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Technical Memorandum

To	North Kent 1 LP	Page	1
CC	Mark Van der Woerd (AECOM), Jonathan Miranda (Pattern), Joshua Vaidhyan (Samsung)		
Subject	**North Kent Wind 1 (Chatham-Kent, ON)** **Well Water Impact Complaint Investigation** [redacted] **– [redacted] (Chatham, ON)**		
From	Jason Murchison, P.Geo.		
Date	May 28th, 2018	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 5-March-2018. Included with this correspondence, Ms. Jacobs attached a copy of an email that was received by MOECC that same day from [redacted], the property owner of [redacted] (Chatham, ON).

Within their email to MOECC, [redacted] describes the well interference complaint, as follows:

> *I would like to inform the Ministry of the Environment and Climate Change that on Saturday February 24, 2018, my water well went cloudy at 12 noon and around 5 p.m. it was black with a lot of sediment.*
>
> *I am aware that the Ministry of the Environment gave permission to the North Kent Wind farm to commence operations on February 21, 2018.*
>
> *I am experiencing interference with my well water from the operating turbines of the North Kent Wind farm. I drilled my water well in 1991 and have never had an issue with my water.*
>
> *I request the ministry to contact North Kent Wind farm to make arrangements to test and collect water and sediment samples of my well water.*
>
> *I give the Ministry permission to come onto my property to take water samples and test for sediments, also the MOECC to take sediment samples for identification in order to determine if the sediments pose any acute or chronic health risks.*
>
> *The sediments releasing in my well are so great that the water flow to our house is non-existent. I am forced to use an alternate water supply.*
>
> *It is my understanding that 50 water wells have been compromised in this area because of the turbines.*

A copy of the correspondence described above pertaining to the property owner's well interference complaint is provided herein as **Attachment A**.

2. REA Condition Response

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

TABLE 1: REA CONDITIONS AND RESPONSE SUMMARY

REA CONDITIONS	ACTION(S) TAKEN
G5. Should the Company receive a complaint about wells or well water from an owner of an active water well (i) within the Project Study Area; or (ii) outside of the Project Study area and located within 1 km from each individual Equipment and meteorological tower, the microwave tower, and the operations & maintenance building, the Company shall retain a qualified expert (P.Eng or P.Geo) to immediately undertake the following: (1) collect a water well sample at the complainant's water well, prior to any treatment systems ("raw"), after allowing the distribution system to flow for approximately 5 minutes and submit the water sample to a qualified laboratory for an analysis of the general chemistry suite of water quality parameters identified in Condition G3; (2) compare the results of the analysis of the water sample noted in Condition G5(1) to the pre-construction water sampling analysis results noted in Condition G3 for the subject well (if a pre-construction water sample at the subject well was taken); and, (3) provide a detailed written opinion as to whether the water sampling analysis results demonstrate that the construction, operation or decommissioning of the Facility caused or may have caused an adverse effect to the well's water supply.	Steps undertaken to satisfy the requirements of Condition G5 are summarized, as follows: (1) AECOM was retained by NKW1 to investigate a Well Interference Complaint received from MOECC at 1:50pm on 5-March-2018. (2) AECOM arranged directly with the property owners an appointment to visit the property at 1:00pm on 7-March-2018 (appointment based on property owner availability). (3) Tasks completed by AECOM during the well interference complaint site visit included: i) interview with the property owner regarding their reported well interference issue(s); ii) collection of a raw (untreated) groundwater sample for analytical laboratory testing; and, iii) digital photographs of pertinent site features (eg. well, pressurization and treatment system, etc.). (4) Information obtained during the site visit has been compiled and is summarized within this technical memorandum. An opinion regarding potential association of the well interference complaint with local operational activities as part of the NKW1 Project is provided and potential remedial options are presented, as appropriate.

2.1 Property Owner Statements Regarding Well Interference Complaint

During AECOM's 7-March-2018 complaint investigation site visit to the subject property, a series of seven (7) standard questions were raised with the property owner for the purposes of obtaining further details regarding the reported well water supply issue(s). Questions raised with the property owner during the site visit 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

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• 24-February-2018 @ 12:00pm – water has very fine material and appears cloudy. • 24-February-2018 @ 5:00pm – noticed increased material in water and slightly coarser grained. • Using well regularly for grey water needs until 25-February-2018. Toilet bowls and tanks filled with

	black sediment. • Switched to municipal water on 25-February-2018; was previously connected to municipal supply as a back-up to the primary well supply.
"What do you think is the cause?"	• Turbine operation or well pump screen.
"When did you first notice the problem (Date/Time)?"	• 24-February-2018 @ ~12:00pm.
"Is the problem still occurring?"	• Yes. • Tried the well on 7-March-2017 and appears worse. • Has been running the well every few days since 24-February-2018 but remains cloudy.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• Yes. • Municipal connection.
"Were you provided a temporary supply of potable water?"	• No.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• No. • No contact during baseline studies(1).

NOTE: 1. The subject property is located outside of the NKW1 Project Study Area and at a distance of greater than 1 km from individual equipment, microwave tower, and O&M building sites. As such, the subject property was not included as part of the MOECC-approved baseline Water Well Survey program for the NKW1 project.

Upon completion of the questionnaire, the property owner [redacted] provided an opportunity to review the responses detailed in **Table 2** to ensure their accuracy.

3. Operational Activities and Vibration Monitoring

3.1 Project Construction

No pile driving activities occurred within approximately a 3.5 month timeframe preceding the property owner's reported outset of well impact (24-February-2018), as foundation construction aspects of the NKW1 Project were completed at that time. The final pile installation for foundation construction as part of the NKW1 Project was completed on 8-November-2017 at turbine T34, located at a distance of approximately [redacted] northwest of the subject property.

The following three (3) turbines represent the closest foundation construction locations to [redacted]:

- T36 – last pile completed on 27-July-2017 @ [redacted] m Northwest
- T35 – last pile completed on 6-July-2017 @ [redacted] m Northeast
- T12 – last pile completed on 6-July-2017 @ [redacted] m North-Northeast

Construction timeframes, along with approximate directions and distances away from the subject property are provided above for reference purposes. As can be observed, pile driving at the turbine sites listed above was completed most recently in July 2017, approximately seven (7) months prior to the property owner's reported outset of well interference impact(s).

