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TO:	CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON OCTOBER 1, 2012
FROM:	JOHN BRAAM, P.ENG. MANAGING DIRECTOR, ENGINEERING AND CITY ENGINEER
SUBJECT:	INTELLIGENT DRINKING WATER MONITORING SYSTEM

RECOMMENDATION

That, on the recommendation of the Managing Director, Engineering and City Engineer, the following actions **BE TAKEN** with respect the City of London entering into an agreement with A.U.G. Signals Ltd. (AUG), to (1) install an "Intelligent Drinking Water Monitoring System" (IDWMS) connected to the City of London Water Distribution System, and (2) act as a pilot demonstration site for the IDWMS:

- a) the attached proposed By-law (Appendix 'A') **BE INTRODUCED** at the Municipal Council meeting to be held on October 9, 2012, to approve a Memorandum of Understanding (MOU) between the Corporation of the City of London and A.U.G. Signals Ltd.;
- b) the Mayor and City Clerk **BE AUTHORIZED** to execute the MOU substantially in the form attached in Appendix 'A', and satisfactory to the City Solicitor, and all documents required to fulfill the conditions of the MOU;
- c) the Civic Administration **BE AUTHORIZED** to undertake all administrative acts that are necessary in connection with the MOU.

BACKGROUND

A.U.G. Signals Ltd. (Airborne Underwater Geophysical Signals) was founded in Toronto in 1986. AUG specializes in signal, image and data processing, with most of their technologies having been applied to, and validated by, military systems.

AUG has employed spectrophotometric sensors to create the TRITON Intelligent Water Surveillance Monitor. The TRITON monitors are designed to provide online, real-time, 24/7 detection and quantification of water contaminants in municipal drinking-water distribution systems.

In order to validate and demonstrate the functionality of their technology, AUG requires municipal partners to install TRITON monitors as pilot projects in actual water distribution systems, creating "Intelligent Drinking Water Monitoring Systems". In 2011, the City of London was approached by AUG regarding the possibility of forming such a partnership. In 2012, AUG, the City of London, and a group of northern Ontario First Nations communities submitted an application for funding to the Ontario Ministry of Economic Development and Innovation (MEDI) for the installation of "Intelligent Drinking Water Monitoring Systems". MEDI has since approved the funding application.

DISCUSSION

The objective of the 3-year AUG/City of London partnership is to create a pilot demonstration of the IDWMS in the City of London. As such, City of London and AUG have agreed to work to achieve the following:

1. To deploy the IDWMS at seven (7) selected locations within the City of London
2. To setup a Command and Control Centre in the City of London
3. To train City of London personnel on system operation and data interpretation

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4. To validate the system in the City of London
5. To demonstrate the system to other municipalities and the media

MEDI has provided AUG with a forgivable loan, covering 50% of eligible project costs. The City of London would also incur some costs through its participation in the project, primarily labour costs for staff involvement. AUG will reimburse the City of London for 50% of the eligible expenses incurred by the City of London, up to \$50,000.

During the 3-year trial, the City of London would continue to use existing technology to meet its regulated monitoring and reporting requirements.

In 2011, London received approximately \$6 million in funding to help establish clean water technologies through the Southern Ontario Water Consortium (SOWC). The International Water Excellence Centre (IWCE) being established in London is a partnership of the City of London, Western University, the London Economic Development Corporation (LEDC) and private sector partners Trojan Technologies and Purifics. The IWCE will be London’s node in the SOWC. The Centre will make London the leading site for industrial water treatment technology commercialization, validation and testing in Canada. The Memorandum of Understanding between the City of London and AUG allows for the possible inclusion of AUGs “Intelligent Drinking Water Monitoring System” within the IWCE.

CONCLUSIONS

Real-time detection and reporting of potential contamination using spectrophotometric sensors represents a unique approach to drinking-water quality monitoring using cutting-edge technology.

By partnering with AUG Signals to evaluate and demonstrate the capabilities of A.U.G.’s “Intelligent Drinking Water Monitoring System”, the City of London will play a vital role in developing this innovative new technology.

