RES'EAU WATERNET
An NSERC Small Water System Strategic Network

UPDATE: RES'EAU-WaterNET

AGM 2016

Annual General Meeting

April 30 – May 1 | Fairmont Chateau Whistler

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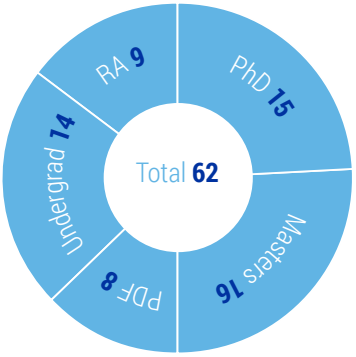
RES'EAU-WaterNET
by the Numbers



NETWORK HQP

PUBLICATIONS

34
Peer-reviewed journals
(submitted or published)

48
Conference presentations

RES'EAU-WaterNET convened its 2016 Annual General Meeting in Whistler, BC in May. The event gave our research teams, highly qualified personnel (HQP) and partner representatives a chance to network and update one another on research results and progress within the Community Circles innovation program. Delegates also heard from five guest speakers, and had the chance to view one of RES'EAU's state-of-the-art Mobile Water Treatment Pilot Plants on site.

Several network HQP made presentations of their research, including two guest from the Design of Risk-reducing, Innovative-implementable Small-system Knowledge (DeRISK) Center at the University of Colorado, Boulder. Richard Inkster and Jim Brown from the First Nations' Operators Water Net for British Columbia & Yukon Territories were also guest speakers.

We're excited about the progress and insights our research teams and collaborators have achieved over the past several months. What follows is a brief synopsis of highlighted outcomes from the meeting – a snapshot of how our innovation agenda is heading for the rest of 2016 and beyond.

Guest Speaker

Broken Pumps and Promises

Incentivizing Impact in Developing Countries and Closing the Loop on Development

Dr. Evan Thomas, Portland State University

Solving the developing world's public health challenges is a massive, expensive undertaking that will require new business models and monitoring methods to ensure solutions are impactful and sustainable, according to a leading expert.

Dr. Evan Thomas, director of the Sustainable Water, Energy and Environmental Technologies (SWEET) Laboratory at Portland State University (www.pdx.edu/sweetlab), provided RES'EAU team members with an overview of lessons learned through innovative development projects he has led in Africa. Dr. Thomas is a former NASA life support systems engineer who has spent several years implementing new approaches to drinking water disinfection, sanitation and reliable cook stoves there.

Dr. Thomas stressed that global development work represent an open loop, where projects are funded and installed but rarely evaluated and monitored in a robust manner. Once funding has run its course, development teams move on, resulting in sobering statistics – some 60% of water pumps installed in many African nations are not working just a few years later, he noted.

His work in Rwanda attempts to close this loop by using a unique business model that sells carbon credits generated by the projects to international buyers, thus generating funding to incentivize and sustain project work. The carbon credits are earned though a reduction in the use of and demand for firewood to cook and boil drinking water after water filters and alternative stoves are introduced.

Technology can also assist in closing the loop, Dr. Thomas suggested. He highlighted his team's use of specialized remote sensors designed at Portland State University that connect to cell phone networks to monitor and report on the performance of and usage patterns in stoves, water filters, latrines and more. More than 300 of the devices are in use in a dozen countries, transmitting data directly to the internet for real-time analysis and reporting to community members, program managers and funders.

While carbon credits and remote sensors are a good first step, more action is needed to close the loop on development, Dr. Thomas concluded, citing the need to engage business in solving problems in a manner that can pay for ongoing services.

Referencing a photo of happy Kenyan children holding cups of crystal clear water, he said: "We need to close the loop in humanitarian projects, and ensure that the day this picture was taken was the first, but not the last, day that these kids had clean water."

Guest Speaker

British Columbia Water and Waste Association:

Safeguarding Public Health and the Environment

Tanja McQueen, CEO, BCWWA

A new program designed to build financial and managerial capacity among small water systems owners and operators has been delivered four times for 89 participants from 39 small BC communities, delegates heard. The Building Sustainable Small Water Systems pilot program – developed through a partnership between the British Columbia Water and Wastewater Association (BCWWA), RES'EAU-WaterNET and others – was designed to empower local leaders to make informed decisions that advance financial sustainability and operational resilience to reduce health risks in small, non-

First Nations communities' water systems.

