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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] – PIN 007460088, [redacted] (Dresden, ON)**		
From	Jason Murchison, P.Geo.		
Date	May 24th, 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 26-February-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 owners of [redacted] (Dresden, ON).

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

> *I'm writing to inform you, the Ministry of the Environment and Climate Change that our water well is experiencing interference from the operating turbines of the North Kent Wind farm.*
>
> *We are aware the Ministry of the Environment gave permission for the North Kent Wind farm to commence operations on February 21st, 2018 and we are asking the Ministry to trigger North Kent REA Permit Conditions G6 & G7.*
>
> *We request the Ministry contact North Kent Wind to make arrangements to test and collect water and sediment samples as per Condition G6.*
>
> *We ask the Ministry staff to come onsite to take water and sediment samples; in particular we request the MOECC to take sediment samples for identification in order to determine if the sediments pose any acute or chronic health risk.*
>
> *We would like you to know that the water well is only 5 years old and has never produced any sediments in all the 5 years it's been operational.*
>
> *The sediment released into our well now is so great that water flow into our house is prevented. We now have no water supply and ask the Ministry to require the proponent to supply us with a water tank with potable water as Condition G6 requires.*

A copy of the correspondence described above pertaining to the property owner's current 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 9:51pm on 26-February-2018. (2) AECOM arranged directly with the property owners an appointment to visit the property at 5:30pm on 1-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); and, ii) digital photographs of pertinent site features (eg. well, pressurization and treatment system, etc.). A sample of raw (untreated) groundwater was unable to be obtained from the well during the site visit due to the presence of an in-line sediment filter. During the site visit, the property owners indicated that AECOM would need to return at a later date to collect a raw (untreated) water sample once their hydrogeological consultant had completed their sediment collection program. (4) Based on the above, AECOM arranged directly with the property owners a second appointment to visit the subject property at 5:30pm on 13-March-2018 (appointment based on property owner availability). (5) Tasks completed by AECOM during the well interference complaint site visit included: i) updated 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.). (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 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 each of AECOM's 1-March-2018 and 13-March-2018 complaint investigation site visits to the subject property, a series of seven (7) standard questions were raised with the property owners ([redacted]) for the purposes of obtaining further details regarding their reported well water supply issue(s). The questions raised with the property owners during each 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 2a: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (1-MARCH-2018)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Sunday morning, shower ok, then laundry, bathroom water (while laundry going) - no water. Then observed laundry - no water. Checked pump. Pressure gauge at 0 psi. Sediment trap dark in colour. • Sediment trap installed in September 2017 with no issues prior to 25-February-2018.
"What do you think is the cause?"	• Operation of new turbines. • Started operating (turning) on 21-February-2018
"When did you first notice the problem (Date/Time)?"	• 25-February-2018 @ ~10:30am.
"Is the problem still occurring?"	• Have not used well since first problem.
"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. • Two visits: 27-January-2017 and 30-January-2017.

TABLE 2b: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY (13-MARCH-2018)

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Plugged with sediment and no water at house as of 25-February-2018. • Water smells (new as of 13-March-2018). • No accumulation of sediment within house plumbing system.
"What do you think is the cause?"	• Operation of NKW1 turbines.
"When did you first notice the problem (Date/Time)?"	• 25-February-2018.
"Is the problem still occurring?"	• Yes.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No.
"Were you provided a temporary supply of potable water?"	• No.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes.

Upon completion of the questionnaire, the property owners and [redacted] was provided an opportunity to review the responses detailed in **Table 2a** and **Table 2b** 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 (25-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 more than [redacted] northwest of the subject property.

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

- T7 – last pile completed on 28-July-2017 @ [redacted] South-Southeast
- T30 – last pile completed on 9-August-2017 @ [redacted] North-Northeast
- T32 – last pile completed on 14-August-2017 @ [redacted] Northwest

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 in July and August 2017, more than six (6) months prior to the property owner's reported outset of well interference impact(s).

Considering the timeline of foundation construction (pile driving) activities described above and reported outset of well interference at the subject property (25-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 current reported outset of well impact on 25-February-2018. Turbine T7, located approximately [redacted] to the south-southeast, represents the closest 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 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 water well located at [redacted], based on details provided to AECOM by the property owners during well interference complaint site visits completed on 1-March-2018 and 13-March-2018, as well as information provided by the property owners on their completed water well survey (WWS) form, and during our baseline site visits on 27-January-2017 and 30-January-2017.

A review of the MOECC on-line database has revealed a water well record (WWR) for the subject property that is consistent with the registration tag observed by AECOM to be affixed directly to the well pipe. Relevant information obtained from the MOECC record also is included in **Table 3**. A copy of the MOECC WWR is provided herein as **Attachment C**.

