The Civilian

One Department, Two Great Programs: Civil and Mineral Engineering / Issue 21 / September 2016

THE WATER ISSUE

Lead Pipes
Preventing a Flint, MI-like crisis from happening in Canada

Water at Gull Lake
The evolution of CAMP: Curriculum includes hydrology as well as surveying

The Civilian

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Managing Editor
Keenan Marie Dixon

Advisors
Prof. Brent Sleep
Nelly Pietropaolo

Writers & Contributors
Colin Anderson
Keenan Marie Dixon
Amanda Hacio
Alicia Sgromo

Photography
Roberta Baker
Keenan Marie Dixon
Neil Ta

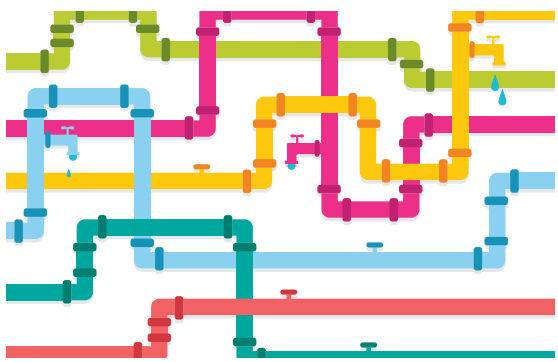
Design
Keenan Marie Dixon

Special Thanks to
Teresa Miniaci
Prof. Robert Andrews
Prof. Bryan Karney

Year 1 CivE students taking a break from studying. (Credit: Neil Ta)

This Issue

Features



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4 WAYS FOR ALUMNI TO GIVE BACK TO THE DEPARTMENT

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Opportunities include mentorship, guest speaking and the Chair's Advisory Board.

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Help us to identify job opportunities in your organization for new graduates.

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We are always looking to grow our industry network to help us ensure our research is relevant.

Donate

Support through financial or gift-in-kind donations help us to meet our funding needs.

From the Editor

Many of our readers receive The Civilian packaged together with the U of T Magazine. This helps the department to offset the cost of mailing the magazine.

This year the U of T Magazine will be published [in print] three times a year, which affects our usual publication schedule of twice a year. We have made the decision to publish The Civilian once a year and to make it longer with more content. When combined with CivMin CONNECT, our new online space exclusively for Civ/Min/Geo alumni, we believe that we can better meet the needs of our community.

Please join CivMin CONNECT (civminconnect.ca) to ensure that you receive notices.

We welcome your feedback and would love to know what you think about the longer Civilian and/or CivMin CONNECT.

Keenan Marie Dixon

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Chair Chat

This issue's theme is water; exploring how engineers are playing a key role in managing our most important natural resource.

As a country Canada has an abundance of water. As such Canadians tend to take access to clean water for granted. However, our water resources are threatened by contamination by industrial chemicals and pathogens, over-use, and climate change. At the same time there is also increasing concern about the frequency of extreme hydrologic events. As engineers, we embrace our role in protecting the environment and human health and ensuring sustainable clean water.

Our featured articles focus on water research in the Department. There is a long history of water research in the Department and activity in this area continues to expand. Among the articles in this Civilian are stories highlighting work by the Drinking Water Research Group on lead in water distribution networks and research of Professor Bryan Karney on Hong Kong's water systems. We also bring you an update on a number of other water researchers and the new Institute for Water Innovation.

Water is an important component of the curriculum for Civil and Lassonde Mineral Engineering students. In recent years the curriculum for the Civil and Mineral Practicals (CAMP) at Gull Lake has been expanded to let our students get hands-on experience in stream gauging, mapping of watersheds and measuring water quality parameters in Gull Lake. As our alumni know, CAMP is also an incredible opportunity for our students to share in Canada's wilderness and create lasting memories. A photo essay documenting recent CAMP memories is a special feature of this issue.

Looking ahead to 2016-2017 in the Department, we have a new crop of great students joining us in First Year, while a cohort of our students are going out after their third year to develop valuable engineering skills through the Professional Experience Year (PEY) Program. The University of Toronto will be hosting the 2017 Mining Games, a prestigious event for our Lassonde Mineral Engineering students. During last year's competition, our team won the top Mine Design award, the largest competition at the event. We look forward to supporting and cheering on this year's team!

Finally, I would like to take this opportunity to invite you to join our newly launched department platform, CivMin CONNECT. The online platform allows our alumni to interact with each other and current students. We look forward to sharing Department news, updates and event invitations with you.

Brent Sleep

Brent Sleep, PhD, PEng, FEIC
Professor & Chair
Department of Civil Engineering

Credit: Staff photographer Ken Jones

Leading the way on lead research

Researchers aim to prevent a Flint-like crisis from happening in Canada

An interview with Prof. Robert Andrews, Sarah Jane Payne (Post-Doc) and Aki Kogo (MASc Candidate).

In 2014, the city of Flint, Michigan, switched its water source from Lake Michigan to the Flint River. Inadequate treatment and reporting caused lead (Pb) contaminated drinking water to be delivered to Flint residents, resulting in a state of emergency being declared.

Researchers at the University of Toronto's Drinking Water Research Group (DWRG) have been actively studying the behaviour of lead (Pb) in water distribution systems since 2012, with a particular focus on southern Ontario drinking water sources.

"The problems in Flint emerged because the alternate water source had a slightly different water chemistry that disturbed the protective lead (Pb)-scale on the existing lead (Pb) pipes," said Prof. Robert Andrews, a principal investigator with the DWRG. "Short of replacing all the lead (Pb) service connections in the system immediately, it will take time for the damaged scale on the interior of the pipes to build up with time and repair itself."

Sarah Jane Payne, U of T Post-Doctoral Fellow, explains that scale (the buildup of materials lining the inside of water pipes), much like rust, can be relatively stable. However, it can cause significant issues when disturbed, as it was with the water change in Flint.

"Municipalities add different chemicals, called corrosion inhibitors, to the local water, which react with dissolved lead (Pb) in the water and re-deposit it on the surface of the pipe to form the scale," Payne describes. "Each water source (lake or river) has a different chemistry, such as alkalinity, pH and inorganic carbon, which affects how the corrosion inhibitors react."

"The crisis in Flint highlighted what many people take for granted," said Andrews. "Researchers are aware of real-life issues and through careful experimentation are always looking for unintended consequences. Asking ourselves if we make one change, how is this going to affect something else?"

The science of inhibitors

As far back as the fourth century B.C.E, the ancient Greeks preferred terracotta pipes over lead (Pb). They knew, even then, that lead (Pb) negatively impacted health. Today, we know lead (Pb) is a powerful neurotoxin with serious implications for

“People in the water industry are very passionate about public health and that’s always at the forefront of any water treatment experiments. What we do every day affects millions of people.”

neurological development in children. Despite this, lead (Pb) has persevered as a material for pipes due to its durability and ease of use. Lead (Pb) service lines, connecting the water main to the home, were widely employed in North America until the early 1950s, when regulations ended the use of lead materials for new lines.