Tanja McQueen, BCWWA's CEO, noted that the BC Ministry of Health allocated $500,000 to the BCWWA for the two-year project that runs through March, 2017. Associated Engineering developed the workshop and resource content, which focuses on three core areas: i) financial best management practices; ii) government regulations and guidelines, including the new Drinking Water Officers Guidelines; and iii) creating a template agreement for point-of-entry, point-of-use systems.

Community engagement is also an important component of the program, which communicates the value of water systems to small water system users. The goal is to build public understanding and support for sustainable rate structures that cover the full cost of operation, upgrades, and replacement, Ms. McQueen said. Four more workshops are planned.

Learn more about the program at: **www.bcwwa.org/sws.html**

Network Research Updates

Tracking and Assessing Sources of Fecal Contamination and Public Health Risks in Community Water Sources

Dr. Asit Mazumder, University of Victoria

The Challenge: Characterizing and quantifying how individual or a combination of activities affect water quality are major challenges, especially under changing climate conditions. How do small/rural communities or their contractors decide on a treatment technology when there is very limited knowledge on seasonal and inter-annual variability in water quality? How do communities assess source water risks if they don't know what the sources of contaminations are?

Approach and Progress to Date: Focusing on tracking sources of fecal contamination, Dr. Mazumder and colleagues have employed three approaches: i) a method that uses caffeine as marker to track septic and sewage contamination; ii) using a stable isotope of nitrogen to track and compare sources of contamination due to agriculture, livestock and sewage; and, iii) developing genetic tools to identify animal sources of fecal bacterial contamination from several communities.

Dr. Mazumder noted that to date several communities and organizations have benefitted from this research. The Comox Valley Regional District is using results to inform the design of a new treatment plant, while the Cowichan Valley Regional District has used it to guide land-use planning to reduce septic and other contaminations of source water. Environment Canada and the Water Economics, Policy and Governance Network have applied results to an assessment of economic valuation from water quality changes, and other water systems are using the team's monitoring tools, land-use and climate impact models in their risk assessment, land-use management and integrated watershed management activities.

Microfabricated Low-cost Sensors for Drinking Water Quality Monitoring

Dr. Jamal Deen, McMaster University

The Challenge: Chlorine is commonly used in drinking water disinfection systems worldwide, but operators must monitor levels of free chlorine within the distribution system and/or pH levels to ensure optimal dosing and fulfill regulatory requirements. Conventional free chlorine and pH monitors are expensive, often require experienced operators and are

predominantly tailored for use in larger treatment plants, among several other limitations. Small water treatment systems would therefore benefit from the development of affordable, highly sensitive chlorine and pH monitors suited to their needs.

Approach and Progress to Date: Dr. Deen's team has focused on developing the potential of microfabricated sensors for chorine and pH monitoring. He noted that their graphite-based amperometric sensor repeatedly demonstrated a linear response to free chlorine concentration, detectable to 6 ppm with a margin of error of 0.13 ppm and a response time of less than 2 minutes at a flow of 75 mL/minute. Dr. Deen also stressed that the sensor is very inexpensive to produce compared with commercial colorimetry and amperometry, and performs within acceptable parameters.

The team is also exploring microfabricated sensors that are much smaller (<1cm^3), cheaper (<1 cent per use) and easy to use, and require less frequent maintenance. To date, their inkjet-printed sensors have been shown to accurately assess pH and chlorine levels.

In terms of pH applications, the team found that potentiometric sensors have a simpler structure and are compatible with more types of sensing materials, which was preferred for fast prototyping. Also, the working of potentiometric sensors does not require external power supply, which is an added advantage. Finally, the readout of the output signal of the potentiometric sensors only requires a voltmeter, which is simpler than using ion-sensitive field-effect transistor (ISFETs). For chlorine, they reported that their pencil-based free chlorine sensor is faster to prototype, easier to fabricate and cost-effective.

Dr. Deen said that next steps include increasing the sensitivity of the sensors while conducting field trials in small communities toward the development of a distributed wireless sensor network.