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	[redacted] (PIN 007460088)
Well Tag #	[redacted]
Well ID	[redacted]
Installation Date	1-February-2013
Well Location	Rear Yard (Northwest of Residence)
Contractor	J.R. McLeod Water Wells (Kerwood, ON)
Contractor No.	7343
Construction Method	Rotary (Conventional)
Total Depth	16.8 mBGS (55')
Target Formation	Black Sand & Black Shale
Casing Length	16.8 mBGS (55') Includes a 1.0 m (3') sump below the screen interval
Casing Diameter	159 mm (6.25") from ground surface to 14.3 mBGS (47') 127 mm (5") from 14.3 m to 14.6 mBGS (47' to 48') 127 mm (5") from 15.9 m to 16.8 mBGS (52' to 55')
Casing Material	Steel
Casing Stick-Up	0.70 m (as measured by AECOM)
Annular Seal	Ground surface to 13.41 mBGS (44')
Sealant Type	Bentonite (Benseal)
Well Screen Installed?	Yes
Well Screen Details	152 mm (6") dia. Stainless Steel 18-Slot (0.45 mm openings)
Well Screen Interval	14.6 m to 15.9 mBGS (48' to 52')
Well Cover Type	Metallic Vermin-Proof
Pump Intake Depth	Well "Bottom" recommended on WWR (unconfirmed)
Pumping Rate	5.7 L/min (1.5 USgpm) recommended on WWR (determined via pumping over 16h) 4.1 L/min (1.1 USgpm) as measured by AECOM on 13-March-2018 (average of 3 separate flow rate measurements)
Well Pump Type	Submersible

DETAILS	[redacted] (PIN 007460088)
Well Pump Size	½ hp as on WWS
Static Level	2.1 mBGS (7') as on WWR
Pumping Level	10.7 mBGS (35') 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**.



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

4.1 Limited Well Flow Rate Testing and Pumping System Assessment

During AECOM's well interference complaint investigation site visit on 13-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 garden hose (supplied by the property owner) connected to a cleanout faucet installed on a tank tee at the base of the water system pressure tank within a small pumphouse located to the rear of the residence (**Photo 2**).

For the test, the water system was permitted to flush continuously for a period of approximately twenty (20) minutes. During pumping, the discharge rate was assessed by AECOM on three (3) 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 pumphouse.

Test results indicated an average flow rate of approximately 4.1 L/min (1.1 USgpm) with the cleanout valve fully open. Comparatively, the MOECC record for the well denotes a recommended pumping rate of approximately 5.7 L/min (1.5 USgpm) with a pump inlet depth positioned at the "bottom" of the well. Based on the foregoing, it would appear that the current pumping rate for the well pump is within the recommended yield for the site well, as indicated on the WWR.



PHOTO 2: Sampling and Flow Rate Testing Location (as on 13-March-2018)

No variation in flow rate (including increasing or decreasing trends) was observed during testing. Some minor surging was observed periodically. Groundwater pumped from the well was observed to be slightly turbid, contain a trace amount of sediment, and possess a 'rotten egg' odour. Small gas bubbles also were observed to collect within a translucent sediment filter housing installed on the inlet line from the well during the test (filter element previously removed; presumably by property owner), as well as within the water quality bottles during sample collection.

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	30-January-2017	Raw (Untreated)	Baseline
	AECOM	13-March-2018	Raw (Untreated)	Complaint Investigation #2

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 13-March-2018 site visit pertaining to the property owner's current interference complaint, as well as baseline (pre-construction) sampling that was completed on 30-January-2017. The analytical results for an additional raw (untreated) groundwater sample

collected during an earlier baseline site visit on 27-January-2017 have been excluded from further consideration due to a potential issue surrounding the sampling methodology.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE #2 (30-January-2017)	COMPLAINT INVESTIGATION #2 (13-March-2018)
Escherichia coli	0 CFU/100mL	MAC	Non detection	Non detection
Total Coliforms	0 CFU/100mL	MAC	Non detection	Non detection
Electrical Conductivity	--	--	901 µS/cm	830 µS/cm
pH	6.5 – 8.5	OG	8.26	8.31
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	85.1 mg/L	89.2 mg/L
Total Dissolved Solids	500 mg/L	AO	482 mg/L	494 mg/L
Total Suspended Solids	--	--	<10 mg/L	<10 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	350 mg/L	377 mg/L
Fluoride	1.5	MAC	0.92 mg/L	0.66 mg/L
Chloride	250	AO	85.7 mg/L	84.2 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	--	--	<0.05 mg/L	0.22 mg/L
Sulphate	500 mg/L	AO	<0.10 mg/L	2.98 mg/L
Ammonia as N	--	--	0.14 mg/L	<0.02 mg/L
Dissolved Organic Carbon	5 mg/L	AO	2.1mg/L	2.8mg/L
Colour	5 TCU	AO	**23 TCU**	**21 TCU**
Turbidity	5 NTU	AO	**5.2 NTU**	3.1 NTU
Calcium	--	--	21.3 mg/L	22.2 mg/L
Magnesium	--	--	7.75 mg/L	8.21 mg/L
Sodium	200 mg/L	AO	161 mg/L	167 mg/L
Potassium	--	--	1.88 mg/L	1.85 mg/L
Iron	0.300 mg/L	AO	**0.372 mg/L**	**0.669 mg/L**
Manganese	0.050 mg/L	AO	0.013 mg/L	0.015 mg/L

NOTE: MAC – Maximum Acceptable Concentration (health-related); AO – Aesthetic Objective (non health-related); OG – Operational Guideline (non health-related).

