

Monitoring Trends in Academic Programs



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ABOUT THE COMPANY

Higher Education Strategy Associates (HESA) is a Toronto-based firm providing strategic insight and guidance to governments, postsecondary institutions, and agencies through excellence and expertise in policy analysis, monitoring and evaluation, and strategic consulting services. Through these activities, HESA strives to improve the quality, efficacy, and fairness of higher education systems in Canada and worldwide.

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Introduction to Monitoring Trends

Volume 4, Issue 1 (2021)

WELCOME

This is the fourth issue in Higher Education Strategy Associates' ongoing series, *Monitoring Trends in Academic Programming*. This issue focuses on programs that focus on the study of water. Our last edition focused on programming around agriculture and food. Combined, these issues speak to HESA's interest in examining programs that speak to broad global issues across a range of disciplines and institutions. They also reveal a trend of providing education that responds in part to the UN Sustainable Development Goals and other international calls for action.

This edition continues *Monitoring Trends'* focus on exploring how different academic disciplines are creatively bringing together different disciplines and breaking down organizational silos. Another overarching theme is how programs connect to communities, organizations, and industries outside academia. This has been a long-standing ambition of post-secondary institutions, but one that becomes more pressing as institutions face increasing financial pressures. While colleges and universities benefit from the entrenched expectation that many jobs require formal training, they are not necessarily seen as engines of economic growth and innovation by politicians or the wider public.

Water sustainability, management, science, and usage require both highly specialized and trained scholars and generalists capable of crossing different disciplines and domains. Science and engineering research needs to be translated into policy, and policy needs to be translated into meaningful action that benefits communities. There's a certain accessibility to thinking about some issues concerning water—we all use it, we are all impacted by its excess or

deficiency, and we are all invested in ensuring that there is a safe, healthy supply. The potential impact of the study of water is immense.

There are three main sections to this edition:

1. **Water Sciences.** Exploring water science programs and research institutes across Canada and around the globe, this section focuses on the growing interdisciplinary nature of programs in the physical and applied sciences.
2. **Water and Governance.** This section identifies a small number of programs and opportunities that explore the overlap between water sciences, political studies, international relations and economics. It also briefly examines the potential of courses that foreground Indigenous ways of understanding water that reframe "governance" in fundamental ways.
3. **Water Management.** This final section examines the management of water from a hands-on, practical standpoint. Focused on developments in engineering and in vocational training, this section considers how programs combine scientific and vocational knowledges to promote sustainable water use.

Together, the sections identify programs and institutes that encourage interdisciplinarity, connect with communities, and link fundamental science with practice.

PROVIDE YOUR VIEWS

To better understand crucial academic trends, we want to hear from experts like you.

Future editions of the Monitoring Trends in Academic Programs series will be informed by one-on-one interviews to accompany our environmental scans and research. Short interviews and/or surveys will reveal major programming trends that can be highlighted in this series. Your contributions will help inform the community at large and foster conversation and innovation in universities and colleges across the globe.

To indicate your interest in participating in future surveys or interviews, click this form and we will be in touch with opportunities to participate in monitoring academic trends. You may withdraw from the list at any time and are under no obligation to participate after signing up.

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Water Science

Physical and applied sciences often quickly come to mind when thinking of water studies. From the biogeochemical cycles of waterways to wave mechanics, sediment pathways, and the studies of aquatic life, all forms of science are present when studying water. While water sciences programs are by their nature interdisciplinary across the sciences, they are increasingly expanding their horizons and introducing courses from the social sciences, economics, and the arts. These programs also bring students outside the classroom, typically by studying in local communities and in multi-faceted water research centers. The skills, knowledge, and research developed by students in their science-focused programs flows into both water policy and water management as research continues to inform policy. This section looks broadly at various degree programs at the undergraduate and graduate levels and discusses research institutes where students apply their classroom learning to real-life environments.

