the NKW1 project.

5. Water Quality Data

Table 5 provides a summary of available groundwater quality data for the site well. Laboratory Certificates of Analysis are included as **Attachment D**.

TABLE 5: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	23-January-2017	Raw (Untreated)	Baseline
[redacted]	AECOM	14-August-2017	Raw (Untreated)	Complaint Investigation (1)
	AECOM	*28-August-2017*	*No Sample Obtained*	*Complaint Investigation (2)*

5.1 Discussion

Available raw (untreated) groundwater sampling data for the well indicates the presence of marginal baseline groundwater quality, with elevated levels of total dissolved solids and sodium, as shown in **Table 6**. Groundwater quality data reported for the sample collected by AECOM during our 14-August-2017 site visit also is included in the table for comparative purposes.

TABLE 6: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE (23-January-2017)	COMPLAINT INVESTIGATION (14-August-2017)
Escherichia coli	0 CFU/100mL	MAC	Non detection	**Overgrown**

Total Coliforms	0 CFU/100mL	MAC	Non detection	**Overgrown**
Electrical Conductivity	--	--	1,290 µS/cm	1,280 µS/cm
pH	6.5 – 8.5	OG	8.27	8.45
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	**49.6 mg/L**	**48.3 mg/L**
Total Dissolved Solids	500 mg/L	AO	**690 mg/L**	**684 mg/L**
Total Suspended Solids	--	--	<10 mg/L	<10 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	350 mg/L	359 mg/L
Fluoride	1.5	MAC	0.98 mg/L	1.02 mg/L
Chloride	250	AO	216 mg/L	221 mg/L
Nitrate as N	10	MAC	<0.05 mg/L	<0.05 mg/L
Nitrite as N	1	MAC	<0.05 mg/L	<0.05 mg/L
Bromide	--	--	0.63 mg/L	0.61 mg/L
Sulphate	500 mg/L	AO	<0.10 mg/L	<0.10 mg/L
Ammonia as N	--	--	0.24 mg/L	0.30 mg/L
Dissolved Organic Carbon	5 mg/L	AO	2.0 mg/L	1.9 mg/L
Colour	5 TCU	AO	<5 TCU	**9 TCU**
Turbidity	5 NTU	AO	<0.5 NTU	<0.5 NTU
Calcium	--	--	12.7 mg/L	12.1 mg/L
Magnesium	--	--	4.34 mg/L	4.39 mg/L
Sodium	200 mg/L	AO	**252 mg/L**	**256 mg/L**
Potassium	--	--	2.39 mg/L	2.44 mg/L
Iron	0.300 mg/L	AO	0.090 mg/L	0.224 mg/L
Manganese	0.050 mg/L	AO	0.010 mg/L	0.011 mg/L

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); Operational Guideline (non health-related)

At the time of AECOM's baseline site visit on 23-January-2017, no water treatment devices were present at the [redacted] residence, as observed by AECOM and per the property owner's completed WWS form. During AECOM's 14-August-2017 site visit, a multi-stage particle (cartridge) filtration system was observed to have been installed within the well pit, as shown in **Photo 2**. According to [redacted], the filter housings contain progressively decreasing pore sizes, including (from right to left in the photo): 30 µm, 15 µm and 0.5 µm. Packaging for the filter cartridge (wound cord type) in the final filter housing was not available at the time of our site visit to confirm. The particle filtration system present at the time of our 14-August-2017 site visit was of recent origin, and according to the property owner was installed on or about 18-July-2017 at the recommendation of Water Wells First (WWF) as part of an ongoing particle/sediment quality study.

The collection of a raw (untreated) groundwater quality sample during our 14-August-2017 site visit was facilitated using a hose faucet installed just above the pump discharge within the upper component of the well pit at a location upstream of the particle filtration array (see **Photo 2**). As noted previously, prior to sampling, the system was permitted to flush for a period of 25 minutes using a sanitized hose assembly (provided by AECOM) attached to the faucet orifice. During flushing an appreciable amount of entrained air / gas was observed in the discharge stream.

PHOTO 2: Particle Filter System (as observed by AECOM on 14-August-2017 & 28-August-2017)

Upon completion of flushing, the hose was disconnected and the faucet orifice was disinfected and flushed once more for a period of about 0.5 minutes prior to sample collection. As the faucet is installed directly above the well pump, plastic sheeting was placed temporarily by AECOM over the pump during sample collection to prevent the potential flow of water onto system electrical components. The plastic sheeting was removed by AECOM upon completion of sample collection. The collected groundwater sample was maintained on ice within a cooler and was delivered directly to the selected laboratory (AGAT Laboratories) under chain of custody documentation within five (5) hours of collection.

As discussed in **Section 4.1** and noted in **Table 5**, a raw (untreated) groundwater sample was not able to be obtained during AECOM's 28-August-2017 site visit.

Both the 23-January-2017 baseline and 14-August-2017 complaint investigation sampling results indicate hardness levels that are low (soft) in the raw (untreated) groundwater and below the Ontario Drinking Water Quality Standard (ODWQS) Operational Guideline (OG) range of 80-100 mg/L. This owes to the relatively low carbonate content of the local shale bedrock and correspondingly low concentrations of calcium and magnesium within the groundwater source. Low hardness levels within water can result in the accelerated corrosion of water pipes, appliances, and other metallic fixtures and components.

With the notable exception of Escherichia coli and Total Coliforms in the 14-August-2017 sample obtained by AECOM (both samples reported by the laboratory to be overgrown), no other exceedances of health-related parameters analyzed, including Escherichia and Total Coliform bacteria, Nitrate (as N), Nitrite (as N) and fluoride, were detected in either the baseline or 14-August-2017 complaint investigation groundwater samples collected from the site well supply. Although not in exceedance of ODWQS limits, fluoride is noted to be somewhat elevated in both the baseline and post-construction sample results.

