ENVS*3060 - Groundwater

Winter 2025 Course Outline
Section: 01
Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

This course provides a general understanding of the physical and chemical processes that operate in the groundwater zone under natural and human-induced conditions. The interrelations between the groundwater regime and the other components of the hydrological cycle are studied. Considerable emphasis is placed on the applied aspects of topics such as exploration, testing and development of aquifers for water supply, the chemical quality of groundwater, and the hydrogeological aspects of waste disposal.
Prerequisite(s): AGR*2320 or ENVS*2060
Department(s): School of Environmental Sciences

Course Description

This course provides an understanding of the physical and chemical properties and processes that operate in the soil-groundwater zone under natural and human-induced conditions. The interrelations between the groundwater regime and the other components of the hydrological cycle particularly connecting to soil and soil water are studied.

Lecture Schedule

MonWedFri 11:30am-12:20pm in MACS*121 (1/6 to 4/21)

Instructor Information

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Professor
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Office Hours:
Wednesday after class- 12:30 pm - 1:30 pm or by appointment
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Monday and Friday 12:30 pm - 1:30 pm or by appointment
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Learning Resources

Recommended/Supporting Textbooks

- Applied Hydrogeology, by C.W. Fetter
- Groundwater, by Freeze, A. and Cherry, J
- Soil Physics, by Jury, W. A. and Horton, R.
- Soil Physics: Agricultural and Environmental Applications by H. Don Scott
- Canada's Groundwater Resources, by Alfonso Rivera

Course Resources

Lecture slides, practice quizzes, old tests and exams, discussions, etc., available on CourseLink (https://courselink.uoguelph.ca/).

Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (https://www.uoguelph.ca/uaic/programcounsellors/) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Cost of Textbooks and Learning Resources

Textbook / Learning Resource	Required / Recommended	Cost
Applied Hydrogeology, C.W. Fetter	Recommended Text	$139.25
Groundwater, Freeze, A. and Cherry, J.	Supporting Text	$96.95
Soil Physics, Jury, W. A. and Horton, R.	Supporting Text	$130.00
Soil Physics: Agricultural and Environmental Applications, H. Don Scott	Recommended Text	$130.95
Canada's Groundwater Resources, Alfonso Rivera	Supporting Text	$146.28

Students are advised that prices are often determined by the publisher or bookstore and may be subject to change.

Library Course Reserve (Ares)

For this course, you will be required to access course reserve materials through the University of Guelph McLaughlin Library. To access these items, select **Ares** on the navbar in CourseLink. Note that you will need your Central Login ID and password in order to access items on reserve.
For further instructions on accessing reserve resources, visit How to Get Course Reserve Materials (https://www.lib.uoguelph.ca/find/course-reserves-ares/).
If at any point during the course you have difficulty accessing reserve materials, please contact the e-Learning Operations and Reserve Services staff at:
Tel: 519-824-4120 ext. 53621 | Email: libres2@uoguelph.ca | Location: McLaughlin Library, First Floor, University of Guelph

Course Learning Outcomes

1. Define physical properties that control flow, storage of water, and contaminant transport in the unsaturated (soil) and groundwater zones.
2. Apply knowledge of these physical properties to understand unsaturated and groundwater flow (with some examples of contaminant transport problems).
3. Resolve the importance and application of geology in defining groundwater flow.
4. Brief introduction to the importance of modeling as a tool in describing water flow and contaminant transport in unsaturated and groundwater zones.
5. Solve soil water and groundwater flow problems (e.g., unsaturated flow in root zone to saturated flow in groundwater, slug, and pumping test problems to identify potential aquifers).
6. Knowing basis for groundwater well construction.
7. Introduction to various instruments used in measuring soil and groundwater properties and flow and storage of water in the unsaturated zone.

Teaching and Learning Activities

Lecture Topics

Part 1: Week 1-4

Physical Properties and Principles of Groundwater and Unsaturated Flow. **Chapters: 3, 4, and 6 (Fetter).**

Bulk soil properties, porosity, soil water, potentials, surface tension, soil water characteristic curves, saturated and unsaturated hydraulic conductivity, permeability, hydraulic head, Darcy's Law, heterogeneity, anisotropy, piezometer, aquifer, aquitard, transmissivity, compressibility, effective stress, storativity, specific yield.