At the time of AECOM's baseline site visit on 30-January-2017, an in-line cartridge filter assembly was observed to be installed a short distance downstream of the pressure tank within the pumphouse (ref. **Photo 2**). This same filter housing was observed to be present during our 1-March-2018 and 13-March-2018 site visits. The filter housing was observed to not contain a cartridge at the time of our most recent site visits.

During AECOM's 1-March-2018 and 13-March-2018 site visits, a particle filter (in-line T-Standard sand separator) was observed to have been installed within the pumphouse a short distance upstream of the water system's pressure switch and pressure tank (ref. **Photo 2**). The filter unit was reported to have been installed in September 2017 and was most recently used for the purposes of

collecting sediment samples for analysis by WSC Consulting. The property owners further indicated that the filter element contained within the housing is a 1,000 mesh (15 µm), albeit unconfirmed.

Raw (untreated) groundwater sample collection during AECOM's 13-March-2018 site visit was completed using the same cleanout faucet that was used for flow rate testing, albeit with the garden hose disconnected. Prior to sample collection, the faucet orifice was disinfected (using chlorine) and flushed. Clean nitrile gloves were worn by AECOM staff during sample collection.

The 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 13-March-2018, the raw (untreated) groundwater was observed to be colourless and appear to possess a slight amount of turbidity (cloudiness). Upon closer inspection of the sample bottles, the cloudiness was observed to be the result of tiny gas bubbles within the water. The water possessed a 'rotten egg' odour and contained no detectable amount of sediment. A photograph of the water quality sample collected by AECOM for laboratory testing on 13-March-2018 is shown in **Photo 3**.



PHOTO 3: Water Quality Sample Clarity (as on 13-March-2018)

No exceedances of health-related parameters analyzed, including Escherichia coli and Total Coliform bacteria, Nitrate (as N), Nitrite (as N), and Fluoride, were detected either in the baseline or complaint investigation raw (untreated) groundwater samples collected from the existing on-site well supply.

Turbidity is an Aesthetic Objective (AO) of the ODWQS. In this regard, a value of 5 Nephelometric Turbidity Units (NTU) has been established by MOECC. The MOECC's *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* (June 2003; revised June 2006) makes a clear distinction between turbidity related to organic constituents and inorganic constituents stating: "Raw water supply which is ground water with very low organic content may contain inorganic-based turbidity, which may not seriously hinder disinfection. For such waters, an Operational Guideline for turbidity is not established". Further guidance is provided by MOECC regarding the relationship between turbidity and its organic and inorganic components, the disinfection processes, and as a measure of the water supply filtration and treatment efficiency. The

technical explanations also note that while organic turbidity is an important measure as related to health concerns, the AO value is an aesthetic component which is set for all waters at the point of consumption (i.e., not at the source). At the site well, turbidity levels were 5.2 NTU in the baseline sample and 3.1 NTU during the recent well interference complaint site visit. The baseline value was higher than the complaint investigation sample result and above the ODWQS AO limit.

Iron concentrations were determined to be in excess of its AO limit in both the baseline and complaint investigation raw (untreated) groundwater samples collected by AECOM from the site well. 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. Discolouration attributed to elevated concentrations of this metal is evident in **Photo 4** as an orange-brown discolouration on the interior of the translucent filter housing. It is surmised that the elevated concentrations of iron in the samples is of a natural (non-anthropogenic) source.



PHOTO 4: Discolouration from Wiping of Filter Housing Interior (as on 13-March-2018)

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 to 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 quantitatively (ie., via laboratory analysis) as part of this investigation, IRB is interpreted to be present within the well which could affect the functionality of the well pump and installed filter system (via clogging). During AECOM's 1-March-2018 site visit, the property owners provided samples of water that reportedly were obtained from their well on the date of outset of impact (25-February-2018). A photograph of one of the samples was obtained by AECOM and is included below (**Photo 5**). A review of the samples presented and photographs obtained indicates the presence of bacteriological floc versus inorganic sediment. Although being a nuisance, there is no documented health risk associated with IRB, and can be managed through treatment combined with regular maintenance disinfection of the well supply.

