

GEOG 9122A – Water and Cities

Course Outline: Fall 2024

This course is taught in-person

1. Course Information

*Details about design and delivery of the course are listed below in sections 4 through 8

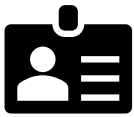


Classes Start	Fall Reading Week	Classes End	Study day(s)	Exam Period
September 5	October 14-20	December 6	December 7 & 8	December 9-22

September 13, 2024: Last day to add a second-term half course

October 14, 2024: Thanksgiving Holiday

November 11, 2024: Last day to drop a first term half course without penalty



Course Instructor	Contact Information	Student drop-in Hours
Geneviève Metson	gmetson@uwo.ca	Wednesday 2:30-3:30pm in person or by appointment

Teaching Assistant(s)	Contact Information	Student drop-in Hours
Saaka Sulemana	ssulem@uwo.ca	Thursday 4:00-5:00pm in person

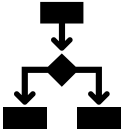
2. Calendar Description

Explores how issues of water quantity and quality upstream, within, and downstream of urban centers are inextricably tied to the sustainability of cities. Students will learn basic water monitoring techniques and draw on systems thinking to better understand quantitative outcomes and identify interventions to support sustainable water management in cities.

2 lecture hours, 2 laboratory hours, 0.5 course

Antirequisite(s): None

Prerequisite(s): One of Geography 2210A/B, Geography 2310A/B, Geography 2320A/B or Geography 2330A/B, or at least 3rd year standing in an Environmental Science or Earth Sciences program, or permission of the instructor with a demonstration of some quantitative coursework.



Senate Regulations state, “unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.”

3. Textbook

Thinking in Systems: A Primer by Donella H. Meadows and Diana Wright. 2008 Chelsea Green Publishing



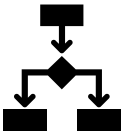
In addition to selected media, peer-reviewed, and other readings are made available via OWL.

The textbook is available for free as a pdf (linked above) and all other resources will be posted in OWL and will include book sections, articles, and other forms of media. Please ensure to check both lecture and lab sections and ensure that you have reviewed the materials in advance of the specific session as these materials will inform the basis for quizzes, discussions, and lab assignments.

4. Course Objectives and Format

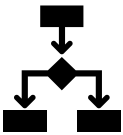
With most people living in cities, understanding their dependence on resources from far away and their impact on landscapes is essential to tackling sustainability goals, including those related to safe and sufficient water. In addition, the way cities are planned, built, and maintained has a large impact on local hydrology, making them a unique ecosystem to manage.

This course uses a system thinking approach to explore how cities manage water for drinking, recreation/housing, and waste. After laying a theoretical foundation for studying complex systems and how water physically flows to, through, and from cities, we will explore causes, effects, and solutions related to fluctuations in water quantity and water quality with real-world urban examples in lectures. In the lab sessions, students will learn how one can plan, collect, and analyze nutrient concentration and water flow information in the Upper Thames watershed. These types of data are an essential part of determining how cities are affecting and are affected by water quality issues. The course takes a socio-ecological-technological lens to issues of water, explicitly teasing out that social and biophysical variables are important to understanding observed patterns and potential solutions. This will allow students to see how 'water issues' are connected to other priority areas such as energy provision, climate change, and land use, as well as issues of power, equity, and knowledge.



This is a participatory and 'hands-on' class. Active participation in lectures and labs will be necessary for students to be successful. All evaluations are designed to build on multiple materials at once and on each other. For example, the quizzes evaluate assigned readings but serve as a basis to clarify misunderstandings via discussion about those readings in the lecture because the final papers must utilize concepts and methods from those same readings. If concepts are new or challenging to a student, that is welcomed, even celebrated. The instructor team expects students to review material outside of class to be prepared to use in-class and in-lab time to engage with others and ask questions. It is important to point out that scheduled lab time is limited, and as such working outside these time slots is likely required, especially if numerical data handling is a skill students are still developing. **Please come to class/lab/seminar prepared to be involved and to be respectful to your classmates and the instructor team.** Derogatory or offensive remarks and responses are not acceptable, nor are they effective forms of academic discussion or debate.

Building on the above, **attendance is required** as quizzes are given in lectures, and most labs cannot be completed without the equipment/instructions provided within sessions. In addition, labs build on each other and as such absences may negatively affect a student's capacity to do well on subsequent assessments. The evaluation scheme already allows for 2 class and 1 lab absence, but it is the student's responsibility to make sure they understand what is missed for absences to not negatively affect their other assessments. The student oral presentations are a core part of the whole class deepening their understanding of water and cities, not only an opportunity for evaluation. Note that a flexible assessment policy is already in place, and thus further academic consideration is likely to be denied (see evaluation section).



