

COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Global Issues in Land and Water Systems	LWS 525	3 credits

PREREQUISITES

There are no course prerequisites. This course is restricted to students in one of these faculties: GRAD

CONTACTS

Course Instructor(s)	Contact Details	Office Location	Office Hours
Les M. Lavkulich	Email: lml@mail.ubc.ca	MCML 127	By appointment (in-person or virtual)

ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəyəm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

COURSE DESCRIPTION

The course provides a comprehensive overview of water resource systems management, integrating concepts and approaches from environmental sciences, resource management, and policy. As climate change and population growth have had significant and diverse impacts on major river drainage basins around the world, students will explore how management of fresh water (the vital, and often “fugitive” resource), is evolving through an era of increased uncertainty.

Principles of systems thinking and analysis and integrated watershed science and management are applied in LWS 525 in the context of the transboundary drainage basin, where cumulative effects and water management and governance become more complex and significant. Several case studies will be discussed and students will prepare a term paper on a transboundary basin case study of the student's interest.

COURSE STRUCTURE

Each class will consist of a lecture or class discussion/activity. Course participants are expected to attend in-person. See the *Learning Activities* below for more details.

This course uses the Canvas Learning Management System (canvas.ubc.ca) to support in-class activities. Students will find lecture slides, readings and assignment instructions here. Classroom lectures may be recorded (once required consent obtained), and recordings will be available to

students via Canvas. Students can also participate in online discussions and submit assignments via Canvas.

SCHEDULE OF TOPICS

Period	Unit
Week 1	Registration & Introduction
Week 2	Photosynthesis & Review of Water Management
Week 3	Discussion and Critical Review #1
Week 4	Transboundary Drainage Basin: Overview
Week 5	Transboundary Drainage Basin: Challenges
Week 6	The Right to Water
Week 7	Ecological Services and Human Well-Being
Week 8	Discussion and Critical Review #2
Week 9	Climate Change
Week 10	Global Case Studies – Term Paper
Week 11	Emerging and Future Concerns
Week 12	Discussion and Critical Review #3
Week 13	Wrap up; Take-home Final Exam sent out

Dates for discussions and assignments will be posted on the course Canvas site. Please note that this schedule is subject to change.

LEARNING OUTCOMES

On completion of this course, students should be able to:

1. Demonstrate an understanding of the hydrological, socioeconomic, environmental and policy facets of water resource management.
2. Identify priority water resource management issues and strategies for major development sectors, such as agriculture, forestry and large industry.
3. Characterize a drainage basin, and demonstrate an understanding of the water management challenges facing large, transboundary drainage basins in a changing climate.
4. Discuss theory and practice of water resource management at international, national and local scale jurisdictions, and their intersections in a transboundary context.
5. Analyze water rights, equity, and potential water conflicts under different management regimes.

6. Identify and discuss the interconnections between water resource management, ecosystem goods and services, and human and ecosystem health.
7. Develop a comprehensive analysis and review of fresh water resources development and management and its challenges on a transboundary river basin case study.

LEARNING MATERIALS & READING LIST

There is no textbook for the course. Students should read the assigned readings in preparation for each week's lecture; required readings are presented in **bold**, while additional readings are provided for reference and interest. Readings are made available through the UBC Library Course Reserves.

1. Introduction

1.1 Water Needs

- **Environment Agency. 2020. Meeting our future water needs: a national framework for water resources.** Horizon House, Bristol, UK. www.gov.uk/environment-agency

1.2 The Vital Resource

- **Aulenbach, D.B. 1968. *Water—Our Second Most Important Natural Resource*, 9 B.C. L. Rev. 535,** <https://lawdigitalcommons.bc.edu/bclr/vol9/iss3/2>

1.3 Additional References

- Boretti, A., Rosa, L. 2019. Reassessing the projections of the World Water Development Report. *Clean Water* 2, 15. <https://doi.org/10.1038/s41545-019-0039-9>
- Pradinaud, C., Northey, S., Amor, B., Bare, J., Benini, L., Berger, M., Boulay, A. M., Junqua, G., Lathuillière, M. J., Margni, M., Motoshita, M., Niblick, B., Payen, S., Pfister, S., Quinteiro, P., Sonderegger, T., & Rosenbaum, R. K. 2019. Defining freshwater as a natural resource: A framework linking water use to the area of protection natural resources. *The international journal of life cycle assessment*, 24(5), 960–974. <https://doi.org/10.1007/s11367-018-1543-8>
- Food and Agriculture Organization of the United Nations. 2014. *The Water-Energy-Food Nexus - A new approach in support of food security and sustainable agriculture*. Rome.