Municipalities today use a variety of methods including the application of corrosion inhibitors, like orthophosphate and zinc-orthophosphate, to reduce the amount of lead (Pb) consumed by the general population. These chemicals react with lead (Pb) to form a compound that precipitates out of solution to form a stable, crystal-like lining on the inner surface of the pipe. The lead (Pb)-scale is very thin - only a few microns thick.

The problem can be made even more complex when considering physical disturbances, changes or fluctuations in water chemistry, and seasonal changes in temperature, which can loosen existing scales and disrupt the chemical balance between the water and the pipes.

Utilities try to form the strongest scales possible given varying water chemistry. Local water quality conditions dictate what needs to be changed or added to reduce corrosion.

“When phosphate-based corrosion inhibitors are used, lead (Pb)-phosphate scales become more and more stable over time,” said Andrews. “Understanding that chemistry and timeline is actually quite complex.”

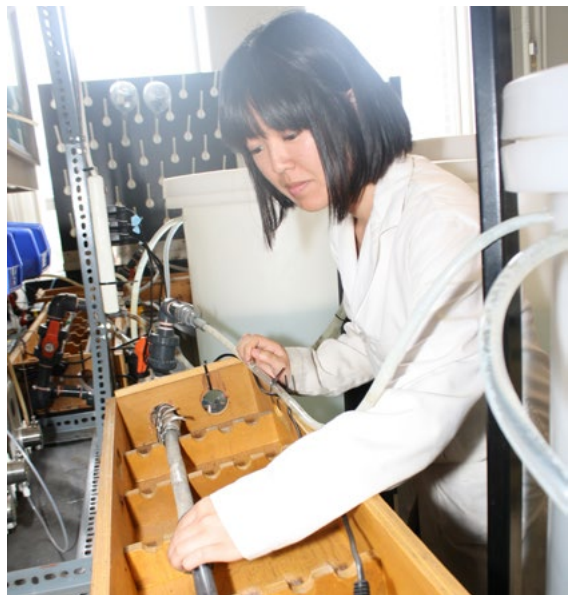
“Reducing corrosion isn’t just about adding corrosion inhibitors. It can also be about changing the attributes of the water itself, such as adjusting the pH,” said Payne. “It is being aware of these details, looking at them holistically that determines what combination of attributes and additives might lead (Pb) to the least amount of lead (Pb) in drinking water.

Study: Comparing Inhibitors

Researchers with the DWRG wanted to compare corrosion control options for Lake Ontario water using the two most common corrosion inhibitors: zinc-orthophosphate and orthophosphate. However, as phosphates are a finite resource, sodium silicate was also selected as a non-phosphate-based inhibitor to research.

“Phosphates are expensive and the price is volatile, so we wanted to include an alternative. That’s why

Aki Kogo (MASc Candidate) looks over the lead (Pb) pipe experimental setup in the Environmental Lab. (Credit: Keenan Dixon)



we looked at sodium silicate," said Payne. "Sodium silicates' corrosion inhibitor properties have been known since the 1920s, but the funny thing is that no one really knows exactly how they work. So we compared it to the performance of phosphate-based inhibitors to try to understand more about this corrosion inhibitor."

To fully understand how Lake Ontario water will interact in local water distribution systems, lead (Pb) pipes that had been in use for 65 years were sourced. To simulate a scenario where a homeowner has not replaced their portion of the water service line, a partial lead (Pb) service line replacement was set up in the DWRG laboratory.

"All of our test pipes came out of a community in Ontario. When you think about these pipes, many have been underground since the 1940s. They've had decades of different chemical combinations pass through them," explained Payne. "What their particular scale is formed of and what conditions keep them stable is not well understood. We use real lead (Pb) pipes that have been pulled out of the ground that we know have a history. We can do more realistic experiments with those because using a new lead (Pb) pipe would be a totally different story."

"Both phosphate-based inhibitors performed very well, though zinc-orthophosphate did seem to perform a little better," said Aki Kogo, MASc Candidate. "Initially, the sodium silicate did not do very well but later in the experiment we started to see some better results with it."

Now that testing has wrapped up at the DWRG lab, this setup of lead (Pb) testing equipment will be moved to a municipality's water treatment facility for future studies.

"It's through a lot of hard work by smart people that this research gets done," Payne said. "Just to get the water every week, Aki and Jim Wang [DWRG Research Chemist] transported 500 litres of 'untreated' water back to the tanks in our lab. There is so much physical work, time and intellectual dedication that goes into research like this."

The impact of research

"People in the water industry are very passionate about public health and that's always at the forefront of any water treatment research," explains Andrews.

"What we do every day affects millions of people. Our research is done quietly, but it's really quite

important. There are strong researchers in Canada, who are truly focused on the health of Canadians and those around the world."

Public health plays a significant role in directing the research on drinking water quality.

"There's the epidemiology and toxicology side that drives the health-based inquiry," said Payne. "The engineering side looks into accomplishing what is required to meet the standards set by health-based researchers. It is a back and forth iterative process that helps regulators set standards that municipalities must meet."

"In Canada, we have a lot of utilities that are forward thinking," explains Andrews. "It is extremely rare for a municipality to change its water source. Because of the safeguards in sampling and reporting that we have in Canada, along with the conscientiousness and vigilance of water treatment personnel, it is very unlikely that a Flint-like emergency situation will happen in Canada."

About DWRG

The Drinking Water Research Group (DWRG), formed in 1998, is a consortium of researchers from the University of Toronto. The group operates as a team working to improve drinking water quality through sound research and engineering. With over 25 ongoing projects, the DWRG typically undertakes collaborative projects examining treatment, distribution, compliance and innovation to meet future water needs. Unique resources, including a large number of municipal and industrial partners, allow for various issues to be examined.

Principal investigators of the DWRG; (from left) Professors Robert Andrews, Susan Andrews and Ron Hoffman (Credit: Roberta Baker)

Finding balance between mineral engineering and Indigenous studies

Paige Clarke (Year 3 MinE) talks about her educational path

Paige Clarke moved from the small town of Kirkland Lake, Ont., to Canada's largest metropolis to attend university. Now, as she prepares to start her Professional Experience Year (PEY), she's looking forward to living in an area with a strong native presence reminiscent of her hometown, where she grew up with the Beaverhouse First Nation and Matachewan First Nation communities nearby.

"I grew up with a basic knowledge of Indigenous cultures and Indigenous thought, but I really wanted to expand my knowledge on the subject," says Clarke. "Indigenous communities value land as more than just the ground that we stand on. It's the water and the wind and the trees and the birds. The land is everything."

It was this understanding that led Clarke to pursue a degree in the Lassonde Mineral Engineering Program (MinE) with a minor in Aboriginal Studies.

