



**CATALYST STUDY:**  
Acadia Centre for Analytical  
Research on the Environment (CARE)

March 2017



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**About this study:** A catalyst is “a person or thing that precipitates a change.” This catalyst study aims to assess the changes that are the result of multiple awards made to an individual project leader or a small group of researchers in a related field over time. This study examines the interplay among five Canada Foundation for Innovation (CFI) [John R. Evans Leaders Fund](#) awards in multiple disciplines led by different project leaders at Acadia University. These awards are integral to the Acadia University Centre for Analytical Research on the Environment (CARE) located in the K.C. Irving Environmental Science Centre.

## KEY FINDINGS

### STRATEGIC USE OF CFI FUNDS HAS CREATED AN INTERNATIONALLY COMPETITIVE CENTRE FOR ENVIRONMENTAL RESEARCH

**The Acadia Centre for Analytical Research on the Environment (CARE) is a centre of expertise that maintains its operations by leveraging opportunities and maximizing available resources through co-located CFI-funded infrastructure.**

- CFI-funded infrastructure projects and the recent development of the K.C. Irving Environmental Science Centre helped Acadia University to attract leading researchers in the area of environment and have played a role in retaining those researchers, resulting in a multidisciplinary group of top-tier scientists at CARE.
- Co-locating CFI-funded infrastructure in a single research centre has created a collaborative environment, and has solidified CARE’s reputation as a dynamic hub with expertise in environmental research and training.
- CARE received a total CFI investment of more than \$600,000 for infrastructure through five projects funded through the John R. Evans Leaders Fund (JELF) over seven years. This investment, combined with partner contribution funds, has allowed CARE to secure more than \$5.2 million for research from multiple sources.

**Students at all levels benefit from the training and learning opportunities offered by CARE and its researchers.**

- Primarily a small undergraduate university, Acadia offers a limited number of graduate programs. CARE is attracting graduate students from other institutions through co-supervision arrangements.
- Trainees benefit from the multidisciplinary environment at CARE and gain the skills and knowledge needed to bolster their future opportunities, including further training in post-secondary institutions or careers in various sectors.
- Multidisciplinary collaborations at CARE helps to increase research productivity and advance knowledge. It also supports the development of tools to address environmental issues and applications in other fields.

## 1. INTRODUCTION

The CFI makes financial contributions to Canada's universities, colleges, research hospitals and non-profit research organizations to increase their capability to carry out high-quality research. Through its investments, the CFI's objectives are to:

- Increase Canada's capability to carry out important world-class scientific research and technology development;
- Support economic growth and job creation as well as health and environmental quality through innovation;
- Expand research and job opportunities by providing support through research infrastructure for the development of highly qualified personnel; and,
- Promote productive networks and collaboration among Canadian universities, colleges, research hospitals, non-profit research institutions and the private sector.

Canadian Oxford Dictionary defines a "catalyst" as "a person or thing that precipitates a change." This study aims to assess whether the CFI's contribution has acted as a "catalyst" to facilitate changes, as per the objectives of the CFI described above. It examines a case where multiple awards have been made over time to a small group of researchers at a single institution in a related field. It also allows us to examine and understand the interplay between CFI awards.

In order to complete this study, the CFI gathered information through existing documentation (applications, project progress reports, researcher CVs, other documentation provided by the institution, bibliometrics data, etc.) and through discussions with institutions, project leaders, and trainees associated with the projects. Draft reports were then shared with those involved to verify facts.