2. Photosynthesis & Review of Water Management

2.1 Photosynthesis

- **Barber, J. 2017. A mechanism for water splitting and oxygen production in photosynthesis.** *Nature Plants* 3, 17041. <https://doi.org/10.1038/nplants.2017.41>

2.2 Agriculture

- **Lubell, M. & A. Fulton. 2008. Local Policy Networks and Agricultural Watershed Management, *Journal of Public Administration Research and Theory*, 18(4), 673–696.** <https://doi.org/10.1093/jopart/mum031>

2.3 Forestry

- Calder, I.R. 2007. Forests and water – ensuring forest benefits outweigh water costs. *Forest Ecology and Management*, 251: 110–120.

2.4 Rangelands

- Dahlgren, R., Tate, K. W, Lewis, D., Atwill, E. R, Harper, J., & Allen-Diaz, B. 2001. Watershed research examines rangeland management effects on water quality. *California Agriculture*, 55(6), 64-71. Retrieved from <https://escholarship.org/uc/item/1gf4v94s>

2.5 Fisheries

- Maitland, P.S., and N. C. Morgan. 2001. *Conservation Management of Freshwater Habitats: Lakes, Rivers and Wetlands*. Boston, MA: Kluwer Academic Publishers.

2.6 Urban

- OECD. 2014. *Managing water for future cities. Policy Perspectives*. <https://www.oecd.org/environment/resources/Policy-Perspectives-Managing-Water-For-Future-Cities.pdf>

2.7 Energy

- U.S. Dept of Energy. 2014. *Water Energy Nexus Full Report* <https://www.energy.gov/sites/default/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf>

2.8 Industry

- General Electric. 2017. *A Global Thirst: Water Use In Industry*. <https://www.ge.com/news/reports/global-thirst-water-use-industry>

2.9 Integrated Watershed Management

- Wang, G., Mang, S., Cai, H. et al. 2016. Integrated watershed management: evolution, development and emerging trends. *J. For. Res.* 27, 967–994.

2.10 Additional References

- Agriculture and Agri-Food Canada (AAFC). 2020. *Agriculture and water quality*. <https://agriculture.canada.ca/en/agriculture-and-environment/agriculture-and-water/watershed-protection/agriculture-and-water-quality>
- Buttle, J.M., I.F. Creed & R.D. Moore. 2009. Advances in Canadian Forest Hydrology, 2003-2007, *Canadian Water Resources Journal*, 34:2, 113-126, DOI: 10.4296/cwrj3402113:https://doi.org/10.4296/cwrj3402113
- Platt, R.H. 2006. Urban watershed management. Sustainability, one stream at a time. *Environment*. Vol. 48, No.4: pp. 26-42.
- Macknick, J., R. Newmark, G. Heath, and K.C. Hallet. 2012. Operational water consumption and withdrawal factors for electricity generating technologies: a review of

existing literature. *Environmental Research Letters*. 7 doi:10.1088/1748-9326/7/4/045802.

- Ritchie, H. & M. Roser. 2018. "Water Use and Stress". Published online at <https://ourworldindata.org/water-use-stress>
- Food and Agriculture Organization. 2017. Watershed management in action: Lessons learned from FAO field projects. <http://www.fao.org/policy-support/tools-and-publications/resources-details/en/c/1155483/>
- Karpuzcu, K.P.T. Mehmet & Delipinar, Sermin. 2011. Integrated watershed management. Socio-economic perspective. *The Online Journal of Science and Technology*, Volume 1.

3. The Transboundary Drainage Basin

3.1 Introduction and Definitions

- Fitzgerald, Helen. 2021. "Facts About Basins" [sciencing.com](https://sciencing.com/basins-8647463.html), <https://sciencing.com/basins-8647463.html>.

3.2 Connectivity

- Degefu, D.M., Liao, Z., He, W., Yuan, L., An, M., Zhang, Z., Xia, W. 2019. The Impact of Upstream Sub-Basins' Water Use on Middle Stream and Downstream Sub-Basins' Water Security at Country-Basin Unit Spatial Scale and Monthly Temporal Resolution. *Int. J. Environ. Res. Public Health*, 16, 450. <https://doi.org/10.3390/ijerph16030450>

3.3 Local and Global Issues

- UN-Water. 2018. Transboundary Waters . <https://www.unwater.org/water-facts/transboundary-waters/>

3.4 Protection

- Rieu-Clarke, A., R. Moynihan & B. Magsig. 2012. UN Watercourses Convention: User's Guide https://www.iucn.org/sites/dev/files/un_watercourses_convention_-_users_guide.pdf