The choice to enter mineral engineering came from the flexibility of location; Kirkland Lake is one of Ontario's leading mining communities, which would allow Clarke to move home in the future.

"Most people in northern Ontario don't leave northern Ontario – they go to northern schools. I decided I was going to leave Kirkland Lake. There was no one else from home when I came here," says Clarke. In the end, MinE was perfect. Her small, tight-knit class was exactly what Clarke needed to get her through the transition from rural to urban living.

Clarke notes that her choice to pursue a minor in Aboriginal Studies has led to a heavier course load than some of her peers, but the effort is worthwhile – many mines exist in areas of significance to Indigenous communities. Clarke believes that while civil and mineral engineers focus on land work and use, they should be just as diligent in working with Indigenous communities, who know the land better than anyone.

Her dual focus gives her an edge among her peers. When interviewing with Vale in Thompson, MB, for her PEY placement, her minor in Aboriginal Studies was one of the first things her interviewer discussed. For Clarke, the social aspects of a project are always at the forefront of her mind and are often the first thing she thinks about when looking at any problem. She believes that social and technical facets go hand in hand.

"I think that my Aboriginal Studies minor is not just a social responsibility to understand the views of the peoples of the land who we're going to be mining, but also an environmental responsibility because so much of their traditional knowledge is about having balance." This keeps her motivated to pursue both an engineering major and arts minor.

Paige Clarke (at right) on a site visit to the Vale Base Metals Technical Excellence Centre with the Year 3 MinE class. (Credit: Neil Ta)

Students travel to Honduras, install solar powered water pump for remote community

This spring two CivE students travelled to Roatán, Honduras as part of the 2016 Student Passport Initiative, to improve water access in a community of 600. The community previously spent upwards of $250 per month to operate a diesel-powered water pump. After students installed a 3kW solar array, which operates the pump continuously, the quality of life for the community's residents vastly improved.

"It's good for students to actually pick up a tool and apply what they learned to a full-scale project," says Dmitri Naoumov (CivE 1T5 + PEY) member of the U of T student chapter of the Canadian Electrical Contractors Association (CECA). "The build was large enough that we needed to work together as a team, but small enough to be manageable and finished during the trip."

The members of CECA student chapter were invited on the trip by the Penn State NECA (North America Electrical Contractors Association) student chapter to encourage CECA's participation in future initiatives. Naoumov and his peers thought they would prefer to work on projects helping remote Canadian communities.

"It is important to us that the project has impact, so we discussed working with geoexchange technology in Indigenous communities in northern Canada," Naoumov says, noting solar arrays would be impractical during a Canadian winter. "Geoexchange systems in the Yukon, using the heat stored in the earth's soil, might be a possible student project."

"By participating, students can really get their minds around the challenges or problems they might be asked to solve in professional careers," says Prof. Brenda McCabe, CECA student chapter faculty advisor. "All of the design and research work is done by the students and I am proud of how much they have done since founding the chapter in 2014."

The participation in the 2016 Student Passport Initiative would not have been possible without industry sponsors Alltrade Industrial Contractors, Fitzpatrick Electrical and Fusion Energie.

In addition to the Student Passport Initiative, CECA student members compete annually in the Green Energy Challenge. Demonstrating their ability to analyze particular electrical construction management problems, they create comprehensive plans and budgets for appropriate retrofitting. The 2015 team designed a solar photovoltaic microgrid system and back-up power plan for Good Shepherd Ministries, a homeless shelter in Toronto. For the 2016 entry, students are planning a lighting retrofit, daylight analysis and solar array for the University of Toronto Schools.

The Canadian Electrical Contractors Association brings together electrical contractors across the country to share experience and advice. The U of T chapter extension is the first of its kind in Canada. Their goal is to bridge the gap between contracting and engineering and engage students with first-hand, applied experience. In addition to competitions, the group hosts networking and social events and connects students with scholarship and job opportunities.

CECA students and Penn State NECA chapter students in Honduras, installing a solar array. (Credit: Dmitri Naoumov)

Learning Water Systems at CAMP

Of all the courses Prof. Jenn Drake has taught, CME358 – better known as Survey Camp – at Gull Lake is her favourite, in particular a special tutorial Drake runs: Marshmallow Roasting 101.

"Civil and Mineral Practicals (CAMP)–Survey Camp– is by far the most rewarding course to teach," says Drake.

For any professor teaching environmental engineering, translating course material into real-world applications is difficult in an urban setting. "CAMP is a microcosm of everything that you use in a city; natural water systems, drinking water and waste water systems. While at camp we focus on water modules, hydrologic and topographical work, lake profiles, and soil identification."

"Students learn in a real-time, life-size setting. They understand how the concepts and theories they learn in class relate to the real world," explains Drake. "The experience helps students become well-rounded, better developed, passionate people which is what we want for our engineers."

Drake notes that there is a big difference between learning about stream gauging compared with doing it; having access to property north of the city is an invaluable tool and tremendous opportunity.

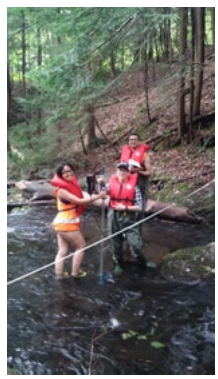
"Students have told me that camp is the most beautiful place they've ever visited; the wealth of Canada in terms of lakes and healthy nature really puts things in perspective. Our student population is highly urban, so survey camp is a unique experience for our students, one that creates memories and long-lasting learning."

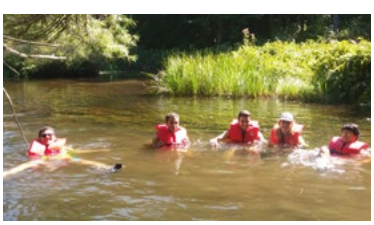
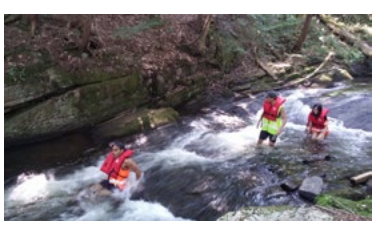
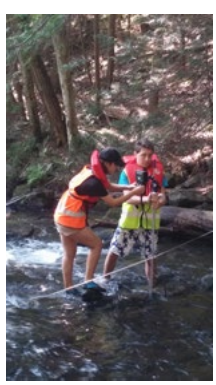
About CAMP

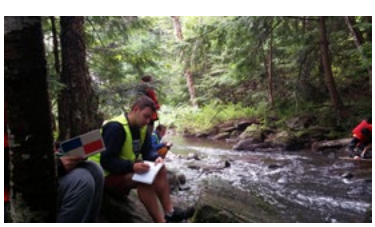
CME358, Civil and Mineral Practicals (CAMP) is a required course for all Civil and Mineral Engineering undergraduate students. The two-week camp instructs students in the art and science of land surveying, engineering project management, geology, hydrology, water treatment, woodlot management and sustainable energy.

