

THE WATER INSTITUTE

Annual Report

2016-2017



UNIVERSITY OF
WATERLOO





OUR PEOPLE

150+
FACULTY
MEMBERS

6 faculties
22 departments
or schools

300+
GRADUATE
STUDENTS

25 RESEARCH
CHAIRS

RESEARCH FUNDING

150+
MILLION

since 2009



SCHOLARLY OUTPUT

1,200+

PAPERS PUBLISHED

since 2009

12,000+

PAPERS CITED

since 2009



WATER INSTITUTE VISION

To be a global leader that substantially advances the sustainable use and management of water for the benefit of the environment, economy and society.

SCHOLARLY TALKS



52 WATERTALKS
since 2010-11

1,000+
PEOPLE VIEWED
the 2016-17
WaterTalks online

5 DISTINGUISHED LECTURES
since 2010-11

12 WATERTALKS
in 2016-17

950+ PEOPLE
ATTENDED
the 2016-17 WaterTalks



COLLABORATION

400+ EXTERNAL
PARTNERS

WATER SCHOLARSHIPS AND FELLOWSHIPS



22 SCHOLARSHIPS
from industrial partners
since 2011 worth

\$110,000

67 RBC SCHOLARSHIPS
since 2013 worth

\$425,000

7 RBC FELLOWSHIPS
since 2014



MESSAGE FROM THE EXECUTIVE DIRECTOR

PROFESSOR ROY BROUWER

The Water Institute's mission is to facilitate collaboration, support excellence, and promote innovation in interdisciplinary research and education, and to promote knowledge exchange in addressing complex water challenges.

This year's annual report highlights progress against our strategic goals.

PROMOTE, SUPPORT AND DEMONSTRATE INTERDISCIPLINARY WATER RESEARCH

The main strength of the Water Institute is its ability to organize and conduct interdisciplinary research to support sustainable water use and management. With over 150 researchers from 22 different departments and schools pushing the boundaries of water science, engineering, economics, and governance, we are able to galvanize interdisciplinary teams and make an impact in priority areas. In this report, we showcase our new, interdisciplinary research themes and highlight flagship projects within theme areas. We also introduce Global Water Futures, a new pan-Canadian research program that will define new water management approaches in cold regions, and that will involve many Water Institute researchers over the coming years.

PROMOTE AND SUPPORT INTERDISCIPLINARY PERSPECTIVES IN WATER-RELATED EDUCATION

With the increasing complexity and scale of key water challenges, it has never been more important for future water managers to understand and apply the perspectives and contributions from various water-related disciplines, often those other than their own. The Water Institute's education flagship – the Collaborative Water Program – aims to achieve just that. This innovative interdisciplinary program, jointly offered by 11 departments and schools, allows our graduate students to learn from a broad range of Water Institute faculty members. Students analyze complex problems from an integrated systems perspective, applying peer-to-peer and collaborative approaches that involve water sector stakeholders from government, the private sector, and civil society.

STRENGTHEN GLOBAL NETWORKS AND PARTNERSHIPS WITH LEADING WATER ORGANIZATIONS AND RESEARCHERS

Promoting sustainable water management through interdisciplinarity and innovation is a key goal of the Water Institute, but there is another role that we aim to play – that of a global partner and connector. In order to remain a global leader in the field of water research and education, we must connect our knowledge and innovations to other global knowledge and innovation centres. This year's report shows how the Water Institute has established mutually beneficial collaborations with leading water organizations from across the globe. This has resulted in various international agreements, joint workshops, faculty and student exchanges, visiting delegations, participation in major water events in Sweden, Singapore and Mexico, and new international research projects.

PROMOTE KNOWLEDGE TRANSFER TO COMMUNICATE THE IMPACT OF WATERLOO'S RESEARCH

The Water Institute believes that it is imperative to link our researchers and their research to end-users, including governments, the private sector, and civil society, in order for our work to have an impact. We are committed to facilitating a two-way exchange of information with our end-users and other stakeholders through various vehicles such as our external partners program, our WaterTalks lecture series, and our exciting new AquaHacking partnership. In addition, over the past year, the Institute has focused on improving various communication channels, including our website, social media platforms and print collateral. In the coming year, we are very excited to host our first international water conference bridging water science, water engineering and water economics, and to launch a new scientific newsletter.

PROFESSOR ROY BROUWER

Executive Director, the Water Institute
University of Waterloo



WHAT WE DO

A primary objective of the Water Institute is to facilitate interdisciplinary research and education to address increasingly complex water issues.

“The Water Institute is a wonderful example of the Waterloo ethos in practice. Through innovation, interdisciplinarity and internationalization, the Institute has become a recognized leader in addressing some of the world’s most pressing water security challenges.”

FERIDUN HAMDULLAHPUR

President and Vice-Chancellor

University of Waterloo

The University of Waterloo established the Water Institute in 2009, building on four decades of excellence in water-related research, education and innovation. Waterloo's water research programs are diverse, and collectively comprehensive, with core disciplinary expertise found in 22 departments and schools across all six faculties.

The Water Institute includes over 150 faculty members and 300 graduate students from:

APPLIED HEALTH SCIENCES

- › Public Health and Health Systems
- › Recreation and Leisure Studies

ARTS

- › Accounting and Finance
- › Economics
- › Philosophy
- › Political Science
- › Social Development Studies

ENVIRONMENT

- › Environment, Enterprise and Development
- › Environment, Resources and Sustainability
- › Geography and Environmental Management
- › Planning

ENGINEERING

- › Architecture
- › Chemical Engineering
- › Civil and Environmental Engineering
- › Electrical and Computer Engineering
- › Mechanical and Mechatronics Engineering
- › Systems Design Engineering

MATHEMATICS

- › Applied Mathematics
- › Computer Science

SCIENCE

- › Biology
- › Chemistry
- › Earth and Environmental Sciences

The Water Institute provides the following support to its members:

RESEARCH

- › Identify funding opportunities and secure incremental funding
- › Identify, introduce and support researchers with common areas of interest
- › Provide review and advice on research proposals
- › Identify partners and solicit letters of support for research projects
- › Provide in-kind support to research projects
- › Lead, manage and support new interdisciplinary research projects

EDUCATION

- › Co-ordinate and support the Collaborative Water Program
- › Support and enable the Water Institute's graduate student chapter (SWIGS)

PARTNERSHIPS

- › Cultivate industrial, governmental, civil society and other partnerships
- › Facilitate and support international collaborations and partnerships
- › Lead faculty delegations to other countries
- › Host academic delegations at Waterloo
- › Serve as a central point of contact

KNOWLEDGE TRANSFER

- › Support and organize workshops, research symposia, WaterTalks and distinguished lectures
- › Promote and profile researchers and research impact through various communications activities
- › Facilitate and support media relations



The Water Institute builds from the legacy of the many water researchers who developed internationally recognized programs at Waterloo during the first several decades of

its existence. During 2016-17, the Water Institute was thrilled that President and Vice-Chancellor Feridun Hamdullahpur welcomed guests to his office with a display that showcased several water “artifacts,” representing Waterloo's significant contribution to water research and education over the years.