Ion Exchange Resins and Nanofiltration for Drinking Water Treatment

Dr. Benoit Barbeau, École Polytechnique de Montréal and Dr. Pierre Berube, University of British Columbia

The Challenge: Natural organic matter (NOM) is commonly found in surface waters and can affect disinfection/disinfectant demand, aesthetics and microbial regrowth, as well as acting as a precursor to disinfection by-products (DBPs). Small and remote communities must address variable source waters and NOM concentration levels, and would benefit from technologies to address NOM that are easy to operate and maintain, robust and affordable.

Approach and Progress to Date: The team has explored the effectiveness of several alternative options for addressing NOM, with an emphasis on ion exchange (IX) resins and hollow fibre nanofiltration technologies. In terms of IX, field tests were conducted to compare the accuracy of traditional column tests versus multiple loading tests (MLTs) for assessing the effectiveness of ion exchange resins, Dr. Pierre Berube noted. Those investigations suggest that MLTs only provide an initial estimate capacity of resins, and that testing under real-world conditions will be essential to accurately assess capacity. Allowing IX columns to operate in biological mode provided longer operation and produced greater NOM removal, and may be suitable for use in remote areas through periodic external regeneration, which recovers 100% of capacity, he said.

A trial of a proposed hollow fiber nanofiltration (HFNF) approach to removing total organic carbon proved successful when using Quebec source waters in the lab, Dr. Benoit Barbeau said. However, a pilot study at Shawnigan Lake conducted using one of the network's Mobile Water Treatment Pilot Plants in BC did not replicate results, likely due to a membrane manufacturing error. Overall, HFNF systems require less frequent cleaning versus hollow-fiber ultra-filtration systems, and the relative energy cost of physical cleaning is low compared with the total operating cost, he concluded.

Next steps include longer-term operation of biological IX resins with in-depth cost analysis of external regeneration versus traditional operation, as well as assessments of seasonal and water matrix effects on biological activity. In terms of the nanofiltration system, the team is investigating the Shawnigan Lake failure before resuming more pilot studies.

UV-based Disinfection and Oxidation Processes

Dr. Madjid Mohseni, UBC

The Challenge: Micropollutants in drinking water can be difficult to address, especially in small water systems that lack updated, sophisticated equipment and highly trained operators. Taste and odour compounds are major sources of complaints associated with water quality in small communities, which increasingly are forced to deal with algal toxins and other emerging contaminants. Small water systems need robust, passive and affordable solutions that can ameliorate traditional and emerging contaminants effectively.

Approach and Progress to Date: Part of RES'EAU-WaterNET's efforts to develop innovative and integrated treatment processes focuses on innovations in advanced oxidation processes (AOP) such as vacuum-UV, which provides simultaneous disinfection and degradation of micropollutants without the use of chemicals. However, the efficacy and efficiency of the VUV process is potentially affected by the background water matrix, temperature and the high adsorption of VUV in water, Dr. Mohseni noted. He highlighted data from testing a VUV approach in a pilot system installed at the Seymour-Capilano Filtration Plant in Vancouver, BC.

Results from the pilot suggest that VUV is a potentially viable process for degradation of micropollutants and cyanotoxins. Energy requirements of the VUV process were found to be within the acceptable range, Dr. Mohseni noted, and cyanotoxin concentrations below the regulatory limit were reached. Direct photolysis at 254 nm also plays a role in the removal of some micropollutants, he said.

Further evaluation of cyanotoxin removal using VUV is underway (including an analysis in actual bloom water), as are studies of the impact of the process on cell-bound toxins, biostability, chlorine demand and disinfection by-product formation potentials.

Electrochemical-Based Approaches for Drinking Water Treatment

Dr. Arman Bonakdarpour, UBC

The Challenge: Electrochemical approaches to drinking water disinfection such as electro-peroxide or ozone production, electroferration, electrocoagulation (EC) and capacitive deionization provide several potential benefits for small systems. They are compact, robust, environmentally friendly systems that do not require chemicals – and they provide on-site, on-demand functionality with simple operational requirements.

Approach and Progress to Date: Dr. Arman Bonakdarpour highlighted the status of several research projects in this area. He noted that work to date on electroferration methods has produced ferrates at neutral pH conditions, and that higher current densities in experiments led to higher rates of ferrate production. Different iron sources had a high impact on the production of ferrates. The current efficiency rapidly decreased in the first stage of all tests, he noted. Next, the team will look at experiments with contaminated water.