Immediately upon receipt of microbiological testing results from the laboratory for the 14-August-2017 sampling event, [redacted] was notified by AECOM of the results via telephone and was recommended to resample his well for microbiological parameters through his local health unit. During that conversation, AECOM also advised [redacted] not to use the water for potable means until the bacteriological quality could be verified. In response, [redacted] indicated to AECOM that he had taken a sample from his well immediately following AECOM's site visit on 14-August-2017 for testing by his local public health unit. He further reported that the results for that sample were within provincial limits (ie. non-detection) for both microbiological parameters. AECOM suggested that at least one (1) additional sample should be taken by the property owner to further confirm the results obtained.

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, turbidity levels were below the laboratory's analytical method detection limit of 0.5 NTU in both the 23-January-2017 baseline sample and 14-August-2017 well interference sample. Both values were well within ODWQS limits.

The potential for groundwater quality impacts associated with pile driving is both time-dependent and related to the intensity and propagation of ground-borne vibration. In the case of piling associated with T30, no significant vibrations attributed to pile driving were detected in the immediate vicinity of at either Well 9 or Well 10, as discussed previously in **Section 3**. The results of raw (untreated) groundwater quality sampling on 14-August-2017, save for bacteriological detection (possible anomalous result based on additional sampling completed by property owner), was consistent with results obtained during baseline assessment and no negative impact from an inorganic perspective has been identified.

According to questionnaire responses provided by the property owners (**Table 3**) during our most recent well interference complaint site visit, the outset of water quality deterioration (sediment) was first detected at on 25-August-2017; nine (9) days following the completion of pile driving at T32 and sixteen (16) days following completion of pile driving at T30. In the week leading up to the property owner's well water quality complaint on 25-August-2017, the only pile driving work being completed as part of the NKW1 project at the time was located more than 4.1 km to the northwest at Turbine Locations #3 and #4. Work being completed at these two turbine locations at the time is not considered to have had the potential to negatively affect groundwater quantity or quality in the vicinity of the site well.

6. Conclusions

Based on a review and interpretation of information gathered during AECOM's well interference complaint investigation, as presented herein, it is our opinion that the groundwater quality / supply issue reported by the property owners at [redacted] (PIN 007500008) is *not* as a result of NKW1 turbine foundation construction or pile-driving activities. No indication of water quantity or

quality impact at the site well was apparent based on our recent testing and sampling works relative to baseline data collected prior to the outset of construction.

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: Wednesday, August 09, 2017 4:36 PM
To: Joshua (j.vaidhyan@samsung.com); jody.law@patternenergy.com; sre.bop@samsung.com; Gagan Chambal (Gagan.Chambal@patternenergy.com); Van der Woerd, Mark; Becky Grieve (Becky.Grieve@patternenergy.com) (Becky.Grieve@patternenergy.com); zzDerek Leung (non-pattern) (derek.leung@samsung.com)
Cc: Moroney, Michael (MOECC); Keyvani, Mohsen (MOECC); Colella, Nick (MOECC); Gilbert, Teri (MOECC); Harman, Bruce (MOECC); Thuss, Simon (MOECC); Vantfoort, Richard (MOECC); Schofield, Carine (MOECC); Lannin, Teresa (MOECC); Smith, Mark (MOECC); Lehouillier, Jason (MOECC); Ubovic, Miroslav (MOECC)
Subject: New water well complaint - [redacted]

Hello Josh / Jody,

I have tried to reach both of you this afternoon by telephone with no luck. We have received a new water well complaint in the NK1 area, as per:

Caller: [redacted]
Time of call: 2:50 pm
Time observed: Approx. 1:50 pm

- Water is not flowing out of his well
- Water used for livestock (pigs, cows,horses) and two homes
- Was away and when returned he was told that there had been pile driving going on in the area
- Water is coming out but not at a rate that he needs it; water was flowing a week ago and was fine
- Installed new filter system around July 18, 2017
- Water is not muddy or diry – just very low flow compared to normal
- Caller had to leave after he installed the filters and assumed everything was running fine.
- Caller gave permission to provide his name, address and phone number to Samsung / Pattern and is looking for the matter to be looked into ASAP

It is the Ministry's expectation that Samsung / Pattern will treat this matter as an official complaint and initiate the complaint response procedure detailed in REA condition G5 forthwith.

I will be attending the site tomorrow at ~11am along with Simon Thuss, a hydrogeologist with our Southwest Region office if you / AECOM wishes to attend concurrently. As an additional note, I did receive assurance from the landowner that there would be no protesters or additional WWF members in attendance at that time.

Sincerely

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

From: Jody Law [mailto:jody.law@patternenergy.com]
Sent: Saturday, August 26, 2017 6:55 PM
To: Jacobs, Deb (MOECC) (deb.jacobs@ontario.ca); Randy Hope (RANDYHOPE@chatham-kent.ca); don.shropshire@chatham-kent.ca; John Norton (JOHNN@chatham-kent.ca); Tomo Matesic (tomo.matesic@entegrus.com); Colella, Nick (MOECC) (Nick.Colella@ontario.ca)
Cc: zzJoshua Vaidhyan; zzHi Byun; zzEdward Heesub Cho; zzDerek Leung (non-pattern); Gagan Chambal; Beth O'Brien; Pat Murray; Matt Dallas; David Herlufsen; 'Boone, Storer'; Jonathan Miranda; Van der Woerd, Mark; Murchison, Jason; Alexander, Matthew (Guelph)
Subject: [redacted]

Hi Deb,

We received another complaint from the [redacted]

We have reached out to [redacted] Aecom is set to visit the well on Monday morning for further investigation.