PREPARED BY:	RECOMMENDED BY:
JOHN SIMON, P.ENG. DIVISION MANAGER, WATER OPERATIONS DIVISION	JOHN BRAAM, P.ENG. MANAGING DIRECTOR, ENGINEERING AND CITY ENGINEER

- c. Art Zuidema – City Manager
 Cathy Saunders – City Clerk
 Roland Welker – Division Manager – Water Engineering
 Andrew Henry – Division Manager – Regional Water Supply
 Dan Huggins, Water Quality Manager
 Dr. George Lampropoulos – A.U.G. Signals Ltd.

APPENDIX 'A'

MEMORANDUM OF UNDERSTANDING

Between

A.U.G. Signals Ltd.

And

The Corporation of the City of London, Ontario

This Memorandum of Understanding (hereinafter referred to as "MOU") is entered into and effective as of the 9th day of October, 2012,

By and between:

A.U.G. Signals Ltd., a corporation duly incorporated under the laws of Ontario (hereinafter referred to as "AUG")

And,

The Corporation of the City of London, Ontario (hereinafter referred to as "City of London")

Individually referred to as a "Party" or collectively referred to as the "Parties".

Whereas A.U.G. Signals Ltd. has developed the Intelligent Drinking Water Monitoring System (hereinafter referred to as "IDWMS"), capable of continuous, 24/7 early warning and monitoring of water quality;

Whereas A.U.G. Signals Ltd. has intellectual property rights to the IDWMS;

Whereas A.U.G. Signals Ltd. has requested that the City of London host demonstration sites for IDWMS;

Whereas the Ontario Ministry of Economic Development and Innovation (hereinafter referred to as "MEDI") has approved a funding application submitted by A.U.G. Signals Ltd. to demonstrate IDWMS in the City of London;

Whereas the A.U.G. Signals Ltd. and the City of London commit to work in a collaborative effort to demonstrate the IDWMS in the City of London;

Therefore, the Parties agree to enter into this MOU as outlined below:

1 Objectives

The core objective of this MOU is to achieve a pilot demonstration of the IDWMS in the City of London. As such, City of London and AUG have agreed to work to achieve the following:

1. To deploy the IDWMS at seven (7) selected locations within the City of London
2. To setup a Command and Control centre in the City of London
3. To train City of London personnel on system operation and data interpretation
4. To validate the system in the City of London
5. To demonstrate the system to other municipalities and the media

2 Implementation

Specific areas of cooperation between AUG and the City of London and responsibilities of the Parties are listed in the Appendix I of this MOU.

3 Reporting

- 3.1 AUG and City of London will communicate and share information on a regular, open and ongoing basis.
- 3.2 Once per year, AUG will formally report activities to the City of London

4 Funding

- 4.1 MEDI has provided AUG with a forgivable loan, covering 50% of eligible project costs. Eligible Costs are defined in Appendix II of this MOU.

AUG Signals will therefore reimburse the City of London for 50% of the eligible expenses incurred by the City of London, up to \$50,000.00 CAD in accordance with Appendix II , with the City of London contributing the other 50% of expenses as in-kind contribution to the project. Expenses over and above that amount will require advanced written authorization by AUG. The City of London will record its incurred expenses, and will submit quarterly, itemized invoices to AUG for reimbursement.

- 4.2 At project completion, if performance criteria outlined in Appendix I to this MOU are satisfied, the loan provided by MEDI will be marked as forgivable and will not have to be repaid. If performance criteria are not satisfied, the repayment of the loan will be the sole responsibility of AUG and no funds will be required from the City of London.
- 4.3 The IDWMS hardware shall remain the property of AUG during and after the term of this Agreement. The IDWMS hardware shall remain at the risk of AUG during the term of this Agreement and AUG shall insure the hardware from loss, damage or such other perils as it deems appropriate. The City of London shall not be responsible for any loss or damage to the hardware while it is located at the test sites, except for damage or loss caused by the wilful or negligent actions of the City's employees.

5 Dispute Resolution

- 5.1 AUG and the City of London acknowledge and agree that it is their mutual intent and desire to maintain, through this MOU, a stable and mutually respectful relationship. The

Parties acknowledge, however, that in the course of implementing this MOU there may arise, between them, differences of opinion, conflicts or disputes (“Differences”) with respect to or arising out of the terms of this MOU, the interpretation or implementation thereof.