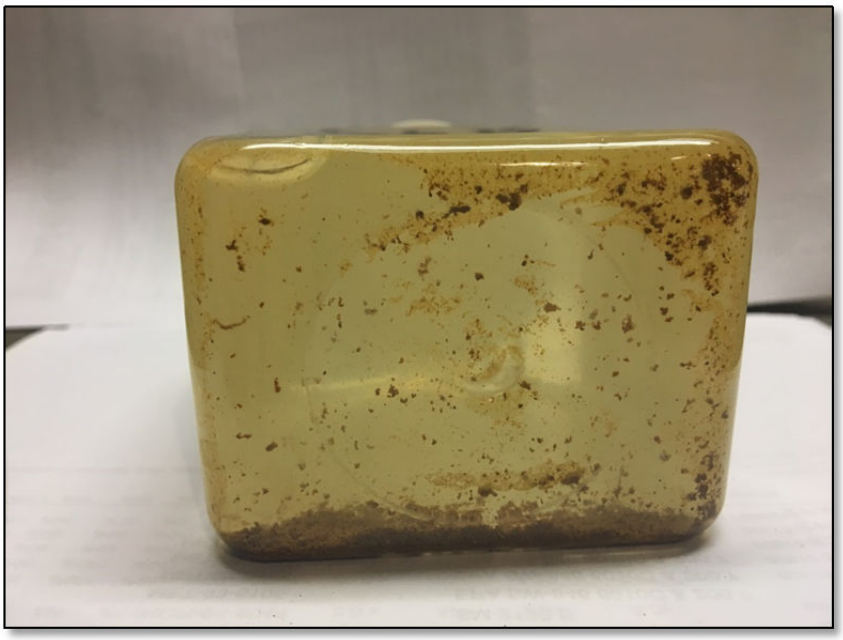


PHOTO 5: Water Sample Provided by Property Owners (reportedly obtained on 25-February-2018)

Total suspended solids (TSS) levels in both the baseline and complaint investigation samples were below laboratory method detection limits (ie. <10 mg/L), indicating a relative absence of detectable sediment load in the raw (untreated) groundwater. An ODWQS criteria limit has not been established for this parameter.

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 current reported outset of well impact on 25-February-2018, with T7 representing the closest location at a distance of approximately [redacted] to the south-southeast. 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 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. 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 quantity and

quality issues currently reported by the property owners at [redacted] (PIN 007460088) are *not* as a result of NKW1 turbine operations.

The water well impact(s) reported by the property owners appear to be related to local water system issue (biofouling) versus an area-wide impact to the local groundwater system. It is recommended that the property owners consult with a qualified water well contractor regarding the current condition of their on-site well supply, pumping and treatment systems.

It is further recommended that the property owner seek the guidance of MOECC, their local Public Health Unit, and/or an experienced water treatment specialist to address the elevated levels of biofouling within their 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

-----Original Message-----
From: Jacobs, Deb (MOECC) [mailto:deb.jacobs@ontario.ca]
Sent: Monday, February 26, 2018 9:51 PM
To: 'Jody Law'; zzJoshua Vaidhyan
Cc: Smith, Mark (MOECC); Lehouillier, Jason (MOECC); Gilbert, Teri (MOECC); Harman, Bruce (MOECC); Moroney, Michael (MOECC); Thuss, Simon (MOECC)
Subject: Fw: well interference

Hello Josh & Jody,

Please see the email complaint below which I received Monday evening (Feb.26, 2018).

Please implement your complaint response procedure and keep the ministry apprised of your findings and all significant developments in the interim.

Thank you
Deb Jacobs

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: [redacted]
Sent: Monday, February 26, 2018 6:02 PM
To: Jacobs, Deb (MOECC)
[redacted]
Subject: well interference

I'm writing to inform you, the Ministry of the Environment and Climate Change that our water well is experiencing interference from the operating turbines of the North Kent Wind farm.

We are aware the Ministry of the Environment gave permission for the North Kent Wind farm to commence operations on February 21st, 2018 and we are asking the Ministry to trigger North Kent REA Permit Conditions G6 & G7.

We request the Ministry contact North Kent Wind to make arrangements to test and collect water and sediment samples as per Condition G6.

We ask the Ministry staff to come onsite to take water and sediment samples; in particular we request the MOECC to take sediment samples for identification in order to determine if the sediments pose any acute or chronic health risk.

We would like you to know that the water well is only 5 years old and has never produced any sediments in all the 5 years it's been operational.

The sediment released into our well now is so great that water flow into our house is prevented. We now have no water supply and ask the Ministry to require the proponent to supply us with a water tank with potable water as Condition G6 requires.

[redacted]

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

May 15, 2018

Project No. 1668031-4000-L03

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 February 26, 2018, related to the well located at [redacted] in Chatham-Kent, Ontario. Golder understands that the resident reported problems with the well on February 26, 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 T7, 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, furthermore, datalogging equipment was in a transition stage from the monitoring requirements for the turbine commissioning phase to the operational phase and thus recording was intermittent. 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 due to active turbine operations. The nearest operating turbine was T7, at a distance of [redacted] The maximum wind speed on February 25, 2018 was approximately 19.5 metres per second (m/s) and the maximum power output for the individual turbines during this time period was approximately 3,195 kilowatts (kW).