We will provide updates as the assessment progresses.

Thanks,

Jody Law
Sr. Manager, Business Development

main +1 416-263-8025
direct +1 416-263-8029
jody.law@patternenergy.com
355 Adelaide Street West, Suite 100
Toronto, ON M5V 1S2
patternenergy.com

Pattern

AECOM

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

October 12, 2017 Project No. 1668031-2000-L08

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

WATER WELL COMPLAINTS 2 AND 5
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Law:

This letter is provided to present and summarize vibration monitoring data associated with Well Complaints 2 and 5, dated August 9 and 26, 2017, respectively, as related to the well located at [redacted] in Dresden, Ontario. For the purposes of this letter, vibration data is summarized for the period starting two days prior to through to two days following the dates of the complaints listed above. This letter summarizes and supplements pile-by-pile monitoring data for each turbine site already provided under separate letters.

A table is attached summarizing the following data:

1) date of pile driving;

2) turbine site at which pile driving was undertaken;

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;

4) notes specific to the monitoring data; and

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

For context when reviewing Table 1, attached, it should be noted that during well monitoring, vibrations directly attributable to the well pumps were measured. Wells 10 and 12 exhibited vibrations of 1.25 and 2.4 millimetres per second (mm/s), respectively, when the pumps were operating. During Phase 1 of the test pile vibration monitoring, specific pile driving-induced vibrations of 0.003 mm/s were measured at Well 3, located 911 m from the pile driving. When piles were driven for turbine T14, specific pile driving-induced vibrations of 0.007 mm/s were measured at Well 14, located 580 metres (m) from the turbine centre. Well 14 is also located within about 13 m of the centreline of Union Line. At this location, a maximum vibration velocity of 0.675 mm/s was measured and clearly associated with a tractor-trailer truck driving northeast along Union Line as it passed the well.

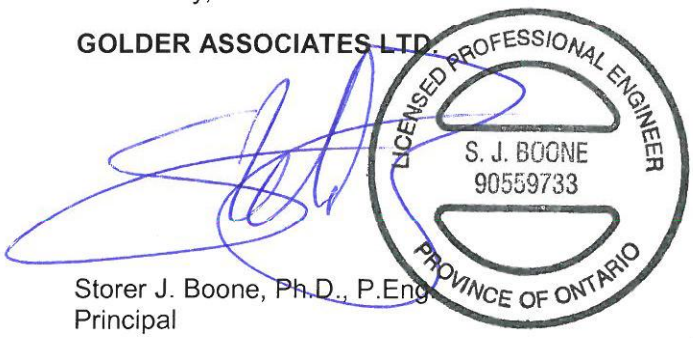
An AECOM Canada Ltd. (AECOM) investigation of the well at [redacted] reported on September 7, 2017, indicated that the well is equipped with a shallow-well jet pump and photographs indicate this pump is mounted less than 1 m from the top of the well casing. Maximum well casing vibration velocities for similar shallow well jet pump and casing configurations in the area (Wells 4, 6 and 13) indicate that these systems induce casing vibrations on the order of 0.6 to just under 5 mm/s, likely dependent on age and the piping connections.

Based on the data available to-date from the test pile and construction monitoring programs, pile-induced vibrations at the well, if any, for which the complaint was noted would be expected to be on the order of 0.005 mm/s (5 µm/s) when pile driving was at its closest on August 8 and 9, 2017. Pile-driving-induced vibrations at the well location should be less than 1/100th to 1/1,000th of pump-induced vibrations for similar pump, piping and well casing configurations. The vibrations at the well site should also be less than 1/100th of vibrations associated with nearby tractor-trailer truck traffic and likely less than those that might be induced by movements of vehicles and equipment on the property. For additional context, the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz is 0.1 mm/s, or about 20 times the value that could be associated with pile-driving-induced vibrations at the distance between the nearest turbine site and the [redacted] well. As previously noted, it is our opinion, based on these measurements, that the vibration magnitudes 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

CC: J. Vaidyan, Samsung

Attachments: Table 1 - Summary of Vibration Monitoring Data, Well Complaints 2 and 5

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Golder Associates

Table 1: Summary of Vibration Monitoring Data, Well Complaints 2 and 5[1]

Date	Turbine	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)	Notes[3]	
Complaint 2 August 9, 2017						
8/7/2017	No Pile Driving					
8/8/2017	T30	3.17	0.080 (W9, 1,808 m)	0.146 (W10, 1,385 m)	7 piles driven, W10	884
8/9/2017	T30	2.41	0.080 (W9, 1,808 m)	0.027 (W10, 1,385 m)	One pile driven only	884
8/10/2017	No Pile Driving					
8/11/2017	T28	5.59	0.812 (W9, 2,568 m)	0.112 (W10, 1,769 m)	Road/utility construction near W9, traffic near W10	1,657
8/11/2017	T32	3.43	1.346 (W9, 680 m)	0.051 (W10, 1122 m)	Road/utility construction near W9	1,226
Complaint 5, August 26, 2017						
8/23/2017	T3	7.27	0.025 (W11, 1707 m)	0.023 (W12, 1,264 m)		4,280
8/23/2017	T45	7.75	0.018 (W11, 1,223 m)	0.043 (W12, 1,635 m)		3,563
8/24/2017	T4	4.32	0.030 (W11, 1,424 m)	0.056 (W12, 1,072 m)		4,136
8/24/2017	T45	3.30	0.026 (W11, 1,223 m)	0.061 (W12, 1,635 m)		3,563
8/25/2017	T4	2.54	0.028 (W11, 1,424 m)	0.018 (W12, 1,072 m)		4,136
8/25/2017	T45	5.97	0.028 (W11, 1,223 m)	0.037 (W12, 1,635 m)		3,563
8/26/2017	No Pile Driving					
8/26/2017	No Pile Driving					
8/28/2017	T21	3.30	0.015 (W11, 3,960 m)	0.071 (W12, 4,161 m)		6,425
8/28/2017	T46	7.85	0.021 (W11, 1,697 m)	0.071 (W12, 2,170 m)		3,596

NOTES:
1) Table shall be read in conjunction with accompanying letter.
2) Other activities included nearby road and utility construction, travel of loaded farm equipment on the property, car and truck traffic on adjacent road, etc.
3) See letter text for discussion of pump influences and specific pile vibration measurements and distances.