Class of 1T8 at Camp







Photos by: Jennifer Drake, Brent Sleep

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INSTITUTE FOR WATER INNOVATION

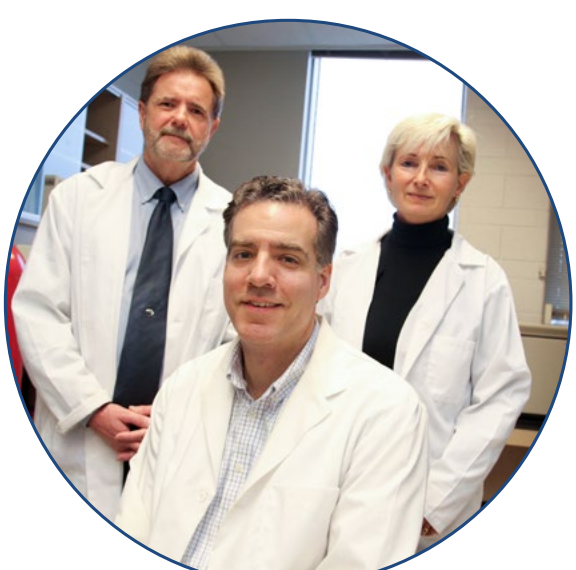
Water plays a critical role in our lives. According to the United Nations Environment Programme (UNEP) "the total usable freshwater supply for ecosystems and humans is 200,000 km^3 of water, which accounts for only 0.01 per cent of all water on earth." By 2050 global water demand is projected to increase by 50 per cent due to growing manufacturing, thermal electricity generation and domestic use.

As global water scarcity and stress persist, solutions are needed to reduce pressure on freshwater assets. Now, more than ever, a focus on innovation is necessary to combat water challenges.

The newly established Institute for Water Innovation (IWI) at the University of Toronto is poised to address these challenges. According to Mandeep Rayat, Manager of IWI, the Faculty of Applied Science & Engineering has over 30 principal investigators from all the major engineering disciplines with research interests related to water. Seven of these researchers are in the Department of Civil Engineering.

The Department of Civil Engineering is playing a key role in addressing water challenges that affect human health, economic development and political stability.

Drinking Water Research Group: Clean water for cities



Credit: Roberta Baker

The Drinking Water Research Group (from top left: Profs. Robert Andrews, Susan Andrews and Ron Hofmann) examine all aspects of drinking water, from distribution optimization to new treatment technologies.

"People in the water industry are very passionate about public health and that's always at the forefront of any water treatment experiments," explains Andrews. "What we do every day affects millions of people. Our research is done quietly but it's really important. There are strong researchers in Canada working really hard who are truly focused on the health of Canadians and those around the world."

With over 25 ongoing projects, the DWRG typically undertakes collaborative projects examining treatment, distribution, compliance and innovation to meet future water needs. By partnering with municipalities, a broad range of issues can be examined and knowledge transferred directly to utilities, regulators and policy-makers.

INSTITUTE FOR WATER INNOVATION

Jennifer Drake: Permeable pavement, rain gardens, green roofs

Prof. Jennifer Drake is looking forward to the future when her urban-based research on permeable pavements, rain gardens and green roofs will benefit from the collaboration at the IWI. “We know that these [technologies] work, but if you put them all in one neighbourhood, how do they work together? Do they interact? Can they mitigate the impacts that urbanization traditionally has on our water resources? This is long-term research where we can see how sustained small changes can make a huge impact on urban living.”

Plans are already underway to increase opportunities for research investment and collaboration with industry partners to focus on water-related needs of private firms, whose primary issue is water remediation; mining and oil sands production require a lot of water and produce a lot of pollution, which makes water-based innovation necessary.

“We need to conduct research that looks beyond remediation and maximizes water usage,” explains Drake. “We’re trying to build U of T as a leader in water technology and sustainability and now we have something that can unite us and give us a bigger presence. We’re highlighting the water expertise by connecting mechanical, chemical and civil engineering so that we increasingly work together.”

Elodie Passeport: Harnessing wetlands to purify our water

Prof. Elodie Passeport’s research focuses on understanding the behaviour of water contaminants and testing passive water treatment system designs that optimize contaminant removal. The belief that environmental quality is a cornerstone of ecosystems and human health, helps drive her research.

Why are wetlands important?

Natural wetlands are important ecosystems that help control flooding, improve water quality and provide multi-species habitats. Engineered wetlands are a low-cost, low-energy alternative to conventional water treatment systems.

Is it true that wetlands help to purify water systems?

Constructed wetlands can be engineered to enhance wetlands’ natural ability to remove pollution. By using natural energies from wind, sun, soil, plants and microorganisms living in the wetlands, the water is cleaned of contaminants. Early designs used single treatment units, often a pond with plants, but resulted in varying efficiency as not all chemicals could be removed in a single unit. A wide range of conditions are required to eliminate multiple chemicals, e.g. different pH, redox or plant densities.

Current approaches use multiple treatment units, each dedicated to one removal process, such as photodegradation in open-water ponds, or biodegradation in vegetated wetlands.

What are the applications for your research?

This research impacts storm water systems as well as municipal, industrial and agricultural wastewaters. By better characterizing the hydrological, physical, chemical and microbial processes governing contaminant levels in various passive water treatment systems, we can propose efficient, affordable and low-maintenance designs.

Brent Sleep: Cleaning up contaminated soil

Across the Canadian landscape sit thousands of forgotten sites that once housed industrial operations. These places, known as brownfields, suffer a tainted legacy of contaminated soil and groundwater that prevent their re-use and can threaten the surrounding environment.

Most sites are contaminated by chemicals like chlorinated solvents, hydrocarbons, creosotes and coal tars, which can be difficult to remove. Just one litre of trichloroethene, a common industrial cleaner, can contaminate three million litres of groundwater. The worst aspect - these pollutants can persist for centuries in underground water sources.

Prof. Brent Sleep and his Innovative Technologies for Groundwater Remediation research team work with the Institute for Water Innovation to address this challenge. Like a medicinal cocktail designed to defeat an aggressive infection, the group is investigating the enhanced effect that combining two or more different remedial technologies can have on contaminant removal.

Individually, innovative technologies like chemical oxidation, electro-kinetics, thermal remediation, and bioremediation can remove large amounts of contaminating particles. Real-world contamination, however, is highly complex. “Partnering complementary technologies addresses site complexities,” the group writes, “targeting both areas of very high contaminant concentration and areas of low – but still toxic – concentration.”

Sleep’s work aims to make brownfield cleanup more efficient, more cost-effective and more wide-spread.