Considering the separation distances involved, timeline of foundation construction (pile driving) activities described above and reported outset of well interference at the subject property (24-February-2018), it is our opinion that the reported impact(s) at the subject well are not related to

NKW1 project construction (pile driving). As such, potential construction-related effects are not evaluated further in this assessment.

3.2 Project Commissioning / Operation

According to Golder Associates Limited (GAL), all turbines with the exception of T41 were in operation at the time of the property owner's reported outset of well impact on 24-February-2018. Turbine T36, located approximately [redacted] m to the northwest, represents the closest operating location to the subject property.

To assess the potential for vibration impact(s) at the site well as a result of NKW1 Project commissioning activities, a site-specific vibration assessment was completed by GAL, the results of which are presented in a technical letter, dated 15-May-2018. The conclusions of GAL's site-specific assessment are summarized, as follows:

> *Based on the measured rock vibration magnitudes associated with multiple operational turbines, it is our opinion that the reported well conditions are unrelated to turbine operations. Vibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and large separation distances. The vibrations measured at all in-rock sensors at the mock wells were two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s), one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz) and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s).*

A copy of GAL's site-specific vibration assessment letter is provided herein as **Attachment B**.

4. Well Construction Details

Table 3 provides a summary of available construction details for the existing private water well at [redacted], based on details provided by the property owner during AECOM's well interference complaint site visit on 7-March-2018.

A review of the MOECC on-line database has revealed a water well record (WWR) for the subject property (MOECC ID [redacted]) that is consistent with the observed well location and date of installation reported by the property owner (1990). Relevant information obtained from the MOECC WWR also is included in **Table 3** for completeness.

Two (2) additional WWR's were located for the subject property within the MOECC database for installations that were completed (via cable tool) within a period of one (1) week prior to construction of the property owner's current water well. These wells, being located in the northeast (MOECC ID [redacted]) and southwest (MOECC ID [redacted]) components of the subject property, respectively, were both abandoned by the water well contractor due to "insufficient supply" from within the shale bedrock. A copy of each MOECC WWR described above (3 in total) is provided herein as **Attachment C**.

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	[redacted]
Well Tag #	[redacted]
Well ID	[redacted]

DETAILS	[redacted]
Installation Date	7-December-1990
Well Location	Rear Yard (Northwest of Residence; Adjacent to a Dog Kennel)
Contractor	Earl Rumble & Sons
Contractor No.	4604
Construction Method	Cable Tool
Total Depth	30.5 mBGS (100')
Water Found Depth	20.7 m to 22.9 mBGS (68-75')
Target Water-Bearing Formation	Black Shale (Layered – Hard)
Casing Length	20.4 mBGS (67')
Casing Diameter	127 mm (5")
Casing Material	Steel
Casing Stick-Up	0.50 m (as measured by AECOM)
Annular Seal	None Indicated
Sealant Type	None Indicated
Well Screen Installed?	No (Open Hole within Bedrock)
Well Screen Details	Not Applicable
Well Screen Interval	Not Applicable
Well Cover Type	Metallic Vermin-Proof
Pump Intake Depth	26.8 mBGS (88') as reported on WWR (unconfirmed)
Pumping Rate	9.5 L/min (2.5 USgpm) recommended on WWR (determined via pumping over 1-hour) 9.4 L/min (2.5 USgpm) as measured by AECOM on 7-March-2018 (average of 3 separate flow rate measurements)
Water Appearance at End of Test	Cloudy, as on WWR ** Cautionary note on WWR that a "*small amount of natural gas in waterbearing formation*" was detected by the contractor **
Well Pump Type	Submersible
Well Pump Size	½ hp as on Pump Control Box
Static Level	5.5 mBGS (18') as on WWR
Pumping Level	16.8 mBGS (55') as on WWR

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

Visual assessment of the water well at surface did not reveal any apparent concerns regarding its condition. A photograph of the well is provided as **Photo 1**.

4.1 Limited Well Flow Rate Testing and Pumping System Assessment

During AECOM's well interference complaint investigation site visit on 7-March-2018, a limited flow rate test was completed to assess the current pumping capacity of the submersible pump (½ hp) connected to the subject well. Testing was completed using a garden hose (supplied and installed by

the property owner) connected to the plumbing system for the well pump at a location immediately downstream of the pressure tank in the basement of the residence (**Photo 2**).



PHOTO 1: Water Well (as on 7-March-2018)

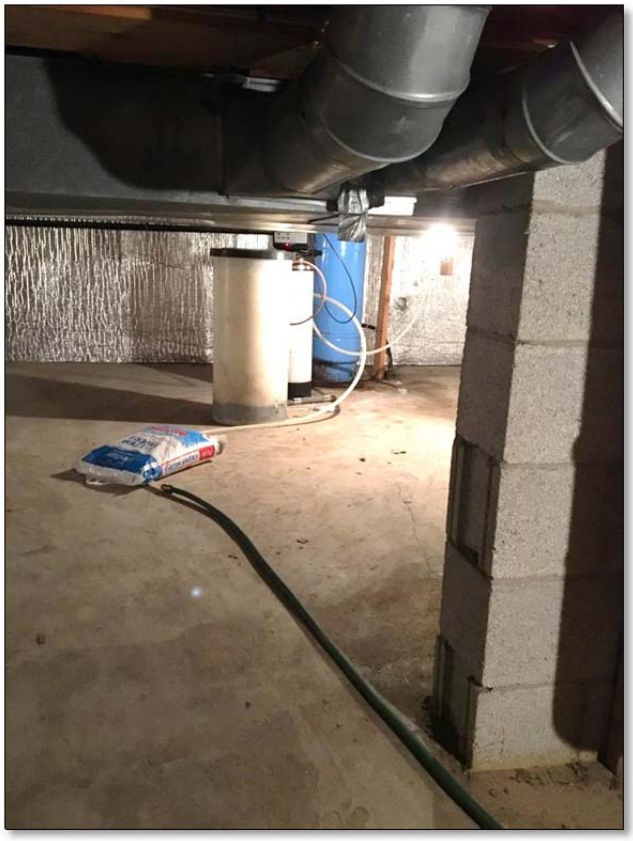


PHOTO 2: Sampling and Flow Rate Testing Location (as on 7-March-2018)

For the test, the submersible well pump was permitted to operate continuously for a period of approximately seventeen (17) minutes. During pumping, the discharge rate was assessed by AECOM on four (4) separate occasions. Flow rate measurement was completed by timing the collection of 12 L of water into a calibrated pail. Discharge from the hose was directed to the ground outside of the residence's attached garage structure.