Lab- and pilot-scale experiments with electrocoagulation for the removal of natural organic matter have also been successful. A pilot-scale EC continuously operating reactor was fabricated. Experiments showed promising decreases in dissolved organic carbon and in UV-Abs-254 under certain conditions. Flowrates of 5 LPM and 10 LPM have been investigated at the community level (Texada Island, BC), and initial current distribution experiments to understand the fundamentals of the reactor system and electrodes have been completed, Dr. Bonakdarpour said. Further investigation for UV-Abs-254 reduction must be conducted to understand effect of iron speciation, he noted.

Understanding the Sources of Vulnerability of First Nations Drinking Water Systems

Dr. Edward McBean, University of Guelph

The Challenge: Drinking water advisories (DWAs) are pervasive challenges for First Nations communities – 65 % of First Nations communities experienced a DWA between 2004 and 2014. Understanding the complex factors at play in terms of the occurrence, duration and frequency of DWAs would be an important step toward enabling First Nations to manage risk.

Approach and Progress to Date: Dr. Edward McBean and collaborators used various data mining techniques to identify correlations and patterns from a large data set recording information on 800 small water systems and 1500 DWA events. More than 20 system attributes were analyzed, allowing the team to identify consistent results with particular, associated variables (see table). Among the conclusions were that operator certification is a key attribute associated with the occurrence, duration and frequency of DWAs in First Nations systems, and that advisories are more quickly resolved when operators are trained.

Main Predictive Attributes of DWAs in First Nations

Occurrence	Duration	Frequency
• Province	• 1st Operator Treatment Certified	• Province
• 1st Operator Treatment Certified	• Environmental remoteness	• Treatment Class
• Treatment class	• 1st Operator Distribution Certified	• Max Daily Volume
• Source	• Province	• Population Served

Dr. McBean also provided an overview of a project designed to assess how easy or difficult it would be for a single person to complete Alberta's 190-question water safety plan (WSP) assessment questionnaire, and to gauge how much variability there could be between respondents' answers. Most risk assessments suggest working as a team (usually with a minimum of three people) to complete the questionnaire; however, many small drinking water systems have only one water treatment operator with limited time and resources, he said. Analysis of the responses suggest respondent fatigue is a significant challenge to be overcome, and that, although there may be similar concerns in the minds of respondents, they aren't necessarily embodied as the same type of answer. A condensed questionnaire containing only 20 questions was subsequently tested. The variability of responses occurred even with the condensed WS, but to a much lesser extent; it also appeared to help users agree on high-risk areas, Dr. McBean noted.

He also highlighted that youth outreach, engagement and education strategies to decrease water system vulnerability within First Nations communities provides tangible returns (see below), and that including both western science and First Nations, Métis, and Inuit knowledge will provide better options to develop SWPs.

Keys to the Retention of Operators

- Youth working with Water Treatment Operators creates greater appreciation for the operator in the community
- Increasing respect for an operator increases operator satisfaction with their employment
- Has also led to youth acting as mentors within the community for other youth
- Empowers the community, the operators and youth themselves.

Analysis of BC's Water Act Modernization: Consequences of Consultation for Water Governance Reform

Dr. Leila Harris, UBC

The Challenge: In 2008, B.C.'s Ministry of Environment released its Living Water Smart plan, which set out the government's

commitment to modernize the province's regulations to ensure the sustainability of water resources. The modernization project commenced in 2009 with an intensive public consultation process that took place over four years, involving thousands of submissions. The new Water Sustainability Act (WSA) received royal assent in 2014, and came into force in April, 2016. Through an analysis of the submissions on the Water Sustainability Act, this RES'EAU team sought to examine just how democratic the consultation process was, and the extent to which it influenced water policy decisions.

Approach and Progress to Date: Kiely McFarlane, a PhD student in the Institute for Resources, Environment and Sustainability at UBC outlined the team's qualitative and quantitative analyses of submissions from consultations 1–3. Specifically, they were looking to conduct i) an analysis of consultation process (comments on the consultation process vs. design of process); ii) analysis of submitter positions on policy issues (more, moderate, or less regulation); and, iii) analysis of policy outcomes in Water Sustainability Act (comparison with submitter positions).