Credit: Neil Ta

Lesley Warren: Aqueous and microbial geochemistry

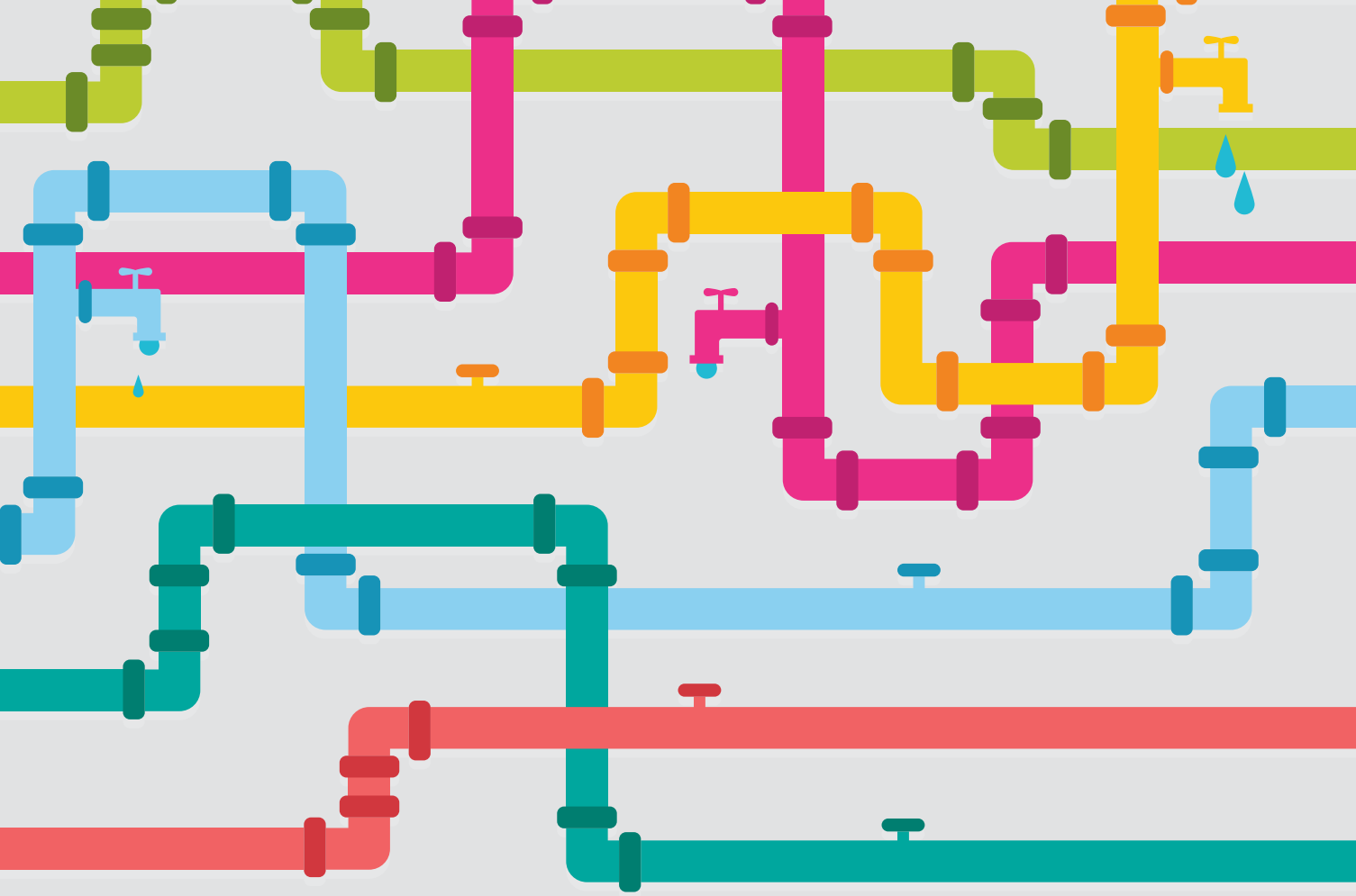
The largest workforce in mining isn’t found in any field camp or office tower. They aren’t wearing safety gear or business suits. They won’t be seen or heard, but their effect on mining operations can be profound. They are naturally-occurring microbes, and they are constantly influencing the water and soil environment.

“Bacteria are present in every aspect of mining, but we don’t fully understand the impacts they can have on water quality,” says Prof. Lesley Warren, an aqueous and microbial geochemist with the Lassonde Institute of Mining and Dept. of Civil Engineering.

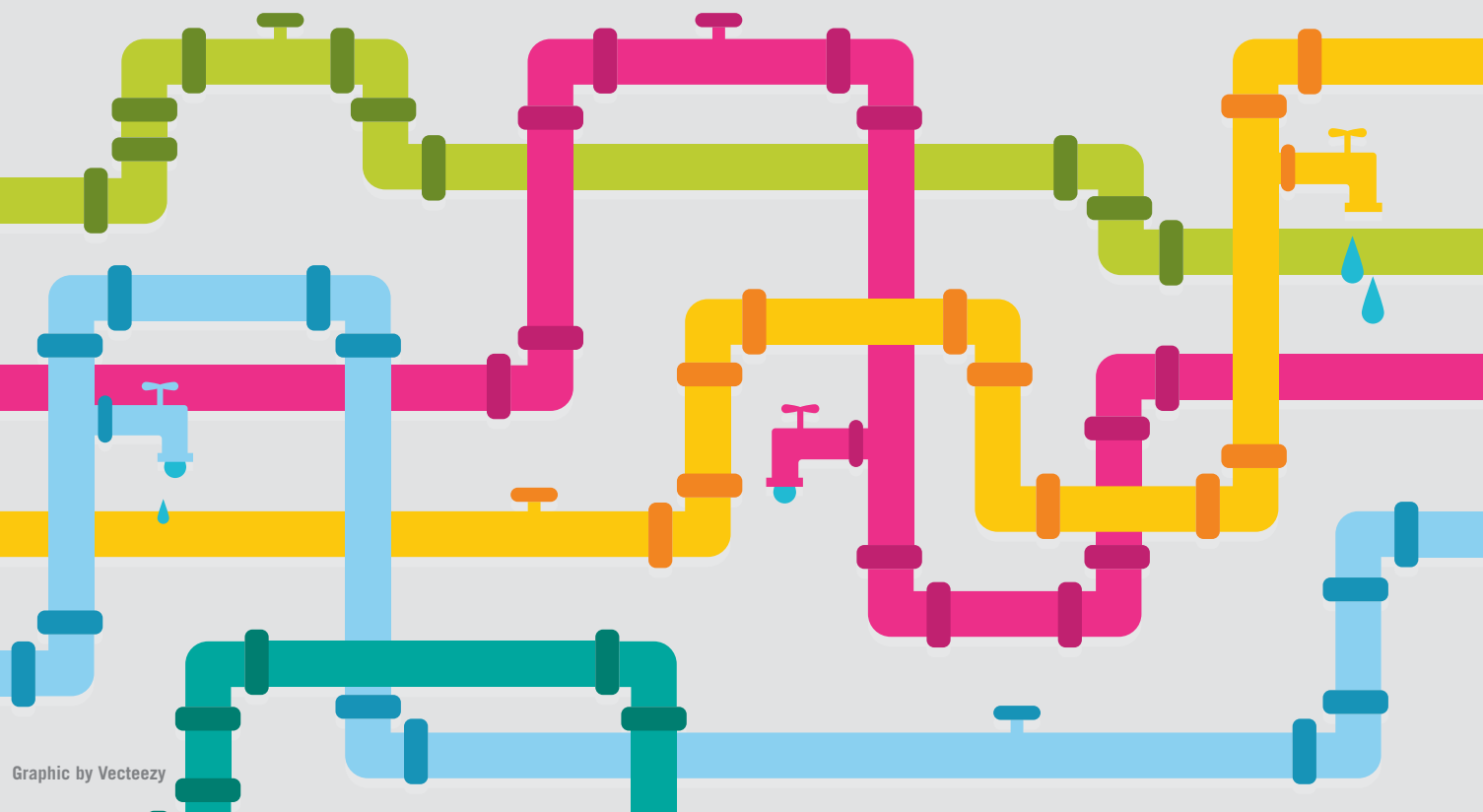
Warren aims to determine the identities and roles of microbes in order to gain an understanding of the bacteria’s beneficial—and detrimental—processes. Her research enables the development of effective biological tools for water quality management with industrial applications.