Results obtained for the initial flow measurement completed within the first three (3) minutes of continuous pumping indicated an instantaneous rate of approximately 28.6 L/min (7.5 USgpm); whereas an average flow rate of 9.4 L/min (2.5 USgpm) was realized during the latter three (3) monitoring events. Comparatively, the MOECC record for the well denotes a recommended pumping rate of approximately 9.5 L/min (2.5 USgpm) with the pump inlet positioned within the open hole (bedrock) component of the well at a depth of approximately 26.8 mBGS (88'). Based on the results obtained, it would appear that the initial measurement may have been affected by system pressure existing at the test outset, which was noted as being approximately 483 kPa (70 psi) at a dial gauge installed at the pressure tank. Between about 0.25 and 2.5 minutes of continuous pumping, the system pressure fluctuated between approximately 207 and 345 kPa (30 and 50 psi). Beyond 3 minutes of continuous pumping, and through to test completion at 17 minutes, the system pressure remained relatively stable at about 69 to 83 kPa (10 to 12 psi).

Groundwater pumped from the well during the test was observed to be slightly turbid (cloudy), possess a faint brown / tan discolouration and contain a trace amount of sediment. Small gas bubbles also were observed to collect within the calibrated pail, as well as within the water quality bottles during sample collection, being consistent with observations made by the drilling contractor at the time of well construction. No apparent odours were observed in the pumped water.

5. Water Quality Data

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

TABLE 4: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	7-March-2018	Raw (Untreated)	Complaint Investigation

The subject property was not included as part of the *Baseline Water Well Survey and Assessment* program for the NKW1 Project due to its location being outside of the established survey area that was approved by MOECC. As a result, a baseline raw (untreated) groundwater quality sample was not obtained for this well.

5.1 Discussion

Available raw (untreated) groundwater quality data for the site well is provided in **Table 5**, which includes analysis results from AECOM's 7-March-2018 site visit pertaining to the property owner's current interference complaint. As noted previously, due to the subject property's location being outside of the NKW1 Project Study Area and at a distance of greater than [redacted] from individual equipment, microwave tower, and O&M building sites, it was not included as part of the MOECC-approved Baseline Water Well Survey program for the NKW1 project. As such, no baseline water quality data for the subject well is available.

During AECOM's 7-March-2018 complaint investigation site visit, a water softener was observed to be installed within the basement of the residence (ref. **Photo 2**). The treatment unit was not connected to the well supply at the time of our site visit as the property owner had disconnected the

piping upstream to facilitate completion of AECOM's testing and sampling work. The age and functional condition of the water softener is unconfirmed.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	COMPLAINT INVESTIGATION (7-March-2018)
Escherichia coli	0 CFU/100mL	MAC	**NDOGN**
Total Coliforms	0 CFU/100mL	MAC	**NDOGN**
Electrical Conductivity	--	--	1,220 µS/cm
pH	6.5 – 8.5	OG	**8.55**
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	**41.2 mg/L**
Total Dissolved Solids	500 mg/L	AO	**800 mg/L**
Total Suspended Solids	--	--	30 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	**601 mg/L**
Fluoride	1.5	MAC	0.59 mg/L
Chloride	250	AO	133 mg/L
Nitrate as N	10	MAC	<0.05 mg/L
Nitrite as N	1	MAC	<0.05 mg/L
Bromide	--	--	0.59 mg/L
Sulphate	500 mg/L	AO	<0.50 mg/L
Ammonia as N	--	--	0.19 mg/L
Dissolved Organic Carbon	5 mg/L	AO	1.2 mg/L
Colour	5 TCU	AO	**204 TCU**
Turbidity	5 NTU	AO	**38.6 NTU**
Calcium	--	--	10.2 mg/L
Magnesium	--	--	3.82 mg/L
Sodium	200 mg/L	AO	**286 mg/L**
Potassium	--	--	2.25 mg/L
Iron	0.300 mg/L	AO	**0.620 mg/L**
Manganese	0.050 mg/L	AO	0.014 mg/L

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); Operational Guideline (non health-related), NDOGN – No Data; Overgrown with Non-Target (refers to over-crowding microbial growth).

Raw (untreated) groundwater sample collection during AECOM's 7-March-2018 site visit was completed using the same hose assembly that was used for flow rate testing. Prior to sample collection, the hose orifice was disinfected (using chlorine) and flushed. Clean nitrile gloves were worn by AECOM staff during sample collection.

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

At the time of sampling on 7-March-2018, the raw (untreated) groundwater was observed to be slightly turbid (cloudy) and possessed a faint brown / tan discolouration. Upon closer inspection of the sample bottles, the cloudiness was observed to be the result, in part, of tiny gas bubbles. This observation is consistent with a cautionary note made by the drilling contractor on the MOECC record for the well wherein a *small amount of natural gas in waterbearing formation* was identified. The groundwater did not possess any apparent odour and contained a trace amount of sediment. A photograph of the water quality sample collected by AECOM for laboratory testing on 7-March-2018 is shown in **Photo 3.**



PHOTO 3: Water Quality Sample Clarity (as on 7-March-2018)

With the notable exception of bacteriological overgrowth (potentially containing E.coli and/or total coliforms) in the 7-March-2018 complaint investigation raw (untreated) groundwater sample, no other exceedances of health-related parameters analyzed, including Nitrate (as N), Nitrite (as N), and fluoride, were detected in the raw (untreated) groundwater sample collected from the well supply.

The water quality sampling results indicated a hardness level that is relatively 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 groundwater can result in the accelerated corrosion of water pipes, appliances, and other metallic fixtures and components.