WATER SCIENCES PROGRAMS IN CANADA

Trent and Waterloo have programs that exemplify the interdisciplinary and community-linked education that is vital to this field. Trent University's four-year Bachelor of Science in Water Sciences, which launched in 2016, reaches across disciplines and offers an innovative structure to train water professionals. Students in the program take courses such as limnology, environmental chemistry, and global change of environmental ecosystems. The program shows its interdisciplinary nature across the sciences but also spans outside of natural sciences by offering courses like Water Policy, which focuses on policy issues such as water security and management across borders. The program also serves as a direct benefit to the community. Four community-based courses (natural resource management, lacustrine shoreline assessment and monitoring, and two research courses) allow students to apply their knowledge in hands-on opportunities and provides valuable knowledge and research about the surrounding area—this can include

water impact assessments, monitoring and mapping, and other projects that are sponsored by community groups. Upon graduation, students who completed the BSc in Water Sciences at Trent can do an accelerated Master of Science in Environmental and Life Sciences. The accelerated master's allows students to get into the field between half-year and a year earlier than others and get a head start on developing their professional portfolios.

The University of Waterloo's Water Institute brings together 11 academic units to provide 13 masters' and 9 doctoral programs, representing one of the globe's most widespread collaborative efforts between departments to study water sciences and management. At the master's level, applied science degrees – such as the MSc in Chemical Engineering and the MSc in Civil Engineering, as well as physical science degrees such as the MSc in in Biology and the MSc in Earth Sciences – have options to concentrate in water studies. While students in the above programs do concentrated work in their individual departments, all students are required to take two interdisciplinary courses. The first course, Integrated Water Management, integrates water knowledge from science, engineering, policy, and economics in effort to introduce students to water as a sector of different disciplines. There is also an Integrated Water Management Project, which takes students on a weeklong field trip and has them consult with a variety of water stakeholders, including scientists, managers, and volunteers, to discuss emerging watershed issues. These required courses provide opportunities for students in otherwise siloed programs to share their department specific work and learn from and amongst peers in other disciplines.



Carleton University, Ottawa, Ontario

WATER SCIENCES PROGRAMS ABROAD

A fascinating international example at the graduate level is the Master of Science in Hydraulic Engineering and Water Resource Management from the National University of Singapore (NUS), situated directly off the Singapore Straits. The 40-credit program consists of 32 credits of interdisciplinary courses and eight credits as a capstone project. While there are traditional courses in physical science and engineering, the program offers particularly innovative courses such as Engineering Economics and Project Evaluation, Water Policy and Governance, and Dynamic Modelling of Public Policy Systems. Field and research experiences are directly integrated into the curricula and required projects. NUS also offers a one-semester exchange for students to study at TU Delft, Netherlands, allowing students to develop a broader comprehension and application of their classroom learnings.

The HZ University of Applied Sciences in the Netherlands hosts a three- or four-year Bachelor of Science in Water Management. Students in the program begin on a general BSc track before going into one of three specializations: aquatic ecotechnology, delta management, and spatial

planning and design. With a pervasive focus on environmental technology, students in any of the three tracks are well-positioned as 21st-century leaders in their respective water management areas. HZ's connection with the local community is embedded deep into their Water Management program with community field trips and through research projects that involve undergraduate students as researchers. Through the ecotechnology stream, one project called NEREUS (an acronym for New Energy and REsources for Urban Sanitation) is aiming towards transforming wastewater into more valuable resources such as nutrients and energy instead of solely being released as treated water to the local water ways.

Water science programs are often community-connected, introducing students to the local waterways, and conducting research that benefits the surrounding areas.



Water treatment plant

Unlike areas in Water Policy, when focusing on Water Science programs and courses, there is a lack of Indigenous / Traditional Knowledge and Ways of Knowing integrated into the curricula. Instead, much of the work in Indigenizing water sciences is happening at research and non-academic institutes. One example is the International Institute for Sustainable Development (IISD), which operates the Experimental Lakes Area (ELA). The IISD-ELA is located on Treaty 3 Territory, the traditional land of the Anishinaabe Nation and homeland of the Métis Nation in Northwestern Ontario. Currently, the IISD-ELA is working to strengthen relationships and collaboration with the Indigenous communities, specifically in areas such as resource development and traditional ecological knowledge.

RESEARCH INSTITUTES AND PROGRAMMING

Cardiff University's Water Research Institute launched in 2015 and focuses on interdisciplinary water research. They partner with industry groups (Dŵr Cymru/Welsh Water), the Welsh government, Third Sector Organizations (WWF, UNESCO) and other academic partners (notably, the Global Institute of Water Security at the University of Saskatchewan). Currently, the Water Research Institute focuses on five main areas: water in a changing world, catchment and ecosystem resilience, circular water, digital solutions for water risk management, and water for health, wellbeing, and livelihoods. Cardiff's Water Research Institute offers three interdisciplinary doctoral programs and two masters' programs. The masters' programs, the MSc in Global Ecology and Conservation and the MSc Water in a Changing World provide access to the Water Innovation Space and the Hyder Hydraulics Lab. While Cardiff's Water Research Institute is new, their commitment to training high caliber students along with their collaborative research approach

well exemplifies the link between research and graduate programming.

