

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

Kevin Hyde 243-2169

CHCB 404

kevin.hyde@umontana.edu*Teaching Assistant*

Julia Berkey

CHCB 424

julia1.berkey@umconnect.umt.edu*Course Time & Location:*

Tue/Thu 0800 – 0920h

Liberal Arts 11

Office Hours: (or by appointment)

Hyde: Tue, 1500-1600h, Wed 1300-1400h

Berkey: Mon, 1200-1300h

Course text: Elements of Physical Hydrology by Hornberger, et al. 2014 (2nd edition). Other readings as assigned. Additional course information and materials will be posted on Moodle: umonline.umt.edu

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.

Grading:

- 1) 4 Problem Sets (40%)
- 2) 3 Exams (45%)
- 3) Quizzes & Class Participation (5%)
- 4) Field Trip (5%)
- 5) Final Report (5%)

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

Week	Date	Topic	Problem Set	Reading (and as assigned)
1	8/27 & 8/29	Course introduction: water in the 21 st century; watershed management.		Hornberger, Ch 1, 11; Wagener paper
2	9/3 & 9/5	Concepts in hydrology: Hydrology dimensional analysis and unit conversions; hydrologic cycle; watersheds; water balance	Dimensional analysis, Water balance: Due Fri, 9/13 1700h	Hornberger, Appendix 1
3	9/10 & 9/12	Meteorology and precipitation Interception		Hornberger, Ch 2. pp. 20-39
4	9/17 & 9/19	Watershed radiation and energy balances	Rainfall evaluation: Due Sun, 9/29 2300h	Hornberger, Ch 2, pp. 40-54
5	9/24 & 9/26	ET: Evaporation & Transpiration Review for Exam		Hornberger Ch 9
6	10/1 10/3 10/5	First Evaluation and Exam 1 Field Trip preparation Greenough Park Field Trip		Hornberger, Appendix 2 pp. 305-306 Field Guide

<i>Week</i>	<i>Date</i>	<i>Topic</i>	<i>Problem Set</i>	<i>Reading (and as assigned)</i>
7	10/8/ & 10/10	Soil and Water Properties Unsaturated Zone Hydrology Disturbance Hydrology		Hornberger, pp. 305-306 Ch 8, pp. 210-222 TBA
8	10/15 & 10/17	Disturbance Hydrology Unsaturated Zone Hydrology & Infiltration	Vadose zone hydrology: Due Sun, 10/27 2300h	Hornberger, Ch 8, pp. 222-239
9	10/22 & 10/24	Groundwater Hydrology		Hornberger, Ch 6
10	10/29 & 10/31	Groundwater – Surface Water Interactions Review for Exam		Hornberger, Ch 7
11	11/5 11/7	<i>Second Evaluation and Exam 2</i> Runoff Generation	Field Trip Report: Due Sun, 11/10 2300h	Hornberger, Ch 5, pp. 263-273
12	11/12 & 11/14	Stream Networks & Hydrographs	Streamflow evaluation: Due Sun, 11/24 2300h	Hornberger, Ch 5, pp. 257-263
13	11/19 & 11/21	Riparian-Wetland Hydrology Wildfire hydrology Snow hydrology		TBA
14	11/26	Hydrology in Forest Management <i>Holiday Break</i>		TBA
5	12/3 & 12/5	Hydrology & Climate Change Exam 3		TBA Study Guide

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: Problem sets will be assigned as handouts on the Moodle site and from the text. Late assignments will be accepted for up to three days from the due date, but 10% will be deducted for every late day. Completed problem sets will only be submitted on Moodle, and will not be accepted via email.

Field Trip: We will take a **mandatory** one-day field trip on Saturday, 5 October, 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 on a limited basis and will require successful completion of an independent paper.

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

Review Sessions: From time to time and before exams I will conduct review sessions to help with questions you have related to the course material. I am not required to host these, and you are also not required to attend. I conduct review sessions because I care about your comprehension of the course material. You are responsible for coming prepared with questions and working through questions in groups.

Additional Information provided at the request of the of FCFC:

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 [Disability Services](#).

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.

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:

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

Important Dates Restricting Opportunities to Drop a Course Fall 2019:

Deadline	Description	Date
To 15 th instructional day	Students can drop classes on CyberBear with refund & no "W" on Transcript	September 16, @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.	September 17 – October 28 @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, <i>leave sufficient time to schedule meetings with each of these individuals</i> (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.	October 28 – December 6 @5 PM