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, a turbidity level of 38.6 NTU was reported by the laboratory for the raw (untreated) groundwater sample collected on 7-March-2018; being above the ODWQS AO limit for this parameter.

The concentration of iron in the raw (untreated) groundwater available from the site well was determined to be in excess of its AO limit in the sample collected by AECOM on 7-March-2018. Elevated concentrations of iron can impart a brownish discolouration to water (including staining of fixtures and laundry) and can also result in an undesirable taste during consumption. It is surmised that the elevated concentrations of iron in the sample is of a natural (non-anthropogenic) source.

Where elevated iron concentrations occur in well water, the presence of iron-related bacteria (IRB) is not uncommon. IRB combine iron (as well as manganese, where present) with oxygen as part of their metabolic processes to form visible 'rust' deposits / stains (eg., yellow, orange, red or brown) that are typically associated with a greasy or slimy texture. Various foul odours may also be associated with the presence of IRB within a well water system (eg. rotten egg, swampy, sewage-like, etc.). The 'slime' will tend stick to fixtures and water system components, including filter elements, pump foot valve assemblies, and well screens, which can result in flow restrictions over time. While not assessed as part of this investigation, IRB may potentially be present within the site well which could affect sample results, most notably turbidity. Although being a nuisance, there is no documented health risk associated with IRB, if present, and can be managed through treatment combined with regular maintenance disinfection of the well supply.

pH is an OG of the ODWQS and a water quality parameter that provides an indication of its acidity. In this regard, an operational range of 6.5 to 8.5 is provided within the ODWQS to serve as a balance between corrosion and incrustation. Where pH levels exceed 8.5, mineral incrustations (scaling) may potentially occur and water may possess a bitter taste during consumption.

Total Dissolved Solids (TDS) is a measure of the amount of inorganic substances that are dissolved within groundwater. The ODWQS specifies an AO for TDS of 500 mg/L, so as to address potential issues relating to mineral deposition / incrustation, corrosion and/or undesirable taste / palatability. The concentration of TDS within the raw (untreated) groundwater sample obtained from the site well on 7-March-2018 exceeded the AO limit with a measured concentration of 800 mg/L.

Total suspended solids (TSS) levels within the 7-March-2018 complaint investigation raw groundwater sample was reported at 30 mg/L, indicating the presence of a detectable sediment load in the raw (untreated) groundwater pumped from the well. An ODWQS criteria limit has not been established for this parameter.

The MOECC record for the well does not indicate that sealing of the annular space along the exterior of the well casing was completed by the contractor at the time the well was constructed. A lack of annular sealing can permit the migration of shallow water (eg. runoff, snowmelt, etc.) and/or contaminates (including bacteria, sediment, etc.) into a well from the near surface. The detection of bacteriological overgrowth (possibly including total coliforms) within the on-site well supply, as presented in **Table 5**, tends to support the potential for shallow water impact, possibly as a result of annular leakage. It is noted that sealing of the annular space is a current requirement for well construction in accordance with Section 14.4(2) of Ontario Regulation 903 ('Wells'), as amended, made under the Ontario Water Resources Act (R.S.O. 1990), which states (**bold** added for emphasis as it applies to the current unscreened bedrock well):

> *(2) If a new well is constructed by any method, other than a method described in section 14.1, 14.2 or 14.3 or by the use of a jetted point, the person constructing the well shall comply with section 14 by ensuring that the following rules are complied with:*
>
> *1. If a well screen is installed,*

i. the annular space shall be filled, from the bottom of the well to at least the top of the well screen with clean, washed gravel or sand that is,

A. deposited during or after placement of the well screen and casing, or

B. developed, after placement of the sealant referred to in subparagraph ii, by surging water through the well screen to remove the adjacent fine grained soils, and

ii. any remaining annular space shall be filled with suitable sealant, upward from the top of the gravel or sand referred to in subparagraph i to the ground surface.

2. If no well screen is installed, the annular space shall be filled with suitable sealant from the bottom of the casing upward to the ground surface.

3. The top of the gravel or sand referred to in paragraph 1 shall not be closer than six metres to the ground surface, unless the only useful aquifer available necessitates a shallower well, in which case the top of the gravel or sand shall not be closer than 2.5 metres to the ground surface.

4. The sealant referred to in paragraphs 1 and 2 shall be continuously deposited by forcing sealant through a tremie pipe, with the bottom end of the pipe immersed in the rising accumulation of sealant.

5. If the sealant referred to in paragraphs 1 and 2 contains cement,

i. it shall be allowed to set according to the manufacturer's specifications or for 12 hours, whichever is longer, and

ii. if, after setting in accordance with subparagraph i, the sealant has settled or subsided, it shall be topped up to the original level. O. Reg. 372/07, s. 15

The potential for groundwater quality impact(s) associated with turbine operations is time-dependent and related to the intensity, propagation and duration of any ground-borne vibration. In this regard, all turbines with the exception of T41, were in operation at the time of the property owner's reported outset of well impact on 24-February-2018 (T36 representing the closest location at a distance of approximately [redacted] m to the northwest). As previously discussed in Section 3, the results of a site-specific vibration assessment completed by GAL (2018) indicated that "v*ibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and large separation distances"*.

As an alternate consideration, to have the potential to impact the subject well, vibration impacts in the immediate vicinity of an operating turbine would have needed to result in: i) the suspension of settled particles within the groundwater system; ii) the particles remaining in suspension for a prolonged period of time; and, iii) the water well being situated in a position hydraulically downgradient of and/or within the radius of pumping influence relative to the operating turbine location(s). Factors (ii) and (iii) above are not considered plausible in the context of the local hydrogeological setting (ie. separation distance, potential hydraulic gradient and groundwater travel times), the vibration assessment completed by GAL, and current investigation results.

6. Conclusions

Based on a review and interpretation of information gathered during AECOM's well interference complaint investigation, as presented herein, it is our opinion that the groundwater quality issue(s) reported by the property owner at [redacted] are *not* as a result of NKW1 turbine operations.

The water quality interference reported by the property owner appears to be related primarily to local natural groundwater quality from within the shale bedrock, potentially coupled with water pumping system and/or well construction / condition issues versus an area-wide impact to the local groundwater system. It is recommended that the property owner consult with a qualified water well contractor regarding the current condition and configuration of their on-site well supply and pumping system.