Overseas, the University of Western Cape in South Africa hosts an Institute for Water Studies. Founded in 2009, eleven faculty members specializing in various sciences from hydrology to botany come together to research surface and groundwater and ecosystem linkages. Currently, there are six main research projects in river water monitoring, urban water management, and support systems for basins and lakes. Five of the projects have student researchers, and projects currently range from three students up to ten. These projects allow students to learn from the associated faculty members and numerous university, industry, and government partners. These projects, like many of the water sciences programs, partners students to the community. An example of this can be seen in the Heuningnes Catchment project: where students join in on the monitoring and mapping of local rivers that run throughout land used as a significant food and livestock production area. The University of Western Cape offers degrees in Environment and Water Studies at both the undergraduate and graduate levels.

SUMMARY

Water science is an area of study that will continue gaining attention as the world navigates complex issues like climate change and global warming. The complexities of these issues also make it possible that water studies will become more interdisciplinary. Innovative solutions will require keen skills in knowledge mobilization, risk analysis, and project management. The interdisciplinary nature of these programs and research institutes also benefits non-academic partners such as industry or NGOs who use science-based research to influence governance and policy. As the water sciences continue to adapt to suit the needs of these challenges, a great emphasis on traditional Ways of Knowing would benefit both students and Indigenous communities that have been negatively impacted by current water management, policy, and research.

Water & Governance

Flowing across municipal, sub-national, and national boundaries, water both crosses and demarks human-made lines. The use and regulation of water is fundamentally complex and requires people who understand the physical and chemical nature of water and can understand a range of regulations and competing interests. Fittingly, there are several programs in the study of water that cross disciplinary boundaries and transcend traditional arts-sciences divisions.

Typically, these programs are offered at the graduate level, with undergraduate education in the study of water limited to individual courses. It is worth keeping an eye on whether the various water research institutes and groups begin developing more undergraduate or certificate programming over time. Given the recent proliferation of these groups and the urgency of the research, we anticipate this to be a growth area for institutions.

WATER AND GOVERNANCE ACROSS BORDERS

Most water programs considered in this issue examine politics in some way or another, usually through a course or case study focusing on the intersection of scientific and political issues. However, a small number of programs focus on the political dimensions of water management.

One of the most intriguing examples of programming that brings together politics and sciences not only crosses disciplines, but even an ocean. In 2018, University of Saskatchewan launched a Master of Water Security, in partnership with Beijing Normal University. The program can be taken in Saskatoon or Beijing, and members of both universities provide courses and research support. There are four main pillars: Concepts (e.g. hydrology); Tools and Technology (e.g. GIS); Water and Health; and Water, Policy, and Management. Given the wide range of topics, students from a wide range of backgrounds are considered. The program is connected to the Global Water Futures Institute, which is housed at U of S and is partnered with Waterloo,

McMaster, and Laurier. Global Water Futures is particularly considered with “water science for cold regions” and “the strategic needs of the Canadian economy in adapting to change.” The Master of Water Security exemplifies the ambitious program planning that can emerge from groups founded on collaboration.

Oxford’s MSc in Water Science, Policy, and Management, which admits approximately 20 students a year, arranges studies across three pillars: Water Science; Water and Policy; and Water Management. The Water and Policy pillar

Kananaskis Dam, Alberta, Canada





has students investigate the interplay between water and power, particularly as it relates to economic decision making and international politics. This is in addition to courses and field trips that provide students with fundamental knowledge in water science and monitoring. The program claims to be “the only interdisciplinary water MSc,” which is a bit of a dubious claim given the other examples discussed here, but it is relatively unique in the high number of courses it devoted to the study of water and policy and water and economics. While the program is primarily situated in the UK, it promotes a global lens, with a built-in field trip to Spain and several global case studies.

Perhaps the clearest expression of a commitment to international political and policy training in water management is the Water Without Borders Collaborative Graduate Programme, which is a joint effort between the UN University of Water, Environment, and Health and McMaster University. The program seeks particularly to help students bridge research and policy. The program has three courses and is open to graduate students at McMaster, and typically features at least one major international trip. It exposes students to ongoing UN projects and helps prepare them for careers in international management.