BEST MANAGED COMPANIES
Platinum member

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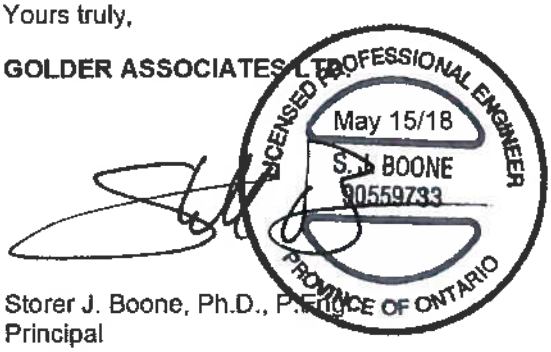
Available data was examined for the period of December 22, 2017 through April 5, 2018 when the turbines were and were not operating. Operational and meteorological data were also reviewed for the 44-day period from February 21, 2018 through April 5, 2018, during which time the 33 turbines were regularly operating simultaneously. For comparison to the date of the complaint, data associated with a wind speed of approximately 21 m/s was recorded on April 5, 2018 and a maximum power generation from the individual turbines of approximately 3,200 kW was also recorded on April 5, 2018. 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 active 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 on April 5, 2018, 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 locations, while comparable, were more severe than the conditions associated with the date of 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

[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

Ontario Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well T[redacted]elow)

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

[redacted]

Address of Well Location (Street Number/Name) [redacted]

Township: Chatham

Lot [redacted] Concession

County/District/Municipality: Kent

City/Town/Village:

Province: Ontario

Postal Code:

UTM Coordinates: NAD 83 Zone 17 Easting 399586 Northing 4707012

Municipal Plan and Sublot Number:

Other:

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
BRN	SAND			0	8'
GRY	CLAY			8	47
BLK	SAND		HARD	47	50
BLK	SHALE			50	55

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	44	BENTONITE - Benseal	
44	55	SILICA SAND #0	

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4	STEEL	.188	+2	47
5	STEEL	.188	45	48
5	STEEL	.188	52	55

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
6"	Stainless Steel	18	48	52

Status of Well

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

Water Details

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	55	9 7/8"

Results of Well Yield Testing

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

If pumping discontinued, give reason:

Pump intake set at (m/ft): Bottom

Pumping rate (l/min / GPM): 1 1/2

Duration of pumping: 16 hrs + 0 min

Final water level end of pumping (m/ft): 35'

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

Recommended pump depth (m/ft): Bottom

Recommended pump rate (l/min / GPM): 1 1/2

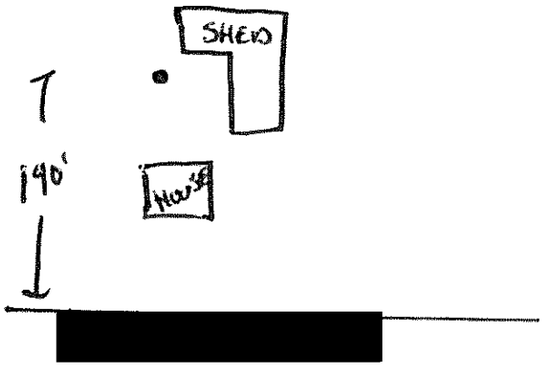
Well production (l/min / GPM): 1 1/2

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	7.0		
1	8.3	1	25.3
2	9.1	2	24.4
3	10.1	3	23.5
4	10.95	4	22.9
5	11.8	5	21.8
10	15.3	10	18.7
15	18.1	15	15.7
20	20.3	20	19.2
25	22.1	25	11.9
30	23.6	30	10.75
40	24.9	40	9.2
50	25.6	50	8.7
60	26.1	60	8.4

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: J.R. McLEOD WATER WELLS

Well Contractor's Licence No.: 7343

Business Address (Street Number/Name): 9500 TOWNSEND LINE

Municipality: KERWOOD

Province: ONTARIO

Postal Code: N0M2B0

Business E-mail Address: mcleodwaterwells@gmail.com

Bus. Telephone No. (inc. area code): 5192473053

Name of Well Technician (Last Name, First Name): McLeod, Jason

Well Technician's Licence No.: 3021

Signature of Technician and/or Contractor:

Date Submitted: 20130216

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

Date Package Delivered: 20130123

Date Work Completed: 20130201

Ministry Use Only

Audit No.: Z163439

Received: MAR 17 2013

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Ministry's Copy

Attachment D

Water Quality Data

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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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: **17T182149**

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

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

DATE REPORTED: **Feb 06, 2017**

PAGES (INCLUDING COVER): **9**

VERSION*: **1**

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

*NOTES
VERSION 1:Partial report sent January 30, 2017.