3.5 Additional References

- Gregory K.J. 1999. Drainage basins. In: *Environmental Geology*. Encyclopedia of Earth Science. Springer, Dordrecht. https://doi.org/10.1007/1-4020-4494-1_83
- UN (2012): UN World Water Development Report 2012: Managing Water under Uncertainty and Risk.
- UNEP-DHI and UNE. 2016. Transboundary River Basins: Status and Trends, Summary for Policy Makers. United Nations Environment Programme (UNEP), Nairobi.
- United Nations. 1992. UN Convention on the protection and use of transboundary watercourses and international lakes.
- Rai, S.P., Sharma, N. & Lohani, A.K. 2019. Novel approach for issues identification in transboundary water management using fuzzy c-means clustering. *Appl Water Sci* 9, 11. <https://doi.org/10.1007/s13201-018-0889-1>

4. Drainage Basin: Challenges

4.1 Dams

- FAO. 2002. Impacts of dams on rivers, <http://www.fao.org/3/y3994e/y3994e0i.htm>

4.2 Diversions

- Jacob-Rousseau, N. 2015. Water diversions, environmental impacts and social conflicts: the contribution of quantitative archives to the history of hydraulics. French cases (nineteenth century). *Water Hist* 7, 101–129 (2015).
<https://doi.org/10.1007/s12685-013-0092-0>

4.3 Extractions

- Sabater, S., Bregoli, F., Acuña, V. et al. 2018. Effects of human-driven water stress on river ecosystems: a meta-analysis. *Sci Rep* 8, 11462. <https://doi.org/10.1038/s41598-018-29807-7>

4.4 Contamination and Pollution

- Schwarzenbach, R.P., T. Egli, T.B. Hofstetter, U. von Gunten, B. Wehrli. 2010. Global Water Pollution and Human Health. *Annual Review of Environment and Resources* 35:1, 109-136

4.5 Additional References

- Schmutz, S. & O. Moog. 2018. Dams: Ecological Impacts and Management. *Riverine Ecosystem Management*, Volume 8.
- Nikiema, J., J. Mateo-Sagasta, Z. Asiedu, D. Saad & B. Lamizana. 2020. Water Pollution by Plastics and Microplastics.; A Review of Technical Solutions from Source to Sea, 2020. United Nations Environment Programme, ISBN No: 978-92-807-3820-9
- Honingh, D., T. van Emmerik, W. Uijttewaal, H. Kardhana, O. Hoes & N. van de Giesen. 2020. Urban River Water Level Increase Through Plastic Waste Accumulation at a Rack Structure. *Front. Earth Sci.*, 14, <https://doi.org/10.3389/feart.2020.00028>

5. The Right to Water

5.1 Global

- Burtka, A.T. & W. Montgomery. 2018. A Right to Water – Is Water a Human Right or a Commodity? University of Michigan: Erb Institute
<http://www.3blmedia.com/News/Right-Water-Water-Human-Right-or-Commodity>

5.2 Indigenous Peoples

- Wilson, N.J. and J. Inkster. 2018. Respecting water: Indigenous water governance, ontologies and politics of kinship on the ground. *Nature and Space*, 1:515-538.

5.3 Additional References

- Scanlon, J., A. Cassar & N. Nemes. 2004. Water as a Human Right? IUCN Environmental Law Programme, Policy and Law Paper No. 51.
- Arden, T. 2016. Water for all? Developing a human right to water in national and international law. *International and Comparative Law Quarterly*. 65:771-798.
- Awume, O., Patrick and R. E. Baijius. 2020. Indigenous Perspectives on Water Security in Saskatchewan, Canada. *Water*. 2020; 12(3):810. <https://doi.org/10.3390/w12030810>
- Levy, Barry S., Victor W. Sidel. 2011. Water Rights and Water Fights: Preventing and Resolving Conflicts Before They Boil Over. *Am J Public Health*, 101(5): 778-780.

6. Ecological Services and Human Well-Being

6.1 Introduction

- Dimple, R., H.D. Venema & M. McCandless. 2011. Ecological Goods and Services: A review of best practices in policy and programing. *International Institute for Sustainable Development (IISD)*. 80 pp.

6.2 Human Needs

- Forslund, A., et al. 2009. Securing Water for Ecosystems and Human Well-being: The Importance of Environmental Flows. Swedish Water House Report 24. SIWI.

6.3 Health

- Baron, J.S., N.L. Poff, P.L. Angermeier, C.N. Dahm, P.H. Gleick, N.G. Hairston, Jr., R.B. Jackson, C.A. Johnston, B.D. Richter, A.D. Steinman. 2003. Sustaining Healthy Freshwater Ecosystems. *Issues in Ecology*, Number 10.