## 2. GENESIS OF CARE

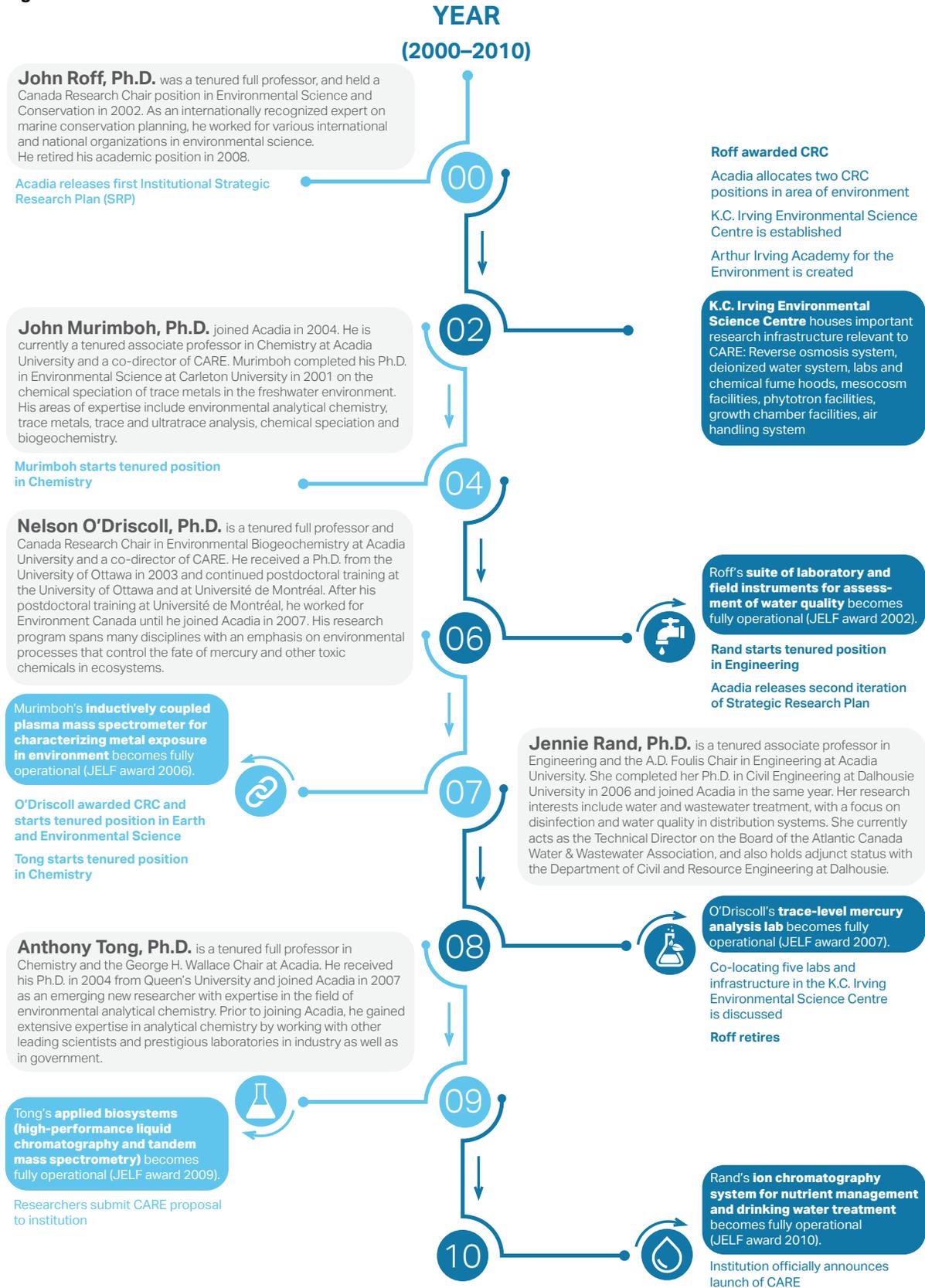
In 2002, Acadia took important steps to develop its environmental research capacity as one of the priorities identified in their first institutional strategic research plan (Figure 1). Acadia assigned two of their 3 Canada Research Chairs (CRCs) allocations to environmental science and at the same time established the K.C. Irving Environmental Science Centre. John Roff obtained a tier I CRC in Environmental Science and Conservation, occupying one of the two allocated awards and was also successful in securing funding from the CFI for infrastructure to enable geochemical analysis of ocean and freshwater ecosystems. John Murimboh was awarded CFI funding in 2006 for a project to enable complex analysis in environmental biogeochemistry, for which he acquired an inductively coupled plasma mass spectrometer for characterizing metal exposure in the environment. In 2007, Nelson O'Driscoll joined Acadia as Canada Research Chair, and added a trace-level mercury analysis system to the existing CFI-funded infrastructure, which enabled the measurement of trace concentrations of mercury in air, water, soils and organisms with its higher precision and sensitivity.

Roff retired from his academic position in 2008. O'Driscoll and Murimboh were increasingly collaborating and making use of each other's infrastructure, which led to a decision to co-locate their infrastructure within the K.C. Irving Environmental Science Centre along with the infrastructure related to Roff's CFI awards. At approximately the same time, two new CFI-funded infrastructure projects were added to the K.C. Irving Environmental Science Centre: Anthony Tong's applied biosystems (high-performance liquid chromatography and tandem mass spectrometry) and Rand's ion chromatography system for nutrient management and drinking water treatment. In 2009, these four researchers submitted a proposal to Acadia University to form the Centre for Analytical Research on the Environment (CARE).

In 2010, Acadia announced CARE as one of its 10 official research centres. The overarching focus of CARE is "the provision of research and analytical services aimed at the quantification of contaminant fate, and understanding processes that support healthy ecosystems."

The decision to co-locate the CFI-funded infrastructure within the K.C. Irving Environmental Science Centre and to create CARE was a natural evolution, as these five different CFI-funded infrastructure projects, led by prolific researchers, support the institution's strategic research priority "to enhance and develop the university's research capacity in six areas: the Environment; Culture, Civilization, and Citizenship; Health and Wellness; Information Technology and Society; Materials Science; and Modelling."