“Acid mine drainage is the number one priority pollution issue for the mining industry on a global scale,” said Warren. “It refers to the creation of acidic water. When sulfide minerals are exposed to water and air, sulfuric acid is generated through a natural, microbial-driven chemical reaction.”

Better understanding of the ecology of the microorganisms that are taking part in this process will help industry alleviate – or even prevent – polluting processes from occurring in the future.



PREVENTATIVE ENGINEERING



Graphic by Vecteezy

The city is a living organism. People are its cells, and water is its lifeblood. This is the analogy Prof. Bryan Karney uses as the philosophical underpinning of his work in water infrastructure. Like any other organism, things get complex fast. "We have infrastructure systems that are highly deteriorated," he says. "The challenge is, how do you detect the deterioration of systems efficiently, effectively and accurately?"

The deterioration of systems shows up as pipes that break, as systems that leak and as pumps that perform inefficiently. Systems can fail slowly, or they can experience acute catastrophic damage.

"We are trying to develop strategies to listen to systems more effectively, understanding what they are telling us about their own performance."

In the past, Karney argues, we have paid attention to the average performance of water systems, reacting only after they experience acute damage the way an ER doctor might respond to a sudden heart attack or stroke. Contemporary computer sensing and processing abilities have grown immensely, giving researchers the ability to actively monitor the health of water systems, as a cardiac specialist might track heart health as a preventative tool.

In the ideal future, engineers and technicians will run continual, complex diagnostics that quickly pinpoint the smallest disruptions, inefficiencies and even unauthorized access to infrastructure systems, stopping small problems before they become big. It's this kind of technology Karney and his team are helping to develop. The stakes are high.

Mohamed Ghidaoui (CivE 8T9 MASc 9T1 PhD 9T3), now a Professor of Civil and Environmental Engineering at Hong Kong University of Science and Technology, provided a vital connection to one of the world's densest cities. There, the unexpected failure of infrastructure can cost billions.

"He has been the leader for us to put together an initiative that is responding to Hong Kong's opportunities," Karney says. "We chose to work in Hong Kong because they take their infrastructure very seriously. The failure of any single system can be particularly catastrophic. Because of the intensity of land use, repairing systems is incredibly difficult."

The strategy Karney and his team are employing is best described with another analogy. "What we are trying to do in Hong Kong is develop something like a SONAR system for pipes," he explains. "We're introducing high-frequency acoustic noise, sending out waves and getting impulses back that tell us about blockages in the system, leaks or unauthorized usage."

The project's approach is informed by additional work that Karney is undertaking through an NSERC Strategic Partnership Grant with the University of Waterloo. There, researchers like Bryan Tolson have developed a base method for introducing innovative diagnostics to existing infrastructure systems.

Such partnerships greatly enhance research capabilities, enabling researchers at multiple institutions with different areas of expertise to participate on a single complex project. In this case, the team is approaching Hong Kong's challenges from structural, data acquisition and geotechnical angles. Karney notes, "we are looking for correlations between various physical parameters and the deterioration and performance of assets, like pipes."

The capital costs of a typical urban water system range around $8,000 per person – in Toronto, that would be a valuation of around $25 billion system-wide. Approximately 70 per cent of that cost is in the pipes, Karney says. That's a large investment to bury and forget about, which is why the assessment of performance and deterioration are so important.

Inefficiencies in water systems have important economic and environmental repercussions. Better diagnostic tools being developed will allow for significant changes in operations, such as improved pump maintenance and scheduling. These new technologies have the potential to drastically lower costs and emit fewer greenhouse gases.

"No system lasts forever," Karney muses. "They will break down. We have to develop diagnostic tools that can anticipate when our systems are going outside their zone of operation. We need to be pro-active instead of reactive."

Karney sees a future in which we will constantly pay attention to the performance of our systems. "We are developing the technology to understand turbines, to understand pumps, to understand conduits and conveyance systems, so that they can tell us what they are doing and how well they are performing."

Prof. Bryan Karney is a Professor in the Department of Civil Engineering and is the Associate Dean of Cross-Disciplinary Programs in the Faculty of Applied Science and Engineering.

Two new faculty members join Civil and, Mechanical and Industrial Engineering

Collaboration is the key to success and the driving factor behind the hiring of two new professors that are cross-appointed with the Departments of Mechanical and Industrial Engineering, and Civil Engineering. Professors Marianne Touchie (CivE, MIE) and Fae Azhari (MIE, CivE) joined the Faculty at the beginning of July.

Professor Touchie completed a BASc and PhD in Civil Engineering at the University of Toronto. Her research focuses on improving the energy performance and indoor environmental quality of existing buildings to make them more comfortable,

Marianne Touchie

Could you explain the focus of your research?

My research focuses on how we can improve the quality of our indoor environment while also striving for greater energy efficiency? Making buildings more comfortable and healthy often come at an energy cost.

Why did you choose U of T?

U of T is my alma mater so I am well aware of the significance and impact of the research done here and I am looking forward to collaborating with so many talented colleagues and students in both the lab and the classroom.

What are you most looking forward to in your new position?

With a cross appointment between Civil Engineering and Mechanical and Industrial Engineering, I'm excited to bring together students from across disciplines.