The Water Institute has

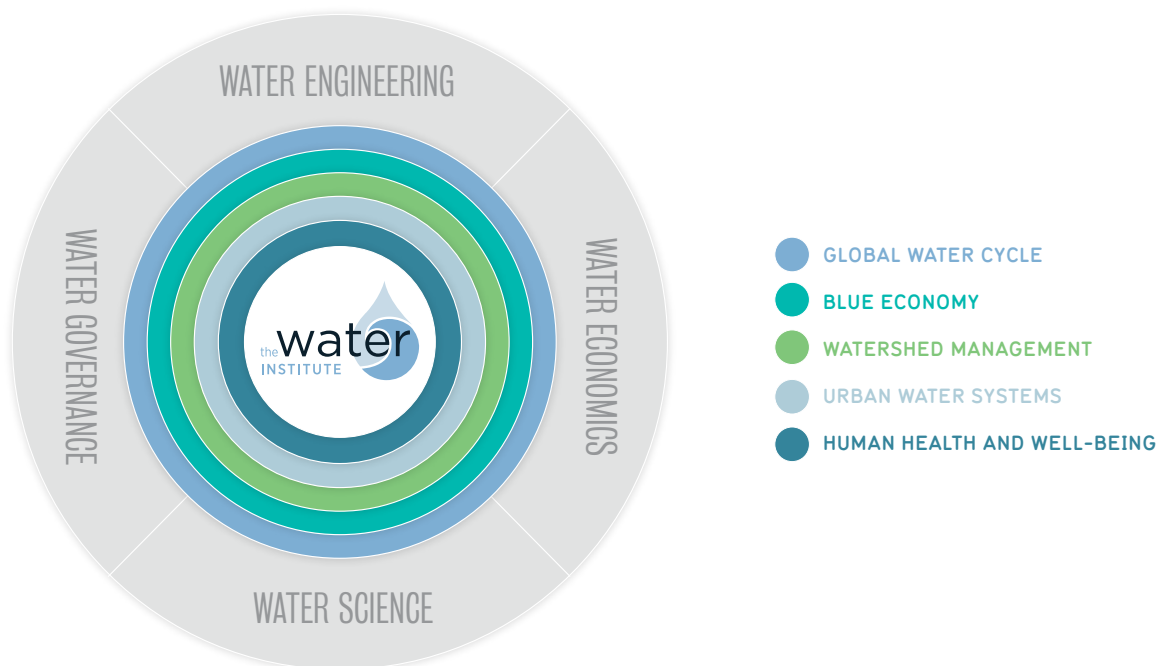
5 RESEARCH THEMES



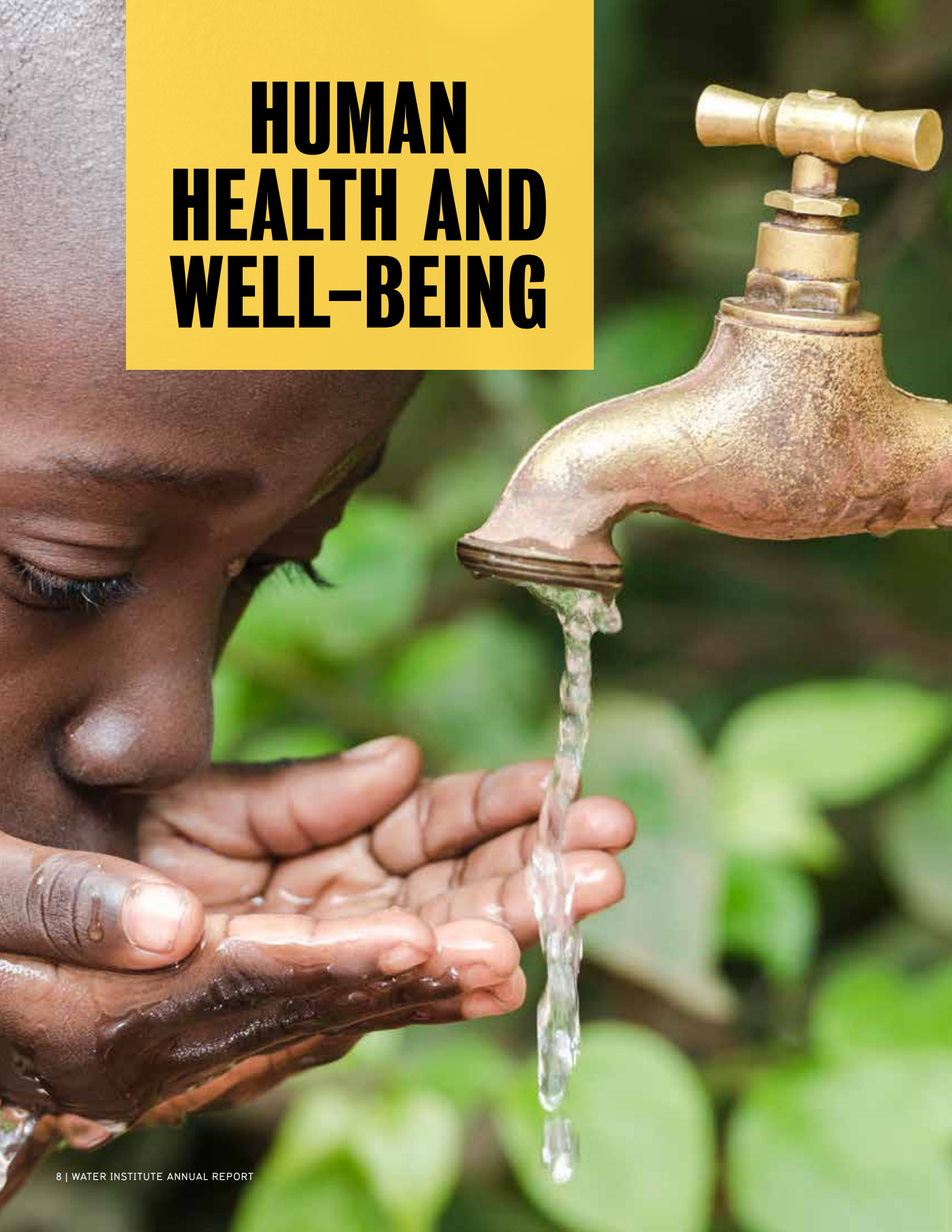
RESEARCH THEMES

An important Water Institute 2016-17 objective was to facilitate the development of key themes where the interdisciplinary work of water scientists, engineers, economists, and governance specialists can make a difference.

Solutions to increasingly complex water issues often require the engagement of various disciplinary perspectives. Water Institute researchers represent a very wide breadth of disciplinary expertise. After significant discussion, five themes were identified as a framework to organize past and current research, and also as a means to catalyze future activities. The themes integrate disciplinary perspectives cascading up from individual human health, to urban systems, to watersheds, to economies, and to the global systems.



HUMAN HEALTH AND WELL-BEING



Water is fundamental to human health and is a key social justice issue. Lack of access to safe drinking water and adequate sanitation is one of the greatest human health and environmental threats facing the world's most vulnerable. According to the United Nations, almost 1,000 children die each day due to preventable water and sanitation-related diarrhoeal diseases. The United Nation's Sustainable Development Goal 6 calls for universal access to clean, affordable drinking water and sanitation for all by the year 2030. Many of the world's poor or vulnerable live in water stressed areas where problems of water scarcity and contamination are increasing.

Climate change, population growth, and poorly planned development is degrading the health and sustainability of watersheds, which is affecting agriculture and fisheries production, nutrition, and economic well-being. In order to meet these challenges, interdisciplinary approaches that include integration and innovation across technical (flood and drought management, improved irrigation, increased recycling, decentralized treatment), economic (affordability, improved system efficiencies, market-based instruments, effective investments), social (accessibility, equity, conservation education, community advocacy), and institutional (transparent information, supporting structures, effective governance) spheres are required.

Current Water Institute research within Human Health and Well-being includes:

- › Understanding relationships between the environment, water, and human health
- › Effective water and sanitation schemes for maternal and child health
- › Understanding the burden of, and risks for, waterborne infectious diseases in human populations
- › Assessing the impact of the extractive industry on public health
- › Developing integrated health impact assessment concepts and methods
- › Understanding the impact of natural disasters on community and human health
- › Developing nano-sensors and lab-on-chip devices to test water quality
- › Assessing public perception and socio-economic valuation of environmental risks

PROFESSOR CRAIG JANES
Public Health and Health Systems



Using a GIS and Satellite Imaging System to Inform Health System Spatial Planning in Zambia

Craig Janes and colleagues are using an open-access geographic information system and satellite imaging system to predict floods, identify and respond to malaria “hotspots,” and to generally improve the public health response in the Western Province of Zambia. The satellite imagery and information system provide near real-time flood mapping, thus allowing public health officials to plan and co-ordinate essential health care and public health services in a more effective and efficient manner.

URBAN WATER SYSTEMS



