Course Description: This rigorous, graduate-level course examines hydrology and biogeochemical cycling in forested watersheds. We will use the primary scientific literature and published research compendia as a guide for discussion and analysis with special focus on long-term research sites and paired-watershed experiments which quantify hydrologic and biogeochemical cycles in forested watersheds. Topics covered include role of forests in hydrologic processes such as precipitation, runoff generation, and streamflow, as well as in watershed exports of sediment, carbon, and nitrogen. Students are expected to read prior to class, actively engage in discussions, lead at least one discussion, and develop and write a research or review paper on a topic of their choice that fits within the general theme of the class.

Objectives:

- For you to demonstrate understanding of the relationships between physical hydrology and the biogeochemical cycling and watershed export of materials (e.g. carbon, sediment, nitrogen, etc.)
- To construct a scientific paper, on a topic of your choice relevant to this course
- To conduct thorough and professional peer reviews

Expectations:

- Class preparation: read prior to class and be able to discuss readings!
  - Post pre-discussion questions / comments on the reading.
  - Attend every class and contribute to all discussions.
- Lead at least one class-length discussion
- Construct a research or review paper on hydrologic or biogeochemical cycling within a vegetated watershed. This includes submitting leading products (outlined in Section 4), conducting a peer review, and revising your paper according to peer review.

Time and Location: Monday and Wednesday, 10:15 am – 11:30 am
Green Hall, Room 19

Instructor: Dr. Diana L. Karwan
Green Hall 301G
Office Hours: Monday noon – 1 pm or by appointment
dlkarwan@umn.edu

Prerequisites: FNRM 3114/5114 Hydrology and Watershed Management, or equivalent
One course in ecology
One course in chemistry

Readings: See Sections 5 & 6, all readings are available on Moodle:
1. Attendance and Participation

Attendance and participation in class is expected, recorded, and contributes 30 points (30%) to your grade. You are also expected to actively participate in class discussions. Makes-ups will only be given in extraordinary situations that are verifiable and well documented. Examples include verified illness, family emergencies, and University sponsored events. Acceptable documentation would include a note from your physician (in the case of a medical problem) or coach (in the case of a University sponsored event). **Unexcused absence will be penalized by a deduction of up to 5 points per absence.**

2. Grading

Grades will be calculated out of a possible 100 points and determined from class participation (25 pts), leading a discussion (15 pts) and your term paper (60 pts). Please note attendance is required and grade deductions will be made for unexcused missed classes.

Grades will be earned as follows:

- > 93.0% = A
- 90.0-92.9 = A-
- 87.0-89.9 = B+
- 83.0-86.9 = B
- 80.0-82.9 = B-
- 77.0-79.9 = C+
- 73.0-76.9 = C
- 70.0-72.9 = C-
- 67.0-69.9 = D+
- 60.0-66.9 = D
- < 60.0% = F

An "Incomplete" will be assigned instead of a grade only under extreme circumstances; we should be communicating about issues with your ability to perform in this course well before you would ask to receive an “Incomplete”. I will set dates and conditions for makeup work, as necessary. "I" grades will automatically lapse to "F"s at the end of the next semester of a student's registration.

3. Class Discussions

This is a graduate-level class. The readings have been selected from recent primary literature and edited scientific compendia in forest hydrology and watershed biogeochemistry. You are expected to complete the assigned readings and post pre-discussion questions or thoughts on the Moodle forum. Pre-discussion posts are due on Monday mornings, at 10:00 am, most weeks of the semester, beginning January 30. A schedule of posting deadlines will be circulated and accessible on Moodle. This does not necessarily mean full mastery of every detail, but you should come to class **prepared to discuss the material.**

Students will each be responsible to lead (alone or in pairs) one class discussion on a selected topic. This could include bringing in information beyond the required reading. Students are encouraged to pair the discussion they lead with their own research and/or paper topic and use this as an opportunity to have further discussion surrounding a topic relevant to your paper and/or research. Sign-up will occur during the first and second week of class. The topics, particularly later in the semester, could be revised by consensus of the class and the instructor, should an alternate topic be agreed on. Student-led discussions are tentatively scheduled for the following topics on the following dates:
### Student-Led Discussion Topic