All course material will be posted to the new OWL Brightspace learning environment: <https://westernu.brightspace.com/d2l/home>. Any changes will be indicated on the OWL site and discussed with the class.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here](#).

If students need assistance, they can seek support on the [OWL Brightspace Help page](#). Alternatively, they can contact the [Western Technology Services Helpdesk](#). They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Learning Outcomes

Upon successful completion of this course, students will be able to:

Insert Learning Outcomes; list at the end of this document

- Describe how water flows to, from, and within the city. This includes a core understanding of watershed boundaries, hydrological flow pathways, and how water imports, impervious surfaces, land use, and infrastructure create unique urban watersheds.
- Integrate social, biophysical, and economic factors into a conceptual systems model to explain an urban water challenge. This requires identifying factors at multiple spatial and temporal levels, and their interactions.
- Determine what types of data may be needed to validate a system model about urban water challenges. This includes diverse data types, includes but is not limited to primary measurements of water quantity and quality, and requires the ability to identify limitations and challenges that may be associated with these data.
- Collect field data and calculate nutrient loads. This includes demonstrating a capacity to safely plan and execute fieldwork and organize, combine, and share collected data so it can be coupled with other sources of information and used by others.
- Articulate urban water-related problems and solutions in a nuanced and data-supported way. This includes effective and clear oral and written components, the use of visual aids, as well as practicing active listening and articulating constructive critique via questions.



6. Course Content and Schedule

Week	Dates	Lecture Topic	Grad seminar	Lab Topic
1	Sept 5-6			Introduction to systems thinking and scales

Week	Dates	Lecture Topic	Grad seminar	Lab Topic
2	Sept 9-13	Urban 'watersheds'	Yes	Lab 1: Principles of water quality field measurements (outdoor activity)
3	Sept 16-20	Nutrient loss pathways		
4	Sept 23-27	Upstream waters - drinking	Yes	Lab 2: Principles of water quantity field measurements (outdoor activity)
5	Sept 30-October 4	Within waters – impervious surfaces and pipes		
6	October 7-11	Downstream waters – wastewater	Yes	<i>Opportunity for feedback/brainstorming on case selection and skills to develop for final paper</i>
7	October 14-18	Fall Study Break		N/A
8	October 21-25	Focus issue* - Floods (Quebec city) <i>Submit final paper topic</i>	Yes	Lab 3: Data organization
9	October 28-Nov 1	<i>Work on your final papers</i>		
10	November 4-8	Focus issue – Contamination (Greater Toronto Area)	Yes	Lab 4: Low Calculations
11	November 11-15	Focus issue - Droughts		
12	November 25-29	Attend presentations	Yes <i>Do peer-review of papers</i>	Attend presentations
13	Dec 2-6	Attend presentations		Submit papers

*Focus issue indicates that we will use case studies that are linked via a specific 'type' of water-related topic. The cases will allow us to use the physical water flow and systems thinking skills built in the 1st 5 weeks. These will touch on issues of quality and quantity of water related to cities.

Week	Dates	Lecture Readings	Grad seminar readings
1	Sept 5-6	NA	
2	Sept 9-13	Ch. 1 and 2 Thinking in Systems Welty 2009. The Urban Water Budget (in OWL)	Metson, G. S., D. M. Iwaniec, L. A. Baker, E. M. Bennett, D. L. Childers, D. Cordell, N. B. Grimm, J. M. Grove, D. A. Nidzgorski, and S. White. 2015. Urban phosphorus sustainability: Systemically incorporating social, ecological, and technological factors into phosphorus flow analysis. <i>Environmental Science and Policy</i> 47:1–11. Liu, Z., J. Ying, C. He, D. Guan, X. Pan, Y. Dai, B. Gong, K. He, C. Lv, X. Wang, J. Lin, Y. Liu, and B. A. Bryan. 2024. Scarcity and quality risks for future global urban water supply. <i>Landscape Ecology</i> 39(2):10.