August 30, 2017 Project No. 1668031-2000-L05

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 PILES - TURBINES T3, T4, T6, T7, T12, T28, T30, T31, T32, T35 AND T36
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) through to August 26, 2017. This period addresses turbines T3, T4, T6, T7, T12, T28, T30, T31, T32, T35 and T36. 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.

The attached pages of summary data and notes include particle velocity measurements made at the sites referenced above taken in close proximity to the pile driving together with measurements obtained at domestic water well casings associated with the turbine clusters as relevant to each of the turbine sites. Previously issues summary pages have been updated to reflect detailed review of Instantel Minimate data histogram files for the turbine sites, refinements in turbine to well distances, monitoring of vibrations during well pump operating periods in the absence of pile driving, well and turbine site vibration monitoring data associated with pile dynamic analyser testing, subsequent pile restrikes or replacements, and typographical corrections.

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. At some of the sites, piles penetrated through the near-surface soils under their own weight or a low number of hammer blows (e.g., less than 5) and, thus, 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.

The pumps at Wells 6, 10 and 12 were noted to influence well casing vibrations. 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. Similar conditions were observed for Wells 10 and 12. At the Well 10 site, maximum well casing particle velocities associated with pump operation during the known pumping time period were significantly greater than any measurements made during pile driving within the turbine cluster associated with Well 10. Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. Vibrations of the casings at Wells 11 and 12 were measured during water quality sampling events on August 17, 2017 in the absence of pile driving at any location. During the well sampling, when the pumps turned on, maximum vibration magnitudes of 0.016 and 0.896 mm/s were measured at these wells, respectively. 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 at Well 12. The pump for Well 12 is a piston pump mounted directly on top of the well casing. Of note, a piston pump for Well 9 is located within the barn immediately adjacent to the Well 9 casing location. Golder has planned to conduct a separate monitoring event at this well to measure the influence of the pump on well casing vibrations in the absence of pile driving. Photographs of Wells 6, 10 and 12 are attached to this letter illustrating the proximity of the well pump to the casing.

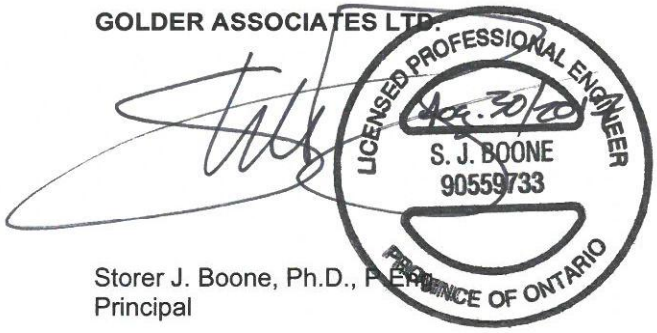
Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor trailer drove by on the road near Well 6 and, at the same time, the resident was hammering in a nearby shed. Vibrations associated with the loaded dump truck were perceptible by our well monitoring staff and registered at about 2.8 mm/s. 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 (without wood crane mats), 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. 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.

In summary, through to August 26, 2017, measured vibrations associated with driving a total of 238 piles on the glacial till/rock have been evaluated and reported (including replacement piles, restrike events and pile dynamic monitoring events). These measurements have been obtained at the turbine sites and at wells located at distances of 623 to 3,368 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/nb

Attachments: Photographs of Wells 6, 10 and 12 Pump Configurations
Vibration Monitoring Summaries, Turbines T3, T4, T6, T7, T12, T28, T30, T31, T32, T35 and T36

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

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

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

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T3

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/23/2017 10:01	8/23/2017 10:10	8/23/2017 10:11	21.6	7.27	NA[e]	0.021	
2	8/23/2017 11:29	8/23/2017 11:35	8/23/2017 12:35	23.2	7.27	0.011	0.003	
3	8/23/2017 11:46	8/23/2017 11:56	8/23/2017 12:41	24.2	7.27	0.024	0.013	
4	8/23/2017 12:12	8/23/2017 12:09	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	

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". 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 showr 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. 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T4

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/25/2017 8:00	8/25/2017 8:08	8/25/2017 8:09	23.9	2.54	0.004	0.006	
2	8/25/2017 8:30	8/25/2017 9:15	8/25/2017 9:16	25.6	2.54	0.006	2.335	0.008
3	8/25/2017 9:03	8/25/2017 9:09	8/25/2017 9:10	26.6	2.54	0.007	2.335	0.008
4	8/25/2017 8:47	8/25/2017 8:56	8/25/2017 8:57	27.0	2.54	0.005	0.011	
5	8/25/2017 8:15	8/25/2017 8:22	8/25/2017 8:23	26.6	2.54	0.028	0.018	
6	8/24/2017 13:01	8/24/2017 13:10	8/24/2017 13:11	25.6	4.32	0.011	0.056	
7	8/24/2017 9:56	8/24/2017 10:04	8/24/2017 10:51	23.9	4.32	0.018	1.511	0.024
8	8/24/2017 13:19	8/24/2017 15:14	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 15:04	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	

Restrikes

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 the 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T6

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

Well Information

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

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

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

Monitoring Notes: Pile driving was completed within one day. During initial pile driving, there was little resistance to pile installation and some piles penetrated many metres into the ground under their own weight. 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).