<table>
<thead>
<tr>
<th></th>
<th>Student-Led Discussion Topic</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Regional Differences in Hydrologic Response to Forest Harvest &amp; Disturbance</td>
<td>3/1</td>
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<tr>
<td>2</td>
<td>Long Term Data: Detecting Disturbance and Change</td>
<td>3/8</td>
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<tr>
<td>3</td>
<td>Water Chemistry and Weathering Solutes</td>
<td>3/22</td>
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<tr>
<td>4</td>
<td>Riparian Ecosystems and Forest Buffers</td>
<td>3/29</td>
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<td>5</td>
<td>Sediment Delivery from Forested Watersheds</td>
<td>4/5</td>
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<tr>
<td>6</td>
<td>Carbon Cycling and Export</td>
<td>4/12</td>
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<td>7</td>
<td>Other Topic / Student Choice</td>
<td>4/19</td>
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<tr>
<td>8</td>
<td>Nitrogen Cycling and Export</td>
<td>4/26</td>
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### 4. Paper

The major assignment (and major portion of your grade) in this course is a research or review paper. The paper topic is your choice within the topic of the course. Because this course is offered at the graduate level, students are welcome to use this assignment to write-up some of their data or conduct a review of published literature on a topic relevant to their thesis. Please feel free to discuss your paper topic with the instructor. We will discuss writing techniques throughout the course and have intermediate products (outlined below) on which your paper will be developed.

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<thead>
<tr>
<th></th>
<th>Intermediate Product</th>
<th>Due Date</th>
<th>Points</th>
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<tbody>
<tr>
<td>1</td>
<td>Topic / Tentative Title</td>
<td>2/1</td>
<td>5</td>
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<td>2</td>
<td>Annotated bibliography of at least 5 sources from primary literature</td>
<td>2/15</td>
<td>5</td>
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<td>3</td>
<td>Dataset (if data analysis paper), OR extensive list of papers to be included (if review)</td>
<td>3/1</td>
<td>5</td>
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<td>4</td>
<td>Detailed outline</td>
<td>3/22</td>
<td>5</td>
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<td>5</td>
<td>Paper Draft for Peer Review</td>
<td>4/5</td>
<td>10</td>
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<td>6</td>
<td>Peer Review of Assigned Colleague Paper</td>
<td>4/19</td>
<td>10</td>
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<td>7</td>
<td>Final Paper</td>
<td>5/3</td>
<td>20</td>
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</table>
5. Topics / Timeline