Week	Dates	Lecture Readings	Grad seminar readings
3	Sept 16-20	Ch. 3 and 4 Thinking in Systems Upper Thames Conservation Authority's Medway Creek Report Card (in OWL with more at https://thamesriver.on.ca/)	
4	Sept 23-27	Ch. 5 and 6 Thinking in Systems Dryan 2024. <u>A pipeline to send water to southern Alberta? Ideas float to surface in times of drought</u>	Lintern, A., L. McPhillips, B. Winfrey, J. Duncan, and C. Grady. 2020. Best Management Practices for Diffuse Nutrient Pollution: Wicked Problems Across Urban and Agricultural Watersheds. <i>Environmental Science & Technology</i> 54(15):9159–9174. Lautz, L. K., S. H. Ledford, and J. Beltran. 2020. Legacy effects of cemeteries on groundwater quality and nitrate loads to a headwater stream. <i>Environmental Research Letters</i> 15(12):125012.
5	Sept 30-Oct 4	Ch. 7 and glossary Thinking in Systems McPheason 2013. <u>Wicked problems, socio-ecological Systems, and the Utility of Systems Thinking</u> . The Nature of Cities	
6	Oct 7-11	Stallard and Fisher 2024. <u>Raw sewage spills onto England rivers and seas doubles in 2023</u> Laville 2021. <u>‘The sea was milky white’: how the Southern Water sewage scandal unfolded</u>	Oswald, C. J., C. Kelleher, S. H. Ledford, K. G. Hopkins, A. Sytsma, D. Tetzlaff, L. Toran, and C. Voter. 2023. Integrating urban water fluxes and moving beyond impervious surface cover: A review. <i>Journal of Hydrology</i> 618:129188. Hodgins, G., C. E. Robinson, J. W. Roy, and C. Power. 2023. Characterization of subsurface pathways contributing to freshwater salinization of urban streams using electrical and electromagnetic imaging techniques. <i>Science of The Total Environment</i> 905:167225.
7	Oct 14-18	Fall Study Break	N/A
8	Oct 21-25	Jean-Olivier Goyette-UQO wetlands and flooding (Quebec City) Office of the Auditor General of Ontario (2022). Value-for-money audit: Climate Change Adaptation: Reducing Urban Flood Risk. Sections 1 and 2 of report available from Ontario Nature website and on OWL: https://ontarionature.org/campaigns/wetlands/wetlands-mitigate-flooding/ Goyette, J.-O., S. Savary, M. Blanchette, A. N. Rousseau, S. Pellerin, and M. Poulin. 2023. Setting Targets for Wetland Restoration to Mitigate Climate Change Effects on Watershed Hydrology. <i>Environmental Management</i> 71(2):365–378.	Kaushal, S. S., K. L. Wood, J. G. Galella, A. M. Gion, S. Haq, P. J. Goodling, K. A. Haviland, J. E. Reimer, C. J. Morel, B. Wessel, W. Nguyen, J. W. Hollingsworth, K. Mei, J. Leal, J. Widmer, R. Sharif, P. M. Mayer, T. A. Newcomer Johnson, K. D. Newcomb, E. Smith, and K. T. Belt. 2020. Making ‘chemical cocktails’ – Evolution of urban geochemical processes across the periodic table of elements. <i>Applied Geochemistry</i> 119:104632. Wellen, C., G. B. Arhonditsis, T. Long, and D. Boyd. 2014. Accommodating environmental thresholds and extreme events in hydrological models: A Bayesian approach. <i>Journal of Great Lakes Research</i> 40:102–116.
9	Oct 28-Nov 1	<u>Nick Cage movie review</u> (example of good writing/storytelling, bringing multiple lines of evidence together)	
10	Nov 4-8	Chris Wellen-TMU nutrient loss pathways in cities and TRCA water management program TBD readings	Li, C., Peng, C., Chiang, P. C., Cai, Y., Wang, X., & Yang, Z. 2019. Mechanisms and applications of green infrastructure practices for stormwater control: a review. <i>Journal of Hydrology</i> , 568, 626-637. Hathaway, J. M., E. Z. Bean, J. T. Bernagros, D. P. Christian, H. Davani, A. Ebrahimian, C. M. Fairbaugh, J. S. Gulliver, L. E. McPhillips, G. Palino, E. W. Strecker, R. A. Tirpak, B. van Duin, N. Weinstein, and

Week	Dates	Lecture Readings	Grad seminar readings
			R. J. Winston. 2024. A Synthesis of Climate Change Impacts on Stormwater Management Systems: Designing for Resiliency and Future Challenges. <i>Journal of Sustainable Water in the Built Environment</i> 10(2):04023014.
11	Nov 11-15	TBD depending on case and speaker	
12	Nov 25-29		
13	Dec 2-6		

7. Communication

Students should check the OWL site every 24 – 48 hours

This course will use the OWL Brightspace for discussions

- Students should post all course-related content questions on the discussion forum so that everyone can access answers to questions
- Students are welcome and encouraged to help answer questions posed by classmates.
- The discussion forums will be monitored every other day on weekdays by instructors.
- Responses may refer students to a section of the book or syllabus, or part of class notes or lab instructions. This is not to be dismissive of any questions or discourage asking; rather instructors want to encourage using the resources at hand and develop independent learning/research skills.

