	School of Science
Yukon University	GEOL 301 Hydrogeology
	Term: Winter, 2026 Number of Credits: 3

Course Outline

INSTRUCTOR: Mary Samolczyk
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OFFICE PHONE: 867.456.8605
OFFICE LOCATION: inside T1090 (Earth Sciences Laboratory)
OFFICE HOURS: by appointment

COURSE DATE: Jan. 06 – Apr. 16
LECTURE LOCATION AND TIME: Wed. 1:00 – 2:20 pm and Fri. 10:30 – 11:50 am (A2101)
LABORATORY LOCATION AND TIME: Fri. 1:00 – 4:00 PM (T1090)

COURSE DESCRIPTION

This course examines the nature and movement of groundwater in subsurface geologic materials. Students are introduced to the concepts and principles governing groundwater flow, as well as the geologic and hydraulic properties of groundwater aquifers. Surface-groundwater interactions are addressed within the context of the larger hydrologic cycle and water budgets on regional to site scales. Students learn how to quantify the three-dimensional movement of groundwater in the subsurface and use data derived from both their own hydrogeologic testing, industry reports and publicly available datasets to define aquifer characteristics (water chemistry, storage, flow rates, etc.). An introduction to basic hydrogeologic modeling and hydrogeologic software packages is provided.

COURSE REQUIREMENTS

Prerequisite(s): Successful completion of MATH 100 or MATH 120; one of GEOL 105, GEOL 106, GEOG 102, or RRMT239/RENR 250; and 12 additional credits (4 courses) in earth sciences, physical geography or environmental science (subject codes GEOL, GEOG, ENVS, RENR, or RRMT); or by permission of the instructor.

EQUIVALENCY OR TRANSFERABILITY

Receiving institutions determine course transferability. Find further information at:
https://www.yukonu.ca/admissions/transfer-credit

LEARNING OUTCOMES

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

- describe the value of groundwater as a resource in terms of human and natural systems, and define the controls of water quantity, quality, and distribution at or near the earth's surface.
- identify the basic principles governing the flow of water in the subsurface environment and the interaction of water with different geological media and the geochemical environment.
- describe the physical properties of aquifers and use laboratory data to generate quantitative estimates for aquifer characteristics (transmissivity, storativity, etc.).
- employ basic groundwater modelling techniques to characterize fluid flow in multiple dimensions.
- describe fundamental concepts in groundwater chemistry and contamination.
- explain the process of borehole drilling and installation of monitoring wells and piezometers, as well as identify different water pump types and groundwater sampling protocols.
- properly conduct groundwater sampling for chemical analysis and basic aquifer testing.
- process data from aquifer tests (e.g. pumping and slug tests) and critically analyse the results to better understand flow systems and aquifer characteristics.

COURSE FORMAT

Weekly breakdown of instructional hours

This course consists of two 90-minute lectures and one 3-hour laboratory period per week; laboratory activities are complimentary to lecture material. Please note that the course schedule will likely be modified during the term to accommodate lecture topics that may not be finished within the predicted lecture time.

Delivery format

Lectures and labs for the Winter 2026 offering of this course will be delivered in a face-to-face setting (classroom, laboratory and field). There may be a significant field component to this course and students must be comfortable completing field activities in the winter. Students are expected to attend each lecture and lab session so that they can ask questions and directly engage with the instructor and their peers. Lectures will not be recorded. Review of any missed material or completion of missed activities is the responsibility of the student. Midterms and exams will be delivered on the Ayamdigut campus.

EVALUATION

Tests and Assignments	Weight	Dates
Weekly Lab Assignments	40%	Due at the start of each subsequent lab session.
Midterm Exam	15%	During a regular lecture period approximately midway through the course.
Final Lecture Exam	30%	During the final exam period.
Term Projects (2)	15%	Due throughout the semester (due dates set by the instructor will be communicated at the start of the course)

Attendance & Participation

Students are strongly encouraged to attend all lectures and laboratory exercises. Lab exercises can be completed only during lab periods and materials may not be available outside these hours. Off-campus field exercises must be completed during the allocated time with the instructor present; completing these activities and an alternative time than scheduled will not be possible.

Assignments

Weekly lab exercises will be due at the start of the following lab session unless otherwise indicated by the lab instructor. Two term projects will be assigned during the semester. These projects will require independent research and a portion of the work will be completed outside of class time. These projects may require the application of students' skillsets in other geologic disciplines (stratigraphy, structural geology, geomorphology, geochemistry, etc.) and encourage thinking about how course theory is used to solve applied problems in hydrogeology. The final products will include a written component and a presentation.

Tests

There will be two exams in this course: a lecture midterm exam and a lecture final exam. **Students must pass the lecture final exam to achieve an overall passing grade.**

Missed exams will be assigned a grade of 0% unless re-scheduling for a valid reason is approved and determined in advance of scheduled exam date. If there are known conflicts with exam scheduling, please see the instructor as soon as possible to discuss an alternative examination date.

