Geology 513-001
Hydrogeology
Spring 2026 Syllabus

Class Meeting Time and Location

Wednesdays 4:30 − 7:10 pm
Exploratory Hall 1005 (in person)

Instructor

Dr. Jules Goldspiel
Department of Atmospheric, Oceanic and Earth Sciences (AOES)
Office: Exploratory Hall 3414
Office Hours: Tuesdays 12:30 − 2:30 pm
Other days and times by appointment
Email: jgoldspi@gmu.edu (best contact method)

Course Description

3 Credits
Prerequisites: Previous laboratory-science courses in Geology, Calculus and Chemistry totaling at least 12 credit hours, or permission of instructor

This course will focus on the geologic and hydrologic factors that control the occurrence, distribution, movement, quality and development of groundwater. In addition to the general properties that distinguish a groundwater system as an aquifer, this course will cover the physical and chemical properties of groundwater, groundwater interactions with the surface, and how groundwater flow can be calculated and studied analytically, graphically and with computer models. Natural and engineered processes will both be discussed.

Computer modeling will be part of the course. University computers will be available for students to participate in the modeling exercises, but students may also use their own computers. Computers running the Microsoft Windows operating system are best suited for the modeling exercises, but other operating systems may be used. Students will also find it helpful to have ready access to a scientific calculator, spreadsheet program or other method for calculations. Please talk to instructor if access to any of these tools may be a problem.

Expected Learning Outcomes

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

- Know the range of physical and chemical properties common in groundwater systems
- Understand how surface conditions affect groundwater systems and vice versa
- Master the principles of groundwater flow, and how flow is characterized and calculated
- Master the principles of groundwater storage, and how storage is characterized
- Understand the practical issues related to aquifer development and depletion
- Understand the processes of aquifer contamination and remediation
- Gain expertise with some of the tools and resources used to monitor, study and understand groundwater systems

Course Textbook and Other References

Primary Lecture Textbook (Recommended)

Applied Hydrogeology, 5th Edition, 2022, C.W. Fetter and D. Kreamer, Waveland Press

Available in print and electronic formats from GMU Bookstore or publisher (https://waveland.com).

Other Useful General References

Alley, W. M., et al., 1999, Sustainability of ground-water resources, USGS Circular 1186. (Available at https://pubs.usgs.gov/circ/circ1186/pdf/circ1186.pdf)

Ferris, J. G., et al., 1962, Theory of aquifer tests, USGS Water-Supply Paper 1536-E.
(Available at https://pubs.usgs.gov/wsp/wsp1536-E/pdf/wsp_1536-E.pdf)

Hem, J. D., 1985, Study and interpretation of the chemical characteristics of natural water, 3rd Edition, USGS Water-Supply Paper 2254.
(Available at https://pubs.usgs.gov/wsp/wsp2254/pdf/wsp2254a.pdf)

Winter, T.C., et al., 1998, Ground water and surface water: A single resource, USGS Circular 1139.
(Available at https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf)

Required Coursework and Grading Weights

GEOL 513 Required Coursework	Weight Towards Final Grade
Quizzes	10%
Homeworks	10%
Semester Exercise and Abstract	15%
Numerical Model Inputs Summary	10%
Preliminary Exam I	15%
Preliminary Exam II	15%
Final Exam	25%

The graded coursework for this class and the weight of each component is as listed in the table at left. The weights shown for the quizzes and homeworks are the weights for the combined score of all quizzes and homeworks taken during the semester.

Quizzes will cover facts and concept details from lectures. They are intended to check your understanding of specific information and concept details discussed since the last quiz. Each quiz will consist of questions in multiple choice and/or short answer format.

Homework assignments will cover quantitative aspects of the course. They will generally involve expert application of calculations, graphing and graph interpretation, basic computer modeling and/or concept questions. Calculators, spreadsheets or other computational programs may be used, but intermediate steps and calculation methods must be shown.

