Geology 9540a/b, Fundamentals of Ground Water Flow and Contaminant Transport – Winter 2016

Description: Occurrence, distribution, movement, chemistry and composition of ground water as a function of the geological environment; water quality and ground water contamination; collection and evaluation of hydrogeologic data; modeling ground water flow and advective transport; case histories. A strong linkage between theory and practice will be maintained and a quantitative approach will be used. The study of ground water is interdisciplinary in nature and is pertinent to many fields including geological sciences, hydrology, soil science, geography, ecology, and agricultural, geotechnical, mining and petroleum engineering.

Prerequisites: Earth Science 3340a/b, or CEE 3326, or 80% in Geography 3342a/b, or permission of the department. (0.5 course)

- *Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may 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.*
- *Accessibility Statement: 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 661-2111 x 82147 for any specific question regarding an accommodation.*

Antirequisites: Earth Sciences 4440b.

Instructor: Dr. Rob Schincariol, P.Eng., P.Geo., 0174 BGS, ext. 83732; schincar@uwo.ca

GTA: Krista Kaski, kkaski@uwo.ca

Course Outline: Lecture Topics	**Laboratory Exercises**
1) Ground water and the hydrologic cycle	
2) Principles of ground water flow	- basic flow calculations
3) Geology and ground water	- determining permeability
4) Hydrostratigraphy, aquifers and confining units	
5) Field mapping of hydraulic head and flow	- mapping flow; piezometers
6) Theory of ground water flow - equations	
7) Theory of ground water flow – boundary conditions & flownets	- flownets
8) Flow in unsaturated zones and fractured media	
9) Hydrogeologic site investigation tools and techniques	- demonstration exercises
10) site investigations – drilling techniques	
11) site investigations – water sampling techniques	
12) Flow system delineation and regional ground water flow	
13) Regional ground water flow – case studies	- case study flow delineation
14) Ground water – surface water interactions	
15) Ground water flow to wells – storage, aquifer types	well hydraulics lab 1
16) Response of confined aquifers to pumping	
17) Response of leaky aquifers to pumping	- well hydraulics lab 2
18) Response of unconfined aquifers to pumping	
19) Slug and step testing of aquifers and aquitards	- well analysis software
20) Ground water geochemistry – dissolved mass & data analysis	
21) Key reactions influencing ground water chemistry	
22) Basics of mass transport – advection	- ground water modelling
23) Basics of mass transport – dispersion and diffusion	
24) Intro. to contaminant hydrogeology – dissolved mass	
25) Intro. to contaminant hydrogeology – NAPL's	
26) Mass transport: economic mineral deposits & petroleum hydrogeology	

Text: Fundamentals of Ground Water, Schwartz and Zhang, Wiley, 2003, ISBN 978-0-471-13785-6

Text is required and should be brought to LAB as text readings, figures, and example problems will be gone over in class on a regular basis.

NOTE: Textbook will NOT be brought into the UWO Bookstore as it is widely available at a much lower cost through online vendors (International Ed. ~ $20 vs. $170 for new domestic version). Used domestic versions are also widely available. However, as shipping can take several weeks you should order well before the start of class.

Lectures/Lab: 2 lecture hours and 2 laboratory hours per week
lectures (BGS 1056) – Mon. 9:30 to 11:20 a.m.
laboratory – Mon. 2:30 to 4:30 p.m. - BGS 0184

Marking Scheme:

Hand-in assignments & presentation	40%	
Seminar Paper	20%	
Midterm (110 min)	20%	Feb. 22 in-class
Final Exam* (2 hrs.)	20%	

Lecture Material: The text portion of the lecture presentation slides will be made available on OWL. Figures used in the lectures come from the textbook, various web links, government sources, or various consulting reports. Text figures, or material with disclosure issues (e.g. consulting reports), will not be posted on OWL. You are expected to attend lectures and make additional notes to augment the text provided. The main purpose of the lectures is to help you understand key hydrogeological parameters & processes and the techniques used to quantify these. The labs are where you apply the techniques. Case studies / consulting reports give you the real world application of these techniques.

Assignments: Help with assignments and some lecture material on assignments will be given during laboratory session. Assignments will be available on OWL along with lecture notes. Many of the exercises will involve spread sheet programs (MS Excel) or aquifer analysis software. Any assignments handed in past the due date will be subject to a penalty of 20% per late day (if you have exceptional circumstances contact Dr. Schincariol prior to due date via email). NOTE: The majority of marks for questions are given for problem setup, assumptions, solution approach, and proper use of significant figures and units. Simply writing down a formula (or providing an Excel output) and giving the answer, even if correct, will not result in full marks.

Labs 1 to 4 are one week labs and worth 4% each. Labs 5 and 6 are two week labs and worth 8%. You should use your time in the lab to both complete the assigned problems and go over any difficulties you had with the previous week's labs. Students who do not use the assigned lab times for inquiries should not expect additional help from the teaching assistant and/or professor.

***** Exams & tests will be closed book (definitions; short answer; calculations). Bring pencil, ruler, eraser, and basic calculator (basic math & geometry functions; but no extensive non-volatile memory capability). *A calculator is to be used for calculations only and not storage of information - any recall of such stored information will be considered a scholastic offense (cheating). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:*
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

➢*If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see the Policy on Accommodation for Medical Illness at: https://studentservices.uwo.ca/secure/index.cfm*

- *For work worth less than 10% (e.g. individual assignments) if accommodation is required for medical or non-medical reasons email the instructor. In these cases either an extension will be given or a re-weighting to other components of the course – at the instructors discretion – will be done.*

Guidelines for Review Paper

1. Topics can be chosen from the topic list below or in consultation with instructor. Prior approval of topic by instructor is required as only one person may present on a given topic.
2. Papers will be typed (double-spaced), follow journal submission format, and are not to exceed 3000 words

Topics *(examples – see me for approval with other topics)*

special problems in karst hydrogeology; ground water heat pumps; salt water intrusion; land subsidence due to ground water withdrawal; the use of geophysical methods to detect contaminant plumes; the use of geophysical methods to delineate aquifer heterogeneity; the use of geophysical methods to delineate the water table; nitrate pollution of ground water; permafrost hydrogeology; ground water in geochemical exploration; ground water in petroleum migration and exploration; nuclear waste disposal - ground water problems; septic tanks - effects on ground water; mine tailings - effects on ground water; ground water and earthquakes; ground water law; artificial recharge; geothermal energy from ground water; perched water tables; ground water and fractured rocks; the use of pump and treat methods in ground water remediation projects