It is further recommended that the property owner seek the guidance of MOECC, the local Public Health Unit, and/or an experienced water treatment specialist to confirm / address the elevated levels of bacteria (health-related parameters) detected during recent sampling of the water well.

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

-- End of Memorandum --

Attachments

Attachment A

Correspondence

From: Jacobs, Deb (MOECC) [mailto:deb.jacobs@ontario.ca]
Sent: Monday, March 05, 2018 1:50 PM
To: Jonathan Miranda; John O'Neill; zzJoshua Vaidhyan
Subject: Fw: Water Well on Pioneer Line Chatham Ontario

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: [redacted]
Sent: Monday, March 5, 2018 2:17 AM
To: Harman, Bruce (MOECC); Jacobs, Deb (MOECC)
Subject: Water Well on [redacted] Chatham Ontario

February 24, 2018

Bruce Harman, Senior Hydrogeologist MOECC

Deb Jacobs MOECC Provincial Officer

I would like to inform the Ministry of the Environment and Climate Change that on Saturday February 24, 2018, my water well went cloudy at 12 noon and around 5 p.m. it was black with a lot of sediment.

I am aware that the Ministry of the Environment gave permission to the North Kent Wind farm to commence operations on February 21, 2018.

I am experiencing interference with my well water from the operating turbines of the North Kent Wind farm. I drilled my water well in 1991 and have never had an issue with my water.

I request the ministry to contact North Kent Wind farm to make arrangements to test and collect water and sediment samples of my well water.

I give the Ministry permission to come onto my property to take water samples and test for sediments, also the MOECC to take sediment samples for identification in order to determine if the sediments pose any acute or chronic health risks.

The sediments releasing in my well are so great that the water flow to our house is non-existent. I am forced to use an alternate water supply.

It is my understanding that 50 water wells have been compromised in this area because of the turbines.

Yours truly,

[redacted]

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

May 15, 2018 Project No. 1668031-4000-L02

Mr. Jonathan Miranda, Facility Manager
North Kent Wind 1 LP
Operations & Maintenance Building
9525 Eberts Line
Chatham ON, N7M 5J2

WATER WELL COMPLAINT [redacted]
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Miranda:

This letter is provided to address vibration concerns associated with [redacted] dated March 5, 2018, related to the well located at [redacted] in Chatham-Kent, Ontario. Golder understands that the resident reported problems with the well on March 5, 2018. During the time period of the observed well problems and date of the complaint, all turbines except T41 were in operation. The closest of these was turbine T36, located approximately [redacted] (m) from the residence.

In accordance with the approved long-term vibration monitoring program, an instrumented mock well with sensors grouted into the bedrock was constructed at each of the turbine locations T23, T41 and T51. Installation was completed on December 21 and 22, 2017. All accelerometers were calibrated by the manufacturers, tested in Golder's office using a controlled vibration source and validated during installation. The mock wells were located at distances of [redacted] from the T23, T41 and T51 turbines, based on surveys completed following their installation. The instruments at the T51 mock well are also within [redacted] of turbine T19, which forms a small two-turbine cluster at this location where the turbines are separated by about [redacted]

During the period leading up to the date of the well interference complaint for [redacted] T41 was not in operation. Therefore, all other data available for the in-rock mock well accelerometers for T23, T41 and T51 for periods during which these turbines, as well as turbine T19, were operating and not operating were used as a basis for evaluating the vibration magnitudes that would be expected at the [redacted] well location. The nearest operating turbine was T36, at a distance of [redacted]. The maximum wind speed on March 4th, 2018 was approximately 10.4 metres per second (m/s) and the maximum power output for the individual turbines during this time period was approximately 2,670 kilowatts (kW).

Available data was examined for the period of December 22, 2017 through to 12:00 am, April 4, 2018 when the turbines were and were not operating. Operational and meteorological data were also reviewed for the 42-day period from February 21, 2018 through April 3, 2018, during which time the 33 turbines were regularly operating

CANADA'S BEST MANAGED COMPANIES Platinum member

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

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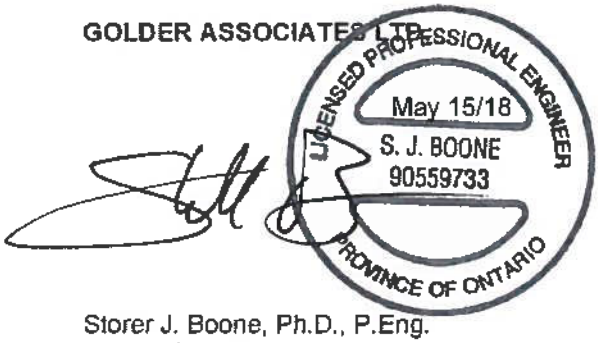
simultaneously. For comparison to the date of the complaint, data associated with a wind speed of approximately 16.7 m/s was recorded on March 31, 2018 and a maximum power generation from the individual turbines of approximately 3,200 kW was recorded on March 8, 2018, noting that the power output maximum does not necessarily increase linearly with wind speed. In all cases, whether the turbines were or were not operating, persistent or repeating vibrations (i.e., exclusive of transient vibrations or other external influences[1]) measured during the non-operational (i.e., "quiet"), commissioning and operational time periods were all of magnitudes less than $2x10^{-3}$ millimetres per second (mm/s) at frequencies of 1 Hertz (Hz) or more. All turbines at the mock well sites were operating, thus the data also represents the effects from a cluster of simultaneously operating turbines at distances ranging from about [redacted] The power and wind speed events during the period for which operational data is available at the mock well turbine locations is also directly comparable to the conditions associated with the well interference complaint.

Based on the measured rock vibration magnitudes associated with multiple operational turbines, it is our opinion that the reported well conditions are unrelated to turbine operations. Vibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and large separation distances. The vibrations measured at all in-rock sensors at the mock wells were two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s)[2], one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz)[3] and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s)[4].