The Semester Exercise will involve collecting, summarizing and understanding groundwater data. The data will be gathered from publicly available U.S. Geological Survey (USGS) websites. GEOL 513 students are further required to formalize the data summaries in the form of short abstracts.

The Numerical Model Inputs Summary assignment will involve collecting and concisely summarizing the geologic and hydrogeologic properties for a specific region of the U.S. so as to permit realistic quantitative modeling of groundwater flow in the region using a professional-level numerical model. (Setting up and executing the numerical model for the specific region is not required.)

Grading Schema

Grade	A+	A	A-	B+	B	B-	C+	C	C-	F
Weighted Score (%)	$\geq$ 99%	92.0 – 98.9%	90.0 – 91.9%	88.0 – 89.9%	82.0 – 87.9%	80.0 – 81.9%	78.0 – 79.9%	70.0 – 77.9%	65.0 – 69.9%	< 65%

Course grades will be determined by the weighted percentage of total points possible (refer to Required Coursework and Grading Weights information above). The standard grading schema for this class is as indicated in the table above.

The final grading schema may be revised from the above standard schema based on general class performance or other factors. However, if any changes are made, the changes will be in a manner that is favorable to student grades (i.e., if the schema is changed, the change will set the cutoff for a grade to a lower weighted score percentage not higher).

Tentative Course Schedule

Week	Date	Topic (and corresponding textbook sections)	Quiz	HW
1	01/21	Course Information & Hydrogeology Overview (Fetter and Kreamer: Chapters 1, 2.1-2.7)		
2	01/28	Physical Properties and Physical Environments of Groundwater (Fetter and Kreamer: Chapters 3, 12.1−12.2)	#1	
3	02/04	Chemical Properties and Chemical Environments of Groundwater (Fetter and Kreamer: Chapter 9)		#1
4	02/11	Hydrologic Connections Between Groundwater and Surface Water (Fetter and Kreamer: Chapters 2.8-2.14, 6)		#2
5	02/18	Groundwater Flow and Storage: Controls and Impacts (Fetter and Kreamer: Chapter 8)	#2	
6	02/25	*Preliminary Exam I*		
7	03/04	Groundwater Flow: Governing Equations and Approximations (Fetter and Kreamer: Chapter 4)	#3	
8	03/11	*Spring Break – No Class*		
9	03/18	Groundwater Flow: Wells (Fetter and Kreamer: Chapter 5)		#3
10	03/25	Groundwater Flow: Regional Systems (Fetter and Kreamer: Chapter 7)	#4	
11	04/01	Aquifer Protection, Contamination and Restoration (Fetter and Kreamer: Chapters 10, 11.7-11.8)		#4
12 ❖	04/08	Hydrogeology in Especially Wet, Dry and/or Cold Environments (Fetter and Kreamer: Chapters 7.7, 8.5-8.6)	#5	
13	04/15	*Preliminary Exam II*		
14 ■	04/22	Numerical Modeling: General Principles, Mechanics and Applications (Fetter and Kreamer: Chapter 13)		
15	04/29	To Be Determined (Possible options: Course Review, Groundwater Rights, Hydrogeology in Planetary Environments, expansion of previous topic and/or topics not previously discussed)		
16	05/06	*Final Exam* (4:30-7:15 pm)		

❖ Numerical Model Inputs Summary due

■ Semester Exercise and associated Abstracts due

Quiz and Homework (HW) numbers in the schedule are the weeks these items will be assigned.

Note: Course content and schedule may be modified by the instructor as the semester progresses.

Key Dates for Class Enrollment

Jan 27 Last day to add classes
Feb 03 1st drop deadline (full tuition refund, no record on transcript)
Feb 10 2nd drop deadline (50% tuition refund, no record on transcript)

After the 2nd Drop deadline, Withdrawals for graduate students require academic dean approval.

Course Policies

Attendance: Students are expected to attend class regularly, but attendance is not strictly required.