<table>
<thead>
<tr>
<th>Topic</th>
<th>Dates</th>
<th>Required Readings (Everyone)</th>
<th>Additional Reading</th>
<th>MEF Group (Required)</th>
<th>HB Group (Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Hydrology Introduction and History</td>
<td>1/18</td>
<td>FHBGC Ch. 1</td>
<td>Andreassian 2004, Ice and Stednick 2004</td>
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<tr>
<td>NO CLASS</td>
<td>1/23 – 1/25</td>
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<tr>
<td>Introduction to Small Watershed and Paired</td>
<td>1/30 - 2/1</td>
<td>FHBGC Ch. 1</td>
<td></td>
<td>MEF Ch. 1</td>
<td>Likens Ch. 1, Fahey et al 2015</td>
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<td>Watershed Experiments</td>
<td></td>
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<td>Hewlett Ch 6 p.86-88</td>
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<tr>
<td>CEI Workshop: Leading Effective Discussion Section</td>
<td>2/1</td>
<td></td>
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<tr>
<td>Measurement &amp; Analysis Techniques, and Watershed</td>
<td>2/6 – 2/8</td>
<td>FHBGC Ch. 2</td>
<td></td>
<td>MEF Ch. 2, 7</td>
<td>Likens Ch. 2</td>
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<td>Hydrology in our Cases</td>
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<tr>
<td>Process 1 - Precipitation and Interception</td>
<td>2/13 - 2/15</td>
<td>FHBGC Ch 17, 18, 20, 21</td>
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<td>FHBGC Ch. 5</td>
<td>FHBGC Ch. 7, Likens Ch. 2</td>
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<tr>
<td>Process 3 - Hillslope Hydrology and Source to Streams</td>
<td>2/27 - 3/1</td>
<td>FHBGC Ch 23</td>
<td>Jencso et al 2009</td>
<td>MEF Ch. 7</td>
<td>McGuire and McDonnell 2010</td>
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<tr>
<td>Response to Forest Disturbance and Harvest</td>
<td>3/6 - 3/8</td>
<td>FHBGC Ch 33, TBD / Student Choice</td>
<td>Brown et al 2005</td>
<td>MEF Ch. 13</td>
<td>Hornbeck et al 1987</td>
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<tr>
<td>Water Chemistry Quantification and Tools</td>
<td>3/20 - 3/22</td>
<td>FHBGC Ch 8, Klaus and McDonnell 2013</td>
<td>Godsey et al 2009</td>
<td>MEF Ch. 8, 14</td>
<td>Likens Ch. 3-6</td>
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<tr>
<td>Topic (cont.)</td>
<td>Dates (cont.)</td>
<td>Readings (cont.)</td>
<td>Additional Reading</td>
<td>MEF Group (Required)</td>
<td>HB Group (Required)</td>
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<tr>
<td>Sediment Yield and Erosion in Forested Watersheds</td>
<td>4/3 - 4/5</td>
<td>Ice and Stednick Ch. 9-10, Litschert and MacDonald 2009</td>
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<tr>
<td>Carbon Cycling in Forested Watersheds</td>
<td>4/10 - 4/12</td>
<td>Raymond and Saiers 2010, TBD / Student Choice</td>
<td>FHBC Ch. 6,</td>
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<tr>
<td>Flexible / Catch Up</td>
<td>4/17 – 4/19</td>
<td>TBD / Student Choice</td>
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<tr>
<td>Field Trip to Marcell Experimental Forest</td>
<td>4/20 – 4/21</td>
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<tr>
<td>Nitrogen and Phosphorus in Forested Watersheds</td>
<td>4/24 – 4/26</td>
<td>Matson et al 2002, Peterson et al 2001</td>
<td>MEF Ch. 7</td>
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<td>Likens Ch. 6</td>
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<tr>
<td>Paired Watershed Approach - Synthesis</td>
<td>5/1 - 5/3</td>
<td>FHBGC Ch. 36 + TBD</td>
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6. Readings

This class will draw heavily on three recently published compendiums in addition to other peer-reviewed publications. These readings are all available electronically on the course Moodle site.

Much of the topic-based material will be drawn from:

*Denoted as ‘FHBGC’ in reading list.

Examples will be taken from the following site-specific books:

*Given the size of the class registered in 2015, I suggest splitting in half, with one half following MEF (Marcell Experimental Forest) and the other following Likens (Hubbard Brook Experimental Forest). This will enable class discussions drawing from both examples.*

*Denoted ‘MEF’ in reading list.

*Denoted ‘Likens’ in reading list.

Examples and ancillary information will be taken from additional papers in the primary literature. Others may be added throughout the semester.


7. If English is not your first language, you are encouraged to use the UMN resources available to you including the Writing Center: http://writing.umn.edu/

8. Course Conduct:

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

9. Use of Personal Electronic Devices in the Classroom:

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference:http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.

Having said that, in this class you will be expected to participate in class data and information assembly in class, therefor, having a laptop computer or table with internet capability will be helpful.

10. Appropriate Student Use of Class Notes and Course Materials:

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see:http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.
11. Academic Honesty

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: http://www1.umn.edu/oscai/integrity/student/index.html. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class - e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

12. Sexual Harassment

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf.

13. Equity, Diversity, Equal Opportunity, and Affirmative Action:

The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf.

14. Meeting the Needs of Students with Disabilities

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.
If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, https://diversity.umn.edu/disability/.

15. Mental Health and Stress Management

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.

16. Academic Freedom and Responsibility

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.