As a new professor, what one piece of advice would you give to new students?

Allow yourself to wrestle with a problem before asking for help. It is effortless to use Google or message someone to find an answer. But this process doesn't improve your own ability to problem solve, think critically or take your own position on an issue. During your time at U of T you will gain plenty of technical knowledge but transferable skills like problem solving will be of the most valuable after graduation.

What do you hope to accomplish in your new position/during your time at U of T Engineering?

Within Civil Engineering, I would like to continue growing the Canadian Centre for Building Excellence (CCBE) with Professors Kim Pressnail and Jeffrey Siegel into a world-renowned research centre for healthy, energy efficient buildings.

I would also like to create stronger links through multidisciplinary design courses which will give students an opportunity to tackle today's important problems with colleagues from a variety of technical backgrounds.

healthy and sustainable through comprehensive retrofits.

Professor Azhari holds degrees in Civil Engineering from Isfahan University of Technology and University of British Columbia, Industrial Engineering from UC Berkeley, and Structural Engineering and Mechanics from UC Davis. She specializes in structural health monitoring (SHM) of engineering systems.

U of T Engineering spoke with the new professors to find out more about their research and what they're looking forward to at U of T:

Fae Azhari

Could you explain the focus of your research?

My work focuses on the SHM of engineering systems. Similar to the way a doctor would point out when an organ is malfunctioning in a patient's body during regular check-ups, SHM is able to diagnose and locate any anomalies in an engineering system. Since this diagnosis happens at a very early stage, the remedial procedure will usually be timely and cost-effective. My goal is to address some of the gaps in the succession of tasks from sensor development to implementation and decision making.

Why did you choose U of T?

Long before pursuing academia, I visited Toronto and the campus here. The historical feel and the intellectual vibe stayed in my mind. I'm so happy to be working here now. My research field is multidisciplinary and having access to the many great resources, facilities, colleagues and mentors at U of T will be extremely valuable in advancing my research and career.

What are you most looking forward to in your new position?

I like the sense of collegiality at U of T and look forward to effective collaborations with other researchers.

As a new professor, what one piece of advice would you give to new students?

At university you are often your own teacher so expect to be treated that way. Try to be proactive and do not be afraid to ask questions.

What do you hope to accomplish in your new position/during your time at U of T Engineering?

I hope to one day truly 'profess' my subject; to understand the old and new bodies of knowledge in such a way that I can properly judge their significance and place in the grand scheme of things.

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"Being involved in transportation infrastructure projects like the Gordie Howe Bridge help to understand international competition between cities and countries, and how infrastructure-related trends shape urban landscapes. Specifically, I'm looking at how Detroit and Windsor compete and compare for people, goods and commerce."

Bilal Yusuf
MEngCEM Practicum 2016

"The work I've done for Yukon Highways and Public Works ties directly into key CEM program concepts: real-life modelling, budget allocation to achieve maximum efficiency and ITS planning to improve effectiveness of road networks."

Sarah Dominie
MEngCEM Practicum 2016

The engineering of cities has never been more important to governments, industry and stakeholders. Urban populations are growing - the population of Toronto is expected to triple in the next 15 years; what does this mean for our services? Transportation? The environment? Our students are being trained to identify and address these problems using multidisciplinary strategies and sound business foundations.

The hallmark of the program is a four month practicum that students complete in the summer. Imagine how your organization could benefit from partnering with the department to hire an MEngCEM student.

Investing in the future by reviving the past: John Starkey gives back to survey camp

Since 1921, survey camp has been an unforgettable experience for University of Toronto engineering students. Looking back over 50 years, John Starkey (MinE 6T1) recalls the important role survey camp played in his career as a mining engineer. To ensure students continue to benefit from this unique experience, Starkey sits on the Gull Lake Committee and recently won an Arbor Award for his contributions.

As a practicing engineer designing grinding mills for the mining industry, Starkey observed a disconnect between simulation-based learning for design and the reality of engineering. What he values most about survey camp is its practicality, which is one reason why he volunteers as a guest lecturer, teaching students about his work designing grinding mills and mineral ore processing plants.

"I've been fortunate to identify a field where I believe there is a real need for new thought, new methods, new ways of serving the industry with engineering advice that is accurate, timely and important, so that's what I focused on," explains Starkey.

As a committee member, Starkey is ensuring survey camp remains an integral part of the civil and mineral engineering curriculum. There's also a sentimental factor: he met his wife, who waitressed at The Red Umbrella Inn, while at camp. It is just one of the many relationships and bonds formed at survey camp for untold numbers of engineering students.

"I find it stimulating to go back and revisit places and ideas and to get involved with younger people," admits Starkey. "Now we're looking for ways to sustain both the property and the experience that U of T students have at camp."

Aside from lecturing, Starkey's favourite part about giving back is the opportunity to work with faculty and students in preparing for the future.

"Why would we not go back and do everything we can to ensure that students have a rich, well-rounded experience in life and in engineering?"

A shared experience: Julia Maloney on giving back

After graduating in 2008, reaching out to students was a natural inclination for civil engineering alumna, and former concrete toboggan captain, Julia Maloney. Maloney has sought out opportunities to impart her knowledge and experiences to students to help them become better candidates as they enter the work force.

"Attending job fairs, mentoring sessions and networking events is something I look forward to, especially since I found the more I did it, the more I learned and was able to give insight," said Maloney.

Throughout her time at U of T, Maloney had a number of faculty, friends and staff to support and guide her along the way. Her positive experiences as a student are what inspires her to stay involved as an alumna.

"I didn't know what my future would look like after I graduated," said Maloney. "So I do my best to show students what their future could look like and give them an idea of different paths they might take. Students will be much more prepared after they graduate if alumni can make time for such a small commitment."

Maloney sees networking and career development opportunities as an enjoyable way to give back. To maintain a relationship with students, she plans to use Civ/Min Connect as a platform to interact when she's unable to attend events.

"It's so easy and I have fun doing it," explains Maloney. "They're intelligent young people who want to talk to you because they all want to learn something. They're going to these events to better themselves and you can really tell."

To connect with Julia and to learn about opportunities to give back, visit www.civminconnect.ca.