Students should email their instructor(s) and teaching assistant(s) only in relation to something that cannot be posted on the discussion forum

- All correspondence with the instructor and TAs should be professional and show how the student has used available resources to independently find an answer when correspondence is about class content. At the end of this section an example template to guide your professional email correspondence is provided.

If the instructor team receives an email about something that should have been posted on the forum they will not respond.

Students drop-in hours

- Students are encouraged to come ask questions about class material as well as general academic/research questions.
- Introduce yourself when you come in, and tell us what course you are in, and then follow the three *explain* steps under the *Example of professional correspondence structure* below
- Drop-in hours will be documented via meeting minutes posted as a discussion forum entry on OWL (i.e. any answers to class content questions will be available to all so thank the students who show up to drop-in hours!)

Example of professional correspondence structure

- The **yellow highlight** indicates where to fill in specific parts with context and questions.

Subject: GEO9122 **short statement about the nature of the inquiry**

Main body of the message:

Hello Dr. xxx,

I hope this email finds you well.

- Explain the issue or question
- Explain what you have already done to find information or resources or what technique you have tried to resolve the issue.
- Explain exactly what you do not understand based on what you have already tried and what kind of assistance or help you are looking for from your TA or instructor.

Thank you for your time.

Kind regards,

Your full name

8. Evaluation

Below is the evaluation breakdown for the course followed by more detailed descriptions of each assessment.

Assessment	Format	Weighting	Due Date
Reading quizzes	In person	15% (average of all, dropping the 2 lowest quiz grades)	Weekly (start of each lecture)
Laboratory exercises	In person activities followed by a written group and individual lab reports submitted via OWL	45% (average of all, dropping the lowest lab grade)	Every other week (on the Wednesday before the start of the next lab)
Final essay	Individual written report submitted via OWL	30%	December 5
Final peer-review	Individual written report submitted via OWL	10%	November 28



The evaluation methods described in the course outline are essential requirements for the course.

Students are responsible for material covered in the lectures as well as the assigned chapters/sections in the text. **To pass the course, students must achieve a passing grade (>50%) on the lab component.**

- All assignments are due Wednesday's at 11:55 pm ET unless otherwise specified
- Written assignments will be submitted to Turnitin (statement in policies below)
- Students will have unlimited submissions to Turnitin
- Late assessments without academic consideration will be subject to a late penalty of 25 %/day

- ☒ Academic consideration must be submitted at the latest within 48 hours of the assessment deadline, for assignments worth more than 10% of the final grade (see the flexibility statement under academic consideration for other assignments). Academic counselling will then issue the instructor a notification for the period of accommodation, and the student must contact the instructor directly to verify what the accommodation will look like for late submission.
- ☒ An assessment cannot be submitted after it has been returned to the class
- ☒ A rubric will be used to evaluate the final essay assessment and will be posted with the instructions
- ☒ After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days

Reading quizzes (15%)

At the beginning of each lecture, there will be a multiple choice or short answer quiz of the readings assigned for that week, where each quiz has the same weight. The lowest 2 grades will be dropped and the remaining will be averaged.

Laboratory exercises (45%, equal weighting with the lowest grade dropped)

There will be four lab assignments throughout the term. Electronic versions of all assignments will be available via OWL several days prior to the beginning of the laboratory session during which they are assigned. Lab assignments will be due on the Wednesday before the start of the next lab (Thursday) via OWL submission. It is the student's responsibility to ensure that completed assignments are properly uploaded to OWL.

Final essay (30%)

Each student will select a water issue specific to the location of their graduate work. The report will include bringing together quantitative water quality and quantity data from official sources together to characterize the situation at hand. They must then utilize systems thinking to show how interlinked factors are causing the issue and propose a solution based on this system's understanding. Further instructions will be provided separately, including a rubric that is aligned with the learning objectives of this course.

Final peer-review (10%)

Each student will be assigned as a reviewer to one other student's essay, where they will review a draft one week before the final is due. The reviewer will use the grading rubric to assign a grade with a justification as well as pose at least 3 critical questions to help the student improve their final submission. The student is assessed for their ability to ask an insightful question and critical eye in evaluation.

Click [here](#) for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable

F	below 50	Fail
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Grades **will not be adjusted** on the basis of need. It is important to monitor your performance in the course. Remember: *You* are responsible for your grades in this course.

9. Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: [Academic Accommodation for Students with Disabilities](#).