- 5.2 The Parties further acknowledge and agree that they will use best efforts to minimize any Differences through honest and open communication on an ongoing basis through the MOU implementation process and will, in good faith, attempt to resolve all Differences to their mutual satisfaction.
- 5.3 In the event Differences cannot be resolved and except for applications for injunctions or restraining orders, any disputes arising out of or in connection with any binding provision of this MOU, will be, insofar as lawfully possible, referred to and finally resolved or determined by arbitration in Ontario, and each party shall be responsible for its own fees.

6 Confidentiality

The Parties agree to execute a separate Proprietary Information Agreement for the purposes of this collaboration.

7 Notices

Where notice or other communication is required or permitted to be given pursuant to this MOU, it shall be in writing and may be delivered personally or by registered mail addressed as follows. These points of contact may be changed at any time by written notice from one Party to the other:

A.U.G. Signals Ltd.
103-73 Richmond Street West
Toronto, Ontario
CANADA M5H 4E8

Attn: Dr. George Lampropoulos

City of London
300 Dufferin Avenue, P.O. Box 5035
London, Ontario
CANADA N6A 6L9

Attn: John Braam
Managing Director,
Engineering and City Engineer

8 Term of MOU

- 8.1 This MOU will be effective upon signing and may be terminated by either City of London or AUG for any reason upon sixty (60) day written notice to the other party of the same.
- 8.2 This MOU may be amended by mutual agreement of the parties in writing.
- 8.3 This MOU will take effect on October 9, 2012 and will expire on October 9, 2015, unless renewed by mutual consent of the two Parties.

8.4 AUG shall remove the IDWMS hardware from all test sites to the satisfaction of the City of London following the termination of this Agreement or as otherwise agreed by the Parties.

8.5 Notwithstanding its involvement in this project, the City shall be under no obligation to purchase or use the IDWMS after completion of the demonstration pilot project.

9 Assignment

9.1 The City of London shall have the right, in its sole discretion, to assign this Agreement or any rights or obligations hereunder to any third party, including a Municipal Service Board and, upon such assignment, the City of London shall be relieved of its obligations hereunder to the extent of such assignment

IN WITNESS WHEREOF, the Parties have caused this MOU to be duly executed in duplicate.

The Corporation of the City of London	
By	
Name	Joseph Fontana
Title	Mayor
Date	October 9, 2012

A.U.G. Signals Ltd.	
By	
Name	Dr. George Lampropoulos
Title	President & CEO
Date	October 9, 2012

The Corporation of the City of London	
By	
Name	Catharine Saunders
Title	City Clerk
Date	October 9, 2012

APPENDIX I

The Infrastructure Pilot Project for Online Drinking Water Monitoring aims to setup a pilot demonstration in collaboration with The City of London. The project will consist of four phases: 1) Production of 7 IDWMS units, including the hardware assembly, software implementation, network setup and system testing; 2) Deployment of the 7 IDWMS units and testing those units for a period of one year; 3) Validation and preparation for demonstration; and 4) Demonstration of complete IDWMS to potential end users. The tasks required to complete these phases are outlined as follows:

Milestone 1: Production of the IDWMS units and deployment at the City of London's drinking water distribution system (Duration: 12 months)

Task 1: Selection of water quality parameters to be monitored

Task 1.1: Selection of target water quality parameters of interest to end user

The target detection parameters will be selected from the table shown below, which include basic drinking water quality parameters, and additional chemical parameters. The system design and performance criteria will be finalized according to the City of London's requirements.

Basic Water Parameters	Additional Chemical Parameters
pH, Turbidity, Conductivity, ORP, Total Chlorine, and Temperature	Nitrate, Nitrite, Iron, Copper, Chromate, and 2,4 - D

Task 1.2: Analysis of parameters to generate spectral signature profiles

The parameters selected in Task 1.1 will be analyzed by IDWMS using the water in London's distribution system as the background information. Following the experimental procedures already established by AUG Signals, experiments will be performed to determine sensor response (turbidity, pH, conductivity, ORP, temperature and total chlorine sensors) to these parameters and the spectral signatures of these parameters, taking into account London's unique water conditions. Parameter profiles will be then generated and populated into a library.