Cities require adequate water supplies and the ability to treat wastewater in order to thrive. Urban water systems have traditionally focused on the provision of safe drinking water, the collection and treatment of wastewater, and more recently, stormwater and protection against flooding. In high-income countries, these systems have had an enormously positive impact on public health and safety, and on ecosystem protection. However, these urban water systems are capital intensive, largely relying on a network of ageing distribution and collection pipes linked to homes and centralized treatment facilities. The implementation of such systems in rapidly urbanizing cities in low-income countries and in emerging economies – which are often located in water-stressed areas – presents unique challenges, requiring innovative technologies, smart spatial planning, and strong institutions to achieve more sustainable and economically-viable urban water solutions.

Current Water Institute research within Urban Water Systems includes:

- › Investigating innovative and emerging drinking and wastewater treatment processes and technologies
- › Assessing the fate and removal of emerging contaminants in wastewater systems
- › Investigating the use of nano-material in wastewater treatment and nano-devices for detection
- › Assessing the impacts of floods and droughts on water treatment systems
- › Developing sustainable financing models for water and wastewater infrastructure asset management tools
- › Evaluating the environmental exposure and effects of emerging contaminants in aquatic systems
- › Conducting field and numerical modelling studies on urban river mechanics, hydraulics, and hydrology
- › Undertaking river restoration/rehabilitation and aquatic habitat improvements
- › Developing integrated management approaches, including land-water management, demand-focused water strategies, and the use of market-based policy instruments

PROFESSOR BLAIR FELTMATE

Environment, Enterprise and Development



The Role of Wetlands in Limiting Urban Flood Damage

Blair Feltmate and his colleagues at Waterloo's Intact Centre on Climate Adaptation are assessing the potential for wetlands to affect the financial impacts associated with urban and rural flooding. Their work has demonstrated, quantitatively, that maintaining wetlands in their natural state offers a broadly-applicable and cost-effective means to reduce the financial and social impacts of flooding affecting Canadians.

An aerial photograph showing a river meandering through a diverse landscape. The river flows from the upper right towards the lower left. On the left bank, there is a residential neighborhood with many houses, a large green golf course, and a field of golden-brown crops. The right bank features rolling green hills, some agricultural fields, and a dense line of trees. The overall scene is a mix of natural and developed environments.

WATERSHED MANAGEMENT

Watersheds are an important hydrologic unit for understanding natural and ecologic functions, and for understanding how human activities affect them. Watersheds supply ecosystem services such as drinking water, water for agriculture and industry, habitats for terrestrial and aquatic species, and recreational opportunities for rural and urban communities.

The impacts of human activities on watersheds, however, are increasingly threatening their ability to produce sufficient quantities of clean water necessary to promote human health and economic prosperity. Investigating the biophysical linkages between watershed components – between groundwater and surface water, water quantity and water quality, terrestrial and aquatic systems – is critical for scientific discovery, and for the design of effective management responses that address drivers of change, while balancing competing water demands with human aspirations and ecosystem health.