Ms. McFarlane then highlighted key insights from the water act modernization process. First, she said, evaluations of consultation processes are typically informed by a majoritarian view of democracy, and are framed around improving participation by the public at large. However, their analysis suggested that broad inclusion in a public consultation process is not sufficient, as different processes may be required for consultation of different groups. The public consultation process did not replace the legal requirement to consult and accommodate First Nations, she stressed, resulting in further disenfranchisement by giving a voice to "the public" yet subsuming First Nations' rights into those of "stakeholders." More attention should be paid to how submissions are classified, weighted and counted, and the politics of these practices, to overcome the huge variability within groups, both in terms of the number of submissions, and who those submissions claim to represent – from individuals, to bands, to organizations.

The team's analysis also provided several insights on the policy impacts of consultation, chief among them that a strong consultation process does not always result in democratic policy outcomes – and that an analysis of policy outcomes is needed to ensure accountability in decision making. Consultations will expose instances of strong opposition to decision makers, who may in consequence may be less willing to support transformative policies, Ms. McFarlane said.

Seven Years of Research within RES'EAU About the Occurrence and Management of DBPs and Residual Disinfectant in Small Drinking Water Systems

Dr. Manuel Rodriguez, Universite Laval

The Challenge: Knowledge on water quality (WQ) variability from source to tap in Canadian small systems still very limited. A better understanding of it will give managers and operators in small systems the data and tools to simplify and improve WQ management.

Approach and Progress to Date: The team took a close look at 44 small systems case studies in three provinces (NL, QC, BC) to asses WQ monitoring programs and monitor seasonal and short term variability using *in situ* and laboratory analyses for diverse WQ parameters as well as disinfection byproducts (DBPs). They also conducted analyses of WQ management tools, including a WQ index for drinking water management, models for estimating non-regulated DBPs occurrence in small drinking water systems, a decision-making scheme for DBP monitoring intended for small systems, and more. Other projects focused on quantifying human/operational factors and their impacts on drinking WQ, including the development of guidelines for small system operators on the management of sodium hypochlorite solutions for chlorination.

Dr. Rodiguez concluded that the projects led to a clearer understanding of source water quality on WQ, improved strategies for both surveillance and the management of disinfectant residuals and contaminants and a better grasp of the human factors that impact WQ. Quality improvement benchmarks were also identified, he said.

Community Circles Update

Several speakers updated participants on RES'EAU-WaterNET's internationally recognized Community Circles collaboration approach. Scientific Director Dr. Madjid Mohseni highlighted how the process works to put communities and stakeholders such as water systems operators at the heart of the innovation process to shape the R&D process (see sidebar). He then outlined historic and ongoing work with several small and First Nations communities in BC – Lytton First Nation, Lhoosk'uz Dené Nation (Kluskus), Van Anda Improvement District, Tl'azt'en Nation (Middle River) and Cedar Creek.

1 Community Engagement
- Used to initiate the process
- Take place regularly throughout the project
- Continue after project completion to discuss an new or reoccurring

2 Water sampling and analysis campaign
- Conducted over the course of the project to monitor seasonal changes in water quality
- Engages community members, helps promote knowledge of their system

3 Water Research
- Based on water quality results research is conducted to develop possible pilot treatment options

4 Pilot Testing
- Mobile water treatment plants are brought to the source to engage community and operators

5 Commissioning of full-scale treatment solutions
- Consultants and suppliers are engaged and RES'EAU with the Community Circle works to see that the community's voice is heard throughout this step

Cedar Creek is a community made up of 44 homes of mostly seasonal residents living completely off the grid using solar power and generators. Work there is focusing on upgrading a fire suppressant system that uses untreated water; many residents have tapped into the system as a water supply, Dr. Mohseni noted. The RES'EAU team is currently working with residents to collect water samples, and its Mobile Water Treatment Pilot Plant will soon be on site to test potential disinfection solutions.

Network research engineer David Chan provided a progress on the Van Anda Improvement District, a remote community of 500 on BC's Taxada Island. Van Anda's drinking water source is high in dissolved organic carbon, and the community experiences common boil water advisories, along with highly chlorinated water high in disinfection byproducts, he noted. To date, the RES'EAU team has tested promising technologies with the mobile treatment plant, while community interactions have built solid, trusting relationships with community members and raised awareness of the issues, Mr. Chan said. As a result, the community is better informed and equipped to move forward on implementing solutions.