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

JK/SJB/MAS/cr

CC: J. Vaidyan, Samsung

[redacted]

[1] Transient vibration sources can include vehicles entering the site and passing the instrumentation (e.g., repairs to turbine T41, access road snow plowing), municipal road traffic, equipment owned by the farm site operating within the detection range of the instruments, pedestrian traffic and personnel movements near the instruments (i.e., during instrument checks and maintenance and data collection). Further, data artefacts caused by electrical voltage perturbations were excluded from the data. Such perturbations can be associated with manual changing of primary and backup batteries, solar power voltage regulators, electrical ground loops, and temporary loss of battery power (primary and backup) during long periods of inclement weather and darkness.

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

[3] 2007 ASHRAE Handbook—HVAC Applications (SI), American Society of Heating, Refrigerating and Air-Conditioning Engineers, threshold for nighttime acceptable levels.

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

Attachment C

MOECC Water Well Record

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

[redacted]

MUNICIP 3,30,02 CON. CON 104

COUNTY OR DISTRICT [redacted] TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE [redacted]tham

CON. BL[redacted] CT, SURVEY ETC

LOT [redacted]

Ontario

DATE COMPLETED DAY 7 MO 12 YR 90

BASIN CODE

21

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	TOP SOIL		LOOSE	0	1
BROWN	CLAY	SAND	PACKED	1	7
GREY	CLAY	SAND	MIXED	7	10
GREY	CLAY		DENSE	10	64
BLACK	GRAVEL	CLAY	CEMENTED	64	66½
BLACK	SHALE		LAYERD-HARD	66½	75
BLACK	SHALE		HARD	75	100

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
68-75	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.180	+2	67
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		67	100
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE: 3 GPM

DURATION OF PUMPING: 1 HOURS 0 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☐ PUMPING 2 ☒ RECOVERY) 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
18 FEET	55 FEET	43 FEET	36 FEET	32 FEET	28 FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: 88 FEET

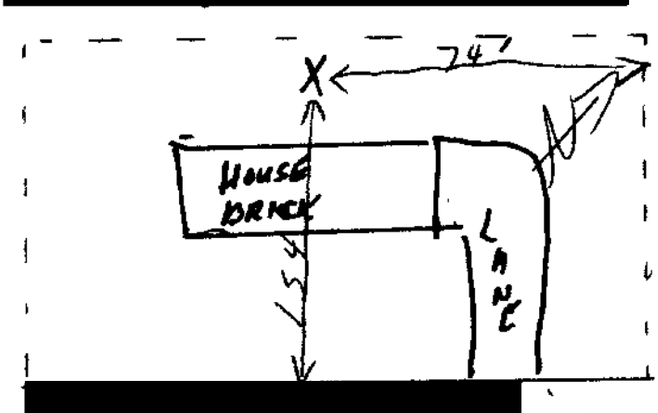
WATER AT END OF TEST: 1 ☐ CLEAR 2 ☒ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 88 FEET

RECOMMENDED PUMPING RATE: 2½ GPM

[redacted]



CAUTION: SMALL AMOUNT NATURAL GAS IN WATERBEARING FORMATION

85247

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED INSUFFICIENT SUPPLY 6 ☐ ABANDONED POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Earl Rumble + Sons

WELL CONTRACTOR'S LICENCE NUMBER: 4604

ADDRESS: Rural Route 5 Blenheim Ont.

NAME OF WELL TECHNICIAN: Garnet Rumble

WELL TECHNICIAN'S LICENCE NUMBER: T-0066

SIGNATURE OF TECHNICIAN/CONTRACTOR: Garnet Rumble

SUBMISSION DATE: DAY 11 MO 12 YR 90

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 4604 | DATE RECEIVED FEB 19 1991

DATE OF INSPECTION | INSPECTOR

REMARKS

FORM NO. 0506 (11/86) FORM 9

MINISTRY OF THE ENVIRONMENT COPY

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

[redacted]

MUNICIP 33002 CON. CON. 10A

COUNTY OR DISTRICT [redacted] TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE Chatham CON. [redacted] SURVEY ETC LOT [redacted]

[redacted] Ontario DATE COMPLETED DAY 5 MO 12 YR 90

99710 590 BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BROWN	TOP SOIL		LOOSE	0	1
BROWN	SAND	CLAY	PACKED	1	5
GREY	CLAY	SAND	LOOSE	5	9
GREY	CLAY		DENSE	9	65
BLACK	GRAVEL	CLAY	CEMENTED	65	67
BLACK	SHALE		HARD	67	96
	CASING PULLED				

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
67	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	67
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		67	96
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE (S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD 1 ☐ PUMP 2 ☐ BAILER | PUMPING RATE GPM | DURATION OF PUMPING HOURS MINS

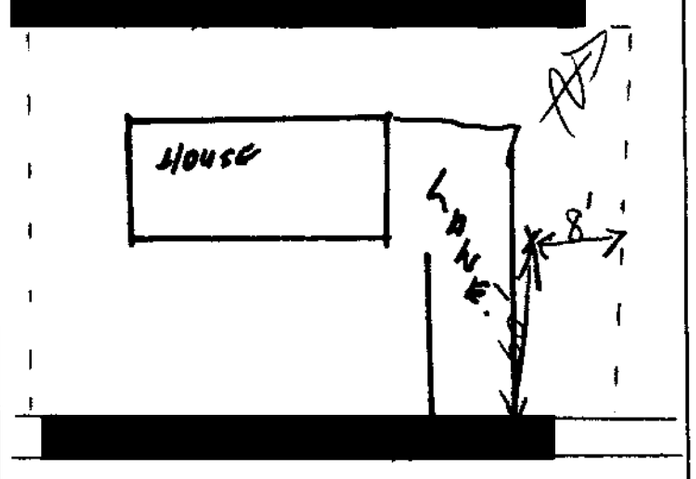
STATIC LEVEL FEET	WATER LEVEL END OF PUMPING FEET	WATER LEVELS DURING 1 ☐ PUMPING 2 ☐ RECOVERY	15 MINUTES FEET	30 MINUTES FEET	45 MINUTES FEET	60 MINUTES FEET

IF FLOWING, GIVE RATE GPM | PUMP INTAKE SET AT FEET | WATER AT END OF TEST 1 ☐ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE ☐ SHALLOW ☐ DEEP | RECOMMENDED PUMP SETTING FEET | RECOMMENDED PUMPING RATE GPM

LOCATION OF WELL

[redacted]



[redacted]

85250

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☐ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☒ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Earl Rumble & Sons | WELL CONTRACTOR'S LICENCE NUMBER: 4604

ADDRESS: Rural Route 5 Blenheim, Ont.

