

NRSM (385) Watershed Hydrology**Instructor:**

Kevin Hyde

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Tue/Thu 0800 – 0920h

Natural Science 307

Office Hours: (or by appointment)**Kevin:** Tue & Thu, 1500 – 1600h**Shea:** Wed & Fri, 1200 – 1300h

Recommended course text: Physical Hydrology by SL Dingman, 2002 (2nd edition). Other readings as assigned. Additional course information and materials will be posted on Moodle: umonline.umt.edu

Science of water resource management in the 21st Century:

Sustainability of all life requires fundamental changes in hydrologic science and water resource management. Forty percent of the Earth's ever-increasing population lives in areas of water scarcity, where the available supply cannot meet basic needs. Water pollution from human activities and increasing water withdrawals for human use impair and threaten entire ecosystems upon which human survival depends. Climate change increases environmental variability, exacerbating drought in some regions while leading to greater hydrologic hazards in others. Higher intensity and more frequent storms generate flooding that is especially destructive in densely developed areas of and where ecosystems are already compromised.

Sustainable water resource management starts with scientifically sound management of forested landscapes. Eighty percent of fresh water supplies in the US originate on forested lands, providing over 60% of municipal drinking water. Forests also account for significant portions of biologically complex and vital ecosystems. Multiple land use activities including logging, agriculture, industry, mining, and urban development compromise forest ecosystems and threaten aquatic ecosystems and freshwater supplies.

As a society we need to protect and conserve water resources and aquatic habitat while providing for basic human needs and building a water secure future. The starting point for doing so is to understand the hydrological processes that control the availability and quality of water resources.

Course Description:

This course introduces fundamental concepts and analytic practices of watershed hydrology. We examine how rainfall and snowmelt become streamflow, evapotranspiration, and groundwater with an emphasis on the hydrological processes in Western U.S. catchments. Topical areas include: the hydrologic cycle and water balances, evapotranspiration and snow energy balances, vadose zone hydrology, hydrogeology, hyporheic zones, riparian zones, streamflow generation mechanisms, and field measurement techniques. Watershed hydrology is by nature an interdisciplinary science and linkages between physical hydrology and broader ecological and environmental sciences will be highlighted. Mathematical analysis and writing assignments will be an integral part of this course.

Learning Outcomes:

Students will obtain an understanding of: 1) the importance of water as a resource, from a human perspective and in terms of the natural environment; 2) the water cycle, including the magnitude of the various above and below ground fluxes and storage; 3) the hydrologic processes that make up the water cycle, including precipitation, snowmelt, evapotranspiration, infiltration, percolation, groundwater recharge, discharge, and streamflow; 4) human impacts on water quantity and quality including effects of climate change, land use activities such as forest harvest, road construction, urban development, and natural disturbance events such as wildfire.

This course reinforces development of professional skills through 1) emphasis on scientific inquiry, 2) frequent, focused writing assignments, and constructing reports to professional standards, 3) encouragement of self-guided learning, 4) and introduction to measurement of hydrologic variables. Additionally, we develop core knowledge of physical hydrology in the context of current hydrologic and water resource issues, relevant to Montana and globally.

Grading:

- 1) 4 Problem Sets (40%)
- 2) 3 Exams (36%)
- 3) Homework, Quizzes & Class Participation (14%)
- 4) Field Trip (5%)
- 5) Group field Trip Report (5%)