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

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

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

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:D.D.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-28

DATE REPORTED: 2017-02-06

				007460088
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-27
Parameter	Unit	G / S	RDL	8154793
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

8154793 ND - Not Detected.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:D.D.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-28

DATE REPORTED: 2017-02-06

				007460088 [redacted]
		SAMPLE DESCRIPTION:		
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-01-27
Parameter	Unit	G / S	RDL	8154793
Electrical Conductivity	uS/cm		2	886
pH	pH Units	(6.5-8.5)	NA	8.26
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	82.8
Total Dissolved Solids	mg/L	500	20	480
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	352
Fluoride	mg/L	1.5	0.05	0.83
Chloride	mg/L	250	0.50	87.1
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	<0.05
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.13
Dissolved Organic Carbon	mg/L	5	0.5	2.3
Colour	TCU	5	5	**46**
Turbidity	NTU	5	0.5	**17.2**
Calcium	mg/L		0.05	20.8
Magnesium	mg/L		0.05	7.49
Sodium	mg/L	20 (200)	0.05	**161**
Potassium	mg/L		0.05	1.86
Iron	mg/L	0.3	0.010	**1.52**
Manganese	mg/L	0.05	0.002	0.022

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

8154793 Elevated RDLs for Anions & Cations indicate the degree of dilution prior to analysis in order to keep analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

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Guideline Violation

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

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]

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

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D.D.

Microbiology Analysis

RPT Date: Feb 06, 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	8154754	8154754	ND	ND	NA	< 1									
Total Coliforms	8154754	8154754	ND	ND	NA	< 1									

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

Certified By:

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D.D.

Water Analysis

RPT Date: Feb 06, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
North Kent - Groundwater Samples															
Electrical Conductivity	8153041		758	762	0.5%	< 2	102%	80%	120%	NA			NA		
pH	8153041		8.33	8.20	1.6%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8154754	8154754	518	512	1.2%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8154754	8154754	< 10	<10	NA	< 10	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8153041		329	328	0.3%	< 5	94%	80%	120%	NA			NA		
Fluoride	8154786	8154786	1.68	1.75	4.1%	< 0.05	102%	90%	110%	94%	90%	110%	93%	80%	120%
Chloride	8154786	8154786	31.7	33.6	5.8%	< 0.10	91%	90%	110%	93%	90%	110%	82%	80%	120%
Nitrate as N	8154786	8154786	< 0.05	<0.05	NA	< 0.05	91%	90%	110%	102%	90%	110%	107%	80%	120%
Nitrite as N	8154786	8154786	< 0.05	<0.05	NA	< 0.05	NA	90%	110%	109%	90%	110%	120%	80%	120%
Bromide	8154786	8154786	< 0.05	0.17	NA	< 0.05	109%	90%	110%	91%	90%	110%	88%	80%	120%
Sulphate	8154786	8154786	< 0.10	<0.10	NA	< 0.10	93%	90%	110%	103%	90%	110%	106%	80%	120%
Ammonia as N	8152989		0.18	0.18	0.0%	< 0.02	107%	90%	110%	97%	90%	110%	100%	80%	120%
Dissolved Organic Carbon	8154755	8154755	1.0	1.2	NA	< 0.5	101%	90%	110%	106%	90%	110%	108%	80%	120%
Colour	8153033		6	6	NA	< 5	100%	90%	110%	NA			NA		
Turbidity	8154801	8154801	1.4	1.3	NA	< 0.5	110%	90%	110%	NA			NA		
Calcium	8154801	8154801	13.0	12.8	1.6%	< 0.05	101%	90%	110%	101%	90%	110%	100%	70%	130%
Magnesium	8154801	8154801	4.74	4.70	0.8%	< 0.05	96%	90%	110%	97%	90%	110%	95%	70%	130%
Sodium	8154801	8154801	187	187	0.0%	< 0.05	102%	90%	110%	101%	90%	110%	98%	70%	130%
Potassium	8154801	8154801	1.83	1.81	1.1%	< 0.05	99%	90%	110%	99%	90%	110%	98%	70%	130%
Iron	8154754	8154754	0.260	0.258	0.8%	< 0.010	97%	90%	110%	95%	90%	110%	103%	70%	130%
Manganese	8154754	8154754	0.009	0.009	NA	< 0.002	102%	90%	110%	105%	90%	110%	89%	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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Results relate only to the items tested and to all the items tested

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CANADA L4Z 1Y2
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http://www.agatlabs.com

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T182149

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D.D.

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

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

AGAT Laboratories

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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: 17T182796

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

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

DATE REPORTED: Feb 09, 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.