2015-16 AWARDS & HONOURS

Faculty

International

ACI George C. Hoff Award for Concrete Technology
Douglas Hooton

ACI Joe W. Kelly Award, American Concrete Institute
Frank Vecchio

National

Canada Research Chair
Matthew Roorda, Freight Transportation and Logistics

Elodie Passeport (ChemE, CivE), Environmental Engineering and Stable Isotopes

CSCE Dr. Albert E. Berry Medal for outstanding contributions to environmental engineering
Robert C Andrews

CSCE Camille A. Dagenais Award for outstanding contributions by a civil engineer to the development and practice of hydrotechnical engineering in canada
Bryan Karney

CSCE Fellow
Jeffrey Packer

EIC Julian C. Smith Medal "for achievement in the development of Canada"
Douglas Hooton

EIC Fellow
Heather MacLean

Foundation CMG Research Chair in Fundamental Petroleum Rock Physics and Rock Mechanics
Giovanni Grasselli

NSERC Strategic Partnership Grant
Elodie Passeport (ChemE, CivE), Smarter stormwater management

NSERC Discover Accelerator Supplement
Marianne Hatzopoulou, Urban air quality monitoring

Students

National

Top 8 Academic All-Canadians
Sasha Gollish (PhD Candidate)

Canadian Engineering Memorial Foundation for mentorship of young women
Sara Maltese (Year 3 CivE)

2016 Mining Games - First Place, Mine Design
Peter Miszkiel (MinE 1T5+PEY)
Justin Samardzic (MinE 1T6 + PEY)
Seung Young Baek (MinE 1T5 + PEY)
Gaurav Acharya (MinE 1T5 + PEY)

Ontario Professional Engineers Foundation for Education Award
Savannah Forest (Year 4 CivE)

WAMIC's Edith Tyrrell Award and Medal
Yoko Yanagimura (Year 3 MinE)

University of Toronto

Gordon Cressy Student Leadership Award
Ernesto Diaz Lozano Patiño (CivE 1T5 + PEY)
Andrew Fisher (MASc 1T6)
Brandon Jacobs (CivE 1T5 + PEY)

Vanier Canada Graduate Scholarship
Michael McKie (PhD Candidate)

FACTS & FIGURES

502
CivE + MinE Undergraduate Students

40
Faculty members

442
Graduate Students

7,532
Living Alumni

208
Degrees conferred on graduating students

10
Funded Research Chairs

FACTS & FIGURES

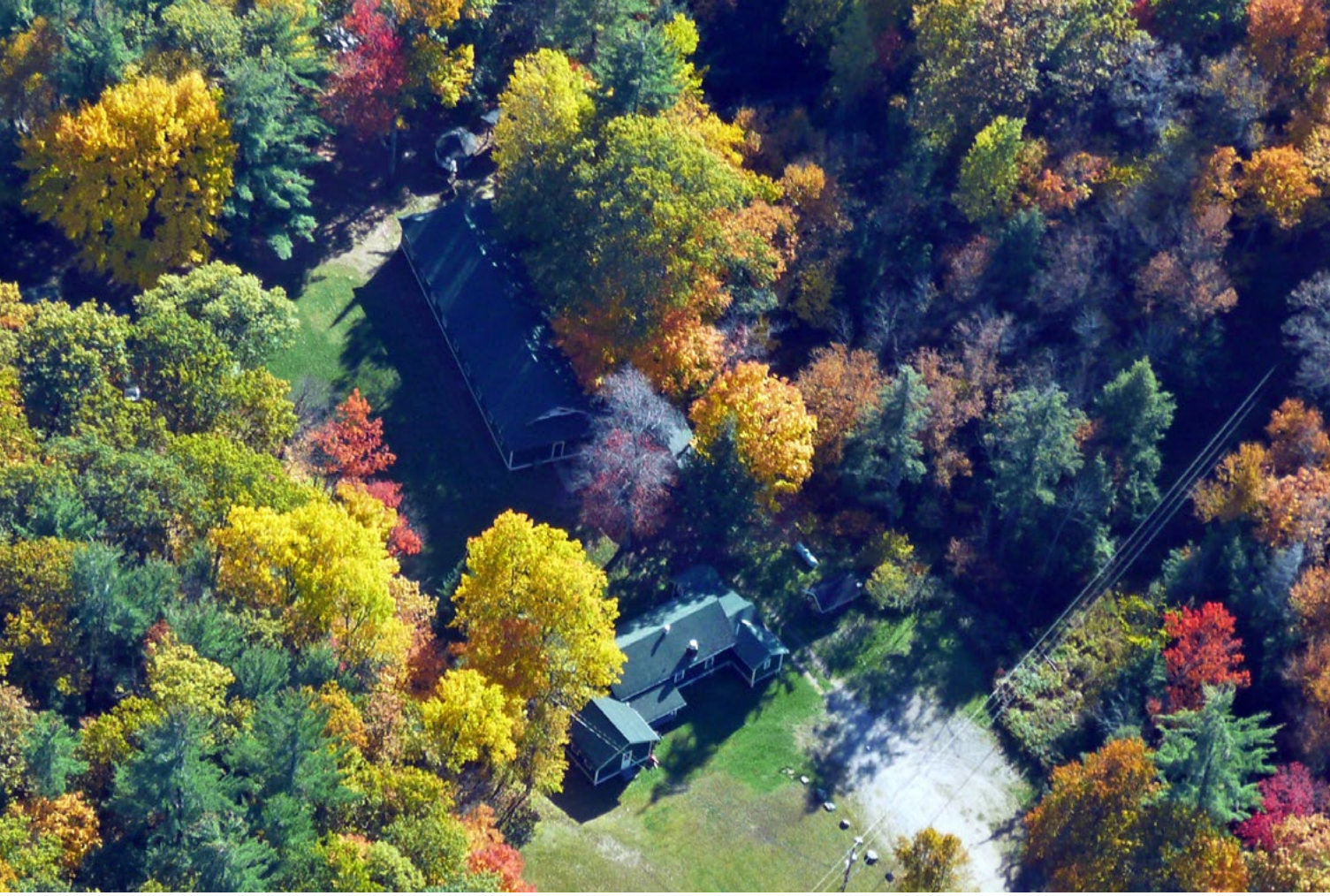
20+
Industry partners

15
Specialized Labs Facilities

6.65M
Total Research Funding

102K
Total Donations

Prof. Oh-Sung Kwon discusses with graduate student in Structures Lab. (Credit: Neil Ta)



The University of Toronto's Camp (also known as Survey Camp), located on the northern shore of Gull Lake near Minden, Ont., has been in operation since 1920. The facility is used to train undergraduate students from the Department of Civil & Mineral Engineering in the art and science of land surveying, engineering project management, geology, hydrology, water treatment, woodlot management and sustainable energy.

With the support of generous benefactors, the University has undertaken necessary renovations, maintaining the camp for almost 100 years. But the camp is at full capacity each summer. With existing foundations, buildings, and water and waste infrastructure unable to meet the needs of the department, the camp requires a comprehensive upgrade and expansion.

For nearly a century, the University of Toronto's Camp has offered a truly unique and memorable experience for students — we aim to ensure this continues well into the future.

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October 24, 2016

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January 12, 2017

2017 MINING GAMES

U of T hosts the popular student competition
February 23-25, 2017

IRON RING CEREMONY & RECEPTION

Graduating students receive their iron rings
March 4, 2017

PDAC ALUMNI RECEPTION

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March 7, 2017

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www.civil.engineering.utoronto.ca
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