NAME OF WELL TECHNICIAN: Garnet Rumble | WELL TECHNICIAN'S LICENCE NUMBER: X-0066

SIGNATURE OF TECHNICIAN/CONTRACTOR: Garnet Rumble | SUBMISSION DATE DAY 11 MO 12 YR 90

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 4604 | DATE RECEIVED FEB 19 1991

DATE OF INSPECTION | INSPECTOR

REMARKS: CSS.88

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Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK [X] CORRECT BOX WHERE APPLICABLE

11

[redacted]

MUNICIP 33002 CON. CON 04

COUNTY OR DISTRICT [redacted]

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE Chatham

CON. BLOCK, TRACT, SURVEY, ETC. —

LOT [redacted]

[redacted] Ontario

DATE COMPLETED DAY 30 MO 11 YR 90

[redacted] 9 9732 ELEVATION 590

21

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BROWN	TOP SOIL		LOOSE	0	1
BROWN	SAND	CLAY	PACKED	1	8
GREY	SAND	CLAY	LOOSE	8	12
GREY	CLAY		DENSE	12	64
BLACK	GRAVEL	CLAY	CEMENTED	64	65
BLACK	SHALE		HARD	65	86

CASING PULLED

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
65	1 [X] FRESH 2 [ ] SALTY 3 [ ] SULPHUR 4 [ ] MINERALS 6 [ ] GAS
	1 [ ] FRESH 2 [ ] SALTY 3 [ ] SULPHUR 4 [ ] MINERALS 6 [ ] GAS
	1 [ ] FRESH 2 [ ] SALTY 3 [ ] SULPHUR 4 [ ] MINERALS 6 [ ] GAS
	1 [ ] FRESH 2 [ ] SALTY 3 [ ] SULPHUR 4 [ ] MINERALS 6 [ ] GAS
	1 [ ] FRESH 2 [ ] SALTY 3 [ ] SULPHUR 4 [ ] MINERALS 6 [ ] GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
5	1 [X] STEEL 2 [ ] GALVANIZED 3 [ ] CONCRETE 4 [ ] OPEN HOLE 5 [ ] PLASTIC	.188	0	65
5	1 [ ] STEEL 2 [ ] GALVANIZED 3 [ ] CONCRETE 4 [X] OPEN HOLE 5 [ ] PLASTIC		65	85
	1 [ ] STEEL 2 [ ] GALVANIZED 3 [ ] CONCRETE 4 [ ] OPEN HOLE 5 [ ] PLASTIC			

SCREEN

SIZE SI OF OPENING - SLOT NO. | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD 1 [ ] PUMP 2 [ ] BAILER

PUMPING RATE GPM

DURATION OF PUMPING HOURS MINS

STATIC LEVEL FEET

WATER LEVEL END OF PUMPING FEET

WATER LEVELS DURING 1 [ ] PUMPING 2 [ ] RECOVERY

15 MINUTES FEET | 30 MINUTES FEET | 45 MINUTES FEET | 60 MINUTES FEET

IF FLOWING GIVE RATE GPM

PUMP INTAKE SET AT FEET

WATER AT END OF TEST 1 [ ] CLEAR 2 [ ] CLOUDY

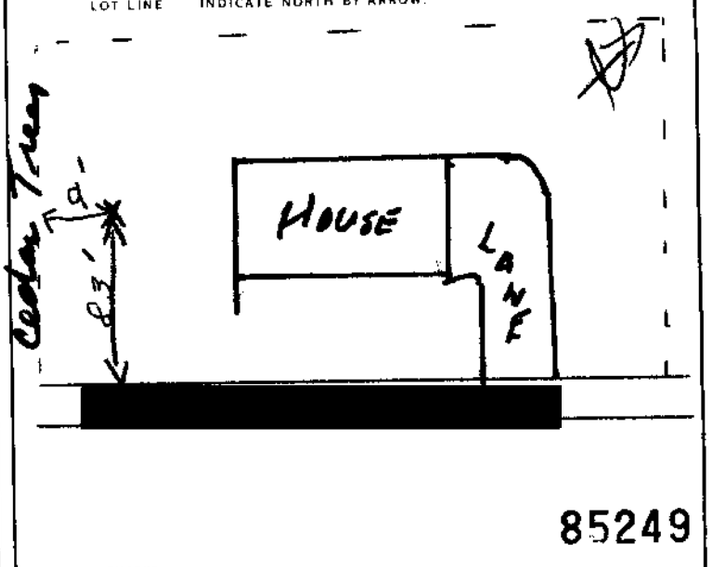
RECOMMENDED PUMP TYPE [ ] SHALLOW [ ] DEEP

RECOMMENDED PUMP SETTING FEET

RECOMMENDED PUMPING RATE GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



85249

DRILLERS REMARKS

FINAL STATUS OF WELL

1 [ ] WATER SUPPLY 2 [ ] OBSERVATION WELL 3 [ ] TEST HOLE 4 [ ] RECHARGE WELL 5 [X] ABANDONED INSUFFICIENT SUPPLY 6 [ ] ABANDONED POOR QUALITY 7 [ ] UNFINISHED [ ] DEWATERING

WATER USE

1 [X] DOMESTIC 2 [ ] STOCK 3 [ ] IRRIGATION 4 [ ] INDUSTRIAL [ ] OTHER 5 [ ] COMMERCIAL 6 [ ] MUNICIPAL 7 [ ] PUBLIC SUPPLY 8 [ ] COOLING OR AIR CONDITIONING 9 [ ] NOT USED

METHOD OF CONSTRUCTION

1 [X] CABLE TOOL 2 [ ] ROTARY (CONVENTIONAL) 3 [ ] ROTARY (REVERSE) 4 [ ] ROTARY (AIR) 5 [ ] AIR PERCUSSION 6 [ ] BORING 7 [ ] DIAMOND 8 [ ] JETTING 9 [ ] DRIVING [ ] DIGGING [ ] OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Earl Rumble & Sons — WELL CONTRACTOR'S LICENCE NUMBER: 4604

ADDRESS: Rural Route 5 Blenheim Ont.