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Western Enviro-Agricultural Laboratory Association (WEALA)
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All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

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Certificate of Analysis

AGAT WORK ORDER: 17T182796

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-31

DATE REPORTED: 2017-02-09

				007460088
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-30
Parameter	Unit	G / S	RDL	8159680
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

8159680 ND - Not Detected.

Certified By:

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AGAT WORK ORDER: 17T182796

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-31

DATE REPORTED: 2017-02-09

				007460088 [redacted]
SAMPLE DESCRIPTION:				
SAMPLE TYPE:				Water
DATE SAMPLED:				2017-01-30
Parameter	Unit	G / S	RDL	8159680
Electrical Conductivity	uS/cm		2	901
pH	pH Units	(6.5-8.5)	NA	8.26
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	85.1
Total Dissolved Solids	mg/L	500	20	482
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	350
Fluoride	mg/L	1.5	0.05	0.92
Chloride	mg/L	250	0.50	85.7
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	<0.05
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.14
Dissolved Organic Carbon	mg/L	5	0.5	2.1
Colour	TCU	5	5	23
Turbidity	NTU	5	0.5	5.2
Calcium	mg/L		0.05	21.3
Magnesium	mg/L		0.05	7.75
Sodium	mg/L	20 (200)	0.05	161
Potassium	mg/L		0.05	1.88
Iron	mg/L	0.3	0.010	0.372
Manganese	mg/L	0.05	0.002	0.013

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

8159680 Elevated RDLs for Chloride indicate the degree of dilution prior to analysis in order to keep analyte within the calibration range of the instrument and to reduce matrix interferences.

Certified By:

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AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T182796

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
[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: 17T182796

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Microbiology Analysis

RPT Date: Feb 09, 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	8159663	8159663	ND	ND	NA	< 1									
Total Coliforms	8159663	8159663	ND	ND	NA	< 1									

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

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T182796

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:S. C.

Water Analysis

RPT Date: Feb 09, 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	8160339		2290	2300	0.4%	< 2	103%	80%	120%	NA			NA		
pH	8160339		8.02	7.95	0.9%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8159663	8159663	560	562	0.4%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8159663	8159663	< 10	<10	NA	< 10	100%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8160339		389	391	0.5%	< 5	95%	80%	120%	NA			NA		
Fluoride	8159680	8159680	0.92	0.92	0.0%	< 0.05	94%	90%	110%	95%	90%	110%	98%	80%	120%
Chloride	8159680	8159680	85.7	83.5	2.6%	< 0.10	100%	90%	110%	100%	90%	110%	96%	80%	120%
Nitrate as N	8159680	8159680	< 0.05	<0.05	NA	< 0.05	99%	90%	110%	104%	90%	110%	109%	80%	120%
Nitrite as N	8159680	8159680	< 0.05	<0.05	NA	< 0.05	NA	90%	110%	101%	90%	110%	88%	80%	120%
Bromide	8159680	8159680	< 0.05	<0.05	NA	< 0.05	109%	90%	110%	101%	90%	110%	88%	80%	120%
Sulphate	8159680	8159680	< 0.10	<0.10	NA	< 0.10	94%	90%	110%	94%	90%	110%	107%	80%	120%
Ammonia as N	8161290		<0.02	<0.02	NA	< 0.02	92%	90%	110%	95%	90%	110%	80%	80%	120%
Dissolved Organic Carbon	8159663	8159663	2.3	2.2	NA	< 0.5	105%	90%	110%	105%	90%	110%	92%	80%	120%
Colour	8167132		16	18	NA	< 5	102%	90%	110%	NA			NA		
Turbidity	8160184		<0.5	<0.5	NA	< 0.5	104%	90%	110%	NA			NA		
Calcium	8161305		75.3	76.8	2.0%	< 0.05	102%	90%	110%	102%	90%	110%	104%	70%	130%
Magnesium	8161305		7.08	7.20	1.7%	< 0.05	99%	90%	110%	100%	90%	110%	100%	70%	130%
Sodium	8161305		12.4	12.3	0.8%	< 0.05	98%	90%	110%	98%	90%	110%	101%	70%	130%
Potassium	8161305		1.01	1.04	2.9%	< 0.05	99%	90%	110%	99%	90%	110%	102%	70%	130%
Iron	8159663	8159663	0.244	0.236	3.3%	< 0.010	98%	90%	110%	97%	90%	110%	83%	70%	130%
Manganese	8159663	8159663	0.007	0.007	NA	< 0.002	102%	90%	110%	98%	90%	110%	87%	70%	130%

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

Certified By:

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T182796

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

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CLIENT NAME: AECOM CANADA LTD
55 WYNDHAM STREET NORTH SUITE 215
GUELPH, ON N1H7T8
(519) 840-2251

ATTENTION TO: Brian Holden

PROJECT: 60343599

AGAT WORK ORDER: 18T320290

MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

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

DATE REPORTED: Mar 21, 2018

PAGES (INCLUDING COVER): 8

VERSION*: 1

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*NOTES

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Certificate of Analysis

AGAT WORK ORDER: 18T320290

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

North Kent - Microbiological Analysis (water)

DATE RECEIVED: 2018-03-14

DATE REPORTED: 2018-03-21

		SAMPLE DESCRIPTION:		[redacted]
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2018-03-13
Parameter	Unit	G / S	RDL	9124818
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 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.