6.4 Additional References

- P.H. Gleick (1996). Basic Water Requirements for Human Activities: Meeting Basic Needs, *Water International*, 21:2, 83-92, DOI: 10.1080/02508069608686494
- Basic Water Requirements for Human Activities: Meeting <https://pacinst.org> › publication › basic-water-needs.
- Guidance for Responding to Drinking Water Contamination ... [https://www.epa.gov/sites/production/files/2018-12/documents/..](https://www.epa.gov/sites/production/files/2018-12/documents/)

7. Climate Change and Land and Water Systems

7.1 Overview

- Luce, Charles; Morgan, Penny; Dwire, Kathleen; Isaak, Daniel; Holden, Zachary; Rieman, Bruce. 2012. Climate change, forests, fire, water, and fish: Building resilient landscapes, streams, and managers. Gen. Tech. Rep. RMRS-GTR-290. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 207

7.2 Additional References

- Jonathan T. Overpeck, Bradley Udall. (2020). Climate change and the aridification of North America. *Proceedings of the National Academy of Sciences*, 117 (22) 11856-11858; DOI: 10.1073/pnas.2006323117
- D. W. Schindler, W. F. Donahue. (2006). An impending water crisis in Canada's western prairie provinces. *Proceedings of the National Academy of Sciences*, 103 (19) 7210-7216; DOI: 10.1073/pnas.0601568103
- Gaur A, Gaur A, Simonovic SP. 2018. Future Changes in Flood Hazards across Canada under a Changing Climate. *Water*. 10(10):1441. <https://doi.org/10.3390/w10101441>

8. Global Case Studies

Readings to be provided following discussion on students' selected drainage basins.

9. Emerging and Future Concerns

9.1 Future predictions and adaptation

- **WMO. 2008. New Challenges of Water Resources Management: The Future ...**
<https://public.wmo.int/en/bulletin/new-challenges-water-resources-management-future-role-chy>

9.2 Additional References

- 18 Surprising Projections About the Future of Water ...
www.seametrics.com/blog/future-water
- Assessing the Vulnerability of Watersheds to Climate Change ... https://www.fs.fed.us/pnw/pubs/pnw_gtr884
- Causes of Water Conflict: Past Wars and Future Predictions
<https://worldwaterreserve.com/water-crisis/causes-of-water-conflic>
- 10 ways technology is changing the future of water ...
<https://www.techrepublic.com/article/10-ways-technology-is-changing>
- William A. Jury, Henry Vaux. 2006. The role of science in solving the world's emerging water problems. *Proceedings of the National Academy of Sciences*, 102 (44) 15715-15720; DOI: 10.1073/pnas.0506467102

LEARNING ACTIVITIES

Students are expected to come prepared to lectures and complete any assigned readings prior to class (see *Reading List* above). Students are invited to discuss the topic of the session by asking questions and/or sharing commentary based on their background and expertise. There will be three scheduled small group discussions throughout the course, with a follow-up critical review essay to be submitted online in Canvas (see *Assessments of Learning* below). Additional readings have been provided as references to support further research for the Case Study Term Paper and Take Home Final Exam.

ASSESSMENTS OF LEARNING

To complete the course, the following assessment components will be graded:

- 1. Discussions and Critical Review (3 x 10% = 30%) – 30%**
- 2. Case Study Term Paper – 30%**
- 3. Final Examination (Take Home) – 40%**

1. Student participation in class is encouraged and can take on several forms. Question periods during lectures are opportunities to ask questions and share commentary on the topic at hand in a more informal way. In addition, there will be three designated discussion periods scheduled, where the class will break into small groups to discuss an assigned topic/question. Following these class discussions, a short critical review essay (500 words) will be assigned and students will submit these to Canvas.

Detailed instructions will be provided during class time and posted in Canvas.

The Canvas Discussion board will also be an available forum for students to continue discussions outside of class time. The instructor will intermittently join in to facilitate.

2. In the term paper, students will present a comprehensive report (~2000 words) on a selected drainage basin case study, that includes the following:

- a geographical characterization of the climate and basin,
- review of the water resource management history and issues,
- explanation of the key policies that inform/guide WRM in the basin,
- an evaluation of what has been successful (provide criteria) and what are the priorities for WRM to continue into the future in a changing climate.

Detailed instructions will be provided during class time and posted in Canvas.

Criteria for evaluation of term paper:

- Read and follow instructions carefully
- Provide clearly stated objectives
- Provide comprehensive subject matter coverage (breadth and depth)
- Cite relevant literature documentation
- Discuss strengths and weaknesses of alternative findings
- Present clear conclusions
- Document is clear, organized and absent of spelling and grammatical errors

3. A take-home Final Examination will be shared with students in the last week of classes. The exam will be open-book, and students will have ~2 weeks to complete their submission. Students will present long-form written responses to given question(s) that integrate concepts presented throughout the course lectures, discussions and in the global drainage basin case studies.

Detailed instructions will be provided during class time and posted in Canvas.

If a student has a concern with an assignment and/or deadline, they should contact an instructor immediately to discuss possible alternatives. If an assignment is submitted late and the student did not contact the instructor prior to the due date, late marks will be deducted at the instructor's discretion.

UNIVERSITY POLICIES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances.

UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on [the UBC Senate website](#).

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