

Introduction to Hydrogeology: ERS 480/580

Text: C. Fitts. 2013. Groundwater Science, Academic Press (other textbooks may be substituted)

Contact Information

Andrew Reeve, 220 BGSC, 581-2353, asreeve@maine.edu

Lectures: 10:00-10:50 MWF (203 BGSC)

Office Hours: MF 12:00 to 1:00

Learning Outcomes

After successfully completing this course, undergraduate and graduate students will be able to:

- critically evaluate information communicated through the media related to groundwater systems
- measure water levels and determine the components of hydraulic head
- delineate a drainage basing from a topographic map
- calculate the direction and flow rates of groundwater
- perform piezometer tests and used data collected to determine aquifer hydraulic conductivity
- interpret pumping test data and calculate aquifer storativity and transmissivity
- create and interpret specialized plots of groundwater chemistry
- perform solute transport calculations related to underground pollution (e.g. from a landfill)

Graduate students will also be able to:

- perform reactive transport calculations related to underground pollution
- develop simple one and two dimensional finite difference groundwater models in spreadsheets or similar software
- understand the basic computational methods underlying Modflow or other standard groundwater flow model
- prepare input files, execute, and read output from Modflow (or other standard groundwater flow model)

Course Goals

The role of groundwater in geologic and water supply processes: the hydrologic cycle, groundwater flow and transport equations, aquifer characterization, chemistry of groundwater, and groundwater as a geologic agent.

Grading

Exam 1	15%	
Exam 2	15%	
Exam 3	15%	
Problem Sets	30%	Bi-weekly
Final Exam	25%	Dec. 18, 12:15

Grades will be assigned based on the following scale:

A	90+%
A-	87-90%
B+	84-86%
B	74-83%
B-	70-73%
C+	68-69%
C	58-67%
C-	55-57%

Classroom Policies

Attendance: Students are expected to attend and participate in class and are responsible for all information presented in class. There will be no grade assigned for classroom attendance or for classroom participation. Students who consistently come to class late (more than 3 minutes) and disrupt the class will have one point subtracted from the next problem set (after the fourth occurrence) for each classroom disruption.

Missed Exams: Students unable to attend an exam must notify the instructor and make alternative arrangements before the exam. Only in exceptional circumstances will students be allowed to miss an exam and take it at a later date outside of the scheduled class period.

Course Structure

This course focuses on the flow and chemistry of groundwater. Students will apply Darcy's Law in its various forms to solve groundwater flow problems, including:

- determining flow direction and rates from water level data,
- assessing the impact of heterogeneity and anisotropy on groundwater flow,
- characterizing the transmissive and storage properties of aquifer materials,
- calculating the impact a pumping well on an aquifer,
- calculating the distribution of dissolved chemicals transported by groundwater.

This course will include about five in-class field-based activities using nearby wells on campus or at a nearby water district site. Field days will typically be scheduled for Fridays and will be scheduled based on weather. Students that cannot participate in full days of in-class field activities will be asked to schedule field activities to make up this time. Students will spend additional time in the field on these days to complete field work. Undergraduate students will be compensated for this additional time by making the last three to five days of classes optional for undergraduate students. These optional classes will be used to present material on computer modeling of groundwater flow required for graduate students enrolled in the cross-listed graduate course (ERS 580).

Problems sets will be given about every two weeks and will require the analysis of hydrogeologic data. Some of the data used in problem sets will be collected by students, exposing students to basic surveying, use of tools for measuring water levels, and the performance of hydraulic testing. Graduate students will complete a problem set applying groundwater modeling tools discussed in class. Completed problem sets will be submitted for grading as paper copies or as a single Pdf files. Assignments submitted as Pdf's must be emailed using a file name that clearly indicates the problem set number, name of student, and class name (e.g. PS1_Reeve_ERS480.pdf). Problem sets should all be typed, and should minimally include a methods section and a results section (along with any other items requested in the problem set). The methods section should provide enough detail to allow the reader to understand the mechanics of solving the given problem.

Three exams will be given through the class at about every 4 weeks. A comprehensive final will be given during finals week. These exams will largely (more the 50%) be based on previous problem sets and on problems worked in class, and will require the assessment of hydrogeologic data or calculations using hydrogeologic data. Students will be allowed to bring one (one sided) sheet of paper containing notes and equations to each exam (two sheets/sides allowed for final exam).

Academic Honesty Statement

Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Course Schedule Disclaimer

In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Special Accommodations

If you have a disability for which you may be requesting an accommodation, please contact Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should privately meet with the course instructor as soon as possible.

Sexual Violence Policy

Sexual discrimination reporting: The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell any of your teachers about sexual discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault and Violence Prevention or the Office of Equal Opportunity.