9124818 ND - Not Detected.

Certified By: Divine Basily

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Certificate of Analysis

AGAT WORK ORDER: 18T320290
PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD
SAMPLING SITE:

ATTENTION TO: Brian Holden
SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2018-03-14

DATE REPORTED: 2018-03-21

					SAMPLE DESCRIPTION:	[redacted]
					SAMPLE TYPE:	Water
					DATE SAMPLED:	2018-03-13
Parameter	Unit	G / S: A	G / S: B	RDL	9124818	
Electrical Conductivity	uS/cm			2	830	
pH	pH Units		6.5-8.5	NA	8.31	
Total Hardness (as CaCO3)	mg/L		80-100	0.5	89.2	
Total Dissolved Solids	mg/L		500	20	494[<B]	
Total Suspended Solids	mg/L			10	<10	
Alkalinity (as CaCO3)	mg/L		30-500	5	377	
Fluoride	mg/L	1.5		0.05	0.66[<A]	
Chloride	mg/L		250	0.50	84.2[<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	0.22	
Sulphate	mg/L		500	0.10	2.98[<B]	
Ammonia as N	mg/L			0.02	<0.02	
Dissolved Organic Carbon	mg/L		5	0.5	2.8[<B]	
Colour	Apparent CU		5	5	21[>B]	
Turbidity	NTU		5	0.5	3.1[<B]	
Calcium	mg/L			0.05	22.2	
Magnesium	mg/L			0.05	8.21	
Sodium	mg/L	20	200	0.05	167[A-B]	
Potassium	mg/L			0.05	1.85	
Iron	mg/L		0.3	0.010	0.669[>B]	
Manganese	mg/L		0.05	0.002	0.015[<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.

Certified By:

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Guideline Violation

AGAT WORK ORDER: 18T320290

PROJECT: 60343599

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CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Brian Holden

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

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T320290

PROJECT: 60343599

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Mar 21, 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 - Microbiological Analysis (water)															
Escherichia coli	9124818	9124818	ND	ND	NA	< 1									
Total Coliforms	9124818	9124818	ND	ND	NA	< 1									

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

Certified By: Nivine Basily

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T320290

PROJECT: 60343599

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Mar 21, 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	9126134		6180	6190	0.2%	< 2	96%	80%	120%	NA			NA		
pH	9126134		7.88	7.81	0.9%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	9121853		2890	2970	2.7%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	9126116		113	127	11.7%	< 10	102%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	9126134		696	695	0.1%	< 5	102%	80%	120%	NA			NA		
Fluoride	9129339		2.46	2.62	6.3%	< 0.05	101%	90%	110%	96%	90%	110%	92%	80%	120%
Chloride	9129339		7.39	7.30	1.2%	< 0.10	90%	90%	110%	103%	90%	110%	107%	80%	120%
Nitrate as N	9129339		<0.05	<0.05	NA	< 0.05	98%	90%	110%	104%	90%	110%	94%	80%	120%
Nitrite as N	9129339		<0.05	<0.05	NA	< 0.05	NA	90%	110%	92%	90%	110%	95%	80%	120%
Bromide	9129339		0.07	0.07	NA	< 0.05	103%	90%	110%	99%	90%	110%	103%	80%	120%
Sulphate	9129339		49.4	49.7	0.6%	< 0.10	92%	90%	110%	102%	90%	110%	97%	80%	120%
Dissolved Organic Carbon	9124818	9124818	2.8	2.8	0.0%	< 0.5	95%	90%	110%	98%	90%	110%	89%	80%	120%
Colour	9124818	9124818	21	21	NA	< 5	108%	90%	110%	NA			NA		
Turbidity	9124818	9124818	3.1	3.1	0.0%	< 0.5	99%	90%	110%	NA			NA		
Calcium	9118619		207	211	1.9%	< 0.05	98%	90%	110%	100%	90%	110%	98%	70%	130%
Magnesium	9118619		93.3	95.5	2.3%	< 0.05	101%	90%	110%	102%	90%	110%	98%	70%	130%
Sodium	9118619		201	206	2.5%	< 0.05	100%	90%	110%	100%	90%	110%	97%	70%	130%
Potassium	9118619		1.99	2.22	10.9%	< 0.05	101%	90%	110%	101%	90%	110%	98%	70%	130%
Iron	9126139		0.041	0.034	NA	< 0.010	106%	90%	110%	100%	90%	110%	88%	70%	130%
Manganese	9126139		0.406	0.382	6.1%	< 0.002	101%	90%	110%	97%	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:

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

AGAT Laboratories

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T320290

PROJECT: 60343599

ATTENTION TO: Brian Holden

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

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