Figure 1. Timeline: CARE and its researchers

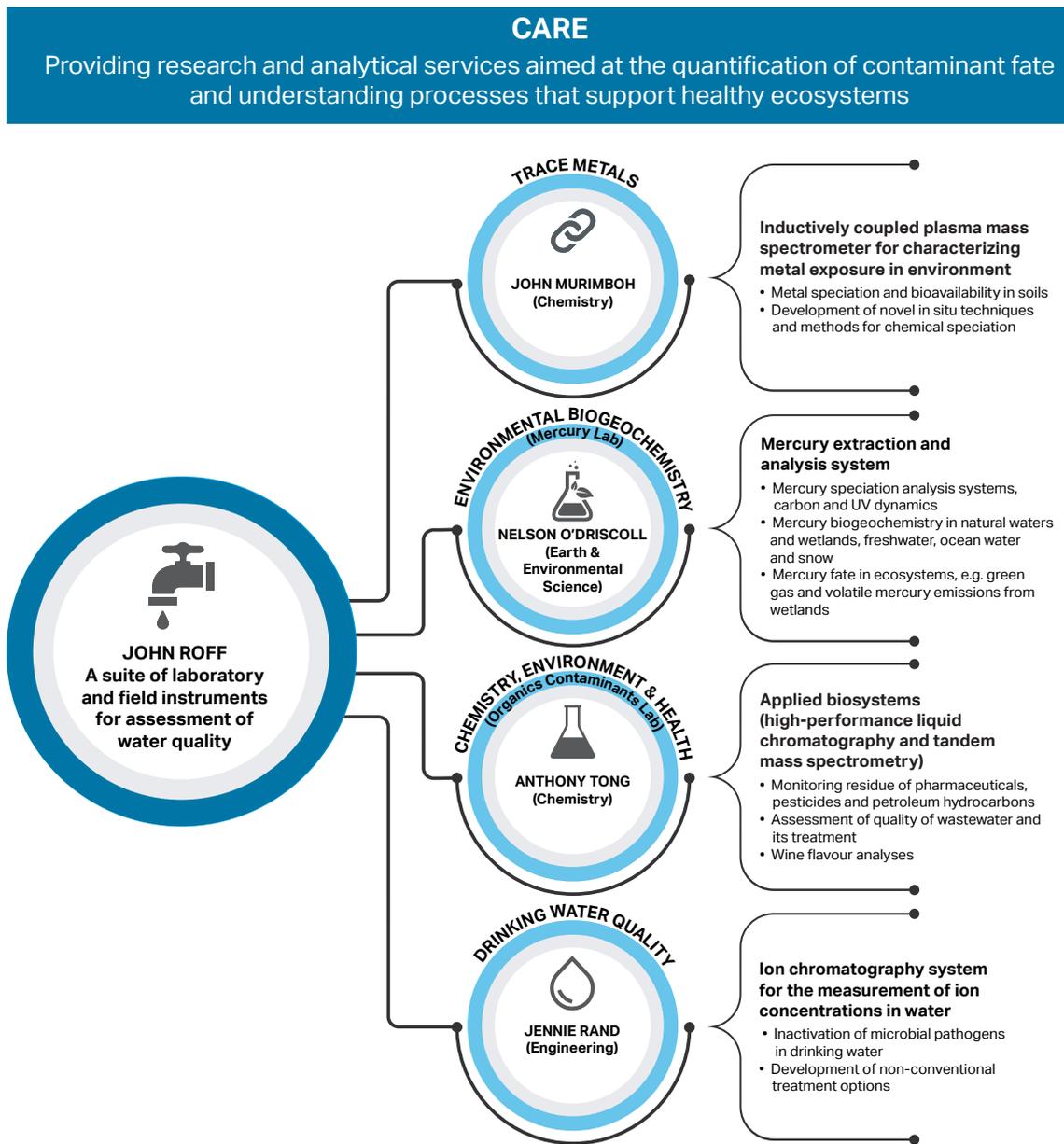


## A CENTRE FOR EXPERTISE IN ENVIRONMENTAL RESEARCH

The nutrients in water analysis system and water quality infrastructure associated with Roff's CFI award and the existing infrastructure associated with the K.C. Irving Environmental Science Centre laid the foundations for the development of CARE (Figure 2). This infrastructure helped Acadia to attract researchers Murimboh, O'Driscoll, Tong and Rand to Acadia, who remain CARE's four principal researchers. All four principal researchers report that CFI-funded infrastructure was an important factor keeping them at Acadia.

In addition, Acadia recruited two new CRC chairs in the natural sciences (Dr. Mike Stokesbury, Canada Research Chair in Ecology of Coastal Environments, and Dr. Mark Mallory, Canada Research Chair in Coastal Wetland Ecosystems). The availability of the CFI-funded infrastructure was a significant factor in their decision to join Acadia.

Figure 2. CARE lab and expertise



CARE: <http://kcirvingcentre.acadiau.ca/care.html>

### 3. MANAGING INFRASTRUCTURE AT CARE

#### BENEFITS OF CO-LOCATION OF MULTIDISCIPLINARY CFI INFRASTRUCTURE

Co-locating five different labs and their CFI-funded infrastructure within a single research centre under the theme of environmental research provided two key benefits:

- Increased national and international visibility for the researchers and their research activities at Acadia, resulting in CARE becoming recognized as a centre of expertise in the area of environmental and contaminant biogeochemistry; and,
- The creation of a dynamic multidisciplinary environment that encourages internal and external collaborations to maximize research productivity and enriched training.