Course Schedule: Subject to change as judged to best serve student needs

Readings will be assigned via Moodle and in-class throughout the semester

Week	Date	Topic	Major Assignment/Problem Set
1	14, 16 Jan	Introduction: Water in the 21 st century; Hydrologic principles, Water, Watershed	
2	21, 23 Jan	Water balance; Hydrology dimensional analysis: Unit conversions, Data analysis in Excel	#1: Watershed delineation; Dimensional analysis, Water balance problem analysis, Basics of hydrologic graphing: Due Sun, 2 Feb, 2359h
3	28, 30 Jan	Meteorology and precipitation	#2: Rainfall evaluation: Due Sun, 9 Feb 2359h
4*	4, 6 Feb	Interception; Atmospheric energy balance; Snow Hydrology	
5*	11, 13 Feb	Evaporation & Transpiration Review for Exam	
6	18, 20 Feb	Exam 1 Soil water properties and Partitioning;	
7	25, 27 Feb	Unsaturated Zone Hydrology Infiltration	#3: Vadose zone hydrology – Analysis of Soil moisture and Environmental Forcing: Due Sun, 8 March 2359h
8	3, 5, Mar	Runoff Generation Disturbance Hydrology	
9*	10, 12 Mar	Stream Networks & Hydrographs	
***	16-20 Mar	Spring Break	
10	24, 26 Mar	Open channel Processes Review for Exam	#4: Streamflow Hydrograph Analysis: Due Sun, 5 Apr 2359h
11	31 Mar 2 Apr	Exam 2 Groundwater Hydrology	
12*	7, 9 Apr	Groundwater – Surface Water Interactions Riparian-Wetland Hydrology	
13	14, 16 Apr	Wildfire hydrology Field Trip preparation	Greenough Park Field Trip Sat, 18 Apr: 0900-1700h Group Report Due Sun, 15 Apr, 2359h
14	21,23 Apr	Hydrology in Forest Management Principles of Watershed Management	
15*	28, 30 Apr	Hydrology Under Changing Climate Review for Final Exam	Take Home Final: Due Thu, 7 May 2359h
16		Take Home Final Due 7 May, 1159h	

* Problem Set or Report due on Sunday of this week

Recommended Preparation: Successful completion of a university-level chemistry course (e.g., CHMY 121N), a physics course (e.g., PHSX 205N) and proficiency in university-level algebra

Assignments:

1. **Problem sets** will be assigned as guidance documents on the Moodle site. Late assignments will be accepted for up to three days from the due date; 10% will be deducted for every late day. Completed problem sets will only be submitted on Moodle, and will not be accepted via email. All problem sets must be submitted as a single pdf document.
2. **Homework assignments** requiring specific work products will be assigned through Moodle and are to be submitted through Moodle unless otherwise instructed; they must be submitted by the stated deadline. No late submissions will be accepted, except as may be allowed per guidelines in the **Class Attendance Policy** below.

Grading: Any concerns about or challenges to grading of required course work products, including about not limited to exams, problem sets, homework assignments, and group field trip reports, must be made in writing transmitted via email to the instructor and the teaching assistant. Students are expected to retain back-up copies of all electronic work submitted.

Field Trip: We will take a mandatory one-day field trip on Saturday, 18 April, to the Greenough Park in Missoula to investigate soil moisture, groundwater-surface water interactions, and stream water quality. You will provide your own transportation; walking, cycling and carpooling are recommended as parking may be limited. We will meet at a designated spot in the park at 0900. This will be an all-day field trip ending at 1700. Please plan accordingly with appropriate food, water, and clothing. Alternative credit for this fieldtrip **may** be arranged in advance on a limited basis and will require successful completion of an independent paper.

Communication: Students will **only** use their official UM email account for communication.

Additional Information provided at the request of the University:

All course activities are governed by the **Student Conduct Code**, which embodies the ideals of academic honesty, integrity, human rights, and individual responsibility. It is your responsibility to read, understand and adhere to the student conduct code. See <http://www.umt.edu/student-affairs/dean-of-students/default.php> for more information.

If you are a student with a disability and wish to request reasonable accommodations for this course, contact me privately to discuss the specific modifications. Please be advised, I may request that you provide a verification letter from Disability Services for Students. If you have not yet registered with Disability Services, located in Lommasson Center 154, please do so in order to coordinate your reasonable modifications. For more information, visit the Disability Services website at www.umt.edu/disability.

Class Attendance Policy: Students are expected to attend all class meetings and complete all assignments for courses in which they are enrolled. Instructors **may excuse** brief and occasional absences for reasons of illness, injury, family emergency, religious observance, cultural or ceremonial events, or participation in a University sponsored activity. You are expected to notify me in advance if you expect to be absent from class, or as soon as reasonably after an unexpected event leading to absence. You are responsible for missed material, examinations or in class exercises, and for working with the instructor to define an acceptable solution for making up missed material. Excessive or unexcused absences may result in a failing grade for the class and/or request that you withdraw following class drop guidelines below. **Please Note: Additional formal statements of Class Attendance Policy follow below per the official policies of the University of Montana**