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT 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: Pile driving was completed within two days. During initial pile driving, there was little resistance to pile installation and some piles penetrated many metres into the ground under their own weight. 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT 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 12:37	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. Note that similar (or exact) data is indicated for well vibration measurements during restrike events since the data analysis process uses 10 minute analysis periods (see below) and with short duration restrikes these periods can overlap.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T28

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[e]
1	8/15/2017 14:33	8/15/2017 14:41	8/15/2017 14:43	21.6	3.17	0.061	0.020	
2	8/15/2017 14:53	8/15/2017 15:04	8/15/2017 15:06	23.9	3.17	0.019	0.036	
3	8/15/2017 15:31	8/15/2017 15:42	8/15/2017 15:44	25.6	3.17	0.111	0.805	0.019
4	8/15/2017 13:23	8/15/2017 13:37	8/15/2017 13:39	26.6	3.17	0.022	0.804	0.100
5	8/15/2017 12:10	8/15/2017 12:22	8/15/2017 12:24	27.0	3.17	0.108	0.158	
6	8/15/2017 11:46	8/15/2017 11:59	8/15/2017 12:00	26.6	3.17	0.012	0.095	
7	8/15/2017 9:56	8/15/2017 10:08	8/15/2017 10:11	25.6	3.17	0.027	0.052	
8	8/15/2017 9:16	8/15/2017 9:34	8/15/2017 9:36	23.9	3.17	0.040	0.009	
9	8/15/2017 8:51	8/15/2017 9:03	8/15/2017 9:04	21.6	3.17	0.046	0.015	
10	8/15/2017 8:18	8/15/2017 8:33	8/15/2017 8:35	19.0	3.17	NA[e]	0.750	0.026
11	8/15/2017 7:45	8/15/2017 7:58	8/15/2017 8:02	16.1	3.17	NA[e]	0.007	
12	8/11/2017 13:27	8/11/2017 14:45	8/11/2017 14:46	13.2	5.59	0.812	0.014	
13	8/11/2017 12:36	8/11/2017 12:48	8/11/2017 12:50	11.0	5.59	0.054	0.006	
14	8/11/2017 12:13	8/11/2017 12:25	8/11/2017 12:27	10.1	5.59	0.055	0.112	
15	8/11/2017 11:49	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 and therefore are under on-going review. Of note, the piston pump for Well 9 is understood to be within the barn adjacent to the well location. 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 (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. 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT 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	
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: 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT 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 11:25	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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T32

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

Restrikes

Well Information

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

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

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

Monitoring Notes: Highlighted values for Well 9 on August 11, 2017 are higher than and inconsistent with other measurements during pile driving at the T32 site and therefore are under on-going review. 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 (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. 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. 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT 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 10:06	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 11:23	6/30/2017 11:37	11.6	4.19	0.001	0.093	0.015
14	6/28/2017 8:34	6/28/2017 8:59	6/28/2017 8:16	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	4/07/2017 13:45:00	7/4/2017 13:51	20.8	4.70	0.004	0.105	
18	6/28/2017 10:40	6/28/2017 10:55	6/28/2017 11:25	23.0	6.86	0.004	0.015	
Restrikes								
1	6/26/2017 7:39	6/26/2017 7:39	6/26/2017 7:39	25.3	4.06	0.007	0.007	
17	6/28/2017 12:54	6/28/2017 12:54	6/28/2017 13:14	20.3	6.86	0.004	0.014	
10	6/29/2017 13:31	6/29/2017 13:31	6/29/2017 13:32	17.4	4.70	0.006	0.004	
13	6/29/2017 13:37	6/29/2017 13:37	6/29/2017 13:42	11.6	4.70	0.004	0.002	
14	6/29/2017 13:47	6/29/2017 13:47	6/29/2017 13:50	12.4	4.70	0.006	0.003	
16	6/29/2017 13:54	6/29/2017 13:54	6/29/2017 13:56	17.4	4.70	0.005	0.003	
15	6/29/2017 14:20	6/29/2017 14:20	6/29/2017 14:25	14.6	4.70	0.008	0.011	
PDA								
13A	7/6/2017 10:06	7/6/2017 10:06	7/6/2017 10:15	12.1	5.21	0.005	0.138	
13	7/6/2017 11:05	7/6/2017 11:05	7/6/2017 11:23	11.6	5.21	0.006	0.219	
15A	7/6/2017 11:39	7/6/2017 11:39	7/6/2017 11:40	15.1	5.21	0.009	0.130	
17A	7/6/2017 11:55	7/6/2017 11:55	7/6/2017 11:56	20.8	5.21	0.010	0.061	
1A	7/6/2017 12:18	7/6/2017 12:18	7/6/2017 12:18	25.8	5.21	0.011	0.084	

Well Information

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

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

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

Monitoring Notes: Tractor was observed operating frequently near Well 6. Water pump was observed cycling on and off during pile driving operations and remaining on for periods of 2 to 4 minutes. When pump was operating, casing at Well 6 exhibited particle velocities in the range of 0.08 to 0.12 mm/s and this data dominated FFT 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T36

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

Well Information

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

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

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

Monitoring Notes: Pile driving was completed within one day. 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. During initial pile driving, there was little resistance to pile installation and some piles penetrated many metres into the ground under their own weight or a few hammer blows. 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 data dominated FFT 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.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering and not other associated work; 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 FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

Attachment C

Well Pump Information

TECHNICAL BROCHURE
BJS+

JS+ J5S, J5SH, J7S, J10S, J15S

SHALLOW WELL JET PUMPS - ½, ¾, 1 AND 1½ HP

GOULDS
WATER TECHNOLOGY
a xylem brand

FEATURES

Compact: Design has an integral shallow well adapter built into the casing, which eliminates the need for a separate shallow well adapter.