General Information about missed work:

University policy on academic considerations are described [here](#). This policy requires that all requests for academic considerations must be accompanied by a self-attestation. Further information about academic considerations, and information about submitting this self-attestation with your academic consideration request may be found here.

Please note that any academic considerations granted in this course will be determined by the instructor, in consultation with the academic advisors in your Faculty of Registration, in accordance with information presented in this course outline.

Formal Documentation Designation statement

Please note that the final essay assessment is considered to be central to the learning objectives for this course. Accordingly, students seeking academic consideration for this assessment will be required to provide formal supporting documentation. Students who are granted academic consideration for this assessment will be provided with the following opportunity to make up this work: December 11th submission + short in-person presentation with instructor questions.

Flexibility statement

Quizzes and laboratory exercises already have flexibility built in by dropping the lowest grades. For this reason, academic consideration will not be granted for missed quizzes or laboratory exercises. If students miss 2/8 quizzes, the remaining 6 quizzes will be used in the calculation of the final grade. If students miss more than 2 quizzes, they will receive a grade of zero on each missed quiz. The same principle is applied to laboratory exercises.

Absence from Course Commitments

Students must familiarize themselves with the [Policy on Academic Consideration – Undergraduate Students in First Entry Programs](#)

Students missing course work for medical, compassionate or extenuating circumstances can request academic consideration by completing a request at the central academic consideration portal. Students are permitted one academic consideration request per course per term without supporting documentation. Note that supporting documentation is **always** required for academic consideration requests for examinations scheduled by the office of the registrar (e.g. December and April exams) and for practical laboratory and performance tests typically schedule during the last week of the term. Students should also note that the instructor may designate one assessment per course per term that requires supporting documentation. This designated assessment is described elsewhere in this document. Please note that any academic considerations granted in this course will be determined by the instructor of this course, in consultation with the academic advisors in your Faculty of Registration, in accordance with information presented in this course outline. Supporting documentation for academic considerations for absences due to illness should use the [Student Medical Certificate](#) or, where that is not possible, equivalent documentation by a health care practitioner.

Course Assessments that Require Supporting Documentation

For this course the following assessment has been designated as requiring supporting documentation: **Final essay due December 5th**

Academic Consideration for Course Components with Flexible Deadlines

There are no flexible deadlines in this class.

Accommodation for Religious Holidays

Students should review the policy for [Accommodation for Religious Holidays](#). Where a student will be unable to write examinations and term tests due to a conflicting religious holiday, they should inform their instructors as soon as possible but not later than two weeks prior to writing the examination/term test. In the case of conflict with a midterm test, students should inform their instructor as soon as possible but not later than one week prior to the midterm.

10. Make-up Examinations

Makeups will be granted with approved documentation only. All documentation for missed exams must be provided to the Academic Counselling Office within 48 hours of the scheduled exam, otherwise the instructor will assign a grade of zero.

The format and content of make-ups may differ substantially from the scheduled test or examination.

11. Academic Offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a [Scholastic Offence](#).

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All

papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

All assignments are to be submitted individually, other than when specifically instructed to submit a group lab component. Although students are strongly encouraged to help each other, assignments should be answered individually, and identical submissions (among students but also other online material or previous student work) will be considered for plagiarism. Similarly, the use of Generative Artificial Intelligence (e.g. chatGPT¹) may be considered plagiarism if it is identical or nearly identical to existing work. Although it is not possible for us to ban students from using AI to help explore a problem, if a student cannot explain, argue for, and defend the answers, text, and graphical representations used in a submission, the student will fail.

12. Western's Commitment to Accessibility

The Department of Geography and Environment strives at all times to provide accessibility to all faculty, staff, students and visitors in a way that respects the dignity and independence of people with disabilities.

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2147 for any specific question regarding an accommodation. [Information regarding accommodation of exams](#) is available on the Registrar's website.

More information about "[Accessibility at Western](#)" is available.

13. Mental Health

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit Western's [Health and Wellness website](#) for more information on mental health resources.

14. Support Services

[Western's Support Services](#)
[Student Development Centre](#)
[Indigenous Student Center](#)

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find

¹ Remember there are also security and ethical concerns with using these services. They collect data on what you input. Although we will use publicly available data in this class, if you input sensitive information, or protected data you have access to, this could put you at risk and/or be a violation of research and academic ethics.

information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

15. Important Dates

September 5: Classes resume

September 13: Last day to add a first-term half course

October 14: Thanksgiving Holiday – Department Office Closed

October 14-20: Fall Reading Week (No classes; Department Office open)

November 11: Last day to drop a first term half-course without penalty

November 30: Last day to drop a full course without penalty

December 6: Classes end

December 7 and 8: Study days

December 9-22: Examination Period