When O'Driscoll first joined Acadia University as a Canada Research Chair (Tier II), he had some concerns about the possible career limitations associated with his position as a researcher within a small university. He was uncertain that he would be able to effectively conduct his research with fewer opportunities for resources, possibly less research infrastructure, less lab space, fewer researchers to collaborate with, and less access to trainees and highly qualified personnel to support his work as compared to what might be available at a larger university. However, being part of the CARE group has allowed him the opportunity to share research infrastructure and resources and has led to the creation of collaborations across sectors and regions. He believes that the collaborative climate at CARE has resulted in much more research productivity than he had originally expected.

*“It is often challenging for us to be in a small institution, being compared to large institutions in terms of funding, collaboration and types of infrastructure. However, by increasing collaborations between small institutions and making the best of available resources at Acadia, CARE can rival labs at big universities in Canada. Each lab within CARE has developed expertise in specific areas so that CARE members are known nationally and internationally for the research we do.”*

– Nelson O'Driscoll

All researchers have offices and lab spaces close by one another, with common open spaces to encourage interaction among researchers and trainees. Although the equipment is shared among the teams, each of the researchers at CARE manages the operations and maintenance of their specific infrastructure, including securing technical staff or trainees to operate equipment. By being located in the K.C. Irving Environmental Science Centre, CARE members have full access to the Centre's common resources and shared facilities, including a series of phytotron labs, growth chambers, mesocosm benches, shelving refrigerators, freezers, autoclaves and dishwashers. The K.C. Irving Environmental Science Centre also provides indirect support for various aspects of CARE's research, including a research manager for the building and a facility manager to oversee everything related to facilities management including: the lab air handling system, the refrigerated storage space and the central lab water supply system (reverse osmosis).

*“One of the strongest assets of CARE is that different researchers from very different backgrounds have their own research projects, but each uses very different approaches and processes. Since we are all located in the K.C. Irving Environmental Science Centre, we are close by each other, with our labs all in the same hallway, and we share our equipment with each other. There is great benefit to having all of us housed in the K.C. Irving Environmental Science Centre. We have all the physical support we need for the lab space, including lighting and heating systems and various lab infrastructure like fridges, freezers and piping for water to each lab.”*

– Jennie Rand

#### LEVERAGED INVESTMENTS FROM ORIGINAL CFI INFRASTRUCTURE

The four CARE researchers note that CFI-funded infrastructure has had an impact on their ability to secure institutional funds, and three out of four also indicate that it has had an impact on their ability to attract federal, provincial, and private-sector funds. In fact, as of February 2017, CARE researchers have secured at least \$5.2 million<sup>1</sup> through grant and/or contract work (**Figure 3**).

<sup>1</sup> The amount used for calculation was based on each project leader's funding record in their CV with their validation. The amount of each award was included in the total amount only if its funding decision date was after the original CFI award of each project leader.

**Figure 3. Funding secured by CARE since 2009**



**GRANTS AND AWARDS**

**FEDERAL GOVERNMENT:**

- Canada Research Chairs Program
- Networks of Centres of Excellence: Canadian Water Network
- Environment and Climate Change Canada
- Indigenous and Northern Affairs Canada
- National Defence
- National Research Council Canada: Industrial Research Assistance Program
- Natural Sciences and Engineering Research Council of Canada
- Agriculture and Agri-Food Canada

**PROVINCIAL ORGANIZATIONS:**

- Innovacorp
- Nova Scotia

**NON-PROFIT ORGANIZATIONS:**

- Springboard Atlantic
- Ducks Unlimited Canada

**FOREIGN ORGANIZATIONS:**

- Portuguese Foundation for Science and Technology

**ACADEMIA:**

- Acadia University
- University of Saskatchewan

**RESEARCH CONTRACTS**

**FEDERAL GOVERNMENT:**

- Environment Canada
- Natural Resources Canada

**INDUSTRY:**

- Maritimes and Northeast Pipeline

**ACADEMIA:**

- Dalhousie University
- University of New Brunswick at Saint John
- University of Saskatchewan
- Universidad de Concepción (Chile)