Ms. Heidi Gable of the Van Anda Board of Trustees (pictured above) also shared her perspective on water issues faced by the community, highlighting the challenges decision makers face when building consensus among constituents and making a relatively major infrastructure investment. She noted that the community's experience with RES'EAU has been positive and beneficial to date, and that the people of Van Anda are anxiously awaiting the network's final report and recommendations.

RES'EAU project manager Megan Wood provided an overview of progress in Middle River, an enclave of 12 homes where a boil water advisory has been in place for decades. In terms

of community engagement, members from Tl'azt'en Nation were enlisted to collect water samples, which brought awareness of the situation in Middle River to the band, she said. The network's pilot plant was displayed at the band office to allow band members to see first-hand the work being performed, while the local water operator was consulted so their preferences can be implemented into the design of a new water system. Further testing of filtration approaches under high turbidity events, experiments with different types of carbon media and validation studies of UV inactivation are under way, Ms. Wood concluded.

Other Community Circle Highlights

Working with both the Tl'azt'en Nation and Lytton First Nation communities, RES'EAU has partnered with Indigenous & Northern Affairs Canada, Opus DaytonKnight, Viqua and the First Nations Health Authority to conduct a one-year feasibility study of point-of-entry (POE) water systems. Eight homes have been selected to test the performance cost-effectiveness of a UV-based POE system, as well as assess the communities' perceptions of it over time. To date, community consultations have been completed as the first of four study phases; so far, homeowners and local operators have expressed their support for POE solutions. The study will enter the design and implementation phase over the summer, and will be completed in early 2017.

RES'EAU researcher and Engagement Coordinator Brett Marchant presented an overview of his ongoing analysis of the decision components that affect the implementation of chlorine disinfection systems in First Nations communities. Surveys of key stakeholders, interviews with 22 First Nation water operators and managers and consultations with nine communities across five regional districts have been conducted, he said. Operators and managers were asked about their level of education and training, job satisfaction, the degree of support they receive from band leadership and more; community members were asked about their perceptions of and receptiveness to chlorination. Highlights of operators' attitudes are listed in the table, top right. Technical and non-technical data collected through this research will be used to inform a design protocol for chlorine systems in small systems, Mr. Marchant said.

Operators' POV Challenges:

- Fair compensation
- Education
- Available labour
- Disconnect between decision-makers and operators
- Cultural sensitivity
- Aging workforce
- Physically demanding work

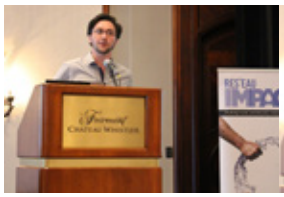
Opportunities:

- High level of commitment and job satisfaction
- Desire for chlorination exists but hesitate with sharing thoughts with local residents
- Continued demand for growing First Nation operator networking and cross-sharing

Jim Brown, level II operator, maintenance manager and lead operator for Lytton First Nation (above) provided his perspective on RES'EAU's Community Circles platform for attendees. Mr. Brown has been an endless source of energy, knowledge and inspiration for the RES'EAU teams working in Lytton, and his commitment to the network's approach greatly improved relationship building abilities within the communities we serve.

Richard Inkster (above), acting director of the First Nation Operators Water Network (FNOWN) BC & Yukon, was on hand to discuss that organization's progress to date. Launched in 2015, FNOWN is an association of indigenous water and wastewater plant operators that are certified under the Environmental Operator Certification Program (EOCP).FNOWN will help to assist indigenous water and wastewater operators in education and training to be EOCP certified across the province of BC and Yukon Territory.