Electronic Devices: The use of electronic devices (computer, tablet, phone and the like) is permitted during class with some restrictions. The use of such devices is subject to the AI Tools policies for this course. Furthermore, their use may not be distractive or disruptive to the class, and all use of electronic devices must be respectful of your peers and instructor while class is being conducted.

For example, while in class, audible alerts on your devices must be off. You also may not use your electronic devices to engage in activities that are unrelated to the class while class is in session. The instructor reserves the right to prohibit the use of electronic devices by any student whose use of a device is unrelated and/or disruptive to the class.

Earbuds and headphones may not be worn during class or during exams without an approved accommodation or prior approval from the instructor.

Calculators are the only aid that may be used during exams. If you plan to use a calculator function on a phone, tablet or other electronic device during an exam, you may only use the calculator function. Except for taking online exams themselves in the event the class transitions to online, no other use of electronic devices is allowed during exams, i.e., you may not use electronic devices to access notes or any other information during exams.

Please also refer to the GMU polices website for a summary of the university computer policies (https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/). All university policies apply to any use of George Mason University computers and computer systems for this course.

Course Materials: All course materials provided or presented by the instructor (e.g., lecture outlines, lecture slides, exams, quizzes, homeworks, demonstrations) are for course use only. ***These materials may not be shared, posted or in any way redistributed outside of the course, either electronically or as hardcopy.*** Sharing or redistribution of course materials in any form is a violation of the GMU Academic Standards Code.

Recording of Lectures: Lectures and demonstrations may *not* be electronically recorded in any format without an approved accommodation or prior permission of the instructor, and completion of a recording agreement form. Acceptable agreement forms are the GMU Disability Services "Recording (Audio/Video) and Copies of Class Presentations Acknowledgement" form, or a similar form provided by the instructor. In all cases, the opinions, questions and comments of other class members may not be shared at any point with anyone else.

Exams: Preliminary Exams will be taken during the class meeting time on the dates listed in the course schedule. The time and date for the Final Exam is as listed on the course schedule. If GMU is closed on the scheduled date of an Exam, a new date and time for the Exam will be announced through the class Canvas website and GMU email.

All exams are to be taken in person.

All exams are closed book and closed notes. Use of books, notes, websites, or any other information from any other source besides the exam itself, is prohibited during all exams.

Homeworks and Quizzes: Homework assignments and quizzes will be posted on Canvas on the dates listed in the course schedule. Except when specifically noted otherwise, quizzes and homework assignments are due by the start of class (4:30 pm) one week after they are issued. Quizzes must be completed within Canvas. Assignments may be given to instructor directly as hardcopies, emailed to the instructor, or submitted through Canvas if that option is enabled. Please do not leave assignments in the instructor's office mailbox or in the instructor's office if the instructor is not present at the time.

Late or Missed Coursework: Accommodations will be made for homework submissions delayed, and quizzes and exams missed, due to sickness, religious observance and other unavoidable schedule conflicts if the instructor is notified prior to the date the homework or quiz is due or date the exam is given. Without prior notification, late

exams and quizzes are subject to a 15% reduction of the possible score (e.g., a 15-point reduction from an exam worth 100 points). Unusual situations that prevent timely notice to the instructor will be handled on a case-by-case basis. In any event, homeworks, quizzes and preliminary exams that are not completed, or remain unexcused, two weeks after the scheduled due date or exam date are subject to a grade of zero.

Collaboration: Students are encouraged to study together and discuss with each other the information and concepts covered in the lectures and recommended course readings. Collaboration on homework assignments, quizzes, the Semester Exercise and the Model Inputs Summary is permitted so long as all students in the collaboration fully participate in the discussion of all questions and do a fair share of the collaborative work. For the Semester Exercise and Model Inputs Summary, collaborating students must also use different data sets and do their own write-ups. Simple division of labor (i.e., dividing questions within the group) is not consistent with this collaboration policy and is not permitted.