**NON-PROFIT ORGANIZATIONS:**

- Ducks Unlimited Canada

**PROVINCIAL ORGANIZATIONS:**

- Innovacorp
- Nova Scotia

**Note:** The list is limited to grants of \$10,000 or more and does not include CFI awards.

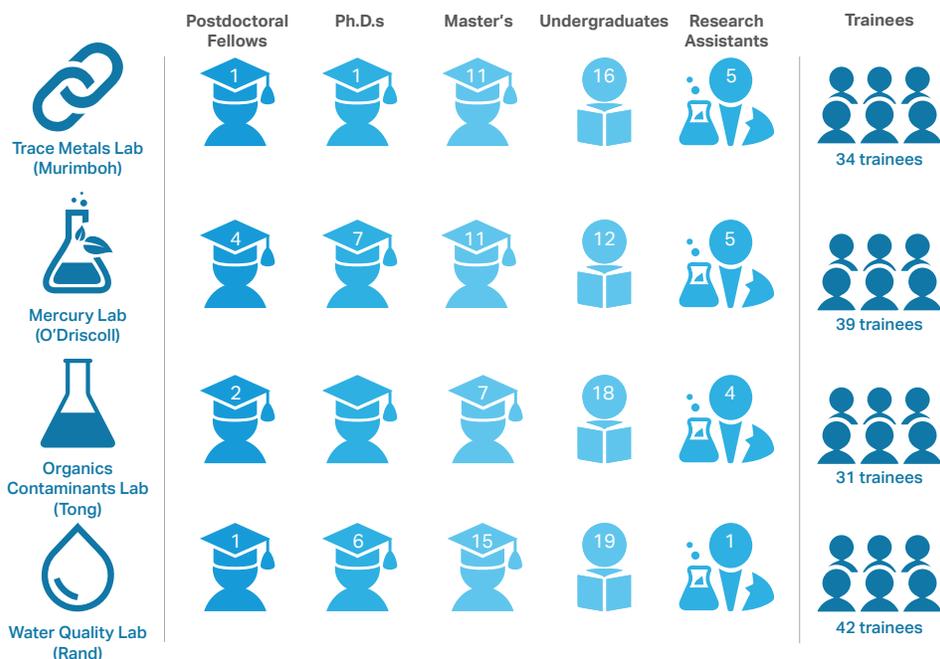
Most contract analyses at CARE are conducted on a collaborative basis, often leading to productive relationships such as co-supervision of students or collaboration on new research projects. CARE also provides analytical services to both the internal and external community in the area of water quality, mercury and organic contaminants on a fee-for-service basis. The revenue is managed within each individual laboratory and is mainly used for the ongoing operation and maintenance of equipment and various other aspects of research where funding may be more challenging to secure.

Even with the contract analyses performed, securing sufficient research funding and funding for the ongoing operations, technical support and maintenance of equipment remains a challenge. The most common challenge reported by all CARE researchers is keeping dedicated, qualified personnel to maintain and manage the infrastructure. CARE researchers manage this challenge with the aid of their trained students or through lab technicians hired on a contractual basis. This is a short-term solution, as these highly-qualified personnel are in high demand and are often well positioned after a short time at CARE to leave for more lucrative salaries or more permanent opportunities. As a result, it is difficult to maintain a reservoir of long-term knowledge for instrument troubleshooting.

## 4. AN ENRICHED TRAINING ENVIRONMENT

Primarily an undergraduate university, Acadia also offers several Master's of Science (MSc) graduate program options including biology, chemistry, geology and applied geomatics. All of the Ph.D. candidates and one third of the master's students at CARE are enrolled in degree programs at other institutions including Dalhousie University, the University of New Brunswick and foreign universities. In these arrangements, the primary supervisor is at CARE where most of the training occurs. Co-supervised students benefit from the expertise of their local supervisors and learn to use the specialized CFI-funded infrastructure at CARE (**Figure 4**). In addition, Postdoctoral fellows and research assistants also benefit from training on the CFI-funded infrastructure.

**Figure 4. Trainees at CARE**



**Note:** training for degree (completed or in progress), course project, and summer training (since 2006)

Of these CARE trainees, 45 percent have pursued further training opportunities at other universities and research institutions. The majority are training at institutions across Canada, with the rest pursuing international training opportunities.

### A VALUED TRAINING ENVIRONMENT

All CARE researchers remarked that the training environment is one of the most notable and successful outcomes of creating the research Centre.

CARE offers a multidisciplinary training environment where students work together across different fields including chemistry, biology, environmental science and geology. Advanced infrastructure in environmental science and analytical chemistry has attracted top students from other universities and institutions, including international students and graduates. In addition, the multidisciplinary environment and the co-location of infrastructure at CARE promotes collaboration among students from different disciplines and programs.

Trainees who were interviewed commonly reported the following as the most significant aspects in CARE's training environment:

- An open and collaborative environment to encourage communication with other trainees and professors in different research areas, sharing equipment and helping each other;
- Hands-on training involving all aspects of research including planning a study, operating equipment, troubleshooting, collecting samples, analyzing the data and presenting the results;
- Availability, attentiveness and willingness of supervisors to provide direct guidance and training on various aspects of research to trainees at all levels; and,
- Having access to advanced infrastructure for all trainees.

*“The level of inter-connectedness of the labs and collaboration was much more than I expected. There was much more opportunity to talk to other people and to interact with them, doing analyses for other people and having other analyses done for you that you wouldn't have necessarily been able to do otherwise. All of the students who worked in the lab and had a shared office space were really able to chat with each other because **we all existed in the same space**. You make friends with the people in the other labs and they tell you about what they are doing and you tell them about what you're doing and sometimes you have a suggestion for them or they have a suggestion for you.”*

– Erin Mann, past Ph.D. student,  
currently pursuing a postdoctoral training at  
John Jay College at New York in the United States

*“The one-on-one training experience from Dr. Rand was outstanding. I was **learning right from the professor who knows exactly what she wants and knows the best about all this equipment**. Important as well are the other people that we were able to be in contact with to learn from. For some of our projects, we went to Dalhousie and talked to Master's students or saw researchers and discussed our projects.”*