Current Water Institute research within Watershed Management includes:

- › Characterizing and modelling interconnected surface and groundwater systems
- › Assessing the effects of human activity and multiple stressors (eutrophication, acidification, climate change, river regulation, urbanization, species invasions) on watershed hydrology, water quality, biogeochemical processes, and aquatic systems
- › Advancing the understanding of the fluxes and transformations of nutrients (phosphorus, nitrogen, silicon) and metals at the groundwater-surface water interface
- › Understanding physical processes and stressors in oceans, lakes, and wetlands and their effects on biogeochemical processes
- › Developing “smart” watershed data integration platforms to monitor conditions in real-time
- › Developing improved techniques for the prediction, remediation and prevention of groundwater contamination
- › Identifying and assessing, including economically, water policy and governance arrangements, including integrated land-water management and drinking water source protection planning

PROFESSOR NANDITA BASU

Earth and Environmental Sciences and
Civil and Environmental Engineering



Biogeochemical Hotspots: Role of Small Water Bodies in Landscape Nutrient Processing

Nandita Basu and colleagues are investigating how the environment naturally protects freshwater resources from agricultural fertilizer contamination. They found that small wetlands have a more significant role to play than larger ones in preventing excess nutrients, like nitrogen and phosphorus from fertilizer, from reaching waterbodies such as the Great Lakes.

BLUE ECONOMY



The blue economy is a concept that envisages the more effective and efficient use and management of water resources within a more sustainable circular economy. Global water security is being threatened by growing demand, by limited or contaminated local supplies, and by increased uncertainty and variability in global supply due to climate change. Meeting these challenges requires the development and implementation of innovative water technology and, at the same time, requires behavioural changes. For these supply and demand factors to work together, they will require supporting institutional-economic governance structures.

In moving towards a blue economy, various disciplinary perspectives need to be integrated to develop evidence-based economic, technological, institutional, and political approaches and mechanisms to reconcile economic prosperity with improvements to human health and long-term environmental sustainability.

Current Water Institute research within Blue Economy includes:

- › Determining the value of water and aquatic ecosystem services
- › Defining market-based instruments for water management, including water pricing
- › Linking and integrating water monitoring and economic accounting systems
- › Integrating hydrological and economic models to support decision-making and policy implementation at the watershed scale
- › Studying the treatment of water risks and opportunities in corporate water management
- › Calculating the water footprint of organizations and products
- › Developing smarter and more efficient circular water technologies and resource recovery systems
- › Innovating transboundary water governance models

PROFESSOR ROY BROUWER

Economics



Who Should Pay for Services that Watersheds Provide?

Forests, wetlands and grasslands all provide watershed services by enhancing water quality and supply, biodiversity, and carbon storage. Roy Brouwer is analyzing the success of payment schemes that have attached a price to these essential services, including the institutional and economic design, and how payment schemes translate into long-term environmental sustainability.

GLOBAL WATER CYCLE



The water cycle links the Earth's lands, oceans, and atmosphere in an integrated global system. Researching the cycling of water through this system is key to understanding the science of water's storage and movement, and how human activities, such as urbanization, deforestation or dam building, impact not only the water cycle, but also related climatic and biogeochemical cycles.

Climate change is making the global water cycle less predictable, and reduces the stability of food, energy and urban systems. By better understanding how climate change is increasing the variability and intensity of rain events, and the associated risk of flooding or drought, more effective approaches can be designed to mitigate or adapt to its impacts.

Current Water Institute research within this theme includes:

- › Optimizing the calibration of atmospheric and hydrologic models
- › Estimating hydrologic extremes, and quantifying uncertainty, under various climate change scenarios
- › Investigating linkages between hydroclimatology, biogeochemical cycling, and surface-water chemistry
- › Understanding physical processes in oceans, lakes, and wetlands and their effects on biogeochemical processes
- › Observing snow and ice hydrology through remote sensing, modelling, and in situ measurement
- › Understanding the effects of climate change on aquatic food webs
- › Examining the hydrodynamics of lakes and wetlands
- › Assessing water-related impacts and socio-economic vulnerabilities from climate change
- › Identifying cost-effective mitigation and adaptive management strategies at multiple governance levels

PROFESSOR MAREK STASTNA
Applied Mathematics



Mass Transport by Mode-2 Internal Solitary-Like Waves

Marek Stastna and his graduate student David Deepwell have performed 3-D simulations that analyze how materials such as phytoplankton, contaminants, and nutrients move within aquatic ecosystems via underwater bulges called mode-2 internal waves. These simulations can help researchers understand how internal waves can carry materials over long distances and can guide both experimental and field measurements.



“The Global Water Futures program will transform water management in Canada. I am confident that the Water Institute, which serves as a catalyst for interdisciplinary approaches to addressing complex water security challenges, is poised to make a very significant contribution to this collaboration.”

GEORGE DIXON

Vice-President Academic and Provost
University of Waterloo

GLOBAL WATER FUTURES

We are facing unprecedented water-related challenges. This exciting new project aims to position Canada as a global leader in preparing for change.



Cold regions in Canada, and globally, are experiencing changes to regional climate and environmental conditions. These changes include severe floods, longer drought periods and deterioration of water quality that are putting economies, communities and ecosystems at risk. In 2016-17, the “Global Water Futures: Solutions to Water Threats in an Era of Global Change” program was launched to position Canada as a global hub for leading-edge, user-driven water science for the world’s cold regions. Global Water Futures will transform the way communities, governments and industries in Canada and other cold regions of the world prepare for and manage these increasing water-related threats.

The Water Institute is pleased to be the lead university partner on this University of Saskatchewan-led initiative, which also includes collaborators from Wilfrid Laurier University, McMaster University and 14 other Canadian universities and colleges. This seven-year program, funded in part by a \$77.8-million grant from the Canada First Excellence Research Fund, is the largest university-led water research program ever funded worldwide. Over upcoming years, a large number of Water Institute researchers and partners will be actively contributing to the Global Water Futures program, and will be providing global leadership in cold regions water science, engineering, economics and governance, and will be delivering the tools needed for effective adaptation and risk management.