HQP Presentations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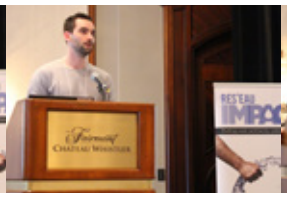
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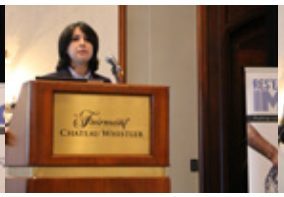

Laleh Dashtban (EPM);


David Chan (UBC);


Siddharth Bhartia (UBC);


Abhirosh Chandran (UVic);

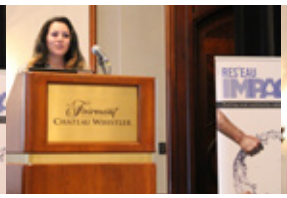

Pranav Chintalapati (UBC);


Adrian Serrano (UBC);


Megan Wood (UBC);


Yvonne Post (UGuelph);

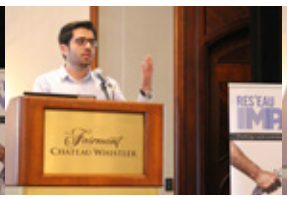

Mike Chung (UBC);

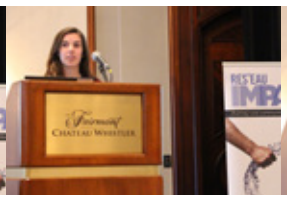

Sonia Rahmani (UBC);

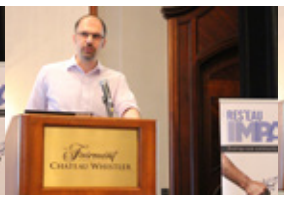

Si Pan (McMaster U);


Cheryl Gomes (UBC);


Kai Song (UBC);


Adel Hajimalayeri (UBC);


Emma Thompson (UGuelph);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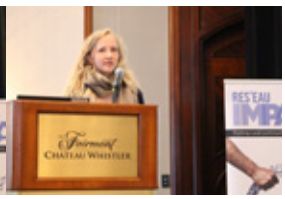
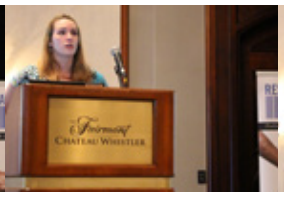

Rachael Marshall (UGuelph);


Sean McBeath (UBC);


Adrian On (UBC);


Natalie Hull (CU Boulder);


Rachael Kenny (UNH);


Ty Bereskie (UBC Okanagan);


Maggie Han (UBC);


Ataollah Kheyrandish (UBC);


Tianyi Guo (McMaster);

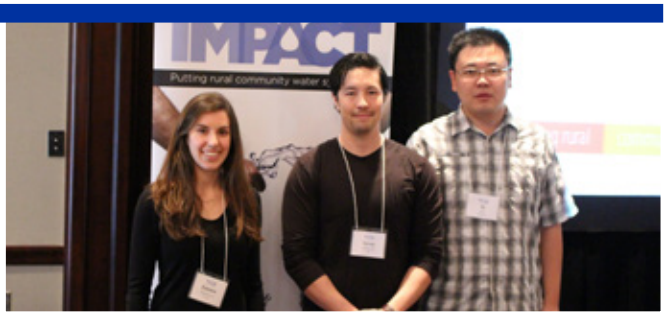
The future leaders of innovation for small water systems always play a central role in RES'EAU's AGM. Nearly 30 highly qualified personnel and students were on hand for 2016, presenting their research to attendees, including two from the Design of Risk-reducing, Innovative-implementable Small-system Knowledge (DeRISK) Center at the University of Colorado, Boulder.

HQP Poster Winners

1st **Sean McBeath** (UBC)

2nd **Si Pan** (McMaster)

3rd **Emma Thompson** (Guelph)



Meet our local, provincial and national co-creators:

Industry Partners

Associated Engineering

BI Pure WATER

HEALTHSPACE HARMONIZED INTELLIGENCE

IBM

kwl

NORAM

OPUS DAYTONKNIGHT

TRITECH Water Infrastructure Solutions

TROJAN UV WATER CONFIDENCE

URBAN systems

VEOLIA WATER

Government, Professional Agencies & NGOs

Aboriginal Affairs and Northern Development Canada

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

British Columbia
Ministry of Community, Sport and Cultural Development

BCWWA
BC WATER & WASTE ASSOCIATION

CWWA ACEPU

Comox Valley Regional District

Développement durable, Environnement, Faune et Parcs
Québec

Health Canada / Santé Canada

Okanagan Basin WATER BOARD

Ville de Québec

WCWC Walkerton Clean Water Centre
CWAE Centre de Walkerton pour l'assainissement de l'eau