– Jonathan Loder, past undergraduate student,  
currently Honours BEng candidate at Dalhousie University

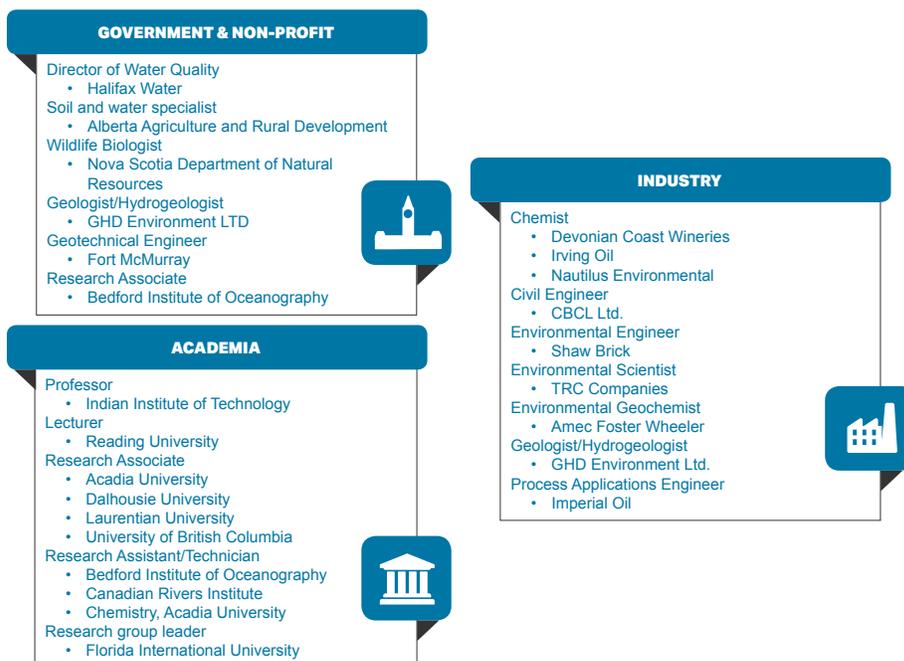
*“Access to the equipment was very easy. **We could come in and use any of the equipment...** for example, I supervised or co-supervised undergraduate honours projects at CARE, and the undergraduate students were given access to all of the resources of the lab.”*

– Tom Sizmur, past postdoctoral fellow,  
currently a Lecturer at the University of Reading, UK.

## PREPARING TRAINEES FOR THE NEXT STEP IN THEIR CAREER

CARE trainees acquire knowledge and a wide range of skills through their use of CFI-funded infrastructure. They noted this as a strong and practical asset to move them forward on their career path (**Figure 5**).

Regardless of disciplines or level of training, all of the four past students who were interviewed mentioned “hands-on skills and knowledge in all aspects of the research process” as one of the important assets of training at CARE. Other top-ranked skills obtained at CARE are: technical skills such as operations and maintenance of advanced instrumentation or equipment, troubleshooting, analysis, knowledge of safety and risk issues in a lab setting or industry, as well as writing and communication skills.

**Figure 5. Positions held by past CARE trainees**

**Note:** The positions and organizations listed are representative of the data available, but may not be exhaustive.

### Well-rounded technical research skills and knowledge useful to industry

Ryan Greenham completed his BSc in 2016 under the supervision of Anthony Tong. One of the top skills that he obtained at CARE was how to do research from A to Z, from organizing sampling collection or doing sampling, to analysis and reporting the results. He also gained knowledge of industry standards, learned how to use advanced chemical instrumentation and learned about how pharmaceutical facilities operated. His goal is to obtain a position doing research at a lab in government or in industry. He believes the wide range of skills and knowledge he acquired at CARE will be a strong asset and help him secure a position. He also noted that for a position in the private sector, where the results have to be produced quickly, being able to do everything that has to be done over the course of a project will be valuable.