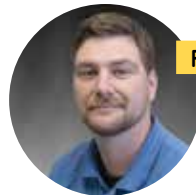
RESEARCH EXCELLENCE

During 2016-17, two Water Institute members were elected to The Royal Society of Canada College of New Scholars, Artists and Scientists in recognition of their high level of achievement at an early stage in their career, and two members were awarded new Canada Research Chairs recognizing excellence in their field.



PROFESSOR ZHONGWEI CHEN

from the Department of Chemical Engineering was recognized by The Royal Society of Canada for his ground-breaking contributions to the development of advanced materials for electrochemical energy storage and conversion technologies.



PROFESSOR JAMES CRAIG

from the Department of Civil and Environmental Engineering was awarded a Canada Research Chair for his work to improve the science of hydrologic modelling and analysis, including the development and application of new modelling approaches for addressing difficult environmental/water resources problems in both groundwater and surface water systems.



PROFESSOR JOHN YEOW

from the Department of Systems Design Engineering was recognized by The Royal Society of Canada for his pioneering contributions to microelectromechanical systems, nanotechnology-based biomedical imaging systems for diagnostic and therapeutic applications, and lab-on-chip designs for contaminant detection.



PROFESSOR LAURA HUG

from the Department of Biology was awarded a Canada Research Chair for her work in environmental microbiology, including the study of the diversity and function of microbial communities in contaminated sites using a mixture of total community approaches, bioinformatics, and wet-lab microbiology techniques.

WATER INSTITUTE RESEARCH CHAIRS

CANADA EXCELLENCE RESEARCH CHAIR

PHILIPPE VAN CAPPELLEN
Ecohydrology

CANADA RESEARCH CHAIRS

DAVID BLOWES
Groundwater Remediation

ZHONGWEI CHEN
Advanced Materials for Clean Energy

JAMES CRAIG
Hydrologic Modelling and Analysis

BRIAN DIXON
Fish and Environmental Immunology

FRANK GU
Nanotechnology Engineering

LAURA HUG
Environmental Microbiology

JANUSZ PAWLISZYN
New Analytical Methods and
Technologies

CAROLYN REN
Droplet Microfluidics and
Lab-on-a-chip Technology

MARK SERVOS
Water Quality Protection

MARIA STRACK
Ecosystems and Climate

ALEXANDER WONG
Medical Imaging Systems

JOHN YEOW
Micro and Nanodevices

INDUSTRIAL RESEARCH CHAIRS

PETER HUCK
Water Treatment

JANUSZ PAWLISZYN
New Analytical Methods and
Technologies

UNIVERSITY RESEARCH CHAIRS

PU CHEN
Nano-Biomaterials

CLAUDE DUGUAY
Cryosphere and Hydrosphere from Space

XIANSHE FENG
Membrane Science and Technology

SHESHA JAYARAM
High Voltage Engineering

JUEWEN LIU
Bionanotechnology and Interfaces

DANIEL SCOTT
Global Change and Tourism

HEIDI SWANSON
Freshwater Ecology

MICHAEL TAM
Functional Colloids and Nanomaterials

NORMAN ZHOU
Microjoining

CENTRE FOR GOVERNANCE AND INNOVATION RESEARCH CHAIR

THOMAS HOMER-DIXON
Global Systems

A person wearing a dark jacket and a red headband is standing on a silver step ladder in a field of tall, dry grasses. They are holding binoculars to their eyes. The background shows a clear sky with a warm, golden light, suggesting sunrise or sunset. The overall scene is a field of tall grasses with several thin poles or markers planted in the ground.

SEED GRANTS

Water Institute seed grants facilitate interaction with national and international authorities, and stimulate new interdisciplinary collaborations. Outputs and outcomes from Water Institute seed grants include new collaborations, major presentations, workshops and symposia, research proposals, new courses, journal publications, books, and new funded research projects.

2016-17 WATER INSTITUTE SEED GRANT RECIPIENTS

BRUCE MacVICAR, Civil and Environmental Engineering

- › Linking stream network process models to robust adaptive data management systems for the development of decision support tools that model cumulative effects in watersheds

CHRIS PARSONS, Earth and Environmental Sciences

- › Nutrient cycling and contaminant transport in groundwater of Southern Ontario (Canada) and Quintana Roo (Mexico): Similarities, differences, collaboration and solutions

MADLINE ROSAMOND, Earth and Environmental Sciences

- › What do current water quality monitoring programs really tell us, and how can we improve them? Assessing water quality monitoring programs with the aim of improving Ontario's provincial Water Quality Monitoring Network

REBECCA ROONEY, Biology

- › Interdisciplinary assessment of whether intervention is warranted in the management of aquatic invasive species

SIMRON SINGH, Environment, Enterprise and Development

- › Governance, institutions and water metabolism: Developing an operational framework for the Caribbean

PU CHEN, Chemical Engineering

- › Polymer/graphene nanocomposite membranes to enhance demineralization of wastewater

PETER DEADMAN, Geography and Environmental Management

- › Integrated assessment of agricultural best management practices and phosphorus runoff

ELIZABETH ENGLISH, Architecture

- › International symposium on the development of government, insurance, and building code policies to support innovation in flood damage reduction

MAHYAR SHAFII, Earth and Environmental Sciences

- › Stormwater management and nutrients control in extreme events: Mobilization of knowledge on the reduction of nutrient loading from urban non-point sources under climate change



33 SEED GRANTS AWARDED

since 2011-12

\$50,000 INVESTED

in new, interdisciplinary activities since 2011-12



WATERTALKS

The Water Institute WaterTalks lecture series provides an opportunity for students, faculty, and the public to learn from, and to interact with, leading water experts from around the world.

2016-17 WATERTALKS

GENEVIEVE ALI, Assistant Professor, Junior Chair, Watershed Systems Research Program, University of Manitoba

- › Preserving prairie wetland hydrological and biogeochemical functions: What do we need to know?