Part 2: Week 5-6

Geology of Groundwater, Regional Groundwater Flow, and Groundwater Recharge. **Chapters. 6, 7 and 8 (Fetter)**

Texture and parent materials, methods to characterize soil texture, geologic heterogeneity, Groundwater in glacial deposits and fractured rock, mapping groundwater flow systems.

Part 3: Week 7-8

Soil Water and Groundwater Measurement and Modelling. **Chapters. 4 and 13. (Fetter)**

Measurement of soil water, direct and indirect measurements, point-based to regional scale measurement, groundwater level measurement, step-by-step procedure, point vs regional scale measurement, groundwater flow models, equation of continuity (law of conservation of mass), steady-state and transient flow equations, flow nets, groundwater flow in confined and unconfined aquifer.

Part 4: Week 9-11

Groundwater Resource Evaluation. **Chapter. 5. (Fetter)**

Groundwater flow equations, pumping and slug tests to estimate aquifer parameters and impact of pumping wells, mathematical basis of calculations.

Part 5: Week 12

Field Methods. **Chapters. 6, 10 and 12. (Fetter)**

Groundwater monitoring, well components and installation of wells, Guelph Ring Infiltrometer, measuring deep drainage.

Part 6: Week 13

Groundwater Contamination (point and dispersed sources, physical processes of contaminant transport, agricultural impacts), pollution vs contamination, sources and causes of pollution, transport processes, removal/containment, well head protection, groundwater vulnerability.

Assessment Breakdown

Description	Weighting (%)	Due Date
Assignment 1	10%	Jan 29
Assignment 2	10%	Feb 12
Midterm	30%	Feb 26
Assignment 3	10%	Mar 12
Assignment 4	10%	Apr 2
Final Exam	30%	Apr 15

Assessment Details

Assignment

Assignment 1 — 10%

Course Learning Outcomes Assessed: 1, 2

Assignment 2 — 10%

Course Learning Outcomes Assessed: 3

Assignment 3 — 10%

Course Learning Outcomes Assessed: 4

Assignment 4 **10%**
Course Learning Outcomes Assessed: 5

Midterm

Midterm **30%**
Course Learning Outcomes Assessed: 1, 2, 3

Exam

Final Exam **30%**
Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7

Final Exam

Date: Apr 15

Time: Tu 11:30am-1:30pm

Location: TBA *Please see Web Advisor closer to the date of scheduled final for location.*

To understand rules and regulations regarding Examinations students are encouraged to read Student's Responsibilities (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/examinations/)

If the student is unable to meet the final exam requirements due to medical, psychological or compassionate circumstances they are encouraged to review Student's Responsibilities in the Academic Consideration, Appeals and Petitions (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/) section of the Academic Calendar.

Last Day to Drop Course

The final day to drop Winter 2025 courses without academic penalty is the last day of classes: April 04

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

Course Grading Policies

Submission of Assignments

Assignments are due at the beginning of the class in-person on the due date.

Late Assignment

A penalty of 10% of the Assignment mark per day will be imposed for late submission. Please inform the instructor well in advance if you are unable to submit an assignment on time or attend the midterm test (with proper justification/proofs).

Course Standard Statements

Grading

Assignments are due at the beginning of class on the due date shown above. A penalty of 10% per day will be assessed for late assignments. Please inform me in advance if you are unable to submit an assignment on time or attend the midterm test so that it can be re- scheduled for you.

Group Work

Individual assignments must be submitted by each student.

Recording of Lectures

Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted, they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

Standard Statements for Undergraduate Courses

Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/) is outlined in the Undergraduate Calendar.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability. Use of the SAS Exam Centre requires students to make a booking at least 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/sas/)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/).

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all undergraduate students except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in the Undergraduate Calendar - Dropping Courses (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/).

Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https://wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators/) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (https://wellness.uoguelph.ca/shine-this-year/). The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/)