Late Policy

Any assignments (lab and lecture) submitted past the due date will be graded based on the following scheme: a deduction of 10% per day up until a total deduction of 50% is reached, following that, assignments must be submitted prior to the date that the instructor hands back the graded assignment (set by the instructor). Any variation from this late policy, for example, where late assignments will not be accepted, will be clearly communicated by the instructor.

COURSE WITHDRAWAL INFORMATION

Refer to the YukonU website for important dates.

TEXTBOOKS & LEARNING MATERIALS

There is no required textbook for this course. The instructor will use several Open Educational Resources (OERs) available on the internet.

It is strongly recommended that students gain access to one of the following textbooks to support their learning in the course.

- Hiscock, K.M., and Bense, V.F. 2014. Hydrogeology: Principles and Practice (2nd ed.). New York: Wiley-Blackwell. 544 p.
- Schwartz, F.W. and Zhang, H. 2003. Fundamentals of Groundwater. New York: John Wiley & Sons. 583 p.
- Fetter, C.W. 2001. Applied hydrogeology (4th ed.) Upper Saddle River (NJ): Prentice-Hall. 598 p.

ACADEMIC INTEGRITY

Students are expected to contribute toward a positive and supportive environment and are required to conduct themselves in a responsible manner. Academic misconduct includes all forms of academic dishonesty such as cheating, plagiarism, fabrication, fraud, deceit, using the work of others without their permission, aiding other students in committing academic offences, misrepresenting academic assignments prepared by others as one's own, or any other forms of academic dishonesty including falsification of any information on any Yukon University document.

Please refer to Academic Regulations & Procedures for further details about academic standing and student rights and responsibilities.

ACCESSIBILITY AND ACADEMIC ACCOMMODATION

Yukon University is committed to providing a positive, supportive, and barrier-free academic environment for all its students. Students experiencing barriers to full participation due to a visible or hidden disability (including hearing, vision, mobility, learning disability, mental health, chronic or temporary medical condition), should contact Accessibility Services for resources or to arrange academic accommodations: access@yukonu.ca.

TOPIC OUTLINE

Module	Topic
1	**Course introduction:** hydrogeology vs. hydrology; hydrologic cycle and groundwater; basin water balances; overview of Canadian and Yukon groundwater resources
2	**Hydrologic processes at the Earth's surface**: Detailed look at hydrologic cycle components: precipitation; evaporation and evapotranspiration; infiltration, overland flow and interflow; estimating baseflow vs. overland/direct precipitation contributions; stream discharge and hydrograph interpretation
3	**Geologic media and groundwater flow**: porosity and permeability/hydraulic conductivity; introduction to Darcy's Law; isotropic vs. anisotropic and homogeneous vs. heterogeneous media; mathematical techniques for evaluating hydraulic conductivity in complex systems
4	**Aquifers**: aquifer terminology; transmissivity, storativity, specific yield and specific storage; aquifer stress and compressibility; types of aquifers in unconsolidated sediment, fractured bedrock, and crystalline media
5	**Water table and potentiometric surfaces:** unconfined vs. confined aquifers; calculating potentiometric surface gradients; three-point problems with well data
6	**Principles of groundwater flow:** Mechanical energy and moving fluids; hydraulic head and hydraulic gradients; Darcy's Law in terms of head and potential; applicability of Darcy's law in laminar vs. turbulent flow regimes; Reynold's number; specific discharge
7	**Modelling groundwater flow**: equations for determining flow in confined and unconfined aquifer; hydraulic head gradients and relationship to groundwater flow; flow lines and flow nets
8	**Theory of wells and groundwater flow**: Pumping, injection and observation wells; cones of depression/impression and zones of influence; composite cones radial flow to wells; types of aquifer tests and basic assumptions; computing drawdown in confined/leaky/unconfined aquifers; determining aquifer parameters (e.g transmissivity, hydraulic conductivity) from rising head or falling head drawdown data
9	**Slug testing**: overdamped vs. underdamped responses and applicable methods (e.g. Hvorslev, Bouwer and Rice); packer tests; aquifer test design principles
10	**Groundwater wells**: process of borehole drilling and well installation; components of a common groundwater well; well development and aquifer stimulation; groundwater pump types and principles of operation; well testing protocols and best practices for groundwater sampling
11	**Water chemistry**: units of measurement; ionic strength; hydrochemical processes affecting water chemistry; cation exchangeability capacity; ion-exchange selectivity and distribution coefficients; oxidation potential and Eh-pH diagrams; major chemical species in groundwater; conservative and reactive elements; cation-anion balance; common water chemistry plots and data display
12	**Water quality:** factors that constitute water quality; commonly measured physical properties of groundwater; contamination definitions and water quality guidelines; Canadian drinking water quality specifications
13	**Introduction to contaminant hydrogeology:** diffusion and advection; Fick's Law; tortuosity of contaminant pathways; mechanical dispersion and controls; hydrodynamic dispersion;

	plume migration from continuous and one-time point sources; calculating contaminant concentrations in a plume or slug; retardation of contaminants
14	**Hydrogeology and geophysics:** introduction to commonly used geophysical methods for hydrogeology investigations; assessment of limitations of techniques given geology considerations; geophysical case study data and preliminary interpretation