Water governance is fundamentally international and water governance programs apply a strong international lens.

DECOLONIZING WATER AND GOVERNANCE RESEARCH AND PEDAGOGY

Increasingly, courses and programs are examining the governance of water from non-western or decolonial perspectives. This effort toward decolonizing the curriculum is acknowledged by the Global Water Futures group noted above, which highlights Indigenization as one of its core areas of focus.

One striking course in this area is the Carleton Global Water Institute's Indigenous Ecological Ways of Knowing and the Academy, which "provide[s] an overview of diverse Indigenous cosmologies and perspectives on land, water, atmospheres, and more-than-human beings and ethical ways of working with these knowledges."¹ The course invites people to "identify decolonizing and/or collaborative research methods," which it applies to thinking about the relationship between the environment and humanity.

More broadly, the SSHRC-funded Decolonizing Water project includes faculty and graduate students from several institutions across Canada. The project foregrounds the Grand Council Treaty #3 Nibi Declaration, which states "Through its flow and movement, nibi (water) cleanses itself and connects us all. It brings us together as families, communities and as a nation."² This statement is a powerful reframing of what 'water and governance' education could look like in the future as the work of decolonization continues.

The Nibi Declaration clarifies how nibi (water) is connective and can be a starting point for reframing our collective understanding of water and policy making as well as understanding how knowledge can be exchanged.

Another source that is integrating the governance of water through a different framework is UBC's Program on Water Governance. This is a team of professors and graduate students who endeavour to "foster dialogue on water policy with communities and decision-makers."³ While the Program does not have formal courses, it offers public modules on water access, justice, and conflicts.⁴ People who complete the modules and associated quizzes may apply for certifica-

tion. The modules are designed by the UBC-launched International Waters Network, which is committed to the mobilization of various knowledges. This Network has participation from the University of Minnesota, the University of Western Cape, Wageningen University, and other institutes and centres around the world. While the education from this initiative remains relatively informal at this stage, given the links between institutions and networks and eventual formal courses of study, the International Waters Network may be another potential source of greater international collaboration in the future.

There are new and exciting efforts to incorporate and develop Indigenous perspectives into governance curriculum.

SUMMARY

Water Governance is an area of study that is covered more by individual courses than by formal programs. However, there are emerging program areas that have come from institutes and policy centres, and as issues around water become ever more pressing, programs that consider the overlap between water science and water management and policy are likely to become more common. Because international policy is foundational to water studies, it is reasonable to expect that more institutions will create collaborative programs that cut across borders.

The second major point is the re-consideration of how Indigenous ways of knowing might re-shape how we understand the political terms of international water management. A vital component of this development is the intervention of ways of knowing beyond the colonial paradigm, as articulated by the Nibi Declaration. Incorporating multiple knowledges will likely lead to some major reframing of where education happens, as formal training moves outside of university and college classrooms and into communities and across distances.

Water Management

The previous chapters considered various political, scientific, and social understandings of water as expressed by programs and institutes across the world. This section examines how institutions train people to manage water in a very direct sense—creating and managing plants, facilities, and infrastructure to help establish and maintain clean water supplies for a variety of uses. It does so by focusing particularly on the field of Integrated Water Management, both in Canada and in Australia.

The chapter, as per the theme of the issue, examines programs that bring together different approaches to enhance our knowledge of water management. While there are certainly longstanding and well-regarded programs in areas like hydraulic engineering, there are also growing shifts towards programs that integrate water management with widely applicable business, project management, and communication skills.

INTEGRATED WATER MANAGEMENT

Integrated Water Management (IWM) is “a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.”⁵ It highlights interrelationships as various levels: between disciplines; between the economy and the social; between central and local; and between the human and non-human. It tends to think less in terms of trade-offs between these binaries and more in terms of developing holistic approaches that account for all these factors.⁶

Effectively, Integrated Water Management serves as an exemplar for the trends we have been examining throughout this edition—it is an approach that seeks to think across different categories and that demands a delicate balance between specialized knowledge and broad applicability.