DIANE DUPONT, Professor, Brock University

- › Floods and droughts: Eliciting customer willingness-to-pay and adverse event likelihood priors for public utility pricing

DMITRI KAVETSKI, Professor, University of Adelaide, Australia

- › From uncertainty quantification to hypothesis-testing in hydrological application: Review of recent advances

JOHN LINDSAY, Professor, University of Guelph

- › Using open-access GIS to address issues in spatial hydrological modelling

RICHARD LUTHY, Professor, Stanford University

- › Urban water supply re-invention for dry cities

MARK MATTSON, Founder and President, Lake Ontario Waterkeeper

- › Help ensure a swimmable, drinkable, fishable Canada

ALEXANDER MAYER, Professor, Michigan Technological University

- › Developing the Great Lakes' blue economy: Water productivity, water depletion, and virtual water trade in the Great Lakes basin

MERRELL-ANN PHARE, Executive Director, Centre for Indigenous Environmental Resources

- › Water co-governance and collaborative consent: Working in partnership with Indigenous peoples to protect water and honour the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

JOAN ROSE, Professor, Michigan State University

- › Monitoring pathogen concentrations in sewage to inform treatment goals and public health risks

JEREMY SCHMIDT, Professor, Durham University, United Kingdom

- › Water: Abundance, scarcity, and security in the age of humanity

CHRISTIAN STAMM, Deputy Head, Department of Environmental Chemistry, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland

- › Unravelling the impacts of wastewater-born micropollutants in stream ecosystems

PIETER VAN DER ZAAG, Professor, UNESCO-IHE Institute for Water Education, and Delft University of Technology, The Netherlands

- › Water storage: Nature-based solutions for resilient communities

950+ PEOPLE
ATTENDED
the 2016-17 WaterTalks

52 WATERTALKS
since 2010-11



Most WaterTalks are available for viewing on the Water Institute YouTube channel.

EXTERNAL PARTNERS PROGRAM

The Water Institute External Partners Program provides private sector, government, civil society, and other organizations with direct access to our researchers and programs.

The Water Institute launched its External Partners Program in 2013 to facilitate partnerships between researchers and members of the private sector, government, civil society and other organizations that have a particular interest in the water sector. Four levels of membership are available to our partners – Platinum, Gold, Silver and Bronze – with commensurate benefits. The Water Institute currently has over 400 external partners.

Depending upon the membership level, External Partners Program benefits can include:

- › Water-related information and news
- › Invitations to the Water Institute's WaterTalks
- › Introductions to relevant Waterloo researchers to discuss opportunities for collaboration
- › Invitations to Water Institute Research Symposiums and Distinguished Lectures
- › Support for student recruiting activities, such as World Water Day booths or Employment Forums
- › Recognition through Water Institute graduate scholarships (Platinum members only)
- › Recognition and acknowledgment of membership and scholarship support on the Water Institute website and at our Research Symposium

The Water Institute sincerely appreciates the support of its 2016-17 Platinum, Gold and Silver partners.

PLATINUM LEVEL

AECOM



GOLD LEVEL

ch2m:



SILVER LEVEL

Geosyntec
consultants

engineers | scientists | innovators



AQUAHACKING PARTNERSHIP

“This three-year partnership with the de Gaspé Beaubien Foundation will help young innovators pursue excellence in technology advancement in the water sector. I look forward to being a part of the groundbreaking, interdisciplinary solutions AquaHacking 2017 will bring to Lake Erie’s water challenges.”

ROY BROUWER

Executive Director
the Water Institute

An exciting new partnership to develop innovative, technology-based solutions that address key challenges in the Great Lakes.

During World Water Day celebrations on March 22, 2017, the Water Institute and the de Gaspé Beaubien Foundation announced an exciting three-year partnership that will combine water expertise and technology to help address the threats facing the Laurentian Great Lakes. More specifically, AquaHacking challenges water scientists, engineers, and entrepreneurs to develop technologies that address water-related issues, or that take advantage of water-related opportunities through a hacking competition.

The partnership brought AquaHacking 2017 – a five-month, Lake Erie-focused hackathon – to Waterloo. From April to June, multi-disciplinary teams were encouraged to form, identify a potential solution, and were coached and mentored by water and technology experts, innovators, and entrepreneurs. Following a semi-final competition in June, five finalist teams will be selected, and will move to a finalist competition in September. The top five AquaHacking 2017 teams will share \$75,000 in acceleration money, and the top three teams will earn placements in local incubators to grow their ideas.



“AquaHacking is a movement that aims to conserve the Great Lakes and the Saint Lawrence, and to foster the quality and responsible use of these waters. Partnerships with organizations like the Water Institute are important to our mission of championing emerging clean-tech innovation and entrepreneurship while bringing together stakeholders from multiple sectors, jurisdictions and generations to develop integrated strategies for water policy and governance.”

CLAUDE PERRAS

Executive Director
de Gaspé Beaubien Foundation

COLLABORATIVE WATER PROGRAM

“I recently attended a national water conference, and it became apparent quickly that my CWP training was very valuable in allowing me to effectively communicate with a wide variety of water sector stakeholders, including government, private sector and civil society representatives. I am very thankful to the program, and now feel equipped in understanding and appreciating the nature of research across different water-related disciplines.”

MARICOR ARLOS

MASc (Water)

PhD Candidate, Department of Biology



An innovative interdisciplinary graduate program for water students aimed at developing broad-minded specialists.

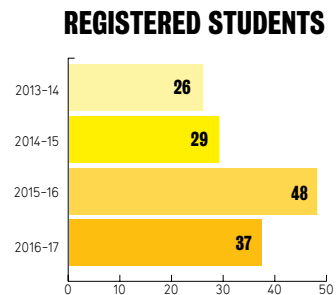
The University of Waterloo's Collaborative Water Program (CWP) was launched in 2013 to promote interdisciplinary perspectives on water. This innovative program, jointly offered by 11 academic departments and schools, is co-ordinated and supported by the Water Institute. Collaborative Water Program students complete their specialist training in their respective home departments or schools, while working with colleagues from a variety of other departments and schools in two interdisciplinary courses (WATER 601 and WATER 602) specifically designed for the program.

During 2016-17, key CWP activities included:

- › The fourth cohort of 37 CWP students participated in an annual leadership retreat and completed WATER 601. The two-day retreat was held at a local YMCA camp, and included a variety of team-building and collaboration exercises; WATER 601 was a case-study oriented course that used peer-to-peer learning in exploring water issues from a variety of disciplines and perspectives.
- › The third cohort of 48 CWP students completed WATER 602, which uses the Grand River watershed as a "living laboratory" to study basin characteristics and issues from a variety of perspectives. The course included a mix of field trips, group and individual work.