Serviceable:

- Back pullout design allows disassembly of pump for service without disturbing piping.
- Two compartment motor for easy access to motor wiring and replaceable components.
- Nozzle clean out plug in pump case.
- Corrosion resistant, engineered plastic tubing and fittings are easily removed for cleaning. Premium O-ring design fittings need only be hand tight to seal.

Impeller: F.D.A. compliant, glass filled Noryl®. Corrosion and abrasion resistant.

Diffuser (Guidevane): Bolt down diffuser provides positive alignment with impeller. Diffuser also has stainless wear ring for extended performance in abrasive conditions. F.D.A. compliant, injection molded, food grade, glass filled Lexan® for durability and abrasion resistance.

Tubing and Fittings: F.D.A. compliant engineered plastic is corrosion and U.V. resistant.

Powered for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits. Can be operated continuously without damage.

Corrosion Resistant: Electro-coated paint process is applied inside and out, then baked on.

Protected Mechanical Seal: Special diaphragm design retains water in the casing at all times to ensure the mechanical seal can never run dry.

Excellent Air Handling Ability: After initial priming the pump has the ability to re-prime itself even when air gets into the system. Pumping resumes once the water level rises above the foot valve.

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Cottages
- Booster service

SPECIFICATIONS

Pump:

- **Pipe connections:** 1¼" NPT suction and 1" NPT discharge
- **Pressure switch:** AS4 preset (30-50 PSI).

Motor:

- NEMA standard
- 60 Hz
- ½ – 1½ HP, 115/230 V capacitor start
- Single phase
- 3500 RPM
- Built-in overload with automatic reset
- Stainless steel shaft
- Rotation: clockwise when viewed from motor end
- UL778 listed

Maximum temperature: 140°F.

SYSTEM COMPONENTS

- **Basic Pump Unit:** Includes pump with integral shallow well jet (nozzle and venturi), motor, pressure switch and tubing.

AGENCY LISTINGS

Canadian Standards Association

Underwriters Laboratories①

MODEL INFORMATION

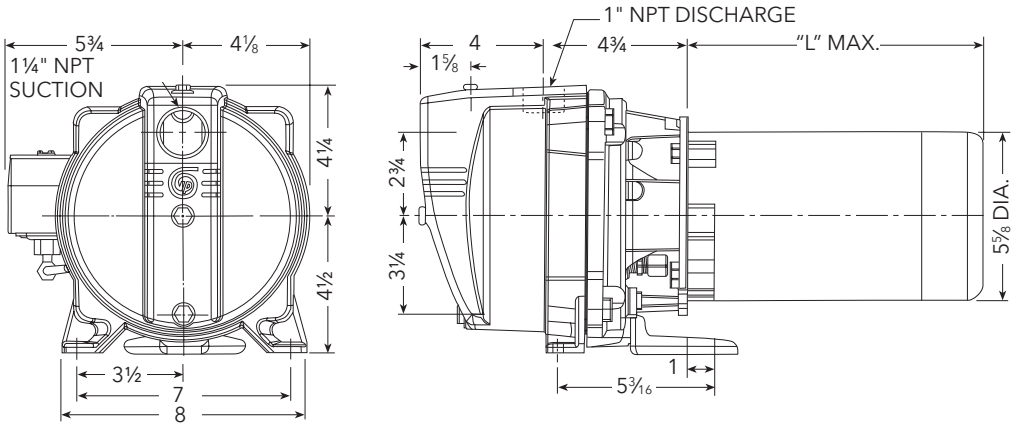
CSA Listed Order No.	U.L. Listed (Indoor use)① Order No.	HP
J5S	J5SUL	½
J5SH	J5SHUL	½
J7S	J7SUL	¾
J10S	J10SUL	1
J15S	J15SUL	1½

SHALLOW WELL PERFORMANCE RATINGS

HP/Model	½ HP – J5S					½ HP – J5SH						¾ HP – J7S					1 HP – J10S					1½ HP – J15S				
Nozzle	AN017					AN019						AN018					AN018					AN022				
Venturi	AD3332					AD3328						AD3336					AD3339					AD3342				
	Discharge Pressure – PSI					Discharge Pressure – PSI						Discharge Pressure – PSI					Discharge Pressure – PSI					Discharge Pressure – PSI				
Total Suction Lift (feet)	20	30	40	50	Max. Shut off (PSI)	20	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)
	Gallons per minute					Gallons per minute						Gallons per minute					Gallons per minute					Gallons per minute				
5	17.5	16.5	10.2	5.0	63	11.5	11.3	11.0	7.7	4.8	83	21.3	18.3	12.5	6.6	70	24.8	24.4	16.6	9.9	74	26.6	26.3	25.0	15.6	80
10	15.7	14.4	9.2	4.3	61	10.3	10.0	9.6	7.0	4.2	81	18.8	17.3	11.3	5.0	68	22.9	22.2	15.8	8.6	72	24.7	24.3	22.6	13.9	77
15	13.7	12.5	8.0	3.6	59	8.8	8.6	8.3	6.3	3.7	79	16.4	15.5	9.6	3.7	66	19.8	19.5	13.8	6.9	70	21.6	21.5	20.4	12.9	75
20	11.5	10.4	7.1	2.3	57	7.0	7.0	6.8	5.8	3.2	76	13.6	13.2	8.3	2.0	63	16.6	16.6	12.2	5.6	67	18.1	18.0	17.6	12.0	73
25	8.7	8.6	6.2	1.3	54	5.3	5.2	5.2	5.0	2.8	73	10.0	9.9	6.4	1.0	59	12.5	12.4	10.4	3.6	65	14.0	14.0	14.0	10.1	71