Collaboration of any sort is not permitted during exams.

Potential for Field Trip: A field trip to a local site of hydrogeologic interest may be offered. Any such trip, should it be possible to arrange, will be optional.

Use of Artificial Intelligence (AI) Tools: AI Tools of any type are neither needed nor encouraged to be used for this class. Students may use an AI Tool for personal study purposes if they choose, for example to test themselves or organize their own notes, but that is the only permitted use of AI Tools for this class.

Consistent with the Recording of Lectures policy stated above, AI Tools may not be used to take notes during class without prior written approval from the instructor. Similarly, AI Tools may not be used to represent or stand-in for any student at any time during class. Deploying an AI Assistant, for example, is not a suitable substitute for attending class.

Consistent with the Course Materials policy stated above, AI Tools may not be used to repackage and redistribute any class materials or presentations provided by the instructor.

AI Tools may not be used to create any coursework that is submitted to the instructor for credit.

If you have any questions or concerns about AI use for this class, please talk to the instructor.

Grade Postings: All course scores will be posted on the course Canvas website unless otherwise requested.

Unscheduled University Closure: In the event of an unscheduled university closure due to weather or other reasons, please check Canvas and your GMU email for any class announcements. If class cannot meet because of a partial or full campus closure, supplementary activities may be assigned.

Extended Emergency Adaptation: All classes are scheduled to be conducted in person. If an extended emergency situation prevents in-person classes, classes may be shifted to a synchronous online mode (i.e., live online) and conducted through Canvas. You will be told if classes are being shifted to online mode and given instructions on how to access the online system.

University Policies

The University Catalog is the central resource for GMU policies affecting student, faculty and staff conduct in university academic affairs. Please see the catalog (https://catalog.gmu.edu) or the University Policy web site (https://universitypolicy.gmu.edu) for information on academic and non-academic policies not explicitly specified in the syllabus.

In addition, students must abide by the GMU Common Policies Addendum. Please consult these policies (posted at https://stearnscenter.gmu.edu/home/gmu-common-course-policies/) so that you know your rights and responsibilities with respect to Academic Standards, Accommodations, FERPA, Title IX and other policies.

Title IX

Title IX is a federal civil rights law that prohibits discrimination on the basis of sex under any education program or activity receiving federal funding. GMU receives federal funds in many forms and so is required to comply with Title IX.

Sexual assault and sexual harassment are forms of sex discrimination covered by Title IX. Other issues that are investigated under Title IX include stalking, intimate partner violence, gender-based harassment, sexual exploitation, complicity in the commission of any act prohibited by this policy, and retaliation for good faith reporting of any of these forms of conduct or participation in any investigation or proceeding.

More information regarding Title IX is available at:

- https://oacc.gmu.edu/access-services/title-ix/title-ix-mason/university-title-ix-statement
- https://www.ed.gov/laws-and-policy/civil-rights-laws/title-ix-and-sex-discrimination

Student Support Resources

GMU has several support resources available to all students. Potentially useful starting points include:

- Mason email: https://mail.gmu.edu
- Learning Services: https://learningservices.gmu.edu
- Student Health Services: https://shs.gmu.edu
- Counseling and Psychological Services: https://caps.gmu.edu
- Student Support and Advocacy Center: https://ssac.gmu.edu
- University Career Services: https://careers.gmu.edu
- Office of the University Ombudsperson: https://ombuds.gmu.edu
- Office of Access, Compliance, and Community: https://oacc.gmu.edu
- Non-Discrimination resources: https://oacc.gmu.edu/access-services/non-discrimination
- Sex- or Gender-based Discrimination and Sexual Misconduct resources:
  https://oacc.gmu.edu/equity-access-services/title-ix/what-title-ix
- Title IX Contacts at Mason:
  https://oacc.gmu.edu/access-services/title-ix/who-can-i-speak

Many other resources are listed on the GMU Student Life website: https://www.gmu.edu/student-life