THE MOST
MULTI-DISCIPLINARY
graduate water program in Canada

**11 DEPARTMENTS/
SCHOOLS** participating



140
STUDENTS
registered
since 2013



63%
of historic
enrolment are
FEMALE

37%
are
MALE

The continuing success of the CWP is a major achievement for the Water Institute in support of its goal to promote interdisciplinary education. The CWP continues to gain momentum as faculty, students, and employers recognize the value associated with broad-minded specialists.

CWP DEPARTMENTS AND SCHOOLS

1. Applied Mathematics
2. Architecture
3. Biology
4. Chemical Engineering
5. Civil and Environmental Engineering
6. Earth and Environmental Sciences
7. Economics
8. Environment, Enterprise and Development
9. Environment, Resources and Sustainability
10. Geography and Environmental Management
11. Public Health and Health Systems

69
FACULTY
SUPERVISORS
since 2013

WATER SCHOLARSHIPS AND FELLOWSHIPS

Every year the Water Institute awards scholarships to graduate students studying in the Collaborative Water Program, and supports fellows who visit campus to contribute to the program. The scholarships and fellowships are generously supported through a gift from the RBC Foundation.

2016-17 RBC WATER SCHOLARSHIP RECIPIENTS

ABDULLAH ALBILADI, MSc candidate, Chemical Engineering
SUHAIB BHATTI, MArch candidate, Architecture
AARON COUTINO, PhD candidate, Applied Mathematics
AMY DIETRICH, MES candidate, Geography and Environmental Management
JAMES ELLIOTT, MES candidate, Geography and Environmental Management
DOROTTYA GARDA, MSc candidate, Earth and Environmental Sciences
TASHA-LEIGH GAUTHIER, MES candidate, Geography and Environmental Management
BRITTNEY GLASS, MSc candidate, Earth and Environmental Sciences
SARAH GRASS, MSc candidate, Civil and Environmental Engineering
XINGTONG JI, MA candidate, Economics
MITCHELL KAY, MSc candidate, Biology
WYNONA KLEMT, MSc candidate, Biology
KATRINE LED, MSc candidate, Civil and Environmental Engineering
KONHEE LEE, MSc candidate, Civil and Environmental Engineering
SEAN MACIEL, MArch candidate, Architecture
ERIN MILLS, PhD candidate, Environment, Resources and Sustainability
CHRISTOPHER MUIRHEAD, MSc candidate, Civil and Environmental Engineering
SYED SHAHID, MSc candidate, Chemical Engineering
STEPHANIE SLOWINSKI, MSc candidate, Earth and Environmental Sciences
IWONA WIDURSKA, MSc candidate, Earth and Environmental Sciences

\$560,000

**IN RBC WATER
SCHOLARSHIPS**

awarded since 2013-14

67 RBC SCHOLARSHIPS

since 2013-14

7 RBC FELLOWSHIPS

since 2014



RBC Foundation

2016-17 RBC VISITING FELLOWS

PIETER VAN DER ZAAG, Professor of Integrated Water Resources Management, IHE Delft Institute for Water Education, The Netherlands, September 2016

CHRISTIAN STAMM, Deputy Head, Department of Environmental Chemistry, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland, January 2017





STUDENTS OF THE WATER INSTITUTE

Students of the Water Institute, Graduate Section (SWIGS) promotes interdisciplinary water research across faculties and enhances the overall graduate student experience.

The Water Institute's graduate students section (SWIGS) was established in 2010. Through academic, community, and social activities and events, SWIGS promotes communication, collaboration, and comradery among water students from across Waterloo's academic faculties. Under the leadership of an executive, and with a membership of several hundred, SWIGS organized a number of well-attended and impactful events in 2016-17. Of particular note was the annual World Water Day Graduate Research Fair organized and co-hosted by SWIGS and the Water Institute, together with partners at Wilfrid Laurier University. This year's event featured a graduate student poster competition, industry booths, keynote speakers, and a networking reception. In addition, the event included the launch of AquaHacking 2017, a joint initiative of the Water Institute and the de Gaspé Beaubien Foundation.

2016-17 SWIGS EXECUTIVE

Chair: **ALLISON TURNER**, Environment, Resources and Sustainability

Vice Chair Operations: **ROBERT CHLUMSKY**, Civil and Environmental Engineering

Vice Chair Academic: **SABRINA BEDJERA**, Civil and Environmental Engineering

Vice Chair Social: **JESS KIDD**, Biology

Vice Chair External Outreach: **LOGAN KOETH**, Civil and Environmental Engineering

Vice Chair Internal Outreach: **IRENE BRUECKNER-IRWIN**, Environment, Resources and Sustainability

Vice Chair Conference: **NICOLE STAMNES**, Environment, Resources and Sustainability

GLOBAL IMPACT

The Water Institute aims to strengthen international networks and partnerships with leading water organizations and researchers.