### Effective project management strategies and communication skills

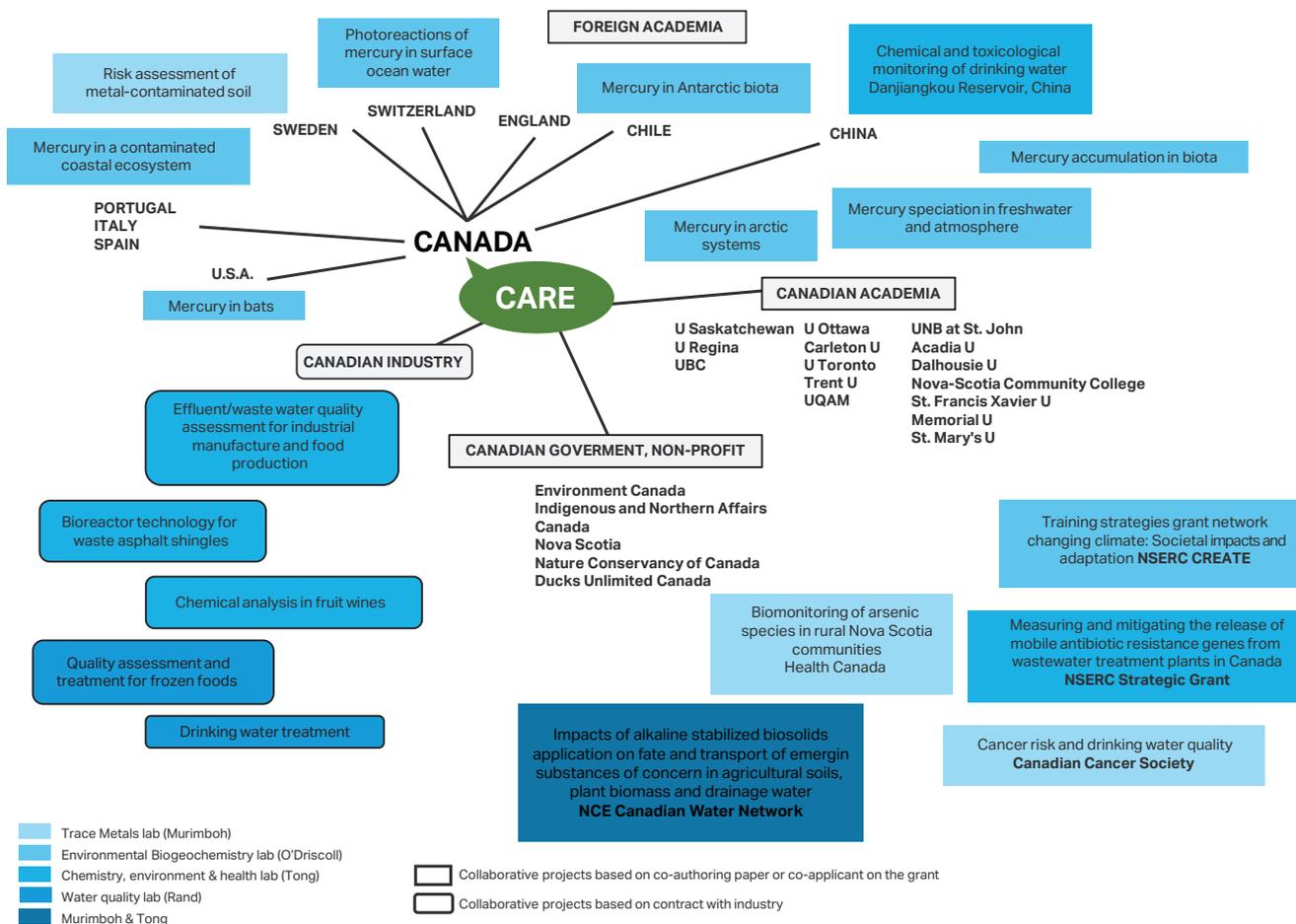
Erin Mann was a Ph.D. candidate at Memorial University of Newfoundland, supported by NSERC's Collaborative Research and Training Experience (CREATE) network. She completed her Ph.D. training in 2015 under Nelson O'Driscoll. In addition to mercury analysis and research methodologies, she notes effective communication skills and project management strategies as the two most important skills that she learned at CARE. She routinely calls upon these skills in her current position as postdoctoral fellow at John Jay College in New York. She believes that they will remain important throughout her career. At CARE, she was required to manage time and resources in order to share facilities effectively among people from different labs and different advisors and keep the research progressing smoothly. During this process, she learned how to convey messages in a clear and confident in various situations. She was not only required to communicate with all other trainees and researchers, but was often requested to give lab tours of CARE. As these tours were targeted to many audiences, she acquired an ability to communicate complex research and science in plain language in order to be understood by people of various ages with technical or non-technical backgrounds.

## 5. A HUB FOR COLLABORATION

Due to its position in the Irving Environmental Science Centre, CARE serves as a node to connect its researchers with research teams within Acadia and at other institutions in Atlantic provinces, across Canada and internationally. CFI-funded infrastructure together with the scientific expertise at CARE underpins various types of collaborations (**Figure 6**):

- Collaborations within and between institutions for research projects, including co-supervising students;
- Collaborations with government (municipal, provincial and national level) to address important environmental issues; and,
- Collaborations with industry based on contract work to provide expertise in advanced technology or innovative approaches to meet their needs.

**Figure 6. Collaboration network of CARE**



**Note:** The research projects and organizations depicted on this network map are intended as examples and are not exhaustive.

These various forms of collaborations also serve as a stimulant to enhance the dynamic and interdisciplinary nature of the research and training environment at CARE. These collaborations led to various outcomes and benefits.

## 6. BENEFITS

The collaborations between CARE researchers and their collaborators from other institutions point to multiple and diverse societal benefits, particularly in the areas of knowledge advancement, innovation/commercialization and public policy. The following are examples of CARE's collaborations and the early benefits they are producing.

### A knowledge base and tool to manage the presence of organic chemicals in agricultural soils

The Canadian Water Network — one of Canada's Networks of Centres of Excellence — is a collaboration involving seven researchers from six institutions, including researchers John Murimboh and Anthony Tong. The network partners with six government and municipal organizations. Responding to stakeholders' concerns about the commonly used application of organic matter recycled from sewage in agricultural soil, a study was conducted that aimed to provide evidence relating to a treatment method (alkaline stabilization of biosolid (ASB)) and its impact on soil and water, as well as its potential toxicity for human health. The results provided the parameters and approaches that will help determine the optimal level of application of ASB.