There are several formal IWM programs in Canada and across the world that seek to provide students with training that prepares them for lateral thinking across disciplines and domains. Both UBC and McGill have Integrated Water Management programs. UBC’s program is within the Faculty of Applied Science but integrates programs from their Business and Engineering programs; McGill’s is within the Faculty of Agriculture and Environmental Sciences but offers students courses from Geography, Engineering, and Natural Resource Sciences. However, the two programs still offer different perspectives on IWM: UBC’s tends to focus more on the “value chain” of water, from resource management to wastewater treatment from a business management approach, while McGill’s tends to highlight engineering and scientific research that is aware of broader business and social trends



In 2019, SAIT launched a two-year degree program in Integrated Water Management, partially with the support of Imperial Oil. This is the first Canadian college degree in IWM. The program provides training in water monitoring, hydrology, GIS, environmental stewardship, and project planning. While there is overlap with programs in water management offered by other colleges, the main difference appears to be in the breadth of applications. For instance, Fleming College’s Advanced Water Systems Operations and Management program focuses particularly on water and wastewater systems, while Assiniboine’s Land and Water Management program focuses more on environmental monitoring and ecology. The potential for overlap between these vocational programs and the scientific basis of those programs is considerable, and SAIT’s program seems to be an early adopter of this approach.

It should be noted that some institutions are not actually using the term “Integrated Water Management.” For instance, Waterloo once offered a IWM degree, but then rolled that into their wide-ranging Collaborative Water Program, though as noted above the water programs all require a course in integrated water management. In Europe, the University of Antwerp recently renamed their Master of Technology for Integrated Water Management to Advanced Master Think Water. However, the focus on providing training on a range of interactions and understanding the inter-relationship between water, economy, society, and science remains the same.

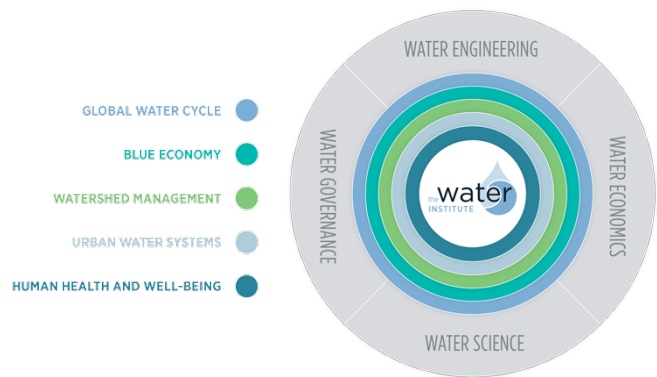
Pop out point: Integrated Water Management programs bring together engineering, governance, environmental sciences, and operations in a way that can combine university and college expertise in ways that can be applied to water operations management.

WATER INSTITUTES AND WATER MANAGEMENT

Canada has world-leading institutes and education in water engineering and hydrology that are committed to robust interdisciplinary inquiry. There are several institutes with connected graduate level and undergraduate level programming courses in Canada, including the Beaty Water Research Centre at Queen’s (which offers a Graduate Diploma for recent graduates and working professional, launched in 2019), the Institute for Water Innovation at the University of Toronto’s Faculty of Applied Science and Engineering (which

has an Emphasis in Advanced Water Technologies for MEng students), and the aforementioned Global Water Institute at Carleton (which has an extensive directory of potential courses).

Organizing research by themes helps promote interdisciplinarity. For instance, the Beaty Water Institute has four guiding themes for its research: Water Governance, Water Use, Water Resources, and Water Quality. It also offers a Graduate Diploma in Water and Human Health, which can stand on its own or can ladder students into graduate studies in Civil Engineering, Environmental Studies, or Geography and Planning. The Water Institute at Waterloo has five major themes: Global Water Cycle, Blue Economy, Watershed Management, Urban Water Systems, and Human Health and Well-Being. These themes are connected to water engineering, governance, science, and economics, as illustrated in the figure below.



Source: <https://uwaterloo.ca/water-institute/research-themes>

These themes have a wide range of programming options through the 22 masters’ and doctoral programs offered via Waterloo’s Collaborative Water Program (see the section on Water Science for more).