CHINA

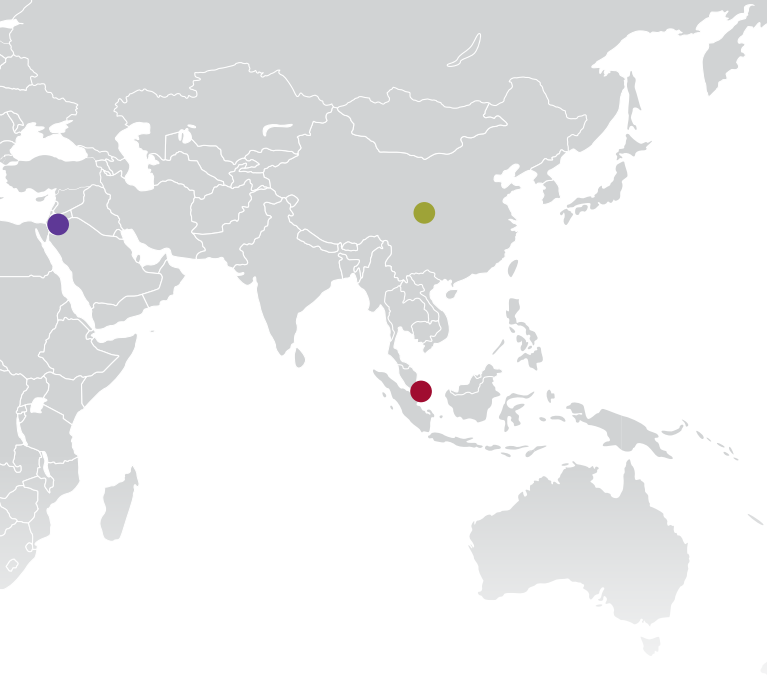
CHINESE RESEARCH ACADEMY OF ENVIRONMENTAL SCIENCES

Since 2014, the Water Institute has partnered with the Chinese Research Academy of Environmental Sciences (CRAES) – China’s largest environmental research Institute – in various water research and education activities. In 2015, a delegation of 10 Water Institute researchers participated in the first Sino-Canadian Water Environment Workshop in Hangzhou, China, together with CRAES researchers and officials from Environment and Climate Change Canada. Canada and China subsequently adopted the 2015-17 China-Canada Bilateral Workplan which identified CRAES and the Water Institute as respective Chinese and Canadian lead contact agencies under the water management work package. In early 2017, the Water Institute and CRAES signed an Memorandum of Understanding to formalize their commitment to continued collaboration. Later in 2017, faculty and student exchanges are anticipated, in addition to the second Sino-Canadian Water Environment Workshop which is scheduled to take place in September in Waterloo.

FRANCE

UNIVERSITY OF BORDEAUX/LABEX COTE

The Water Institute and the University of Bordeaux/LabEx COTE have been collaborating since 2014, when the Institute convened a workshop in Waterloo with Bordeaux researchers to explore potential areas of collaboration. In 2016, more detailed exploration of respective research programs was the objective when eight Water Institute researchers visited Bordeaux to participate in a follow-up workshop. Outcomes from the workshop included the identification and establishment of several joint Water Institute-Bordeaux/LabEx COTE research clusters, each of which anticipates applying for project funding to initiate new activities. In addition, Water Institute faculty and graduate students were invited to participate in LabEx COTE’s 2017 interdisciplinary summer school on “weak signals and emerging issues in ecological transition.”



- Brazil** ● University of São Paulo
- China** ● Capital Normal University
China University of Geosciences
Chinese Research Academy of Environmental Sciences
Hohai University
Wuhan University
Southwest University
- France** ● Université de Bordeaux
- Germany** ● Helmholtz Centre for Environmental Research
- Israel** ● Technion – Israel Institute of Technology
- Netherlands** ● IHE Delft Institute for Water Education
- Singapore** ● National University of Singapore
Nanyang Technological University
- Switzerland** ● Swiss Federal Institute of Aquatic Science and Technology

SINGAPORE

**NATIONAL UNIVERSITY OF SINGAPORE
NANYANG TECHNOLOGICAL UNIVERSITY**

The University of Waterloo has collaborated with the National University of Singapore and the Nanyang Technological University in Singapore for many years. In mid-2016, the Water Institute participated in the Singapore International Water Week, a premier global platform for various water sector stakeholders to share innovative water solutions. While in Singapore, the Water Institute delegation met water colleagues from the National University of Singapore and the Nanyang Technological University; two highly regarded water research institutions. Discussions included the identification of potential collaboration opportunities in research and education. In October 2016, the Water Institute was pleased to meet with the President of the National University of Singapore during his visit to Waterloo, and in early 2017, to welcome the Executive Director of the Nanyang Environment and Water Research Institute at the Nanyang Technological University to the Water Institute’s External Advisory Board.

ISRAEL

TECHNION – ISRAEL INSTITUTE OF TECHNOLOGY

In 2014, the University of Waterloo formalized an agreement with Technion – Israel Institute of Technology to accelerate joint research and innovation in quantum computing, nanotechnology and water. Prior to the agreement, the Water Institute was invited to visit Technion to explore potential collaboration. The following year, Waterloo hosted a workshop to explore complimentary research areas in more detail, and to develop funding proposals. These initiatives led to several new joint research projects with Water Institute researchers collaborating with Technion colleagues. These investigations include the use of membranes to remove organic pollutants, and the non-invasive monitoring of the vadose zone.

2017-18 PRIORITIES

Several priorities have been established for 2017-18 as we continue efforts to implement the 2014 to 2019 Water Institute strategic plan.

RESEARCH

- › Significantly improve knowledge mobilization and transfer functions
- › Launch a new Water Institute research newsletter
- › Successfully implement and support Global Water Futures projects
- › Assist in the development of new interdisciplinary research proposals
- › Provide management services to new interdisciplinary research projects
- › Facilitate new or strengthened international partnerships
- › Administer the Seed Grants Program
- › Manage the RBC Visiting Fellows Program

EDUCATION

- › Organize an international water conference
- › Successfully execute AquaHacking 2017 in partnership with the de Gaspé Beaubien Foundation
- › Co-ordinate and support the Collaborative Water Program, including RBC water scholarships
- › Organize the RBC Distinguished Lecture
- › Organize the WaterTalks lecture series
- › Support the Students of the Water Institute, Graduate Section

INTERNATIONAL RANKINGS

Employers and other collaborators recognize the value of a Waterloo degree. A highly-respected water program can open doors for your career.



**10th
BEST**

**WATER RESEARCH
INSTITUTION
IN THE WORLD**

Source: Lux Research Inc.,
Top Academics and Institutions
in Water Research 2013.

**20th
MOST PROLIFIC
WATER RESEARCH
INSTITUTION IN THE WORLD**

Source: Stockholm International Water
Institute and Elsevier, The Water and
Food Nexus: Trends and Development of
the Research Landscape, August 2012.

**26th
BEST UNIVERSITY FOR WATER
RESEARCH IN THE WORLD**

Source: ShanghaiRanking's Global Ranking of
Academic Subjects – Water Resources, 2017.



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AMY GEDDES, Communications Officer
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- Jonathan Witt**, Biology
- Sarah Wolfe**, Environment Resources and Sustainability
- Alexander Wong**, Systems Design Engineering
- Michael Wood**, Environment, Enterprise and Development
- Lingling Wu**, Earth and Environmental Sciences
- John Yeow**, Systems Design Engineering
- Youngki Yoon**, Electrical and Computer Engineering
- Aiping Yu**, Chemical Engineering
- Norman Zhou**, Mechanical and Mechatronics Engineering



YEARS OF **INNOVATION**



UNIVERSITY OF
WATERLOO



the **water**
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