DIMENSIONS AND WEIGHTS

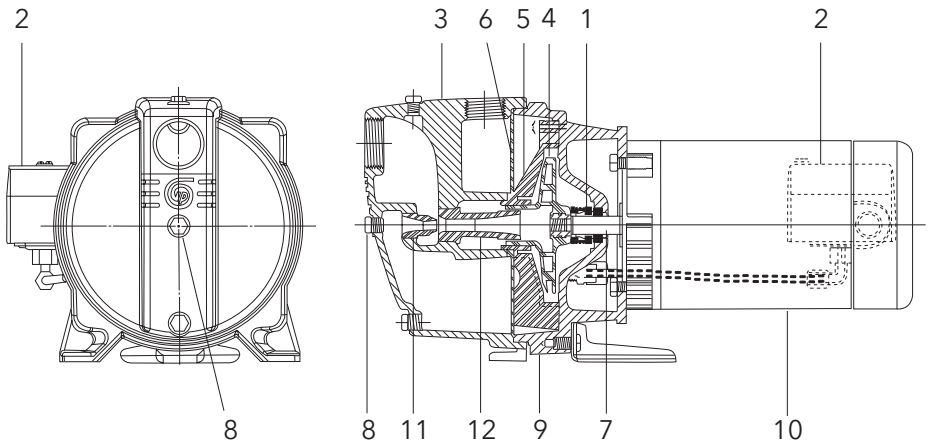
Model	J5S	J5SH	J7S	J10S	J15S
Wt. (lbs.)	43	43	47	50	60
Length	17¼	17¼	18¼	18¾	19¼
Width	9⅞				
Height	8¾				
HP	½	½	¾	1	1½
"L" Max.	8½	8½	9½	10	10½



(All dimensions are in inches and weights in lbs. Do not use for construction purposes.)

COMPONENTS

Item No.	Description
1	Mechanical seal
2	Pressure switch
3	Casing
4	Impeller
5	Diffuser (Guidevane)
6	Diaphragm
7	Stainless steel shaft
8	Nozzle clean-out plug
9	Motor adapter
10	Motor
11	Nozzle
12	Venturi (diffuser)



Xylem, Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Phone: (866) 325-4210
Fax: (888) 322-5877
www.xyleminc.com/brands/gouldswatertechnology

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: **17T180623**

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

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

DATE REPORTED: **Jan 31, 2017**

PAGES (INCLUDING COVER): **10**

VERSION*: **1**

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

*NOTES

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

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-24

DATE REPORTED: 2017-01-31

				007500008 [redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-23
Parameter	Unit	G / S	RDL	8143974
Escherichia coli	CFU/100mL	0	1	ND
Total Coliforms	CFU/100mL	0	1	ND

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

8143974 ND - Not Detected.

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-24

DATE REPORTED: 2017-01-31

				007500008 [redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-23
Parameter	Unit	G / S	RDL	8143974
Electrical Conductivity	uS/cm		2	1290
pH	pH Units	(6.5-8.5)	NA	8.27
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	49.6
Total Dissolved Solids	mg/L	500	20	**690**
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	350
Fluoride	mg/L	1.5	0.05	0.98
Chloride	mg/L	250	0.50	216
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	0.63
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.24
Dissolved Organic Carbon	mg/L	5	0.5	2.0
Colour	TCU	5	5	<5
Turbidity	NTU	5	0.5	<0.5
Calcium	mg/L		0.10	12.7
Magnesium	mg/L		0.10	4.34
Sodium	mg/L	20 (200)	0.10	**252**
Potassium	mg/L		0.10	2.39
Iron	mg/L	0.3	0.010	0.090
Manganese	mg/L	0.05	0.002	0.010

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

8143974 Elevated RDLs for Chloride indicate the degree of dilution prior to analysis in order to keep analyteswithin the calibration range of the instrument and to reduce matrix interferences.

Certified By:

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

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CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8143974	007500008[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	252
8143974	007500008[redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	690

AGAT Laboratories

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Microbiology Analysis

RPT Date: Jan 31, 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	8143939	8143939	ND	ND	NA	< 1									
Total Coliforms	8143939	8143939	ND	ND	NA	< 1									

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

Certified By:

AGAT Laboratories
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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Water Analysis

RPT Date: Jan 31, 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	8145114		336	336	0.0%	< 2	101%	80%	120%	NA			NA		
pH	8145114		7.99	7.98	0.1%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8148634		52	52	NA	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8147132		<10	<10	NA	< 10	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8145114		88	88	0.0%	< 5	104%	80%	120%	NA			NA		
Fluoride	8143327		1.08	1.12	3.6%	< 0.05	96%	90%	110%	95%	90%	110%	98%	80%	120%
Chloride	8143327		57.1	59.5	4.1%	< 0.10	92%	90%	110%	90%	90%	110%	94%	80%	120%
Nitrate as N	8143327		<0.05	<0.05	NA	< 0.05	96%	90%	110%	100%	90%	110%	105%	80%	120%
Nitrite as N	8143327		<0.05	<0.05	NA	< 0.05	NA	90%	110%	91%	90%	110%	100%	80%	120%
Bromide	8143327		0.37	0.39	5.3%	< 0.05	109%	90%	110%	94%	90%	110%	96%	80%	120%
Sulphate	8143327		<0.10	<0.10	NA	< 0.10	92%	90%	110%	96%	90%	110%	87%	80%	120%
Ammonia as N	8147132		0.23	0.23	0.0%	< 0.02	97%	90%	110%	97%	90%	110%	97%	80%	120%
Dissolved Organic Carbon	8143939	8143939	1.5	1.4	NA	< 0.5	100%	90%	110%	105%	90%	110%	114%	80%	120%
Colour	8143939	8143939	< 5	<5	NA	< 5	102%	90%	110%	NA			NA		
Turbidity	8143939	8143939	< 0.5	<0.5	NA	< 0.5	106%	90%	110%	NA			NA		
Calcium	8143830		96.6	97.4	0.8%	< 0.05	103%	90%	110%	103%	90%	110%	104%	70%	130%
Magnesium	8143830		39.7	39.6	0.3%	< 0.05	98%	90%	110%	99%	90%	110%	99%	70%	130%
Sodium	8143830		3.87	3.77	2.6%	< 0.05	102%	90%	110%	102%	90%	110%	98%	70%	130%
Potassium	8143830		1.43	1.41	1.4%	< 0.05	101%	90%	110%	101%	90%	110%	103%	70%	130%
Iron	8143939	8143939	< 0.010	<0.010	NA	< 0.010	99%	90%	110%	106%	90%	110%	94%	70%	130%
Manganese	8143939	8143939	< 0.002	<0.002	NA	< 0.002	108%	90%	110%	108%	90%	110%	91%	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:

AGAT Laboratories

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

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180623

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

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

AGAT Laboratories

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

ATTENTION TO: Jason Murchison

PROJECT: 60343599

AGAT WORK ORDER: 17T248618

MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

WATER ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Aug 21, 2017

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

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

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T248618

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiological Analysis (water)

DATE RECEIVED: 2017-08-14

DATE REPORTED: 2017-08-21

		SAMPLE DESCRIPTION:		007500008
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-08-14
Parameter	Unit	G / S	RDL	8635758
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
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.

8635758 NDOGN – No Data; Overgrown with nontarget, refers to over-crowding microbial growth

Certified By: Vivine Basily

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T248618

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-08-14

DATE REPORTED: 2017-08-21

		SAMPLE DESCRIPTION:		007500008
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-08-14
Parameter	Unit	G / S	RDL	8635758
Electrical Conductivity	uS/cm		2	1280
pH	pH Units	(6.5-8.5)	NA	8.45
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	48.3
Total Dissolved Solids	mg/L	500	20	684
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	359
Fluoride	mg/L	1.5	0.05	1.02
Chloride	mg/L	250	0.50	221
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	0.61
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.30
Dissolved Organic Carbon	mg/L	5	0.5	1.9
Colour	Apparent CU	5	5	9
Turbidity	NTU	5	0.5	<0.5
Calcium	mg/L		0.10	12.1
Magnesium	mg/L		0.10	4.39
Sodium	mg/L	20 (200)	0.10	256
Potassium	mg/L		0.10	2.44
Iron	mg/L	0.3	0.010	0.224
Manganese	mg/L	0.05	0.002	0.011

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.

8635758 Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

Certified By: Amanjot Bhela

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T248618

PROJECT: 60343599

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

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8635758	007500008	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	Apparent CU	5	9
8635758	007500008	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	256
8635758	007500008	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	684

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Quality Assurance

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SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Aug 21, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8635486		ND	ND	NA	< 1									
Total Coliforms	8635486		ND	ND	NA	< 1									

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

Certified By: Nivine Basily

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Water Analysis

RPT Date: Aug 21, 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	8636010		94	93	1.1%	< 2	102%	80%	120%	NA			NA		
pH	8636010		7.36	7.43	0.9%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8635937		328	334	1.8%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8638207		<10	<10	NA	< 10	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8636010		25	25	0.0%	< 5	98%	80%	120%	NA			NA		
Fluoride	8633574		<0.25	<0.25	NA	< 0.05	95%	90%	110%	98%	90%	110%	96%	80%	120%
Chloride	8633574		115	111	3.5%	< 0.10	90%	90%	110%	109%	90%	110%	102%	80%	120%
Nitrate as N	8633574		<0.25	<0.25	NA	< 0.05	94%	90%	110%	109%	90%	110%	106%	80%	120%
Nitrite as N	8633574		<0.25	<0.25	NA	< 0.05	NA	90%	110%	102%	90%	110%	97%	80%	120%
Bromide	8633574		<0.25	<0.25	NA	< 0.05	103%	90%	110%	107%	90%	110%	103%	80%	120%
Sulphate	8633574		104	100	3.9%	< 0.10	94%	90%	110%	109%	90%	110%	100%	80%	120%
Ammonia as N	8635758	8635758	0.30	0.29	3.4%	< 0.02	110%	90%	110%	99%	90%	110%	89%	80%	120%
Dissolved Organic Carbon	8635511		2.2	2.3	NA	< 0.5	104%	90%	110%	104%	90%	110%	98%	80%	120%
Colour	8635998		26	26	0.0%	< 5	107%	90%	110%	NA			NA		
Turbidity	8635758	8635758	<0.5	<0.5	NA	< 0.5	107%	90%	110%	NA			NA		
Calcium	8628148		32.3	32.4	0.3%	< 0.05	97%	90%	110%	99%	90%	110%	96%	70%	130%
Magnesium	8628148		9.84	10.0	1.6%	< 0.05	96%	90%	110%	98%	90%	110%	94%	70%	130%
Sodium	8628148		4.68	4.74	1.3%	< 0.05	100%	90%	110%	100%	90%	110%	95%	70%	130%
Potassium	8628148		0.49	0.49	0.0%	< 0.05	97%	90%	110%	99%	90%	110%	98%	70%	130%
Iron	8638443		<0.010	<0.010	NA	< 0.010	104%	90%	110%	104%	90%	110%	105%	70%	130%
Manganese	8638443		0.012	0.013	8.0%	< 0.002	92%	90%	110%	94%	90%	110%	93%	70%	130%

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

Certified By: Amanjot Bhela

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Method Summary

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

AECOM