NAME OF WELL TECHNICIAN: Garnet Rumble — WELL TECHNICIAN'S LICENCE NUMBER: T-0066

SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature] — SUBMISSION DATE: DAY 11 MO. 12 YR. 90

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR 4604 — DATE RECEIVED FEB 19 1991

DATE OF INSPECTION — INSPECTOR

REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

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**
5080 COMMERCE BLVD
MISSISSAUGA, ON L4W4P2
(905) 238-0007

ATTENTION TO: **Jason Murchison**

PROJECT: **60343599**

AGAT WORK ORDER: **18T318124**

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

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

DATE REPORTED: **Mar 15, 2018**

PAGES (INCLUDING COVER): **8**

VERSION*: **1**

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

*NOTES

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

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

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

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

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Microbiological Analysis (water)

DATE RECEIVED: 2018-03-08

DATE REPORTED: 2018-03-15

				SAMPLE DESCRIPTION:	[redacted]
				SAMPLE TYPE:	Water
				DATE SAMPLED:	2018-03-07
Parameter	Unit	G / S	RDL	9108677	
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 ON 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.

9108677 NDOGN – No Data; Overgrown with nontarget, refers to over-crowding microbial growth;

Certified By:

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

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Jason Murchison

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2018-03-08

DATE REPORTED: 2018-03-15

			SAMPLE DESCRIPTION:		[redacted]
			SAMPLE TYPE:		Water
			DATE SAMPLED:		2018-03-07
Parameter	Unit	G / S: A	G / S: B	RDL	9108677
Electrical Conductivity	uS/cm			2	1220
pH	pH Units		6.5-8.5	NA	8.55
Total Hardness (as CaCO3)	mg/L		80-100	0.5	41.2
Total Dissolved Solids	mg/L		500	20	800[>B]
Total Suspended Solids	mg/L			10	30
Alkalinity (as CaCO3)	mg/L		30-500	5	601
Fluoride	mg/L	1.5		0.05	0.59[<A]
Chloride	mg/L		250	0.50	133[<B]
Nitrate as N	mg/L	10.0		0.05	<0.05[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]
Bromide	mg/L			0.05	0.59
Sulphate	mg/L		500	0.50	<0.50[<B]
Ammonia as N	mg/L			0.02	0.19
Dissolved Organic Carbon	mg/L		5	0.5	1.2[<B]
Colour	Apparent CU		5	5	204[>B]
Turbidity	NTU		5	0.5	38.6[>B]
Calcium	mg/L			0.10	10.2
Magnesium	mg/L			0.10	3.82
Sodium	mg/L	20	200	0.10	286[>B]
Potassium	mg/L			0.10	2.25
Iron	mg/L		0.3	0.010	0.620[>B]
Manganese	mg/L		0.05	0.002	0.014[<B]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
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.

9108677 Elevated RDLs indicate the degree of sample dilutions prior to analysis in order to keep the analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

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

AGAT Laboratories

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Guideline Violation

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Mar 15, 2018			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
North Kent - Microbiological Analysis (water)															
Escherichia coli	9108677	9108677	NDOGN	NDOGN	NA	< 1									
Total Coliforms	9108677	9108677	NDOGN	NDOGN	NA	< 1									

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

Certified By:

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

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SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Mar 15, 2018			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	9112148		1730	1740	0.6%	< 2	105%	80%	120%	NA			NA		
pH	9112148		8.05	8.05	0.0%	NA	99%	90%	110%	NA			NA		
Total Dissolved Solids	9108677	9108677	800	802	0.2%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	9104739		94	90	4.3%	< 10	102%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	9112148		217	222	2.3%	< 5	111%	80%	120%	NA			NA		
Fluoride	9112331		<0.05	<0.05	NA	< 0.05	99%	90%	110%	100%	90%	110%	95%	80%	120%
Chloride	9112331		11.3	11.3	0.0%	< 0.10	90%	90%	110%	106%	90%	110%	105%	80%	120%
Nitrate as N	9112331		0.12	0.12	NA	< 0.05	92%	90%	110%	101%	90%	110%	94%	80%	120%
Nitrite as N	9112331		<0.05	<0.05	NA	< 0.05	NA	90%	110%	101%	90%	110%	95%	80%	120%
Bromide	9112331		<0.05	<0.05	NA	< 0.05	102%	90%	110%	106%	90%	110%	96%	80%	120%
Sulphate	9112331		24.8	24.8	0.0%	< 0.10	91%	90%	110%	102%	90%	110%	95%	80%	120%
Ammonia as N	9108632		<0.02	<0.02	NA	< 0.02	106%	90%	110%	102%	90%	110%	92%	80%	120%
Dissolved Organic Carbon	9108677	9108677	1.2	1.4	NA	< 0.5	93%	90%	110%	98%	90%	110%	100%	80%	120%
Colour	9108677	9108677	204	203	0.5%	< 5	107%	90%	110%	NA			NA		
Turbidity	9108677	9108677	38.6	38.9	0.8%	< 0.5	100%	90%	110%	NA			NA		
Calcium	9112222		161	155	3.8%	< 0.05	106%	90%	110%	104%	90%	110%	97%	70%	130%
Magnesium	9112222		66.4	64.6	2.7%	< 0.05	101%	90%	110%	100%	90%	110%	91%	70%	130%
Sodium	9112222		847	815	3.9%	< 0.05	99%	90%	110%	98%	90%	110%	85%	70%	130%
Potassium	9112222		8.91	8.73	2.0%	< 0.05	100%	90%	110%	98%	90%	110%	94%	70%	130%
Iron	9107612		<0.010	<0.010	NA	< 0.010	101%	90%	110%	103%	90%	110%	87%	70%	130%
Manganese	9107612		<0.002	<0.002	NA	< 0.002	105%	90%	110%	107%	90%	110%	102%	70%	130%

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

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T318124

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

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

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