Task 2: Production of 7 IDWMS units

Task 2.1: Hardware acquisition and assembly

Based on the system design completed in Task 1.1, the hardware of IDWMS will be acquired by AUG at its cost and assembled, according to the hardware design architecture already developed during the SDTC project. The assembled sensor suites will be connected to the tap water in AUG's laboratory.

Task 2.2: System calibration and performance validation

The IDWMS units assembled in Task 2.1 will be individually tested under standard operational conditions to validate system performance and reliability. These 7 units will first be calibrated to

generate the profiles of parameters in regular tap water, and then the spectral signature library obtained in Task 1.2, and database, will be uploaded into each system unit. After that, the system performance will be further validated to detect simulated contamination events in terms of the sensitivity and accuracy.

Task 2.3: Sensor suite auto mode test

The IDWMS units will run on an auto mode in the lab for two weeks on a continuous basis. During the test period, the sensor suites will be operated in the same way as in the real application – functions, such as reference updating, auto wash, reporting, etc., will be tested. Meanwhile, the false alarm rate will be determined.

Task 3 Software adaption and network setup

Task 3.1: Software adaptation for the single unit system

Software modules for the monitoring system will be adapted according to the City of London's requirements. Several of the software modules will be modified to meet the further expansion needs of the system scale. The user interface will also be updated to incorporate information specified by the City of London.

Task 3.2: Data storage and transmission

The system database (where all sensor readings, parameter profiles, baselines, and other information is stored) will be updated to incorporate information specified by the City of London. Database storage modules will be scaled-up to support the 7 unit monitoring system. Meanwhile, more powerful data storage media and CPU will be used to support the growing data needs. Database queries will be optimized to meet the performance requirement. If any of the IDWMS units will be located in areas where wired internet is not available, a suitable data transmission method will be selected and applied to relay information between the sensor units and the command and control centre.

Task 3.3: System reliability test

Due to the scale-up of the system, the system reliability will be retested for all planned and unplanned events. System modifications will be applied if needed.

Task 3.4: Network setup and test

The command and control centre will be setup with connection to all the installed IDWMS units. The data transmission will be tested and network failure events will be identified and analyzed.

Task 4 IDWMS Deployment

Task 4.1: Selection of deployment sites

AUG Signals will work with the City of London to select 7 strategic sites for IDWMS deployment. The selection criteria will include the availability of regular water quality sampling (for system validation), infrastructure (e.g., power, internet, and workspace) and deployment environment (e.g., temperature and humidity).

Task 4.2: Installation of IDWMS units

7 IDWMS units will be deployed in the drinking water distribution system at locations selected in Task 4.1. The command and control centre will be setup at a site selected by the City of London.

Task 4.3: Initialization, re-calibration, and testing of the IDWMS onsite

Before the IDWMS runs automatically, each unit will be initialized, re-calibrated and tested onsite. Based on the specific drinking water conditions at each site, profiles of normal drinking water and parameters will be established and updated into each IDWMS unit. Meanwhile, data management and network capabilities will be tested.

Task 5 City of London personnel training on IDWMS operation

Training will be provided to City of London personnel by AUG Signals, including data interpretation, basic operations and maintenance. The operators utilizing the command and control centre will be trained on reading the water quality information received from multiple locations, and using the software for system control.

Milestone 2: Continuous Online Monitoring of Water Quality – Pilot tests of IDWMS in the Drinking Water Distribution System (Duration: 12 months)

Task 6 Automatic and continuous monitoring of water quality

Task 6.1: Automatic and continuous operation

The 7 IDWMS units will run automatically and continuously with minimal supervision required by City of London personnel. Water quality data will be collected, analyzed, and reported to the central command and control centre, as well as AUG Signals. All the water quality data accumulated in the database will be used as the pilot project's one-year operational record. In addition, the water anomaly detection results and false alarms will be automatically recorded by the system, allowing for system performance to be supervised by the City of London and AUG Signals.

Task 6.2: System maintenance

AUG Signals will provide a comprehensive check-up and maintenance for the 7 IDWMS units during the one-year pilot test. This maintenance includes hardware checks, system cleanup, sensor calibration, database management and software updates.

Task 6.3: 24/7 technical support

Technical support, either online or onsite, will be provided by AUG Signals to the City of London on a 24/7 basis. Feedback from the City of London regarding system performance will also be recorded, and system improvement will be made accordingly.