A note on course drop deadlines: If you decide to drop this course, you have the first 15 instructional days of the semester to do so on Cyberbear. **Beginning the sixteenth (16) instructional day of the semester through the forty-fifth (45) instructional day**, you may use paper forms to drop, add and make changes of section, grading

option, or credit. However, after 45 days, I will not sign drop forms except under extraordinary circumstances, such as:

An accident or illness prevents you from meeting the course requirements

1. You received no evaluation of your performance before the drop deadline
2. A family or personal emergency prevents you from meeting course requirements
3. Your employment schedule changed, preventing you from meeting course requirements

Important Dates Restricting Opportunities to Drop a Course Spring 2020:

Deadline	Description	Date
To 15 th instructional day	Students can drop classes on CyberBear with refund & no "W" on Transcript	February 3, @5 PM
16 th to 45 th instructional day	A class drop requires a form with instructor and advisor signature, a \$10 fee from registrar's office, student will receive a 'W' on transcript, no refund.	February 4 – March 24 @5 PM
Beginning 46 th instructional day	<u><i>Students are only allowed to drop a class under very limited and unusual circumstances.</i></u> Not doing well in the class, deciding you are concerned about how the class grade might affect your GPA, deciding you did not want to take the class after all, switching majors, and similar reasons are not among those limited and unusual circumstances. If you want to drop the class for these sorts of reasons, make sure you do so by the end of the 45 th instructional day of the semester. Requests to drop must be signed by the instructor, advisor, and Associate Dean (in that order) so if you pursue this request, leave sufficient time to schedule meetings with each of these individuals (generally this will take at least 3-5 working days). A \$10 fee applies if approved. Instructors must indicate whether the individual is Passing or Failing the class at the time of request.	March 25 – May 1 @5 PM

Formal UM Statement of Class Attendance Policies

- The University allows faculty some flexibility in establishing absence policies but they need to be specified in the syllabus. For other University guidelines, be sure to read the relevant section of the [UM Catalog](#) (lots of other text on that page, search for "Class Attendance/Absence Policy"). Some key points:
 - Students who are registered for a course but do not attend the first two class meetings may be required by the instructor to drop the course. ... Students not allowed to remain must complete a drop form or drop the course through CyberBear to avoid receiving a failing grade. Students who know they will be absent should contact the instructor in advance.
 - Students are expected to attend all class meetings and complete all assignments for courses in which they are enrolled. Instructors are encouraged to notify advisors or the appropriate administrators regarding students with excessive unexcused absences. Instructors **may excuse** brief and occasional absences for reasons of illness, injury, family emergency, religious observance, cultural or ceremonial events, or participation in a University sponsored activity. (University sponsored activities include for example, field trips, ASUM service, music or drama performances, and intercollegiate athletics.)
 - **Cultural or ceremonial leave allows excused absences for cultural, religious, and ceremonial purposes to meet the student's customs and traditions or to participate in related activities.** To receive an authorized absence for a cultural, religious or ceremonial event the student or their advisor (proxy) must submit a formal written request to the instructor. This must include a brief description (with inclusive dates) of the cultural event or ceremony and the importance of the

student's attendance or participation. **Authorization for the absence is subject to approval by the instructor. Appeals may be made to the Chair, Dean or Provost.** The excused absence or leave may not exceed five academic calendar days (not including weekends or holidays). Students remain responsible for completion or make-up of assignments as defined in the syllabus, at the discretion of the instructor.

- Instructors **shall excuse** absences for reasons of military service or mandatory public service.
- See the accompanying "Faculty/Instructor Reference and Referral Guide" document for Title IX requirements regarding attendance questions in relation to a pregnancy.
- Instructors may establish absence policies to conform to the educational goals and requirements of their courses with due consideration of the class's diversity. **Such policies should be set out in the course syllabus and should include the procedures for giving timely notice of absences, explain how work missed because of an excused absence may be made up, and stipulate any penalty to be assessed for excessive or unexcused absences.**
- The UM Faculty Senate encourages the faculty to accommodate students incurring an excused absence by allowing them to make up missed work when this can be done in a manner consistent with the educational goals of their courses. Students expecting to incur excused absences should consult with their instructors early in the term to be sure that they understand the absence policies for each of their courses."