*Impact of alkaline stabilized biosolids application on the fate and transport of emerging substances of concern in agricultural soils, plant biomass, and groundwater, NCE Water Network, G. W. Price, Dalhousie University, research conducted 2013-2015* <http://www.cwn-rce.ca/assets/End-User-Reports/Agri-Food/Price/CWN-EN-Price-2016-5Pager-Web.pdf>

### A recommendation for the minimum doses of chlorine required for disinfection of the municipal water distribution system

Jennie Rand collaborated with Halifax Water to examine the amount of chlorine needed to control micro-organisms in the drinking water distribution system in Nova Scotia. The project led to recommendations for the minimum amount of chlorine required to disinfect the system.

*Jennie L. Rand; Graham A. Gagnon; Alisha Knowles, Water Practice and Technology 2014, 9 (4) 491-501; DOI: 10.2166/wpt.2014.055* <http://wpt.iwaponline.com/content/9/4/491>

### First national comprehensive evaluation of mercury in the Canadian environment

Nelson O'Driscoll collaborates with researchers and experts in government and municipal organizations to quantify and assess the fate of mercury and its impact on ecosystems, in response to various factors including climate change, how it interacts with natural waters and wetlands and its accumulation in food webs. Many of the results and implications from these projects have been presented in prestigious international peer-reviewed journals related to environmental science as well as policy documents and governmental reports. One of the examples is the recent report released by Environment Canada called "Canadian Mercury Science Assessment" of which O'Driscoll is the author of two chapters.

*Canadian Mercury Science Assessment, Environment and Climate Change Canada* <http://ec.gc.ca/mercure-mercure/default.asp?lang=En&n=A2D7E54F-1>

### Recommendation for action plan and indicators to Parks Canada to monitor the level of methylmercury in Kejimikujik National Park

Kejimikujik National Park in Nova Scotia is known to be a hotspot for the bioaccumulation of methylmercury, which is a neurotoxin. Mercury concentration is tabled as one of the ecological integrity indicators to ensure water quality and seasonal fluctuations and interactions with plants in the park. CARE's research infrastructure has enabled O'Driscoll and his collaborators to investigate why methylmercury levels are high in this remote ecosystem. This research led to the recommendation to prioritize further research into mercury levels and acidification in freshwater ecosystems as part of the management plans for National Parks and National Historic Sites (Nova Scotia section).

*Kejimikujik, National Park and National Historic Site of Canada, Management plan, Parks Canada* <https://www.pc.gc.ca/en/pn-np/ns/kejimikujik/info/plan/plan-gestion-management>

### Treatment of harmful chemicals in wastewater

Most of Anthony Tong's collaborations involve chemical analysis of wastewater treatment using a membrane reactor technique developed in his lab. This technique, which uses CFI-funded infrastructure, has been applied in various areas, including: the treatment of petroleum-contaminated wastewater in collaboration with Loomers' Pumping Service Limited; and, monitoring antioxidants in vehicle exhaust and marine oil spills in collaboration with Environment Canada. Tong is also a co-applicant of a NSERC strategic grant with research groups at Regina and Saskatchewan to measure and mitigate the release of mobile antibiotic resistance genes from wastewater treatment plants in Canada.

*"The NSERC funding provides an excellent opportunity for graduate students and postdoctoral fellows to work in a collaborative multidisciplinary team with investigators from the universities of Regina, Dalhousie and Acadia."* – Christopher Yost, University of Regina <http://news.gc.ca/web/article-en.do?nid=944309>

### Supporting the growing wine industry in Nova Scotia

Tong has been using his membrane reactor technique to assess the efficiency and kinetics of biodegradation in wine for optimizing taste. The Annapolis Valley, where Acadia University is located, has been gaining recognition as an area with the best climate and geographical conditions in Canada for producing high quality grapes. The wine industry has been growing in this area, as evidenced by CBC News and *The Globe and Mail*.

*"Canada's next great wine region"* <http://www.cbc.ca/news/canada/nova-scotia/nova-scotia-great-wine-1.3512006>,  
*"Surprise! One of Canada's best wines is from Nova Scotia"* <http://www.theglobeandmail.com/life/food-and-wine/wine/surprise-one-of-canadas-best-wines-is-from-nova-scotia/article627121/>.

## 7. CONCLUSION

This case study demonstrates how five awards through the Canada Foundation for Innovation's John R. Evans Leaders Fund have helped to position Acadia University as a leader in environmental sciences. It also indicates that CFI has played an important role in enabling the creation of an internationally competitive research centre for a relatively small CFI investment.

These awards have had a catalytic effect on the capacity and dynamism of Acadia's Centre for Analytical Research on the Environment (CARE). Through strategic use of its CFI funding envelope, Acadia University has been successful in attracting and retaining top research talent in environmental sciences and has created an environment that continues to perpetuate this priority.