Behaviors that can be “sexual discrimination” include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. Therefore, all of these behaviors must be reported.

Why do teachers have to report sexual discrimination? The university can better support students in trouble if we know about what is happening. Reporting also helps us to identify patterns that might arise—for example, if more than one victim reports having been assaulted or harassed by the same individual.

What will happen to a student if a teacher reports? An employee from the Office of Sexual Assault and Violence Prevention or the Office of Equal Opportunity will reach out to you and offer support, resources, and information. You will be invited to meet with the employee to discuss the situation and the various options available to you.

If you have requested confidentiality, the University will weigh your request that no action be taken against the institution’s obligation to provide a safe, nondiscriminatory environment for all students. If the University determines that it can maintain confidentiality, you must understand that the institution’s ability to meaningfully investigate the incident and pursue disciplinary action, if warranted, may be limited. There are times when the University may not be able to honor a request for confidentiality because doing so would pose a risk to its ability to provide a safe, nondiscriminatory environment for everyone. If the University determines that it cannot maintain confidentiality, the University will advise you, prior to starting an investigation and, to the extent possible, will share information only with those responsible for handling the institution’s response.

The University is committed to the well-being of all students and will take steps to protect all involved from retaliation or harm. If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For confidential resources on campus:

- Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000.

For confidential resources off campus:

- Rape Response Services: 1-800-871-7741 or Spruce Run: 1-800-863-9909.

Other resources: The resources listed below can offer support *but may have to report the incident to others* who can help:

For support services on campus:

- Office of Sexual Assault and Violence Prevention: 207-581-1406,
- Office of Community Standards: 207-581-1409,
- University of Maine Police: 207-581-4040 or 911.

Refer to the OSAVP website for a complete list of services at <http://www.umaine.edu/osavp/>

Class Schedule

Wed Sep 4	Physical properties of water	Ch 2	
Fri Sep 6	Groundwater reservoirs and fluxes	Ch 1	
Mon Sep 9	Surface water and groundwater interaction	Ch 5.2,3.11	
Wed Sep 11	Darcy's Law and associated parameters	Ch 3.1-3.4	Assign Prob. 1 Set
Fri Sep 13	Three-point problems and contouring		
Mon Sep 16	Anisotropy and heterogeneity	Ch 3.5,3.6	
Wed Sep 18	Review Prob. Set		
Fri Sep 20	Three-point problems and anisotropy		
Mon Sep 23	NO CLASS:GSA		
Wed Sep 25	NO CLASS:GSA		
Fri Sep 27	NO CLASS:GSA		
Mon Sep 30	Subsurface exploration, well installation and design	4.1-4.3	Assign Prob. 2 Set
Wed Oct 2	Analytic solutions to steady state flow	7.1,7.2,7.5	
Fri Oct 4	EXAM 1		
Mon Oct 7	Review Prob. Set		
Wed Oct 9	Graphical Flow nets	Ch. 7.4	
Fri Oct 11	Exam review		
Mon Oct 14	NO CLASS:Fall Break		
Wed Oct 16	Groundwater Storage	Ch. 6.1-6.3,6.8-6.9	
Fri Oct 18	Hydrogeo. params and grain size	3.8	
Mon Oct 21	Review Prob. Set		
Wed Oct 23	Hydrogeo. params and grain size	3.8	
Fri Oct 25	Hydrogeo. params: permeameters		Assign Prob. 4 Set
Mon Oct 28	Hydrogeo. parameters: piezometer tests	8.1,8.2	
Wed Oct 30	Hydrogeo. parameters: pumping tests	8.3-8.5	
Fri Nov 1	EXAM 2		
Mon Nov 4	Hydrogeo. parameters: pumping tests	8.3-8.5	
Wed Nov 6	Pumping tests and boundary effects		Assign Prob. 5 Set
Fri Nov 8	Exam review		
Mon Nov 11	NO CLASS:Veterans Day		
Wed Nov 13	Pumping tests and boundary effects		
Fri Nov 15	Review Prob. Set		
Mon Nov 18	Solute transport processes, Measuring dispersion	11.5	
Wed Nov 20	Chemical Kinetics and solute transport		Assign Prob. 6 Set
Fri Nov 22	Solutions to the advection-disp. eqn.	11.7	
Mon Nov 25	Groundwater chemistry: graphical interpretation		
Wed Nov 27	NO CLASS:Thanksgiving		
Fri Nov 29	NO CLASS:Thanksgiving		
Mon Dec 2	Review Prob. Set		
Wed Dec 4	EXAM 3		
Fri Dec 6	Groundwater chemistry: graphical interpretation		Assign Prob. 7 Set
Mon Dec 9	Groundwater contamination	11.1-11.4	
Wed Dec 11	Exam review		
Fri Dec 13	Review Prob. Set		