Task 7 Challenge tests for IDWMS network

Task 7.1: Design of a simulated contamination event

Water contamination events will be simulated and challenge test processes will be designed so that no contamination to the City of London's drinking water system will occur. One IDWMS unit

will be selected as the contaminant injection point, depending on its deployment environment and work conditions. An injection system, including pipes, backflow prevention devices, and flow control valves, will be built at the selected location.

Task 7.2: Challenge tests of IDWMS network

Challenge tests will be conducted - the parameter to be tested and the number of tests will be determined by the City of London. During the tests, the system's response to the events will be observed through the network, i.e., the operator at the command and control centre and the City of London will be aware of the simulated contamination event in near real time. An anomaly detection report, including the detection time, parameter name, estimated concentration, location of occurrence, and other water quality parameters and event assessment confidence, will be sent to personnel authorized by the City of London and AUG Signals.

Task 8 Validation of IDWMS – multiple sensor suites (7 units)

In this task, the City of London will evaluate the performance of the 7 IDWMS units by comparing the water quality data reported by IDWMS with data obtained by parallel laboratory tests using water samples manually collected at the system deployment sites. At the same time, the City of London can test the IDWMS units and evaluate the stability of system operation, the consistency of the detection results, and response to parameters (in simulated contamination events) as well as the performance of central command and control centre in receiving and managing the data sent by multiple IDWMS units at remote sites.

Milestone 3 Final optimization of IDWMS (Duration: 6 months)

Task 9 Refinement of the IDWMS

Task 9.1: Development of solutions for system optimization

During the one-year pilot test, AUG will consistently study feedback and concerns from the City of London. During this task, AUG will develop practical solutions for system upgrades and better adaptation for the City of London's requirements.

Task 9.2: Upgrade and finalization of the IDWMS

The system will be improved by modifying the hardware and upgrading the software during the entire pilot test period. However, a final touch-up of the system will be performed so that all the problems identified in subtask 9.1 are resolved, and the system performance meets the City of London's requirements. By the end of this task, the 7 IDWMS units will be finalized as a product for municipal drinking water monitoring.

Task 9.3: Finalization of system functions for demonstration

System functions will be selected for onsite demonstration, including automatic continuous water quality monitoring, water quality data reports in real time, system response to simulated contamination (i.e. real time anomaly alarm), and the setup of the command and control centre. AUG will also cooperate with the City of London to select a demonstration site to best present the system functions and also minimizes the influences of the demonstration on routine operations.

Milestone 4: Commercialization (Duration: 2.5 years)

The Commercialization phase of the project will include onsite presentations by AUG staff to showcase product capabilities to potential suppliers, end-users and members of the media. During the Commercialization phase, AUG Signals and the City of London commit to work in a collaborative effort to demonstrate the IDWMS in the City of London

ROLES AND RESPONSIBILITIES

AUG will lead and manage the project on day-to-day basis.

MEDI will provide financial support to cover part of the project costs.

The City of London will provide the locations to deploy 7 IDWMS units, within its drinking water systems. The deployment locations must meet the following conditions:

1. Indoor surroundings with temperature between 4-40 °C
2. Access to internet (5 Mbps bandwidth)
3. Access to the drinking water supply (200-300 mL/min, 1-70 psi)
4. Access to power supply (110 VAC, 5 A)

The City of London will assist AUG staff in understanding the local environment and provide end-user feedback for AUG to optimize the system.

The Project shall be deemed to be successful if:

- (a) Each individual IDWMS unit deployed in this pilot test is dedicated to continuously collect, analyze and report sufficient amounts of water quality data with detection rate of anomaly larger than 80%.
- (b) The system demonstrates its operational reliability and stability during this pilot test with critical system failure rate of less than 10^{-3} per hour; and
- (c) During the product demonstration, the system receives a positive response from the majority of the attendees.

APPENDIX II

Eligible Cost Categories:

- Start-up costs associated with the development and design of prototypes;
- Equipment purchase, installation and retrofitting costs;
- Direct labour costs for personnel involved in the Project;
- Maintenance costs;
- Costs associated with the development of codes and standards and regulatory approvals;
- Costs associated with training of skilled resources and public awareness; and
- Monitoring and evaluation costs.