Perhaps one of the largest expressions of interdisciplinary efforts to study and provide education about water issues, linking research and education, is found in Australia’s International WaterCentre, found in Griffith University. The Centre launched in 2005 and “play[s] a central role in stimulating and brokering relationships between Australian



and international academics, researchers and practitioners, to collectively strengthen integrated water management approaches to tackling complex water challenges.”⁷ The Centre has projects throughout the southern hemisphere and offers two masters’ degrees and several online certificates. Notably, it’s blended Master of Integrated Water Management program that draws on researchers WaterCentre projects and invites lecturers from Queensland and Monash as well as from industry and NGOs. The program has four specializations: Urban Water; Water, Sanitation and Hygiene (WASH) and Development; Water Finance; and Water, Land and People. Students can participate in several applied research projects as part of their studies, particularly pertaining to WASH. They also offer both diplomas and degrees in Catchment Science, which provides professional training in protection and restoration projects.

SUMMARY

Whereas the first section considered programs that were more focused on policy and human relations and the second focused on science, the programs here blend the two categories. Integrated Water Management explicitly points to the interconnected relation between different processes, as is well illustrated by the image above. IWM, and other programs considered here, also bring in people who are trained in the essential operations of water and wastewater management, including operations at plants and site monitoring. As the SAIT program illustrates, it is here where diploma-level programming can play a crucial role in bridging gaps between practitioners and policy makers. Water institutes in Canada and Australia are also developing increasingly ambitious educational programs at both the short-cycle and degree levels.

Water research leads to considerable developments in cross-disciplinary and international programming. There are clear and growing links between research and education.

In Conclusion

There are a few points to highlight from this review of water-based programs:

- **Water studies are a key means for Indigenizing the academy.** From institutes to researchers to community links, the study of water will not be conducted correctly without incorporating multiple perspectives and without incorporating or foregrounding Indigenous knowledges. There are new courses and research programs being developed, but these efforts will need to continue to accelerate.
- **International thinking is necessary.** While stewardship of water can often be a highly local concern, the study of water is an international question and one where students will need to think internationally to fully understand the scope of the questions. Through embracing pedagogical techniques adopted during the Covid-19 pandemic, there may be opportunities to invite more international speakers to provide their insights into water use and stewardship and to foster knowledge of water relations digitally.
- **Water is becoming a coherent program of study.** While many programs now incorporate water concentrations, more standalone water sciences programs are becoming available to students at graduate and undergraduate levels. While these standalone programs are focused predominantly on the physical and applied sciences, they are highly interdisciplinary by nature, reaching across the sciences and beyond into project management, economics, and public policy.
- **Community links are fundamental. Institutions hosting water sciences programs also provide great benefits to their wider communities.** Field trips and research monitoring coastlines, conducting elemental analyses, and producing reports provide local communities with in-depth information specific to their region, which would be highly costly to obtain otherwise. This in-depth knowledge can be mobilized to support policy and other initiatives that can benefit the community.
- **Water studies bridge research and education.** While links between programming and research are often asserted, this field demonstrates the operationalization of these links across both short-cycle and degree-based programming. Programs that cut across fields flow from interdisciplinary research institutes.
- **The gap between scientist and practitioner must be bridged.** There are several key vocational training programs in colleges across Canada in areas like wastewater management and water engineering technology. IWM programs reveal a need for programming that educates people about the policy and scientific elements of water management and emphasize that understanding water management means having knowledge of the social and political forces that shape management. There is likely considerable opportunity for joint programs or short-term certificates that build on college or university credentials.

There are many exciting developments in the study and research of water, from multiple disciplinary angles. This is a developing area with considerable potential for growth, both at individual institutions and across different institutions. It is our hope that this brief document provides a wider readership with appreciation of the potential for collaboration and inspires thinking about what programming around fundamental issues looks like around the world.

Endnotes

¹ From the course syllabus. Dr. Zoe Todd has generously uploaded many of the course materials here:

<https://fishphilosophy.org/indg-3015-winter-term-public-site/>

² <http://decolonizingwater.ca/grand-council-treaty-3-nibi-declaration/>

³ <http://watergovernance.ca/about-us/>

⁴ <http://blogs.ubc.ca/internationalwaters/>

⁵ UNEP, "What is Integrated Water Resources Management?"

<https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/sudan/what-integrated-water-resources-management>

⁶ Chris White, "Integrated Water Management: What is it and why is it used?" <https://globalwaterforum.org/2013/06/10/integrated-water-resources-management-what-is-it-and-why-is-it-used/>

⁷ <https://www.watercentre.org/about/about-us/>

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At HESA, we keep a close eye on academic trends to understand what programs are attracting students and the sort of studies that attract and excite students.

Our company has produced reviews for disciplines ranging from drama to sociology.

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